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REMEDIAL ACTION PLAN SITE 278 NSA PANAMA CITY FL
4/1/1996

REMEDIAL ACTION PLAN

SITE 278

COASTAL SYSTEMS STATION PANAMA CITY
PANAMA CITY, FLORIDA

UNIT IDENTIFICATION CODE: N61331
CONTRACT NO. N62467-89-D-0317/011

APRIL 1996

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORTH CHARLESTON, SOUTH CAROLINA
29419-9010

CSS PANAMA CITY
PANAMA CITY, FLORIDA

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REMEDIAL ACTION PLAN

SITE 278

COASTAL SYSTEMS STATION PANAMA CITY
PANAMA CITY, FLORIDA

Unit Identification Code: N61331

Contract No. N62467-89-D-0317/011

Prepared by:

ABB Environmental Services, Inc.
2590 Executive Center Circle, East
Tallahassee, Florida 32301

Prepared for:

Department of the Navy, Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29418
Nick Ugolini, Code 1843, Engineer-in-Charge

April 1996

CERTIFICATION OF TECHNICAL
DATA CONFORMITY (MAY 1987)

The Contractor, ABB Environmental Services, Inc., hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. N62467-89-D-0317/011 are complete and accurate and comply with all requirements of this contract.

DATE: April 2, 1996

NAME AND TITLE OF CERTIFYING OFFICIAL: Mark C. Diblin, P.G.
Task Order Manager

NAME AND TITLE OF CERTIFYING OFFICIAL: Mike Dunaway, P.E., P.G.
Project Technical Lead

(DFAR 252.227-7036)

FOREWORD

Subtitle I of the Hazardous and Solid Waste Amendments of 1984 to the Solid Waste Disposal Act of 1965 established a national regulatory program for managing underground storage tanks (USTs) containing hazardous materials, especially petroleum products. Hazardous wastes stored in USTs were already regulated under the Resource Conservation and Recovery Act of 1976. Subtitle I requires that the U.S. Environmental Protection Agency (USEPA) promulgate UST regulations. The program was designed to be administered by individual States, who were allowed to develop more stringent, but not less stringent standards. Local governments were permitted to establish regulatory programs and standards that are more stringent, but not less stringent than either State or Federal regulations. The USEPA UST regulations are found in the Code of Federal Regulations, Title 40, Part 280 (40 CFR 280) (*Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks*) and 40 CFR 281 (*Approval of State Underground Storage Tank Programs*). 40 CFR 280 was revised and published on September 23, 1988, and became effective December 22, 1988.

The Navy's UST program policy is to comply with all Federal, State, and local regulations pertaining to USTs. This report was prepared to satisfy the requirements of Chapter 62-770, Florida Administrative Code (*State Underground Petroleum Environmental Response*) regulations on petroleum contamination in Florida's environment as a result of spills or leaking tanks or pipelines.

Questions regarding this report should be addressed to the Commanding Officer, Coastal Systems Station Panama City, Panama City, Florida, or to Southern Division, Naval Facilities Engineering Command, Code 1843, at 803-820-5596 (AUTOVON 563-5596).

EXECUTIVE SUMMARY

Remedial action is necessary because the Contamination Assessment of Coastal Systems Station, Site 278, Panama City, Florida, identified contamination that exceeds the State of Florida parameters for Class G-II groundwater. This Remedial Action Plan has been developed to present a plan for cleanup of the contamination at the Site.

The existing free product will be recovered by vacuum enhanced extraction from an existing monitoring well. Groundwater contamination will be reduced by a limited extraction and treatment of groundwater. Free product and groundwater will be simultaneously extracted and discharged into the oily waste collection and treatment system located on base. Since soil contamination is limited to the capillary zone and is associated with the free product, a separate treatment technology is not warranted for the soil. The vacuum enhanced extraction system will be operated until the kerosene and mixed products analytical group constituents in groundwater reach the required target concentrations or until further remedial activities are not effective. It is estimated that the operation period will not exceed 3 years.

ACKNOWLEDGMENTS

In preparing this report, the Underground Storage Tank personnel at ABB Environmental Services, Inc., commends the support, assistance, and cooperation provided by the personnel at Coastal Systems Station (CSS), Panama City, Florida, and Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM). In particular, we acknowledge the effort of the following people in the preparation of this report.

NAME	TITLE	POSITION	LOCATION
Nick Ugolini	Environmental Engineer	Engineer-in-Charge	SOUTHNAVFACENGCOM
Mike Clayton	Environmental Coordinator	Environmental Coordinator	CSS, Panama City
Arturo McDonald	Environmental Coordinator	Environmental Coordinator	CSS, Panama City

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GLOSSARY

ABB-ES	ABB Environmental Services, Inc.
BTEX	benzene, toluene, ethylbenzene, and xylenes
bls	below land surface
CA	Contamination Assessment
CAR	Contamination Assessment Report
CARA	Contamination Assessment Report Addendum
CSS	Coastal Systems Station
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FDER	Florida Department of Environmental Regulation
FDOT	Florida Department of Transportation
FID	flame ionization detector
Hg	mercury
IRA	Initial Remedial Action
NFA	no further action
OVA	organic vapor analyzer
PAHs	poly-aromatic hydrocarbons
ppb	parts per billion
ppm	parts per million
RAP	Remedial Action Plan
SOUTHNAV-FACENGCOM	Southern Division Naval Facilities Engineering Command
SVE	soil vapor extraction
SVOCs	semivolatile organic compounds
™	trade mark
TRPH	total recoverable petroleum hydrocarbons
UV	ultraviolet
USEPA	United States Environmental Protection Agency
USTs	underground storage tanks
VEE	Vacuum Enhanced Extraction
VOA	volatile organic aromatics
VOCs	volatile organic compounds
WWTP	Waste Water Treatment Plant

CHAPTER 1.0

1.0 INTRODUCTION

A Contamination Assessment Report (CAR) for Site 278 at Coastal Systems Station (CSS), Panama City, Florida, was submitted by ABB Environmental Services, Inc. (ABB-ES, 1993), in July 1993 to Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM). A CAR Addendum (CARA) was submitted in May 1995. After approval of the CARA by Florida Department of Environmental Protection (FDEP), formerly known as Florida Department of Environmental Regulation (FDER), ABB-ES was authorized by SOUTHNAVFACENGCOM to develop a Remedial Action Plan (RAP). This work is being performed under Contract Task Order No. 011 of the Comprehensive Long-term Environmental Action, Navy contract.

1.1 PURPOSE. The purpose of the RAP is to present a plan for remediation of petroleum contamination at Site 278. The RAP presented herein is designed for implementation at Site 278 and, when implemented, will result in compliance with the requirements of Chapters 62-770 and 62-775, Florida Administrative Code (FAC) (FDEP, 1994).

1.2 SCOPE. This RAP presents the rationale for the remedial actions to be implemented at Site 278. Implementation of remedial actions described in this RAP will include the following tasks:

- vacuum enhanced extraction (VEE) of free product and groundwater,
- treatment and disposal of mixed fluids including free product and groundwater at the oily waste collection and treatment system located at the facility, and
- groundwater monitoring.

CHAPTER 2.0

2.0 BACKGROUND

2.1 SITE DESCRIPTION. Site 278 is located at the east dock alongside Alligator Bayou (Figures 2-1 and 2-2). The site is the former location of four 7,500-gallon underground storage tanks (USTs) used for diesel fuel storage. These USTs were removed and replaced with two 15,000-gallon, double-walled steel tanks with a resin coating. The USTs are buried in a grassy area approximately 65 feet from the outer edge of the adjacent pier. The elevation of the grassy area where the USTs are buried is approximately 5 to 6 feet higher than the pier. This pier is used as a refueling station for ships. The pier is constructed of reinforced concrete. A subsurface concrete slab, known as the relieving platform is located along the bulk head approximately 7 feet below land surface (bls). According to drawings provided by CSS Panama City Public Works Department, the below ground slab is 25 feet wide, 20 inches thick, and extends the length of the pier. A schematic diagram of the slab is presented on Figure 2-3.

2.2 SITE HISTORY. Site 278 is the former location of four 7,500-gallon USTs. Two of the tanks were constructed of asphalt-coated steel and were installed in 1964. The other two tanks were constructed of fiberglass and were installed in 1977. Each tank contained diesel fuel and all had asphalt-coated steel pipes. The four tanks were removed in 1989 and replaced with two 15,000-gallon, double-walled steel tanks with a resin coating and interstitial leak detection equipment. During removal of the four tanks, a high level of petroleum vapors was present, exceeding the range of the explosive gas meter in use at that time. A visual inspection of the removal area indicated that stained soil was present under the tank pads. Some of the stained soil was excavated during tank replacement and disposed of. The remainder of the soil that was visibly contaminated was spread over Visqueen™ and allowed to aerate. Samples were collected for determining acceptable levels for transport and disposal at appropriate facilities. No groundwater samples were collected for analyses during the tank removal and replacement work. A Closure Report for the tank removal and replacement was not submitted to the activity by the contractor. The activity was not provided copies of the manifests for transportation and disposal of the petroleum-contaminated soil.

2.3 SUMMARY OF CONTAMINATION ASSESSMENT REPORT (CAR). ABB-ES was contracted by SOUTHNAVFACENGCOM to perform a contamination assessment (CA) for this site.

- A CA of Site 278 was conducted and a CAR was submitted to the FDEP in July 1993 (ABB-ES, 1993). The FDEP reviewed the assessment and requested additional information and clarification of site data.

- ABB-ES performed additional work at the site and provided data clarification in a CARA submitted to the FDEP on November 12, 1993. Following a review of this updated information, the FDEP requested further data clarification, a supplemental soil assessment in the vicinity of the tanks, resampling selected wells, and collection and analyses of surface water and sediment samples from the Alligator Bayou.

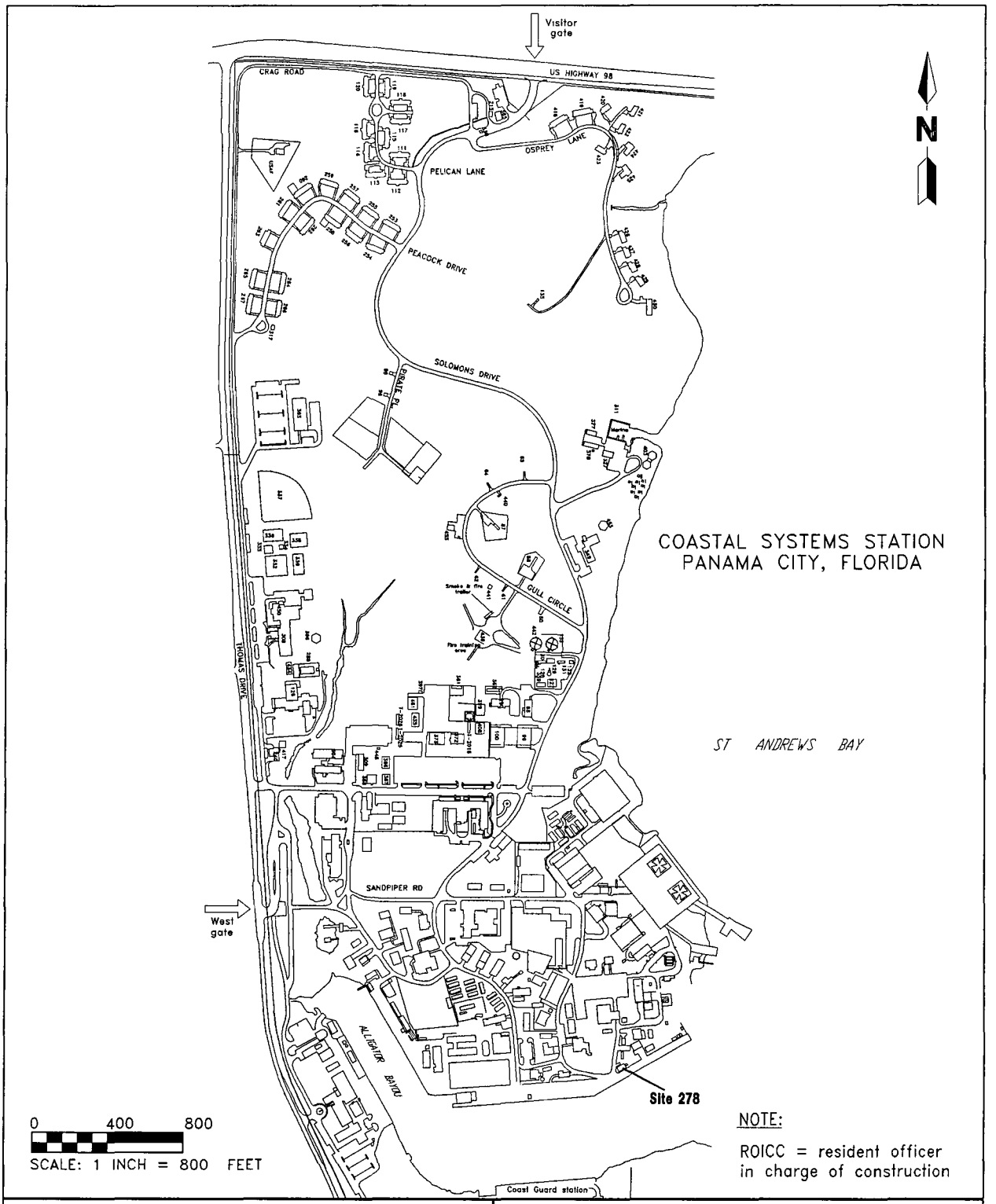

FIGURE 2-1
SITE LOCATION MAP

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REMEDIAL ACTION PLAN
SITE 278

COASTAL SYSTEMS STATION
PANAMA CITY, FLORIDA

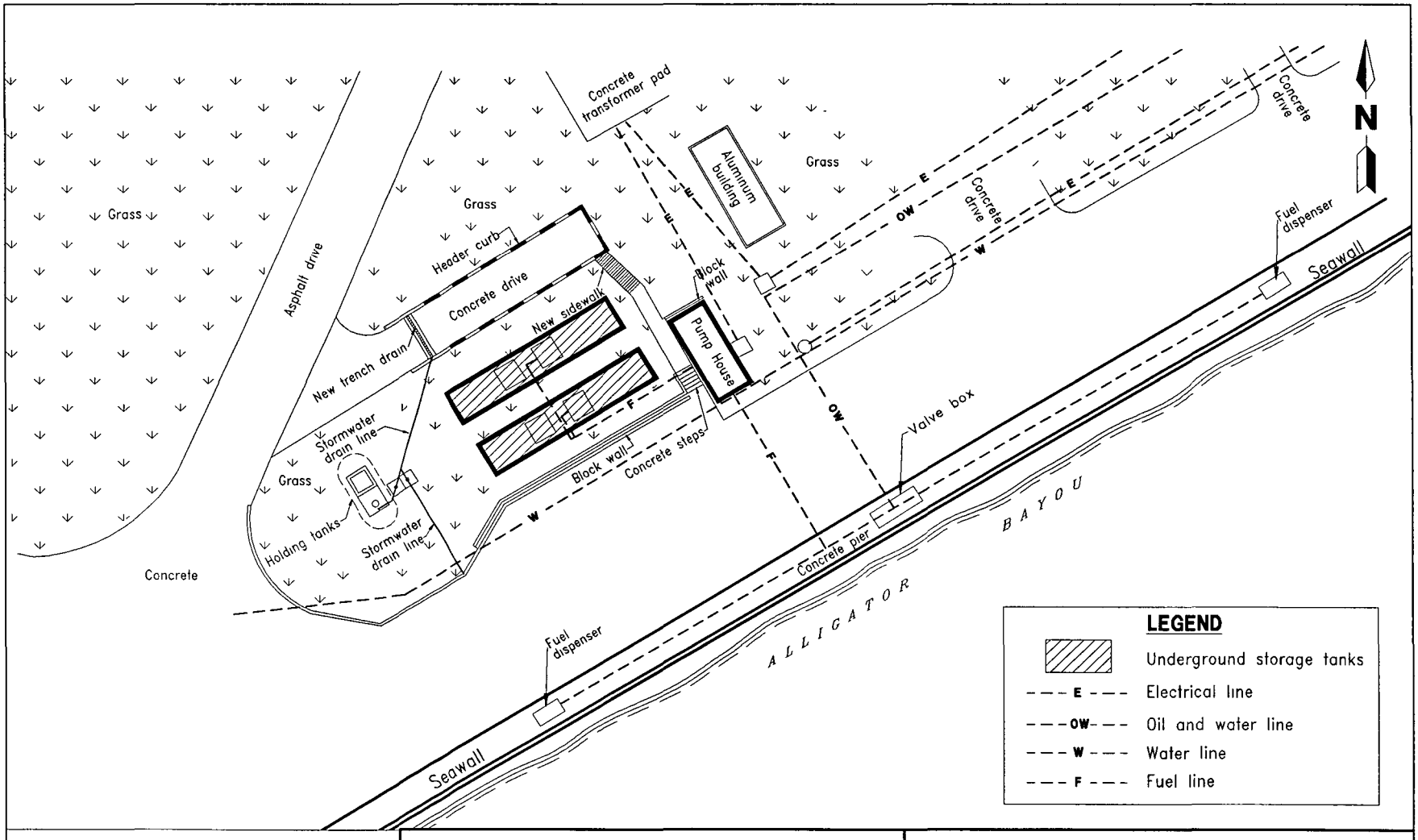

FIGURE 2-2
SITE PLAN

REMEDIAL ACTION PLAN
SITE 278

COASTAL SYSTEMS STATION
PANAMA CITY, FLORIDA

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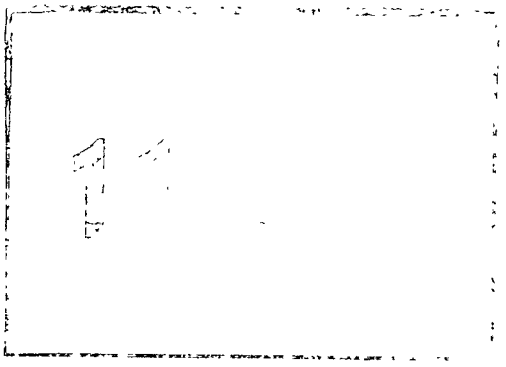
Figure 2-3 Seawall and Dock Cross Section



- In response to FDEP's request for additional assessment and site information in their letter dated March 4, 1994, ABB-ES performed a supplemental investigation to complete the CA of the site and submitted the supplemental information in May 1995 (ABB-ES, 1995).

- In September 1995, FDEP completed the review of CAR, CARA and supplemental information and recommended submission of an RAP.

The following presents a summary of field investigations conducted during the CA and the additional assessments conducted as per FDEP:

- Thirty soil borings were drilled, and soil samples were collected and analyzed for total volatile organic compounds (VOCs) using an Organic Vapor Analyzer (OVA) equipped with a flame ionization detector.

- Fifteen monitoring wells were installed, and groundwater samples were collected and analyzed for constituents of the kerosene analytical group. Three separate episodes of groundwater sampling were conducted, which include: monitoring wells CSS-278-MW-1 through MW-14 on October 13, 1992; monitoring wells MW-1 through MW-15 on May 19, 1993; and monitoring wells MW-1 through MW-4 and MW-6 through MW-15 on February 2-3, 1995.

- Three sets of surface water and sediment samples were collected on February 4, 1995, from Alligator Bayou and analyzed for constituents of the kerosene analytical group.

- Groundwater levels were recorded in monitoring wells MW-1 through MW-14 on October 13 and November 9, 1992, May 19, 1993, February 2, 1995, and October 11, 1995.

- A tidal influence study was conducted on October 13, 1992, within 24 hours of the full-moon phase of the lunar cycle. The study was conducted to assess the effect of low and high tides on groundwater flow and water-table elevation fluctuations at the site.

- Rising head slug tests were performed in monitoring wells MW-1, MW-3, and MW-4 to estimate the hydraulic conductivity of the aquifer.

- A review of interim remedial action (IRA) and free product recovery records for Site 278 was conducted at the activity.

The findings, conclusions, and recommendations of this CA are summarized below.

2.3.1 CAR and CARA Findings

Free Product

- Petroleum product measured 1.58 feet in thickness in monitoring well MW-5 on November 9, 1992. Laboratory analysis indicated that the petroleum product was degraded diesel fuel.

- On February 16, 1993, the CSS Panama City activity contracted for tightness testing of the Site 278 USTs and associated pipelines installed in 1989. The test revealed no evidence of leaking from the tanks or associated pipes.

- A review of the IRA data and free product recovery records for Site 278 indicates that approximately 18 gallons of free product have been recovered by manual bailing between February 1993 and October 1995 (see Appendix B).

Soil

- OVA analyzer headspace analyses of discrete soil samples collected from 15 soil borings between September 22-23, 1992, indicate excessive petroleum contamination in soil samples collected from SB4/MW4, SB6/MW5, and SB7/MW6 as defined by FDEP, Chapter 62-770.200, FAC.

- OVA headspace analyses of additional soil samples collected from 16 hand-augered borings on February 1, 1995, did not detect excessive levels of hydrocarbon contamination in soil around the USTs.

Groundwater

- Groundwater level measurements conducted between 1992 and 1995 indicate the groundwater flow direction at the site is generally to the southeast towards the Alligator Bayou.

- Groundwater level measurements in site monitoring wells on February 2, 1995, and subsequent groundwater elevation data confirmed the hydrologic conditions previously assessed at the site. Figure 2-4 presents the groundwater potentiometric surface estimated, based on groundwater level measurements taken on October 11, 1995.

- Contaminants detected in groundwater samples collected on October 13, 1992, include benzene, ethylbenzene, xylenes, toluene, naphthalene, 1-methylnaphthalene, 2-methylnaphthalene, fluorene, phenanthrene, total recoverable petroleum hydrocarbons (TRPH), and acenaphthene.

- Laboratory analysis of groundwater samples collected on May 19, 1993, confirmed the presence of contaminants detected in October 13, 1992. However, comparison of concentrations of total benzene, toluene, ethylbenzene, and xylene (BTEX), and TRPH establish that natural attenuation is occurring at this site.

- Laboratory analytical results obtained from groundwater samples collected on February 2-3, 1995, indicate continued attenuation of contaminants. Total BTEX concentrations detected in groundwater samples are below the FDEP guidance concentration of 50 parts per billion (ppb). Benzene was not detected in any of the groundwater samples. Total naphthalene concentrations (the sum of 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene) exceeded the FDEP guidance concentration of 100 ppb in samples from wells MW-4 and MW-6 (369 ppb and 130 ppb, respectively). TRPH concentrations exceeded the FDEP guidance concentration of 5 parts per million (ppm) only in the sample from well MW-6 (43.2 ppm). The vertical extent of petroleum contamination is assessed by groundwater samples from well MW-13D in which all of the target analytes were below analytical detection limits.

- Low level concentrations of chlorinated compounds previously detected in groundwater samples from some site monitoring wells are suspected to be

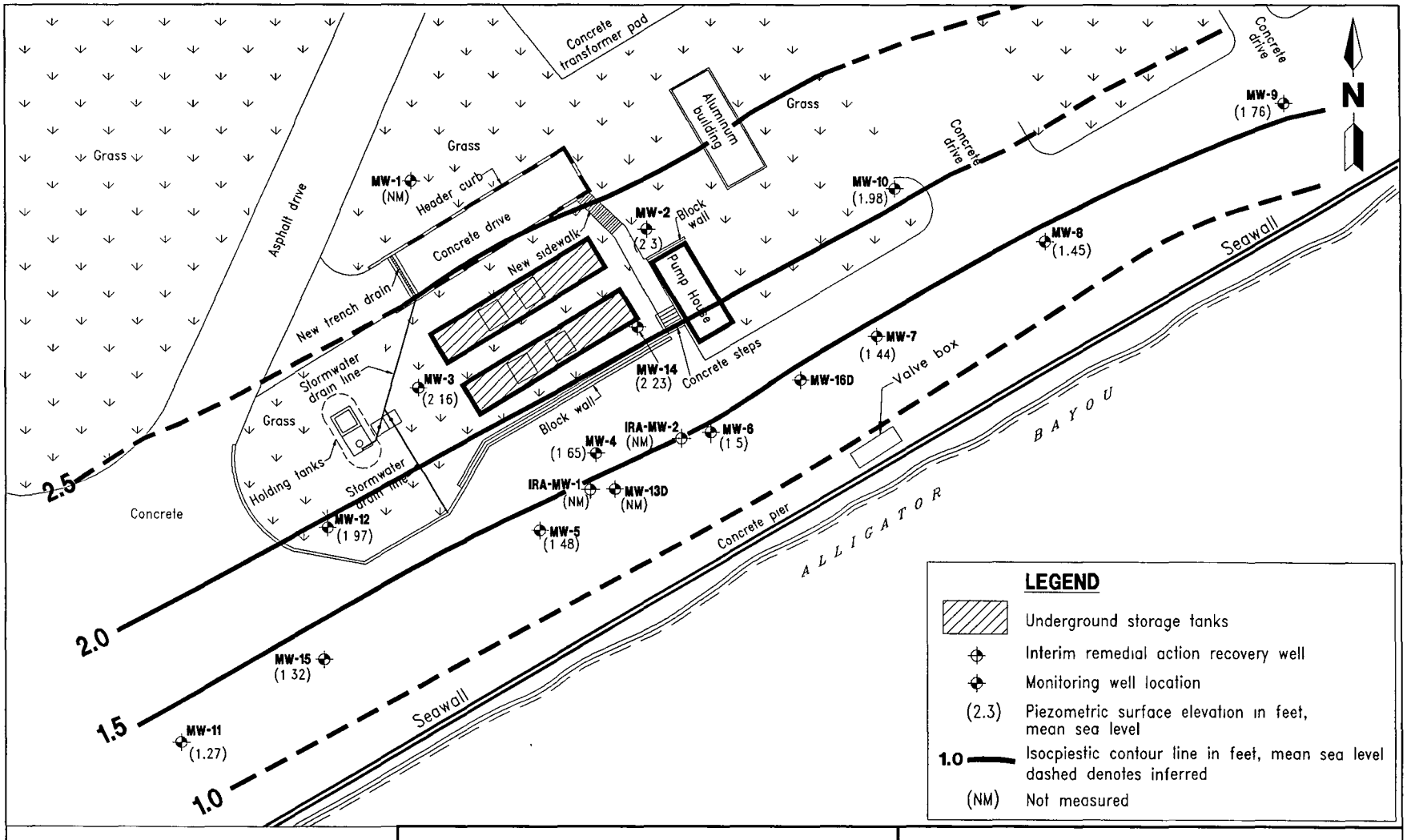


FIGURE 2-4
PIEZOMETRIC SURFACE MAP
OCTOBER 11, 1995

REMEDIAL ACTION PLAN
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PANAMA CITY, FLORIDA

laboratory contamination. Chlorinated compounds were not detected in any of the groundwater samples collected in February 1995.

Surface Water and Sediments

- Analytical results of surface water samples collected in Alligator Bayou adjacent to Site 278 on February 4, 1995, reported no detections of any of the target analytes. However, the analytical results for the surface water sediment samples reported elevated concentrations of polynuclear aromatic hydrocarbons (PAHs), TRPHs, and lead.

2.3.2 CAR Conclusions

- Soil and groundwater contamination at the site exceeds Chapter 62-770, FAC, target levels for kerosene analytical group constituents.

- Results of analytical data do not indicate that the area of concern extends upgradient of monitoring well MW-3. The horizontal and vertical extent of contaminants of concern has been defined.

- Approximately 18 gallons of free product have been recovered from monitoring wells MW-5 and MW-6. Free product continues to appear in monitoring wells MW-5 and MW-6; however, the thickness of the free product is apparently decreasing with time.

- The extent of groundwater contamination (total naphthalenes and TRPH) exceeding FDEP guidance concentrations is limited to a small area south of the USTs around monitoring wells MW-4, MW-5, and MW-6.

- Historical and current analytical results have documented a decline in BTEX, PAH, and TRPH concentrations in groundwater samples collected at the site. The decline in contaminant concentrations is likely the result of source abatement and IRA (free product removal), and natural attenuation of contaminants in groundwater (see Appendix A).

- Results of visual screening of Site 278 USTs and associated pipelines and dispenser stations on October 16, 1995, confirmed earlier findings that there is no visual evidence of continuing release of free phase petroleum product into the vadose zone.

- Low concentrations of chlorinated compounds detected previously in groundwater samples from site monitoring wells were not detected in the supplemental CA; therefore, chlorinated compounds do not appear to be a concern at Site 278.

- Lead detected in groundwater samples collected during the previous CA was probably caused by turbid samples and dissolution of particulates entrained in the sample matrix during preservation. The results of the February 1995 groundwater sampling from site monitoring wells collected with a peristaltic pump under low-flow quiescent sampling conditions indicate that lead was not present above the method detection limits in any of the groundwater samples.

- Surface water samples collected from Alligator Bayou adjacent to Site 278 indicate that petroleum contaminants from the site are apparently not impacting the bayou.

- Elevated PAH, TRPH, and lead concentrations detected in surface water sediment samples collected from the Alligator Bayou adjacent to Site 278 are similar to concentrations detected in surface water and sediment samples elsewhere in the bayou. The data do not indicate that Site 278 is the source of contamination of the Alligator Bayou sediment samples.

2.3.3 CAR Recommendations Because contamination in the groundwater and soil at Site 278 exceeds Chapter 62-770, FAC, target levels for Class G-II groundwater and soil contaminated by kerosene group constituents, it was recommended in the CAR that a RAP be prepared as a follow-up report to address cleanup of the contamination.

CHAPTER 3.0

3.0 REMEDIAL ALTERNATIVES

3.1 CONTAMINANTS OF CONCERN. Contaminants of concern for Site 278 are associated with a limited area of free product, soil contamination in the direct vicinity of free product, and groundwater contamination. Finger print analyses conducted on the free phase product has indicated that the source of the contamination is diesel fuel (ABB-ES, 1993).

3.2 APPLICABLE CLEANUP STANDARDS. Standards and regulations regarding required remedial goals for soil and groundwater are contained in Chapter 62-770 FAC and should be applied following treatment by any method. Based on the available data and requirements in Chapter 62-770, FAC (see table below), the constituents of the kerosene and mixed products analytical group are the basis for remedial actions.

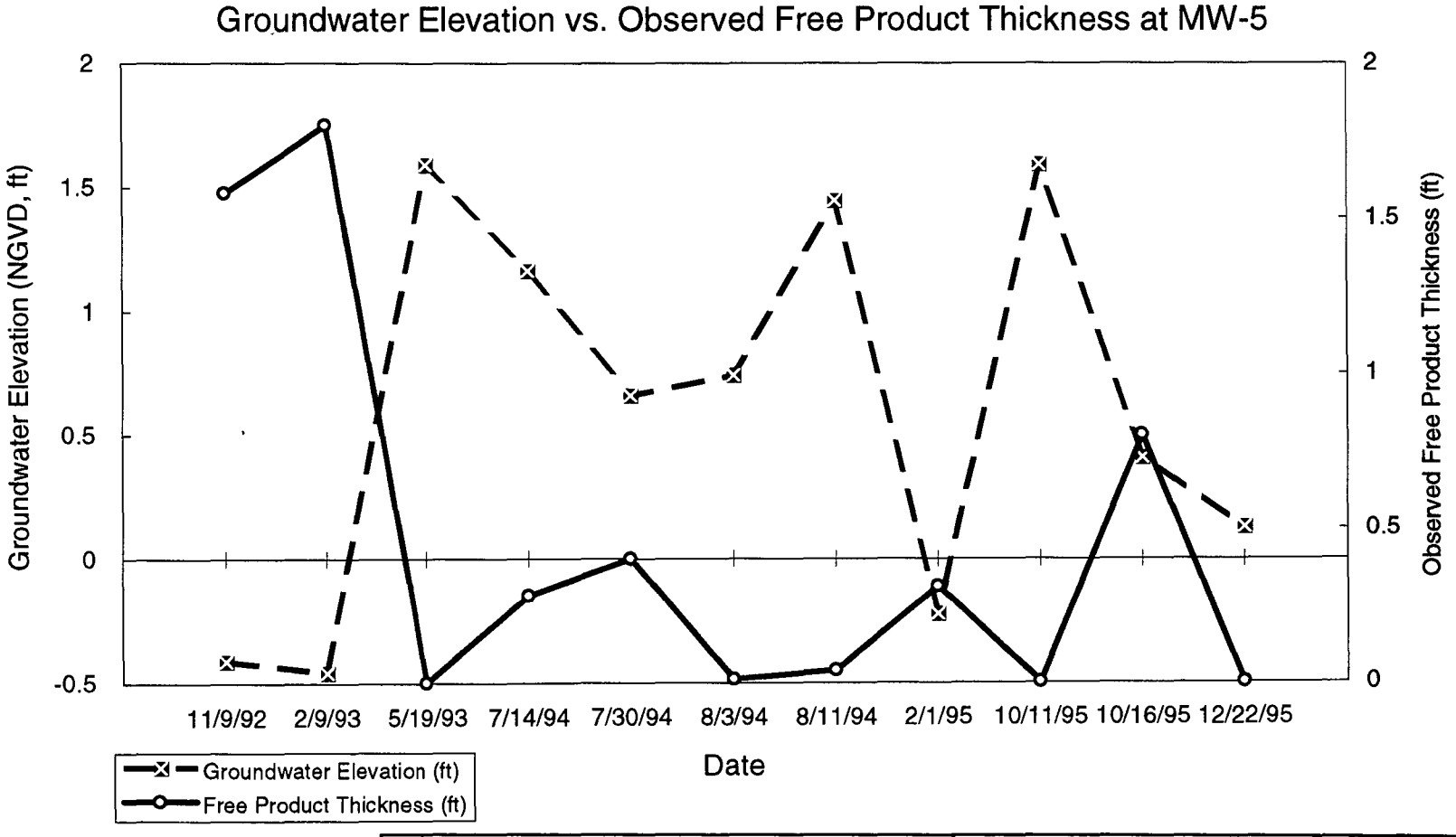
Parameter	Target Concentration	
	Soil	Groundwater
OVA reading for excessively contaminated soil	50 ppm	
Total Volatile Organic Aromatics (TVOA)		50 ppb
Benzene		1 ppb
1,2-Dibromoethane (EDB)		0.02 ppb
PAHs excluding Naphthalenes		10 ppb
Total Naphthalenes		100 ppb
Lead		50 ppb
Methyl Tert-Butyl Ether (MTBE)		50 ppb
Total Recoverable Petroleum Hydrocarbons		5 ppm

Notes: OVA = organic vapor analyzer. ppb = parts per billion.
ppm = parts per million. PAH = polyaromatic hydrocarbons.

3.3 EXTENT OF CONTAMINATION. Areas of contamination at CSS Panama City, Site 278 include the free product plume consisting of degraded diesel fuel, soil contaminated with kerosene analytical group petroleum hydrocarbons, and groundwater contaminated with total naphthalenes and TRPH.

The subsections below present a description on the extent of contamination in each of the areas.

3.3.1 Free Product Free-phase petroleum product is the primary source of contamination for soil and groundwater. Figure 3-1 presents the graph for the observed values of free product thickness and the groundwater elevations at MW-5 between 1992 and 1995. This graph indicates that the observed free product thickness varies with the groundwater level at MW-5. Observed thickness of free product is generally decreasing with an increase in groundwater level and vice versa (except for the set of readings taken on December 22, 1995). An IRA has been implemented to remove the free product since November 1992, and a total of 18 gallons were removed as of October 1995. Estimated free product recovery information is summarized in Appendix B.



NOTES:
NGVD = National Geodetic Vertical Datum
MW = monitoring well

FIGURE 3-1
FREE-PRODUCT THICKNESS VS GROUNDWATER ELEVATION AT MW-5

REMEDIAL ACTION PLAN
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PANAMA CITY, FLORIDA

7520-52 FIG 3-1032796MAW

Figure 3-2 presents a distribution map of free product at Site 278 observed on November 16, 1995. Based on the free product thickness measurements recorded on November 16, 1995, and the thickness contours presented on Figure 3-2, the volume of free product remaining in the subsurface is estimated at 400 gallons. Volume estimates are presented in Appendix A.

3.3.2 Soil As per Chapter 62-770, FAC, excessive soil contamination has been defined as soil with OVA headspace measurements exceeding 50 ppm. In accordance with this definition, the area near SB4/MW4, SB6/MW5, and SB7/MW6 can be identified as excessively contaminated, based on the data in the CAR and CARA for soil at or above the water table.

Table 3-1 presents a summary of OVA headspace readings for subsurface soil samples collected on September 22-23, 1992, and February 1, 1995. The measurements exceeding 50 ppm were taken from soil at less than 0.5 foot from the water table (except for one sample from SB4/MW4 that was collected from nearly 2 feet above the water table). Calculations presented in Appendix A show that a capillary fringe thickness of 0.89 foot or more is likely to be present at this site. Therefore it is believed that the reported soil contamination is the result of the presence of floating free product at MW5 and MW6 and the contaminated groundwater. Tidal influence or seasonal variations in the water table may have resulted in some smearing of the free product, but these fluctuations do not appear to exceed 1 foot (ABB-ES, 1995). These facts indicate that the contamination is closely related to the groundwater and does not represent excessive soil contamination. Therefore, soil contamination associated with SB4/MW4, SB6/MW5, and SB7/MW6 areas would be addressed as part of free product removal and any groundwater remediation alternatives.

3.3.3 Groundwater Results of laboratory analysis for groundwater samples collected on February 2 and 3, 1995, are summarized in Appendix A. Based on target concentrations presented in Section 3.1, groundwater contamination is limited to the area of monitoring wells MW-4, MW-5, and MW-6. Total naphthalene concentrations were found to exceed target concentrations in monitoring wells MW-4 and MW-6, and TRPH concentrations were found to exceed target concentrations in monitoring well MW-6. Groundwater samples were not collected from MW-5 because of the presence of free product. Figures 3-3 and 3-4 present the distribution of total naphthalenes and TRPH, respectively. Estimated volume of groundwater contaminated with total naphthalenes and TRPH is 47,400 gallons (see Appendix A).

3.4 EXPOSURE PATHWAYS. Figure 3-5 presents a cross section through Site 278 and adjacent Alligator Bayou. The potential exposure pathways for the existing contaminants in groundwater are either via direct ingestion through a potable water supply well within the zone of contamination or migration of contaminated water into the adjacent bayou, which is class III surface water and presents further exposure to the environment and human health.

These two pathways have very limited probability of existence due to the following reasons:

There are no existing water supply potable wells within the zone (0.25 mile radius) of contamination. CSS Panama City's supply of potable water is obtained from the Panama City Municipal Water Supply. Four former public water supply

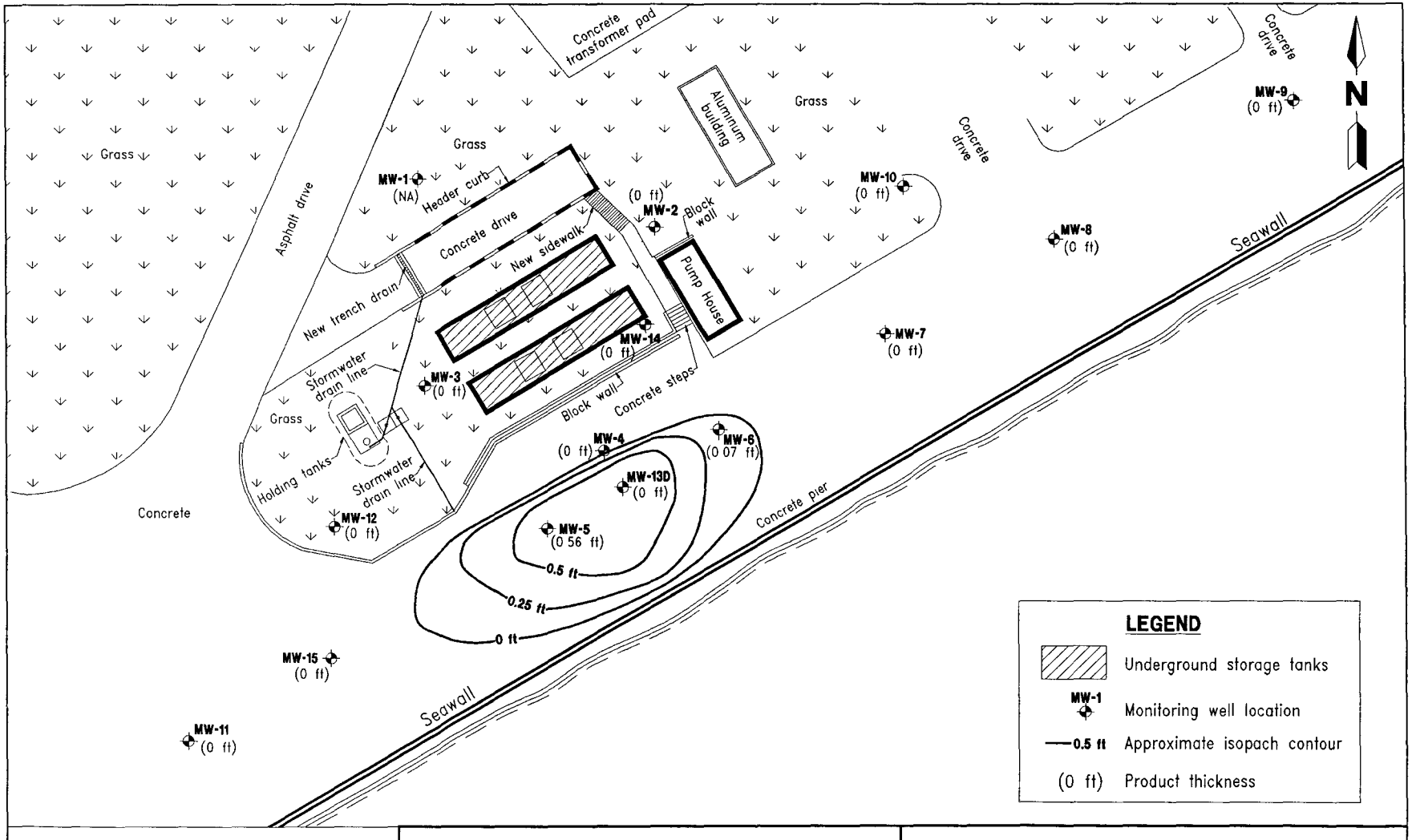

FIGURE 3-2
LATERAL EXTENT OF FREE PRODUCT
NOVEMBER 16, 1995

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Table 3-1
Summary of OVA Readings in Subsurface Soil Samples

Remedial Action Plan, Site 278
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Panama City, Florida

Sample ID[1]	Depth to Groundwater (ft. bls)	Sampling Interval, ft bls						
		(0-2)	(2-4)	(4-6)	(6-8)	(8-10)	(10-12)	(12-14)
SB1/MW1	8.98	0	0	0	0	0	0	NS
SB2/MW2	9.95	0	0	0	NS	NS	NS	NS
SB3/MW3	9.27	0	0	0	0	0	0	NS
SB4/MW4	6.6	NS	NS	**1,800**	**5,000**	NS	NS	NS
SB5	6.84	0	0	1	20	NS	NS	NS
SB6/MW5	6.84	0	0	0	**1,100**	**5,000**	NS	170
SB7/MW6	6.82	0	0	0	**5,000**	NS	NS	NS
SB8/MW7	7.05	0	0	0	NS	NS	NS	NS
SB9/MW8	7.09	0	0	4	NS	NS	NS	NS
SB10/MW9	6.96	0	0	0	NS	NS	NS	NS
SB11/MW10	6.98	0	0	0	NS	NS	NS	NS
SB12/MW11	7.84	0	0	0	NS	NS	NS	NS
SB13/MW12	6 68	0	0	0	NS	NS	NS	NS
SB14/MW14	10.08	0	0	0	0	19	0	0
SB15	10	0	0	NS	NS	NS	NS	NS
SB16	10	0	0	0	0	0	NS	NS
SB17	10	0	0	0	0	0	NS	NS
SB18	10	0	0	0	0	0	NS	NS
SB19	10	0	0	0	0	0	NS	NS
SB20	10	0	0	0	0	8	NS	NS
SB21	10	0	0	0	0	0	NS	NS
SB22	10	0	0	0	0	0	NS	NS
SB23	10	0	0	0	0	0	NS	NS
SB24	10	0	0	0	0	0	NS	NS
SB25	10	0	0	0	2	2	NS	NS
SB26	10	0	0	0	0	0	NS	NS
SB27	10	0	0	0	0	1	NS	NS
SB28	10	0	0	0	0	0	NS	NS
SB29	10	0	0	0	0	0	NS	NS
SB30	10	0	0	0	0	0	NS	NS
SB31	10	0	0	0	0	0	NS	NS

[1] SB1 through SB15 were sampled between September 22-24, 1992, and SB16 through SB31 were sampled on February 1, 1995.

Notes: OVA = organic vapor analyzer
ft. bls = feet below land surface.
ID = inside diameter.
NS = not sampled.
1800 = exceeds Chapter 62.770 FACs "excessively contaminated soils" criteria.

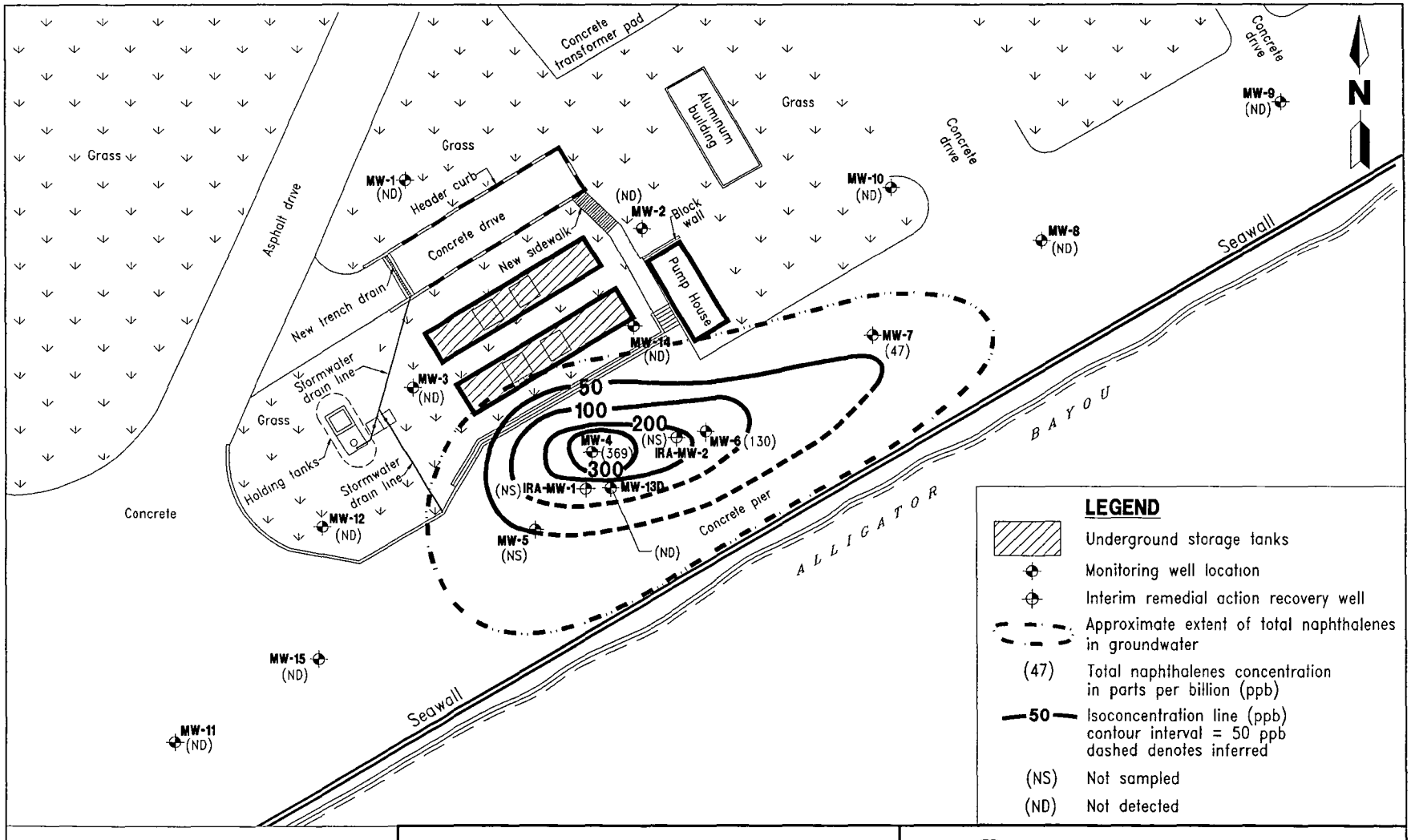

FIGURE 3-3
GROUNDWATER ISOCONCENTRATION MAP OF TOTAL NAPHTHALENES, FEBRUARY 1995

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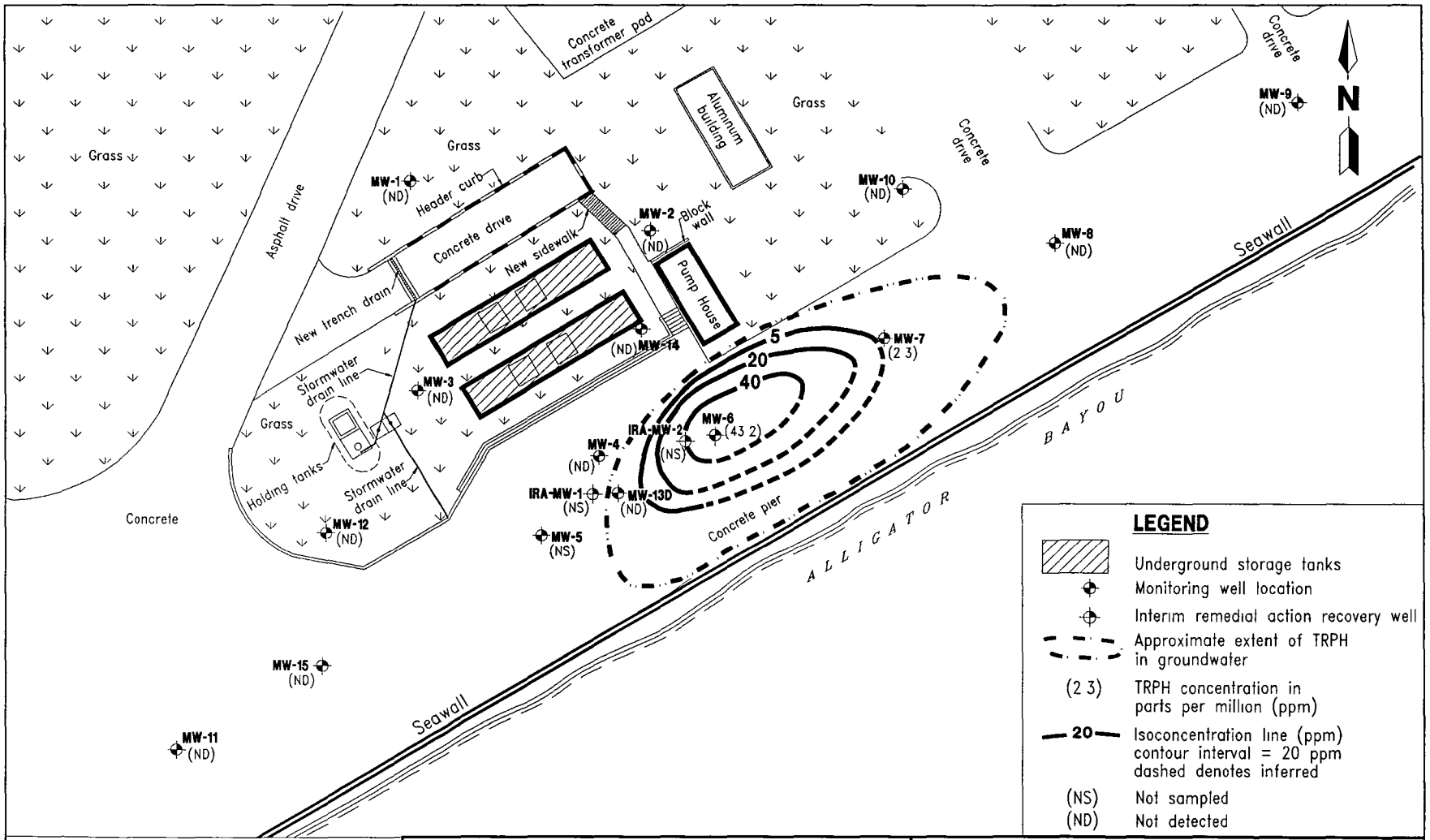

FIGURE 3-4
GROUNDWATER ISOCONCENTRATION MAP OF TOTAL RECOVERABLE PETROLEUM HYDROCARBONS (TRPH), FEBRUARY 1995

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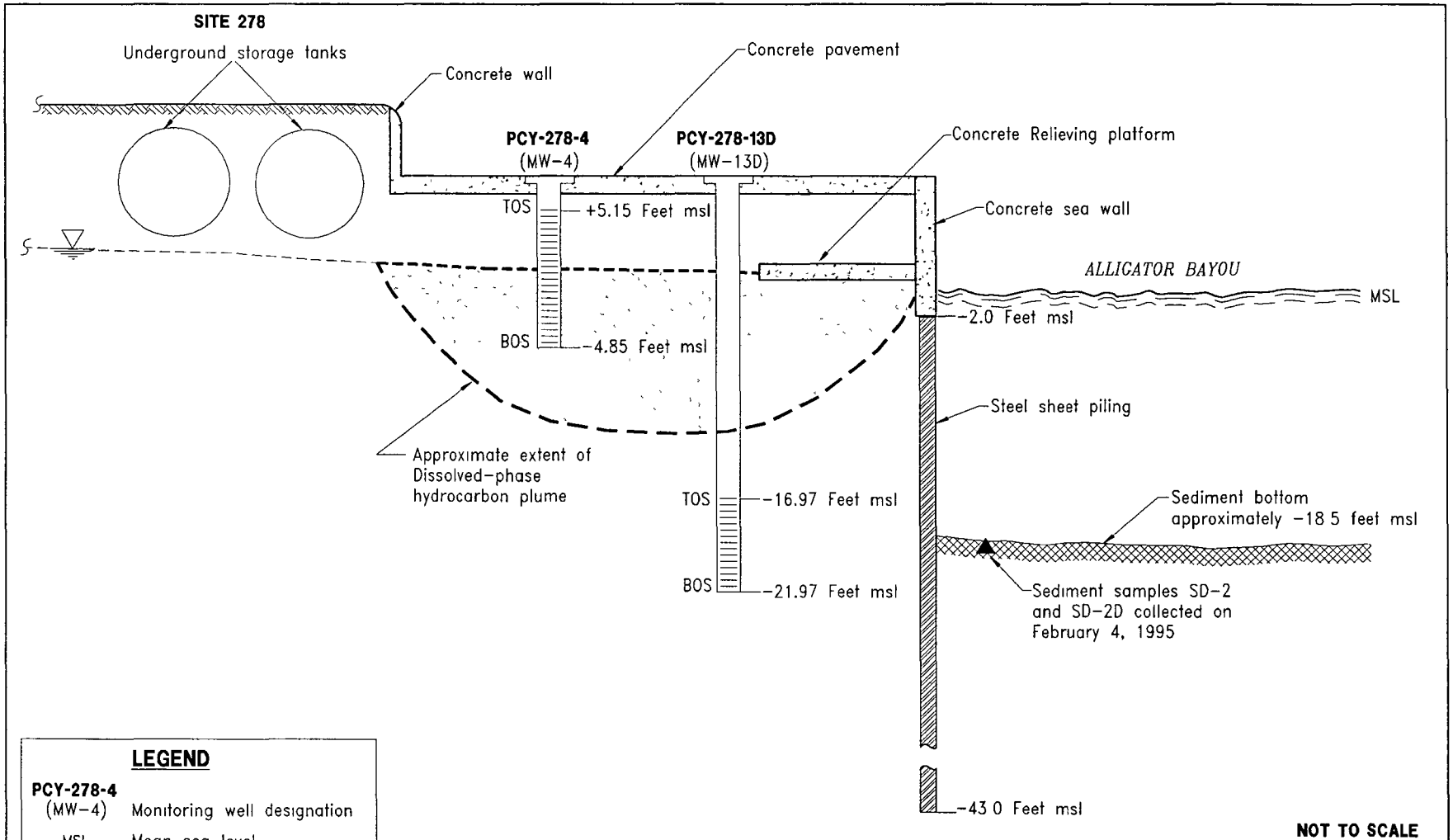


FIGURE 3-5
CROSS SECTION THROUGH SITE 278
AND ADJACENT ALLIGATOR BAYOU

REMEDIAL ACTION PLAN
SITE 278

COASTAL SYSTEMS STATION
PANAMA CITY, FLORIDA

wells are located at CSS Panama City within 0.25 mile radius of Site 278. None of these wells are located downgradient of Site 278. Only the well located near Building 394 (which is within 800 feet from Site 278) is currently in operation drawing water for heating and air conditioning purposes. All the public water supply wells are screened between 350 feet and 400 feet intervals (this interval is within the Floridian Aquifer System, see Appendix C). The petroleum contamination at Site 278 is less than 25 feet bls. Based on this information, contamination of public water supply wells from the contamination at Site 278 is not likely.

Direct migration of contaminants to the adjacent bayou is limited due to the existing bulk head which is constructed of steel z-type sheet pile sections and concrete sea wall extending to a total depth of more than 50 feet bls.

Surface water and sediment samples collected and analyzed from the bayou adjacent to the area of groundwater contamination indicate the presence of contaminants similar to those found at other areas of the bayou.

3.5 SITE-SPECIFIC LIMITATIONS TO ALTERNATIVES. The site contamination is located beneath a concrete paved area of the dock that serves as a roadway (see Figure 3-5). This is an active area and any remedial construction or operation and maintenance activities would be disruptive and should be minimized. The site is also underlain by many active and abandoned fuel lines and utility lines. Additionally, structural components of the seawall and dock are present, including the original seawall, concrete relieving platform walls and wooden structural piles supporting the relieving platform. These structural features would potentially restrict any subsurface activities such as trenching, well drilling, or excavation.

3.6 REMEDIAL STRATEGY. A remedial system chosen for Site 278 should be designed to address the area of free product, the associated soil and groundwater contamination.

Contamination associated with the soil is primarily confined within the capillary fringe (see Appendix A) and is due to the presence of free product, therefore any remedial technologies chosen for free product removal and groundwater cleanup should also address the contamination associated with the soil. A separate treatment technology for soil is not warranted for this site.

3.7 DISCUSSION OF ALTERNATIVES. After defining the contaminants of concern, the applicable cleanup standards, extent of contamination, and exposure pathways, and developing a remedial strategy, it is necessary to identify and screen technologies that may be applicable to mitigating the contamination at the site. Because each site is unique and cleanup technologies applicable to sites contaminated with petroleum substances are continually being improved and developed, it is important to develop remedial action alternatives using the most effective technologies available.

3.7.1 Technologies for Free Product Removal The CAR has identified that a limited area near monitoring wells MW-5 and MW-6 has been contaminated with free

product. A free product removal system may include either a passive, active, or a combination of passive and active means of removal based on the amount of recoverable free product in the unsaturated and saturated zones of the aquifer.

Passive mode of Free Product Removal: Passive mode involves technologies that rely on the existing hydraulic gradients of the free product and groundwater. Two technologies are considered for evaluation: One technology is free product removal by periodic manual bailing, which is currently being implemented for source abatement at Site 278. Another technology is the use of oil absorbing hydrophobic socks inside the monitoring well and periodic extraction of free product from the absorbent socks. Efficiency of these technologies is dependent on the natural gradient of free product near the well and availability of recoverable free product within the zone of the screen interval of the monitoring well.

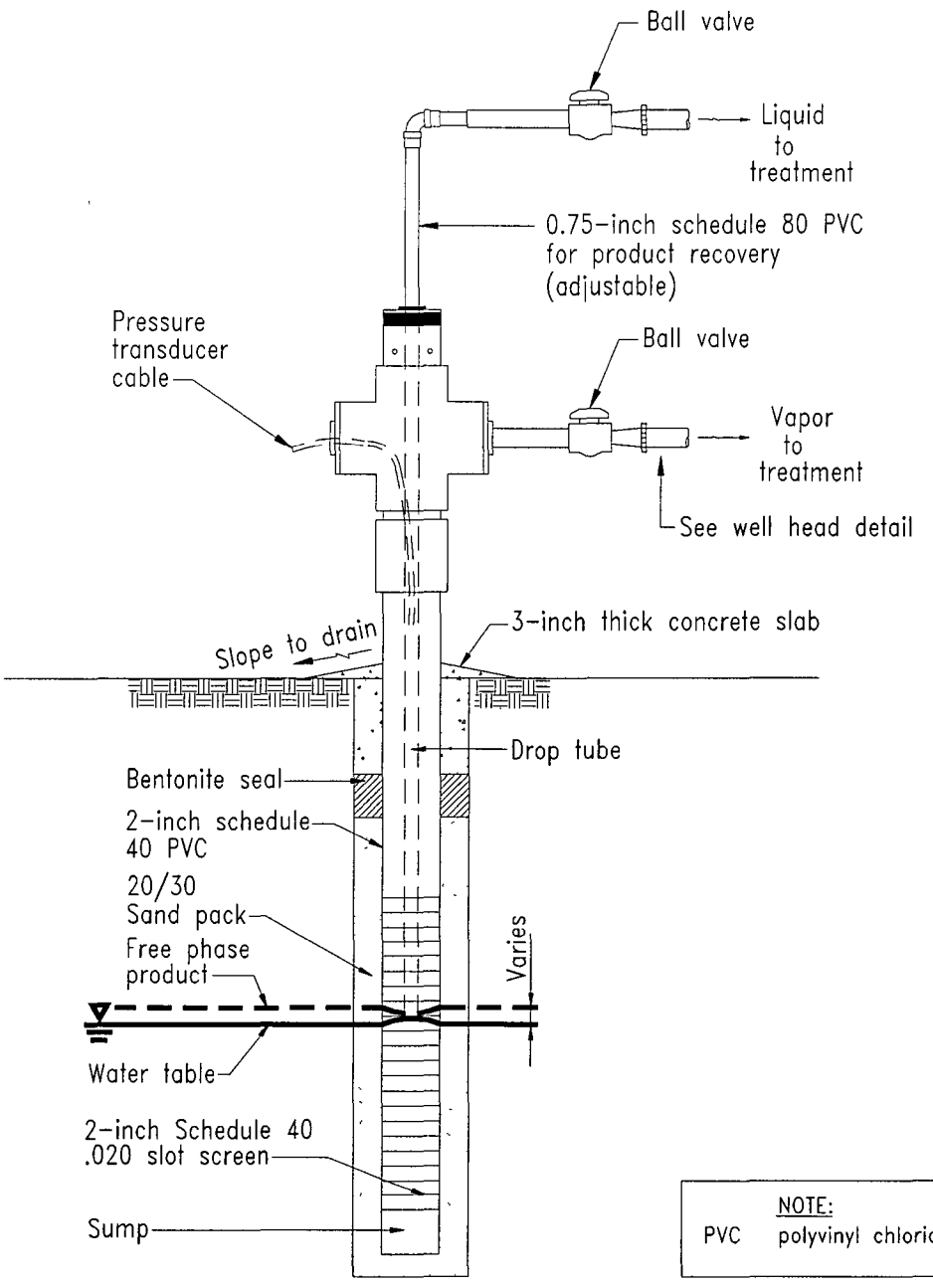
Active Mode of Free Product Removal: Active mode involves technologies that would actively enhance the fluid recovery process by inducing low pressures within the extraction well at the oil-water interface, and accelerate accumulation of free product within the extraction well during recovery. Two technologies are considered for the active mode of free product removal. The technologies evaluated include use of submersible skimmer pumps and the use of vacuum enhanced extraction.

Submersible Skimmer Pumps. Submersible pumps create pressure differences by lowering the free product levels within the extraction well. However, skimmer pumps can not enhance the natural hydraulic gradient of free product. Hence efficiency of a skimmer pump is greatly dependent on the potential for continued migration of recoverable free product into the extraction well.

Vacuum Enhanced Extraction (VEE). VEE involves removal of free product, soil vapor and groundwater by applying a high vacuum (6 to 12 inches of mercury [Hg]) to the recovery well. An application of high vacuum to the well-head increases the hydraulic gradient of free product and groundwater. When the vacuum is applied in the well, liquids in the well and pore gasses in the soil will migrate towards the extraction well due to reduced pressure above the fluid interfaces.

Figure 3-6 presents a schematic of a well head for a VEE system . A vacuum may be applied both within the well casing and the drop tube. The drop tube and the well casing are manifolded to the same vacuum source. A high vacuum is applied to the drop tube to lift the water and/or free product near the well formation. A lower vacuum is applied to the well itself to cleanup the unsaturated zone soils by soil vapor extraction (SVE) and to enhance the liquid recovery aspect of the extraction system. The vacuum influence of the well increases the hydraulic gradient for flow of groundwater and product to the well, improving the ability of the extraction system to recover the free product and extract the groundwater through the smear zones within the soil. Thus groundwater is always directed to migrate through soil pores that were earlier occupied by contaminated groundwater or free product.

3.7.2 Technologies for Groundwater Remediation Groundwater remediation may be accomplished via *ex-situ* treatment or *in-situ* treatment.



VACUUM ENHANCED EXTRACTION WELL DETAIL

NOT TO SCALE

FIGURE 3-6
VACUUM ENHANCED EXTRACTION WELL DETAIL

H:\PCY\RAP\EXWELL\GLC-NP\03-22-96

REMEDIAL ACTION PLAN
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***Ex-situ* Treatment** This alternative would consist of collecting the contaminated groundwater, treating it to reduce its mobility, toxicity, and volume, and disposing of the treated effluent. The groundwater would be collected through extraction wells. Treatment technologies considered include options that use CSS Panama City's oily-waste collection and treatment system, and those that require installing alternate treatment systems on site.

Groundwater Extraction: If *ex-situ* treatment of groundwater is selected, a groundwater extraction method must be selected. Alternatives considered include extraction wells, VEE systems, and recovery trenches.

Extraction wells consist of one or more wells from which groundwater can be pumped to the treatment system. Wells are designed based on the location of the contamination, the aquifer hydraulic conductivity, the hydraulic gradient of the water table, and the depth to the water table. The depth, diameter, screen length, pumping rate and draw down for each well, as well as the number and location of wells are designed to produce the appropriate capture zone. This is a widely used and accepted groundwater recovery method.

Combined vapor-fluid vacuum enhanced extraction systems consist of vacuum pumps that remove soil vapors and dewater the selected zone simultaneously. The systems typically are similar to well point dewatering systems with draw tubes within the vapor recovery. If a saturated part of the aquifer is dewaterd, air continues to flow through the pores allowing the remediation to continue. This is particularly an advantage in aquifers with low transmissivities. Because the depth of dewatering is controlled by the magnitude of the vacuum, the affected area is automatically maintained during variation of the water table. This method has a physical limitation on the depth from which water can be removed. Theoretically, a perfect vacuum can support a water column of about 34 feet. In application this method can typically lift water from 18 to 20 feet below the elevation of the vacuum pump. This option would not incur any additional cost, if combined with the VEE option of free product removal, and groundwater is extracted in batch flow rather than continuous extraction. Thus volumes of groundwater will be extracted along with the recovery of free product.

Recovery trenches typically consist of perforated pipe laid in a trench, which is backfilled with a material that is more permeable than the surrounding soil. Groundwater flows by gravity into the pipe and to a sump where it is collected and pumped to the treatment system. Recovery trenches can be placed at the water from all directions, or downgradient and perpendicular to the flow direction to intercept the flow at sites with greater water table gradients. The existing structures at Site 278 would make it difficult to implement any excavation activities. Hence, installation of recovery trenches is not a viable technology for groundwater extraction.

Groundwater Treatment: Extracted groundwater will be run through an oily-waste collection and treatment system located on base. This system consists of a collection tank, an oil-water separator, and a waste water treatment plant.

Ultra violet (UV)/Oxidation is a process in which organic contamination in extracted groundwater is oxidized through simultaneous application of UV light with ozone and/or hydrogen peroxide. Pretreatment for removal of naturally occurring inorganics (e.g., iron, lead, or manganese) may be required to prevent fouling of the oxidation system. UV/Oxidation has not been as widely used for

petroleum cleanups as air stripping or carbon adsorption, but can be an effective technology for treating VOC contaminated water.

Biological treatment is a process that destroys organics through biodegradation, acclimation-degradation, or chemical conversion of the organic wastes by introducing the extracted groundwater to either an aerobic or anaerobic biological treatment processes. Microorganisms and nutrients (if needed) are added to induce one or more of the responses. Site VOC concentrations must be able to support the biological processes for this to be feasible. Implementation would require additional testing and may require secondary treatment to achieve target concentrations.

Air stripping is a technology that is proven effective for removal of VOCs and semivolatile organic compounds (SVOCs). It reduces concentrations of volatile compounds through intimate contact of extracted groundwater with air. Water descends a packed column while air is forced up the column to promote mass transfer of organics from aqueous to gaseous phase. Off gases may require further treatment to meat air regulations. Pretreatment for removal of naturally occurring inorganics (e.g., iron, lead, manganese) may be required to prevent fouling of air strippers.

Carbon adsorption is a proven technology for removing VOCs and SVOCs from groundwater, but typically is not cost effective for treating groundwater with high VOC concentrations. It is easily implemented, although periodic changeout of spent carbon is required. Disposal of spent carbon is also a consideration. Carbon adsorption may be used, with another technology, as a polishing step.

Effluent Disposal: If *ex-situ* treatment of groundwater is selected, disposal of the treated effluent must be considered. The options considered include discharge to the CSS Panama City oily waste collection and treatment system, reinjection to the groundwater, and discharge to a surface water body.

The CSS Panama City Oily waste collection and treatment system has sufficient capacity to accept the treated effluent. There would be very limited additional disposal costs associated with this option.

The existing structures at the site would make it difficult to excavate trenches and discharge treated effluent through a recharge gallery.

Discharge to a surface water body would be easy to implement, but would require a National Pollution Discharge Elimination System permit. The permit monitoring requirements, which might include more frequent sampling and bioassays, would add significantly to the cost of this option.

***In-situ* Treatment** The alternative would consist of treating groundwater to reduce the mobility, toxicity, and /or volume of the contamination without removal. *In-situ* treatment technologies considered include natural attenuation and enhanced bioremediation.

Natural Attenuation: Natural attenuation consists of destructive and non-destructive attenuation of contaminants in groundwater. Components of non-destructive attenuation include, volatilization, dispersion, dilution and adsorption. Components of destructive attenuation include aerobic and anaerobic

biological degradation. Natural attenuation is appropriate if the following conditions are satisfied:

- The loss of contaminants of concern has been documented at the field scale;
- biodegradation is evident by means of geochemical indicators including nutrient concentrations such as oxygen, sulfur, phosphorous, and nitrogen; and
- microbial studies indicate presence of petroleum-degrading microorganisms in groundwater.

Data supporting natural attenuation at Site 278 is included in Appendix A.

Enhanced Bioremediation: Enhanced bioremediation typically involves the delivery of nutrients to bacteria that degrade the petroleum products, breaking them down to carbon dioxide and water. Some type of initial testing is typically required to assess the existing level of biological activity and the appropriate nutrient supplements needed to affect the biodegradation. This technology has been used successfully to reduce VOC contamination levels. Implementation would require a system for injection of nutrients and oxygen. The biological processes may be difficult to control *in-situ*, and nutrients would be difficult to deliver due to site pavement.

Table 3-2 presents a list of all the technologies evaluated for Site 278, and describes the rationale for screening and selection of technologies for further consideration.

3.8 ALTERNATIVE SELECTION. Below are the characteristics of the remedial system.

The remedial system will present the flexibility of continuing the current passive mode of free product removal until an active mode of extraction is in place because free product has been observed over only a limited area (MW-5, and MW-6); product thicknesses are less than 1 foot and are diminishing over time; and an IRA was begun in February of 1993.

The free product removal and the soil cleanup will be combined by use of a vacuum enhanced free product extraction because excessively contaminated soil is confined only to a limited area; soil contamination is primarily associated with free product; and any excavation activities are restricted due to the structural features at the site.

The remedial system will include limited extraction and treatment of groundwater from monitoring wells MW-5 and MW-6 using VEE followed by a monitoring plan for the following reasons:

- it is evident through three episodes of groundwater sampling that the concentrations of total BTEX, total naphthalenes, and TRPH were steadily decreasing both in extent and level of concentrations (see Appendix A);
- total BTEX were completely eliminated;

Table 3-2
Selection of Technologies

Remedial Action Plan, Site 278
Coastal Systems Station Panama City
Panama City, Florida

Component	Technology	Rationale	Decision
Free product Removal	Manual Bailing	• Dependent on natural hydraulic gradient of free product. • Removal process takes longer time frames. Can not remove all the recoverable volume of free product. • Groundwater recovery and cleanup can not be initiated until free product removal is complete.	Deleted.
	Absorbent Socks	• Same as above.	Deleted.
	Skimmer Pumps	• Same as above.	Deleted.
	Vacuum Enhanced Extraction	• Vacuum enhances the hydraulic gradient of the free product • Free product removal process takes relatively shorter time frames. • Free product, groundwater, and soil vapors can be extracted simultaneously.	Retained.
Groundwater Treatment *Ex-situ*			
Extraction	Pumping	• Requires installation of extraction wells, and removal of free product before groundwater extraction could be initiated.	Deleted.
	Vacuum Enhanced Extraction	• Existing monitoring wells/piezometer could be used for removal of free product and groundwater	Retained.
	Recovery Trenches	• Excavation activities are restricted at the site.	Deleted.
Treatment	Air-stripping UV/Ox Carbon Adsorption	• Use of these technologies require installing capital intensive treatment systems • Groundwater contamination is limited to total naphthalenes and TRPH	Deleted.
	Oily waste collection and treatment system	• Emulsified fluids may be separated into oil and water. Separated water may be further treated at the oily waste treatment system.	Retained.

See notes at end of table.

Table 3-2 (Continued)
Selection of Technologies

Remedial Action Plan, Site 278
Coastal Systems Station Panama City
Panama City, Florida

Component	Technology	Rationale	Decision
Discharge	Infiltration Galleries	• Excavation activities are limited due to the presence of concrete pavement	Deleted.
	Oily Waste Collection and Treatment System	• Base's oily waste collection and treatment system has the capacity to handle the extracted groundwater.	Retained
	Surface Water	• Requires NPDES permit be maintained.	Deleted.
In-situ	Natural Attenuation	• Evidence of natural attenuation based on three episodes of historical sampling.	Retained.
	Enhanced Biodegradation	• Requires supply of nutrients and control over the microbial growth.	Deleted.

Notes: UV/OX = ultraviolet/oxidation.
TRPH = total recoverable petroleum hydrocarbons
NPDES = Nation Pollution Discharge Elimination System.

- total naphthalenes and TRPH are confined to a small area that matches with the area of the free product; and

- concentrations of total naphthalenes and TRPH at the source area monitoring wells are below MOP target levels of 62-770, FAC.

Thus, pump and treat to meet NFA target levels is not warranted at Site 278. (Appendix A includes potential estimated volume of groundwater to be flushed out in pump and treat type remedial actions to meet NFA target levels.)

CHAPTER 4.0

4.0 RECOMMENDED REMEDIAL ACTION

The recommended remedial action for Site 278 soil and groundwater contamination at CSS Panama City is source abatement through a free product monitoring and recovery program, and limited extraction of groundwater followed by groundwater monitoring. The components of the remedial action are as follows:

- VEE of free product and groundwater,
- treatment of mixed fluids at the oily waste collection and treatment system, and
- groundwater monitoring.

4.1 VEE OF FREE PRODUCT AND GROUNDWATER. Components of a VEE system include the following:

- extraction well head,
- total fluids collection tank,
- piping network,
- vacuum pump,
- vapor treatment unit,
- oil-water separator, and
- groundwater collection and treatment system.

Figure 4-1 presents the schematic for the VEE system.

4.1.1 Technology Description A vacuum truck consisting of a vacuum pump, total fluids collection tank, and a vapor containment and treatment unit will be used at Site 278. Vendors who could supply a vacuum truck with the required specifications are readily available in the industry. Typically vacuum trucks are equipped with a vacuum pump that is capable of producing a range of air flow rates (1,000 to 3,000 cubic feet per minute) and vacuum to facilitate the selective extraction of free-phase petroleum products and groundwater from the extraction well.

The vacuum pump could generate a maximum vacuum of 27 inches Hg. The maximum allowable vacuum at the extraction well is limited by the structural stability of the extraction well construction materials. For a schedule 40, 2-inch diameter PVC. 0.1-inch slotted screen has a maximum allowable vacuum of 24 inches Hg (MDEQ, 1995).

Vacuum trucks also come equipped with vapor containment and treatment equipment. Vacuum trucks used for petroleum hydrocarbon extraction are typically equipped with a liquid ring pump. The liquid ring pump which is also known as a true vacuum pump, consists of a single aluminum impeller that spins at a very low speed (700 revolutions per minute) inside an aluminum housing. The liquid ring is developed inside the pump housing and becomes the housing wall. The liquid used inside the pump is generally water, however, any suitable liquid can be used. These principle design characteristics available with liquid ring pumps minimize the risk for a spark to occur in the pump.

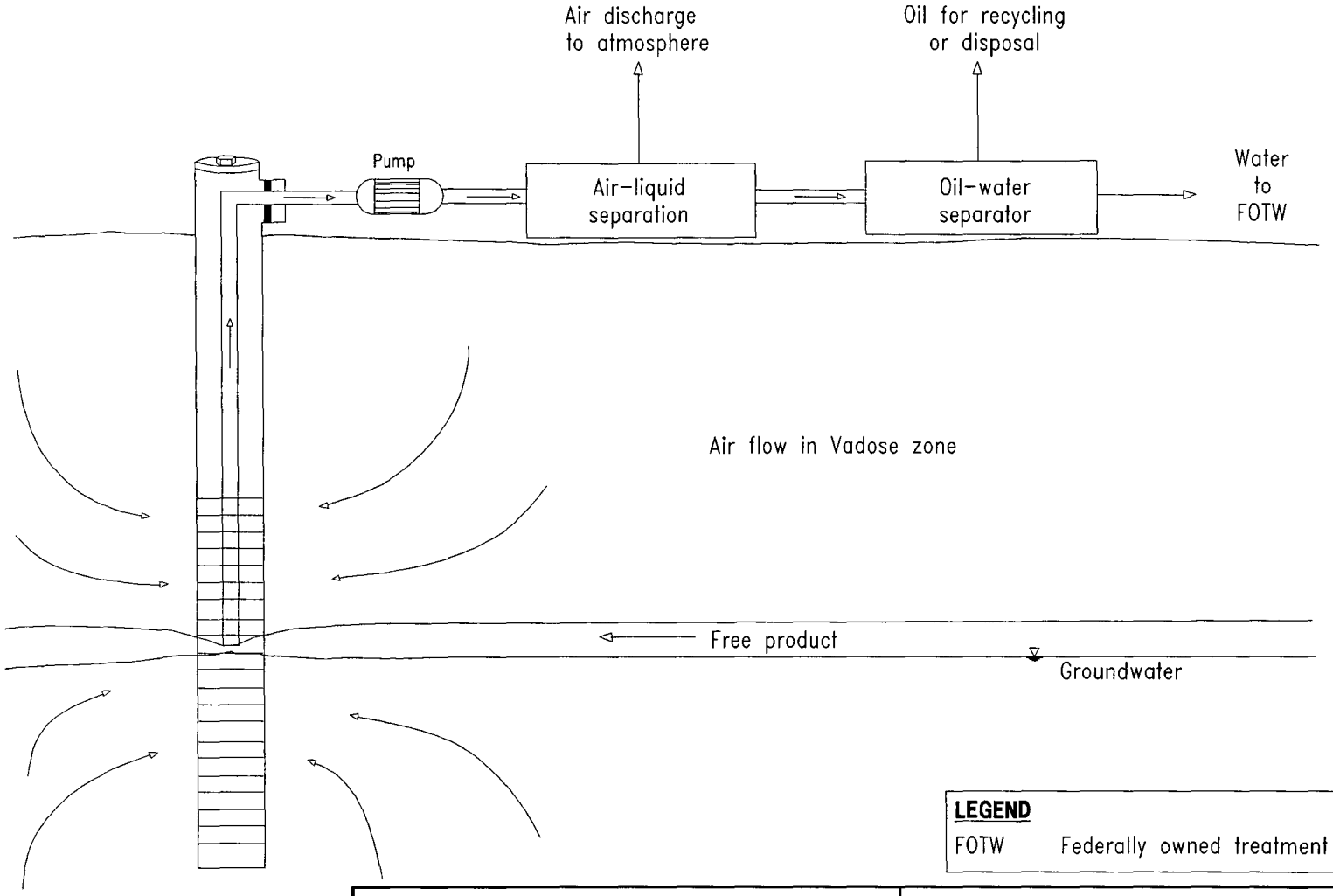

FIGURE 4-1
VACUUM ENHANCED EXTRACTION SYSTEM

REMEDIAL ACTION PLAN
SITE 278

COASTAL SYSTEMS STATION
PANAMA CITY, FLORIDA

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As the product vapor enters the liquid ring pump, it is compressed on the housing wall of water. The discharge air and vapor, along with a portion of the pump's liquid supply, are then discharged to an unrestricted exhaust tower. The pump liquid supply that is discharged absorbs some of the vapor resulting in a reduced concentration of vapor into the atmosphere. Water from the liquid ring pump tower may be collected and treated along with the total fluids collected in the fluids collection tank.

VEE Principles: Figure 3-6 presents the well head for the VEE. Free-phase liquid and groundwater are extracted, using a drop tube with its tip located at the oil-water interface. Location of the tip of the drop tube is adjusted based on the depth to oil-water interface. A vacuum is initially applied to the drop tube to begin removal of groundwater and free product. The drop tube and the well casing are manifolded to the same vacuum source. High vacuum is applied to the drop tube in order to lift the water and/or free product, thus lowering the water table in the local area. Lower vacuum is applied to the well itself to cleanup the unsaturated zone soils by SVE.

The vacuum applied to the subsurface with VEE system creates vapor-phase pressure gradients toward the extraction well. These vapor-phase pressure gradients are also transmitted directly to the subsurface liquids present, and these liquids existing in a continuous phase (water and free product) will flow toward the extraction well in response to the imposed gradients. The higher the applied vacuum, the larger the hydraulic gradients that can be achieved in both vapor and liquid phases, and thus the greater the vapor and liquid recovery rates (U.S. Environmental Protection Agency [USEPA], 1995). Required vacuum rates are determined in the field during the initial events of VEE application. Typical vacuum rates are between 6 inches to 12 inches of Hg. Less permeable soils (clayey and silty sands) require higher well head vacuum pressures to produce reasonable radii of influence. However, high vacuums can cause upwelling of the water table and occlusion of all or part of extraction well screens (USEPA, 1995).

4.1.2 **Extraction of Free product and Groundwater** Free product has been observed in monitoring wells MW-5 and MW-6. Groundwater contamination is reported in monitoring wells MW-4, MW-5, and MW-6. Hence, monitoring wells MW-5 and/or MW-6 will be used as recovery wells for application of VEE.

Based on the groundwater flow direction and boundaries of the contaminant plume the upgradient, source area, and the perimeter area monitoring wells are defined as follows:

- Upgradient wells: MW-1, MW-2, and MW-3
- Source Area Wells: MW-4, MW-5, and MW-6
- Perimeter Area Wells: MW-7, MW-10, MW-12, MW-13D, MW-14, and MW-15.

The primary objective of VEE is to recover the free product. Implementation of the free product recovery program using VEE incidentally will result in extraction of contaminated groundwater and soil vapor from the hot spot areas. Pilot-scale tests conducted elsewhere using VEE have also reported observation of increased dissolved oxygen levels in the groundwater within the influence area of the VEE (as described in Subsection 3.7.2, oxygen is one of the main nutrients required for sustaining natural attenuation of petroleum hydrocarbon components dissolved in groundwater). Hence, monitoring wells MW-5 and/or MW-6 will be used as recovery wells for application of VEE.

The overall performance of VEE will be evaluated based on the data obtained for the monitoring parameters listed below.

Recover Free Product:

- Initial and final thicknesses of free product in source area and perimeter area monitoring wells
- Composition of total fluids collected at the end of extraction event

Reduce Groundwater Contamination at the Source Area Wells:

- Groundwater samples from source area and perimeter area wells
- Increase in dissolved oxygen concentrations in groundwater at the source area and perimeter area wells

Reduce Soil Contamination within the Capillary Zone:

- Vapor flow rates from the recovery wells
- Vapor concentrations during application of VEE
- Vacuum readings at the well heads from source area and perimeter area wells during application of VEE

Table 4-1 presents the data log for VEE.

4.2 TREATMENT OF TOTAL FLUIDS. At the end of each VEE event the total fluids collected in the vacuum truck will be discharged into a 1,000-gallon polyethylene tank next to the oily-waste collection and treatment system. This tank is connected to the oily-waste collection and treatment system. Mixed fluids are temporarily stored in the polyethylene tank to make a visual estimation of composition of fluids collected during each extraction event.

The oily-waste collection and treatment system at CSS Panama City consists of an oil-water separator and an oily-waste treatment plant. Contaminated groundwater will be treated at the oily-waste treatment plant.

4.3 SYSTEM STARTUP. Prior to the initiation of the free product and groundwater recovery and monitoring program, groundwater from the source area and perimeter area monitoring wells will be collected for laboratory analyses as a baseline concentration for the monitoring program.

Currently, Site 278 has one deep monitoring well (MW-13D) for monitoring of vertical migration of contaminants. FDEP has recommended installing an additional deep monitoring well between MW-6 and MW-7 in order to better define the vertical extent and potential migration of contaminants at Site 278 (meeting minutes, FDEP,

Table 4-1
Vacuum-Enhanced Extraction Data Log

Remedial Action Plan, Site 278
Coastal Systems Station Panama City
Panama City, Florida

Site:													
Date:				Vac-Truck Operator:									
Logged By:				Checked By:									
Time[1]	**Applied Vacuum[2] (H_2O in.)**			**Vapor Flow Rate[3] (SCFM) at the Recovery Well**	**Vapor Concentration[4]**	**Well Head Vacuum[5] (H_2O in.)**					**Volume of Fluids[6] (gallons)**		
	Total	Drop Tube	Well Casing	Total	Total	MW-4	MW-5	MW-6	MW-7	MW-12	Total	Water	FP

[1] Time: Time at which the measurements are made
[2] Applied Vacuum: Vacuum measured at V1, V2, and V3 — Use Vacuum Gauges
[3] Vapor Flow Rate: Measured at V1 — Use Anemometer
[4] Vapor Concentration: Measured at V1 — Use Tedlar Bags to collect Vapor Sample and measure with a VOA analyzer
[5] Well Head Vacuum: Vacuum measured at monitoring wells — Use Vacuum Gauges
[6] Volume of Fluids: Measured from the polyethylene tank — Use Oil Water Interface Probe

Notes. H_2O = water.
SCFM = standard cubic feet per minute.
FP = free product.
V1 = at Vac-Truck.
V2 = at the drop tube.
V3 = at the well casing.
VOA = volatile organic aromatic.

1996). This additional deep well (MW-16D) will be installed before the system startup and beginning of any remedial activities. Location and construction details of the deep monitoring well are included in Appendix E.

4.4 SYSTEM MONITORING AND REPORTING. To maximize and monitor system performance, monitoring during every extraction event is recommended.

Frequency of monitoring and recovery events for free product and groundwater weekly, monthly, and quarterly will vary according to the flow scheme presented on Figure 4-2.

. Extraction events will be scheduled once every week. However, if excessive volumes of free product are observed to be accumulating near any of the recovery wells, extraction frequency will be changed to twice every week. VEE will be applied for an 8-hour period during each extraction event.

. Application of VEE will be continued until no recoverable free product is observed for 3 consecutive months of weekly monitoring.

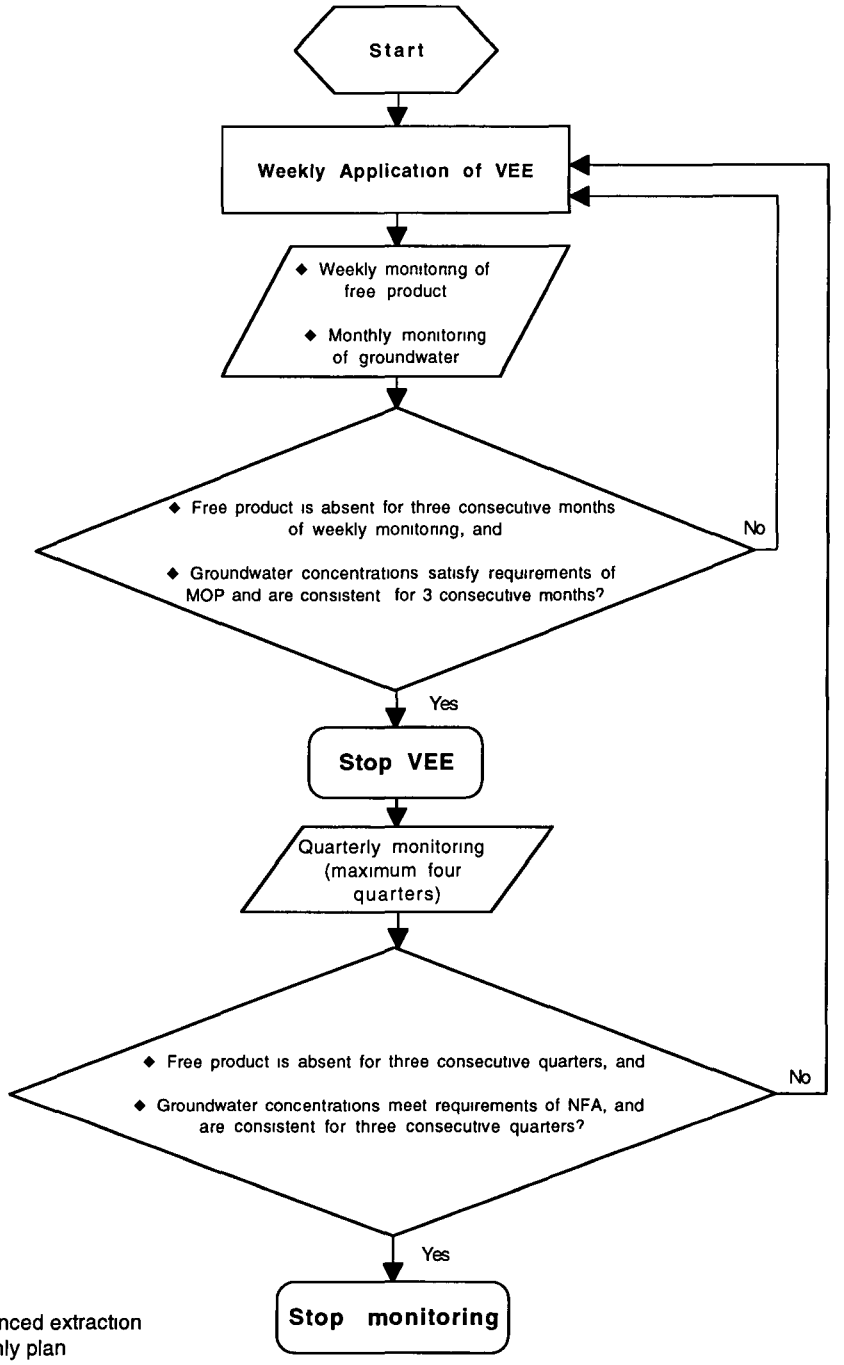
. Groundwater concentrations of total naphthalene and TRPH at the source area monitoring wells will be verified if they meet "monitoring only plan" requirements of Chapter 62-770, FAC, and are consistent for 3 consecutive months of monitoring.

. Upon verification of groundwater concentrations at the source area wells, groundwater monitoring intervals will be switched to quarterly intervals.

Once the quarterly groundwater monitoring program has stopped, a no further action (NFA) request will be submitted based on FDEP's essential conditions for an approvable NFA found in the Technical Criteria Overview Section of the No Further Action and Monitoring Only Guidelines for Petroleum Contaminated Sites document (FDER, 1990), the guidelines document lists four of the following NFA criteria that must exist at the site:

- the source of the contamination has been abated;
- free product is not currently present;
- excess soil contamination is not currently present; and
- the groundwater contamination (if present) is not wide spread, not extending offsite, or not migrating vertically.

It is anticipated that the free product recovery program will last about 12 months. Groundwater will be monitored quarterly for a period of 12 months. Table 4-2 summarizes the intervals of the groundwater monitoring plan.



NOTES:
VEE = vacuum enhanced extraction
MOP = monitoring only plan
NFA = no further action

FIGURE 4-2
FREE PRODUCT AND GROUNDWATER RECOVERY AND MONITORING PLAN

REMEDIAL ACTION PLAN
SITE 278

COASTAL SYSTEMS STATION
PANAMA CITY, FLORIDA

Table 4-2
Groundwater Monitoring Plan Sampling Schedule

Remedial Action Plan, Site 278
Coastal Systems Station Panama City
Panama City, Florida

Task	Monthly Monitoring							Quarterly Monitoring			
	1	2	3	.	.	.	[1]12	1	5	9	13
Measure water levels	0	0	0	0	0	0	0	X	X	X	X
Measure free product thickness	0	0	0	0	0	0	0	X	X	X	X
Sample perimeter area wells[2]	X	X	X	X	X	X	X	X	X	X	X
Sample source area wells[3]	X	X	X	X	X	X	X	X	X	X	X

[1] Estimated maximum time to cleanup.
[2] Includes monitoring wells MW-3, MW-4, MW-7, MW-8, MW-13D, MW-15, and MW-16D.
[3] Includes monitoring wells MW-5, and MW-6.

Notes: 0 indicates task to be performed weekly in the given month.
X indicates task to be performed once in the given month.

CHAPTER 5.0

5.0 COST ESTIMATE

The cost estimate is inserted following Appendix E in those report copies that require it and has been omitted in others. This was done to facilitate Navy procurement requirements.

CHAPTER 6.0

6.0 SCHEDULE

It is estimated that the monitoring and recovery programs can begin approximately 2 weeks following the monitoring and recovery work contract agreement.

The free product monitoring and recovery program has the potential to last a minimum of 6 months, and a maximum of 12 months. Limited extraction of groundwater will occur simultaneously with free product removal. Thus, free product recovery and groundwater extraction would require a maximum estimated time of 12 months. The groundwater monitoring program will extend 1 year past the end of the product monitoring and recovery program and limited extraction of groundwater. These time estimates assume a weekly interval for application of VEE at the site.

CHAPTER 7.0

7.0 DOCUMENTATION

A free product monitoring and recovery plan, limited extraction of groundwater, and groundwater monitoring plan will be provided at the initiation of the monitoring and recovery program. The plan will provide all necessary information for the proper operation and maintenance of the product monitoring and recovery program. The plan will include, at minimum, the following:

- Material Safety Data Sheets for materials used or being treated;
- monitoring schedules, including sampling frequency, sampling locations, required analyses, and parameters for field measurement; and
- instructions for maintaining a site activity log.

The plan will be assembled and bound in a manner suitable for use in the field.

8.0 PROFESSIONAL REVIEW CERTIFICATION

This RAP was prepared using standard engineering and designs. The plan for remediating this site is based on the information collected between October 1992 and October 1995, and engineering detailed in the text and appended in this report. If conditions are determined to exist that are different than those described, the undersigned professional engineer should be notified to evaluate the effects of any additional information on the design in this report.

This RAP was developed for Site 278, CSS Panama City, Panama City, Florida, and should not be construed to apply to any other site.

Gopi Kanchibhatla
P.E. No. 49494

REFERENCES

REFERENCES

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APPENDIX A

APPENDIX A

EXTENT OF CONTAMINATION

HEIGHT OF CAPILLARY RISE CALCULATION
CSS Panama City, Site 278
Panama City, Florida

The height of capillary rise above the saturated zone in soil can be estimated as follows (Terzaghi and Peck, 1967).

$$h_c = \frac{C}{e\ D_{10}}$$

where: h_c = the height of capillary rise (centimeters)
C = an empirical constant which ranges from 0.1 to 0.5 cm^2
D_{10} = the effective grain size (centimeters)

The void ratio is calculated from the porosity (n), estimated at 0.25 at this site, as follows.

$$e = \frac{n}{1-n} = \frac{0.25}{1-0.25} = 0.3333$$

Soil at the site is described as very fine to fine grained sand. Based on the particle size distribution analyses (ABB-ES, Wakefield Treatability Study Laboratory, MA) soil at Site 278 has a D_{10} of 0.011 cm. Using a conservative C value of 0.1 cm^2, the height of capillary rise is:

$$h_c = \frac{0.1\ cm^2}{0.3333\ X\ 0.011\ cm} = 27.28\ cm = 0.89\ ft$$

FREE PRODUCT THICKNESS ESTIMATE
CSS Panama City, Site 278
Panama City, Florida

The measured free product thickness in a monitoring well is an apparent thickness and not the actual thickness of product in the soil. The primary factors which influence the degree of exaggeration in the apparent thickness include grain size and product density. Various methods for estimating the actual thickness are presented in Testa and Winegardner (1991). The following equation, referred to as CONCAWE in that text, may be used.

$$\frac{H}{h} = \frac{P_c^{wo}}{P_c^{oA}} \frac{\rho_o}{\rho_w - \rho_o}$$

where: H is the apparent thickness
h is the actual thickness
P_c^{wo} is the capillary pressure at the water-oil interface
P_c^{oA} is the capillary pressure at the oil-air interface
ρ_o is the density of the product
ρ_w is the density of water

The specific gravity of the product at this site is estimated to be 0.8. Therefore;

$$\rho_o = 0.8\rho_w \quad \textit{and} \quad \frac{H}{h} = \frac{P_c^{wo}}{P_c^{oA}} \frac{0.8\rho_w}{\rho_w - 0.8\rho_w} = \frac{P_c^{wo}}{P_c^{oA}} \frac{0.8}{1 - 0.8} = 4 \frac{P_c^{wo}}{P_c^{oA}}$$

Assuming the capillary pressures at the water-oil and oil-air interfaces are equal;

$$\frac{H}{h} \approx 4 \frac{P_c^{wo}}{P_c^{oA}} \approx 4 \quad \textit{or} \quad h \approx \frac{H}{4}$$

The product thickness is directly related to the volume of product contaminated soil, therefore, using the above equation, and assuming the porosity of the soil to be 0.25. The volume of the product is estimated as 439 gallons.

This estimate is consistent with actual measurements referenced in the text and is considered appropriate for this site.

Reference: Testa, S.M., and Winegardner, D.L., 1991, Restoration of Petroleum Contaminated Aquifers: Lewis Publishers, Chelsea, Michigan, 269 p.

FREE PRODUCT VOLUME CALCULATION
CSS Panama City, Site 278
Panama City, Florida

PROJECT:	CSS PANAMA CITY, Site 278	CHECKED BY:	
DATE:	22 FEB 1996	ENGINEER:	KGK

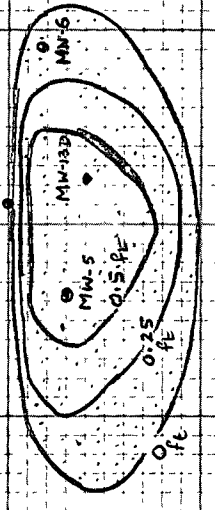
The estimated thickness and extent of product at Site 278 is illustrated in Figure 3.
In November 16, 1995 free product was detected in MW–5 with a thickness of 0.56 ft, and in MW–6 with a thickness of 0.07 ft. The volume of actual free product saturated soil is estimated in the table using the average end area method.

Apparent Thickness (ft)	Actual Thickness	Area (ft^2)	Average Area (ft^2)	Incremental Volume (ft^3)	Cumulative Volume (ft^3)
0.56	0.140	0	0	0.000	0.00
0.50	0.125	896.00	448	6.720	6.72
0.25	0.063	1744.00	1320	82.500	89.22
0.00	0.000	2912.00	2328	145.500	234.72

V	Volume of soil saturated with product:	234.72 ft^3	
n	Porosity	0.25	assumed
nV	Free Product Volume	58.68 ft^3	
	Conversion of above	438.99 gallons	

PROJECT	COMP. BY	JOB NO.
CSS Panama City Site 278 RAP	KGK.	7520-52.
	CHK. BY BSL	DATE 2/27/96

FREE PRODUCT THICKNESS CONTOURS.



0.5 ft 56 Units = $\frac{56}{10} \times [40 \times 40]$ ft².

= 896 ft².

0.25 ft (567-53) Units = $\frac{109}{10} \times [40 \times 40]$ ft².

= 1744 ft².

0 ft (73+109) Units = $\frac{182}{10} \times [40 \times 40]$ ft²

= 29,12 ft².

PROJECT: CSS Panama City, Site 270

COMP. BY: LGK

CHK. BY: BDJ

JOB NO.: 7520.52

DATE: 3/1/96

GROUND WATER CONTAMINATION CONCENTRATION CONTOURS

Vertical Extent of Contamination ≃ 9 ft

Areal Extent of TRPH + total Naphthalene plume ≃ 2815 ft²

Assume Porosity ≃ 0.25

Volume of contaminated ground water = 2815 × 9 × 0.25

= 6333 ft³

= 46996 gal

Table A-1
Summary of Groundwater Sample Laboratory Analysis, October 13, 1992

Remedial Action Plan
Site 278, Coastal Systems Station
Panama City, Florida

Compound	Method Detection Limit	State Target Level or Guidance Concentration	MW 1	MW 2	MW 3	MW 4	DUP MW4	MW 5	MW 6	MW 7	MW 8	MW 9	MW 10	MW 11	MW 12	MW 13D	MW 14
Benzene	1	1	ND	ND	ND	ND	ND	6	7	1	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	1		ND	ND	ND	51	48	43	53	41	14	ND	ND	ND	ND	ND	ND
Toluene	1		ND	ND	ND	ND	ND	ND	2	ND	ND	ND	ND	ND	ND	ND	ND
Xylenes	1		ND	ND	ND	30	22	ND	9	2	ND	ND	ND	ND	ND	ND	ND
Total VOA[1]	1	[2]50	ND	ND	ND	81	70	50	71	44	14	ND	ND	ND	ND	ND	ND
1,2-Dichloroethene	1		ND	ND	ND	ND	ND	1	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	1		ND	ND	ND	15	14	8	17	10	6	ND	ND	ND	ND	ND	ND
1-Methylnaphthalene	5		ND	ND	ND	150	140	35	150	62	ND	ND	ND	ND	ND	ND	26
2-Methylnaphthalene	5		ND	ND	ND	170	160	16	160	61	ND	ND	ND	ND	ND	ND	15
Naphthalene	5		ND	ND	ND	150	150	31	130	54	ND	ND	ND	ND	ND	ND	ND
Total naphthalene[3]	5	[2]100	ND	ND	ND	470	450	82	440	177	ND	ND	ND	ND	ND	ND	41
Fluorene	5	[4]10	ND	ND	ND	28	26	11	21	14	8	ND	ND	ND	ND	ND	9
Phenanthrene	5	[4]10	ND	ND	ND	24	23	ND	19	10	8	ND	ND	ND	ND	ND	16
TRPH	1	[2]5	ND	ND	ND	3	2	2	2	ND	2	ND	ND	ND	ND	ND	6
Lead	5	[2]50	ND	ND	ND	ND	ND	ND	ND	7	ND	19	6	52	5	ND	ND

[1]Total VOA is the sum of all volatile organic aromatics detected.
[2]State target level (Florida Department of Environmental Protection [FDEP], Chapter 17-770, Florida Administrative Code [FAC]).
[3]Guidance concentrations recommended by FDEP (February, 1989).
[4]Total naphthalenes is the sum of naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene.

Notes: Shade denotes concentration equals or exceeds State target level or guidance concentration.
Concentrations are in parts per billion, except for total recoverable petroleum hydrocarbons (TRPH), which are in parts per million.
DUP = duplicate sample.
ND = not detected.
VOA = volatile organic aromatics.
TRPH = total recoverable petroleum hydrocarbons

Table A-2
Summary of Groundwater Sample Laboratory Analysis, May 19, 1993

Remedial Action Plan
Site 278, Coastal Systems Station
Panama City, Florida

Compound	Method Detection Limit	State Target Level or Guidance Concentration	MW 1	MW 2	MW 3	MW 4	MW 5	DUP MW5	MW 6	DUP MW6	MW 7	MW 8	MW 9	MW 10	MW 11	MW 12	MW 13D	MW 14	MW 15
Benzene	1	1	ND	ND	ND	ND	ND	ND	1	1	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	1		ND	ND	ND	22	3	3	11	10	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	1		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylenes	1		ND	ND	ND	5	ND	ND	4	1	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total VOA[1]	1	[2]50	ND	ND	ND	27	3	3	16	12	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane			ND	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethene	1		ND	ND	ND	ND	ND	ND	ND	ND	ND	~~2~~	6	ND	ND	ND	ND	ND	ND
Trichlorofluoro-methane			ND	ND	ND	ND	2	2	ND	ND	ND	3	2	ND	ND	2	ND	ND	5
Acenaphthene	1		ND	ND	ND	5	ND	9	ND	15	ND	ND	ND	12	ND	ND	ND	ND	ND
Dichlorodifluoro-methane			ND	ND	ND	ND	ND	ND	ND	ND	ND	5	55	ND	ND	ND	ND	ND	ND
1-Methylnaphthalene	5		ND	ND	ND	17	25	28	38	7	ND	ND	ND	ND	ND	ND	ND	7	ND
Di-Bromochloro-methane	5		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	55	ND	ND	ND	ND	ND
2-Methylnaphthalene	5		ND	ND	ND	ND	9	14	9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	5		ND	ND	ND	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total naphthalene[3]	5	[2]100	ND	ND	ND	22	34	42	47	7	ND	ND	ND	ND	ND	ND	ND	7	ND
Fluoranthene	5		ND	ND	ND	ND	ND	ND	23	13	6	ND	ND	ND	ND	ND	ND	ND	ND
Fluorene	5	[4]10	ND	ND	ND	5	9	9	~~28~~	10	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	5	[4]10	ND	ND	ND	ND	~~14~~	~~11~~	~~68~~	~~23~~	9	ND	ND	ND	ND	ND	ND	ND	ND
Pyrene	5		ND	ND	ND	ND	ND	ND	7	6	5	ND	ND	ND	ND	ND	ND	ND	ND

See notes at end of table.

Table A-2(Continued)
Summary of Groundwater Sample Laboratory Analysis, May 19, 1993

Remedial Action Plan
Site 278, Coastal Systems Station
Panama City, Florida

Compound	Method Detection Limit	State Target Level or Guidance Concentration	MW 1	MW 2	MW 3	MW 4	MW 5	DUP MW5	MW 6	DUP MW6	MW 7	MW 8	M W9	MW 10	MW 11	MW 12	MW 13D	MW 14	MW 15
TRPH	1	[2]5	ND	ND	ND	3	120	74	54	55	7	ND	ND	ND	ND	ND	ND	3	ND
Lead[5]	5	[2]50	ND	ND	16	ND	ND	ND	9	8	ND	ND	ND	8	8	10	ND	ND	30

[1]Total VOA is the sum of all volatile organic aromatics detected.
[2]State target level (Florida Department of Environmental Protection [FDEP], Chapter 17-770, Florida Administrative Code [FAC]).
[3]Total naphthalenes is the sum of naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene.
[4]Guidance concentrations recommended by FDEP (February, 1989).
[5]The results reflect total lead.

Notes: Shade denotes concentration equals or exceeds state target level or guidance concentration.
Concentrations are in parts per billion, except for total recoverable petroleum hydrocarbons (TRPH), which are in parts per million.
DUP = duplicate sample.
ND = not detected.
VOA = volatile organic aromatics
TRPH = total recoverable petroleum hydrocarbons.

Table A-3
Summary of Groundwater Analytical Results, February 2 and 3, 1995

Remedial Action Plan Addendum
Site 278, Coastal Systems Station
Panama City, Florida

	Analyte Regulatory Standards for Class G-II Groundwater	MW-278-1	MW-278-2	MW-278-3	MW-278-4	MW-278-4 Duplicate	MW-278-5	MW-278-6	MW-278-6 Duplicate	MW-278-7	MW-278-8	MW-278-9
Analyte												
Benzene	1	ND	ND	ND	ND	ND	NS	ND	ND	ND	ND	ND
Ethylbenzene		ND	ND	ND	4.8	ND	NS	12	10	2.3	ND	ND
Toluene		ND	ND	ND	ND	ND	NS	ND	ND	ND	ND	ND
Xylenes		ND	ND	ND	ND	ND	NS	1.4	1.1	ND	ND	ND
Total BTEX	50	ND	ND	ND	4.8	ND	NS	13.4	11.1	2 3	ND	ND
1,2-DCE		ND	ND	ND	ND	ND	NS	ND	ND	ND	ND	ND
Acenaphthene		ND	ND	2.9	ND	ND	NS	ND	ND	ND	ND	ND
Dichlorodifluoromethane		ND	ND	ND	ND	ND	NS	ND	ND	ND	1.6	ND
1-Methylnaphthalene		ND	ND	ND	51	59	NS	130	120	26	ND	ND
2-Methylnaphthalene		ND	ND	ND	100	110	NS	ND	ND	21	ND	ND
Naphthalene		ND	ND	ND	180	200	NS	ND	ND	ND	ND	ND
Total naphthalenes	100	ND	ND	ND	331	369	NS	130	120	47	ND	ND
Fluoranthene		ND	ND	ND	ND	ND	NS	ND	ND	ND	0.88	ND
Fluorene	10	ND	ND	ND	ND	ND	NS	ND	ND	ND	ND	ND
Phenanthrene	10	ND	ND	ND	ND	ND	NS	ND	ND	ND	ND	ND
TRPH	5	ND	ND	ND	ND	ND	NS	43.2	27.1	2.3	ND	ND
Lead	15	ND	ND	ND	ND	NS	NS	ND	NS	ND	ND	ND
EDB	0.02	ND	ND	ND	ND	ND	NS	ND	ND	ND	ND	ND

See notes at end of table.

Table A-3 (Continued)
Summary of Groundwater Analytical Results,
February 2 and 3, 1995

Remedial Action Plan Addendum
Site 278, Coastal Systems Station
Panama City, Florida

Analyte	Analyte Regulatory Standards for Class G-II Groundwater	MW-278-9 Duplicate	MW-278-10	MW-278-11	MW-278-12	MW-278-12 Duplicate	MW-278-13D	MW-278-14	MW-278-15	RS-1	RS-2	Trip Blank
Benzene	1	NS	ND	ND	ND	NS	ND	ND	ND	ND	NS	ND
Ethylbenzene		NS	ND	ND	ND	NS	ND	ND	ND	ND	NS	ND
Toluene		NS	ND	ND	ND	NS	ND	ND	ND	ND	NS	ND
Xylenes		NS	ND	ND	ND	NS	ND	ND	ND	ND	NS	ND
Total BTEX	50	NS	ND	ND	ND	NS	ND	ND	ND	ND	NS	ND
1,2-DCE		NS	ND	ND	ND	NS	ND	ND	ND	ND	NS	ND
Acenaphthene		NS	6.0	ND	ND	NS	ND	ND	ND	ND	NS	NS
Dichlorodifluoromethane		NS	63	ND	ND	NS	ND	ND	ND	ND	NS	ND
1-Methylnaphthalene		NS	ND	ND	ND	NS	ND	ND	ND	ND	NS	NS
2-Methylnaphthalene		NS	ND	ND	ND	NS	ND	ND	ND	ND	NS	NS
Naphthalene		NS	ND	ND	ND	NS	ND	ND	ND	ND	NS	NS
Total naphthalenes	100	NS	ND	ND	ND	NS	ND	ND	ND	ND	NS	NS
Fluoranthene		NS	1.2	ND	ND	NS	ND	ND	ND	ND	NS	NS
Fluorene	10	NS	ND	ND	ND	NS	ND	ND	ND	ND	NS	NS
Phenanthrene	10	NS	ND	ND	ND	NS	ND	ND	ND	ND	NS	NS
TRPH	5	NS	ND	ND	ND	NS	ND	ND	ND	ND	NS	NS
Lead	15	ND	ND	ND	ND	ND	ND	ND	ND	NS	ND	NS
EDB	0.02	NS	ND	ND	ND	NS	ND	ND	ND	ND	NS	NS

Notes: All concentrations are reported in parts per billion (ppb) except for total recoverable petroleum hydrocarbons (TRPH), which are reported in parts per million (ppm).

ND = not detected.
NS = not sampled or analyzed for.
BTEX = benzene, toluene, ethylbenzene, and xylene.
1,2-DCE = 1,2-dichloroethene.
TRPH = total recoverable petroleum hydrocarbons.
EDB = ethylene dibromide
FDEP = Florida Department of Environment Protection.
ppb = parts per billion.
ppm = parts per million

APPENDIX B

APPENDIX B

FREE-PHASE PETROLEUM PRODUCT RECOVERY DATA

APPENDIX – B
INITIAL REMEDIAL ACTION
FREE PRODUCT RECOVERY DATA
CSS–278–MW–5
February 1993 – October 1995

Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
23–Feb–93	10:55	29.875	93.75	Y	0
23–Feb–93	15:00	18.875	95.75	Y	0
24–Feb–93	07:45	18.5	97.625	Y	0
24–Feb–93	16:40	19.25	98.375	Y	0
25–Feb–93	07:50	18.5	93.75	Y	0
25–Feb–93	17:50	19	88.125	Y	0
26–Feb–93	07:20	0	69.25	Y	0
26–Feb–93	17:40	0	69.125	Y	0
01–Mar–93	07:55	17.25	97.5	Y	0
01–Mar–93	16:00	3.75	81	Y	0
02–Mar–93	07:30	18	97	Y	0
02–Mar–93	16:55	8.5	85	Y	0
03–Mar–93	07:30	0	72	Y	0
03–Mar–93	16:05	0	63	Y	0
04–Mar–93	07:30	0	77.75	Y	0
04–Mar–93	15:55	0	77	Y	0
05–Mar–93	07:30	0	86.5	Y	0
05–Mar–93	15:50	2	79	Y	0
08–Mar–93	07:30	26	104	Y	0
08–Mar–93	15:00	17	95	Y	0
26–Mar–93	16:30	2.125	87	Y	125
29–Mar–93	16:00	3.5	76.75	Y	150
30–Mar–93	16:15	1.75	71.625	Y	85
31–Mar–93	16:00	0	68.5	Y	0
02–Apr–93	15:30	14	78.5	Y	630
04–Apr–93	15:45	0	70.5	Y	0
05–Apr–93	15:30	5	82.75	Y	210
06–Apr–93	16:15	33.75	81	Y	1150
07–Apr–93	16:00	7.125	86.75	Y	310
08–Apr–93	16:00	0	70.125	Y	0
09–Apr–93	16:00	0	66.25	Y	0
12–Apr–93	16:00	0	67.25	Y	0
13–Apr–93	16:00	0	70.5	Y	40
14–Apr–93	15:30	0	72.625	Y	0
15–Apr–93	16:00	0	66.5	Y	0
16–Apr–93	15:30	0	76	Y	0
19–Apr–93	16:00	0	80.25	Y	735
20–Apr–93	15:45	0	80.5	Y	35
21–Apr–93	16:15	0	78.25	Y	10

APPENDIX – B
INITIAL REMEDIAL ACTION
FREE PRODUCT RECOVERY DATA
CSS–278–MW–5
February 1993 – October 1995

Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
22–Apr–93	16:30	0	69.75	Y	960
23–Apr–93	16:15	0	77.75	Y	205
26–Apr–93	16:00	0	72.125	Y	0
27–Apr–93	15:30	0	76.25	Y	0
28–Apr–93	13:25	0	74.125	Y	20
29–Apr–93	12:25	3.625	74.125	Y	105
30–Apr–93	12:30	3.125	75.25	Y	75
03–May–93	17:32	0	75.75	Y	0
04–May–93	14:50	0	75	Y	0
05–May–93	14:45	0	76.5	Y	0
06–May–93	12:00	0	71.875	Y	0
07–May–93	11:00	0	77.125	Y	0
10–May–93	14:20	0	69.75	Y	0
11–May–93	10:30	0	74.125	Y	0
12–May–93	11:10	0	72.125	Y	0
13–May–93	13:40	1.5	70.25	Y	0
17–May–93	16:30	16.75	75.75	Y	775
18–May–93	07:30	0.25	68	Y	10
19–May–93	09:40	0	69.75	Y	0
20–May–93	08:00	0	69.5	Y	0
21–May–93	08:00	0	71.25	Y	0
24–May–93	09:00	0	71.375	Y	0
25–May–93	16:10	0	71.75	Y	0
26–May–93	14:00	0	71.375	Y	0
27–May–93	14:55	0	72.5	Y	0
28–May–93	14:00	0.875	74.25	Y	30
01–Jun–93	14:50	1.5	70.5	Y	0
02–Jun–93	09:45	0	71	Y	0
03–Jun–93	10:00	0	71.5	Y	0
04–Jun–93	12:10	0	72.375	Y	0
07–Jun–93	09:05	4	76	Y	0
08–Jun–93	08:00	2	69.75	Y	0
09–Jun–93	08:45	6.5	69.125	Y	0
10–Jun–93	08:15	5.5	76.5	Y	0
11–Jun–93	07:45	3.5	76.5	Y	0
14–Jun–93	14:50	3	71.5	Y	0
15–Jun–93	13:17	3.25	78.125	Y	0
16–Jun–93	10:00	0	72.5	Y	0
17–Jun–93	08:30	0	74.75	Y	0

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
18–Jun–93	11:35	0	70.125	Y	0
21–Jun–93	16:00	0	74.5	Y	0
22–Jun–93	11:03	0	69.5	Y	0
23–Jun–93	15:25	0	68.125	Y	0
24–Jun–93	08:26	0	75	Y	0
25–Jun–93	12:10	0.25	75	Y	0
28–Jun–93	16:00	0.25	65.5	Y	0
29–Jun–93	16:40	0	67.5	Y	0
30–Jun–93	15:30	0	72.25	Y	0
01–Jul–93	15:45	0	81.125	Y	0
02–Jul–93	14:00	0	71	Y	0
06–Jul–93	09:30	0	76.25	Y	0
07–Jul–93	14:45	2.125	73.875	Y	65
08–Jul–93	15:30	0	78.375	Y	0
09–Jul–93	07:20	0	68.625	Y	0
12–Jul–93	11:00	2.75	76.75	Y	100
13–Jul–93	14:50	0.5	68.25	Y	15
14–Jul–93	14:37	3.5	79.25	Y	130
15–Jul–93	09:45	0	67.375	Y	0
16–Jul–93	14:50	0	67.125	Y	0
19–Jul–93	15:20	0	75	Y	0
20–Jul–93	14:20	0	73.75	Y	0
21–Jul–93	08:30	0	73.625	Y	0
22–Jul–93	15:15	0	71.375	Y	0
23–Jul–93	11:40	10	76	Y	640
26–Jul–93	12:55	3.125	79.5	Y	680
27–Jul–93	12:30	7.625	73	Y	460
28–Jul–93	09:30	0	75.5	Y	0
29–Jul–93	09:45	0	71.375	Y	0
30–Jul–93	09:10	0	73.5	Y	0
02–Aug–93	12:30	0	71.875	Y	20
03–Aug–93	09:00	0.25	72.625	Y	0
04–Aug–93	09:30	0	67.75	Y	0
05–Aug–93	13:15	0	73.25	Y	0
06–Aug–93	09:00	0	69.75	Y	0
09–Aug–93	07:30	0	78.25	Y	0
10–Aug–93	09:35	0	70.125	Y	0
11–Aug–93	07:45	0.75	71.375	Y	0
12–Aug–93	08:50	0	68.375	Y	0

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
13–Aug–93	09:00	0	70.75	Y	0
16–Aug–93	08:30	0	72	Y	0
17–Aug–93	08:00	0	72.25	Y	0
18–Aug–93	07:30	0	71.5	Y	0
19–Aug–93	07:00	0	71.375	Y	0
20–Aug–93	07:00	0	72.125	Y	0
23–Aug–93	08:25	0	68	Y	0
24–Aug–93	09:00	0	76	Y	0
25–Aug–93	08:50	0	72	Y	0
26–Aug–93	09:00	0	63.625	Y	0
27–Aug–93	08:15	0	72.25	Y	0
30–Aug–93	08:10	0	68.25	Y	0
31–Aug–93	07:40	0	71	Y	0
22–Sep–93	08:40	11.125	71.625	Y	480
23–Sep–93	08:15	8.5	71.5	Y	295
24–Sep–93	16:00	9	70.125	Y	310
27–Sep–93	08:06	10.75	69	Y	320
05–Oct–93	07:43	7.5	65.875	Y	230
15–Oct–93	07:45	2.25	66.125	Y	75
20–Oct–93	09:21	0.625	72.5	Y	30
26–Oct–93	09:48	4	71.5	Y	110
01–Nov–93	10:24	21	87.125	Y	710
08–Nov–93	10:00	15	78	Y	420
19–Nov–93	08:10	7.75	76.5	Y	280
23–Nov–93	11:23	34	79	Y	1120
30–Nov–93	09:26	21.75	73.875	Y	840
07–Dec–93	10:55	12.5	82	Y	450
13–Dec–93	09:50	13	83	Y	480
21–Dec–93	10:35	18.625	80.125	Y	810
21–Dec–93	16:00	17.5	80.75	Y	650
22–Dec–93	08:40	18	81.5	Y	750
22–Dec–93	15:45	15.25	80.25	Y	490
23–Dec–93	08:10	4.125	79.125	Y	110
23–Dec–93	14:28	1.25	79	Y	30
27–Dec–93	07:48	24.75	84.75	Y	920
27–Dec–93	14:10	12.5	84.625	Y	410
28–Dec–93	08:15	18.5	84.25	Y	760
28–Dec–93	15:50	10.25	84	Y	420
29–Dec–93	08:10	8.875	86.25	Y	870

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
29–Dec–93	15:20	6.25	86	Y	230
30–Dec–93	07:10	3.375	86.875	Y	550
30–Dec–93	15:28	3	87.125	Y	100
03–Jan–94	09:10	2.375	78.125	Y	450
03–Jan–94	16:00	5	78.5	Y	100
04–Jan–94	06:53	9.5	81.25	Y	370
04–Jan–94	15:43	4.125	81.625	Y	110
05–Jan–94	07:15	2.25	76.125	Y	70
05–Jan–94	16:30	0.875	76.875	Y	35
06–Jan–94	06:48	3.5	76.5	Y	90
06–Jan–94	17:20	1	76.125	Y	30
07–Jan–94	06:45	9.5	78.875	Y	240
07–Jan–94	17:10	5.125	79	Y	160
10–Jan–94	06:28	3.125	76	Y	100
10–Jan–94	16:10	0.75	76.5	Y	25
11–Jan–94	07:36	4.25	77.125	Y	135
11–Jan–94	15:56	0.75	77.375	Y	25
12–Jan–94	08:20	0.25	74.5	Y	15
12–Jan–94	15:35	0	74.25	Y	0
13–Jan–94	08:18	1	76.75	Y	30
13–Jan–94	16:00	0.125	77.125	Y	5
14–Jan–94	08:10	0.25	78.125	Y	10
14–Jan–94	16:30	0.125	78.5	Y	5
18–Jan–94	07:15	6	81	Y	180
18–Jan–94	15:10	2.25	82	Y	60
19–Jan–94	07:10	3.25	79.25	Y	100
19–Jan–94	16:10	2.125	79.875	Y	55
20–Jan–94	08:00	3.125	71.25	Y	75
20–Jan–94	16:10	5	71	Y	50
21–Jan–94	07:10	10	71.875	Y	10
21–Jan–94	15:20	0	72	Y	0
24–Jan–94	07:30	11.25	84	Y	820
24–Jan–94	16:15	4.5	84.5	Y	90
25–Jan–94	07:10	3.75	80.5	Y	470
25–Jan–94	15:30	4.5	80.75	Y	90
26–Jan–94	07:20	5.5	88.875	Y	160
26–Jan–94	09:20	5.5	88.875	Y	160
26–Jan–94	16:15	4.5	78.625	Y	110
26–Jan–94	16:15	4.5	78.625	Y	110

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
27–Jan–94	07:35	5	76.5	Y	130
27–Jan–94	07:35	5	76.5	Y	130
27–Jan–94	15:10	3.875	75.25	Y	95
27–Jan–94	15:10	3.875	75.25	Y	95
28–Jan–94	07:45	6.375	75.625	Y	210
28–Jan–94	07:45	6.375	75.625	Y	210
28–Jan–94	15:20	5.5	75.25	Y	65
28–Jan–94	15:20	2.5	75.25	Y	65
31–Jan–94	07:10	9.625	74.5	Y	720
31–Jan–94	07:10	9.625	74.5	Y	720
31–Jan–94	15:40	1.25	74.125	Y	350
31–Jan–94	15:40	1.25	74.125	Y	350
01–Feb–94	08:45	6.875	73.25	Y	230
01–Feb–94	14:30	2.25	73.125	Y	60
02–Feb–94	08:10	8.25	75.5	Y	260
02–Feb–94	14:30	3.125	76	Y	100
03–Feb–94	07:16	12.25	67.75	Y	410
03–Feb–94	14:32	5.375	66.5	Y	250
04–Feb–94	08:20	2.875	67.125	Y	460
04–Feb–94	15:35	8.75	67.5	Y	350
07–Feb–94	09:35	0	84	Y	0
07–Feb–94	15:30	0	78	Y	0
08–Feb–94	07:16	0	81.125	Y	0
08–Feb–94	14:00	0	85.25	Y	0
09–Feb–94	07:45	0	75.5	Y	0
09–Feb–94	15:45	0	74	Y	0
10–Feb–94	08:20	0	72.5	Y	0
10–Feb–94	16:00	0	71.75	Y	0
11–Feb–94	09:15	0	78.125	Y	0
11–Feb–94	17:00	0	78.5	Y	0
14–Feb–94	08:30	24	84	Y	1900
14–Feb–94	16:30	24	84.5	Y	850
15–Feb–94	09:30	12.5	80.25	Y	610
15–Feb–94	15:30	4.75	79.25	Y	200
16–Feb–94	08:45	9.5	82	Y	530
16–Feb–94	15:30	4	81.25	Y	185
17–Feb–94	09:00	11	82	Y	560
17–Feb–94	15:00	0	77.875	Y	0
18–Feb–94	07:45	6.25	87	Y	210

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
18–Feb–94	15:00	0	79.125	Y	0
22–Feb–94	08:35	0	79.875	Y	0
22–Feb–94	15:45	0	72.5	Y	0
23–Feb–94	07:30	0	80.5	Y	520
23–Feb–94	16:15	0	78	Y	50
24–Feb–94	06:50	0	83.125	Y	0
24–Feb–94	15:30	0	82	Y	0
25–Feb–94	07:45	0	81	Y	0
25–Feb–94	14:40	0	80.5	Y	0
28–Feb–94	07:45	0	79.375	Y	160
28–Feb–94	15:45	0	81	Y	0
01–Mar–94	15:20	0	80.5	Y	0
02–Mar–94	08:55	0	70	Y	0
02–Mar–94	16:20	0	73	Y	0
03–Mar–94	07:30	0	89	Y	0
03–Mar–94	16:30	0	72.875	Y	0
04–Mar–94	07:15	0	91.5	Y	0
04–Mar–94	14:30	0	80.5	Y	0
07–Mar–94	07:30	0	84.625	Y	0
07–Mar–94	15:00	0	77.5	Y	0
08–Mar–94	07:30	0	82	Y	0
08–Mar–94	15:10	0	76.5	Y	0
09–Mar–94	09:15	0	77.625	Y	0
09–Mar–94	16:00	0	75	Y	0
10–Mar–94	07:30	0	82.875	Y	0
10–Mar–94	14:15	0	83.25	Y	0
11–Mar–94	07:15	0.375	89.875	Y	10
11–Mar–94	16:30	3.5	88	Y	100
14–Mar–94	07:00	0.75	76.5	Y	90
14–Mar–94	16:10	0	73.5	Y	0
15–Mar–94	06:30	1.5	79	Y	45
15–Mar–94	17:00	0	79.25	Y	0
16–Mar–94	08:10	1	79	Y	30
16–Mar–94	14:00	0	76	Y	0
17–Mar–94	08:00	5	83	Y	265
17–Mar–94	16:00	1	78.5	Y	25
18–Mar–94	06:15	2.125	79.5	Y	85
18–Mar–94	07:30	5.375	80.625	Y	22
21–Mar–94	07:45	1	97.25	Y	30

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
21–Mar–94	14:45	0	74	Y	0
22–Mar–94	08:00	2	81	Y	40
22–Mar–94	14:25	0	79.875	Y	0
23–Mar–94	07:00	5.5	85	Y	215
23–Mar–94	15:35	0	83	Y	0
24–Mar–94	06:50	2.125	81.375	Y	105
24–Mar–94	16:00	0	81	Y	0
25–Mar–94	07:45	1	82.5	Y	35
25–Mar–94	14:00	1.5	81.5	Y	45
28–Mar–94	08:20	0	74	Y	0
28–Mar–94	16:00	0	73.375	Y	0
29–Mar–94	07:20	2	83.5	Y	90
29–Mar–94	15:00	11	81.5	Y	500
30–Mar–94	09:00	10	79	Y	490
30–Mar–94	16:00	8	62	Y	325
31–Mar–94	08:45	9	80.125	Y	450
31–Mar–94	16:00	6	78.625	Y	260
01–Apr–94	08:10	9	84.5	Y	475
01–Apr–94	15:10	1.25	77.25	Y	40
04–Apr–94	09:00	2.125	82.5	Y	105
04–Apr–94	15:00	2.625	82.125	Y	105
05–Apr–94	06:30	1.5	85	Y	90
05–Apr–94	15:30	0	85.5	Y	0
06–Apr–94	06:30	0	84	Y	0
06–Apr–94	15:30	0	83.5	Y	0
07–Apr–94	06:30	0	81.25	Y	0
07–Apr–94	15:15	2.25	80	Y	100
08–Apr–94	09:15	11.25	78.75	Y	540
08–Apr–94	16:30	1.375	80.625	Y	510
11–Apr–94	09:00	0	73.5	Y	0
11–Apr–94	16:15	0	72.75	Y	0
12–Apr–94	06:40	0	73	Y	0
12–Apr–94	17:30	0	71	Y	0
13–Apr–94	09:00	0	73	Y	0
13–Apr–94	16:30	0	77.25	Y	0
14–Apr–94	09:00	0	70.75	Y	0
14–Apr–94	16:40	0	70.5	Y	0
15–Apr–94	08:00	0	70.5	Y	0
15–Apr–94	14:45	0	71.5	Y	0

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
18–Apr–94	08:00	0	77.5	Y	25
18–Apr–94	17:30	0	74	Y	0
19–Apr–94	07:25	0	73.5	Y	0
19–Apr–94	17:00	0	72	Y	0
20–Apr–94	07:30	3	79	Y	120
20–Apr–94	16:00	0	75	Y	0
21–Apr–94	08:00	1.5	63.5	Y	50
21–Apr–94	15:15	1.5	63.25	Y	65
22–Apr–94	07:30	1.25	71.75	Y	40
22–Apr–94	16:00	0.75	74.25	Y	30
25–Apr–94	08:30	0	68.25	Y	0
25–Apr–94	16:00	0	76	Y	0
26–Apr–94	08:00	0.5	77.5	Y	15
26–Apr–94	16:30	0	76.75	Y	0
27–Apr–94	07:25	0	70.75	Y	0
27–Apr–94	17:00	0	70.125	Y	0
28–Apr–94	09:00	0	70.375	Y	0
28–Apr–94	15:00	0	71	Y	0
29–Apr–94	07:00	0	75.25	Y	0
29–Apr–94	14:30	0	74.625	Y	0
02–May–94	07:30	0.125	77.5	Y	5
02–May–94	16:20	0.25	73.75	Y	10
03–May–94	08:25	1.75	77.25	Y	90
03–May–94	16:00	0.5	77	Y	15
04–May–94	09:30	3	77.25	Y	100
04–May–94	16:00	3.25	77.75	Y	125
05–May–94	07:00	2.375	77.625	Y	80
05–May–94	15:30	1.25	77.25	Y	55
06–May–94	08:30	11.25	78.25	Y	465
06–May–94	16:00	13	81.5	Y	650
09–May–94	08:30	0	73	Y	0
09–May–94	15:15	0	78.75	Y	0
10–May–94	07:00	0.5	75.5	Y	15
10–May–94	15:45	0	81	Y	0
11–May–94	07:00	3	76	Y	95
11–May–94	15:00	0.75	77.25	Y	15
12–May–94	08:50	0.75	78	Y	15
12–May–94	15:50	0	79	Y	0
13–May–94	07:30	0.625	75	Y	15

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
13–May–94	15:30	0	74.75	Y	0
16–May–94	08:15	0	74.5	Y	0
16–May–94	15:45	0	72.125	Y	0
17–May–94	08:00	0	72.5	Y	0
17–May–94	14:30	0	73	Y	180
18–May–94	07:30	4.5	78	Y	0
18–May–94	16:00	0	79	Y	220
19–May–94	08:30	6	77	Y	0
19–May–94	17:30	0	76.5	Y	250
20–May–94	07:00	4.5	75.25	Y	90
20–May–94	15:00	1.5	74.875	Y	0
23–May–94	09:00	0	74.375	Y	0
23–May–94	16:15	0	75.125	Y	0
24–May–94	06:00	0	75.125	Y	0
24–May–94	14:20	0	76	Y	0
25–May–94	08:00	0	68.5	Y	0
25–May–94	16:25	0	76.875	Y	0
26–May–94	07:00	0	71.5	Y	0
26–May–94	15:00	0	69.875	Y	0
27–May–94	07:00	0	73.25	Y	0
27–May–94	16:30	0	71.5	Y	0
31–May–94	07:00	0	73.125	Y	0
31–May–94	16:00	0	72.625	Y	0
01–Jun–94	07:00	0	77	Y	0
01–Jun–94	15:15	0	76	Y	0
02–Jun–94	09:00	0	75	Y	0
02–Jun–94	16:00	0	78.5	Y	0
03–Jun–94	08:00	0.5	74.5	Y	10
03–Jun–94	15:30	0.375	79.875	Y	20
06–Jun–94	09:00	0	71.5	Y	0
06–Jun–94	16:00	0	78.5	Y	0
07–Jun–94	08:00	0	68	Y	0
07–Jun–94	14:20	0	71.875	Y	0
08–Jun–94	08:30	0	68	Y	0
08–Jun–94	15:00	0	73.875	Y	0
09–Jun–94	07:00	0	72.25	Y	0
09–Jun–94	15:20	0	74.875	Y	0
10–Jun–94	07:40	0	72.75	Y	0
10–Jun–94	15:30	0	71.5	Y	0

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
13–Jun–94	09:00	0.875	75.5	Y	20
13–Jun–94	16:40	0	77	Y	0
14–Jun–94	07:30	5	77.5	Y	200
14–Jun–94	14:20	1.625	76.375	Y	90
15–Jun–94	08:00	5	77.25	Y	205
15–Jun–94	15:00	1.125	75.5	Y	55
16–Jun–94	08:00	6.25	77.5	Y	310
16–Jun–94	14:15	6.75	78.25	Y	350
17–Jun–94	07:00	0.25	74.25	Y	10
17–Jun–94	14:30	1.5	80	Y	45
20–Jun–94	09:00	0	67.875	Y	0
20–Jun–94	16:00	0	68	Y	0
21–Jun–94	09:00	0	69.5	Y	0
21–Jun–94	15:45	0	78.5	Y	0
22–Jun–94	08:00	0	70.125	Y	0
22–Jun–94	17:00	0	81.5	Y	0
23–Jun–94	07:00	0	70	Y	0
23–Jun–94	16:30	0	78	Y	0
24–Jun–94	09:00	0	71.5	Y	0
24–Jun–94	15:00	0	73	Y	0
27–Jun–94	08:00	0	77.375	Y	0
27–Jun–94	16:00	0	71.75	Y	0
28–Jun–94	08:00	0	74	Y	0
28–Jun–94	16:40	0.125	74.875	Y	5
29–Jun–94	08:00	1.75	77	Y	60
29–Jun–94	15:30	3	75.75	Y	120
30–Jun–94	08:00	2.5	74	Y	100
30–Jun–94	15:15	3	77	Y	145
01–Jul–94	08:00	2.5	73	Y	100
01–Jul–94	15:50	2.25	72	Y	70
05–Jul–94	08:00	0	66	Y	0
05–Jul–94	15:40	0	68	Y	0
06–Jul–94	08:30	0	67	Y	0
06–Jul–94	18:10	0	78.5	Y	0
07–Jul–94	07:00	0	65.25	Y	0
07–Jul–94	15:25	0	70	Y	0
08–Jul–94	08:20	0	63.5	Y	0
08–Jul–94	16:10	0	61	Y	0
11–Jul–94	09:30	0	67.75	Y	0

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
11–Jul–94	17:20	0	66.25	Y	0
12–Jul–94	08:40	0	68.75	Y	0
12–Jul–94	16:30	0	70.5	Y	0
13–Jul–94	08:00	0.125	72.25	Y	5
13–Jul–94	16:30	0.125	71.125	Y	5
14–Jul–94	07:30	1.125	74	Y	40
14–Jul–94	15:00	0.125	72.625	Y	5
15–Jul–94	08:25	2	74.5	Y	90
15–Jul–94	14:30	0.5	73	Y	15
18–Jul–94	08:00	1.5	70.75	Y	80
18–Jul–94	17:30	4.375	84.625	Y	210
19–Jul–94	07:10	0.375	70	Y	15
19–Jul–94	17:20	1.25	83	Y	60
20–Jul–94	06:50	0.5	71.375	Y	15
20–Jul–94	16:30	0.125	82	Y	5
21–Jul–94	07:50	0.125	70.5	Y	5
21–Jul–94	17:00	0	82.625	Y	0
22–Jul–94	08:20	0.25	71	Y	10
22–Jul–94	15:00	0	73.25	Y	0
25–Jul–94	07:00	1	71	Y	30
25–Jul–94	17:05	0.375	76	Y	10
26–Jul–94	08:00	1.75	76.5	Y	80
26–Jul–94	16:00	0.75	75.25	Y	25
27–Jul–94	07:30	1.5	75	Y	80
27–Jul–94	17:00	2.25	76.25	Y	110
28–Jul–94	07:00	1.125	74.5	Y	60
28–Jul–94	16:30	0.625	75	Y	15
29–Jul–94	08:00	1.5	75	Y	75
29–Jul–94	15:20	0.5	75.25	Y	25
01–Aug–94	08:10	1.125	72.625	Y	60
01–Aug–94	16:00	1.125	82	Y	60
02–Aug–94	08:15	0.625	71	Y	75
02–Aug–94	18:00	0.875	79.75	Y	40
03–Aug–94	08:10	0	69.125	Y	0
03–Aug–94	17:00	0	75.25	Y	0
04–Aug–94	07:30	0	70.125	Y	0
04–Aug–94	17:00	0.0625	79	Y	5
05–Aug–94	07:00	0	69	Y	0
05–Aug–94	17:30	0.0625	78.75	Y	5

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
08–Aug–94	08:00	0	71.625	Y	0
08–Aug–94	14:40	0	73.25	Y	0
09–Aug–94	07:00	0.125	75.5	Y	10
09–Aug–94	15:20	0	73.25	Y	0
10–Aug–94	08:00	0	75	Y	0
10–Aug–94	15:00	0	73.125	Y	0
12–Aug–94	08:00	0.125	72.25	Y	10
12–Aug–94	16:45	0.0625	74.375	Y	5
15–Aug–94	07:50	0	61	Y	0
15–Aug–94	16:45	0	69.5	Y	0
16–Aug–94	07:30	0	61.25	Y	0
16–Aug–94	16:10	0	62.5	Y	0
18–Aug–94	07:30	0	65.25	Y	0
18–Aug–94	17:30	0	69.625	Y	0
19–Aug–94	07:10	0	67	Y	0
19–Aug–94	16:30	0	73	Y	0
22–Aug–94	08:00	0	69.625	Y	0
22–Aug–94	16:15	0	69.75	Y	0
23–Aug–94	07:30	0	72.25	Y	0
23–Aug–94	17:15	0	74	Y	0
25–Aug–94	08:00	0	73.25	Y	0
25–Aug–94	15:10	0	72	Y	0
26–Aug–94	07:30	0	71.25	Y	0
26–Aug–94	15:30	0	71	Y	0
29–Aug–94	08:40	0.0625	68.75	Y	5
29–Aug–94	18:25	0.0625	73.875	Y	5
30–Aug–94	08:30	0.0625	67.25	Y	5
30–Aug–94	16:00	0	76.5	Y	0
31–Aug–94	08:00	0	67	Y	0
31–Aug–94	15:30	0	73.5	Y	0
01–Sep–94	07:00	0	67	Y	0
01–Sep–94	15:30	0	72.625	Y	0
02–Sep–94	08:30	0	67.5	Y	0
02–Sep–94	15:00	0	73.25	Y	0
06–Sep–94	08:00	0	69.75	Y	0
06–Sep–94	17:00	0	71.25	Y	0
07–Sep–94	08:00	0	73.75	Y	0
07–Sep–94	16:10	0	70	Y	0
08–Sep–94	07:00	0	63.25	Y	0

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
08–Sep–94	18:00	0	70.75	Y	0
09–Sep–94	09:00	0	72.375	Y	0
09–Sep–94	15:30	0	70.125	Y	0
12–Sep–94	07:30	0	63.375	Y	0
12–Sep–94	16:00	0	79.25	Y	0
13–Sep–94	08:30	0	68	Y	0
13–Sep–94	17:30	0	75.5	Y	0
14–Sep–94	08:00	0	65.75	Y	0
14–Sep–94	18:00	0	74	Y	0
15–Sep–94	07:15	0	62.5	Y	0
15–Sep–94	16:00	0	68.625	Y	0
16–Sep–94	08:30	0	61	Y	0
16–Sep–94	16:15	0	67.125	Y	0
19–Sep–94	07:30	0	71.5	Y	0
19–Sep–94	15:25	0	70	Y	0
20–Sep–94	08:00	0	72	Y	0
20–Sep–94	16:00	0	70	Y	0
21–Sep–94	08:30	0	73.375	Y	0
21–Sep–94	17:10	0	70	Y	0
22–Sep–94	07:30	0	73.5	Y	0
22–Sep–94	15:30	0	68.875	Y	0
23–Sep–94	08:00	0	70.25	Y	0
23–Sep–94	16:30	0	69.625	Y	0
26–Sep–94	07:30	0	67.75	Y	0
26–Sep–94	15:30	0	73	Y	0
27–Sep–94	08:30	0	69.75	Y	0
27–Sep–94	15:30	0	73.75	Y	0
28–Sep–94	07:30	0	68.5	Y	0
28–Sep–94	16:10	0	74	Y	0
29–Sep–94	07:30	0	70.5	Y	0
29–Sep–94	15:00	0	72.25	Y	0
30–Sep–94	08:00	0	66	Y	0
30–Sep–94	15:30	0	71.75	Y	0
03–Oct–94	07:10	0	58	Y	0
03–Oct–94	16:10	0	62.25	Y	0
04–Oct–94	07:15	0	68.5	Y	0
04–Oct–94	16:10	0	68.375	Y	0
05–Oct–94	08:00	0	72.5	Y	0
05–Oct–94	16:10	0	69.375	Y	0

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
06–Oct–94	07:15	0	74.375	Y	0
06–Oct–94	17:00	0	69.25	Y	0
07–Oct–94	08:10	0	75.75	Y	0
07–Oct–94	18:00	0	69	Y	0
11–Oct–94	08:10	0	66.875	Y	0
11–Oct–94	16:15	0	73.875	Y	0
12–Oct–94	08:00	0	64.125	Y	0
12–Oct–94	15:00	0	70.25	Y	0
13–Oct–94	08:30	0.25	64.5	Y	10
13–Oct–94	16:00	0.125	69.5	Y	5
14–Oct–94	08:40	0.875	66.375	Y	35
14–Oct–94	16:30	0.375	70.875	Y	10
17–Oct–94	07:10	2	71.25	Y	95
17–Oct–94	16:30	1	69.125	Y	35
18–Oct–94	08:00	1.25	70.875	Y	75
18–Oct–94	15:10	1	69.5	Y	40
19–Oct–94	08:00	0.375	70.5	Y	10
19–Oct–94	15:00	0.375	67.25	Y	10
20–Oct–94	07:00	0.125	71.25	Y	5
20–Oct–94	15:00	0.0625	69.5	Y	<5
21–Oct–94	07:00	0.125	73.125	Y	5
21–Oct–94	17:00	0.0625	69.125	Y	<5
24–Oct–94	08:00	0.5	75.25	Y	30
24–Oct–94	16:30	0.375	75.5	Y	20
25–Oct–94	07:05	1	72.25	Y	55
25–Oct–94	16:00	0.375	74.625	Y	40
26–Oct–94	08:30	0.625	75.25	Y	20
26–Oct–94	16:00	0.25	77.625	Y	5
27–Oct–94	09:00	1.25	75.25	Y	75
27–Oct–94	16:45	0.625	71.125	Y	30
28–Oct–94	07:30	1.25	74.75	Y	75
28–Oct–94	16:30	1	75.875	Y	45
31–Oct–94	08:00	1.5	68	Y	75
31–Oct–94	15:30	0.625	70.25	Y	20
01–Nov–94	08:00	1.25	71.125	Y	60
01–Nov–94	15:20	0.375	73.375	Y	10
02–Nov–94	08:00	1	80	Y	40
02–Nov–94	15:20	0.375	73.5	Y	10
03–Nov–94	08:00	0.25	83.625	Y	5

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
03–Nov–94	16:10	0.625	73	Y	15
04–Nov–94	07:30	0.25	83.625	Y	10
04–Nov–94	15:00	1	75.75	Y	35
07–Nov–94	07:30	0	79.5	Y	0
07–Nov–94	17:20	0	71.75	Y	0
08–Nov–94	07:30	0	78.75	Y	0
08–Nov–94	15:00	0	80	Y	0
09–Nov–94	07:15	0.0625	76.875	Y	<5
09–Nov–94	16:00	0	69	Y	0
10–Nov–94	08:30	0	72.5	Y	0
10–Nov–94	16:10	0.125	74.125	Y	<5
14–Nov–94	07:30	9	77.5	Y	350
14–Nov–94	15:30	3	70.75	Y	200
15–Nov–94	08:20	3	80.5	Y	450
15–Nov–94	15:30	5.5	75.625	Y	290
16–Nov–94	07:30	7	85	Y	800
16–Nov–94	16:10	5	79.5	Y	300
17–Nov–94	09:00	6.5	90	Y	750
17–Nov–94	17:30	4	85.75	Y	225
18–Nov–94	09:45	1.5	83	Y	60
18–Nov–94	16:30	0.75	77.5	Y	40
21–Nov–94	09:50	0	80.25	Y	0
21–Nov–94	16:00	0	77.75	Y	0
22–Nov–94	07:30	0	80.25	Y	0
22–Nov–94	17:00	0	77.875	Y	0
23–Nov–94	07:30	0	84.5	Y	0
23–Nov–94	16:00	1.5	81.75	Y	65
25–Nov–94	08.05	0	79.375	Y	0
25–Nov–94	16:00	0	73.75	Y	0
28–Nov–94	08:10	0	69.625	Y	0
28–Nov–94	16:30	0	68.5	Y	0
29–Nov–94	08:20	0	71.25	Y	0
29–Nov–94	16:30	0	68.25	Y	0
30–Nov–94	08:30	0	81.5	Y	0
30–Nov–94	15:30	0	74	Y	0
01–Dec–94	08:30	0	86	Y	0
01–Dec–94	15:45	0	76	Y	0
02–Dec–94	08:15	0	85	Y	0
02–Dec–94	16:30	0	77	Y	0

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
05–Dec–94	07:30	0	77	Y	0
05–Dec–94	15:30	0	80	Y	0
06–Dec–94	08:30	0	83.5	Y	0
06–Dec–94	15:30	0	82.75	Y	0
07–Dec–94	08:00	0	84.375	Y	0
07–Dec–94	16:20	0	82.5	Y	0
08–Dec–94	08:00	1.5	81	Y	60
08–Dec–94	16:20	2.75	79.5	Y	105
09–Dec–94	07:45	2.75	79.75	Y	160
09–Dec–94	16:00	1.5	76.5	Y	75
12–Dec–94	08:40	3.5	80	Y	125
12–Dec–94	16:30	0.75	75.5	Y	20
13–Dec–94	08:30	12.25	80	Y	350
13–Dec–94	15:30	0.75	75.75	Y	20
14–Dec–94	07:40	0	83.125	Y	0
14–Dec–94	15:50	1.25	77.125	Y	40
15–Dec–94	08:00	8	83	Y	225
15–Dec–94	16:00	1.125	77	Y	40
16–Dec–94	08:05	0.0625	81.75	Y	<5
16–Dec–94	16:00	0	72.5	Y	0
19–Dec–94	09:00	0	86	Y	0
19–Dec–94	15:30	0	78.25	Y	0
20–Dec–94	08:10	0	80.5	Y	0
20–Dec–94	15:00	0	76.5	Y	0
21–Dec–94	07:15	0	78.375	Y	0
21–Dec–94	15:00	0	73.5	Y	0
22–Dec–94	08:00	0	82.125	Y	0
22–Dec–94	15:10	0	78.5	Y	0
23–Dec–94	08:00	0	86	Y	0
23–Dec–94	15:30	0.75	83	Y	25
26–Dec–94	CHRISTMAS				
26–Dec–94	CHRISTMAS				
27–Dec–94	08:30	4.5	81	Y	560
27–Dec–94	16:30	0	75.5	Y	0
28–Dec–94	08:00	1.75	81.125	Y	90
28–Dec–94	15:15	0	74	Y	0
29–Dec–94	08:10	0	79.125	Y	0
29–Dec–94	15:00	0	70.25	Y	0
30–Dec–94	08:30	0	79.625	Y	0

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
30–Dec–94	15:10	0	71	Y	0
03–Jan–95	08:00	0	86.75	Y	0
03–Jan–95	15:50	0	82.375	Y	0
04–Jan–95	08:30	0	87	Y	0
04–Jan–95	15:10	0	85.5	Y	0
05–Jan–95	08:30	0.75	88.25	Y	20
05–Jan–95	15:40	3.75	86.25	Y	110
06–Jan–95	08:45	3.75	79.625	Y	90
06–Jan–95	15:25	0	70.875	Y	0
09–Jan–95	08:30	1.375	85.25	Y	50
09–Jan–95	15:40	0.25	79.25	Y	5
10–Jan–95	08:00	9.25	84.625	Y	375
10–Jan–95	15:00	0.75	78.125	Y	15
11–Jan–95	08:20	8	82.375	Y	240
11–Jan–95	15:10	0	76.5	Y	0
12–Jan–95	08:10	0	84.125	Y	<5
12–Jan–95	15:05	0	73.25	Y	0
13–Jan–95	08:00	0	80.375	Y	0
13–Jan–95	16:10	0	71	Y	0
17–Jan–95	08:30	0	88.75	Y	0
17–Jan–95	16:40	0	82.75	Y	0
18–Jan–95	08:30	0	86	Y	0
18–Jan–95	15:30	0	81	Y	0
19–Jan–95	07:45	0	81	Y	0
19–Jan–95	15:50	0	77	Y	0
20–Jan–95	08:15	0.0625	84	Y	10
20–Jan–95	16:00	0	81	Y	0
23–Jan–95	08:30	1.75	77	Y	100
23–Jan–95	17:30	1.5	79.5	Y	50
24–Jan–95	08:30	1	87	Y	575
24–Jan–95	15:30	3	83.375	Y	110
25–Jan–95	08:30	10.5	87	Y	400
25–Jan–95	15:30	4.5	80.75	Y	90
25–Jan–95	15:30	1.5	82.125	Y	50
26–Jan–95	08:35	9.75	88.5	Y	390
26–Jan–95	15:25	1	82.375	Y	25
27–Jan–95	08:30	3.25	87.5	Y	170
27–Jan–95	16:00	0	85.25	Y	0
30–Jan–95	09:15	0	93.125	Y	0

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
30–Jan–95	16:00	0	87.625	Y	0
31–Jan–95	08:00	0	86.125	Y	0
31–Jan–95	16:30	Trace	86.125	Y	<5
01–Feb–95	No reading – ABB Sampling			–	–
01–Feb–95	15:10	3.375	86.125	Y	105
02–Feb–95	09:15	3.5	85.5	Y	130
02–Feb–95	15:45	5	84.625	Y	200
03–Feb–95	09:45	10.5	83	Y	315
03–Feb–95	15:50	1.75	82.5	Y	100
06–Feb–95	09:00	4.5	87.625	Y	700
06–Feb–95	17:00	4.5	83.75	Y	130
07–Feb–95	09:15	7.25	87.25	Y	300
07–Feb–95	15:45	7.25	82.125	Y	30
08–Feb–95	09:10	0.875	90.125	Y	320
08–Feb–95	15:25	7.5	89.25	Y	130
09–Feb–95	09:00	3.75	90.375	Y	190
09–Feb–95	16:30	5.25	86.375	Y	40
10–Feb–95	08:00	0.75	85.25	Y	90
10–Feb–95	15:25	1.75	80.625	Y	0
13–Feb–95	09:10	0	91	Y	0
13–Feb–95	16:20	0	86.75	Y	0
14–Feb–95	08:05	0	89.625	Y	Trace
14–Feb–95	16:30	0.5	82.5	Y	10
15–Feb–95	09:10	0	84.25	Y	Trace
15–Feb–95	16:40	0	82	Y	Trace
16–Feb–95	08:15	1.5	85.25	Y	60
16–Feb–95	14:45	0.5	82.375	Y	25
17–Feb–95	08:10	0.75	81.875	Y	20
17–Feb–95	15:00	0	80.25	Y	Trace
21–Feb–95	08:30	10.25	84.5	Y	930
21–Feb–95	15:00	5.375	84.25	Y	275
22–Feb–95	08:30	8	88.5	Y	370
22–Feb–95	17:15	1.875	83.25	Y	90
23–Feb–95	09:30	3.75	96.625	Y	160
23–Feb–95	16:00	0	73.125	Y	Trace
24–Feb–95	07:30	0.75	89.125	Y	20
24–Feb–95	15:30	0	77	Y	0
27–Feb–95	08:00	0	87.625	Y	0
27–Feb–95	17:20	0	75.25	Y	0

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
28–Feb–95	07:00	0	87.625	Y	0
28–Feb–95	16:00	0	86.125	Y	0
01–Mar–95	08:00	0.75	82.5	Y	20
01–Mar–95	15:10	0	84	Y	0
02–Mar–95	08:20	0	86.375	Y	0
02–Mar–95	16:15	5	66	Y	130
03–Mar–95	07:30	6.5	83.75	Y	190
03–Mar–95	15:10	2.375	81.875	Y	130
06–Mar–95	07:20	0	78.375	Y	0
06–Mar–95	15:00	0	87.875	Y	0
07–Mar–95	08:30	0	74	Y	0
07–Mar–95	17:50	0	66.25	Y	0
08–Mar–95	08:30	0	70	Y	0
08–Mar–95	15:15	0	74.625	Y	0
09–Mar–95	08:10	0	93	Y	0
09–Mar–95	16:00	0	84.625	Y	0
10–Mar–95	08:00	0	88.25	Y	0
10–Mar–95	15:10	0	82.125	Y	0
13–Mar–95	07:20	0	82.5	Y	0
13–Mar–95	16:10	0	72.25	Y	0
14–Mar–95	09:05	0	81.5	Y	0
14–Mar–95	16:30	0	78.25	Y	0
15–Mar–95	07:50	0	85	Y	0
15–Mar–95	15:30	0	73.75	Y	0
17–Mar–95	07:30	0	74.625	Y	0
17–Mar–95	15:00	0	74.375	Y	0
20–Mar–95	07:30	0	78.125	Y	0
20–Mar–95	15:10	0	75.25	Y	0
21–Mar–95	07:30	0	75	Y	0
21–Mar–95	16:00	0	74.25	Y	0
22–Mar–95	08:00	0	75	Y	0
22–Mar–95	15:15	0	71.375	Y	0
23–Mar–95	07:30	0	75.75	Y	0
23–Mar–95	15:30	0	70.25	Y	0
24–Mar–95	07:20	0	75.25	Y	0
24–Mar–95	15:20	0	76.875	Y	0
27–Mar–95	07:30	0	77.25	Y	0
27–Mar–95	16:00	0	75.375	Y	0
28–Mar–95	07:30	0	77.375	Y	0

APPENDIX – B
INITIAL REMEDIAL ACTION
FREE PRODUCT RECOVERY DATA
CSS–278–MW–5
February 1993 – October 1995

Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
28–Mar–95	16:30	0	80.25	Y	0
29–Mar–95	07:20	0	77.625	Y	0
29–Mar–95	16:20	0	78.5	Y	0
30–Mar–95	07:10	0	76	Y	0
30–Mar–95	16:10	0	80	Y	0
31–Mar–95	07:00	0	71	Y	0
31–Mar–95	15:00	0	77	Y	0
03–Apr–95	07:10	0	75.125	Y	0
03–Apr–95	17:10	0	84	Y	0
04–Apr–95	08:00	0.5	75.5	Y	15
04–Apr–95	16:15	0.125	72.75	Y	<5
05–Apr–95	07:30	0.5	74.25	Y	15
05–Apr–95	17:10	Trace	75.125	Y	Trace
06–Apr–95	08:00	0.5	68.875	Y	10
06–Apr–95	15:10	0.25	65.125	Y	5
07–Apr–95	07:30	Trace	65.25	Y	Trace
07–Apr–95	15:00	Trace	68	Y	Trace
10–Apr–95	08:15	0.5	77.5	Y	10
10–Apr–95	15:00	0.25	73.375	Y	5
11–Apr–95	07:15	0.25	73.375	Y	5
11–Apr–95	15:00	0.125	71.125	Y	<5
12–Apr–95	08:00	Trace	67.375	Y	Trace
12–Apr–95	15:00	Trace	69.25	Y	Trace
13–Apr–95	08:30	Trace	73.625	Y	Trace
13–Apr–95	15:30	Trace	77.25	Y	Trace
14–Apr–95	07:15	0.25	75.875	Y	5
14–Apr–95	16:10	0.25	80.25	Y	5
16–Apr–95	07:40	0	75.125	Y	0
16–Apr–95	15:20	0	78.5	Y	0
17–Apr–95	07:35	0.125	70.125	Y	<5
17–Apr–95	15:05	0.125	71	Y	<5
18–Apr–95	08:30	0	68.625	Y	0
18–Apr–95	15:30	0	68.25	Y	0
19–Apr–95	07:00	0	71	Y	0
19–Apr–95	15:30	0	65.125	Y	0
20–Apr–95	07:10	0	72.75	Y	0
20–Apr–95	15:15	0	65	Y	0
21–Apr–95	08:00	0	70.125	Y	0
21–Apr–95	15:45	0	68.75	Y	0

APPENDIX – B
INITIAL REMEDIAL ACTION
FREE PRODUCT RECOVERY DATA
CSS–278–MW–5
February 1993 – October 1995

Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
24–Apr–95	07:30	0	71.75	Y	0
24–Apr–95	15:00	0	72	Y	0
25–Apr–95	07:45	0	77.5	Y	0
25–Apr–95	15:00	0	78	Y	0
26–Apr–95	07:30	Trace	73	Y	Trace
26–Apr–95	15:00	Trace	75.25	Y	Trace
27–Apr–95	07:00	Trace	72	Y	Trace
27–Apr–95	15:15	Trace	78	Y	Trace
28–Apr–95	07:00	0.25	73	Y	5
28–Apr–95	16:00	0.125	79.5	Y	<5
01–May–95	07:30	Trace	68.375	Y	Trace
01–May–95	16:20	Trace	74.625	Y	Trace
02–May–95	08:00	Trace	73	Y	Trace
02–May–95	15:35	Trace	74.25	Y	Trace
03–May–95	08:00	0	75.5	Y	0
03–May–95	15:30	0	73	Y	0
04–May–95	07:10	0	76	Y	0
04–May–95	15:00	0	71.25	Y	0
05–May–95	07:00	Trace	75.25	Y	Trace
05–May–95	15:30	0	77.375	Y	0
08–May–95	08:15	Trace	73.75	Y	Trace
08–May–95	15:30	0	74.875	Y	0
09–May–95	08:30	0.25	69.75	Y	5
09–May–95	16:15	0.25	71.25	Y	5
10–May–95	07:40	Trace	70.5	Y	Trace
10–May–95	16:40	0	71.25	Y	0
11–May–95	07:30	0	67.25	Y	0
11–May–95	15:30	0	70.625	Y	0
12–May–95	07:30	0	67.25	Y	0
12–May–95	16:00	0	70.125	Y	0
15–May–95	07:30	0	67	Y	0
15–May–95	16:30	0	75.125	Y	0
16–May–95	08:30	0	68	Y	0
16–May–95	16:00	0	71.125	Y	0
17–May–95	07:00	0	67.25	Y	0
17–May–95	15:00	0	70.375	Y	0
18–May–95	07:00	0	70	Y	0
18–May–95	16:15	0	69.125	Y	0
19–May–95	07:30	0	70.5	Y	0

APPENDIX – B
INITIAL REMEDIAL ACTION
FREE PRODUCT RECOVERY DATA
CSS–278–MW–5
February 1993 – October 1995

Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
19–May–95	16:45	0	65.5	Y	0
22–May–95	07:15	0	77	Y	0
22–May–95	15:00	0	71	Y	0
23–May–95	07:00	0	77	Y	0
23–May–95	16:30	0	80.75	Y	0
24–May–95	07:00	0	73.5	Y	0
24–May–95	15:00	0	76.75	Y	0
25–May–95	07:00	0	71	Y	0
25–May–95	15:00	0	78.375	Y	0
26–May–95	07:30	0	70.25	Y	0
26–May–95	14:45	0	79.25	Y	0
30–May–95	08:00	0	70.25	Y	0
30–May–95	15:15	0	73.75	Y	0
31–May–95	06:50	0	72.25	Y	0
31–May–95	15:00	0	68.375	Y	0
01–Jun–95	06:40	0	74.5	Y	0
01–Jun–95	15:30	0	71	Y	0
02–Jun–95	07:00	0	73	Y	0
02–Jun–95	15:30	0	69.375	Y	0
05–Jun–95	09:15	0	65.375	Y	0
05–Jun–95	15:45	0	63.5	Y	0
06–Jun–95	07:00	0	74.75	Y	0
06–Jun–95	15:30	0	73.75	Y	0
07–Jun–95	07:00	0	71.5	Y	0
07–Jun–95	16:00	0	70.25	Y	0
08–Jun–95	07:00	0	72.25	Y	0
08–Jun–95	15:30	0	79.75	Y	0
09–Jun–95	07:00	0	73	Y	0
09–Jun–95	15:30	0	80.25	Y	0
12–Jun–95	08:00	0	68	Y	0
12–Jun–95	15:15	0	65	Y	0
13–Jun–95	07:30	0	71.125	Y	0
13–Jun–95	16:45	0	74.375	Y	0
14–Jun–95	08:00	0	76.25	Y	0
14–Jun–95	15:30	0	76.375	Y	0
15–Jun–95	08:00	0	78.75	Y	0
15–Jun–95	15:30	0	72.125	Y	0
16–Jun–95	07:00	0	77.375	Y	0
16–Jun–95	15:00	0	79.75	Y	0

APPENDIX – B
INITIAL REMEDIAL ACTION
FREE PRODUCT RECOVERY DATA
CSS–278–MW–5
February 1993 – October 1995

Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
19–Jun–95	07:30	0.25	79.375	Y	5
19–Jun–95	15:00	0.25	78.25	Y	5
20–Jun–95	07:30	0.25	75.25	Y	5
20–Jun–95	15:00	0.25	73	Y	5
21–Jun–95	08:00	0.25	72.625	Y	5
21–Jun–95	16:30	0.125	79	Y	<5
22–Jun–95	08:30	0.125	72	Y	<5
22–Jun–95	17:30	0.125	78.625	Y	<5
23–Jun–95	09:00	0.125	70.375	Y	<5
23–Jun–95	15:30	0.125	69.25	Y	<5
26–Jun–95	06:30	0	69.25	Y	0
26–Jun–95	15:30	0	77.375	Y	0
27–Jun–95	08:00	0	68.125	Y	0
27–Jun–95	16:15	0	78	Y	0
28–Jun–95	08:00	0	72.75	Y	0
28–Jun–95	16:00	0	78.5	Y	0
29–Jun–95	07:15	0	73.25	Y	0
29–Jun–95	16:00	0	79	Y	0
30–Jun–95	07:30	0	75	Y	0
30–Jun–95	17:45	0	78.625	Y	0
03–Jul–95	08:15	0.125	73.75	Y	<5
03–Jul–95	18:00	0	79	Y	0
05–Jul–95	07:30	0.125	74	Y	<5
05–Jul–95	16:30	0	78.75	Y	0
06–Jul–95	08:50	0.125	75.5	Y	<5
06–Jul–95	18:15	0.125	80.375	Y	<5
07–Jul–95	08:10	0.25	78.5	Y	5
07–Jul–95	14:30	0.5	82.5	Y	10
10–Jul–95	08:15	0	67.75	Y	0
10–Jul–95	17:00	0.125	73	Y	<5
11–Jul–95	07:00	0	66.625	Y	0
11–Jul–95	15:00	0	74.5	Y	0
12–Jul–95	07:00	0	69	Y	0
12–Jul–95	14:00	0	68.75	Y	0
13–Jul–95	06:55	0	72.25	Y	0
13–Jul–95	18:30	0	77.5	Y	0
14–Jul–95	08:45	0	70.75	Y	0
14–Jul–95	15:00	0	68.75	Y	0
17–Jul–95	08:30	0	78.375	Y	0

APPENDIX – B
INITIAL REMEDIAL ACTION
FREE PRODUCT RECOVERY DATA
CSS–278–MW–5
February 1993 – October 1995

Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
17–Jul–95	15:30	0	73.75	Y	0
18–Jul–95	08:20	0	64.5	Y	0
18–Jul–95	14:40	0	66.5	Y	0
19–Jul–95	07:45	0	72.5	Y	0
19–Jul–95	15:00	0	74.25	Y	0
20–Jul–95	07:30	0	71.75	Y	0
20–Jul–95	15:30	0	80	Y	0
21–Jul–95	07:30	0	72.125	Y	0
21–Jul–95	16:30	0	79.875	Y	0
24–Jul–95	07:30	0.125	70.25	Y	<5
24–Jul–95	16:00	0.125	75.375	Y	<5
25–Jul–95	08:00	0	70.25	Y	0
25–Jul–95	16:30	0	76.125	Y	0
26–Jul–95	08:00	0	70.375	Y	0
26–Jul–95	15:45	0	75.25	Y	0
27–Jul–95	08:00	0	69	Y	0
27–Jul–95	15:30	0	72.75	Y	0
28–Jul–95	07:45	0	68.375	Y	0
28–Jul–95	15:30	0	70	Y	0
31–Jul–95	08:00	0	66.25	Y	0
31–Jul–95	16:00	0	70.25	Y	0
01–Aug–95	08:20	0	69.5	Y	0
01–Aug–95	16:30	0	68.25	Y	0
02–Aug–95	06:00	0	69.75	Y	0
02–Aug–95	15:00	0	68	Y	0
03–Aug–95	11:45	0	59	Y	0
03–Aug–95	18:00	0	63	Y	0
04–Aug–95	08:00	0	63.25	Y	0
04–Aug–95	15:45	0	68.5	Y	0
07–Aug–95	08:15	0	61.5	Y	0
07–Aug–95	17:45	0	70	Y	0
08–Aug–95	08:15	0	68.25	Y	0
08–Aug–95	16:00	0	81	Y	0
09–Aug–95	09:00	0	68.5	Y	0
09–Aug–95	15:15	0	79.75	Y	0
10–Aug–95	08:00	0	73.375	Y	0
10–Aug–95	18:30	0	82.25	Y	0
11–Aug–95	07:30	0	70	Y	0
11–Aug–95	16:00	0	80.25	Y	0

APPENDIX – B
INITIAL REMEDIAL ACTION
FREE PRODUCT RECOVERY DATA
CSS–278–MW–5
February 1993 – October 1995

Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
14–Aug–95	08:15	0	86.75	Y	0
14–Aug–95	15:00	0	84.5	Y	0
15–Aug–95	08:00	1.5	87	Y	80
15–Aug–95	15:00	1.5	86	Y	80
16–Aug–95	07:00	0.25	81.625	Y	5
16–Aug–95	15:00	0	80.5	Y	<5
17–Aug–95	07:15	0	77.5	Y	0
17–Aug–95	15:00	0	75.125	Y	0
18–Aug–95	07:30	0	77.5	Y	0
18–Aug–95	16:00	0	78.5	Y	0
21–Aug–95	07:00	0	65.25	Y	0
21–Aug–95	15:30	0	72.5	Y	0
22–Aug–95	07:30	0	63.75	Y	0
22–Aug–95	15:45	0	72.75	Y	0
23–Aug–95	08:00	0	64	Y	0
23–Aug–95	15:30	0	73.125	Y	0
24–Aug–95	08:00	0	63.625	Y	0
24–Aug–95	15:30	0	71.75	Y	0
25–Aug–95	08:15	0	64.25	Y	0
25–Aug–95	15:45	0	71	Y	0
28–Aug–95	08:00	0	70.125	Y	0
28–Aug–95	16:30	0	72	Y	0
29–Aug–95	08:00	0	72.75	Y	0
29–Aug–95	16:45	0	71	Y	0
30–Aug–95	08:00	0	73	Y	0
30–Aug–95	15:15	0	71	Y	0
31–Aug–95	08:00	0	72	Y	0
31–Aug–95	16:30	0	70	Y	0
01–Sep–95	08:00	0	67.25	Y	0
01–Sep–95	17:00	0	65.75	Y	0
05–Sep–95	08:00	0	64	Y	0
05–Sep–95	18:00	0	71	Y	0
06–Sep–95	08:00	0	64.5	Y	0
06–Sep–95	16:00	0	73	Y	0
07–Sep–95	08:30	0	64	Y	0
07–Sep–95	15:30	0	69.5	Y	0
08–Sep–95	08:00	0	64	Y	0
08–Sep–95	15:00	0	65	Y	0
11–Sep–95	08:30	0	70.25	Y	0

APPENDIX – B
INITIAL REMEDIAL ACTION
FREE PRODUCT RECOVERY DATA
CSS–278–MW–5
February 1993 – October 1995

Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
11–Sep–95	16:30	0	69.5	Y	0
12–Sep–95	08:30	0	72	Y	0
12–Sep–95	17:00	0	71.75	Y	0
13–Sep–95	08:15	0	69.75	Y	0
13–Sep–95	17:00	0	65.5	Y	0
14–Sep–95	07:45	0	68.25	Y	0
14–Sep–95	18:00	0	69	Y	0
15–Sep–95	08:00	0	69	Y	0
15–Sep–95	15:10	0	66	Y	0
18–Sep–95	07:00	0	65.375	Y	0
18–Sep–95	17:00	0	68.75	Y	0
19–Sep–95	07:00	0	64	Y	0
19–Sep–95	16:00	0	70	Y	0
20–Sep–95	07:00	0	65.125	Y	0
20–Sep–95	17:00	0	72	Y	0
21–Sep–95	07:00	0	66.5	Y	0
21–Sep–95	15:00	0	73.375	Y	0
22–Sep–95	07:10	0	65	Y	0
22–Sep–95	15:00	0	73.5	Y	0
25–Sep–95	08:00	0	72	Y	0
25–Sep–95	16:45	0	68.5	Y	0
26–Sep–95	08:20	0	70.5	Y	0
26–Sep–95	15:30	0	69.375	Y	0
27–Sep–95	08:00	0	70.625	Y	0
27–Sep–95	15:00	0	68.25	Y	0
28–Sep–95	08:00	0	70.25	Y	0
28–Sep–95	16:00	0	68	Y	0
29–Sep–95	08:00	0	70.25	Y	0
02–Oct–95	08:00	0	65	Y	0
02–Oct–95	15:15	0	73	Y	0
03–Oct–95	07:00	0	65.25	Y	0
03–Oct–95	16:00	0	72.75	Y	0
04–Oct–95	Base closed – Hurricane Opal				
04–Oct–95	07:00	0	62	Y	0
05–Oct–95	Base closed – Hurricane Opal				
05–Oct–95	Base closed – Hurricane Opal				
06–Oct–95	09:00	0	63.5	Y	0
06–Oct–95	17:00	0	68	Y	0
10–Oct–95	09:00	0	74.5	Y	0

APPENDIX – B
INITIAL REMEDIAL ACTION
FREE PRODUCT RECOVERY DATA
CSS–278–MW–5
February 1993 – October 1995

Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
10–Oct–95	16:45	0	72.5	Y	0
11–Oct–95	07:30	0	73.75	Y	0
11–Oct–95	16:00	0	69.125	Y	0
12–Oct–95	07:30	0	72.25	Y	0
12–Oct–95	15:45	0	69.375	Y	0
13–Oct–95	07:30	0	70.25	Y	0
13–Oct–95	16:00	0	67	Y	0
16–Oct–95	08:15	0	79	Y	0
16–Oct–95	16:30	0	74	Y	0
17–Oct–95	08:30	0	75	Y	0
17–Oct–95	15:45	0	77.25	Y	0
18–Oct–95	07:30	0	68	Y	0
18–Oct–95	15:30	0	70	Y	0
19–Oct–95	07:30	0	66.5	Y	0
19–Oct–95	15:00	0	68	Y	0
20–Oct–95	07:30	0	64	Y	0
20–Oct–95	15:10	0	67	Y	0
23–Oct–95	08:00	0	74.5	Y	0
23–Oct–95	15:45	0	70	Y	0
24–Oct–95	08:00	0	74.75	Y	0
24–Oct–95	15:00	0	70.5	Y	0
25–Oct–95	08:00	0	77	Y	0
25–Oct–95	16:30	0	69.5	Y	0
26–Oct–95	07:30	0	78.5	Y	0
26–Oct–95	15:00	0	73.5	Y	0
27–Oct–95	08:30	0	79	Y	0
27–Oct–95	15:10	0	75.25	Y	0
30–Oct–95	08:15	0	78	Y	0
30–Oct–95	14:30	0	81	Y	0
31–Oct–95	00:00	0	75	Y	0
31–Oct–95	00:00	0	76	Y	0

	cc	62742
Total Volume of Free Product Recovered from MW–5	galllons	16.576486

APPENDIX – B
INITIAL REMEDIAL ACTION
FREE PRODUCT RECOVERY DATA
CSS–278–MW–6
February 1993 – October 1995

Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
23–Feb–93	11:30	0	75.625	Y	0
23–Feb–93	15:15	0	80.625	Y	0
24–Feb–93	07:15	0	83.5	Y	0
24–Feb–93	16:25	0	82.625	Y	0
25–Feb–93	07:35	0.25	79	Y	0
25–Feb–93	17:35	0	74.25	Y	0
26–Feb–93	07:00	0	69.875	Y	0
26–Feb–93	17:20	0	69.5	Y	0
01–Mar–93	07:30	0.25	86	Y	0
01–Mar–93	16:05	0	77.25	Y	0
02–Mar–93	07:15	0.25	84.25	Y	0
02–Mar–93	16:30	0	74.75	Y	0
03–Mar–93	07:10	0	74.75	Y	0
03–Mar–93	15:50	0	66.25	Y	0
04–Mar–93	07:10	0	79	Y	0
04–Mar–93	15:35	0	72.75	Y	0
05–Mar–93	07:10	0	87.25	Y	0
08–Mar–93	07:10	0	81.5	Y	0
08–Mar–93	14:45	0	82	Y	0
08–Mar–93	15:35	0	78.75	Y	0
26–Mar–93	16:10	0	76.75	Y	0
02–Apr–93	15:15	0	83.375	Y	0
09–Apr–93	15:40	0	64.875	N	0
16–Apr–93	15:20	0	78	Y	0
23–Apr–93	16:00	0	78.25	N	0
30–Apr–93	12:15	0	77.25	N	0
02–Jun–93	09:35	0	72.5	N	0
07–Jun–93	08:55	0	79.5	N	0
18–Jun–93	11:40	0	73.5	N	0
22–Jun–93	11:11	0	71	N	0
01–Jul–93	15:35	0	82.5	N	0
09–Jul–93	07:25	0	73	N	0
12–Jul–93	10:45	0	76.875	N	0
23–Jul–93	11:35	0	78.875	N	0
26–Jul–93	12:40	0	80.25	N	0
02–Aug–93	12:20	0	73.625	N	0
10–Aug–93	09:40	0	71.25	N	0
16–Aug–93	08:43	0	74.25	N	0
23–Aug–93	08:30	0	71.5	N	0

APPENDIX – B
INITIAL REMEDIAL ACTION
FREE PRODUCT RECOVERY DATA
CSS–278–MW–6
February 1993 – October 1995

Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
31–Aug–93	07:45	0	70.25	N	0
08–Sep–93	07:53	0	61.125	N	0
13–Sep–93	10:17	0	71.25	N	0
20–Sep–93	08:30	0	74.125	N	0
27–Sep–93	08:20	0	71.125	N	0
05–Oct–93	07:49	0	67.75	N	0
20–Oct–93	09:35	0	72.625	N	0
08–Nov–93	09:50	0	81.75	N	0
22–Nov–93	11:10	1.25	85.25	N	35
07–Dec–93	10:44	0	85	N	0
21–Dec–93	10:30	0	83.625	N	0
22–Dec–93	16:00	0	82.5	N	0
23–Dec–93	08:20	0	75.5	Y	6
27–Dec–93	08:00	0.125	86.5	N	0
28–Dec–93	16:05	0	82.5	Y	15
29–Dec–93	08:38	0.5	89.375	N	0
30–Dec–93	15:40	0	89.25	N	0
03–Jan–94	09:30	0	81.25	N	0
04–Jan–94	07:10	0	81.625	N	0
05–Jan–94	16:40	0	77.5	N	0
06–Jan–94	17:35	0	76.875	N	0
07–Jan–94	07:03	0	79.625	N	0
10–Jan–94	16:23	0	76.375	N	0
11–Jan–94	16:10	0	76.5	N	0
12–Jan–94	15:45	0	75	N	0
13–Jan–94	16:10	0	78.25	N	0
14–Jan–94	16:40	0	77.625	N	0
18–Jan–94	15:15	0	81.25	N	0
19–Jan–94	16:20	1.5	80	N	0
20–Jan–94	16:00	0	72.25	N	0
21–Jan–94	15:30	0	72.5	N	0
24–Jan–94	16:23	0	83.25	N	0
25–Jan–94	15:40	0	81	N	0
26–Jan–94	16:30	0	79	N	0
27–Jan–94	15:20	0	65	N	0
28–Jan–94	15:15	0	64.625	N	0
31–Jan–94	15:30	0	76.875	N	0
01–Feb–94	14:40	0	71.625	N	0
02–Feb–94	14:40	0	77.125	N	0

APPENDIX – B
INITIAL REMEDIAL ACTION
FREE PRODUCT RECOVERY DATA
CSS–278–MW–6
February 1993 – October 1995

Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
03–Feb–94	14:45	0	66.625	N	0
04–Feb–94	15:40	0	67.625	N	0
07–Feb–94	15:35	0	77.75	N	0
08–Feb–94	14:20	0	79.5	N	0
09–Feb–94	16:00	0	78.25	N	0
10–Feb–94	16:15	0	70.5	N	0
11–Feb–94	16:50	0	78	N	0
14–Feb–94	12:45	0	89.5	N	0
15–Feb–94	15:15	0	84.75	N	0
16–Feb–94	15:45	0	84.5	N	0
17–Feb–94	09:15	0	83.75	N	0
18–Feb–94	07:30	0	89.5	N	0
22–Feb–94	08:40	0	81.125	N	0
23–Feb–94	07:40	0	82.375	N	0
24–Feb–94	07:00	0	84	N	0
25–Feb–94	07:55	0	82.25	N	0
28–Feb–94	07:50	0	85.5	N	0
01–Mar–94	06:40	0	80.375	N	0
02–Mar–94	09:20	0	69.5	N	0
03–Mar–94	07:40	0	89	N	0
04–Mar–94	07:30	0	92	N	0
07–Mar–94	07:45	0	85.625	N	0
08–Mar–94	07:50	0	82.125	N	0
09–Mar–94	09:30	0	80	N	0
10–Mar–94	07:45	0	83	N	0
11–Mar–94	07:35	0	92.25	N	0
30–Mar–94	09:15	0	62.5	N	0
31–Mar–94	09:00	0	81	N	0
01–Apr–94	08:30	0	87.25	N	0
04–Apr–94	09:20	0	62.5	N	0
05–Apr–94	06:45	0	83.5	N	0
06–Apr–94	06:42	0	85	N	0
07–Apr–94	06:45	0	83.125	N	0
08–Apr–94	09:30	3.875	81.125	Y	150
11–Apr–94	09:10	0	78.5	N	0
12–Apr–94	06:50	0	787.25	N	0
13–Apr–94	09:10	0	73.5	N	0
14–Apr–94	09:15	0	74.75	N	0
15–Apr–94	08:15	0	73.375	N	0

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INITIAL REMEDIAL ACTION
FREE PRODUCT RECOVERY DATA
CSS–278–MW–6
February 1993 – October 1995

Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
18–Apr–94	07:50	0	81.25	N	0
19–Apr–94	07:40	0	74	N	0
20–Apr–94	07:45	0	78.5	N	0
21–Apr–94	08:15	0	65.5	N	0
22–Apr–94	07:45	0	75	N	0
25–Apr–94	08:40	0	76	N	0
26–Apr–94	08:15	0	74.25	N	0
27–Apr–94	07:35	0	72.5	N	0
28–Apr–94	09:15	0	71.5	N	0
29–Apr–94	07:10	0	77	N	0
02–May–94	07:40	0	79.75	N	0
03–May–94	08:40	0	79.25	N	0
04–May–94	09:45	0	78	N	0
05–May–94	07:15	0	76.875	N	0
06–May–94	08:40	6.5	79	N	0
09–May–94	07:10	0	75	N	0
10–May–94	07:10	0	78	N	0
11–May–94	09:00	0	79.5	N	0
12–May–94	07:40	0	77.125	N	0
13–May–94	08:40	0	78.5	N	0
16–May–94	08:10	0	77.5	N	0
17–May–94	07:45	0	78	N	0
18–May–94	16:10	0	80.5	N	0
19–May–94	08:45	1	80	Y	20
20–May–94	07:15	1.75	77.25	Y	80
23–May–94	09:15	0	75.125	N	0
24–May–94	06:15	0	77	N	0
25–May–94	08:15	0	72	N	0
26–May–94	07:10	0	75.375	N	0
27–May–94	07:10	0	75	N	0
30–May–94	HOLIDAY––––	–––––––––	Memorial Day		
31–May–94	07:10	0	73.5	N	0
01–Jun–94	07:10	0	79.5	N	0
02–Jun–94	09:10	0	78	N	0
03–Jun–94	08:15	0	83.375	N	0
06–Jun–94	09:10	0	73.75	N	0
07–Jun–94	08:10	0	70.5	N	0
08–Jun–94	08:40	0	70	N	0
09–Jun–94	07:10	0	73.5	N	0

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
10–Jun–94	07:50	0	75.25	N	0
13–Jun–94	09:10	0	77.375	N	0
14–Jun–94	07:45	0	79.75	N	0
15–Jun–94	08:15	0	79.75	N	0
16–Jun–94	08:15	0	79.25	N	0
17–Jun–94	07:10	0	76.5	N	0
20–Jun–94	09:10	0	69.5	N	0
21–Jun–94	09:10	0	71	N	0
22–Jun–94	08:05	0	72.125	Y	0
23–Jun–94	07:10	0	72	Y	0
24–Jun–94	09:10	0	74.875	Y	0
27–Jun–94	09:10	0	79.5	Y	0
28–Jun–94	08:10	0	76.5	Y	0
29–Jun–94	08:15	0.5	79.5	Y	0
30–Jun–94	08:15	1.25	76.5	Y	0
01–Jul–94	08:15	1	75	Y	30
05–Jul–94	08:10	0	69.75	Y	0
06–Jul–94	08:40	0	68.875	Y	0
07–Jul–94	07:10	0	65.625	Y	0
08–Jul–94	08:30	0	65.375	N	0
11–Jul–94	09:40	0	69.375	Y	0
12–Jul–94	08:50	0	72.25	Y	0
13–Jul–94	08:10	0	74.5	Y	0
14–Jul–94	07:40	0	75	Y	0
15–Jul–94	08:40	0.25	77	Y	5
18–Jul–94	08:10	0	73.75	Y	0
19–Jul–94	07:20	0	72.25	Y	0
20–Jul–94	07:00	0	71	Y	0
21–Jul–94	08:00	0	72.25	Y	0
22–Jul–94	08:30	0	73.375	Y	0
25–Jul–94	16:20	0	72.5	Y	0
26–Jul–94	09:10	0	79.25	Y	0
27–Jul–94	07:40	0	77.75	Y	0
27–Jul–94	07:40	0	77.75	Y	0
28–Jul–94	07:15	0	75	Y	0
28–Jul–94	07:15	0	75	Y	0
29–Jul–94	08:15	0.125	77.625	Y	5
29–Jul–94	08:15	0.125	77.625	Y	5
01–Aug–94	08:17	0	74.5	Y	0

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
01–Aug–94	08:17	0	74.5	Y	0
02–Aug–94	08:25	0	73.75	Y	0
02–Aug–94	08:25	0	73.75	Y	0
03–Aug–94	08:20	0	71.75	Y	0
03–Aug–94	08:20	0	71.75	Y	0
04–Aug–94	07:40	0	73	Y	0
04–Aug–94	07:40	0	73	Y	0
05–Aug–94	07:10	0	71.625	Y	0
05–Aug–94	07:10	0	71.625	Y	0
08–Aug–94	08:10	0	73.75	Y	0
08–Aug–94	08:10	0	73.75	Y	0
09–Aug–94	07:10	0	77.625	Y	0
09–Aug–94	15:30	0	73.75	Y	0
10–Aug–94	08:20	0	77.75	Y	0
10–Aug–94	08:20	0	77.75	Y	0
11–Aug–94	Not Required" see CSS LTR 10 Aug 94				
12–Aug–94	08:10	0	75.5	Y	0
15–Aug–94	08:05	0	64.375	Y	0
16–Aug–94	07:45	0	63.375	Y	0
17–Aug–94	Not required...see CSS Ltr 10 Aug 94				
18–Aug–94	07:45	0	63.375	Y	0
19–Aug–94	07:25	0	69	Y	0
22–Aug–94	08:10	0	72.5	Y	0
23–Aug–94	07:40	0	76	Y	0
24–Aug–94	Not required...see CSS Ltr 10 Aug 94				
25–Aug–94	08:10	0	76.5	Y	0
26–Aug–94	07:40	0	74.25	Y	0
29–Aug–94	08:50	0	71.25	Y	0
30–Aug–94	08:40	0	71	Y	0
31–Aug–94	08:10	0	70	Y	0
01–Sep–94	07:10	0	69	Y	0
02–Sep–94	08:40	0	69.5	Y	0
05–Sep–94	Holiday				
06–Sep–94	08:10	0	72.5	Y	0
07–Sep–94	08:10	0	75.5	Y	0
08–Sep–94	07:15	0	76.125	Y	0
09–Sep–94	09:10	0	75.5	Y	0
12–Sep–94	07:40	0	71.25	Y	0
13–Sep–94	08:40	0	71.375	Y	0

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
14–Sep–94	08:10	0	68.75	Y	0
15–Sep–94	07:25	0	65.375	Y	0
16–Sep–94	08:40	0	63.25	Y	0
19–Sep–94	07:40	0	74.25	Y	0
20–Sep–94	08:10	0	75.5	Y	0
21–Sep–94	08:40	0	76.375	Y	0
22–Sep–94	07:40	0	76	Y	0
23–Sep–94	08:10	0	75.75	Y	0
26–Sep–94	07:40	0	71	Y	0
27–Sep–94	08:40	0	72.75	Y	0
28–Sep–94	07:40	0	71.5	Y	0
29–Sep–94	07:40	0	97.5	Y	0
30–Sep–94	08:10	0	68.25	Y	0
03–Oct–94	07:20	0	61	Y	0
04–Oct–94	07:25	0	72.5	Y	0
05–Oct–94	08:10	0	76	Y	0
06–Oct–94	07:25	0	78.125	Y	0
07–Oct–94	08:20	0	78.5	Y	0
11–Oct–94	08:20	0	70.5	Y	0
12–Oct–94	08:10	0	66.5	Y	0
13–Oct–94	08:40	0	68	Y	0
14–Oct–94	08:50	0	69.375	Y	0
17–Oct–94	08:20	0	75.5	Y	0
18–Oct–94	08:10	0	74.5	Y	0
19–Oct–94	08:10	0	73.5	Y	0
20–Oct–94	07:10	0	75.5	Y	0
21–Oct–94	07:10	0	77.25	Y	0
24–Oct–94	08:10	0	77.75	Y	0
25–Oct–94	07:15	0	76.5	Y	0
26–Oct–94	08:40	0	77.75	Y	0
27–Oct–94	09:10	0	78.75	Y	0
28–Oct–94	07:40	0	77.25	Y	0
31–Oct–94	08:10	0	73	Y	0
01–Nov–94	08:10	0	75	Y	5
02–Nov–94	08:10	0	83	Y	0
03–Nov–94	08:10	0	86	Y	0
04–Nov–94	07:40	0	85.875	Y	0
05–Nov–94	07:45	0	82	Y	0
06–Nov–94	08:40	0	86.5	Y	5

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
07–Nov–94	07:40	0	81.625	Y	0
08–Nov–94	07:40	0	80.75	Y	0
09–Nov–94	07:25	0	79.625	Y	0
10–Nov–94	08:40	0	76.5	Y	0
14–Nov–94	07:40	0	82	Y	0
15–Nov–94	08:30	0	87	Y	0
16–Nov–94	08:40	0	90	Y	0
17–Nov–94	08:45	0	88.625	Y	0
18–Nov–94	09:30	0	86.5	Y	0
21–Nov–94	09:00	0	83	Y	0
22–Nov–94	07:40	0	82.25	Y	0
23–Nov–94	07:45	0	87	Y	0
25–Nov–94	08:15	0	81.875	Y	0
28–Nov–94	08:20	0	72.375	Y	0
29–Nov–94	08:35	0	74.875	Y	0
30–Nov–94	08:40	0	84	Y	0
01–Dec–94	08:40	0	87	Y	0
02–Dec–94	08:25	Trace	88.5	Y	Trace
07–Dec–94	08:15	0	86.5	Y	0
08–Dec–94	08:15	0	83.25	Y	0
09–Dec–94	07:55	0	81.875	Y	0
12–Dec–94	08:50	0	83.125	Y	0
13–Dec–94	08:40	0	84	Y	0
14–Dec–94	07:55	0	85.5	Y	0
15–Dec–94	08:20	0	87	Y	0
16–Dec–94	08:20	0	84.25	Y	0
19–Dec–94	09:15	0	88.125	Y	0
20–Dec–94	08:25	0	82.5	Y	0
21–Dec–94	07:30	0	87	Y	0
22–Dec–94	08:20	0	83.75	Y	0
23–Dec–94	08:15	0	88	Y	0
26–Dec–94	----------	----------	----------	-------	
27–Dec–94	08:45	0	86	Y	0
28–Dec–94	08:15	0.0625	81.75	Y	5
29–Dec–94	08:20	0	81.25	Y	0
30–Dec–94	08:45	0	81.5	Y	0
03–Jan–95	08:15	0	89.625	Y	0
04–Jan–95	08:45	0	89.25	Y	0
05–Jan–95	08:40	0	91.625	Y	0

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
06–Jan–95	09:00	0	82.5	Y	0
09–Jan–95	08:40	0	88	Y	0
10–Jan–95	08:15	0	87	Y	0
11–Jan–95	08:35	0	86.125	Y	0
12–Jan–95	08:25	0	87	Y	0
13–Jan–95	08:15	0	82.25	Y	0
17–Jan–95	08:45	0	90.5	Y	0
18–Jan–95	08:40	0	87.625	Y	0
19–Jan–95	08:05	0	79.125	Y	0
20–Jan–95	08:30	0	87.25	Y	0
23–Jan–95	08:45	0	79.75	Y	0
24–Jan–95	08:45	0	91	Y	0
25–Jan–95	08:45	0.75	91.75	Y	20
26–Jan–95	08:40	0	92.75	Y	20
30–Jan–95	09:25	0	91	Y	0
31–Jan–95	08:10	0	94.75	Y	0
01–Feb–95	ABB Sampling				
02–Feb–95	09:00	0	88	Y	0
03–Feb–95	09:25	0	88.75	Y	0
06–Feb–95	09:20	0	92.25	Y	0
07–Feb–95	09:30	0	91	Y	0
08–Feb–95	08:55	0	94.25	Y	0
09–Feb–95	09:15	0.75	94.25	Y	25
10–Feb–95	08:15	0	88.25	Y	Trace
13–Feb–95	09:00	0	93.625	Y	0
14–Feb–95	08:20	0	92.625	Y	Trace
15–Feb–95	09:30	0	87.5	Y	Trace
16–Feb–95	08:30	0	86	Y	Trace
17–Feb–95	08:25	0	84.875	Y	0
21–Feb–95	08:50	0	90.25	Y	0
22–Feb–95	08:50	0.25	91.5	Y	5
23–Feb–95	07:50	0	90.125	Y	Trace
24–Feb–95	07:45	0	85.625	Y	0
27–Feb–95	08:25	0	90.5	Y	0
28–Feb–95	07:15	0	85.375	Y	0
01–Mar–95	08:15	0	84.5	Y	0
02–Mar–95	08:40	0	67	Y	0
03–Mar–95	07:50	0	88	Y	0
06–Mar–95	07:40	0.5	80.75	Y	10

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
07–Mar–95	08:45	0.25	77.375	Y	5
08–Mar–95	08:45	0.125	72.5	Y	5
09–Mar–95	08:35	0.125	90.625	Y	5
10–Mar–95	08:15	0	90.875	Y	0
13–Mar–95	07:35	0.125	84.625	Y	5
14–Mar–95	10:20	0.125	82.75	Y	5
15–Mar–95	08:00	0	88.125	Y	0
16–Mar–95	07:50	0	77.875	Y	0
17–Mar–95	07:45	0	77.25	Y	0
20–Mar–95	07:45	0	71	Y	0
21–Mar–95	07:45	0	78.25	Y	0
22–Mar–95	08:15	0	77.25	Y	0
23–Mar–95	07:45	0	78.375	Y	0
24–Mar–95	07:35	0	78.25	Y	0
27–Mar–95	07:45	0	78.5	Y	0
28–Mar–95	07:45	0	80	Y	0
29–Mar–95	07:35	0	79.5	Y	0
30–Mar–95	07:25	0	78.375	Y	0
31–Mar–95	07:15	0	72.25	Y	0
03–Apr–95	09:15	2.75	77.25	Y	160
04–Apr–95	08:15	4	77.25	Y	195
05–Apr–95	07:45	1.25	76.75	Y	70
06–Apr–95	08:15	0	63.5	Y	0
07–Apr–95	07:45	0	68.5	Y	0
10–Apr–95	08:30	2	80	Y	105
11–Apr–95	07:30	1.5	76	Y	70
12–Apr–95	08:15	0	70.25	Y	0
13–Apr–95	08.45	Trace	76.625	Y	Trace
14–Apr–95	07:30	0.25	78.875	Y	5
17–Apr–95	07:50	0	75.75	Y	0
18–Apr–95	08:45	0	71.75	Y	0
19–Apr–95	07:15	0	74.5	Y	0
20–Apr–95	07:25	0	75.5	Y	0
21–Apr–95	08:15	0	72.75	Y	0
24–Apr–95	07:45	0	75.25	Y	0
25–Apr–95	08:00	0	80.75	N	0
26–Apr–95	07:45	2	75.5	Y	100
27–Apr–95	07:15	4	74.5	Y	150
28–Apr–95	07:15	5	75.75	Y	220

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Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
01–May–95	07:40	3	72.25	Y	170
02–May–95	08:15	Trace	75.5	Y	Trace
03–May–95	08:15	0	78	Y	0
04–May–95	07:25	Trace	78.375	Y	Trace
05–May–95	07:15	Trace	78.25	Y	Trace
08–May–95	08:30	0	77.5	Y	0
09–May–95	08:45	0	74	Y	0
10–May–95	08:00	0	74	Y	0
11–May–95	07:45	0	70.75	N	0
12–May–95	07:45	0	71.375	N	0
15–May–95	07:45	0	71	N	0
16–May–95	08:45	0	71	N	0
17–May–95	07:15	0	70	N	0
18–May–95	07:15	0	73.25	N	0
19–May–95	07:45	0	73.75	N	0
22–May–95	07:30	0	79.75	N	0
23–May–95	07:15	0	80	N	0
24–May–95	07:15	0	75.875	N	0
25–May–95	07:15	0	74	N	0
26–May–95	07:45	0	74	N	0
30–May–95	08:15	0	73	N	0
31–May–95	07:05	0	76	N	0
01–Jun–95	07:00	0	71	N	0
02–Jun–95	07:15	0	76.75	N	0
05–Jun–95	09:30	0	69.125	N	0
05–Jun–95	09:45	0	70.25	N	0
06–Jun–95	07:15	0.25	77.25	N	0
07–Jun–95	07:15	1.5	74.75	N	0
08–Jun–95	07:15	1.5	75	N	0
09–Jun–95	07:15	0	76.5	N	0
12–Jun–95	08:15	0	71.75	N	0
12–Jun–95	08:30	0	72.5	N	0
13–Jun–95	07:45	0	82	N	0
14–Jun–95	08:15	0	78.5	N	0
15–Jun–95	08:15	0	81.25	N	0
16–Jun–95	07:15	0	79.5	N	0
19–Jun–95	08:00	0.25	82.25	N	0
19–Jun–95	08:00	0.25	82.25	Y	5
20–Jun–95	07:45	0.5	78.25	Y	10

APPENDIX – B
INITIAL REMEDIAL ACTION
FREE PRODUCT RECOVERY DATA
CSS–278–MW–6
February 1993 – October 1995

Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
21–Jun–95	08:15	0	76	N	0
22–Jun–95	08:15	0	75	N	0
23–Jun–95	09:15	0	73.5	N	0
26–Jun–95	07:00	0	74.375	N	0
26–Jun–95	07:00	0	74.375	N	0
27–Jun–95	08:15	0	71.75	N	0
28–Jun–95	08:15	0	76	N	0
29–Jun–95	07:30	0	76.875	N	0
30–Jun–95	07:15	0	78.625	N	0
03–Jul–95	08:30	0	78.25	N	0
05–Jul–95	07:45	0	77.25	N	0
06–Jul–95	08:40	0.125	78.5	Y	5
07–Jul–95	08:25	0	63.5	N	0
10–Jul–95	08:30	0	71	N	0
11–Jul–95	07:15	0	70	N	0
12–Jul–95	07:20	0	72.75	N	0
13–Jul–95	07:10	0	76.75	N	0
14–Jul–95	09:00	0	74	N	0
17–Jul–95	08:45	0	79.625	N	0
18–Jul–95	08:30	0	67.5	N	0
19–Jul–95	08:00	0	76.5	N	0
20–Jul–95	07:45	0	74.5	N	0
21–Jul–95	07:45	0	75.25	N	0
24–Jul–95	07:45	0	72.625	N	0
25–Jul–95	08:30	0	73.375	N	0
26–Jul–95	08:15	0	74.5	N	0
27–Jul–95	08:15	0	72	N	0
28–Jul–95	08:00	0	71.5	N	0
31–Jul–95	08:00	0	70.5	N	0
01–Aug–95	08:35	0	73	N	0
02–Aug–95	06:15	0	72.625	N	0
03–Aug–95	12:00	0	62.25	N	0
04–Aug–95	08:15	0	66.5	N	0
07–Aug–95	08:30	0	64.5	N	0
08–Aug–95	08:30	0	71.375	N	0
09–Aug–95	09:15	0	71.375	N	0
10–Aug–95	08:15	0	70.375	N	0
11–Aug–95	07:45	0	69.5	N	0
14–Aug–95	08:30	0	81	N	0

APPENDIX – B
INITIAL REMEDIAL ACTION
FREE PRODUCT RECOVERY DATA
CSS–278–MW–6
February 1993 – October 1995

Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
15–Aug–95	08:15	0	81.5	N	0
16–Aug–95	07:15	0	77.625	N	0
17–Aug–95	07:30	0	76	N	0
18–Aug–95	07:45	0	73	N	0
21–Aug–95	08:15	0	68.5	N	0
22–Aug–95	07:45	0	67.125	N	0
23–Aug–95	08:15	0	67	N	0
24–Aug–95	08:20	0	67.625	N	0
25–Aug–95	08:25	0	68	N	0
28–Aug–95	08:15	0	73	N	0
29–Aug–95	08:15	0	75	N	0
30–Aug–95	08:15	0	76.5	N	0
31–Aug–95	08:20	0	75.5	N	0
01–Sep–95	08:15	0	70.75	N	0
05–Sep–95	08:15	0	68.25	N	0
06–Sep–95	08:15	0	67.5	N	0
07–Sep–95	08:45	0	67.125	N	0
08–Sep–95	08:15	0	67	N	0
11–Sep–95	08:45	0	73.5	N	0
12–Sep–95	08:45	0	75.25	N	0
13–Sep–95	08:30	0	72.75	N	0
14–Sep–95	08:00	0	71	N	0
15–Sep–95	08:15	0	71.375	N	0
18–Sep–95	07:15	0	68.5	N	0
19–Sep–95	07:15	0	67	N	0
20–Sep–95	07:15	0	68.375	N	0
21–Sep–95	07:15	0	69.5	N	0
22–Sep–95	07:25	0	68.75	N	0
25–Sep–95	08:15	0	75.25	N	0
26–Sep–95	08:35	0	73.75	N	0
27–Sep–95	08:15	0	74.25	N	0
28–Sep–95	08:15	0	73.75	N	0
29–Sep–95	07:45	0	73	N	0
02–Oct–95	08:15	0	68.75	N	0
03–Oct–95	07:15	0	69	N	0
04–Oct–95	07:15	0	65	N	0
05–Oct–95	Base Closed –	Hurricane OPAL			
06–Oct–95	09:15	0	66.75	N	0
10–Oct–95	09:15	0.625	76	Y	15

APPENDIX – B
INITIAL REMEDIAL ACTION
FREE PRODUCT RECOVERY DATA
CSS–278–MW–6
February 1993 – October 1995

Date	Time	FP Thickness	GW Depth BTOC	FP Recovered	
				Sheen	Product
		inches	inches	cc	
11–Oct–95	07:45	0.125	75.5	Y	<5
12–Oct–95	07:45	0	75.25	Y	Trace
13–Oct–95	07:45	0	73	Y	Trace
16–Oct–95	08:30	0.25	80.5	N	5
17–Oct–95	08:45	Trace	78	Y	Trace
18–Oct–95	07:45	0	71	N	0
19–Oct–95	07:45	Trace	69.25	Y	Trace
20–Oct–95	07:10	Trace	68	Y	Trace
23–Oct–95	08:15	Trace	79	Y	Trace
24–Oct–95	08:15	0	78	N	0
25–Oct–95	08:15	0	79.5	N	0
26–Oct–95	07:45	0	81	N	0
27–Oct–95	08:45	0	81.5	N	0
30–Oct–95	08:45	0	81	N	0
31–Oct–95	08:45	0	78	N	0

	CC	1756
Total volume of free product recovered from MW–6	GAL.	0.463937

APPENDIX C

APPENDIX C

BASIS OF DESIGN

BASIS OF DESIGN

The purpose of this Remedial Action Plan (RAP) is to present a plan for remediation of petroleum contamination at the Site 278, CSS Panama City, Panama City, Florida, in accordance with the requirements of Chapter 62-770, Florida Administrative Code (FAC). Implementation of the RAP will include the following tasks:

- Vacuum enhanced extraction of free product and groundwater,
- treatment of mixed fluids at the oily waste collection and treatment system, and
- quarterly monitoring of the site for up to 1 year following the completion of product and groundwater recovery program.

Based on the field data and laboratory analytical results, as presented in the Contamination Assessment Report (CAR) and CAR Addendum, site conditions are as follows. Groundwater depths range approximately from 5 to 7 feet below land surface (bls). Groundwater flow direction near the site is generally to the southeasterly direction towards the bulkhead with some gradient reversals due to tidal influence. Ground elevations at the site are approximately 9 feet above msl. The calculated average hydraulic gradient in the surficial aquifer is 7.39×10^{-3} feet per foot (ft/ft). Slug test results indicate an average horizontal hydraulic conductivity (K) of 1.1 ft/day. Maximum amplitude of the tidal influence observed at the site was 0.8 ft.

CSS Panama City is underlain by three water bearing zones. These zones include the water-table aquifer, the secondary artesian aquifer, and the Floridan aquifer system. The water table aquifer is comprised of highly permeable quartz sands with scattered lenses of clayey sands and sandy clays. It ranges in thickness from 65 to 145 feet. The Floridan aquifer system is separated from the overlying aquifers by semi-confining beds within the Intracoastal Formation. It is hydraulically connected with the overlying strata in this area. It has been estimated that the thickness of the potable zone of the Floridan aquifer ranges between 250 feet and 1,000 feet in Bay County (Causey, and Leve, 1976).

Soil contamination at this site is primarily associated with the free product and the groundwater and is confined with in the capillary zone of the water-table aquifer; therefore, a soil remedial system is not warranted.

Free product as a source of groundwater contamination in the area is the greatest threat. Free product has been observed in MW-5 and MW-6 with an in-situ thickness varying from 0 to 1.58 feet. Based on the finger print analyses the free product has been reported as diesel fuel.

Total naphthalene and total recoverable petroleum hydrocarbon (TRPH) were the only contaminants detected in groundwater samples collected in February 1995. Total naphthtalenes concentrations exceed the State target level of 100 micrograms per liter (μg/l) for source wells for G-II waters in samples collected from MW-4 and MW-6 with a maximum of 360 μg/l. TRPH concentrations exceed the

State target level of 5 milligrams per liter (mg/l) for source wells for G-II waters in samples collected from MW-6, at a concentration of 40 mg/l.

Free product recovery and groundwater extraction will be implemented simultaneously using a mobile vacuum enhanced extraction unit (Vac-Truck) and the total fluids will be discharged in the oily waste collection and treatment system located on base. Once the free product is removed and the groundwater meets the Florida guidance requirements a quarterly monitoring plan will be implemented for one year. Once the quarterly monitoring plan is completed the site will be proposed for a No Further Action (NFA).

101-7520
Gopi

ABB ENVIRONMENTAL SERVICES, INC
TREATABILITY LABORATORY
LABORATORY ANALYSIS REPORT

Prepared For:

Mark Diblin
ABB Environmental Services, Inc.
2590 Executive Center
Circle East, Berkeley Building
Tallahassee, FL 32301-5001

Prepared By:

ABB Environmental Services,Inc.
107 Audubon Road
Wakefield, MA 01880

Patricia Byrnes
Treatability Laboratory Manager

ABB ENVIRONMENTAL SERVICES, INC.

SDG #

COC #

Task Order #:

Job #: 7531.20

Office Ph #: (904)656-1293

Field Office Ph #:

PROJECT NAME: NAVY-UST CSS-PCY
SITE NAME: SITE 16 (BLDG 278)
PROJECT MANAGER: MARK. DIBLIN
COPY TO: MARK. DIBLIN
REQ. COMPLETION DATE:

LAB TEST CODES

A 0059

	SAMPLE IDENTIFIER	SAMPLE DATE	SAMPLE TIME	MATRIX	SAMPLE TYPE COMP	SAMPLE TYPE GRAB	TICS (Y/N)	TOTAL CONTAINERS	1 Sieve Analysis ASTM 421 & 422	2 Fraction of Organic Content	3	4	5	6	7	8	LAB CODE PARAMETER METHOD PRESERVATIVE VOLUME	LAB BATCH NO: / Comments
2-2.5 ft	Unsaturated	16B03201	10/11/95	Soil		✓		12	6	6								
5.5-6 ft	Saturated	16B03202	10-11-95	Soil		✓		10	5	5								

Comments

TOTAL PARAMETERS PER COLUMN: 22 | 11 | 11

NOTES.

LAB COMMENTS.

NEESA QC LEVEL: E

SAMPLED BY	RECEIVED BY.	RELINQUISHED BY.	DATE	TIME	RECEIVED BY:	DATE	TIME
K. Lynn Knight 10-11-95	K. Lynn 10/12/95 1040						
RELINQUISHED BY. DATE TIME	RECEIVED BY:	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY DATE TIME	RECEIVED BY.	RELINQUISHED BY.	DATE	TIME	RECEIVED BY:	DATE	TIME

SHIPPING AIRBILL NUMBER: 704324025 6 SHIPPED VIA: Fedex

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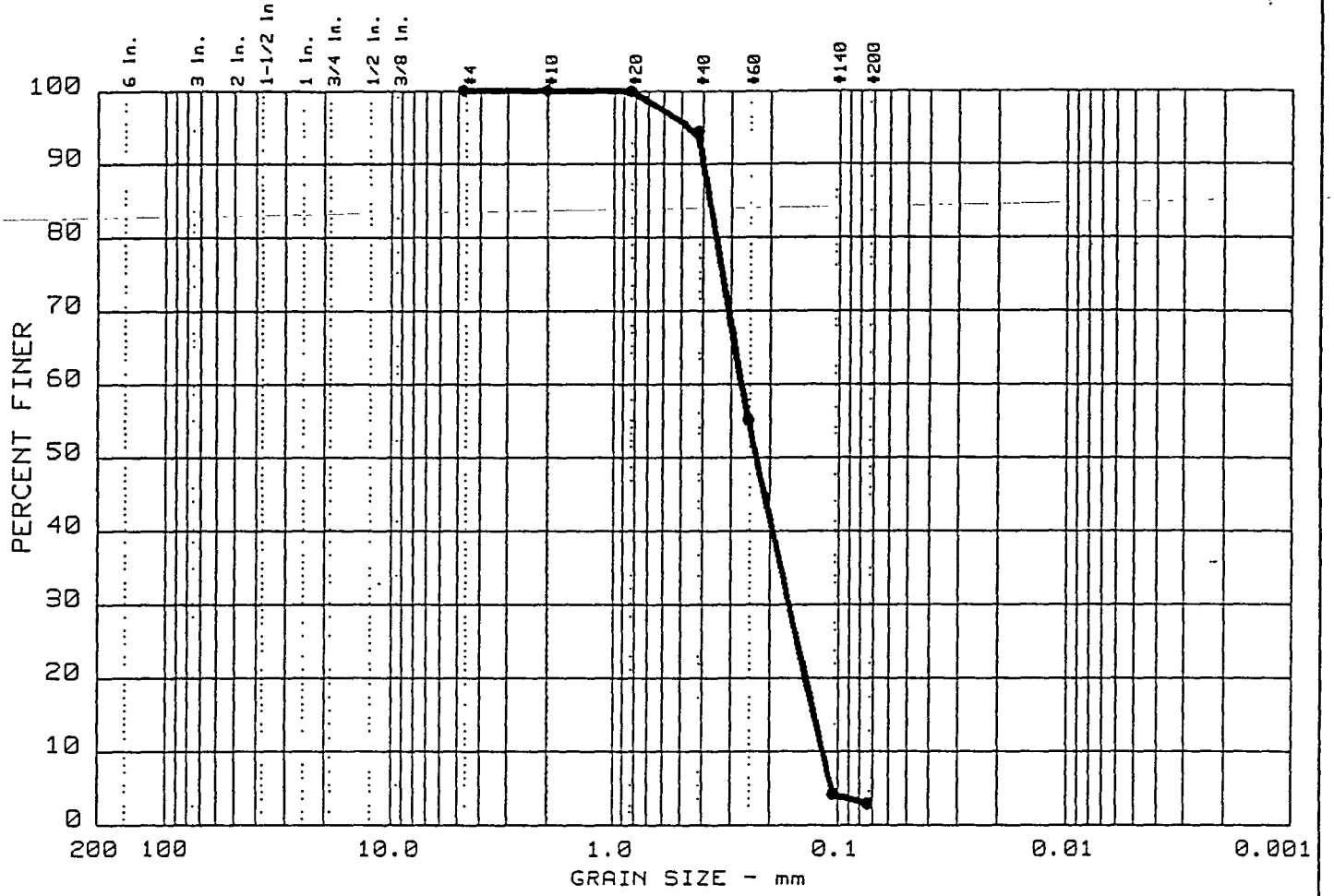
PAGE ___ OF ___

95-10-011

C-4

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
●	0.0	0.0	97.0	3.0		SP		

SIEVE inches size	PERCENT FINER ●		
GRAIN SIZE			
D_{60}	0.27		
D_{30}	0.16		
D_{10}	0.11		
COEFFICIENTS			
C_c	0.86		
C_u	2.3		

SIEVE number size	PERCENT FINER ●		
4	100.0		
10	100.0		
20	99.9		
40	94.3		
60	55.1		
140	4.2		
200	3.0		

Sample information:
● 16B03202
Poorly graded sand

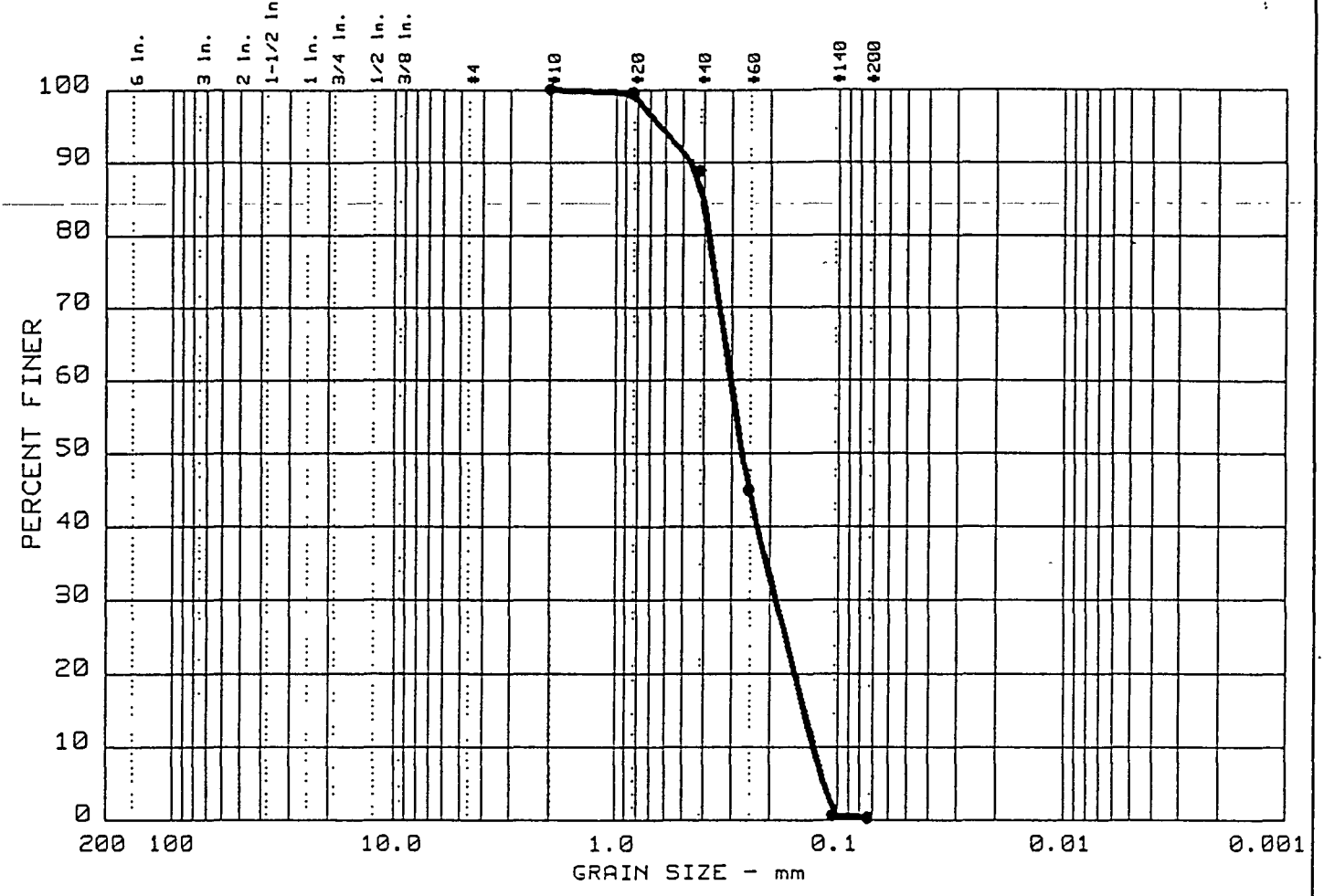
Remarks:
SIEVE ONLY

ABB Environmental Services, Inc.

Project No.: 07531.20
Project: Navy UST CSS

Date: 11/6/95 Data Sheet No. 1

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
●	0.0	0.0	99.7	0.3		SP		

SIEVE inches size	PERCENT FINER ●		
	GRAIN SIZE		
D_{60}	0.30		
D_{30}	0.19		
D_{10}	0.12		
	COEFFICIENTS		
C_c	0.92		
C_u	2.4		

SIEVE number size	PERCENT FINER ●		
10	100.0		
20	99.5		
40	88.8		
60	44.9		
140	0.7		
200	0.3		

Sample information:
● 16B03201
Poorly graded sand

Remarks:
SIEVE ONLY

ABB Environmental Services, Inc.

Project No.: 07531.20
Project: Navy UST CSS

Date: 11/6/95 Data Sheet No. 2

ABB

ABB ENVIRONMENTAL SERVICES, INC.
ANALYTICAL LABORATORY
FRACTION ORGANIC CARBON
ANALYSIS REPORT

Project: Navy UST CCS
Project Number: 07520.31
Date of Analysis: 10/21/95
Date Reported: 11/6/95

Sample ID	% Volatilzed	Approx. % Organic Carbon
16B03201	0.064	0.03
16B03201 DUP	0.097	0.05
16B03202	0.199	0.1
16B03202 DUP	0.219	0.11
17B00101 saturated	0.545	0.27
17B00101 saturated DUP	0.444	0.22
17B00101 unsaturated	0.128	0.06 ✓
17B00101 unsaturated DUP	0.129	0.06

ABB Environmental Services Inc.

Corporate Place 128
107 Audubon Road
Wakefield MA 01880

Telephone (617) 245-6606
Fax (617) 246-5060

ABB ENVIRONMENTAL SERVICES, INC.

SDG #

COC #

Task Order #: 011

Job #: 07520-31

Office Ph #: (904) 656 1293

Field Office Ph #: —

PROJECT NAME:
SITE NAME:
PROJECT MANAGER:
COPY TO:
REQ. COMPLETION DATE:

LAB TEST CODES 1 2 3 4 5 6 7 8

1: Total Barium 9075 Mod
2: Specific Lab Biodegrad. 9078 B. Mod
3: Fingerprint Analysis R100

A0078

LAB CODE
PARAMETER
METHOD
PRESERVATIVE
VOLUME

LAB BATCH NO:

Comments	SAMPLE IDENTIFIER	SAMPLE DATE	SAMPLE TIME	MATRIX	SAMPLE TYPE COMP	SAMPLE TYPE GRAB	TICS (Y/N)	TOTAL CONTAINERS	1	2	3	4	5	6	7	8	Comments
	16G00703	11-16-95	14:05	W		✓		1		1							
TOTAL PARAMETERS PER COLUMN								1									

NEESA QC LEVEL

NOTES

W. Lin Kuhar 11-16-95

LAB COMMENTS

SAMPLED BY:	RECEIVED BY:	RELINQUISHED BY	DATE	TIME	RECEIVED BY:	DATE	TIME
W. Lin Kuhar 11-20-95							
RELINQUISHED BY. DATE TIME	RECEIVED BY.	RELINQUISHED BY	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY DATE TIME	RECEIVED BY.	RELINQUISHED BY.	DATE	TIME	RECEIVED BY:	DATE	TIME

SHIPPING AIRBILL NUMBER: 2238077310

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C-8

ABB ENVIRONMENTAL SERVICES, INC.
TREATABILITY LABORATORY
BACTERIA ANALYSIS REPORT

Project: CSS Panama City Site ~~325~~ 278 (Kg)
Project Number: 7520.31
Date of Analysis: 12/6/95
Date Reported: 12/8/95

Sample ID	Date Sampled	Matrix	Total Bacteria (CFU/g)	Hydrocarbon Bacteria (CFU/g)
16G00703	~~12/6/95~~ 11/16/95 (ty)	AQ	2.7×10^5	3.3×10^4

CSS10195.BAC

APPENDIX D

DESIGN CALCULATIONS

Vacuum Enhanced Extraction
Estimation of Time of Cleanup

PROJECT: CSS Panama City, Site 278, Panama City, Florida
DATE: 31–Mar–96 ENGINEER: KGK CHECKED BY:

Free Product Recovery Time

Assuming a worst–case senario with the lower recovery rate, recovering 1 part hydrocarbon for 30 parts groundwater and using the former estimate of 440 gallons of product, 13,200 gallons of groundwater would have been extracted.

Equation Parameters	Description	Value	Units	
	free product volume	440.00	gallons	
	equivalent groundwater volume	13200.00	gallons	
	flow rate of groundwater per well	1.00	gpm	
	number of recovery wells	1.00		
	extraction time per trip	480.00	min.	assume 8 hr. pumping per trip
	number of trips	27.50	trips	8 hr. per trip
	conversion of above	6.42	months	assume 1 trip per week

POTENTIAL VOLUME OF GROUNDWATER TO BE FLUSHED IN PUMP AND TREAT MECHANISMS

Non-ionizable chemicals that sorb onto organic materials in an aquifer (i.e., organic carbon), are retarded in their movement in groundwater. The sorbing solute travels at linear velocity that is lower than the groundwater flow velocity by a factor of R_d, the retardation factor. If the K_{oc} of a compound is known, the retardation factor may be calculated using the following equation from Freeze and Cherry for unconsolidated sediments.

$$R_d = \frac{V_w}{V_c} = 1 + \frac{BK_d}{n_e}$$

where

R_d = retardation factor (unitless)
V_w = average linear velocity of groundwater (eg., ft/day)
V_c = average linear velocity of contaminant (e.g., ft/day)
B = average soil bulk density (g/cm^3)
n_e = effective porosity (unitless)
K_d = distribution (sorption) coefficient (cm^3/g)

By definition, K_d is defined as the ratio of the concentration of the solute on the solid to the concentration of the solute in solution. The distribution coefficient is related to K_{oc} by the equation:

$$K_{oc} = \frac{K_d}{f_{oc}}$$

where f_{oc} is the fraction of naturally occurring organic carbon in soil.

Estimation of Number of Pore Volumes to be Flushed:

$$C_f = C_0 \left(1 - \frac{1}{R_d}\right)^N$$

Where

C_0 = initial concentration
C_f = target concentration after N flushes
N = number of pore volumes of groundwater flushed

Freeze, R.A., and J.A. Cherry. *Groundwater* (Englewood Cliffs, NJ: Prentice-Hall, Inc., 1974), 604 p.

Harris and Kratichvil, "An Introduction to Chemical Analysis"Saunders College Publishing, 1981, Philadelphia, PA.

"Environment of Fate Mechanism", Microbial Process in degradation of Groundwater Contamination, Association of Groundwater Scientists and Engineers, June 12-14, 1990, Sanfransisco, CA, pp 42.

POTENTIAL VOLUME OF GROUNDWATER TO BE FLUSHED IN PUMP AND TREAT MECHANISMS

PROJECT: CSS Panama City, Site 278, Panama City, Floirida			
DATE:	01-Apr-96	ENGINEER: KGK	CHECKED BY:

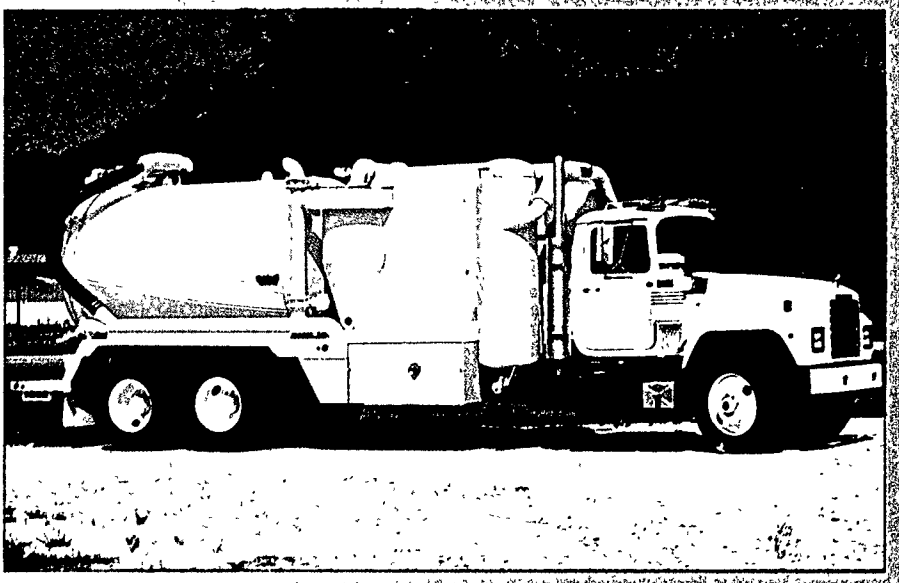
Parameter: total naphthalenes, and TRPH

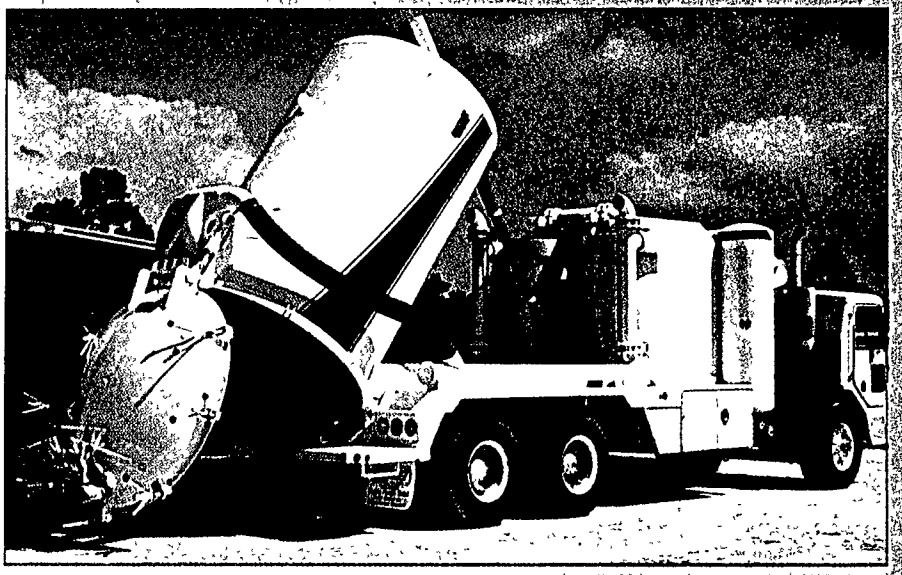
The total volume to be flushed calculation is based on the retardation of desorbtion of organic contaminant solutes from soil. Site specific data is used to calculate the number of pore volumes of groundwater necessary to be removed to adequately flush the contaminants from the soil. That number of pore volumes is then used, to estimate the total volume of groundwater needed to be flushed to reduce the concentrations.

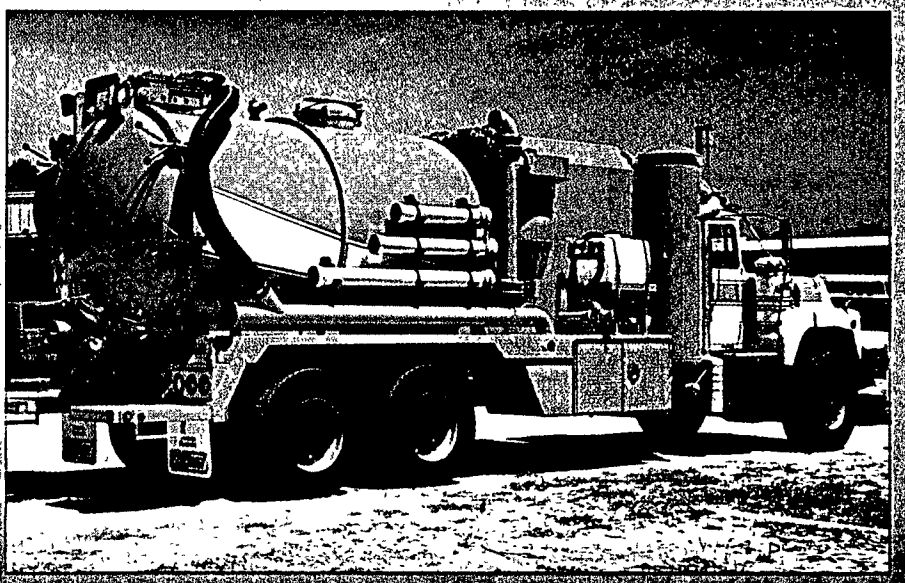
Variable	Description	Value	Units	Source
Koc	partitioning coefficient	1996.00	dimensionless	1
foc	fraction of organics	0.10	dimensionless	2
ne	effective porosity	0.25	dimensionless	
Kd	distibution coefficient	2.00	dimensionless	
B	unit weight of soil	170.00	lb/ft3	
Ka	sorbed to dissolved ratio	16.313		
Rd	retardation factor	17.313		
Ci	initial concentration	360.00	ppb	
Co	target concentration	100.00	ppb	
Ci/C0	fraction remaining	0.278	dimensionless	
N	no. of pore volumes	21.531	dimensionless	
V	pore volume	6333.00	ft3	
NV	total volume to be flushed	136353.17	ft3	
	conversion of above	1019921.74	gallons	

Source:
1. Leo A., 1983, log P parameter database, issue no. 24, Dec 16, 1983.
2. Laboratory Analytical Results, ABB-ES, Inc., Treatability Study Laboratory, Wakefield, MA.

KING VAC







Keith Huber, Inc. introduced the **King Vac™** in 1986 to offer industrial cleaning companies a mobile vacuum loader that combined high cfm and deep vacuum. This combination provided the features of two different loading principles. Vacuum Loading *(Wet Vac Machine)* and Air Conveying *(Dry Vac Machine)*.

In the past, prior to the **King Vac™**, one machine was required for each of the two loading principles. Vacuum loading is used for heavy liquid or sludges when the hose can be submerged during the loading process. Air conveying is used for solid and dusty applications when the hose is not submerged during the loading process.

Noise control was addressed during the development of the **King Vac™**. Standing at the rear of the unit, while product is being loaded, the decibel level is well under 85dbA.

Growth in the petro-chemical industry has focused attention on an additional design feature of the **King Vac™** - the reduction of vapors from hazardous waste. A special absorption chamber helps to reduce the vapor content of hydrocarbons to the atmosphere. The absorption chamber is also effective on many other related products in the petro-chemical industry.

STATE OF THE ART

KING VAC™

KING VAC™ Features

- HIGH C.F.M. — UP TO 3700 CUBIC FEET PER MINUTE — OVER 200 MPH.
- DEEP VACUUM — MORE THAN 27"Hg. VACUUM — 375 COLUMN INCHES OF WATER.
- REDUCED VAPOR EMISSION FROM HAZARDOUS WASTE MATERIAL LOADING.
- LOW NOISE LEVEL — LESS THAN 85 dbA AT FULL POWER.
- DUST CONTROL WITHOUT THE NEED OF A BAG HOUSE.
- CLEARS MOST SUCTION LINE PLUGGING INSTANTLY BY PULLING DOWN TO 27"Hg.
- PRESSURIZED LIQUID DISCHARGE DIRECTLY FROM THE TANK.
- CYCLONE SEPARATORS SELF CLEAN INDIVIDUALLY WHILE VACUUM LOADING IS IN PROGRESS.
- ROUND TANK DESIGN — 3000 GALLONS (15 CUBIC YARD CAPACITY).
- WET/DRY VACUUM LOADER DESIGNED TO PNEUMATICALLY CONVEY DRY SOLIDS, LIQUIDS OR SLUDGE FROM GREAT DISTANCES WITH 4", 6", OR 8" VACUUM LINES.
- HIGH C.F.M. & DEEP VACUUM ALLOWS OPERATOR TO USE SMALLER DIAMETER HOSES.
- HYDRAULIC TANK LIFT FOR DUMPING.
- FULL OPENING REAR DOOR, EQUIPPED WITH A HYDRAULIC REAR DOOR OPENER.
- NO MANUAL CHANGE OVER FROM WET TO DRY.
- NOTED FOR SIMPLICITY OF OPERATION AND DEPENDABILITY.
- MINIMAL CARE AND MAINTENANCE.
- NO PORT HOSE REQUIRED, VACUUM HOSES HOOKED UP AT GROUND LEVEL.
- DESIGNED FOR SAFETY, ALL OPERATOR FUNCTIONS AT GROUND LEVEL.

KING VAC™ Options

- Hydraulic Boom; raise, lower, extend, retract, open & close intake valve, all from a single push button pendant control.
- Three pumps available for jetting or clean-up; 10 GPM @ 2000 PSI; 35 GPM @ 2000 PSI; 0-90 GPM @ 2850 PSI.
- Built in accordance with ASME & DOT for hazardous waste.

VACUUM: CEMENT, LIME, FLY ASH, VERMICULITE, PERLITE, WOOD CHIPS, SAND, TANK BOTTOMS, SLUDGE, OILS, MOST CATALYST, ANTHRACITE, RATCHET RINGS, CERAMIC AND PLASTIC SADDLES, STEEL SHOT, MILL SCALE, REFRACTORY BRICK, DIRT AND OTHER MATERIALS TOO NUMEROUS TO MENTION.

AREAS OF RECOVERY: PAPER MILLS, REFINERIES, CHEMICAL PLANTS, STEEL MILLS, MINES, ROLLING MILLS, FOUNDRIES, TANK FARMS, WATER AND SEWAGE TREATMENT PLANTS, UNDERGROUND BORING AND MANY OTHER APPLICATIONS.

We offer over 2600 different vacuum tank combinations. Our complete product line includes: Portable Restroom Service Units, Vacuum Trailers & Truck-mounted Vacuum/Jetting Packages.

KEITH HUBER

800 334 8237

BERRINGER

- Keith Huber, Inc. began testing the **BERRINGER™** in 1989 due to a direct need expressed by its industrial division customers; a vacuum loader with the advanced technology of the **King Vac™** and the payload transportability of the **Dominator™**.

- Transportation of hazardous and non-hazardous waste has always been a critical issue. Legal payloads, in some cases, are more important than the power of the vacuum loader. Trading off one for the other was common until the **BERRINGER™**.

Relentless silent power combined with vapor reduction technology in a vacuum loader light enough to provide profitable payload transportation and powerful enough for those difficult wet or dry loading applications.

- The **BERRINGER™** comes equipped with a 1,000 cfm vaneless pump capable of 27"Hg., full opening rear door, hydraulic rear door opener, hydraulic tank lift, hydraulic pump drive, extra storage cabinet and push button controls.

- When the loading application requires high cfm, deep vacuum, the ability to scrub harmful vapors, compliance with low noise standards, and transportation of a profitable payload, the **BERRINGER™** is the right choice.

After years of testing, Keith Huber, Inc.
is proud to introduce

BERRINGER

KEITH HUBER

P.O. Box 3368 ■ Gulfport, MS ■ 39505 ■ 800-334-8237

KING VAC™

The King Vac™ will pump Wet or Dry material from depths and distances once thought impossible. Because of the ability to move a large amount of air and produce continuous high vacuum, the King Vac™ will pump materials ranging from "Fly Ash" to "Tar".

Wet or Dry, dust or sludge, the King Vac™ will pump in all applications. It's like having several different pieces of machinery all in one unit. There are no changes that the operator needs to make to pump different types of materials. Simply put the hose "into" or "in front of" the material.

The King Vac™ moves a tremendous amount of air on an open 6" hose. Up to 3700 cubic feet per minute but that's not all. Once the suction hose starts to feel restriction, the real power begins. The King Vac™ will build to 27"Hg. vacuum power in less than 20 seconds. This enormous power ability of High CFM and Deep Vacuum creates a performance that is unknown to many Industrial Vacuum Equipment user's.

Standard equipment provided on the King Vac™ includes an auxiliary vacuum pump that is hydraulically driven. This pump can be used for vacuum or pressure and gives the operator the capability of pressurized unloading.

The King Vac™ is extremely quiet running. While at full power, the vacuum pump makes less noise than the truck engine itself.

The vacuum pump a virtually maintenance free design. There are no vanes to wear, break, or check, no timing gears to set or replace, and no internal oil lubrication to monitor.

A highly efficient separation and emissions reduction system is standard equipment.

The King Vac™ is available with belt drive or total hydraulic drive. While both drive systems are proven, the hydraulic drive offers less maintenance and enables the vacuum system to operate without effecting the truck chassis odometer.

KEITH HUBER INC.

OPTIONS DESCRIPTION

- ASME Certification
- D.O.T. 412
- Hydraulic Rear Door Opener
- High Pressure Wash Down System 10 GPM @ 2000 PSI
- High Pressure Jetting System 35 GPM @ 2000 PSI
- High Pressure Transformer System 0-90 GPM @ 2850 PSI
- Hydraulic Boom
- Hose Tube Set w/Rack
- Hydraulic Hose Reel
- Tachometer/Hour Meter
- Rear Hose Hooks
- 6" Sample Port
- Epoxy Paint
- Two Tone Paint
- Hydraulic Vibrator
- Aux. Transfer Pump (KHB3300)
- Aux. Transfer Pump (KHF28552)
- 4" S/S Gate - Piston Valve
- 6" S/S Gate - Piston Valve
- Air Open/Spring Close Assem.
- Integral Water Compartment
- Rear Work Lights
- Grounding Reel
- 20" Manway
- Dominator Stripe
- Two Tone Stripe
- Cross-over Piping Sys.
- Interior Tank Epoxy
- Aux. Hyd. Power Valve
- 316L S/S Tank
- Push Button Control

ASME CERTIFICATION

A tank must be built in accordance to Section VIII of the ASME (American Society of Mechanical Engineers) boiler code before it can be in accordance with the U.S. Department of Transportation for hauling hazardous materials on the highway. A tank built in accordance with ASME must have a plaque attached to it which displays the ASME stamp. If it does not have this identification, it is not properly certified.

D.O.T. 412

Any tank used to haul hazardous waste on the highway must be built in accordance with the U.S. Department of Transportation specification DOT412. A plaque must be attached to the tank which displays data of compliance to this specification. Additional components such as self closing discharge valve with dual controls, increased automatic pressure relief system, isolation valve(s), roll-over protection, complete rear valve protection, and placards are required.

KEITH HUBER INC.

Hydraulic Rear Door Opener

The rear door opener consists of two dual acting hydraulic cylinders which are controlled by a spool valve to fully open or close the rear door.
(Standard on the King Vac Model)

High Pressure Wash Down System

A high pressure water pump installed in the right side cabinet is powered by the power take off. This pump will produce 10 GPM @ 2000 PSI for clean up of equipment, rinsing of sumps and tank walls, or pushing material to the suction hose. The water tank is made integral with the vacuum tank by using an internal head to section off 200 gallons from the total tank capacity. A handgun with 30' of handgun hose is included.

High Pressure Jetting System

A high pressure water pump installed in the right side cabinet is powered by the power take off. This pump will produce 35 GPM @ 2000 PSI for power to jet sewer lines and pipes up to 48" in diameter. This system can also be used for equipment cleaning, rinsing of sumps and tank walls, or pushing material to the suction hose. An electric rewind hose reel which has the capacity to hold 200' of 5/8" hose is mounted inside the cabinet with the pump. The water tank is made integral with the vacuum tank by using an internal head to section off 300 gallons from the total tank capacity. A handgun with 30' of handgun hose is included.

High Pressure Transformer System

Our High Pressure Transformer pump is a single piston pump which senses the water flow demand and adjusts its output to that demand automatically. The water flow is infinitely variable with a range from 0 to 90 GPM @ 2,850 PSI. Use a 5 GPM nozzle and deliver 5 GPM @ 2,850 PSI. Use a 60 GPM nozzle and deliver 60 GPM @ 2,850 PSI. Use a 90 GPM nozzle and deliver 90 GPM @ 2,850 PSI. Because of the unique construction of this pump, it is able to run dry and use dirty water without causing damage to the pump. This system includes a hydraulic hose reel which has the capacity to hold up to 350' of 1" jetting hose. The hose reel lowers to a working position when in use and raises into the body for out of the way storage when not in use. The reel is equipped with a swivel base to allow for easy maneuvering of the jetting hose. The water tank is made integral with the vacuum tank by using an internal head to section off 500 gallons from the total tank capacity. A crossover piping system is also provided to allow the entire tank capacity to be used for jetting when needed. A handgun with 30' of handgun hose is included.

Hydraulic Boom

A fully powered hydraulic boom mounted to the top of the tank handles the suction hose for you. The operator simply pushes buttons to raise or lower the hose, extend or retract it, and open or close the valve which is built into the base. The rotation is also hydraulic with a "positive lock" gear motor drive. The boom is popular with municipalities and utility companies because of the ease in which the hose can be placed into a manhole without the need for a man to "wrestle" with the hose. The boom is equipped with 6" suction hose to reach ground level and parks on a support rack at the rear of the tank.

Hose Tube Set w/Rack

Three (3) aluminum tubes with camlock fittings are mounted on each side of the tank. Tube sizes are: Two (2) 6"x3', Two (2) 6"x4', and Two (2) 6"x6'.

This is mostly used in conjunction with the hydraulic boom option. The hose tubes allow for ridged extension of the suction hose when pumping below the ground level.

Hydraulic Hose Reel

The top mounted hydraulic hose reel is located above the cabinet on the passenger side of the truck. This large capacity hose reel will hold up to 500' of 3/4" hose and is hydraulically powered in both directions. The speed of travel is infinitely controlled and an extra "park" valve allows for starting and stopping the rotation at the preset speed you select.

Tachometer/Hour Meter

An electric tachometer installed on the vacuum pump will indicate the rotor shaft speed and the total hours the pump has run. This option provides excellent control of job costs and maintenance scheduling.

Rear Work Lights

Mounted on the rear head are two (2) work lights. The base is equipped with a swivel joint and the power switch is mounted inside the vacuum pump cabinet.

Rear Hose Hooks

Two adjustable hose hooks are mounted to the rear head and provide ample space for hose storage. (Not recommended on the King Vac model)

Grounding Reel

Our grounding reel is equipped with a 25' retractable cable and end clamp. It is mounted at the rear of the tank.

6" Sample Port

The sample port is installed on the top center line of the tank. This opening allows for complete payload samples to be taken and is equipped with an access ladder.

20" Manway

Large enough for a man to enter, our 20" manway is designed for easy opening and positive sealing. An o-ring seal is matched to a dome cover lid with four (4) eye loop wing nuts. The cover dome is equipped with a handle and rest pad for fast and easy opening and closing of hatch.

Epoxy Paint

Dupont epoxy paint, also referred to as Imron, is applied in two coats over the primer paint. Epoxy paint is resistant to chips and fading.

Hydraulic Vibrator

A hydraulically driven vibrator is secured to a mounting bracket which is welded to a crush pad then secured to the bottom of the tank. The vibrator helps to remove stubborn solids from the tank when dumping. The vibrator should be used intermittently and only when there are heavy deposits of material in the tank. Failure to operate the vibrator properly can cause severe damage to the tank.

Aux. Transfer Pump (KHB3300)

The auxiliary transfer pump is used to transfer material into and out of the tank. The KHB3300 is a 3" rotary pump with a cast iron housing, buna-n gears, high lead bronze bushings, stainless steel shaft, and is equipped with camlock fittings and dust caps. The pump is driven hydraulically and has the capacity to produce flows up to 233 gpm and deliver pressures of up to 100 psi.

Aux. Transfer Pump (KHF28552)

The auxiliary transfer pump is used to transfer material into and out of the tank. The KHF28552 is a 2" centrifugal pump with a cast iron housing, stainless steel shaft sleeve, carbon/ceramic seal, stainless steel fasteners, and is equipped with camlock fittings and dust caps. The pump is driven hydraulically and has the capacity to produce flows up to 210 gpm and deliver pressures of up to 190 feet of head.

4" S/S Gate - Piston Valve

A steel case with a 4" stainless steel gate that opens to allow full flow of material, is manually operated.

6" S/S Gate - Piston Valve

A steel case with a 6" stainless steel gate that opens to allow full flow of material, is manually operated.

Air Open/Spring Close Assem.

Dual air cylinders and return springs are provided for air operation of 4" or 6" valves. Dual control valves are installed for operation at the valve or remotely from the cab of the truck. The entire assembly is protected with a cover box and is equipped with external position indicators.

Integral Water Compartment

The water tank is made integral with the vacuum tank by using an internal head to section off 200-500 gallons from the total tank capacity. Suction and return piping is provided and capped inside the passenger side storage cabinet. A sight tube, vented fill port, and drain valve are included.

Cross-Over Piping System

A piping system with an external ball valve is installed between the water compartment and the sludge compartment on units equipped with an integral water head. This allows the full tank capacity to be used as a water tank when needed.

Interior Tank Epoxy Coating

The interior of the sludge tank is sandblasted and coated with coal tar epoxy. The coating is applied to a 3 mil thickness per coat and includes two coats.

Auxiliary Hydraulic Power Valve

An extra control valve is mounted in the hydraulic system and includes two remote mount quick disconnect fittings. This allows operation of hydraulic tools or pumps directly from the truck.

316L Stainless Steel Tank

316L stainless steel is used in lieu of SA36 carbon steel. Included items are the tank shell and heads, baffle(s), primary shut-off, and all flanged openings.

Push Button Control

For units equipped with hydraulic pump drive, tank lift, full opening rear door with hydraulic door opener, this option offers full control of all functions at the rear of the unit. From a lockable control panel the operator can engage the PTO, engage the vacuum pump, raise the engine throttle to low speed or high speed, set the "vacuum" or "pressure" mode, raise or lower the tank, open or close the rear door, open or close the vent valve and test the hydraulic pressure. A tachometer/hour meter, 30/30 vacuum/pressure gauge and a 0-3000 PSI oil pressure gauge are mounted in the control panel.

What About The Vacuum Pump ?

It is easy to get confused about vacuum pump lingo, for example; CFM, . . M3h, . . . Rated @ 18", . . . Free Air, . . . 29" of Mercury, . . . 29" of Vacuum,. . . Column Inches of Water, . . . Feet of Lift, . . . Air Cooled, . . . Liquid Cooled, .. Rotary Vane, . . . Blower, . . . etc. If you do not understand this lingo, it is not surprising. Different Manufacturers use different terms to say the same thing. We have years of experience with vacuum pumps and we know most pumps on the market today are good, provided they are used in the right application.

AC32

The AC32 is an air cooled 318 CFM vacuum pump that gives an impressive performance for all types of pumping. It is limited however to intermittent duty. Over heating will occur if the pump is run continuously at a high vacuum (over 18"HG). Its advantages are numerous; light weight, simple to install, high CFM in a small package, less expensive, easy to service and dependable. Ideal for water, sludge slurry, chemicals or septic waste.

LC44

The LC44 is by far the most popular pump offered. It moves 440 cubic feet of air per minute. Liquid cooled for continuous operation, this pump is ideal for all types of pumping. The best choice when you want to be sure you have enough pump for septic tank pumping, car wash pits, paper pulp, heavy crude oil, mud, wet sand and other heavy sludges and semi solids. This pump can pull 29" of vacuum for loading and push 15 PSI for unloading.

LR1K

The LR1K, using no vanes, requiring no internal lubrication and virtually no maintenance, spins any suitable liquid to move over 1,000 cubic feet of air per minute. It also develops 27" of vacuum for industrial sludges generally considered difficult to move. If your need is for quiet power, reduced vapor emissions, and less maintenance, the LR1K is the pump, The GENERATION I I is the machine.

LR4K

The LR4K has the same basic features as the LR1K with increased power. The LR4K has the ability to move up to 3,700 CFM and 27" of continuous vacuum. This pump is available only on our King Vac™ model.

We are certain you will find the perfect choice for your application among these models, however, if you have a special application and do not find the exact size pump you are looking for, call us. We have many more fine quality pumps available.

Whether You're Looking For A Single Unit Or A Fleet, We Are Prepared To Serve You.

We use pressure vessel quality steel in all of our tanks and can provide you with mill test reports to guarantee you the properties and integrity of the material used in the fabrication of your tank. We carry an ASME Code Stamp and can certify tanks to be built in accordance to ASME Section VIII, Division I, as well as D.O.T. 407/412 Specification for Hazardous Wastes.

Any pump which we install as original equipment on our vacuum trucks will carry a one (1) year warranty. If you have a favorite pump brand and would prefer to install it yourself, we can provide you with a vacuum tank and body system set up with the proper moisture trap (scrubber), muffler, mounting platform and connections ready for your pump.

Although the hydraulic drive has proven to be positively the best way to drive any pump, we also offer a belt drive to help hold costs down. We have designed our belt drive systems so that maintenance and down time can be held to a minimum. The belts can easily be adjusted or replaced.

Regardless of the type of pumping that you do, consider one of our High Pressure Pump Systems. The smaller system allows you to wash down your equipment and hoses or push material to the suction hose. The larger systems provide sufficient water pressure and flow for sewer line cleaning.

At KEITH HUBER, INC. our single most important goal is to provide the very best vacuum equipment. As product technology changes, we change to bring you the very latest improvements.
The Dominator ™, introduced in 1979, has been a true work horse in the liquid waste industry and continues to perform in a legendary manner.
The King Vac™, in production since 1986, takes the phrase "Power Vacuum Loading" literally. High CFM, Deep Vacuum, Wet or Dry, No Bags or Filters, Low Noise Level,....Experience The King Vac™...Muscle Beyond Your Imagination.

Please contact our office for complete detailed specifications on the size, model, and options of your choice.

KEITH HUBER INC.

APPENDIX E

CORRESPONDENCE WITH FDEP

Department of Environmental Protection

Lawton Chiles
Governor

Twin Towers Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Virginia B. Wetherell
Secretary

September 21, 1995

Mr. Gabriel Magwood
Code 1849
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
P.O. Box 190010
North Charleston, South Carolina 29419-9010

RE: Contamination Assessment Report Addendum, Site 278, Coastal Systems Station Panama City
Contract No. N62467-89-D-0317, CTO No. 011
DEP Facility #035118667

Dear Mr. Magwood:

The Bureau of Waste Cleanup has reviewed the Contamination Assessment Report (CAR) Addendum dated May, 1995 (received May 5, 1995), submitted for this site. We found all the documents submitted to date to be adequate to meet the contamination assessment requirements of Rules 62-770.600 and 62-770.630, Florida Administrative Code (F.A.C.). Therefore, you must now submit a Remedial Action Plan (RAP) in accordance with Rule 62-770.700, F.A.C.

Please submit the RAP within two (2) months of receipt of this request, as required by Rule 62-770.700(1), F.A.C. If you should have any questions concerning this review, please contact me at (904)921-9989.

Sincerely,

John W. Mitchell
Remedial Project Manager

/jwm

cc: B.K. Morin, Navy SouthDiv
Arturo McDonald, Naval CSS Panama City
Craig Benedikt, USEPA Region IV
Tom Moody, FDEP Northwest District
Mark Diblin, ABB Tallahassee

TJB 3 JJC JJC ESN ESN

"Protect, Conserve and Manage Florida's Environment and Natural Resources"

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MEETING MINUTES

from the RAC Interface Meeting for Site 278
TOPIC: Technologies Selection
CSS Panama City

When: Wednesday, Jan. 31, 1996, 09:00
Where: CSS Panama City, Building 453

List of Attendees:	Phone Number:
Nick Ugolini, SOUTHDIV	(803)-820-5596
Van Smith, CSS Panama City	(904)-234-4762
Arturo McDonald, CSS Panama City	(904)-234-4743
Mike Clayton, CSS Panama City	(904)-235-5859
J. Michael Cross, CSS Panama City	(904)-234-4744
Karen Atchley, Bechtel	(423)-220-2167
Tom Conrad, Bechtel	(423)-220-2205
Mike Dunaway, ABB-ES	(904)-656-1293
Mark Diblin, ABB-ES	(904)-656-1293
Gopi Kanchibhatla, ABB-ES	(904)-656-1293
John Mitchell, FDEP	(904)-921-9989

The meeting began at 09:10 with a brief introduction by Mark Diblin. The objective of the meeting was to come to consensus on a specific remedial approach (one chosen technology) to site cleanup so that the Remedial Action Plan (RAP) could be completed and submitted to the Florida Department of Environmental Protection (FDEP).

Gopi Kanchibhatla presented an overview of the site description, site history, potential remedial options, and the selected remedial approach. A copy of the overhead materials used for the presentation is attached in Attachment A. These meeting minutes will focus on questions brought up during the presentation and deviations from the presentation material.

Mike Cross and Arturo McDonald brought up the possibility that contamination at the site may also be attributed to a product line that ran behind the dock area. They said that records indicate a leak near Building 9 sometime in the 1950's. The line did not run that far beyond the eastern boundary of the site.

John Mitchell asked if we had observed higher water levels near the dock? Yes, we had observed some flow reversal but the relieving platform prevented well installation within about 25 feet of the bulkhead.

Tom Conrad asked if we had installed any wells above the relieving platform? No, but we did conduct one soil boring in that area and groundwater was not encountered above the platform.

Tom Conrad then asked if the free product was new or old and was benzene or BTEX currently in the groundwater? The free product is somewhat clear and fresh looking. Benzene was present in the groundwater in 1992 and 1993 but has been absent since 1993 to the present time. The fingerprint analysis of the product indicated it was diesel.

There were no potable wells within a 1/4-mile radius of the site but it was mentioned that there is a well or two approximately 400 to 1000 feet away (near AOC 2) that are set between 200 and 300 feet below land surface (bls). John Mitchell asked if they were set below a confining layer but no one knew the answer.

John Mitchell asked if the vapor enhanced extraction (VEE) was the same as bioslurping? No, in bioslurping the air flow is controlled and monitored more closely to maximize biological degradation. VEE is operated to recover the liquid (free product) and the biological treatment is a byproduct.

Nick Ugolini asked about the results of the pilot test? We recovered 160 gallons of liquid at about 1 gallon per minute. Of that about 15 gallons was free product.

John mitchell asked if we were able to measure the effects of the vacuum on the hydraulic gradient during the pilot test? As of this time no, we were not ready to do that measurement during the test. We are planning on taking liquid level measurements during sampling visits with the vacuum truck. Also, vacuum readings will be recorded.

The statement was made that during high water level periods we may not recover free product without a more aggressive pumping scheme. We recognized that and realized that we may need to pump more aggressively while bearing in mind that too high of a vacuum on the well may cause a casing collapse. Another option would be to pump from a different well.

John Mitchell suggested that an additional deep well be installed more down gradient to the plume between wells MW-6 and MW-7. We concurred with that idea and agreed to set the screen depth as in other deep wells (i.e., MW-13D screen is set 25 to 30 feet bls).

The presentation ended at 10:40 and we began an open discussion at 10:45. Nick Ugolini discussed the background behind the technology and how we got the idea from the Mississippi Department of

Environmental Quality (MDEQ). They have had much success with the technology. Nick discussed the cost effectiveness of the technology for the facility and for SOUTHDIV. Since the base has a vacuum truck that may be acceptable to use, the cost savings relative to pump and treat would be very significant.

Mike Cross said that he could arrange for use of the base owned vacuum truck if it was adequate in terms of its capabilities. Mike will check on the specifications for the truck so that we can determine if it is adequately equipped to handle the job.

The monitoring plan for the site to be included in the RAP would include quarterly groundwater monitoring for free product until it was gone and then a monitoring only plan (MOP) with quarterly monitoring for one year.

The question was asked if we could pump straight to the oil water separator and bypass the vacuum truck. If we did that there would be no way to measure the performance of the remedial system. The idea of a skid mounted system was also brought up. The drawbacks of a skid mounted system are that we would need a power drop and we get into a more fixed system that may need a compound, etc.

John Mitchell had a concern about soil contamination in the capillary fringe and would the technology remove it all? We said that we would bring vacuum gauges with us during the site visits to measure the vacuum at other wells in the vicinity. This would allow us to determine if vacuum extraction of the soil was happening during the vacuum episodes. If sufficient vacuum is being detected in the surrounding wells then the capillary fringe soils may not be a concern when the free product has been removed. It was mentioned that at a flow rate of 1 gpm, a significant volume of air would still be flowing through the well (especially if the bleed air is restricted).

Tom Conrad asked if air discharge would be a concern? The vacuum truck we had in mind would scrub the air before discharge to the atmosphere. It was strongly suggested that we contact the district air person for FDEP, Carolyn Salmon. We do not foresee a problem and during the pilot test we did not smell any unusual odors. In any event we will at least check with Carolyn before we start.

The only concern that Public Works had was the 8 hour time frame for the facility truck to be on site. This may be a problem if the truck is needed during that 8 hours for an emergency. It will have to leave if a emergency arises and the hose connections should all be the quick disconnect type. No problem! Also, we may want to use barricades around the truck at the dock area to keep people

from running into or through the work area and disrupting the activities.

A concern was raised about using a Navy owned truck with potentially a civilian operator. The average sailor may not be qualified to handle the required duties (but they do not need that much training). This decision will be made at a later date.

The plan is to stop the manual bailing of free product once the vacuum truck starts regular visits. Discharge to the FOTW will need test for halogenated compounds before release to the FOTW. It was agreed that Jefferson Brothers could handle that responsibility. Public works will handle the coordination of this when the date gets closer.

There was a possibility that we could use an existing tank at the base as a holding tank for the storage of recovered liquid prior to release to the oil water separator.

Site 325 was briefly discussed. The site parameters are very similar and it is recommended that once the CAR is reviewed and approved by FDEP, that the RAP for Site 325 will recommend the same technology. This may also increase the economies of scale for using the base vacuum truck.

As a final note ABB-ES was to get Greg Brown a copy of the presentation for his review (this was done on Friday, February 2, 1996).

We then spent a few minutes reviewing the Responsibility Assignment Matrix (RAM) for Site 278. A few modifications were made to the RAM and a final copy with revision included is presented as Attachment B.

The following is a schedule for the upcoming events at Site 278:

RAP Submittal to FDEP	April 1, 1996
RAP Approval by FDEP (or comments)	mid to late June 96
Start vacuum truck visits	September 1, 1996

Upon completion of all meeting related business, all ABB-ES, Bechtel, and SOUTHDIV representatives made site visits to Site 278 and Site 325.

SUMMARY OF ACTION ITEMS

1) Bechtel to handle the installation of the one additional deep monitoring well.

2) Mike Cross will check on the specifications for the base owned vacuum truck and pass that information on to Mark Diblin at ABB-ES. This will allow ABB-ES to determine if the truck is adequately equipped to handle the job.

3) ABB-ES will contact the district air person for FDEP, Carolyn Salmon, prior to the start of vacuum truck visits. If the vacuum truck scrubs the air prior to discharge this concern should not be an issue.

4) Someone from public works will coordinate with Jefferson Brothers (the oil water separator operators and maintainers) to test for halogenated compounds in the groundwater before release to the FOTW.

5) ABB-ES will contact public works about the use of an existing tank as a holding tank for liquids removed during vacuum truck activities. We will call when the date for implementation gets closer.

6) ABB-ES will send Greg Brown (FDEP) a copy of the presentation material for review.

7) ABB-ES will send Mike Cross a copy of the presentation material, an idea of the costs involved in using the base truck versus renting one, and any information concerning modifications that may be necessary to the base vacuum truck. Mike will use this information to brief the base CO.

Installation of CSS-278-MW-16D

One double-cased deep monitoring well, MW-16D, will be installed to a depth of 30 feet bls. Proposed location of MW-16D is presented on Figure E-1. The well will be constructed of 2-inch ID PVC with 5 feet of 0.010-inch slot screen and 25 feet of riser. The well will be installed inside 6-inch-diameter PVC surface casing which extends to a depth of 23 feet bls. Installation details for the deep monitoring well are presented on Figure E-2. Monitoring well construction will be in accordance with the following documents:

- "Monitoring Well Construction Specifications and Related Issues", memorandum, FDEP, August 16, 1993, by Douglas A. Jones., Chief bureau of Waste Cleanup.

- "Guidelines for Groundwater Monitoring Well Installation", SOUTHDIVNAVFACENGCOM, Charleston, South Carolina., March 27, 1989.

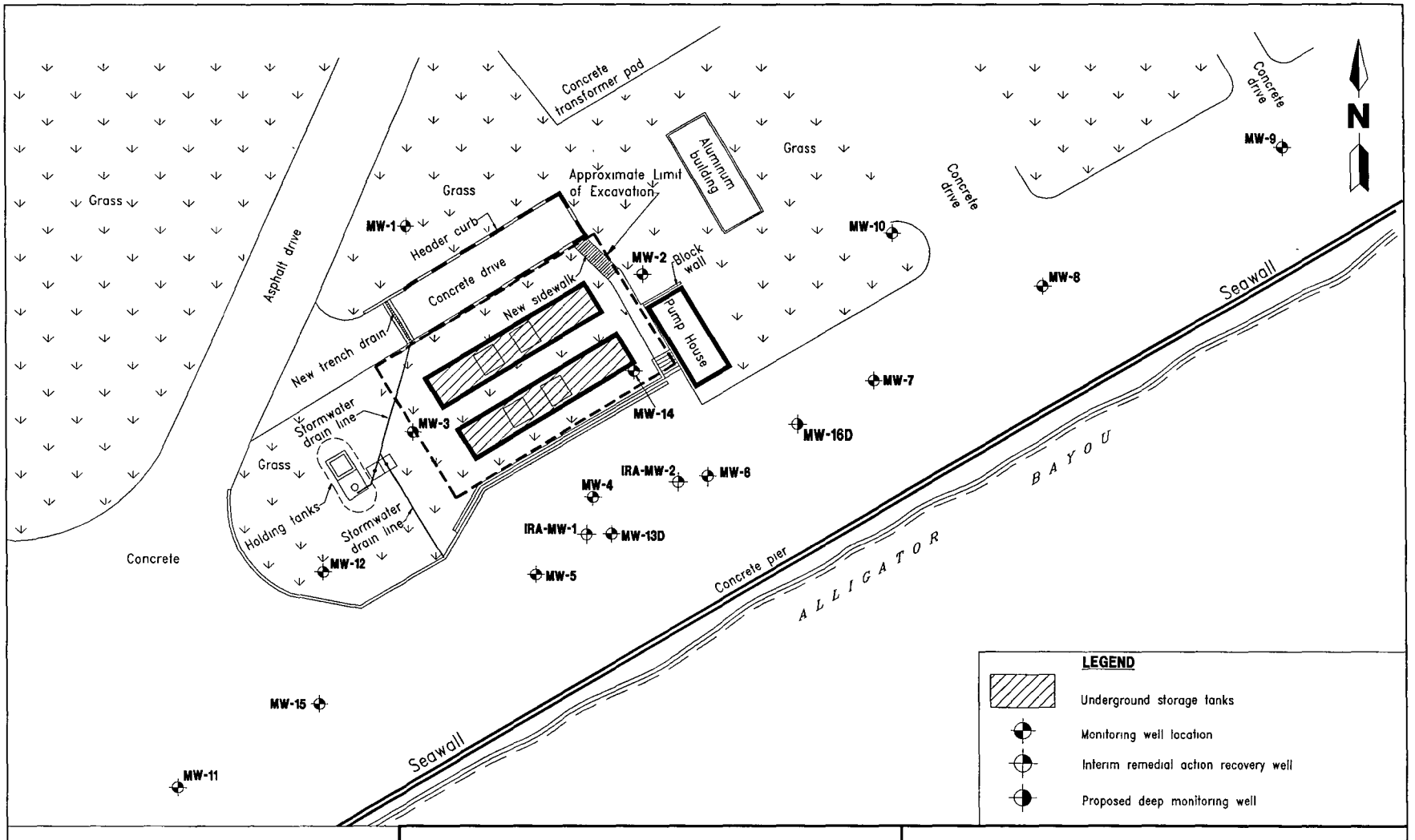

FIGURE E-1
LOCATION OF PROPOSED DEEP MONITORING WELL, MW-16D

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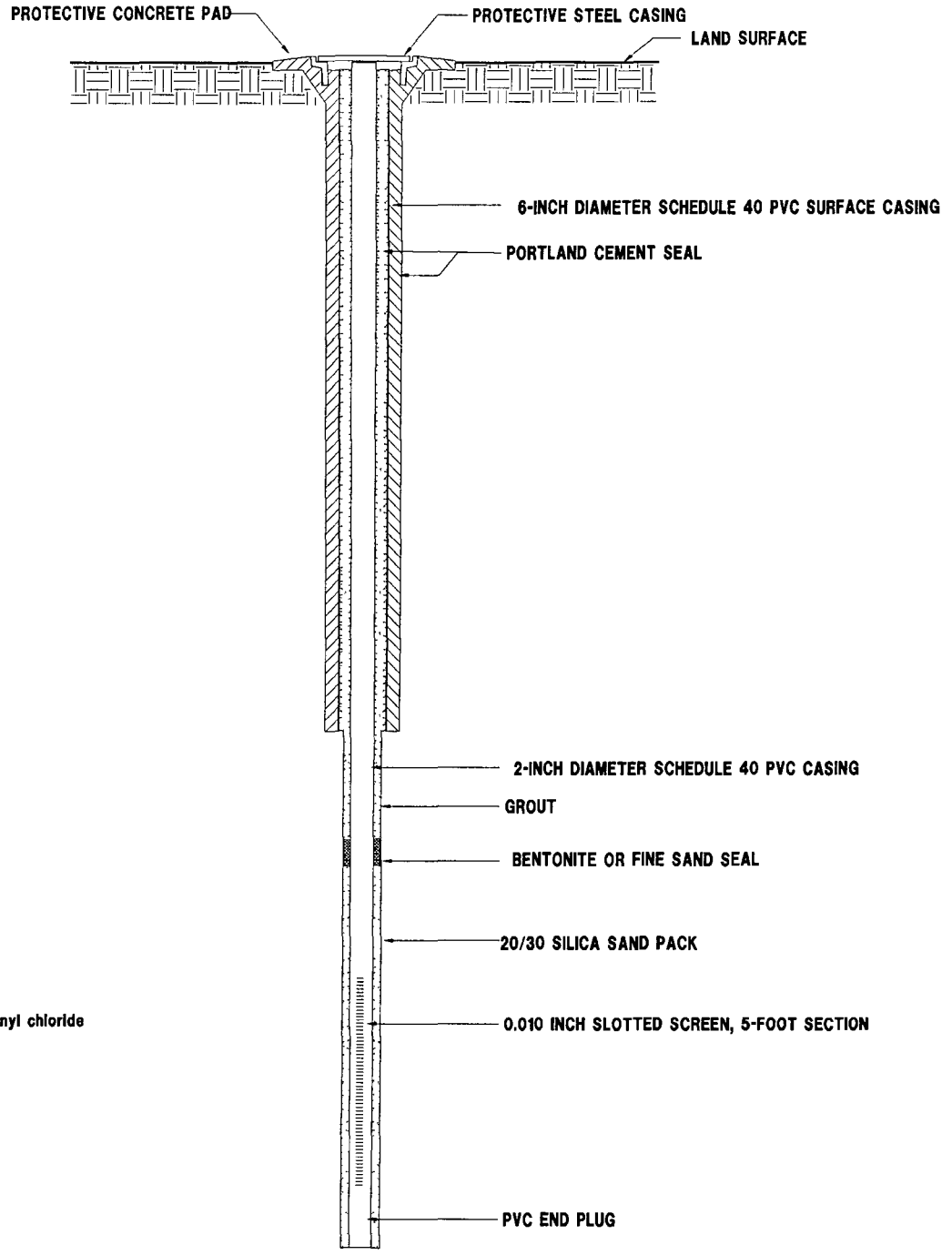

NOTE:
PVC = polyvinyl chloride

NOT TO SCALE

FIGURE E-2
TYPICAL DEEP MONITORING WELL INSTALLATION DETAIL

H:\9590\180400\CCK-NAB\04-01-96

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