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GROUNDWATER SAMPLING REPORT TREATABILITY/ FEASIBILITY STUDY LIGHTER
AMPHIBIOUS RESUPPLY CARGO (LARC) 60 MAINTENANCE AREA FORT STORY VA
3/1/2003
MALCOLM PIRNIE

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GROUNDWATER SAMPLING REPORT

TREATABILITY/FEASIBILITY STUDY
LARC 60 MAINTENANCE AREA
FORT STORY, VIRGINIA

Installation Restoration Program
Fort Story, Virginia

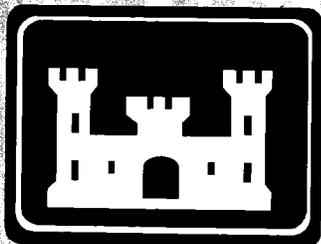
U. S. Army Transportation Center
Fort Eustis, Virginia

and

U.S. Army Corps of Engineers
Baltimore District

March 2003

0285-900-100



**GROUNDWATER SAMPLING REPORT
JANUARY 2002 SAMPLING EVENT
LARC 60 SITE**

1.0 INTRODUCTION

Malcolm Pirnie, Inc. was contracted by the U.S. Army Corps of Engineers (USACE), Baltimore District to install additional wells and conduct additional groundwater monitoring in support of an upcoming Treatability Study (TS) and Feasibility Study (FS) at the LARC 60 Maintenance Area site at Fort Story, Virginia under Contract DACA31-00-D-0043.

Benzene, ethylbenzene, toluene, methyl isobutyl ketone (MIBK), tetrachloroethene (PCE), trichloroethene (TCE), cis 1,2-dichloroethene (cis 1,2-DCE), vinyl chloride, arsenic, and iron were detected in groundwater above EPA risk screening criteria (EPA RBCs and/or USEPA MCLs) in previous investigations conducted at the site. To assist in the planned TS for the groundwater at the site and to further refine the plume configuration at the site, the installation and sampling of additional monitoring wells was required.

2.0 INVESTIGATION PROGRAM

2.1 Investigation Methodologies

The investigation methodologies for monitoring well installation, decontamination, and site restoration were described in the previously approved Field Investigation Plan, dated December 1994 and were utilized for this investigation. Procedures for monitoring well sampling (all wells have QED well pumps) utilized in this investigation were described in Section 1.4.1 of the *Final Work Plan Addendum, Groundwater Investigations, Treatability/Feasibility Study*, dated December 2002, which was reviewed and approved by the Virginia Department of Environmental Quality (VDEQ).

2.2 Monitoring Well Installations

To supplement the data gathered during previous investigations and to further refine the plume configuration for the TS and FS, six additional monitoring wells were installed and developed at the site. The wells were installed at the following locations:

- Cluster wells (one shallow and one deep) (6MW-5S and 6MW-5D) were installed approximately 300 feet downgradient of the former UST location.

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- One well (6MW-6) was installed approximately 200 feet west of the cluster wells.
- One well (6MW-7) was installed approximately 200 feet east of the cluster wells.
- One well (6MW-8) was installed approximately 300 feet east of the cluster wells 6MW-3S and 6MW-3D.
- One well (6MW-9) was installed approximately 300 feet downgradient (north) of the cluster wells 6MW-3S and 6MW-3D.

The location of each well (new and existing) is presented on **Figure 1**.

Each well has a 10-foot screened interval with one foot of the screened interval set above the water table interface. The depth to water across the site was approximately 2.5 to 8 feet below land surface. The deep well (6MW-5D) was screened at a depth of 30 to 40 feet below land surface to assess any vertical migration of contaminants. This is the approximate depth that the other two existing deeper wells (6MW-2 and 6MW-3D) are screened. The well construction and boring logs that provide the details on the construction of each new well are provided in **Appendix A**.

2.2 Groundwater Sampling

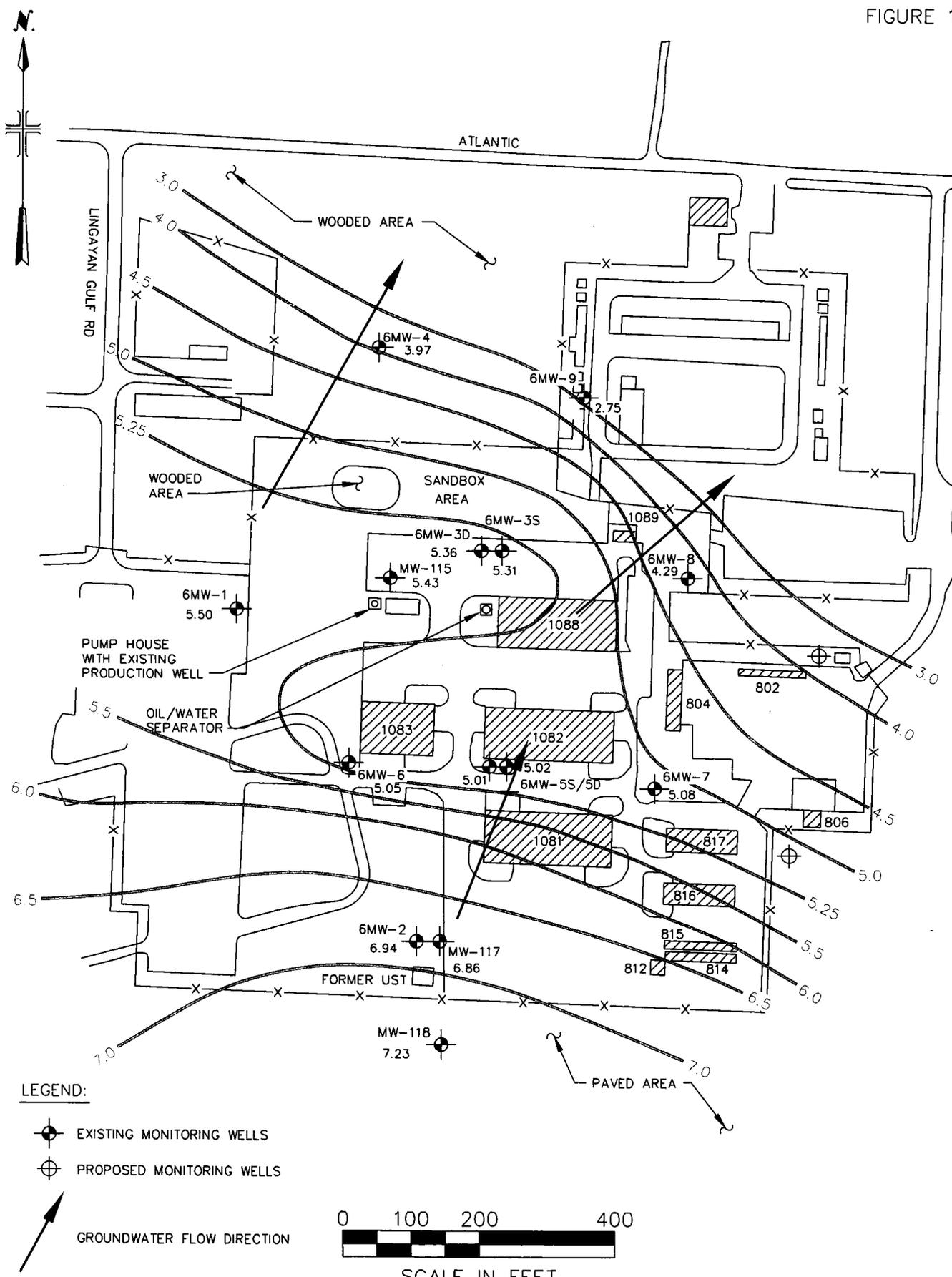
Prior to sampling activities, QED Ferret well pumps were installed for the six new wells. Groundwater samples were collected from eight existing and six newly installed wells at the LARC 60 site. The locations of these monitoring wells are provided on **Figure 1**.

Water level measurements were collected from all monitoring wells on January 29, 2002 to assist in the determination of the groundwater flow direction. A copy of the *Groundwater Level Measurement Sheet* is provided in **Appendix A**. Groundwater elevation contours are also presented on **Figure 1**.

Samples were analyzed for TCL volatile organic compounds (VOCs) using Method 8260 and arsenic and iron using ICP 6010 series methods.

FIGURE 1

File: L:\0285 - US Army Corps of Engineers\900 - LARC Treatability\Cadd\Feb03-GW Sampling Rpt\FIG 1-1.DWG Scale: 1:1 Date: 03/06/2003 Time: 14:25



FORT STORY, VIRGINIA
 GROUNDWATER SAMPLING REPORT
 LARC 60 MAINTENANCE AREA
 MONITORING WELL LOCATIONS

MALCOLM PIRNIE, INC.
 MARCH 2003

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3.0 GROUNDWATER SAMPLING RESULTS

As part of the investigations to further refine plume configuration and the potential groundwater remediation area of the site, groundwater samples were collected from 14 monitoring wells and analyzed for VOCs and total and dissolved arsenic and iron. A discussion of each of these contaminant groups is provided below.

3.1 Volatile Organics

VOC results for the groundwater samples are provided in **Table 1**. Numerous VOCs were detected in the samples. A summary of concentration ranges, detection frequencies, and comparison to EPA screening criteria is provided in the following table:

Groundwater Samples – VOC Results (ug/L)				
VOC	Range	Detection Frequency	Frequency above EPA RBC	Frequency above EPA MCL
Acetone	4.0 to 32.0	4 / 14	0 / 14	---
Benzene	0.1 to 0.6	3 / 14	1 / 14	0 / 14
Chlorobenzene	0.3 to 9.0	2 / 14	0 / 14	0 / 14
Cyclohexane	15.0	1 / 14	---	---
1,2-Dichlorobenzene	0.2	2 / 14	0 / 14	0 / 14
1,3-Dichlorobenzene	0.5	1 / 14	0 / 14	---
1,4-Dichlorobenzene	0.2 to 1.0	9 / 14	1 / 14	0 / 14
Cis 1,2-DCE	1.0 to 22.0	2 / 14	1 / 14	0 / 14
Ethylbenzene	29.0	1 / 14	1 / 14	0 / 14
Isopropylbenzene	12.0	1 / 14	---	---
Methylene chloride	0.2 to 0.3	6 / 14	0 / 14	0 / 14
Methylcyclohexane	26.0	1 / 14	0 / 14	---
PCE	0.4 – 11.0	3 / 14	2 / 14	1 / 14
Toluene	0.4 – 1.0	14 / 14	0 / 14	0 / 14
1,2,4-Trichlorobenzene	0.3	1 / 14	0 / 14	0 / 14
TCE	0.5 to 1.0	3 / 14	3 / 14	0 / 14
Vinyl chloride	1.0	1 / 14	1 / 14	0 / 14
Xylenes	130.0	1 / 14	0 / 14	0 / 14

TABLE 1
GROUNDWATER RESULTS - VOCs - JANUARY 2002 SAMPLING EVENT
LARC 60 MAINTENANCE AREA

Compound	6MW-1 (ug/L)	6MW-2 (ug/L)	6MW-3D (ug/L)	6MW-3S (ug/L)	6MW-4 (ug/L)	6MW-4 (dup) (ug/L)	6MW-5D (ug/L)	6MW-5S (ug/L)	6MW-6 (ug/L)	6MW-7 (ug/L)	EPA RBCs (ug/L)	MCLs (ug/L)
Acetone	4 J	5 J	13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	61	---
Benzene	5 U	0.1 J	5 U	0.6 J	5 U	5 U	5 U	5 U	5 U	5 U	0.32	5
Bromodichloromethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.17	80
Bromoform	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	8.5	80
Bromomethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.85	---
2-Butanone (MEK)	13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	190	---
Carbon Disulfide	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100	---
Carbon tetrachloride	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.16	5
Chlorobenzene	5 U	0.3 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	11	100
Chloroethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	3.6	---
Chloroform	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.15	80
Chloromethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2.1	---
Cyclohexane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	---	---
Dibromochloromethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.13	80
1,2-Dibromo-3-chloropropane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.047	---
1,2-Dibromoethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.00075	---
1,2-Dichlorobenzene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	27	600
1,3-Dichlorobenzene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	18	---
1,4-Dichlorobenzene	0.3 J	0.2 J	0.3 J	5 U	0.3 J	0.3 J	0.3 J	5 U	0.3 J	5 U	0.47	75
Dichlorodifluoromethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.3 J	5 U	5 U	35	---
1,1-Dichloroethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	80	---
1,2-Dichloroethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.12	5
1,1-Dichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	35	7
cis-1,2-Dichloroethene	5 U	5 U	5 U	1 J	5 U	5 U	5 U	5 U	5 U	5 U	6.1	70
Trans 1,2-dichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	12	100
1,2-Dichloropropane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.16	5
Cis-1,3-Dichloropropene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.44	---
Trans 1,3-dichloropropene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.44	---
Ethylbenzene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	3.3	700
2-Hexanone	13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	150	---
Isopropylbenzene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	---	---
Methyl acetate	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	610	---
Methylene chloride	5 U	0.3 J	5 U	0.3 J	5 U	0.3 J	0.3 J	0.2 J	5 U	5 U	4.1	5
Methylcyclohexane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	630	---
Methyl-tert-butyl ether	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2.6	---
4-Methyl-2-pentanone (MIBK)	13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	14	---
Styrene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	160	100
1,1,2,2-Tetrachloroethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.053	---
Tetrachloroethene	5 U	5 U	5 U	0.4 J	5 U	5 U	5 U	5 U	5 U	5 U	0.63	5
Toluene	0.4 JB	0.5 JB	0.9 JB	0.8 J	0.6 J	0.7 J	1 JB	1 JB	1 JB	1 JB	75	1,000
1,2,4-Trichlorobenzene	0.3 JB	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.72	70
1,1,1-Trichloroethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	320	200
1,1,2-Trichloroethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.19	5
Trichloroethene	5 U	5 U	5 U	1 J	5 U	5 U	5 U	5 U	5 U	5 U	0.026	5
Trichlorofluoromethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	130	---
1,1,2-trichloro-1,2,2-trifluoromethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5,900	---
Vinyl chloride	5 U	5 U	5 U	1 J	5 U	5 U	5 U	5 U	5 U	5 U	0.015	2
Xylene (total)	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1,200	10,000

Color Codes:

Indicates detect above the EPA RBC for tap water

Indicates detect above the USEPA MCL

1 Bold text indicates analyte detected

Data Qualifiers:

J Indicates estimated concentration (concentration is greater than the detection limit but less than the quantitation limit)

U Not detected

B Indicate analyte was also detected in associated blank sample

**TABLE 1
GROUNDWATER RESULTS - VOCs - JANUARY 2002 SAMPLING EVENT
LARC 60 MAINTENANCE AREA**

Compound	6MW-8 (ug/L)	6MW-9 (ug/L)	6MW-9 (dup) (ug/L)	MW-115 (ug/L)	MW-117 (ug/L)	MW-118 (ug/L)	MW-118 (dup) (ug/L)	TB1-14 (ug/L)	TB1-15 (ug/L)	TB1-20 (ug/L)	EPA RBCs (ug/L)	MCLs (ug/L)
Acetone	13 U	4 J	5 J	13 U	32	13 U	13 U	13 U	13 U	13 U	61	---
Benzene	5 U	0.2 J	0.2 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.32	5
Bromodichloromethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.17	80
Bromoform	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	8.5	80
Bromomethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.85	---
2-Butanone (MEK)	13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	190	---
Carbon tetrachloride	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100	---
Carbon Disulfide	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.16	5
Chlorobenzene	5 U	9	9	5 U	5 U	5 U	5 U	5 U	5 U	5 U	11	100
Chloroethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	3.6	---
Chloroform	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.15	80
Chloromethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2.1	---
Cyclohexane	5 U	5 U	5 U	5 U	15	5 U	5 U	5 U	5 U	5 U	---	---
Dibromochloromethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.13	80
1,2-Dibromo-3-chloropropane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.047	---
1,2-Dibromoethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.00075	---
1,2-Dichlorobenzene	5 U	0.2 JB	0.2 JB	0.2 J	5 U	5 U	5 U	5 U	5 U	5 U	27	600
1,3-Dichlorobenzene	5 U	0.5 JB	0.5 JB	5 U	5 U	5 U	5 U	5 U	5 U	5 U	18	---
1,4-Dichlorobenzene	0.3 J	1 J	1 J	0.3 J	5 U	5 U	5 U	5 U	0.3 J	5 U	0.47	75
Dichlorodifluoromethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	35	---
1,1-Dichloroethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	80	---
1,2-Dichloroethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.12	5
1,1-Dichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	35	7
cis-1,2-Dichloroethene	5 U	5 U	5 U	5 U	22	5 U	5 U	5 U	5 U	5 U	6.1	70
Trans 1,3-dichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	12	100
1,2-Dichloropropane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.16	5
Cis-1,3-Dichloropropene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.44	---
Trans 1,3-dichloropropene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.44	---
Ethylbenzene	5 U	5 U	5 U	5 U	29	5 U	5 U	5 U	5 U	5 U	3.3	700
2-Hexanone	13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	150	---
Isopropylbenzene	5 U	5 U	5 U	5 U	12	5 U	5 U	5 U	5 U	5 U	---	---
Methyl acetate	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	610	---
Methylene chloride	0.3 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	4.1	5
Methylcyclohexane	5 U	5 U	5 U	5 U	26	5 U	5 U	5 U	5 U	5 U	630	---
Methyl-tert-butyl ether	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2.6	---
4-Methyl-2-pentanone	13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	14	---
Styrene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	160	100
1,1,2,2-Tetrachloroethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.053	---
Tetrachloroethene	5 U	5 U	5 U	5 U	2 J	5 U	5 U	5 U	5 U	5 U	0.63	5
Toluene	0.7 J	0.5 JB	0.5 JB	0.7 J	1 JB	1 JB	0.8 JB	1 JB	0.9 JB	0.6 JB	75	1,000
1,2,4-Trichlorobenzene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.4 JB	0.72	70
1,1,1-Trichloroethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	320	200
1,1,2-Trichloroethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.19	5
Trichloroethene	0.5 J	5 U	5 U	5 U	1 J	5 U	5 U	5 U	5 U	5 U	0.026	5
Trichlorofluoromethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	130	---
1,1,2-trichloro-1,2,2-trifluo	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5,900	---
Vinyl chloride	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.015	2
Xylene (total)	5 U	5 U	5 U	5 U	130	5 U	5 U	5 U	5 U	5 U	1,200	10,000

Color Codes:

Indicates detect above the EPA RBC for tap water

Indicates detect above the USEPA MCL

1 Bold text indicates analyte detected

Data Qualifiers:

J Indicates estimated concentration (concentration is greater than the detection limit but less than the quantitation limit)

U Not detected

B Indicate analyte was also detected in associated blank sample

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JANUARY 2002 SAMPLING EVENT
LARC 60 SITE**

Concentrations of benzene, 1,4-dichlorobenzene, cis 1,2-DCE, ethylbenzene, PCE, TCE, and vinyl chloride exceeded EPA RBCs in at least one well on-site for the 2002 sampling event. However, PCE was the only VOC detected above EPA MCLs and it was detected above the 5 ug/L MCL in only one well (6MW-7).

EPA RBCs and/or MCLs were exceeded in groundwater samples from the following five monitoring wells:

- MW-117 which is located adjacent to the former waste oil UST (the suspected source of the contamination); cis 1,2-DCE, ethylbenzene, PCE, and TCE exceeded EPA RBCs
- 6MW-7 which is located approximately 400 feet in a downgradient direction from the former UST; PCE exceeded the EPA RBC and EPA MCL
- 6MW-3S which is located approximately 600 feet in a downgradient direction from the former UST; benzene, TCE, and vinyl chloride exceeded EPA RBCs
- 6MW-8 which is located approximately 700 feet downgradient of the former UST; TCE was detected above the EPA RBC
- 6MW-9 which is located approximately 900 feet downgradient of the former UST; 1,4-dichlorobenzene (1,4-DCB) was detected above the EPA RBC. However, it should be noted that, although 1,4-DCB was noted detected in the associated method blank sample, it was detected in one of the trip blank samples.

A summary of all VOC data collected at the site from the remedial investigation through the 2002 data is presented in **Table 2**. The extent of contamination and any trends are summarized as follows:

- Chlorinated organics are present throughout the site with the highest concentrations present in MW-117 that is located directly downgradient and adjacent to the location of the former UST.
- Concentrations detected in MW-117 have varied greatly over the three sampling events primarily due to the presence of a petroleum sheen in this well during most sampling events. The former waste oil

**TABLE 2
MONITORING WELL GROUNDWATER RESULTS - 1995/2000/2002 SAMPLING EVENTS
LARC 60 MAINTENANCE AREA**

Parameters	Well ID and Results (ug/L) for 1995/2000/2002 Sampling Event								New wells installed in 2002 and Results (ug/L)						EPA RBCs	USEPA MCLs
	6MW-1	6MW-2	6MW-3S	6MW-3D	6MW-4	MW-115	MW-117	MW-118	6MW-5D	6MW-5S	6MW-6	6MW-7	6MW-8	6MW-9		
Benzene	<5 / <5 / <5	<5 / NS / <5	<5 / <5 / 0.6J	<5 / NS / <5	<5 / <5 / <5	<5 / <5 / <5	<5 / <5 / <5	<5 / <5 / <5	<5	<5	<5	<5	<5	0.2J	0.32	5
1,4-DCB	<5 / <5 / 0.3	<5 / <5 / 0.2	<5 / <5 / <5	<5 / <5 / 0.3	<5 / <5 / 0.3	<5 / <5 / 0.3	<5 / <5 / <5	<5 / <5 / <5	0.3	<5	0.3	<5	0.3	1 J	0.47	75
cis 1,2-DCE	<5 / <5 / <5	<5 / NS / <5	<5 / 2J / 1J	<5 / NS / <5	<5 / <5 / <5	<5 / <5 / <5	20 / 1,900 / 22	<5 / <5 / <5	<5	<5	<5	<5	<5	<5	6.1	70
Ethylbenzene	<5 / <5 / <5	<5 / NS / <5	<5 / <5 / <5	<5 / NS / <5	<5 / <5 / <5	<5 / <5 / <5	66 / 76 / 29	<5 / <5 / <5	<5	<5	<5	<5	<5	<5	3.3	700
MIBK		<5 / NS / <5		<5 / NS / <13		<5 / <5 / <5	<5 / <250 / < 13	<5 / <5 / <13	<13	<13	<13	<13	<13	<13	14	---
PCE	<5 / <5 / <5	<5 / NS / <5	<5 / <5 / 0.4J	<5 / NS / <5	<5 / <5 / <5	<5 / <5 / <5	8.5 / <50 / 2J	<5 / <5 / <5	<5	<5	<5	11	<5	<5	0.63	5
Toluene	<5 / <5 / 0.4J	<5 / NS / 0.5J	<5 / <5 / 0.8J	<5 / NS / 0.9JB	<5 / <5 / 0.7J	<5 / <5 / 0.7J		<5 / <5 / 1JB	1JB	1JB	1JB	1JB	0.7J	0.5JB	75	1,000
TCE	<5 / <5 / <5	<5 / NS / <5	<5 / 1.3J / 1J	<5 / NS / <5	<5 / <5 / <5	<5 / <5 / <5	18 / <50 / 1J	<5 / <5 / <5	<5	<5	<5	<5	0.5J	<5	0.026	5
Vinyl chloride	<10 / <10 / <5	<10 / NS / <5	<10 / 3.1J / 1J	<10 / NS / <5	<10 / <10 / <5	<10 / <10 / <5		<10 / <10 / <5	<5	<5	<5	<5	<5	<5	0.015	2

Notes:

Date Qualifiers:

U - Not detected

J - Estimated concentration (result between MDL and PQL for organics)

B - Analyte detected in associated blank sample)

NS - Not sampled

Color Codes:

Indicates detect above the EPA RBC for tap water

Indicates detect above the USEPA MCL

Indicates detect above EPA screening criteria (RBC or MCL) in past samples but not above criteria in 2002 samples

1 J Bold text indicates analyte detected

GROUNDWATER SAMPLING REPORT
JANUARY 2002 SAMPLING EVENT
LARC 60 SITE

tank included the storage of petroleum products as well as waste degreaser that accounts for the presence of chlorinated organics. If any of the sheen/free product were captured during groundwater monitoring, chlorinated organic concentrations would be expected to be higher. Cis 1,2-DCE was detected at a concentration of 1,900 ug/L during the 2000 sampling event but only at 22 ug/L in 2002.

- Except for the PCE concentration (11 ug/L) in 6MW-7, downgradient concentrations are less than 1 ug/L for any individual VOC. As presented in **Table 2**, minimal concentration variations have been noted in those downgradient wells (6MW-3S and MW-115) that have been sampled three times.
- Historically, EPA MCLs have only been exceeded six times in the following monitoring wells on-site:
 - 6MW-3S: Vinyl chloride at 3.1 ug/L in 2000
 - 6MW-7: PCE at 11 ug/L in 2002
 - MW-117: Cis 1,2-DCE at 1,900 ug/L in 2000
Vinyl chloride at 8.6 ug/L in 2000
PCE at 8.5 ug/L in 1995
TCE at 18 ug/L in 1995

3.1 Arsenic and Iron

Arsenic and iron results for the groundwater samples are provided in **Table 3**. Arsenic was detected in five monitoring wells with concentrations ranging from 3.8 to 27.1 ug/L, which exceed the EPA RBC in all of the samples with arsenic detects. However, arsenic does not exceed the existing MCL of 50 ug/L and only exceeds the new EPA MCL (does not come into effect until January 2006) in one well, MW-117.

Iron was detected in all monitoring wells with concentrations ranging from 23 to 33,300 ug/L, which exceed the EPA RBC in all of the samples. Iron concentrations were highest in two of the wells that are screened the deepest (30 to 40 feet below land surface as compared to the shallows wells which are typically screened at a depth of not greater than 20 feet below land surface). However, it should be noted that no chlorinated organics have been detected in these wells potentially indicating that these iron levels are typical of the formation. Except for the two deep wells discussed above, iron concentrations in well MW-117 (8,840 and

TABLE 3
ARSENIC AND IRON RESULTS
LARC 60 SITE - JANUARY 2002 SAMPLING EVENT

Well I.D.	Arsenic Results (ug/L)		Iron Results (ug/L)	
	Total	Dissolved	Total	Dissolved
6MW-1	3.6 U	3.8 B	4,020	2,200
6MW-2	3.6 U	4.2 B	8,280	8,340
6MW-3S	3.7 U	3.6 U	7,510	8,270
6MW-3D	3.7 U	3.6 U	32,000	33,300
6MW-4	3.7 U	3.6 U	4,600	1,820
6MW-5S	3.7 U	3.6 U	95 B	43 B
6MW-5D	3.9 B	3.6 U	26,900	19,900
6MW-6	3.7 U	3.6 U	720	705
6MW-7	3.7 U	3.6 U	60 B	23 B
6MW-8	3.7 U	3.6 U	1,040	1,150
6MW-9	3.6 U	3.6 U	3,890	3,910
MW-115	3.7 U	4.2 B	7,120	7,100
MW-117	26.8	27.1	9,240	8,840
MW-118	3.7 U	3.6 U	2,360	140
EPA RBC ⁽¹⁾	0.045		1,100	
EPA MCL ⁽²⁾	50 / 10		300	

Notes:

- (1) EPA risk-based concentrations (RBCs) for tap water (October 2002)
- (2) EPA Maximum contaminant levels for drinking water
 - a. Arsenic MCL to be lowered to 10 ug/L in 2006.
 - b. Iron MCL is secondary MCL for aesthetics only.

26.8 Indicates arsenic detect above new MCL of 10 ug/L

3.9 Indicates arsenic detect above RBC but below MCL

2,400 Indicates iron detect above EPA RBC of 1,100 ug/L

**GROUNDWATER SAMPLING REPORT
JANUARY 2002 SAMPLING EVENT
LARC 60 SITE**

9,240 ug/L) that is located adjacent to the former source area are similar to downgradient wells at the site (e.g., MW-115 - iron at over 7,000 ug/L and 6MW-3S – iron at over 8,000 ug/L). Iron concentrations vary across the site with no pattern present that would indicate that iron was introduced to the site through the former UST.

4.0 CONCLUSIONS AND RECOMMENDATIONS

As discussed above, various concentrations of various VOCs continue to exceed EPA RBCs and/or EPA MCLs across the site. However, only a few detects above the EPA MCLs are currently present for the VOCs with the major area of concern continuing to be the area adjacent to and just downgradient of the former source area (former UST). The upcoming Groundwater Treatability Study, which will include an in-situ chemical oxidation process, will focus on this area. Currently, in-situ chemical oxidation vendors are providing assistance in the development of a Treatability Study Work Plan that will be forwarded to Fort Eustis and VDEQ for review and comment prior to implementation of the treatability test field work.

With the detection of PCE at 11 ug/L from 6MW-7, the full plume configuration required for potential remediation has not been identified in that area of the site. Therefore, it is recommended that two additional monitoring wells be installed and sampled to further refine the plume configuration. The proposed locations of the two wells are presented on **Figure 1**.

Except for the arsenic detected in MW-117, there appears to be no metallic-related plume at the site requiring remediation. Additional discussion on this issue will be provided in the upcoming Feasibility Study.

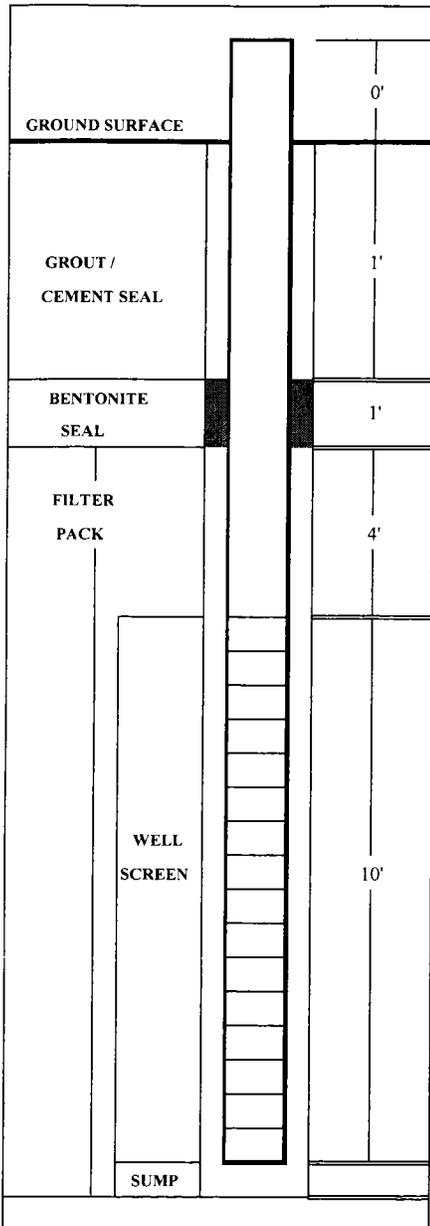
*Appendix A
Water Level Sheet and Well Logs*

*Groundwater Sampling Report
January 2002 Sampling Event
LARC 60 Maintenance Area Site
Fort Story, Virginia*



Malcolm Pirnie Inc. 701 Town Center Drive Suite 600 Newport News, VA 23606 757-873-8700 FAX: 757-873-8723

PROJECT NAME: LARC 60 MAINTENANCE ARE			PROJECT NO: 0285900		ELEVATIONS
LOCATION: FORT STORY					GROUND:
NORTHING:			DRILLING INFORMATION		WELL:
EASTING:			COMPANY: FISHBURNE		SECURITY CASING:
INSTALLATION	DATE	TIME	DRILLER: ROLLEN	FLUIDS:	
STARTED:	12/06/02	1015	EQUIPMENT: DRILL RIG	BORE HOLE DIAMETER 4.25"	
COMPLETED:	12/06/02	1100	METHOD: HOLLOW STEM AUGER	SAMPLE INTERVAL CONTINUOUS	
MPI PERSONNEL:			EQUIPMENT DECON. STEAM CLEAN	SAMPLE METHOD: SPLIT SPOON-2FT.	

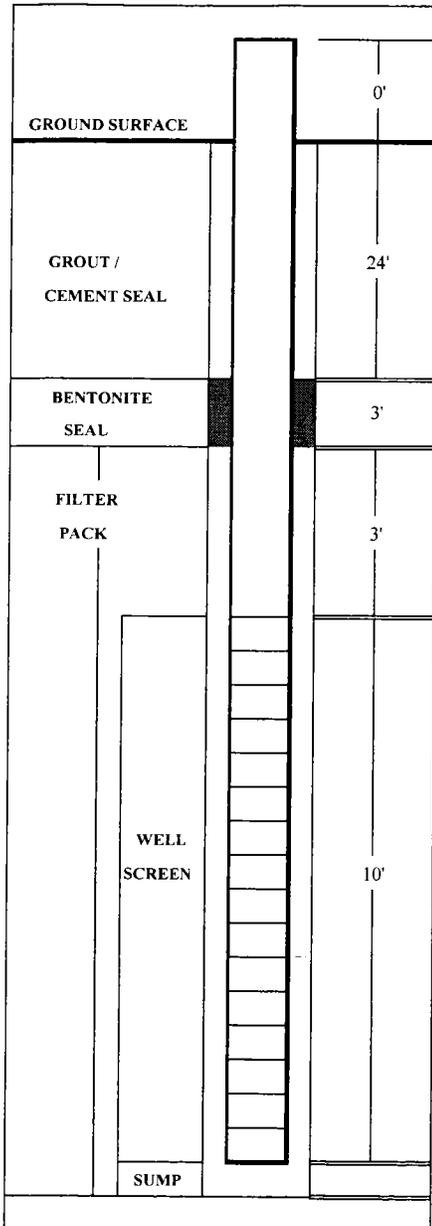


WELL CONSTRUCTION DATA			
PROTECTIVE CASING:			
Locking Cap (Y/N):	<input type="checkbox"/> Y	Protective Posts (#):	<input type="checkbox"/> 0
Protective outer casing: _____			
Pad: CONCRETE			
WELL MATERIALS:			
<i>Screen</i>			
Type:	PVC		
Diameter:	2"	Slot Type:	WIRE WRAPPED
Joint:	FLUSH THREAD	Slot Size:	0.01
		Length:	10'
<i>Riser</i>			
Type:	N/A		
Diameter:	N/A	Length:	N/A
TOTAL DEPTH OF WELL:	16'		
INITIAL WATER LEVEL:	6.5'		
FILTER PACK:			
Material:	SAND		
Amount used:	1 BAG		
Total thickness:	14'		
BENTONITE:			
Type:	BENTONITE HOLE PLUG		
Size:	3/8"		
Amount used:	1 BAG		
GROUT:			
Type:	CEMENT		
Amount used:	1 BAG		
WELL DEVELOPMENT			
Method:	PUMP AND SURGE		
Development Time:	~20 MIN		

NOTES:

Malcolm PIRNIE Inc. 701 Town Center Drive Suite 600 Newport News, VA 23606 757-873-8700 FAX: 757-873-8723

PROJECT NAME: LARC 60 MAINTENANCE AREA			PROJECT NO: 0285900		ELEVATIONS
LOCATION: FORT STORY					GROUND:
NORTHING:			DRILLING INFORMATION		WELL:
EASTING:			COMPANY: FISHBURNE		SECURITY CASING:
INSTALLATION	DATE	TIME	DRILLER: ROLLEN	FLUIDS:	
STARTED:	12/06/02	1100	EQUIPMENT: DRILL RIG	BORE HOLE DIAMETER 4.25"	
COMPLETED:	12/06/02	1400	METHOD: HOLLOW STEM AUGER	SAMPLE INTERVAL CONTINUOUS	
MPI PERSONNEL:			EQUIPMENT DECON: STEAM CLEAN	SAMPLE METHOD: SPLIT SPOON-2FT	

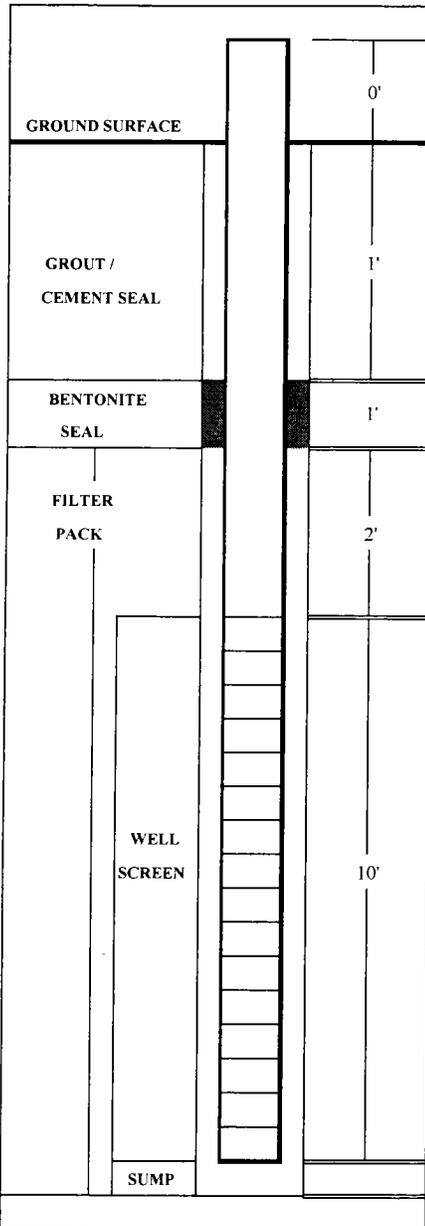


WELL CONSTRUCTION DATA			
PROTECTIVE CASING:			
Locking Cap (Y/N):	<input checked="" type="checkbox"/> Y	Protective Posts (#):	<input type="checkbox"/> 0
Protective outer casing:	_____		
Pad:	CONCRETE		
WELL MATERIALS:			
Screen			
Type:	PVC		
Diameter: 2"	Slot Type:	WIRE WRAPPED	Slot Size: 0.01
Joint:	FLUSH THREAD	Length:	10'
Riser			
Type:	N/A		
Diameter:	N/A	Length:	N/A
TOTAL DEPTH OF WELL:	40'		
INITIAL WATER LEVEL:	6.55'		
FILTER PACK:			
Material:	SAND		
Amount used:	2 BAGS		
Total thickness:	13'		
BENTONITE:			
Type:	BENTONITE HOLE PLUG		
Size:	3/8"		
Amount used:	2 BAGS		
GROUT:			
Type:	CEMENT		
Amount used:	2 BAGS		
WELL DEVELOPMENT			
Method:	PUMP AND SURGE		
Development Time:	~50 MIN		

NOTES:

Malcolm PIRNIE Inc. 701 Town Center Drive Suite 600 Newport News, VA 23606 757-873-8700 FAX: 757-873-8723

PROJECT NAME: LARC 60 MAINTENANCE AREA			PROJECT NO: 0285900		ELEVATIONS
LOCATION: FORT STORY					GROUND:
NORTHING:			DRILLING INFORMATION		WELL:
EASTING:			COMPANY: FISHBURNE		SECURITY CASING:
INSTALLATION	DATE	TIME	DRILLER: ROLLEN	FLUIDS:	
STARTED:	12/06/02	0900	EQUIPMENT: DRILL RIG	BORE HOLE DIAMETER 4.25"	
COMPLETED:	12/06/02	1000	METHOD: HOLLOW STEM AUGER	SAMPLE INTERVAL CONTINUOUS	
MPI PERSONNEL:			EQUIPMENT DECON: STEAM CLEAN	SAMPLE METHOD: SPLIT SPOON-2FT.	

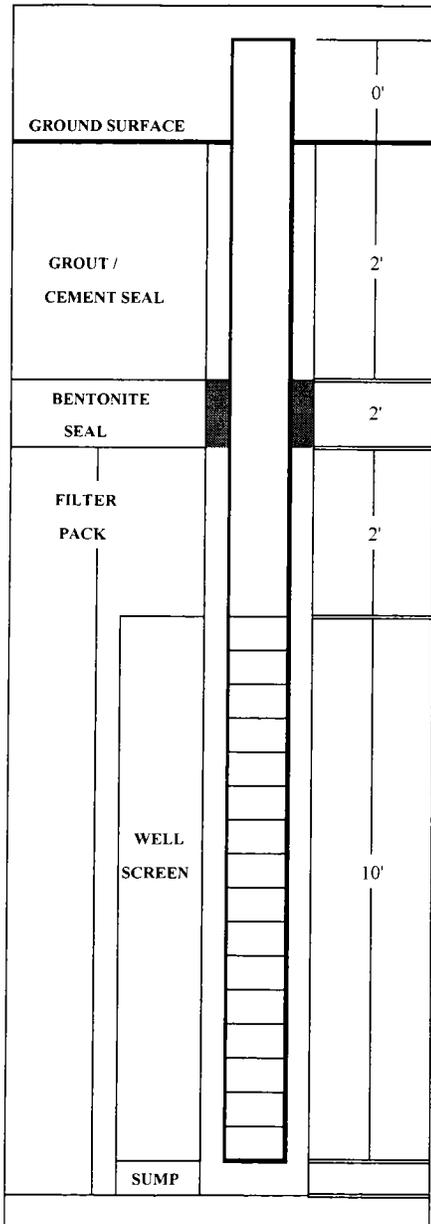


WELL CONSTRUCTION DATA			
PROTECTIVE CASING:			
Locking Cap (Y/N):	<input checked="" type="checkbox"/> Y	Protective Posts (#):	<input type="checkbox"/> 0
Protective outer casing:	_____		
Pad:	CONCRETE		
WELL MATERIALS:			
Screen			
Type:	PVC		
Diameter: 2"	Slot Type:	WIRE WRAPPED	Slot Size: 0.01
Joint:	FLUSH THREAD	Length:	10'
Riser			
Type:	N/A		
Diameter:	N/A	Length:	N/A
TOTAL DEPTH OF WELL:	14'		
INITIAL WATER LEVEL:	5.4'		
FILTER PACK:			
Material:	SAND		
Amount used:	1 BAG		
Total thickness:	12'		
BENTONITE:			
Type:	BENTONITE HOLE PLUG		
Size:	3/8"		
Amount used:	1 BAG		
GROUT:			
Type:	CEMENT		
Amount used:	1 BAG		
WELL DEVELOPMENT			
Method:	PUMP AND SURGE		
Development Time:	~25 MIN		

NOTES:

Malcolm Pirnie Inc. 701 Town Center Drive Suite 600 Newport News, VA 23606 757-873-8700 FAX: 757-873-8723

PROJECT NAME: LARC 60 MAINTENANCE AREA			PROJECT NO: 0285900		ELEVATIONS
LOCATION: FORT STORY					GROUND:
NORTHING:			DRILLING INFORMATION		WELL:
EASTING:			COMPANY: FISHBURNE		SECURITY CASING:
INSTALLATION	DATE	TIME	DRILLER: ROLLEN	FLUIDS:	
STARTED:	12/06/02	1405	EQUIPMENT: DRILL RIG	BORE HOLE DIAMETER 4.25"	
COMPLETED:	12/06/02	1450	METHOD: HOLLOW STEM AUGER	SAMPLE INTERVAL CONTINUOUS	
MPI PERSONNEL:			EQUIPMENT DECON. STEAM CLEAN		SAMPLE METHOD: SPLIT SPOON-2FT.

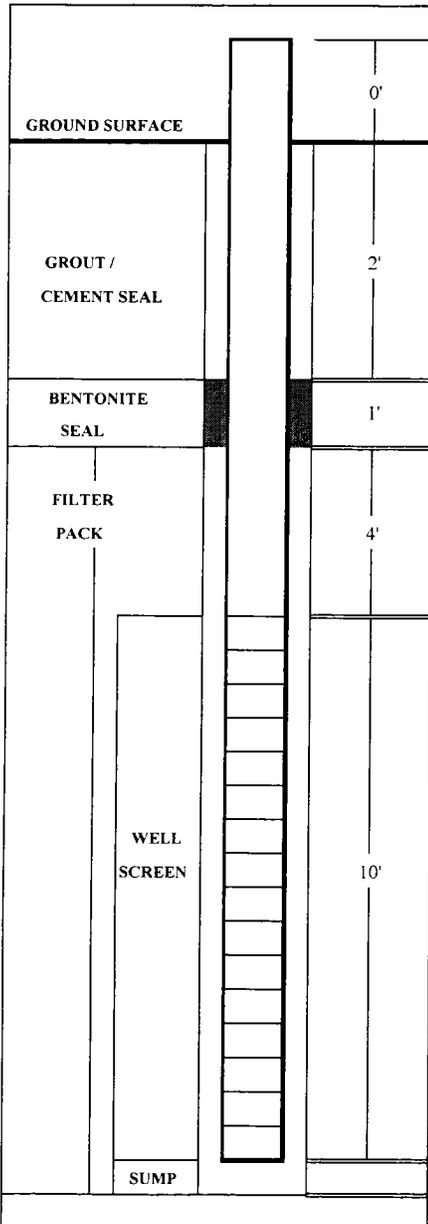


WELL CONSTRUCTION DATA			
PROTECTIVE CASING:			
Locking Cap (Y/N):	<input checked="" type="checkbox"/>	Protective Posts (#):	<input type="text" value="0"/>
Protective outer casing:			
Pad:	CONCRETE		
WELL MATERIALS:			
Screen			
Type:	PVC		
Diameter: 2"	Slot Type:	WIRE WRAPPED	Slot Size: 0.01
Joint:	FLUSH THREAD	Length:	10'
Riser			
Type:	N/A		
Diameter:	N/A	Length:	N/A
TOTAL DEPTH OF WELL:	16'		
INITIAL WATER LEVEL:	7.03'		
FILTER PACK:			
Material:	SAND		
Amount used:	1 BAG		
Total thickness:	12'		
BENTONITE:			
Type:	BENTONITE HOLE PLUG		
Size:	3/8"		
Amount used:	1 BAG		
GROUT:			
Type:	CEMENT		
Amount used:	1 BAG		
WELL DEVELOPMENT			
Method:	PUMP AND SURGE		
Development Time:	~ 30 MIN		

NOTES:

Malcolm PIRNIE Inc. 701 Town Center Drive Suite 600 Newport News, VA 23606 757-873-8700 FAX: 757-873-8723

PROJECT NAME: LARC 60 MAINTENANCE AREA			PROJECT NO: 0285900		ELEVATIONS	
LOCATION: FORT STORY					GROUND:	
NORTHING:			DRILLING INFORMATION		WELL:	
EASTING:			COMPANY: FISHBURNE		SECURITY CASING:	
INSTALLATION	DATE	TIME	DRILLER: ROLLEN		FLUIDS:	
STARTED:	12/06/02	1500	EQUIPMENT: DRILL RIG		BORE HOLE DIAMETER 4.25"	
COMPLETED:	12/06/02	1545	METHOD: HOLLOW STEM AUGER		SAMPLE INTERVAL CONTINUOUS	
MPI PERSONNEL:			EQUIPMENT DECON. STEAM CLEAN		SAMPLE METHOD: SPLIT SPOON-2FT.	



WELL CONSTRUCTION DATA

PROTECTIVE CASING:
 Locking Cap (Y/N): Y Protective Posts (#): 0
 Protective outer casing: _____
 Pad: CONCRETE

WELL MATERIALS:
Screen
 Type: PVC
 Diameter: 2" Slot Type: WIRE WRAPPED Slot Size: 0.01
 Joint: FLUSH THREAD Length: 10'
Riser
 Type: N/A
 Diameter: N/A Length: N/A

TOTAL DEPTH OF WELL: 17'
INITIAL WATER LEVEL: 6.8'

FILTER PACK:
 Material: SAND
 Amount used: 1 BAG
 Total thickness: 14'

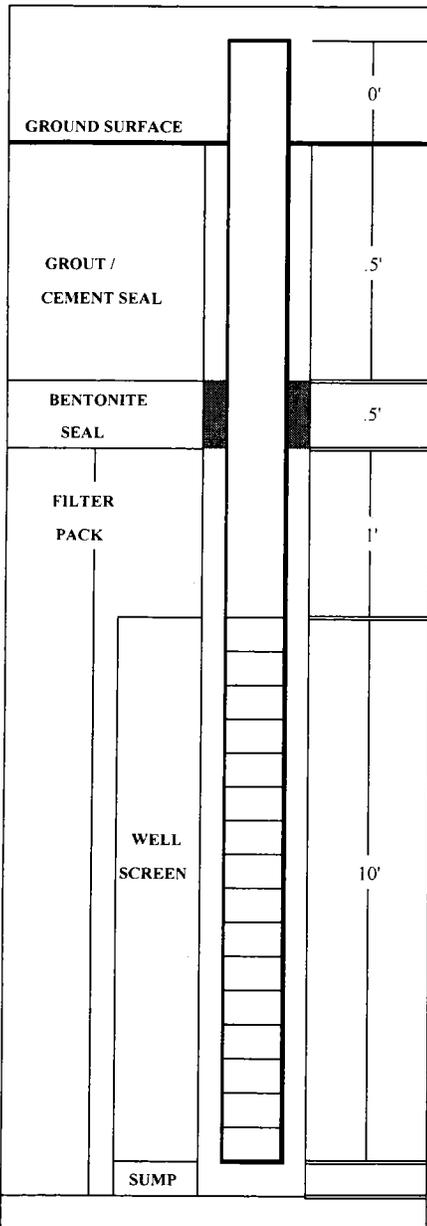
BENTONITE:
 Type: BENTONITE HOLE PLUG
 Size: 3/8"
 Amount used: 1 BAG

GROUT:
 Type: CEMENT
 Amount used: 1 BAG

WELL DEVELOPMENT
 Method: PUMP AND SURGE
 Development Time: ~20 MIN

NOTES:

PROJECT NAME: LARC 60 MAINTENANCE AREA			PROJECT NO: 0285900		ELEVATIONS	
LOCATION: FORT STORY					GROUND:	
NORTHING:			DRILLING INFORMATION			WELL:
EASTING:			COMPANY: FISHBURNE			SECURITY CASING:
INSTALLATION	DATE	TIME	DRILLER: ROLLEN		FLUIDS:	
STARTED:	12/05/02	1240	EQUIPMENT: DRILL RIG		BORE HOLE DIAMETER 4.25"	
COMPLETED:	12/05/02	1340	METHOD: HOLLOW STEM AUGER		SAMPLE INTERVAL CONTINUOUS	
MPI PERSONNEL:			EQUIPMENT DECON. STEAM CLEAN		SAMPLE METHOD: SPLIT SPOON-2FT	



WELL CONSTRUCTION DATA			
PROTECTIVE CASING:			
Locking Cap (Y/N):	<input checked="" type="checkbox"/>	Protective Posts (#):	<input type="text" value="0"/>
Protective outer casing: _____			
Pad: <u>CONCRETE</u>			
WELL MATERIALS:			
<i>Screen</i>			
Type:	<u>PVC</u>		
Diameter: 2"	Slot Type:	<u>WIRE WRAPPED</u>	Slot Size: <u>0.01</u>
Joint:	<u>FLUSH THREAD</u>		Length: <u>10'</u>
<i>Riser</i>			
Type:	<u>N/A</u>		
Diameter: 2"	Length: <u>N/A</u>		
TOTAL DEPTH OF WELL:	<u>12'</u>		
INITIAL WATER LEVEL:	<u>2.5'</u>		
FILTER PACK:			
Material:	<u>SAND</u>		
Amount used:	<u>1 BAG</u>		
Total thickness:	<u>11'</u>		
BENTONITE:			
Type:	<u>BENTONITE HOLE PLUG</u>		
Size:	<u>3/8"</u>		
Amount used:	<u>1 BAG</u>		
GROUT:			
Type:	<u>CEMENT</u>		
Amount used:	<u>1 BAG</u>		
WELL DEVELOPMENT			
Method:	<u>PUMP AND SURGE</u>		
Development Time:	<u>~30 MIN</u>		

NOTES:

MALCOLM PIRNIE

Project: LARC 60 Maintenance Area	Boring: 6MW-5S	Page 1 of 1
Date: 06-Dec-02	Project Number: 0285-900	
Location: Fort Story, VA	Drilling Contractor: Fishburne Drilling	
Inspector: Tina Jung	Driller: Rollen Ross	
Elevation:	Drilling Equipment: Hollow Stem Auger	

Scale	SPT Sample		Sample Type	Sample Depth	Rec.	Sample Description	USCS	Remarks/ PID
	No.	Blows						
1'		10			70	Top 5": Silty fine sand, roots, 10YR3/2 Remainder: Medium sand, well sorted, loose, 10YR6/6	SP	10:15
2'		6 8 10						0
3'		6			60	Medium sand, well sorted, clean, 10YR6/6	SP	0
4'		10 13 8						
5'		10			65	Medium sand, well sorted, clean, 10YR6/6 6" from top: Medium sand, well sorted, clean, 10YR4/1, 6" layer Remainder: Medium sand, well sorted, clean, 10YR6/6	SP	0
6'		6 6 9						
7'		7			75	Top-3": Medium sand, with silty fine sand patches, well sorted, clean, 10YR6/6, pebble Next: Medium sand, well sorted, clean, 10YR6/6 Half point: Medium-coarse sand, well sorted, clean, 10YR6/6, with intermittent stained seams, 7.5YR5/8	SP	WET
8'		5 4 4						(lower half) 0
9'		5			80	Medium-coarse sand, organic matter, brick fragment, 7.5YR6/1	SP	0
10'		6 7 7						
11'		2			45	Medium-coarse sand, 7.5YR6/1	SP	0
12'		2 2 3						
13'		3			80	Medium-coarse sand, organic matter, occasional pebbles, 7.5YR6/1 Bottom 6": Medium-coarse sand, organic matter, occasional pebbles, 10YR3/6	SP	0
14'		6 10 14						
15'		4			80	Medium sand, well sorted, clean, 10YR6/3, some organic matter Bottom 3": Medium-coarse sand, well sorted, clean, 10YR6/3	SP	0
16'		6 6 7						
17'								
18'								
19'								
20'								

Notes:

MALCOLM PIRNIE

Project: LARC 60 Maintenance Area	Boring: 6MW-5D	Page 1 of 2
Date: 06-Dec-02	Project Number: 0285-900	
Location: Fort Story, VA	Drilling Contractor: Fishburne Drilling	
Inspector: Tina Jung	Driller: Rollen Ross	
Elevation:	Drilling Equipment: Hollow Stem Auger	

Scale	SPT Sample		Sample Type	Sample Depth	Rec.	Sample Description	USCS	Remarks/ PID
	No.	Blows						
1'		8			50	Top half: Silty fill, dark brown Remainder: Medium sand, well sorted, loose, light brown, 10YR7/4	SP	0
2'		8 8 8						
3'		8			50	Medium sand, well sorted, loose, light brown, 10YR7/4	SP	16
4'		6 7 9						
5'		6			30	Medium sand, well sorted, loose, light brown, 10YR7/4, dark patches	SP	2.7
6'		10 13 14						
7'		17			45	Medium sand, well sorted, loose, light brown, 10YR7/4	SP	11:25AM
8'		12 11 8						11.6
9'		7			40	Medium sand, well sorted, loose, light brown, 10YR6/6 4" from top: Med fine sand, 10YR6/1, 1cm layer Next: organic matter layer Remainder: Medium-coarse sand, well sorted, clean, 10YR6/1	SP	WET (last 6")
10'		5 7 7						22
11'		4			75	Medium-coarse sand, well sorted, clean, 10YR6/1 Lower half: Medium sand, well sorted, clean, 10YR6/1	SP	>300
12'		3 6 4						
13'		7			75	Medium-coarse sand, well sorted, clean, 10YR6/1	SP	>100
14'		7 7 13 16						
15'		7			85	Medium-coarse sand, well sorted, clean, 10YR5/3, some organic matter, some pebbles	SP	1300
16'		6 8 14						
17'		9			75	Medium-coarse sand, well sorted, clean, 10YR5/3, some organic matter, some pebbles, silty chunks (approx 0.75" diam) at half point Lower 6": Medium sand, well sorted, clean, 10YR5/3	SP	47
18'		13 13 16						
19'		16			50	Coarse sand, poorly sorted, 10YR5/2	SW	
20'		24 19 21						

Notes:

MALCOLM PIRNIE

Project: LARC 60 Maintenance Area	Boring: 6MW-5D	Page 2 of 2
Date: 06-Dec-02	Project Number: 0285-900	
Location: Fort Story, VA	Drilling Contractor: Fishburne Drilling	
Inspector: Tina Jung	Driller: Rollen Ross	
Elevation:	Drilling Equipment: Hollow Stem Auger	

Scale	SPT Sample		Sample Type	Sample Depth	Rec.	Sample Description	USCS	Remarks
	No.	Blows						
21'		12			?	Coarse to medium sand, poorly sorted, organic matter, 10YR6/2		5.7
22'		17 20 23						
23'		15			80	Coarse to medium sand, poorly sorted, organic matter, 10YR6/2, two large pebbles at bottom		33
24'		15 21 27						
25'		6			25	Medium sand, clean, organic matter, 10YR5/2		12:06PM 130
26'		14 24 26						
27'		14			0	No recovery		
28'		16 19 23						
29'		14			90	Medium sand, becomes progressively more coarse towards bottom, 10YR5/1 Bottom 6": Coarse to medium sand, poorly sorted	SP	<20
30'		26 29 19					SW	
31'		21			40	Medium sand, well sorted, clean, organic matter, 10YR5/1 and 10YR5/2 Bottom 6": layer colours interspersed,		>900
32'		30 36 42						
33'		25			70	Medium sand, well sorted, clean, some gravel, 10YR5/2 6" from top: same, but colour change, gley2 5/5PB Last 3": silty fine sand, gley 2 5/5PB		30
34'		32 38 44						
35'		3			75	Medium sand, well sorted, clean, 10YR6/1 10" from bottom: Interspersed layers of silty fine sand and medium sand, gley2 4/5PB		30
36'		2 2 6						
37'		7			70	Medium sand, well sorted, gley2 4/5PB		40
38'		17 24 26						
39'		8			60	Top 6": Medium-fine sand, well sorted, clean, gley2 4/5PB Remainder: Medium sand, well sorted, clean, gley2 4/5PB		40
40'		12 18 21						

Notes:

MALCOLM PIRNIE

Project: LARC 60 Maintenance Area	Boring: 6MW-6	Page 1 of 1
Date: 06-Dec-02	Project Number: 0285-900	
Location: Fort Story, VA	Drilling Contractor: Fishburne Drilling	
Inspector: Tina Jung	Driller: Rollen Ross	
Elevation:	Drilling Equipment: Hollow Stem Auger	

Scale	SPT Sample		Sample Type	Sample Depth	Rec.	Sample Description	USCS	Remarks/ PID
	No.	Blows						
1'		7			75	Medium sand, well sorted, roots, 10YR4/3 Half point: silty fine sand, 1" layer, black 10YR3/1 Remainder: Medium sand, well sorted, black staining immediately below silty fine sand layer, 10YR6/4	SP	4.6
2'		7 6						
3'		13			60	Medium sand, well sorted, clean, 10YR7/4	SP	30
4'		11 11 8						
5'		9			0	Rock stuck in end		
6'		7 6 6						
7'		4			50	Medium sand, well sorted, clean, 10YR7/4 3" from top: medium-fine sand, black staining Remainder: Medium sand, well sorted, clean, 10YR7/2, wet	SP	WET
8'		6 6 5						48
9'		4			20	Medium sand, well sorted, clean, 10YR5/3	SP	
10'		3 4 4						
11'		5			55	Medium-coarse sand, well sorted, clean, 10YR6/2, with silty orange small chunks, 7.5YR6/8	SP	0
12'		5 8 8						
13'		8			75	Medium-coarse sand, well sorted, clean, 10YR6/2 Half point: Medium sand, well sorted, clean, 10YR7/1	SP	9:30AM
14'		6 4 4						0
15'								
16'								
17'								
18'								
19'								
20'								

Notes:

MALCOLM PIRNIE

Project: LARC 60 Maintenance Area	Boring: 6MW-7	Page 1 of 1
Date: 06-Dec-02	Project Number: 0285-900	
Location: Fort Story, VA	Drilling Contractor: Fishburne Drilling	
Inspector: Tina Jung	Driller: Rollen Ross	
Elevation:	Drilling Equipment: Hollow Stem Auger	

Scale	SPT Sample		Sample Type	Sample Depth	Rec.	Sample Description	USCS	Remarks/ PID
	No.	Blows						
1'		4			45	Top- 4": Medium sand, roots, pebbles, loose Remainder: Medium sand, well sorted, clean, moist, few pebbles, 10YR6/4	SP	2:20PM 5.4
		4						
		4						
2'		4						
3'		3			25	Medium sand, well sorted, clean, moist, few pebbles, 10YR6/4	SP	19
		3						
		4						
		3						
5'		1			40	Top 2-4": Medium sand, well sorted, clean, moist, few pebbles, 10YR5/2 Medium sand, well sorted, clean, moist, few pebbles, 10YR6/4	SP	11.7
		1						
		1						
6'		1						
7'		2			60	Medium sand, well sorted, clean, moist, few pebbles, 10YR6/4 At 5" from top: Same, with mottling, 10YR4/6, 10YR3/6, 10YR6/3 Bottom 6": medium-coarse sand, wet	SP	WET (approx 7.5ft)
		2						
		2						
8'		2						
9'		3			40	Top-1": Medium sand, with pebbles, roots 1-3": asphalt Remainder: Medium sand, well sorted, clean, 10YR6/3	SP	
		3						
		2						
10'		3						
11'		2			70	Top-6": Medium sand, roots, asphalts chunks Remainder: Medium sand, well sorted, clean, 10YR6/4	SP	
		2						
12'		4						
13'		3			50	Top-4": Medium sand, with coarse sand (<3%), roots Remainder: Medium sand, well sorted, clean, 10YR6/4	SP	
		3						
14'		3						
15'		4			75	Medium-coarse sand, occasional coarse sand to gravel (<3%), asphalt bits, 10YR6/4		2:40PM
		6						
16'		12						
17'								
18'								
19'								
20'								

Notes:

MALCOLM PIRNIE

Project: LARC 60 Maintenance Area	Boring: 6MW-8	Page 1 of 1
Date: 06-Dec-02	Project Number: 0285-900	
Location: Fort Story, VA	Drilling Contractor: Fishburne Drilling	
Inspector: Tina Jung	Driller: Rollen Ross	
Elevation:	Drilling Equipment: Hollow Stem Auger	

Scale	SPT Sample		Sample Type	Sample Depth	Rec.	Sample Description	USCS	Remarks/ PID
	No.	Blows						
1'		6			90	Top-2": Medium sand, gravels, roots Next 2": Fine to medium sands, pebbles, roots Next 3-4": Top soil, dry, dark brown Next 3-4": Medium sand, well sorted, clean	SP	3:01PM
2'		8 8 14						
3'		9			55	Top-8": Medium sand, roots, 10YR6/6 Next 1-2": Black stained fine sand Remainder: Medium sand, roots, 10YR6/6	SP	
4'		7 7 7						
5'		5			65	Top-4": Medium sand, roots, 10YR6/6, intermittent black to dark brown staining Remainder: Medium sand, roots, 10YR6/6, with a little 10YR6/8 colour below the black stained area	SP	
6'		6 7 9						
7'		4			60	Medium sand, roots, 10YR6/6, with bits of black staining, occasional 7.5YR5/8 stains	SP	WET at bottom end
8'		6 8 8						
9'		3			50	Medium sand, well sorted, clean	SP	
10'		3 5 5						
11'		2			55	Medium sand, clean Top 4" only: With gravels (approx. 10%)	SP	
12'		2 3 3						
13'		4			80	Coarse to medium sand, poorly sorted, 10YR5/2 Half point: Medium sand, well sorted, clean, 10YR7/1	SW SP	
14'		4 6 9						
15'		7			80	Medium sand, with coarse to gravels (approx. 15%), 10YR6/2, asphalt bits at bottom	SP	
16'		7 6 9						
17'		4			85	Medium sand, few gravels, 10YR6/2	SP	
18'		4 5 6						
19'								
20'								

Notes:

MALCOLM PIRNIE

Project: LARC 60 Maintenance Area	Boring: 6MW-9	Page 1 of 1
Date: 05-Dec-02	Project Number: 0285-900	
Location: Fort Story, VA	Drilling Contractor: Fishburne Drilling	
Inspector: Tina Jung	Driller: Rollen Ross	
Elevation:	Drilling Equipment: Hollow Stem Auger	

Scale	SPT Sample		Sample Type	Sample Depth	Rec.	Sample Description	USCS	Remarks/ PID
	No.	Blows						
1'		11			45	Top 5": Silty clay, roots, dry, low plasticity, 10YR4/2 Remainder: Medium-coarse sand, well sorted, brown with orange mottling, 10YR7/3 and 7.5YR6/8	SP	12:41PM 7.9
2'		11 8 11						
3'		9			75	Medium sand, well sorted, clean, 10YR7/3	SP	9.5
4'		9 8 5						
5'		2			25	Medium sand, well sorted, clean, 10YR6/2	SP	WET 11.5
6'		3 4 4						
7'		3			75	Medium sand, well sorted, clean, 10YR6/2	SP	11.9
8'		3 6 4						
9'		4			45	Medium-coarse sand, well sorted, clean, 10YR6/1, trace roots, odour 4: from top: Silt seams	SP	6
10'		6 6 4						
11'		5			55		SP	2.6
12'		5 5 5						
13'		5				Medium-coarse sand, well sorted, clean, 10YR6/1, trace roots	SP	1:02PM 5.8
14'		6 7 7						
15'								
16'								
17'								
18'								
19'								
20'								

Notes:

GROUNDWATER LEVEL MEASUREMENT SHEET

PROJECT INFORMATION					
Site Name	LARC 60 Maintenance Area	Date	January 29, 2003		
Project Name	Groundwater Treatability Study	Personnel	G. Perlas/ Allen Long		
Project No.	0285-900	Equipment Type	SOLINIST 101		
WEATHER CONDITIONS					
Temp. Range	45 to 50 F	Precipitaton	Light showers		
Pressure		Humidity	High		
WELL DATA					
Well or Piezometer I.D.	Measurement Time	Elevation of Reference Point (ft)	Water Level Indicator Reading (ft)	Adjusted Depth (ft)	Groundwater Elevation (ft) Mean Sea Level
6MW-1	1425	11.42	5.92		5.50
6MW-2	1350	13.52	6.58		6.94
6-MW3S	1435	9.86	4.55		5.31
6-MW3D	1440	10.09	4.73		5.36
6MW-4	1505	6.98	3.01		3.97
6MW-5S	1405	12.12	7.11		5.01
6-MW-5D	1400	12.15	7.13		5.02
6MW-6	1355	11.05	6.00		5.05
6MW-7	1415	12.74	7.66		5.08
6MW-8	1445	11.77	7.48		4.29
6MW-9	1455	5.85	3.10		2.75
MW-115	1430	9.45	4.02		5.43
MW-117	1345	16.01	9.15		6.86
MW-118	1340	13.24	6.01		7.23