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FINAL CORRECTIVE ACTION PLAN UNDERGROUND STORAGE TANK SYSTEM AT BUILDING 787 NWS YORKTOWN VA

6/28/1993

ROY F. WESTON

FINAL

CORRECTIVE ACTION PLAN
UST SYSTEM AT BUILDING 787

NAVAL WEAPONS STATION
YORKTOWN, VIRGINIA

CONTRACT TASK ORDER 0189

PC No. 92-1681

Prepared For:

NAVAL FACILITIES
ENGINEERING COMMAND
ATLANTIC DIVISION
NORFOLK, VIRGINIA

Under:

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Prepared By:

ROY F. WESTON, INC.
Virginia Beach, Virginia

Under the Direction of:

BAKER ENVIRONMENTAL, INC.
Coraopolis, Pennsylvania

28 JUNE 1993

TABLE OF CONTENTS

Page

1.0 INTRODUCTION 1
1.1 Purpose and Objectives 1
1.2 Report Organization 1

2.0 SITE BACKGROUND 4
2.1 Site Location and Description 4
2.2 Investigative History 4
2.3 Geology 7
2.4 Hydrogeology 7
2.5 Nature and Extent of Contamination 9
2.5.1 Liquid-Phase Hydrocarbons 9
2.5.2 Adsorbed-Phase Hydrocarbons 9
2.5.3 Dissolved-Phase Hydrocarbons 11
2.6 Site Assessment Summary 11
2.7 Risk Assessment Summary 15
2.8 Remediation Assessment Summary 17

3.0 CORRECTIVE ACTION APPROACH 22
3.1 Remediation Endpoints 22
3.2 Remediation System Design 23
3.3 CAP Permitting 25
3.3.1 General CAP Permit 25
3.3.2 Building And Electrical Permits 25
3.3.3 Public Notification And Local Government Ordinance Form 25
3.4 Remediation System Installation And Operation 26
3.4.1 Site Health And Safety Plan 26
3.4.2 Site Preparation 26
3.4.3 LPH Recovery System Installation 27
3.4.4 LPH Recovery System Operation 27
3.5 Site Monitoring Plan 27
3.5.1 Well Gauging 28
3.5.2 Groundwater Samples 28
3.5.3 Field QA/QC Plan 28
3.6 Project Reporting 29
3.7 Site Closure And Restoration Plan 29
3.8 Remediation Schedule 30
3.9 Estimated Project Cost 30
3.10 CAP Summary 32

LIST OF TABLES

2-1 Summary of TPH and BTEX Analyses for Soil Samples 12
2-2 Summary of TPH and VOC Analyses for Groundwater Samples 14
2-3 Frequency Summary for Volatiles in Groundwater 16
2-4 Soil Remediation Options 18
2-5 Screening of Potential Product Recovery Alternatives 21
3-1 Anticipated CAP Schedule 31
3-2 CAP Summary Worksheet 33

TABLE OF CONTENTS (cont.)

LIST OF FIGURES

1-1 Regional Site Location Map 2
1-2 Area Map 3
2-1 Site Map 5
2-2 Soil Borings and Well Locations 6
2-3 Groundwater Contour and Free Product Map 8
2-4 TPH in Soil Isoconcentrations 10
2-5 TPH in Groundwater Isoconcentrations 13
3-1 LPH Recovery System Layout 24

LIST OF APPENDICES

APPENDIX

A - CORRECTIVE ACTION PLAN CHECKLIST
B - WESTON BOREHOLE LOGS
C - LIQUID LEVEL MEASUREMENTS
D - LABORATORY ANALYSES
E - LPH RECOVERY SYSTEM EQUIPMENT SPECIFICATIONS
F - REFERENCES

EXECUTIVE SUMMARY

Roy F. Weston, Inc. (WESTON®), as partners with Baker Environmental, Inc. (Baker) on the Comprehensive Long-Term Environmental Action Navy (CLEAN) Program, was contracted by the Atlantic Division (LANTDIV), Department of the Navy to prepare a Corrective Action Plan (CAP) related to a leaking petroleum hydrocarbon fuel line. The fuel line is part of the underground storage tank (UST) system at Building 787, Naval Weapons Station, Yorktown, Virginia. The CAP was prepared in accordance with the Commonwealth of Virginia's and the Virginia Department of Environmental Quality's (DEQ) Underground Storage Tank (UST) Regulations, Code VR 680-13-02.

The Site Characterization Report (SCR) study was conducted by WESTON during August and September 1992 and included a background information review, completion of 11 soil borings, installation of seven groundwater monitoring wells, soil and groundwater sampling and analysis, and performance of two hydraulic conductivity tests. This investigation revealed the presence of subsurface petroleum hydrocarbon contamination located in the vicinity of the eastern side of Building 787. Liquid-phase hydrocarbons (LPH) were detected in two wells at a thickness of up to 0.80 feet. The LPH is No. 2 fuel oil and is likely due to a release from a detached fuel supply line. The SCR was completed in December 1992 and forwarded to the DEQ.

This CAP addresses the liquid-phase hydrocarbons (LPH) in the vicinity of Building 787. Proposed remedial endpoints are less than or equal to 0.01 feet LPH, 500 parts per million (ppm) total petroleum hydrocarbons (TPH) in soils, and 10 ppm TPH in groundwater. The proposed remedial system design is comprised of LPH skimming systems outfitted in two recovery wells. The LPH recovery system compound would be located in the grass area just south of Building 787. Site monitoring will be conducted in accordance with the General CAP Permit requirements in order to monitor progress towards site remediation. It is anticipated that the LPH recovery system would operate for two years. A one year post operational monitoring period would be conducted to ensure achievement and maintenance of remedial goals. The current estimated total project costs are approximately $165,000.

1.0 INTRODUCTION

Roy F. Weston, Inc. (WESTON®), as partners with Baker Environmental, Inc. (Baker) on the Comprehensive Long-Term Environmental Action Navy (CLEAN) Program, was contracted by the Atlantic Division (LANTDIV), Department of the Navy to prepare a Corrective Action Plan (CAP) addressing the No. 2 fuel oil release associated with the underground storage tank (UST) system at Building 787, Naval Weapons Station, Yorktown, Virginia (see Figures 1-1 and 1-2). This CAP was prepared in accordance with the Commonwealth of Virginia's Underground Storage Tank (UST) Regulations Part VI of VR 680-13-02 following the Commonwealth of Virginia Department of Environmental Quality's (DEQ) guidelines. The CAP checklist is provided as Appendix A.

1.1 PURPOSE AND OBJECTIVES

The purpose of this report is to describe and provide supporting documentation for the corrective action approach selected for remediation of liquid-phase hydrocarbons (LPH) in the vicinity of Building 787. The specific objectives of this report are to provide background characterization and assessment information; propose permanent corrective actions to mitigate the migration of LPH to the environment; propose remediation endpoints for the site; and outline a monitoring plan to evaluate the progress of the corrective action.

1.2 REPORT ORGANIZATION

This report is organized in three sections. Section 1 presents the purpose and objectives of this report. Section 2 presents the site background information, including a description of the site, site investigative history, a summary of the nature and extent of contamination, and a summary of the risk and remediation assessments. Section 3 presents a description of the corrective action approach and includes the proposed remediation endpoints, the remediation system design, an outline of requirements for installation of the remediation system, a site monitoring plan, a CAP schedule, and an estimate of project cost.

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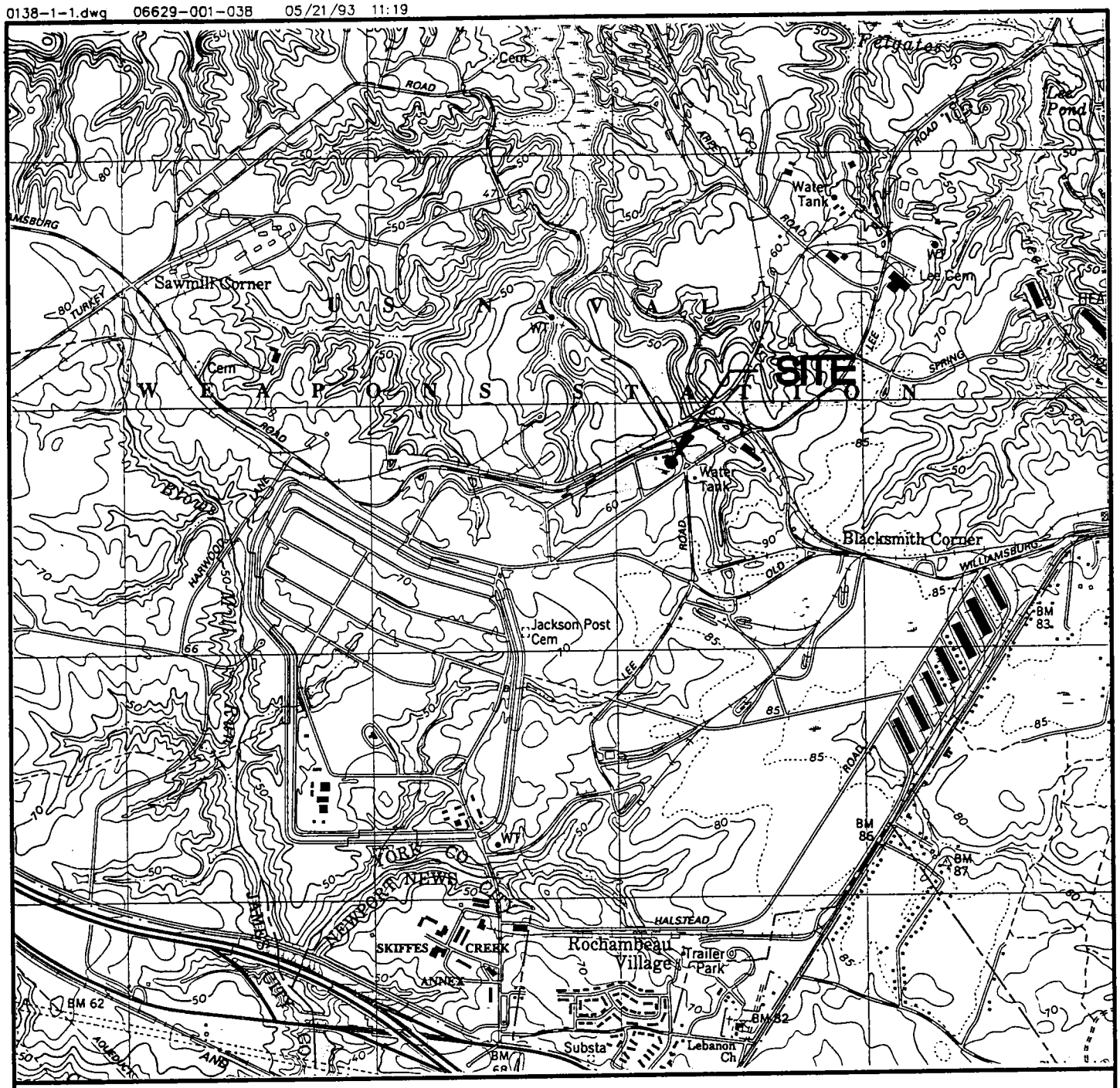
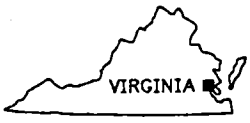


1 1/2 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0.5 0 1 KILOMETER

-N-



QUADRANGLE LOCATION

SOURCE: YORKTOWN, VA
7.5' QUADRANGLE
37076-B5-TF-024
1984

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DWG. TITLE REGIONAL SITE LOCATION MAP	FIGURE NO. 1-1	

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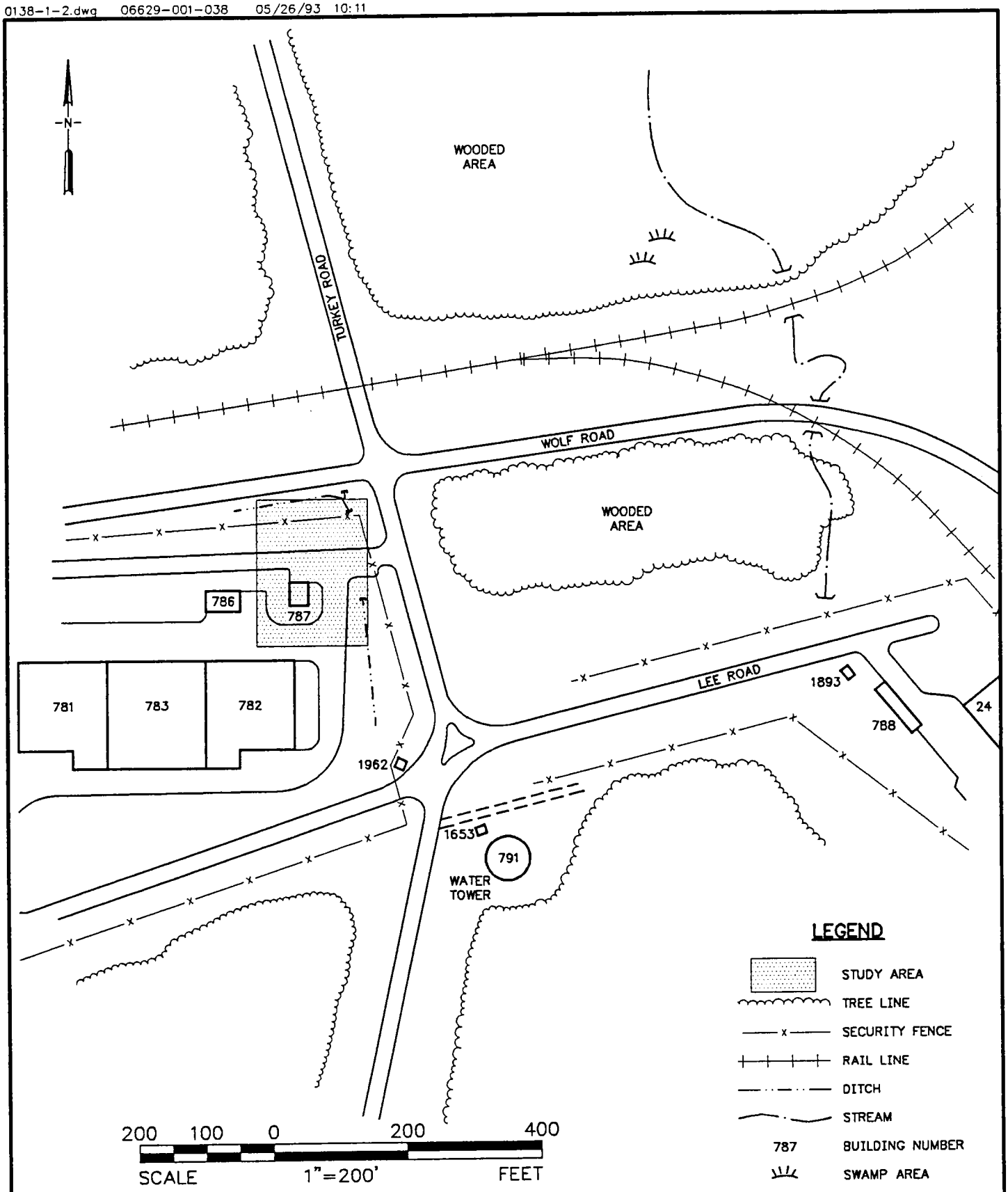

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DWG. TITLE AREA MAP	FIGURE NO. 1-2	

2.0 SITE BACKGROUND

This section provides site background information that includes a site description, a review of investigative history, a summary of the nature and extent of contamination, and a summary of the risk and remediation assessments. The reader is referred to the Site Characterization Report (SCR) (WESTON, 1992) for additional site background information.

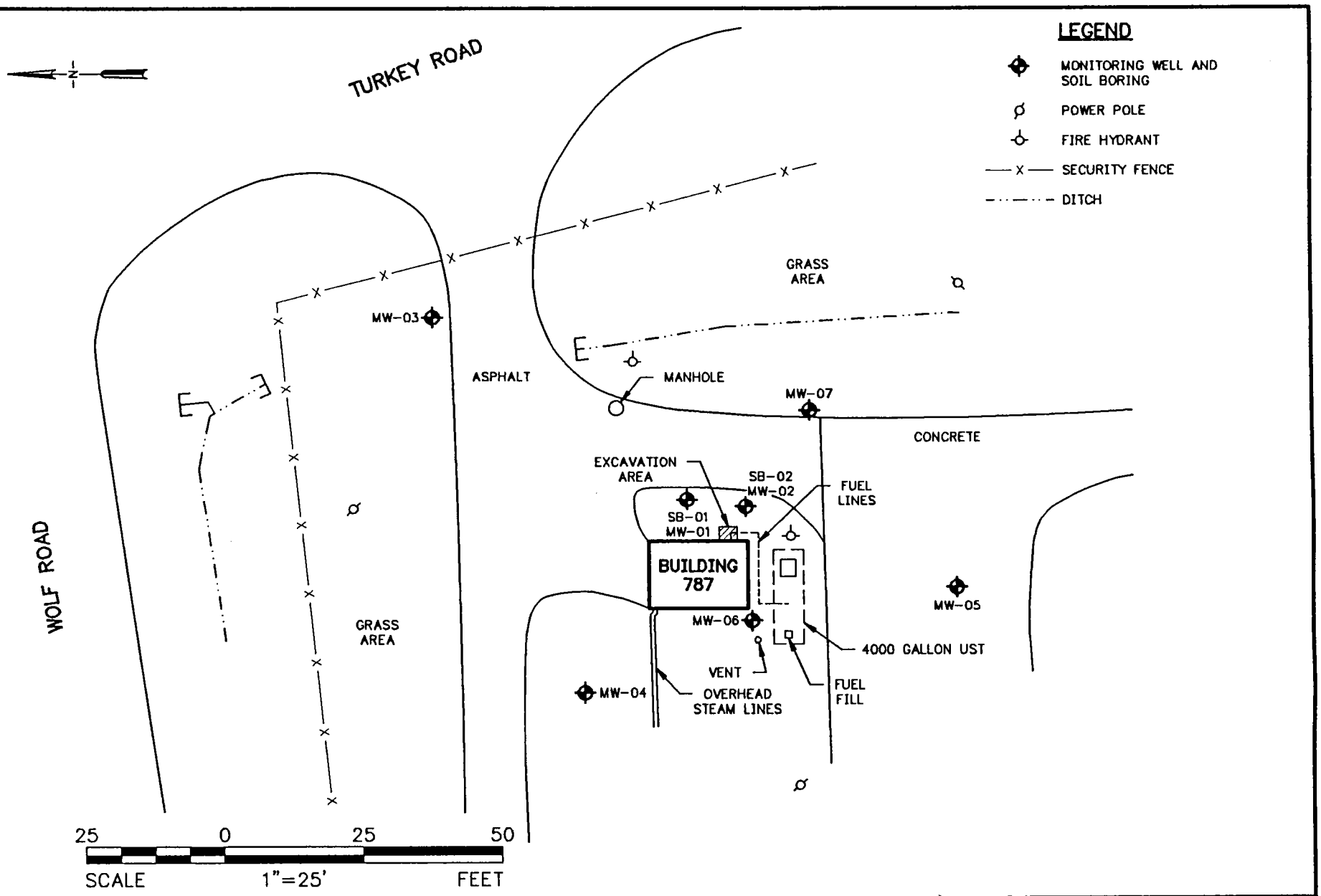
2.1 SITE LOCATION AND DESCRIPTION

Building 787 is located in a high-security area in the south-central portion of NWS Yorktown (see Figure 1-1). The building houses two boilers used for steam generation, providing a heating source to nearby buildings. The site is bounded on the north and east by woods. South and west of the site are additional buildings also located in a high-security area. Buildings 781 through 783 are used for storage and quality control inspection of munitions. Further south of the site is a water tower and woods (see Figure 1-2).

2.2 INVESTIGATIVE HISTORY

In March 1992 NWS Yorktown maintenance personnel observed a persistent loss of pressure in the continuous-feed fuel supply line for the boilers located in Building 787. NWS personnel also identified stressed vegetation where the subsurface fuel lines enter the building (see Figure 2-1). Number 2 fuel oil is supplied to the boilers in Building 787, via the subsurface fuel lines, from a 4,000-gallon capacity UST. An initial investigation was conducted by NWS Yorktown personnel who identified a detached return fuel line from the UST system. The return fuel line was subsequently repaired. The quantity of soil excavated during the repair of the detached return line was less than a cubic yard. Soil borings by NWS Yorktown personnel identified vertical contamination up to 12 feet below ground surface (bgs).

WESTON, as partners with Baker on the CLEAN Program, was contracted by LANTDIV to perform a site characterization study (SCS) at Building 787. WESTON conducted the field portion of the SCS from 10 August 1992 through 1 September 1992. The specific objectives of the assessment were to investigate the site geologic and hydrogeologic conditions and to define the extent of subsurface contamination in the vicinity of the previously identified areas with soil contamination. During the SCS, WESTON advanced 11 soil borings, screened and collected soil samples for analysis, completed seven monitoring wells, collected groundwater samples for analysis, and conducted two aquifer tests. Figure 2-2 illustrates the soil boring and well locations. The SCR was completed in December 1992 and forwarded to the DEQ.



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DWG. TITLE SITE MAP		FIGURE NO. 2-1	

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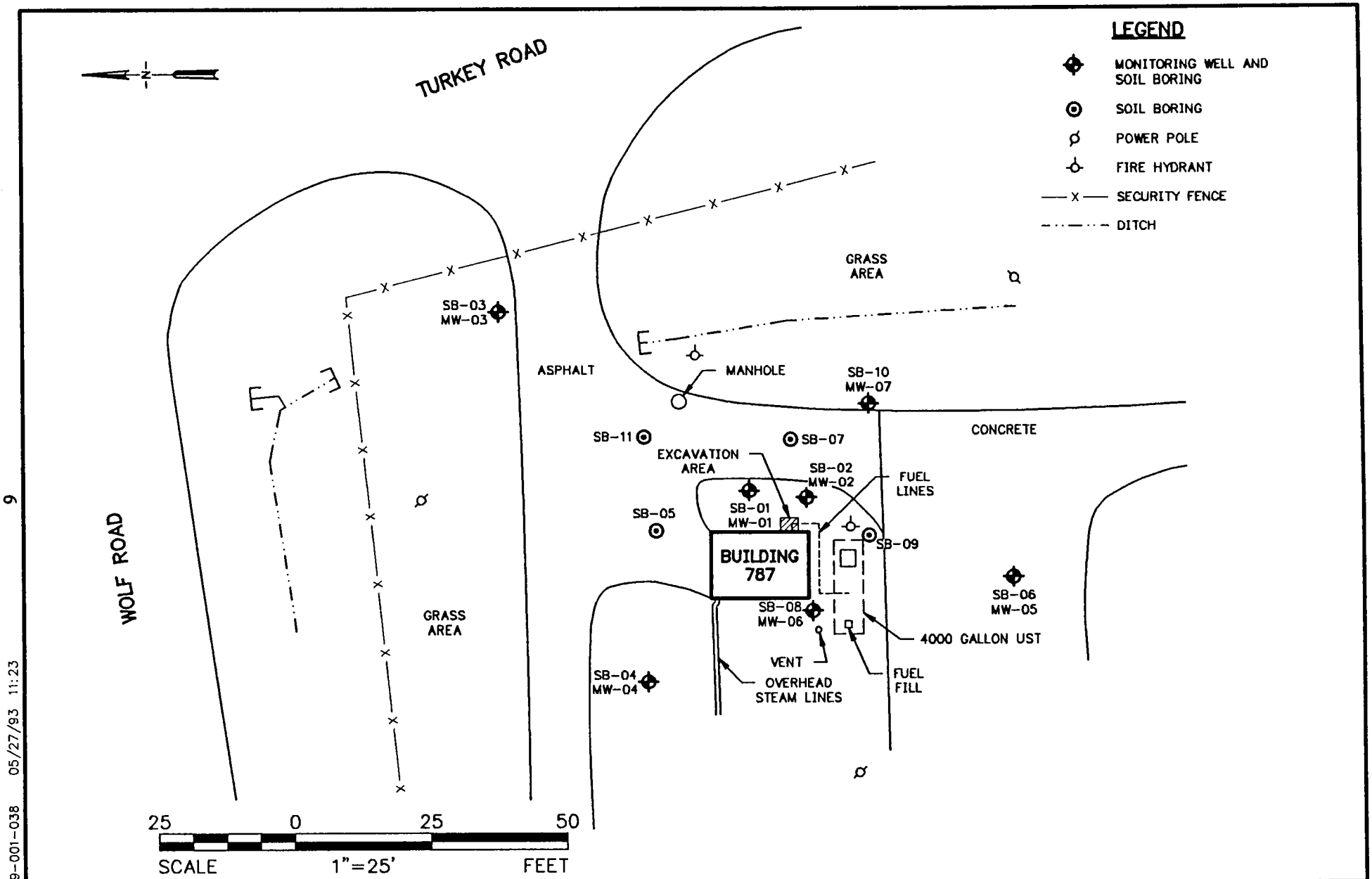

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DWG. TITLE SOIL BORINGS AND WELL LOCATIONS	FIGURE NO. 2-2

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2.3 GEOLOGY

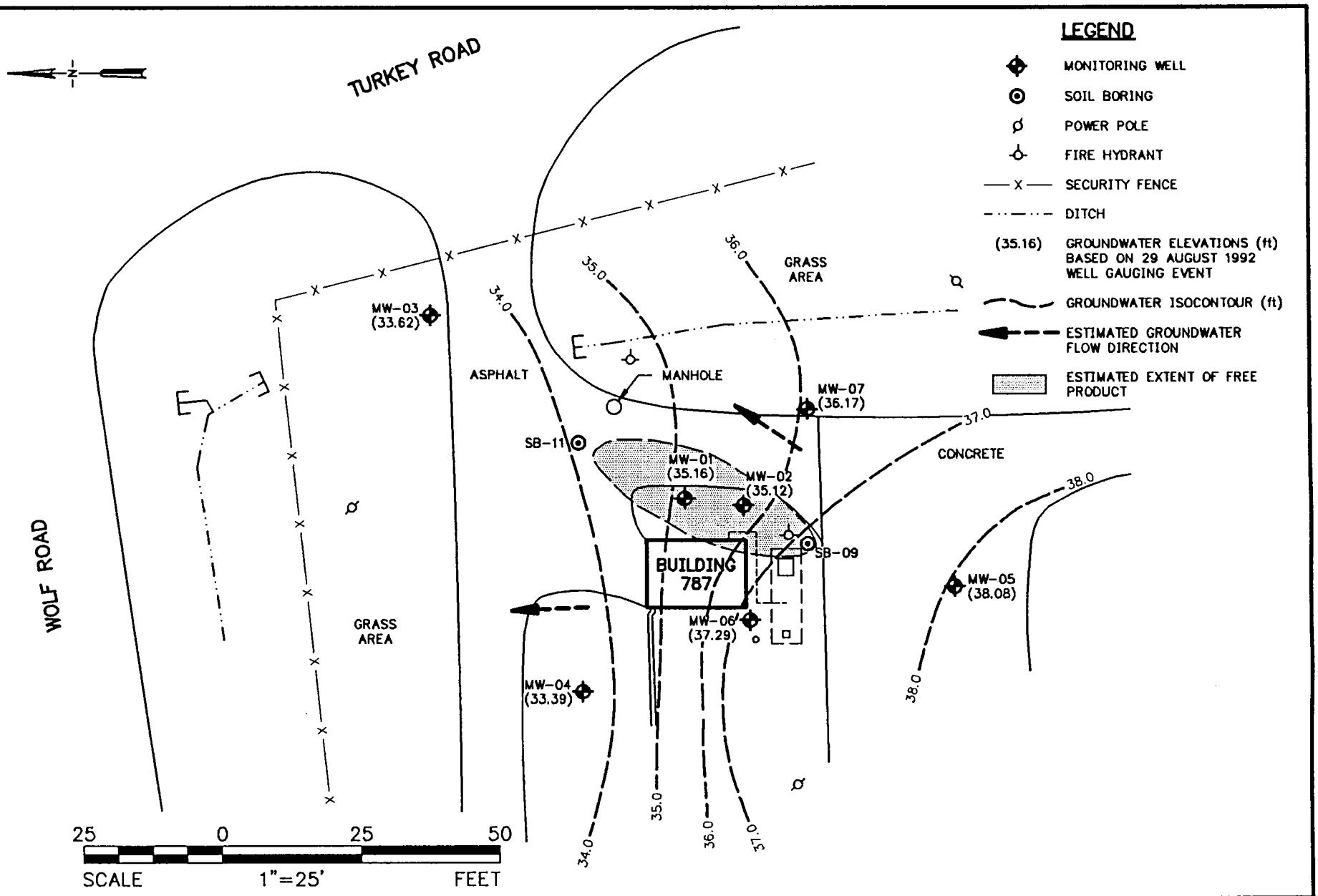
Soil samples were obtained from each of the 11 borings to characterize subsurface soil conditions. In general, the study area is underlain by 18 to 28 feet of mottled rusty orange to light gray fine-grained sandy to silty clay interlayered with lenses of fine grained silty sand. The sandy to silty clay overlies a 15 to 20 foot layer of clayey to silty sand with shells. The shell fraction generally increases with depth to where, in some cases, the soil is predominantly a slightly cemented shell hash with a silty sand matrix. The shelly silty sand overlies a tight, plastic, blue-gray silty clay with shells. The silty clay was encountered in most soil borings at a depth of approximately 38 feet bgs. The dense blue gray silty clay with thin laminations (less than 1/8-inch) of gray to black very fine-grained silty sand is characteristic of an upper sequence in the Yorktown Formation. Copies of the boring logs describing the soils encountered are provided in Appendix B.

Based on a review of the borehole logs and regional geology maps (Mixon et al, 1989, Johnson, 1972), the uppermost geologic units in the study area are the Pleistocene Age Windsor and Miocene Age Yorktown Formations. The Windsor in this area is a fining upward sequence of silty and sandy clays that are interbedded with small fine-grained silty sand lenses. The thickness of the Windsor ranges from 15 to 26 feet. The sandy clays grade into a shelly silty sand characteristic of the uppermost sequence in the Yorktown Formation. Together, the Windsor and Yorktown Formations form the water table aquifer.

2.4. HYDROGEOLOGY

The appearance of saturated soils were encountered during soil boring activities at depths ranging from 22 to 28 feet bgs. After the monitoring wells were constructed, groundwater stabilized in the wells to a level of approximately 20 to 28 feet bgs. Liquid level measurements were taken periodically during the SCS and are provided in Appendix C. While all liquid level measurements show a similar potentiometric surface, the 29 August 1992 data appear most representative of subsurface conditions. Based on this data, groundwater appears to be flowing across the site in a north-northeasterly direction (see Figure 2-3).

The dense blue gray laminated silty clay was consistently encountered in soil borings at approximately 38 feet bgs. This silty clay layer may act as a confining layer, thus inhibiting vertical movement of groundwater. Groundwater in the study area migrates laterally towards natural and developed discharge areas through the surficial aquifer. The groundwater encountered during the site investigation is under water table conditions and, therefore, fluctuates in response to seasonal variations of recharge and discharge.



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DWG. TITLE GROUNDWATER CONTOUR AND FREE PRODUCT MAP	FIGURE NO. 2-3	

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Site-specific aquifer characteristics were determined by evaluating the rising-head test data from the 1 September 1992 slug tests in monitoring wells MW-04 and MW-05. The field data were evaluated using the Bouwer and Rice (1976) equation for a partially penetrated unconfined aquifer. Hydraulic conductivity (K) was determined to be 2.8 x 10^{-3} and 5.1 x 10^{-3} ft/min for MW-04 and MW-05, respectively. Using this range of values for K, a groundwater gradient of 1.6 x 10^{-2} ft/ft and an estimated porosity of 30% (Fetter, 1980), the range of groundwater flow velocities is calculated as 1.5 x 10^{-4} to 2.7 x 10^{-4} ft/min, or 79 to 143 ft/year.

2.5 NATURE AND EXTENT OF CONTAMINATION

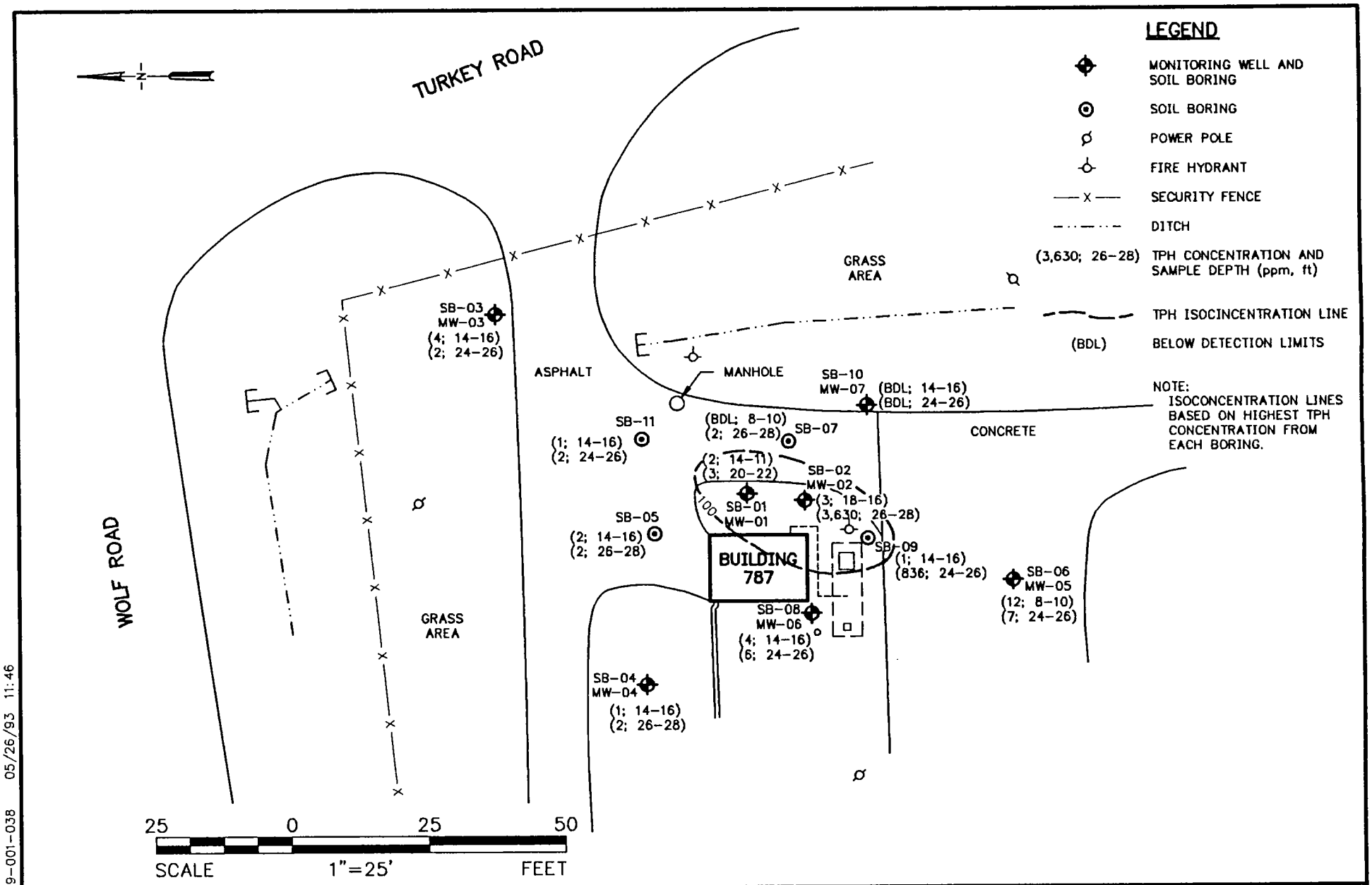
SCS results confirm that subsurface soils in the vicinity of the UST system fuel supply lines on the eastern side of Building 787 are contaminated with petroleum compounds related to No. 2 fuel oil. Elevated levels of contamination in the form of liquid-, adsorbed-, and dissolved-phased hydrocarbons were identified. Based on field screening data, vapor-phase hydrocarbons do not appear to represent a contaminant concern at the site which is consistent with the low volatility of No. 2 fuel oil. The nature and extent of the identified phases of subsurface hydrocarbons are provided in subsequent portions of this report.

2.5.1 Liquid-Phase Hydrocarbons

Liquid-phase hydrocarbons were detected in monitoring wells MW-01 and MW-02 (up to 0.80 and 0.31 feet, respectively). LPH was also observed in soil boring SB-09 (0.04 feet) and in soil boring SB-11 (0.01 feet) after the boring was allowed to remain open overnight. Field observations regarding the presence/absence of LPH in SB-11 were not substantiated by soil or groundwater analyses. The estimated lateral extent of LPH, as shown in Figure 2-3 is approximately 1,100 ft^2.

2.5.2 Adsorbed-Phase Hydrocarbons

During the SCS, WESTON collected 24 soil samples for analysis of TPH by modified EPA method 8015. Two samples from each borehole plus two duplicates were collected. Two composite soil samples were also collected and analyzed for benzene, toluene, ethylbenzene, and total xylenes (BTEX) by EPA method 8020. The distribution pattern of TPH in soil indicates that the highest area of soil contamination is located in the vicinity of SB-01, SB-02, SB-09, and SB-11. Soil boring SB-09 is included within the 100-ppm isoconcentration line based on LPH being observed in the borehole. Approximately 0.04 feet of LPH was observed in a bailer inserted in SB-09 upon completion of the boring. Although LPH was observed in SB-11 after the borehole was left open overnight, field observations were not substantiated by the analytical results. Therefore, SB-11 is not included within the 100 ppm TPH isocontour in Figure 2-4. Based on the contaminant distribution, concentrations of TPH are likely related to



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DWG. TITLE SOIL TPH ISOCONCENTRATION MAP	FIGURE NO. 2-4	

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the confirmed release of petroleum hydrocarbons from the return fuel line. Concentrations of TPH in soil in the vicinity of the Building 787 are depicted in Figure 2-4. Table 2-1 summarizes TPH and BTEX analytical results for soil samples.

2.5.3 Dissolved-Phase Hydrocarbons

Groundwater samples were collected from all monitoring wells not containing LPH and analyzed for TPH by EPA method 418.1 and for volatile organic compounds by EPA method 602. Figure 2-5 illustrates the concentration of TPH in groundwater. The contaminant distribution pattern for TPH appears to be in the immediate vicinity of Building 787. TPH was detected only in groundwater sample 142GW06 (MW-06), with a TPH value of 4 ppm. No purgeable aromatics were detected in any groundwater samples.

Groundwater samples were also analyzed for total lead and showed that all groundwater samples analyzed contained lead. The highest levels of lead were detected in 142GW07-01 (MW-07) at 0.753 ppm and 142GW04-01A (MW-04) at 0.148 ppm. The federal maximum contaminant levels (MCL) for dissolved lead in drinking water is 0.015 ppm. All five groundwater samples analyzed for total lead are greater than the federal MCLs. The state groundwater standards for dissolved lead is 0.05 ppm. Four of five groundwater samples analyzed for total lead are greater than state water quality standards. Lead is not usually a constituent of No. 2 fuel oil. Table 2-2 summarizes TPH, VOC, and total lead analytical results for groundwater samples collected during the SCS. Soil and groundwater analytical results are provided in Appendix D.

2.6 SITE ASSESSMENT SUMMARY

The following summary is based on the results of the SCS:

- Soils in the area consist of 18 to 28 feet of fine-grained sandy to silty clay with lenses of fine-grained silty sand, underlain by a 15 to 20 foot interval of clayey to silty sand with shells. In places, the silty sand is predominantly an indurated shell hash. The shelly silty sand overlies a tight, plastic, silty clay with shells, encountered throughout the site at approximately 38 feet bgs.

- Groundwater in the study area was encountered at varying depths across the site ranging from 20 to 28 feet bgs and generally flows in north-northeasterly direction at about 79 to 143 ft/yr.

- LPH (No. 2 fuel oil) was encountered in MW-01, MW-02, SB-09, and SB-11, however LPH in SB-11 is not substantiated with the analytical results. The maximum apparent product thickness in MW-01 measured during this investigation was approximately 0.8 feet. The product is clear, suggesting that it is the result of a recent release and/or lacks any significant degradation.

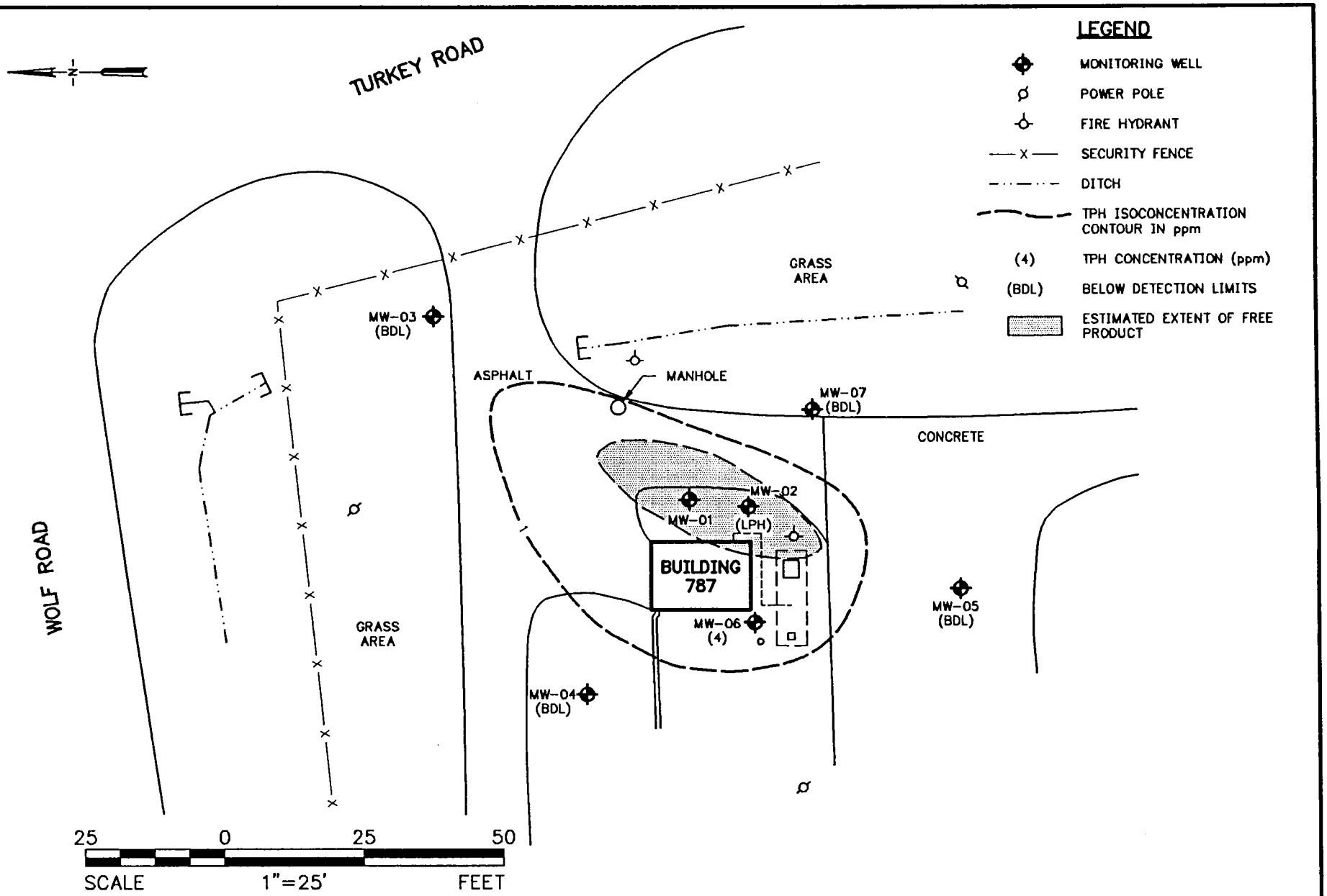
TABLE 2-1
SUMMARY OF TPH AND BTEX ANALYSIS FOR SOIL SAMPLES (ppm)

Soil Boring Number	Field Sample Number	Sample Interval[a]	TPH	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX
SB-01	142S01-01	14-16	2					
SB-01	142S01-02	20-22	3					
SB-02	142S02-01	14-16	3					
SB-02	142S02-02	26-28	3,630					
SB-02	142S02-03	COMPOSITE		BDL	0.014	0.127	0.107	0.248
SB-03	142S03-01	14-16	4					
SB-03	142S03-02	24-26	2					
SB-04	142S04-01	14-16	1					
SB-04	142S04-02	26-28	2					
SB-05	142S05-01	14-16	2					
SB-05	142S05-02	26-28	2					
SB-06	142S06-01	8-10	12					
SB-06	142S06-02	24-26	7					
SB-06	142S06-03	COMPOSITE		BDL	BDL	BDL	BDL	ND
SB-07	142S07-01	8-10	BDL					
SB-07	142S07-02	26-28	2					
SB-08	142S08-01	14-16	4					
SB-08	142S08-02	24-26	4					
SB-08[1]	142S08-03	24-26	6					
SB-09	142S09-01	14-16	1					
SB-09	142S09-02	24-26	836					
SB-09[1]	142S09-03	24-26	835					
SB-10	142S10-01	14-16	BDL					
SB-10	142S10-02	24-26	BDL					
SB-11	142S11-01	14-16	1					
SB-11	142S11-02	24-26	2					

ppm - parts per million.
blank cell - not analyzed.

BDL - below detection limits.
ND - not detected.

Note: a feet below ground surface



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DWG. TITLE TPH IN GROUNDWATER ISOCONCENTRATION MAP	FIGURE NO. 2-5	

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TABLE 2-2
SUMMARY OF TPH AND PURGEABLE AROMATIC, AND TOTAL LEAD ANALYSES FOR GROUNDWATER SAMPLES (ppm)

Sample Location	Sample No.	TPH	Benzene	Toluene	Xylenes (Total)	Ethyl-benzene	Total BTEX	1,3-Dichloro-benzene	1,4-Dichloro-benzene	1,2-Dichloro-benzene	Chloro-benzene	Total Purg. Arom.	Total Lead
MW-03	142GW03-01	BDL	BDL	BDL	BDL	BDL	ND	BDL	BDL	BDL	BDL	ND	0.033
MW-03	142GW03-01A	NA	BDL	BDL	BDL	BDL	ND	BDL	BDL	BDL	BDL	ND	NA
MW-04	142GW04-01	BDL	BDL	BDL	BDL	BDL	ND	BDL	BDL	BDL	BDL	ND	0.124
MW-04	142GW04-01A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.148
MW-04	142GW04-01B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.003
MW-05	142GW05-01	BDL	BDL	BDL	BDL	BDL	ND	BDL	BDL	BDL	BDL	ND	0.024
MW-06	142GW06-01	1	BDL	BDL	BDL	BDL	ND	BDL	BDL	BDL	BDL	ND	0.097
MW-06	142GW06-01A	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW-06	142GW06-01B	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW-07	142GW07-01	BDL	BDL	BDL	BDL	BDL	ND	BDL	BDL	BDL	BDL	ND	0.753
MW-07	142GW07-01B	NA	BDL	BDL	BDL	BDL	ND	BDL	BDL	BDL	BDL	ND	NA
MW-07	142GW07-01C	NA	BDL	BDL	BDL	BDL	ND	BDL	BDL	BDL	BDL	ND	NA

ppm - parts per million.
BDL - Below detection limits.
NA - Not applicable.
ND - Not detected.
A - Duplicate sample.
B - Rinsate Sample.
C - Trip blank; only analyzed for purgeable aromatics.
ND - Not detected.

- Soils with elevated levels of TPH were detected in the immediate vicinity of Building 787. The source of the soil contamination is likely due to a release resulting from the failure of a subsurface fuel line.

- No purgeable organics were detected in any groundwater samples. The lack of dissolved BTEX compounds in groundwater suggests that the source of contamination is due to a recent release.

2.7 RISK ASSESSMENT SUMMARY

To date there have been no reported impacts to sensitive receptors from the subsurface hydrocarbons at the site. There are limited actual or potential human or nonhuman receptors in the study area. The possible exposure pathways of concern for human exposure may include: ingestion, inhalation (of volatile organics from groundwater, surface water, and particulates), and dermal contact of contaminated groundwater and surface waters. Contaminated surface waters and sediments would be the likely environmental exposure pathways to aquatic organisms.

For the most part, the soil contamination detected in the area occurs below the ground surface. The surrounding surface area is either paved or grassed. Therefore, there is little potential for dispersion due to fugitive dust except during intrusive activities such as construction or landscaping. Even though groundwater monitoring wells installed adjacent to the building indicate free product and levels of lead above the Commonwealth of Virginia and federal MCLs, present and future use of the groundwater is considered unlikely. Since drinking water is supplied to NWS Yorktown by municipal pipeline from off-site sources and no groundwater is used for any purposes in the vicinity of the site, human receptors of contaminated groundwater appears unlikely. One water supply well was located approximately one mile away from Building 787. However, it does not appear to be within the same groundwater flow regime, and it is not used as a drinking water supply.

Groundwater transportation of leached TPH and/or BTEX constituents into a surface water receiver is an exposure pathway. The nearest surface water receiver is a stream approximately 750 foot downgradient and northeast of the site; an unnamed tributary to Felsgate Creek. This exposure pathway is highly restricted by the 750 foot distance to the stream. No purgeable organics were detected in any groundwater samples collected. Total lead was detected in all groundwater samples collected. The concentrations ranged from 0.024 to 0.753 ppm. Concentrations of total lead in all five groundwater samples are greater than the federal MCL of 0.015 ppm (Table 2-3).

Potential concentrations of lead in groundwater at the nearest potential downgradient receptor was quantified using a three-dimensional computer model. The model used is entitled Analytical Transient One-, Two-, and Three-Dimensional Simulation of Waste Transport in the Aquifer System (AT123D) (Yeh, 1981). The model was used

TABLE 2-3

FREQUENCY SUMMARY FOR VOLATILES IN GROUNDWATER (ppm)

Parameter	State Standards[1]	Federal MCLs[1]	Minimum Detected Concentration	Maximum Detected Concentration	Frequency of Detected Values (%)	Number of Detects Greater Than Standards	
						State	Federal
Benzene	0.710	0.005	BDL	BDL	0	0	0
Chlorobenzene	N/A	0.100	BDL	BDL	0	0	0
1,2-Dichlorobenzene	17.000	0.600	BDL	BDL	0	0	0
1,3-Dichlorobenzene	2.600	0.600	BDL	BDL	0	0	0
1,4-Dichlorobenzene	2.600	0.075	BDL	BDL	0	0	0
Ethylbenzene	29.000	0.700	BDL	BDL	0	0	0
Toluene	200.000	1.000	BDL	BDL	0	0	0
Xylenes, total	N/A	10.000	BDL	BDL	0	0	0
Lead	0.05[2]	0.015	0.024	0.753	100	4	5

NA - Not applicable, no standards have been set.
BDL - Below detection limits.
Note: 1) Federal MCLs are based on the federal Drinking Water Standard, and state standards are based on the surface water standards with general, statewide application.
2) Groundwater standards by the state were used for lead.

to evaluate the potential level to which the elevated levels of total lead could impact the nearest potential sensitive receptor (the creek). Based on computer modeling results, impact on sensitive receptors appears unlikely. Using current information, the model predicts that total lead will not migrate a distance of 750 feet from the site. The model predicts that a lead concentration of 1 ppb would not reach a distance of 531 feet after 105 years.

In summary, no human or nonhuman receptors are anticipated to be affected by contamination at this site. Therefore, a quantitative risk evaluation was not warranted. From a qualitative perspective, the contaminants identified do not represent or pose a public health risk as there are limited opportunities for exposure to contaminants.

2.8 REMEDIATION ASSESSMENT SUMMARY

Results of the risk assessment conducted for this site identified that the potential human or environmental receptors will not be impacted by the contamination at the site. Therefore, based on the results of the site and risk assessments and state guidelines, remediation is recommended only to recover the LPH. Remediation of soil and groundwater at the site is not anticipated. Subdivision 6.5 of Part IV of VR 680-13-02 requires owners and operators to remove LPH to the maximum practical extent while preparing for corrective action. LPH should be removed until a significant layer (>0.01 ft) is not identified in the monitoring wells at the site.

Because of the apparent no risk to both human and environmental receptors, active soil and groundwater remediation is not recommended. Once the LPH has been recovered, natural processes, such as degradation and dispersion, will in time reduce the concentrations of the contaminants. Therefore, the projected remedial endpoints for soil (adsorbed-phase) and groundwater (dissolved-phase) at the site are the existing site conditions. Because of the nature of the contaminant present No. 2 fuel oil, remediation of vapors is not warranted or recommended. No. 2 fuel oil has a low percentage of volatile compounds present; therefore, remediation of the vapor phase would not be appropriate or effective.

As previously stated, it is not anticipated that soils at the site will be remediated. However, soils that may require remediation at some time in the future include those excavated for construction or subsurface utilities repair. Table 2-4 presents demonstrated technologies for soil remediation. The table also summarizes the evaluation of each technology based on applicability to the site, implementability, and costs. Remediation technologies applicable to soils at the site that may at some time in the future be excavated include excavation and disposal as solid waste or excavation and low-temperature thermal treatment.

TABLE 2-4
SOIL REMEDIATION OPTIONS

OPTION	PROCESS	ESTIMATED COSTS[1]	PRACTICAL CONSTRAINTS	REMARKS	APPLICABLE TO SITE (Y/N)
Excavation and disposal as hazardous waste	Excavate and haul to Class I landfill; emplace and compact clean fill	$300/yd^3	Cradle-to-grave liability as waste generator	High cost	N
Excavation and disposal as solid waste (nonhazardous)	Excavate and haul to Class III landfill; backfill with clean fill	$60/yd^3	Location of a suitable landfill	Economical on small projects	Y
Excavation, aeration, and disposal off-site	Excavate and spread on-site; turn repeatedly to aerate; haul to clean fill disposal site; emplace and compact new clean fill	$40-120/yd^3	Emission considerations; space considerations	Technically feasible; permitting very difficult under current legislation; requires numerous analytical tests	N
Excavation, landfarming, and replacement	Excavate and spread on-site; aerate and add nutrients and water; re-emplace and compact	$50/yd^3	Emission considerations; space considerations; leaves excavation open during treatment	Technically feasible, permitting may be difficult; requires numerous analytical tests	N
Mechanically enhanced volatilization	Excavate; pass through crusher; aerator; and re-emplace	$250/yd^3	Requires dust control and vapor treatment	High cost, but suitable for specific locations	N
In situ venting (vacuum extraction)	Investigate extent of contamination and soil conditions; design and install venting system; permit system; operate system; reinvestigate to monitor effectiveness	$20-50/yd^3	Fine-grained soils and low volatility of hydrocarbon in soils limit the effectiveness of this method	Not a technically viable option for sites with clayey soils	N
Excavation and low-temperature thermal reduction (LTTR)	Contamination in soil reduced through volatilization by the application of heat	$50/ton + trans-portation	Emissions considerations for the treatment facility	Moderate cost, suitable for small projects	Y
In situ bioremediation or chemical degradation	Investigate extent of contamination and soil and groundwater conditions; conduct feasibility study; design and install pumping and injection system; permit system; operate system; reinvestigate to monitor effectiveness	$70-100/yd^3	Fine-grained soils limit ability to inject and pump fluids through soils. System could be engineered to be installed and operated around existing facilities; requires ongoing operations and maintenance (O&M) and monitoring. Requires periodic soil sampling and final investigation	Effectiveness has been demonstrated only for shallow contaminated soils; requires extensive preoperational bio-analytical studies	N

[1] Estimated costs reflect 1990 dollars.

Source: Testa, Stephen M. and Duane L. Winegardner. Restoration of Petroleum-Contaminated Aquifers. Lewis Publishers, inc., Chelsea, MI. 1991.

TABLE 2-4 (Cont.)
SOIL REMEDIATION OPTIONS

OPTION	PROCESS	ESTIMATED COSTS[1]	PRACTICAL CONSTRAINTS	REMARKS	APPLICABLE TO SITE (Y/N)
Stream injection and stripping	Investigate extent of contamination and soil and groundwater conditions; conduct feasibility study; design and install steam injection and recovery system; permit system; operate system; monitor effectiveness on an ongoing basis	$100-200/yd^3	Fine-grained soils limit ability to inject steam and recover fluids from soils	Overall effectiveness cannot be assured, pending pilot study results; O&M cost	N
Asphalt stabilization	Cover soils with impermeable asphalt layer to prevent soil leaching.	$125/ton	Graded site in low impact traffic area. Not practical at site due to large areal extent (120,000 ft^2).	Moderate costs, good option for hydrocarbons affected soils not amenable to excavation.	Y
No action	No action		No risk to public health, safety, and welfare. No risk to surface water or groundwater considered of beneficial use.	Site-specific. Appropriate at site due to low risk.	Y
Soil washing/extraction	Excavate; crush; mix with wash fluid; separate; replace; treat wash water		Limited to granular soils; wash fluid treatment may be difficult	Technically feasible; high cost; limited applications	N
In situ leaching	Construct infiltration and recovery systems; irrigate washing fluid; retrieve fluid; treat fluid	$150 to $200/yd^3	Limited to permeable soil, and higher solubility hydrocarbons	Often used in conjunction with biotreatment practices, permit approval may be difficult	N
Aboveground leaching/replacement	Excavate; crush; place over collector bed; flush with wash fluid; replace; treat fluid		Total washing fluid collection, temperature, and odor control; requires fairly large open area	May be used in association with biotreatment, often effective; permitting not as difficult	N

[1] Estimated costs reflect 1990 dollars.

Source: Testa, Stephen M. and Duane L. Winegardner. Restoration of Petroleum-Contaminated Aquifers. Lewis Publishers, inc., Chelsea, MI. 1991.

Stabilization of contaminated soils is an option where excavation is not warranted. Conducted as a preventative measure for soil contaminant leaching, soil stabilization utilizing an asphalt patch over the contaminated area can decrease the rate of soil contamination leaching into groundwater.

Product recovery technologies applicable to remediation of the LPH at the site are shown in Table 2-5. These technologies are evaluated (with respect to advantages and disadvantages) in the table. Those that are appropriate for LPH recovery at the site are briefly discussed in the following subsections. These are generic recovery methods and not specific variations on each type of technology.

Recovery wells are a conventional, demonstrated technology that is useful with permeable aquifers. The wells would be larger in diameter than a well point, and would be spaced further apart than a well point system. Because of soil conditions present at the site and the relatively small extent of the LPH plume, one recovery well would adequately remediate the site if LPH recovery was enhanced by water table depression. However, a considerable quantity of groundwater would be generated by this process and would require treatment of contaminants prior to discharge.

Because of the soil conditions and type of contaminant present at the site, the concept of a recovery well system is suitable. LPH recovery from one or more 6-inch diameter wells could be performed to accelerate the overall free product recovery operations if water table depression is not utilized. However, based on the estimated areal extent of LPH, the low risk to potential receptors, and costs, water table depression to enhance LPH recovery is not recommended.

In conclusion, soils at the site should be directly remediated only in areas where excavation is necessary. Soil stabilization is an applicable option with the use of an asphalt patch. The recommended option for the remediation of soils that are excavated is low-temperature thermal reduction. LPH will be recovered until a significant layer (0.01 feet or greater) is not identified in the monitoring wells at the site. The applicable product recovery method is the installation of one or more 6-inch diameter wells with a product skimming system that can be installed to inhibit product migration. The primary recovery well would be located in the southeast corner of Building 787 in the vicinity of MW-02. An additional well in the vicinity of SB-11 would aid in the recovery of the LPH plume at the plume front.

TABLE 2-5
SCREENING OF POTENTIAL PRODUCT RECOVERY ALTERNATIVES

ALTERNATIVE	DESCRIPTION	CAPABILITY	LIMITATION	EVALUATION	APPLICABLE TO SITE (Y/N)
1. Passive Remediation	Take no action - continue groundwater monitoring to determine if product plume is migrating off-site.	Simplest, least costly option	Does not facilitate containment, control, or recovery of product.	The option does not actively improve site groundwater quality.	N
2. Subsurface Flow Controls (barriers)	Install slurry, membrane, or structural walls around plume to isolate it and preclude further migration.	A conventional, demonstrated technology	This option is usually very expensive. Many slurry wall mixtures or membranes may not provide long-term durability. Fill material on site (riprap) precludes advancing sheet piling (wall).	This option is expensive and does not actively improve site aquifer quality.	N
3. Well Points	Install closely spaced small-diameter wells around the plume.	A conventional, demonstrated technology	Requires a large number of well points to be effective. Large quantities of water would be generated. Requires frequent maintenance.	Not effective for sites with moderate to high permeability and shallow water table.	N
4. Recovery Wells	Install groundwater/free product recovery wells at selected locations.	A conventional, demonstrated technology	Several wells may be required to renovate the aquifer. Usually suited for use in sandy aquifers. Requires VPDES permit if groundwater is pumped.	Effective for sites with moderate to high permeability.	Y
5. Large-Diameter Sumps	Install a few large-diameter sumps at selected locations.	A conventional, demonstrated technology	Only effective in shallow aquifers with low permeabilities.	May be effective in shallow conditions where low permeabilities exist.	N
6. Interceptor Trenches	Construct trenches with sumps at right angles to existing groundwater flow patterns.	A conventional, demonstrated technology	Effective in shallow aquifers with low permeabilities. Construction may disrupt facility operations. Installation may not be possible for areas.	May be effective in shallow conditions where low permeabilities exist and where groundwater treatment and disposal costs are prohibitive.	N
7. In Situ Biotreatment	Utilize recovery and injection wells or a reinfiltration gallery to assist in biodegradation of contaminants.	A demonstrated technology	Requires large capital costs. Maintenance is usually expensive. Biotreatment is slow as compared to other remediation methods.	Presence of free phase product makes this option less effective. Would also require soil oxygenation/ extraction.	N
8. Soil Vapor Extraction/Volatilization	Apply vacuum to soils at several vapor extraction points to enhance volatilization of LPH. Enhances biodegradation processes.	A conventional, demonstrated technology.	Not effective for non-volatile contaminants. Requires greater than 6 ft depth to water table and moderately permeable soils.	May not be effective because of the nature of contaminant in not volatile.	N

Note: Estimated costs for remediation alternatives are not possible due to variables such as volume of groundwater to be removed, number of pumps required, etc.

TABLE 2-5
SCREENING OF POTENTIAL PRODUCT RECOVERY ALTERNATIVES

ALTERNATIVE	DESCRIPTION	CAPABILITY	LIMITATION	EVALUATION	APPLICABLE TO SITE (Y/N)
1. Passive Remediation	Take no action - continue groundwater monitoring to determine if product plume is migrating off-site.	Simplest, least costly option	Does not facilitate containment, control, or recovery of product.	The option does not actively improve site groundwater quality.	N
2. Subsurface Flow Controls (barriers)	Install slurry, membrane, or structural walls around plume to isolate it and preclude further migration.	A conventional, demonstrated technology	This option is usually very expensive. Many slurry wall mixtures or membranes may not provide long-term durability. Fill material on site (riprap) precludes advancing sheet piling (wall).	This option is expensive and does not actively improve site aquifer quality.	N
3. Well Points	Install closely spaced small-diameter wells around the plume.	A conventional, demonstrated technology	Requires a large number of well points to be effective. Large quantities of water would be generated. Requires frequent maintenance.	Not effective for sites with moderate to high permeability and shallow water table.	N
4. Recovery Wells	Install groundwater/free product recovery wells at selected locations.	A conventional, demonstrated technology	Several wells may be required to renovate the aquifer. Usually suited for use in sandy aquifers. Requires VPDES permit if groundwater is pumped.	Effective for sites with moderate to high permeability.	Y
5. Large-Diameter Sumps	Install a few large-diameter sumps at selected locations.	A conventional, demonstrated technology	Only effective in shallow aquifers with low permeabilities.	May be effective in shallow conditions where low permeabilities exist.	N
6. Interceptor Trenches	Construct trenches with sumps at right angles to existing groundwater flow patterns.	A conventional, demonstrated technology	Effective in shallow aquifers with low permeabilities. Construction may disrupt facility operations. Installation may not be possible for areas.	May be effective in shallow conditions where low permeabilities exist and where groundwater treatment and disposal costs are prohibitive.	N
7. In Situ Biotreatment	Utilize recovery and injection wells or a reinfiltration gallery to assist in biodegradation of contaminants.	A demonstrated technology	Requires large capital costs. Maintenance is usually expensive. Biotreatment is slow as compared to other remediation methods.	Presence of free phase product makes this option less effective. Would also require soil oxygenation/ extraction.	N
8. Soil Vapor Extraction/Volatilization	Apply vacuum to soils at several vapor extraction points to enhance volatilization of LPH. Enhances biodegradation processes.	A conventional, demonstrated technology.	Not effective for non-volatile contaminants. Requires greater than 6 ft depth to water table and moderately permeable soils.	May not be effective because of the nature of contaminant in not volatile.	N

Note: Estimated costs for remediation alternatives are not possible due to variables such as volume of groundwater to be removed, number of pumps required, etc.

3.0 CORRECTIVE ACTION PLAN

The CAP presents a discussion of the corrective action approach selected for remediation of the LPH in the vicinity of Building 787. The following subsections contain the proposed remediation endpoints, the LPH recovery system design, system installation and operation, permitting requirements, site monitoring and reporting, the CAP project schedule, and an estimate of the CAP project costs.

3.1 REMEDIATION ENDPOINTS

Inherent in the CAP are two primary objectives: 1) reduce or eliminate the risk to health and the environment from the on-site contamination; and 2) comply with the DEQ regulations governing USTs, groundwater quality, and site remediation. Selection of the proposed remedial approach has been based not only on the extent of the contamination, technologies available, time and cost considerations, and physical characteristics of the site, but also on the risk evaluation. The proposed remedial approach addresses the contamination source (LPH) to reduce other phases of contamination, thereby reducing the potential threat to the public and the environment in consideration of the current and potential future use of the site.

Because of the apparent no risk to both human and environmental receptors, active soil and groundwater remediation is not proposed. Once the LPH has been recovered, natural processes including degradation and dispersion, will in time reduce the contaminant concentrations. EPA guidelines (1990) include in-place passive remediation as a corrective action option. Therefore, the projected remedial endpoints for soil (adsorbed-phase) and groundwater (dissolved-phase) at the site are the existing site conditions. However, in order to accurately assess achievement and maintenance of these remedial goals and remediation of the LPH, numerical remedial endpoints are proposed.

Due to the nature of the contaminant present, i.e., No. 2 fuel oil, remediation of vapors is not recommended. No. 2 fuel oil has a low percentage of volatile compounds present; therefore, remediation or monitoring of the vapor phase would not be appropriate or effective. Proposed endpoints include the following:

- liquid-phase hydrocarbons to less than or equal to 0.01 feet, as measured with an interface probe and observed/confirmed with a bailer;

- adsorbed-phase hydrocarbons to less than or equal to 500 ppm TPH, as quantified with select soil samples analyzed by modified EPA method 8015; and

- dissolved-phase hydrocarbons to less than or equal to 10 ppm TPH as quantified with select groundwater samples analyzed by modified EPA method 8015.

As previously discussed, once LPH at the site has been recovered, impacted soils will remain in-place to passively remediate over time. Those soils that are excavated for construction activities, including drilling or system installation, would be transported to a local thermal reclamation facility for treatment.

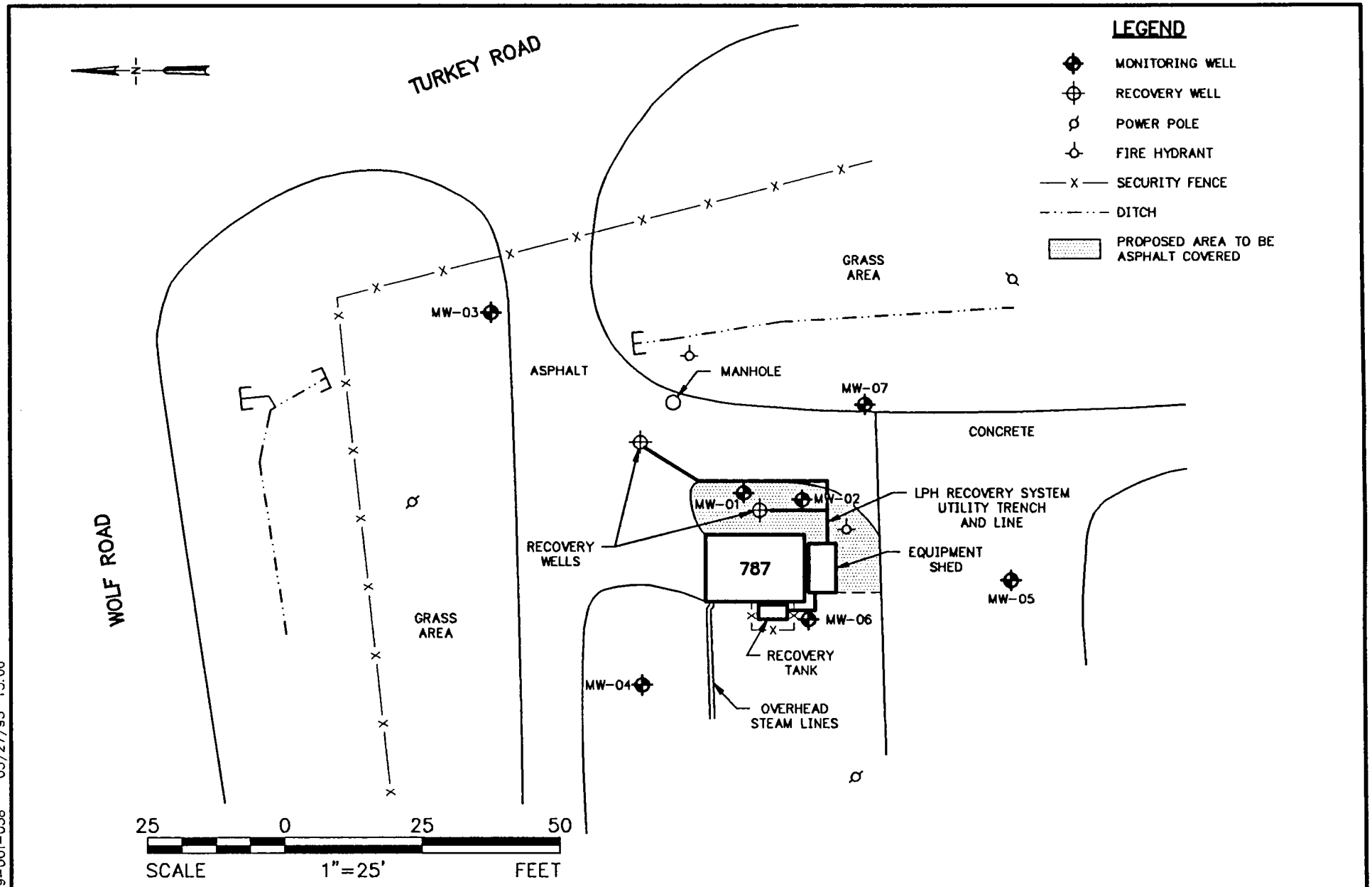
3.2 REMEDIATION SYSTEM DESIGN

Recovery of fuel in the vicinity of Building 787 will be implemented using two 6-inch diameter recovery wells outfitted with product skimming systems. The proposed recovery wells would extend to 38 feet bgs to take into account potential water level fluctuations. The wells would be screened from approximately 18-feet bgs to depth with continuous slot, and enclosed in a 2-foot by 2-foot by 2-foot flush-to-grade concrete well head equipment and access vault. The LPH recovery system layout is illustrated in Figure 3-1.

Each recovery well will be outfitted with a pneumatic product only skimming pump. The pneumatic product only pumps were selected for there intrinsicly safe characteristics, reduced operation and maintenance costs, and product skimming capabilities. QED® Seeker product pumps are recommended as the skimming pumps. These pumps, would meet the design requirements for the LPH recovery system. These systems include a self-adjusting product interface skimmer that does not include hydrophobic materials, a system control unit capable of regulating both recovery well skimmers, and a compressor capable of supplying oil free pressurized air at a minimum 100 pounds per square inch (psi). The compressor would require a single-phase, 115-volt electrical supply.

In order to reduce equipment and maintenance costs, the controller panel and compressor would be housed in a prefabricated 6-feet by 10-feet by 8-feet high equipment compound shed. The equipment shed would be located in the immediate area (see Figure 3-1). Recovered free product from both wells would be transferred directly from the skimming pumps to a product recovery tank. It is anticipated that a 500 gallon recovery tank would be of sufficient capacity. The product recovery tank would be staged within a concrete containment pad with a 6-foot high security fence. The tank will be fitted with a site tube and an explosion proof tank overfill shut-off controller switch. At the Navy's discretion, recovered product will either be recycled at NWS Yorktown, or transported off-site by an approved waste disposal firm.

System utility lines are to be installed in subsurface utility trenches. Permitting requirements are further discussed in subsequent portions of this report. An LPH recovery system equipment list, system design drawing, and individual equipment specification and efficiency sheets are provided in Appendix F.



PROJECT TITLE: CORRECTIVE ACTION PLAN UST SYSTEM – BUILDING 787 NAVAL WEAPONS STATION YORKTOWN, VIRGINIA		CLIENT DEPARTMENT OF THE NAVY ATLANTIC DIVISION NAVAL FACILITIES ENGINEERING COMMAND NORFOLK, VIRGINIA	WESTON
DWG. TITLE LPH RECOVERY SYSTEM LAYOUT		FIGURE NO. 3-1	

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24

- NWS Yorktown personnel or an approved subcontractor will provide utilities clearance of the excavation areas prior to the initiation of construction activities.

3.4.3 LPH Recovery System Installation

Utility trenching and line installation will commence subsequent to installation of the recovery wells and asphalt patching of the grassed area. The subsurface utility trench will house the electrical lines, the air supply, and product return lines for the LPH skimming pumps. Separate, 3-inch diameter PVC sleeves within the trench will house the lines. Trenching will be in accordance with Navy construction specifications. It is estimated that the utility trench to the proposed recovery wells will extend to 2.5 feet below grade and be approximately 55 feet in length. Only approximately 15 feet of the utility trenching would require saw-cutting and asphalt patching.

Installation of the proposed recovery wells and the flush-to-grade equipment vaults should be conducted concurrently with utility trenching in order to reduce construction time.

Concrete work for the equipment compound will include a containment pad for the recovery tank. This area should have a security fence. A prefabricated equipment shed will be installed adjacent to Building 787 to house system control panels and the air compressor. All control panels are designed to be all-weather; however, the air compressor is not. The alternative to installation of the equipment shed would be mounting the control systems and an all-weather air compressor outside, within the fenced-in equipment compound. It is anticipated that a single-phase, 115-volt electrical supply will be routed from Building 787 to a breaker panel in the compound area.

3.4.4 LPH Recovery System Operation

The LPH recovery system will operate continuously 24 hours a day, seven days a week. A two week shake-down period will be conducted to identify any system discrepancies, to correct them, and to make appropriate system adjustments to optimize equipment operations. As part of the General CAP Permit requirements, a system operations and maintenance plan will be forwarded to the DEQ within 45 days from system start-up.

3.5 SITE MONITORING PLAN

The monitoring plan associated with the selected corrective action alternative for the site includes well gauging and groundwater sampling to monitor the progress towards site remediation. The site monitoring plan includes a schedule for monitoring both achievement and maintenance of endpoints. The site monitoring plan during remediation and for post-operative monitoring includes sampling frequency, sample locations, parameters to be analyzed, and a field QA/QC plan. The tasks associated with the monitoring program are outlined below.

3.5.1 Well Gauging

All monitoring wells at the site will be gauged on a monthly basis with an oil/water interface probe. Product thickness (if any) and water levels will be documented in the field log book. The presence/absence of LPH will be visually confirmed with a bailer.

3.5.2 Groundwater Samples

Groundwater samples will be collected upon the LPH recovery system start-up and then performed on a bi-annual basis to document groundwater quality. Groundwater samples will be collected from the five monitoring wells at the site not containing LPH and analyzed by modified EPA method 8015.

3.5.3 Field QA/QC Plan

This field Quality Assurance/Quality Control (QA/QC) Plan has been developed for the groundwater activities to be conducted for the corrective action for the site. This plan addresses the QA/QC steps and procedures that will be administered for sample collection. The QA objectives associated with the selected corrective action are: 1) to gather data in accordance with procedures appropriate for the intended use of the data; and 2) to obtain data that will be of acceptable precision, accuracy, completeness, representativeness, and comparability.

Each sample must be documented in a manner that makes it legally defensible and which provides the necessary data for proper analysis. This documentation includes entries in a field sample logbook, sample labels, and sample chain-of-custody procedures.

Every sample will be affixed with a gummed label at the time of collection. The label will contain at least the following information: site name, sample number, date and time of collection, sample type (grab or composite), matrix, and sampler's initials.

Chain-of-custody (COC) documentation is necessary to track the possession of each sample from collection through analysis. Custody of all samples will be maintained by field personnel from the time of collection until the time the samples are forwarded to the analytical laboratory. Sample custody will be documented using COC record forms. A COC form will be completed by the field personnel in waterproof ink. The original copy of the COC form must be placed in a sealable plastic bag and placed in the appropriate sampling cooler being forwarded from the site to the laboratory. Pertinent information on the COC form includes: client, sampling location, sample identification, sample description, sample container numbers and volumes, analytical method, signatures of persons involved in COC, and date and time of possession.

If the sampling cooler is shipped by a commercial air carrier, the cooler must be secured with custody seals (broken seals will identify that the cooler has been opened). The laboratory sample custodian or his/her designee accepting the sample shipment will sign and date the COC record upon sample receipt. The original COC record form will be returned along with the final data report.

Data from site visits will be entered into a hard-cover, bound Field Sample Logbook. Information to be entered includes, but is not limited to, client name, sampling location, sampling methodology, sample container numbers and volumes, date and time of collection, field sample identification number, field observations and measurements, preservation, and names of sample collector(s).

3.6 PROJECT REPORTING

As previously stated, daily monitoring and system adjustments will be completed for the first two weeks of operation followed by weekly site visits until remediation goals have been met. A summary report will be prepared on a quarterly basis for submittal to the DEQ. The report will be forwarded to the DEQ within one month of receipt of analytical results. The following information will be included in the quarterly progress report:

- All monitoring data including well gauging, soil and groundwater analytical results.
- Product recovery rates with a graphical representation of cumulative recovery.

Progress towards site remediation will be evaluated monthly comparing site monitoring data with previous information. Modifications to system operation or additional remedial activities will be proposed, as necessary, to maintain a site closure goal of two years. Should modifications to the CAP be required, it is anticipated that enhanced LPH recovery using water table depression would be the CAP alternative approach. If necessary, the proposed recovery well in the vicinity to SB-11 would be outfitted with an electric submersible pump.

3.7 SITE CLOSURE AND RESTORATION PLAN

It is anticipated to take approximately 2 years to achieve the remedial endpoint for free floating product (less than or equal to 0.01 feet). Once this remediation goal has been achieved, the Navy will petition the DEQ for closure. Once closure has been granted, the one year post-operative monitoring program will commence to ensure maintenance of the remedial goals. In addition to monthly well gauging and bi-annual groundwater sampling, a soil confirmation sample and soil vapor samples collected from the monitoring well head spaces will be included within the site monitoring program. The one time soil confirmation sample will be collected by the split spoon method in the grass median near MW-01.

Subsequent to completion of the post operative monitoring program and receipt of case closure notification from the DEQ, site restoration will commence. Restoration will include decommissioning the LPH recovery system, abandoning all wells in accordance with DEQ guidelines, and general site cleanup.

3.8 REMEDIATION SCHEDULE

The project remediation schedule associated with this CAP is presented on Table 3-1. As shown on this table, it is estimated that approximately 3 months will be required to complete the activities associated with obtaining all necessary permits. Subsequent to CAP permitting, site preparation, contractor selection and procurement, and LPH recovery system installation will commence. System installation and the initial shake-down process will be completed in approximately one month. It is anticipated that it will take approximately two years for removal of the LPH and an additional one year of post remediation monitoring in order to obtain site closure with the DEQ. It should be noted that this project life-time estimate is a first order approximation.

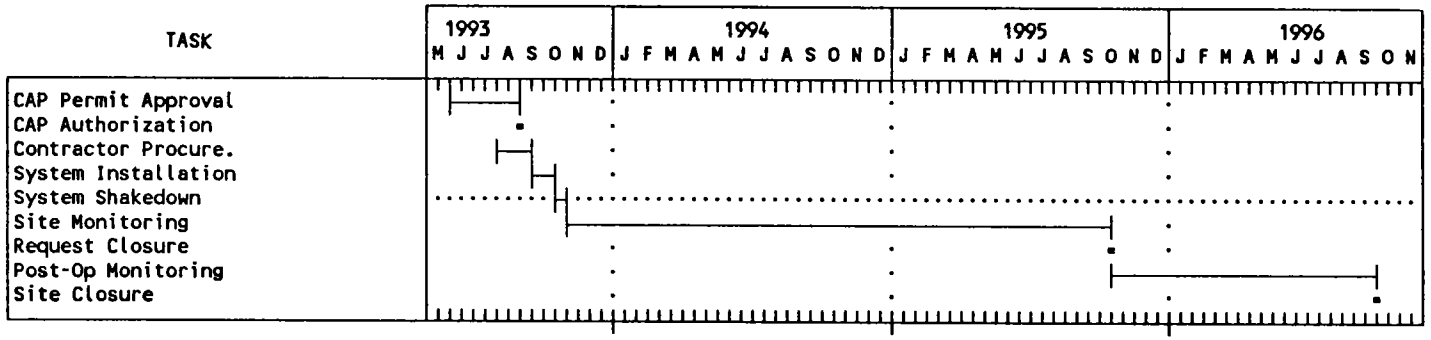
3.9 ESTIMATED PROJECT COSTS

Confirmation of final system design, preparation of bid specification drawings, implementation of system installation, subcontractor procurement, and project oversight is estimated to be approximately $25,000. Concrete pad and fencing, and asphalt patching for the utility trench, is estimated to be $10,000. The estimated cost for the LPH recovery system equipment is estimated to be $17,000. This includes the skimming pumps, control panel, air compressor, and the recovery tank. Construction of the subsurface utility lines, including the lines to both recovery wells and the recovery tank, is estimated to be $4,000. This cost includes materials, labor, and removal of rubble. Utility installation cost would also include electrical hook-up. Installation of the two recovery wells is estimated to cost approximately $9,000. Total costs for installation of the LPH recovery system are estimated to be approximately $65,000.

Annual O&M of the system, site monitoring, and project reporting is estimated to be approximately $30,000. Site restoration is estimated to be $10,000. The total current estimated project costs are approximately $165,000, including two years of LPH recovery system operation and one year post operational monitoring. It is estimated that total project costs may be increased by an additional $1,000 should the Navy require off-site transportation and disposal of the recovered No. 2 fuel oil. The current estimated project costs are summarized as follows:

TABLE 3-1

ANTICIPATED CAP SCHEDULE



Note: Project startup date selected for illustrative purposes only and may not reflect actual project startup date.

Design, Bid, and Construction Oversite	$25,000
Concrete Work, Fencing, Trenching and Asphalt Patching	10,000
Equipment Costs	17,000
Utility Installation Costs	4,000
Recovery Well Installation	9,000
Total Recovery System Installation	$ 65,000
O&M (2 years operation + 1 year post closure)	90,000
Site Restoration	10,000
Current Estimated Project Cost	$165,000

3.10 CAP SUMMARY

This CAP addresses the LPH in the vicinity of Building 787. Proposed remedial endpoints are less than or equal to 0.01 feet LPH, 500 ppm TPH in soils, and 10 ppm TPH in groundwater. The proposed remedial system design is comprised of LPH skimming systems outfitted in two recovery wells. An equipment compound would be located in the grass area adjacent to Building 787. To reduce potential contaminant leaching into the groundwater, an asphalt patch is proposed for the grass area. Site monitoring will be conducted in accordance with the General CAP Permit requirements in order to monitor progress towards site remediation. It is anticipated that the LPH recovery system would operate for two years. A one year post-operational monitoring period would be conducted subsequent to system shut-down to ensure that remedial goals have been achieved. The total current estimated project costs are approximately $165,000. The DEQ CAP summary worksheet is provided in Table 3-2.

TABLE 3-2 CAP SUMMARY WORKSHEET

PHASE OF CONTAMINATION	PROPOSED CLEANUP ENDPOINTS	PROPOSED MONITORING TO ACHIEVE ENDPOINTS					SYSTEM SHUTDOWN	PROPOSED POST OPER. MONITORING		CLOSE SITE OR REACTIVATE SYSTEM
		SAMPLING LOCATION	SAMPLING FREQUENCY & TYPE	METHOD OF ANALYSIS	SCHEDULE TO ACHIEVE ENDPOINTS	SCHEDULE TO MAINTAIN ENDPOINTS		SAMPLING FREQUENCY & TYPE	POST OPER. MONITORING SCHEDULE	
FREE PRODUCT	≤0.01 feet	MW-1 through 7	Monthly	Interface Probe and bailer	2 yrs	6 mths		Monthly, I.P. and bailer	1 yr.	
DISSOLVED PRODUCT IN GW	10 ppm	MW-1 through 7	bi-annual, (once every 3 months) Grab	TPH by mod. EPA method 8015	2 yrs	6 mths		bi-annual, Grab	1 yr.	
RESIDUAL PRODUCT IN SOILS	500ppm	Grass median near MW-01	NA (not applicable)	TPH by mod. EPA method 8015	NA	NA		Once	1 yr.	
VAPOR PRODUCT EXTRACTED FROM SOILS	100ppmv	Well Head Space, RW-1, RW-2 MW-1, 2	NA	VOCs by EPA method TO-3	NA	NA		Once Grab	1 yr.	

For SWCB Use: Comments: _____

Reviewed by: _____ Date: _____

APPENDIX A

CORRECTIVE ACTION PLAN CHECKLIST

CORRECTIVE ACTION PLAN CHECKLIST

Site: UST System at Building 787 PC# 92-1681 Region TRO

The following checklist must be filled out by the Responsible Party and/or his Consultant and included in the Corrective Action Plan. **Indicated on the checklist the page and section number where each item is addressed in the attached plan.** Also indicate on the checklist the section and page number where justification is given for items omitted from the attached plan. The contents of the report should reflect and be commensurate with the nature of the release, degree of contamination and complexity of the site investigation.

A copy of the Initial Abatement Measures Report and Site Characterization Report must be attached to or included in the Corrective Action Plan.

Items marked with an * are required as part of the CAP Permit Application.

1. CORRECTIVE ACTION PLAN

PAGE / SECTION

4 /2.2 Cleanup measures conducted under Interim Authorization

23 /3.2 * Block diagram, conceptual design, and narrative description of all proposed remediation systems (sketches, locations, design calculations, etc.)

- 27 /3.4 * Maximum hours / day of operation
- 27 /3.4 * Average hours / day of operation
- 27 /3.4 * Days / week of operation

22 /3.1 Numerical remediation endpoints for all applicable phases (eg. TPH, BTEX, lead and other appropriate pollutants)

- 22 /3.1 Free product
- 22 /3.1 Dissolved
- 22 /3.1 Residual
- NA /___ Vapor
- NA /___ System effluent

27 /3.5 Operational monitoring schedule (Also see Table 3-2, CAP Summary Worksheet, pg 33)

- 27 /3.5 Parameters
- 27 /3.5 Frequency
- 27 /3.5 Locations
- 27 /3.5 Methods (media, detection limits, units of measure)

27 /3.5 Achievement of endpoints as evidenced by maintenance of values (numerical endpoints) over time

- 27 /3.5 Parameters
- 27 /3.5 Duration (period of time)
- 27 /3.5 Locations
- 27 /3.5 Methods (media, detection limits, units of measure)

30 /3.8 Proposed system shutdown schedule

Site: UST System at Building 787

29 /3.7 Post-operational monitoring schedule
- 29 /3.7 Parameters
- 29 /3.7 Frequency
- 29 /3.7 Locations
- 29 /3.7 Methods (media, detection limits, units of measure)

29 /3.6 Resumption of cleanup/site closure (CAP modification if necessary)

29 /3.6 Reporting schedule (compliance monitoring and annual reports)

23 /3.2 * Disposal/treatment of contaminated material (soils, free product, filter media, etc.)

29 /3.6 Submittal schedule for free product removal reports

25 /3.3.4 * Proposed actions to notify persons affected by CAP

25 /3.3 * Proposed actions to obtain all applicable Federal, State, and local permits or approvals (DWM, VAPCB, VDH, EPA, UIC etc.)

FOR OFFICE USE ONLY

COMMENTS: _____

DEFICIENCIES: _____

REVIEWED BY: _____ DATE: _____

APPENDIX B

WESTON BOREHOLE LOGS

BOREHOLE LOG

PROJECT ID - PHASE: CTO -142

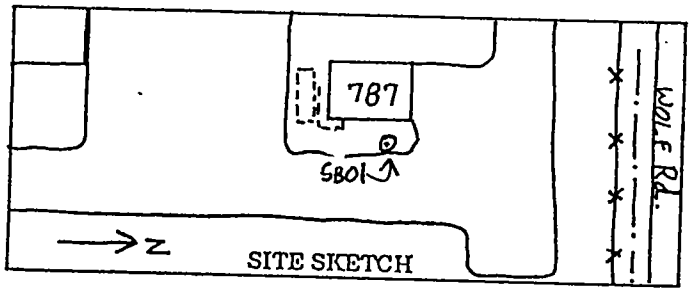
FACILITY ID NWS, Yorktown

LOCATION ID 142SB01 (MW-01)

DATE ESTABLISHED 11 Aug 92 (DD-MMM-YY)

ESTABLISHING COMPANY Weston

LOCATION DESCRIPTION



BOREHOLE DIAMETER (IN) 6.5" I.D., 10" O.D.

TOTAL DEPTH (FT) 38

WATER ENCOUNTERED (FT) 22

TOP OF BEDROCK (FT) N/A

DRILLING/EXCAVATING METHOD H.S.A.

DRILLING/EXCAVATING COMPANY Atec, Inc.

TIME (HHMM)	SAMPLE ID	BEGIN DEPTH (FT)	END DEPTH (FT)	SOIL ROCK TYPE	GEOL MAT TYPE	RECOV (FT)	BLOW COUNT	DESCRIPTION
11:00		26	28	CS/MS	1	100%	3-3-4-3	-27' wet, med. gray w/ rusty brown clayey silt w/ 3" layer of shell fragments intermittent stringers of clayey sand.
11:15		28	30	MS	64	100%	3-6-6-9	wet, light blueish gray sandy silt w/clay, shell fragments (LPH odor)
		30	32	MS-GS	42	100%	4-3-6-3	same, to shell hash (LPH odor)
		32	34	GS	21	100%	6-4-5-4	same
		34	36	GS	6	100%	6-4-7-6	same, shell hash slightly consolidated w/ calcite cement
2:00		36	38	CM	7	100%	3-6-6-6	(-37') v. moist, med. stiff, plastic, dark blue gray clay w/ trace silt and v. thin silty sand laminations.

WESTON

BOREHOLE LOG

PROJECT ID - PHASE: CTO -142

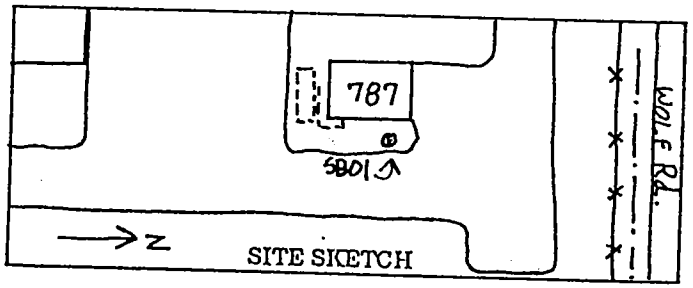
FACILITY ID NWS, Yorktown

LOCATION ID 142SB01 (MW-01)

DATE ESTABLISHED 11 Aug 92 (DD-MMM-YY)

ESTABLISHING COMPANY Weston

LOCATION DESCRIPTION



BOREHOLE DIAMETER (IN) 6.5" I.D., 10" O.D.

TOTAL DEPTH (FT) 38

WATER ENCOUNTERED (FT) 22

TOP OF BEDROCK (FT) N/A

DRILLING/EXCAVATING METHOD H.S.A.

DRILLING/EXCAVATING COMPANY Atec, Inc.

TIME (HHMM)	SAMPLE ID	BEGIN DEPTH (FT)	END DEPTH (FT)	SOIL ROCK TYPE	PPM GEOL MAT TYPE	RECOV (FT)	BLOW COUNT	DESCRIPTION
9:15		0	2	GM	0	50%	5.5.5.6	12" blacktop loam, some crushed stone, yellowish orange, v. moist fine gr. silty sand (fill)
		2	4	|	1	100%	7.8.14.12	(31) Native moist med. gray non cohesive fine gr. silty sand, roots
		4	6	↓	0	"	3.4.4.3	v. moist/sat., yellow to buff orange, non cohesive fine grained silty sand.
9:35	142501-01	6	8	CL/CM	2	"	6.5.5.5	(7.5') v. moist, sat, mottled rusty red to yellowish orange, med. stiff, n. plastic sandy clay.
		8	10	"	1	"	5.7.9.13	v. moist, mottled rusty red to yellowish orange, silty clay with trace sand med. stiff nonplastic.
9:50		10	12	CM	0	"	6.5.5.4	same
10:10		12	14	GM	0	"	6.8.8.9	v. moist (same) mottled rusty saddish brown to tan (10R6/6), stiff silty clay with trace sand.
		14	16	CM	1	"	8.10.8.9	moist, mottled light gray to yellowish orange, slightly micaceous, stiff, non plastic silty clay with trace sand. sand increasing w/ depth
10:20		16	18	MS	0	"	7.9.10.11	(17') 8" dark rusty brown shell hash w/ silty clay matrix, 18.5' v. moist rusty brown sandy silt w/ shells non plastic, friable
10:35	142501-02	18	20	CM	1	"	5.4.3.4	v. moist, dark rusty orange, soft, slightly plastic silty clay w/ trace sand.
		22	22	CM	4	"	2.4.3.3	sats, yellowish orange w/ light gray streaks of clay, v. fine grained silty clay w/ sand (v. fine grained), soft slightly plastic
		22	24	GM/CS	1	"	2.3.3.5	22-23' wet, v. fine grained micaceous silty sand, rusty brown flecks 23-24 wet sandy clay (soft)
		24	26	CS	6	"	3.3.4.4	wet, rusty brown soft, sl. plastic sandy clay with pronounced layers of fine grained sand w/ fines (up to 3" thick).

WESTON

PAGE 1 OF 1

BOREHOLE LOG

PROJECT ID - PHASE: CTO-142

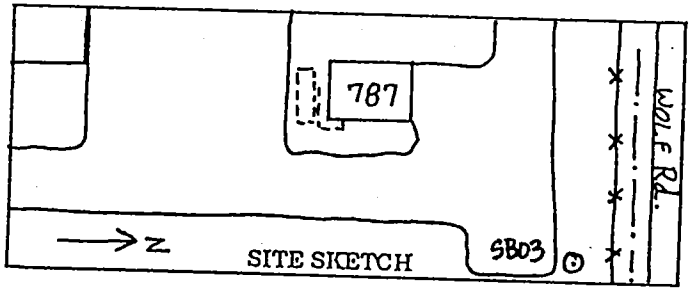
FACILITY ID NWS, Yorktown

LOCATION ID 142SB03 (MW-03)

DATE ESTABLISHED 14 Aug 92 (DD-MMM-YY)

ESTABLISHING COMPANY Weston

LOCATION DESCRIPTION



BOREHOLE DIAMETER (IN) 6.5" I.D., 10" O.D.

TOTAL DEPTH (FT) 40'

WATER ENCOUNTERED (FT) 26'

TOP OF BEDROCK (FT) N/A

DRILLING/EXCAVATING METHOD H.S.A.

DRILLING/EXCAVATING COMPANY Atec, Inc.

TIME (HHMM)	SAMPLE ID	BEGIN DEPTH (FT)	END DEPTH (FT)	SOIL ROCK TYPE	PDM GEOL MAT TYPE	RECOV (FT)	BLOW COUNT	DESCRIPTION
		0	2	SM	0	100%	3-4-4-4	moist/v. moist, yellowish brown to orange, fine grained silty sand, sl. dense.
12:45		4	6	CS	0	100%	4-5-6-6	v. moist; reddish rusty brown, med. stiff, slightly plastic, sandy clay w/silt
1:50		8	10	CS	0	100%	6-7-7-9	v. moist-sat, slightly micaceous, mottled rusty red/orange sandy clay, stiff non plastic fine gr. sand increasing w/depth
2:10	142S03-01	14	16	CS	0	80%	4-6-5-6	v. moist, yellowish orange, sandy clay
		18	20	CM	0	100%	3-6-4-6	v. moist to sat., rusty brown silty clay w/trace sand, stiff, slightly plastic
2:20	142S03-02	24	26	SM	0	100%	3-5-6-8 (26)	sat., silty sand w/shells, buff to light yellowish tan
		28	30	SM	0	100%	6-8-7-8	sat, same w/increase in shells
		34	36	SM	0	50%	9-6-6-7	sat, same
		38	40	CL	0	100%	5-4-6-4	-38', v. moist slate blue gray plastic mod. stiff, silty clay w/sand strongers

WESTON

BOREHOLE LOG

PROJECT ID - PHASE: CTO -142

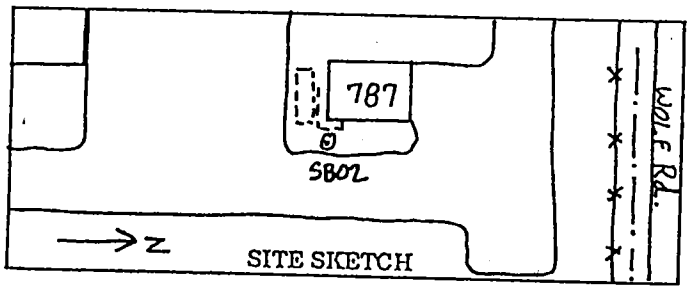
FACILITY ID NWS, Yorktown

LOCATION ID 142SB02 (MW-02)

DATE ESTABLISHED _____ (DD-MMM-YY)

ESTABLISHING COMPANY Weston

LOCATION DESCRIPTION _____



BOREHOLE DIAMETER (IN) 6.5" I.D., 10" O.D.

TOTAL DEPTH (FT) 40

WATER ENCOUNTERED (FT) 29

TOP OF BEDROCK (FT) N/A

DRILLING/EXCAVATING METHOD H.S.A.

DRILLING/EXCAVATING COMPANY Atec, Inc.

TIME (HHMM)	SAMPLE ID	BEGIN DEPTH (FT)	END DEPTH (FT)	SOIL ROCK TYPE	PPM GEOL MAT TYPE	RECOV (FT)	BLOW COUNT	DESCRIPTION
		0	2	CS	0	100%	4-4-3-6	v. moist, yellowish orange sandy clay w/silt, soft, roots fill
9:15		4	6	SM	1	100%	4-3-6-6	v. moist, yellowish orange, silty sand (v. fine gr.) w/clay, non cohesive
		8	10	CS	0	100%	8-7-9-10	v. moist/wet, mottled buff to reddish orange, med. stiff sandy clay w/ silt
11:15	142S02-01	14	16	MS	20	100%	6-6-7-10	v. moist, buff to orange, med. stiff V. fine grained sandy silt w/clay.
11:25		18	20	SC/CS	41	100%	7-5-3-5	(18.5) v. moist rusty brown clayey sand. v. moist dark rusty brown sandy clay w/ trace black (limonite) shells (slight LPH odor in sand)
		24	26	SC	88	50%	2-1-1-2	v. moist/wet, dark gray v. fine grained sandy clay (LPH odor) shell hash at base
11:45	142S02-02	28	30	SM	110	80%	2-2-2-4	v. wet, LPH, light gray silty sand w/ shells, trace clay, very loose
								sat at 29' < 3" lenses of black to dark gray fine grained sand, lots of shell hash in places.
12:00		34	36	MS w/G	10	80%	12-10-10-9	wet, light gray to yellowish buff, shell hash in sandy silt matrix
		38	40	MS/CH	0	100	4-8-10-11	(39') v. moist, blue gray, med. stiff, plastic, silty clay

WESTON

BOREHOLE LOG

PROJECT ID - PHASE: CTO-142

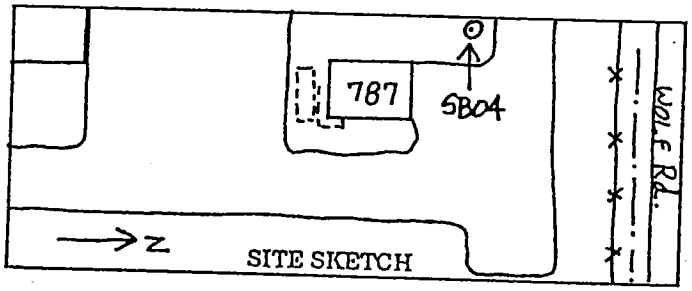
FACILITY ID NWS, Yorktown (...)

LOCATION ID 142SB04 (MW-04)

DATE ESTABLISHED _____ DD-MMM-YY

ESTABLISHING COMPANY Weston

LOCATION DESCRIPTION _____



BOREHOLE DIAMETER (IN) 6.5" I.D., 10" O.D.

TOTAL DEPTH (FT) _____

WATER ENCOUNTERED (FT) 27'

TOP OF BEDROCK (FT) N/A

DRILLING/EXCAVATING METHOD H.S.A.

DRILLING/EXCAVATING COMPANY Atec, Inc.

TIME (HHMM)	SAMPLE ID	BEGIN DEPTH (FT)	END DEPTH (FT)	SOIL ROCK TYPE	~~PPM~~ GEOL MAT TYPE	RECOV (FT)	BLOW COUNT	DESCRIPTION
9:28		0	2	SM	0	75%	3-6-8-10	loam, v. moist to wet, black to rusty brown, silty sand w/ clay
								fine grained, cohesive w/ depth, med. dense
9:36		4	6	SM	3	100%	5-5-5-6	wet, rusty brown to med. gray, med. dense, cohesive, fine grained
								silty sand, rare wood frags.
9:45		8	10	CS/CL	2	100%	4-6-8-10	(8.5) v. moist, mottled rusty brown to light brick red, sandy clay stiff, mod. dense/plastic
9:50	142504-01	14	16	CL/CS	1	100%	3-5-6-6	same, sandier dense at 14.5-14.8' med. stiff, less plastic
10:05		18	20	WCL	3	100%	3-4-5-6	(19') v. moist-wet, rusty orange, soft to med. stiff, clayey silt
								w/ trace sand, black limonitic concretions throughout (30-40%)
10:20	142504-02	24	26	SM	9	80%	4-4-4-6	(26') v. moist to wet (▼27') rusty brown fine grained sand w/ silt, trace clay, loose, black flecks, reach bend
								Δ at 29' based on auger resistance?
10:30		28	30	SM	2	100%	3-5-3-3	same
11:00		34	36	CL/S	6	100%	5-6-6-8	wet, buff to light cream brown, sandy clay and shell hash some silt shell hash
12:00		38	40	CL	0	100%	5-9-10-13	(38') v. moist, slate gray, clay w/ trace silt, shell frags., <1/8" laminations

WESTON

BOREHOLE LOG

PROJECT ID - PHASE: CTO-142

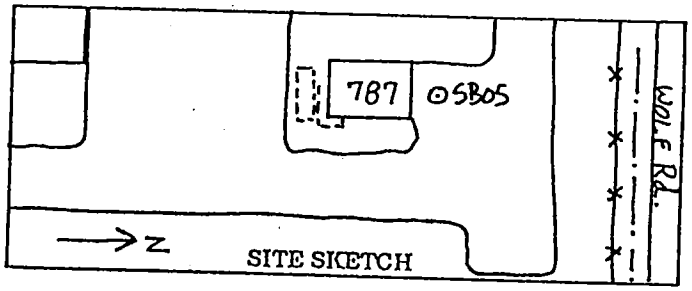
FACILITY ID NWS, Yorktown

LOCATION ID 142SB05

DATE ESTABLISHED 18-08-92 (DD-MMM-YY)

ESTABLISHING COMPANY Weston

LOCATION DESCRIPTION



BOREHOLE DIAMETER (IN) 6.5" I.D., 10" O.D.

TOTAL DEPTH (FT) 38'

WATER ENCOUNTERED (FT) 27'

TOP OF BEDROCK (FT) NA

DRILLING/EXCAVATING METHOD H.S.A.

DRILLING/EXCAVATING COMPANY Atec, Inc.

TIME (HHMM)	SAMPLE ID	BEGIN DEPTH (FT)	END DEPTH (FT)	SOIL ROCK TYPE	PPM GEOL MAT TYPE	RECOV (FT)	BLOW COUNT	DESCRIPTION
2:45		0	2	SM	0	75%	2-3-2	6" asphalt, v. moist rusty brown loose v fine grained silty sand
3:00		4	6	SM	2	100%	4-3-3-4	same, 6" layer dark brown, silty sand at 4-4.5'
3:10		10	12	CS	8	100%	5-6-7-8	v. moist, mottled light brown to rust orange, v. fine grained sandy clay w/ silt med. dense slight plastic
3:15	142S05-01	14	16	MS	7	100%	2-3-6-6	moist, rusty orange, sandy silt with trace clay, med. dense, non-plastic
3:30		20	22	CS	9	60%	3-4-4-5	v. moist, rusty brown to orange, sandy clay w/ silt, sl. plastic, soft.
3:40	142S05-02	26	28	SM	3	100%	4-4-4-3	(24') v. moist to wet (▼27'), light tan, shelly silty sand w/ clay
3:50		32	34	SM	1	100%	5-6-9-8	same, shell hash increase w/ depth
		36	38	CL	0	100%	4-5-6-6	v. moist slate blue gray, dense, plastic, clay with trace silt and sand
								w/ shells, thin <1/8" sandy (v. fine) laminations

WESTON

BOREHOLE LOG

PROJECT ID - PHASE: CTO-142

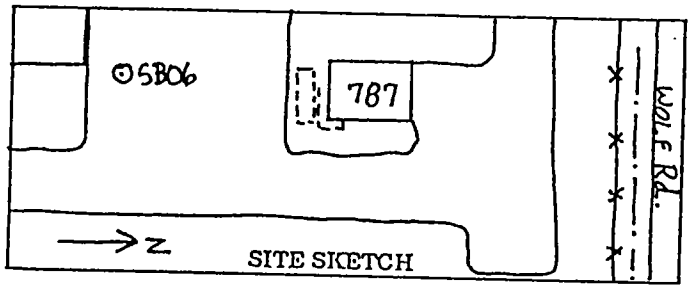
FACILITY ID NWS, Yorktown

LOCATION ID 142SB06 (MW-05)

DATE ESTABLISHED 19 Aug 92 (DD-MMM-YY)

ESTABLISHING COMPANY Weston

LOCATION DESCRIPTION upgradient well



BOREHOLE DIAMETER (IN) 6.5" I.D., 10" O.D.

TOTAL DEPTH (FT) 40'

WATER ENCOUNTERED (FT) 26'

TOP OF BEDROCK (FT) NA

DRILLING/EXCAVATING METHOD H.S.A.

DRILLING/EXCAVATING COMPANY Atec, Inc.

TIME (HHMM)	SAMPLE ID	BEGIN DEPTH (FT)	END DEPTH (FT)	SOIL ROCK TYPE	~~PDM~~ GEOL MAT TYPE	RECOV (FT)	BLOW COUNT	DESCRIPTION
10:40		0	2	CS	10	75%	2·3·3	6" crusher rem (12" concrete removed), v. moist–wet, light brown, sandy clay, med. dense, non plastic
11:00		4	6	SC	8	100%	2·2·3·6	moist, light brown, loose, fine grained clayey sand
11:15	142506-01	8	10	CS	11	100%	3·6·6·10	moist, mottled rusty orange to tan med. stiff sandy clay w/ trace silt
1125		14	16	SC	10	100%	4·6·6·8	moist, mottled rusty orange to tan med stiff clayey sand w/ trace silt
11:35		18	20	MS	7	100%	3·3·5·6	v. moist, mottled rusty orange clayey sandy silt, at 19' thin discrete lenses of black sandy brown material
11:45	142506-02	24	26	SC	2	100%	2·2·2·2	Δ 25.5' ▼26' wet rusty brown loose shelly sand w/ clay
11:55		28	30	CS	0	50%	2·11	wet, v. soft, sand, clay w/ shells, rusty brown, med plastic
12:15		34	36	GS	0	100%	4·4·7·11	wet, buff to tan, shell hash with sandy clay matrix (which is sl. plastic)
		38	40	CL	0	100%	4·4·6·6	38' v. moist, 39' slate blue gray, shelly, stiff, plastic, clay, w/ thin laminations v. fine grained black sand

WESTON

BOREHOLE LOG

PROJECT ID - PHASE: CTO-142

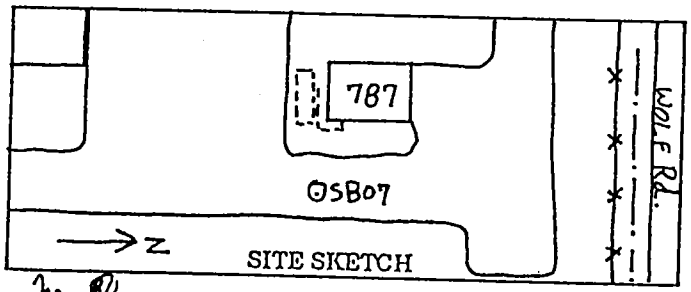
FACILITY ID NWS, Yorktown

LOCATION ID 142SB07

DATE ESTABLISHED 19-Aug-92 (DD-MMM-YY)

ESTABLISHING COMPANY Weston

LOCATION DESCRIPTION



BOREHOLE DIAMETER (IN) 6.5" I.D., 10" O.D.

TOTAL DEPTH (FT) 40'

WATER ENCOUNTERED (FT) 27'

TOP OF BEDROCK (FT) NA

DRILLING/EXCAVATING METHOD H.S.A.

DRILLING/EXCAVATING COMPANY Atec, Inc.

hnu @

TIME (HHMM)	SAMPLE ID	BEGIN DEPTH (FT)	END DEPTH (FT)	SOIL ROCK TYPE	~~PPM~~ GEOL MAT TYPE	RECOV (FT)	BLOW COUNT	DESCRIPTION
2:55		0	2	CS	4	60%	6-7-8-11	6" asphalt, dry, stiff, nonplastic, light brown sandy clay w/ silt
3:05		4	6	SC	8	100%	4-6-9-9	sl. moist, light rusty orange, sandy clay w/ some silt
3:15	142S07-01	8	10	MS	14	100%	6-6-6-6	moist, mottled rusty orange to tan, sandy silt w/ clay
3:25		14	16	MS	10	90%	4-3-4-4	same
3:30		18	20	MS	2	50%	4-4-4-4	v. moist, rusty brown, w/ limonite coated shell frags., sandy silt w/ clay
3:40	142S07-02	26	28	CS/SM	4	100%	2-4-7-3	26-27' rusty brown sandy clay Δ27' wet (@27') shelly. To loose tan to light gray clayey sand w/ silt
4:00		34	36	GS	0	100%	5-5-4-9	wet, shell hash w/ silty sand, buff to grayish tan, sl. dense
4:15		38	40	CL	0	100%	4-6-3-4	Δ38') v. moist slate gray plastic sl. dense, silty sandy clay, shelly.

WESTON

BOREHOLE LOG

PROJECT ID - PHASE: CTO -142

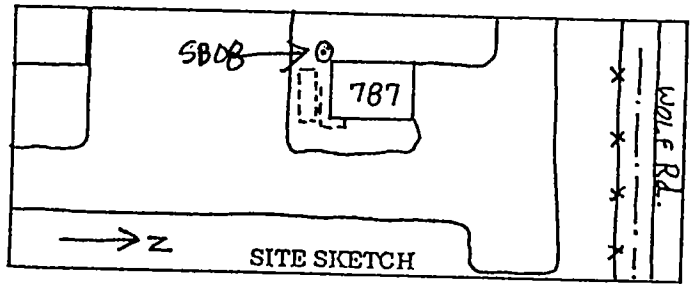
FACILITY ID NWS, Yorktown

LOCATION ID 142SB08 (MW-06)

DATE ESTABLISHED 20 Aug 92 (DD-MMM-YY)

ESTABLISHING COMPANY Weston

LOCATION DESCRIPTION near UST



BOREHOLE DIAMETER (IN) 6.5" I.D., 10" O.D.

TOTAL DEPTH (FT) 36'

WATER ENCOUNTERED (FT) 25'

TOP OF BEDROCK (FT) NA

DRILLING/EXCAVATING METHOD H.S.A.

DRILLING/EXCAVATING COMPANY Atec, Inc.

TIME (HHMM)	SAMPLE ID	BEGIN DEPTH (FT)	END DEPTH (FT)	SOIL ROCK TYPE	PID/FID GEOL MAT TYPE	RECOV (FT)	BLOW COUNT	DESCRIPTION
10:26		0	2	SC	0	80%	1-2-2-2	wet, med. rusty brown, clayey fine grained sand w/some silt and rare gravel
10:40		4	6	CS/GM	4	100%	2-3-3-2	v. moist, med brown to black sandy clay to 4.5', 6" black loam w/ roots
							(5')	5-6' v. fine grained brown sand loose, some silt,
10:50		8	10	CS	0	100%	3-5-5-5	wet, mottled gray to light orange, M. stiff, sl. plastic, sandy clay
11:00	142SOB-01	14	16	CS/CM	6	100%	3-3-5-7	v. moist, silty clay w/sand and limonitic concretions, rust orange, P. stiff
11:10		18	20	CM	1	100%	3-4-4-3	same
11:25	142SOB-02	24	26	CM/SM	3	100%	3-2-3-3	▼25', (25) rust brown, wet, shelly, soft, plastic silty sand
11:30		28	30	GS	8	100%	4-4-4-7	wet, light rusty brown to tan, shell hash, with sandy clay matrix, loose
		34	36	GS/C	11	100%	37-4-6	same, cleared auger w/ plug retrieve w/ blue gray clay
								likely at 1.27'

WESTON

BOREHOLE LOG

PROJECT ID - PHASE: CTO -142 _

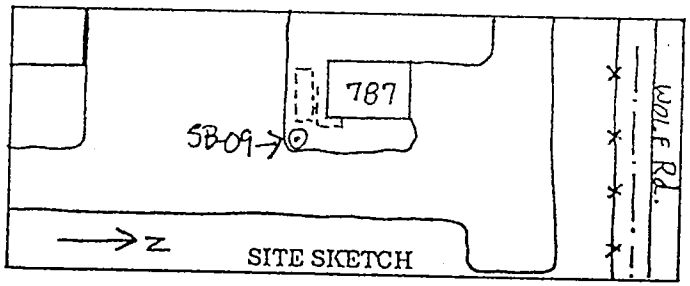
FACILITY ID NWS, Yorktown _ _)

LOCATION ID 142SB09 _

DATE ESTABLISHED 21 Aug 92 (DD-MMM-YY)

ESTABLISHING COMPANY Weston

LOCATION DESCRIPTION _____



BOREHOLE DIAMETER (IN) 6.5" I.D., 10" O.D.

TOTAL DEPTH (FT) 36'

WATER ENCOUNTERED (FT) 22.7'

TOP OF BEDROCK (FT) NA

DRILLING/EXCAVATING METHOD H.S.A.

DRILLING/EXCAVATING COMPANY Atec, Inc.

TIME (HHMM)	SAMPLE ID	BEGIN DEPTH (FT)	END DEPTH (FT)	SOIL ROCK TYPE	~~PPM~~ GEOL MAT TYPE	RECOV (FT)	BLOW COUNT	DESCRIPTION
12:30		0	2	SC	0	100%	1-2-2-2	V. moist, brownish gray, clayey sand, Sill
1:20		4	6	CS	0	100%	4-3-4-3	4' V. moist med. stiff, brown, sandy clay
1:28		8	10	CS	4	60%	4-6-6-7	Moist, mottled rusty brown to light gray, sandy clay, mod. stiff dense
1:35	142509-01	14	16	CS	2	100%	6-5-6-3	V. moist, mottled orange-tan, sandy clay, mod. stiff, dense
		18	20	CS/CM	0	100%	1-2-1-2	Same V. moist, soft, plastic, sandy silty clay, brownish green LPH staining
1:55	142509-02	24	26	CS	48	100%	14-24-4	▼27' same w/ increase in silt content w/depth
		28	30	CS/MS	14	80%	3-2-4-2	sat., sandy clay to sandy silt, soft, some clay
		34	36	SM	2	100%	3-4-6-5	sats, sandy clayey silt, rusty brown, v. wet, sl. dense
								LPH observed in casing after soft open 1/hr (2 1/2") as on bailer

WESTON

BOREHOLE LOG

PROJECT ID - PHASE: CTO -142

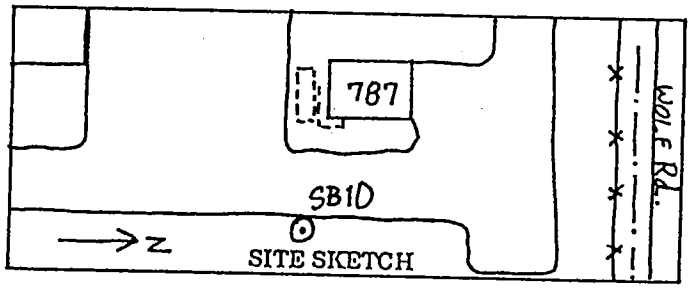
FACILITY ID NWS, Yorktown

LOCATION ID 1425B10 (MW-07)

DATE ESTABLISHED 24-Aug-92 (DD-MMM-YY)

ESTABLISHING COMPANY Weston

LOCATION DESCRIPTION



BOREHOLE DIAMETER (IN) 6.5" I.D., 10" O.D.

TOTAL DEPTH (FT) 36'

WATER ENCOUNTERED (FT) 24'

TOP OF BEDROCK (FT) NA

DRILLING/EXCAVATING METHOD H.S.A.

DRILLING/EXCAVATING COMPANY Atec, Inc.

TIME (HHMM)	SAMPLE ID	BEGIN DEPTH (FT)	END DEPTH (FT)	SOIL ROCK TYPE	~~PDM~~ GEOL MAT TYPE	RECOV (FT)	BLOW COUNT	DESCRIPTION
9:50		0	2	SC	2	100%	2-5-6-5	sl-mod. sl. moist, brown clayey sand, fine grained, dense, roots
10:20		4	6	CS	1	100%	3-6-7-7	moist, mottled rusty orange to tan, fine grained sandy clay with silt m. stiff NP
10:30		8	10	CS	3	100%	3-6-7-8	same
10:45	1425B10-01	14	16	CS/shell	3	100%	4-4-8-8	(15') moist, sandy clay w/ limonitic concretions and coated shells, non-plastic, mod. stiff
10:52		18	20	CS	1	100%	3-3-4-5	v. moist, rusty orange w/ speckled tan (shell casts) sandy clay, soft, plastic
11:00	1425B10-02	24	26	SM	2	100%	3-3-3-1	(24') v. moist to wet (▼24') grayish tan to rusty tan, shelly silty sand w/ clay, loose
11:12		28	30	GS/SC	0	100%	3-23-5	wet, loosely consolidated gravelly shell hash, calcic with soupy clayey sand matrix
11:20		34	36	MS	0	100%	3-2-3-3	wet, tan, shelly sandy silt, with clay, sl. plastic, soft.

WESTON

BOREHOLE LOG

PROJECT ID - PHASE: CTO-142

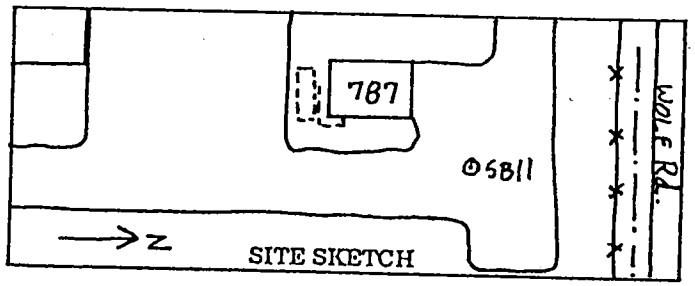
FACILITY ID NWS, Yorktown

LOCATION ID 142SB11

DATE ESTABLISHED 24-Aug-92 (DD-MMM-YY)

ESTABLISHING COMPANY Weston

LOCATION DESCRIPTION



BOREHOLE DIAMETER (IN) 6.5" I.D., 10" O.D.

TOTAL DEPTH (FT) 36'

WATER ENCOUNTERED (FT) ~26.0

TOP OF BEDROCK (FT) N/A

DRILLING/EXCAVATING METHOD H.S.A.

DRILLING/EXCAVATING COMPANY Atec, Inc.

TIME (HHMM)	SAMPLE ID	BEGIN DEPTH (FT)	END DEPTH (FT)	SOIL ROCK TYPE	PPM GEOL MAT TYPE	RECOV (FT)	BLOW COUNT	DESCRIPTION
1:30		0	2	CS	3	100%	3-6-5-4	6" asphalt, 6" crushed run; 1' dry, brown, sandy clay, non plastic, stiff
1:35		4	6	CS	3	100%	6-3-5-6	moist, med. brown, fine grained, mod. stiff, non plastic, sandy clay
1:45		8	10	CM	2	100%	8-5-7-8	moist, mottled rusty orange to tan, stiff, med. plastic, silty clay with trace sand.
1:55	142S11-01	14	16	MS	3	100%	4-7-7-5	moist, rusty brown stain, sandy silt (v. fine grained) with trace clay, slightly stiff, non plastic.
2:02		18	20	CMS	2	100%	4-4-4-5	v. moist, rusty brown, soft, plastic, sandy clay with some silt
2:10	142S11-02	24	26	CS/S	6	100%	2-2-2-2	v. moist to sat. (◀~26'), rusty brown to gray sandy clay to fine grained non cohesive sand at depth
2:20		28	30	GS	12	100%	2-3-3-3	sat., gravelly & shell hash with silty sand matrix, product odor
2:30		34	36	GS	10	100%	5-3-5-8	sat, shell hash with silty sand, med. dense, buff to grayish tan

Borehole left open overnite. Placed bailer in SB-11 on 8/25/92. Observed ~¼" LPA, clear, yellow, #2 fuel oil

APPENDIX C

LIQUID LEVEL MEASUREMENTS

Fluid Level Measurements
Building 787, NWS Yorktown
Yorktown, VA
29 August 1992

Recorded By: Ed Dullaghan

Monitoring Wells

WELL NO.	DTP (ft)	DTW (ft)	PT (ft)	ELEV.[1] (ft)	WATER ELEV. (ft)	CORRECTED WATER ELEV. (ft)	COMMENTS
MW-01	26.06	26.10	.04	61.23	35.13	35.16	
MW-02	25.62	26.05	.43	60.83	34.78	35.12	
MW-03	–	28.15		61.77	33.62		
MW-04	–	26.89		60.28	33.39		
MW-05	–	20.11		58.19	38.08		
MW-06	–	23.42		60.71	37.29		
MW-O7	–	22.32		58.49	36.17		

ft - Feet.
[1] - Elevation from temporary benchmark set with spike in power pole relative to mean sea level.
DTP - Depth to product.
DTW - Depth to water, as measured relative to mark at top of PVC casing.
PT - Product Thickness.
Elev - Elevation of marked top of PVC casing.
Water Elev - Elevation of Groundwater.
Corrected W Elev - Where product detected, groundwater elevation has been corrected by a factor of 0.81 (No. 2 fuel oil).
– Not detected.

Fluid Level Measurements
Building 787, NWS Yorktown
Yorktown, VA
25 August 1992

Recorded By: Ed Dullaghan

Monitoring Wells

WELL NO.	DTP (ft)	DTW (ft)	PT (ft)	ELEV.[1] (ft)	WATER ELEV. (ft)	CORRECTED WATER ELEV. (ft)	COMMENTS
MW-01	25.61	25.71	.10	61.23	35.52	35.60	
MW-02	24.23	25.03	.80	60.83	36.45	35.12	Honey colored Clear LPH
MW-03	--	27.63		61.77	34.14		
MW-04	--	25.49		60.28	34.79		
MW-05	--	20.00		58.19	38.19		
MW-06	--	23.19		60.71	37.52		
MW-O7	--	22.01		58.49	36.48		

ft - Feet.
[1] - Elevation from temporary benchmark set with spike in power pole relative to mean sea level.
DTP - Depth to product.
DTW - Depth to water, as measured relative to mark at top of PVC casing.
PT - Product Thickness.
Elev - Elevation of marked top of PVC casing.
Water Elev - Elevation of Groundwater.
Corrected W Elev - Where product detected, groundwater elevation has been corrected by a factor of 0.81 (No. 2 fuel oil).
-- Not detected.

III. Aromatic Volatiles: EPA Method 602, Purge & Trap.

(Results presented in ug/l)
Matrix: Liquid

SAMPLE ID	ETS ID#	BENZENE	TOLUENE	C.BENZENE	E.BENZENE	1,3-DCB	1,4-DCB	1,2-DCB	XYLENES
142GW03-01	22284	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
142GW03-01A	22285	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
142GW04-01	22287	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
142GW05-01	22286	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
142GW06-01	22288	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.4
142GW07-01	22293	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
142GW07-01B	22294	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
142GW07-01C	22295	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Anne S. Burnett
Quality Control Officer

CHAIN-OF-CUSTODY RECORD

ENVIRONMENTAL TESTING SERVICES, INC.
P.O. Box 12715 • 888 Norfolk Square • Norfolk, VA 23502
(804) 461-3874 • Fax (804) 461-0379

CLIENT INFORMATION	
Company Prov. Forrester / Baker Environmental	
Contact Ed Dullaghan	
Address Pembroke II, Suite 113, 287 Independence, Va. Beach, Va	
Phone & FAX 804-473-9729 / 804 473 9744	
Job No. 06629-001-024-0050	Purchase Order No.
Project NAVS Yorktown, bldg 787	Quote Number

20-22' EMD

Sample ID	Lab No.	Sample Location	Date/Time Collected	Collected By	Matrix	Preservative	Analysis	Field Readings/ Comments
142S01-01		Soil boring SB1(14-16')	8/11/92 9:35	Dullaghan	Soil	Ice	TPH	
142S01-02		Soil boring SB1(26-28')	8/11/92 - 10:35				TPH	
142S02-01		SB2-(14-16)	8/12/92 - 11:15				TPH	
142S02-02		SB2-(26-28)	8/12/92 - 11:45				TPH	
142S02-03		SB2 composite	8/12/92 - 12:30				BTEX, Sieve, TCLP Flash Point	
142S03-01		SB3 (14-16')	8/14/92 - 1:10				TPH	
142S03-02		SB3 (24-26')	8/14/92 - 2:30				TPH	
142S04-01		SB4 (14-16')	8/17/92 - 9:50				TPH	
142S04-02		SB4 (26-28')	8/17/92 - 10:20				TPH	
142S05-01		SB5 (14-16')	8/18/92 - 3:15	↓	↓	↓	TPH	

Special Instructions: _____

Possible Sample Hazards: _____

Sample Disposal: Return to Client _____ *or* Disposal by Lab ✓

Express Service: yes / no Express Hours: _____

ETS USE ONLY:
SF-254 Classification No.: _____
Code S: _____
Pick-up / Collection Charge (circle one): _____
Mileage Charge yes / no (# _____)

Relinquished By:	Signature	Company	Date/Time 8-19-92 7:35
Received By:	Signature	Company ETS	Date/Time 8-19-92 7:35AM
Relinquished By:	Signature	Company	Date/Time
Received By:	Signature	Company	Date/Time
Relinquished By:	Signature	Company	Date/Time
Received By:	Signature	Company	Date/Time 3-31

CHAIN-OF-CUSTODY RECORD

ENVIRONMENTAL TESTING SERVICES, INC.
P.O. Box 12715 • 888 Norfolk Square • Norfolk, VA 23502
(804) 461-3874 • Fax (804) 461-0379

CLIENT INFORMATION	
Company Baker/R E Weston	
Contact Ed Dullaghan	
Address Pembroke II, Suite 113, 287 Independence, Va. Bch, Va. 23462	
Phone & FAX 804 473 9779 473 9744	
Job No. CTO 147	Purchase Order No.
Project NWS Yorktown, bld 787	Quote Number

Sample ID	Lab No.	Sample Location	Date/Time Collected	Collected By	Matrix	Preservative	Analysis	Field Readings/ Comments
147 SOB-01		grab SB08 (14-16')	8/20/92 - 11:00	Dullaghan	Soil	Preservative	TPH	
147 SOB-02		grab SB08 (24-26')	8/20/92 - 11:25	↓	↓	↓	TPH	
147 SOB-03		grab SB08 (24-26')	8/20/92 - 11:25				TPH	
147 SO9-01		grab SB09 (14-16')	8/21/92 - 1:35				TPH	
147 SO9-02		grab SB09 (24-26')	8/21/92 - 1:55				TPH	
147 SO9-03		grab SB09 (24-26')	8/21/92 - 1:55				TPH	
147 S10-01		grab SB10 (14-16')	8/24/92 - 10:45				TPH	
147 S10-02		grab SB10 (24-26')	8/24/92 - 11:00	↓	↓	↓	TPH	

Special Instructions: _____

Possible Sample Hazards: _____

Sample Disposal: Return to Client _____ *or* Disposal by Lab _____

Express Service: yes / no Express Hours: _____

ETS USE ONLY:

SF-254 Classification No. _____

Code S: _____

Pick-up / Collection Charge (circle one): _____

Mileage Charge yes / no (# _____)

Relinquished By:	Signature EM Dullaghan	Company W.E.	Date/Time 8-25-92 7:20 AM
Received By:	Signature J.E. Reed	Company ETS	Date/Time 8-25-92 7:20 AM
Relinquished By:	Signature	Company	Date/Time
Received By:	Signature	Company	Date/Time
Relinquished By:	Signature	Company	Date/Time
Received By:	Signature	Company	Date/Time

CHAIN-OF-CUSTODY RECORD

ENVIRONMENTAL TESTING SERVICES, INC.
P.O. Box 12715 • 888 Norfolk Square • Norfolk, VA 23502
(804) 461-3874 • Fax (804) 461-0379

CLIENT INFORMATION	
Company Baker / R.F. Weston	
Contact Ed Dullaghan	
Address Pembroke II Suite 113, 287 Independence Va Beach VA 23462	
Phone & FAX 804 473 9729 / 473 9749	
Job No. CTO-142	Purchase Order No.
Project NWS Yorktown bldg 787	Quote Number

Sample ID	Lab No.	Sample Location	Date/Time Collected	Collected By	Matrix	Preservative	Analysis	Field Readings/ Comments
142 S11-01		grab (14-16')	8/24/92 - 1:55	Dullaghan	Soil	Ice	TPH	
142 S11-02		grab (24-26')	8/24/92 - 2:10	"	"	"		
142 S12-01		grab	8/24/92 - 2:30	"	"	"	BTEX	

Special Instructions: _____

_____

Possible Sample Hazards: _____

Sample Disposal: Return to Client _____ *or* Disposal by Lab _____

Express Service: yes / no Express Hours: _____

ETS USE ONLY:

SF-254 Classification No. _____

Code S: _____

Pick-up / Collection Charge (circle one): _____

Mileage Charge yes / no (# _____)

Relinquished By:	Signature E.M. Dullaghan	Company Weston	Date/Time 8-25-92 7:20AM
Received By:	Signature N. Floyd	Company ETS	Date/Time 8-25-92 7:20AM
Relinquished By:	Signature	Company	Date/Time
Received By:	Signature	Company	Date/Time
Relinquished By:	Signature	Company	Date/Time
Received By:	Signature	Company	Date/Time

CHAIN-OF-CUSTODY RECORD

ENVIRONMENTAL TESTING SERVICES, INC.
P.O. Box 12715 • 888 Norfolk Square • Norfolk, VA 23502
(804) 461-3874 • Fax (804) 461-0379

CLIENT INFORMATION	
Company Baker/Weston	
Contact Ed Dullaghan	
Address Pembroke II, Suite 113, 287 Independence Blvd Va Beach 23462	
Phone & FAX 804-473 9729 / 473-9744	
Job No. NNS Yorktown 787	Purchase Order No.
Project 06629-001-028-0510	Quote Number

Delivery Order #

SWD

Sample ID	Lab No.	Sample Location	Date/Time Collected	Collected By	Matrix	Preservative	Analysis	Field Readings/ Comments
142GW03-01		142GW03	10:10/8-28-92	Ed Dullaghan	Water	Ice	Purgable Aromatics	(602)
142GW03-01			10:10/8-28-92	Dullaghan	Water	HCl, Ice	TPH	(418.1)
142GW03-01			10:10/8-28-92	Dullaghan	Water	HNO3, Ice	Lead	(239.2)
142GW03-01A			10:10/8-28-92	Dullaghan	Water	Ice	Purgable Aromatics	(602)
142GW05-01		142GW05	11:35/8-28-92	Dullaghan	Water	Ice	Purgable Aromatics	602
142GW05-01		142GW05	11:35/8-28-92	Dullaghan	Water	HCl, Ice	TPH	418.1
142GW05-01		142GW05	11:35/8-28-92	Dullaghan	Water	HNO3, Ice	Lead	239.2
142GW04-01		142GW04	12:30/8-28-92	Dullaghan	Water	Ice	Purgable Aromatics	602
142GW04-01		142GW04	12:30/8-28-92	Dullaghan	Water	HCl, Ice	TPH	418.1
142GW04-01		142GW04	12:30/8-28-92	Dullaghan	Water	HNO3 Ice	Lead	239.2

Special Instructions: _____

_____

Possible Sample Hazards: _____

Sample Disposal: Return to Client _____ *or* Disposal by Lab _____

Express Service: yes / no **Express Hours:** _____

ETS USE ONLY:

SF-254 Classification No. _____

Code S: _____

Pick-up / Collection Charge (circle one): _____

Mileage Charge yes / no (# _____)

Relinquished By:	Signature EM Dullaghan	Company Weston	Date/Time 8-28-92
Received By:	Signature [illegible]	Company ESE	Date/Time 8-29-92 / 1555
Relinquished By:	Signature	Company	Date/Time
Received By:	Signature	Company	Date/Time
Relinquished By:	Signature	Company	Date/Time
Received By:	Signature	Company	Date/Time

CHAIN-OF-CUSTODY RECORD

ENVIRONMENTAL TESTING SERVICES, INC.
P.O. Box 12715 • 888 Norfolk Square • Norfolk, VA 23502
(804) 461-3874 • Fax (804) 461-0379

CLIENT INFORMATION	
Company	Baker/Weston
Contact	Ed Dullaghan
Address	Pembroke IV, Suite 113 2857 Under Va. Beach 234[illegible]
Phone & FAX	804 473-9729 / 473-9744
Job No.	Purchase Order No.
Project 06629-001-028-050	Quote Number

Delivery Order # →

Sample ID	Lab No.	Sample Location	Date/Time Collected	Collected By	Matrix	Preservative	Analysis	Field Readings/ Comments
1426W04-01A		1426W04	12:30 / 8-28-92	Dullaghan	Water	HNO3, Ice	Lead	(239.2)
1426W04-01B		1426W04	12:30 / 8-28-92	Dullaghan	Water	HNO3, Ice	Lead	239.2
1426W07-01		1426W07	1:00 / 8-28-92	Dullaghan	Water	Ice	Purgable Aromatics	602
1426W07-01		1426W07	1:00 / 8-28-92	Dullaghan	Water	HCl Ice	TPH	418.1
1426W07-01		1426W07	1:00 / 8-28-92	Dullaghan	Water	HNO3 Ice	Lead	239.2
1426W07-01B		1426W07	1:00 / 8-28-92	Dullaghan	Water	Ice	Purgable Aromatics	602
1426W07-01C		1426W07	1:00 / 8-28-92	Dullaghan	Water	Ice	Purgable Aromatics	602

Special Instructions: _____

_____

Possible Sample Hazards: _____

Sample Disposal: Return to Client _____ *or* Disposal by Lab _____

Express Service: yes / no **Express Hours:** _____

ETS USE ONLY:
SF-254 Classification No. _____
Code S: _____
Pick-up / Collection Charge (circle one): _____
Mileage Charge yes / no (# _____)

Relinquished By:	Signature		Company Weston	Date/Time 8-28-92
Received By:	Signature		Company ETS	Date/Time 8-28-92 / 1550
Relinquished By:	Signature		Company	Date/Time
Received By:	Signature		Company	Date/Time
Relinquished By:	Signature		Company	Date/Time
Received By:	Signature		Company	Date/Time

CHAIN-OF-CUSTODY RECORD

ENVIRONMENTAL TESTING SERVICES, INC.
P.O. Box 12715 • 888 Norfolk Square • Norfolk, VA 23502
(804) 461-3874 • Fax (804) 461-0379

CLIENT INFORMATION	
Company	Baker / Weston
Contact	Ed Dillashaw
Address	Pembroke 1 Suite 113 287 Independence Blvd Va Beach 23462
Phone & FAX	497 473 9729 / 473 9744
Job No.	Purchase Order No.
Project IK677-01.07350	Quote Number

Delivery Order # →

Sample ID	Lab No.	Sample Location	Date/Time Collected	Collected By	Matrix	Preservative	Analysis	Field Readings/ Comments
1426WD6-01		1426WD6	1:30 / 8-28-92	Dillashaw	Water	Ice	Purge & Properties	602
1426WD6-01			1:30 / 8-28-92			HCl Ice	TPH	418.1
1426WD6-01			1:30 / 8-28-92			HNO3 Ice	Field	229.2
1426WD6-01A			1:30 / 8-28-92			HCl Ice	TPH	418.1
1426WD6-01B			1:30 / 8-28-92			HCl, Ice	TPH	418.1

Special Instructions: _____

Possible Sample Hazards: _____

Sample Disposal: Return to Client _____ *or* Disposal by Lab _____

Express Service: yes / no Express Hours: _____

ETS USE ONLY:

SF-254 Classification No. _____

Code S: _____

Pick-up / Collection Charge (circle one): _____

Mileage Charge yes / no (# _____)

Relinquished By:	Signature	Company Weston	Date/Time 8-28-92
Received By:	Signature	Company ESS	Date/Time 8-28-92 / 1550
Relinquished By:	Signature	Company	Date/Time
Received By:	Signature	Company	Date/Time
Relinquished By:	Signature	Company	Date/Time
Received By:	Signature	Company	Date/Time

APPENDIX E

LPH RECOVERY SYSTEM EQUIPMENT SPECIFICATIONS

LPH RECOVERY SYSTEM
EQUIPMENT LIST
NWS-YORKTOWN BUILDING 787

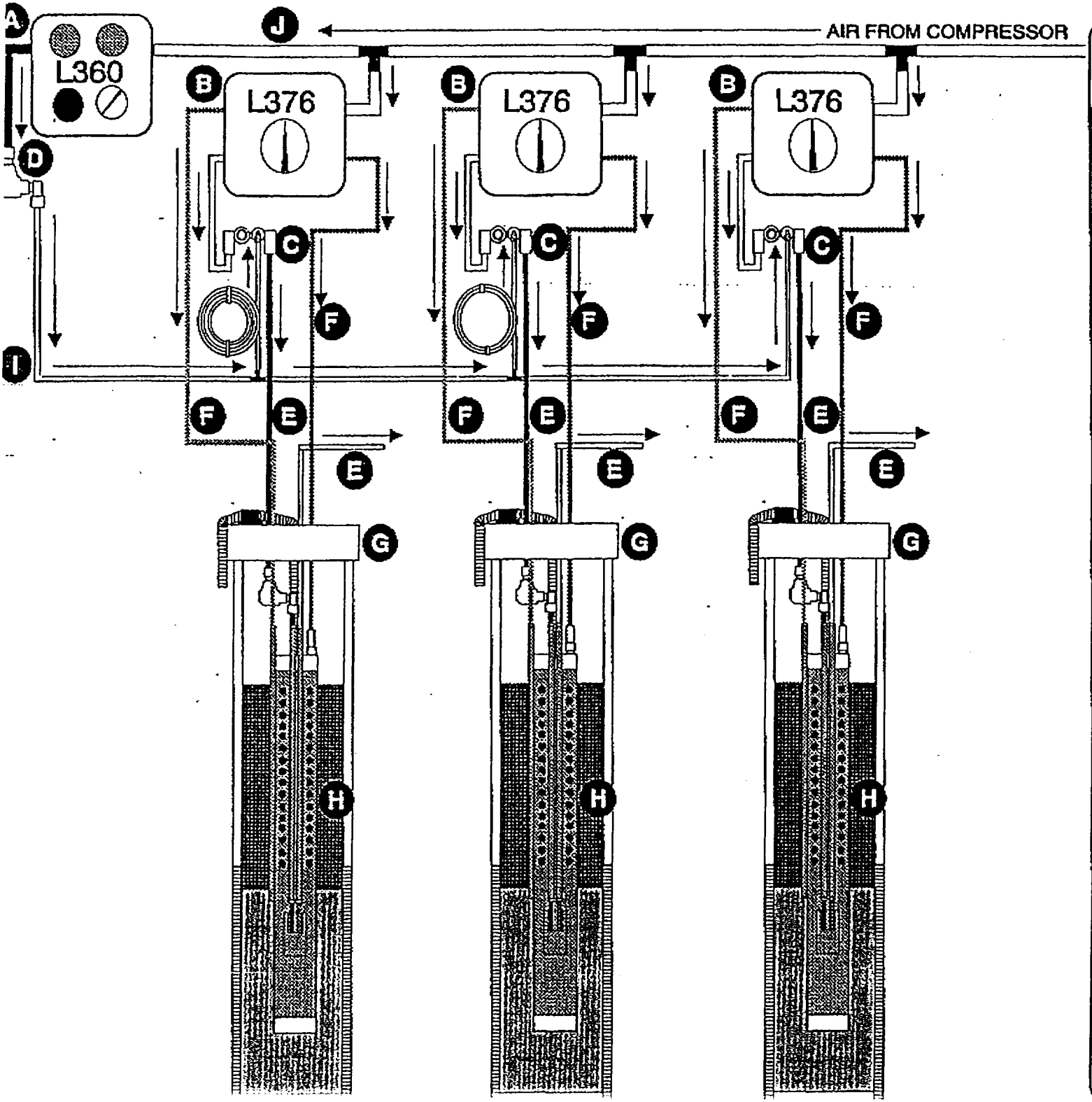
Product Pumps P-1a,b:

- Two (2) QED Seeker Pneumatic Pump for 0.25 gpm of free floating product, complete with one (1) Model L376 Seekermate multiwell controller, Quotation No. 5096.

Product Storage Tank T-1:

- One (1) 500-gallon steel storage tank complete with secondary containment pan and site tube.

  - One (1) QED explosion proof electro-pneumatic high tank level shutoff switch.



PULSE PUMP SYSTEM "K"

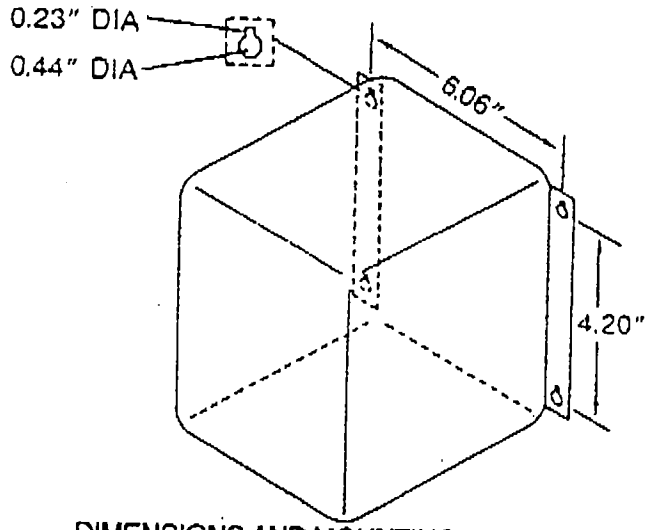
ONE CONTROLLER CONTROLLING MORE THAN ONE SEEKER PUMP

- **A** L360 CONTROLLER
- **B** L376 SEEKERMATE OR L377 (VACUUM REFFERENCED)
- **C** L600 REMOTE WELL OPERATOR
- **D** L358 CONTROLLER EXHAUST VALVE
- **E** SEEKER CONTROL HOSES
- **F** SEEKER GAUGE HOSES
- **G** SEEKER WELL CAP
- **H** LP1501 SEEKER PUMP
- **I** 1/4" LOGIC LINE
- **J** 1/2" AIR SUPPLY TUBING

OPTIONS:

MODULE ENCLOSURE
FILTER PACKAGE
PNEUMATIC CYCLE COUNTER

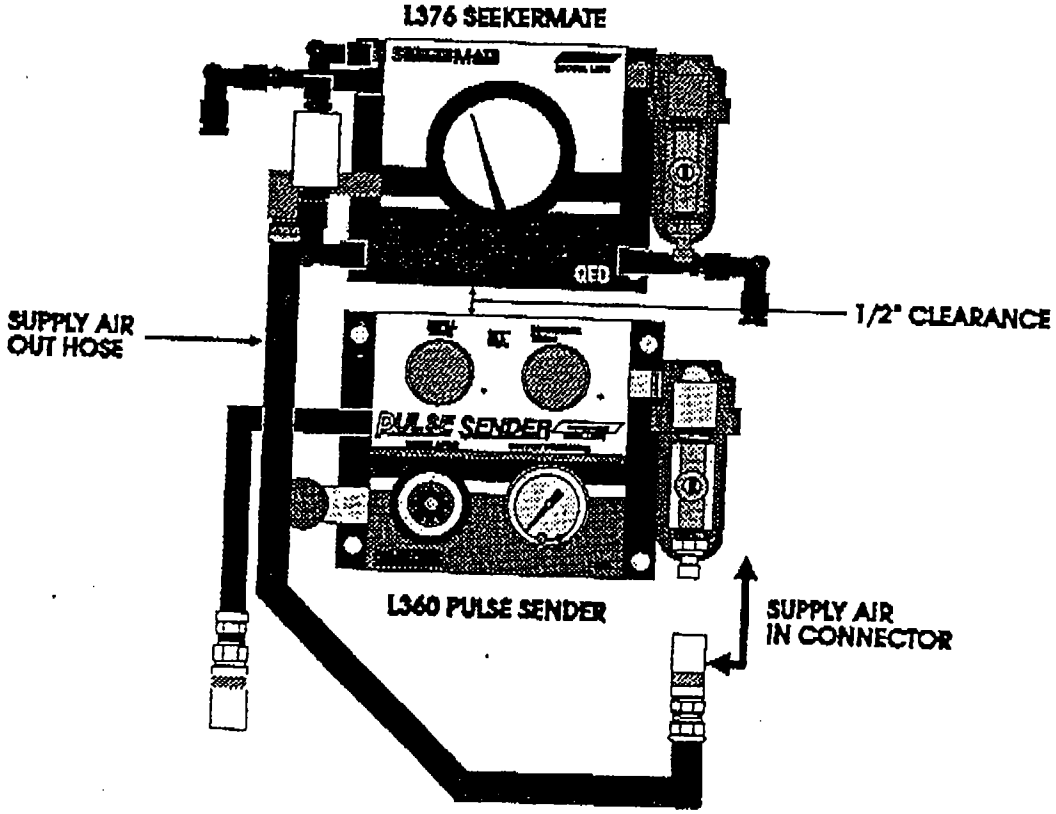
FIND A PROPER LOCATION TO MOUNT YOUR CONTROLLER MODULES, WHERE THEY WILL BE CLOSE TO YOUR WELL AND WILL BE WELL PROTECTED FROM HARSH WEATHER. THE L376 SEEKERMATE SHOULD BE MOUNTED DIRECTLY ABOVE YOUR L360 PULSE SENDER CONTROLLER WITH APPROXIMATELY 1/2" SPACE BETWEEN THE TOP OF YOUR L360 AND THE BOTTOM OF YOUR L376, SO THE HOSE CONNECTION BETWEEN YOUR MODULES WILL REACH AND FIT PROPERLY. (IF YOU HAVE PURCHASED AN OPTIONAL 35890 WEATHER TIGHT MODULE ENCLOSURE THIS HAS ALREADY BEEN DONE FOR YOU,SIMPLY MOUNT YOUR ENCLOSURE IN CLOSE PROXIMITY TO YOUR WELL)



DIMENSIONS AND MOUNTING L376 & L360

2. CONNECTING YOUR L376 TO YOUR L360

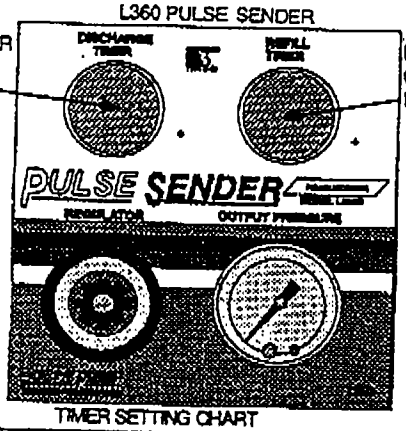
ONCE YOU HAVE MOUNTED YOUR CONTROLLER MODULES YOU CAN CONNECT THE TWO UNITS TOGETHER BY ATTACHING THE BLACK HOSE COMING OUT OF THE LEFT HAND SIDE OF THE L376 MARKED,"SUPPLY AIR OUT", TO THE CONNECTOR ON THE RIGHT HAND SIDE OF THE L360 MARKED,"SUPPLY AIR IN",.



ADJUSTMENTS & OPERATION

1. SET THE REFILL AND DISCHARGE TIMERS OF THE L360 ON A LONG REFILL/DISCHARGE TIME (ABOUT 15 SECONDS OR THE "D" SETTING).THIS SETTING ENSURES THAT YOUR PUMP HAS AN AMPLE AMOUNT OF TIME TO FILL COMPLETELY AND GIVE YOU AN ACCURATE MEASUREMENT OF YOUR PUMP'S INTERNAL CAPACITY. THIS MEASUREMENT IS USED AS YOU OPTIMIZE YOUR PUMP TO MAKE SURE IT IS PUMPING AT FULL CAPACITY.

L360 PULSE SENDER

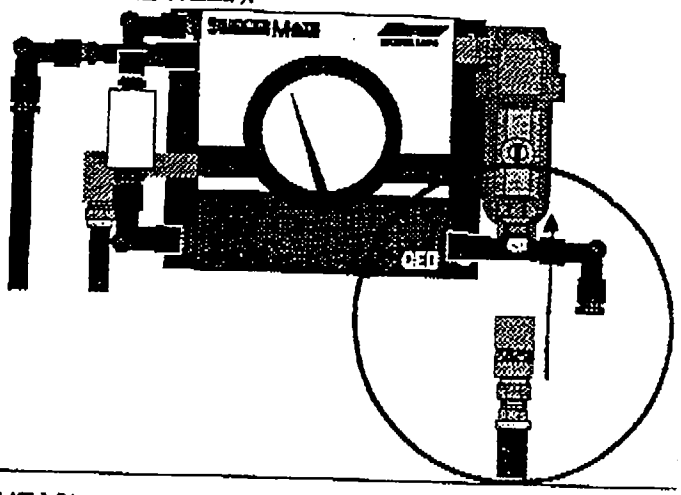


TIMER SETTING CHART

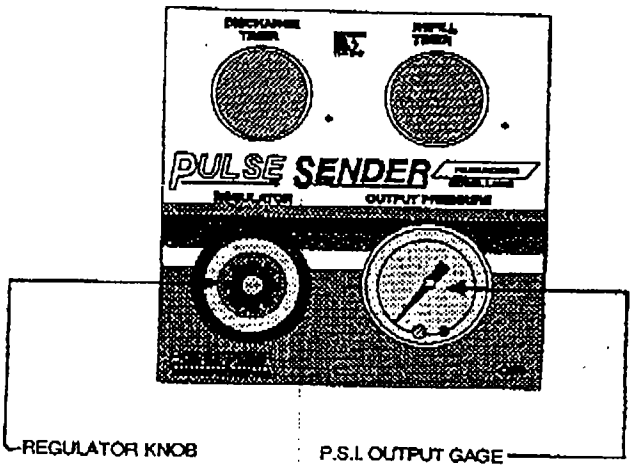
A	B	C	D	E	F
1 SEC.	3 SEC.	9 SEC.	15 SEC.	30 SEC.	42 SEC.

(TIMES ARE APPROXIMATE)

2. RE-ATTACH YOUR AIR SOURCE TO THE RIGHT HAND SIDE OF THE L376 SEEKERMATE MARKED,"AIR IN FROM COMPRESSOR". LIQUID SHOULD BEGIN TO FLOW THROUGH THE PUMP'S GREEN DISCHARGE HOSE AFTER 5-15 CYCLES OF PUMPING,(DEPENDING ON THE DEPTH OF THE WELL).



3. SHOULD AN ADJUSTMENT IN THE AMOUNT OF AIR PRESSURE DELIVERED TO THE PUMP BECOME NECESSARY YOU CAN DO SO WITH THE AIR REGULATOR LOCATED ON THE L360. TO UNLOCK REGULATOR PULL UP ON THE YELLOW KNOB. TO INCREASE PRESSURE TURN YELLOW KNOB CLOCKWISE TO DECREASE PRESSURE TURN KNOB COUNTER CLOCKWISE. APPROXIMATELY 40 P.S.I. IS ADEQUATE FOR SEEKER PUMP OPERATION. THE P.S.I. OUTPUT THE L360'S REGULATOR HAS BEEN PRE-SET TO 60 . P.S.I. THIS ADJUSTMENT SHOULD ONLY BE NECCESSARY IN DEEPER WELL SITUATIONS (BEYOND 130').



4. MEASURE THE LIQUID DISCHARGED DURING ONE CYCLE. (THE VOLUME OF THE LIQUID MAY BE SLIGHTLY LESS THAN THE INTERNAL VOLUME CAPACITY OF THE PUMP).

THE SEEKER PUMP'S INTERNAL CAPACITY

MILLILITERS	LITERS	GALLONS
45	.045	.01

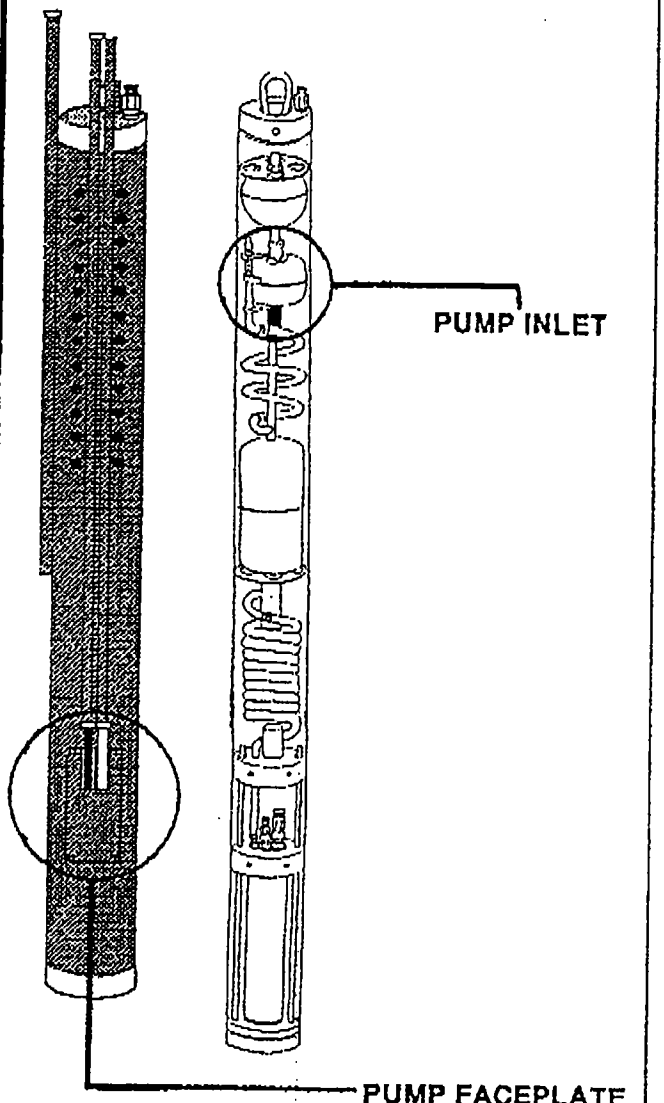
5. DECREASE THE DISCHARGE TIMER'S TIME GRADUALLY, (ALLOW THE PUMP TO GO THROUGH IT'S CYCLE 3-5 TIMES BETWEEN EACH ADJUSTMENT), UNTILYOU BEGIN TO SEE A DROP IN THE VOLUME OF THE LIQUID COMING OUT OF YOUR DISCHARGE HOSE. INCREASE THE DISCHARGE TIME SLIGHTLY UNTIL YOU YOU ARE ONCE AGAIN GETTING THE AMOUNT DISCHARGED PER CYCLE THAT YOU MEASURED IN STEP 4. THE DISCHARGE CYCLE OPTIMIZATION IS NOW COMPLETE.

INTERNAL PUMP INLET ADJUSTMENT

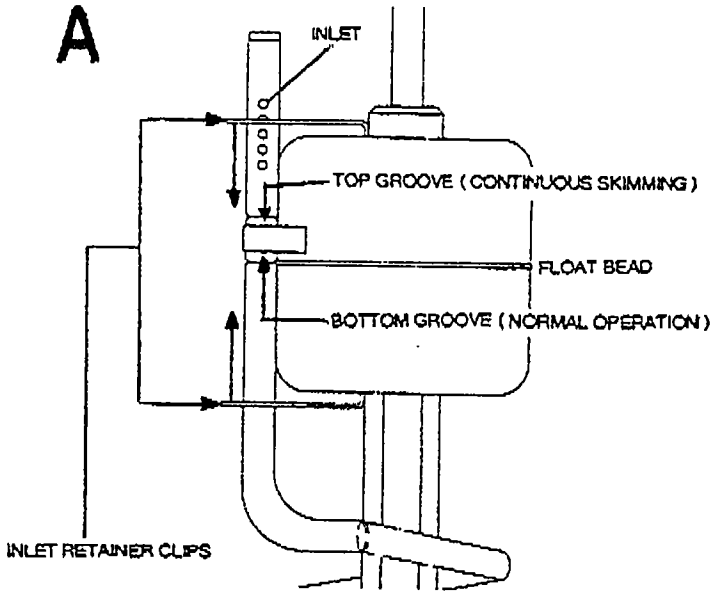
The LP1501 "SEEKER PUMP" is equipped, (internally), with an adjustable hydrocarbon inlet. The pump's inlet can be lowered to allow a thinner final product layer to be achieved if the inlet is lowered far enough, the upper portion of the water can also be removed.

To adjust inlet, pinch the retainer clip together and gently work the inlet downward until the desired position is reached. In some cases the inlet may prove difficult to dislodge from the factory set, "KEEPER GROOVE". If this is the case, gently tap the top of the inlet with a tool until the inlet tube is dislodged, then work the inlet tube downward as previously described.

Remove pump face plate by removing the 4 screws holding it in place. Disconnect the pump air and discharge lines. The pump's internal components should be free to slide out the bottom of the pump. Once internal components are removed locate the pump inlet.

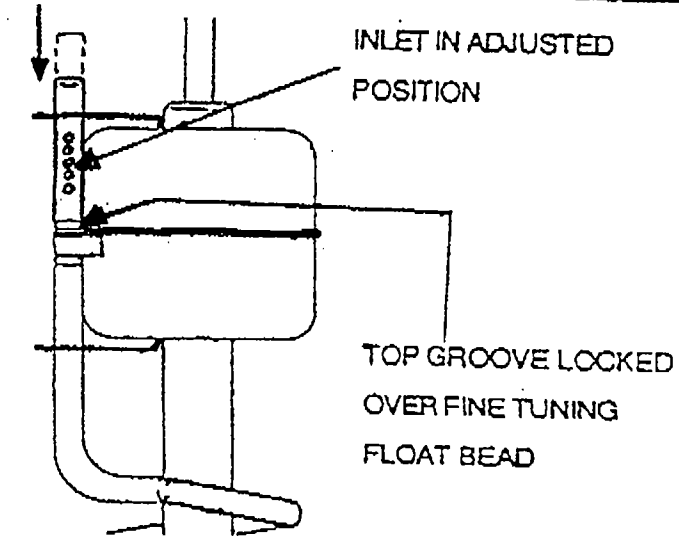


A



The pump's inlet can be lowered to allow for continuous skimming of the surface of the water after the product layer has been removed. To lower the inlet into this position pinch the inlet retainer clip together and lower the inlet until the top groove is locked over the float bead.

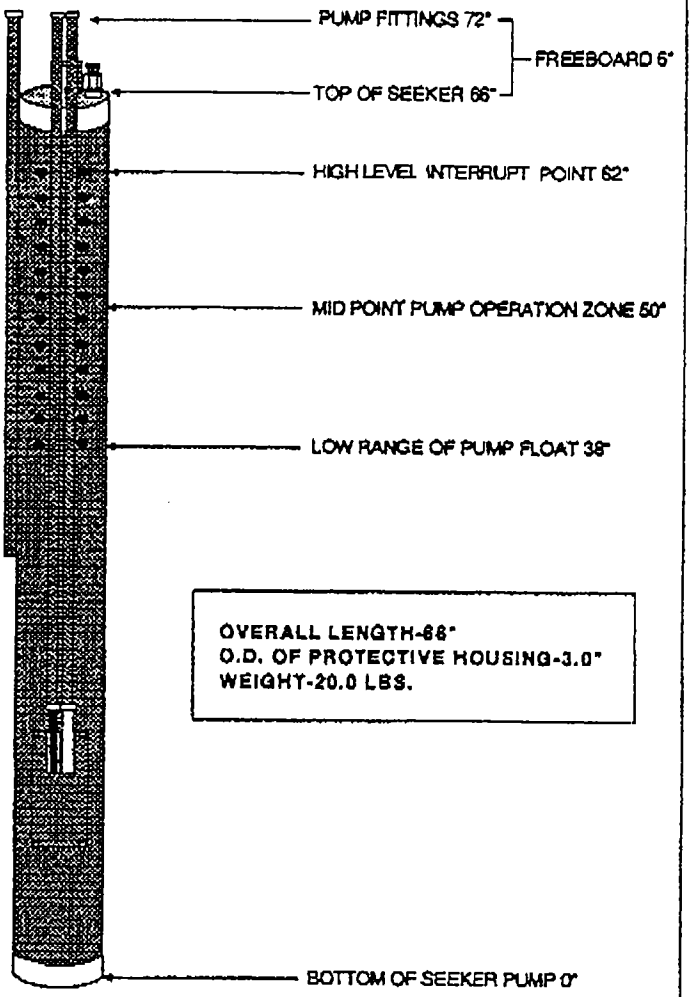
B



QED GROUNDWATER SPECIALISTS
TECHNICAL DATA / SPECIFICATIONS

SEEKER PUMP
MODEL LP1501

PUMP DIMENSIONS



OVERALL LENGTH-66"
O.D. OF PROTECTIVE HOUSING-3.0"
WEIGHT-20.0 LBS.

DESCRIPTION:

THE SEEKER IS AN ALL-PNEUMATIC PUMP AND FLOAT SYSTEM DESIGNED TO REMOVE FLOATING HYDROCARBONS, WITHOUT PUMPING WATER, FROM 4" DIAMETER AND LARGER WELLS. THE UNIQUE LAYERED FLOAT DESIGN DELIVERS MODERATE FLOW RATE PRODUCT PUMPING (0 TO .25 G.P.M.). HYDROCARBON LAYERS AS SMALL AS 1/4" OR LESS* CAN BE RECOVERED AND THE FLOAT HAS THE ABILITY TO FOLLOW STATIC WATER LEVEL CHANGES OF UP TO 24". A STATIC WATER LEVEL SENSING TUBE EASES POSITIONING OF THE SEEKER IN THE WELL.

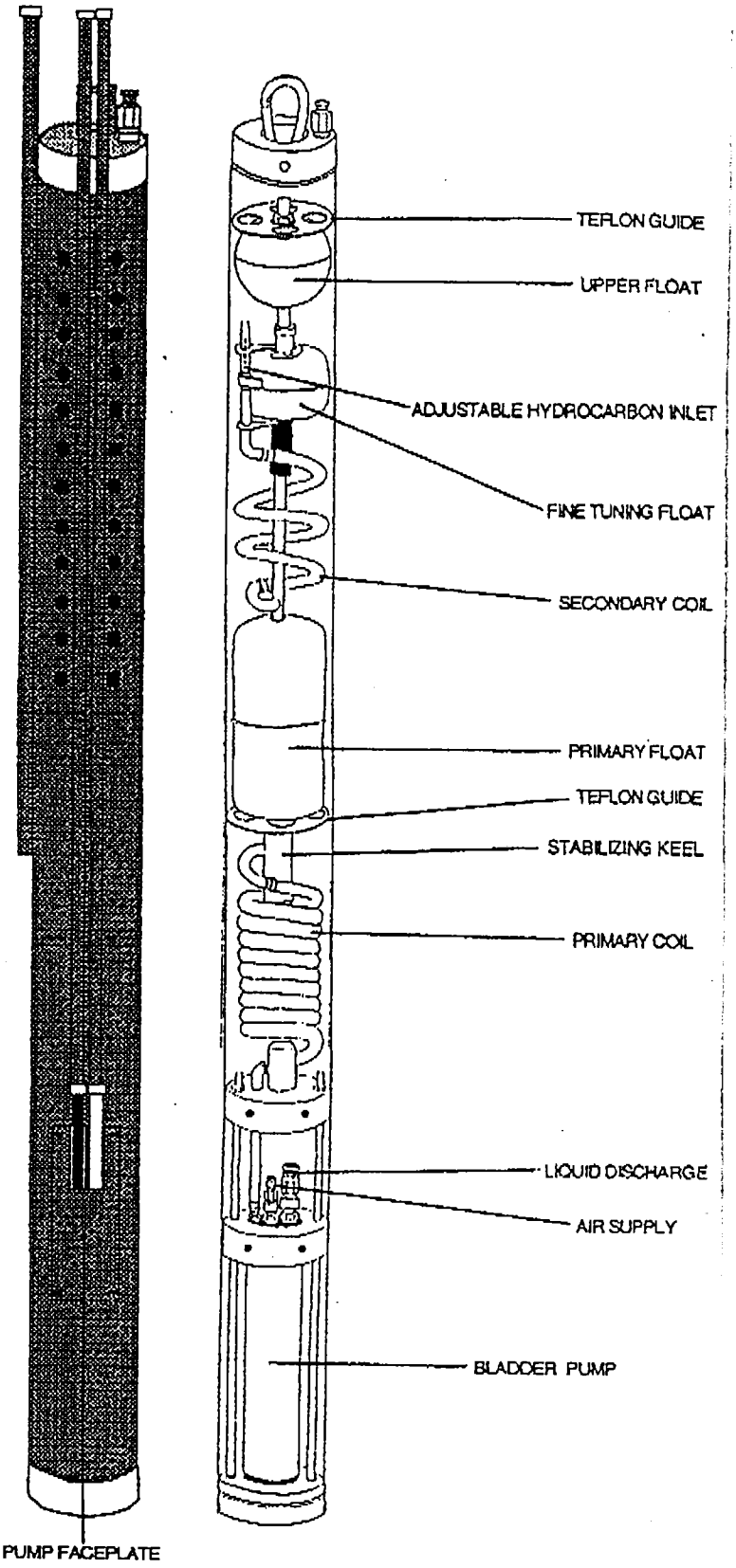
THE WHOLE ASSEMBLY IS HOUSED INSIDE A SMOOTH STAINLESS STEEL CYLINDER FOR EASE OF INSTALLATION AND OPERATION - NO FLOATS TO HANG UP INSIDE YOUR WELL. THE SEEKER HAS BEEN DESIGNED TO WORK WITH STANDARD PULSE-LINK SERIES PNEUMATIC CONTROL MODULES.

MATERIALS:

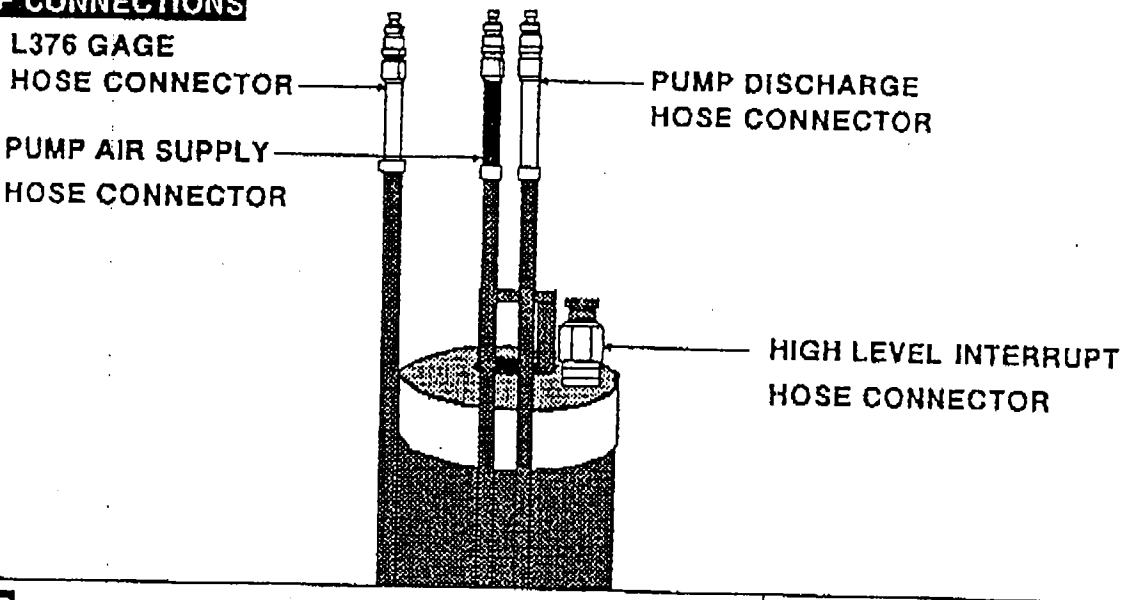
PUMP-316 STAINLESS STEEL AND NYLON
FLOAT-316 STAINLESS STEEL
HOUSING-316 STAINLESS STEEL
END CAPS- NYLON
FLOAT DRAIN TUBE-GASOLINE RESISTANT TYGON

* PRODUCT-ONLY PUMPING OF LAYER THICKNESS OF LESS THAN 1/4" IS POSSIBLE DEPENDING ON FLOAT LOCATION WITHIN ITS OPERATING RANGE AND DENSITY OF THE HYDROCARBON.

INSIDE VIEW OF PUMP

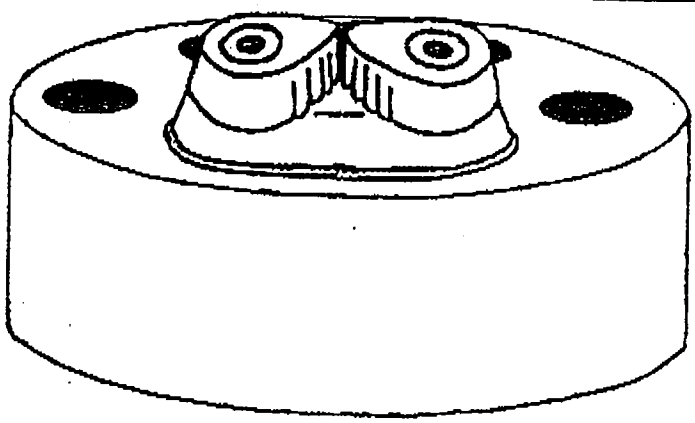


TOP OF PUMP CONNECTIONS



SEEKER CAPS

4" CAP L230C
6" CAP L230E
8" CAP L230G



SEEKER HOSES

H25C 25' HOSE CONTROLLER
H25G 25' HOSE ON/OFF

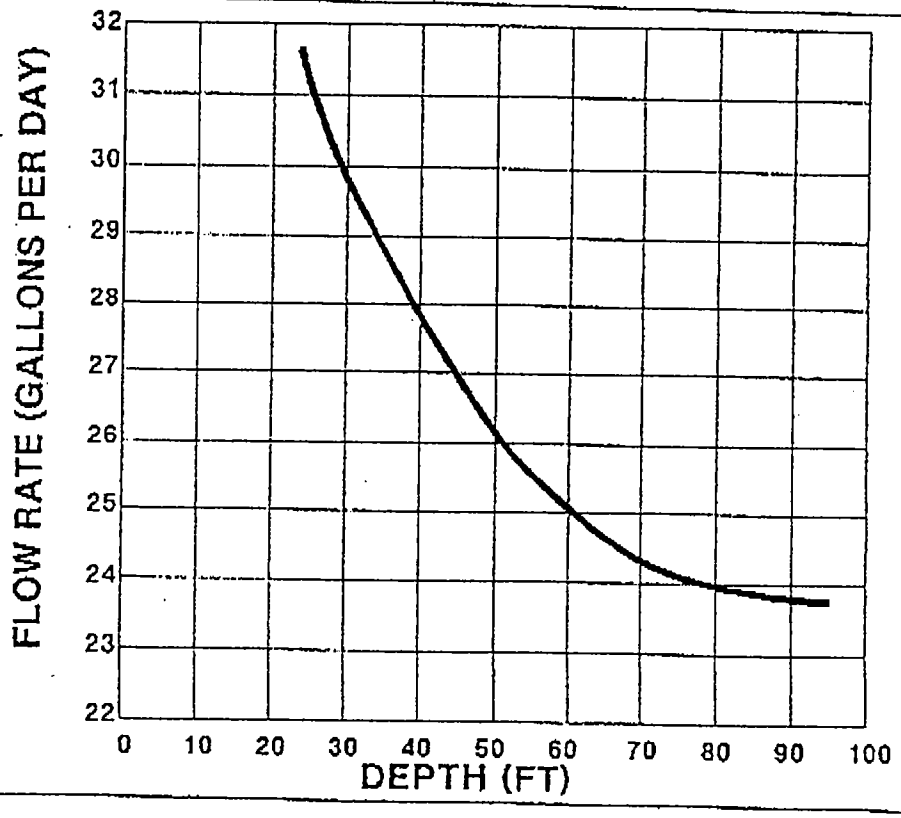
H50C 50' HOSE CONTROLLER
H50G 50' HOSE ON/OFF

H100C 100' HOSE CONTROLLER
H100G 100' HOSE ON/OFF

SEEKER FLOW RATES

Conditions:

1.5 SCFM air-flow, 0-100 PSI.



APPENDIX F

REFERENCES

REFERENCES

Fetter, C. W., Jr. 1980. *Applied Hydrogeology*. Charles E. Merrill Publishing Company, Columbus, OH., p. 116.

Hamilton, Pixie A. and J.D. Larson. 1988. Hydrogeology and Analysis of the Groundwater Flow System in the Coastal Plain of Southeastern Virginia: U.S. Geological Survey (USGS), Water Resources Investigations Report 87-4240.

Johnson, C.C., 1972. Geology of the Yorktown, Poquoson, and Poquoson East Quadrangles, Virginia: Virginia Division of Minerals Resources Report of Investigations p.41 and p.72.

Mixon, R. B., C.R., Jr., Berquist, W.L. Newell, and F.G. Johnson. 1989. Geologic Map and Generalized Cross Sections of the Coastal Plan and Adjacent Parts of the Piedmont, Virginia: Virginia Division of Mineral Resources Miscellaneous Investigations Series, Map I-2033.

Siudyla, E.A., A.E. May, and D.W. Hawthorne. 1981. Groundwater Resources of the Four Cities Area, Virginia: Virginia State Water Control Board Planning Bulletin 331, 168 p.

U.S. Environmental Protection Agency (EPA) June 1990. Assessing UST Corrective Action Technologies: Early Screening of Cleanup Technologies for the Saturated Zone. EPA/600/2-90/027.

Roy F. Weston, Inc. (WESTON) December 1992. Final Site Characterization Report, UST System Building 787 Naval Weapons Station Yorktown, Contract Task Order 0142, Prepared for Naval Facilities Engineering Command Atlantic Division.

Yeh, G.T., 1981. AT123D: Analytical Transient One-, Two-, and Three Dimensional Simulation of Waste Transport in an Aquifer System; ORNL-5602, Oak Ridge National Laboratory, Oak Ridge, Tennessee, p.77.