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FINAL
REPORT ON SYSTEM PERFORMANCE OF THE VACUUM ENHANCED LNAPL AND GROUND-WATER RECOVERY AND TREATMENT SYSTEM JANUARY 1998 TO JANUARY 1999 SITE 10; NAVY FUEL FARM NAVAL AIR STATION JOINT RESERVE BASE WILLOW GROVE, HORSHAM TOWNSHIP, PENNSYLVANIA

Contract No. N62472-9219-1296
CTO No. 0074

Prepared for

Department of the Navy
Northern Division
Naval Facilities Engineering Command
10 Industrial Highway
Mail Stop No. 82
Lester, Pennsylvania 19113-2090

Prepared by

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Sparks, Maryland 21152
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June 1999

FINAL
Project No. 29600.74.7200

29600.74.7200

Final
Report on System Performance of the Vacuum Enhanced LNAPL and Ground-Water Recovery and Treatment System
January 1998 to January 1999
Site 10; Navy Fuel Farm
Naval Air Station Joint Reserve Base
Willow Grove, Horsham Township, Pennsylvania

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June 1999

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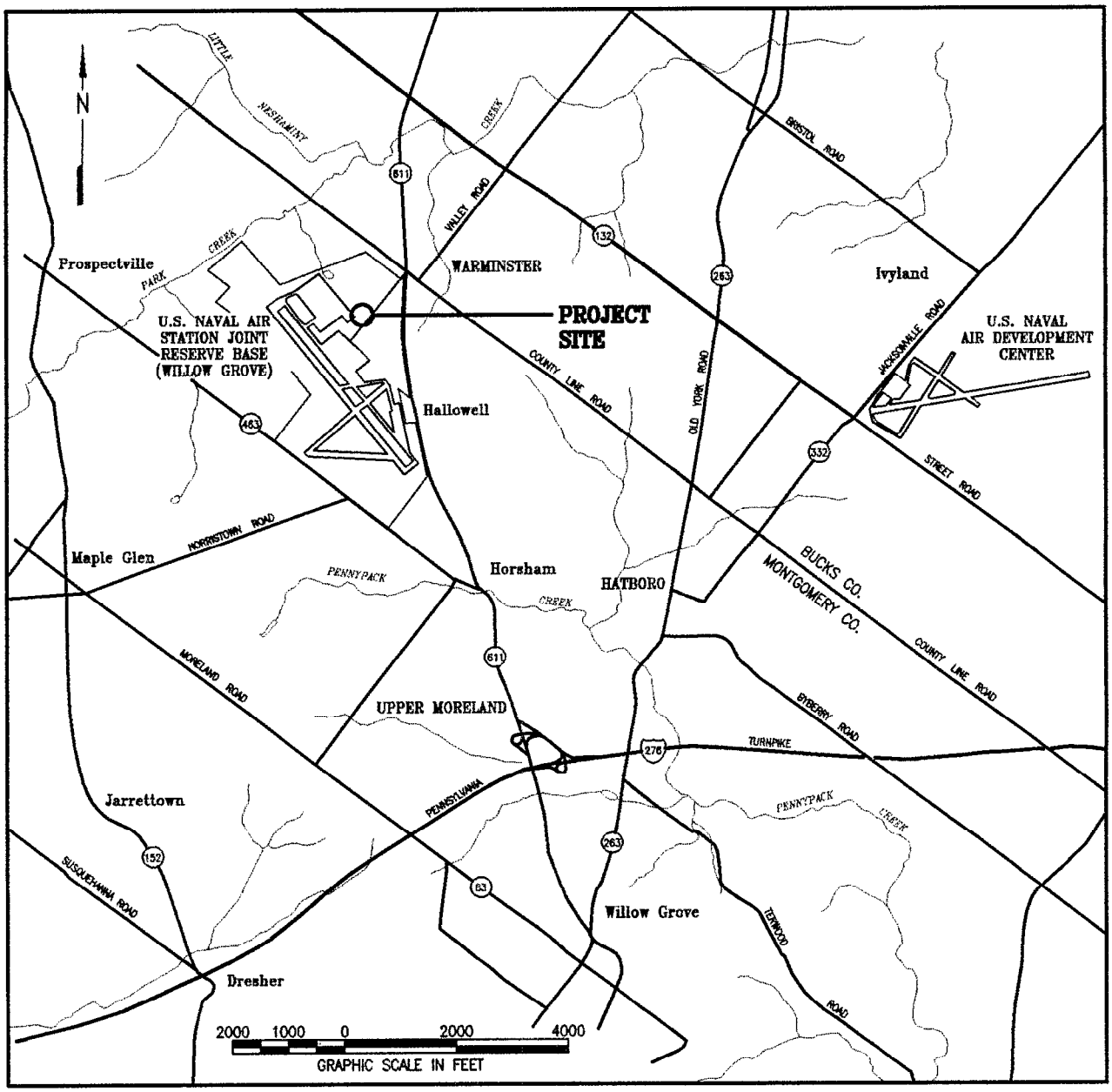
1. INTRODUCTION

1.1 OBJECTIVE

Under contract number N62472-9219-1296, CTO No. 0074, a Vacuum Enhanced Light Non-Aqueous Phase Liquid (LNAPL) and Ground-Water Recovery and Treatment System has been installed at the Navy Fuel Farm, Naval Air Station Joint Reserve Base (NASJRB) Willow Grove. Figure 1-1 is a site location map and Figure 1-2 is a site map of the Navy Fuel Farm.

The report objective is the evaluation of the remediation systems effectiveness at achieving the Remedial Action Objective for the site. The Remedial Action Objective is the removal of recoverable LNAPL from the subsurface. The comparison of the gauging data and ground-water analytical data collected during the last year of operation with historical site data is used to evaluate system effectiveness. Records of LNAPL recovery will be used to assess the continuing effectiveness of the remediation system. Historical data from the site has been collected from the following documents:

> EA Engineering, Science, and Technology, Inc. 1991 *Interim Report On Investigations At The Navy Fuel Farm, NAS Willow Grove, November 1990 - July 1991*. Contract Number N62472-86-C-1037. November.
>
> EA Engineering, Science, and Technology, Inc. 1993 *Interim Report On Investigations, Navy Fuel Farm, Willow Grove NAS*. Contract Number N62472-91-D-1449. September.
>
> EA Engineering, Science, and Technology, Inc. 1996 *Final Pilot Study Report, Product Recovery Pilot System, Navy Fuel Farm Facility, Naval Air Station Willow Grove, Horsham Township, Pennsylvania*. Contract Number N62472-92-D-1296. Contract Task Order Number 0009. November.
>
> EA Engineering, Science, and Technology, Inc. 1991 *Interim Report On Investigations At The Navy Fuel Farm, NAS Willow Grove, November 1990 - July 1991*. Contract Number N62472-86-C-1037. November



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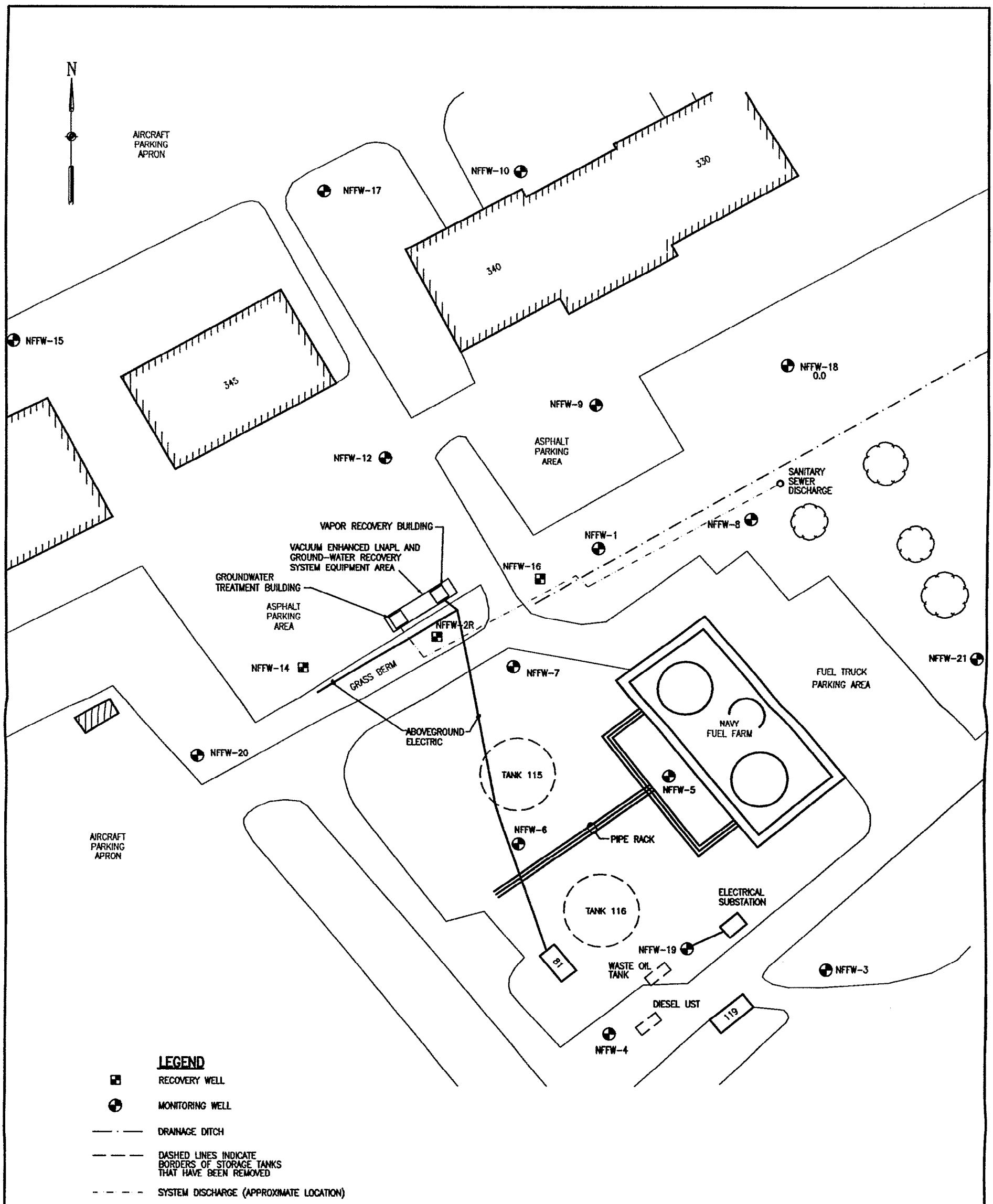
EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.	NAVY FUEL FARM NAVAL AIR STATION JOINT RESERVE BASE WILLOW GROVE, PENNSYLVANIA	SITE LOCATION MAP					
PROJECT MGR HGP	DESIGNED BY SHD	DRAWN BY CJV/PMH	CHECKED BY CR	SCALE AS SHOWN	DATE 2-23-99	PROJECT NO 29600.74	FIGURE 1-1



NOTE:

BASE MAP DEVELOPED FROM EA FIELD MEASUREMENTS AND SITE PLAN DEVELOPED BY EA (1993). NO AS-BUILT DRAWINGS OF NEW FUEL FARM FACILITY WERE AVAILABLE FROM NAVY PERSONNEL PRIOR TO DEVELOPMENT OF BASE MAP. BASE MAP IS INTENDED AS A REFERENCE ONLY. ANY DECISIONS MADE BASED ON THE CONTENT OF THIS MAP ARE THE SOLE RESPONSIBILITY OF THE USER.

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NAVY FUEL FARM
NAVAL AIR STATION JOINT RESERVE BASE
WILLOW GROVE, PENNSYLVANIA

SITE PLAN

PROJECT MGR.	DESIGNED BY	DRAWN BY	CHECKED BY	DATE	SCALE	PROJECT NO.	FILE NAME	DRAWING NO.	FIGURE
HGP	MK	FDV	CGR	4-20-99	AS SHOWN	29600.74	SITE	-	1-2

EA Engineering, Science, and Technology, Inc. 1997 *Sampling And Analysis Plan For Remedial Action At The Naval Air Station Joint Reserve Base, Willow Grove, Horsham Township, Pennsylvania*. Contract Number N62472-92-D-1296. Contract Task Order Number 0074. 20 August.

EA Engineering, Science, and Technology, Inc. 1997 *Remedial Action Engineering Work Plan For Installation Of Remedial Action System At Naval Air Station Joint Reserve Base, Willow Grove, Horsham Township, Pennsylvania*. Contract Number N62472-92-D-1296. Contract Task Order Number 0074. 3 July.

EA Engineering, Science, and Technology, Inc. 1998 *Sampling and Analysis Report For Remedial Action At The Navy Fuel Farm, Naval Air Station Joint Reserve Base, Willow Grove, Horsham Township, Pennsylvania*. Contract Number N62472-92-D-1296. Contract Task Order Number 0074. 11 June.

1.2 SCOPE OF WORK

This report presents the system monitoring, ground-water gauging, and ground-water sampling results collected during the first year of operation of the Vacuum Enhanced LNAPL and Ground-Water Recovery and Treatment System at the Navy Fuel Farm, NASJRB Willow Grove. Ground-water analytical data collected after a year of system operation are to be compared to the analytical data collected prior to system start-up. Recommendations for improving the remediation system are to be included along with predicted yearly operation and maintenance costs for the existing remediation system.

1.3 ORGANIZATION OF THE REPORT

This Report on System Performance is comprised of the text, tables and figures in Chapters 1 through 5, and Appendices A through D. The five chapters in this report include:

Chapter 1: Introduction - Objective, scope and organization of this report.

Chapter 2: Ground-Water Gauging Data - Compares ground-water gauging data and LNAPL occurrence from before and after system operation.

Chapter 3: Ground-Water Analytical Data Compares ground-water analytical data from before and after system operation

Chapter 4: System Operations - Evaluates system operation for the last year and recommends changes to remedial system. Anticipated annual operation costs are also evaluated.

Chapter 5: Conclusions and Recommendations - Summarizes the conclusion drawn about system effectiveness, system improvements, and annual operation costs.

1.4 SITE HISTORY

From 1950 to 1991, two partially buried 210,000-gal JP-4/JP-5 aviation fuel tanks (Tank Nos. 115 and 116) were located at the Navy Fuel Farm. A 500-gal underground waste oil tank and an underground diesel fuel tank were also located at the southwestern corner of the site.

In 1986, a release occurred when Tank No. 115 was overfilled and fuel flowed from the vent pipe onto the ground. The event was attributed to faulty gauges that registered less fuel than was actually present. During this same year, a utility trench was excavated along the western boundary of the site, but work discontinued when LNAPL was observed floating on the water within the trench. The area where the LNAPL was discovered is immediately adjacent to a former drywell. The drywell accepted water that was periodically siphoned from the bottom of the fuel tanks.

In March 1989, JP-5 jet fuel was detected emanating from two patches of dead grass to the west of Tank No. 115. As a result, it was decided to empty and remove these tanks. Removal occurred in 1991. During this time the waste oil and diesel fuel USTs were also removed. Inspection of the waste oil tank during removal revealed the tank was not intact as holes up to 1 in. in diameter were reported.

Following the completion of removal activities, a new AST system was installed to the east of the former tank field location. The new tank system at the Navy Fuel Farm consists of

aboveground steel tanks set in a concrete berm. The Navy currently stores potassium acetate in the new 40,000-gal AST. One of the 210,000 gal ASTs is connected to the boiler house, Building 6, with an underground pipeline and holds #2 fuel oil. The second 210,000 gal AST remains empty.

The Navy performed a pilot study (March 1994 to October 1996) of remedial alternatives to address the recovery of LNAPL petroleum products at the Navy Fuel Farm (EA 1996). Based on results of the pilot study, the Navy proceeded with the expansion of the Vacuum-Enhanced LNAPL and Ground Water Recovery and Treatment System to include recovery from three wells (NFFW-2R, NFFW-14, and NFFW-16). The expansion was completed in January 1998 and operation of the remedial action commenced. The system has operated for one year and this Report on System Performance assesses system operation from January 1998 to January 1999.

1.5 PREVIOUS INVESTIGATIONS

Several investigations have been conducted at the Navy Fuel Farm. The Vacuum Enhanced LNAPL and Ground-Water Recovery and Treatment System has been installed as a result of the following reports and regulations:

- Draft Appendix B, Soil Vapor Contaminant Assessment at NAS Willow Grove. (EA December, 1988b).
- Interim Report, Electromagnetic Survey, Soil Vapor Contaminant Assessment, and Revised Field Sampling Plan for Site Inspection Studies at NAS Willow Grove. (EA March, 1989a).
- Final Report, Environmental Test Boring Investigation at the Navy Fuel Farm, NAS Willow Grove, Horsham Township, Pennsylvania. (EA June, 1989a)
- Final Report, Site Inspection Studies at NAS Willow Grove, Horsham Township, Pennsylvania. Volumes I and II. (EA May, 1990)
- Final Interim Report on Investigations at the Navy Fuel Farm, NAS Willow Grove, November 1990 - July 1991. (EA November, 1991).

- Commonwealth of Pennsylvania Department of Environmental Resources, Ground Water Quality Protection Strategy. (PADER February, 1992).

- Title 25 - Pennsylvania Code Chapter 245 Subchapter D, Storage Tanks; Corrective Action. August. Commonwealth of Pennsylvania, Environmental Quality Board (EQB 1993).

- Final Report of Interim Site Investigations, Navy Fuel Farm - Willow Grove NAS. (EA September, 1993b).

- Final Pilot Study Report, Product Recovery Pilot System at the Navy Fuel Farm, Naval Air Station Willow Grove, Horsham Township Pennsylvania. (EA, November 1996).

- Remedial Action Engineering Work Plan for Installation of Remedial Action System at Naval Air Station Joint Reserve Base, Willow Grove, Horsham Township, Pennsylvania. (EA, 3 July 1997)

- Sampling and Analysis Plan for Remedial Action at the Navy Fuel Farm, Naval Air Station Joint Reserve Base Willow Grove, Horsham Township, Pennsylvania. (EA, 20 August 1997)

- Sampling and Analysis Report for Remedial Action at the Navy Fuel Farm, Naval Air Station Joint Reserve Base Willow Grove, Horsham Township, Pennsylvania. (EA, 11 June 1998)

- Operation and Maintenance Manual for the Vacuum Enhanced LNAPL and Ground-Water Recovery System at Navy Fuel Farm, Naval Air Station Joint Reserve Base Willow Grove, Horsham Township, Pennsylvania. (EA, October 1998)

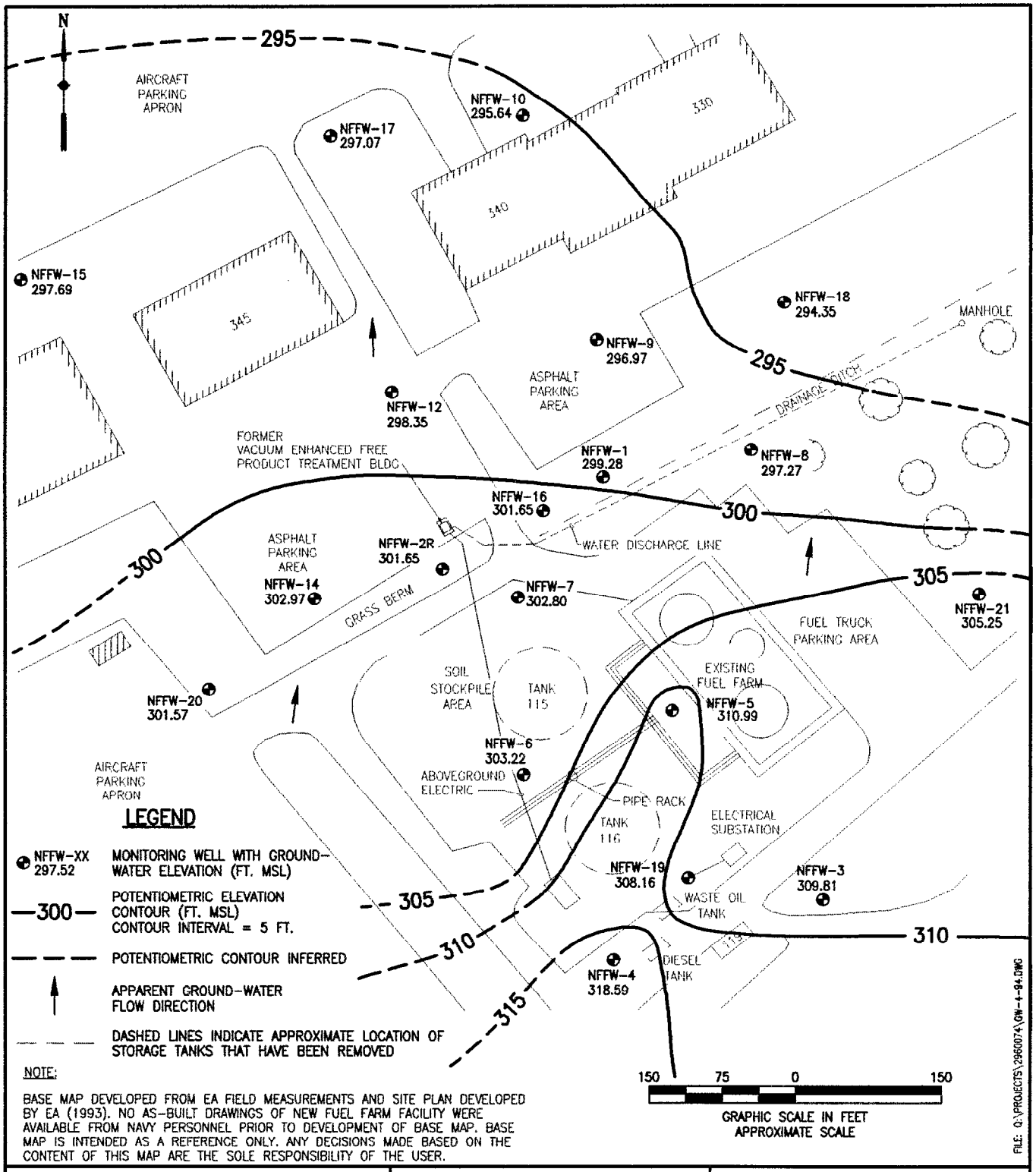
2. GROUND-WATER GAUGING DATA

This chapter presents and evaluates the remediation system's effectiveness at achieving the Remedial Action Objective based on the analysis of ground-water gauging at the Navy Fuel Farm. Section 2.1 presents historical gauging data and Section 2.2 presents the gauging data collected during the first year of the remediation systems operation. Discussion and comparison of the data is reserved for Section 2.3.

2.1 HISTORICAL GROUND-WATER GAUGING DATA

Ground-water level and LNAPL occurrence gauging data has been collected from the site monitoring wells since March 1994 and is presented in Appendix A. This data indicates a relationship between water table elevation and LNAPL occurrence. During periods of high ground-water table elevation, LNAPL is present in only a few monitoring wells. During periods of low ground-water table elevation, the occurrence of LNAPL increases, both in extent and in thickness of the LNAPL layer observed in the monitoring wells.

Figure 2-1 shows the poteniometric surface of the ground water at the Navy Fuel Farm on 4 April 1994, prior to the operation of the pilot LNAPL recovery systems. The ground-water flow direction is northeasterly in Figure 2-1. Figure 2-2 shows LNAPL distribution at the site on the 4 April 1994. LNAPL is only present in NFFW-6 during this period of a high ground-water table. Figure 2-3 shows the poteniometric surface of the ground water at the Navy Fuel Farm on 8 December 1995, during the operation of a pilot LNAPL recovery system at NFFW-2R. Figure 2-3 shows ground-water flow is northeasterly, however the cone of depression around NFFW-2R appears to intercept ground-water and LNAPL flow from the area of the release (former tanks 115 and 116). Figure 2-4 shows that during a period of low water table elevation LNAPL is present in more monitoring wells and that the depression of the ground-water table at NFFW-2R has caused LNAPL to collect around the recovery well.



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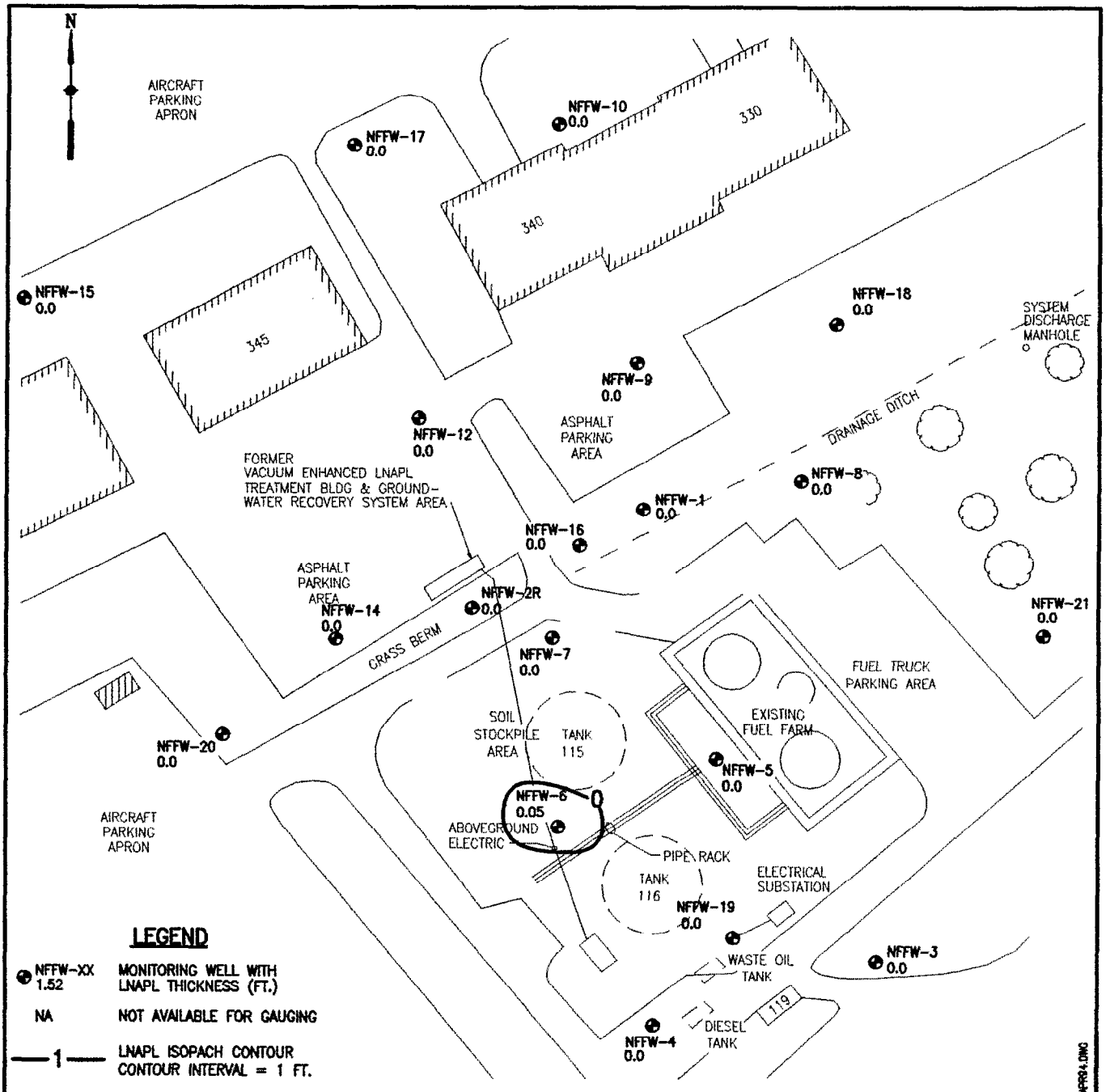
NAVY FUEL FARM
NAVAL AIR STATION JOINT RESERVE BASE
WILLOW GROVE, PENNSYLVANIA

POTENTIOMETRIC SURFACE
4 APRIL 1994

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
HGP	BS	DWM	BS	1"=150'	4-20-99	29600.74	2-1



LEGEND

NFFW-XX 1.52	MONITORING WELL WITH LNAPL THICKNESS (FT.)
NA	NOT AVAILABLE FOR GAUGING
—1—	LNAPL ISOPACH CONTOUR CONTOUR INTERVAL = 1 FT.
- - - -	DASHED LINES INDICATE APPROXIMATE LOCATION OF STORAGE TANKS THAT HAVE BEEN REMOVED

NOTE:

BASE MAP DEVELOPED FROM EA FIELD MEASUREMENTS AND SITE PLAN DEVELOPED BY EA (1993). NO AS-BUILT DRAWINGS OF NEW FUEL FARM FACILITY WERE AVAILABLE FROM NAVY PERSONNEL PRIOR TO DEVELOPMENT OF BASE MAP. BASE MAP IS INTENDED AS A REFERENCE ONLY. ANY DECISIONS MADE BASED ON THE CONTENT OF THIS MAP ARE THE SOLE RESPONSIBILITY OF THE USER.

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GRAPHIC SCALE IN FEET
APPROXIMATE SCALE

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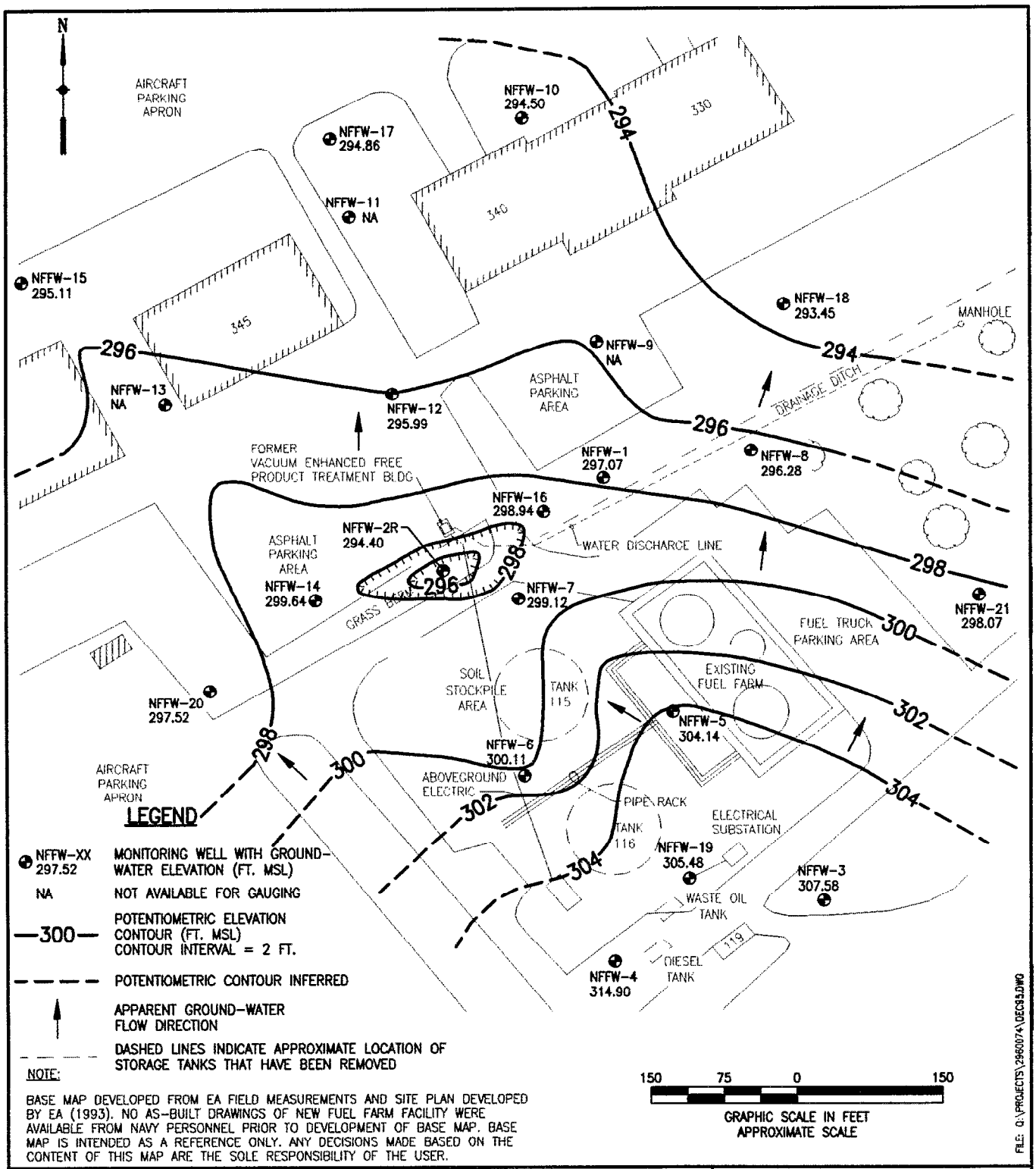
NAVY FUEL FARM
NAVAL AIR STATION JOINT RESERVE BASE
WILLOW GROVE, PENNSYLVANIA

ISOPACH MAP OF THE LNAPL MEASURED IN MONITORING WELLS
4 APRIL 1994

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
HGP	MK	DWM	CR	1"=150'	4-20-99	29600.74	2-2



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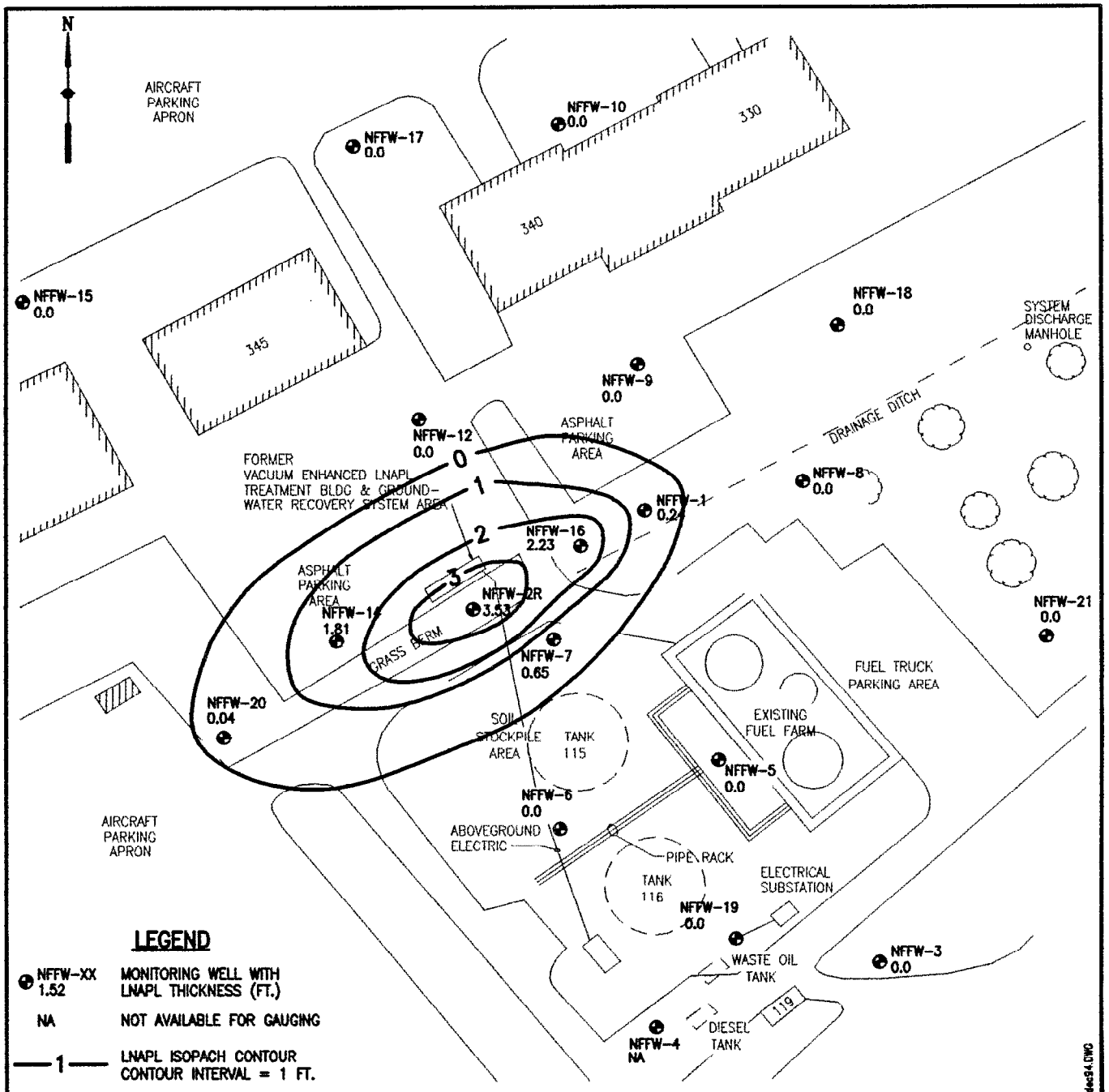
NAVY FUEL FARM
NAVAL AIR STATION JOINT RESERVE BASE
WILLOW GROVE, PENNSYLVANIA

POTENTIOMETRIC SURFACE
8 DECEMBER 1995

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
HGP	BS	DWM	BS	1"=150'	4-20-99	29600.74	2-3



LEGEND

NFFW-XX 1.52	MONITORING WELL WITH LNAPL THICKNESS (FT.)
NA	NOT AVAILABLE FOR GAUGING
—1—	LNAPL ISOPACH CONTOUR CONTOUR INTERVAL = 1 FT.
- - - -	DASHED LINES INDICATE APPROXIMATE LOCATION OF STORAGE TANKS THAT HAVE BEEN REMOVED

NOTE:

BASE MAP DEVELOPED FROM EA FIELD MEASUREMENTS AND SITE PLAN DEVELOPED BY EA (1993). NO AS-BUILT DRAWINGS OF NEW FUEL FARM FACILITY WERE AVAILABLE FROM NAVY PERSONNEL PRIOR TO DEVELOPMENT OF BASE MAP. BASE MAP IS INTENDED AS A REFERENCE ONLY. ANY DECISIONS MADE BASED ON THE CONTENT OF THIS MAP ARE THE SOLE RESPONSIBILITY OF THE USER.

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GRAPHIC SCALE IN FEET
APPROXIMATE SCALE

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NAVY FUEL FARM
NAVAL AIR STATION JOINT RESERVE BASE
WILLOW GROVE, PENNSYLVANIA

ISOPACH MAP OF THE LNAPL MEASURED IN MONITORING WELLS 21 DECEMBER 1994

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
HGP	MK	DWM	CR	1"=150'	4-20-99	29600.74	2-4

Table 2-1 summarizes the extent of LNAPL detected in the site monitoring wells from March 1994 to October 1996. LNAPL was not detected in wells not included in Table 2-1.

2.2 JANUARY 1998 TO JANUARY 1999 GROUND-WATER GAUGING DATA

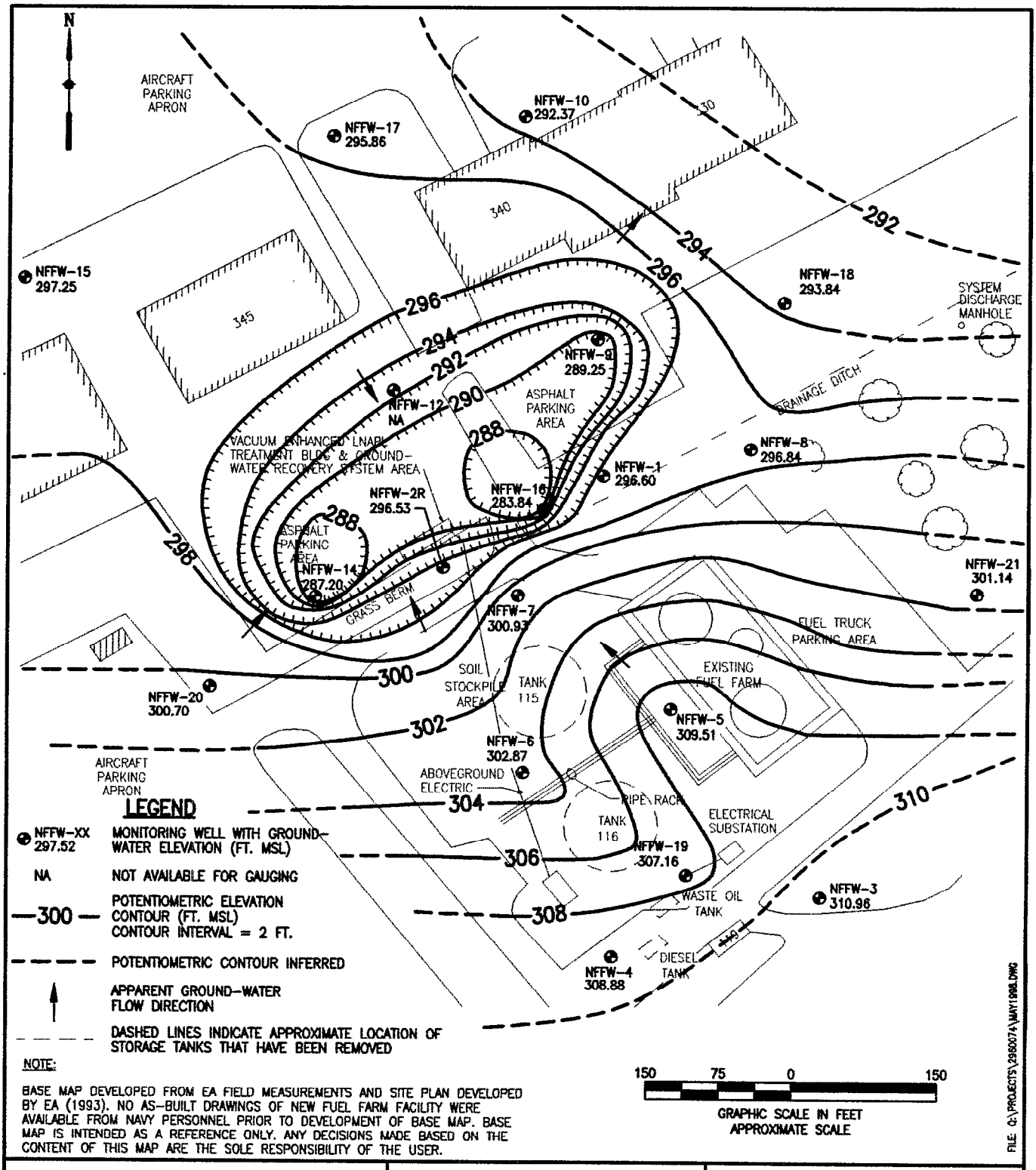
Ground-water level gauging data has been collected from the site monitoring wells during the operation of the Vacuum Enhanced LNAPL and Ground-Water Recovery and Treatment System and is presented in Appendix A. Figure 2-5 shows the poteniometric surface of the ground water at the Navy Fuel Farm on 21 May 1998. Ground-water flow remains northeasterly with a large cone of depression apparent around NFFW-2R, NFFW-14 and NFFW-16. The cone of depression created by the recovery wells is directly down gradient from the release area (former tanks 115 and 116) and aids in drawing LNAPL into the recovery wells. Figure 2-6 shows an isopach map of the site from 21 May 1998. Small amounts of product were present in the recovery wells only.

Table 2-2 summarizes the extent of LNAPL detected in site monitoring wells during the first year of system operation. LNAPL was not detected in wells not included in Table 2-2.

2.3 COMPARISON OF DATA

Prior to the pilot system ground water flow was toward the north-northeast (Figure 2-1). Previous reports have noted that during periods of high ground-water table elevation LNAPL is present in only a few monitoring wells (Figure 2-2) while during periods of low ground-water table elevation the occurrence of LNAPL increases. The intent of the remediation system is to recover LNAPL by inducing flow of LNAPL into the recovery by creating low ground-water table elevation at the recovery well. The artificially induced low ground-water table would aid in LNAPL recovery help to achieve the Remedial Action Objective.

The installation of the pilot system imposed a cone of depression on the north side of the site retarding the migration of petroleum products north of NFFW-2R (Figure 2-3 and 2-4).



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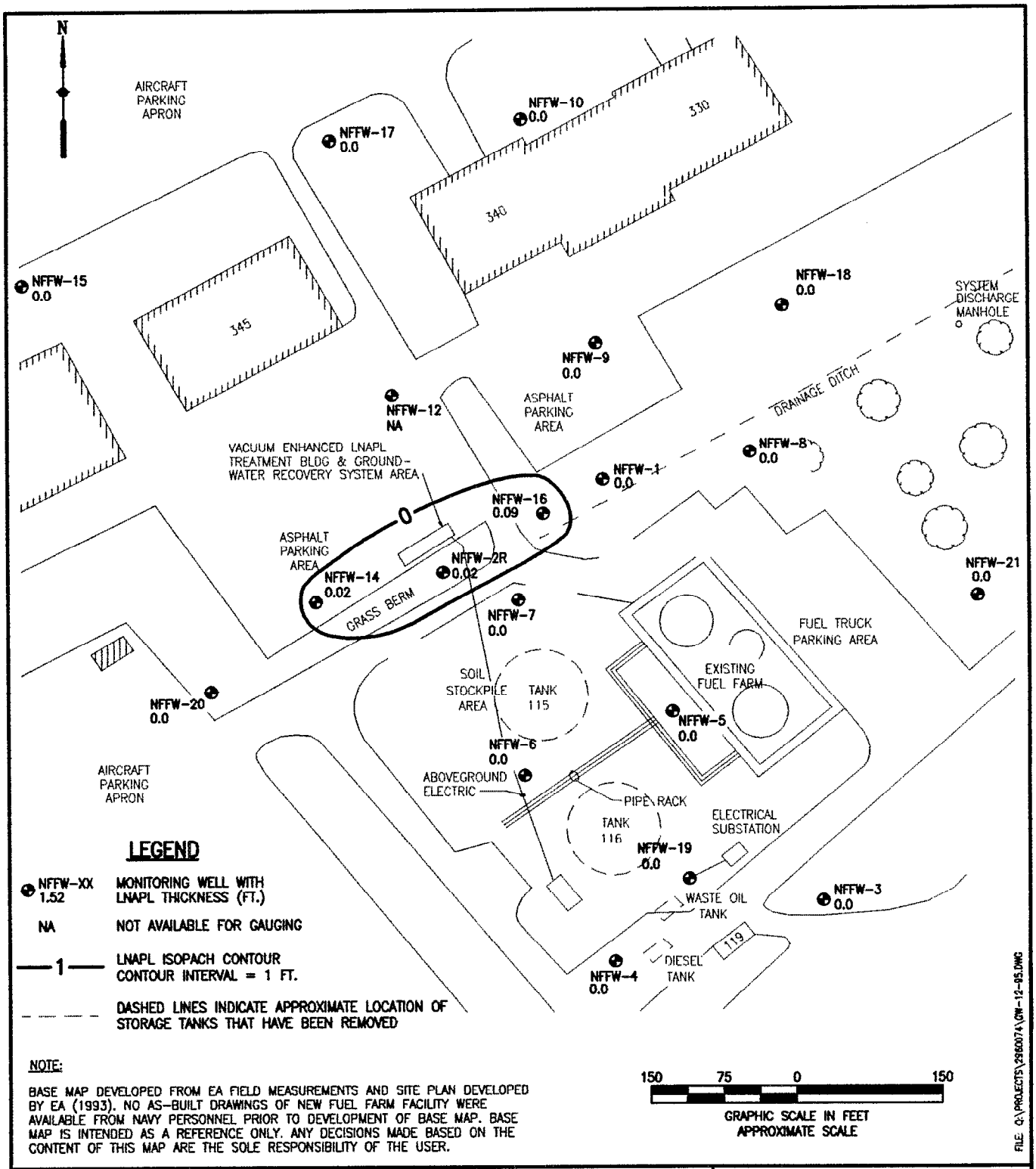
NAVY FUEL FARM
NAVAL AIR STATION JOINT RESERVE BASE
WILLOW GROVE, PENNSYLVANIA

POTENTIOMETRIC SURFACE
21 MAY 1998

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
HGP	MK	DWM	CR	1"=150'	4-20-99	29600.74	2-5



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NAVY FUEL FARM
NAVAL AIR STATION JOINT RESERVE BASE
WILLOW GROVE, PENNSYLVANIA

ISOPACH MAP OF THE LNAPL MEASURED IN MONITORING WELLS
21 MAY 1998

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
HGP	MK	DWM	CR	1"=150'	4-20-99	29600.74	2-6

TABLE 2-1 LNAPL OCCURRENCE AND THICKNESS DISTRIBUTION DURING THE PILOT STUDY
MARCH 1994 TO OCTOBER 1996
NAVY FUEL FARM, NAVAL AIR STATION JOINT RESERVE BASE
WILLOW GROVE, HORSHAM TOWNSHIP, PENNSYLVANIA

Well #	Number of Monitoring Events	LNAPL Occurrence and Thickness Distribution				Product Occurrence (% of Monitoring Events)
		0.01 ft - 0.10 ft	0.11 ft - 0.50 ft	0.51 ft - 1.00 ft	> 1.00 ft	
NFFW-1	72	9	8	0	0	24 %
NFFW-2R	92	13	9	7	23	57 %
NFFW-6	68	19	6	0	0	37 %
NFFW-7	71	14	15	2	0	44 %
NFFW-8	61	5	0	0	0	8 %
NFFW-12	71	9	2	0	0	15 %
NFFW-14	77	28	18	4	9	77 %
NFFW-16	72	12	7	3	8	42 %
NFFW-19	71	4	0	0	0	6 %
NFFW-20	62	3	11	2	0	26 %
NFFW-21	62	1	0	0	0	2 %

Source: EA 1996.

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TABLE 2-2 LNAPL OCCURRENCE AND THICKNESS DISTRIBUTION DURING THE OPERATION OF THE VACUUM ENHANCED LNAPL AND GROUND-WATER RECOVERY AND TREATMENT SYSTEM JANUARY 1998 TO JANUARY 1999 NAVY FUEL FARM, NAVAL AIR STATION JOINT RESERVE BASE WILLOW GROVE, HORSHAM TOWNSHIP, PENNSYLVANIA

Well #	Number of Monitoring Events	LNAPL Occurrence and Thickness Distribution				Product Occurrence (% of Monitoring Events)
		0.01 ft - 0.10 ft	0.11 ft - 0.50 ft	0.51 ft - 1.00 ft	> 1.00 ft	
NFFW-1	10	1	1	0	0	20 %
NFFW-2R	29	12	3	1	4	69 %
NFFW-6	10	2	0	0	0	20 %
NFFW-7	10	0	1	0	1	20 %
NFFW-8	10	0	1	0	0	10 %
NFFW-12	9	0	0	0	0	0 %
NFFW-14	29	20	3	1	0	79 %
NFFW-16	29	11	7	0	7	86 %
NFFW-19	10	0	0	0	0	0 %
NFFW-20	10	1	2	0	0	30 %
NFFW-21	5	0	0	0	0	0%

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Operation of the Vacuum Enhanced LNAPL and Ground-Water Recovery and Treatment System has extended the cone of depression seen during the pilot system from NFFW-2R to include NFFW-14 and NFFW-16 (Figure 2-5). The cone of depression has artificially created low ground-water table elevations around the recovery wells.

The recovery system has induced LNAPL flow into the recovery wells as exhibited by the increased percentage of LNAPL occurrence from Table 2-1 to 2-2 in wells NFFW-2R, 14, and 16. During the pilot system LNAPL occurred in wells NFFW-2R, 14 and 16 during 58% of the gauging events. During the operation of the remediation system LNAPL occurred in NFFW-2R, 14 and 16 during 79% of the gauging events. The percentage of LNAPL occurrence has decreased in the majority of monitoring wells and LNAPL has not been detected in wells NFFW-12, 19 and 21 since the remediation system was activated. The percentage of LNAPL occurrence increased, but not substantially, in NFFW-8 and NFFW-20. The increase in LNAPL occurrence at all the recovery wells coupled with the decrease in LNAPL occurrence at the monitoring wells indicates that the remediation system is achieving the Remedial Action Objectives and decreasing the extent of LNAPL across the site.

3. GROUND-WATER ANALYTICAL DATA

This chapter presents and evaluates the remediation system based on the analysis of ground-water analytical data at the Navy Fuel Farm. Section 3.1 presents historical analytical data and Section 3.2 presents the analytical data collected after the first year of the remediation systems operation. Discussion and comparison of the data is reserved for Section 3.3.

3.1 HISTORICAL GROUND-WATER ANALYTICAL DATA

A total of 36 ground-water samples were collected from selected monitoring wells on five occasions from June 1989 through June 1993. Of these samples, 14 contained concentrations of benzene in excess of the 5 microgram per liter (µg/L) ACT II guidance criteria with concentrations ranging from 5 to 990 µg/L. These wells were NFFW-1, NFFW-2 (two samples), NFFW-5, NFFW-7 (two samples), NFFW-9 (two samples), NFFW-11, NFFW-13 NFFW-16, NFFW-17, NFFW-19, and NFFW-20. Non-petroleum VOC were also reported for the June 1993 ground-water sampling event, including acetone (10 wells), carbon disulfide (three wells), trichloroethene (two wells), and chlorobenzene (one well). No ACT 2 guidance criteria exist for carbon disulfide or acetone. The concentrations reported for trichloroethene and chlorobenzene were less than the guidance criteria. Sampling results from June 1993 are included in Table 3-1. In 1993 wells NFFW-1, NFFW-2R, NFFW-6, NFFW-7, NFFW-12, NFFW-14, and NFFW-16 were not sampled due to the presence of LNAPL

Ground-water samples collected during the September 1997 sampling event are presented in Table 3-2. These ground-water samples were collected prior to activation of the Vacuum Enhanced LNAPL and Ground-Water Recovery and Treatment System and were intended to aid in assessing the effectiveness of the remedial action. The compounds detected are hydrocarbons indicative of jet aviation fuel (SRI International, October 1981) with the exception of 1,1-dichloroethane, which was detected at NFFW-10 (0.7 µg/L). This compound was also detected at the same concentration in the duplicate sample (NFFW-DUP1), which was collected

TABLE 3-1 SUMMARY OF ANALYTICAL RESULTS FOR GROUND-WATER SAMPLES COLLECTED JUNE 1993
NAVY FUEL FARM, NAVAL AIR STATION JOINT RESERVE BASE
WILLOW GROVE, HORSHAM TOWNSHIP, PENNSYLVANIA

	Units	Guidance Criteria*	Monitoring Wells							
			NFFW-3	NFFW-4	NFFW-5	NFFW-5D	NFFW-8	NFFW-9	NFFW-10	NFFW-11
VOLATILE ORGANIC COMPOUNDS										
Acetone	µg/L	--	ND	ND	ND	77	59 B	ND	14 B	ND
Carbon Disulfide	µg/L	--	ND	ND	14	12	ND	ND	ND	ND
Trichloroethene	µg/L	5	ND	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	µg/L	55	ND	ND	ND	ND	ND	5 J	ND	ND
Benzene	µg/L	5	ND	ND	53	52	ND	29	ND	16
Toluene	µg/L	1,000	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	µg/L	700	ND	ND	23	21	30	ND	ND	70
Total Xylenes	µg/L	10,000	ND	ND	12	11	9 J	ND	ND	ND
Total BTEX	µg/L	--	ND	ND	88	84	39	29	ND	86
TOTAL PETROLEUM HYDROCARBONS										
TPH (GasolineRange Organics -GRO)	µg/L	--	1,600	ND	1,600	1,700	8,800	1,300	360	8,300
TPH (JP-4)	µg/L	--	ND	ND	ND	ND	3,200	ND	ND	40,000

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TABLE 3-1 (Continued)

	Units	Guidance Criteria*	NFFW-15	NFFW-17	NFFW-18	NFFW-19	NFFW-20	NFFW-21	Trip Blank	Trip Blank
VOLATILE ORGANIC COMPOUNDS										
Acetone	µg/L	--	13 B	15 B	27 B	24 B	19 B	13 B	16 B	ND
Carbon Disulfide	µg/L	--	ND	ND	ND	ND	17	ND	ND	ND
Trichloroethene	µg/L	5	3 J	ND	ND	ND	2 J	ND	ND	ND
Chlorobenzene	µg/L	55	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	µg/L	5	ND	6 J	2 J	67	6 J	1 J	ND	ND
Toluene	µg/L	1,000	ND	ND	1 J	17 J	2 J	1 J	ND	ND
Ethylbenzene	µg/L	700	ND	ND	ND	320	ND	ND	ND	ND
Total Xylenes	µg/L	10,000	ND	ND	ND	500	46	ND	ND	ND
Total BTEX	µg/L	--	ND	6	3	904	54	2	ND	ND
TOTAL PETROLEUM HYDROCARBONS										
TPH (GasolineRange Organics - GRO)	µg/L	--	ND	530	6,800	6,900	5,900	ND	NA	NA
TPH (JP-4)	µg/L	--	ND	8,400	ND	3,600,000	1,600,000	ND	NA	NA

SOURCE (EA, September 1993)
NOTE: Wells NFFW-1, NFFW-2, NFFW-6, NFFW-7, NFFW-12, NFFW-13, NFFW-14, NFFW-16, and NFFW-19 not sampled due to presence of LNAPL in well.

ND indicate not detected; refer to EA (1993) for complete results.
D - Duplicate sample
NA - Not analyzed;
J - Estimated concentration
B - Compound detected in associated method blank
-- indicates No Guidance Criteria Value
Shaded values exceed guidance criteria.
* - Statewide Human Health Standards for Groundwater ≤ 2,500 TDS, Pennsylvania Land Recycling and Environmental Remediation Standards Act, 19 May 1995.

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TABLE 3-2 SUMMARY OF ANALYTICAL RESULTS FOR GROUND-WATER SAMPLES COLLECTED SEPTEMBER 1997
NAVY FUEL FARM, NAVAL AIR STATION JOINT RESERVE BASE
WILLOW GROVE, HORSHAM TOWNSHIP, PENNSYLVANIA

	Units	Guidance Criteria *	Monitoring Well					
			NFFW-6	NFFW-7	NFFW-8	NFFW-10	NFFW-10 (DUP 1)	NFFW-12
1,1-Dichloroethane	g/L	27	ND (1.0)	ND (1.0)	ND (1.0)	0.7 J	0.7 J	ND (1.0)
Benzene	µg/L	5	3	47 D	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Toluene	µg/L	1,000	0.6 J	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Ethylbenzene	µg/L	700	51 D	120 D	ND (1.0)	ND (1.0)	ND (1.0)	6
m + p-Xylene	µg/L	10,000 (total)	17	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
o - Xylene	µg/L	10,000 (total)	ND (1.0)	0.7 J	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Isopropylbenzene	µg/L	--	10	20	19	ND (1.0)	ND (1.0)	25
n-Propylbenzene	µg/L	--	14	24	16	ND (1.0)	ND (1.0)	19
1,3,5-Trimethylbenzene	µg/L	--	19 D	15	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
tert-Butylbenzene	µg/L	--	11	ND (1.0)	0.6 J	ND (1.0)	ND (1.0)	ND (1.0)
Sec-Butylbenzene	µg/L	--	5	8	5	ND (1.0)	ND (1.0)	9
1,2,4-Trimethylbenzene	µg/L	--	97 D	76 D	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
p-Isopropyltoluene	µg/L	--	9	11	0.6 J	ND (1.0)	ND (1.0)	4
1,2,3-Trimethylbenzene	µg/L	--	ND (10)	170 D	15	ND (1.0)	ND (1.0)	ND (1.0)
n-Butylbenzene	µg/L	--	8	9	ND (1.0)	ND (1.0)	ND (1.0)	6
Naphthalene	µg/L	20	96 D	200 D	11	ND (1.0)	ND (1.0)	49 JD

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TABLE 3-2 (Continued)

	Units	Guidance Criteria *	Monitoring Well			
			NFFW-14	NFFW-16	NFFW-19	NFFW-20
1,1-Dichloroethane	µg/L	27	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Benzene	µg/L	5	200 D	120 D	ND (1.0)	1
Toluene	µg/L	1,000	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Ethylbenzene	µg/L	700	230 D	140 D	ND (1.0)	56 D
m + p-Xylene	µg/L	10,000 (total)	ND (1.0)	ND (1.0)	ND (1.0)	120 D
o - Xylene	µg/L	10,000 (total)	1	0.9 J	ND (1.0)	9
Isopropylbenzene	µg/L	--	25	22	7	14
n-Propylbenzene	µg/L	--	20	18	17	17
1,3,5-Trimethylbenzene	µg/L	--	11	8	ND (1.0)	60 D
tert-Butylbenzene	µg/L	--	6	ND (1.0)	0.6 J	18
Sec-Butylbenzene	µg/L	--	7	5	8	7
1,2,4-Trimethylbenzene	µg/L	--	23	20	0.6 J	170 D
p-Isopropyltoluene	µg/L	--	10	7	1	16
1,2,3-Trimethylbenzene	µg/L	--	ND (10)	ND (25)	ND (1.0)	ND (10)
n-Butylbenzene	µg/L	--	8	5	3	9
Naphthalene	µg/L	20	220 D	130 D	ND (1.0)	45 D

SOURCE: (EA, 11 June 1998)
ND - Analyte not detected, value in parenthesis if laboratory detection limit.
D - Diluted sample.
J - Estimated value.
E - exceeds instrument calibration range.
-- indicates No Guidance Criteria Value.
Shaded values exceed guidance criteria.
* - Statewide Human Health Standards for Groundwater ≤ 2,500 TDS. Pennsylvania Land Recycling and Environmental Remediation Standards Act, 19 May 1995.
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at this well. However, it must be noted that the reported concentration was noted with a "J" qualifier, which means that the reported value is less than the quantification limit. Of the hydrocarbons detected, benzene exceeded the ACT II guidance criteria (5 μg/L) in three wells (NFFW-7, NFFW-14, and NFFW-16) and naphthalene exceeded the ACT II guidance criteria (20 μg/L) in six wells (NFFW-6, NFFW-7, NFFW-12, NFFW-14, NFFW-16, and NFFW-20).

3.2 1999 GROUND-WATER ANALYTICAL DATA

Ground-water samples were collected from wells NFFW-1, NFFW-5 (and Duplicate), NFFW-8, NFFW-10 (and Duplicate), NFFW-12, NFFW-14 (Recovery Well), NFFW-15, NFFW-16 (Recovery Well), NFFW-17 (and Duplicate), NFFW-18 (and Duplicate), NFFW-19, and NFFW-21 between 13 and 15 January 1999. The purge sheets for these wells are located in Appendix B. Ground-water samples were not collected from wells NFFW-2R, NFFW-3, NFFW-4, NFFW-6, NFFW-7, and NFFW-20 because the wells were dry due to an abnormally low ground-water table at the time of sampling. NFFW-9 was not sampled because the flush mounted well cap was submerged on 15 January 1999.

The analytical results for the ground-water samples collected are summarized in Table 3-3 and the laboratory results are included as Appendix C. The samples were analyzed for BTEX and naphthalene because previous sampling indicated that the compounds historically detected were hydrocarbons indicative of jet aviation fuel. Of the hydrocarbons detected, benzene exceeded the ACT II guidance criteria (5 μg/L) in seven wells (NFFW-1, NFFW-5, NFFW-8, NFFW-12, NFFW-14, NFFW-16, and NFFW-17) and naphthalene exceeded guidance criteria (20 μg/L) in four wells (NFFW-12, NFFW-14, NFFW-16, and NFFW-19).

3.3 CONCLUSIONS

The 1999 ground-water samples indicate that the concentrations of benzene and naphthalene have remained stable since the 1997 ground-water sampling event. Concentrations of benzene and naphthalene have remained within the same order of magnitude for all the wells that were

TABLE 3-3 SUMMARY OF ANALYTICAL RESULTS FOR GROUND-WATER SAMPLES COLLECTED JANUARY 1999 NAVY FUEL FARM, NAVAL AIR STATION JOINT RESERVE BASE WILLOW GROVE, HORSHAM TOWNSHIP, PENNSYLVANIA

	Units	Guidance Criteria*	Monitoring Wells							
			NFFW-1	NFFW-5	NFFW-5 Duplicate	NFFW-8	NFFW-10	NFFW-10 Duplicate	NFFW-12	NFFW-14 (RW)
Benzene	µg/L	5	5	ND (1.0)	10	6	ND (1.0)	ND (1.0)	22	220
Toluene	µg/L	1,000	6	ND (1.0)	7	ND (1.0)	ND (1.0)	ND (1.0)	27	17
Ethylbenzene	µg/L	700	7	ND (1.0)	5	ND (1.0)	ND (1.0)	ND (1.0)	19	150
Total Xylenes	µg/L	10,000	13	ND (1.0)	9	2	ND (1.0)	ND (1.0)	71	60
Naphthalene	µg/L	20	11	ND (5.0)	10	ND (5.0)	ND (5.0)	ND (5.0)	53	120

	Units	Guidance Criteria*	Monitoring Wells							
			NFFW-15	NFFW-16 (RW)	NFFW-17	NFFW-17 Duplicate	NFFW-18	NFFW-18 Duplicate	NFFW-19	NFFW-21
Benzene	µg/L	5	ND (1.0)	290	9	9	2	2	4	ND (1.0)
Toluene	µg/L	1,000	ND (1.0)	36	3	3	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Ethylbenzene	µg/L	700	ND (1.0)	260	2	2	ND (1.0)	ND (1.0)	15	ND (1.0)
Total Xylenes	µg/L	10,000	ND (1.0)	137	1	3	ND (1.0)	ND (1.0)	25	ND (1.0)
Naphthalene	µg/L	20	ND (5.0)	190	17	18	ND (5.0)	ND (5.0)	22	ND (5.0)

ND - Analyte not detected, value in parenthesis if laboratory detection limit.
Shaded values exceed guidance criteria.
* - Statewide Human Health Standards for Groundwater ≤ 2,500 TDS. Pennsylvania Land Recycling and Environmental Remediation Standards Act, 19 May 1995.

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sampled during the 1997 and 1999 sampling event except NFFW-12 and NFFW-19. In monitoring well NFFW-12 the benzene concentration has increased from ND in 1997 to 22 μg/L in 1999 but the well was not sampled in 1993 due to the presence of LNAPL. In monitoring well NFFW-19 the naphthalene concentration has increased from ND in 1997 to 22 μg/L in 1999.

4. SYSTEM OPERATIONS

The Vacuum Enhanced LNAPL and Ground-Water Recovery and Treatment System has been operating since 9 January 1998. As construction of different components of the system were completed the components were activated. The ground-water recovery/treatment, LNAPL recovery, and vapor extraction systems were operating by 9 February 1998. The Genesis SCADA system was not completely operational until 17 April 1998. System data recorded from 9 January 1998 to 26 January 1999 is presented in Table 4-1.

This chapter reviews the first year of the remediation systems operation. The Vacuum Enhanced LNAPL and Ground-Water Recovery and Treatment System review is broken down into the three components of the system which all operate independently of each other as outlined in the O&M manual (EA October 1998). These components: the ground-water recovery and treatment system, the LNAPL recovery system and the vapor recovery and treatment system are reviewed in sections 4.1, 4.2, and 4.3 respectively. Each section is broken into a review of system operations and recommendations associated with the continuing operation of the component. Section 4.4 is the projected annual operating costs for the entire The Vacuum Enhanced LNAPL and Ground-Water Recovery and Treatment System.

4.1 GROUND-WATER RECOVERY AND TREATMENT SYSTEM

4.1.1 System Operation

The ground-water recovery and treatment system has recovered and treated 1,355,460 gallons of ground-water from wells NFFW-2R, NFFW-14, and NFFW-16 during the first year of operation (Table 4-1). The ground-water recovery system operated continuously through-out the period except for NFFW-2R which was not functional from 28 May to 10 July due to a faulty motor. The motor was replaced under warranty. Ground water recovery was minimal in the fourth quarter due to an abnormally low potentiometric surface caused by a lack of precipitation.

TABLE 4-1 SYSTEM REPORT ON VACUUM ENHANCED LNAPL AND GROUND WATER RECOVERY AND TREATMENT SYSTEM NAVY FUEL FARM, NAVAL AIR STATION JOINT RESERVE BASE WILLOW GROVE, HORSHAM TOWNSHIP, PENNSYLVANIA

	NFFW-2R						NFFW-14						NFFW-16							Thermal -Oxidizer		Product Recovery			
	Ground-Water System				VER System		Ground-Water System				VER System		Ground-Water System				VER System		System Effluent Totalizer (gal)						
	Product Recovered		Ground-Water Recovered				Product Recovered		Ground-Water Recovered				Product Recovered		Ground-Water Recovered										
Date	Total (gal)	gpd (avg.)	Total (gal)	gpm	Vacuum (psia)	Flow (SCFM)	Total (gal)	gpd (avg.)	Total (gal)	gpm	Vacuum (psia)	Flow (SCFM)	Total (gal)	gpd (avg.)	Total (gal)	gpm	Vacuum (psia)	Flow (SCFM)		Chamber Temperature (F)	Effluent Concentration (ppmv)	LNAPL All Wells (gal)	Vapor Phase All Wells (gal)	Dissolved Phase All Wells (gal)	Total All Wells (gal)
01/02/98	0.00		(1)	(2)	(3)	(3)	0.00		(1)	(2)	(3)	(3)	0.00		(1)	(2)	(3)	(3)		(3)	(3)	(5)	(3)	(6)	
01/09/98	0.00	0.00	(1)	(2)	(3)	(3)	0.00	0.00	(1)	(2)	(3)	(3)	0.00	0.00	(1)	(2)	(3)	(3)	1628750	(3)	(3)	(5)	(3)	(6)	
01/09/98	0.00	0.00	(1)	6.0	(3)	(3)	22.40	22.40	(1)	2.5	(3)	(3)	0.00	0.00	(1)	(2)	(3)	(3)	1628750	(3)	(3)	22.40	(3)	(6)	22.40
01/13/98	3.40	0.85	(1)	3.0	(3)	(3)	42.40	5.00	(1)	1.0	(3)	(3)	0.00	0.00	(1)	(2)	(3)	(3)	1653960	(3)	(3)	45.80	(3)	0.02	45.82
01/20/98	8.10	0.67	(1)	2.0	(3)	(3)	51.50	1.30	(1)	1.0	(3)	(3)	0.00	0.00	(1)	(2)	(3)	(3)	1689130	(3)	(3)	59.60	(3)	0.06	59.65
01/28/98	13.30	0.65	(1)	-	(3)	(3)	55.30	0.48	(1)	-	(3)	(3)	0.00	0.00	(1)	(2)	(3)	(3)	1742210	(3)	(3)	68.60	(3)	0.11	68.70
02/02/98	13.30	0.00	(1)	-	(3)	(3)	55.30	0.00	(1)	-	(3)	(3)	0.00	0.00	(1)	(2)	(3)	(3)	1742210	(3)	(3)	68.60	(3)	0.11	68.70
02/09/98	13.80	0.07	(1)	-	(3)	(3)	64.02	1.25	(1)	-	(3)	(3)	0.00	0.00	(1)	(2)	(3)	(3)	1857420	(3)	(3)	77.82	(3)	0.21	78.02
02/16/98	13.80	0.00	(1)	3.3	12.44	(4)	65.94	0.27	(1)	-	12.39	(4)	0.00	0.00	(1)	(2)	12.61	(4)	1924760	1413	14.0	79.74	0.00	0.26	80.00
02/20/98	13.80	0.00	(1)	3.0	12.73	(4)	69.40	0.86	(1)	-	12.49	(4)	0.00	0.00	(1)	(2)	12.61	(4)	1964660	1410	25.0	83.20	22.43	0.30	105.93
02/23/98	17.40	1.20	(1)	2.8	12.49	(4)	69.50	0.03	(1)	-	12.49	(4)	0.00	0.00	(1)	(2)	12.61	(4)	2001060	1410	3.8	86.90	29.95	0.33	117.18
02/27/98	18.90	0.38	(1)	-	12.61	(4)	71.90	0.60	(1)	-	12.24	(4)	11.82	2.96	(1)	(2)	12.36	(4)	2041600	1410	-	102.62	33.05	0.37	136.03
03/02/98	19.17	0.09	(1)	-	12.98	19.0	71.90	0.00	(1)	-	12.73	9.9	11.82	0.00	(1)	(2)	12.98	6.9	2078240	1410	-	102.89	39.17	0.39	142.45
03/05/98	19.17	0.00	137	3.7	12.24	15.9	73.50	0.53	(1)	0.0	11.99	22.2	12.08	0.09	877	(2)	-	-	2110370	1410	1.9	104.75	43.40	0.41	148.56
03/09/98	19.17	0.00	27305	3.8	-	-	74.70	0.30	337	0.0	-	-	12.08	0.00	-	(2)	-	-	2149390	-	-	105.95	43.40	0.44	149.79
03/13/98	19.17	0.00	27809	3.7	11.50	12.9	74.70	0.00	367	0.0	11.75	8.5	12.18	0.02	5024	(2)	-	-	2150320	1410	2.0	106.05	43.40	0.44	149.89
03/16/98	(7)	(7)	29999	2.1	12.98	11.6	75.70	0.33	491	0.1	-	-	12.18	0.00	109999	0.30	-	-	2191350	1410	2.4	107.05	44.26	0.47	151.79
03/23/98	(7)	(7)	-	-	12.49	11.3	75.70	0.00	-	-	12.49	13.4	19.38	1.03	-	-	11.75	8.0	2193290	1410	-	114.25	45.27	0.47	159.99
04/02/98	19.17	0.00	-	-	11.99	11.1	77.50	0.18	-	-	12.24	10.0	19.38	0.00	-	-	12.24	10.5	2238360	1410	-	116.05	47.46	0.50	164.01
04/13/98	19.17	0.00	-	-	12.98	14.6	79.20	0.15	-	-	13.47	12.9	19.38	0.00	-	-	13.22	9.8	2318420	1410	1.7	117.75	52.68	0.56	170.99
04/17/98	19.17	0.00	29999	2.0	12.98	13.7	79.70	0.13	531	0.3	13.22	33.0	19.38	0.00	1059999	4.80	12.98	6.9	2346880	1410	1.8	118.25	57.31	0.58	176.13
04/22/98	19.17	0.00	-	-	13.22	12.2	79.70	0.00	-	-	13.47	-	19.38	0.00	-	-	13.47	6.1	2406460	1410	-	118.25	62.83	0.61	181.69
05/05/98	(7)	(7)	-	-	13.71	14.6	79.70	0.00	-	-	13.71	6.5	19.38	0.00	-	-	13.47	7.0	2550430	1410	2.0	92.08	85.04	0.69	177.81
05/21/98	22.47	1.84	-	-	11.50	6.9	82.10	0.15	-	-	11.75	7.8	27.58	0.51	-	-	10.77	9.9	2703620	1410	2.1	132.15	89.30	0.78	222.23
05/28/98	22.55	0.01	123026	-	13.22	9.0	82.10	(7)	22595	-	13.71	17.6	35.88	1.19	1659999	-	13.22	6.9	2755810	1412	-	140.53	90.74	0.81	232.07
06/12/98	22.55	(8)	(8)	(8)	13.22	7.4	83.04	0.06	25740	0.4	12.98	5.2	38.59	0.18	1829999	0.40	11.99	6.6	2777010	1410	-	144.18	94.09	0.81	239.08
06/23/98	22.55	(8)	(8)	(8)	(8)	(8)	83.19	0.01	29999	0.2	13.22	7.4	65.98	2.49	2352729	1.70	13.22	8.5	2830750	1410	-	171.72	99.55	0.83	272.10
07/10/98	22.55	(8)	(8)	(8)	(8)	(8)	83.64	0.03	29999	0.1	13.47	3.7	75.28	0.55	2490841	2.10	12.98	6.9	2844880	1410	1.7	181.47	102.13	0.83	284.42
07/28/98	22.55	0.00	-	-	-	-	83.64	0.00	-	-	-	-	75.30	0.00			-	-	-	-	-	181.49	102.13	0.83	284.44
07/31/98	22.55	0.00	128313	-	-	-	83.68	0.01	51559	0.7	12.24	10.0	77.78	0.83	3445104	1.30	-	-	2923400	1410	-	184.01	106.01	0.87	290.88
08/05/98	22.55	0.00	-	-	-	-	84.84	0.23	-	-	13.96	6.6	78.34	0.11	-	-	-	-	2931480	1410	0.9	185.73	108.02	0.87	294.62
08/14/98	30.95	0.93	-	-	13.96	7.6	86.44	0.18	-	-	14.20	5.4	79.28	0.10	-	-	-	-	2941320	1410	-	196.67	112.80	0.88	310.34
08/27/98	60.95	2.31	-	-	13.71	9.2	89.34	0.22	-	-	-	-	79.28	0.00	-	-	-	-	2960150	1410	2.9	229.57	125.03	0.89	355.48
09/11/98	68.25	0.49	-	-	-	-	89.64	0.02	-	-	-	-	79.32	0.00	-	-	-	-	2970340	-	-	237.21	125.03	0.90	363.13
09/16/98	68.25	0.00	129999	0.0	13.96	11.4	89.64	0.00	59999	0.0	14.70	0.0	79.38	0.01	5249999	0.20	14.70	0.0	2970620	1410	-	237.27	125.03	0.90	363.19
09/25/98	68.25	0.00	129999	3.5	-	-	89.64	0.00	59999	0.6	-	-	79.48	0.01	5349999	2.10	13.94	8.7	2973240	1410	3.4	237.37	125.05	0.90	363.32
10/14/98	68.25	0.00	-	0.0	-	-	90.44	0.04	-	0.0	14.70	0.0	79.48	0.00	-	4.50	12.49	9.5	2973240	1410	-	238.17	133.08	0.90	372.15
10/27/98	68.65	0.03	-	0.0	-	-	91.94	0.12	-	3.1	-	-	79.48	0.00	-	0.20	13.71	9.3	2978160	1410	1.9	240.07	133.18	0.91	374.16
11/03/98	68.65	0.00	-	-	-	-	92.64	0.10	-	-	-	-	82.68	0.46	-	-	13.71	10.0	2978160	1410	2.9	243.97	133.18	0.91	378.06
11/10/98	68.65	0.00	-	-	-	-	92.64	0.00	-	-	-	-	86.58	0.56	-	-	-	-	2978160	-	-	247.87	133.18	0.91	381.96
11/23/98	69.15	0.04	129999	0.0	-	-	94.24	0.12	15999	0.0	-	-	96.08	0.73	733544	0.20	11.99	12.3	2978230	1410	3.3	259.47	133.18	0.91	393.56
12/11/98	71.85	0.15	129999	-	-	-	95.84	0.09	179999	-	-	-	98.58	0.14	8119999	0.90	12.73	14.4	2978250	1410	-	266.27	133.18	0.91	400.36
12/21/98	71.85	0.00	129999	-	-	-	96.24	0.04	179999	-	-	-	99.88	0.13	8589999	1.00	12.49	17.2	2978250	1410	1.2	267.97	133.18	0.91	402.06
01/13/99	71.85	0.00	-	-	-	-	97.04	0.03	-	-	-	-	99.88	0.00	9317282	0.10	12.49	9.5	2978290	1410	-	268.77	133.18	0.91	402.86
01/26/99	71.85	0.00	-	-	-	-	97.04	0.00	179999	0.2	-	-	101.38	0.12	9834366	0.60	12.49	11.7	2984210	1410	3.6	270.27	141.68	0.91	412.85

Notes:
VER - Vapor Enhanced Product Recovery.
- Indicates data is not available.
(1) Genesis was not yet programmed to totalize flow from individual wells.
(2) PLC was not yet programmed to convert 4 to 20 mA signal to gpm.
(3) VER System was not turned on yet.
(4) Magnahelic gauges were not yet connected to the flow sensors.
(5) Product recovery pumps were not operating properly.
(6) System effluent totalizer was not installed yet.
(7) Product meter ran backwards due to vacuum on well.
(8) RW-2R off because groundwater pump motor is being replaced

P:\Federal\DOD\Navy\projects\2960074\YEAR-SUM\Table 4-1.doc

Dissolved phase hydrocarbons recovered with the ground water during the period totaled the equivalent of 0.91 gallons of LNAPL (Table 4-1). The primary carbon vessel was changed out on 14 October 1998 and rotated in to the secondary position. The treated ground-water is discharged to the base waste water treatment system. Therefore, no discharge permits are required for the ground-water treatment system.

Ground-water level gauging data (January 1998 to January 1999), Section 2-2, indicates that the ground-water table is being depressed in the vicinity of the recovery wells. The depression of the ground-water table induces flow of LNAPL towards the recovery points and retards migration of petroleum products past the recovery points, north of the site.

4.1.2 Recommendations

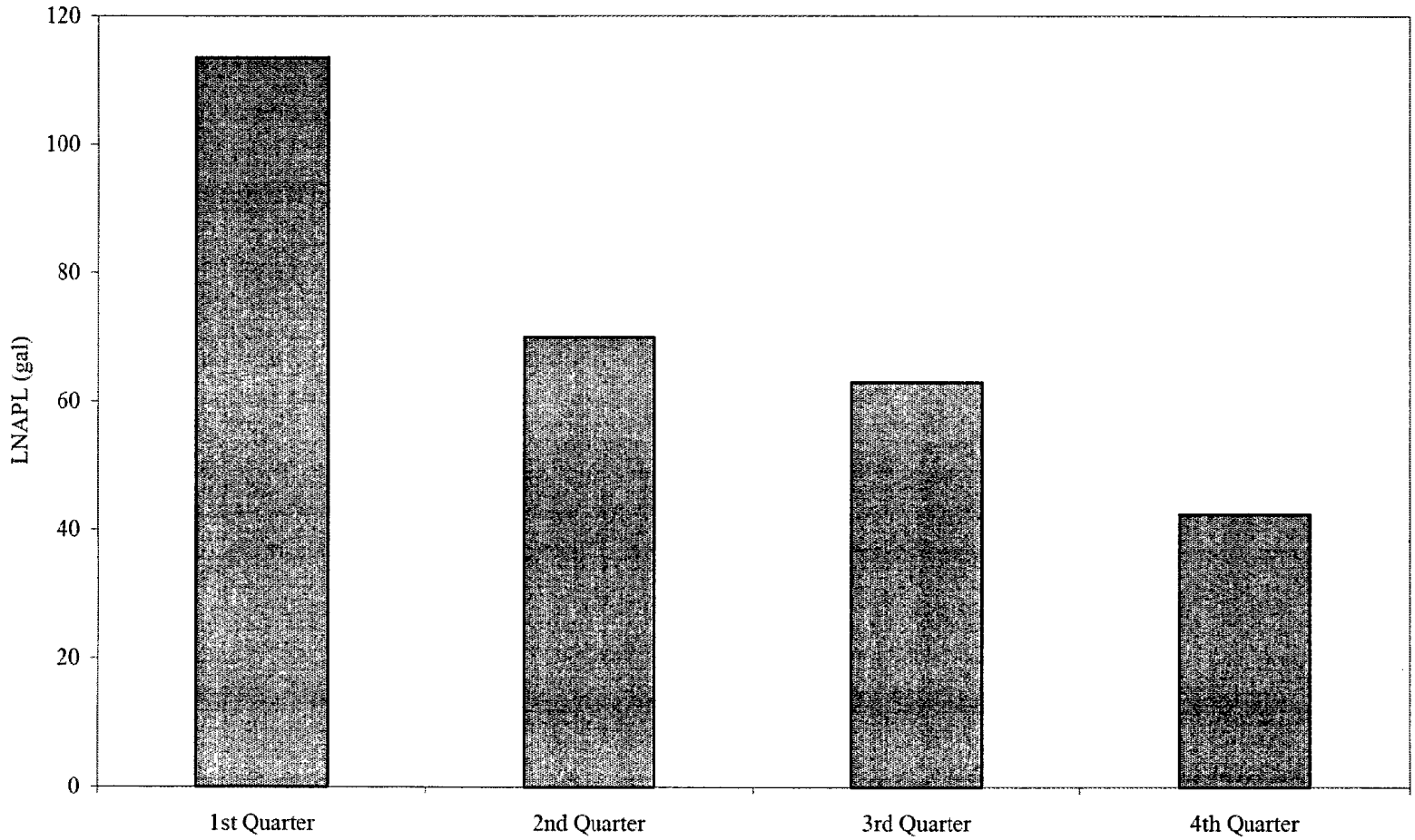
Continued depression of the ground-water table will aid in LNAPL recovery from the site by establishing a downward gradient into the recovery wells, there-by enhancing LNAPL flow along the gradient and towards the recovery wells.

4.2 PRODUCT RECOVERY AND STORAGE

4.2.1 System Operation

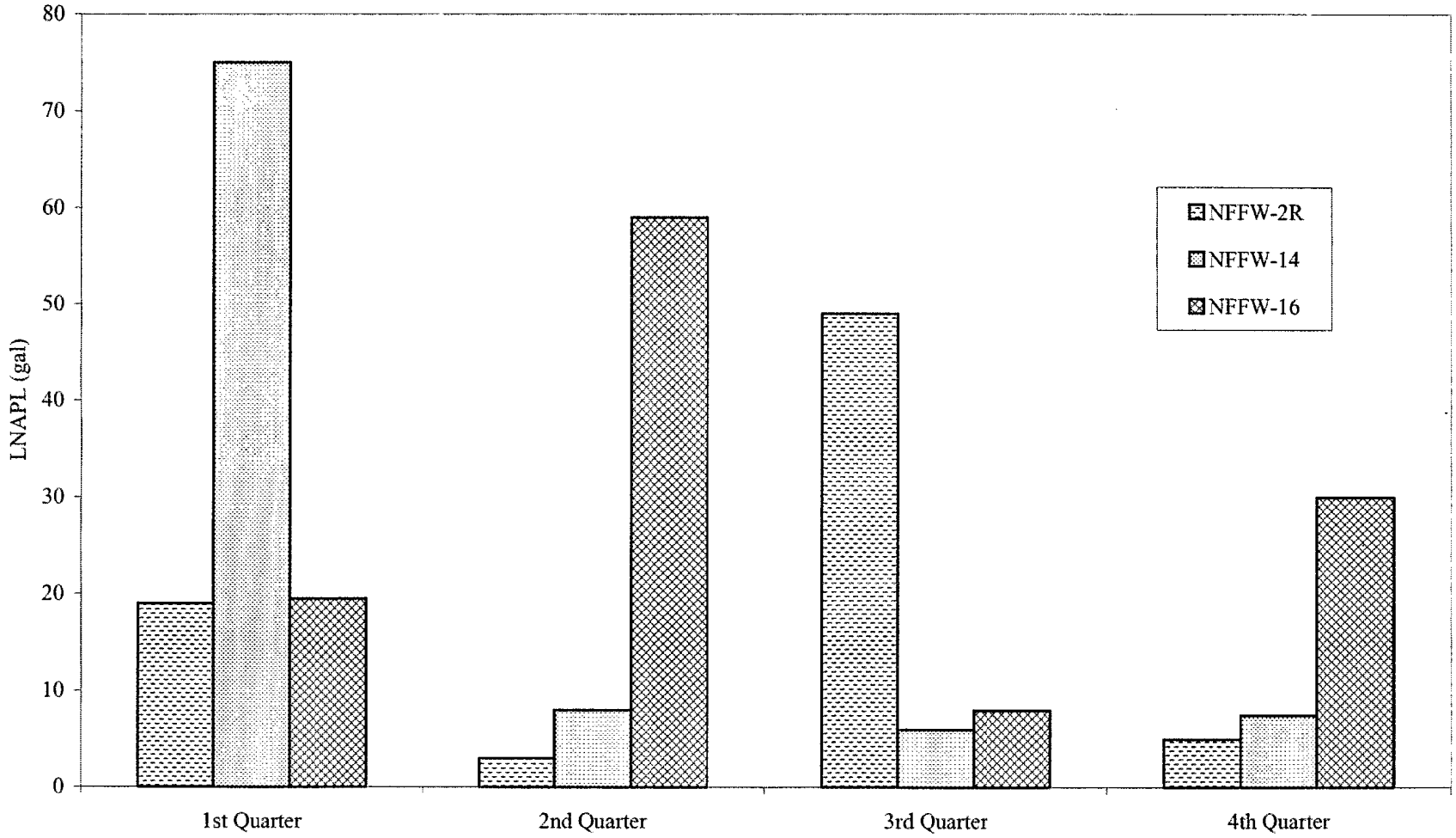
The LNAPL recovery and storage system was operated throughout the period. The LNAPL recovery pumps were returned to the manufacturer for upgrades that are expected to reduce wear on the system. Therefore, over the operating period the product recovery system was not active from: 10 March to 2 April in NFFW-16, 23 June to 14 August in NFFW-2R, and 14 August to 19 September in NFFW-16. LNAPL recovery from the individual recovery wells is detailed on Table 4-1. Total quarterly LNAPL recovery by the LNAPL recovery system is presented in Figure 4-1. As expected quarterly LNAPL recovery is declining. However, LNAPL recovery from individual wells, as seen in Figure 4-2, does not show a decreasing quantity of LNAPL recovered per quarter but rather a more random scatter of product recovery. There were two

FIGURE 4-1 TOTAL QUARTERLY LNAPL RECOVERY BY THE VACUUM ENHANCED LNAPL AND GROUND-WATER RECOVERY AND TREATMENT SYSTEM NAVY FUEL FARM, NAVAL AIR STATION JOINT RESERVE BASE WILLOW GROVE, HORSHAM TOWNSHIP, PENNSYLVANIA



P:\Federal\DOD\Navy\projects\2960074\YEAR-SUM\Figure 4-1.doc

FIGURE 4-2 QUARTERLY LNAPL RECOVERY FROM INDIVIDUAL WELLS BY THE VACUUM ENHANCED LNAPL AND GROUND-WATER RECOVERY AND TREATMENT SYSTEM NAVY FUEL FARM, NAVAL AIR STATION JOINT RESERVE BASE WILLOW GROVE, HORSHAM TOWNSHIP, PENNSYLVANIA



P:\Federal\DOD\Navy\projects\2960074\YEAR-SUM\Figure 4-2.doc

primary factors that contributed to the fluctuations in LNAPL recovery. Firstly, during periods of low ground-water table elevations the LNAPL/Air interface was below the LNAPL recovery pumps. Secondly, occasional maintenance issues (detailed above) with the LNAPL recovery pumps resulted in periods were LNAPL was not recovered from a well. Cumulative LNAPL recovery for the entire system and by recovery well is presented in Figure 4-3. A total of 270 gallons of LNAPL was recovered during the period.

4.2.2 Recommendations

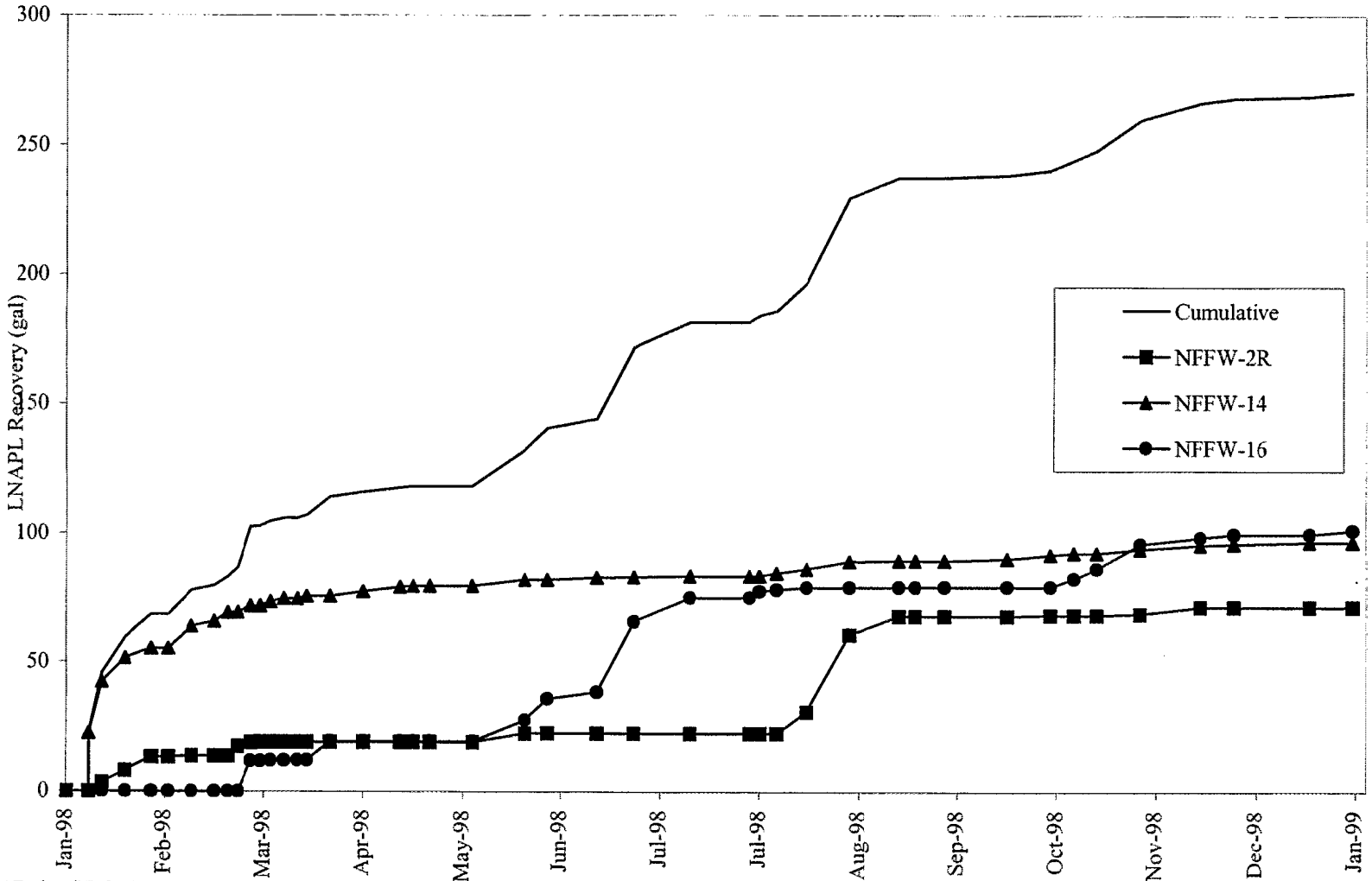
Many of the repairs necessary to the LNAPL recovery system required shipping the systems back to the manufacturer for hardware upgrades. Shipping parts back to the manufacturer resulted in considerable down time for the LNAPL recovery system during the operating period, however, the manufactures upgrade is expected minimize the need for further repairs. Since LNAPL recovery is the Remedial Action Objective of the system, procurement of a shelf spare product recovery system is recommended. This will allow LNAPL recovery to continue when the LNAPL recovery pumps require maintenance

4.3 VAPOR RECOVERY AND TREATMENT SYSTEM

4.3.1 System Operation

The vapor recovery and treatment system was activated on 9 February 1998, after installation of the heat exchanger. The vapor recovery system recovered the equivalent of 141 gallons of LNAPL in the vapor phase over the operating period. As the water table dropped in the third and fourth quarter of 1998, vapor recovery flow rates from each well increased and it was eventually necessary to isolate vapor recovery on individual recovery wells to maximize system performance. By focusing vapor recovery on individual recovery wells during the third and fourth quarters, increases in vapor phase product recovery were realized. Vapor recovery will be redistributed to the recovery wells as the ground-water table rises.

FIGURE 4-3 LNAPL RECOVERY FROM
VACUUM ENHANCED LNAPL AND GROUND-WATER RECOVERY AND TREATMENT SYSTEM
NAVY FUEL FARM, NAVAL AIR STATION JOINT RESERVE BASE
WILLOW GROVE, HORSHAM TOWNSHIP, PENNSYLVANIA



P:\Federal\DOD\Navy\projects\2960074\YEAR-SUM\Figure 4-3.doc

The vapor recovery system has met the requirements of the air discharge permit the entire operating period. The discharge permit requires a minimum chamber temperature of 1410° F and a maximum effluent concentration of 300 ppm. Results of the monitoring of these system parameters in included in Table 4-1.

4.3.2 Recommendations

Operation costs of the vapor recovery and treatment system are substantial. The operating cost for the vapor recovery and treatment system are associated with technician time for maintenance, electric costs, and supplemental fuel costs. The costs of supplemental fuel is budgeted at $14,400 (1999 dollars) a year, 13 % of the yearly operating budget. The cost analysis of the vapor recovery and treatment system presented in Appendix D is an attempt to reduce the costs associated with the supplemental fuel.

Two alternatives were identified as ways to reduce the costs of supplemental fuel. The first alternative was to replace the current vacuum blower with a larger blower allowing the system to collect more of it's fuel source from the recovery points. The increased vapor recovery rates from this alternative could possibly increase LNAPL and ground water recovery rates at the recovery points. The second alternative was to modify the thermal oxidizer to catalytic oxidation allowing the treatment system to operate at a lower temperature and lower the fuel consumption rate. Both options reduced the consumption rate of supplemental fuel and pay off periods for capital investment were found to be highly dependent on fuel costs.

The pay off period for the larger blower is greater then 10 years for the considered fuel costs making it unfeasible based purely on system economics. The potential of increased LNAPL recovery due to increased soil vapor flow rates was not incorporated into the economic analysis but should be considered as a benefit associated with a larger vacuum blower

The pay off period for converting the oxidizer to catalytic operation ranges from 2 years to less then 1 year as fuel prices range from $0.50 to $1.50 respectively. The current fuel price is $0.75

and corresponds to a payback period of one and a half years. The immediate conversion of the oxidizer to catalytic operation is recommended since expected operation of the system is greater then two additional years. Prior to implementing the conversion of the oxidizer to catalytic operation it will be necessary to insure that there are no compounds in the extracted soil vapors that would have a detrimental effects on the longevity of the catalyst bed. It is also necessary to renegotiate the air permit to reduce the minimum chamber temperature to 600° F. The upgrade of the oxidizer to catalytic operation is estimated at $7000.

4.4 PROJECTED ANNUAL OPERATION COSTS

The projected annual operating costs for the remediation system are based on the operation and maintenance costs for 1998. The activities covered under the projected operating costs include:

- Preparation of the Cost Impact Letter.
- Biweekly O&M site visits.
- Monthly Before, Between, and Effluent samples from the ground-water treatment system (36 samples per year) analyzed for BTEX and Naphthalene.
- Quarterly gauging of all site wells.
- Four unscheduled site visits.
- Monthly system operation reports.
- A yearly System Performance Report.
- Disposal of 500 gallons of LNAPL a year.
- Two change-outs of the carbon vessels.
- Propane supply for a year.

The cost for these tasks in 1999 dollars is $ 106,000.

5. CONCLUSIONS

5.1 SYSTEM EFFECTIVNESS

The remediation system's ROA is LNAPL recovery. The Vacuum Enhanced LNAPL and Ground Water Recovery and Treatment System recovered 270.27 gallons of LNAP, 141.68 gallons of vapor phase, and 0.91 gallons of liquid phase product during the period. Another 2.75 gallons of LNAPL was bailed from the monitoring wells during the period.

Based on comparisons of LNAPL occurrence during gauging events (Table 2-1 and 2-2), the aerial extent of LNAPL occureacne has been reduced since no LNAPL has been observed in Wells NFFW-19 and NFFW-21 in 1998. Currently, LNAPL occurs more frequently in the recovery wells then during the operation of the pilot system. The combination of these facts indicates that by selectively drawing LNAPL to the recovery wells the system is reducing the areial extent of LNAPL while recovering LNAPL.

The ground-water recovery system has been operating consistently throughout the period and has created a cone of depression around the recovery wells that enhances the flow of LNAPL toward the recovery wells (Figure 2-5).

The vapor recovery system has increased LNAPL recovery at the recovery wells, especially during periods when the ground-water table is low. Unfortunately, when the ground-water table is low vapor flow rates from individual wells increase making it ineffective to apply the vapor recovery system to all three of the recovery wells. Therfore, it has been necessary to focus vapor recovery on a single recovery well when the ground-water table is low.

The remediation system has been recovering LNAPL from the Navy Fuel Farm and LNAPL occurrence of product across the site has decreased over the period. Although trends have appeared in LNAPL recovery from the site (Figure 4-1), these trends are not present in the individual recovery wells (Figure 4-2). LNAPL recovery from individual recovery wells

fluctuates with fluctuations in the ground-water table and LNAPL recovery system repairs. In conclusion the Vacuum Enhanced LNAPL and Ground Water Recovery and Treatment System has been effective at recovering LNAPL and this trend will be evaluated as the system is operated in 1999.

5.2 SYSTEM IMPROVMENTS

System improvements included under this 1999's budget include the purchase of a shelf spare product recovery system and resurvey of the site wells (Section 4.2.2).

It is further recommended that the current thermal oxidizer be converted to catalytic operation as the capital costs will be recouped from savings of operating costs in 1 to 2 years (Section 4.3.2).

Continued operation of the system is recommended to further assess the effectiveness of the remedial action.

5.3 ANNUAL OPERATING COSTS

The anticipated annual operating costs are $ 106,000 dollars a year to operate, maintain, and report on the Vacuum Enhanced LNAPL and Ground Water Recovery and Treatment System. This estimated cost is in 1999 dollars and does not include the costs for the system improvements recommended to the thermal oxidizer in Section 5.2.

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APPENDIX A

GAUGING DATA

Notes:

- indicates that data is not available.

* indicates that the product meters ran backwards due to the vacuum on the well. No product recovery information is available for this period.

Well ID: **NFFW-1**
TOC: **311.18** ft amsl
Ground: **309.78** ft amsl
Depth of Well: **28.88** ft bgs
Depth to Screen **8.88** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
03/30/94	-	11.60	0.00	299.58	-	-	Lock 2C22 is rusty
04/04/94	-	11.90	0.00	299.28	-	-	
04/06/94	-	12.12	0.00	299.06	-	-	
04/07/94	-	12.30	0.00	298.88	-	-	
04/12/94	-	12.83	0.00	298.35	-	-	
04/20/94	-	13.04	0.00	298.14	-	-	
04/27/94	-	13.31	0.00	297.87	-	-	
05/04/94	-	14.17	0.00	297.01	-	-	
05/12/94	-	14.20	0.00	296.98	-	-	
05/13/94	-	14.27	0.00	296.91	-	-	
05/16/94	-	14.54	0.00	296.64	-	-	
05/24/94	-	15.35	0.00	295.83	-	-	
05/27/94	-	15.60	0.00	295.58	-	-	
06/03/94	-	16.35	0.00	294.83	-	-	
06/15/94	17.20	17.21	0.00	293.98	-	-	
06/16/94	17.29	17.30	0.01	293.89	-	-	
07/01/94	19.11	19.16	0.05	292.06	-	-	
07/13/94	20.92	21.10	0.18	290.24	0.25	0.25	Bailed 0.25 gal
08/05/94	-	17.42	0.00	293.76	-	0.25	
08/17/94	-	17.68	0.00	293.50	-	0.25	
08/30/94	-	16.20	0.00	294.98	-	0.25	
09/08/94	-	16.46	0.00	294.72	-	0.25	
09/14/94	-	17.07	0.00	294.11	-	0.25	
09/19/94	-	17.53	0.00	293.65	-	0.25	
09/30/94	-	17.88	0.00	293.30	-	0.25	Odor
10/17/94	20.27	20.33	0.06	290.90	-	0.25	
10/25/94	21.42	21.56	0.14	289.74	-	0.25	
11/11/94	23.20	23.55	0.35	287.93	-	0.25	
11/22/94	23.22	23.56	0.34	287.92	-	0.25	
12/07/94	21.19	21.46	0.27	289.95	-	0.25	
12/21/94	19.46	19.70	0.24	291.69	-	0.25	
01/04/95	19.32	19.48	0.16	291.84	-	0.25	
01/16/95	17.79	17.88	0.09	293.38	-	0.25	
01/23/95	-	16.87	0.00	294.31	-	0.25	
02/16/95	-	16.94	0.00	294.24	-	0.25	
02/28/95	-	15.96	0.00	295.22	-	0.25	
03/10/95	-	14.80	0.00	296.38	-	0.25	
03/29/95	-	14.84	0.00	296.34	-	0.25	
04/04/95	-	15.24	0.00	295.94	-	0.25	
04/27/95	-	16.49	0.00	294.69	-	0.25	
05/11/95	-	16.50	0.00	294.68	-	0.25	
05/24/95	-	16.85	0.00	294.33	-	0.25	
06/15/95	-	17.35	0.00	293.83	-	0.25	
06/29/95	-	18.11	0.00	293.07	-	0.25	Sheen
07/06/95	-	18.90	0.00	292.28	-	0.25	
07/25/95	20.01	20.02	0.01	291.17	-	0.25	
08/01/95	20.34	20.43	0.09	290.83	-	0.25	
08/21/95	23.10	23.42	0.32	288.04	-	0.25	
09/14/95	24.08	24.18	0.10	287.09	-	0.25	
09/28/95	22.55	22.65	0.10	288.62	-	0.25	
10/06/95	21.08	21.14	0.06	290.09	-	0.25	
10/25/95	-	16.17	0.00	295.01	-	0.25	
11/21/95	-	12.87	0.00	298.31	-	0.25	
12/08/95	-	14.11	0.00	297.07	-	0.25	
12/21/95	-	14.15	0.00	297.03	-	0.25	
01/23/96	-	12.98	0.00	298.20	-	0.25	
02/09/96	-	12.02	0.00	299.16	-	0.25	

Well ID: **NFFW-1**
TOC: **311.18** ft amsl
Ground: **309.78** ft amsl
Depth of Well: **28.88** ft bgs
Depth to Screen **8.88** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
02/19/96	-	13.25	0.00	297.93	-	0.25	
01/09/98	-	14.79	0.00	296.39	-	0.25	New System Started
01/13/98	-	14.76	0.00	296.42	-	0.25	
02/20/98	-	13.57	0.00	297.61	-	0.25	
02/27/98	-	12.87	0.00	298.31	-	0.25	
03/16/98	-	13.03	0.00	298.15	-	0.25	
05/21/98	-	14.58	0.00	296.60	-	0.25	
08/14/98	-	19.24	0.00	291.94	-	0.25	
10/14/98	-	19.63	0.00	291.55	-	0.25	
12/21/98	23.85	23.97	0.12	287.11	-	0.25	
01/13/99	21.29	21.30	0.01	289.87	-	0.25	

Well ID:	**NFFW-2R**	(Recovery Well)
TOC:	**313.97**	ft amsl
Ground:	**312.53**	ft amsl
Depth of Well:	**35.50**	ft bgs
Depth to Screen	**5.50**	ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Pressure Transducer	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Ground-water Flow Rate (gpm)	Ground-water Recovered (gal)	Vacuum at Vault (psia)	Flow Rate (SCFM)	Concentration (ppmv)	Comments
03/30/94	-	12.58	0.00		302.57	-	-		-				START WELL @ 1600
03/31/94	-	13.50	0.00		301.65	-	0.00	1.25	0				1400 HOURS, PUMP AT 13.5 FT
04/04/94	-	13.50	0.00		301.65	-	0.00	-	-				NEED TO RESURVEY WELL
04/04/94	24.40	24.70	0.30		290.71	-	0.00	5.00	7122				1400 HOURS, PUMP RESET AT 17.5 FT
07/04/94	-	17.50	0.00		297.65	-	0.00		-				1100 HOURS
07/04/94	-	19.50	0.00		295.65	-	0.00	4.50	12212				
04/12/94	-	20.08	0.00		295.07	0.57	0.57	6.00	42122				Lowered pump to approx 21.72 ft
04/20/94	-	16.73	0.00		298.42	-	0.57	0.00	87452				Pump not running
04/27/94	-	15.25	0.00		299.90	0.28	0.85	6.00	89052				Lowered pump 1.5 ft
05/04/94	-	16.75	0.00		298.40	-	0.85	4.00	94562				lowered pump about 1 ft to 18.2 ft
05/12/94	16.00	16.02	0.02		299.15	-	0.85	0.00	97329				SYSTEM ALARM LIGHT ON, PUMPS OFF
05/13/94	16.23	16.25	0.02		298.92	-	0.85	0.00	-				1130 HRS, PUMPS TURNED BACK ON
05/13/94	23.50	23.52	0.02		291.65	-	0.85	-	97402				1300 HRS
05/16/94	24.21	24.23	0.02		290.94	42.48	43.33	2.50	108562				1205 HRS
05/24/94	24.19	27.08	2.89		290.58	34.68	78.01		18937				
05/27/94	27.41	27.42	0.01		287.74	92.98	170.99	1.00	131602				1200 hours
06/03/94	-	26.75	0.00		288.40	44.76	215.75	1.17	143542				1300 hrs, Product pump turned on, vacuum enhanced tested for 2 hours
06/07/94	-	-	-		-	-	215.75	1.71	148159				1650 hrs; 7.5" Hg vacuum
06/07/94	-	-	-		-	-	215.75	-	148162				1710 hrs; Decreased vacuum to 2.5" Hg
06/07/94	-	-	-		-	-	215.75	-	148162				1710 hrs
06/07/94	-	-	-		-	-	215.75	-	148182				1735 hrs
06/07/94	-	-	-		-	-	215.75	0.60	148188				1745 hrs
06/07/94	-	-	-		-	-	215.75	1.36	148222				1810 hrs
06/07/94	-	-	-		-	19.21	234.96	1.00	148232				1820 hrs
06/07/94	-	-	-		-	10.53	245.49	0.67	148242				1835 hrs
06/07/94	-	-	-		-	-	245.49	1.17	148277				1905 hrs
06/08/94	26.93	26.94	0.01		288.22	14.28	259.77	0.90	148961				0745 hrs
06/08/94	-	-	-		-	-	259.77	0.90	149185				1200 hrs
06/15/94	23.53	23.72	0.19		291.60	2.60	262.37	-	150232				1210 hrs; Turn on vacuum enhanced system
06/15/94	-	-	-		-	-	262.37	2.10	150247				1217 hrs; approx 4" Hg vacumm
06/15/94	-	-	-		-	-	262.37	3.50	150254				1219 hrs
06/15/94	-	-	-		-	-	262.37	0.75	150257				1223 hrs
06/15/94	-	-	-		-	-	262.37	2.30	150264				1226 hrs
06/15/94	-	-	-		-	-	262.37	2.05	150303				1245 hrs
06/15/94	-	-	-		-	-	262.37	1.39	150407				1400 hrs; shut off vacuum system at 1510
06/16/94	-	26.60	0.00		288.55	5.55	267.92	0.52	151026				0948 hrs; Started vacuum at 4" Hg
06/16/94	-	-	-		-	-	267.92	0.42	151031				1000 hrs
06/16/94	-	-	-		-	-	267.92	1.17	151038				1006 hrs
06/16/94	-	-	-		-	-	267.92	3.10	151044				1015 hours
06/16/94	-	-	-		-	-	267.92	1.20	151062				1030 hours
06/16/94	-	-	-		-	-	267.92	0.73	151073				1045 hours
06/20/94	-	-	-		-	12.52	280.44	0.28	152666				1030 hrs
06/21/94	-	-	-		-	4.92	285.36	0.17	152910				1040 hrs; Reconfigure system to place moisture trap before carbon

Well ID:	NFFW-2R	(Recovery Well)
TOC:	313.97	ft amsl
Ground:	312.53	ft amsl
Depth of Well:	35.50	ft bgs
Depth to Screen	5.50	ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Pressure Transducer	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Ground-water Flow Rate (gpm)	Ground-water Recovered (gal)	Vacuum at Vault (psia)	Flow Rate (SCFM)	Concentration (ppmv)	Comments
06/21/94	-	-	-		-	-	285.36	0.11	152941				1515 hrs; Start up vacuum enhanced system at 3" Hg; New air carbons
06/21/94	-	-	-		-	-	285.36	0.27	152956				1610 hrs; 99.5% treatment after 1st carbon-100% after 2nd carbon
06/21/94	-	-	-		-	-	285.36	0.23	153006				1940 hrs; 87% removal after 1st carbon; 99.5% after 2nd carbon
06/22/94	-	-	-		-	-	285.36	-	153062				0800 hrs; System shut down - water over ride; restart at 3" Hg
06/22/94	25.50	28.25	2.75		289.29	9.81	295.17	-	153086				0930 hrs; Water over ride restart at 2.5" Hg; 8% removal after 1st carbon, 48% after 2nd
06/22/94	-	-	-		-	-	295.17	0.40	153100				1005 hrs; 17% removal after 1st carbon, 46% after 2nd
06/22/94	-	26.40	0.00		288.75	6.52	301.69	-	153109				1320 hrs
06/24/94	-	-	-		-	-	301.69	0.18	153502				0040 hrs; 4% removal after 1st carbon, 12.5% after 2nd
06/24/94	-	27.10	0.00		288.05	9.74	311.43	0.01	153558				0845 hours; turn vacuum enhaced system off continue recovery under normal conditions
07/01/94	27.19	28.65	1.46		287.77	-	311.43		153558				
07/13/94	32.05	33.28	1.23		282.94	-	311.43		153558				
07/13/94	32.05	33.28	1.23		282.94	8.45	319.88		153558				After bailing monitoring wells
08/05/94	22.95	23.63	0.68		292.11	-	319.88		153558				
08/05/94	22.95	23.63	0.68		292.11	-	319.88		153558				After bailing monitoring wells
08/17/94	22.98	24.47	1.49		291.98	1.16	321.04		153558				
08/17/94	22.98	24.47	1.49		291.98	-	321.04		153558				After bailing monitoring wells
08/30/94	20.08	20.35	0.27		295.03	-	321.04		153558				
09/08/94	19.54	19.73	0.19		295.59	-	321.04		153558				
09/14/94	21.15	21.63	0.48		293.94	-	321.04		153558				
09/19/94	21.07	22.00	0.93		293.96	-	321.04		153558				
09/30/94	22.63	24.00	1.37		292.34	-	321.04		153572				
10/17/94	27.11	33.27	6.16		287.24	-	321.04		153572				
10/25/94	29.95	36.47	6.52		284.35	-	321.04		153572				
11/11/94	33.35	35.30	1.95		281.55	-	321.04		153572				Installed winch lowered pump
11/22/94	-	-	0.00		NG	-	321.04		153572				IFP BROKE DURING GAUGING, NO INFORMATION AVAILABLE
12/07/94	30.08	34.15	4.07		284.54	318.04	639.07		153572				Tank gauged after bailing
12/21/94	25.73	29.26	3.53		288.96	110.74	749.82		153579				Tank Full
12/31/94	-	-	-		NG	45.00	794.82		153579				55 Gal Drum Full
01/04/95	25.12	28.98	3.86		289.53	-	794.82		153582				Tank & Drum Pumped out
01/16/95	24.11	29.11	5.00		290.39	10.95	805.76		153724				
01/23/95	25.12	28.98	3.86		289.53	0.95	806.71		153772				
02/16/95	21.28	23.18	1.90		293.62	0.24	806.95		154047				Replaced carbons
02/28/95	-	23.15	0.00		292.00	6.36	813.30		154167				Pump on overide on arival
03/10/95	-	24.45	0.00		290.70	160.89	974.20		180222				
03/29/95	-	16.24	Sheen		296.91	33.24	1007.44		216109				Pump on overide on arival
04/04/95	-	22.30	0.00		292.85	2.51	1009.95		236537				

Well ID:	**NFFW-2R**	(Recovery Well)
TOC:	**313.97**	ft amsl
Ground:	**312.53**	ft amsl
Depth of Well:	**35.50**	ft bgs
Depth to Screen	**5.50**	ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Pressure Transducer	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Ground-water Flow Rate (gpm)	Ground-water Recovered (gal)	Vacuum at Vault (psia)	Flow Rate (SCFM)	Concentration (ppmv)	Comments
04/27/95	-	26.15	0.00		289.00	134.25	1144.20		286732				
05/11/95	26.25	26.28	0.03		288.90	21.35	1165.55		296942				Pump Submurged on arrival
05/24/95	-	26.05	0.00		289.10	38.09	1203.64		318783				
06/15/95	-	27.70	0.00		287.45	61.20	1264.84		344582				Sampled Carbons
06/29/95	23.86	24.76	0.90		291.17	5.98	1270.83		347172				Tank Full
07/06/95	25.35	25.54	0.19		289.78	-	1270.83		347252				Tank Pumped out
07/25/95	25.61	26.45	0.84		289.43	20.31	1291.13		348509				System down
08/01/95	25.82	27.29	1.47		289.14	-	1291.13		348509				System down
08/21/95	-	-	0.00		NG	-	1291.13		348509				Vacuum recovery system running, COULD NOT OPEN
09/14/95	-	Dry	0.00		Dry	-	1291.13		348509				Vacuum recovery system running
09/28/95	29.73	32.59	2.86		285.05	-	1291.13		348509				Vacuum recovery system running
10/06/95	26.55	27.95	1.40		288.42	1.23	1292.37		348509				Vacuum recovery system running
10/18/95	25.75	27.46	1.71		289.18	16.08	1308.44		358462				Vacuum recovery system running
10/25/95	26.62	26.72	0.10		288.52	4.30	1312.75		359305				Vacuum recovery system running
11/21/95	17.60	17.60	Sheen		297.55	-	1312.75		433812				Vac system off
12/08/95	20.71	21.05	0.34		294.40	-	1312.75		515782				
12/21/95	16.23	16.32	0.09		298.91	-	1312.75		534802				
01/23/96	-	14.35	0.00		300.80	-	1312.75		534851				Line Frozen
02/09/96	17.60	17.80	0.20		297.52	-	1312.75		535362				
02/19/96	-	17.00	0.00		298.15	-	1312.75		592952				
01/02/98	-	-	0.00	-	NG	-	1312.75	-	-	-	-	-	New System Started
01/09/98	-	15.38	0.00	48.6	298.59	-	1312.75	-	-	-	-	-	
01/09/98	26.18	26.30	0.12	36.5	287.57	-	1312.75	6.00	-	-	-	-	
01/13/98	-	26.90	0.00	36.0	287.07	3.40	1316.15	3.00	-	-	-	-	
01/20/98	-	-	0.00	36.0	NG	4.70	1320.85	2.00	-	-	-	-	
01/28/98	-	-	0.00	36.0	NG	5.20	1326.05	-	-	-	-	-	
02/02/98	-	-	0.00	-	NG	-	1326.05	-	-	-	-	-	
02/09/98	27.36	27.41	0.05	36.0	286.52	0.50	1326.55	-	-	-	-	-	
02/16/98	-	-	0.00	36.0	NG	-	1326.55	3.30	-	12.4	-	185	
02/20/98	22.80	26.35	3.55	35.9	284.53	-	1326.55	3.00	-	12.7	-	535	
02/23/98	-	-	0.00	35.9	NG	3.60	1330.15	2.80	-	12.5	-	725	
02/27/98	24.98	25.07	0.09	38.3	288.82	1.50	1331.65	-	-	12.6	-	-	
03/02/98	23.75	23.79	0.04	-	290.15	0.27	1331.92	-	-	13.0	19.0	-	
03/05/98	22.06	22.16	0.10	42.6	291.72	-	1331.92	3.70	137	12.2	15.9	486	
03/09/98	23.09	23.45	0.36	40.1	290.21	-	1331.92	3.80	27305	-	-	-	
03/13/98	17.42	17.45	0.03	47.6	296.49	-	1331.92	3.70	27809	11.5	12.9	-	
03/16/98	-	18.34	0.00	46.2	295.63	*	1331.92	2.10	29999	13.0	11.6	230	Product meter went backwards due to Vacuum at vault/Groundwater pump off
03/23/98	-	-	0.00	-	NG	*	1331.92	-	-	12.5	11.3	-	Product meter went backwards due to Vacuum at vault
04/02/98	-	10.74	0.00	53.4	303.23	-	1331.92	-	-	12.0	11.1	-	
04/13/98	-	11.02	0.00	52.7	302.95	-	1331.92	-	-	13.0	14.6	105	
04/17/98	-	-	0.00	48.8	NG	-	1331.92	2.00	29999	13.0	13.7	286	Cleaned screen on product pump/ installed flow meter

Well ID:	NFFW-2R	(Recovery Well)
TOC:	313.97	ft amsl
Ground:	312.53	ft amsl
Depth of Well:	35.50	ft bgs
Depth to Screen	5.50	ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Pressure Transducer	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Ground-water Flow Rate (gpm)	Ground-water Recovered (gal)	Vacuum at Vault (psia)	Flow Rate (SCFM)	Concentration (ppmv)	Comments
04/22/98	-	-	0.00	-	NG	-	1331.92	-	-	13.2	12.2	-	
05/05/98	23.97	25.00	1.03	-	288.07	*	1331.92	-	-	13.7	14.6	940	
05/21/98	17.40	17.42	0.02	-	296.53	3.30	1335.22	-	-	11.5	6.9	190	
05/28/98	-	-	0.00	48.5	NG	0.08	1335.30	-	123026	13.2	9.0	-	RW-2R not operating (variable frequency drive)
06/12/98	13.55	13.60	0.05	50.6	300.33	-	1335.30	-	123151	13.2	7.4	-	RW-2R not operating (variable frequency drive)
06/23/98	-	14.70	0.00	-	299.27	-	1335.30	-	123912	-	-	-	Pulled pump, motor siezed up, still under warrenty
07/10/98	15.20	15.21	0.01	48.7	298.75	*	1335.30	0.60	123912	14.0	5.4	396	
07/28/98	-	-	0.00	-	NG	-	1335.30	-	-	-	-	-	
07/31/98	-	-	0.00	-	NG	-	1335.30	-	128313	-	-	-	
08/05/98	-	-	0.00	-	NG	-	1335.30	-	-	-	-	-	
08/14/98	20.84	21.91	1.07	-	291.13	8.40	1343.70	-	-	14.0	7.6	-	
08/27/98	27.03	27.05	0.02	-	286.90	30.00	1373.70	-	-	13.7	9.2	880	
09/11/98	15.80	15.82	0.02	-	298.13	7.30	1381.00	-	-	-	-	-	
09/16/98	-	-	0.00	44.3	NG	-	1381.00	0.00	129999	14.0	11.4	-	
09/25/98	-	-	0.00	57.8	NG	-	1381.00	3.50	129999	-	-	196	
10/14/98	23.30	24.00	0.70	57.3	289.36	-	1381.00	0.00	-	-	-	-	
10/27/98	24.97	25.12	0.15	57.5	288.72	0.40	1381.40	0.00	-	-	-	-	
11/03/98	29.55	29.63	0.08	-	284.27	-	1381.40	-	-	-	-	-	
11/10/98	-	-	0.00	-	NG	-	1381.40	-	-	-	-	-	
11/23/98	28.05	29.22	1.17	57.0	283.73	0.50	1381.90	0.00	129999	-	-	-	
12/11/98	31.80	31.82	0.02	57.7	282.13	2.70	1384.60	-	129999	-	-	-	
12/21/98	-	Dry	0.00	-	Dry	-	1384.60	-	129999	-	-	-	
01/13/99	-	Dry	0.00	57.7	Dry	-	1384.60	-	-	-	-	-	
01/26/99	-	Dry	0.00	57.7	Dry	-	1384.60	-	-	-	-	-	

Well ID: **NFFW-3**
TOC: **324.08** ft amsl
Ground: **321.92** ft amsl
Depth of Well: **26** ft bgs
Depth to Screen **6** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
03/30/94	-	12.18	0.00	310.40			NO LOCK
04/04/94	-	12.77	0.00	309.81			
04/12/94	-	9.84	0.00	312.74			
04/20/94	-	14.25	0.00	308.33			
05/12/94	-	17.03	0.00	305.55			
05/24/94	-	19.35	0.00	303.23			
06/03/94	-	23.40	0.00	299.18			
07/01/94	-	28.25	0.00	294.33			
07/13/94	-	Dry	0.00	Dry			
08/05/94	-	23.26	0.00	299.32			
08/17/94	-	25.90	0.00	296.68			
08/30/94	-	19.72	0.00	302.86			
09/08/94	-	22.39	0.00	300.19			
09/19/94	-	27.90	0.00	294.68			
09/30/94	-	28.18	0.00	294.40			
10/17/94	-	28.20	0.00	294.38			
10/25/94	-	28.19	0.00	294.39			
11/11/94	-	28.21	0.00	294.37			
11/22/94	-	28.21	0.00	294.37			
12/07/94	-	28.17	0.00	294.41			
12/21/94	-	28.19	0.00	294.39			
01/04/95	-	28.18	0.00	294.40			
01/23/95	-	25.76	0.00	296.82			
02/16/95	-	24.77	0.00	297.81			
02/28/95	-	21.06	0.00	301.52			
03/10/95	-	16.64	0.00	305.94			
03/29/95	-	16.48	0.00	306.10			
04/04/95	-	17.40	0.00	305.18			
04/27/95	-	21.42	0.00	301.16			
05/11/95	-	21.83	0.00	300.75			
05/24/95	-	23.29	0.00	299.29			
06/15/95	-	27.12	0.00	295.46			
06/29/95	-	28.22	0.00	294.36			
07/06/95	-	28.14	0.00	294.44			
07/25/95	-	28.15	0.00	294.43			
08/01/95	-	28.20	0.00	294.38			
08/21/95	-	Dry	0.00	Dry			
09/14/95	-	Dry	0.00	Dry			
09/28/95	-	Dry	0.00	Dry			
10/06/95	-	23.79	0.00	298.79			
10/25/95	-	15.80	0.00	306.78			
11/21/95	-	13.21	0.00	309.37			
12/08/95	-	15.00	0.00	307.58			
12/21/95	-	15.01	0.00	307.57			
01/23/96	-	12.26	0.00	310.32			
02/09/96	-	12.88	0.00	309.70			
02/19/96	-	13.94	0.00	308.64			

Well ID: **NFFW-3**
TOC: **324.08** ft amsl
Ground: **321.92** ft amsl
Depth of Well: **26** ft bgs
Depth to Screen **6** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
01/09/98	-	17.33	0.00	306.75	-	0.00	New System Started
02/20/98	-	13.39	0.00	310.69	-	0.00	
05/21/98	-	13.12	0.00	310.96	-	0.00	
12/21/98	-	Dry	0.00	Dry	-	0.00	
01/13/99	-	Dry	0.00	Dry	-	0.00	

Well ID:	**NFFW-4**	
TOC:	**320.61**	ft amsl
Ground:	**320.98**	ft amsl
Depth of Well:	**26**	ft bgs
Depth to Screen	**6**	ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
03/30/94	-	8.39	0.00	318.47			NO LOCK
04/04/94	-	8.27	0.00	318.59			
04/12/94	-	9.93	0.00	316.93			
04/20/94	-	14.27	0.00	312.59			
05/12/94	-	15.02	0.00	311.84			
05/24/94	-	17.85	0.00	309.01			
06/03/94	-	22.15	0.00	304.71			
07/01/94	-	Dry	0.00	Dry			
07/13/94	-	Dry	0.00	Dry			
08/05/94	-	24.35	0.00	302.51			
08/17/94	-	Dry	0.00	Dry			
08/30/94	-	21.58	0.00	305.28			
09/08/94	-	23.07	0.00	303.79			
09/19/94	-	24.36	0.00	302.50			
09/30/94	-	Dry	0.00	Dry			
10/17/94	-	Dry	0.00	Dry			
10/25/94	-	Dry	0.00	Dry			
11/11/94	-	Dry	0.00	Dry			
11/22/94	-	Dry	0.00	Dry			
12/07/94	-	Dry	0.00	Dry			
12/21/94	-	Dry	0.00	Dry			
01/04/95	-	Dry	0.00	Dry			
01/23/95	-	23.89	0.00	302.97			
02/16/95	-	23.81	0.00	303.05			
02/28/95	-	21.66	0.00	305.20			
03/10/95	-	16.02	0.00	310.84			
03/29/95	-	14.47	0.00	312.39			
04/04/95	-	15.43	0.00	311.43			
04/27/95	-	19.81	0.00	307.05			
05/11/95	-	20.62	0.00	306.24			
05/24/95	-	21.87	0.00	304.99			
06/15/95	-	Dry	0.00	Dry			
06/29/95	-	Dry	0.00	Dry			
07/06/95	-	Dry	0.00	Dry			
07/25/95	-	Dry	0.00	Dry			
08/01/95	-	Dry	0.00	Dry			
08/21/95	-	Dry	0.00	Dry			
09/14/95	-	Dry	0.00	Dry			
09/28/95	-	Dry	0.00	Dry			
10/06/95	-	23.93	0.00	302.93			
10/25/95	-	16.73	0.00	310.13			
11/21/95	-	10.49	0.00	316.37			
12/08/95	-	11.96	0.00	314.90			
12/21/95	-	12.03	0.00	314.83			
01/23/96	-	9.17	0.00	317.69			
02/09/96	-	8.81	0.00	318.05			
02/19/96	-	10.32	0.00	316.54			
01/09/98	-	14.40	0.00	306.21	-	0.00	New System Started

Well ID: **NFFW-4**
TOC: **320.61** ft amsl
Ground. **320.98** ft amsl
Depth of Well: **26** ft bgs
Depth to Screen **6** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
01/13/98	-	13.89	0.00	306.72	-	0.00	
02/27/98	-	8.64	0.00	311.97	-	0.00	
03/16/98	-	8.64	0.00	311.97	-	0.00	
05/21/98	-	11.73	0.00	308.88	-	0.00	
10/14/98	-	Dry	0.00	Dry	-	0.00	
12/21/98	-	Dry	0.00	Dry	-	0.00	
01/13/99	-	Dry	0.00	Dry	-	0.00	

Well ID: **NFFW-5**
TOC: **316.54** ft amsl
Ground: **314.94** ft amsl
Depth of Well: **26** ft bgs
Depth to Screen **6** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
03/30/94	-	3.40	0.00	313.48	-	-	NO CAP OR LOCK
04/04/94	-	5.89	0.00	310.99	-	-	
04/12/94	-	4.13	0.00	312.75	-	-	
04/20/94	-	11.50	0.00	305.38	-	-	
05/12/94	-	12.12	0.00	304.76	-	-	
05/24/94	-	13.85	0.00	303.03	-	-	
06/03/94	-	15.48	0.00	301.40	-	-	
07/01/94	-	12.64	0.00	304.24	-	-	
07/13/94	-	20.95	0.00	295.93	-	-	
08/05/94	-	13.28	0.00	303.60	-	-	
08/17/94	-	14.23	0.00	302.65	-	-	
08/30/94	-	13.55	0.00	303.33	-	-	
09/08/94	-	16.38	0.00	300.50	-	-	
09/19/94	-	12.53	0.00	304.35	-	-	
09/30/94	-	12.94	0.00	303.94	-	-	
10/17/94	-	18.35	0.00	298.53	-	-	
10/25/94	-	12.34	0.00	304.54	-	-	
11/11/94	-	12.10	0.00	304.78	-	-	
11/22/94	-	4.57	0.00	312.31	-	-	
12/07/94	-	4.97	0.00	311.91	-	-	
12/21/94	-	15.04	0.00	301.84	-	-	
01/04/95	-	6.58	0.00	310.30	-	-	
01/23/95	-	5.69	0.00	311.19	-	-	
02/16/95	-	4.32	0.00	312.56	-	-	
02/28/95	-	2.85	0.00	314.03	-	-	
03/10/95	-	4.60	0.00	312.28	-	-	
03/29/95	-	13.06	0.00	303.82	-	-	
04/04/95	-	-	-	NG	-	-	
04/27/95	-	15.79	0.00	301.09	-	-	
05/11/95	-	5.91	0.00	310.97	-	-	
05/24/95	-	15.41	0.00	301.47	-	-	
06/15/95	-	16.96	0.00	299.92	-	-	
06/29/95	-	19.10	0.00	297.78	-	-	
07/06/95	-	19.96	0.00	296.92	-	-	
07/25/95	-	14.46	0.00	302.42	-	-	
08/01/95	-	18.88	0.00	298.00	-	-	
08/21/95	-	22.89	0.00	293.99	-	-	
09/14/95	-	8.49	0.00	308.39	-	-	
09/28/95	-	6.67	0.00	310.21	-	-	
10/06/95	-	4.17	0.00	312.71	-	-	
10/25/95	-	10.19	0.00	306.69	-	-	
11/21/95	-	6.09	0.00	310.79	-	-	
12/08/95	-	12.74	0.00	304.14	-	-	
12/21/95	-	5.70	0.00	311.18	-	-	
01/23/96	-	5.18	0.00	311.70	-	-	
02/09/96	-	2.85	0.00	314.03	-	-	
02/19/96	-	11.92	0.00	304.96	-	-	

Well ID: **NFFW-5**
TOC: **316.54** ft amsl
Ground: **314.94** ft amsl
Depth of Well: **26** ft bgs
Depth to Screen **6** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
01/09/98	-	3.86	0.00	312.68	-	-	New System Started
01/13/98	-	9.93	0.00	306.61	-	-	
02/20/98	-	3.94	0.00	312.60	-	-	
02/27/98	-	5.14	0.00	311.40	-	-	
03/16/98	-	5.42	0.00	311.12	-	-	
05/21/98	-	7.03	0.00	309.51	-	-	
08/14/98	-	17.44	0.00	299.10	-	-	
10/14/98	-	9.11	0.00	307.43	-	-	
12/21/98	-	23.00	0.00	293.54	-	-	
01/13/99	-	4.78	0.00	311.76	-	-	

Well ID:	**NFFW-6**	
TOC:	**319.85**	ft amsl
Ground:	**319.05**	ft amsl
Depth of Well:	**26**	ft bgs
Depth to Screen	**6**	ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
03/30/94	15.73	15.92	0.19	303.87	-	0.00	1000 HOURS
03/30/94	15.66	15.86	0.20	303.93	-	0.00	1400 HOURS
04/04/94	16.41	16.46	0.05	303.20	1.24	1.24	1000 HOURS
04/06/94	16.40	16.43	0.03	303.22	0.21	1.45	1200 HOURS
04/07/94	-	16.58	0.00	303.04	-	1.45	1100 HOURS
04/12/94	17.86	18.00	0.14	301.74	-	1.45	Lowered pump to approx 18 ft
04/20/94	-	18.09	0.00	301.53	0.41	1.86	1230 hours
04/27/94	18.17	18.19	0.02	301.45	-	1.86	1105 hours
05/04/94	19.22	19.29	0.07	300.39	-	1.86	0800 hours, lowered pump approx 1 ft
05/12/94	19.34	19.45	0.11	300.27	-	1.86	LOWERED PUMP ABOUT 1 FT
05/13/94	19.49	19.50	0.01	300.13	-	1.86	
05/16/94	-	20.04	0.00	299.58	-	1.86	
05/24/94	20.76	20.77	0.01	298.86	-	1.86	
05/27/94	21.04	21.05	0.01	298.58	-	1.86	
06/03/94	21.64	21.66	0.02	297.98	-	1.86	
06/15/94	23.20	23.24	0.04	296.41	-	1.86	
06/16/94	23.40	23.46	0.05	296.21	-	1.86	
06/21/94	24.40	24.50	0.10	295.21	-	1.86	Well TD 27.90
07/01/94	26.44	26.62	0.18	293.16	-	1.86	Pump set 4" from bottom of well, water and oil intakes
07/13/94	27.30	27.31	0.01	292.32	-	1.86	
08/05/94	21.38	21.40	0.02	298.24	-	1.86	
08/17/94	22.92	22.94	0.02	296.70	-	1.86	
08/30/94	20.62	20.65	0.03	299.00	-	1.86	
09/08/94	21.57	21.65	0.08	298.04	-	1.86	
09/14/94	22.93	23.01	0.08	296.68	-	1.86	
09/19/94	24.05	24.11	0.06	295.56	-	1.86	
09/30/94	-	24.05	0.00	295.57	-	1.86	
10/17/94	26.90	27.17	0.27	292.68	-	1.86	
10/25/94	-	27.89	0.00	291.73	-	1.86	
11/11/94	-	Dry	0.00	Dry	-	1.86	
11/22/94	-	Dry	0.00	Dry	-	1.86	
12/07/94	-	27.85	0.00	291.77	-	1.86	
12/21/94	-	24.82	0.00	294.80	-	1.86	
01/04/95	-	25.54	0.00	294.08	-	1.86	
01/16/95	-	23.09	0.00	296.53	-	1.86	
01/23/95	-	21.03	0.00	298.59	-	1.86	
02/16/95	-	22.20	0.00	297.42	-	1.86	
02/28/95	-	20.77	0.00	298.85	-	1.86	No Power To Pump
03/10/95	-	19.32	0.00	300.30	-	1.86	No Power To Pump
03/29/95	-	19.66	0.00	299.96	-	1.86	No Power To Pump
04/04/95	-	-	0.00	NG	-	1.86	No Power To Pump
04/27/95	-	21.82	0.00	297.80	-	1.86	No Power To Pump
05/11/95	-	21.82	0.00	297.80	-	1.86	No Power To Pump
05/24/95	-	22.40	0.00	297.22	-	1.86	No Power To Pump
06/15/95	-	22.97	0.00	296.65	-	1.86	No Power To Pump
06/29/95	-	24.86	0.00	294.76	-	1.86	No Power To Pump
07/06/95	-	25.74	0.00	293.88	-	1.86	No Power To Pump
07/25/95	-	25.98	0.00	293.64	-	1.86	No Power To Pump
08/01/95	-	25.48	0.00	294.14	-	1.86	No Power To Pump
08/21/95	-	Dry	0.00	Dry	-	1.86	Panel removed for repair
09/14/95	-	Dry	0.00	Dry	-	1.86	
09/28/95	-	27.71	0.00	291.91	-	1.86	
10/06/95	-	25.10	0.00	294.52	-	1.86	

Well ID:	**NFFW-6**	
TOC:	**319.85**	ft amsl
Ground:	**319.05**	ft amsl
Depth of Well:	**26**	ft bgs
Depth to Screen	**6**	ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
10/25/95	-	20.15	0.00	299.47	-	1.86	
11/21/95	-	17.30	0.00	302.32	-	1.86	
12/08/95	-	19.51	0.00	300.11	-	1.86	
12/21/95	-	19.37	0.00	300.25	-	1.86	
01/23/96	-	17.10	0.00	302.52	-	1.86	
02/09/96	-	16.00	0.00	303.62	-	1.86	
02/19/96	-	18.40	0.00	301.22	-	1.86	
01/09/98	-	18.84	0.00	301.01	-	1.86	New System Started
01/13/98	-	19.31	0.00	300.54	-	1.86	
02/20/98	-	18.03	0.00	301.82	-	1.86	
02/27/98	-	17.39	0.00	302.46	-	1.86	
03/16/98	-	17.07	0.00	302.78	-	1.86	
05/21/98	-	16.98	0.00	302.87	-	1.86	
08/14/98	-	22.64	0.00	297.21	-	1.86	
10/14/98	25.19	25.21	0.02	294.62	-	1.86	
12/21/98	-	Dry	0.00	Dry	-	1.86	
01/13/99	27.29	27.39	0.10	292.37	-	1.86	

Well ID:	**NFFW-7**	
TOC:	**314.46**	ft amsl
Ground:	**312.57**	ft amsl
Depth of Well:	**26**	ft bgs
Depth to Screen	**6**	ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
03/30/94	-	11.50	0.00	302.58	-	-	1030 HOURS, NO LOCK
03/30/94	-	11.42	0.00	302.66	-	-	1400 HOURS
04/04/94	-	11.28	0.00	302.80	-	-	1000 HOURS
04/06/94	-	11.99	0.00	302.09	-	-	1200 HOURS
04/07/94	-	12.16	0.00	301.92	-	-	1100 HOURS
04/12/94	-	13.57	0.00	300.51	-	-	1200 HOURS
04/20/94	-	14.08	0.00	300.00	-	-	
04/27/94	-	13.50	0.00	300.58	-	-	
05/04/94	-	14.64	0.00	299.44	-	-	
05/12/94	-	14.89	0.00	299.19	-	-	
05/13/94	-	14.93	0.00	299.15	-	-	
05/16/94	15.92	15.93	0.01	298.16	-	-	
05/24/94	16.92	16.96	0.04	297.15	-	-	
05/27/94	17.69	17.78	0.09	296.38	-	-	
06/03/94	18.52	18.60	0.08	295.55	-	-	
06/15/94	20.06	20.26	0.20	293.99	-	-	
06/16/94	20.38	20.56	0.18	293.68	-	-	
07/01/94	24.12	24.41	0.29	289.92	-	-	
07/13/94	26.57	26.95	0.38	287.46	0.50	0.50	BAILED 0.5 GAL
08/05/94	-	19.38	0.00	294.70	-	0.50	
08/17/94	20.24	20.25	0.01	293.84	-	0.50	
08/30/94	-	17.33	0.00	296.75	-	0.50	
09/08/94	18.41	18.42	0.01	295.67	-	0.50	SHEEN
09/14/94	19.96	19.97	0.01	294.12	-	0.50	
09/19/94	21.25	21.27	0.02	292.83	-	0.50	
09/30/94	21.10	21.10	Sheen	292.98	-	0.50	
10/17/94	24.76	24.90	0.14	289.30	-	0.50	
10/25/94	27.14	27.48	0.34	286.90	-	0.50	
11/11/94	-	Dry	0.00	Dry	-	0.50	28.08 Bottom
11/22/94	-	Dry	0.00	Dry	-	0.50	
12/07/94	27.88	28.08	0.20	286.17	-	0.50	
12/21/94	22.92	23.57	0.65	291.08	-	0.50	
01/04/95	23.17	23.91	0.74	290.81	1.00	1.50	Bailed Product
01/16/95	21.09	21.29	0.20	292.96	-	1.50	
01/23/95	19.05	19.12	0.07	295.02	-	1.50	
02/16/95	18.80	18.93	0.13	295.26	-	1.50	
02/28/95	17.17	17.22	0.05	296.90	-	1.50	
03/10/95	16.42	16.45	0.03	297.66	-	1.50	
03/29/95	14.98	14.98	0.01	299.10	-	1.50	product .005
04/04/95	16.46	16.51	0.05	297.61	-	1.50	
04/27/95	18.46	18.49	0.03	295.62	-	1.50	
05/11/95	17.90	17.96	0.06	296.17	-	1.50	
05/24/95	19.08	19.25	0.17	294.98	-	1.50	
06/15/95	-	-	0.00	NG	-	1.50	Well Knocked Over During Soil Removal Operations
06/29/95	22.02	22.25	0.23	292.03	-	1.50	Well is bent over
07/06/95	23.05	23.30	0.25	291.00	0.25	1.75	Bailed Product
07/25/95	23.35	23.50	0.15	290.71	-	1.75	Well is bent over
08/01/95	23.42	23.65	0.23	290.63	0.25	2.00	
08/21/95	-	Dry	0.00	Dry	-	2.00	
09/14/95	-	Dry	0.00	Dry	-	2.00	
09/28/95	-	Dry	0.00	Dry	-	2.00	
10/06/95	23.97	24.08	0.11	290.10	-	2.00	
10/25/95	-	16.86	0.00	297.22	-	2.00	
11/21/95	-	12.70	0.00	301.38	-	2.00	

Well ID:	**NFFW-7**	
TOC:	**314.46**	ft amsl
Ground:	**312.57**	ft amsl
Depth of Well:	**26**	ft bgs
Depth to Screen	**6**	ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
12/08/95	-	14.96	0.00	299.12	-	2.00	
12/21/95	-	15.18	0.00	298.90	-	2.00	
01/23/96	-	12.83	0.00	301.25	-	2.00	
02/09/96	-	11.46	0.00	302.62	-	2.00	
02/19/96	-	14.12	0.00	299.96	-	2.00	
01/09/98	-	14.86	0.00	299.60	-	2.00	New System Started
01/13/98	-	15.71	0.00	298.75	-	2.00	
02/20/98	-	15.41	0.00	299.05	-	2.00	
02/27/98	-	14.34	0.00	300.12	-	2.00	
03/16/98	-	13.40	0.00	301.06	-	2.00	
05/21/98	-	13.53	0.00	300.93	-	2.00	
08/14/98	22.50	22.63	0.13	291.72	-	2.00	
10/14/98	22.80	24.13	1.33	289.17	-	2.00	
10/27/98	-	-	0.00	NG	1.00	3.00	Passive Bailer
11/03/98	-	-	0.00	NG	0.50	3.50	Passive Bailer
11/10/98	-	-	0.00	NG	0.50	4.00	Passive Bailer
11/23/98	-	-	0.00	NG	0.50	4.50	Passive Bailer
12/21/98	-	Dry	0.00	Dry	-	4.50	
01/13/99	-	Dry	0.00	Dry	-	4.50	

Well ID: **NFFW-8**
TOC: **309.61** ft amsl
Ground: **308.49** ft amsl
Depth of Well: **27.5** ft bgs
Depth to Screen **7.5** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
03/30/94	-	12.25	0.00	297.82			1030 HOURS, NO LOCK
04/04/94	-	12.80	0.00	297.27			1000 HOURS
04/12/94	-	13.26	0.00	296.81			1200 HOURS
04/20/94	-	13.63	0.00	296.44			
05/12/94	-	14.80	0.00	295.27			
05/24/94	-	15.82	0.00	294.25			
06/03/94	-	16.94	0.00	293.13			
07/01/94	-	19.83	0.00	290.24			
07/13/94	21.78	21.79	0.01	288.29			
08/05/94	-	18.03	0.00	292.04			
08/17/94	-	18.83	0.00	291.24			
08/30/94	-	16.77	0.00	293.30			
09/08/94	-	17.51	0.00	292.56			
09/19/94	-	18.55	0.00	291.52			
09/30/94	-	18.69	0.00	291.38			
10/17/94	-	21.28	0.00	288.79			
10/25/94	-	21.97	0.00	288.10			
11/11/94	24.42	24.45	0.03	285.65			
11/22/94	24.71	24.76	0.05	285.35			
12/07/94	-	20.89	0.00	289.18			
12/21/94	-	20.20	0.00	289.87			
01/04/95	-	20.00	0.00	290.07			
01/23/95	-	16.48	0.00	293.59			
02/16/95	-	17.32	0.00	292.75			
02/28/95	-	15.38	0.00	294.69			
03/10/95	-	13.99	0.00	296.08			
03/29/95	-	14.88	0.00	295.19			
04/04/95	-	15.29	0.00	294.78			
04/27/95	-	16.51	0.00	293.56			
05/11/95	-	16.25	0.00	293.82			
05/24/95	-	17.01	0.00	293.06			
06/15/95	-	17.51	0.00	292.56			
06/29/95	-	18.02	0.00	292.05			
07/06/95	-	19.20	0.00	290.87			
07/25/95	-	19.02	0.00	291.05			
08/01/95	-	20.36	0.00	289.71			
08/21/95	23.37	23.37	Sheen	286.70			
09/14/95	26.21	26.32	0.11	283.85			
09/28/95	-	19.90	0.00	290.17			
10/06/95	-	17.48	0.00	292.59			
10/25/95	-	15.38	0.00	294.69			
11/21/95	-	12.59	0.00	297.48			
12/08/95	-	13.79	0.00	296.28			
12/21/95	-	13.78	0.00	296.29			
01/23/96	-	12.69	0.00	297.38			
02/09/96	-	12.12	0.00	297.95			
02/19/96	-	12.19	0.00	297.88			
01/09/98	-	14.63	0.00	294.98	-	0.00	New System Started
01/13/98	-	14.82	0.00	294.79	-	0.00	
02/20/98	-	13.05	0.00	296.56	-	0.00	
02/27/98	-	12.34	0.00	297.27	-	0.00	
03/16/98	-	12.12	0.00	297.49	-	0.00	
05/21/98	-	12.77	0.00	296.84	-	0.00	
08/14/98	-	17.02	0.00	292.59	-	0.00	

Well ID: **NFFW-8**
TOC: **309.61** ft amsl
Ground: **308.49** ft amsl
Depth of Well: **27.5** ft bgs
Depth to Screen **7.5** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
10/14/98	-	19.06	0.00	290.55	-	0.00	
12/21/98	23.70	23.89	0.19	285.55	-	0.00	
01/13/99	-	19.49	0.00	290.12	-	0.00	

Well ID:	**NFFW-9**	
TOC:	**300.29**	ft amsl
Ground:	**300.45**	ft amsl
Depth of Well:	**26**	ft bgs
Depth to Screen	**6**	ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
03/30/94	-	2.92	0.00	297.69			1030 HOURS
04/04/94	-	3.64	0.00	296.97			1000 HOURS
04/12/94	-	3.91	0.00	296.70			1200 HOURS
04/20/94	-	4.25	0.00	296.36			
05/12/94	-	5.18	0.00	295.43			
05/24/94	-	6.19	0.00	294.42			
06/03/94	-	7.44	0.00	293.17			
07/01/94	-	9.91	0.00	290.70			
07/13/94	-	12.65	0.00	287.96			
08/05/94	-	8.62	0.00	291.99			
08/17/94	-	9.40	0.00	291.21			
08/30/94	-	7.33	0.00	293.28			
09/08/94	8.18	8.18	Sheen	292.43			
09/19/94	-	8.91	0.00	291.70			
09/30/94	-	9.14	0.00	291.47			
10/17/94	-	11.93	0.00	288.68			
10/25/94	-	11.50	0.00	289.11			
11/11/94	-	13.53	0.00	287.08			
11/22/94	-	13.15	0.00	287.46			
12/07/94	-	10.36	0.00	290.25			
12/21/94	-	10.64	0.00	289.97			
01/04/95	-	10.14	0.00	290.47			
01/23/95	-	-	0.00	NG			CAR PARKED ON WELL
02/16/95	-	7.54	0.00	293.07			
02/28/95	-	-	0.00	NG			CAR PARKED ON WELL
03/10/95	-	4.39	0.00	296.22			
03/29/95	-	5.54	0.00	295.07			
04/04/95	-	6.95	0.00	293.66			
04/27/95	-	7.10	0.00	293.51			
05/11/95	-	6.63	0.00	293.98			
05/24/95	-	7.58	0.00	293.03			
06/15/95	-	8.52	0.00	292.09			
06/29/95	-	7.95	0.00	292.66			
07/06/95	-	9.68	0.00	290.93			
07/25/95	-	9.45	0.00	291.16			
08/01/95	-	10.95	0.00	289.66			
08/21/95	-	14.49	0.00	286.12			
09/14/95	-	17.64	0.00	282.97			
09/28/95	-	9.85	0.00	290.76			
10/06/95	-	7.35	0.00	293.26			
10/25/95	-	6.04	0.00	294.57			
11/21/95	-	4.10	0.00	296.51			
12/08/95	-	-	0.00	NG			Car Over Well
12/21/95	-	-	0.00	NG			Well Under Snow
01/23/96	-	3.94	0.00	296.67			
02/09/96	-	3.60	0.00	297.01			
02/19/96	-	4.26	0.00	296.35			
01/09/98	-	5.13	0.00	295.16	-	0.00	New System Started
01/13/98	-	5.42	0.00	294.87	-	0.00	
02/20/98	-	3.87	0.00	296.42	-	0.00	
02/27/98	-	3.76	0.00	296.53	-	0.00	
03/16/98	-	9.54	0.00	290.75	-	0.00	
05/21/98	-	11.04	0.00	289.25	-	0.00	
08/14/98	-	8.46	0.00	291.83	-	0.00	

Well ID: **NFFW-9**
TOC: **300.29** ft amsl
Ground: **300.45** ft amsl
Depth of Well: **26** ft bgs
Depth to Screen **6** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
10/14/98	-	18.02	0.00	282.27	-	0.00	
12/21/98	-	16.15	0.00	284.14	-	0.00	
01/13/99	-	9.98	0.00	290.31	-	0.00	

Well ID: **NFFW-10**
TOC: **300.51** ft amsl
Ground: **300.85** ft amsl
Depth of Well: **37** ft bgs
Depth to Screen **7** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
03/30/94	-	5.33	0.00	295.77			NEEDS NEW LOCK
04/04/94	-	5.46	0.00	295.64			1000 HOURS
04/12/94	-	6.60	0.00	294.50			1200 HOURS
04/20/94	-	6.96	0.00	294.14			
05/12/94	-	3.65	0.00	297.45			
07/01/94	-	12.45	0.00	288.65			
07/13/94	-	15.78	0.00	285.32			
08/05/94	-	11.05	0.00	290.05			
08/17/94	-	11.31	0.00	289.79			
08/30/94	-	8.88	0.00	292.22			
09/08/94	-	9.56	0.00	291.54			
09/19/94	-	11.32	0.00	289.78			
09/30/94	-	11.23	0.00	289.87			
10/17/94	-	14.27	0.00	286.83			
10/25/94	-	15.66	0.00	285.44			
11/11/94	-	19.18	0.00	281.92			
11/22/94	-	19.77	0.00	281.33			
12/07/94	-	15.75	0.00	285.35			
12/21/94	-	13.83	0.00	287.27			
01/04/95	-	13.66	0.00	287.44			
01/23/95	-	10.27	0.00	290.83			
02/16/95	-	-	0.00	NG			BURIED UNDER SNOW
02/28/95	-	8.76	0.00	292.34			
03/10/95	-	7.72	0.00	293.38			
03/29/95	-	-	0.00	NG			CAR PARKED ON WELL
04/04/95	-	7.73	0.00	293.37			
04/27/95	-	8.91	0.00	292.19			
05/11/95	-	8.91	0.00	292.19			
05/24/95	-	9.53	0.00	291.57			
06/15/95	-	10.57	0.00	290.53			
06/29/95	-	-	0.00	NG			TRUCK PARKED ON WELL
07/06/95	-	-	0.00	NG			TRUCK PARKED ON WELL
07/25/95	-	12.86	0.00	288.24			
08/01/95	-	13.79	0.00	287.31			
08/21/95	-	17.75	0.00	283.35			
09/14/95	-	22.39	0.00	278.71			
09/28/95	-	15.00	0.00	286.10			
10/06/95	-	12.09	0.00	289.01			
10/25/95	-	8.24	0.00	292.86			
11/21/95	-	-	0.00	NG			Equipment over well
12/08/95	-	6.60	0.00	294.50			
12/21/95	-	-	0.00	NG			Manhole Filled With Ice
01/23/96	-	-	0.00	NG			Manhole Filled With Ice
02/09/96	-	-	0.00	NG			
02/19/96	-	-	0.00	NG			
01/09/98	-	7.74	0.00	292.77	-	0.00	New System Started
02/20/98	-	6.28	0.00	294.23	-	0.00	
05/21/98	-	8.14	0.00	292.37	-	0.00	
12/21/98	-	19.06	0.00	281.45	-	0.00	
01/13/99	-	14.92	0.00	285.59	-	0.00	

Well ID: **NFFW-12**
TOC: **309.02** ft amsl
Ground: **309.13** ft amsl
Depth of Well: **26.5** ft bgs
Depth to Screen **6.5** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
03/30/94	-	8.73	0.00	298.63			1030 HOURS, NO LOCK
04/04/94	-	9.01	0.00	298.35			1000 HOURS
04/06/94	-	9.22	0.00	298.14			1200 HOUR
04/07/94	-	9.28	0.00	298.08			1100 HOURS
04/12/94	-	10.04	0.00	297.32			1200 HOURS
04/20/94	-	10.43	0.00	296.93			
04/27/94	-	10.74	0.00	296.62			
05/04/94	-	11.72	0.00	295.64			
05/12/94	-	11.95	0.00	295.41			
05/13/94	-	11.98	0.00	295.38			
05/16/94	-	12.35	0.00	295.01			
05/24/94	-	13.23	0.00	294.13			
05/27/94	-	13.65	0.00	293.71			
06/03/94	-	14.44	0.00	292.92			
06/15/94	15.74	15.75	0.02	291.62			
06/16/94	15.91	15.92	0.02	291.45			
07/01/94	18.03	18.11	0.08	289.32			
07/13/94	20.08	20.20	0.12	287.26	0.25	0.25	BAILED 0.25 GAL
08/05/94	16.92	16.94	0.02	290.44	-	0.25	
08/17/94	16.35	16.37	0.02	291.01	-	0.25	
08/30/94	-	14.17	0.00	293.19	-	0.25	
09/08/94	-	14.31	0.00	293.05	-	0.25	
09/14/94	-	14.17	0.00	293.19	-	0.25	
09/19/94	-	15.99	0.00	291.37	-	0.25	
09/30/94	-	16.77	0.00	290.59	-	0.25	
10/17/94	18.95	19.05	0.10	288.40	-	0.25	
10/25/94	-	20.80	0.00	286.56	-	0.25	
11/11/94	23.89	23.97	0.08	283.46	-	0.25	
11/22/94	-	-	0.00	NG	-	0.25	IFP BROKE DURING GAUGING, NO INFORMATION
12/07/94	22.52	22.52	Sheen	284.84	-	0.25	
12/21/94	-	19.30	0.00	288.06	-	0.25	
01/04/95	-	19.10	0.00	288.26	-	0.25	
01/16/95	-	17.54	0.00	289.82	-	0.25	
01/23/95	-	15.95	0.00	291.41	-	0.25	
02/16/95	-	15.33	0.00	292.03	-	0.25	
02/28/95	-	14.14	0.00	293.22	-	0.25	
03/10/95	-	12.96	0.00	294.40	-	0.25	
03/29/95	-	12.32	0.00	295.04	-	0.25	
04/04/95	-	13.02	0.00	294.34	-	0.25	
04/27/95	-	14.64	0.00	292.72	-	0.25	
05/11/95	-	14.57	0.00	292.79	-	0.25	
05/24/95	-	15.19	0.00	292.17	-	0.25	
06/15/95	-	16.14	0.00	291.22	-	0.25	
06/29/95	-	17.14	0.00	290.22	-	0.25	
07/06/95	-	17.84	0.00	289.52	-	0.25	
07/25/95	-	18.88	0.00	288.48	-	0.25	
08/01/95	-	19.05	0.00	288.31	-	0.25	
08/21/95	22.37	22.38	0.01	284.99	-	0.25	
09/14/95	25.38	25.65	0.27	281.94	-	0.25	
09/28/95	21.56	21.64	0.08	285.79	-	0.25	
10/06/95	-	19.26	0.00	288.10	-	0.25	
10/25/95	-	13.78	0.00	293.58	-	0.25	
11/21/95	-	9.70	0.00	297.66	-	0.25	
12/08/95	-	11.37	0.00	295.99	-	0.25	

Well ID:	**NFFW-12**	
TOC:	**309.02**	ft amsl
Ground:	**309.13**	ft amsl
Depth of Well:	**26.5**	ft bgs
Depth to Screen	**6.5**	ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
12/21/95	-	11.80	0.00	295.56	-	0.25	
01/23/96	-	10.37	0.00	296.99	-	0.25	
02/09/96	-	9.45	0.00	297.91	-	0.25	
02/19/96	-	10.60	0.00	296.76	-	0.25	
01/09/98	-	12.46	0.00	296.56	-	0.25	New System Started
01/13/98	-	12.42	0.00	296.60	-	0.25	
02/20/98	-	10.32	0.00	298.70	-	0.25	
02/27/98	-	9.58	0.00	299.44	-	0.25	
03/16/98	-	3.63	0.00	305.39	-	0.25	
08/14/98	-	15.63	0.00	293.39	-	0.25	
10/14/98	-	10.07	0.00	298.95	-	0.25	
12/21/98	-	23.89	0.00	285.13	-	0.25	
01/13/99	-	20.73	0.00	288.29	-	0.25	

Well ID:	**NFFW-14**	(Recovery Well)
TOC:	**314.40**	ft amsl
Ground:	**313.13**	ft amsl
Depth of Well:	**37.5**	ft bgs
Depth to Screen	**7.5**	ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Pressure Transducer	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Ground-water Flow Rate (gpm)	Ground-water Recovered (gal)	Vacuum at Vault (psia)	Flow Rate (SCFM)	Concentration (ppmv)	Comments
03/30/94	-	10.28	0.00		302.88	-	0.00						1030 HOURS, NEEDS NEW LOCK
04/04/94	-	10.19	0.00		302.97	-	0.00						1000 HOURS
04/06/94	-	10.88	0.00		302.28	-	0.00						1200 HOUR
04/07/94	-	11.09	0.00		302.07	-	0.00						1100 HOURS
04/12/94	12.57	12.58	0.01		300.59	-	0.00						1200 HOURS
04/20/94	12.57	12.96	0.39		300.54	-	0.00						
04/27/94	12.65	12.67	0.02		300.51	-	0.00						bailed 12 oz product
05/04/94	13.85	13.89	0.04		299.30	-	0.00						bailed 32 oz of product
05/12/94	14.23	14.29	0.06		298.92	-	0.00						
05/13/94	14.17	14.18	0.01		298.99	-	0.00						BAILED PRODUCT
05/16/94	15.30	15.38	0.08		297.85	-	0.00						BAILED PRODUCT
05/24/94	16.44	16.50	0.06		296.71	-	0.00						BAILED PRODUCT
05/27/94	17.04	17.08	0.05		296.12	-	0.00						BAILED PRODUCT
06/03/94	17.93	17.98	0.05		295.22	-	0.00						BAILED PRODUCT
06/15/94	19.54	19.58	0.04		293.61	-	0.00						BAILED PRODUCT
06/16/94	19.72	19.83	0.11		293.43	-	0.00						BAILED PRODUCT
07/01/94	23.03	23.38	0.35		290.08	-	0.00						
07/13/94	26.70	31.74	5.04		285.80	10.00	10.00						BAILED APPROX 10 GAL
08/05/94	17.53	21.55	4.02		295.11	5.00	15.00						BAILED APPROX 5 GAL
08/17/94	17.70	21.78	4.08		294.93	7.00	22.00						BAILED APPROX 7 GAL
08/30/94	18.28	18.31	0.03		297.21	-	22.00						INSTALLED FAP ADDED 28" OF 4" CASING
09/08/94	19.15	19.42	0.27		296.30	-	22.00						
09/14/94	20.77	20.80	0.03		294.72	-	22.00						FIXED TANK-FULL PROBE
09/19/94	21.90	21.92	0.02		293.59	-	22.00						
09/30/94	22.35	22.36	0.01		293.14	-	22.00						
10/17/94	25.36	25.46	0.10		290.12	-	22.00						
10/25/94	27.86	33.50	5.64		286.90	-	22.00						Passive Bailer Installed After Gauging
11/11/94	31.31	36.54	5.23		283.50	1.10	23.10						Passive Bailer Installed
11/22/94	-	-	0.00		NG	5.00	28.10						0.2' OF WATER, 4' PRODUCT (APPROX) BAILED PROD, IFP BROKE DURING GAUGING
12/07/94	27.86	33.90	6.04		286.84	11.00	39.10						BAILED PRODUCT
12/21/94	23.47	25.28	1.81		291.78	3.00	42.10						BAILED PRODUCT
01/04/95	24.00	24.48	0.48		291.43	1.00	43.10						BAILED PRODUCT
01/16/95	22.35	22.56	0.21		293.11	-	43.10						
01/23/95	-	20.64	0.00		294.85	0.37	43.47						PRODUCT FROM PASSIVE BAILER
02/16/95	20.36	20.37	0.01		295.13	-	43.47						
02/28/95	-	18.93	0.00		296.56	-	43.47						
03/10/95	-	17.73	0.00		297.76	-	43.47						
03/29/95	16.60	16.76	0.16		298.87	-	43.47						MOVED PASSIVE SKIMMER TO WELL
04/04/95	18.29	18.54	0.25		297.17	-	43.47						
04/27/95	20.22	20.67	0.45		295.21	-	43.47						LOWERED SKIMMER
05/11/95	20.11	20.35	0.24		295.35	0.37	43.84						
05/24/95	21.07	21.22	0.15		294.40	0.37	44.21						

Well ID:	**NFFW-14**	(Recovery Well)
TOC:	**314.40**	ft amsl
Ground:	**313.13**	ft amsl
Depth of Well:	**37.5**	ft bgs
Depth to Screen	**7.5**	ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Pressure Transducer	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Ground-water Flow Rate (gpm)	Ground-water Recovered (gal)	Vacuum at Vault (psia)	Flow Rate (SCFM)	Concentration (ppmv)	Comments
06/15/95	21.86	22.12	0.26		293.60	-	44.21						
06/29/95	23.79	23.89	0.10		291.69	0.37	44.58						
07/06/95	24.52	24.58	0.06		290.96	-	44.58						
07/25/95	24.52	24.86	0.34		290.93	0.55	45.13						
08/01/95	25.44	25.64	0.20		290.02	0.37	45.50						
08/21/95	31.66	35.21	3.55		283.37	0.37	45.87						
09/14/95	33.93	34.45	0.52		279.16	0.37	46.24						
09/28/95	24.80	28.18	3.38		287.92	6.50	52.74						Bailed Product
10/06/95	22.12	22.77	0.65		290.96	-	52.74						
10/25/95	15.78	16.02	0.24		297.35	0.37	53.11						
11/21/95	11.29	12.03	0.74		301.77	-	53.11						
12/08/95	13.39	14.36	0.97		299.64	2.00	55.11						
12/21/95	-	-	0.00		NG	-	55.11						Covered Under Plowed Snow
01/23/96	-	-	0.00		NG	-	55.11						Covered Under Plowed Snow
01/02/98	-	-	0.00	-	NG	-	55.11	-	-	-	-	-	New System Started
01/09/98	-	15.44	0.00	52.00	298.96	-	55.11	-	-	-	-	-	
01/09/98	29.28	29.41	0.13	35.00	284.88	22.40	77.51	2.5	-	-	-	-	
01/13/98	-	29.71	0.00	35.00	284.69	20.00	97.51	1.0	-	-	-	-	
01/20/98	-	-	0.00	35.00	NG	9.10	106.61	1.0	-	-	-	-	
01/28/98	-	-	0.00	35.00	NG	3.80	110.41	-	-	-	-	-	
02/02/98	-	-	0.00	-	NG	-	110.41	-	-	-	-	-	
02/09/98	29.89	29.94	0.05	35.00	284.42	8.72	119.13	-	-	-	-	-	
02/16/98	-	-	0.00	34.70	NG	1.92	121.05	-	-	12.4	-	235	
02/20/98	-	-	0.00	34.90	NG	3.46	124.51	-	-	12.5	-	610	
02/23/98	-	-	0.00	34.70	NG	0.10	124.61	-	-	12.5	-	232	
02/27/98	29.42	29.55	0.13	34.60	284.74	2.40	127.01	-	-	12.2	-	-	
03/02/98	-	29.49	0.00	-	284.91	-	127.01	-	-	12.7	9.9	-	
03/05/98	29.80	29.84	0.04	34.70	284.53	1.60	128.61	0.0	9999	12.0	22.2	78	
03/09/98	28.97	29.03	0.06	35.80	285.32	1.20	129.81	0.0	337	-	-	-	
03/13/98	30.25	30.30	0.05	35.60	284.06	-	129.81	0.0	367	11.7	8.5	-	
03/16/98	28.88	28.90	0.02	35.20	285.48	1.00	130.81	0.1	491	-	-	85	
03/23/98	-	-	0.00	35.60	NG	-	130.81	-	-	12.5	13.4	-	
04/02/98	29.40	29.41	0.01	35.80	284.98	1.80	132.61	-	-	12.2	10.0	-	
04/13/98	29.75	29.76	0.01	35.50	284.63	1.70	134.31	-	-	13.5	12.9	30	
04/17/98	-	-	0.00	35.90	NG	0.50	134.81	0.3	531	13.2	33.0	243	Cleaned screen on product pump/ installed flow meter
04/22/98	-	-	0.00	-	NG	-	134.81	-	-	13.5	-	-	
05/05/98	28.00	28.94	0.94	-	284.64	-	134.81	-	-	13.7	6.5	320	
05/21/98	27.16	27.18	0.02	-	287.20	2.40	137.21	-	-	11.7	7.8	88	
05/28/98	-	-	0.00	44.70	NG	*	137.21	-	22695	13.7	17.6	-	
06/12/98	24.25	24.26	0.01	39.30	290.13	0.94	138.15	0.4	25740	13.0	5.2	-	
06/23/98	-	25.26	0.00	39.90	289.14	0.15	138.30	0.2	29999	13.2	7.4	-	
07/10/98	17.16	17.18	0.02	49.50	297.20	0.45	138.75	0.1	29999	13.5	3.7	385	

Well ID:	**NFFW-14**	(Recovery Well)
TOC:	**314.40**	ft amsl
Ground:	**313.13**	ft amsl
Depth of Well:	**37.5**	ft bgs
Depth to Screen	**7.5**	ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Pressure Transducer	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Ground-water Flow Rate (gpm)	Ground-water Recovered (gal)	Vacuum at Vault (psia)	Flow Rate (SCFM)	Concentration (ppmv)	Comments
07/28/98	-	-	0.00	-	NG	-	138.75	-	-	-	-	-	
07/31/98	-	-	0.00	37.10	NG	0.04	138.79	0.7	51559	12.2	10.0	-	
08/05/98	-	-	0.00	-	NG	1.16	139.95	-	-	14.0	6.6	615	
08/14/98	27.07	27.13	0.06	-	287.22	1.60	141.55	-	-	14.2	5.4	-	
08/27/98	27.10	27.14	0.04	-	287.23	2.90	144.45	-	-	-	-	-	
09/11/98	17.74	17.77	0.03	-	296.60	0.30	144.75	-	-	-	-	-	
09/16/98	27.47	27.51	0.04	36.70	286.86	-	144.75	0.0	59999	14.7	0.0	-	
09/25/98	-	-	0.00	43.80	NG	-	144.75	0.6	59999	-	-	330	
10/14/98	-	23.25	0.00	39.40	291.15	0.80	145.55	0.0	-	14.7	0.0	-	
10/27/98	23.85	23.87	0.02	36.20	290.51	1.50	147.05	3.1	-	-	-	-	
11/03/98	23.70	23.74	0.04	-	290.63	0.70	147.75	-	-	-	-	-	
11/10/98	-	-	0.00	-	NG	-	147.75	-	-	-	-	-	
11/23/98	24.17	24.19	0.02	36.70	290.19	1.60	149.35	0.0	15999	-	-	-	
12/11/98	34.90	34.90	0.00	34.90	279.50	1.60	150.95	-	179999	-	-	-	
12/21/98	31.77	31.90	0.13	35.00	282.39	0.40	151.35	-	179999	-	-	-	
01/13/99	29.90	29.92	0.02	36.80	284.46	0.80	152.15	-	-	-	-	-	
01/26/99	28.90	28.93	0.03	43.60	285.44	-	152.15	0.2	179999	-	-	-	

Well ID: **NFFW-15**
TOC: **308.42** ft amsl
Ground: **305.97** ft amsl
Depth of Well: **32.5** ft bgs
Depth to Screen **7.5** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
03/30/94	-	8.94	0.00	297.93			1030 HOURS, NO LOCK
04/04/94	-	9.18	0.00	297.69			1000 HOURS
04/12/94	-	10.46	0.00	296.41			1200 HOURS
04/20/94	-	10.39	0.00	296.48			
05/12/94	-	13.35	0.00	293.52			
05/24/94	-	14.61	0.00	292.26			
06/03/94	-	16.15	0.00	290.72			
07/01/94	-	21.48	0.00	285.39			
07/13/94	-	24.28	0.00	282.59			
08/05/94	-	17.29	0.00	289.58			
08/17/94	-	17.36	0.00	289.51			
08/30/94	-	13.95	0.00	292.92			
09/08/94	-	14.93	0.00	291.94			
09/19/94	-	17.32	0.00	289.55			
09/30/94	-	18.21	0.00	288.66			
10/17/94	-	21.37	0.00	285.50			
10/25/94	-	23.82	0.00	283.05			
11/11/94	-	27.50	0.00	279.37			
11/22/94	-	28.30	0.00	278.57			
12/07/94	-	23.33	0.00	283.54			
12/21/94	-	19.95	0.00	286.92			
01/04/95	-	20.56	0.00	286.31			
01/23/95	-	17.01	0.00	289.86			
02/16/95	-	17.17	0.00	289.70			
02/28/95	-	15.72	0.00	291.15			
03/10/95	-	13.42	0.00	293.45			
03/29/95	-	13.27	0.00	293.60			
04/04/95	-	14.01	0.00	292.86			
04/27/95	-	16.22	0.00	290.65			
05/11/95	-	16.70	0.00	290.17			
05/24/95	-	17.31	0.00	289.56			
06/15/95	-	18.50	0.00	288.37			
06/29/95	-	20.48	0.00	286.39			
07/06/95	-	21.55	0.00	285.32			
07/25/95	-	21.72	0.00	285.15			
08/01/95	-	22.04	0.00	284.83			
08/21/95	-	26.98	0.00	279.89			
09/14/95	-	31.88	0.00	274.99			
09/28/95	-	23.00	0.00	283.87			
10/06/95	-	18.91	0.00	287.96			
10/25/95	-	13.42	0.00	293.45			
11/21/95	-	9.48	0.00	297.39			
12/08/95	-	11.76	0.00	295.11			
12/21/95	-	12.46	0.00	294.41			
01/23/96	-	-	0.00	-			Covered With Plowed Snow
02/09/96	-	9.69	0.00	297.18			
02/19/96	-	10.92	0.00	295.95			
01/09/98	-	12.86	0.00	295.56	-	0.00	New System Started
02/20/98	-	9.92	0.00	298.50	-	0.00	
05/21/98	-	11.17	0.00	297.25	-	0.00	
12/21/98	-	27.29	0.00	281.13	-	0.00	
01/13/99	-	22.90	0.00	285.52	-	0.00	

Well ID: **NFFW-16** (Recovery Well)
TOC: **312.08** ft amsl
Ground: **310.67** ft amsl
Depth of Well: **32.5** ft bgs
Depth to Screen **7.5** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Pressure Transducer	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Ground-water Flow Rate (gpm)	Ground-water Recovered (gal)	Vacuum at Vault (psia)	Flow Rate (SCFM)	Concentration (ppmv)	Comments
03/30/94	-	11.40	0.00		301.54	-	0.00						1030 HOURS
04/04/94	-	11.29	0.00		301.65	-	0.00						1000 HOURS
04/06/94	-	11.83	0.00		301.11	-	0.00						1200 HOUR
04/07/94	-	12.11	0.00		300.83	-	0.00						1100 HOURS
04/12/94	-	13.08	0.00		299.86	-	0.00						1200 HOURS
04/20/94	-	13.44	0.00		299.50	-	0.00						
04/27/94	-	3.30	0.00		309.64	-	0.00						Invalid data?
05/04/94	-	14.15	0.00		298.79	-	0.00						
05/12/94	-	14.32	0.00		298.62	-	0.00						
05/13/94	-	14.39	0.00		298.55	-	0.00						
05/16/94	-	14.88	0.00		298.06	-	0.00						
05/24/94	-	15.71	0.00		297.23	-	0.00						
05/27/94	16.18	16.18	0.00		296.76	-	0.00						
06/03/94	16.04	16.07	0.03		296.90	-	0.00						
06/15/94	18.27	18.34	0.07		294.66	-	0.00						
06/16/94	18.49	18.56	0.07		294.45	-	0.00						
07/01/94	21.62	21.77	0.15		291.30	-	0.00						
07/13/94	24.18	24.68	0.50		288.70	0.25	0.25						BAILED 0.25 GAL
08/05/94	17.43	18.66	1.23		295.35	1.00	1.25						BAILED 1 GAL
08/17/94	18.52	19.26	0.74		294.32	0.50	1.75						BAILED 0.5 GAL
08/30/94	16.45	16.58	0.13		296.47	0.25	2.00						BAILED 0.25 GAL INSTALLED P SKIMMER
09/08/94	17.11	17.17	0.06		295.82	-	2.00						
09/14/94	20.77	20.80	0.03		292.17	-	2.00						
09/19/94	19.28	19.29	0.01		293.66	0.07	2.07						BAILED 250 ML
09/30/94	19.36	19.36	0.00		293.58	-	2.07						SHEEN
10/17/94	22.52	22.61	0.09		290.41	-	2.07						
10/25/94	24.86	26.20	1.34		287.91	-	2.07						
11/11/94	29.80	32.36	2.56		282.81	-	2.07						
11/22/94	31.22	34.19	2.97		281.33	-	2.07						
12/07/94	25.45	28.90	3.45		287.04	-	2.07						
12/21/94	20.88	23.11	2.23		291.77	4.00	6.07						Bailed Product
01/04/95	21.27	22.03	0.76		291.57	1.00	7.07						Bailed Product
01/16/95	19.33	19.64	0.31		293.57	1.00	8.07						Bailed Product
01/23/95	17.72	17.97	0.25		295.19	-	8.07						
02/16/95	17.58	17.73	0.15		295.34	-	8.07						Installed Bailer
02/28/95	-	16.41	0.00		296.53	-	8.07						
03/10/95	-	15.84	0.00		297.10	-	8.07						
03/29/95	-	14.90	0.00		298.04	0.25	8.32						Removed Bailer
04/04/95	-	15.47	0.00		297.47	-	8.32						
04/27/95	16.98	16.99	0.00		295.96	-	8.32						Product .005 thick
05/11/95	-	16.85	0.00		296.09	-	8.32						
05/24/95	17.59	17.60	0.01		295.35	-	8.32						
06/15/95	18.46	18.47	0.01		294.48	-	8.32						

Well ID: **NFFW-16** (Recovery Well)
TOC: **312.08** ft amsl
Ground: **310.67** ft amsl
Depth of Well: **32.5** ft bgs
Depth to Screen **7.5** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Pressure Transducer	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Ground-water Flow Rate (gpm)	Ground-water Recovered (gal)	Vacuum at Vault (psia)	Flow Rate (SCFM)	Concentration (ppmv)	Comments
06/29/95	19.78	19.86	0.08		293.15	-	8.32						
07/06/95	-	21.08	0.00		291.86	-	8.32						
07/25/95	21.75	21.83	0.08		291.18	-	8.32						
08/01/95	21.90	21.99	0.09		291.03	-	8.32						
08/21/95	27.72	29.10	1.38		285.04	-	8.32						
09/14/95	33.59	36.60	3.01		278.96	6.00	14.32						Bailed Product
09/28/95	27.05	27.81	0.76		285.79	-	14.32						
10/06/95	22.20	22.38	0.18		290.72	-	14.32						
10/25/95	-	15.92	0.00		297.02	-	14.32						
11/21/95	-	12.17	0.00		300.77	-	14.32						
12/08/95	-	14.00	0.00		298.94	-	14.32						
12/21/95	-	14.15	0.00		298.79	-	14.32						
01/23/96	-	12.55	0.00		300.39	-	14.32						
02/09/96	-	11.24	0.00		301.70	-	14.32						
02/19/96	-	13.26	0.00		299.68	-	14.32						
01/02/98	-	-	0.00	-	NG	-	14.32	-	-	-	-	-	New System Started
01/09/98	-	13.91	0.00	48.60	298.17	-	14.32	-	-	-	-	-	
01/09/98	-	-	0.00	-	NG	-	14.32	-	-	-	-	-	
01/13/98	-	14.16	0.00	52.10	297.92	-	14.32	-	-	-	-	-	
01/20/98	-	-	0.00	-	NG	-	14.32	-	-	-	-	-	
01/28/98	-	-	0.00	52.80	NG	-	14.32	-	-	-	-	-	
02/02/98	-	13.18	0.00	53.40	298.90	-	14.32	-	-	-	-	-	
02/09/98	28.13	30.79	2.66	38.00	278.98	11.82	26.14	-	-	-	-	-	
02/16/98	-	-	0.00	42.50	NG	*	26.14	-	-	12.6	-	452	
02/20/98	-	-	0.00	42.70	NG	0.26	26.40	-	-	12.6	-	620	
02/23/98	-	-	0.00	42.50	NG	-	26.40	-	-	12.6	-	426	
02/27/98	16.48	31.70	15.22	45.90	267.14	0.10	26.50	-	-	12.4	-	-	
03/02/98	14.62	30.85	16.23	-	267.11	-	26.50	-	-	13.0	6.9	-	GW system off b/c product system not recovering product
03/05/98	12.63	12.77	0.14	32.90	299.19	7.20	33.70	-	877	-	-	-	6.7 gal of product was hand bailed
03/09/98	12.33	12.62	0.29	-	299.21	-	33.70	-	-	-	-	-	
03/13/98	11.03	11.14	0.11	37.60	300.84	-	33.70	-	5024	-	-	-	
03/16/98	20.48	24.20	3.72	40.60	284.64	-	33.70	0.3	109999	-	-	-	
03/23/98	-	-	0.00	44.20	NG	-	33.70	-	-	11.7	8.0	-	
04/02/98	28.45	28.64	0.19	49.70	283.27	-	33.70	-	-	12.2	10.5	-	
04/13/98	29.42	29.49	0.07	46.30	282.53	8.20	41.90	-	-	13.2	9.8	173	
04/17/98	-	-	0.00	43.80	NG	8.30	50.20	4.8	1059999	13.0	6.9	420	installed flow sensor (water)
04/22/98	-	-	0.00	-	NG	2.71	52.91	-	-	13.5	6.1	-	
05/05/98	31.08	31.15	0.07	-	280.87	27.39	80.30	-	-	13.5	7.0	790	
05/21/98	28.02	28.11	0.09	-	283.89	9.30	89.60	-	-	10.8	9.9	209	
05/28/98	-	-	0.00	45.00	NG	0.02	89.62	-	1659999	13.2	6.9	-	
06/12/98	31.70	31.83	0.13	31.70	280.14	2.48	92.10	0.4	1829999	12.0	6.6	-	
06/23/98	30.98	31.11	0.13	36.50	280.86	0.56	92.66	1.7	2352729	13.2	8.5	-	

Well ID: **NFFW-16** (Recovery Well)
TOC: **312.08** ft amsl
Ground: **310.67** ft amsl
Depth of Well: **32.5** ft bgs
Depth to Screen **7.5** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Pressure Transducer	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Ground-water Flow Rate (gpm)	Ground-water Recovered (gal)	Vacuum at Vault (psia)	Flow Rate (SCFM)	Concentration (ppmv)	Comments
07/10/98	16.04	16.12	0.08	53.60	295.89	0.94	93.60	2.1	2490841	13.0	6.9	716	
07/28/98	-	-	0.00	-	NG	-	93.60	-	-	-	-	-	
07/31/98	-	-	0.00	42.10	NG	0.04	93.64	1.3	3445104	-	-	-	
08/05/98	-	-	0.00	-	NG	0.06	93.70	-	-	-	-	-	
08/14/98	30.48	30.56	0.08	-	281.45	0.10	93.80	-	-	-	-	-	
08/27/98	30.70	32.30	1.60	-	278.39	-	93.80	-	-	-	-	-	
09/11/98	19.12	20.44	1.32	-	290.49	-	93.80	-	-	-	-	-	
09/16/98	27.55	29.10	1.55	42.80	281.63	3.20	97.00	0.2	5249999	14.7	0.0	-	
09/25/98	-	-	0.00	56.60	NG	3.90	100.90	2.1	5349999	13.9	8.7	-	
10/14/98	-	20.74	0.00	40.40	291.34	9.50	110.40	4.5	-	12.5	9.5	-	
10/27/98	24.12	24.17	0.05	35.70	287.87	2.50	112.90	0.2	-	13.7	9.3	640	
11/03/98	24.00	24.03	0.03	-	288.02	1.30	114.20	-	-	13.7	10.0	595	
11/10/98	-	-	0.00	-	NG	-	114.20	-	-	-	-	-	
11/23/98	23.87	23.88	0.01	37.30	288.19	1.50	115.70	0.2	733544	12.0	12.3	638	
12/11/98	29.98	29.99	0.01	36.80	282.08	11.30	127.00	0.9	8119999	12.7	14.4	-	
12/21/98	30.01	30.12	0.11	36.80	281.86	1.40	128.40	1.0	8589999	12.5	17.2	444	
01/13/99	31.25	31.28	0.03	37.90	280.77	2.10	130.50	0.1	9317282	12.5	9.5	-	
01/26/99	30.88	30.90	0.02	36.80	281.16	-	130.50	0.6	9834366	12.5	11.7	388	

Well ID: **NFFW-17**
TOC: **301.08** ft amsl
Ground: **301.76** ft amsl
Depth of Well: **24** ft bgs
Depth to Screen **4** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
03/30/94	-	2.38	0.00	297.14			1030 HOURS
04/04/94	-	2.45	0.00	297.07			1000 HOURS
04/12/94	-	3.58	0.00	295.94			1200 HOURS
04/20/94	-	3.67	0.00	295.85			
05/12/94	-	5.97	0.00	293.55			
05/24/94	-	7.13	0.00	292.39			
06/03/94	-	8.26	0.00	291.26			
07/01/94	-	11.70	0.00	287.82			
07/13/94	-	14.15	0.00	285.37			
08/05/94	-	10.67	0.00	288.85			
08/17/94	-	9.78	0.00	289.74			
08/30/94	-	7.15	0.00	292.37			
09/08/94	-	7.62	0.00	291.90			
09/19/94	-	10.85	0.00	288.67			
09/30/94	-	9.98	0.00	289.54			
10/17/94	-	12.35	0.00	287.17			
10/25/94	-	14.15	0.00	285.37			
11/11/94	17.91	17.91	Sheen	281.61			
11/22/94	-	18.37	0.00	281.15			
12/07/94	-	15.44	0.00	284.08			
12/21/94	-	12.82	0.00	286.70			
01/04/95	-	12.62	0.00	286.90			
01/23/95	-	9.62	0.00	289.90			
02/16/95	-	-	0.00	NG			Well Buried in Snow
02/28/95	-	7.72	0.00	291.80			
03/10/95	-	6.35	0.00	293.17			
03/29/95	-	6.01	0.00	293.51			
04/04/95	-	6.49	0.00	293.03			
04/27/95	-	8.25	0.00	291.27			
05/11/95	-	8.45	0.00	291.07			
05/24/95	-	8.94	0.00	290.58			
06/15/95	-	9.77	0.00	289.75			
06/29/95	-	10.81	0.00	288.71			
07/06/95	-	11.78	0.00	287.74			
07/25/95	-	12.82	0.00	286.70			
08/01/95	-	13.17	0.00	286.35			
08/21/95	-	17.03	0.00	282.49			
09/14/95	-	21.62	0.00	277.90			
09/28/95	-	15.25	0.00	284.27			
10/06/95	-	11.22	0.00	288.30			
10/25/95	-	6.80	0.00	292.72			
11/21/95	-	2.62	0.00	296.90			
12/08/95	-	4.66	0.00	294.86			
12/21/95	-	-	0.00	NG			Covered With Snow
01/23/96	-	3.51	0.00	296.01			
02/09/96	-	2.78	0.00	296.74			
02/19/96	-	-	0.00	NG			
01/09/98	-	5.86	0.00	295.22	-	0.00	New System Started
02/20/98	-	3.46	0.00	297.62	-	0.00	
05/21/98	-	5.22	0.00	295.86	-	0.00	
12/21/98	-	18.33	0.00	282.75	-	0.00	
01/13/99	-	15.07	0.00	286.01	-	0.00	

Well ID: **NFFW-18**
TOC: **308.47** ft amsl
Ground: **305.49** ft amsl
Depth of Well: **25** ft bgs
Depth to Screen **5** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
03/30/94	-	11.95	0.00	294.99			1030 HOURS, N0 LOCK
04/04/94	-	12.59	0.00	294.35			1000 HOURS
04/12/94	-	12.84	0.00	294.10			1200 HOURS
04/20/94	-	13.09	0.00	293.85			
05/12/94	-	13.95	0.00	292.99			
05/24/94	-	14.93	0.00	292.01			
06/03/94	-	16.12	0.00	290.82			
07/01/94	-	19.30	0.00	287.64			
07/13/94	-	22.05	0.00	284.89			
08/05/94	-	17.15	0.00	289.79			
08/17/94	-	18.17	0.00	288.77			
08/30/94	-	15.78	0.00	291.16			
09/08/94	-	16.74	0.00	290.20			
09/19/94	-	17.80	0.00	289.14			
09/30/94	-	17.91	0.00	289.03			
10/17/94	-	21.15	0.00	285.79			
10/25/94	-	21.48	0.00	285.46			
11/11/94	-	24.55	0.00	282.39			
11/22/94	-	24.83	0.00	282.11			
12/07/94	-	19.49	0.00	287.45			
12/21/94	-	19.27	0.00	287.67			
01/04/95	-	19.23	0.00	287.71			
01/23/95	-	15.23	0.00	291.71			
02/16/95	-	16.30	0.00	290.64			
02/28/95	-	14.12	0.00	292.82			
03/10/95	-	12.91	0.00	294.03			
03/29/95	-	14.07	0.00	292.87			
04/04/95	-	14.42	0.00	292.52			
04/27/95	-	15.59	0.00	291.35			
05/11/95	-	15.26	0.00	291.68			
05/24/95	-	16.11	0.00	290.83			
06/15/95	-	16.41	0.00	290.53			
06/29/95	-	17.12	0.00	289.82			
07/06/95	-	18.41	0.00	288.53			
07/25/95	-	18.25	0.00	288.69			
08/01/95	-	19.87	0.00	287.07			
08/21/95	-	23.80	0.00	283.14			
09/14/95	-	27.81	0.00	279.13			
09/28/95	-	18.70	0.00	288.24			
10/06/95	-	15.85	0.00	291.09			
10/25/95	-	14.39	0.00	292.55			
11/21/95	-	12.66	0.00	294.28			
12/08/95	-	13.49	0.00	293.45			
12/21/95	-	13.33	0.00	293.61			
01/23/96	-	12.64	0.00	294.30			
02/09/96	-	12.36	0.00	294.58			
02/19/96	-	12.91	0.00	294.03			
01/09/98	-	13.67	0.00	294.80	-	0.00	New System Started
02/20/98	-	12.50	0.00	295.97	-	0.00	
05/21/98	-	14.63	0.00	293.84	-	0.00	
12/21/98	-	25.96	0.00	282.51	-	0.00	
01/13/99	-	19.70	0.00	288.77	-	0.00	

Well ID: **NFFW-19**
TOC: **323.00** ft amsl
Ground: **319.73** ft amsl
Depth of Well: **31** ft bgs
Depth to Screen **6** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
03/30/94	-	12.93	0.00	308.51	-	0.00	1030 HOURS
04/04/94	-	13.28	0.00	308.16	-	0.00	1000 HOURS
04/06/94	-	13.59	0.00	307.85	-	0.00	1200 HOUR
04/07/94	-	13.97	0.00	307.47	-	0.00	1100 HOURS
04/12/94	-	15.24	0.00	306.20	-	0.00	1200 HOURS
04/20/94	-	15.22	0.00	306.22	-	0.00	
04/27/94	-	15.31	0.00	306.13	-	0.00	
05/04/94	-	15.27	0.00	306.17	-	0.00	
05/12/94	-	18.50	0.00	302.94	-	0.00	
05/16/94	-	19.35	0.00	302.09	-	0.00	
05/24/94	-	14.35	0.00	307.09	-	0.00	
05/27/94	-	22.33	0.00	299.11	-	0.00	
06/03/94	-	25.46	0.00	295.98	-	0.00	
06/15/94	31.66	31.74	0.07	289.77	-	0.00	
06/16/94	32.23	32.30	0.07	289.20	-	0.00	
06/21/94	33.32	33.42	0.10	288.11	-	0.00	
07/01/94	33.33	33.43	0.10	288.10	-	0.00	
07/13/94	-	29.30	0.00	292.14	-	0.00	
08/05/94	-	28.13	0.00	293.31	-	0.00	
08/17/94	-	29.78	0.00	291.66	-	0.00	
08/30/94	-	24.02	0.00	297.42	-	0.00	
09/06/94	-	25.97	0.00	295.47	-	0.00	
09/14/94	-	29.87	0.00	291.57	-	0.00	
09/19/94	-	21.18	0.00	300.26	-	0.00	
10/17/94	-	33.37	0.00	288.07	-	0.00	ODOR
10/25/94	-	33.35	0.00	288.09	-	0.00	
11/11/94	-	33.34	0.00	288.10	-	0.00	
11/22/94	-	33.31	0.00	288.13	-	0.00	
12/07/94	33.26	33.26	Sheen	288.18	-	0.00	
12/21/94	-	33.29	0.00	288.15	-	0.00	
01/04/95	-	33.27	0.00	288.17	-	0.00	
01/16/95	-	32.11	0.00	289.33	-	0.00	
01/23/95	-	26.21	0.00	295.23	-	0.00	
02/16/95	-	26.73	0.00	294.71	-	0.00	
02/28/95	-	23.80	0.00	297.64	-	0.00	
03/10/95	-	18.67	0.00	302.77	-	0.00	
03/29/95	-	17.87	0.00	303.57	-	0.00	
04/04/95	-	18.81	0.00	302.63	-	0.00	
04/27/95	-	22.71	0.00	298.73	-	0.00	
05/11/95	-	23.23	0.00	298.21	-	0.00	
05/24/95	-	24.76	0.00	296.68	-	0.00	
06/15/95	-	28.10	0.00	293.34	-	0.00	
06/29/95	-	32.55	0.00	288.89	-	0.00	
07/06/95	-	23.28	0.00	298.16	-	0.00	
07/25/95	-	32.45	0.00	288.99	-	0.00	
08/01/95	-	33.26	0.00	288.18	-	0.00	
08/21/95	-	33.26	0.00	288.18	-	0.00	
09/14/95	-	-	0.00	NG	-	0.00	Did Not Have Key For Well
09/28/95	-	32.53	0.00	288.91	-	0.00	
10/06/95	-	26.15	0.00	295.29	-	0.00	
10/25/95	-	18.92	0.00	302.52	-	0.00	
11/21/95	-	14.58	0.00	306.86	-	0.00	
12/08/95	-	15.96	0.00	305.48	-	0.00	
12/21/95	-	16.01	0.00	305.43	-	0.00	
01/23/96	-	13.14	0.00	308.30	-	0.00	
02/09/96	-	13.12	0.00	308.32	-	0.00	
02/19/96	-	14.46	0.00	306.98	-	0.00	
01/09/98	-	17.65	0.00	305.35	-	0.00	New System Started
01/13/98	-	17.33	0.00	305.67	-	0.00	
02/20/98	-	13.69	0.00	309.31	-	0.00	

Well ID: **NFFW-19**
TOC: **323.00** ft amsl
Ground: **319.73** ft amsl
Depth of Well: **31** ft bgs
Depth to Screen **6** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
02/27/98	-	12.94	0.00	310.06	-	0.00	
03/16/98	-	13.09	0.00	309.91	-	0.00	
05/21/98	-	15.84	0.00	307.16	-	0.00	
08/14/98	-	23.15	0.00	299.85	-	0.00	
10/14/98	-	28.79	0.00	294.21	-	0.00	
12/21/98	-	Dry	0.00	Dry	-	0.00	
01/13/99	-	32.08	0.00	290.92	-	0.00	

Well ID: **NFFW-20**
TOC: **326.11** ft amsl
Ground: **323.36** ft amsl
Depth of Well: **34** ft bgs
Depth to Screen **14** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
03/30/94	-	23.16	0.00	301.39	-	-	1030 HOURS
04/04/94	-	22.98	0.00	301.57	-	-	1000 HOURS
04/12/94	-	25.41	0.00	299.14	-	-	1200 HOURS
04/20/94	-	25.90	0.00	298.65	-	-	
05/12/94	-	27.88	0.00	296.67	-	-	
05/24/94	-	29.45	0.00	295.10	-	-	
06/03/94	30.94	30.94	0.00	293.61	-	-	
07/01/94	34.29	34.84	0.55	290.19	-	-	
07/13/94	35.29	35.31	0.02	289.26	0.10	0.10	BAILED 0.10 GAL
08/05/94	-	32.04	0.00	292.51	-	0.10	
08/17/94	-	31.52	0.00	293.03	-	0.10	
08/30/94	-	29.45	0.00	295.10	-	0.10	
09/08/94	-	30.25	0.00	294.30	-	0.10	
09/19/94	-	31.60	0.00	292.95	-	0.10	
09/30/94	-	31.99	0.00	292.56	-	0.10	ODOR
10/17/94	33.30	33.55	0.25	291.22	-	0.10	Installed Pasive Bailer
10/25/94	35.09	35.13	0.04	289.45	0.25	0.35	Removed Bailer
11/11/94	35.57	35.77	0.20	288.95	-	0.35	
11/22/94	35.90	36.15	0.25	288.62	-	0.35	
12/07/94	36.00	36.29	0.29	288.51	-	0.35	
12/21/94	34.60	34.64	0.04	289.94	-	0.35	
01/04/95	-	33.31	0.00	291.24	-	0.35	
01/23/95	-	31.18	0.00	293.37	-	0.35	
02/16/95	-	31.10	0.00	293.45	-	0.35	
02/28/95	-	30.08	0.00	294.47	-	0.35	
03/10/95	-	28.41	0.00	296.14	-	0.35	
03/29/95	-	27.65	0.00	296.90	-	0.35	
04/04/95	-	28.80	0.00	295.75	-	0.35	
04/27/95	30.73	30.74	0.01	293.82	-	0.35	Product .005 thick
05/11/95	-	30.27	0.00	294.28	-	0.35	
05/24/95	-	30.27	0.00	294.28	-	0.35	
06/15/95	-	31.67	0.00	292.88	-	0.35	
06/29/95	32.55	33.54	0.99	291.87	-	0.35	
07/06/95	33.09	33.54	0.45	291.40	-	0.35	
07/25/95	35.05	35.29	0.24	289.47	-	0.35	
08/01/95	34.81	34.97	0.16	289.72	-	0.35	
08/21/95	35.08	35.39	0.31	289.43	-	0.35	
09/14/95	36.00	36.37	0.37	288.50	-	0.35	
09/28/95	36.13	36.50	0.37	288.37	-	0.35	
10/06/95	36.00	36.27	0.27	288.51	-	0.35	
10/25/95	-	28.77	0.00	295.78	-	0.35	
11/21/95	-	24.37	0.00	300.18	-	0.35	
12/08/95	-	27.03	0.00	297.52	-	0.35	
12/21/95	-	27.31	0.00	297.24	-	0.35	
01/23/96	-	24.72	0.00	299.83	-	0.35	
02/09/96	-	23.25	0.00	301.30	-	0.35	
02/19/96	-	26.08	0.00	298.47	-	0.35	
01/09/98	-	26.91	0.00	299.20	-	0.35	New System Started
01/13/98	-	27.25	0.00	298.86	-	0.35	
02/20/98	-	25.81	0.00	300.30	-	0.35	
02/27/98	-	25.17	0.00	300.94	-	0.35	
03/16/98	-	24.57	0.00	301.54	-	0.35	
05/21/98	-	25.41	0.00	300.70	-	0.35	

Well ID: **NFFW-20**
TOC: **326.11** ft amsl
Ground: **323.36** ft amsl
Depth of Well: **34** ft bgs
Depth to Screen **14** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
08/14/98	-	31.45	0.00	294.66	-	0.35	
10/14/98	33.96	33.99	0.03	292.09	-	0.35	
12/21/98	35.61	35.80	0.19	290.14	-	0.35	
01/13/99	36.07	36.32	0.25	289.57	0.25	0.60	

Well ID: **NFFW-21**
TOC: **318.91** ft amsl
Ground: **315.96** ft amsl
Depth of Well: **34** ft bgs
Depth to Screen **9** ft bgs

Gauge Date	Depth To LNAPL (ft)	Depth To Water (ft)	LNAPL Thickness (ft)	Corrected GW Elevation (ft amsl)	LNAPL Recovered (gal)	Total LNAPL Recovered (gal)	Comments
03/30/94	-	12.11	0.00	305.25			1030 HOURS, NO LOCK
04/04/94	-	12.11	0.00	305.25			1000 HOURS
04/12/94	-	13.32	0.00	304.04			1200 HOURS
04/20/94	-	18.94	0.00	298.42			
05/12/94	-	22.96	0.00	294.40			
05/24/94	-	25.55	0.00	291.81			
06/03/94	-	28.56	0.00	288.80			
07/01/94	-	36.47	0.00	280.89			
07/13/94	-	36.51	0.00	280.85			WELL DRY?
08/05/94	-	32.54	0.00	284.82			
08/17/94	-	32.78	0.00	284.58			
08/30/94	-	30.15	0.00	287.21			
09/08/94	29.27	29.28	0.01	288.09			SHEEN
09/19/94	-	32.95	0.00	284.41			
09/30/94	-	33.39	0.00	283.97			
10/17/94	-	36.47	0.00	280.89			
10/25/94	-	36.50	0.00	280.86			
11/11/94	-	36.51	0.00	280.85			
11/22/94	-	36.51	0.00	280.85			
12/07/94	36.48	36.48	Sheen	280.88			
12/21/94	-	36.48	0.00	280.88			
01/04/95	-	36.48	0.00	280.88			
01/23/95	-	29.31	0.00	288.05			
02/16/95	-	28.49	0.00	288.87			
02/28/95	-	25.38	0.00	291.98			
03/10/95	-	21.55	0.00	295.81			
03/29/95	-	21.07	0.00	296.29			
04/04/95	-	22.07	0.00	295.29			
04/27/95	-	25.12	0.00	292.24			
05/11/95	-	25.47	0.00	291.89			
05/24/95	-	26.82	0.00	290.54			
06/15/95	-	29.08	0.00	288.28			
06/29/95	-	32.33	0.00	285.03			
07/06/95	-	33.03	0.00	284.33			
07/25/95	-	34.18	0.00	283.18			
08/01/95	-	34.70	0.00	282.66			
08/21/95	-	36.45	0.00	280.91			
09/14/95	-	36.48	0.00	280.88			
09/28/95	-	36.49	0.00	280.87			
10/06/95	-	32.65	0.00	284.71			
10/25/95	-	22.82	0.00	294.54			
11/21/95	-	16.64	0.00	300.72			
12/08/95	-	19.29	0.00	298.07			
12/21/95	-	19.70	0.00	297.66			
01/23/96	-	14.89	0.00	302.47			
02/09/96	-	15.58	0.00	301.78			
02/19/96	-	17.61	0.00	299.75			
01/09/98	-	21.71	0.00	297.20	-	0.00	New System Started
02/20/98	-	16.34	0.00	302.57	-	0.00	
05/21/98	-	17.77	0.00	301.14	-	0.00	
12/21/98	-	36.50	0.00	282.41	-	0.00	
01/13/99	-	34.63	0.00	284.28	-	0.00	

APPENDIX B

WELL PURGE SHEETS

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Well ID: NFFW-1
Site Name: WILLOW GROVE/NAS
Well Condition: O.K.
Site Location:
Gauge Date: 1/13/99
Weather: RAIN, 40's
Gauge Time:
Sounding Method: 1FP
Measurement Reference: T.O.C.
Stick Up/Down (ft): 2.5
Well Diameter (in.): 4"
Purge Date: 1/15/99
Purge Method: 2" SUBMERSIBLE
Purge Time: 45 MIN
Sampler's Name: A. McGrede

Well Gauging and Tubing Placement

A. Well Depth (ft): 29.20
B. Depth to Water (ft): 21.30
C. Screening Interval (ft):
D. Depth to tubing intake (ft) 26.0'

Final Purging and Sampling Data

Total Quantity of Water Removed (gal): 22,500 mL
Samplers: ASM
Sampling Date: 1/15/99
Sampling Time: ~~1055~~ 45 min
Sample Time: 1055
Split Sample (Yes or No)? NO
If Yes, With Whom? —
Comments/Observations: Collected Dup-4

Well Volume	Time 1000	Depth to Water (ft)	Rate (mL/min)	Volume Purged (mL)	PH	Temperature (°C)	Conductivity (µmhos/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Eh (mV)
Beginning	START	21.30	500	0	6.74	13.06	375	17.6	8.30	-121.9
1	5 min	21.90	"	2500	6.62	14.48	385	16.9	7.32	-169.1
2	10 min	22.03	"	5000	6.61	14.76	386	13.4	7.98	-19[illegible]
3	15	22.05	"	7500	6.60	15.77	391	15.0	8.54	-206.5
4	20	[illegible]	"	10000	6.60	15.92	397	14.7	8.60	-210.2
5	25	22.06	"	12,500	6.60	16.04	400	19.9	9.44	-216.3
6	30	22.07	"	15,000	6.59	16.22	403	22.6	10.28	-221.0
7	35	22.07	"	17,500	6.56	16.30	405	23.9	10.64	-221.3

NFFW-1

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Well Volume	Time	Depth to Water (ft)	Rate (mL/min)	Volume Purged (mL)	PH	Temperature (°C)	Conductivity (µmhos/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Eh (mV)
8	40 min	22.08	500	20,000	6.58	16.30	405	25.9	10.77	-221.6
9	45	22.10	500	22,500	6.51	16.36	406	26.8	10.98	-221.8
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FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Well ID: NFFW-3
Site Name: Willow Grove Naval Base
Well Condition: okay
Site Location:
Gauge Date: 1/13/99
Weather:
Gauge Time: 13:00
Sounding Method:
Measurement Reference: toc
Stick Up/Down (ft): ≈ 3'
Well Diameter (in.): 4
Purge Date: N/A
Purge Method:
Purge Time: N/A
Sampler's Name: Eddie Meadows

Well Gauging and Tubing Placement

A. Well Depth (ft):
B. Depth to Water (ft):
C. Screening Interval (ft):
D. Depth to tubing intake (ft)

Final Purging and Sampling Data

Total Quantity of Water Removed (gal):
Samplers:
Sampling Date:
Sampling Time:
Sample Time:
Split Sample (Yes or No)?
If Yes, With Whom?
Comments/Observations:

Did not sample - well was dry

Well Volume	Time	Depth to Water (ft)	Rate (mL/min)	Volume Purged (mL)	PH	Temperature (°C)	Conductivity (µmhos/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Eh (mV)
Beginning										
1										
2										
3										
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5										
6										
7										

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Well ID: [illegible]
Site Name: [illegible]
Well Condition: [illegible]
Site Location:
Gauge Date: [illegible]
Weather:
Gauge Time: 13:15
Sounding Method:
Measurement Reference: [illegible]
Stick Up/Down (ft): 1'
Well Diameter (in.): 4
Purge Date: [illegible]
Purge Method: 2" submersible
Purge Time: 13:26
Sampler's Name: [illegible]

Well Gauging and Tubing Placement

A. Well Depth (ft): 27'
B. Depth to Water (ft): 2.40'
C. Screening Interval (ft):
D. Depth to tubing intake (ft) ~12'

Final Purging and Sampling Data

Total Quantity of Water Removed (gal):
Samplers: [illegible]
Sampling Date: [illegible]
Sampling Time: 36 mins.
Sample Time: 14:05
Split Sample (Yes or No)? No
If Yes, With Whom? N/A
Comments/Observations: Again, turbidity!

Well Volume	Time	Depth to Water (ft)	Rate (mL/min)	Volume Purged (mL)	PH	Temperature (°C)	Conductivity (µmhos/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Eh (mV)
Beginning	13:26	2.40	1000	0	6.68	9.30	0.617	5.1	4.74	120.3
1	3	3.22		3000	6.82	9.71	0.618	5.7	4.26	112.1
2	6	3.82		6000	6.87	9.64	0.619	5.1	4.40	115.8
3	9	4.05	500	7500	6.92	9.78	0.620	4.8	3.93	114.3
4	12	4.14		9000	7.02	9.66	0.632	24.9	4.75	110.9
5	15	4.21		10500	7.06	9.61	0.634	42.8	4.99	109.5
6	18	4.17		12000	7.07	9.73	0.635	60.9	4.82	108.3
7	21	4.13		13500	7.11	9.49	0.640	89.4	5.09	107.1

NFF W-5 (cont.)

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Well Volume	Time	Depth to Water (ft)	Rate (mL/min)	Volume Purged (mL)	PH	Temperature (°C)	Conductivity (µmhos/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Eh (mV)
8	24	4.18	500	15000	7.12	9.30	0.640	86.5	5.17	105.9
9	27	4.21		16,500	7.13	9.09	0.642	118.4	5.53	105.3
10	30	4.31		18,000	7.14	8.93	0.643	138.2	5.82	103.9
11	33	4.35		19,500	7.16	8.85	0.642	152.0	5.74	102.2
12	36	4.38		21,000	7.14	8.84	0.641	149.1	6.13	102.6
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FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Well ID: NFFW-8
Site Name: Willow Grove Naval Base
Well Condition: okay
Site Location:
Gauge Date: 1/13/99
Weather:
Gauge Time: 14:50
Sounding Method:
Measurement Reference: toc
Stick Up/Down (ft): 1'
Well Diameter (in.): 4
Purge Date: 1/13/99
Purge Method: 2" submersible - slow purge
Purge Time: 15:00
Sampler's Name: Eddie Meadows

Well Gauging and Tubing Placement

A. Well Depth (ft): 30.5'
C. Screening Interval (ft):
B. Depth to Water (ft): 19.44'
D. Depth to tubing intake (ft) 30'

Final Purging and Sampling Data

Total Quantity of Water Removed (~~gal~~): 9L
Samplers: Eddie Meadows
Sampling Date: 1/13/99
Sampling Time: 18 mins
Sample Time: 15:20
Split Sample (Yes or No)? N
If Yes, With Whom? n/a
Comments/Observations:

Well Volume	Time	Depth to Water (ft)	Rate (mL/min)	Volume Purged (mL)	PH	Temperature (°C)	Conductivity (µmhos/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Eh (mV)
Beginning	15:00	19.44	500	0	6.41	14.10	0.825	388.4	2.02	-98.9
1	3	19.82	500	1500	6.42	15.42	0.972	310.0	1.40	-109.6
2	6	19.91		3000	6.45	16.32	0.870	187.2	1.28	-113.5
3	9	20.07		4500	6.43	16.87	0.870	71.8	1.03	-112.5
4	12	20.28		6000	6.37	16.51	0.863	49.7	0.98	-112.3
5	15	20.53		7500	6.38	16.49	0.854	51.2	0.97	-119.8
6	18	20.60		9000	6.36	16.75	0.849	53.6	0.96	-121.2
7										

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Well ID: NFFW-10 (& DUPS)
Site Name:
Well Condition: okay
Site Location:
Gauge Date: 1/15/98
Weather: crap
Gauge Time: 9:15
Sounding Method:
Measurement Reference: toc
Stick Up/Down (ft): 0'
Well Diameter (in.): 4
Purge Date: 1/15/99
Purge Method: 2" submersible - [illegible]
Purge Time: 9:30
Sampler's Name: Eddie Meadows

Well Gauging and Tubing Placement

A. Well Depth (ft): 38'
C. Screening Interval (ft):
B. Depth to Water (ft): 14.46
D. Depth to tubing intake (ft) 25.00'

Final Purging and Sampling Data

Total Quantity of Water Removed (~~gal~~): +18 L
Samplers: Eddie Meadows
Sampling Date: 1/15/99
Sampling Time: 18 min
Sample Time: 9:50
Split Sample (Yes or No)? N
If Yes, With Whom? N/A
Comments/Observations: well taking on surface water runoff of snow, shelf, etc. slope - depth to water is bogus for 2 reasons - 1- see above & 2 - as water was running down the sides [illegible] to get accurate read. gave up on turbidity - it was all over the place

Well Volume	Time	Depth to Water (ft)	Rate (mL/min)	Volume Purged (mL)	PH	Temperature (°C)	Conductivity (µmhos/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Eh (mV)
Beginning	9:30	11.20	1000	0	6.38	14.86	0.475	78.2	8.43	113.0
1	3	10.24	1000	3000	6.24	10.00	0.199	86.6	8.04	127.4
2	6			6000	6.29	7.94	0.163	54.7	10.44	126.9
3	9			9000	6.39	7.11	0.171	39.6	10.69	125.5
4	12	10.02		12000	6.36	6.02	0.175	32.0	11.21	127.4
5	15			15000	6.35	6.98	0.183	46.2	10.63	127.7
6	18			18000	6.33	6.90	0.161	57.9	10.66	129.9
7										

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Well ID: NFFW-12
Site Name: WILLOW GROVE NAS
Well Condition: O.K.
Site Location:
Gauge Date: 1/13/99
Weather: RAIN, 40°F
Gauge Time: —
Sounding Method: JFP
Measurement Reference: T.O.C.
Stick Up/Down (ft): 0.5
Well Diameter (in.): 4"
Purge Date: 1/15/99
Purge Method: 2" SUBMERSIBLE
Purge Time: 40 min
Sampler's Name: A. McBRIDE

Well Gauging and Tubing Placement

A. Well Depth (ft): 27.05
C. Screening Interval (ft):
B. Depth to Water (ft): 20.23
D. Depth to tubing intake (ft) 24.0'

Final Purging and Sampling Data

Total Quantity of Water Removed (~~gal~~ mL): 16,000
Samplers: A JM
Sampling Date: 1/15/99
Sampling Time: 40 min
Sample Time: 1210
Split Sample (Yes or No)? NO
If Yes, With Whom? —
Comments/Observations:

Well Volume	Time	Depth to Water (ft)	Rate (mL/min)	Volume Purged (mL)	PH	Temperature (°C)	Conductivity (µmhos/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Eh (mV)
Beginning	1125 START	20.23	400	0	5.83	9.30	559	206.3	5.82	-0.3
1	5 min	20.54	400	2,000	5.95	9.89	582	345.8	4.21	-52.3
2	10 min	21.59	"	4,000	5.21	8.38	571	129.8	3.85	21.8
3	15 min	21.60	"	6,000	5.33	15.87	631	55.9	2.98	25.3
4	20	21.61	"	8,000	5.54	15.20	615	34.9	2.54	33.2
5	25	21.62	"	10,000	5.59	14.64	609	23.4	2.40	35.6
6	30	21.62	"	12,000	5.67	13.07	584	20.2	2.11	47.0
7	35	21.63	"	14,000	5.70	13.14	588	19.7	2.09	48.5
8	40	21.64	"	16,000	5.69	13.20	586	18.1	2.06	48.1

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Well ID: NFFW-15
Site Name: Willow Grove Naval Base
Well Condition: okay
Site Location:
Gauge Date: 1/15/99
Weather: wet slop
Gauge Time: 10:25
Sounding Method:
Measurement Reference: toc
Stick Up/Down (ft): ~3'
Well Diameter (in.): 4
Purge Date: 1/15/99
Purge Method: 2" submersible - slow purge
Purge Time: 10:40
Sampler's Name: Eddie Meadows

Well Gauging and Tubing Placement

A. Well Depth (ft): 34.5'
C. Screening Interval (ft):
B. Depth to Water (ft): 22.29
D. Depth to tubing intake (ft) 28'

Final Purging and Sampling Data

Total Quantity of Water Removed ~~(gal)~~: ~13.5 L
Samplers: Eddie Meadows
Sampling Date: 1/15/99
Sampling Time: 27 mins
Sample Time: 11:10
Split Sample (Yes or No)? N
If Yes, With Whom? N/A
Comments/Observations: everything was stable except for turbidity - I could not slow the purge rate and as I reached 2' drawdown decided to sample. (or it would cut off)

Well Volume	Time	Depth to Water (ft)	Rate (mL/min)	Volume Purged (mL)	PH	Temperature (°C)	Conductivity (µmhos/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Eh (mV)
Beginning	10.40	22.29	500	0	6.29	15.14	0.191	3.1	3.26	12[illegible].0
1	3	22.66		1500	6.27	15.47	0.226	5.4	4.[illegible]	[illegible].7
2	6	22.94		3000	6.16	15.62	0.221	4.4	3.63	130.3
3	9	23.27		4500	5.92	16.02	0.224	3.9	2.[illegible]2	138.1
4	12	23.81		6000	6.05	16.67	0.237	4.8	2.81	138.7
5	15	24.10		7500	5.98	16.67	0.233	9.6	2.76	142.8
6	18	23.92		9000	5.71	17.22	0.249	19.2	2.11	148.6
7	21	24.13		10500	5.96	17.28	0.248	48.8	1.67	140.4

MWFW-15 (cont.)

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Well Volume	Time	Depth to Water (ft)	Rate (mL/min)	Volume Purged (mL)	PH	Temperature (°C)	Conductivity (µmhos/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Eh (mV)
8	24	24.27	500	12000	6.00	17.01	0.251	127.4	2.52	138.2
9	27	24.34	|	13,500	5.68	16.51	0.2	389.8	2.70	145.9
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FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Well ID: NFFW-17
Site Name: WILLOW GROVE N.A.S.
Well Condition: O.K.
Site Location:
Gauge Date: 1/13/99
Weather:
Gauge Time:
Sounding Method:
Measurement Reference: T.O.C.
Stick Up/Down (ft): 0.5
Well Diameter (in.): 4"
Purge Date: 1/13/99
Purge Method: 2" Submersible
Purge Time:
Sampler's Name: A. McBride

Well Gauging and Tubing Placement

A. Well Depth (ft): 22.40
C. Screening Interval (ft):
B. Depth to Water (ft): 15.07
D. Depth to tubing intake (ft) 21.5'

Final Purging and Sampling Data

Total Quantity of Water Removed (gal):
Samplers: A. McBride
Sampling Date:
Sampling Time:
Sample Time:
Split Sample (Yes or No)?
If Yes, With Whom?
Comments/Observations: Collected Dup-1

Well Volume	Time ΔTIME	Depth to Water (ft)	Rate (mL/min)	Volume Purged (mL)	PH	Temperature (°C)	Conductivity (µmhos/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Eh (mV)
Beginning	1300 START	15.06	400	0	6.79	14.61	492	34.5	6.49	-125.1
1	5 min	15.13	400	2000	6.64	16.73	416	31.8	5.95	-155.6
2	10 min	15.13	400	4,000	6.61	15.43	402	14.5	6.81	-162.3
3	15 min	15.13	400	6,000	6.57	16.38	407	12.0	8.88	-184.8
4	20 min	15.13	400	8,000	6.56	15.40	405	11.6	18.43	-203.3
5	25 min	15.18	400	10,000	6.56	16.88	447	14.2	10.50	-225.1
6	30 min	15.17	400	12,000	6.57	16.80	447	16.8	10.73	-229.6
7	35 min	15.18	400	14,000	6.57	16.78	447	15.9	10.17	-232.4

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Well ID: NFFW-18 (-000)
Site Name: Willow Grove Naval Base
Well Condition: okay
Site Location:
Gauge Date: 1/13/09
Weather:
Gauge Time:
Sounding Method:
Measurement Reference: toc
Stick Up/Down (ft): 3'
Well Diameter (in.): 4
Purge Date: 11/9/09
Purge Method: 2" submersible - slow purge
Purge Time: 16:15
Sampler's Name: Eddie Meadows

Well Gauging and Tubing Placement

A. Well Depth (ft): 28'
C. Screening Interval (ft):
B. Depth to Water (ft): 19.73'
D. Depth to tubing intake (ft) 27.5'

Final Purging and Sampling Data

Total Quantity of Water Removed (~~gal~~): ~15 L
Samplers: Eddie Meadows
Sampling Date: 11/9/09
Sampling Time: 30 mins
Sample Time: 16:45
Split Sample (Yes or No)? N
If Yes, With Whom? N/A
Comments/Observations: turbidity was beginning to go up again when sampling ended.

Well Volume	Time	Depth to Water (ft)	Rate (mL/min)	Volume Purged (mL)	PH	Temperature (°C)	Conductivity (µmhos/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Eh (mV)
Beginning	16:15	19.73	500	0	6.62	13.33	0.799	31.2	2.39	-45.1
1	3	19.75		1500	6.46	14.73	0.803	28.1	1.40	-41.3
2	6	19.76		3000	6.40	14.78	0.801	10.3	1.22	-34.9
3	9	19.76		4500	6.31	14.62	0.799	5.8	1.09	-36.8
4	12	19.76		6000	6.31	14.65	0.800	4.4	1.23	-40.0
5	15	19.76		7500	6.29	14.66	0.799	4.3	1.16	-41.6
6	18	19.76		9000	6.29	14.68	0.801	5.1	1.21	-44.7
7	21	19.76		10500	6.28	14.69	.802	6.7	1.12	-48.8

NFFW-18 (continued)

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Well Volume	Time	Depth to Water (ft)	Rate (mL/min)	Volume Purged (mL)	PH	Temperature (°C)	Conductivity (µmhos/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Eh (mV)
8	24	19.76	500	12000	6.28	14.71	0.805	7.6	1.16	-51.3
9	27	19.76		13500	6.28	14.71	0.807	7.7	1.22	-57.9
10	30	19.76		15000	6.27	14.72	0.809	8.8	1.24	-55.2
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FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Well ID: NFFW-19
Site Name: Willow Grove Naval Base
Well Condition: okay
Site Location:
Gauge Date: 1/13/99
Weather:
Gauge Time: 13:10
Sounding Method:
Measurement Reference: toc
Stick Up/Down (ft): 4'
Well Diameter (in.): 4
Purge Date: 1/13/99
Purge Method: 2" submersible - slow flow
Purge Time: 13:20
Sampler's Name: Eddie Meadows

Well Gauging and Tubing Placement

A. Well Depth (ft): 35'
C. Screening Interval (ft): -
B. Depth to Water (ft): 32.08
D. Depth to tubing intake (ft) 34.5'

Final Purging and Sampling Data

Total Quantity of Water Removed ~~(gal)~~: 10.5 L
Samplers: Eddie Meadows
Sampling Date: 1/13/99
Sampling Time: 21 mins
Sample Time: 13:45
Split Sample (Yes or No)? N
If Yes, With Whom? N/A
Comments/Observations:

Well Volume	Time	Depth to Water (ft)	Rate (mL/min)	Volume Purged (mL)	PH	Temperature (°C)	Conductivity (µmhos/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Eh (mV)
Beginning	13:20	32.08	500	0	8.11	13.93	0.575	809.4	1.98	-75.1
1	3	32.45	500	1500	7.06	15.60	.576	782.2	1.09	[illegible]
2	6	32.81		3000	6.54	[illegible]	.552	251.4	0.69	-70.7
3	9	32.92		4500	6.48	17.52	.547	251.1	0.70	-72.7
4	12	33.07		6000	6.44	18.09	.544	276.1	0.71	-76.8
5	15	33.11		7500	6.47	[illegible]	.543	222.8	0.62	-80.2
6	18	33.20		9000	6.43	18.30	.544	218.3	0.59	-97.7
7	21	33.74		10500	6.34	18.65	.571	205.4	0.56	-104.7

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Well ID: NFFW-20
Site Name: WILLOW GROVE N.A.S.
Well Condition: O.K.
Site Location:
Gauge Date: 1/13/99
Weather: RAIN, 40'S
Gauge Time:
Sounding Method: IFP.
Measurement Reference: T.O.C.
Stick Up/Down (ft): 3.0
Well Diameter (in.): 4"
Purge Date: 1/15/99
Purge Method: 2" SUBMERSIBLE
Purge Time:
Sampler's Name: A McBRIDE

Well Gauging and Tubing Placement

A. Well Depth (ft): 36.96
C. Screening Interval (ft):
B. Depth to Water (ft): 36.42
D. Depth to tubing intake (ft)

Final Purging and Sampling Data

Total Quantity of Water Removed (gal): 0
Samplers: AJM
Sampling Date: 1/15/99
Sampling Time:
Sample Time:
Split Sample (Yes or No)? NO
If Yes, With Whom? —
Comments/Observations: BAILED PRODUCT (.25 GAL) PRIOR TO SAMPLING
- COULD NOT COLLECT SAMPLE AFTER BAILING PRODUCT
ONLY 0.39 ft. WATER IN WELL

Well Volume	Time	Depth to Water (ft)	Rate (mL/min)	Volume Purged (mL)	PH	Temperature (°C)	Conductivity (µmhos/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Eh (mV)
Beginning										
1										
2										
3										
4										
5										
6										
7										

N/A

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Well ID: NFFW-21
Site Name: Willow Grove Naval Base
Well Condition: okay
Site Location:
Gauge Date: 1/15/99
Weather: wet foot
Gauge Time: 11:45
Sounding Method:
Measurement Reference: toc
Stick Up/Down (ft): 3'
Well Diameter (in.): 4
Purge Date: 1/15/99
Purge Method: 2" submersible
Purge Time: 12:03
Sampler's Name: Eddie Meadows

Well Gauging and Tubing Placement

A. Well Depth (ft): 36.5'
C. Screening Interval (ft):
B. Depth to Water (ft): 33.77'
D. Depth to tubing intake (ft) 35.5'

Final Purging and Sampling Data

Total Quantity of Water Removed (~~gal~~): 21 L
Samplers: Eddie Meadows
Sampling Date: 1/15/99
Sampling Time: 42 mins
Sample Time: 12:45
Split Sample (Yes or No)? N
If Yes, With Whom? N/A
Comments/Observations: would have been done in 15 mins except for that turbidity thing! - Even w/ the 3 foot turbidity readings being okay, it should be noted that it jumped anywhere in between 400 & 1200 just in between readings. Maybe it's the YSI probe.

Well Volume	Time	Depth to Water (ft)	Rate (mL/min)	Volume Purged (mL)	PH	Temperature (°C)	Conductivity (µmhos/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Eh (mV)
Beginning	12:03	33.77	500	0	5.55	13.14	0.510	164.7	4.92	[illegible]
1	3	33.79		1500	5.59	13.50	0.510	117.4	4.40	198.7
2	6	33.85		3000	5.65	14.22	0.511	51.6	5.35	188.9
3	9	33.86		4500	5.70	14.87	0.510	13.4	4.41	182.6
4	12	33.88		6000	5.75	14.96	0.511	4.9	4.52	178.9
5	15	33.89		7500	5.73	14.91	0.513	3.2	4.31	181.2
6	18	33.91		9000	5.67	14.85	0.515	12.2	3.84	185.6
7	21	33.92		10500	5.72	14.93	0.517	169.3 what?	4.52	185.3

NFFW-21 (cont.)

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Well Volume	Time	Depth to Water (ft)	Rate (mL/min)	Volume Purged (mL)	PH	Temperature (°C)	Conductivity (µmhos/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Eh (mV)
8	24	33.92	500	12000	5.73	14.82	0.517	196.7	4.42	185.1
9	27	33.94		13500	5.72	14.89	0.518	255.7	4.37	186.8
10	30	33.96		15000	5.72	14.89	0.519	436.4	4.58	187.0
11	33	33.96		16500	5.69	14.93	0.520	491.7	3.82	187.1
12	36	33.98		18000	5.72	14.91	0.521	600.6	3.90	184.6
13	39	33.99		19500	5.74	14.88	0.521	551.0	4.01	180.4
14	42	34.01		21000	5.68	14.97	0.521	598.3	4.38	175.5
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APPENDIX C

LABORATORY ANALYTICAL RESULTS

LABORATORY DATA REPORT

Prepared for:

EA Engineering, Science, and Technology, Inc.
Willow Grove

Prepared by:

EA Laboratories
19 Loveton Circle
Sparks, Maryland 21152

Report 990027

February 1999

EA Laboratories

19 Loveton Circle
Sparks, MD 21152
Telephone: 410-771-4920
Fax: 410-771-4407

5 February 1999

Mr. Carl G. Reitenbach
EA Engineering, Science, & Technology, Inc.
15 Loveton Circle
Sparks, MD 21152

Re: Willow Grove (29600.74)

Dear Mr. Reitenbach:

Enclosed is our report on the analysis of 16 water samples collected for the Willow Grove project on 13 and 15 January 1999. The invoice is included.

Please contact me if you have any questions or require further information and refer to report 990027. Unless other arrangements are made, we reserve the right to dispose of your samples sixty (60) days from the date of this letter. We will retain the raw data for seven years from this date.

Sincerely,

Michael J. Walsh
Laboratory Project Manager

enclosure

1. NARRATIVE

EA LABORATORIES
ANALYTICAL NARRATIVE

Client: **EA Eng., Sci., and Tech.,Inc.**
Site: **Willow Grove**
Project number: **29600.74**

EA Laboratories Report: **990027**
Laboratory Project Manager: **Michael J. Walsh**
Report Date: **5 February 1999**

This report contains the results of the analysis of 16 water samples collected on 13 and 15 January 1999 in support of the referenced project.

SAMPLE RECEIPT

The samples and two field blanks arrived by Federal Express at EA Laboratories on 16 January 1999. Upon receipt, the samples and blanks were inspected and compared with the chain-of-custody records. The samples and blanks were then logged into the laboratory computer system with an assigned laboratory accession number and released for analysis.

Client Sample Designation	EA Lab Number
FIELD BLANK	9900159
FIELD BLANK	9900160
NFFW-16	9900161
NFFW-05	9900162
NFFW-14	9900163
NFFW-12	9900164
NFFW-01	9900165
DUP3	9900166
DUP4	9900167
NFFW-10	9900168
NFFW-21	9900169
NFFW-15	9900170
NFFW-19	9900171
NFFW-08	9900172
NFFW-18	9900173
NFFW-17	9900174
DUP1	9900175
DUP2	9900176
TRIP BLANK	9900177

Following this narrative section is a glossary of data qualifiers (Table 1) and the original chain-of-

custody records. Analytical results and quality control information are summarized in the appended data package which has been formatted to be consistent with the deliverable requirements of this project.

QUALITY CONTROL

The following sections are ordered as the data appears in this report. They contain observations made during sample analysis, summarize the results of quality control measurements, and address the impact on data usability based upon project Data Quality Objectives. For each fractional analysis the narrative includes:

- Sample chronology: This section summarizes the sample history by fraction including the sample preparation method and date, analytical method, and analysis date. Anything unusual about the samples, digestates, or extracts is identified. Holding time compliance is evaluated in this section.

- Laboratory method performance: All quality control criteria for method performance must be met for all target analytes for data to be reported. These criteria generally apply to instrument tune, calibration, method blanks, and Laboratory Control Samples (LCS). In some instances where method criteria fail, useable data can be obtained and are reported with client approval. The narrative will then include a thorough discussion of the impact on data quality.

- Sample performance: Quality control field samples are analyzed to determine any measurement bias due to the sample matrix based on evaluation of matrix spikes (MS), matrix spike duplicates (MSD), and laboratory duplicates (D). If acceptance criteria are not met, matrix interferences are confirmed either by reanalysis or by inspection of the LCS results to verify that laboratory method performance is in control. Data are reported with appropriate qualifiers or discussion.

AROMATIC VOLATILES by GC - WATER (EA9900159 - EA9900177)

Sample Chronology: Nineteen samples and associated quality control were analyzed on 26 and 27 January 1999 for benzene, toluene, ethylbenzene, and xylenes (BTEX) plus naphthalene by USEPA SW-846 Methods 5030/8020. All holding times were met.

EA LABORATORIES
ANALYTICAL NARRATIVE

Client: **EA Eng., Sci., and Tech.,Inc.**
Site: **Willow Grove**
Project number: **29600.74**

EA Laboratories Report: **990027**
Laboratory Project Manager: **Michael J. Walsh**
Report Date: **5 February 1999**

Sample NFFW-14 was analyzed at a 2X dilution in order to bring the concentrations of target analytes within instrument calibration range. Sample NFFW-16 was analyzed at a 5X dilution.

Laboratory Method Performance: All laboratory method performance criteria were met for the reported samples.

Sample Performance: All quality control criteria were met for the reported samples.

CERTIFICATION OF RESULTS

The Laboratory certifies that this report meets the project requirements for analytical data as stated in the Analytical Task Order (ATO) and the chain-of-custody. In addition, the Laboratory certifies that the data as reported meet the Data Quality Objectives for precision, accuracy, and completeness specified for this project or as stated in EA Laboratories Quality Assurance program for other than the conditions detailed above. It is recommended by the Laboratory that this analytical report should only be reproduced in its entirety. EA Laboratories is not responsible for any assumptions of data quality if partial packages are used to interpret data. Release of the data contained in this report as been authorized by the appropriate Laboratory Manager as verified by the following signature.

Michael J. Walsh 5 February 1999
Michael J. Walsh, Laboratory Project Manager

TABLE 1. LABORATORY ORGANIC ANALYSIS DATA QUALIFIERS [1]

Qualifiers other than those listed below may be required to properly define the results. If used, they are given an alphabetic designation not already specified in this table or in a project/program document. such as a Quality Assurance Project Plan or a contract Statement of Work. Each additional qualifier is fully described in the Analytical Narrative section of the laboratory report.

U Indicates a target compound was analyzed for but not detected. The sample Reporting Limit (RL) is corrected for dilution and, if a soil sample, for percent moisture, if reported on a dry weight basis.

J Indicates an estimated value. This qualifier is used under the following circumstances:

1) when estimating a concentration for tentatively identified compounds (TICs) in GC/MS analyses, where a 1:1 response is assumed,
2) when the mass spectral and retention time data indicate the presence of a compound that meets the volatile and semivolatile GC/MS identification criteria, and the result is less than the RL but greater than the method detection limit (MDL).

B This qualifier is used when the analyte is found in the associated method blank as well as in the sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action. For GC/MS analyses, this qualifier is used for a TIC, as well as, for a positively identified target compound.

E This qualifier identifies compounds whose concentrations exceed the calibration range of the instrument for that specific analysis.

D When applied, this qualifier identifies all compound concentrations reported from a secondary dilution analysis.

A This qualifier indicates that a TIC is a suspected aldol-condensation product.

N Indicates presumptive evidence of a compound. This qualifier is only used for GC/MS TICs, where the identification is based on a mass spectral library search. For generic characterization of a TIC, such as chlorinated hydrocarbon, the N qualifier is not used.

P When applied, this qualifier indicates a reported value from a GC analysis when there is greater than 25% difference for detected concentrations between the two GC columns.

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(1) These Data Qualifiers are added by the laboratory to provide additional information for the reported results. ***They should not be confused with the qualifiers applied to the reported data as a result of a data validation process performed independently of the laboratory reporting procedure.***

2. CHAIN-OF-CUSTODY

Chain of Custody Record

EA Laboratories
19 Loveton Circle
Sparks, MD 21152
Telephone: (410) 771-4920
Fax: (410) 771-4407

Company Name: EA

Project Manager or Contact: Carl Reitenbach
Phone: x5167

Project No. 29600074

Project Name: Willow Grove Naval Base

Dept.: 2121 Task: 4220

Sample Storage Location: VOA 10

ATO Number:

Page 2 of 1 of 1

Report #: 990027

Report Deliverables: 1 (2) 3 4 (D) E

EDD: Yes/(No)

DUE TO CLIENT: 2-6-99

Parameters/Method Numbers for Analysis: BTEX 8020; Naphthalene 8020

Date	Time	Water	Soil	Sample Identification 19 Characters	No. of Containers	BTEX 8020	Naphthalene 8020	EA Labs Accession Number	Remarks
1/15/99	12:30	X		FIELD BLANK	3	X	X	9900159	LPM: MJW
	16:00			FIELD BLANK	3	X	X	9900160	EAL-PS-090
	12:45			NFFW-116	3	X	X	9900161	
	14:05			NFFW-015	3	X	X	9900162	
	13:00			NFFW-114	3	X	X	9900163	
	12:10			NFFW-112	3	X	X	9900164	
	10:55			NFFW-011	3	X	X	9900165	
	X			DUP3	3	X	X	9900166	
	X			DUP4	3	X	X	9900167	
	9:50			NFFW-110	3	X	X	9900168	L15442
	12:45			NFFW-121	3	X	X	9900169	
	11:10			NFFW-115	3	X	X	9900170	
	13:45			NFFW-119	3	X	X	9900171	
	15:30			NFFW-108	3	X	X	9900172	
									0000004534
									56 vers

Sampled by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
Sadie Meadows	1/15/99 17:00	Sadie Meadows	1/15/99 1900	[signature]	1/15/99 1840
Relinquished by: (Signature)	**Date/Time**	**Received by Laboratory: (Signature)**	**Date/Time**	**Airbill Number:**	
		[signature]	1/16/99 1100		

Cooler Temp. 20 C pH: ☐ Yes ☐ No Comments: Custody Seals Intact ☐ Yes ☐ No

Sample Shipped by: (Circle) Fed Ex. Puro. UPS Hand Carried Other:

NOTE: Please indicate method number for analyses requested. This will help clarify any questions with laboratory techniques.

WHITE—EA Laboratories YELLOW—EA Laboratories PINK—Project Manager *Shaded Areas for Lab Use Only*

Chain of Custody Record

EA Laboratories
19 Loveton Circle
Sparks, MD 21152
Telephone: (410) 771-4920
Fax: (410) 771-4407

Company Name: EA

Project Manager or Contact: Carl Reitenbach
Phone: x5107

Project No. 2960074

Project Name: Willow Grove Naval Base

Dept.: 2121 Task: 4220

Sample Storage Location: VOA 10

ATO Number:

Page 2 of 2 Report #: 9900027

Report Deliverables: 1 (2) 3 4 (D) E

EDD: Yes/(No)

DUE TO CLIENT: 2-6-99

Parameters/Method Numbers for Analysis: BTEX 8020; Naphthalene 8020

Date	Time	Water	Soil	Sample Identification 19 Characters	No. of Containers	BTEX 8020	Naphthalene 8020	EA Labs Accession Number	Remarks
1/13/99	16:45	X		NFFW-118	3	X	X	9900173	LPM: MJW
	15:45			NFFW-117	3	X	X	9900174	EAL-PS-090
	15:20			NFFW-08	3				
	13:45			NFFW-19	3				
				DUP1	3	X	X	9900175	
				DUP2	3	X	X	9900176	
		—		TRIP BLANK	~~3~~ 2	X	X	9900177	

Didn't arrive

Sampled by: (Signature) Sedric Meadows — Date/Time 1/15/99 1840

Relinquished by: (Signature) Sedric Meadows — Date/Time 1/15/99 1840

Received by: (Signature) [signature] — Date/Time 1/15/99 1840

Relinquished by: (Signature) — Date/Time

Received by Laboratory: (Signature) [signature] — Date/Time 1/16/99 1100

Airbill Number:

Sample Shipped by: (Circle) Fed Ex. Puro. UPS Hand Carried Other:

Cooler Temp. 2° C pH: Yes No Comments: Custody Seals Intact Yes No

NOTE: Please indicate method number for analyses requested. This will help clarify any questions with laboratory techniques.

WHITE—EA Laboratories [redacted] YELLOW—EA Laboratories [redacted] PINK—Project Manager [redacted] Shaded Areas for Lab Use Only

3. BTEX DATA

A. QC Summary

3A-LCS
WATER VOLATILE LABORATORY CONTROL SAMPLE RECOVERY

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW GI Method: 8020 LCS#: VL901266

COMPOUND	SPIKE ADDED (ug/L)	LCS CONCENTRATION (ug/L)	LCS % REC #	REC.
Benzene	50	49	98	(87-121)
Toluene	50	48	96	(81-125)
Chlorobenzene	50	52	104	(81-133)

Column to be used to flag recovery with an asterisk

* Values outside of QC limits

Comments:

3A-LCS
WATER VOLATILE LABORATORY CONTROL SAMPLE RECOVERY

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW GI Method: 8020 LCS#: VL901273

COMPOUND	SPIKE ADDED (ug/L)	LCS CONCENTRATION (ug/L)	LCS % REC #	REC.
Benzene	50	52	104	(87-121)
Toluene	50	53	106	(81-125)
Chlorobenzene	50	53	106	(81-133)

Column to be used to flag recovery with an asterisk

* Values outside of QC limits

Comments:

4A

VOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.

VBLK01

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW GROVE Method: 8020 SDG No.:

Lab File ID: VB2A5759.D Lab Sample ID: VB901266

Date Analyzed: 1/26/99 Time Analyzed: 2015

GC Column: DB-VRX ID: 0.45 (mm) Heated Purge: (Y/N) N

Instrument ID: VB2

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
01	VLCS01	VL901266	VB2A5758.D	1939
02	FIELD BLANK	#9900160	VB2A5761.D	2127
03	TRIP BLANK	#9900177	VB2A5762.D	2202
04	NFFW-05	#9900162	VB2A5764.D	2314
05	NFFW-05MS	#9900162MS	VB2A5765.D	2350
06	NFFW-05MSD	#9900162MSD	VB2A5766.D	0025
07	NFFW-12	#9900164	VB2A5770.D	0248
08	NFFW-01	#9900165	VB2A5771.D	0324
09	DUP3	#9900166	VB2A5773.D	0435
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COMMENTS:

FORM IV VOA

4A

VOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.

VBLK02

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW GROVE Method: 8020 SDG No.:

Lab File ID: VB2A5778.D Lab Sample ID: VB901273

Date Analyzed: 1/27/99 Time Analyzed: 1151

GC Column: DB-VRX ID: 0.45 (mm) Heated Purge: (Y/N) N

Instrument ID: VB2

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
01	VLCS02	VL901273	VB2A5779.D	1227
02	DUP4	#9900167	VB2A5780.D	1303
03	NFFW-10	#9900168	VB2A5781.D	1339
04	NFFW-21	#9900169	VB2A5782.D	1415
05	NFFW-15	#9900170	VB2A5783.D	1451
06	NFFW-19	#9900171	VB2A5784.D	1528
07	NFFW-08	#9900172	VB2A5785.D	1604
08	NFFW-18	#9900173	VB2A5786.D	1640
09	NFFW-17	#9900174	VB2A5787.D	1716
10	DUP1	#9900175	VB2A5790.D	1904
11	DUP2	#9900176	VB2A5791.D	1940
12	NFFW-10MS	#9900168MS	VB2A5792.D	2016
13	NFFW-10MSD	#9900168MSD	VB2A5793.D	2052
14	FIELD BLANK	#9900159	VB2A5794.D	2128
15	NFFW-16DL	#9900161DL	VB2A5795.D	2204
16	NFFW-14DL	#9900163DL	VB2A5796.D	2240
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COMMENTS:

FORM IV VOA

B. Sample Data

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

Client ID No.
FIELD BLANK

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW GI Method: 8020 SDG No.:

Matrix: (soil/water) WATER Lab Sample ID: #9900159

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VB2A5794.D

Level: (low/med) Date Sampled: 1/15/99

% Moisture: not dec. 0 Date Analyzed: 1/27/99

GC Column: DB-VRX ID: 0.45 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/L	Q
71-43-2	Benzene	1	U
108-88-3	Toluene	1	U
100-41-4	Ethylbenzene	1	U
	m&p-Xylenes	1	U
95-47-6	o-Xylene	1	U
91-20-3	Naphthalene	5	U

FORM I VOA

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

Client ID No.
FIELD BLANK

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW GI Method: 8020 SDG No.:

Matrix: (soil/water) WATER Lab Sample ID: #9900160

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VB2A5761.D

Level: (low/med) Date Sampled: 1/15/99

% Moisture: not dec. 0 Date Analyzed: 1/26/99

GC Column: DB-VRX ID: 0.45 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/L	Q
71-43-2	Benzene	1	U
108-88-3	Toluene	1	U
100-41-4	Ethylbenzene	1	U
	m&p-Xylenes	1	U
95-47-6	o-Xylene	1	U
91-20-3	Naphthalene	5	U

FORM I VOA

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

Client ID No.
NFFW-16

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW G Method: 8020 SDG No.:

Matrix: (soil/water) WATER Lab Sample ID: #9900161

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VB2A5795.D

Level: (low/med) Date Sampled: 1/15/99

% Moisture: not dec. 0 Date Analyzed: 1/27/99

GC Column: DB-VRX ID: 0.45 (mm) Dilution Factor: 5.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/L	Q
71-43-2	Benzene	290	
108-88-3	Toluene	36	
100-41-4	Ethylbenzene	260	
	m&p-Xylenes	110	
95-47-6	o-Xylene	27	
91-20-3	Naphthalene	190	

FORM I VOA

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

Client ID No.
NFFW-05

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW GI Method: 8020 SDG No.:

Matrix: (soil/water) WATER Lab Sample ID: #9900162

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VB2A5764.D

Level: (low/med) Date Sampled: 1/15/99

% Moisture: not dec. 0 Date Analyzed: 1/26/99

GC Column: DB-VRX ID: 0.45 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Concentration Units: (ug/L or ug/Kg) ug/L

CAS No.	Compound		Q
71-43-2	Benzene	1	U
108-88-3	Toluene	1	U
100-41-4	Ethylbenzene	1	U
	m&p-Xylenes	1	U
95-47-6	o-Xylene	1	U
91-20-3	Naphthalene	5	U

FORM I VOA

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

Client ID No.
NFFW-14

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW G Method: 8020 SDG No.: _____

Matrix: (soil/water) WATER Lab Sample ID: #9900163

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VB2A5796.D

Level: (low/med) _____ Date Sampled: 1/15/99

% Moisture: not dec. 0 Date Analyzed: 1/27/99

GC Column: DB-VRX ID: 0.45 (mm) Dilution Factor: 2.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/L	Q
71-43-2	Benzene	220	
108-88-3	Toluene	17	
100-41-4	Ethylbenzene	150	
	m&p-Xylenes	43	
95-47-6	o-Xylene	17	
91-20-3	Naphthalene	120	

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1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

Client ID No.
NFFW-12

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW GI Method: 8020 SDG No.:

Matrix: (soil/water) WATER Lab Sample ID: #9900164

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VB2A5770.D

Level: (low/med) Date Sampled: 1/15/99

% Moisture: not dec. 0 Date Analyzed: 1/27/99

GC Column: DB-VRX ID: 0.45 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/L	Q
71-43-2	Benzene	22	
108-88-3	Toluene	27	
100-41-4	Ethylbenzene	19	
	m&p-Xylenes	10	
95-47-6	o-Xylene	61	
91-20-3	Naphthalene	53	

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Client ID No.
NFFW-01

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW GI Method: 8020 SDG No.:

Matrix: (soil/water) WATER Lab Sample ID: #9900165

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VB2A5771.D

Level: (low/med) Date Sampled: 1/15/99

% Moisture: not dec. 0 Date Analyzed: 1/27/99

GC Column: DB-VRX ID: 0.45 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Concentration Units: (ug/L or ug/Kg) ug/L

CAS No.	Compound		Q
71-43-2	Benzene	5	
108-88-3	Toluene	6	
100-41-4	Ethylbenzene	7	
	m&p-Xylenes	4	
95-47-6	o-Xylene	9	
91-20-3	Naphthalene	11	

FORM I VOA

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

Client ID No.
DUP3

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW GI Method: 8020 SDG No.:

Matrix: (soil/water) WATER Lab Sample ID: #9900166

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VB2A5773.D

Level: (low/med) Date Sampled: 1/15/99

% Moisture: not dec. 0 Date Analyzed: 1/27/99

GC Column: DB-VRX ID: 0.45 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/L	Q
71-43-2	Benzene	1	U
108-88-3	Toluene	1	U
100-41-4	Ethylbenzene	1	U
	m&p-Xylenes	1	U
95-47-6	o-Xylene	1	U
91-20-3	Naphthalene	5	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Client ID No.: DUP4

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW GI Method: 8020 SDG No.: _____

Matrix: (soil/water) WATER Lab Sample ID: #9900167

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VB2A5780.D

Level: (low/med) _____ Date Sampled: 1/15/99

% Moisture: not dec. 0 Date Analyzed: 1/27/99

GC Column: DB-VRX ID: 0.45 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Concentration Units: (ug/L or ug/Kg) ug/L

CAS No.	Compound		Q
71-43-2	Benzene	10	
108-88-3	Toluene	7	
100-41-4	Ethylbenzene	5	
	m&p-Xylenes	3	
95-47-6	o-Xylene	6	
91-20-3	Naphthalene	10	

FORM I VOA

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

Client ID No.
NFFW-10

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW GI Method: 8020 SDG No.:

Matrix: (soil/water) WATER Lab Sample ID: #9900168

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VB2A5781.D

Level: (low/med) Date Sampled: 1/15/99

% Moisture: not dec. 0 Date Analyzed: 1/27/99

GC Column: DB-VRX ID: 0.45 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/L	Q
71-43-2	Benzene	1	U
108-88-3	Toluene	1	U
100-41-4	Ethylbenzene	1	U
	m&p-Xylenes	1	U
95-47-6	o-Xylene	1	U
91-20-3	Naphthalene	5	U

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1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

Client ID No.
NFFW-21

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW GI Method: 8020 SDG No.:

Matrix: (soil/water) WATER Lab Sample ID: #9900169

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VB2A5782.D

Level: (low/med) Date Sampled: 1/15/99

% Moisture: not dec. 0 Date Analyzed: 1/27/99

GC Column: DB-VRX ID: 0.45 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Concentration Units: (ug/L or ug/Kg) ug/L

CAS No.	Compound		Q
71-43-2	Benzene	1	U
108-88-3	Toluene	1	U
100-41-4	Ethylbenzene	1	U
	m&p-Xylenes	1	U
95-47-6	o-Xylene	1	U
91-20-3	Naphthalene	5	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Client ID No.
NFFW-15

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW GI Method: 8020 SDG No.:

Matrix: (soil/water) WATER Lab Sample ID: #9900170

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VB2A5783.D

Level: (low/med) Date Sampled: 1/15/99

% Moisture: not dec. 0 Date Analyzed: 1/27/99

GC Column: DB-VRX ID: 0.45 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/L	Q
71-43-2	Benzene	1	U
108-88-3	Toluene	1	U
100-41-4	Ethylbenzene	1	U
	m&p-Xylenes	1	U
95-47-6	o-Xylene	1	U
91-20-3	Naphthalene	5	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Client ID No.
NFFW-19

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW GI Method: 8020 SDG No.:

Matrix: (soil/water) WATER Lab Sample ID: #9900171

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VB2A5784.D

Level: (low/med) Date Sampled: 1/15/99

% Moisture: not dec. 0 Date Analyzed: 1/27/99

GC Column: DB-VRX ID: 0.45 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/L	Q
71-43-2	Benzene	4	
108-88-3	Toluene	1	U
100-41-4	Ethylbenzene	15	
	m&p-Xylenes	22	
95-47-6	o-Xylene	3	
91-20-3	Naphthalene	22	

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Client ID No.
NFFW-08

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW GI Method: 8020 SDG No.:

Matrix: (soil/water) WATER Lab Sample ID: #9900172

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VB2A5785.D

Level: (low/med) Date Sampled: 1/15/99

% Moisture: not dec. 0 Date Analyzed: 1/27/99

GC Column: DB-VRX ID: 0.45 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/L	Q
71-43-2	Benzene	6	
108-88-3	Toluene	1	U
100-41-4	Ethylbenzene	1	U
	m&p-Xylenes	2	
95-47-6	o-Xylene	1	U
91-20-3	Naphthalene	5	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Client ID No.
NFFW-18

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW GI Method: 8020 SDG No.:

Matrix: (soil/water) WATER Lab Sample ID: #9900173

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VB2A5786.D

Level: (low/med) Date Sampled: 1/13/99

% Moisture: not dec. 0 Date Analyzed: 1/27/99

GC Column: DB-VRX ID: 0.45 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/L	Q
71-43-2	Benzene	2	
108-88-3	Toluene	1	U
100-41-4	Ethylbenzene	1	U
	m&p-Xylenes	1	U
95-47-6	o-Xylene	1	U
91-20-3	Naphthalene	5	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Client ID No.
NFFW-17

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW GI Method: 8020 SDG No.:

Matrix: (soil/water) WATER Lab Sample ID: #9900174

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VB2A5787.D

Level: (low/med) Date Sampled: 1/13/99

% Moisture: not dec. 0 Date Analyzed: 1/27/99

GC Column: DB-VRX ID: 0.45 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/L	Q
71-43-2	Benzene	9	
108-88-3	Toluene	3	
100-41-4	Ethylbenzene	2	
	m&p-Xylenes	1	
95-47-6	o-Xylene	1	U
91-20-3	Naphthalene	17	

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Client ID No.: DUP1

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW GI Method: 8020 SDG No.:

Matrix: (soil/water) WATER Lab Sample ID: #9900175

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VB2A5790.D

Level: (low/med) Date Sampled: 1/13/99

% Moisture: not dec. 0 Date Analyzed: 1/27/99

GC Column: DB-VRX ID: 0.45 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Concentration Units: (ug/L or ug/Kg) ug/L

CAS No.	Compound		Q
71-43-2	Benzene	9	
108-88-3	Toluene	3	
100-41-4	Ethylbenzene	2	
	m&p-Xylenes	3	
95-47-6	o-Xylene	1	U
91-20-3	Naphthalene	18	

FORM I VOA

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Client ID No.: DUP2

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW GI Method: 8020 SDG No.:

Matrix: (soil/water) WATER Lab Sample ID: #9900176

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VB2A5791.D

Level: (low/med) Date Sampled: 1/13/99

% Moisture: not dec. 0 Date Analyzed: 1/27/99

GC Column: DB-VRX ID: 0.45 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/L	Q
71-43-2	Benzene	2	
108-88-3	Toluene	1	U
100-41-4	Ethylbenzene	1	U
	m&p-Xylenes	1	U
95-47-6	o-Xylene	1	U
91-20-3	Naphthalene	5	U

FORM I VOA

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

Client ID No.
TRIP BLANK

Lab Name: EA LABORATORIES Report#: 990027

Lab Code: EA ENG Client: WILLOW GI Method: 8020 SDG No.:

Matrix: (soil/water) WATER Lab Sample ID: #9900177

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: VB2A5762.D

Level: (low/med) Date Sampled: 1/13/99

% Moisture: not dec. 0 Date Analyzed: 1/26/99

GC Column: DB-VRX ID: 0.45 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Concentration Units: (ug/L or ug/Kg) ug/L

CAS No.	Compound		Q
71-43-2	Benzene	1	U
108-88-3	Toluene	1	U
100-41-4	Ethylbenzene	1	U
	m&p-Xylenes	1	U
95-47-6	o-Xylene	1	U
91-20-3	Naphthalene	5	U

FORM I VOA

APPENDIX D

VAPOR RECOVERY AND TREATMENT SYSTEM COST ANALYSIS

Project Willow Grove — Project No. 29600.79.7200
Subject Thermal Oxidizer Fuel Consumption — Sheet No. 1 of 8
Drawing No.
Computed by: MK — Date 2/26/99 — Checked by CR — Date 4/28/99

Capital Costs: (Approximate)
- $15,000 to upgrade to 100 SCFM Blower
- $7,000 to upgrade to catalytic op.

Assumptions:
- AT 25 SCFM from RWs, PPMV = 500
- AT 100 SCFM from RWs, PPMV = 300

Calcs:
25 SCFM @ 500 PPMV mixed with 75 SCFM of ambient becomes 100 SCFM @ 125 PPMV

Assume:
- Thermal Oxidizer requires 100 SCFM. If blower supplies less the rest must be made up with ambient air.
- 90,000 BTU/gal of Propane

1st: Thermal operation w/ 50% efficient Heat Exchanger (B)

A w/ 25 SCFM @ 500 PPMV + 75 SCFM Ambient or 100 SCFM @ 125 PPMV
Oxidizer requires 1060 BTU/SCFM/HR

$$1060 \frac{BTU}{SCFM \cdot Hr} \times 100\ SCFM \times \frac{gal}{90{,}000\ BTU} = 1.17 \frac{gal}{Hr}$$

B w/ 100 SCFM @ 300 PPMV
Oxidizer requires 1030 BTU/SCFM/HR

$$1030 \frac{BTU}{SCFM \cdot Hr} \times 100\ SCFM \times \frac{gal}{90{,}000\ BTU} = \frac{1.14\ gal}{Hr}$$

C w/ 100 SCFM @ 500 PPMV
Oxidizer requires 980 BTU/SCFM/Hr

$$980 \frac{BTU}{SCFM \cdot Hr} \times 100 \times \frac{gal}{90{,}000\ BTU} = 1.08 \frac{gal}{Hr}$$

Project _____ Project No. 2960074.7200
Subject Thermal Oxidizer Fuel Sheet No. 2 of 8
Drawing No. _____
Computed by: MK Date 2/28/99 Checked by CR Date 4/28/99

2nd: Catalytic Operation W/ Heat Exchanger

A W/ 25 SCFM @ 500 PPMV + 75 SCFM Ambient
1.17 gal/Hr

D W/ 25 SCFM @ 500 PPMV + 75 SCFM Ambient
100 SCFM @ 125 PPMV
Catalytic requires 380 BTU/SCFM/Hr

$380 \frac{BTU}{SCFM \cdot Hr} \times 100\ SCFM \times \frac{gal}{90{,}000\ BTU} = 0.42\ gal/Hr$

E W/ 100 SCFM @ 300 PPMV
Catalytic requires 350 BTU/SCFM/Hr

$350 \times 100 \times \frac{1}{90{,}000} = 0.39 \frac{gal}{Hr}$

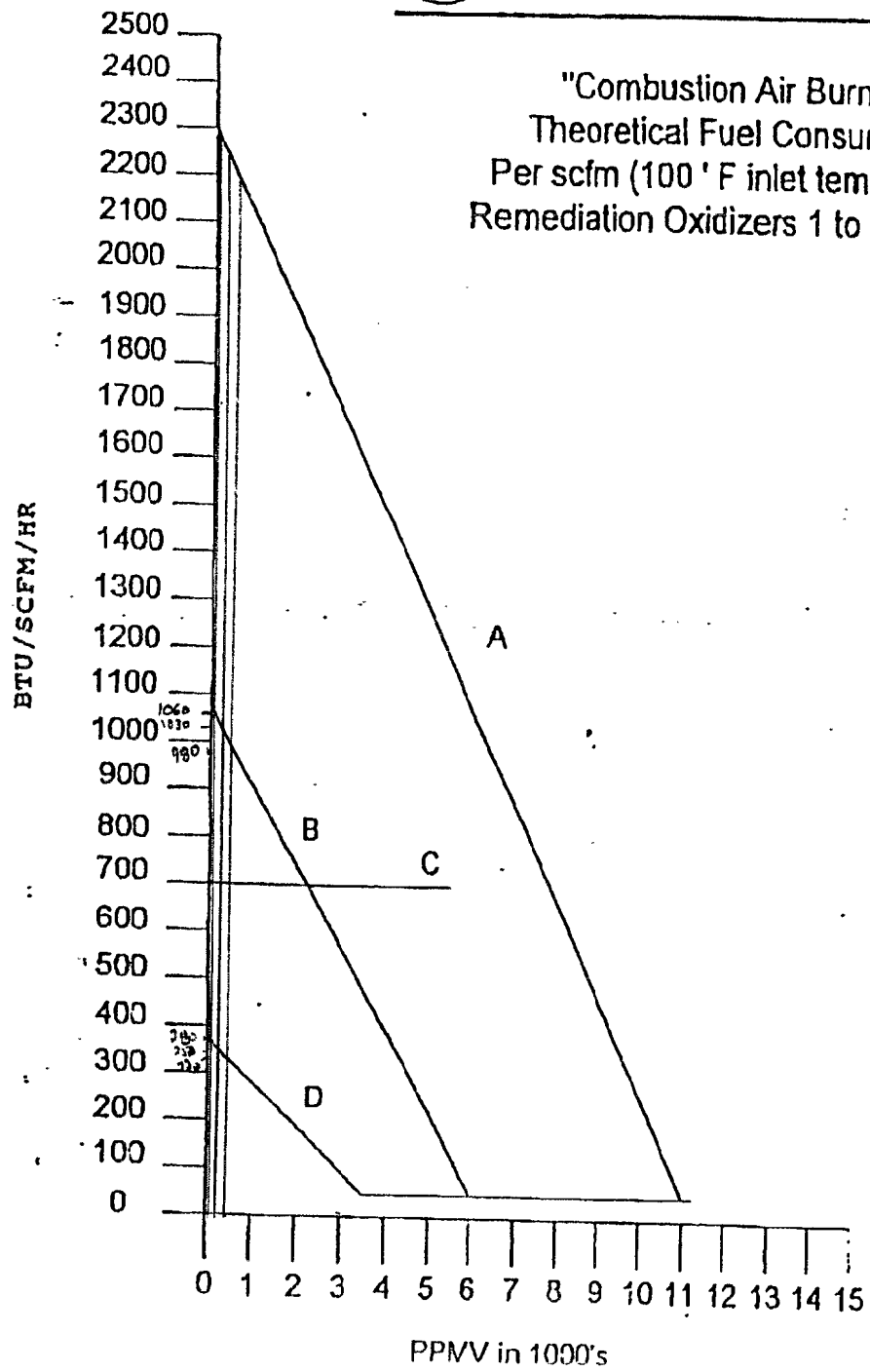
F W/ 100 SCFM @ 500 PPMV
Catalytic requires 330 BTU/SCFM/Hr

$330 \times 100 \times \frac{1}{90{,}000} = 0.37\ gal/Hr$

Note: Pay off period is dependent on price of propane. Current propane costs are $0.75/gal. See the following graphs for the pay off period for gas prices from $0.50 to $1.50/gal. (Sheets 4-9)

THERMTECH, INC.

"Combustion Air Burners"
Theoretical Fuel Consumption
Per scfm (100 ' F inlet temperature)
Remediation Oxidizers 1 to 1500 scfm



Process Stream

PPMV	Lbs/Hr/scfm
15000	0.158
14000	0.147
13000	0.137
12000	0.126
11000	0.116
10000	0.105
9000	0.094
8000	0.084
7000	0.074
6000	0.063
5000	0.053
4000	0.042
3000	0.032
2000	0.021
1000	0.011
0	0.000

18,500 BTU/LB

The higher the process stream concentrations the less fuel you need to purchase

A = Thermal Operation
B = Thermal Operation W/50% Efficient Heat Exchanger
C = Catalytic Operation (600'F Lite-off Temperature)
D = Catalytic Operation W/Heat Exchanger

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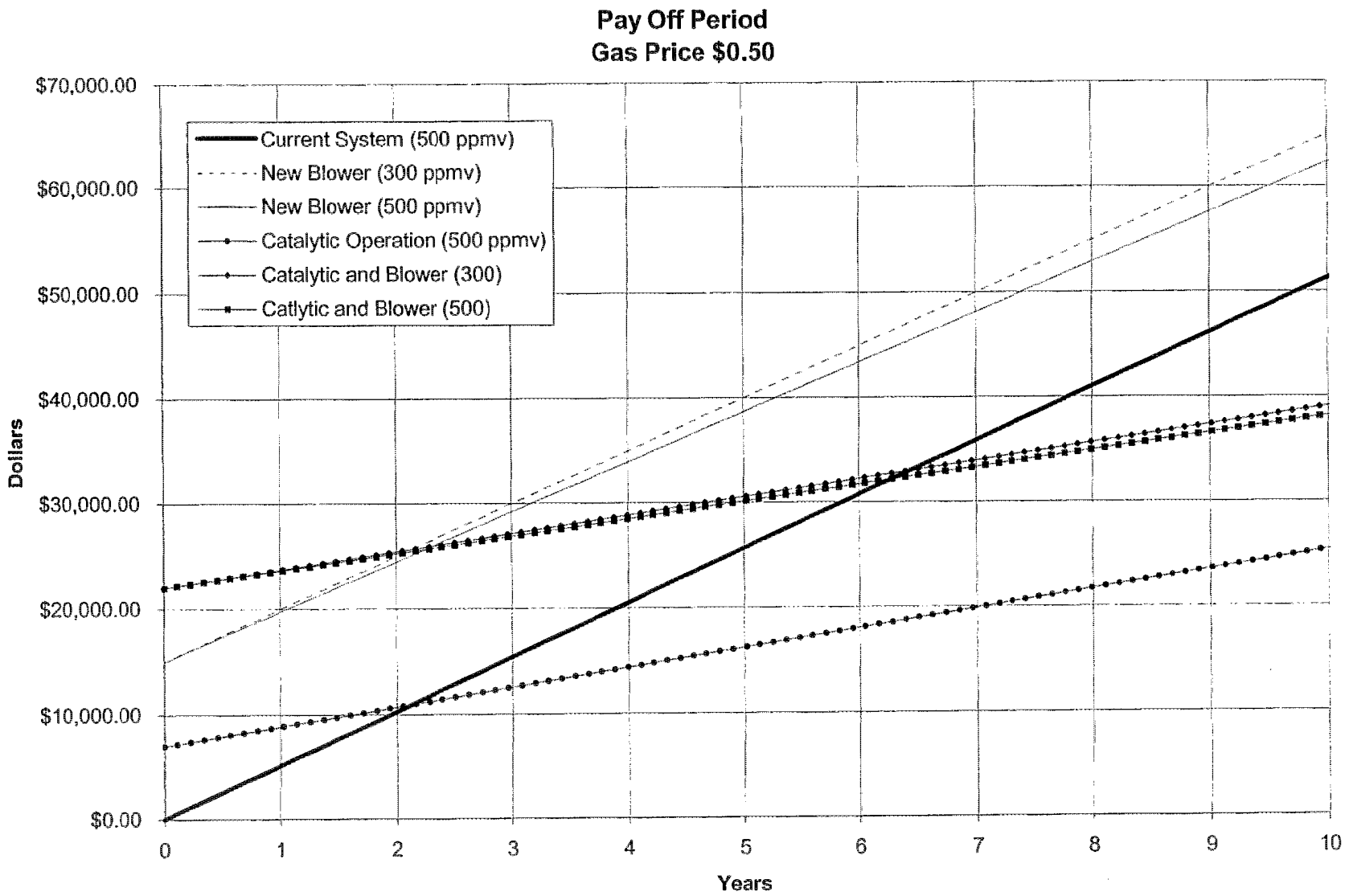
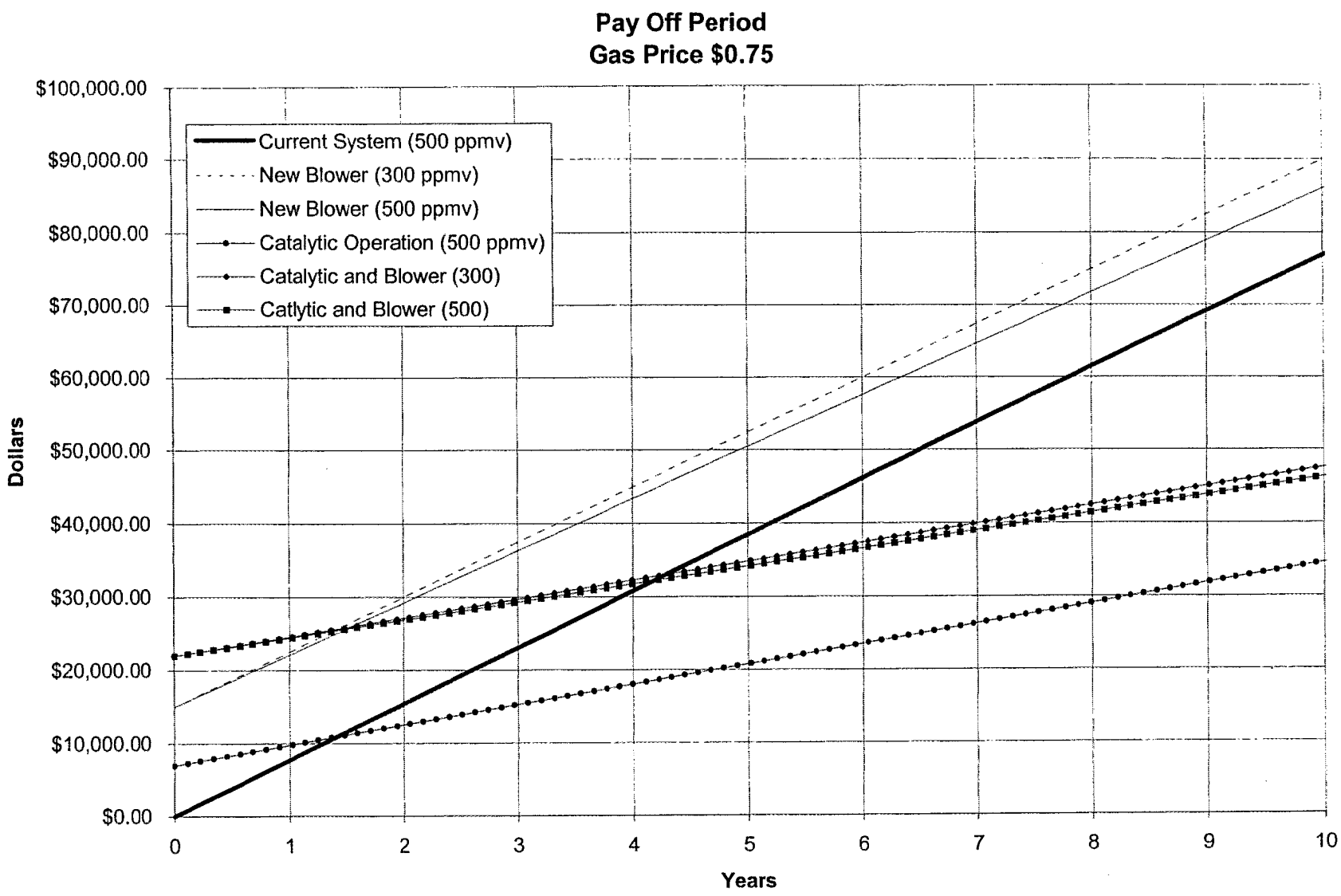
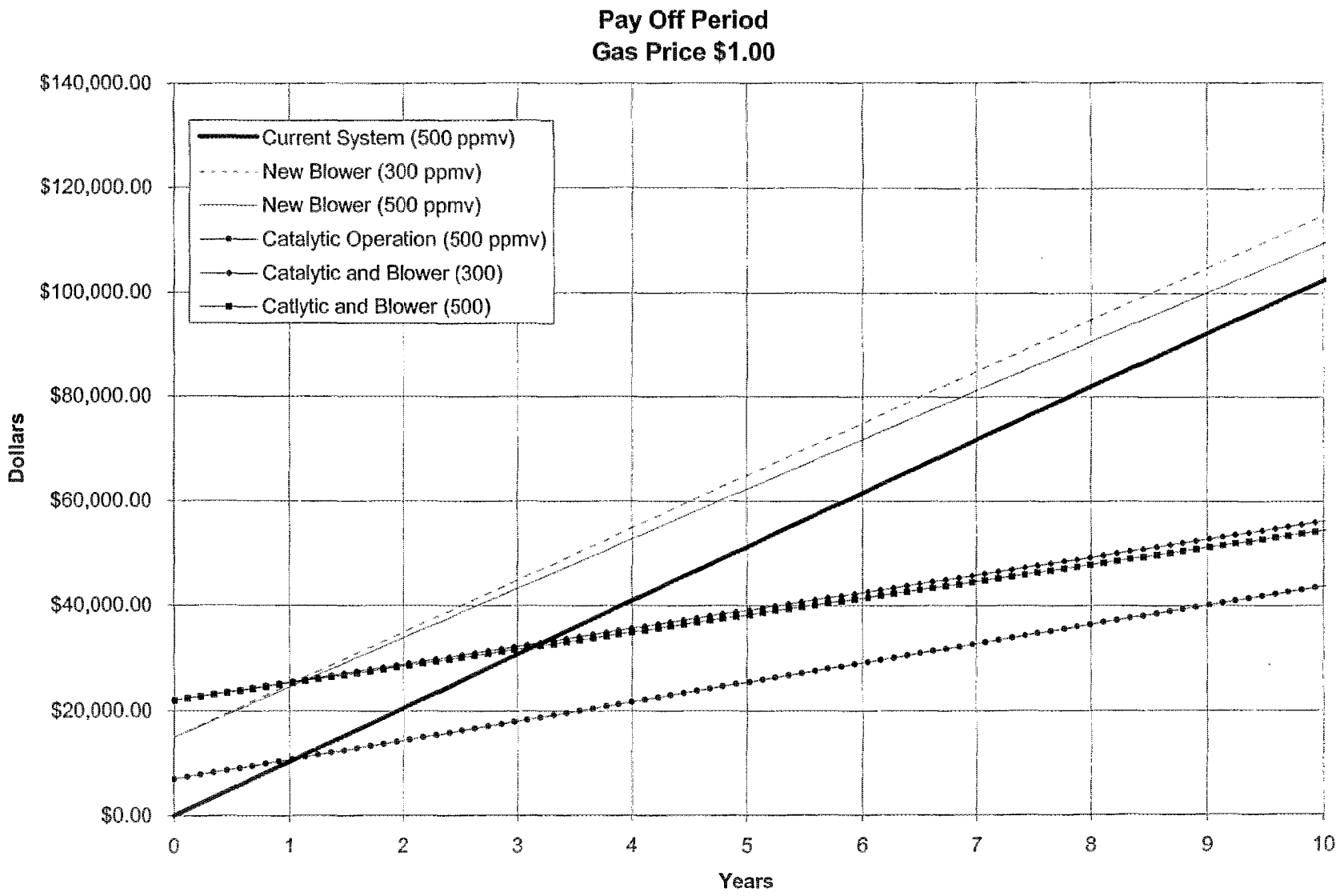
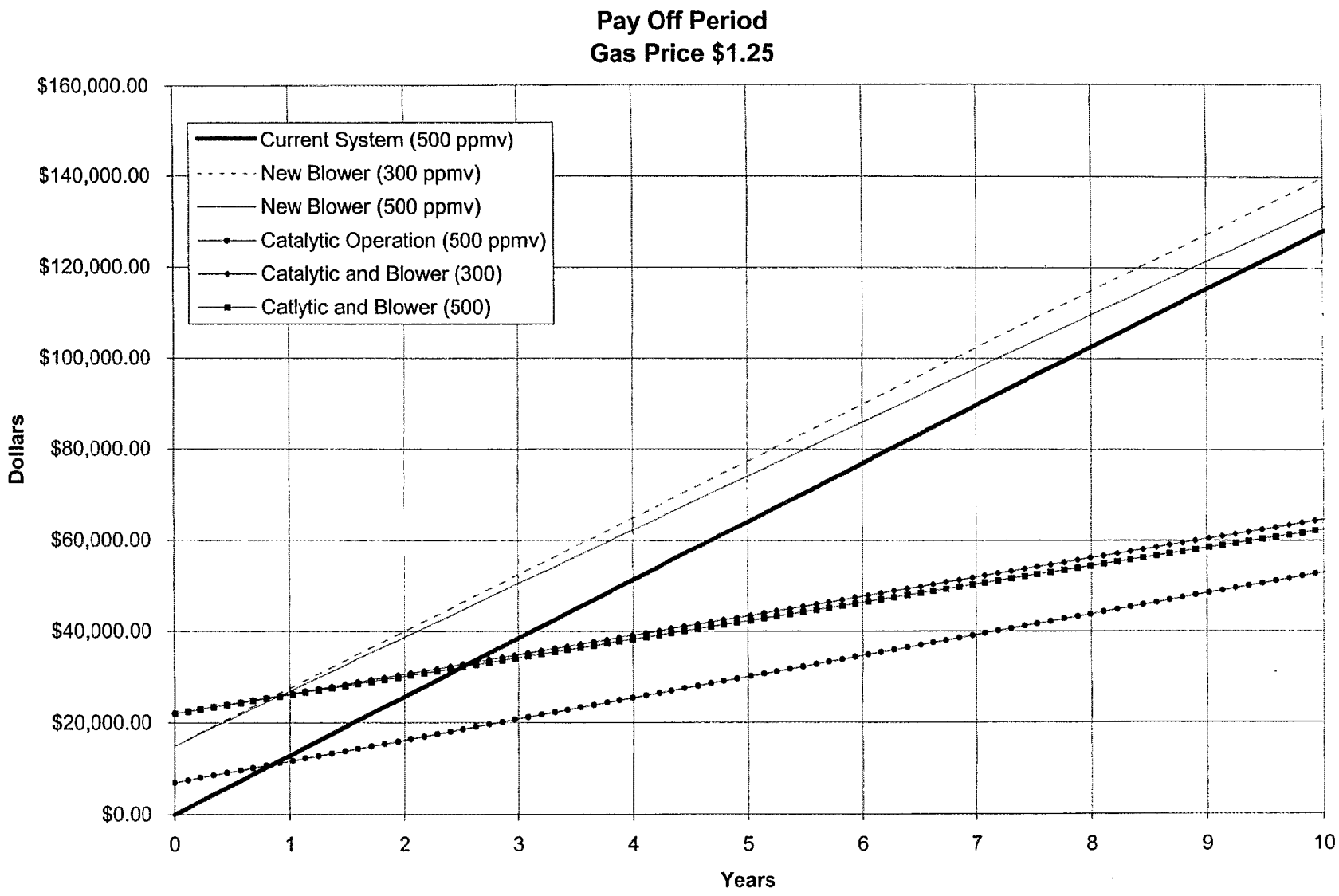
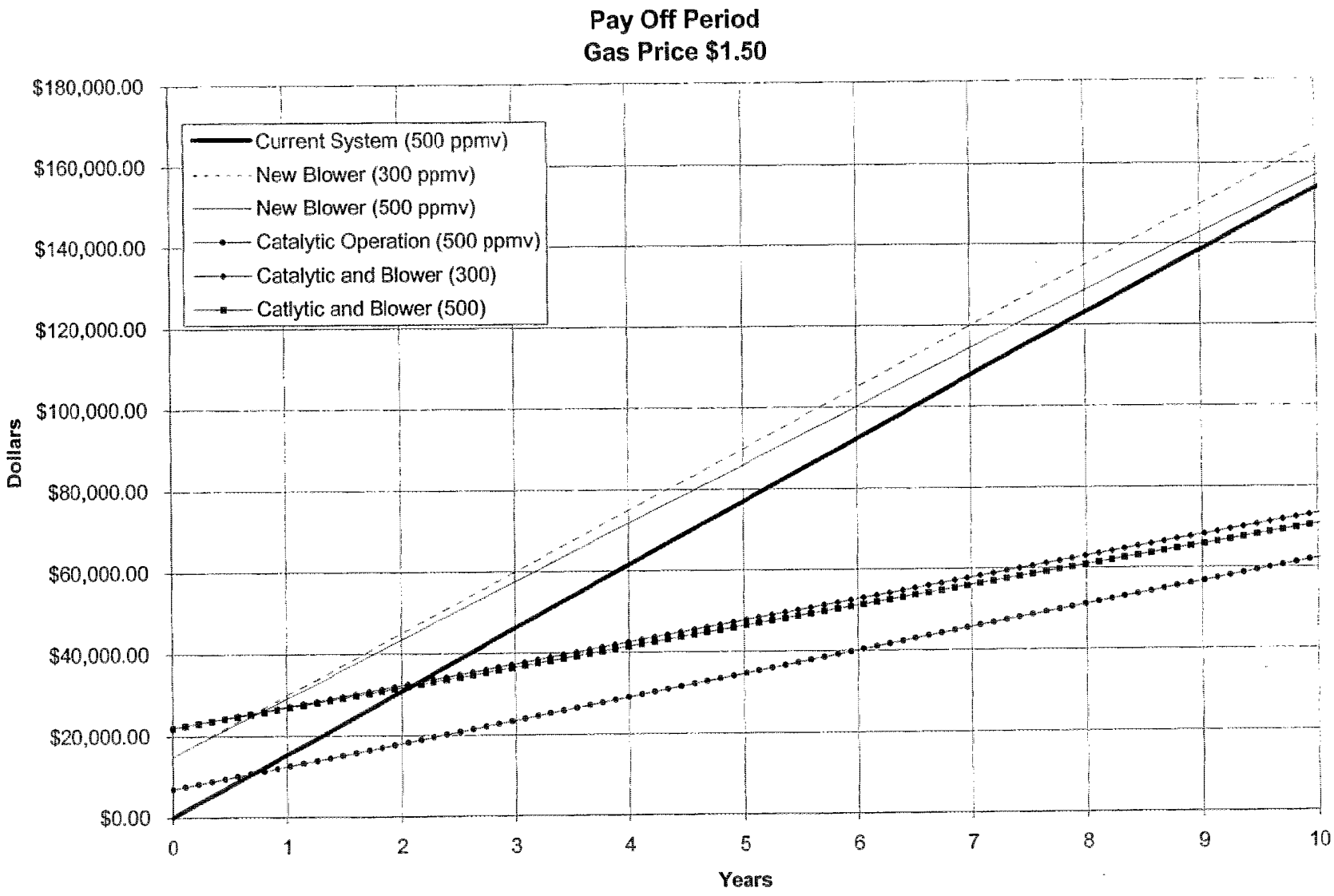

Pay Off Period
Gas Price $0.50
$70,000.00
$60,000.00
$50,000.00
$40,000.00
$30,000.00
$20,000.00
$10,000.00
$0.00
Dollars
0
1
2
3
4
5
6
7
8
9
10
Years
Current System (500 ppmv)
New Blower (300 ppmv)
New Blower (500 ppmv)
Catalytic Operation (500 ppmv)
Catalytic and Blower (300)
Catlytic and Blower (500)


Pay Off Period
Gas Price $0.75
$100,000.00
$90,000.00
$80,000.00
$70,000.00
$60,000.00
$50,000.00
$40,000.00
$30,000.00
$20,000.00
$10,000.00
$0.00
Dollars
0
1
2
3
4
5
6
7
8
9
10
Years
Current System (500 ppmv)
New Blower (300 ppmv)
New Blower (500 ppmv)
Catalytic Operation (500 ppmv)
Catalytic and Blower (300)
Catlytic and Blower (500)


Pay Off Period
Gas Price $1.00
$140,000.00
$120,000.00
$100,000.00
$80,000.00
$60,000.00
$40,000.00
$20,000.00
$0.00
Dollars
0
1
2
3
4
5
6
7
8
9
10
Years
Current System (500 ppmv)
New Blower (300 ppmv)
New Blower (500 ppmv)
Catalytic Operation (500 ppmv)
Catalytic and Blower (300)
Catlytic and Blower (500)


Pay Off Period
Gas Price $1.25
$160,000.00
$140,000.00
$120,000.00
$100,000.00
$80,000.00
$60,000.00
$40,000.00
$20,000.00
$0.00
Dollars
0
1
2
3
4
5
6
7
8
9
10
Years
Current System (500 ppmv)
New Blower (300 ppmv)
New Blower (500 ppmv)
Catalytic Operation (500 ppmv)
Catalytic and Blower (300)
Catlytic and Blower (500)


Pay Off Period
Gas Price $1.50
$180,000.00
$160,000.00
$140,000.00
$120,000.00
$100,000.00
$80,000.00
$60,000.00
$40,000.00
$20,000.00
$0.00
Dollars
0
1
2
3
4
5
6
7
8
9
10
Years
Current System (500 ppmv)
New Blower (300 ppmv)
New Blower (500 ppmv)
Catalytic Operation (500 ppmv)
Catalytic and Blower (300)
Catlytic and Blower (500)