LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS

ADMINISTRATIVE RECORD

Volume 10 of 16

2011

Bate Stamp Numbers
00107066 – 00108016

Prepared for

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Longhorn Army Ammunition Plant

1976 – 2011

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
ADMINISTRATIVE RECORD – CHRONOLOGICAL INDEX

VOLUME 10 of 16

2011

A. Title: Report (continued)– Final Feasibility Study LHAAP-47, Plant 3 Area, Group 4, Longhorn Army Ammunition Plant, Karnack, Texas
Author(s): Shaw Environmental, Inc., Houston, Texas
Recipient: All Stakeholders
Date: July 27, 2011
Bate Stamp: 00107066 – 00107542

B. Title: Report – Final Remedial Design LHAAP-35B(37), Chemical Laboratory and LHAAP-67, Aboveground Storage Tank Farm, Longhorn Army Ammunition Plant, Karnack, Texas
Author(s): U.S. Army
Recipient: All Stakeholders
Date: August 1, 2011
Bate Stamp: 00107543 – 00108016

00107066

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: Site 47
Weather: clear, 50s

Sampling location ID: 47WW08
Sample ID: NA
Collection Time/Date: NA 11-29-07

Pump Installation

Pump installation crew: A. Willmore / D. Haines
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 21.38
Initial (pre-installation) DTW/time: DRY
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.):
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

Installation date/beginning time: DRY
Installation date/completion time:
Screen Interval (ft. BTOC): 11 to 21
Pump intake depth (ft BTOC): NA
Post-installation DTW/time:
Max. sustainable pump rate (mL/min): DRY
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

DRY

Purging

Purging/sampling crew: A. Willmore / D. Haines
Purge date/beginning time: NA
Initial (pre-purging) DTW (ft. BTOC): NA
Calculated tubing + pump volume: NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

PID/FID reading (well head/background):
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC): DRY
No. of tubing + pump volumes purged:

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

PURGED DRY DRY

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

PURGED DRY

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47WW08

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

DRY

Sampling

Sampling beginning time: NA

Sampling completion time: NA

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY

Sample Information

Sample ID: 47WW08

Sample collection date/time: NA

Duplicate sample collected (Y/N): NA

Duplicate sample ID:

Split sample collected (Y/N):

Split sample ID:

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

DRY

Comments:

Well is DRY

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107068

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP
Weather: clear 60s

Sampling location ID: 47WW09
Sample ID: 47WW09-113007
Collection Time/Date:

Pump Installation

Pump installation crew: A. Willmore / D. Haines
PID/FID reading (well head/background): 2.2
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 41'
Initial (pre-installation) DTW/time: 21.37
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.): 39'

Installation date/beginning time: 11/30/07 10:40
Installation date/completion time: 11/30/07 10:41
Screen Interval (ft. BTOC): 31 to 41
Pump intake depth (ft BTOC): 36'
Post-installation DTW/time: 21.34
Max. sustainable pump rate (mL/min): 100
Appearance of product: None
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NR psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)						11/30/07			

Purging

Purging/sampling crew: A. Willmore / D. Haines
Purge date/beginning time: 11/30/07 10:45
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.8
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	22								22
Refill Setting	10								10
Discharge Setting	5								5
Flow rate (mL/min)	160								

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
10:50	21.69	100	0.5	17.10	4.336	7.00	-19.9	1.01	0.0
10:55	21.67	100	1.0	17.11	4.344	6.99	-23.7	1.03	0.0
11:00	21.69	100	1.5	17.15	4.346	6.99	-24.8	1.01	0.0
11:05	21.69	100	2.0	17.23	4.349	6.99	-24.7	0.80	0.0
11:10	21.69	100	2.5	17.32	4.361	6.98	-24.5	0.58	0.0
11:15	21.69	100	3.0	17.34	4.362	6.99	-24.4	0.52	0.0
11:20	21.67	100	3.5	17.40	4.360	6.98	-24.3	0.44	0.0
11:25	21.69	100	4.0	17.46	4.357	6.98	-24.3	0.40	0.0

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

11/30/09

10-20

Sampling

Sampling beginning time: 11:30 Sampling completion time: 11:50

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
11:55	21.69	100	6.5	17.58	4.339	6.99	-24.6	0.49	0.0

Sample Information

Sample ID: 47WW09-113007

Sample collection date/time: 11-30-09

Duplicate sample collected (Y/N): Y

Duplicate sample ID: 47WW09-113007-QA

Split sample collected (Y/N): N

Split sample ID:

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
Metals - Filter @ lab		2-500 mL plastic			
Metals - Unfiltered		2-500 mL plastic			
TSS/TDS		2-500 mL plastic			

Comments: Sampled w/ Stainless Steel-cased bladder pump w/ HDPE bladder.

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

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GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: Site 47
Project Name/#: LHAAP
Weather: clear 50s

Sampling location ID: 47WW13
Sample ID: ~~47WW13-112907~~ 47WW13-113007
Collection Time/Date: 09:30 11/30/07

Pump Installation

Pump installation crew: A. Willmore / D. Haines
PID/FID reading (well head/background): 54.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): ~21
Initial (pre-installation) DTW/time: 11.81
Final (after pump priming) DTW/time: 12.10
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): 19

Installation date/beginning time: 11/29/07 14:29
Installation date/completion time: 11/29/07 14:31
Screen Interval (ft. BTOC): 11 to 21
Pump intake depth (ft BTOC): 16'
Post-installation DTW/time: 11.81
Max. sustainable pump rate (mL/min):
Appearance of product: None
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

11/29/07

Purging

Purging/sampling crew: A. Willmore / D. Haines
Purge date/beginning time: 11/29/07 14:25
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 54.0
Purge date/completion time: 11/29/07
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

11/29/07

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
11/29/07 14:35	12.1	120	~~0.00~~ 0.00	22.53	0.215	6.00	301.1	1.80	58.9
14:40	12.4	120	1.20	22.62	0.215	6.07	303.5	2.09	57.7
←		CONTINUED	PURGING	NEXT DAY					→
			Bailed	dry.	well	would	not		
				recharge					

00107071

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

11/30/07

Sampling

Sampling beginning time: 0:930 Sampling completion time: 09:35

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (gal/L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
09:16	NR	NA	~~8.9~~ gal.	22.20	0.212	5.78	410.7	2.88	1240

Sample Information

Sample ID: ~~47WW13-113007~~ 47WW13-113007 Sample collection date/time: 11/30/07 09:30

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
TSS/TDS		1-500 mL			
Metals - Dissolved		1-500 mL			
Metals - Undissolved		1-500 mL			

Comments: Purge w/ peristaltic pump, HAD to bail dry @ 9:00

Odor noticed

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107072

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: Site 47
Project Name/#: LHAAP
Weather: clear, 70s

Sampling location ID: 47WW19
Sample ID: 47WW19-113007
Collection Time/Date: ~~1442~~

Pump Installation

Pump installation crew: A. Willmore / D. Haynes
PID/FID reading (well head/background): 5.1
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): ~53'
Initial (pre-installation) DTW/time: 21.31
Final (after pump priming) DTW/time: 21.31
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NR
Discharge tube length (ft.): 56'

Installation date/beginning time: 11/30/07 13:40
Installation date/completion time: 11/30/07 13:42
Screen Interval (ft. BTOC): 43 to 53
Pump intake depth (ft BTOC): 48'
Post-installation DTW/time: 21.29
Max. sustainable pump rate (mL/min): 200
Appearance of product: No
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NR psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting					11/30/07				
Flow rate (mL/min)									

Purging

Purging/sampling crew: A. Willmore / D. Haines
Purge date/beginning time: 11/30/07 13:45
Initial (pre-purging) DTW (ft. BTOC): 21.29
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 5.1
Purge date/completion time: 11/30/07
Final (post-purging) DTW (ft. BTOC): 21.44
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	33								33
Refill Setting	10								10
Discharge Setting	5								5
Flow rate (mL/min)	200								200

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
13:50	21.44	200	1	NR	3.010	6.60	87.3	4.85	132.2
14:20	21.44	200	7	18.64	2.709	6.64	194.1	5.86	20.3
14:25	21.44	200	8	18.62	2.709	6.64	199.6	5.89	17.0
14:30	21.44	200	9	18.62	2.708	6.64	202.5	5.80	16.1
14:35	21.44	200	10	18.61	2.709	6.64	201.1	5.85	16.1
14:40	21.44	200	11	18.60	2.709	6.64	202.0	5.84	15.4

00107073

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

10 - e 20

11/30/07

Sampling

Sampling beginning time: 14:45 Sampling completion time: 14:50

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
14:55	21.44	200	12.5	19.47	2.710	6.63	213.2	6.19	9.3

Sample Information

Sample ID: 47WW19 - 113007 Sample collection date/time: 11/30/07

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
TSS/TDS		1-500 mL plastic			
Metals - Filtered		1-500 mL plastic			
Metals - Unfiltered		1-500 mL plastic			

Comments: Purged w/ bladder pump.

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107074

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: Site 47
Project Name/#: LNAPL
Weather: Clear - 50s to 60s

Sampling location ID: 47ww22
Sample ID: 47ww22-112907
Collection Time/Date: 13:30 11/29/07

Pump Installation

Pump installation crew: A. Willmore / D. Haines
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 22.35
Initial (pre-installation) DTW/time: NA
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: NA
Installation date/completion time: NA
Screen Interval (ft. BTOC): 12 to 22
Pump intake depth (ft BTOC): NA
Post-installation DTW/time: NA
Max. sustainable pump rate (mL/min): NA
Appearance of product: No
Discharge tube diameter (3/8" or 1/4"): NA
Inlet reducer used (Y/N): NA

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = NR psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

11/29/07

Purging

Purging/sampling crew: A. Willmore / D. Haines
Purge date/beginning time: 11/29/07 12:25
Initial (pre-purging) DTW (ft. BTOC): 22.35
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.0
Purge date/completion time: 11/29/07
Final (post-purging) DTW (ft. BTOC): ~22
No. of tubing + pump volumes purged: NR

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = NR psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)			Bailed		Dry				

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Bailed Dry

00107075

GROUNDWATER SAMPLING FORM

Sheet 2 of 3

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

Bailed Dry

11/29/07

Sampling

Sampling beginning time: 13:30 Sampling completion time: 13:34

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
13:35	~DD		1.5	18.40	7.306	5.94	128.4	3.98	1224.3

Sample Information

Sample ID: 47WW22 Sample collection date/time: 11/29/07

Duplicate sample collected (Y/N): No Duplicate sample ID: NA

Split sample collected (Y/N): No Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
Metals - Filt		1 - 500 mL plastic			
Metals - Unfilt		1 - 500 mL plastic			
TSS/TDS		1 - 500mL plastic			

Comments: Bailed dry

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107076

Shaw® Shaw Environmental, Inc.

3010 Briarpark Drive, Suite 4N
Houston, TX 77042 (713) 996-4400

CHAIN-OF-CUSTODY

No. 10722

Laboratory Name: Kemron Address: 156 Starlite Drive Marietta, Ohio Contact: Stephanie Mossburg

Project Name LHAAP Project Location Ivanhoe, Tx

Project No. 117591.0004A130 Project Contact Allen Willmore Project Telephone No. 713 247 9242

Point of contact: Larry Duty Project Manager/Supervisor: Praveen Srivastav

Telephone No. 713-996-4586

Item No.	Sample Number	Date	Time	Comp	Grab	Matrix	Sample Description, Location	Number of Containers	TAL Metals - Dissolved	TAL Metals To Be FILTERED	TSS / TDS - same container					Remarks
1	47WW09-113007	11/20/07	11:30		✓	W	LHAAP-47	3	X	X	X					* Metals To be filtered @ lab.
2	47WW09-113007-QA	11/20/07	11:30		✓	W	LHAAP-47	3	X	X	X					Duplicate
3	47WW19-113007	11/20/07	14:45		✓	W	LHAAP-47	3	X	X	X					
4	47WW13-113007	11/20/07	15:45		✓	W	LHAAP-47	3	X	X	X					47WW13-113007
5	47WW22-112907	11/29/07	13:30		✓	W	LHAAP-47	3	X	X	X					
6																
7																
8																
9																
10																

Transfers Relinquished By (Signature)	Date/Time	Transfers Accepted By (Signature)	Date/Time
	12/3/07 09:30		
		Laboratory	

Special Instructions: * Metals To be filtered @ lab. 7-day TAT

FedEx Airbill No.:

Sampler's Signature

TAT: 7 day Standard ____ Rush Due: ___ Seals Intact? ____ Y ____ N Received Good Condition ____ Y ____ N ____ Cold

White - Lab Copy Canary - Field Copy Pink - File Copy

00107077

Shaw® Shaw Environmental, Inc.

3010 Briarpark Drive, Suite 4N
Houston, TX 77042 (713) 996-4400

CHAIN-OF-CUSTODY

No. 10345

Laboratory Name: Kemron | Address: 156 Starlite Drive, Marietta, Ohio 45750 | Contact: Stephanie Mossburg

Project Name: LHAAP | Project Location: Karnack, Texas

Project No.: 117591.2009A130 | Project Contact: Allen Willmore | Project Telephone No.: (713) 247-9292

Point of contact: Larry Duty | Telephone No.: (713) 996-4547

Project Manager/Supervisor: Praveen Srivastav

Analysis and Method Desired (Indicate separate containers)

Item No.	Sample Number	Date	Time	Comp	Grab	Matrix	Sample Description, Location	Number of Containers	TAL Metals (filtered & unfiltered)	TSS/TDS	Perchlorate 314	VOCs 8260				Remarks
1	47WW08-101707	10/17/07	0810		✓	W	47WW08, LHAAP-47	2	X	X						
2	LHSMW54-101707	10/17/07	12:90		✓	W	LHSMW54, LHAAP-47	4			X	X				
3	47WW03-101707	10/17/07	16:30		✓	W	47WW03, LHAAP-47	3			X					
4	47WW09-101607	10/16/07	15:50		✓	W	47WW09, LHAAP-47	2	X	X						
5	47WW13-101607	10/16/07	16:20		✓	W	47WW13, LHAAP-47	2	X	X						
6	47WW19-101707	10/17/07	10:68		✓	W	47WW19, LHAAP-47	2	X	X						
7	47WW28-101707	10/17/07	0855		✓	W	47WW28, LHAAP-47	4			X	X				
8	47WW29-101707	10/17/07	1330		✓	W	47WW29, LHAAP-47	3				X				
9	47WW09-101607-FD	10/16/07	15:50		✓	W	47WW09, LHAAP-47	2	X	X						Field Duplicate
10																

Please filter metals

TRIP BLANK INCL.

Transfers Relinquished By (Signature)	Date/Time	Transfers Accepted By (Signature)	Date/Time
[signature]	10/17/07 17:00		
		Laboratory	

Special Instructions: Please filter metals
7-day TAT

FedEx Airbill No.:

Sampler's Signature: [signature]

TAT: ____ Standard ____ Rush Due: ___ Seals Intact? ____ Y ____ N Received Good Condition ____ Y ____ N ____ Cold

White - Lab Copy Canary - Field Copy Pink - File Copy

00107078

Chain of Custody

NO. 10304

Shaw® Shaw Environmental & Infrastructure, Inc.
3010 Briarpark Drive, Suite 400
Houston, TX 77042
(713) 996-4400

Laboratory Name: Kemron Address: 159 Starlite Drive, Marietta, Ohio Contact: Stephanie Mastburg

Project Name: LHAAP Project Location: Karnack, Texas

Project No.: 117591.0009A130 Project Contact: Allen Willmore Project Telephone No.: (713) 247-9292

Point of Contact: Larry Dunn Telephone No.: 713 986-4547

Project Manager/Supervisor: Praveen Srivastava

Analysis and Method Desired (Indicate separate containers)

Item No.	Sample Number	Date	Time	Comp	Grab	Matrix	Sample Description, Location	Number of Containers	VOCs 8260	Remarks
1	47MW18-101807	10/18/07	08:45		✓	W	47WW18	3	X	
2	47WW18-101807	10/18/07	08:45		✓	W	47WW18 Field Dup	3	X	Field Dup.
3	47WW32-101807	10/18/07	11:45		✓	W	47WW32	3	X	
4	47WW30-101807	10/18/07	10:32		✓	W	47WW30	3	X	
5	47WW36-101907	10/19/07	09:55		✓	W	LHSMW36	3	X	
6	47WW31-101807	10/18/07	11:50		✓	W	47WW31	3	X	
7	47WW25-101607	10/18/07	09:00		✓	W	47WW25	3	X	
8	LHSMW34-101807	10/18/07	16:45		✓	W	LHSMW34	3	X	
9	EQUIPMENT RINSE 1	10/19/07	17:00		✓	W	ER # 1	3	X	From Probe
10										

Transfers Relinquished By (signature)	Date/Time	Transfers Accepted By (signature)	Date/Time
Chris Mabo	10/19/07 13:00	[signature]	10/19/07 13:00
[signature]	10/22/07 11:30		

Special Instructions: 7-day TAT

FedEx Airbill No.:

Laboratory

Sampler's Signature: Chris Mabo

TAT: _____ Standard _____ Rush Date _____ Seals Intact? _____ Y _____ N Received Good Condition _____ Y _____ N _____ Cold

White - Lab Copy Canary - Field Copy Pink - File Copy

Form Number: 433_1
Rev. 03-19-07

00107079

Chain of Custody

NO. 10305

Shaw® Shaw Environmental & Infrastructure, Inc.
3010 Briarpark Drive, Suite 400
Houston, TX 77042
(713) 996-4400

Laboratory Name: Kemron Labs Address: 154 Stanhope Drive Marietta, Ohio Contact: Stephanie Mossburg

Project Name: LHAAP Project Location: Karnack, Texas

Project No.: 117591.0009A130 Project Contact: Allen Williams Project Telephone No.: (713) 247-9292

Point of Contact: Larry Duty Telephone No.: (713) 996-4547

Project Manager/Supervisor: Praveen Srivastav

Item No.	Sample Telephone Number	Date	Time	Comp	Grab	Matrix	Sample Description, Location	Number of Containers	VOCs 8260	Perchlorate	TAL Metals *	TSS / TDS				Remarks
1	LHSMWS6-102007	10/20/07	08:10		✓	W	LHSMWS6	3	X							
2	47WW05-102007	10/20/07	08:50		✓	W	47WW05	3	X							
3	LHSMWL0-101807	10/18/07	15:50		✓	W	LHSMWL60	2		X						Field Duplicate + Rinse
4	47WW23-101907	10/19/07	09:45		✓	W	47WW23	3	X							
5	47WW27-101907	10/19/07	08:20		✓	W	47WW27	1		X						
6	47WW21-101807	10/18/07	14:20		✓	W	47WW21	6	X							Field Dup + Rinse Sample
7	47WW01-101807	10/18/07	10:15		✓	W	47WW01	3	X							
8	47WW04-101807	10/18/07	11:30		✓	W	47WW04	3	X							
9	47WW22-101807	10/18/07	09:55		✓	W	47WW22	5	X		X	X				
10	EQUIPMENT RINSE #2	10/22/07	14:20		✓	W	ERB2	2		X		X				From Bladder Pump

Transfers Relinquished By (signature)	Date/Time	Transfers Accepted By (signature)	Date/Time
	10/22/07 17:30		
		Laboratory	

Special Instructions: * The Metals are to be filtered @ lab. 7-day TAT

FedEx Airbill No.:

Sampler's Signature:

TAT: ____ Standard ____ Rush Date ____ Seals Intact? ____ Y ____ N Received Good Condition ____ Y ____ N ____ Cold

White - Lab Copy Canary - Field Copy Pink - File Copy

Form Number: 433_1
Rev. 03-19-07

00107080

GROUP	LOCATION	ALIAS (C		DTW	Date	Time	
AREA 35A	LHSMW07		LOW	17.89	12/02/07	12:15	
AREA 35B	35BWW01		LOW	18.24	12/01/07	14:27	
AREA 35B	35BWW02		LOW	dry	12/01/07	14:35	
AREA 35B	LHSMW58		LOW	22.41	12/1/07	14:12	21.31
~~AREA 35B~~	~~LHSMW59~~		~~RMEDIATE~~				ABANDONED
AREA 50	50WW01		LOW	18.14	12/01/07		
AREA 50	50WW02		LOW	20.69	12/01/07	14:23	
AREA 50	50WW03		LOW	21.57	12/01/07	14:46	
AREA 50	50WW04		~~LOW~~	18.67	12/01/07	14:51	
AREA 50	50WW06	50WW05	~~LOW~~	18.01	12/01/07	14:48	
AREA 67	67WW01	G4WW01	LOW	23.96	12/02/07	09:00	
AREA 67	67WW02	G4WW02	LOW	22.61	12/02/07	08:57	
AREA 67	67WW03	G4WW03	LOW	23.28	12/03/07	09:03	
AREA 67	67WW04		LOW	dry	12/02/07	08:52	
AREA 67	67WW05		LOW	23.23	12/02/07	08:47	
AREA 67	67WW06		RMEDIATE	23.96	12/02/07	09:08	
AREA 67	67WW07		LOW	23.97	12/03/07	09:06	
AREA 46	46WW01		LOW	dry	12/03/07	11:01	
AREA 46	46WW02		RMEDIATE	32.10	12/03/07	11:08	
AREA 46	46WW03			36.15	12/02/07	11:07	
AREA 46	46WW04		LOW	22.68	12/02/07	11:43	
AREA 46	LHSMW08		RMEDIATE	25.61	12/02/07	09:29	DH?
AREA 46	LHSMW09		LOW	21.50	12/2/07	09:39	TREE FELL; DRUM PAD BOARD; WELL OK
AREA 46	LHSMW11		LOW	23.10	12/02/07	10:50	
AREA 46	LHSMW12		LOW	dry	12/03/07	10:48	
AREA 46	LHSMW13		LOW	dry	12/02/07	10:46	
AREA 46	LHSMW14		LOW	13.94	12/02/07	11:35	
AREA 46	LHSMW15		LOW	dry	12/02/07	11:24	
AREA 46	LHSMW16		LOW	17.00	12/02/07	11:28	
AREA 46	LHSMW17		LOW	26.49	12/03/07	10:57	
AREA 46	LHSMW18		LOW	22.97	12/02/07	10:59	
AREA 46	LHSMW19		LOW	dry	12/02/07	11:14	
AREA 46	LHSMW20		LOW	22.17	12/02/07	10:33	
AREA 46	LHSMW21		LOW	19.74	12/02/07	10:31	DH?
AREA 46	LHSMW22		LOW	25.83	12/02/07	10:38	
AREA 46	LHSMW23		RMEDIATE	27.33	12/02/07	10:41	
AREA 46	LHSMW24		LOW	23.00	12/2/07	10:22	
AREA 46	LHSMW25		RMEDIATE	25.41	12/2/07	10:19	
AREA 46	LHSMW26		LOW	26.37	12/2/06	09:43	DH?
AREA 46	LHSMW27		LOW	DRY	12/03/07	09:40	
AREA 47	105		LOW	20.25	11/30/07	15:33	2" well
AREA 47	47WW01		LOW	19.12	11/30/07	08:13	
AREA 47	47WW02		LOW	19.76	12/1/07	09:11	
AREA 47	47WW03		LOW	20.15	~~11/30/07~~	08:20	
AREA 47	47WW04		LOW	15.80	11/30/07	16:21	
AREA 47	47WW05		LOW	26.78	11/30/07	15:59	
AREA 47	47WW06		RMEDIATE	21.27	11/30/07	15:57	
AREA 47	47WW07			22.75	11/30/07	15:56	
AREA 47	47WW08		LOW	DRY	11/29/07	NR	21.36=TD
AREA 47	47WW09		RMEDIATE	21.37	11/29/07	NR	21.37
AREA 47	47WW11		LOW	21.95	11/30/07	15:26	

00107081

Drilling Log

Monitoring Well **47WW32**

Project *Longhorn Army Ammunition Plant* Owner *USACE*

Location *Karnack, Texas* Proj. No. *117591*

Surface Elev. *191.1 ft.* Total Hole Depth *34.0 ft.* North *6961495.38307 ft.* East *3311345.92196 ft.*

Top of Casing *193.82 ft.* Water Level Initial ▽ *14.5 ft.* Static *NA* Diameter *6 in.*

Screen: Dia *2 in.* Length *10 ft.* Type/Size *PVC/2 in.*

Casing: Dia *2 in.* Length *22 ft.* Type *PVC*

Fill Material *20/40 SILICA SAND* Rig/Core *CME 75/SS*

Drill Co. *JEDI* Method *HOLLOW STEM*

Driller *OSCAR GARCIA* Log By *ALLEN WILLMORE* Date *9/13/07* Driller # *NA*

Checked By _____ License No. _____

COMMENTS

Depth (ft.)	Well Completion	PID (ppm)	Sample ID / % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) — Geologic Descriptions are Based on the USCS.	Elevation (ft.)
0							191.1186
2		0.0	100%		SC	SAND, VERY CLAYEY, DENSE, MODERATELY-SORTED, MOIST, NO ODOR, GRAY	190
4		0.0	100%				188
6		0.0	90%				186
8		0.0	100%		CL	CLAY, SILTY, HARD, LOW TO NO PLASTICITY, IRON STAINING (MOTTLING), DRY, NO ODOR	184
10		0.0	100%				182
12		0.0	90%				180
14 ▽		1.2	65%		SC	SAND, CLAYEY, POORLY-SORTED, LOOSE, SATURATED, NO ODOR	178
16		1.4	65%				176
18		0.0	85%				174
20		0.0	100%				172
22		0.0	75%				170
24		0.0	100%				168
26		0.0	85%				166
28		0.0	75%				164
30		0.0	75%				162
						END OF BORING	

Continued Next Page

MANCHACA Rev: 10/25/04 47WW32.GPJ 7/9/08

00107082

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Sample Collection Log

117591 - Longhorn Army Ammunition Plant

Manager: Praveen Srivastav

RFA / COC Number: 109166 / 109167

Location Code: 47WW09
Sample Number: 47WW09-FEB2007
Sample Name: 47WW09-GW-47WW09-FEB2007-REG
Sampling Method: SP
Sample Type: GW *Sample Purpose:* REG
Sampling Equip: BLADDER PUMP

Task: MNA_EVENT_FEB07
Collection Date: 2/21/07
Collection Time: 1422
Start Depth: 20.79
End Depth: 26.80
Sample Matrix: WATER
Sample Team: JLB / MM

QC Partners:
(TB) - 2/21/07 (ER) (FB)

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
VOC-FULL	N	A	3	40	mL	VOA VIAL
ANIONS	N	B	1	500	mL	HDPE
PERC	N	C	1	500	mL	HDPE
GASES	N	D	2	40	mL	VOA Vial
ALKALINITY	N	E	1	100	mL	HDPE
TOC_415	N	F	1	100	mL	HDPE
DHC	N	G	1	1	L	Amb. Glass
Sulfides	N	H	1	500	mL	HDPE

ERPIMS Values:
Sacode:
Lot Control#:

Groundwater Information:
Measured Well Depth: 41.20 **Depth To Water:** 20.79

Comments: FERROUS IRON: 0.0
Salinity: 2.57

Sketch Location:

Logged BY / Date: JLB 2/21/07 *Reviewed BY / Date:*

00107083

Shaw™
Shaw E & I, Inc.

Sample Collection Log

117591 - Longhorn Army Ammunition Plant
Manager: Praveen Srivastav

Location Code: **47WW09**
Sample Number: **47WW09-FEB2007**

PURGE RECORD:

Initial	Time(24hr)	DepthtoWater (ft)	Eh (mV)	pH (SU)	Conductivity (mS/cm)	Turbidity (NTU)	DissOxygen (ppm)	Temperature (C)	Purge Volume (gal)
Sample:	1502	26.80	116.5	7.37	4.800	16.3	2.02	19.26	6.25

2/21/07 JCB

Logged BY / Date: JCB 2/21/07 *Reviewed BY / Date:* _____

00107084

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: AREA 47
Project Name/#: LONGHORN AAP/117591
Weather: CLEAR 75°

Sampling location ID: 47WW09
Sample ID: 47WW09 FEB2007
Collection Time/Date: 2/21/07 1422

Pump Installation

Pump installation crew: JLB/MM
PID/FID reading (well head/background): 4.3 PPM
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 41.20
Initial (pre-installation) DTW/time: 20.79 @ 1245
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): 1000
Discharge tube length (ft.): 45'
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = 20 psi

Installation date/beginning time: 2/21/07 @ 1250
Installation date/completion time: ~~28' - 38'~~ 2/21/07 @ 1321
Screen Interval (ft. BTOC): 28' to 38'
Pump intake depth (ft BTOC): 33'
Post-installation DTW/time: 20.55 @ 1307
Max. sustainable pump rate (mL/min): 250
Appearance of product: NONE
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	20								20
Refill Setting	12								12
Discharge Setting	6.5								6.5
Flow rate (mL/min)	~~300~~ 250								250

Purging

Purging/sampling crew: JLB/MM
Purge date/beginning time: 2/21/07 1311
Initial (pre-purging) DTW (ft. BTOC): 20.55
Calculated tubing + pump volume: NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = 20 psi

PID/FID reading (well head/background): 4.3 PPM
Purge date/completion time: 2/21/07 @ 1503
Final (post-purging) DTW (ft. BTOC): 26.80
No. of tubing + pump volumes purged: 2.5 L

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	20								20
Refill Setting	12								12
Discharge Setting	6.5								6.5
Flow rate (mL/min)	~~250~~ 250								250

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1301	21.20	~~250~~ 250	0	19.30	4.085	7.08	27.1	1.40	51.2
1331	21.73	250	1.25	19.26	4.806	7.12	10.0	0.88	43.0
1336	22.0	250	2.50	19.26	4.803	7.14	6.3	0.79	37.9
1341	22.25	250	3.75	19.15	4.800	7.14	9.2	0.70	36.9
1346	22.55	250	5.0	19.05	4.787	7.17	13.8	0.65	34.0
1351	22.88	250	6.25	19.08	4.779	7.19	15.6	0.62	29.8
1356	23.14	250	~~7.50~~ 7.50	19.08	4.768	7.21	40.2	0.65	27.4
1401	23.45	250	8.75	19.06	4.765	7.22	63.7	0.65	24.9

1425

00107085

GROUNDWATER SAMPLING FORM

Sheet ___ of ___

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
1406	23.70	250	10	19.06	4.761	7.22	86.9	0.64	33.8
1411	23.93	250	11.25	19.09	4.761	7.22	60.0	0.64	24.4
1416	24.30	250	12.50	19.05	4.760	7.23	55.9	0.63	22.1
1421	24.63	250	13.75	18.96	4.762	7.22	66.9	0.63	21.1
MSS				PUL SAMPLES					

10 - esp nec / 20

2/21/07 JCB

Sampling

Sampling beginning time: 1422 Sampling completion time: 1503

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1502	26.80	250		19.26	4.800	7.37	116.5	2.02	16.3

2/21/07 JCB

Sample Information

Sample ID: 47WW09-FEB2007 Sample collection date/time: 2/21/07 @ 1422

Duplicate sample collected (Y/N): NONE Duplicate sample ID: NONE

Split sample collected (Y/N): NONE Split sample ID: NONE

COC No(s): 10916 / 10917

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC's - Full	8260B	3 VOA's	Sulfides	376.2	1-500 mL HDPE
Gases	175	3 VOA's	ANIONS	300.0	1-1000 mL HDPE
TOC	415.1	3 VOA's	DHC	—	2-1L Ambers
Percholate	314.0	1-500 mL HDPE			
Alkalinity	310.1	1-500 mL HDPE			

Comments: Ferrous IRON: 0.0
Salinity: 2.57

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107086

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Shaw E & I, Inc.

Sample Collection Log

117591 - Longhorn Army Ammunition Plant

Manager: Praveen Srivastav

RFA / COC Number: 10914 / 10915

Location Code: 47WW13
Sample Number: 47WW13-FEB2007
Sample Name: 47WW13-GW-47WW13-~~FEB2007~~-REG
Sampling Method: SP
Sample Type: GW *Sample Purpose:* REG
Sampling Equip: BLADDER PUMP

Task: MNA_EVENT_FEB07
Collection Date: 2/20/07
Collection Time: 1554
Start Depth: ~~20.85~~ 11.38
End Depth: 14.13
Sample Matrix: WATER
Sample Team: JCB/MM

QC Partners:
(TB) TB-02 (ER) N/A (FB) N/A

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
VOC-FULL	N	A	3	40	mL	VOA VIAL
ANIONS	N	B	1	~~500~~ 1000	mL	HDPE
PERC	N	C	1	500	mL	HDPE
GASES	N	D	3	40	mL	VOA Vial
ALKALINITY	N	E	1	~~100~~ 500	mL	HDPE
TOC_415	N	F	3	~~100~~ 40	mL	HDPE
DHC	N	G	2	1	L	Amb. Glass
Sulfides	N	H	1	500	mL	HDPE

ERPIMS Values:
Sacode:
Lot Control#:

Groundwater Information:
Measured Well Depth: 20.85 **Depth To Water:** 11.38

Comments: Ferrus Iron :
Salinity : 0.10

Sketch Location:

Logged BY / Date: JCB 2/20/07 *Reviewed BY / Date:*

00107087

Shaw™
Shaw E & I, Inc.

Sample Collection Log

117591 - Longhorn Army Ammunition Plant

Manager: Praveen Srivastav

Location Code: 47WW13
Sample Number: 47WW13- FEB 2007

PURGE RECORD:

Initial	Time(24hr)	DepthtoWater (ft)	Eh (mV)	pH (SU)	Conductivity (mS/cm)	Turbidity (NTU)	DissOxygen (ppm)	Temperature (C)	Purge Volume (gal)
Sample:	1635	14.13	404.0	5.95	0.203	1423.4	4.88	18.42	4.78

Logged BY / Date: JLB 2/20/07 *Reviewed BY / Date:* _____

00107088

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: AREA 47
Project Name/#: LONGHORN AAP
Weather: Cloudy 70°
Sampling location ID: 47WW13
Sample ID: 47WW13
Collection Time/Date: 02-20-07 / 1554

Pump Installation

Pump installation crew: JCB/mm
PID/FID reading (well head/background): 5.0/~~0.0~~
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 20.85
Initial (pre-installation) DTW/time: 11.38 @ 1054
Final (after pump priming) DTW/time: 11.63/1503
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): 1000
Discharge tube length (ft.): 35'
Installation date/beginning time: 2/20/07 @ 1447
Installation date/completion time:
Screen Interval (ft. BTOC): 8' to 18'
Pump intake depth (ft BTOC): 15'
Post-installation DTW/time: 11.28 @ 1447
Max. sustainable pump rate (mL/min): 450
Appearance of product: NONE
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = 30 psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	30	20	15						15
Refill Setting	10	10	10						10
Discharge Setting	5	5	5						5
Flow rate (mL/min)	450	225	200						200

Purging

Purging/sampling crew: JCB/mm
Purge date/beginning time: 2/20/07 @ 1453
Initial (pre-purging) DTW (ft. BTOC): 11.28
Calculated tubing + pump volume: NA
PID/FID reading (well head/background): 5.0
Purge date/completion time: 2/20/07 @ 1636
Final (post-purging) DTW (ft. BTOC): 14.13
No. of tubing + pump volumes purged: 19.127

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = 30 psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	30	20	15						15
Refill Setting	10	10	10						10
Discharge Setting	5	5	5						5
Flow rate (mL/min)	450	225	200						200

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1503	11.63	450	-0-	18.42	0.239	6.94	307.6	1.65	1698.3
1513	12.02	225	2.25	18.18	0.232	6.58	324.4	2.48	1694.3
1518	12.18	225	3.375	18.04	0.226	6.47	337.3	3.11	1668.7
1523	12.39	225	4.5	17.89	0.220	6.33	351.3	3.68	1466.1
1528	12.57	225	5.625	17.81	0.213	6.17	362.2	3.90	1262.1
1533	12.68	220	6.725	17.78	0.210	6.06	371.6	4.07	1145.0
1538	12.80	220	6.825	17.81	0.206	5.92	379.9	4.27	1085.8
1543	12.92	220	7.925	17.75	0.204	5.85	386.6	4.54	1089.7

00107089

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
1548	13.06	220	8.025	17.74	0.203	5.80	393.0	4.70	1098.9
1553	13.18	220	9.125	17.65	0.203	5.79	396.9	4.84	1114.1
1554			Begin Sampling						

10 - esp
20

Sampling

Sampling beginning time: ~~1554~~ 1554

Sampling completion time: 1634

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1635	14.13	220	19.127	18.42	0.203	5.95	404.0	4.88	1423.4

Sample Information

Sample ID: 47WW13

Sample collection date/time: 2/20/07 @ 1554

Duplicate sample collected (Y/N): N

Duplicate sample ID: N

Split sample collected (Y/N): N

Split sample ID: N

COC No(s): 10914 / 10915

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs - Full	8260	3 VOA s	Perchlorate	314.0	1-500mL HDPE
ANIONS	300	1- 1000 mL HDPE	Sulfides	376.2	1-500 mL HDPE
Gases	175	3 -VOAs	DHE		2 1-L Amber
ALKALINITY	310.1	1-500 mL HDPE			
TOC	415.1	3 VOAs			

Comments: Ferrous IRON = 0.0
Salinity = 0.10

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

9.02

00107090

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Sample Collection Log

117591 - Longhorn Army Ammunition Plant

Manager: Praveen Srivastav

RFA / COC Number: 10914 / 10915

Location Code: 47WW14
Sample Number: 47WW14- FEB 2007
Sample Name: 47WW14-GW-47WW14- -REG
Sampling Method: SP
Sample Type: GW *Sample Purpose:* REG
Sampling Equip: Bladder Pump

Task: MNA_EVENT_FEB07
Collection Date: 2/20/07
Collection Time: 1223
Start Depth: 22.76
End Depth: 23.17
Sample Matrix: WATER
Sample Team: JLB/mm

QC Partners:
(TB) TB-02 (ER) N/A (FB) N/A

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
VOC-FULL	N	A	3	40	mL	VOA VIAL
ANIONS	N	B	1	~~500~~ 1000	mL	HDPE
PERC	N	C	1	500	mL	HDPE
GASES	N	D	3	40	mL	VOA Vial
ALKALINITY	N	E	1	~~100~~ 500	mL	HDPE
TOC_415	N	F	1	~~100~~ 40	mL	HDPE
DHC	N	G	2	21	L	Amb. Glass
SULFIDES	N	H	1	500	mL	HDPE

ERPIMS Values:
Sacode:
Lot Control#:

Groundwater Information:
Measured Well Depth: 51.63 **Depth To Water:** 22.76

Comments: FERROUS IRON: 0.0
Salinity: 0.87
QC 47WW14-FEB 2007-FD

Sketch Location:

Logged BY / Date: JLB 2/20/07 *Reviewed BY / Date:*

00107091

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Sample Collection Log

117591 - Longhorn Army Ammunition Plant

Manager: **Praveen Srivastav**

Location Code: 47WW14

Sample Number: 47WW14- FEB 2007

PURGE RECORD:

Initial	Time(24hr)	DepthtoWater (ft)	Eh (mV)	pH (SU)	Conductivity (mS/cm)	Turbidity (NTU)	DissOxygen (ppm)	Temperature (C)	Purge Volume (gal)
Sample:	1317	23.14	242.2	7.32	1.718	46.9	1.32	20.74	6.52

2/20/07 JCB

Logged BY / Date: JCB 2/20/07 *Reviewed BY / Date:* _____

00107092

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: 47
Project Name/#: Longhorn AAP
Weather: OVERCAST 68°

Sampling location ID: 47WW14
Sample ID: 47WW14 FEB2007
Collection Time/Date: 1223 / 2/20/07

Pump Installation

Pump installation crew: JCB / MM
PID/FID reading (well head/background): 0.4 | 0.0
Casing diameter (inches): 4" STAINLESS
Total well Depth (ft. BTOC): 51.63
Initial (pre-installation) DTW/time: 22.76 @ 1050
Final (after pump priming) DTW/time: 23.02
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): 1000
Discharge tube length (ft.): 58'

Installation date/beginning time: 2/20/07 @ 1055
Installation date/completion time: 2/20/07 @ 1057
Screen Interval (ft. BTOC): 39' to 49'
Pump intake depth (ft BTOC): 44'
Post-installation DTW/time: 22.70
Max. sustainable pump rate (mL/min): 220
Appearance of product: N/A
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = 35 psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	35								35
Refill Setting	10								10
Discharge Setting	5								5
Flow rate (mL/min)	220								220

Purging

Purging/sampling crew: JCB / MM
Purge date/beginning time: 2/20/07 1110
Initial (pre-purging) DTW (ft. BTOC): 22.70
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.4 | 0.0
Purge date/completion time: 2/20/07 @ 1314
Final (post-purging) DTW (ft. BTOC): 22.76
No. of tubing + pump volumes purged: 26.08 (L)

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = 35 psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	35								35
Refill Setting	10								10
Discharge Setting	5								5
Flow rate (mL/min)	220								220

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1119	23.02	220	-0-	20.95	1.789	6.87	198.4	1.37	192.3
1129	23.14	220	2.2	21.02	1.832	7.06	169.2	0.59	108.1
1134	23.17	220	3.3	21.00	1.822	7.08	172.3	0.48	140.6
1139	23.13	220	4.4	20.98	1.812	7.11	176.5	0.44	163.4
1144	23.14	220	5.5	20.97	1.795	7.13	180.8	0.41	175.2
1149	23.15	220	6.6	20.97	1.776	7.14	182.9	0.42	186.2
1154	23.15	220	7.7	20.90	1.758	7.16	186.5	0.44	176.2
1159	23.16	220	8.8	20.92	1.733	7.24	190.6	0.47	161.9

00107093

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity ±3% (uMhos/cm)	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
1204	23.14	220	9.9	20.92	1.724	7.23	195.7	0.49	147.5
1209	23.15	220	10.10	20.87	1.717	7.25	198.8	0.52	131.6
1214	23.18	220	12.1	20.88	1.713	7.25	201.7	0.55	114.9
1218	23.17	220	13.2	20.84	1.711	7.25	204.9	0.57	101.3
1223			Pulling	Samples					

10 - esp next 20

2/20/07 JCB

Sampling

Sampling beginning time: 1223 Sampling completion time: 1314

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1317	23.14	220	26.08	20.74	1.718	7.32	240.2	1.32	46.9

Sample Information

Sample ID: 47WW14

Duplicate sample collected (Y/N): Y

Split sample collected (Y/N): N/A

COC No(s): 10914 | 10915

Sample collection date/time: 2/20/07 @ 1223

Duplicate sample ID: 47WW14-FEB2007-FD

Split sample ID: N/A

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC's-Full	8260	3 VOAs	Perchlorate	314.0	1-500 mL HDPE
ANIONS	300	1-1000 mL HDPE	Sulfides	376.2	1-500 mL HDPE
GASES	175	3-VOAs	DHC	—	2-1 Liter Amber
ALKALINITY	310.1	1-500 mL HDPE			
TOC	415.1	3 VOAs			

Comments: Ferrous Iron = 0.0
Salinity = 0.87

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

12.88

00107094

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Sample Collection Log

117591 - Longhorn Army Ammunition Plant

Manager: Praveen Srivastav

RFA / COC Number: 10928/10929

Location Code: 47WW30
Sample Number: 47WW30- FEB 2007
Sample Name: 47WW30-GW-47WW30- -REG
Sampling Method: SP
Sample Type: GW *Sample Purpose:* REG
Sampling Equip: QED Bladder Pump

Task: MNA_EVENT_FEB07
Collection Date: 02-22-07
Collection Time: 0941
Start Depth: 21.25'
End Depth: 21.96'
Sample Matrix: WATER

QC Partners:
(TB) 2-22-07 (ER) N/A (FB) N/A
Sample Team: M. Martinez/J. Selcoe

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
VOC-FULL	N	A	3	40	mL	VOA VIAL
ANIONS	N	B	1	~~500~~ 1000	mL	HDPE
PERC	N	C	1	~~500~~ 1000	mL	HDPE
GASES	N	D	3	40	mL	VOA Vial
ALKALINITY	N	E	1	~~100~~ 1000	mL	HDPE
TOC_415	N	F	3	~~100~~ 40	mL	~~HDPE~~ VOA VIAL
DHC	N	G	1	1	L	Amb. Glass
Sulfides	N	H	1	500	mL	HDPE

ERPIMS Values:
Sacode:
Lot Control#:

Groundwater Information:
Measured Well Depth: 25.29 **Depth To Water:** 21.15

Comments: Ferrous Iron 0.00 MG/L
Salinity 2.49

Sketch Location:

Logged BY / Date: M. Martinez/02-22-07 *Reviewed BY / Date:*

00107095

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Sample Collection Log

117591 - Longhorn Army Ammunition Plant

Manager: Praveen Srivastav

Location Code: **47WW30**

Sample Number: **47WW30-** FEB 2007

PURGE RECORD:

Initial	Time(24hr)	DepthtoWater (ft)	Eh (mV)	pH (SU)	Conductivity (mS/cm)	Turbidity (NTU)	DissOxygen (ppm)	Temperature (C)	Purge Volume (gal)
Sample:	1016	21.96	205.6	6.69	4.644	0.0	1.83	18.08	2.65

1816
02-22-07

Logged BY / Date: M. Martinez / 02-22-07 *Reviewed BY / Date:* _____

00107096

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: AREA 47
Project Name/#: LONGHORN AAP / 110591
Weather: Clear 73° 2/21/07

Sampling location ID: 47WW30
Sample ID: 47WW30-FEB2007
Collection Time/Date: 02-22-07 / 0941

Pump Installation

Pump installation crew: JLB / MM
PID/FID reading (well head/background): 26.0 PPM
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 25.29
Initial (pre-installation) DTW/time: 21.15 @ 1632
Final (after pump priming) DTW/time: 21.54 / 0845
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): 1000
Discharge tube length (ft.): 28'

Installation date/beginning time: 2/21/07 @ 1645
Installation date/completion time: 2/21/07 @ 1645
Screen Interval (ft. BTOC): ~~12.5~~ 15.0 to ~~35.0~~ 37.5
Pump intake depth (ft BTOC): ~~21.5~~ 23.5
Post-installation DTW/time: 21.25 / 0836
Max. sustainable pump rate (mL/min): 100
Appearance of product: None
Discharge tube diameter (3/8" or 1/4"): 1/4
Inlet reducer used (Y/N): NO

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = 22 psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	22	20							20
Refill Setting	10	10							10
Discharge Setting	5	3.2							3.2
Flow rate (mL/min)	250	100							100

Purging

Purging/sampling crew: M. Malone / J. Belcourt
Purge date/beginning time: 02-22-07 / 0841
Initial (pre-purging) DTW (ft. BTOC): 21.25 / 0838
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.0 / 0.0
Purge date/completion time: 02-22-07 / 1017
Final (post-purging) DTW (ft. BTOC): 21.96
No. of tubing + pump volumes purged: 11.6

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = 22 psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	22	20							20
Refill Setting	10	10							10
Discharge Setting	5	3.2							3.2
Flow rate (mL/min)	250	100							100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
0845	21.54	250	0	15.80	4.254	6.54	299.1	4.76	12.5
0855	21.78	100	2.5	16.03	4.343	6.60	280.1	3.43	9.0
0900	21.81	100	3.0	16.74	4.338	6.60	271.1	3.04	9.4
0905	21.85	100	3.5	16.79	4.339	6.59	266.8	2.94	10.1
0910	21.90	100	4.0	16.85	4.348	6.59	255.8	2.53	8.4
0915	21.93	100	4.5	16.92	4.350	6.59	244.1	2.43	6.9
0920	21.94	100	5.0	16.94	4.357	6.59	239.6	2.10	6.1
0925	21.94	100	5.5	17.04	4.354	6.59	235.4	2.00	5.7

21.15
25.29

00107097

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity ±3% (uMhos/cm)	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
0930	21.95	100	6.0	17.12	4.350	6.59	228.4	1.90	6.8
0935	21.98	100	6.5	17.19	4.357	6.60	225.0	1.93	8.1
0940	21.98	100	7.0	17.19	4.360	6.60	221.0	1.94	9.0
0941	Sample								

10 - esp 20

0222-07

Sampling

Sampling beginning time: 0941 Sampling completion time: 1013

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1010	21.90	100	10.0	18.08	4.044	6.69	205.0	1.83	0.0

Sample Information

Sample ID: 47MW30-FEB2007 Sample collection date/time: 02-22-07 / 0941

Duplicate sample collected (Y/N): N Duplicate sample ID: N/A

Split sample collected (Y/N): N Split sample ID: N/A

COC No(s): 10928 / 10929

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC - Full	8260B	3 VOA's	Sulfides	376.2	1-500mL HDPE
Gasses		3 VOA's	Anions	300.0	1-1000mL HDPE
TOC	415.1	3 VOA's	DHC		2-1 Liter Amber
Perchlorate	314.0	1-~~500~~ 1000mL HDPE			
Alkalinity	310.1	1-~~500~~ 1000mL HDPE			

Comments: Ferrous Iron 0.00 mg/L

Salinity 2.49

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107098

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Sample Collection Log

117591 - Longhorn Army Ammunition Plant

Manager: Praveen Srivastav

RFA / COC Number: 10928/10929

Location Code: **LHSMW43**
Sample Number: **LHSMW43-** FEB 2007
Sample Name: **LHSMW43-GW-LHSMW43- -REG**
Sampling Method: **SP**
Sample Type: **GW** *Sample Purpose:* **REG**
Sampling Equip: Disposable bailer

Task: **MNA_EVENT_FEB07**
Collection Date: 02-22-07
Collection Time: 1100
Start Depth: 20.05 02-22-07
End Depth: n/a
Sample Matrix: **WATER**
Sample Team: M. Martin / J. Belcourt

QC Partners:
(TB) 2-22-07 (ER) N/A (FB) N/A

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
VOC-FULL	N	A	3	40	mL	VOA VIAL
ANIONS	N	B	1	~~500~~ 1000	mL	HDPE
PERC	N	C	1	~~500~~ 1000	mL	HDPE
GASES	N	D	2	40	mL	VOA Vial
ALKALINITY	N	E	1	1000	mL	HDPE
TOC_415	N	F	~~3~~ 2	~~100~~ 40	mL	~~HDPE~~ VOA VIAL
DHC	N	G	1	1	L	Amb. Glass
Sulfides	N	H	1	500	mL	HDPE

ERPIMS Values:
Sacode:
Lot Control#:

Groundwater Information:
Measured Well Depth: 22.90' **Depth To Water:** 20.23 / 02-21-07

Comments (N) baled yesterday 02/21/07 DTW@ 22.40 02/22/07 DTW@ 20.05 Sampled with Disposable bailer. Ground water was very clear @ beginning. Got cloudy @ end. Final readings were done @ end which is why turbidity is high.

Sketch Location: Ferrous Iron 0.02 mg/L
Salinity 1.05

Logged BY / Date: [signature] / 02/22/07 *Reviewed BY / Date:* _____

00107099

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Sample Collection Log

117591 - Longhorn Army Ammunition Plant
Manager: Praveen Srivastav

Location Code: **LHSMW43**
Sample Number: **LHSMW43-** FEB 2007

PURGE RECORD:

Initial	Time(24hr)	DepthtoWater (ft)	Eh (mV)	pH (SU)	Conductivity (mS/cm)	Turbidity (NTU)	DissOxygen (ppm)	Temperature (C)	Purge Volume (gal)
Sample:	1100	20.05	266.5	6.93	3.009	365.2 (*)	6.03	18.36	≈ 15.4 Gallons

(*) See Comments

M&e 2-22-07

3.85 gallons

Logged BY / Date: [signature] 02/22/07

Reviewed BY / Date: _____

00107100

GROUNDWATER SAMPLING FORM

Sheet 1 of 3

Operable Unit/Site ID: AREA 47
Project Name/#: LONGHORN AAP
Weather: CLEAR 75°
Sampling location ID: LHS MW 43
Sample ID: LHS MW43 - FEB2007
Collection Time/Date: N/A

Pump Installation

Pump installation crew: JCB/MM
PID/FID reading (well head/background): 111.0 PPM
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 22.90
Initial (pre-installation) DTW/time: 20.23 @1513
Final (after pump priming) DTW/time: 20.15 @ 1523
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): 1000
Discharge tube length (ft.): 30'
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = 20 psi

Installation date/beginning time: 2/21/07 @1520
Installation date/completion time: 12/21/07
Screen Interval (ft. BTOC): 9' to 19'
Pump intake depth (ft BTOC): Bottom/22.90
Post-installation DTW/time: 22.90
Max. sustainable pump rate (mL/min): 180
Appearance of product: NONE
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

See P 3 of 3 2/22/07 MBL

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	20								
Refill Setting	10								
Discharge Setting	5								
Flow rate (mL/min)	180								

2/21/07 JCB

Purging

Purging/sampling crew: JCB/MM
Purge date/beginning time: 2/21/07 @ 1523
Initial (pre-purging) DTW (ft. BTOC): 20.23
Calculated tubing + pump volume: NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = 20 psi

PID/FID reading (well head/background): 111.0 PPM
Purge date/completion time: 2/21/07 @ 1600
Final (post-purging) DTW (ft. BTOC): 22.90 (DRY)
No. of tubing + pump volumes purged: 6.4

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	20								20
Refill Setting	10								10
Discharge Setting	5								5
Flow rate (mL/min)	180								180

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1527	20.40	180	-0-	19.24	3.443	6.43	216.9	4.42	49.8
1532	21.45	180	1.8	18.76	3.396	6.19	260.1	3.34	29.8
1542	21.65	180	↓	18.76	3.397	6.19	262.2	3.12	30.1
1547	21.80	180	↓	18.73	3.391	6.19	263.6	3.07	46.6
1552	21.90	180	5.4 total	19.21	3.387	6.21	266.7	3.39	62.8
1600									

2/21/07 JCB

00107101

GROUNDWATER SAMPLING FORM

Sheet 2 of 3

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
						2/21/07		JCB	

10 - esp max 20

Sampling

Sampling beginning time: N/A

Sampling completion time: N/A

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
						2/21/07		JCB	

Sample Information

Sample ID: N/A

Sample collection date/time: N/A

Duplicate sample collected (Y/N): N

Duplicate sample ID: N

Split sample collected (Y/N): N

Split sample ID: N

COC No(s): N

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
				2/21/07	JCB

Comments: well went DRY 2/21/07 @1600 72.00' DTW

See p 3 of 5 02/22/07

Will come back Thursday week to check on Recharge.

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107102

GROUNDWATER SAMPLING FORM

Sheet 3 of 3

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

10 - esp
20

MS
02/22/07

Sampling

Sampling beginning time: 1100 Sampling completion time: 1115

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1115		N/A	N/A	18.36	3.009	6.93	266.5	6.03	3452
			Note: readings once taken @ end of sampling.						
			Used 1 disposable bailer to collect sample & take reading.						

Sample Information

Sample ID: LHS MW-43-FEB 2007
Sample collection date/time: 02-22-07 / 1100
Duplicate sample collected (Y/N): N
Duplicate sample ID: N/A
Split sample collected (Y/N): N
Split sample ID: N/A
COC No(s): 10928 / 10929

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC	8260B	3 VOAs	Sulfides	376.2	1-500mL HDPE
Gases	175	3 VOAs	Anions	300.0	1-1000mL HDPE
TOC	415.1	3 VOAs	DHC		2-1 Liter Ambers
Perchlorate	314.0	1-1000mL HDPE			
Alkalinity	310.1	1-1000mL HDPE			

MS

Comments: See note

Ferrous Iron 0.02 mg/L

Salinity 1.05

Hand bailed ≈ 3.0 Liters
pumped ≈ 0.4
≈ 3.4 Liters

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107103

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Sample Collection Log

117591 - Longhorn Army Ammunition Plant

Manager: Praveen Srivastav

RFA / COC Number: 109166 | 109177

Location Code: 47WW09
Sample Number: 47WW09-FEB2007
Sample Name: 47WW09-GW-47WW09-FEB2007-REG
Sampling Method: SP
Sample Type: GW *Sample Purpose:* REG
Sampling Equip: BLADDER PUMP

Task: MNA_EVENT_FEB07
Collection Date: 2/21/07
Collection Time: 1422
Start Depth: 20.79
End Depth: 26.80
Sample Matrix: WATER
Sample Team: JLB | MM

QC Partners:
(TB) - 2/21/07 (ER) (FB)

ERPIMS Values:
Sacode:
Lot Control#:

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
VOC-FULL	N	A	3	40	mL	VOA VIAL
ANIONS	N	B	1	500	mL	HDPE
PERC	N	C	1	500	mL	HDPE
GASES	N	D	2	40	mL	VOA Vial
ALKALINITY	N	E	1	100	mL	HDPE
TOC_415	N	F	1	100	mL	HDPE
DHC	N	G	1	1	L	Amb. Glass
SULFIDES	N	H	1	500	mL	HDPE

Groundwater Information:
Measured Well Depth: 41.20 **Depth To Water:** 20.79

Comments: FERROUS IRON: 0.0
Salinity: 2.57

Sketch Location:

Logged BY / Date: JLB 2/21/07 *Reviewed BY / Date:*

00107104

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Sample Collection Log

117591 - Longhorn Army Ammunition Plant
Manager: Praveen Srivastav

Location Code: 47WW09
Sample Number: 47WW09-FEB 2007

PURGE RECORD:

Initial	Time(24hr)	DepthtoWater (ft)	Eh (mV)	pH (SU)	Conductivity (mS/cm)	Turbidity (NTU)	DissOxygen (ppm)	Temperature (C)	Purge Volume (gal)
Sample:	1502	26.80	116.5	7.37	4.800	16.3	2.02	19.26	6.25

2/21/07 JCB

Logged BY / Date: JCB 2/21/07 *Reviewed BY / Date:* _____

00107105

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: AREA 47
Project Name/#: LONGHORN AAP/117591
Weather: CLEAR 75°

Sampling location ID: 47WW09
Sample ID: 47WW09 FEB2007
Collection Time/Date: 2/21/07 1422

Pump Installation

Pump installation crew: JLB/mm
PID/FID reading (well head/background): 4.3 PPM
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 41.20
Initial (pre-installation) DTW/time: 20.79 @ 1245
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): 1000
Discharge tube length (ft.): 45'
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = 20 psi

Installation date/beginning time: 2/21/07 @ 1250
Installation date/completion time: ~~28-30~~ 2/21/07
Screen Interval (ft. BTOC): 28' to 38'
Pump intake depth (ft BTOC): 33'
Post-installation DTW/time: 20.55 @ 1307
Max. sustainable pump rate (mL/min): 250
Appearance of product: NONE
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	20								20
Refill Setting	12								12
Discharge Setting	6.5								6.5
Flow rate (mL/min)	~~200~~ 250								250

Purging

Purging/sampling crew: JLB/mm
Purge date/beginning time: 2/21/07 1311
Initial (pre-purging) DTW (ft. BTOC): 20.55
Calculated tubing + pump volume: NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = 20 psi

PID/FID reading (well head/background): 4.3 PPM
Purge date/completion time: 2/21/07 @ 1503
Final (post-purging) DTW (ft. BTOC): 26.80
No. of tubing + pump volumes purged: 2.5 L

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	20								20
Refill Setting	12								12
Discharge Setting	6.5								6.5
Flow rate (mL/min)	250								250

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1301	21.20	~~250~~ 250	0	19.30	4.285	7.08	27.1	1.40	51.2
1331	21.73	250	1.25	19.26	4.806	7.12	10.0	0.88	43.0
1326	22.0	250	2.50	19.26	4.803	7.14	6.3	0.79	37.9
1341	22.25	250	3.75	19.15	4.800	7.14	9.2	0.70	36.9
1346	22.55	250	5.0	19.05	4.787	7.17	13.3	0.65	34.0
1351	22.88	250	6.25	19.08	4.779	7.19	15.0	0.62	29.5
1356	23.14	250	7.50	19.08	4.768	7.21	40.2	0.65	27.4
1401	23.45	250	8.75	19.06	4.765	7.22	63.7	0.65	24.9

14.75

00107106

GROUNDWATER SAMPLING FORM

Sheet ___ of ___

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	±3% Electrical Conductivity (uMhos/cm)	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
1406	23.70	250	10	19.06	4.761	7.22	86.9	0.64	33.8
1411	23.93	250	11.25	19.09	4.761	7.22	60.0	0.64	24.4
1416	24.30	250	12.50	19.05	4.760	7.23	55.9	0.63	22.1
1421	24.03	250	13.75	18.96	4.762	7.22	66.9	0.63	21.1
MDS				PUL SAMPLES					
								2/21/07	

Sampling

Sampling beginning time: 1422 Sampling completion time: 1503

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1502	26.80	250		19.26	4.800	7.37	116.5	2.02	16.3
						2/21/07			

Sample Information

Sample ID: 47WW09-FEB2007 Sample collection date/time: 2/21/07 @ 1502

Duplicate sample collected (Y/N): NONE Duplicate sample ID: NONE

Split sample collected (Y/N): NONE Split sample ID: NONE

COC No(s): 10916 / 10917

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC's - Full	8260B	3 VOAs	Sulfides	376.2	1-500 mL HDPE
Gases	175	3 VOA's	ANIONS	300.0	1-1000 mL HDPE
TOC	415.1	3 VOA's	DHC	—	2-1L Ambers
Perchlorate	314.0	1-500 mL HDPE			
Alkalinity	310.1	1-500 mL HDPE			

Comments: Ferrous IRON: 0.0
Salinity: 2.57

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107107

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Sample Collection Log

117591 - Longhorn Army Ammunition Plant

Manager: Praveen Srivastav

RFA / COC Number: 10914 / 10915

Location Code: 47WW13
Task: MNA_EVENT_FEB07
Sample Number: 47WW13-~~FEB2007~~
Collection Date: 2/20/07
Sample Name: 47WW13-GW-47WW13-~~FEB2007~~-REG
Collection Time: 1554
Sampling Method: SP
Start Depth: ~~20.85~~
Sample Type: GW *Sample Purpose:* REG
End Depth: 14.13
Sampling Equip: Bladder Pump
Sample Matrix: WATER

QC Partners:
(TB) TB-02 (ER) N/A (FB) N/A
Sample Team: JCB/MM

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
VOC-FULL	N	A	3	40	mL	VOA VIAL
ANIONS	N	B	1	~~500~~ 1000	mL	HDPE
PERC	N	C	1	500	mL	HDPE
GASES	N	D	3	40	mL	VOA Vial
ALKALINITY	N	E	1	~~100~~ 300	mL	HDPE
TOC_415	N	F	3	~~100~~ 40	mL	HDPE
DHC	N	G	2	1	L	Amb. Glass
Sulfides	N	H	1	500	mL	HDPE

ERPIMS Values:
Sacode:
Lot Control#:

Groundwater Information:
Measured Well Depth: 20.85 **Depth To Water:** 11.38

Comments: Ferrus Iron :
Salinity : 0.10

Sketch Location:

Logged BY / Date: JCB 2/20/07 *Reviewed BY / Date:*

00107108

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Sample Collection Log

117591 - Longhorn Army Ammunition Plant
Manager: Praveen Srivastav

Location Code: 47WW13
Sample Number: 47WW13- FEB 2007

PURGE RECORD:

Initial	Time(24hr)	DepthtoWater (ft)	Eh (mV)	pH (SU)	Conductivity (mS/cm)	Turbidity (NTU)	DissOxygen (ppm)	Temperature (C)	Purge Volume (gal)
Sample:	1635	14.13	404.0	5.95	0.203	1423.4	4.88	18.42	4.78

Logged BY / Date: JLB 2/20/07 *Reviewed BY / Date:* _____

00107109

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: AREA 47
Project Name/#: Longhorn AAP
Weather: Cloudy 70°

Sampling location ID: 47WW13
Sample ID: 47WW13
Collection Time/Date: 02-20-07 / 1554

Pump Installation

Pump installation crew: JLB/mm
PID/FID reading (well head/background): 5.0/~~0.0~~
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 20.85
Initial (pre-installation) DTW/time: 11.38 @ 1054
Final (after pump priming) DTW/time: 11.63/1503
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): 1000
Discharge tube length (ft.): 35'

Installation date/beginning time: 2/20/07 @ 1447
Installation date/completion time:
Screen Interval (ft. BTOC): 8' to 18'
Pump intake depth (ft BTOC): 15'
Post-installation DTW/time: 11.28 @ 1447
Max. sustainable pump rate (mL/min): 450
Appearance of product: NONE
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = 30 psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	30	20	15						15
Refill Setting	10	10	10						10
Discharge Setting	5	5	5						5
Flow rate (mL/min)	450	225	200						200

Purging

Purging/sampling crew: JLB/mm
Purge date/beginning time: 2/20/07 @ 1453
Initial (pre-purging) DTW (ft. BTOC): 11.28
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 5.0
Purge date/completion time: 2/20/07 @ 1636
Final (post-purging) DTW (ft. BTOC): 14.13
No. of tubing + pump volumes purged: 19.127

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = 30 psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	30	20	15						15
Refill Setting	10	10	10						10
Discharge Setting	5	5	5						5
Flow rate (mL/min)	450	225	200						200

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1503	11.63	450	-0-	18.42	0.239	6.94	307.6	1.65	1690.3
1513	12.02	225	2.25	18.18	0.232	6.58	324.4	2.48	1674.3
1518	12.18	225	3.375	18.04	0.226	6.47	337.3	3.11	1668.7
1523	12.39	225	4.5	17.89	0.220	6.33	351.3	3.68	1466.1
1528	12.57	225	5.625	17.81	0.213	6.17	362.2	3.90	1201.1
1533	12.68	220	6.725	17.78	0.210	6.06	371.6	4.07	1145.0
1538	12.80	220	6.825	17.81	0.206	5.92	379.9	4.27	1085.8
1543	12.92	220	7.925	17.75	0.204	5.85	386.6	4.54	1089.7

00107110

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
1548	13.06	220	8.025	17.74	0.203	5.80	393.0	4.70	1098.9
1553	13.10	220	9.125	17.65	0.203	5.79	396.9	4.84	1114.1
1554			Begin Sampling						

Sampling

Sampling beginning time: ~~1554~~ 1554 Sampling completion time: 1634

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1635	14.13	220	19.127	18.42	0.203	5.95	404.0	4.88	1423.4

Sample Information

Sample ID: 47WW13
Sample collection date/time: 2/20/07 @ 1554
Duplicate sample collected (Y/N): N
Duplicate sample ID: N
Split sample collected (Y/N): N
Split sample ID: N
COC No(s): 10914 / 10915

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs - Full	8260	3 VOA S	Perchlorate	314.0	1-500mL HDPE
ANIONS	300	1- 1000 mL HDPE	Sulfides	376.2	1-500 mL HDPE
Gases	175	3 -VOAS	DHE		2 1-L Amber
ALKALINITY	310.1	1-500 mL HDPE			
TOC	415.1	3 VOAS			

Comments: Ferrous IRON = 0.0
Salinity = 0.10

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

9.02

00107111

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Sample Collection Log

117591 - Longhorn Army Ammunition Plant

Manager: Praveen Srivastav

RFA / COC Number: 10914 / 10915

Location Code: 47WW14
Sample Number: 47WW14- FEB 2007
Sample Name: 47WW14-GW-47WW14- -REG
Sampling Method: SP
Sample Type: GW *Sample Purpose:* REG
Sampling Equip: Bladder Pump
QC Partners:
(TB) ~~N/A~~ TB3-02 (ER) N/A (FB) N/A

Task: MNA_EVENT_FEB07
Collection Date: 2/20/07
Collection Time: 1223
Start Depth: 22.76
End Depth: 23.17
Sample Matrix: WATER
Sample Team: JLB/mm

ERPIMS Values:
Sacode:
Lot Control#:

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
VOC-FULL	N	A	3	40	mL	VOA VIAL
ANIONS	N	B	1	~~500~~ 1000	mL	HDPE
PERC	N	C	1	500	mL	HDPE
GASES	N	D	3	40	mL	VOA Vial
ALKALINITY	N	E	1	~~100~~ 500	mL	HDPE
TOC_415	N	F	1	~~100~~ 40	mL	HDPE
DHC	N	G	2	1	L	Amb. Glass
SULFIDES	N	H	1	500	mL	HDPE

Groundwater Information:

Measured Well Depth: 51.63 Depth To Water: 22.76

Comments: FERROUS IRON: 0.0
Salinity: 0.87
QC 47WW14-FEB 2007-FD

Sketch Location:

Logged BY / Date: JLB 2/20/07 *Reviewed BY / Date:*

00107112

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Sample Collection Log

117591 - Longhorn Army Ammunition Plant
Manager: Praveen Srivastav

Location Code: 47WW14
Sample Number: 47WW14- FEB 2007

PURGE RECORD:

Initial	Time(24hr)	DepthtoWater (ft)	Eh (mV)	pH (SU)	Conductivity (mS/cm)	Turbidity (NTU)	DissOxygen (ppm)	Temperature (C)	Purge Volume (gal)
Sample:	1317	23.14	240.2	7.32	1.718	46.9	1.32	20.74	6.52

2/20/07 JCB

Logged BY / Date: JCB 2/20/07 *Reviewed BY / Date:* _____

00107113

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: 47
Project Name/#: Longhorn AAP
Weather: OVERCAST 68°
Sampling location ID: 47 MW 14
Sample ID: 47 MW14 FEB 2007
Collection Time/Date: 1223 / 2/20/07

Pump Installation

Pump installation crew: JCB / MM
PID/FID reading (well head/background): 0.4 | 0.0
Casing diameter (inches): 4" STAINLESS
Total well Depth (ft. BTOC): 51.63
Initial (pre-installation) DTW/time: 22.76 @ 1050
Final (after pump priming) DTW/time: 23.02
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): 1000
Discharge tube length (ft.): 58'
Installation date/beginning time: 2/20/07 @ 1055
Installation date/completion time: 2/20/07 @ 1057
Screen Interval (ft. BTOC): 39' to 49'
Pump intake depth (ft BTOC): 44'
Post-installation DTW/time: 22.70
Max. sustainable pump rate (mL/min): 220
Appearance of product: N/A
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = 35 psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	35								35
Refill Setting	10								10
Discharge Setting	5								5
Flow rate (mL/min)	220								220

Purging

Purging/sampling crew: JCB / MM
Purge date/beginning time: 2/20/07 1110
Initial (pre-purging) DTW (ft. BTOC): 22.70
Calculated tubing + pump volume: NA
PID/FID reading (well head/background): 0.4 | 0.0
Purge date/completion time: 2/20/07 @ 1314
Final (post-purging) DTW (ft. BTOC): 23.76
No. of tubing + pump volumes purged: 26.08 (L)

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = 35 psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	35								35
Refill Setting	10								10
Discharge Setting	5								5
Flow rate (mL/min)	220								220

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1119	23.02	220	- 0 -	20.95	1.789	6.87	198.4	1.37	89.2
1129	23.14	220	2.2	21.02	1.832	7.06	169.2	0.59	108.1
1134	23.17	220	3.3	21.00	1.822	7.08	172.3	0.48	140.6
1139	23.13	220	4.4	20.98	1.812	7.11	176.5	0.44	163.4
1144	23.14	220	5.5	20.97	1.795	7.13	180.8	0.41	175.2
1149	23.15	220	6.6	20.97	1.776	7.14	182.9	0.42	186.2
1154	23.15	220	7.7	20.90	1.758	7.16	186.5	0.44	176.2
1159	23.16	220	8.8	20.92	1.733	7.21	190.6	0.47	161.9

00107114

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
1204	23.14	220	9.9	20.92	1.724	7.23	195.7	0.49	145
1209	23.15	220	14.0	20.87	1.717	7.25	198 H	0.52	131.6
1214	23.18	220	17.1	20.88	1.713	7.25	201.7	0.55	114.9
1218	23.17	220	13.2	20.84	1.711	7.25	204.9	0.57	101.3
1223			Pulling Samples						
						2/20/07 JLB			

Sampling

Sampling beginning time: 1223 Sampling completion time: 1314

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1317	23.14	220	26.08	20.74	1.718	7.32	242.2	1.32	46.9

Sample Information

Sample ID: 47WW14
Duplicate sample collected (Y/N): Y
Split sample collected (Y/N): N/A
COC No(s): 10914 / 10915

Sample collection date/time: 2/20/07 @ 1223
Duplicate sample ID: 47WW14-FEB2007-FD
Split sample ID: N/A

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC's-FULL	8260	3 VOAS	Perchlorate	314.0	1-500 mL HDPE
ANIONS	300	1-1000 mL HDPE	Sulfides	376.2	1-500 mL HDPE
GASES	175	3-VOAS	DHC	—	2-1 Liter Amber
ALKALINITY	310.1	1-500 mL HDPE			
TOC	415.1	3 VOAS			

Comments: Ferrus IRON = 0.0
Salinity = 0.87

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

12.38

00107115

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Sample Collection Log

117591 - Longhorn Army Ammunition Plant

Manager: Praveen Srivastav

RFA / COC Number: 10928/10929

Location Code: 47WW30
Sample Number: 47WW30- FEB 2007
Sample Name: 47WW30-GW-47WW30- -REG
Sampling Method: SP
Sample Type: GW *Sample Purpose:* REG
Sampling Equip: QED Bladder Pump

Task: MNA_EVENT_FEB07
Collection Date: 02-22-07
Collection Time: 0941
Start Depth: 21.25'
End Depth: 21.90'
Sample Matrix: WATER

QC Partners:
(TB) 2-22-07 (ER) N/A (FB) N/A

Sample Team: M. Martinez / J. Selcoe

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
VOC-FULL	N	A	3	40	mL	VOA VIAL
ANIONS	N	B	1	~~500~~ 1000	mL	HDPE
PERC	N	C	1	~~500~~ 1000	mL	HDPE
GASES	N	D	23	40	mL	VOA Vial
ALKALINITY	N	E	1	~~100~~ 1000	mL	HDPE
TOC_415	N	F	~~23~~	~~100~~ 40	mL	~~HDPE~~ VOA vial
DHC	N	G	1	1	L	Amb. Glass
Sulfides	N	H	1	50	mL	HDPE

ERPIMS Values:
Sacode:
Lot Control#:

Groundwater Information:
Measured Well Depth: 25.29 **Depth To Water:** 21.15

Comments: Ferrous Iron 0.00 MG/L
Salinity 2.49

Sketch Location:

Logged BY / Date: M. Martinez / 02-22-07 *Reviewed BY / Date:*

00107116

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Sample Collection Log

117591 - Longhorn Army Ammunition Plant

Manager: Praveen Srivastav

Location Code: **47WW30**

Sample Number: **47WW30-** FEB 2007

PURGE RECORD:

Initial	Time(24hr)	DepthtoWater (ft)	Eh (mV)	pH (SU)	Conductivity (mS/cm)	Turbidity (NTU)	DissOxygen (ppm)	Temperature (C)	Purge Volume (gal)
Sample:	1016	21.96	205.6	6.69	4.644	0.0	1.83	18.08	2.65

1816
02-22-07

Logged BY / Date: M. Mortimer / 02-22-07 *Reviewed BY / Date:* _____

00107117

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: AREA 47 | Sampling location ID: 47WW30
Project Name/#: LONGHORN AAP / 117591 | Sample ID: 47WW30-FEB2007
Weather: Clear 73° 2/21/07 | Collection Time/Date: 02-22-07 / 0941

Pump Installation

Pump installation crew: JCB/MM | Installation date/beginning time: 2/21/07 @1645
PID/FID reading (well head/background): 26 o PPM | Installation date/completion time: 2/21/07 @1645
Casing diameter (inches): 4" | Screen Interval (ft. BTOC): ~~25~~ 15.0 to ~~30~~ 35.0
Total well Depth (ft. BTOC): 25.29 | Pump intake depth (ft BTOC): ~~21.5~~ 23.5
Initial (pre-installation) DTW/time: 21.15 @1632 | Post-installation DTW/time: 21.25 / 0830
Final (after pump priming) DTW/time: 21.54 / 0845 | Max. sustainable pump rate (mL/min): 100
Free product (circle): LNAPL / DNAPL | Appearance of product: none
Volume of water removed during priming (mL): 1000 | Discharge tube diameter (3/8" or 1/4"): 1/4
Discharge tube length (ft.): 28' | Inlet reducer used (YES): NO

21.15
25.29

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = 22 psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	22	20							20
Refill Setting	10	10							10
Discharge Setting	5	3.2							3.2
Flow rate (mL/min)	250	100							100

Purging

Purging/sampling crew: M. Morris / J. Bolcourt | PID/FID reading (well head/background): 0.0 / 0.0
Purge date/beginning time: 02-22-07 / 0841 | Purge date/completion time: 02-22-07 / 1017
Initial (pre-purging) DTW (ft. BTOC): 21.25 / 0838 | Final (post-purging) DTW (ft. BTOC): 21.96
Calculated tubing + pump volume: NA | No. of tubing + pump volumes purged: 11.6

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = 22 psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	22	20							20
Refill Setting	10	10							10
Discharge Setting	5	3.2							3.2
Flow rate (mL/min)	250	100							100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
0845	21.54	250	0	15.80	4.254	6.54	299.1	4.76	12.5
0855	21.78	100	2.5	16.03	4.343	6.60	281	3.43	9.0
0900	21.81	100	3.0	16.14	4.338	6.60	271.1	3.04	9.4
0905	21.85	100	3.5	16.19	4.339	6.59	266.8	2.94	10.1
0910	21.90	100	4.0	16.85	4.348	6.59	255.8	2.53	8.4
0915	21.93	100	4.5	16.92	4.350	6.59	244.1	2.43	6.9
0920	21.94	100	5.0	16.94	4.357	6.59	239.6	2.10	6.1
0925	21.94	100	5.5	17.04	4.354	6.59	235.4	2.06	5.7

00107118

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
0930	21.95	100	6.0	17.12	4.356	6.59	225.4	1.70	6.8
0935	21.98	100	6.5	17.19	4.357	6.60	225.0	1.93	8.1
0940	21.98	100	7.0	17.19	4.360	6.60	224.0	1.94	9.0
0941	Sample								

10 - esf
20

Sampling

Sampling beginning time: 0941 Sampling completion time: 1013

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1010	21.96	100	10.0	18.08	4.044	6.69	205.0	1.83	0.0

Sample Information

Sample ID: 47MW30-FEB2007 Sample collection date/time: 02-22-07 / 0941

Duplicate sample collected (Y/N): N Duplicate sample ID: N/A

Split sample collected (Y/N): N Split sample ID: N/A

COC No(s): 10923 / 10929

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC - Full	8260B	3 VOA's	Sulfides	376.2	1 - 500mL HDPE
Gasses		3 VOA's	Anions	300.0	1 - 1000mL HDPE
TOC	415.1	3 VOA's	DHC		2 - 1 Liter Amber
Perchlorate	314.0	1 - ~~500~~ 1000mL HDPE			
Alkalinity	310.1	1 - ~~500~~ mL HDPE			

Comments: Ferrous Iron 0.00 mg/L

Salinity 2.49

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107119

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Sample Collection Log

117591 - Longhorn Army Ammunition Plant

Manager: Praveen Srivastav

RFA / COC Number: 10928/10929

Location Code: LHSMW43
Sample Number: LHSMW43- FEB 2007
Sample Name: LHSMW43-GW-LHSMW43- -REG
Sampling Method: SP
Sample Type: GW *Sample Purpose:* REG
Sampling Equip: Disposable bailer

Task: MNA_EVENT_FEB07
Collection Date: 02-22-07
Collection Time: 1108
Start Depth: 20.05 02-22-07
End Depth: n/a
Sample Matrix: WATER
Sample Team: M. Martin / J. Belcart

QC Partners:
(TB) 2-22-07 (ER) N/A (FB) N/A

ERPIMS Values:
Sacode:
Lot Control#:

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
VOC-FULL	N	A	3	40	mL	VOA VIAL
ANIONS	N	B	1	~~500~~ 100	mL	HDPE
PERC	N	C	1	~~500~~ 100	mL	HDPE
GASES	N	D	2	40	mL	VOA Vial
ALKALINITY	N	E	1	100	mL	HDPE
TOC_415	N	F	~~3~~	~~100~~ 40	mL	~~HDPE~~ VOA VIAL
DHC	N	G	1	1	L	Amb. Glass
Sulfides	N	H	1	500	mL	HDPE

Groundwater Information:

Measured Well Depth: 22.90' Depth To Water: 20.23 / 02-21-07

Comments: (X) baled yesterday 02/21/07 DTW@ 22.40 02/22/07 DTW@ 20.05 Sampled with Disposable Bailer. Ground water was very clear @ beginning. Got cloudy @ end. Final readings were done @ end which is why turbidity is high.

Sketch Location: Ferrous Iron 0.02 MG/L
Salinity 1.05

Logged BY / Date: [signature] 02/23/07 *Reviewed BY / Date:* _____

00107120

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Sample Collection Log

117591 - Longhorn Army Ammunition Plant

Manager: Praveen Srivastav

Location Code: **LHSMW43**

Sample Number: **LHSMW43-** FEB 2007

PURGE RECORD:

Initial	Time(24hr)	DepthtoWater (ft)	Eh (mV)	pH (SU)	Conductivity (mS/cm)	Turbidity (NTU)	DissOxygen (ppm)	Temperature (C)	Purge Volume (gal)
Sample:	1100	20.05	244.5	6.93	3.009	305.2 (*)	6.03	18.36	~15.4 Liters

MSe

(*) See Comments

MSe 2-22-07

3.859 gallons

Logged BY / Date: [signature] 02/22/07 *Reviewed BY / Date:* _____

00107121

GROUNDWATER SAMPLING FORM

Sheet 1 of 3

Operable Unit/Site ID: AREA 47
Project Name/#: LONGHORN AAP
Weather: CLEAR 75°

Sampling location ID: LHS MW 43
Sample ID: LHS MW 43 - FEB 2007
Collection Time/Date: N/A

Pump Installation

Pump installation crew: JLB/MM
PID/FID reading (well head/background): 111.0 PPM
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 22.90
Initial (pre-installation) DTW/time: 20.23 @ 1513
Final (after pump priming) DTW/time: 20.15 @ 1523
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): 1000
Discharge tube length (ft.): 30'

Installation date/beginning time: 2/21/07 @ 1520
Installation date/completion time: 12/21/07
Screen Interval (ft. BTOC): 9' to 19'
Pump intake depth (ft BTOC): Bottom / 22.90
Post-installation DTW/time: 22.90
Max. sustainable pump rate (mL/min): 180
Appearance of product: NONE
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = 20 psi

See P 3 of 3 2/22/07 HBL

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	20								
Refill Setting	10								
Discharge Setting	5								
Flow rate (mL/min)	180							2/21/07 JLB	

Purging

Purging/sampling crew: JLB/MM
Purge date/beginning time: 2/21/07 @ 1523
Initial (pre-purging) DTW (ft. BTOC): 20.23
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 111.0 PPM
Purge date/completion time: 2/21/07 @ 1600
Final (post-purging) DTW (ft. BTOC): 22.90 (DRY)
No. of tubing + pump volumes purged: 6.4

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = 20 psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	20								20
Refill Setting	10								10
Discharge Setting	5								5
Flow rate (mL/min)	180								180

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1527	20.40	180	-0-	19.24	3.443	6.43	216.9	4.42	49.8
1532	21.45	180	1.8	18.76	3.396	6.19	260.1	3.34	29.8
1537	21.65	180	↓	18.76	3.397	6.19	262.2	3.12	30.1
1542	21.80	180	↓	18.73	3.391	6.19	263.6	3.07	46.4
1547	21.90	180	5.4 total	19.21	3.387	6.21	266.7	3.39	62.8
1600									
~~1600~~ 1600									

2/21/07 JLB

00107122

GROUNDWATER SAMPLING FORM

Sheet 2 of 3

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
						2/21/07		JCB	

10 - esp
20

Sampling

Sampling beginning time: N/A

Sampling completion time: N/A

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
						2/21/07		JCB	

Sample Information

Sample ID: N/A

Sample collection date/time: N/A

Duplicate sample collected (Y/N): N

Duplicate sample ID: N

Split sample collected (Y/N): N

Split sample ID: N

COC No(s): N

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
				2/21/07	JCB

Comments: well went Dry 2/21/07 @1600 22.00' DTW

See p 3 of 3 02/22/07

Will Come Back Thursday week to Check on Recharge.

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107123

GROUNDWATER SAMPLING FORM

Sheet 3 of 3

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

10 – esp nac / 20

MSE 02/22/07

Sampling

Sampling beginning time: 1100 Sampling completion time: 1115

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1115		N/A	N/A	18.36	3.009	6.93	266.5	6.03	3.52
			Note: Reading		taken @ end				
			Sampling:	USED	A disposable bailer			to	
			Sample	& take	reading. Water clear @ First				

Sample Information

Sample ID: LHS MW-43-FEB 2007

Sample collection date/time: 02-22-07 / 1100

Duplicate sample collected (Y/N): N

Duplicate sample ID: N/A

Split sample collected (Y/N): N

Split sample ID: N/A

COC No(s): 10926 / 10929

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC	8260B	3 v 0.4 s	Sulfides	376.2	1-500mL HDPE
Gases	175	3 v 0.4s	Anions	300.0	1-1000mL HDPE
TOC	415.1	3 v 0.4s	DHC		2-1L Liter Ambers
Perchlorate	314.0	1-1000mL HDPE			
Alkalinity	310.1	1-1000mL HDPE			

MSE

Comments:

See note

Ferrous Iron 0.02 mg/L

Salinity 1.05

Hand bailed ≈ 3.0 Liters

purged ≈ 0.4

3.4 Liters

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107124

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Sample Collection Log

117591 · Longhorn Army Ammunition Plant

Manager: Praveen Srivastav

RFA / COC Number: 10920 / 10921

Location Code: 50WW03
Sample Number: 50WW03- FEB 2007
Sample Name: 50WW03-GW-50WW03- -REG
Sampling Method: SP
Sample Type: GW *Sample Purpose:* REG
Sampling Equip: QED Bladder Pump

Task: MNA_EVENT_FEB07
Collection Date: 02-24-07
Collection Time: 0856
Start Depth: 20.30
End Depth: 20.88
Sample Matrix: WATER
Sample Team: M Martinez / J. Belcher

QC Partners:
(TB) 02-24-07 (ER) N/A (FB) N/A

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
VOC-FULL	N	A	3	40	mL	VOA VIAL
ANIONS	N	B	1	~~500~~ 1000	mL	HDPE
PERC	N	C	1	500	mL	HDPE
GASES	N	D	~~3~~ 3	40	mL	VOA Vial
ALKALINITY	N	E	1	100~~0~~	mL	HDPE
TOC_415	N	F	~~3~~ 3	~~100~~ 40	mL	~~HDPE~~ VOA vials
DHC	N	G	~~2~~ 2	1	L	Amb. Glass
Silicates	N	H	1	500	mL	HDPE

ERPIMS Values:
Sacode:
Lot Control#:

Groundwater Information:
Measured Well Depth: 22.98' **Depth To Water:** 20.44

Comments: Ferrous Iron 0.00 mg/L
Salinity 3.78

Sketch Location:

Reviewed BY / Date: [signature] 02-24-07 *Reviewed BY / Date:*

00107125

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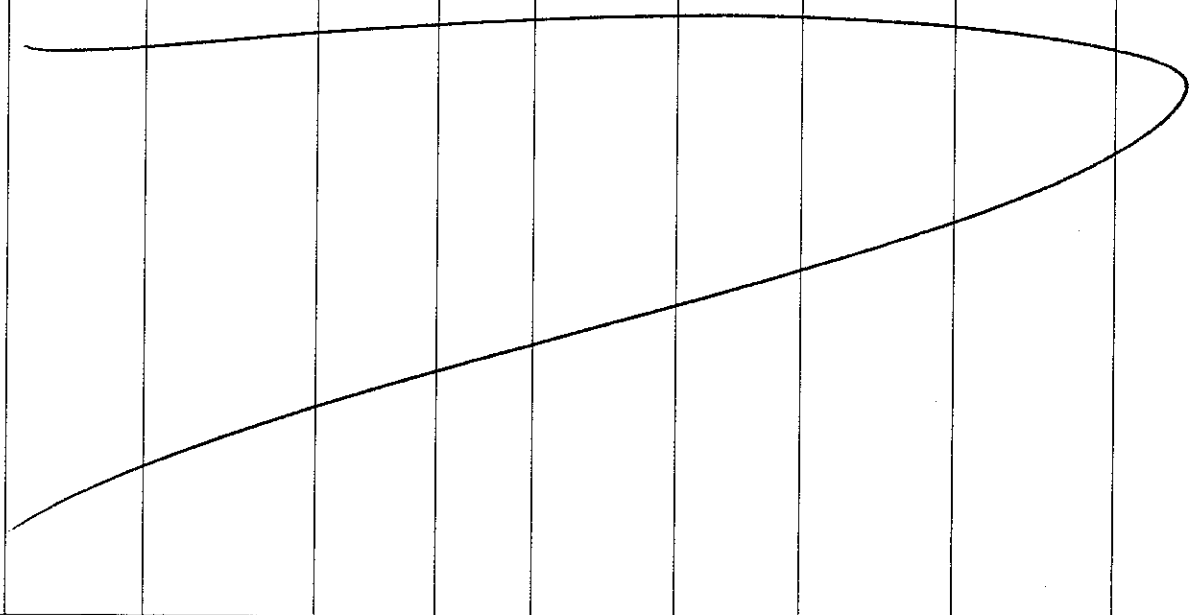
Sample Collection Log

117591 - Longhorn Army Ammunition Plant
Manager: Praveen Srivastav

Location Code: **50WW03**
Sample Number: **50WW03-** FEB 2007

PURGE RECORD:

Initial	Time(24hr)	DepthtoWater (ft)	Eh (mV)	pH (SU)	Conductivity (mS/cm)	Turbidity (NTU)	DissOxygen (ppm)	Temperature (C)	Purge Volume (gal)
Sample:	0955	20.88	600.0	7.05	6.867	4.5	3.08	18.75	11.475



ged BY / Date: 02-24-07 *Reviewed BY / Date:* _____

00107126

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: AREA 50
Project Name/#: Longhorn AAP 117591
Weather: Cloudy 76°
Sampling location ID: SOUW03
Sample ID: SOUW03-FEB2007
Collection Time/Date: 02-24-07

Pump Installation

Pump installation crew: J.Belcourt / M. Martinez
PID/FID reading (well head/background): 0.0 PPM
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 22.98
Initial (pre-installation) DTW/time: 20.44 @1622
Final (after pump priming) DTW/time: 20.
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): 1000
Discharge tube length (ft.): 30'
Installation date/beginning time: 2/23/07 @ 1625
Installation date/completion time: 2/23/07 @ 1630
Screen Interval (ft. BTOC): 13' to 23'
Pump intake depth (ft BTOC): 21'
Post-installation DTW/time: 20.38 @1629
Max. sustainable pump rate (mL/min):
Appearance of product: NONE
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = 18 psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	18								18
Refill Setting	10								10
Discharge Setting	5								5
Flow rate (mL/min)	133								135

Purging

Purging/sampling crew: J.Belcourt / M. Martinez
Purge date/beginning time: 2/23/07 @ 1630 02-24-07
Initial (pre-purging) DTW (ft. BTOC): ~~20.38~~ 2030-02-24-07
Calculated tubing + pump volume: NA
PID/FID reading (well head/background): 0.0 / 0.0
Purge date/completion time: 02-24-07 / 0755
Final (post-purging) DTW (ft. BTOC): 20.88
No. of tubing + pump volumes purged: 2.473

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = 18 psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	18								18
Refill Setting	10								10
Discharge Setting	5								5
Flow rate (mL/min)	135								135

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
0830	20.02	135	0	18.08	0.888	6.93	292	3.90	28.7
0840	20.05	135	1.35	18.13	0.900	6.94	290.1	3.87	27.1
0845	20.70	135	2.02	18.15	0.907	6.94	287.2	3.85	26.2
0850	20.78	135	2.7	18.19	0.907	6.94	285.7	3.66	24.7
0855	20.78	135	3.375	18.21	0.911	6.95	283.6	3.72	20.9
0856	Sample								

02-24-07

00107127

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

02-24-07

Sampling

Sampling beginning time: 0550 Sampling completion time: 0950

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
0955	20.88	~~475~~ 135	11.475	18.95	6.867	7.05	200	3.08	4.5

02-24-07

Sample Information

Sample ID: SOLW03-FEB2007

Sample collection date/time: 02-24-07

Duplicate sample collected (Y/N): N

Duplicate sample ID: N

Split sample collected (Y/N): N

Split sample ID: N

COC No(s): 10920 / 10921

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC's - Full	8260B	3 VOA's	Sulfides	~~376.2~~ 376.1	1-500 mL HDPE
Gases	175	3 VOA's	ANIONS	300	1-100 mL HDPE
TOC	415.1	3 VOA's	DHC		2 1 L Amber
Perchlorate	314.0	1-500 mL HDPE			
ALKALINITY	310.1	1-100 mL HDPE			02-24-07

Comments: Ferrous IRON: 0.00 MG/L

Salinity: 3.78

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107128

GROUNDWATER SAMPLING FORM

Sheet 1 of 5

Operable Unit/Site ID: ~~47W001~~ 101807 LHAAP-47
Project Name/#: LHAAP / 117591 0009A130
Weather: DRY, Pdly cloudy, 70s

Sampling location ID: 47W001
Sample ID: 47W001-101807
Collection Time/Date: 10:15 10/18/07

Pump Installation

Pump installation crew: A. Willmore / S. Beesinger
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 22.11
Initial (pre-installation) DTW/time: 18.72
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: NA
Installation date/completion time: NA
Screen Interval (ft. BTOC): 12 to 22
Pump intake depth (ft BTOC): NA
Post-installation DTW/time: NA
Max. sustainable pump rate (mL/min): NA
Appearance of product: None
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): No

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting			BAILED DRY						
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: A. Willmore / S. Beesinger
Purge date/beginning time: NA
Initial (pre-purging) DTW (ft. BTOC): NA
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.0
Purge date/completion time: 10/18/07 ~~10/19/07~~ NA
Final (post-purging) DTW (ft. BTOC): NA
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting			BAILED DRY						
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
					DRY				
				BAILED					

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

10/19/07

Bailed Dry

10-20

Sampling

Sampling beginning time: 10:15 Sampling completion time: 10:20

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
10:25	NA	NA	< 1 gal	21.53	2.190	6.58	482.9	3.30	27.1

Sample Information

Sample ID: 47wwo1 - 101907

Sample collection date/time: 10/19/07 10:15

Duplicate sample collected (Y/N): N

Duplicate sample ID: NA

Split sample collected (Y/N): N

Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs	8260	3 - 40 mL Voa vials			

Comments: Bailed Dry; Sampled w/ disposable HDPE bailer

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

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GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LTMMP-47
Project Name/#:
Weather: Pty Cloudy; 70s

Sampling location ID: 47WW03
Sample ID: 47WW03 - 101707
Collection Time/Date: 16:30 10/17/07

Pump Installation

Pump installation crew: A. Willmore / S. Bessinger
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 27.00
Initial (pre-installation) DTW/time: 19.96
Final (after pump priming) DTW/time: 19.94
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NR
Discharge tube length (ft.): ~~10~~ 26'
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NR psi

Installation date/beginning time: 10/17/07 15:38
Installation date/completion time: 10/17/07 15:48
Screen Interval (ft. BTOC): 17.00 to 27.00
Pump intake depth (ft BTOC): 23.00
Post-installation DTW/time: 19.94
Max. sustainable pump rate (mL/min): 100
Appearance of product: None
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): No

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)						10/17/07			

Purging

Purging/sampling crew: A. Willmore / S. Bessinger
Purge date/beginning time: 10/17/07
Initial (pre-purging) DTW (ft. BTOC): 19.96
Calculated tubing + pump volume: NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NR psi

PID/FID reading (well head/background): 0.0
Purge date/completion time: 10/17/07 16:45
Final (post-purging) DTW (ft. BTOC): 20.09
No. of tubing + pump volumes purged:

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting	NA								
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
16:07	20.09	100	0.5	21.98	4.902	6.41	617.7	0.57	1.8
16:12	20.09	100	1.0	21.76	4.892	6.39	634.6	0.58	1.2
16:17	20.09	100	1.5	21.72	4.881	6.39	656.9	0.54	1.4
16:22	20.09	100	2.0	21.66	4.875	6.39	661.6	0.54	1.3
16:27	20.09	100	2.5	21.68	4.875	6.39	662.0	0.54	1.2

20.09

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

10/17/07

10-20

Sampling

Sampling beginning time: 16:30 Sampling completion time: 16:45

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
16:35	20.09	100	3	21.72	4.87	6.39	665	.55	1.5

Sample Information

Sample ID: 47MW13 Sample collection date/time: 10/17/07 16:30

Duplicate sample collected (Y/N): No Duplicate sample ID: NA

Split sample collected (Y/N): No Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs	8260	3-40mL VOA vials			

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107132

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP / 117591.0009A.1B8
Weather: Partly cloudy High 70s
Sampling location ID: 47W004 - 101807
Sample ID: 47W004
Collection Time/Date: 11:30 10/18/07

Pump Installation

Pump installation crew: A. Williams / S. Bessinger
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 21.89
Initial (pre-installation) DTW/time: 15.65
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): 21.5
Installation date/beginning time: 10/18/07 10:35
Installation date/completion time: 10/18/07 10:36
Screen Interval (ft. BTOC): 11.5 to 21.5
Pump intake depth (ft BTOC): 18.5
Post-installation DTW/time: 15.65
Max. sustainable pump rate (mL/min): 100
Appearance of product: None
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NR psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)						10/18/07			

Purging

Purging/sampling crew: A. Williams / S. Bessinger
Purge date/beginning time: 10/18/07 10:45
Initial (pre-purging) DTW (ft. BTOC): 15.65
Calculated tubing + pump volume: NA
PID/FID reading (well head/background): 0.0
Purge date/completion time: 10/18/07 11:35
Final (post-purging) DTW (ft. BTOC): 15.65
No. of tubing + pump volumes purged: NR

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NR psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
10:45	15.78	100	0	22.45	5.985	6.54	639.7	0.92	25.9
10:50	15.78	100	0.5	22.29	5.990	6.50	653.4	0.75	32.3
10:55	15.78	100	1.0	22.10	5.987	6.45	678.0	0.62	36.7
11:00	15.78	100	1.5	22.01	5.988	6.43	695.6	0.56	29.6
11:05	15.78	100	2.0	21.92	5.989	6.40	717.0	0.53	22.8
11:10	15.78	100	2.5	21.87	5.987	6.39	729.8	0.49	20.1
11:15	15.78	100	3.0	21.96	5.991	6.37	732.1	0.47	17.2
11:20	15.78	100	3.5	22.00	5.993	6.35	738.4	0.46	14.8

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical ±3% Conductivity (uMhos/cm)	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
11:35	15.78	100	4.0	22.10	5.996	6.36	734.0	0.47	11.5

10-20

10/18/07

Sampling

Sampling beginning time: 11:30 Sampling completion time: 11:32

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
11:35	15.78	100	5.0	22.60	5.997	6.34	783.1	0.41	12.5

Sample Information

Sample ID: 47www04-101807 Sample collection date/time: 10/18/07 11:30

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs	8260	3-40 mL Voas			

Comments: Purged w/ Peristaltic pump. Sampled w/ peristaltic pump

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

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GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAA-47
Project Name/#: LHAAP / 117691.0009.A130
Weather: Clear 60s

Sampling location ID: 47WW05
Sample ID: 47WW05-101907
Collection Time/Date: 0850 10/20/07

Pump Installation

Pump installation crew: A. Willmore / S. Bessinger
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 21.50
Initial (pre-installation) DTW/time: 20.59
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: NA
Installation date/completion time: NA
Screen Interval (ft. BTOC): 10.5 to 20.5
Pump intake depth (ft BTOC): NA
Post-installation DTW/time: NA
Max. sustainable pump rate (mL/min): NA
Appearance of product: NA
Discharge tube diameter (3/8" or 1/4"): NA
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: A. Willmore / S. Bessinger
Purge date/beginning time: 10/18/07
Initial (pre-purging) DTW (ft. BTOC): 20.59
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.0
Purge date/completion time: 10/18/07
Final (post-purging) DTW (ft. BTOC): NA
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting			Bailed Dry						
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
			Bailed		Dry				

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

10-ea/20

10/20/07

Sampling

Sampling beginning time: 0850 Sampling completion time: 0852

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
0900	NR	NA	~3	21.89	2.880	6.06	564.6	3.41	738.7

Sample Information

Sample ID: 47mw05-101807 Sample collection date/time: 0850 10/20/07

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs	8260	3-40mL Vog vials			

Comments: Bailed dry w/ 3.5" disposable bailer (HDPE

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

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GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: CHAAP-47
Project Name/#: 117591.0009A130
Weather: cloudy, mid 70's

Sampling location ID: 47WW08
Sample ID: 47WW08-101707
Collection Time/Date: ~~8/10/07~~ 8:10 10/17/07

Pump Installation

Pump installation crew: A. Willmore / S. Bessinger
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 21.57
Initial (pre-installation) DTW/time: 21.18
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: NA
Installation date/completion time: NA
Screen Interval (ft. BTOC): 11.6 to 21.5
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min): NA
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: A. Willmore / S. Bessinger
Purge date/beginning time: 10/16/07 and 10/17/07
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.0
Purge date/completion time: 10/16/07 and 10/17/07
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ± 10%	±3% Electrical Conductivity (uMhos/cm)	pH ± 0.1	Eh (mv) ± 10	DO (mg/L) ± 10%	Turbidity (NTU) ± 10%

10/17/07

10/20

Sampling

Sampling beginning time: ~~810~~ 16:40 (10-16-07) Sampling completion time: 0810 (10-17-07)

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
13:05	Bottom of well	NA	~1	23.32	6.485	6.33	493.6	4.24	2655.9

Sample Information

Sample ID: 47W208-101707

Sample collection date/time: 10/17/07 8:10

Duplicate sample collected (Y/N): No

Duplicate sample ID: NA

Split sample collected (Y/N): No

Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
TAL METALS	6020B	1-500mL			
TSS/TDS		1-500mL			

Comments: Well nearly dry. Purged ~300mL from well.
Collected sample w/ bailer over the timeframe of two days. Well continued to gain
Only able to fill 2-1/2 500mL bottles. * Field parameter taken when enough water was collected.

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

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GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: 117591.0009A130
Weather: Sunny, Low 80s 40 Hi 90s

Sampling location ID: 47WW09
Sample ID: 47WW09-101607
Collection Time/Date: 15:50 10/16/07

Pump Installation

Pump installation crew: A. Willmore / S. Beesinger
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 41.21
Initial (pre-installation) DTW/time: 21.18
Final (after pump priming) DTW/time: ~~20.95~~ NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NR
Discharge tube length (ft.): 39'

Installation date/beginning time: 10/16/07 14:48
Installation date/completion time: 10/16/07 14:50
Screen Interval (ft. BTOC): 31 to 41
Pump intake depth (ft BTOC): 36'
Post-installation DTW/time: 20.95
Max. sustainable pump rate (mL/min): 100
Appearance of product: None
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): No

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NR psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

10/16/07

Purging

Purging/sampling crew: A. Willmore / S. Beesinger
Purge date/beginning time: 10/16/07 15:00
Initial (pre-purging) DTW (ft. BTOC): 20.95
Calculated tubing + pump volume: NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NR psi

PID/FID reading (well head/background): 0.6
Purge date/completion time: 10/16/07
Final (post-purging) DTW (ft. BTOC): 21.46
No. of tubing + pump volumes purged: NR

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	22								22
Refill Setting	10								10
Discharge Setting	5								5
Flow rate (mL/min)	100								100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
15:31	21.46	100	1.5	19.57	4.409	6.75	52.9	0.30	1.0
15:26	21.46	100	2.0	19.72	4.414	6.77	76.2	0.30	0.8
15:31	21.46	100	2.5	19.75	4.420	6.80	82.1	0.30	0.8
15:36	21.46	100	3.0	19.75	4.420	6.80	84.9	0.30	0.8
15:41	21.46	100	3.5	19.84	4.419	6.83	85.1	0.30	0.7
15:46	21.46	100	4.0	19.85	4.419	6.82	85.1	0.30	0.7

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ± 10%	±3% Electrical Conductivity (uMhos/cm)	pH ± 0.1	Eh (mv) ± 10	DO (mg/L) ± 10%	Turbidity (NTU) ± 10%

10/16/07

10/20

Sampling

Sampling beginning time: ~~15:48~~ 15:50 Sampling completion time: 16:16

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
16:12									
~~16:48~~	21.46	100	6.5	20.04	4.548	6.82	100.1	0.29	0.4

Sample Information

Sample ID: 47WW09-101607

Duplicate sample collected (Y/N): Yes

Split sample collected (Y/N): No

COC No(s):

Sample collection date/time: 10/16/07 16:50

Duplicate sample ID: 47WW09-101607

Split sample ID: NA

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
TAL METALS TO BE FLD	6020B	2- 500 mL HDPE			
~~T~~	~~E026B~~	~~1- 500 mL HDPE~~			
TSS/TDS		2- 500mL HDPE			

Comments: INTERMEDIATE WELL

TOOK FIELD DUPLICATES

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

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GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP/ 117591. 0009A130
Weather: clear/ 60s

Sampling location ID: 47WW11
Sample ID: 47WW11-101907-DRY
Collection Time/Date: DRY

Pump Installation

Pump installation crew: A. Willmore / S. Beesinger
PID/FID reading (well head/background): 0.0
Casing diameter (inches):
Total well Depth (ft. BTOC): 21.89
Initial (pre-installation) DTW/time: Dry
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):

Installation date/beginning time: DRY
Installation date/completion time:
Screen Interval (ft. BTOC): 12 to 22
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min):
Appearance of product: DRY
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew:
Purge date/beginning time:
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA

PID/FID reading (well head/background):
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

10 - e
20

Sampling

Sampling beginning time:_____ Sampling completion time:_____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID: 47W04-101907-DRY

Sample collection date/time:_____

Duplicate sample collected (Y/N):_____

Duplicate sample ID:_____

Split sample collected (Y/N):_____

Split sample ID:_____

COC No(s):_____

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107142

GROUNDWATER SAMPLING FORM

Sheet 1 of 7

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP / 117591.0009A130
Weather: clear, low 90s

Sampling location ID: 47WW12
Sample ID: 47WW12 - 101807
Collection Time/Date: NA - DRY

Pump Installation

Pump installation crew: A. Willmore / S. Beesinger
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 21.90
Initial (pre-installation) DTW/time: DRY
Final (after pump priming) DTW/time: DRY
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: NA
Installation date/completion time: NA
Screen Interval (ft. BTOC): 12 to 22
Pump intake depth (ft BTOC):
Post-installation DTW/time: DRY
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting			DRY						
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: A. Willmore / S. Beesinger
Purge date/beginning time: NA
Initial (pre-purging) DTW (ft. BTOC): NA
Calculated tubing + pump volume: NA

PID/FID reading (well head/background):
Purge date/completion time: NA
Final (post-purging) DTW (ft. BTOC): NA
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting			DRY						
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
				DRY					

00107143

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

10-e 20

10/10/01

DRY

Sampling

Sampling beginning time: NA Sampling completion time: NA

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY

Sample Information

Sample ID: 47WW12

Sample collection date/time:

Duplicate sample collected (Y/N): NA

Duplicate sample ID:

Split sample collected (Y/N):

Split sample ID:

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

NA

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107144

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: CHAAD-47
Project Name/#: ~~Lockheed~~ CHAAP
Weather: Overcast; WARM

Sampling location ID: 47GW13
Sample ID: 47WW13-101607
Collection Time/Date: 10/16/07 16:20

Pump Installation

Pump installation crew: Mabe/Smith
PID/FID reading (well head/background): ~~0.0~~ 0.0
Casing diameter (inches): 4" well
Total well Depth (ft. BTOC): 20.62
Initial (pre-installation) DTW/time: 10.53
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): 18

Installation date/beginning time: 10/16/07 1515
Installation date/completion time: 10/16/07 1620
Screen Interval (ft. BTOC): 10.62 to 20.62
Pump intake depth (ft BTOC): 15.00
Post-installation DTW/time: 10.52
Max. sustainable pump rate (mL/min): 300
Appearance of product:
Discharge tube diameter (3/8" or 1/4"): 1/4
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting				NA					
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: Mabe/Smith
Purge date/beginning time: 10/16/07 1525
Initial (pre-purging) DTW (ft. BTOC): 10.53
Calculated tubing + pump volume: NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

PID/FID reading (well head/background): 0.0
Purge date/completion time: 10/16/07 1620
Final (post-purging) DTW (ft. BTOC): 13.67
No. of tubing + pump volumes purged: NA

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting				NA					
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity ~~(uMhos/cm)~~ mS/cm	pH	Eh (mv) ORP	DO (mg/L)	Turbidity (NTU)
1525	11.48	300		24.70	0.216	5.89	199.6	1.59	338.4
1530	11.72	300		24.72	0.208	5.64	183.8	1.35	241.7
1535	11.89	300		24.68	0.206	5.61	173.6	1.34	162.6
1540	12.28	250		24.89	0.216	5.71	157.1	1.94	86.3
1545	12.61	250		25.06	0.216	5.70	153.1	2.00	108.8
1550	12.74	250		24.92	0.217	5.70	152.8	1.60	577.7
1555	12.93	250		24.71	0.217	5.69	170.9	1.45	569.6
1600	13.25	250		24.85	0.215	5.66	160.6	1.80	180.9

K = mS/cm

00107145

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical ±3% Conductivity (uMhos/cm)	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
1605	13.27	250		24.88	0.215	5.65	158.9	1.82	176.9
1610	13.50	250		24.98	0.214	5.64	154.8	1.90	153.5
1615	13.67	250	5 gal	24.83	0.212	5.63	156.4	1.87	163.2

10 - 6
20

Sampling

Sampling beginning time: 1615

Sampling completion time: 1620

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1620	13.67	250	5 gal	24.83	0.212	5.63	156.4	1.87	163.2

Sample Information

Sample ID: 47WW13-101607

Sample collection date/time: 10/16/07 16:20

Duplicate sample collected (Y/N): N

Duplicate sample ID: NA

Split sample collected (Y/N): N

Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
Metals		2-500mL			
TDS		↓			
TSS					

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107146

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP
Weather: 80's

Sampling location ID: 47WW17
Sample ID:
Collection Time/Date: 10/17/07 None

Pump Installation

Pump installation crew: Mabe/Smith
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): DRY
Initial (pre-installation) DTW/time:
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

Installation date/beginning time: DRY
Installation date/completion time:
Screen Interval (ft. BTOC): _____ to
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting			NA						
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: Mabe/Smith
Purge date/beginning time: NA
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

PID/FID reading (well head/background): 0.0
Purge date/completion time: DRY
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)				NA					
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
				DRY					

00107147 10/17/07

GROUNDWATER SAMPLING FORM

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
					NA				

10 - every 20

Sampling

Sampling beginning time: NA Sampling completion time: NA

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
					NA				

Sample Information

Sample ID: NA Sample collection date/time: NA

Duplicate sample collected (Y/N): Duplicate sample ID:

Split sample collected (Y/N): ✓ Split sample ID: ✓

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
		NA			

Comments:
10/17/07 well still dry
DRY 10/18/07

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107148

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP
Weather: 80's

Sampling location ID: 47WW18
Sample ID: 47ww18-101807
Collection Time/Date: 10/18/07 08:45

Pump Installation

Pump installation crew: Mabe/Smith
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 23.75
Initial (pre-installation) DTW/time: 21.31
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.):

Installation date/beginning time: Bailed
Installation date/completion time:
Screen Interval (ft. BTOC): _____ to _____
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting			NA						
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: Mabe/Smith
Purge date/beginning time: 10/17/07 1100
Initial (pre-purging) DTW (ft. BTOC): NA
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.0
Purge date/completion time: 10/17/07
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting				NA					
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
				NA					

00107149

GROUNDWATER SAMPLING FORM

Sheet ___ of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

10-20 ml

Sampling

Sampling beginning time: 0840 10/18/07 Sampling completion time: 0845

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
10-18-07	21.31								

Sample Information

Sample ID: 47WW18-101807 Sample collection date/time: 10/18/07 0845

Duplicate sample collected (Y/N): ~~N~~ Y Duplicate sample ID: DUP-03

Split sample collected (Y/N): N Split sample ID: NA

COC No(s): ___

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs		3-VOAs			

11:00 Comments: Dry. NOT ENOUGH water to pump. Hand Bailed Dry. 1.5 Gal purge water
845 Collected DUP 03

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107150

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP
Weather: 80's

Sampling location ID: 47WW19
Sample ID: 47WW19-101707
Collection Time/Date: 10/17/07 1015

Pump Installation

Pump installation crew: Mabe/Smith
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 64.23
Initial (pre-installation) DTW/time: 20.82
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): 62

Installation date/beginning time: 10/17/07 0915
Installation date/completion time: 10/17/07 1015
Screen Interval (ft. BTOC): 54.27 to 64.23
Pump intake depth (ft BTOC): 59.00
Post-installation DTW/time: 20.8
Max. sustainable pump rate (mL/min): 250
Appearance of product:
Discharge tube diameter (3/8" or 1/4"): 1/4
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)					NA				
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: Mabe/Smith
Purge date/beginning time: 10/17/07 0915
Initial (pre-purging) DTW (ft. BTOC): 20.82
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.0
Purge date/completion time: 10/17/07 1015
Final (post-purging) DTW (ft. BTOC): 20.98
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)					NA				
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv) ORP	DO (mg/L)	Turbidity (NTU)
9:30	20.95	250.0		20.14	2.963	6.21	80.6	2.73	78.6
9:35	20.96			19.84	2.999	6.22	45.7	2.62	89.2
9:40	20.96			19.84	2.984	6.24	45.2	2.92	87.4
9:45	20.98			19.79	2.976	6.26	45.3	3.25	
9:50	20.98			19.78	2.976	6.25	45.5	3.51	79.3
9:55	20.97			19.78	2.971	6.26	45.8	3.70	70.3
10:00	20.97			19.83	2.970	6.27	46.1	3.94	69.6
10:05	20.98	↓	4 gal	19.85	2.966	6.27	46.4	4.11	65.5

00107151

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ± 10%	±3% Electrical Conductivity (uMhos/cm)	pH ± 0.1	Eh (mv) ± 10	DO (mg/L) ± 10%	Turbidity (NTU) ± 10%
					NA				

10/20

Sampling

Sampling beginning time: 10:08 Sampling completion time: ~~10:14~~ 10:15

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1015	20.98	250	4 gal	19.85	2.466	6.27	46.4	4.11	65.5

Sample Information

Sample ID: 47WW19-101707 Sample collection date/time: 10:08 10/17/07

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
Metals		2 500 mL			
TSS		↓			
TDS					

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107152

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP / 117591.0009A130
Weather: Partly Cloudy High 80's

Sampling location ID: 47WW21
Sample ID: 47WW21-101807
Collection Time/Date: 14:20 10/18/07

Pump Installation

Pump installation crew: A. Willmore / S. Beesinger
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 23.91
Initial (pre-installation) DTW/time: 13.13
Final (after pump priming) DTW/time: 13.13
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): 21'

Installation date/beginning time: 10/18/07 13:31
Installation date/completion time: 10/18/07 13:34
Screen Interval (ft. BTOC): 14 to 24
Pump intake depth (ft BTOC): 18'
Post-installation DTW/time: 13.13
Max. sustainable pump rate (mL/min): 100
Appearance of product: None
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NR psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

NA

Purging

Purging/sampling crew: A. Willmore / S. Beesinger
Purge date/beginning time: 10/18/07 13:35
Initial (pre-purging) DTW (ft. BTOC): 13.13
Calculated tubing + pump volume: NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NR psi

PID/FID reading (well head/background): 0.0
Purge date/completion time: 10/18/07 14:16
Final (post-purging) DTW (ft. BTOC): 13.40
No. of tubing + pump volumes purged: NA

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	NA								NA
Refill Setting	NA								NA
Discharge Setting	NA								NA
Flow rate (mL/min)	100								100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
13:46									
1346	1340	100	0	23.47	0.562	5.40	35.0	2.12	21.7
13:51	13.40	100	0.5	23.07	0.521	5.26	39.6	1.88	22.7
15:56	13.40	106	1.0	22.97	0.506	5.22	56.3	1.83	20.0
14:01	13.40	100	1.5	22.98	0.492	5.18	82.9	1.72	18.1
14:06	13.40	100	2.0	23.50	0.470	5.13	113.9	2.47	20.1
14:11	13.40	100	2.5	24.48	0.467	5.17	116.1	2.48	17.6
14:16	13.40	100	3.0	24.59	0.467	5.17	117.1	2.49	17.9

00107153

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

10-e 20

10/18/07

Sampling

Sampling beginning time: 14:20 Sampling completion time: 14:25

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
14:35	13.40	100	5.0	25.05	0.466	5.15	141.3	4.03	15.6

Sample Information

Sample ID: 47WW21-101807

Sample collection date/time: 14:20 10/18/07

Duplicate sample collected (Y/N): Yes

Duplicate sample ID: 47WW21-101807

Split sample collected (Y/N): No

Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs	8260	6 40mL VOA vials			

Comments: Took field duplicate.
Sampled w/ peristaltic pump

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107154

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP WT591.1009A130
Weather: Partly cloudy low to mid 80s

Sampling location ID: 47WW22
Sample ID: ~~LHBMW~~ 47WW22-101807
Collection Time/Date: 09:55 10/18/07

Pump Installation

Pump installation crew: A. Willmore / S. Bessinger ✓
PID/FID reading (well head/background): 0.8
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 22.60
Initial (pre-installation) DTW/time: 21.38
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: NA
Installation date/completion time: NA
Screen Interval (ft. BTOC): 12.60 to 22.60
Pump intake depth (ft BTOC): NA
Post-installation DTW/time: NA
Max. sustainable pump rate (mL/min): NA
Appearance of product: NA
Discharge tube diameter (3/8" or 1/4"): NA
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting			BAILED		DRY				
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: A. Willmore / S. Bessinger ✓
Purge date/beginning time: 10/17/07 14:25
Initial (pre-purging) DTW (ft. BTOC): 21.38
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.6
Purge date/completion time: 10/17/07 14:30
Final (post-purging) DTW (ft. BTOC): NA
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting			BAILED		DRY				
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
				BAILED		DRY			

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00107155

GROUNDWATER SAMPLING FORM

Sheet 2 of 3

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

10-20

10/17/07

Sampling

Sampling beginning time: 0955 Sampling completion time: 10:00

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
10:05	NR	NA	NR	20.48	7.762	5.52	505.3	2.29	200.8

Sample Information

Sample ID: 47WW22-101807

Sample collection date/time: ~~10/17~~ 10/18/07

Duplicate sample collected (Y/N): N

Duplicate sample ID: NA

Split sample collected (Y/N): N

Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
TAL Metals	C	1-500 mL HDPE			
TSS/TDS		1-500mL HDPE			
VOCs		3-40mL Voa vials			

Comments: Due to low volume of water in well, 47WW22 was purged dry w/ a disposable HDPE bailer. Purged ~1 gallon from 47WW22. Sampled w/ bailer. Samples very silty

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107156

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP / 117593-0009A130
Weather: clear, low 60s to High 80s

Sampling location ID: 47WW23
Sample ID: 47WW23-101907
Collection Time/Date: 0945 10-19-07

Pump Installation

Pump installation crew: A. Willmon / S. Beesinger
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 3
Initial (pre-installation) DTW/time: 21.15
Final (after pump priming) DTW/time: 34.92
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NR
Discharge tube length (ft.): ~~H~~ 31

Installation date/beginning time: 10/19/07 8:45
Installation date/completion time: 10/19/07 8:55
Screen Interval (ft. BTOC): 25 to 35
Pump intake depth (ft BTOC): 28.00
Post-installation DTW/time: 21.10 8:55
Max. sustainable pump rate (mL/min): 100
Appearance of product: None
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NR psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

10/19/07

Purging

Purging/sampling crew: A. Willmon / S. Beesinger
Purge date/beginning time: 10/19/07 9:00
Initial (pre-purging) DTW (ft. BTOC): 21.10
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.00 ppm
Purge date/completion time: 10/19/07 ~~10:00~~ 09:50
Final (post-purging) DTW (ft. BTOC): 21.45
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	17								10
Refill Setting	10								10
Discharge Setting	5								5
Flow rate (mL/min)	100								100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
9:05	21.45	100	.5	20.41	1.096	6.59	451.0	1.49	4.7
9:10	21.45	100	1.0	20.71	1.091	6.51	478.2	1.19	2.8
9:15	21.45	100	1.5	20.86	1.087	6.45	497.8	1.24	2.4
9:20	21.45	100	2.0	20.89	1.084	6.38	512.7	1.27	1.9
9:25	21.45	100	2.5	21.09	1.081	6.30	533.1	1.22	1.2
9:30	21.45	100	3.0	21.22	1.080	6.19	551.0	1.25	1.4
9:35	21.45	100	3.5	21.30	1.078	6.13	562.6	1.25	1.2
9:40	21.45	100	4.0	20.92	1.076	6.12	559.3	1.25	1.0

00107157

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

10-20

10/19/07

Sampling

Sampling beginning time: 09:45 Sampling completion time: 09:47

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
9:50	21.95	100	5.0	20.84	1.074	5.95	587.1	1.15 ~~589.1~~	1.3

Sample Information

Sample ID: 47uw23-101907 Sample collection date/time: 10/19/07 09:45

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		3-40 ml glass			

Comments: Purged and sampled w/ bladder pump

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107158

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP
Weather: 80's

Sampling location ID: 47WW25
Sample ID: 47WW25-101807
Collection Time/Date: 10/17/07 0900 → 10/18/07

Pump Installation

Pump installation crew: Mabe/Smith
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 28.04
Initial (pre-installation) DTW/time: 26.3
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): —
Discharge tube length (ft.): —

Installation date/beginning time: NA
Installation date/completion time:
Screen Interval (ft. BTOC): to
Pump intake depth (ft BTOC): Did Not
Post-installation DTW/time: Pump
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)			NA						
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: Mabe/Smith
Purge date/beginning time: 10/17/07 1615
Initial (pre-purging) DTW (ft. BTOC): 26.3
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.0
Purge date/completion time: 10/17/07 1630
Final (post-purging) DTW (ft. BTOC): NA - Dry
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)			NA						
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
	26.3			Will not pump due to lack of water					
				Bailed 1.5 gal					
10/18/07	26.40 → Bail to Sample								

00107159

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
				N/A					

10-20 ml

Sampling

Sampling beginning time: 0850 Sampling completion time: 0900 10/18/07

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
0900	NA —		Bailed						

Sample Information

Sample ID: 47WW25 - 101807 Sample collection date/time: 10/18/07 0900

Duplicate sample collected (Y/N): N Duplicate sample ID: N

Split sample collected (Y/N): N Split sample ID: N

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs		3 VOAs			

Comments: 10/18/07

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107160

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: 117591.0009.A130
Weather: clear, Low 50s

Sampling location ID: 47WW26
Sample ID: 47WW26-101907
Collection Time/Date: DRY

Pump Installation

Pump installation crew: A. Willmore
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 22.87
Initial (pre-installation) DTW/time: Dry
Final (after pump priming) DTW/time: Dry
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: NA
Installation date/completion time: NA
Screen Interval (ft. BTOC): 13 to 23
Pump intake depth (ft BTOC):
Post-installation DTW/time: Dry
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"): NA
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

DRY

Purging

Purging/sampling crew: A. Willmore / S. Beesinger
Purge date/beginning time: DRY
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

PID/FID reading (well head/background): 0.0
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC): DRY
No. of tubing + pump volumes purged:

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

DRY

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY

00107161

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

DRY

10/19/07

10 - < 20

Sampling

Sampling beginning time: NA

Sampling completion time: NA

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY

Sample Information

Sample ID: 47WW26-

Sample collection date/time: NA

Duplicate sample collected (Y/N): N

Duplicate sample ID: N/A

Split sample collected (Y/N): N

Split sample ID: N/A

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

DRY

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107162

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP 117591.0009A130
Weather: clear; low 90s

Sampling location ID: 47WW27
Sample ID: 47WW27-101907
Collection Time/Date: 08:20 10/18/07 08:20

Pump Installation

Pump installation crew: A. Willmore / S. Beesinger
PID/FID reading (well head/background): 0.6
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 22.33
Initial (pre-installation) DTW/time: 19.84
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: NA
Installation date/completion time: NA
Screen Interval (ft. BTOC): 12 to 22
Pump intake depth (ft BTOC): NA
Post-installation DTW/time: NA
Max. sustainable pump rate (mL/min): NA
Appearance of product: None
Discharge tube diameter (3/8" or 1/4"): NA
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting			BAILED DRY						
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: A. Willmore / S. Beesinger
Purge date/beginning time: 10/18/07 14:55
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.0
Purge date/completion time: 10/18/07 15:00
Final (post-purging) DTW (ft. BTOC): NA
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting			BAILED DRY						
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
				BAILED DRY					

00107163

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

Baled Dry

10 - 20

Sampling

Sampling beginning time: 08:20 Sampling completion time: 08:23

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
0825	NR	NA	~3gal	19.68	0.412	5.51	399.5	2.36	164.8

Sample Information

Sample ID: 47WWL3 Sample collection date/time: 10/19/07 8:20

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
Perchlorate	314.1	1-500 mL HDPE			

Comments: Baled dry w/ disposable HDPE bailer. Baited ~ 3gal.

Collected Sample w/ Bailer

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107164

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: ~~47MW28~~ LHAAP-47 | Sampling location ID: 47MW28
Project Name/#: LHAAP | Sample ID: 47MW28-101707
Weather: 80's | Collection Time/Date: 10/17/07 1400

Pump Installation

Pump installation crew: Mabe/Smith | Installation date/beginning time: 10/17/07 1320
PID/FID reading (well head/background): 0.0 | Installation date/completion time: 10/17/07
Casing diameter (inches): 4" | Screen Interval (ft. BTOC): 14.90 to 24.90
Total well Depth (ft. BTOC): 24.90 | Pump intake depth (ft BTOC): 21.00
Initial (pre-installation) DTW/time: 18.76 | Post-installation DTW/time: 19.28
Final (after pump priming) DTW/time: | Max. sustainable pump rate (mL/min): 200
Free product (circle): LNAPL / DNAPL | Appearance of product:
Volume of water removed during priming (mL): NA | Discharge tube diameter (3/8" or 1/4"): 1/4
Discharge tube length (ft.): 24.00 | Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)				NA					
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: Mabe/Smith | PID/FID reading (well head/background): 0.0
Purge date/beginning time: 10/17/07 1300 | Purge date/completion time: 10/17/07 1400
Initial (pre-purging) DTW (ft. BTOC): 18.76 | Final (post-purging) DTW (ft. BTOC): 19.28
Calculated tubing + pump volume: NA | No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)				NA					
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv) ORP	DO (mg/L)	Turbidity (NTU)
1325	19.11	200		20.64	2.332	6.45	162.7	2.42	2.0
1330	19.2	↓		20.47	2.334	6.45	131.2	2.08	82.3
1335	19.23			20.44	2.332	6.45	126.7	2.07	75.6
1340	19.24			20.42	2.331	6.45	123.1	2.05	43.9
1345	19.25			20.54	2.332	6.44	117.1	2.06	119.7
1350	19.26			20.20	2.331	6.44	112.3	2.03	118.3
1355	19.28	↓	4 gal	20.14	2.326	6.44	111.2	1.99	117.0

00107165

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
					NA				

Sampling

Sampling beginning time: 1355 Sampling completion time: 1400

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1400	19.28	200	4 gal	20.14	2.326	6.44	111.2	4.93	11.30

Sample Information

Sample ID: 47WW28-101707 Sample collection date/time: 10/17/07 1400

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs		3 VOAs			
Perch		500 mL			

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107166

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP
Weather: 80's

Sampling location ID: 47WW29
Sample ID: 47WW29-101707
Collection Time/Date: 10/17/07 ~~14:00~~ 15:30

Pump Installation

Pump installation crew: Mabe/Smith
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 64.54
Initial (pre-installation) DTW/time: 17.26
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): 63.00

Installation date/beginning time: 10/17/07 14:00
Installation date/completion time: 10/17/07
Screen Interval (ft. BTOC): 54.54 to 64.54
Pump intake depth (ft BTOC): 60.00
Post-installation DTW/time: 17.26
Max. sustainable pump rate (mL/min): 250
Appearance of product:
Discharge tube diameter (3/8" or 1/4"): 1/4
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting			NA						
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: Mabe/Smith
Purge date/beginning time: 10/17/07 1440
Initial (pre-purging) DTW (ft. BTOC): 17.26
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.0
Purge date/completion time: 10/17/07 ~~1330~~ 1530
Final (post-purging) DTW (ft. BTOC): 18.01
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)					NA				
Refill Setting									
Discharge Setting									
Flow rate (mL/min)	150								

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv) ORP	DO (mg/L)	Turbidity (NTU)
1440	17.58	250		20.58	1.293	8.07	33.8	6.44	10.7
1445	17.73	↓		20.34	1.294	7.82	27.9	6.67	10.7
1450	17.81			20.00	1.299	7.28	-35.0	6.91	7.2
1455	17.90			19.98	1.306	7.01	-34.2	7.29	8.9
1500	17.95			19.89	1.304	6.94	-28.3	7.47	8.1
1505	17.90			19.88	1.312	6.76	-19.8	6.81	7.2
1510	17.98			20.48	1.317	6.67	-14.9	6.48	6.6
1515	18.00	↓		20.26	1.319	6.68	-17.4	6.81	6.5

00107167

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh ORP (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
1520	18.00	250		20.20	1.320	6.64	-14.1	6.78	5.4
1525	18.01	250	5 gal	20.24	1.337	6.61	-9.3	6.71	4.9

Sampling

Sampling beginning time: ~~1330~~ 1525 Sampling completion time: 1550

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1530	18.01	250	5 gal	20.24	1.337	6.61	-9.3	6.71	4.9

Sample Information

Sample ID: 47WW29-101707 Sample collection date/time: 10/17/07 1530

Duplicate sample collected (Y/N): N Duplicate sample ID: —

Split sample collected (Y/N): N Split sample ID: —

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs		3 VOAs			
		N			

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107168

GROUNDWATER SAMPLING FORM

Sheet 1 of 3

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP
Weather: 80's

Sampling location ID: 47WW30
Sample ID: 47WW30-101807
Collection Time/Date: 10/18/07 1032

Pump Installation

Pump installation crew: Mabe/Smith
PID/FID reading (well head/background): 11.4
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 25.03
Initial (pre-installation) DTW/time: 21.34
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): 26

Installation date/beginning time: 10/18/07 1000
Installation date/completion time: 10/18/07 1030
Screen Interval (ft. BTOC): 15.03 to 25.03
Pump intake depth (ft BTOC): 23.00
Post-installation DTW/time: 21.34
Max. sustainable pump rate (mL/min): 250
Appearance of product:
Discharge tube diameter (3/8" or 1/4"): 1/4
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)				N/A					
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: Mabe/Smith
Purge date/beginning time: 10/18/07 1015
Initial (pre-purging) DTW (ft. BTOC): 21.34
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 11.4
Purge date/completion time: 10/18/07
Final (post-purging) DTW (ft. BTOC): 22.15
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)				N/A					
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv) ORP	DO (mg/L)	Turbidity (NTU)
1015	21.78	250		20.08	4.468	6.72	160.5	2.94	-3.7
1020	21.93	250		19.93	4.463	6.74	153.7	2.81	-4.1
1025	22.13	250		20.02	4.456	6.75	148.4	2.76	-4.3
1030	22.15	200	2.5 gal	20.25	4.447	6.75	144.7	2.82	-4.5

00107169

GROUNDWATER SAMPLING FORM

Sheet 2 of 3

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
					N/A				

10 - 20%

Sampling

Sampling beginning time: 1032

Sampling completion time: 1032

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1032	22.15	200	2.5	20.25	4.447	6.75	144.7	2.82	-4.5

Sample Information

Sample ID: 47WW30-101807

Duplicate sample collected (Y/N): N

Split sample collected (Y/N): N

COC No(s):

Sample collection date/time: 10/18/07 1032

Duplicate sample ID: NA

Split sample ID: NA

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs		3 - VOAs			

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107170

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP
Weather: 80's, sunny

Sampling location ID: 47GW31
Sample ID: 47GW31-101807
Collection Time/Date: 10/18/07 1150

Pump Installation

Pump installation crew: Mabe/Smith
PID/FID reading (well head/background): 0.2
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 51.70
Initial (pre-installation) DTW/time: 21.13
Final (after pump priming) DTW/time: ~~21.92~~ NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): 49

Installation date/beginning time: 10/18/07 1115
Installation date/completion time: 10/18/07 1145
Screen Interval (ft. BTOC): 41.70 to 51.70
Pump intake depth (ft BTOC): 46.00
Post-installation DTW/time: 21.13
Max. sustainable pump rate (mL/min): 250
Appearance of product:
Discharge tube diameter (3/8" or 1/4"): 1/4
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting			NA						
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: Mabe/Smith
Purge date/beginning time: 10/18/07 1115
Initial (pre-purging) DTW (ft. BTOC): 21.13
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.2
Purge date/completion time: 10/18/07 1150
Final (post-purging) DTW (ft. BTOC): 21.92
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting					NA				
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv) ORP	DO (mg/L)	Turbidity (NTU)
1120	21.67	250		19.31	4.794	6.91	151.9	1.86	6.2
1125	21.79	250		19.30	4.790	6.91	148.2	1.84	4.2
1130	21.85	250		19.18	4.788	6.91	146.4	1.85	1.0
1135	21.90	250		19.22	4.781	6.90	143.1	1.87	0.2
1140	21.92	250		19.15	4.773	6.91	142.1	1.89	~~0.0~~ 0.0
1145	21.92	250	5 gal	19.15	4.762	6.91	141.0	1.90	0.0

00107171

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
					N/A				

10 - 20%

Sampling

Sampling beginning time: 1145 Sampling completion time: 1150

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1150	21.92	250	3gal	19.15	4762	6.91	141.0	1.90	0

Sample Information

Sample ID: 47ww31-101807 Sample collection date/time: 10/18/07 1150

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs		3 - VOAs			

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107172

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP
Weather: 80's

Sampling location ID: 47 WW 33
Sample ID: 47WW33-101807
Collection Time/Date: 10/18/07 ~~1645~~ 1445

Pump Installation

Pump installation crew: Mabe/Smith
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 2"
Total well Depth (ft. BTOC): 35.04
Initial (pre-installation) DTW/time: 21.27
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): 33

Installation date/beginning time: 10/18/07 1330
Installation date/completion time: 10/18/07 1445
Screen Interval (ft. BTOC): 25.04 to 35.04
Pump intake depth (ft BTOC): 30.00
Post-installation DTW/time: 21.27
Max. sustainable pump rate (mL/min): 200
Appearance of product:
Discharge tube diameter (3/8" or 1/4"): 1/4
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting			NA						
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: Mabe/Smith
Purge date/beginning time: 10/18/07 1340
Initial (pre-purging) DTW (ft. BTOC): 21.27
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.0
Purge date/completion time: 10/18/07 1445
Final (post-purging) DTW (ft. BTOC): 22.29
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting					NA				
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1340	21.74	200		20.09	9.137	6.59	110.6	2.47	1.0
1345	21.90	200		20.51	9.081	6.60	125.9	2.38	0
1350	21.70	200		22.17	9.020	6.59	129.7	2.61	0
1355	22.07	200		20.20	9.176	6.58	132	2.35	0
1400	22.16	200		19.87	8.960	6.60	132.6	2.41	1.0
1405	22.23	200		19.41	8.432	6.62	133.6	2.39	0
1410	22.26	200		19.33	8.069	6.64	133.8	2.41	0
1415	22.28	200		19.16	7.562	6.67	133.6	2.39	0

00107173

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity ±3% (uMhos/cm)	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
1420	22.29	200		19.13	7033	6.70	133.5	2.43	0
1425	22.28	↓		19.19	6.655	6.71	133.5	2.35	0
1430	22.29	↓		19.13	6.561	6.71	133.6	2.38	0
1435	22.29	↓		19.13	6.521	6.72	133.8	2.42	0
1440	22.29	↓	5 gal	19.15	6.501	6.73	133.9	2.48	0

10 - 20

Sampling

Sampling beginning time: 1440

Sampling completion time: ~~1645~~ 1445

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1445	22.29	200	5 gal	19.15	6.501	6.73	133.9	2.48	0

Sample Information

Sample ID: 47WW32-101807

Sample collection date/time: 10/18/07 1445

Duplicate sample collected (Y/N): N

Duplicate sample ID: NA

Split sample collected (Y/N): N

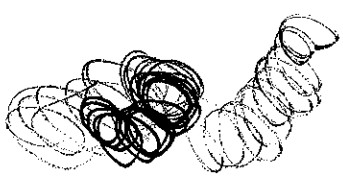
Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs		3 - VOAs			

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter



00107174

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP
Weather: 50's, sunny

Sampling location ID: LHSMW36
Sample ID: LHS MW 36-101907
Collection Time/Date: 10/19/07 0955

Pump Installation

Pump installation crew: Mabe/Smith
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4.1
Total well Depth (ft. BTOC): 29.08
Initial (pre-installation) DTW/time: 20.05
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): 28.00

Installation date/beginning time: 10/19/07 0900
Installation date/completion time: 10/19/07 0950
Screen Interval (ft. BTOC): 19.08 to 29.08
Pump intake depth (ft BTOC): 25.00
Post-installation DTW/time: 20.05
Max. sustainable pump rate (mL/min): 250
Appearance of product:
Discharge tube diameter (3/8" or 1/4"): 1/4
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting			NA						
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: Mabe/Smith
Purge date/beginning time: 10/19/07
Initial (pre-purging) DTW (ft. BTOC): 20.05
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.0
Purge date/completion time: 10/19/07 0955
Final (post-purging) DTW (ft. BTOC): ~~0~~ 21.16
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting					NA				
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
0915	20.57	250		18.01	0.379	6.42	137.4	2.17	52.7
0920	20.73	250		18.18	0.354	6.32	137.5	2.29	55.6
0925	20.90	250		18.28	0.337	6.25	141.7	2.40	52.9
0930	20.98	250		18.33	0.336	6.24	145.1	2.50	52.2
0935	21.30	250		18.33	0.337	6.24	146.6	2.48	51.4
0940	21.08	250		18.36	0.338	6.26	148.3	2.24	51.1
0945	21.14	250		18.39	0.340	6.27	148.9	2.28	50.7
0950	21.16	250	4 gal	18.41	0.341	6.28	149.1	2.30	48.7

00107175

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
					NA				

10 - 20

Sampling

Sampling beginning time: 0950

Sampling completion time: 0955

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
0950	21.14	250	4.1	18.41	0.341	6.28	149.1	2.30	48.7

Sample Information

Sample ID: LHSMW36-101907

Sample collection date/time: 10/19/07 0955

Duplicate sample collected (Y/N): N

Duplicate sample ID: NA

Split sample collected (Y/N): N

Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs		3- VOAs			

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107176

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP
Weather: 80's

Sampling location ID: LHSMW28
Sample ID: LHSMW28
Collection Time/Date: 10/18/07 ~~8:00~~ 0900

Pump Installation

Pump installation crew: Mabe/Smith
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): DRY
Initial (pre-installation) DTW/time:
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

Installation date/beginning time: DRY
Installation date/completion time:
Screen Interval (ft. BTOC): _____ to _____
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting				NA	NA				
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: Mabe/Smith
Purge date/beginning time: DRY
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

PID/FID reading (well head/background): 0.0
Purge date/completion time: DRY
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting				NA	NA				
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
				DRY					

00107177

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
					NA				

10 - 20%

Sampling

Sampling beginning time: NA

Sampling completion time: NA

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
					NA				

Sample Information

Sample ID: LHSMW28

Sample collection date/time: NA

Duplicate sample collected (Y/N): NA

Duplicate sample ID:

Split sample collected (Y/N):

Split sample ID:

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
		NA			

Comments: well dry

10/18/07 still dry

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107178

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: CHAAP-47
Project Name/#: CHAAP
Weather: 60s

Sampling location ID: CHSMW34
Sample ID: CHSMW34-101807
Collection Time/Date: 10/18/07 16:45

Pump Installation

Pump installation crew: Mabe/Smith
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 25.20
Initial (pre-installation) DTW/time: 20.73
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): 26.00

Installation date/beginning time: 10/18/07 1600
Installation date/completion time: 10/18/07 1645
Screen Interval (ft. BTOC): 15.20 to 25.20
Pump intake depth (ft BTOC): 23.00
Post-installation DTW/time: 20.73
Max. sustainable pump rate (mL/min): 275
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting			NA						
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: Mabe/Smith
Purge date/beginning time: 10/18/07 16:00
Initial (pre-purging) DTW (ft. BTOC): 20.73
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.0
Purge date/completion time: 10/18/07 16:45
Final (post-purging) DTW (ft. BTOC): 21.11
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting				NA					
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1600	21.00	275		21.09	2.115	6.52	188.9	3.26	11.1
1605	21.02			20.95	2.095	6.49	190.9	3.20	9.0
1610	21.07			20.98	2.075	6.47	214.4	3.06	10.1
1615	21.10			20.84	2.052	6.46	193.2	2.65	2.0
1620	21.10			20.84	2.045	6.45	135.1	2.46	0.2
1625	21.10			20.83	2.036	6.44	94.7	2.31	0
1630	21.10			20.81	2.033	6.43	79.7	2.32	0
1635	21.10	↓		20.58	2.034	6.42	77.1	2.32	0

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity ±3% (uMhos/cm)	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
1640	21.11	275	5gal.	20.56	2.033	6.42	70.9	2.29	0

10 - 5% / 20

Sampling

Sampling beginning time: 1640 Sampling completion time: 1645

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1645	21.11	275	5gal	20.56	2.033	6.42	70.9	2.29	0

Sample Information

Sample ID: LHSMW34 Sample collection date/time: 10/18/07 1645

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs		3 VOAs			

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107180

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP / 117591.0009A130
Weather: clear

Sampling location ID: LHSMW-40
Sample ID: LHSMW40-101907-DR
Collection Time/Date: DRY

Pump Installation

Pump installation crew: A. Willard
PID/FID reading (well head/background): 6.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 16.92
Initial (pre-installation) DTW/time: DRY
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):

Installation date/beginning time: NA
Installation date/completion time:
Screen Interval (ft. BTOC): 6 to 16
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

DRY

Purging

Purging/sampling crew:
Purge date/beginning time:
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA

PID/FID reading (well head/background):
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

DRY

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

10-20

DRY

10/19/07

Sampling

Sampling beginning time:_____ Sampling completion time:_____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY

Sample Information

Sample ID: CHSmw46 - 101907 - DRY

Duplicate sample collected (Y/N): NA

Split sample collected (Y/N): NA

COC No(s):_____

Sample collection date/time:_____

Duplicate sample ID:_____

Split sample ID:_____

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

DRY

Comments: No water in well.

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107182

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: CHAAP-47
Project Name/#: 117591.0009.0150
Weather: Overcast Low 70s, low 70s wet from previous day's rain

Sampling location ID: LHSMW-46
Sample ID: LHSMW46-100607
Collection Time/Date: NA-Dry

Pump Installation

Pump installation crew: A. Willmore / S. Beesinger
PID/FID reading (well head/background):
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 19.90
Initial (pre-installation) DTW/time: 19.46
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.): NA

Installation date/beginning time: NA
Installation date/completion time: NA
Screen Interval (ft. BTOC): NA to NA
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min): NA
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

10/16/07

Purging

Purging/sampling crew:
Purge date/beginning time:
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA

PID/FID reading (well head/background):
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

DRY

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY

00107183

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ± 10%	±3% Electrical Conductivity (uMhos/cm)	pH ± 0.1	Eh (mv) ± 10	DO (mg/L) ± 10%	Turbidity (NTU) ± 10%

DRY

10/14/07

10/20

Sampling

Sampling beginning time: NA

Sampling completion time: NA

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY

Sample Information

Sample ID: LHSMW-46

Sample collection date/time: NA

Duplicate sample collected (Y/N): NA

Duplicate sample ID: NA

Split sample collected (Y/N): NA

Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

DRY

Comments: Well nearly dry. Purged ~ 300 mL, Not enough water to obtain sample.

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107184

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: 117591.0009A130
Weather: Overcast, low 70s, wet from previous days' rain
Sampling location ID: LHSMW-51
Sample ID: LHSMW51-101607
Collection Time/Date: NA - DRY

Pump Installation

Pump installation crew: A. Willmot / B. Bessinger
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 21.76
Initial (pre-installation) DTW/time: 21.76
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: NA
Installation date/completion time: NA
Screen Interval (ft. BTOC): 11.5 NA to 21.5
Pump intake depth (ft BTOC): NA
Post-installation DTW/time: NA
Max. sustainable pump rate (mL/min): NA
Appearance of product: No
Discharge tube diameter (3/8" or 1/4"): NA
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)			DRY						

Purging

Purging/sampling crew: A. Willmot / S. Beesinger
Purge date/beginning time: NA
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.0
Purge date/completion time: NA
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting			DRY						
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
				DRY					

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ± 10%	±3% Electrical Conductivity (uMhos/cm)	pH ± 0.1	Eh (mv) ± 10	DO (mg/L) ± 10%	Turbidity (NTU) ± 10% 10/20

Sampling

Sampling beginning time: _____ Sampling completion time: _____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID: LHSMW-51

Sample collection date/time: _____

Duplicate sample collected (Y/N): _____

Duplicate sample ID: _____

Split sample collected (Y/N): _____

Split sample ID: _____

COC No(s): _____

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments: Well is dry. Only silt @ bottom

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107186

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP / 117591.0009A130
Weather: clear, low 90s

Sampling location ID: LHSMW62
Sample ID: LHSMW62-101807
Collection Time/Date: NA

Pump Installation

Pump installation crew: A. Willmore / S. Beesinger
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 25.31
Initial (pre-installation) DTW/time: NA - Dry
Final (after pump priming) DTW/time: Dry
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: DRY
Installation date/completion time: DRY
Screen Interval (ft. BTOC): 15 to 25
Pump intake depth (ft BTOC): NA
Post-installation DTW/time:
Max. sustainable pump rate (mL/min): NA
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting			DRY						
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: A. Willmore / S. Beesinger
Purge date/beginning time:
Initial (pre-purging) DTW (ft. BTOC): NA
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.0
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC): NA
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting			DRY						
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
				DRY					

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

DRY — NA — NA — 10/18/07

10-20

Sampling

Sampling beginning time: NA Sampling completion time: NA

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY

Sample Information

Sample ID: LnSmw52-101808 Sample collection date/time: NA

Duplicate sample collected (Y/N): NA Duplicate sample ID: NA

Split sample collected (Y/N): NA Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

NA - DRY WELL

Comments: No water in well

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107188

GROUNDWATER SAMPLING FORM

Sheet 1 of 5

Operable Unit/Site ID: LHMM-47
Project Name/#: 117591.6009M130
Weather: Partly cldy mid 80s
Sampling location ID: LHMW53
Sample ID: LHMW53-101707
Collection Time/Date: NA - DRY

Pump Installation

Pump installation crew: A. Willmore / S. Beesinger
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 16.95
Initial (pre-installation) DTW/time: 16.89
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):
Installation date/beginning time: NA
Installation date/completion time: NA
Screen Interval (ft. BTOC): 7 to 17
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min): NA
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting			DRY						
Flow rate (mL/min)									

Purging

Purging/sampling crew:
Purge date/beginning time: NA
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA
PID/FID reading (well head/background):
Purge date/completion time: NA
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting			DRY						
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
				DRY					

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

10-20

N/A 10/7/09

Sampling

Sampling beginning time: NA Sampling completion time: NA

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
			DRY						

Sample Information

Sample ID: LHSmw53 Sample collection date/time:

Duplicate sample collected (Y/N): No Duplicate sample ID: NA

Split sample collected (Y/N): No Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
		DRY			

Comments: Insufficient Water To Sample

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107190

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP / 117591.0009A130
Weather: cloudy, humid, mid 70s, light rain

Sampling location ID: LHSMW-54
Sample ID: LHSMW54-101707
Collection Time/Date: 12:40 10/17/07

Pump Installation

Pump installation crew: A. Willmore / S. Beesinger
PID/FID reading (well head/background): 0.1
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 45.45
Initial (pre-installation) DTW/time: 15.55
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): 48'

Installation date/beginning time: 10/17/07 10:55
Installation date/completion time: 10/17/07 11:00
Screen Interval (ft. BTOC): 35.5 to 45.5
Pump intake depth (ft BTOC): 40'
Post-installation DTW/time: 15.48
Max. sustainable pump rate (mL/min): 100
Appearance of product: None
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): No

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NR psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

10/17/07

Purging

Purging/sampling crew: A. Willmore / S. Beesinger
Purge date/beginning time: 10/17/07 11:10
Initial (pre-purging) DTW (ft. BTOC): 15.48
Calculated tubing + pump volume: NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NR psi

PID/FID reading (well head/background): 0.0
Purge date/completion time: 10/17/07 13:00
Final (post-purging) DTW (ft. BTOC): 15.78
No. of tubing + pump volumes purged: NR

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	21								21
Refill Setting	10								10
Discharge Setting	5								5
Flow rate (mL/min)	100								100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
11:15	15.78	100	0.00	20.09	0.989	6.40	756.7	86.2	123.4
11:20	15.78	100	0.15	20.16	1.515	6.36	702.0	85.4	104.1
12:10	15.78	100	~~5.1~~ 5.6	20.29	1.563	6.34	700.1	0.31	78.1
12:15	15.78	100	~~6.1~~ 6.1	20.29	1.570	6.34	694.1	0.31	38.1
12:20	15.78	100	~~6.6~~ 6.6	20.29	1.569	6.32	693.7	0.30	37.7
12:25	15.78	100	7.1	20.30	1.570	6.32	690.2	0.29	36.8
12:30	15.78	100	7.6	20.31	1.570	6.33	701.7	0.29	33.4

00107191

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

10/17/07

10-20

Sampling

Sampling beginning time: 12:40 Sampling completion time: 12:50

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
12:55	15.78	100	~10	19.50	1.572	6.31	715.0	8.22	37.0

Sample Information

Sample ID: LHSmw54-101707 Sample collection date/time: 12:40 10/17/07

Duplicate sample collected (Y/N): No Duplicate sample ID: NA

Split sample collected (Y/N): No Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs	8260	3-40mL voa vials			
Perchlorate	314.1	1-500mL HDPE			

Comments: Turbidity did not drop below 37.4 NTU

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107192

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#:
Weather: overcast Low 70s

Sampling location ID: LHSMW55
Sample ID: DRY
Collection Time/Date: DRY

Pump Installation

Pump installation crew: A. Willmon / S. Bessinger
PID/FID reading (well head/background):
Casing diameter (inches):
Total well Depth (ft. BTOC): 20.36
Initial (pre-installation) DTW/time: 20.07
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):

Installation date/beginning time: NM
Installation date/completion time:
Screen Interval (ft. BTOC): 10 to 20
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min): NA
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

DRY

Purging

Purging/sampling crew:
Purge date/beginning time:
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA

PID/FID reading (well head/background):
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

DRY

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY

00107193

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ± 10%	±3% Electrical Conductivity (uMhos/cm)	pH ± 0.1	Eh (mv) ± 10	DO (mg/L) ± 10%	Turbidity (NTU) ± 10% 10/20

Sampling

Sampling beginning time: LHSMW-55 Sampling completion time: _____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID: LHSMW55 Sample collection date/time: _____

Duplicate sample collected (Y/N): _____ Duplicate sample ID: _____

Split sample collected (Y/N): _____ Split sample ID: _____

COC No(s): _____

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107194

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP / 117591.0009A130
Weather: clear 70's

Sampling location ID: LHSMW56
Sample ID: LHSMW56-102007
Collection Time/Date: 0810 10/20/07

Pump Installation

Pump installation crew: A. Willmore / S. Beesinger
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 20.75
Initial (pre-installation) DTW/time: ~~20.90~~ 21.98
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):

Installation date/beginning time: NA
Installation date/completion time: NA
Screen Interval (ft. BTOC): 12 to 22
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min): NA
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting			Bailed Dry						
Flow rate (mL/min)									

Purging

Purging/sampling crew: A. Willmore / S. Beesinger
Purge date/beginning time: 10/19/07
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 6.0
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting			BAILED		DRY				
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
				BAILED DRY					

00107195

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

10/19/07

10-e 20

Sampling

Sampling beginning time: 0810 Sampling completion time: 08:12

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
08:20	NR	NA	~3	22.19	1.790	6.43	439.5	4.87	2000.4

Sample Information

Sample ID: LHSMW66-102007 Sample collection date/time: 10/20/07 0810

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs	8260	8-40mL VoaVials			

Comments: Bailed Dry w/ 3.5" disposable HDPE bailer.
Sampled w/ 1.5" disposable HDPE bailer

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107196

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: 117591.0004A130 LHAAP
Weather: Overcast, low 70s

Sampling location ID: LHSMW-57
Sample ID: LHSMW57-101807 (D)
Collection Time/Date: ~~0940~~ 10/18/07 DRY

Pump Installation

Pump installation crew: A. Willmore / S. Beesinger
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 17.44
Initial (pre-installation) DTW/time: 9.46
Final (after pump priming) DTW/time: 9.46
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): 17

Installation date/beginning time: 10/17/07 0857
Installation date/completion time: 10/17/07 0859
Screen Interval (ft. BTOC): 7 to 17
Pump intake depth (ft BTOC): 13'
Post-installation DTW/time: 9.46
Max. sustainable pump rate (mL/min): 125
Appearance of product: None
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): No

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NR psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

10/17/07

Purging

Purging/sampling crew: A. Willmore / S. Beesinger
Purge date/beginning time: 10/17/07
Initial (pre-purging) DTW (ft. BTOC): 9.46
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.0
Purge date/completion time: 10/17/07
Final (post-purging) DTW (ft. BTOC): (D) 10.13
No. of tubing + pump volumes purged: NR

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NR psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	NA								NA
Refill Setting	NA								NA
Discharge Setting	NA								NA
Flow rate (mL/min)	125								125

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
~~09~~ 9:35	10.13	125	0.525	22.68	0.142	5.19	588.7	0.84	88.8
~~09~~ 9:55	10.43	125	~~2.100~~ 2.1	22.69	0.142	5.19	590.6	0.85	85.7
10:00	10.50	125	2.625	22.74	0.140	5.19	594.7	0.93	89.6
10:05	10.73	125	3.150	22.82	0.137	5.18	605.5	1.12	74.2
10:10	10.43	125	4.775	22.86	0.137	5.18	610.9	1.38	64.6
10:15	10.19	125	5.900	22.86	0.136	5.17	615.6	1.54	62.7
10:20	10.13	125	6.025	22.95	0.171	5.16	622.9	1.71	60.0
			~~9.450~~						

Water level continues to drop, will pump dry after lunch

00107197

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ± 10%	±3% Electrical Conductivity (uMhos/cm)	pH ± 0.1	Eh (mv) ± 10	DO (mg/L) ± 10%	Turbidity (NTU) ± 10%

10/20

10/17/07

Sampling

Sampling beginning time: ~~1400~~ NA

Sampling completion time: NA

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
			NO SAMPLE				DRY		

Sample Information

Sample ID: LHSMW-57-101807

Sample collection date/time: 10/18/07 ~~0940~~ NA

Duplicate sample collected (Y/N): No

Duplicate sample ID: NA

Split sample collected (Y/N): No

Split sample ID: NA

COC No(s): ~~NA~~

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs	8260	8-40mL Voa vials			
TSS/TDS		1-500mL HDPE			
TAL METALS	6020 B	1-500mL HDPE			

Comments: Peristaltic Pump used for purging & sampling. * No Sample, well does not recharge.

1320- Began purging LHSMW57 & dry. Water sampled is extremely silty. Not likely a quality sample.

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107198

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: LHAAP / 117591.0009A130
Weather: Clear, low 90s

Sampling location ID: LHSMW60
Sample ID: LHSMW60 - 101807
Collection Time/Date: 15:50 10/18/07

Pump Installation

Pump installation crew: A. Willmore / S. Beesinger
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 29.48
Initial (pre-installation) DTW/time: 18.45
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): 28'

Installation date/beginning time: 10/18/07 13:10
Installation date/completion time: 10/18/07 13:15
Screen Interval (ft. BTOC): 19.5 to 29.5
Pump intake depth (ft BTOC): 23'
Post-installation DTW/time: 18.45
Max. sustainable pump rate (mL/min): 100
Appearance of product: None
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): Y

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NR psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting						10/18/07			
Flow rate (mL/min)									

Purging

Purging/sampling crew: A. Willmore / S. Beesinger
Purge date/beginning time: 10/18/07 15:20
Initial (pre-purging) DTW (ft. BTOC): 18.45
Calculated tubing + pump volume: NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NR psi

PID/FID reading (well head/background): 0.0
Purge date/completion time: 10/18/07 16:06
Final (post-purging) DTW (ft. BTOC): 18.63
No. of tubing + pump volumes purged: NA

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	NA								NA
Refill Setting	NA								NA
Discharge Setting	NA								NA
Flow rate (mL/min)	100								100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
15:29	18.63	100	0	22.09	1.342	5.34	595.1	1.88	2.4
15:34	18.63	100	0.5	21.12	1.338	5.33	600.1	1.82	1.6
15:39	18.63	100	1.0	21.19	1.337	5.34	601.4	1.81	1.0
15:44	18.63	100	1.5	20.96	1.336	5.36	602.3	1.80	1.1

10/18/07

00107199

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

10 - 20

Sampling

Sampling beginning time: 15:50 Sampling completion time: 16:00

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
16:05	18.63	100	~3	21.24	1.335	5.55	616.1	1.44	0.8

Sample Information

Sample ID: LHSMW60-101807 Sample collection date/time: 10/18/07

Duplicate sample collected (Y/N): N Duplicate sample ID: LHSMW60-101807-FD

Split sample collected (Y/N): N Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
Perchlorate	314.1	2- 500-mL HDPE			

Comments: Took Field Duplicate

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107200

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP -47
Project Name/#: Longhorn Army Ammo. Plant
Weather:

Sampling location ID: 47LWW07
Sample ID: 47LWW07 - 09B07
Collection Time/Date: 09-13-07 / 1726

Pump Installation

Pump installation crew: M. MARTINEZ
PID/FID reading (well head/background): NM
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 86.95
Initial (pre-installation) DTW/time: 21.85 / 1623
Final (after pump priming) DTW/time:
Free product (circle): ~~LNAPL / DNAPL~~
Volume of water removed during priming (mL):
Discharge tube length (ft.):

Installation date/beginning time: 09-13-07 / 1625
Installation date/completion time: 09-13-07 / 1637
Screen Interval (ft. BTOC): _____ to _____
Pump intake depth (ft BTOC):
Post-installation DTW/time: 1638 / 21.55
Max. sustainable pump rate (mL/min):
Appearance of product: NA
Discharge tube diameter ~~(3/8"~~ or (1/4"): 1/4
Inlet reducer used (Y/N): NO

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: M. MARTINEZ
Purge date/beginning time: 09-13-07 / 1639
Initial (pre-purging) DTW (ft. BTOC): 1640 / 21.55'
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): NM
Purge date/completion time: 09-13-07 / 1745
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	45								45
Refill Setting	18								18
Discharge Setting	9								9
Flow rate (mL/min)	150								150

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1650	21.89	150	0	23.45	1.82	7.30	61.5	0.78	18.5
1705	22.70	150	2.25	22.02	1.783	8.07	55.0	0.18	11.4
1710	22.81	150	3.00	22.15	1.784	8.10	54.5	0.14	10.7
1715	23.00	150	3.75	22.05	1.789	8.10	53.7	0.16	9.9
1720	23.38	150	4.50	22.00	1.788	8.11	53.1	0.12	9.9
1725	23.69	150	5.25	21.98	1.787	8.12	52.8	0.12	9.8
1726	Sample								

00107201

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ± 10%	±3% Electrical Conductivity (uMhos/cm)	pH ± 0.1	Eh (mv) ± 10	DO (mg/L) ± 10%	Turbidity (NTU) ± 10%

Sampling

Sampling beginning time: 1726 Sampling completion time: 1742

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1748	24.20	150	8.55	21.98	1.793	7.45	49.7	0.14	8.9

Sample Information

Sample ID: 47LxX07 - 091307 Sample collection date/time: 09-13-07 / 1726

Duplicate sample collected (Y/N): NO Duplicate sample ID: N/A

Split sample collected (Y/N): NO Split sample ID: N/A

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
		1x500mL HDPE NoPr.			
		1x500mL HDPE NoPr.			
		1x500mL HDPE NoPr.			
		1x500mL HDPE HNO3			
		1x500mL HDPE NoPr.			

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107202

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: Longhorn Army Ammo. Plant
Project Name/#: LHAAP / 117591
Weather:

Sampling location ID: 47WW06
Sample ID: 47WW06-091307
Collection Time/Date: 09-13-07 / 1601

Pump Installation

Pump installation crew: M. Martinez
PID/FID reading (well head/background): 2/14
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 47.86'
Initial (pre-installation) DTW/time: 20.89' / 1500
Final (after pump priming) DTW/time:
Free product (circle): ~~LNAPL / DNAPL~~
Volume of water removed during priming (mL):
Discharge tube length (ft.):

Installation date/beginning time: 09-13-07 / 1505
Installation date/completion time: 09-13-07 / 1517
Screen Interval (ft. BTOC): _____ to _____
Pump intake depth (ft BTOC):
Post-installation DTW/time: 20.68' / 1518
Max. sustainable pump rate (mL/min):
Appearance of product: N/A
Discharge tube diameter (3/8" or 1/4"): 1/4
Inlet reducer used (Y/N): NO

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: M. Martinez
Purge date/beginning time: 09-13-07 / 1525
Initial (pre-purging) DTW (ft. BTOC): 20.68'
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): N/A
Purge date/completion time: 09-13-07 / 1600
Final (post-purging) DTW (ft. BTOC): 22.35'
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	38								38
Refill Setting	14								14
Discharge Setting	7								7
Flow rate (mL/min)	~~330~~								250

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min) 250	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1530	21.28	~~360~~	0	22.01	1.697	7.09	64.1	0.54	39.7
1545	21.86	250	3.75	21.37	1.681	5.60	70.0	0.12	30.8
1550	22.00	250	5.00	21.35	1.680	5.52	68.5	0.13	38.7
1555	22.04	250	6.25	21.30	1.680	5.47	68.0	0.13	29.8
1600	22.10	250	7.50	21.28	1.679	5.43	63.7	0.13	35.9
1601	Sample								

00107203

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ± 10%	±3% Electrical Conductivity (uMhos/cm)	pH ± 0.1	Eh (mv) ± 10	DO (mg/L) ± 10%	Turbidity (NTU) ± 10% 10/20

Sampling

Sampling beginning time: 1601 Sampling completion time: 1615

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) 21.36	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1620	22.35	250	12.50	~~22.00~~	1.685	5.44	60.7	0.21	23.0

Sample Information

Sample ID: 47 MW 06 Sample collection date/time: 09-13-07 / 1601

Duplicate sample collected (Y/(N)): NO Duplicate sample ID: N/A

Split sample collected (Y/(N)): NO Split sample ID: N/A

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
		1x 500 mL HDPE NoPr.			
		1x 500 mL HDPE NoPr.			
		1x 500 mL HDPE NaOH			
		1x 500 mL HDPE HNO3			
		~~1x 500 mL HDPE NoPr.~~			

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

NoPr - No Preservative

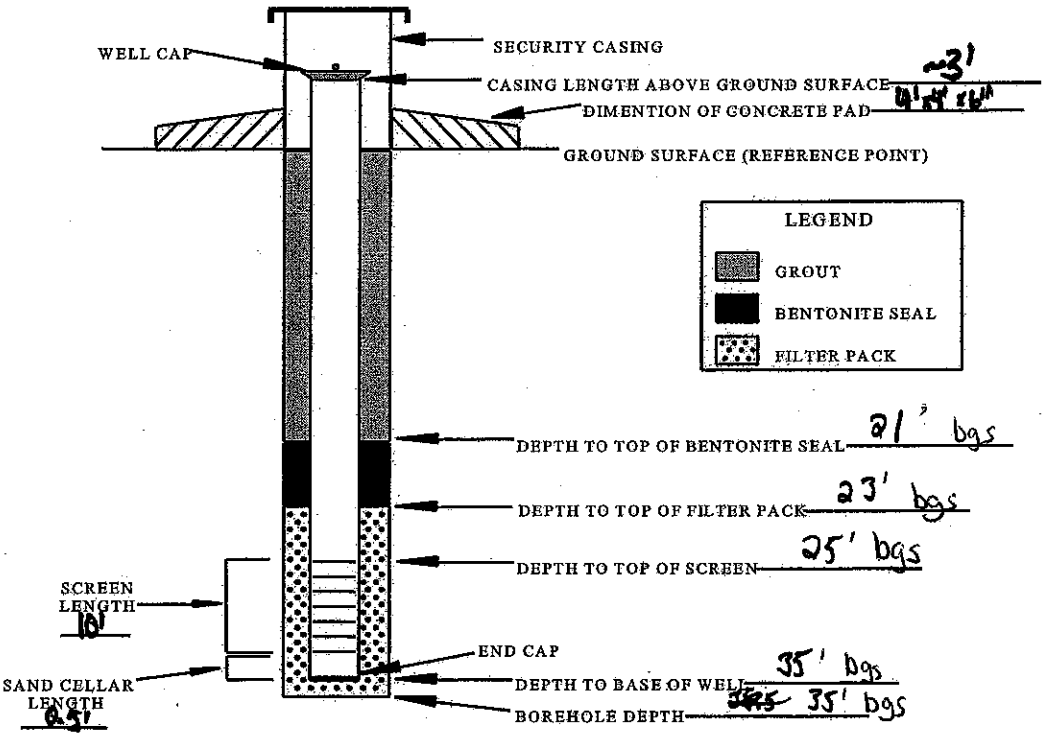
00107204 47WW33

WELL COMPLETION FORM (Stickup or Above Grade Completion Well)

FIELD REPRESENTATIVE: Allen Willmore
DRILLING CONTRACTOR: JEDI
DRILLING TECHNIQUE: Hollow Stem
AUGER SIZE AND TYPE:
BOREHOLE IDENTIFICATION: 47WW03
BOREHOLE DIAMETER: 8"
WELL IDENTIFICATION: 47WW03
WELL CONSTRUCTION START DATE: 2/9/08
WELL CONSTRUCTION COMPLETE DATE: 2/9/08
SCREEN MATERIAL: SCH 40 PVC
SCREEN DIAMETER: 4"
STRATUM-SCREENED INTERVAL (FT):
CASING MATERIAL: SCH 40 PVC
CASING DIAMETER: 4"

TYPE OF FILTER PACK: Silica Sand
GRADIATION: 20/40
AMOUNT OF FILTER PACK USED: 3-50 lb bags
TYPE OF BENTONITE: Bentonite chips
AMOUNT BENTONITE USED: 1/2 50 lb bucket
TYPE OF CEMENT: Portland - Cement
AMOUNT CEMENT USED: 3-94 lb bags
GROUT MATERIALS USED: bentonite slurry
DIMENSIONS OF SECURITY CASING: 8" x 8"
TYPE OF WELL CAP: plugging cap
TYPE OF END CAP: PVC 6" cap
COMMENTS:

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: OSCAR GARCIA (JEDI) INSTALLATION OBSERVED BY: ALLEN WILLMORE (CSHAM)

DISCREPANCIES:

00107205

HOLE NO. 47WW33

DRILLING LOG

DIVISION: FEDERAL

INSTALLATION: LHAAP

SHEET 1 OF 3 SHEETS

1. PROJECT: LHAAP
2. LOCATION (Coordinates or Station): Karnack, Texas
3. DRILLING AGENCY: JCDI
4. HOLE NO. (As shown on drawing title and file number): 47WW33
5. NAME OF DRILLER: Oscar Garcia
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED 90° DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: NA
8. DEPTH DRILLED INTO ROCK: NA
9. TOTAL DEPTH OF HOLE: 35
10. SIZE AND TYPE OF BIT: 8"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: ~~AARL~~ CME 75
13. OVERBURDEN SAMPLES: DISTURBED; UNDISTURBED (Yes)
14. TOTAL NUMBER CORE BOXES: NR
15. ELEVATION GROUND WATER: NR
16. DATE HOLE: STARTED 2/8/08; COMPLETED
17. ELEVATION TOP OF HOLE: NR
18. TOTAL CORE RECOVERY FOR BORING: NR %

INSPECTOR: Allen Willmore

ELEVATION PID (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
0.0		CL	CLAY, SILTY, HIGH PLASTICITY, SOFT, DARK BROWN, ORGANIC, NO ODOR, MOIST - IRON STAINING MOTTLING	10'/.		10:40 - Began drilling 47WW33 12:15 - Lunch Break 13:35 - Returned to Drilling Activities.
0.0				75'/.		
0.0	5	SP	Sand, silty, dense, well-sorted, gray w/ iron staining (mottling), moist, no odor	100'/.		
0.0		CL	Clay, silty to sandy, low to no plasticity, stiff, dry, no odor - BECOMES STIFF TO SOFT.	100'/.		
0.0	10			100'/.		
0.0		SC	SAND, clayey, dense, well-sorted, gray, with some iron staining, wet	100'/.		
0.0				100'/.		

00107206

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE: NR | Hole No. 478WW33

PROJECT: LHAAP | INSTALLATION: LHAAP | SHEET 2 OF 3 SHEETS

ELEVATION PID (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
			-Becomes more clayey	100%		
	14		-Becomes less clayey			
0.0	15			100%		
0.0			-Becomes loose, silty, reddish brown, saturated	100%		
0.0				100%		
	20		CLAY, ~~SAN~~ SILTY, hard, medium plastic, red iron stainings, gray, ~~wet~~ moist to dry			
0.0				100%		
0.0			Sand, clayey, Moderately dense, gray with red mottling (iron staining), well sorted, wet to saturated	100%		
			-Becomes SILTY, LIGHT BROWN TO TAN, VERY SATURATED.			
0.0	25			100%		
0.0						

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PROJECT | HOLE NO.

00107207

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE NR | Hole No. 47WW33

PROJECT LHAAP | INSTALLATION LONGHORN | SHEET 3 OF 3 SHEETS

PID ~~ELEVATION~~ (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
	30		same as above			
0.0						
0.0						
			CLAY, SANDY, MOIST, BROWN TO GRAY, NO ODOR, LOW PLASTICITY			
0.0	35		END OF BORING			
	46					

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MAR 71

PROJECT | HOLE NO.

00107208 47ww33

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: 47
Project Name/#: Longhorn
Weather: clear, ~~80~~ 70s

Sampling location ID: 47ww33
Sample ID: 47ww33 - 022007
Collection Time/Date: 09:30 2/20/08

Pump Installation

Pump installation crew: A. Willmore
PID/FID reading (well head/background): 0.8
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 36.95
Initial (pre-installation) DTW/time: 10.91
Final (after pump priming) DTW/time: ~~36.90~~ NR
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NR
Discharge tube length (ft.): 34

Installation date/beginning time: 2/20/08 ~~08:08~~
Installation date/completion time: 2/20/08 ~~08:08~~
Screen Interval (ft. BTOC): 27 to 37
Pump intake depth (ft BTOC): ~32
Post-installation DTW/time: ~~36.98~~ 10.87
Max. sustainable pump rate (mL/min): 200
Appearance of product: None
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): No

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NR psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting						2/20/08			
Flow rate (mL/min)									

Purging

Purging/sampling crew: A. Willmore
Purge date/beginning time: 2/20/08 08:55
Initial (pre-purging) DTW (ft. BTOC): 36.92
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.0
Purge date/completion time: 09:25
Final (post-purging) DTW (ft. BTOC): 10.88
No. of tubing + pump volumes purged: NR

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	25								25
Refill Setting	10								10
Discharge Setting	5								5
Flow rate (mL/min)	200								200

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
08:50									
08:55									
09:00	10.89	200	1	19.82	1.341	6.50	103.1	8.21	21.1
09:05	10.89	200	2	19.79	1.343	6.50	102.9	8.22	19.6
09:10	10.89	200	3	19.72	1.343	6.49	102.6	8.24	14.3
09:15	10.88	200	4	19.73	1.343	6.48	102.1	8.24	13.1
							2/20/08		

00107209 47ww33

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

10-20

2/20/08

Sampling

Sampling beginning time: 09:17 Sampling completion time: 09:20

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
09:25	10.88	200	6	19.75	1.344	6.48	102.2	8.23	12.7

Sample Information

Sample ID: 47ww33-022008

Duplicate sample collected (Y/N): Yes

Split sample collected (Y/N): N

COC No(s): NR

Sample collection date/time: 2/20/08 9:20

Duplicate sample ID: 47ww33-022008-QA

Split sample ID: NA

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs 8260	8260	6 x 40 mL - Voa vials			

Comments: Stainless-Steel-cased bladder pump used for purging and sampling

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107210

WELL DEVELOPMENT RECORD

WELL/PIEZOMETER ID 47aw053
SHEET 1 of 1

PROJECT NAME: Longhorn AAP PROJECT NO.: 117591 DATE: 2/19/08

LOCATION: Kosmack, Tx DATE INSTALLED: 2/9/08

TOTAL DEPTH (FTOC) 36.95 CASING DIAMETER 4"

METHODS OF DEVELOPMENT

☐ Swabbing ☐ Bailing ☑ Pumping ☐ Describe Air Lift

Equipment decontaminated prior to development ☑ Yes ☐ NO

Describe

EQUIPMENT NUMBERS:

pH Meter YSI 650 MDS (36919) EC Meter YSI 650 MDS (36919) Turbidity Meter YSI 650 MDS (36919) Thermometer YSI 650 MDS (36919)

CASING VOLUME INFORMATION:

Casing ID (inch)	1.0	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (A) (gal/ft)	0.04	0.09	0.16	0.2	0.37	0.65	0.75	1.0	1.5	2.0	2.6

PURGING INFORMATION:

Measured Well Depth (B) 36.95 ft.

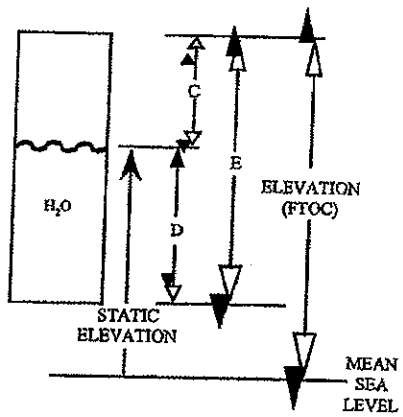
Measured Water Level Depth (C) 10.91 ft.

Length of Static Water Column (D) 36.95 (B) - 10.91 (C) = 26.04 ft.

Casing Water Volume (E) = 0.65 (A) x 26.04 (D) = 16.93 gal

16.93 * 5 = 84.63

Total Purge Volume = 110 (gal)



Date	Time	Water Level (FTOC)	Volume Removed (gal)	pH	EC	Temperature F or C	Turbidity/ Sand (ppm)	Comments
2/19/08	13:20	NR	70	6.50	1.341	19.14	171.4	murky
2/19/08	13:25		75	6.51	1.340	19.14	122.3	murky
2/19/08	13:30		80	6.51	1.339	19.26	46.8	brownish
2/19/08	13:35		85	6.50	1.346	19.28	31.2	grayish
2/19/08	13:40		90	6.49	1.347	19.29	26.1	clear
2/19/08	13:45		95	6.49	1.341	19.28	22.3	clear
2/19/08	13:50		100	6.49	1.348	19.28	10.1	clear
2/19/08	14:00	NR	110	6.49	1.340	19.28	4.5	clear

FIGURE 5

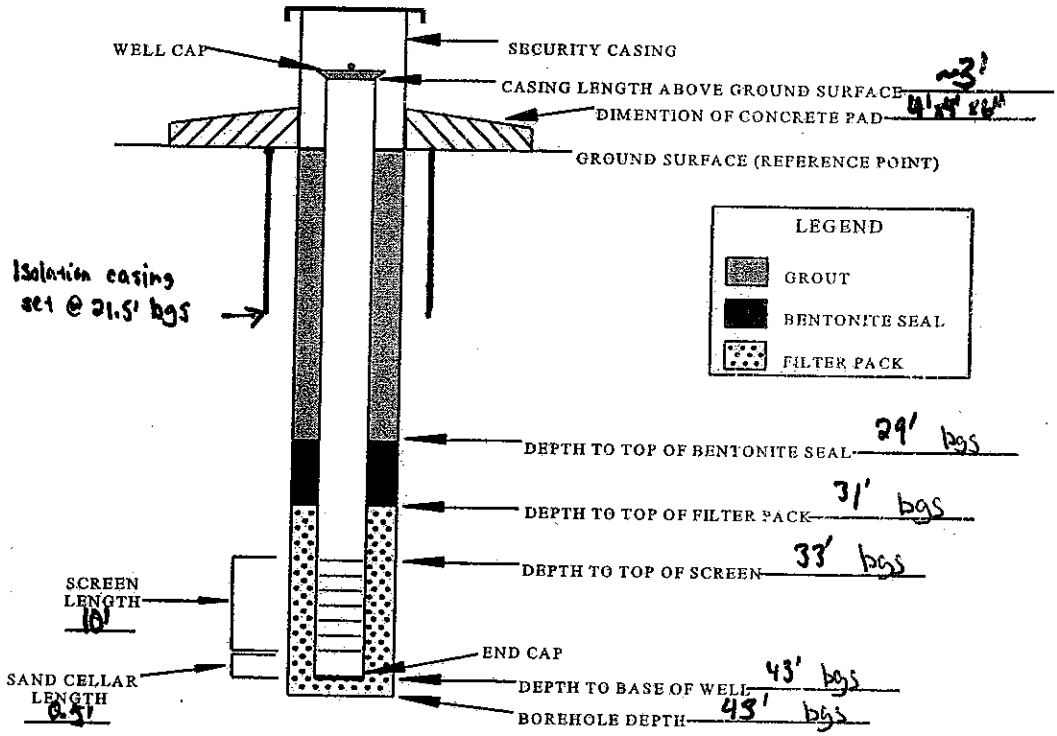
00107211 47WW34

WELL COMPLETION FORM (Stickup or Above Grade Completion Well)

FIELD REPRESENTATIVE: Allen Wilmore
DRILLING CONTRACTOR: JEDI
DRILLING TECHNIQUE: Hollow Stem
AUGER SIZE AND TYPE:
BOREHOLE IDENTIFICATION: 47WW34
BOREHOLE DIAMETER: 8"
WELL IDENTIFICATION: 47WW34
WELL CONSTRUCTION START DATE: 2/6/08
WELL CONSTRUCTION COMPLETE DATE: 2/13/08
SCREEN MATERIAL: SCH 40 PVC
SCREEN DIAMETER: 4"
STRATUM-SCREENED INTERVAL (FT): 10'
CASING MATERIAL: SCH 40 PVC
CASING DIAMETER: 4"

TYPE OF FILTER PACK: SILICA SAND
GRADIATION: 20/40
AMOUNT OF FILTER PACK USED: 7-50 lb bags
TYPE OF BENTONITE: Bentonite chips
AMOUNT BENTONITE USED: 1/2 50-lb bucket
TYPE OF CEMENT: Portland-Cement
AMOUNT CEMENT USED: 5-94 lb bag
GROUT MATERIALS USED: bentonite slurry
DIMENSIONS OF SECURITY CASING: 8" x 8'
TYPE OF WELL CAP: plugging cap
TYPE OF END CAP: PVC 4" cap
COMMENTS:

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: OSCAR GARCIA (JEDI) INSTALLATION OBSERVED BY: ALLEN WILMORE (CSHAM)

DISCREPANCIES: PVC Isolation casing (12" I.D.) set at 21.5' bgs

00107212

HOLE NO. 47WW34

DRILLING LOG	DIVISION: FEDERAL	INSTALLATION: LHAAP	SHEET 1 OF 3 SHEETS
1. PROJECT: Longhorn Army Ammunition Plant		10. SIZE AND TYPE OF BIT: 8" HSA	
2. LOCATION (Coordinates or Station): Karnack, Texas		11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
3. DRILLING AGENCY: JEDI		12. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
4. HOLE NO. (As shown on drawing title and file number): 47WW34		13. OVERBURDEN SAMPLES: DISTURBED	UNDISTURBED: VC
5. NAME OF DRILLER: OSCAR GARCIA		14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED 0° DEG. FROM VERT.		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN: NA		16. DATE HOLE: STARTED 2/4/08	COMPLETED 2/5/08
8. DEPTH DRILLED INTO ROCK: NA		17. ELEVATION TOP OF HOLE: NR	
9. TOTAL DEPTH OF HOLE: 47'		18. TOTAL CORE RECOVERY FOR BORING: NR	
		Allen Wilmore	INSPECTOR

ELEVATION (PD) a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
		CL	CLAY, SILTY, HARD, LOW TO NO PLASTICITY, IRON STAINING (MOTTLING), DRY TO DAMP	100%		Soil isolation casing @ 21.5' bgs. Well set @ 43' bgs.
	5		- BECOMES SANDY			
		CL	- BECOMES STIFF, LESS HARD	100%		
	10			100%		
				100%		

00107213

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE NR | Hole No. 47WW34

PROJECT: LHAAP | INSTALLATION: LHAAP | SHEET 2 OF 3 SHEETS

ELEVATION PID (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
			Same as above			
	15			100%		
		SC	SAND, VERY CLAYEY, DENSE, ~~Poor~~ MODERATELY SORTED, MOIST, NO ODOR, GRAY	100%		
	20		-BECOMES WET, LESS CLAYEY			
		CL	~~CLAY~~ CLAY, SANDY, Low Plasticity, moist to dry Stiff, no odor	100%		
		SP	Sand, Silty, poorly sorted, loose, saturated, no odor			
	25			100%		
				100%		

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PROJECT | HOLE NO.

00107214

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE: NR

Hole No. 47GW34

PROJECT: LHAAP

INSTALLATION: LHAAP

SHEET 3 OF SHEETS

ELEVATION PID (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
	30		- SILT SEAM (6")	100%		
	35	SP	- SILT SEAM (3")	100%		
				100%		
	40			100%		
		CL	CLAY, SILTY, LOW TO MEDIUM PLASTICITY, SOFT, DAMP TO DRY			
			END OF BORING			

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PROJECT

HOLE NO.

00107215 47WW34

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: 47WW34-021908 (D)
Project Name/#: Longhorn
Weather: ptly cloudy Low 60s

Sampling location ID: 47WW34-021908 (D)
Sample ID: 47WW34-021908
Collection Time/Date: 17:10 2-19-08

Pump Installation

Pump installation crew: A. Willmore
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): ~~47.88~~ (A) 46.15
Initial (pre-installation) DTW/time: 17.88
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: 2-19-08 16:37
Installation date/completion time: 2-19-09 16:39
Screen Interval (ft. BTOC): 36.5 to 46.5
Pump intake depth (ft BTOC): 41.5
Post-installation DTW/time: 17.93
Max. sustainable pump rate (mL/min): 200
Appearance of product: None
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

A. Willmore 2/19/09

Purging

Purging/sampling crew: A. Willmore
Purge date/beginning time: 16:45 2-19-08
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.0
Purge date/completion time: 2-19-09 17:20
Final (post-purging) DTW (ft. BTOC): 17.98
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	35								35
Refill Setting	10								10
Discharge Setting	6								5
Flow rate (mL/min)	200								200

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
16:50	17.97	200	1	18.90	1.069	7.18	1.9	3.21	3.2
16:55	17.97	200	2	18.81	1.004	7.11	2.1	3.26	3.1
17:00	17.97	200	3	18.79	1.001	7.09	2.4	3.21	3.0
17:05	17.97	200	4	18.76	1.003	7.09	2.6	3.23	2.7

A. Willmore 2/19/09

00107216 47WW34

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

10-20

2/19/08

Sampling

Sampling beginning time: 17:16 Sampling completion time: 17:15

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
17:20	17.92	200	4	18.76	1.006	7.09	2.4	3.24	2.8

Sample Information

Sample ID: 47ww34 - 021908

Sample collection date/time: 2-19-08 17:10

Duplicate sample collected (Y/N): N

Duplicate sample ID: NA

Split sample collected (Y/N): N

Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs	8260	2-40mL VOA vials			

Comments: sampled and purged w/ stainless steel cased bladder pump.

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107217

WELL DEVELOPMENT RECORD

WELL/PIEZOMETER ID 47WW34
SHEET ____ of ____

PROJECT NAME: Longhorn AAP PROJECT NO.: 117591 DATE: 2/18/08

LOCATION: Kavanack, Tx DATE INSTALLED: 2/13/08

TOTAL DEPTH (FTOC) 46.15 CASING DIAMETER 4"

METHODS OF DEVELOPMENT

☐ Swabbing ☐ Bailing ☒ Pumping ☐ Describe Air lift

Equipment decontaminated prior to development ☐ Yes ☐ NO

Describe

EQUIPMENT NUMBERS:

pH Meter YSI 650 MDS 36919 EC Meter YSI 650 MDS 36919 Turbidity Meter YSI 650 MDS 36919 Thermometer YSI 650 MDS 36919

CASING VOLUME INFORMATION:

Casing ID (inch)	1.0	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (A) (gal/ft)	0.04	0.09	0.16	0.2	0.37	0.65	0.75	1.0	1.5	2.0	2.6

PURGING INFORMATION:

Measured Well Depth (B) 43 (used for calc) 46.15 (actual) ft.

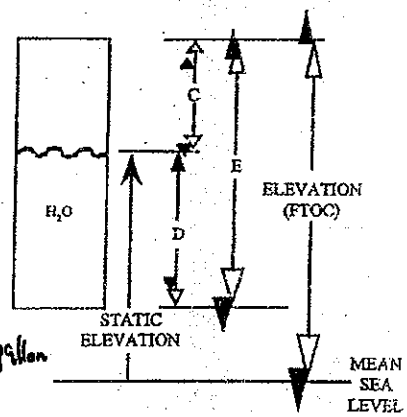
Measured Water Level Depth (C) 20 ft.

Length of Static Water Column (D) 43 (B) - 20 (C) = 23 ft.

Casing Water Volume (E) = 0.65 (A) x 23 (D) = 14.95 gal

5 x 14.95 = 74.75 gallon

Total Purge Volume = 90 (gal)



Date	Time	Water Level (FTOC)	Volume Removed (gal)	pH	EC	Temperature F or C	Turbidity/ Sand (ppm)	Comments
2/18/08	10:45	NR	75	8.24	1.078	17.96	14.1	clear
2/18/08	10:55	NR	80	8.33	1.063	16.82	10.6	clear
2/18	11:05	NR	85	8.21	1.066	16.78	9.3	clear

FIGURE 5

Began developing @ 16:00 2/17/08
1st reading taken 2/18/08

00107218

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: Longhorn / 47591
Weather: clear, 70s - becomes ptly cloudy

Sampling location ID: 47WW35
Sample ID: 47WW35-100908
Collection Time/Date: ~~10:50~~ 11:55 10/9/08

Pump Installation

Pump installation crew: A. Willmore
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): ~50
Initial (pre-installation) DTW/time: 20.01
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): ~43'

Installation date/beginning time: 10.9.08 11:14
Installation date/completion time: 10.9.08 11:17
Screen Interval (ft. BTOC): 40 to 50
Pump intake depth (ft BTOC): 45'
Post-installation DTW/time: ~~20~~ 19.76
Max. sustainable pump rate (mL/min): 100'
Appearance of product: None
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NR psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting				NA					
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: A. Willmore
Purge date/beginning time: 11:27
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.0
Purge date/completion time: 10.9.08 12:07
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NR psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	40								40
Refill Setting	10								10
Discharge Setting	5								5
Flow rate (mL/min)	100								100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
11:32	20.12	100	0.5	20.01	2.104	6.78	62.4	5.39	39.0
11:37	20.21	100	1.0	20.17	2.109	6.78	63.6	5.42	19.7
11:42	20.21	100	1.5	20.18	2.112	6.74	64.2	5.46	11.3
11:47	20.21	100	2.0	20.14	2.119	6.72	62.1	5.51	9.2

00107219

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47WW35

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

10/9/08

Sampling

Sampling beginning time: 11:55 Sampling completion time: 12:00

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
12:07	20.21	100	4.0	20.09	2.123	6.73	68.3	5.51	9.0

Sample Information

Sample ID: 47WW35-100908 Sample collection date/time: 10.9.08 11:55

Duplicate sample collected (Y/N): Y Duplicate sample ID: 47WW35-1D0908-FD

Split sample collected (Y/N): N Split sample ID: NA

COC No(s): NR

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs	8260	6- 40 mL voa vials			

Comments: Sampled w/ bladder pump. Took Field Duplicate

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107220

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: HMAP-47 | Sampling location ID: 47ww36
Project Name/#: Longhorn/ 117591 | Sample ID: 47ww36-100908
Weather: clear 70s | Collection Time/Date: 08:20 10/9/08

Pump Installation

Pump installation crew: A. Willmore | Installation date/beginning time: 10.09.08
PID/FID reading (well head/background): 0.0 | Installation date/completion time: 10.09.08
Casing diameter (inches): 4" | Screen Interval (ft. BTOC): 42 to 52
Total well Depth (ft. BTOC): ~52 | Pump intake depth (ft BTOC): 47
Initial (pre-installation) DTW/time: 19.43 | Post-installation DTW/time: 19.30
Final (after pump priming) DTW/time: NA | Max. sustainable pump rate (mL/min): 100
Free product (circle): LNAPL / DNAPL | Appearance of product: None
Volume of water removed during priming (mL): NR | Discharge tube diameter (3/8" or 1/4"): 1/4"
Discharge tube length (ft.): 50' | Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NR psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting				NA					
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: A. Willmore | PID/FID reading (well head/background): 0.0
Purge date/beginning time: 10.09.08 07:56 | Purge date/completion time: 10.09.08 08:31
Initial (pre-purging) DTW (ft. BTOC): | Final (post-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA | No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NR psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	40								40
Refill Setting	10								10
Discharge Setting	5								5
Flow rate (mL/min)	100								100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
08:01	19.49	100	0.5	18.48	0.501	7.01	46.9	61.4	111.4
08:06	19.52	100	1.0	18.41	0.531	7.03	51.3	62.1	36.2
08:11	19.53	100	1.5	18.46	0.522	7.04	52.3	94.7	20.1
08:16	19.54	100	2.0	18.53	0.513	7.04	52.8	99.6	14.3

00107221

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47WW36

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

10/9/08

Sampling

Sampling beginning time: 08:20 Sampling completion time: 08:25

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
08:31	19.54	100	3.5	20.08	0.512	7.04	98.1	100.1	11.1

Sample Information

Sample ID: 47WW36-100908
Duplicate sample collected (Y/N): N
Split sample collected (Y/N): N
COC No(s): NA

Sample collection date/time: 10.09.08 08:20
Duplicate sample ID: NA
Split sample ID: NA

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs	8260	3-40 mL voa vials			

Comments: Sampled w/ bladder pump.

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107222

3/14/08 Site 47 Sampling
Clear 65°F

0900 - Setup on 47WW33 with a bladder pump. Decomed equipment prior to sampling. New disposable gloves were used. Sample 47WW33-031408 was collected at 9:50 for VOA's.

1100 - Setup on 47WW34 with a bladder pump. All equipment was decomed before sampling and disposable gloves were used. Sample 47WW34-031408 was collected at 12:00 for VOA's.

3/14/08 Site 17 Sampling

2:00 - Setup on 17WW11 with a bladder pump. Decomed equipment before sampling and used disposable gloves. Sample collected at for VOA's.

Scott Belanger

00107223

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009BE10
Weather: Clear 65°F

Sampling location ID: SITE 47
Sample ID: 47WW33-031405
Collection Time/Date: 9:50 3/14/08

Pump Installation

Pump installation crew: Beesinger
PID/FID reading (well head/background):
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 37.00
Initial (pre-installation) DTW/time: 9.20
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):

Installation date/beginning time: 3/14/08 8:30
Installation date/completion time: 3/14/08 8:40
Screen interval (ft. BTOC): 27.00 to 37.00
Pump intake depth (ft BTOC): 32.00
Post-installation DTW/time: 9.08
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: Beesinger
Purge date/beginning time: 3/14/08 8:40
Initial (pre-purging) DTW (ft. BTOC): 9.08
Calculated tubing + pump volume: NA
PID/FID reading (well head/background):
Purge date/completion time: 3/14/08 9:50
Final (post-purging) DTW (ft. BTOC): 9.25
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	22								
Refill Setting	18								
Discharge Setting	22								
Flow rate (mL/min)	100								

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
8:45	9.12	100	500	16.48	1.767	5.94	160.1	1.87	23.5
8:50	9.15	100	1000	16.53	1.827	5.82	164.2	3.56	24.6
8:55	9.18	100	1500	16.37	1.855	5.81	162.8	2.75	25.1
9:00	9.21	100	2000	16.32	1.876	5.78	159.0	2.14	25.1
9:05	9.23	100	2500	16.36	1.882	5.77	153.3	1.91	23.6
9:10	9.24	100	3000	16.37	1.886	5.76	1482	1.88	22.6
9:15	9.25	100	3500	16.43	1.889	5.76	1495	1.84	21.8
9:20	9.25	100	4000	16.98	1.892	5.77	139.8	1.80	20.4

00107224

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity ±3% (uMhos/cm)	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
9:25	9.25	100	4500	16.52	1.893	5.77	134.6	1.84	18.4
9:30	9.25	100	5000	16.54	1.898	5.78	129.5	1.77	15.1
9:35	9.25	100	5500	16.56	1.903	5.77	125.7	1.75	12.9
9:40	9.25	100	6000	16.62	1.907	5.77	122.0	1.73	11.0
9:45	9.25	100	6500	16.65	1.910	5.77	118.9	1.71	9.6
9:50	9.25	100	7000	16.67	1.911	5.77	117.1	1.68	9.4

10-20

Sampling

Sampling beginning time: ~~9:50~~ 9:50 Sampling completion time: 9:52

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
9:52	9.25	100	7200	16.68	1.912	5.77	116.8	1.68	8.9

Sample Information

Sample ID: 47WW33-031408 Sample collection date/time: 3/14/08 9:50

Duplicate sample collected (Y/N): Duplicate sample ID:

Split sample collected (Y/N): Split sample ID:

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOA		2-40 ml glass			

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; ft - feet; mL - milliliter; L - Liter

00107225

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009.B8.ID
Weather: Clear 70°F

Sampling location ID: SWMU 47
Sample ID: 47MW34-031408
Collection Time/Date: 12:00 3/14/08

Pump Installation

Pump installation crew: Beesinger
PID/FID reading (well head/background):
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 46.25
Initial (pre-installation) DTW/time: 17.30
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

Installation date/beginning time: 3/14/08 11:00
Installation date/completion time: 3/14/08 11:15
Screen Interval (ft. BTOC): 36.25 to 46.25
Pump intake depth (ft BTOC): 31.25
Post-installation DTW/time: 17.15
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: Beesinger
Purge date/beginning time: 3/14/08 11:15
Initial (pre-purging) DTW (ft. BTOC): 17.15
Calculated tubing + pump volume: NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

PID/FID reading (well head/background):
Purge date/completion time: 3/14/08 12:00
Final (post-purging) DTW (ft. BTOC): 17.33
No. of tubing + pump volumes purged:

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	28								
Refill Setting	25								
Discharge Setting	28								
Flow rate (mL/min)	100								

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
11:20	17.20	100	500	19.48	1.041	7.21	110.2	3.38	-0.5
11:25	17.23	100	1000	19.18	1.044	7.22	110.0	2.78	-0.5
11:30	17.26	100	1500	19.21	1.038	7.22	107.2	2.13	-0.7
11:35	17.29	100	2000	19.57	1.032	7.22	103.4	1.98	-0.2
11:40	17.31	100	2500	19.76	1.032	7.22	99.5	1.70	-0.5
11:45	17.32	100	3000	19.87	1.033	7.22	97.2	1.66	-0.2
11:50	17.33	100	3500	19.90	1.032	7.20	95.2	1.69	-0.1
11:55	17.33	100	4000	19.92	1.031	7.20	94.3	1.65	-0.3

00107226

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity ±3% (uMhos/cm)	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
12:00	17.33	100	4500	19.95	1.031	7.20	93.6	1.64	-0.3

10-20

Sampling

Sampling beginning time: 12:00 Sampling completion time: 12:02

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
12:02	17.33	100	4700	19.96	1.031	7.20	93.0	1.65	-0.2

Sample Information

Sample ID: 47W34 - 031408 Sample collection date/time: 3/14/08 12:00

Duplicate sample collected (Y/N): Duplicate sample ID:

Split sample collected (Y/N): Split sample ID:

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOA		2-40ml glass			

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107227

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAMP
Project Name/#: 117591.0009B810
Weather: Sunny & 20°F

Sampling location ID: Site 17
Sample ID: 17WW17-031408
Collection Time/Date: 3:10 3/14/08

Pump Installation

Pump installation crew: Bressler
PID/FID reading (well head/background): _____
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 53.55
Initial (pre-installation) DTW/time: 10.00
Final (after pump priming) DTW/time: _____
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): _____
Discharge tube length (ft.): _____
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

Installation date/beginning time: 3/14/08 2:00
Installation date/completion time: 3/14/08 2:15
Screen Interval (ft. BTOC): 43.55 to 53.55
Pump intake depth (ft BTOC): 48.5
Post-installation DTW/time: 9.40
Max. sustainable pump rate (mL/min): _____
Appearance of product: _____
Discharge tube diameter (3/8" or 1/4"): _____
Inlet reducer used (Y/N): _____

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: Bressler
Purge date/beginning time: 3/14/08 2:15
Initial (pre-purging) DTW (ft. BTOC): 9.40
Calculated tubing + pump volume: NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

PID/FID reading (well head/background): _____
Purge date/completion time: 3/14/08 3:10
Final (post-purging) DTW (ft. BTOC): _____
No. of tubing + pump volumes purged: _____

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	35								
Refill Setting	31								
Discharge Setting	35								
Flow rate (mL/min)	125								

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
2:20	9.45	125	625	24.23	1.549	6.27	-43.5	1.07	1.4
2:25	9.50	125	1250	24.58	1.541	6.21	-51.5	0.68	2.3
2:30	9.53	125	1875	24.25	1.545	6.21	-54.0	0.38	2.0
2:35	9.55	125	2500	24.06	1.540	6.21	-56.0	0.43	6.1
2:40	9.57	125	3125	23.67	1.539	6.21	-56.2	0.33	4.0
2:45	9.59	125	3750	23.54	1.536	6.20	-56.7	0.34	4.9
2:50	9.60	125	4375	24.16	1.538	6.21	-58.9	0.41	4.8
2:55	9.61	125	5000	23.80	1.538	6.21	-60.6	0.40	5.1

00107228

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical ±3% Conductivity (uMhos/cm)	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%
3:00	9.62	125	5625	23.76	1,538	6.21	-60.4	0.40	6.0
3:05	9.62	125	6250	23.80	1,539	6.21	-61.5	0.45	3.8
3:10	9.62	125	6875	23.83	1,539	6.21	-62.2	0.43	3.2

10-20

Sampling

Sampling beginning time: 3:10 Sampling completion time: 3:12

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
3:12	9.62	125	7125	23.84	1,539	6.21	-62.7	0.42	4.0

Sample Information

Sample ID: 17WW17-031408 Sample collection date/time: 3/14/08 3:10

Duplicate sample collected (Y/N): Duplicate sample ID:

Split sample collected (Y/N): Split sample ID:

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOA		2-40 ml glass			

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

22 Site 26 Sampling
Sunny 85° 3/14/08

3:40 - LHSMW1D is Dry
No Sample could be
TAKEN.

Scott Belsey

00107230

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009.BB30
Weather: SUNNY 85°F

Sampling location ID: Site 46
Sample ID: LHSMW10-031408
Collection Time/Date:

Pump Installation

Pump installation crew: Resuga
PID/FID reading (well head/background):
Casing diameter (inches): 4.11
Total well Depth (ft. BTOC): 27.80
Initial (pre-installation) DTW/time: DRY
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

Installation date/beginning time: 3/14/08 3:10
Installation date/completion time:
Screen Interval (ft. BTOC): _____ to _____
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew:
Purge date/beginning time:
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

PID/FID reading (well head/background):
Purge date/completion time
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
	NA	NA	NA		NA				
						DRY			

00107231

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ±10%	Electrical Conductivity (uMhos/cm) ±3%	pH ±0.1	Eh (mv) ±10	DO (mg/L) ±10%	Turbidity (NTU) ±10%

10-20

Sampling

Sampling beginning time:_____ Sampling completion time:_____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID: No Sample well is DRY

Duplicate sample collected (Y/N):

Split sample collected (Y/N):

COC No(s):

Sample collection date/time:

Duplicate sample ID:

Split sample ID:

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

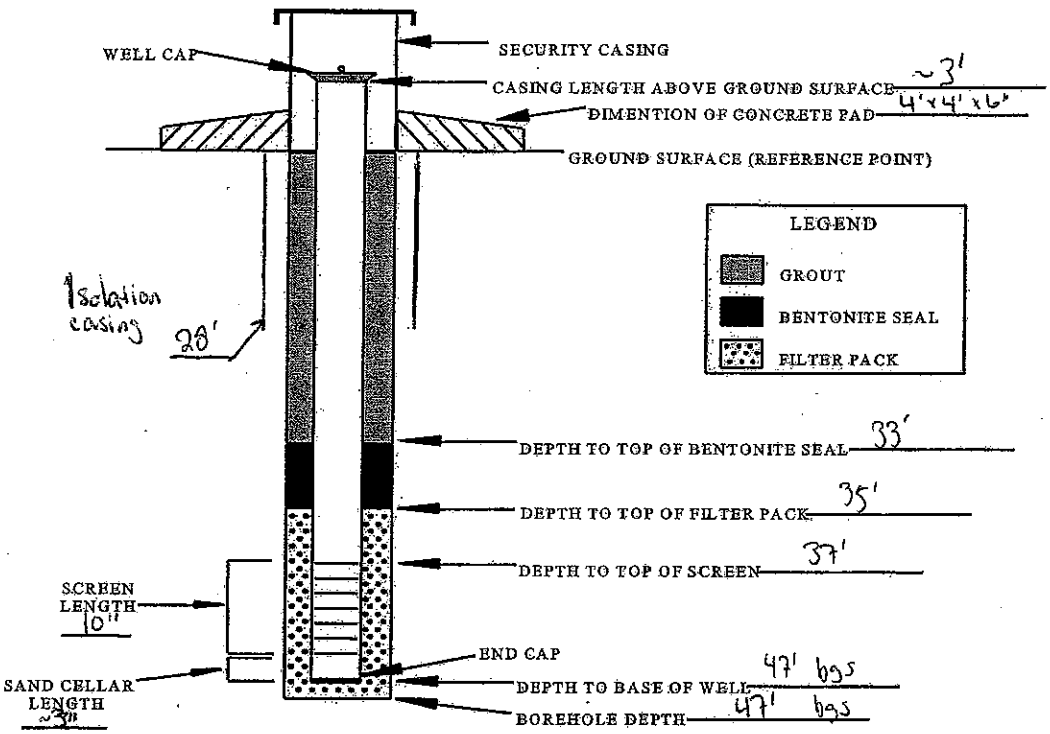
00107232 47WW35

WELL COMPLETION FORM (Stickup or Above Grade Completion Well)

FIELD REPRESENTATIVE: Allen Willmore
DRILLING CONTRACTOR: ETEC
DRILLING TECHNIQUE: HSA
AUGER SIZE AND TYPE: 10"
BOREHOLE IDENTIFICATION: 47WW35
BOREHOLE DIAMETER: 10"
WELL IDENTIFICATION: 47WW35
WELL CONSTRUCTION START DATE: 9/23/08
WELL CONSTRUCTION COMPLETE DATE: 9/26/08
SCREEN MATERIAL: Sch. 40 PVC
SCREEN DIAMETER: 4"
STRATUM-SCREENED INTERVAL (FT): 10
CASING MATERIAL: Sch 40 PVC
CASING DIAMETER: 4"

TYPE OF FILTER PACK: 20/40 silica sand
GRADIATION: 20/40
AMOUNT OF FILTER PACK USED: 9 bags
TYPE OF BENTONITE: bentonite pellets
AMOUNT BENTONITE USED: 1-50lb bucket
TYPE OF CEMENT: Portland cement
AMOUNT CEMENT USED: ~5-6 94 lb bags
GROUT MATERIALS USED: grout
DIMENSIONS OF SECURITY CASING: 6"x6"
TYPE OF WELL CAP: plugging cap
TYPE OF END CAP: PVC
COMMENTS:

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: Tommy Cook
INSTALLATION OBSERVED BY: Allen Willmore
DISCREPANCIES: none

00107233

HOLE NO. 47WW035

BORING LOG	DIVISION: FEDERAL	INSTALLATION: LHAAP	SHEET 1 OF 4 SHEETS
1. PROJECT: Longhorn AAP		9. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
2. LOCATION: Karnack, TX		10. MANUFACTURER'S DESIGNATION OF DRILL: Foremost 5500 / Mayhew 500	
3. DRILLING AGENCY: ETTL		11. OVERBURDEN SAMPLES: DISTURBED --	UNDISTURBED --
4. HOLE NO. (As shown on drawing title and file number): 47WW35		12. TOTAL NUMBER CORE BOXES: NA	
		13. ELEVATION GROUND WATER: NA	
5. NAME OF DRILLER: Tommy Cook		14. DATE HOLE: STARTED 9/23/08	COMPLETED 9/26/08
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED 0° DEG. FROM VERT.		15. ELEVATION TOP OF HOLE: TOC = 189.90	
7. TOTAL DEPTH OF HOLE: 47'		16. TOTAL CORE RECOVERY FOR BORING: 100 %	
8. SIZE AND TYPE OF BIT: 10" HSA / Tri-cone roller bit / HSA		17. LOGGED BY: A. Willmore	QC:

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0 NR		CL	CLAY, SANDY, BROWN, MEDIUM PLASTICITY			13:30 - Began drilling w/ 10" HSA
				40'.		14:45 - Decide to set Casing @ ~~30~~ 28' bgs.
0.0 NR						
		SC	SAND, CLAYEY, BROWN, LOOSE, NO ODOR, DRY			1st 30' drilled w/ 10" HSA.
0.0 NR	5	CL	CLAY, SANDY, ~~HARD~~ STIFF, LOW PLASTICITY, NO ODOR, DRY, Iron staining			Well set @ 47'
0.0			- BECOMES MORE STIFF	100'.		
0.0	10					
0.0				100%.		

00107234

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE: Toc = 189.90 | Hole No. 47WW35

PROJECT: LHAAP- MARC | INSTALLATION: LHAAP | SHEET 2 OF 4 SHEETS

ELEVATION FID (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
10.0	15		-Becomes dark gray, organic, hard -Becomes grayish-brown	100%		
	20		-Becomes soft, sandy, less clayey	100%		
	25		clay, silty, brown to gray, mottling low plasticity, dry no odor, stiff	100%		

00107235

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE: TOC = 189.90 — Hole No. 47WW35

PROJECT: LHAAP- MARC — INSTALLATION: LHAAP — SHEET 3 OF 4 SHEETS

ELEVATION (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
0.0	30			100%		
				100%		
0.0		CL	- Becomes hard			
0.0				100%		
0.0	35			60%		
		MLS	SILT, SAND, GRAV, DENSE, MOIST, well SORTED, NO ODOR			
0.0			Sand, silty, moderately-sorted, moist no odor,	100%		
0.0		SP	- Becomes LESS DENSE, well-sorted, wet	100%		
	40					
0.0				100%		
0.0				100%		
0.0			- Becomes MORE DENSE, clayey	100%		

00107236

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE TOC = 189.90 | Hole No. 47WW35

PROJECT LHAAP-MARC | INSTALLATION LHAAP | SHEET 4 OF 4 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	45	SP		100%		
		CL	clay, very sandy, gray, dry, nonplastic, low plasticity, moderately stiff	100%		
			END OF BORING @ 47' bgs			
	50					

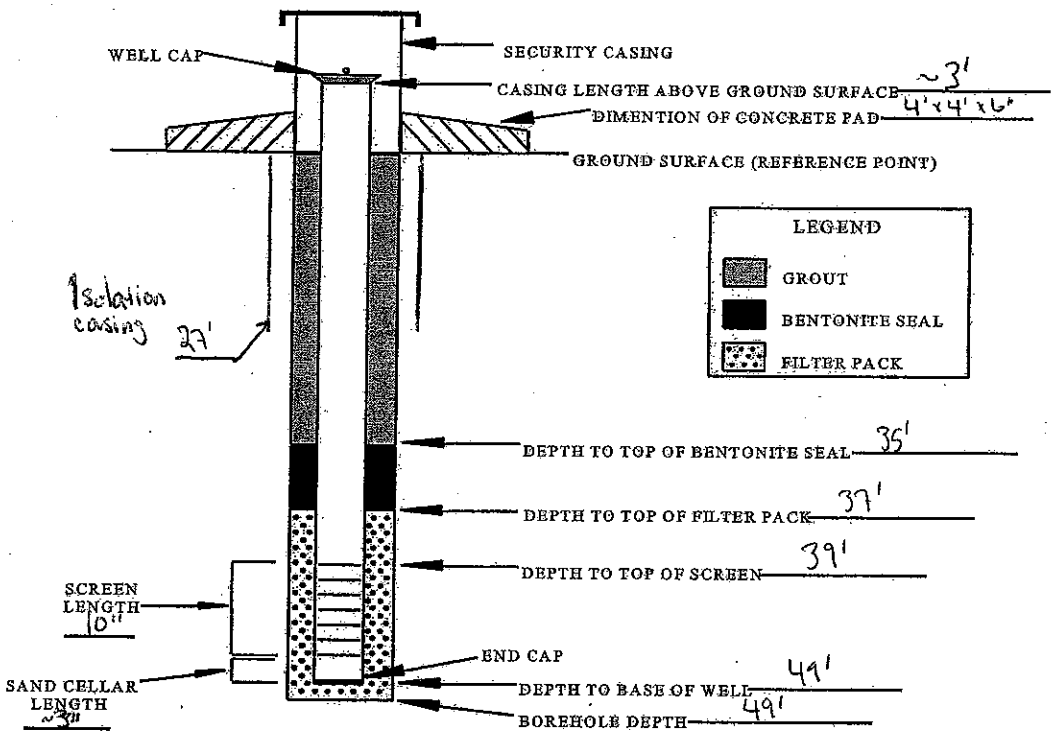
00107237 47 WW 36

WELL COMPLETION FORM (Stickup or Above Grade Completion Well)

FIELD REPRESENTATIVE: Allen Willmore
DRILLING CONTRACTOR: ETI
DRILLING TECHNIQUE: HSA
AUGER SIZE AND TYPE: 10"
BOREHOLE IDENTIFICATION: 47 WW 36
BOREHOLE DIAMETER: 10"
WELL IDENTIFICATION: 47WW 36
WELL CONSTRUCTION START DATE: 9/24/08
WELL CONSTRUCTION COMPLETE DATE: 9/29/08
SCREEN MATERIAL: Sch. 40 PVC
SCREEN DIAMETER: 4"
STRATUM-SCREENED INTERVAL (FT): 10
CASING MATERIAL: Sch 40 PVC
CASING DIAMETER: 4"

TYPE OF FILTER PACK: 20/40 silica sand
GRADIATION: 20/40
AMOUNT OF FILTER PACK USED: 9 bags
TYPE OF BENTONITE: bentonite pellets
AMOUNT BENTONITE USED: 1-5gal bucket
TYPE OF CEMENT: Portland cement
AMOUNT CEMENT USED: ~5-6 94 lb bags
GROUT MATERIALS USED: grout
DIMENSIONS OF SECURITY CASING: 6"x6"
TYPE OF WELL CAP: plugging cap
TYPE OF END CAP: PVC
COMMENTS:

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: Tommy Cook
INSTALLATION OBSERVED BY: Allen Willmore
DISCREPANCIES: None

00107238

HOLE NO. 47WW36 47WW36

BORING LOG

DIVISION: Federal

INSTALLATION: LHAAP

SHEET 1 OF 4 SHEETS

1. PROJECT: Longhorn AAP
2. LOCATION: Karnack, Texas
3. DRILLING AGENCY: ETTL
4. HOLE NO. (As shown on drawing title and file number): 47WW36
5. NAME OF DRILLER: Doug Hinds
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED 0° DEG. FROM VERT.
7. TOTAL DEPTH OF HOLE: 49'
8. SIZE AND TYPE OF BIT: 10" HSA / 9 7/8" tri-cone roller
9. DATUM FOR ELEVATION SHOWN (TBM or MSL):
10. MANUFACTURER'S DESIGNATION OF DRILL: Foremost 5500 / Mayhew 5000
11. OVERBURDEN SAMPLES: DISTURBED --; UNDISTURBED --
12. TOTAL NUMBER CORE BOXES: NA
13. ELEVATION GROUND WATER: NR
14. DATE HOLE: STARTED 9/24/08; COMPLETED 9/24/08
15. ELEVATION TOP OF HOLE: TOC= 196.46 Surveyed later
16. TOTAL CORE RECOVERY FOR BORING: NR %
17. LOGGED BY: A. Willmore; QC RL

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	0	SC	SAND, CLAYEY, LOOSE, REDDISH, to BROWN, Fe Staining, NO ODOR, DRY.	20'1-		11:00- Began drilling w/ ~10" HSA.
0.0			- Becomes GRAY, DENSE, LESS CLAY, DR			13:10- Began Setting isolation casing @ 27' bgs.
0.0	5		- Becomes WHITE, CHALKY	160'1-		Well set @ 49' bgs
0.0		CL	CLAY, SILTY, HARD, NO PLASTICITY, GRAY-BROWN, Iron Staining, NO ODOR, DRY			
0.0	10			100'1-		
0.0						

00107239

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE TOC = 196.46 | Hole No. 47WW36

PROJECT LHAAP - MARC | INSTALLATION LHAAP | SHEET 2 OF 4 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	15	CL	Same as above			
0.0		SP	SAND, SILTY, MODERATELY DENSE, RED IRON STAINING, MOIST TO DAMP, NO ODOR - Becomes clayey			
0.0			CLAY, SILTY, STIFF TO HARD, LOW PLAST, dry, no odor, gray, some mottling			
0.0	20	CL				
0.0			- Becomes sandy Sand, clayey, brown, dense, wet, no odor, poorly sorted			
0.0	25		CLAY, sandy, grayish brown, moist to dry ~~Becomes~~ Sandy no odor,			
0.0		SP	~~SAND, CLAYEY, BROWN, DENSE, WET, NO ODOR, POORLY-SORTED~~ Sand, clayey,			
0.0						

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PROJECT LHAAP | HOLE NO. 47WW36

00107240

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE: TOC = 196.46 | Hole No. 47WW36

PROJECT: LHAAP MARC | INSTALLATION: LONGHORN AAP | SHEET 3 OF 4 SHEETS

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
a	b	c	d	e	f	g
6.0	30	SP	SAND, SILTY, LOOSE, GRAY, SATURATED, NO ODOR, POORLY-SORTED			
0.0		CL	CLAY, SANDY, GRAY, MEDIUM PLASTICITY, STIFF, NO ODOR			
0.0	36					
0.0						
0.0	40					
0.0			- BECOMES MOIST			
0.0						
0.0		SP	SAND, CLAYEY, POORLY-SORTED, GRAY, DENSE, WET, NO ODOR			

00107241

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE TOC = 196.46	Hole No. 47WW36
PROJECT LHAAP MARC	INSTALLATION LHAAP	SHEET 4 OF 4 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0			Same as above			
0.0						
0.0						
	50		End of boring @ 49' bgs			

00107242

GROUNDWATER SAMPLING FORM

Shaw

Operable Unit/Site ID: Area 7
Project Name/#: USACE - CAMAP
Weather:
Sampling location ID: 47WW16
Sample ID:
Collection Time/Date: /WS

Pump Installation

Pump installation by: M. Proctor
PID/FID reading (well head/background):
Casing diameter (inches):
Total well Depth (ft BTOC): 21.25'
Initial (pre-installation) DTW/time: 21.00'
Final (after pump priming) DTW/time:
Free product (Y/N): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):
Installation date/beginning time:
Installation date/completion time:
Screen Interval (ft. BTOC):
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = psi

	Initial	2	3	4	5	6	7		Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging method:
Purge date/beginning time:
Initial (pre-purge) DTW (ft BTOC):
Calculated tubing + pump volume: NA
PID/FID reading (well head/background):
Purge date/completion time:
Final (post-purging) DTW (ft BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = psi

	Initial	2	3	4	5	6	7		Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

3" of water in the bottom of the well was not sufficient to allow collection of water for field testing of water quality measurements. Well 47WW16 was sampled directly into sample vials (at 13:26).

00107243

GROUNDWATER SAMPLING FORM

Page 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mV)	DO (mg/L)	Turbidity (NTU)

Sampling

Sampling sequence time: NO Sample Sampling comments:

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mV)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID: Sample collected (Y/N):
Duplicate sample collected (Y/N): Duplicate sample ID:
Split sample collected (Y/N): Split sample ID:
COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments:

47WW16 was sampled directly into sample vials.

Purge data: DTOC = Below top of casing; DTW = Depth to water; Drawdown = Initial DTW - Final DTW

A similar situation existed at well 47WW12, insufficient water to measure water quality parameters. Well 47WW12 was also sampled directly into sample vials (at 13:00).

00107244

1090405 70

Chain of Custody

NO. 5728

Shaw® Shaw Environmental & Infrastructure, Inc.
3010 Briarpark Drive, Suite 400
Houston, TX 77042
(713) 996-4400

Laboratory Name: Microbac Address: 158 Starlite Dr. Marietta, OH Contact: Stephanie Mossburg (740) 373 4071

Project Name: USACE - LHAAP | Project Location: Kaenack TX | Analysis and Method Desired (Indicate separate containers) | Remarks

Project No.: 117591.0005.0004 | Project Contact: Jen Hoang | Project Telephone No.: 713 996 4408

Point of Contact: Jen Hoang | Project Manager/Supervisor: Praveen Srivastav

Telephone No.: 713 996 4408

Item No.	Sample Number	Date	Time	Comp	Grab	Matrix	Sample Description, Location	Number of Containers	VOC's							Remarks
1	47WW12042209	04/22/09	1300		X	GW	LHAAP 47	3	3							Trip blank in cooler
2	47WW11E042209	04/22/09	1321		X	GW	LHAAP 47	3	3							
3																
4																
5																
6																
7																
8																
9																
10																

Transfers Relinquished By (signature)	Date/Time	Transfers Accepted By (signature)	Date/Time	Special Instructions
	04-22-09 / 1400			
				FedEx Airbill No.:
		Laboratory	4/23/09 0930	Sampler's Signature

TAT: ___ Standard ___ Rush Date ___ Seals Intact? ___ Y ___ N Received Good Condition ___ Y ___ N ___ Cold

White - Lab Copy Canary - Field Copy Pink - File Copy

Form Number: 433_2
Rev. 10-19-07

00107245

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: Area 47
Project Name/#: USACE- LHAAP
Weather: P/C ≈ 65°-70°F
Sampling location ID: 105
Sample ID: 105 0218-09
Collection Time/Date: 02-18-09 / 0951

Pump Installation

Pump installation crew: M. Martinez
PID/FID reading (well head/background): NA
Casing diameter (inches): 2"
Total well Depth (ft. BTOC): 26.55
Initial (pre-installation) DTW/time: 22.05 / 0840
Final (after pump priming) DTW/time: 21.55
Free product (circle): ~~LNAPL / DNAPL~~
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA
Installation date/beginning time 02-18-09
Installation date/completion time 02-18-09
Screen Interval (ft. BTOC): 14' to 26'
Pump intake depth (ft BTOC): 25.20'
Post-installation DTW/time: 21.55 0850
Max. sustainable pump rate (mL/min):
Appearance of product: NA
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): No

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: M. Martinez
Purge date/beginning time: 02-18-09 / 0900
Initial (pre-purging) DTW (ft. BTOC) 21.55'
Calculated tubing + pump volume: NA
PID/FID reading (well head/background): NA
Purge date/completion time: 02-18-09 / 1100
Final (post-purging) DTW (ft. BTOC) 23.05
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	19								19
Refill Setting	12								12
Discharge Setting	3								3
Flow rate (mL/min)	100								100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
0917	23.00	100	2.0	18.30	7.330	6.44	-20.8	0.31	2284.0
0930	23.05	100	3.3	18.30	7.166	6.45	-29.8	0.24	2284.2
0935	23.05	100	3.8	18.30	7.125	6.45	-30.4	0.24	2284.2
0940	23.05	100	4.3	18.29	7.094	6.45	-31.4	0.23	2283.8
0945	23.05	100	4.8	18.27	7.053	6.45	-30.7	0.25	2283.7
0950	23.05	100	5.3	18.38	7.009	6.46	-33	0.24	2285.7
0958	Sample								

00107246

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

105

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

NAL

Sampling

Sampling beginning time: 0951 Sampling completion time: 1020

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1025	23.05	100	8.3	18.63	6.890	6.47	-360	0.25	2285.0

Sample Information

Sample ID: 105 021809 Sample collection date/time: 02-18-09

Duplicate sample collected (Y/N): NO Duplicate sample ID: NA

Split sample collected (Y/N): NO Split sample ID NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2 x 40mL VOA			
MEE		3x 40mL VOA			
TOC		1 x 250mL HDPE			
Anions		1 x 250mL HDPE			
DHE		2 x 1 Liter Amber			

NAL

Comments:

Abbreviations: BTOC - Below top of casing, DTW - Depth to water; H - head above pump intake, mL - milliliter; L - Liter

00107247

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: Area 47
Project Name/#: USACE LAAAP
Weather:

Sampling location ID: LHS MW 41
Sample ID: LHS MW 41 022309
Collection Time/Date: 02-23-09 / 1139

Pump Installation

Pump installation crew: M. Martinez
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 38.00'
Initial (pre-installation) DTW/time: 22.18
Final (after pump priming) DTW/time: 22.09
Free product (circle): ~~LNAPL / DNAPL~~
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

Installation date/beginning time: 022309
Installation date/completion time: 022309
Screen Interval (ft. BTOC): 28 to 38
Pump intake depth (ft BTOC): 33
Post-installation DTW/time: 22.09
Max. sustainable pump rate (mL/min): NA
Appearance of product: NA
Discharge tube diameter (~~3/8"~~ or 1/4"): 1/4
Inlet reducer used (Y/N): NO

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: M. Martinez
Purge date/beginning time: 02-23-09 / 1037
Initial (pre-purging) DTW (ft. BTOC): 22.09
Calculated tubing + pump volume: NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

PID/FID reading (well head/background): NA
Purge date/completion time: 022309 /
Final (post purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged: NA

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	25								25
Refill Setting	10								10
Discharge Setting	5								5
Flow rate (mL/min)	200								200

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1043	22.49	200	2.0	15.62	2.541	6.23	71.0	3.49	241.1
1053	22.71	200	4.0	16.72	2.623	6.32	49.4	1.10	216.1
1058	22.80	200	5.0	16.83	2.630	6.25	49.2	1.00	205.8
1103	22.85	200	6.0	17.01	2.636	6.17	50.6	0.87	194.6
1108	22.90	200	7.0	17.17	2.639	6.11	50.0	0.78	181.6
1113	22.92	200	8.0	17.18	2.641	6.05	50.6	0.74	172.3
1118	22.95	200	9.0	17.19	2.646	6.01	49.8	0.69	164.9
1123	22.95	200	10.00	17.24	2.646	5.99	49.8	0.66	153.1

00107248

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

LHSMW41

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1128	22.95	200	11.0	17.27	2.048	5.95	49.8	0.04	136.1
1133	22.95	200	12.0	17.27	2.048	5.92	49.2	0.02	134.6
1138	22.95	200	130	17.27	2.048	5.92	49.2	0.01	133.1
1139	Sample								

Sampling

Sampling beginning time: 1139 Sampling completion time: 1139

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1145	22.95	200	14.0	17.29	2.048	5.93	49.2	0.00	130.3

Sample Information

Sample ID: LHS MW 41 022309

Sample collection date/time: 02-23-09 / 1139

Duplicate sample collected (Y/N): NO

Duplicate sample ID: NO

Split sample collected (Y/N): NO

Split sample ID: NO

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2 x 40 mL			

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107249

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: Area 47
Project Name/#: USACE - LHAAP
Weather: Clear Skies 55°F

Sampling location ID: 47S MW43
Sample ID: L/4S MW43 021909
Collection Time/Date: 02-19-09 / 0834

Pump Installation

Pump installation crew: M. Martinez
PID/FID reading (well head/background):
Casing diameter (inches):
Total well Depth (ft. BTOC): 22-70'
Initial (pre-installation) DTW/time: 21.60' / 0845
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):

Installation date/beginning time:
Installation date/completion time:
Screen Interval (ft. BTOC): to
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew:
Purge date/beginning time:
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA

PID/FID reading (well head/background):
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

LHSMW 43

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sampling

Sampling beginning time: _____ Sampling completion time: _____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID: _____ Sample collection date/time: _____

Duplicate sample collected (Y/N): NO Duplicate sample ID: NA

Split sample collected (Y/N): NO Split sample ID: NA

COC No(s): _____

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2 x 40mL VOA			
MEE		3 x 40 mL VOA			
TOC		1 x 250 mL HDPE			
Anions		1 x 250 mL HDPE			
DHE		1 x 1 Liter Amber			

Comments: Bailed well DRY .581 02-18-09 1235

Sampled w/ DB 02-19-09 0824

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107251

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: Area 47
Project Name/#: USACE-CHAAP
Weather: Clear Skies 55°F

Sampling location ID: LHSMW45
Sample ID: LHSMW45 021408
Collection Time/Date: 02-14-09 / 1001

Pump Installation

Pump installation crew: M. Martinez
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 39.15'
Initial (pre-installation) DTW/time: 22.60'
Final (after pump priming) DTW/time: 22.60'
Free product (circle): ~~LNAPL~~ / ~~DNAPL~~
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: 02-14-09
Installation date/completion time: 02-14-09
Screen Interval (ft. BTOC): 29 to 39
Pump intake depth (ft BTOC): 34'
Post-installation DTW/time: 22.60'
Max. sustainable pump rate (mL/min): NA
Appearance of product: NA
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): NO

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: M. Martinez
Purge date/beginning time: 02-14-09 / 0910
Initial (pre-purging) DTW (ft. BTOC): 22.40
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): NA
Purge date/completion time: 02-14-09 / 1040
Final (post-purging) DTW (ft. BTOC): 22.81
No. of tubing + pump volumes purged: _____

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	25								25
Refill Setting	10								10
Discharge Setting	5								5
Flow rate (mL/min)	200								200

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (m.v)	DO (mg/L)	Turbidity (NTU)
0915	22.77	200	3.0	15.38	2.950	7.45	-14.5	4.84	-1.9
0925	22.81	200	4.0	14.20	2.937	6.99	4.2	3.20	-11.2
0930	22.81	200	5.0	14.24	2.936	6.85	5.0	3.15	-11.9
0935	22.81	200	6.0	14.28	2.936	6.95	6.8	3.09	-12.0
0940	22.81	200	7.0	14.30	2.932	6.91	7.0	2.99	-13.1
0945	22.81	200	8.0	14.32	2.934	6.91	7.7	2.80	-14.3
0950	22.81	200	9.0	14.24	2.937	6.90	7.6	2.65	-15.0
0955	22.81	200	10.0	14.27	2.937	6.90	7.6	2.64	-15.1

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

LHSMW45

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1000	22.81	200	11	16.29	2.936	6.96	7.6	2.61	-15.3
1001	Sample								

Sampling

Sampling beginning time: 1001 Sampling completion time: 1016

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1620	22.81	200	15.0	16.14	2.934	6.88	9.1	2.61	-15.5

Sample Information

Sample ID: LHS MW 45 021909 Sample collection date/time: 02-19-09

Duplicate sample collected (Y/N): NO Duplicate sample ID: NA

Split sample collected (Y/N): NO Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2 x 40mL VOA			
MEE		3 x 40mL VOA			
TOC		1 x 250 mL HDPE			
Anions		1 x 250 mL HDPE			
DHE		2 x 1 Liter Amber			

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107253

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: Area 47
Project Name/#: USACE - LHAAP
Weather: Overcast

Sampling location ID: LHS MW50
Sample ID: LHS MW50 021709
Collection Time/Date: 02-17-09 / 1334

Pump Installation

Pump installation crew: M. Martinez
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 30.20'
Initial (pre-installation) DTW/time: 24.25'
Final (after pump priming) DTW/time: 24.28
Free product (circle): ~~LNAPL / DNAPL~~
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: 02-17-09
Installation date/completion time: 02-17-09
Screen Interval (ft. BTOC): 20.00' to 30.00'
Pump intake depth (ft BTOC): 28.25'
Post-installation DTW/time: 24.20
Max. sustainable pump rate (mL/min): NA
Appearance of product: NA
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): No

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: M. Martinez
Purge date/beginning time: 02-17-09 1140
Initial (pre-purging) DTW (ft. BTOC): 24.28'
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): NA
Purge date/completion time: 02-17-09
Final (post-purging) DTW (ft. BTOC): 24.51
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	20								20
Refill Setting	10								10
Discharge Setting	5								5
Flow rate (mL/min)	170								170

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1153	24.46	170	1.5	14.44	3.403	6.52	92.5	1.46	204.3
1203	24.51	170	3.2	15.00	3.450	6.63	85.3	1.03	127.1
1208	24.51	170	4.05	15.19	3.453	6.63	82.9	0.98	118.3
1213	24.51	170	4.9	15.31	3.455	6.63	80.3	0.94	100.1
1218	24.51	170	5.75	15.56	3.460	6.64	79.2	0.90	94.9
1223	24.51	170	6.6	15.60	3.469	6.64	77.5	0.85	83.6
1228	24.51	170	7.45	15.74	3.469	6.65	74.3	0.83	73.2
1233	24.51	170	8.3	15.78	3.470	6.65	73.6	0.83	76.9

00107254

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

LHSMW50

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1238	24.51	170	9.15	15.96	3.468	6.65	72.1	0.80	63.8
1243	24.51	170	10.00	16.02	3.473	6.65	70.5	0.78	56.7
1248	24.51	170	10.85	16.10	3.477	6.66	67.5	0.76	52.1
1253	24.51	170	11.70	16.14	3.480	6.66	64.9	0.72	45.5
1258	24.51	170	12.55	16.20	3.483	6.67	62.1	0.69	39.3
1303	24.51	170	13.40	16.25	3.484	6.67	60.7	0.67	34.6
1308	24.51	170	14.25	16.24	3.484	6.67	59.1	0.66	30.4
1313	24.51	170	15.10	16.45	3.482	6.67	56.0	0.64	25.0
1318	24.51	170	15.95	16.50	3.485	6.68	55.2	0.63	23.2
1323	24.51	170	16.80	16.55	3.485	6.68	53.2	0.60	18.8
1328	24.51	170	17.45	16.58	3.496	6.68	52.2	0.58	15.0
1333	24.51	170	~~18.30~~	16.61	3.491	6.68	50.2	0.57	10.0
1334	Sampled								

Sampling

Sampling beginning time: 1334 Sampling completion time: 1352

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1358	24.51	170	21.90	16.74	3.495	6.69	49.5	0.67	6.0

Sample Information

Sample ID: LHS MW 50 021709

Sample collection date/time: 02-17-09

Duplicate sample collected (Y/N): NO

Duplicate sample ID: NA

Split sample collected (Y/N): NO

Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2 x 40mL VOA			
MEE		3 x 40mL VOA			
TOC		1 x 250mL HDPE			
Anions		1 x 250mL HDPE			
DHE		2 x 1 Liter Amber			

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107255

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Shaw

Operable Unit/Site ID: Area 47 | Sampling location ID:
Project Name/#: USACE-LHAAP | Sample ID: LHS MW 56
Weather: Clear Skies 55°F | Collection Time/Date: 02-19-09 / NS

Pump Installation

Pump installation crew: M. Martinez | Installation date/beginning time:
PID/FID reading (well head/background): | Installation date/completion time:
Casing diameter (inches): | Screen Interval (ft. BTOC): to
Total well Depth (ft. BTOC): 21-71 | Pump intake depth (ft BTOC):
Initial (pre-installation) DTW/time: 21.52/0755 | Post-installation DTW/time:
Final (after pump priming) DTW/time: | Max. sustainable pump rate (mL/min):
Free product (circle): LNAPL / DNAPL | Appearance of product:
Volume of water removed during priming (mL): | Discharge tube diameter (3/8" or 1/4"):
Discharge tube length (ft.): | Inlet reducer used (Y/N):

Pneumatic Controller Tuning:

Initial air pressure = H (ft) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: | PID/FID reading (well head/background)
Purge date/beginning time: | Purge date/completion time:
Initial (pre-purging) DTW (ft. BTOC) | Final (post-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA | No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:

Initial air pressure = H (ft) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

LHSMW56

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sampling

Sampling beginning time: NO Sample Sampling completion time: _____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID: _____ Sample collection date/time: _____

Duplicate sample collected (Y/N): _____ Duplicate sample ID: _____

Split sample collected (Y/N): _____ Split sample ID: _____

COC No(s) _____

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments: 021909 0857 Bailed well dry less than .25 gals

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107257

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: Area 47
Project Name/#: USACE - CHIAP
Weather:

Sampling location ID: LHS MW 57
Sample ID: LHS MW 57 022309
Collection Time/Date: 02-23-09 / 1001

Pump Installation

Pump installation crew: M. Martinez
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 17.25
Initial (pre-installation) DTW/time: 10.89
Final (after pump priming) DTW/time:
Free product (circle): ~~LNAPL / DNAPL~~
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: 022309 /
Installation date/completion time: 022309 /
Screen Interval (ft. BTOC): 7 to 17
Pump intake depth (ft BTOC): 15.50
Post-installation DTW/time: 10.76 / 0921
Max. sustainable pump rate (mL/min): NA
Appearance of product: NA
Discharge tube diameter (3/8" or 1/4"): 1/4
Inlet reducer used (Y/N): NO

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: M. Martinez
Purge date/beginning time: 02-23-09 / 0927
Initial (pre-purging) DTW (ft. BTOC): 10.76
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): NA
Purge date/completion time: 02-23-09 / 1015
Final (post-purging) DTW (ft. BTOC): 12.22
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	20	15							15
Refill Setting	12	13							13
Discharge Setting	3	2							2
Flow rate (mL/min)	170	100							100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
0930	11.00	170	2.0	14.16	0.211	8.22	113.0	7.53	352.7
0940	11.76	100	3.7	13.97	0.175	5.76	155.4	7.22	250.0
0945	11.91	100	4.2	13.76	0.173	5.57	154.9	7.22	237.1
0950	11.96	100	4.7	13.40	0.171	5.50	154.8	7.27	229.6
0955	12.01	100	5.2	13.30	0.170	5.45	140.4	7.29	232.9
1000	12.11	100	5.7	13.28	0.168	5.40	164.2	7.30	228.4
1001	Sample								

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

LHSMW57

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sampling

Sampling beginning time: 1001 Sampling completion time: 1002

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1005	11.22	100	0.2	13.31	0.148	5.40	166.5	7.35	231.4

Sample Information

Sample ID: LHS MW 57 022309 Sample collection date/time: 02/23/09 - 1001

Duplicate sample collected (Y/N): NO Duplicate sample ID: NA

Split sample collected (Y/N): NO Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2 x 40mL VOA			

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107259

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: Area 47
Project Name/#: USACE - LHAAP
Weather: Sunny 75°F

Sampling location ID: 47WW09
Sample ID: 47 WW09 021809
Collection Time/Date: 02-18-09 / 1216

Pump Installation

Pump installation crew: M. Martinez
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 41.05'
Initial (pre-installation) DTW/time: 22.21' / 1110
Final (after pump priming) DTW/time: 22.21
Free product (circle): ~~LNAPL~~ / ~~DNAPL~~
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: 02-18-09 / 1122
Installation date/completion time: 02-18-09 / 1123
Screen Interval (ft. BTOC): 31 to 41
Pump intake depth (ft BTOC): 36
Post-installation DTW/time: 22.21 / 1125
Max. sustainable pump rate (mL/min): NA
Appearance of product: NA
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): NO

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: M. Martinez
Purge date/beginning time: 02-18-09 / 1130
Initial (pre-purging) DTW (ft. BTOC): 22.21
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): NA
Purge date/completion time: 02-18-09
Final (post-purging) DTW (ft. BTOC): 25.45
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	22								22
Refill Setting	11								11
Discharge Setting	4								4
Flow rate (mL/min)	130								130

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1140	22.58	130	2.0	18.70	4.159	7.73	-167.2	1.84	-14.4
1150	23.18	130	3.3	18.60	4.150	7.38	-186.0	0.54	-19.8
1155	23.43	130	3.95	18.67	4.092	7.35	-187.6	0.47	-19.2
1200	23.60	130	4.6	18.67	4.084	7.34	-189.0	0.41	-19.2
1205	23.84	130	5.25	18.68	4.071	7.33	-190.0	0.32	-19.2
1210	24.05	130	5.90	18.73	4.065	7.33	-192.1	0.32	-19.3
1215	24.25	130	6.55	18.72	4.064	7.33	-193.1	0.31	-19.4
1216	Sample								

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47MW09

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sampling

Sampling beginning time: 1210 Sampling completion time: 1240

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1245	25.45	130	10.45	18.81	4.074	7.32	-198.1	0.28	19.1

Sample Information

Sample ID: 47MW09 021809 Sample collection date/time: 02-18-09

Duplicate sample collected (Y/N): NO Duplicate sample ID: NA

Split sample collected (Y/N): NO Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2 x 40mL VOA			
TOC		1 x 250mL HDPE			
MEE		3 x 40mL VOA			
Anions		1 x 250mL HDPE			
DHE		2 x 1 L. Amber			

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107261

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: USACE- LHAAP Site 47
Project Name/#: LHAAP
Weather: Overcast 50-55°F

Sampling location ID: 47WW13
Sample ID: 47WW13 090217MS
Collection Time/Date: 02-17-09 / 1006

Pump Installation

Pump installation crew: M. Martinez
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 19.95'
Initial (pre-installation) DTW/time: 10.18 / 0830
Final (after pump priming) DTW/time: 10.00
Free product (circle): ~~LNAPL / DNAPL~~
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: 02-17-09 / 0834
Installation date/completion time: 02-17-09 / 0835
Screen Interval (ft. BTOC): 9.95' to 19.95
Pump intake depth (ft BTOC): 15.00'
Post-installation DTW/time: 10.00 / 0839
Max. sustainable pump rate (mL/min): 150
Appearance of product: NA
Discharge tube diameter (3/8" or 1/4"): 1/4
Inlet reducer used (Y/N): NO

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: M. Martinez
Purge date/beginning time: 02-17-09 / 0841
Initial (pre-purging) DTW (ft. BTOC): 10.00
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): NA
Purge date/completion time: 02-17-09
Final (post-purging) DTW (ft. BTOC): 13.42
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	20	19							19
Refill Setting	10	12							12
Discharge Setting	5	3							3
Flow rate (mL/min)	280	150							150

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
0845	10.75	150	1.5	16.37	0.241	6.06	180.9	4.29	438.6
0855	11.05	150	3.0	15.19	0.228	5.77	230.5	4.82	377.6
0900	11.15	150	3.75	15.24	0.229	5.78	233.2	4.89	367.1
0905	11.21	150	4.50	14.98	0.228	5.78	244.6	5.09	339.1
0910	11.35	150	5.25	14.93	0.223	5.80	249.2	5.39	283.1
0915	11.51	150	6.00	14.83	0.215	5.82	273.2	5.82	220.9
0920	11.61	150	6.75	14.78	0.211	5.83	273.4	5.86	202.1
0925	11.69	150	7.50	14.79	0.212	5.83	268.2	5.83	196.9

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47MW13

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
0930	11.85	150	8.25	14.89	0.210	5.83	270.1	5.95	190.3
0935	12.00	150	9.00	15.09	0.207	5.84	272.4	6.01	185.1
0940	12.05	150	9.75	15.14	0.207	5.85	277.4	5.89	180.4
0945	12.20	150	10.50	15.23	0.205	5.84	277.1	5.83	185.7
0950	12.30	150	11.25	15.29	0.204	5.83	287.6	5.75	184.7
0955	12.40	150	12.00	15.46	0.203	5.82	297.1	5.63	184.4
1000	12.50	150	12.75	15.47	0.204	5.80	297.1	5.63	180.6
1005	13.01	150	13.50	15.48	0.204	5.77	297.5	5.61	179.3
1006	Sample								

Sampling

Sampling beginning time: 1006 Sampling completion time: 1036

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1041	13.42	150	18.0	15.38	0.200	5.73	291.9	5.53	181.1

Sample Information

Sample ID: 47 MW 13 021709

Sample collection date/time: 02-17-09 / 1006

Duplicate sample collected (Y/N): yes

Duplicate sample ID: 47MW13 021709 FD ~~0907 - Dup 1~~

Split sample collected (Y/N): no

Split sample ID:

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC's		4 x 40mL VOA's			
MEE		6 x 40 mL VOA			
TOC		2 x 250mL HDPE			
Anions		2 x 250mL HDPE			
DHE		2 x 1L Amber			

Comments: NO Dup taken for DHE. As per Jen Hoang.

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107263

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: Area 47
Project Name/#: USACE - LHAAP
Weather:
Sampling location ID: 47WW14
Sample ID: 47WW14 021909
Collection Time/Date: 0219-09 / 1201

Pump Installation

Pump installation crew: M. Martinez
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 51.40
Initial (pre-installation) DTW/time: 24.85
Final (after pump priming) DTW/time: 22.76
Free product (circle): ~~LNAPL / DNAPL~~
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA
Installation date/beginning time: 0219-09
Installation date/completion time: 0219-09
Screen Interval (ft. BTOC): 41 to 51
Pump intake depth (ft BTOC): 46
Post-installation DTW/time: 24.76
Max. sustainable pump rate (mL/min): NA
Appearance of product: NA
Discharge tube diameter (3/8" or (1/4")): 1/4"
Inlet reducer used (Y/N): NO

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = ___ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: M. Martinez
Purge date/beginning time: 02-19-09 / 1100
Initial (pre-purging) DTW (ft. BTOC): 22.76
Calculated tubing + pump volume: NA
PID/FID reading (well head/background): NA
Purge date/completion time: 02-19-09
Final (post-purging) DTW (ft. BTOC): 25.09
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = ___ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	30								30
Refill Setting	10								10
Discharge Setting	5								5
Flow rate (mL/min)	160								160

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1120	25.09	160	2.0	18.71	2.037	6.74	-16.2	0.96	-9.6
1130	25.09	160	3.6	18.98	2.036	6.72	-30.2	0.71	-9.6
1135	25.09	160	4.4	18.99	2.034	6.72	-31.1	0.64	-9.5
1140	25.09	160	5.2	19.00	2.033	6.72	-32.1	0.61	-9.5
1145	25.09	160	6.0	18.92	2.026	6.72	-35.5	0.57	-10.6
1150	25.09	160	6.8	18.96	2.016	6.72	-40.2	0.55	-10.9
1155	25.09	160	7.6	19.00	2.006	6.72	-43.2	0.54	-11.0
1200	25.09	160	8.4	19.06	2.004	6.72	-46.2	0.53	-11.8

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47MW14

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1201	Sample								

Sampling

Sampling beginning time: 1201 Sampling completion time: 1203

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1210	25.09	160	10	19.09	1.999	6.72	-40.1	0.50	-12.2

Sample Information

Sample ID: 47MW14021909

Sample collection date/time: 02/19-09 / 1201

Duplicate sample collected (Y/N): YES

Duplicate sample ID: 47MW14021909-FD

Split sample collected (Y/N): NO

Split sample ID: NA

COC No(s)

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs		4 x 40mL VOA			

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107265

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: Area 47
Project Name/#: USACE - CHHAP
Weather:
Sampling location ID: 47 GW 16
Sample ID:
Collection Time/Date: NS

Pump Installation

Pump installation crew: M. Martinez
PID/FID reading (well head/background):
Casing diameter (inches):
Total well Depth (ft. BTOC): 21.25'
Initial (pre-installation) DTW/time: 21.00'
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):
Installation date/beginning time:
Installation date/completion time:
Screen Interval (ft. BTOC):
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew:
Purge date/beginning time:
Initial (pre-purging) DTW (ft. BTOC)
Calculated tubing + pump volume: NA
PID/FID reading (well head/background):
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (m.v)	DO (mg/L)	Turbidity (NTU)

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47MW16

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sampling

Sampling beginning time: NO Sample Sampling completion time: _____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID: _____ Sample collection date/time: _____

Duplicate sample collected (Y/N): _____ Duplicate sample ID: _____

Split sample collected (Y/N): _____ Split sample ID: _____

COC No(s): _____

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107267

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: Area 47 | Sampling location ID: 47WW19
Project Name/#: USACE - LHAAP | Sample ID: 47WW19 021909
Weather: | Collection Time/Date: 0219-09 / 1343

Pump Installation

Pump installation crew: M. Martinez | Installation date/beginning time: 0219-09
PID/FID reading (well head/background): NA | Installation date/completion time: 0219-09
Casing diameter (inches): 4" | Screen Interval (ft. BTOC): 54 to 64
Total well Depth (ft. BTOC): 64.25 | Pump intake depth (ft BTOC): 59.00'
Initial (pre-installation) DTW/time: 21.71 | Post-installation DTW/time: 21.71
Final (after pump priming) DTW/time: 21.71 | Max. sustainable pump rate (mL/min): NA
Free product (circle): LNAPL / DNAPL | Appearance of product: NA
Volume of water removed during priming (mL): NA | Discharge tube diameter (3/8" or 1/4"): 1/4"
Discharge tube length (ft.): NA | Inlet reducer used (Y/N): NO

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = ____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: M. Martinez | PID/FID reading (well head/background): NA
Purge date/beginning time: 0219-09 / 1357 | Purge date/completion time: 0219-09 / 1415
Initial (pre-purging) DTW (ft. BTOC): 21.71 | Final (post-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA | No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = ____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	40								40
Refill Setting	12								12
Discharge Setting	8								8
Flow rate (mL/min)	190								190

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1302	21.81	190	2.0	19.24	3.200	6.73	-2.9	4.32	155.3
1312	21.81	190	3.9	18.90	3.525	6.14	-8.2	1.07	182.6
1317	21.81	190	4.85	18.92	3.549	6.09	-13.9	0.65	168.2
1322	21.81	190	5.8	18.87	3.554	6.08	-17.3	0.54	154.2
1327	21.81	190	6.75	18.82	3.556	6.07	-18.3	0.50	142.2
1332	21.81	190	7.7	18.82	3.559	6.07	-21.2	0.49	136.1
1337	21.81	190	8.65	18.79	3.559	6.06	-24.5	0.46	134.2
1342	21.81	190	9.6	18.74	3.556	6.05	-26.4	0.48	132.6

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47MW19

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sampling

Sampling beginning time: 1343 Sampling completion time 1345

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1345	21.81	190	10.17	18.74	3.557	6.06	-27.5	0.50	130.1

Sample Information

Sample ID: 47MW19 021909 Sample collection date/time: 02-19-09 / 1345

Duplicate sample collected (Y/N): NO Duplicate sample ID: NA

Split sample collected (Y/N): NO Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2 x 40mL VOA			

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

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GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: Area 47
Project Name/#: USACE - LHAAP
Weather: Sunny ~75°F

Sampling location ID: 47GW25
Sample ID: 47GW25
Collection Time/Date: /NS

Pump Installation

Pump installation crew: M. Martinez
PID/FID reading (well head/background):
Casing diameter (inches):
Total well Depth (ft. BTOC): 28.05
Initial (pre-installation) DTW/time: 27.42
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):

Installation date/beginning time:
Installation date/completion time:
Screen Interval (ft BTOC):
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew:
Purge date/beginning time:
Initial (pre-purging) DTW (ft. BTOC)
Calculated tubing + pump volume: NA

PID/FID reading (well head/background):
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mV)	DO (mg/L)	Turbidity (NTU)

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47MW25

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sampling

Sampling beginning time: NO Sample Sampling completion time:

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID: Sample collection date/time:

Duplicate sample collected (Y/N): Duplicate sample ID:

Split sample collected (Y/N): Split sample ID:

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107271

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: Area 47
Project Name/#: USACE - UHAAP
Weather:

Sampling location ID: 47 MW 34
Sample ID: 47 MW 34 022309
Collection Time/Date: 02-23-09 / 1326

Pump Installation

Pump installation crew: M. Martinez
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 46.20
Initial (pre-installation) DTW/time: 18.10
Final (after pump priming) DTW/time:
Free product (circle): ~~LNAPL / DNAPL~~
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: 02-23-09/
Installation date/completion time: 02-23-09/
Screen Interval (ft. BTOC): 36 to 46
Pump intake depth (ft BTOC): 41
Post-installation DTW/time: 18.10
Max. sustainable pump rate (mL/min): NA
Appearance of product: NA
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): NO

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: M. Martinez
Purge date/beginning time: 02-23-09 1247
Initial (pre-purging) DTW (ft. BTOC): 18.10
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): NA
Purge date/completion time: 02-23-09 / 1345
Final (post-purging) DTW (ft. BTOC): 19.00'
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	30								30
Refill Setting	12								12
Discharge Setting	3								3
Flow rate (mL/min)	130								130

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1250	18.80	130	2.0	18.31	1.244	7.11	13.2	2.22	-18.8
1300	19.00	130	3.3	18.44	1.245	6.97	-4.4	0.94	-19.9
1305	19.00	130	3.95	18.26	1.244	6.95	-13.3	0.71	-20.1
1310	19.00	130	4.6	18.05	1.242	6.92	-22.6	0.56	-20.1
1315	19.00	130	5.25	17.96	1.241	6.91	-27.0	0.53	-20.1
1320	19.00	130	5.90	17.93	1.240	6.91	-30.1	0.51	-20.1
1325	19.00	130	6.55	17.90	1.240	6.90	-34.5	0.50	-19.1
1326	Sample								

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47MW34

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sampling

Sampling beginning time: 1326 Sampling completion time: 1326

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1327	19.00	130	6.81	17.95	1239	6.90	-36.7	0.53	-19.5

Sample Information

Sample ID: 47MW34 022309

Sample collection date/time: 022309 / 1326

Duplicate sample collected (Y/N): NO

Duplicate sample ID: NA

Split sample collected (Y/N): NO

Split sample ID: NA

COC No(s):

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2 x 40mL VOA			

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

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GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: Longhorn MARC / 117591
Weather: clear

Sampling location ID: LHSMW56
Sample ID: LHSMW56-040309
Collection Time/Date: 12:50 4/3/09

Pump Installation

Pump installation crew: A. Willmore
PID/FID reading (well head/background): 0.0
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 23
Initial (pre-installation) DTW/time: 21.04
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): 26

Installation date/beginning time: 4.3.09 12:45
Installation date/completion time: 4.3.09 12:46
Screen Interval (ft. BTOC): 13 to 23
Pump intake depth (ft BTOC): 23
Post-installation DTW/time: 21.03
Max. sustainable pump rate (mL/min): 100
Appearance of product: None
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting				NA					
Flow rate (mL/min)									

Purging

Purging/sampling crew: A. Willmore
Purge date/beginning time: 4.3.09 12:50
Initial (pre-purging) DTW (ft. BTOC): 21.03
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.0
Purge date/completion time: 4.3.09 12:55
Final (post-purging) DTW (ft. BTOC): dry
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting				NA					
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
				Purged		Dry			

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

LHSMW56

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ± 10%	±3% Electrical Conductivity (uMhos/cm)	pH ± 0.1	Eh (mv) ± 10	DO (mg/L) ± 10%	Turbidity (NTU) ± 10% 10/20

4/3/09

Sampling

Sampling beginning time: 12:50 Sampling completion time: 12:50

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
	Insufficient water for field parameters								

Sample Information

Sample ID: LHSmw56-040309
Sample collection date/time: 12:50
Duplicate sample collected (Y/N): N
Duplicate sample ID: NA
Split sample collected (Y/N): N
Split sample ID: NA
COC No(s): NA

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs	8260	3-40 mL voa vials			
Perchlorate	300	1-250 mL HDPE			

Comments: Purged & Sampled w/Peristaltic pump. dry

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

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GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP-47
Project Name/#: Longhorn MARC / 117591
Weather: clear;

Sampling location ID: 47WW28
Sample ID: 47WW28-040309
Collection Time/Date: 10:55 4.03.09

Pump Installation

Pump installation crew: A. Willmore
PID/FID reading (well head/background): 0.3
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 29
Initial (pre-installation) DTW/time: 27.56
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): 33

Installation date/beginning time: 4.3.09 10:50
Installation date/completion time: 4.3.09 10:50
Screen Interval (ft. BTOC): 19 to 29
Pump intake depth (ft BTOC): ~29
Post-installation DTW/time: 27.52
Max. sustainable pump rate (mL/min): 100
Appearance of product: None
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting				NA					
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: A. Willmore
Purge date/beginning time: 4.3.09 10:55
Initial (pre-purging) DTW (ft. BTOC): 27.52
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): 0.3
Purge date/completion time: 4.3.09 11:00
Final (post-purging) DTW (ft. BTOC): dry
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting				NA					
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Purged Dry

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47WW25

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C) ± 10%	±3% Electrical Conductivity (uMhos/cm)	pH ± 0.1	Eh (mv) ± 10	DO (mg/L) ± 10%	Turbidity (NTU) ± 10% 10/20
					4/3/09				

Sampling

Sampling beginning time: 10:55 Sampling completion time: 11:00

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
			INSufficient	H2O for	field	parameters			

Sample Information

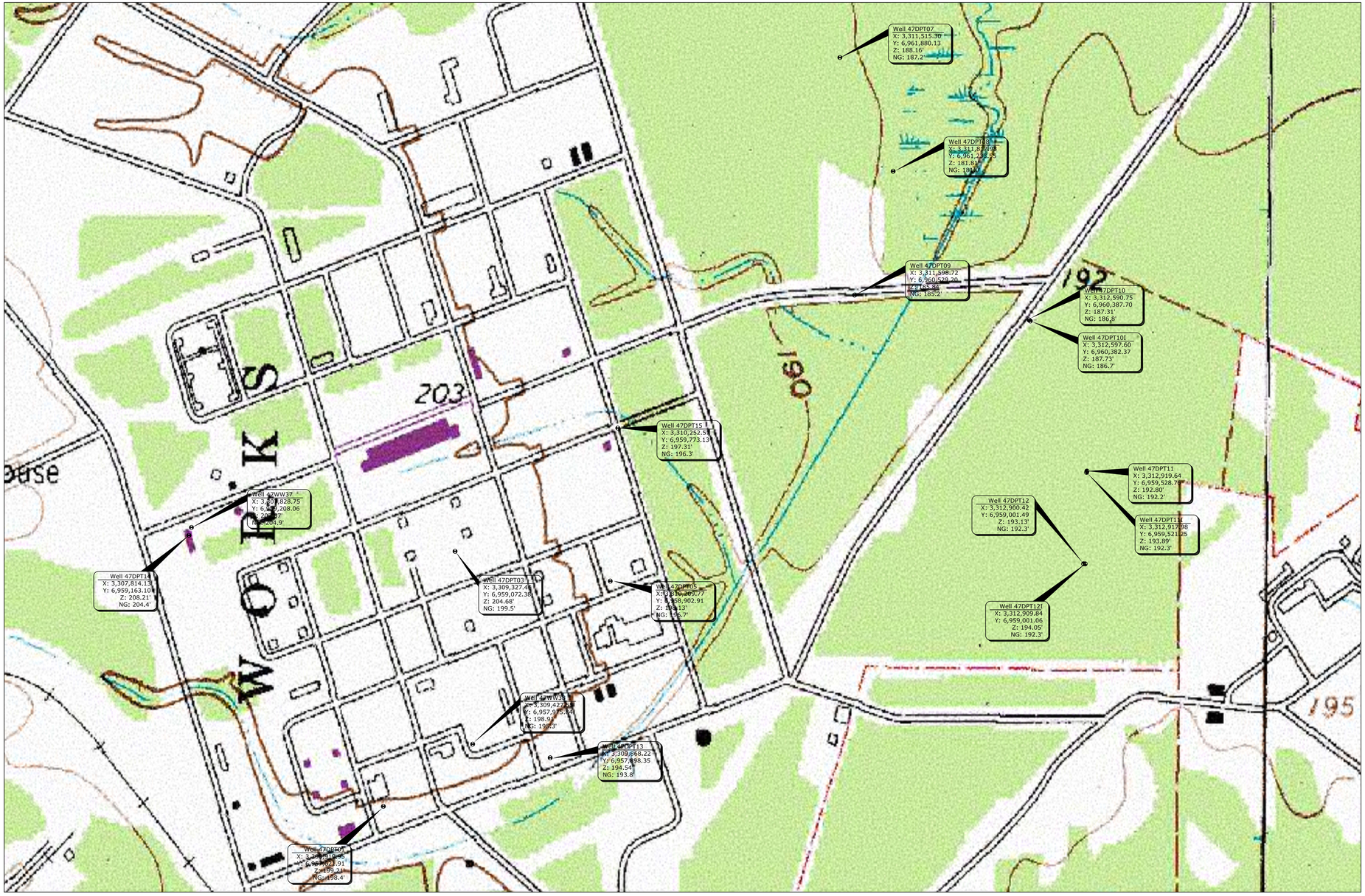
Sample ID: 47ww25-040309
Duplicate sample collected (Y/N): N
Split sample collected (Y/N): N
COC No(s): NA

Sample collection date/time: 4.3.09 10:55
Duplicate sample ID: NA
Split sample ID: NA

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOCs	8260	3- 40 mL vaa vials			
Perchlorate	300	1-250 mL HDPE			

Comments: Purged dry ! Sampled w/ Peristaltic pump.

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter



NOTES:

1. HORIZONTAL COORDINATES ARE BASED ON GPS SOLUTIONS BASED ON THE "NATIONAL SPATIAL REFERENCE SYSTEM" (NSRS) USING BY THE "ONLINE POSITIONING USER SERVICE" (OPUS) SERVICE PROVIDED BY THE NATIONAL GEODETIC SURVEY" (NGS) ALL COORDINATES SHOWN ARE BASED ON THE "TEXAS STATE PLANE COORDINATE SYSTEM, NORTH CENTRAL ZONE (4202), NORTH AMERICAN DATUM (NAD) 1983. THE STATIC GPS OBSERVATIONS FOR CONTROL POINTS WERE OBTAINED OCT. 15, 2010.

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DH3772	TXMA MARSHALL TX CORS ARP	N323207.125	W0941719.082	21194.1
DG7396	SHRV SHREVEPORT CORS ARP	N322539.651	W0934216.664	49553.2
DH7103	ARHP HOPE CORS ARP	N334145.778	W0933601.957	123472.3
DG5394	TXTY TYLER CORS ARP	N321458.597	W0952336.968	127091.3
DL3492	TXCR CLARKSVILLE CORS ARP	N333639.319	W0950418.556	134985.1
DL8637	LTEC LTEC 285 CORS ARP	N323100.147	W0923911.724	140770.3
DH7101	ARCN CAMDEN CORS ARP	N333232.635	W0925257.804	151451.8
DH3616	TXPA PARIS CORS ARP	N334027.228	W0953325.257	172114.8
DF7048	LESV LEESVILLE CORS ARP	N310832.877	W0931608.243	189315.5

2. ELEVATIONS SHOWN HEREON ARE BASED ON ELEVATIONS TRANSFERRED FROM ELEVATION MARKS ON EXISTING (NEARBY) WELLS. ELEVATIONS FOR THESE NEARBY WELLS WERE PROVIDED BY SHAW ENVIRONMENTAL.

3. DUE TO GPS COVERAGE ISSUES, THE HORIZONTAL ACCURACY OF PROPOSED WELL 47DPT07 DID NOT YEILD "SURVEY GRADE" TOLERANCES. THE HORIZONTAL LOCATION OF THIS WELL MAY BE IN ERROR BY SEVERAL FEET. THE ELEVATION OF THIS WELL IS ACCURATE AND WITHIN TOLERANCES.

REVISED 11/1/2010: ADD WELLS 04WW04 & 04WW05
REVISED 11/185/2010: CORRECTION OF CONVERSION ERROR.

STATE OF TEXAS
REGISTERED
ROBERT A. MARLOWE
4218
PROFESSIONAL
LAND SURVEYOR

THE UNDERSIGNED HEREBY CERTIFIES THAT THIS SURVEY WAS MADE ON THE GROUND UNDER MY SUPERVISION, AND THAT THIS PLOT REPRESENTS THE FACTS AS FOUND AT THE TIME OF THE SURVEY.

SIGNED:
ROBERT A. MARLOWE
REGISTERED PROFESSIONAL LAND SURVEYOR NO 4218

TETRA
3601 Welch Street
Houston, Texas 77006
(P) 713-462-6300 (F) 713-462-3003
E-Mail: Survey@TSATX.com
www.TSATX.com

CLIENT: SHAW ENVIRONMENTAL

ADDRESS: LONGHORN ARMY AMMUNITION PLANT
KARNACK, TX

SCALE:	DATE:	DRAWN:
1"=300'	10-27-10	RGH

G.F. NUMBER –
EFFECTIVE –

JOB NO. 0910-057

LOT: –	BLOCK: –

SUBDIVISION
LONGHORN ARMY AMMUNITION PLANT

RECORDING
VOL: NA PG: NA M.R.H.C.T.

SURVEY & ABSTRACT
H. MARTIN, A-448 & JC HAWLEY, A-324

CITY	COUNTY	STATE
KARNACK	HARRISON	TEXAS

Table of Groundwater Elevations						
Zone	Date	Location	Measuring Point	Depth to Water	Groundwater Elevation	Presented on Figure
SHALLOW	12/2/07	105	199.41	20.25	179.16	Figure 1-4
SHALLOW	12/2/07	08WW01	199.31	17.49	181.82	Figure 1-4
SHALLOW	12/2/07	08WW02	200.29	-	dry	Figure 1-4
SHALLOW	12/1/07	35BWW01	202.88	18.24	184.64	Figure 1-4
SHALLOW	12/1/07	35BWW02	203.95	-	dry	Figure 1-4
SHALLOW	12/1/07	35BWW04	202.57	20.53	182.04	Figure 1-4
SHALLOW	12/1/07	35BWW05	203.04	20.82	182.22	Figure 1-4
SHALLOW	12/1/07	35BWW07	203.53	22.84	180.69	Figure 1-4
SHALLOW	12/1/07	35BWW08	204.12	21.59	182.53	Figure 1-4
SHALLOW	11/30/07	47WW01	194.40	19.12	175.28	Figure 1-4
SHALLOW	12/1/07	47WW02	197.23	19.76	177.47	Figure 1-4
SHALLOW	12/1/07	47WW03	195.24	20.15	175.09	Figure 1-4
SHALLOW	11/30/07	47WW04	190.90	15.80	175.10	Figure 1-4
SHALLOW	11/30/07	47WW05	198.55	20.78	177.77	Figure 1-4
SHALLOW - INTERMEDIATE	11/30/07	47WW06	199.02	21.27	177.75	Figure 1-4
SHALLOW	11/29/07	47WW08	199.45	-	dry	Figure 1-4
SHALLOW - INTERMEDIATE	11/30/07	47WW09	201.04	21.37	179.67	Figure 1-4
SHALLOW	11/30/07	47WW11	199.14	21.95	177.19	Figure 1-4
SHALLOW	11/30/07	47WW12	202.27	-	dry	Figure 1-4
SHALLOW - INTERMEDIATE	12/1/07	47WW14	205.00	23.75	181.25	Figure 1-4
SHALLOW	12/1/07	47WW16	203.73	-	dry	Figure 1-4
SHALLOW	12/1/07	47WW17	201.76	-	dry	Figure 1-4
SHALLOW	11/30/07	47WW18	199.69	21.86	177.83	Figure 1-4
SHALLOW	12/1/07	47WW21	187.59	14.75	172.84	Figure 1-4
SHALLOW	11/29/07	47WW22	195.62	21.83	173.79	Figure 1-4
SHALLOW	12/1/07	47WW24	207.90	-	dry	Figure 1-4
SHALLOW	12/1/07	47WW25	208.53	26.94	181.59	Figure 1-4
SHALLOW	12/1/07	47WW26	203.99	-	dry	Figure 1-4
SHALLOW	12/1/07	47WW27	200.97	20.24	180.73	Figure 1-4
SHALLOW	12/1/07	47WW28	194.43	19.00	175.43	Figure 1-4
SHALLOW	11/30/07	47WW30	197.12	21.50	175.62	Figure 1-4
SHALLOW	12/1/07	50WW01	198.50	18.14	180.36	Figure 1-4
SHALLOW	12/1/07	50WW02	200.74	20.69	180.05	Figure 1-4
SHALLOW	12/1/07	50WW03	202.94	21.57	181.37	Figure 1-4
SHALLOW	12/1/07	50WW04	204.51	-	dry	Figure 1-4
SHALLOW	12/1/07	50WW05	197.68	18.67	179.01	Figure 1-4
SHALLOW	12/2/07	67WW01	200.89	23.96	176.93	Figure 1-4
SHALLOW	12/2/07	67WW02	199.79	22.61	177.18	Figure 1-4
SHALLOW	12/2/07	67WW03	200.19	23.28	176.91	Figure 1-4
SHALLOW	12/2/07	67WW05	201.00	23.23	177.77	Figure 1-4
SHALLOW	12/2/07	67WW07	200.84	23.97	176.87	Figure 1-4
SHALLOW	12/2/07	LHSMW26	204.72	26.37	178.35	Figure 1-4
SHALLOW	12/1/07	LHSMW27	202.10	-	dry	Figure 1-4
SHALLOW	12/1/07	LHSMW28	205.52	-	dry	Figure 1-4
SHALLOW	12/1/07	LHSMW29	203.24	-	dry	Figure 1-4
SHALLOW	12/1/07	LHSMW30	203.74	-	dry	Figure 1-4
SHALLOW	12/1/07	LHSMW31	201.03	22.37	178.66	Figure 1-4
SHALLOW	12/1/07	LHSMW32	200.18	-	dry	Figure 1-4
SHALLOW	12/1/07	LHSMW33	199.39	-	dry	Figure 1-4
SHALLOW	12/1/07	LHSMW34	198.59	21.25	177.34	Figure 1-4
SHALLOW	12/1/07	LHSMW35	198.37	21.31	177.06	Figure 1-4
SHALLOW	12/1/07	LHSMW36	196.53	20.26	176.27	Figure 1-4
SHALLOW	12/1/07	LHSMW37	195.18	19.63	175.55	Figure 1-4
SHALLOW - INTERMEDIATE	12/1/07	LHSMW38	200.84	22.50	178.34	Figure 1-4
SHALLOW	11/30/07	LHSMW39	198.71	-	dry	Figure 1-4
SHALLOW	11/30/07	LHSMW40	199.99	-	dry	Figure 1-4
SHALLOW - INTERMEDIATE	11/30/07	LHSMW41	199.85	21.50	178.35	Figure 1-4

Table of Groundwater Elevations

Zone	Date	Location	Measuring Point	Depth to Water	Groundwater Elevation	Presented on Figure
SHALLOW	11/30/07	LHSMW42	200.29	21.23	179.06	Figure 1-4
SHALLOW	12/1/07	LHSMW43	200.26	20.73	179.53	Figure 1-4
SHALLOW	11/30/07	LHSMW44	200.36	20.85	179.51	Figure 1-4
SHALLOW	12/1/07	LHSMW45	201.39	21.34	180.05	Figure 1-4
SHALLOW	12/1/07	LHSMW46	201.72	-	dry	Figure 1-4
SHALLOW	12/1/07	LHSMW47	200.54	-	dry	Figure 1-4
SHALLOW	12/1/07	LHSMW48	202.06	-	dry	Figure 1-4
SHALLOW	12/1/07	LHSMW49	201.74	-	dry	Figure 1-4
SHALLOW	12/1/07	LHSMW50	205.17	23.46	181.71	Figure 1-4
SHALLOW	12/1/07	LHSMW51	208.50	-	dry	Figure 1-4
SHALLOW	12/1/07	LHSMW52	205.91	24.46	181.45	Figure 1-4
SHALLOW	12/1/07	LHSMW53	197.61	-	dry	Figure 1-4
SHALLOW	11/30/07	LHSMW55	199.76	-	dry	Figure 1-4
SHALLOW	11/30/07	LHSMW56	198.59	21.30	177.29	Figure 1-4
SHALLOW	11/30/07	LHSMW57	200.53	-	dry	Figure 1-4
SHALLOW	12/1/07	LHSMW58	203.56	22.41	181.15	Figure 1-4
SHALLOW - INTERMEDIATE	12/1/07	LHSMW60	199.28	19.01	180.27	Figure 1-4
SHALLOW	11/30/07	47WW13	204.97	11.83	193.14	-
SHALLOW - INTERMEDIATE	12/1/07	47WW23	197.86	12.61	185.25	-
INTERMEDIATE	12/1/07	35BWW03	203.56	24.46	179.10	
INTERMEDIATE	12/1/07	35BWW06	202.11	20.01	182.10	
INTERMEDIATE	11/30/07	47WW19	198.93	21.31	177.62	
INTERMEDIATE	12/1/07	47WW29	194.08	17.60	176.48	
SHALLOW - INTERMEDIATE	11/30/07	47WW31	196.94	21.40	175.54	
SHALLOW - INTERMEDIATE	11/30/07	47WW32	193.82	21.75	172.07	
SHALLOW	12/2/07	67WW04	203.76	-	dry	
INTERMEDIATE	12/2/07	67WW06	200.81	23.96	176.85	
INTERMEDIATE	12/1/07	LHSMW54	193.71	16.30	177.41	
INTERMEDIATE	4/3/08	35BWW03	203.56	25.20	178.36	Figure 1-5
INTERMEDIATE	4/3/08	35BWW06	202.11	19.49	182.62	Figure 1-5
SHALLOW - INTERMEDIATE	4/3/08	47WW06	199.02	21.22	177.80	Figure 1-5
SHALLOW - INTERMEDIATE	4/3/08	47WW09	201.04	21.40	179.64	Figure 1-5
SHALLOW - INTERMEDIATE	4/3/08	47WW14	205.00	23.55	181.45	Figure 1-5
INTERMEDIATE	4/3/08	47WW19	198.93	20.60	178.33	Figure 1-5
INTERMEDIATE	4/3/08	47WW29	194.08	17.13	176.95	Figure 1-5
SHALLOW - INTERMEDIATE	4/3/08	47WW31	196.94	21.27	175.67	Figure 1-5
INTERMEDIATE	4/3/08	47WW34	191.43	17.15	174.28	Figure 1-5
INTERMEDIATE	4/3/08	48WW01	193.24	22.63	170.61	Figure 1-5
INTERMEDIATE	4/3/08	67WW06	200.81	23.27	177.54	Figure 1-5
INTERMEDIATE	4/3/08	LHSMW54	193.71	14.80	178.91	Figure 1-5
DEEP	11/30/07	47WW07	199.24	22.75	176.49	Figure 1-6
DEEP	12/1/07	47WW15	205.17	26.55	178.62	Figure 1-6
DEEP	11/30/07	47WW20	198.78	21.15	177.63	Figure 1-6

Note:

Elevations at 47WW13 and 47WW23 were not used in Figure 1-4.

ID	Date	0-2	(2-4)	GW/VZ	(GW/VZ)	Int
17EXCO3SB02	09/15/10	1405	1410	1425	9-10	DUP 04
*7EXCO2SB01	09/16/10	1500	1505	1510	4.25-5.25	
*7EXCO1SB01	9/16/10	~~0955~~ 1100	1105	1110	(6-8)	
7EXCO1SB03	9/16/10	0950	NA ~~0955~~	0955 DUP 03	(2-4)	
7EXCO1SB04	9/16/10	0925 TOOK DUP 17-DUP01	0930	0935 17 DUP 02 MS/MSD	(5-7)	
7EXCO2SB04	9/16/10	0830	~~0835~~	0835 MS/MSD	(2-3)	
7EXCO3SB05	09/15	1425	1430	1435		DUP20
17EXCO3SB04	09/15	1400	1405	1410	8.5-9.5	
17EXCO2SB05	9/16/10	~~0855~~ 0900	~~0900~~ 0905	0910 DUP 04	(9-10)	
17EXCO3SB06	09/15	1340	1345	1350	(5-6)	
17EXCO3SB07	09/15	1320	1325	1330	(5-6)	
7EXCO1SB02	9/16/10	1046	1045	1050 TOOK 17 DUP 05 MS/MSD	(4-6)	
7EXCO2SB03		See page 20.				
*7EXCO3SB01		See page 20.				
7EXCO3SB02		See page 20.				
7EXCO3SB03		See page 20.				
~~2EXCO3SB04~~						
7EXCO2SB06		See page 20.				
7EXSO3SB08		See page 20.				
**7SB-D0	~~9/16/10~~	~~1535~~ 1330	~~1340~~ 1335	1340 DUP06	(12.5-13.5)	
**7SB-E1	9/16/10	~~1405~~ 1410	1415 DUP07	~~1420~~ DUP07 1420	(4-6)	
**7SB-C0	9/16/10	1425	1455 DUP09	1435 DUP08	(9-10)	

**- Perchlorate only!

* S. Oller MUST complete table, A. Wellmore RECEIVED NOTE 9/16/10.

All locations sampled and analyzed for explosives

** Sample Location sampled and analyzed for explosives AND Perchl.

09/02/10 LHAAP-47 20

0630 Arrive on-site. Drillers will be late. Looking for parts to make drill pass to rig. 0830 Drillers on-site and rig repairs started 1035 Driller, Jeremy Rainey has touched a screw on the muffler of rig. Treated w/ first aid. Reported to Ray Everitt. 12:00 Spoke w/ Shawn Swisdak and Jim Joyce concerning injury. Will have drillers complete JSA, HARP and discuss care of wound w/ Jeremy. 1245 Arrive at 47DPT101 to begin set up. 1310 Spoke w/ J. Swisdak concerning well. Drilling has reached 55'. Still in bearing sand. Will set up at 65' per his

9/16/10 Pre-Remediation Investigation @ 17 Weather: clear

0630 - Arrived @ site

0645 - Performed tailgate H&S meeting.

0715 - Began reviewin Susan Olker's notes and logs for continuation of work.

0740 - E-mails from Robert Duffield requests that 3 add'l samples be collected from LHAAP-17 & 18 add'l samples be collected from LHAAP-47.

0830 - Began advancing boring @ 17EXC02SB04, See boring log for details for all borings.

0855 - Began advancing boring @ 17EXC02SB05.

0915 - Due to standing water, relocated Boring 17EXC01SB01 12' away from 17EXC01SB04 (to North), bisecting 17EXC01SB01 & 03.

* See boring logs for time of DPT advancement.

(Continued from previous page).

1530 - Began preparing samples for shipment.

1710 - LEFT SITE.

9/16/10

00107281

9/17/10 Pre-Remediation Sampling @ LHAAP-47

0730 - Arrived @ site.

0830 - Began advancing 475B-J5

0920 - Began advancing 475B-H4

0950 - Began advancing 475B-H6

10:35 - Began advancing 475B-H7

11:25 - Began advancing 475B-H8

1200 - Went to plant to prep samples for shipping.

1400 - Left Site.

9/17/10

00107282

08/10/2010 LHAAP-47
Clear, hot humid, heat index ~103-105
08:40 Meet drillers at GWTP. Tailgate Safety & JSA. Gather supplies and discuss work
11:00 Arrive @ 47DPT03 and began set up.
11:30 Start hand auger.
12:40 auguring complete Begin rig set up
13:10 Drilling started
15:30 Drilling complete
16:00 Left site for day

08/10/2010

Alla

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08/11/2010 LHAAP-47 Alla
Clear, hot, humid, heat index ~103-105
08:30 Arrive @ GWTP to meets drillers. Tailgate safety / JSA
09:05 Set up at 47DPT03 to push 5 ft more as instructed by Kay Everett.
10:00 Additional push complete. No water past originally noted zone. PID = 0.0
10:15 Start setting temp. well per instructions from Kay Everett.
10:45 Well complete. Attempted water level reading - no water.
11:00 Start decon & move to next location
12:30 Set up on 47DPT04
13:00 Set up complete. Start ~~Alla~~ hand augering. Soil is very hard. Is taking an unusually long time

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08/11/2010
to complete.
1400 Hand auguring complete. Drilling started
1600 Set well at 35' w/ screen 20-30'
1630 Arrive @ 47DPT02 and begin set up.
1715 Hand auguring complete. Start drilling
1830 Well complete. Set at 25 w/ screen 15-25'.
1900 Left site for the day

08/11/2010

Allen

75

08/12/2010 Allen
Clear, hot, humid, heat index ~103-105
0630 Arrive at GWTP to meet drillers. Tailgate safety/JSA
0700 Arrive @ LHAAP ~~to~~ 47 Allen to gather supplies and organize for the day.
0800 Rig is down. Jason New, driller, will go to Marshall for part.
0830 Sampled 47DPT04 per instruction from Kay Everett (could not purge due to slow recharge and low water level)
0900 Sampled 47DPT02
0945 Took samples to GWTP
1020 Drillers back w/ part
1100 Rig is mobile
1210 Returned to purge wells
47DPT02
47DPT04

76

Date	Well ID	Water Level	Sample collect	Time
08/12/10	47DPT03	21.4		
08/12/10	47DPT02	21.08	VOC	0900
08/12/10	47DPT04	23.3	VOC Perchlorate	0830

1220 Start hand augering
1320 augering finished
1400 finished well
moved to 47DPT06
1430 started augering
1530 began drilling
1630 well complete
1645 move to 47DPT01
1710 set up & began augering
1810 Start drilling
1835 stopped drilling due to equipment overheat.
1900 Left site for the day

08/12/2010

77

08/13/2010 LHAAP-47 (Alk)
Clear hot (102 expected high temp w/ heat index @ 105 - 110, dry
0630 Arrive ~~at~~ at GWTP
0715 Set well 47DPT01 @ 19.5
0730 Returned to GWTP to gather more supplies & to go over work site. Had discussion w/ Ray Everett concerning location and sampling.
10:30 Moved to Building 25D. Area has now been cleared. Boring locations were marked
11.15 Returned to 47DPT04, 47DPT02, 47DPT06 ~~plat~~ pulled wells and grouted openings.
12:30 Started Soil Sampling @ 475B-25D-02
1330 Due to need to ship samples today sampling was stopped

78

00107286

08/12/2010
Sample 47SB-25D-02
GW/VZ ~~was~~ Shipped
~~dec~~ dec

Equipment was deconed and site was cleared up.
14:30 Unloaded supplies finished paperwork
1500 Off Site for the day.

08/12/2010

08/13/2010 LHAAP-47 (25D)
Clear, hot (101°) w/ heat index 105-110 humid
0630 Arrive on-site. Tailgate safety/JSA.
0700 Set well @ 47DPT01 @ 19.5'.
0730 Waiting for clearing at (25D). Returned to GWTP to gather new supplies, dump decon water, gather incoming paperwork & to make calls to office.
10:30 Return to 25D to mark sample location
11:30 Returned to original drilling locations to pull temp wells 47DPT02, 47DPT04 and 47DPT06. Made sure wells were sealed w/ ~~bb~~ 10% bentonite.
12:30 Started drilling & sampling 47SB-25D-02
13:30 Broke down site deconed equipment, loaded supplies

00107287

08/13/10 LHAAP-47(25D)
14:30 Completed daily paperwork
15:00 Left site for the day

08/13/2010

Allen

08/16/2010 LHAAP-47(25D)
Allen
Clear, hot (97-100) w/ heat index of 102-105 humid.
0630 Arrive on-site. Tailgate Safety/JSA. Gather supplies
0700 Arrive at boring location @ LHAAP-47(25D) and began set up.
0735 Began drilling and sampling at 47SB-25D-01
0940 moved rig to 47SB-25D-03
0950 Began drilling and sampling at 47SB-25D-03
1145 transported samples to GWTP due to heat.
1200 Began drilling & sampling 47SB-25D-04
1300 Began drilling & sampling 47SB-25D-05
1330 transported samples to GWTP. Met w/ new drilling team, ETT.
Reviewed HASP/plan.

08/16/10 LHAAP-47
Did site inspection
Located a drop area
for equipment.
16:30 Off-site for day

08/16/10

Allen

Clear, hot (101) (Allen)
08/17/10 Sunday LHAAP-47 (250)
06:30 Arrive on-site. Tail-
gate Safety & JSA. Discuss
plans for drilling.
Gather supplies.
07:30 Arrive at drilling
location - LHAAP-47 (250)
and start set up
next to well LHS-MW60.
08:20 Began drilling
LHS-MW60 - DTB = 29.40 ~~19.4~~
09:25 Have reached 30' w/
drilling. Will stop
until casing (isolation)
can be set.
09:30 Graves, Driver, Dixon
Watson and Tony Everett
came by drilling site.
Examined boring. Measured
depth to water as 19.01.
(LHS-MW60). Marked low
line.
10:00 Visitors left site. Drillers
went to decon equipment
and to exchange for more
equipment. Will cover 1st

Allen

08/17/2010
Mobe to productive
covering to protect boring
1120 Arrived at site for
well 47WW38 Allen
~~DTW~~
~~DTB~~
Allen
well measure 47WW25
DTW - 0.00 (dry)
DTB - 29.01
11:30 Began set up
~~12:20~~ 13:20 per Drilling is complete
to 30'. Crew will clean
up and load equipment
14:20 moving to LHAAP-04
for set up to start drilling.
15:10 started drilling. Per
instructions from Nisa
Millmore will not log
just twelve feet of well with
due to backfill put in
place during shaw excavation
activities.
1630 Drilling complete. Well
Set well at 17-18 ft. Well
verify w/ Allen Millmore
85

1700 Off site for the day

08/17/10

Allen

20

Clear, very hot in humidity (100) (Allen)
08/18/2010 LHAAP-05
0630 Arrive at EWTP to meet drillers. Tailgate Safety / JSA. Gather Supplies
0730 Return to well 04WW05. Began backfill to set.
09:30 Well complete.
10:00 Marked Record well location 04WW05. Moved rig and began drilling.
12:30 Work stopped due to weather (thunder/lightning)
14:15 Weather has cleared enough to return to work.
14:50 Boring complete. Setting well.
15:30 Paul Brunckie and Kerr Still stopped by site to observe operations
16:00 Well is complete. Sand and casing to be installed by ETTL on Friday 08/20/10

87

14:30 Off-site for the day

08/18/10

Allen

88

00107291

Clear, humid, hot 100 w/ Heat Index 105-107
08/19/2010 LHAAP-47
0630 Arrive on-site. Tailgate Safety / JSA at GWTP. Gather supplies.
0700 Arrive at LHAAP-47 to measure distance between existing well and new boring. LHSMW-60 and 47WW37 are 10.5' apart. 47WW25 and 47WW38 are 28.7' apart.
0730 Drillers begin set up at boring to set well ~~casing~~ screen (isolation) 47WW37
0835 Casing for ~~47WW38~~ (deep) will be set @ 30'.
47WW25 = 29.01'
12:15 Drilling has stopped because roll off boxes have not arrived. Contacting office for assistance
15:30 Roll off boxes delivered and set up.
16:30 Left site for the day.

08/19/20[illegible]

Allen

89

Clear, hot, humid (RCA) 100
08/20/2010 LHAAP-47
0630 Arrive on site. Tailgate Safety / JSA @ GWTP.
0700 Arrive at drilling location ~~(deep) 47WW37~~ ~~47WW37~~ to resume work.
0920 Paul Bruinicks stopped by site to observe work.
1305 Casing is set. Returning to GWTP to decon.
1430 Arrive at well 47WW38 and begin set up for drilling
18:30 Casing is set. Decon & clean up started
19.00 Left site for the day

08/20/2010

Allen

90

Clear, humid, 96 (Index 105-108)

08/23/2010 LHAAP-47

0630 Arrive on-site. Tailgate safety/JSA @ GWTP w/ drillers. Gather supplies

0700 Arrive @ 47WW38 to resume work

0900 pumps used for clean up are down. Crew will proceed by hand.

0925 Driller, Jonny Cook arrived at site to complete and develop well pair @ site LHAAP-04.

10:45 Started drilling in intermediate zone

17:00 Collected mud box samples. Start of mud rotary after complete decon of equipment

17:50 Reached clay layer. Due to weather stoppage work. Going to GWTP for water

18:00 Left site for day

08/23/10

Allen

91

Clear, hot (99) some humidity

08/24/10 LHAAP-47

0630 Arrive @ Site. Tailgate safety/JSA. Gather supplies Called to office

0715 Arrive at 47WW38 and resume drilling.

0745 Rig down -

0805 Rig must go back to office for repairs. Crew will contact me when starting back to site.

1300 Drillers have returned and began set up of new rig.

1430 Drilling complete & well is set @ 54' w/ 0' screen.

1450 Decon'ing equipment

1700 Arrive @ ~~47~~ 47WW38 and begin set up

1730 During set up, a dead bat was found in isolation casing. Animal was removed at the end of a saw. No one physically handled the animal

Allen

92

00107293

08/24/10
17:20 We continue set up and then start drilling tomorrow.
1800 Left for the day.

08/24/10

93

Cool (65) cloudy, dry, warmer (93)

08/25/10 LHAAP-47

0630 Arrived at GWTP, Jail-gate safety / JSA.
0700 Arrived at LHAAP-04 to check wells & GPS (drills)
0730 Arrived at LHAAP-47 and resume well installation
0830 Sampled mud box for VOC and perchlorate.
1600 Well is complete. Will begin decon & breakdown.
17:20 Arrived at 47WW38 to start grouting well.
18:30 Grouting of 47WW38 complete. Moving to 47WW37 to start grouting process.

94

8/16/10 Weather clear 3

PRE-REMEDIATION INVESTIGATION DPT @ 90s

47

1330- ARRIVED @ SITE.

1415- MET SUSAN OLLER

1420- LOADED MAPS FROM E-MAIL (SITE 47 + 17)

1510- Spoke with Robert Duffield @ sampling + drilling strategy, said temp wells will be set @ 47 DPTs, no soil sampling for permanent wells @ 04 & 47.

1605- R. Wagner began clearing and locating 47DPT11, showed GRI next days location.

1800- Left Site.

8/16/10

4 8/17/10

Weather: clear to p/ly cloudy. 90s.

PRE-REMEDIATION INVESTIGATION DPT @ 47

0600 - Arrived @ site.

0630 - Performed Tailgate H&S meeting w/ GRI & ETTL & Shaw.

Personnel:

Shaw	GRI	ETTL
Susan Oller	Jason Mew	Billy Ragon
Allen Willmore	Jeremy Ruiz	Mark Calley
Ray Wagner		Johnathan Hart

0700 - Mobilized w/ Ray Wagner to begin clearing & locating 47DPT12.

0800 - GRI arrives. Crew initially took wrong route to site location.

0815 - Located 47DPT12 w/ GPS (TRIMBLE HAND-HELD)

0830 - Praveen Srivastav, Kay Everett & Susan Watson arrive @ site 47DPT12.

0900 - P. Srivastav, K. Everett, & S. Watson leave site.

0910 - GRI Hand augers 47DPT10 to 5' bgs.

0940 - Kent , Rose Zeiler, & Paul Bruckwilki arrive @ 47DPT10 to observe.

5

(continued from previous page)

1000 - Faye Duke arrives @ site.

10:45 - Completed setting TW47DPT to 25' bgs.

1115 - Showed Ray Wagner where 47DPT09 was located, Drillers leave site to get some materials from trailer.

1245 - GRI drillers arrive back @ site.

1300 - DPT rig ~~breaks~~ 8/17/10 RD breaks down (track-rollers are sheared) / DPT is down for the day.

1320 - Mobilized to help Ray Wagner locate 47DPT07 & 08.

1645 - Left Site.

8/17/10

00107296

8/18/10 Pre-Remediation Investigation @ 47. Weather: AM: clear to PM cloudy 90s PM: cloudy

0700 - Arrived @ Site. GRI drillers must wait on track rollers to be delivered.

0815 - Spoke w/ Mary Norris @ roll-off box delivered.

0825 - Spoke w/ Tom Carling & Tanya Harvard, was told to call Keith @ roll-off boxes.

0830 - Began doing expense report from previous project.

0945 - Took Susan Otter to get Ray Wagner to clear location for 04MW05.

10:30 Continued Expense Report.

12:30 Drillers arrive @ site, begin repairing rig.

1325 Begins to rain

1415 Mobilized to 47DPT11.

14:25 - Began advancing.

(continued from previous page).

1505 - Set temporary (1") well @ 47DPT11.

1520 - Mobilized to 47DPT12

1630 - Left Site.

8/18/10

8/19/10 Pre-Remediation Investigation @ 47 Weather: clear 90s

0640 - Arrived @ site.

0700 - Performed tailgate H&S meeting.
Attendees: Jeremy Ruiz (QR1) Allen Willmore (Shaw)
Jason New (QR1) Ray Wagner (Shaw)

0710 - Mobilized to 47DPT 04

0720 - Began advancing 47DPT 04. See boring log.

0900 - Began advancing 47DPT08. See boring log.

1005 - Began advancing 47DPT07. See boring log.

1135 - Went to print out location to 47DPT13. Drillers track rig out of location. 47DPT07

1210 - Drillers take lunch; mobilize to get trailer.

1235 - Began waiting for QR1 drillers by rig.

1300 - Ray Wagner calls on behalf of the QR1 drillers from plant. Not sure why drillers went to plant.

(Continued from previous page).

1325 - Began advancing 47DPT13.

1410 - Began setting well 47 DPT 13 @ 25' bgs

1445 - Mobilized to Site 50 (LHAAP-50)

1520 - Began advancing two Post borings w/ DPT rig

LHAAP 50 Sampler Time + Dates

	Time 0-1	Time 1-2	DATE
A1	15:20 S	1525 S C	
A2	15:30 S	1535 S C	
A3	15:40 S	1545 S S	
A4	15:50 S	1555 C	
A5	16:00 S	1605 C	
A6	1610 S	1615 S	
A7	1620 S	1625	

S - Sand
C - Clay

17:30 - Left Site.

00107298

8/20/10 Pre-Remediation Investigation @ 47 Weather pt cloudy 90s

0630 - Arrived @ site.

0645 - Performed tailgate H&S meeting
Shaw — QRI
Allen Willmon — Jeremy Ruiz
Jason New

0720 - Began advancing 50SB17R

0740 - Sampled 50SB17R (12-14) * Took DUP01-082010

0750 - Sampled 50SBR (14-16)

0800 - Sampled 50SB17R (GW/VE) @ 17'-18' bgs

0830 - Began mobilizing to Bldg 25-C @ LHAAP-47

0900 - Staked out rows E & C @ 47.

1015 - Began advancing DPT @ bldg 25-C. (see table on page 12)

10:30 - *Vadose Zone @ 47SBE1 was encountered @ 9'-10' bgs.

1105 - Creosote or tar observed @ 9'-11' interval @ E1, Took photo.

11:15 - Texted P. Srivastava/S. Watson photo.

(Continued from previous page)

11:30 - Talked to Susan Oller @ Hollow Stem/Rotary sched.

11:45 - Lunch, Made copies of paperwork.

12:45 Began advancing 47SB-C3

13:15 - Began advancing 47SB-C5

1400 - Began advancing 47SB-E3

1445 - Began advancing 47 SB-E5

1610 - Collected ER-082010 FOR PERC.

1715 - LEFT SITE.

8/20/10

00107299

12 Samples @ 47		(0-2)	(4-6)	(8-10)	(GW/VZ)
	Date	Time	Time	Time	Time
47SB A1	8/24/10	1355 S	1400 C	1410 C	1415 C [13-14]
Sh A3	8/24/10	1440 S	1445 C	1450 C	1455 S [14-15]
Sh A5	8/25/10	1440 S	1445 S/C	1450 C	1455 (18.5-19.5)
Sh A7	8/25/10	1545 S	~~1550~~ NA	~~1555~~ NA	~~1600~~ ~~1545~~ (4-6)
Sh A9	8/25/10	1615 S	1620 S	NA	1625 C (9-11)
Sh C1	8/20/10	10:55 S	11:00 C	NA	11:10 C/S (9-10)
Sh C3	8/20/10	12:50 S	12:55 S	1300 C	1305 C/S [13-14]
Sh C5	8/20/10	13:20 S	13:25 S	1330 wet soil/S	NA
Sh C7	8/25/10	1520 S	~~1525~~ 1530	1530	1535 [15-16]
C9	8/26/10	07:45 S	07:50 S	07:55 C	[9-11]
C11	8/26/10	08:25 S	08:30 S	08355 ~~08:35~~	0840 [12.5-13.5]
Sh E1	8/20/10	1020 S	1025 C	NA	1035 C (9-10)
Sh E3	8/20/10	1405 S	1410	NA	~~1415~~ 1435 (7-10)
Sh E5	8/20/10	1450	1455	NA	1500 (8-9)
E7	8/26/10	0940 S	~~0945~~	~~0950~~ 0945	(4-6)
E9	8/26/10	0910 C	0915 C	0920 C	0925 S/C [11-12]
G5	8/26/10	1230 C	1235 C	1240 C	1245 C [11-12]
G7	8/26/10	1000 S	1005 C	1010 C	1015 S/C [14-15]
I5	8/27/10	0815 S	0820 C	NA	NA
I5	8/26/10	1315	1320	NA	1325 [9-10]
I7	8/26/10	1055 C	1100 C/S	1105 C	1110 [13.5-14.5]
K3	8/26/10	1420 C	1425 C	1430 C	1435 [20.5-21.5]
K5	8/26/10	1510 C	1515 C	1520 C	1525 C [21.5-22.5]
K7	8/26/10	1545	1550 C	1555 C	1600 S [18-19]

S- Sand C- Clay Sh- Shipped

* All samples were analyzed for pace only

8/23/10 Pre-Remediation Investigations @ 47

weather clear-13 Mostly cloudy Hi 90s

0640- Arrived @ site.

0800- Began staking out locations @ Bldg 25-C.

1300- Showed Ray Wagner what areas needed to be cleared @ LHHAP-17.

1450- Began packing samples collected on Friday August 20th, 2010 for shipment.

1600- Spoke to Lacy Cuccetti, informed that GPR drillers will not be our site until noon tomorrow

1845- Left Site.

8/23/10

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clear to pthly cloudy

8/24/10 Pre-Remediation Investigation @ 90s
47.

0700- Arrived @ site.

* Susan Eller decides to set well @ ~57' bgs.

0730 ~~0830~~ - ETTL DRILL RIG BREAKS DOWN.

0900 - Began taking GPS coordinates of 47 DPT locations.

11:30 - Lunch Break

12:30 - QRI Drill crew arrives. Crew goes to GWTP to get decon water and ice.

1355 - Began advancing 47 SB-A1

1435 - Began advancing 47 SB-A3

15:20 - Drillers notice something looking up the tracks to the DPT rig.

1630 - Collected ER-effluent for PEPC.

1710 - Left Site.

00107301

16

8/25/10 Pre-Remediation Investigation @ 47.

Weather: PM/ cloudy low 90s

0900- Arrived @ site.

0930- Q. Hong Hoang project chemist says lab never received samples

1015- Spoke to Stephanie Mossburg @ MicroBac. MicroBac locates samples.

1045- Began locating points for DPT @ 17.

12:30- QA arrives

12:45- Began working on 6610 DT rig.

1410- Rig is operational again. Track bearing was faulty.

1420- Began advancing 47SA5

1515- Began advancing 47SB-C7

~~1610~~ 1540 - Began advancing 47SB-A7

1610 - Began advancing 47SB-A9

17:30 - LEFT SITE. 8/25/10

17

8/26/10 Pre-Remediation Investigation @ 47

Weather: clear 90s

0645 - Arrived @ site.

0700 - Performed Tailgate H&S

0750 - Completed paperwork, e-mailed via S. Boesinger to Houston

0740 - Began advancing 47SB-C9

08:20 - Began advancing 47SB-C11

0900 - Began advancing 47SB-E9

0935 - Began advancing 47SB-E7

0955 - Began advancing 47SB-G7

1050 - Began advancing 47SB-I7

1225 - Began advancing 47SD-G5

1310 - Began advancing 47SD-I5

1330 - Began advancing 47SB-I3, hit concrete refusal.

(continued from previous page).

1415 - Began advancing 47SB-K3

1430 - Spoke to Kay Everett who conferred w/ P. Srivastav. Advancing 47 DPT 10, 11, 12 deeper can be done next week.

1505 - Began advancing 47SB-K5

1540 - Began advancing 47SB-K7

1700 - Began organizing samples (Susan Olew)

1745 - Left Site.

8/27/10

8/27/10

Weather: clear 60s-70s

Pre-Remedial Investigation @ 47th

17

0730 - Arrived @ site

0745 - Performed tailgate H+S meeting.

0810 - Began advancing 47SB-I3

0900 - Began mobilizing to LHAAP-17.

1000 - Began advancing 17SB-D4

~~1005~~ 1020 - Began advancing 17SB-D3

1055 - Began advancing 17SB-D2

11:35 - Began advancing 17SB-D1

1150 - HANDLE ON DPT rig breaks.

12:35 - COLLECTED EQUIPMENT RINSATE ~~ER~~-082710 FROM BARREL OF DPT. COLLECT 2 1-L AMBERS FOR EXPLOSIVES AND 1-500mL PLASTIC FOR PERCHLORATE

1330 - Packed Samples

1520 - Left Site

8/27/10

00107303

20 LHAAP-17 SAMPLES

ID	DATE	(GW/VZ)	TIMES (4-6)	(GW/VZ)	(GW/VZ) Int.
17SB-A1	08/31/10	0830	0835	0840 Dup13	5.0-6.0
A2	08/31/10 8 oc	0805	0810		5-6
A3	08/31/10	1455	1500	1505	5-6
A4	08/31/10				
B1	08/30/10	1040	1045	1050	8-9
B2	08/30/10	1240	—	1245	5-5.5
B3	08/30/10	1305	1310	1315 Dup1	7.5-8.5
B4	08/30/10	1400	1405	1410 Dup2	6-7
C1	08/30/10	1000	1005	1010	8.5-9.5
C2	08/30/10	0935	0940	0945 ac	5.5-6.5
C3	08/30/10	0915	0920	0925	5.5-6.5
C4	08/30/10	08:40	0850	0900	9.5-10.5
C5	08/31/10	1440	—	1450	2.5-3.5
P/E D1	8/27/10	1140	1145	1150 Dup 13 ms/mso	[8.5-9.5]
P/E D2	8/27/10	1100 s	1105 c	1110 Dup12 c/s	[9.5-10.5]
P/E D3	8/27/10	1030 s	1035 c	1040 Dup11 Trip	[9.5-10.5]
P/E D4	8/27/10	1005 s	1010 c	1015 c Trip missing	[7-8]
17EXC03SB01	08/30/10	1420	1425 2-4 0930 +G 0930	1430	8-9
17EXC03SB08	08/31/10	0925		0935	5-6
17EXC03SB02	08/31/10	1010	—	1020	2-3
17EXC03SB03	08/31/10	1040	1045	1050	5-6
17EXC03SB06	08/31/10	1235	1240	1250	7.5-8.5
17EXC02SB03	8/31/10	1345	1350	1355	8-9

See note pg 22 - Ola

Cont pg 21

E- sampled for explosives
P- Sampled for perchlorate

S- Sand C- Clay

21

08/30/10 LHAAP-17

06:30 Arrive on-site for Tailgate safety / JSA. Gather supplies and equipment.
0800 Arrive @ LHAAP-17
0830 Began advancing 17SB-C04
0910 Began advancing 17SB-C03
0935 Began advancing 17SB-C02
0955 Began advancing 17SB-C01
1035 Began advancing 17SB-B01
12:15 Began advancing 17SB-B02
1300 Began advancing 17SB-B03
1355 Began advancing 17SB B04
1415 Began advancing 17EXC03-SB1
1445 Began advancing 17SB-A03
15:20 Left site to Ranch
Ship Samples
1730 Left base for the day

08/30/10

Ola

00107304

22

08/31/10 LHAAP-17

0630 Arrive on site. Tailgate safety / JSA. Gather supplies and paperwork.
0800 Arrive at LHAAP-17.
0802 Began advancing 17SBA02
Note - Date ~~08/30/10~~ for samples A3, B1, B2, B3, B4, C1, ~~C2~~ C2, C3, C4, 17EXC03 SB01 should read 08/31/10.
0825 Began advancing 17SBA01
0920 Began advancing 17EXC03-SB01
0950 Began advancing 17EXC03-SB02
1020 Began advancing 17EXC03-SB03
1225 Began advancing 17EXC02-SB06
1300 Spotted lighting - stand down for 30 mins.
1330 Began advancing 17EXC02-SB03
1400 Began advancing 17EXC02SB01
1435 Began advancing 17SBC05
1450 Began advancing 17EXC02SB01
1500 Returned to GWTP to process samples
1700 Left site for the day

23

09/01/10 LHAAP-17

0630 Arrive on-site. Tailgate safety / JSA.
0700 Arrive at LHAAP-17 to begin marking remaining locations.
0715 After speaking w/ Kay Everett will move to 47 to resume / install new temp wells.
0935 Began drilling 47 DPT 18I.
1210 Experiencing difficulties w/ heaving sand. Will attempt to clear rods ~~and~~ 14.00 Resume drilling
15.45 Continued difficulties Will attempt to push to clay w/o collecting samples.
1705 Rig down. Have decided to call day.
1800 Left site

ID	Date	0-2	(2-4)	GW/VZ	(GW/VZ) in
17EXCO3SB02	09/15/10	1405	1410	1425	9-18 BRK
17EXCO2SB01	08/3/10	1500	1505	1510	4.25-5.25
17EXCO1SB01 **	9/16/10	1100	1105	1110	(6-8)
17EXCO1SB03	9/16/10	0950	NA	0935 DUP 03	(2-4)
17EXCO1SB04	9/16/10	0925	0930	0935 17 DUP 02 MS/MSD	(5-7)
17EXCO2SB04	9/16/10	0830 Took DUP 17 DUP 01		0835 MS/MSD	(2-3)
17EXCO3SB05	09/15	1425	1430	1435	8.5-9.5 DUP 20
17EXCO3SB04	09/15	1400	1405	1410	8.5-9.5
17EXCO2SB05	9/16/10	0900	0905	0910 DUP 04	(9-10)
17EXCO3SB06	09/15	1340	1345	1350	(5-6)
17EXCO3SB07	09/15	1320	1325	1330	(5-6)
17EXCO1SB02	9/16/10	1040	1045	1050 Took 17 DUP 05 MS/MSD	(4-6)
17EXCO2SB03		See page 20.			
17EXCO3SB01		See page 20.			
17EXCO3SB02		See page 20.			
17EXCO3SB03		See page 20.			
~~17EXCO3SB01~~					9/16/10
17EXCO2SB06		See page 20.			
17EXSO3SB08		See page 20.			
17SB-D0 ***	9/16/10	1330	1335	1340 DUP 06	(12.5-13.5)
17SB-E1 ***	9/16/10	1410	1415 DUP 03	1420 DUP 07	(4-6)
17SB-C0 ***	9/16/10	1425	1455 DUP 09	1435 DUP 08	(9-10)

*** - Perchlorate only!

* S. Allen MUST complete table, A. Williamson RECEIVED NOTE 9/16/10.

All locations sampled and analyzed for explosives

** Sample Location sampled and analyzed for explosives AND Perchl.

09/02/10 LHAAP-47

0630 Arrive on-site. Drillers will be late. Looking for parts to make drill pipe to rig.

0830 Drilling on-site and rig repairs started.

1035 Driller, Jeremy Reising has touched a screw on the muffler & was treated w/ first aid. Reported to Ray Everitt.

12:00 Spoke w/ Graves, Drivastava and Jim Joyce concerning injury. Will have drillers complete JSA, HARP and discuss care & turn w/ Jeremy.

1245 Arrive at 47DPT101 to begin set up.

1310 Spoke w/ C. Drivastava concerning well. Drilling has reached 55'. Still in bearing sand. Will set up at 65' per his

00107306

28

09/02/10 LHAAP-47

Drop off drop off
12:00 Left site for the day

09/03/10

29

09/09/10 LHAAP-47

0630 Arrive GWTP. Drillers are not here. Will contact.
0700 Spoke with driller, Q. New. They are not scheduled to be on-site until 09/13. Will contact home office (Houston)
0730 Will mark locations at LHAAP-17
08:30 Marked
17EXC03-SB07
17EXC03-SB06
17EXC03-SB05
17EXC03-SB04
17EXC02-SB05
17EXC02-SB04
17EXC01-SB01
17EXC01-SB03
17EXC01-SB04
Spoke w/Ray about clearing for next set of borings (step-out)
0900 Left site for the day

09/02/10 LHAAP-47

Instruction.
1345 Rain & Thunder have stopped work
1500 Left site for the day

09/02/10

Allen

09/03/10 LHAAP-47

0600 Arrive at GWTP. Tailgate Safety / JSA. Discuss equipment, Daily supplies, Load water tank & water
0730 Arrive on site @ 47DPT10I and began set up
0800 Began drilling w/ water to deal w/ heaving sands.
0920 well was set @ 55'. Approx. 10 gallons of water ~~was~~ was added to the well during this process. Discussed this w/ D. Driscoll before. We will remove 2X the amount added plus 3 well volumes during development.
10:00 Cleaned site and returned to GWTP for decon and supply.

Allen

09/13/10 LHAAP-47

0630 Arrive on-site Tailgate Safety / JSA. ~~Hallie~~ Nathan Supplies.

0730 Ray walk out @ LHAAP-47 to discuss clearing

0830 Arrive at LHAAP-47 and began set up.

0900 Began drilling 47DPT11I

1310 Began setting well @ 55'

1430 Moved to 47DPT12I and began drilling.

1630 Hole is advanced to 28'. Will resume drilling tomorrow. Lift site for the day

09/13/10

09/14/10 LHAAP-47

0630 Arrive @ GWTP for Tailgate Safety / JSA. Discuss daily activities. Nathan Supplies

0730 Began drilling @ 47DPT12I

0930 After discussing lithology w/ Crawford Drinkard and Ray Everett decided to set well @ 40 ft. Screen from 30 to 40

1100 Will complete. Breaking down pit cleaning up & will return to GWTP to decon

1340 Arrived at LHAAP-47 to begin drilling 47DPT13

1440 Began setting well @ 31'

1630 Left site for day

09/14/10

00107309

32

09/15/10 LHAAP-47

0630 Arrive @ GWTP for Tailgate Safety / JSA.
0730 Arrive at 47DPT15 and begin set up
0800 Began drilling 47DPT15.
1000 Refusal @ 43.5. Will set well
1050 Well would not be set @ 43.5. Sand became packed and resistant to direct push. Well was set @ 40. Screened 30-40'
1055 Driller, J. New, corrected his earlier statement. Well was set @ 44. Screened 34-44.
11:15 Returned to GWTP for decon
13:00 Arrive @ LHAAP-17 to begin soil sampling
13:15 Began advancing 17EXC03-SB01
1335 Began advancing 17EXC03-SB02
1355 Began advancing 17EXC03SB04
1420 Began advancing 17EXC03SB05
Collected Dup20
1500 Left site for the day Returned to GWTP

33

09/15/10 LHAAP-17

to pack samples.
1600 Left site

09/15/10

9/16/10 Pre-Remediation investigation weather: clear @ 17

0630 Arrived @ Site

0645 - Performed tailgate H/S meeting.

0715 - Began reviewin Susan Oller's notes and logs for continuation of work.

0740 - E-mails from Robert Duffield requests that 3 add'l samples be collected from LHAAP-17 & 18 add'l samples be collected from LHAAP-47.

0830 - Began advancing boring @ 17EXC025B04. See boring log for details for all borings.

0855 - Began advancing boring @ 17EXC025B05.

0915 - Due to standing water, relocated Boring 17EXC01SB01 12' away from 17EXC01SB04 (to North), bisecting 17EXC01SB01 & 03.

* See boring logs for time of DPT advancement.

(Continued from previous page).

1530 - Began preparing samples for shipment.

1710 - LEFT SITE.

9/16/10

9/17/10 Pre-Remediation Sampling @ LHAAP-47

0730 - Arrived @ site.

0830 - Began advancing 47SB-H5

0920 - Began advancing 47SB-H4

0950 - Began advancing 47SB-H6

10:35 - Began advancing 47SB-H7

11:25 - Began advancing 47SB-H8

1200 - Went to plant to prep samples for shipping

1400 - Left Site.

9/17/10

LHAAP-47 STCP INS

Sample ID	(0-2)	(4-6)	(9-11)	GW/VZ	Interval GW
47SB-J5 9/17	8:35	8:40	8:45	8:50 DUP01	(17.5-18.5)
47SB-H4 9/17	9:25	9:30	9:35	9:40 DUP02	(12-13)
47SB-H6 9/17	9:55	10:00	10:05	10:10 DUP03	(20-21)
47SB-H7 9/17	10:40	10:45	10:50	10:55 DUP04	(18-19)
47SB-H8 9/17	11:30	11:35	11:40	11:45 DUP05	(14-15)

✓ - TOOK MS/MSD

*All dates are 2010

9/20/10 Pt.y cloudy 90s 3

Pre Remediation Investigation

10:30 - Arrived @ site.

10:45 - Driller go to get truck inspected. Received ticket this morning

1200 - Drillers return.

1270 - Performed tailgate H&S meeting

* Left previous logbook in Houston ~~over~~ the weekend

1240 - Began advancing 47SD - J3

1310 - Began advancing 47SB - F4

1335 - Began advancing 47SB - F6

1400 - Began advancing 47SB - F7

1420 - Began advancing 47SB - E9

1445 - Began advancing 47SB - E6

1505 - Began advancing 47SB - C2

Sample ID	(0-2)	(4-6)	(9-11)	GWTP	GWTP Interval
4750 J3 9/20	12:45	~~1250~~ NA	~~1255~~ NA	R: 30 ~~1330~~ Dup of	(4,5-6,5)
F4 9/20	1315	1320	~~1325~~ NA	13:25 Dup of	(9-11)
F6 9/20	1340	1345	~~1350~~ NA	1350 DUP05	(8-10)
F7 9/20	1405	1410 ←	Same →	1410	(4-6)
E9 9/20	1425	1430 →			(4-6)
E6 9/20	1440	1445	NA	14:50	(8-10)
C2 9/20	1510	1515	~~1520~~ NA	1520	(6-7)
E2 9/20	1530	1535	NA	1540	(8-9)
F3 9/21	835	840	845	850	~~(12-13)~~ (12-13)
~~D8~~ D8 9/21	~~835~~ 835	~~940~~ 940	~~945~~ NA	~~950~~ 945	(6-7)
D9 9/21	955	1000 →	NA		(4-6)
B10 9/21	1010	1015	1020	1025	(12-13)
J6 9/21	1040	1045	1050	1055	(11-12)

* All Dates are 2010

** Labels (some) say WGTP but should be analyzed for SOIC

(Continued from page 3).

1525- Began advancing 4750-E6 ~~E6~~.

1610- Began prepping samples

1700- Left Site.

9/20/10

9/20/10 Pre-Remediation Sampling @ LHAAP-47

Weather: Clear 90s

0715 - Arrived @ site.

0730 - Performed tailgate H&S meeting

0830 - Began advancing 473B-F3

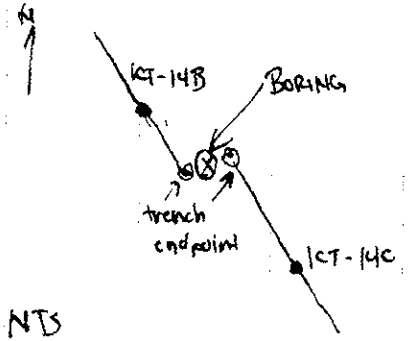
0935 - Began advancing 473B-D8

0950 - Began advancing 473B-D9

1005 - Began advancing 473B-B10

1330 - Began advancing boring @ LHAAP-18 Per instructions from Praveen Srivastav and Van Vangala, boring will not be logged.

1515 - Completed Boring @ LHAAP-18 b/w endpoints of trenching ICT-14B and ICT-14C. No gravel observed. Boring advanced to 43'



NTS

(Continued from page 6)

1710 - Left Site after site cleanup.

9/20/10

00107316

8

9/22/10 Pre-Remediation Pump Test @ LHMP-17

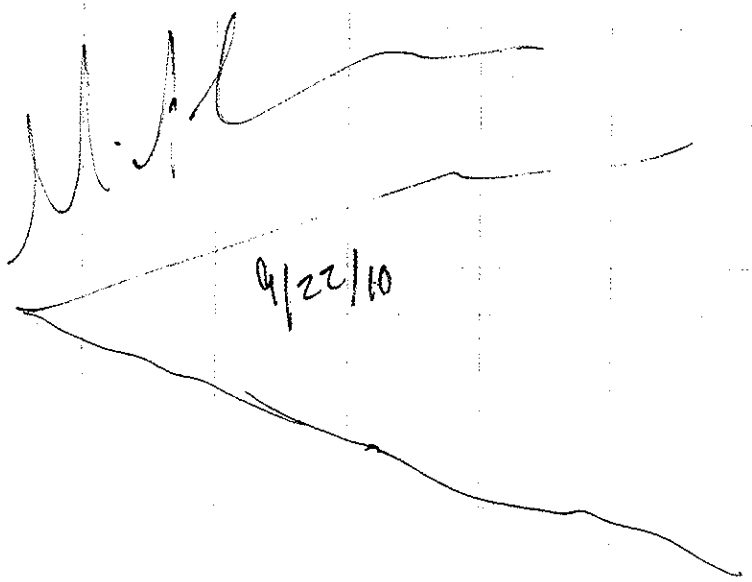
Weather: ptly cldy 90s

11.00 - Arrived @ site. Waited for equipment to arrive. Pump for test will not arrive until 3:00 pm.

11:30 - Began preparing samples for shipment.

1400 - Helped fix Ray Wagner's computer

16:30 - Left Site.



9

9/23/10 Pre-Remediation Pump Test @ LHMP-17

Weather: ptly cloudy 80

0700 - Arrived @ Site SHAW PERSONNEL: Allen Willmore ~~Ray Wagner~~

0730 - Unloaded equipment

0900 - Called manufacturer concerning operation of rugged reader

1100 - Spoke to Praveen Srivastav, Susan Watson & Robert Duffield @ Schedule.

*Set log files to each transducer

12:45 - Having complication w/ flow meter

1400 - Set all transducers in wells

1530 - Flow meter still not working called manufacturer

~~1800 A. Willmore is relieved by Ray Wagner.~~

1615 - Left Site.

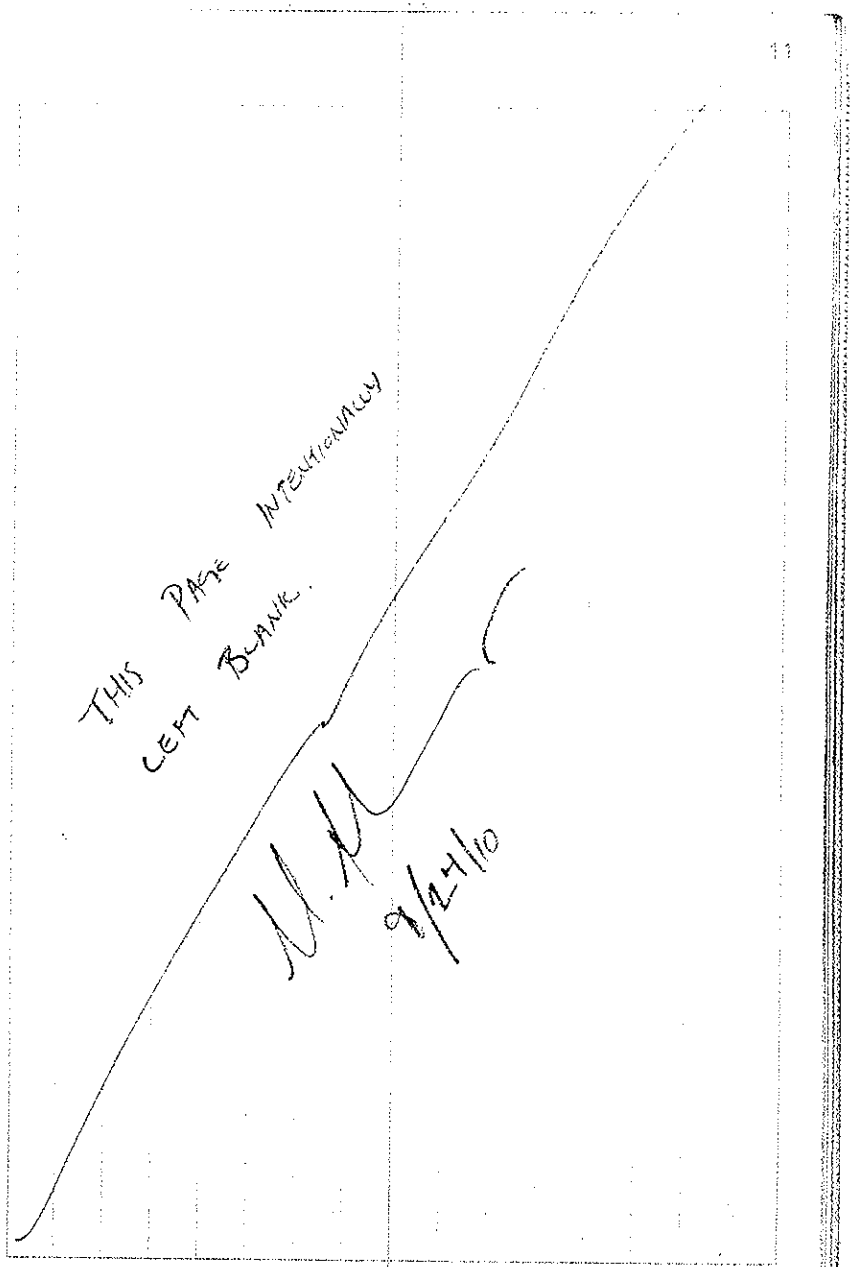
9/23/10

Initial DTWs

Well ID	Date	Time	DTW
17WW06	9/23/10	10:20	10.86
17WW10	9/23/10	~~10:36~~ 14:35	see transducer file
17WW14	9/23/10	~~10:30~~ 14:35	see transducer file
17WW02	9/23/10	~~10:50~~ 14:50	see transducer file

Recharge Times

~~Time~~ Date	~~Date~~ Time initial	DTW initial	DTW final	Time final
9/23/10	0815	see transducer info		
9/24/10	1034	1256	11.32	1045



12

9/24/00 Pre-Remediation Pump Test @ 17

0600 - Arrived @ Site Shaw Personel: Allen Williams / Ray Wagner

650 - Began pump test 1 gallon/minute

~~0659~~ 0659

0659 - Pump rate 1.60 gpm. experienced drawdown

~~0716~~ 0716 - Turned pump off, well begins recharging see transducer information beginning @ 7:16 for recharge data

0729 - Synced transducer time to real time

0747 - Began pumping

0810 - Adjusted controller to find point of stabilization

0815 - Pump off, let re-charge

824 - Recharged to 11.25

826 - Pump on (24 test

0835 - Received call from Jennifer to re-collect 475B-E07

10:34 - Pump off; 0.6 gpm pump rate fails, let recharge. DTW: 12.56

13

(continued from previous page).

1045 - Recharged to 11.32

1047 - Pump on ; DTW = 11.32 * Also start of 36-hour test!!

1200 - Ray Wagner leaves. Scott Beesinger arrives.

1247 - Began pump test (36-hour), will only run for 34 hours since water level has started constant. Water level dropped @ 0.6 gallons/minute but staying stable @ 0.5 gallons/minute

1328 - Synced time for 17WW14. All data recorded before this time must be backtracked!!

1342 - Synced time for 17WW~~14~~02 @. All data recorded before this time must be back-tracked!!

1800 - Ray Wagner arrives @ site. Allen Williams leaves site.

~~1940 - Discovered clamp was not on battery~~

(Continued from previous page)

19:00 Dumped tank at GWTP Approx. 340 gallons.

9/25/10

2400 - Allen Willmore Relieves Scott Beesinger

0600 Ray Wagner is Relieved by Scott Beesinger.

0710 - Dumped tank @ GWTP. Approx. 250 gallons

12:00 Ray Wagner Relieves Allen Willmore

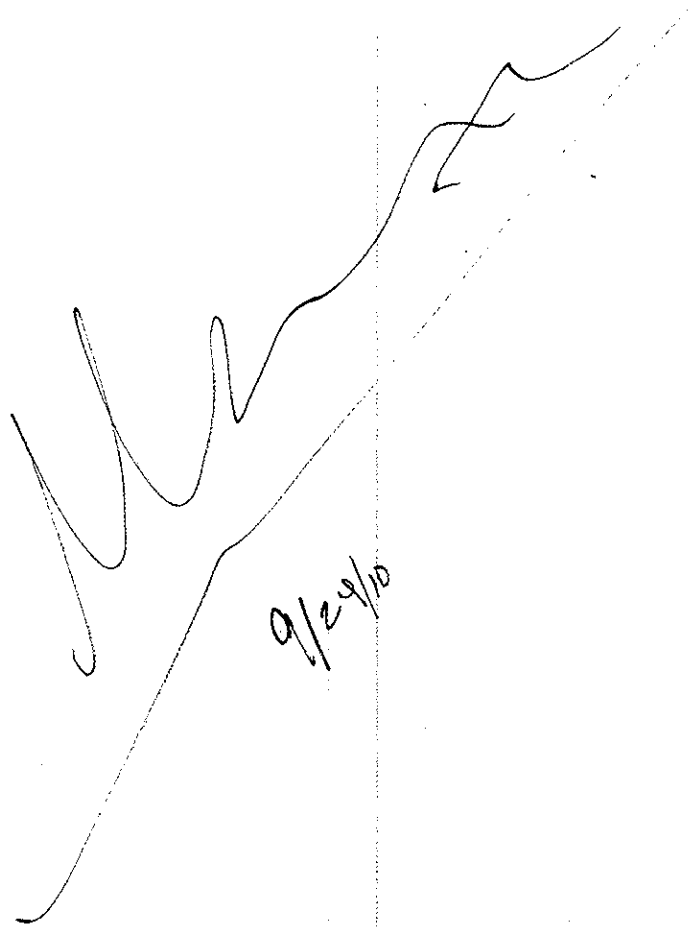
1730 - Dumped tank @ GWTP Approx. 240 Gallons.

1800 - Scott Beesinger leaves; Allen Willmore arrives

1940 - Discovered Battery clamp was disconnected not sure for how long. Must look @ data to determine, Pump ON !!

(Continued from previous page)

2248 - Pump off!!; Test Over!!



16

Pump Recharge Test

~~0824~~ 0824 DTW ~~10.87~~ 10.81 TIME DRY ~~907.~~ TIME RECHARGED

NA

See transducer info file.

* Pump off @ 11:34

DTW = 10.81
T.D = 22.80
90% = 12.01

17

clear 70s

9/27/10 Well ~~Pump~~ Recharge Test @ LHAA-72

~~0814~~ 0630 - Arrived @ Site.

0819 - Began Pump Recharge Test Forgot to take DTW; Pump off Let Re-charge.

0826 - 1.7 gpm

0853 - 2 gpm

~~0856~~ 11:34 - Turned Pump off Let re-charge. ~400 Gallons of H_2O purged

1230 - Rugged Reader did a cold re-boot.

1330 - Began loading equipment

1500 - Left Site

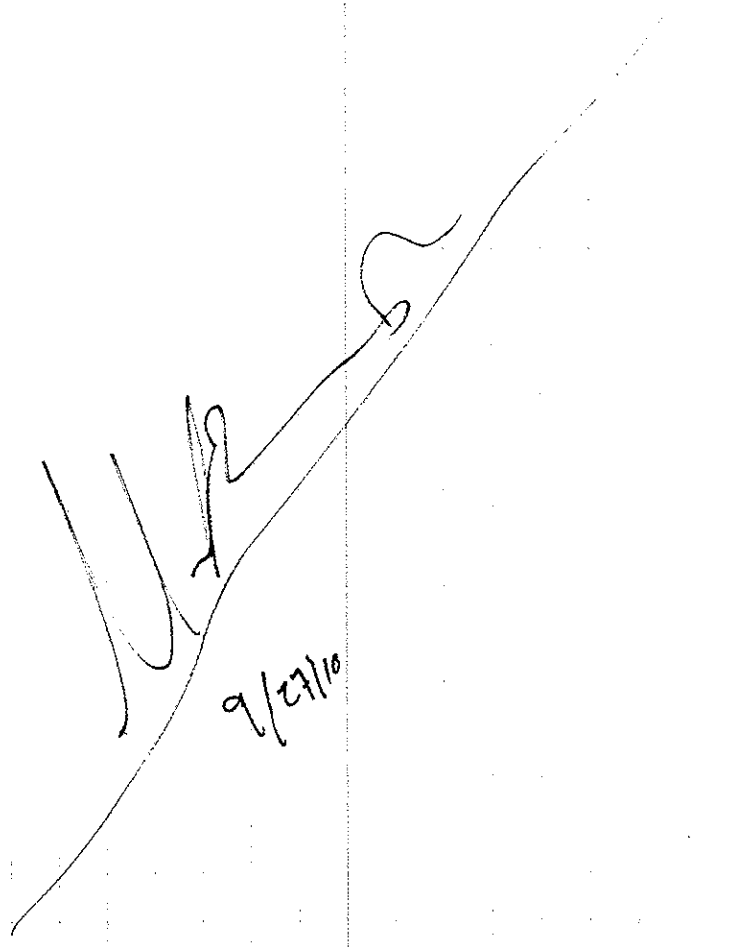
1530 - Spoke to S. Watson explained that during well Pump re-charge test it seemed that well recharge at faster rate once 4-5 ft of water was pumped from well

9/27/10 17MW06 Pump DRAWDOWN (BEFORE RECHARGE)

TIME	DTW	gpm	
~~0826~~			
0826	10.81	1.7	
0833	NR	~~2.0~~	
0839	14.30	2.0	
0907	15.18	2.0	
11:34	16.10	2.0	TURNED PUMP OFF

(continued from page 17).

1600 - S. Watson decides to re-rerun test @ ~~deep~~ 15-16 ft btoc water level.



9/28/10 Well ~~Test~~ Pump Re-Test. (Test 2) Weather - clear 70s-80s Dry

0730 - Arrived @ site. (Allen Willmore)

0815 - Began setting up transducers + pumps.

1000 - Survey crew arrives, showed crew where 19 wells were located.

12:15 - Initial Water Level @ 17WW02 is 8.62 (btoc); Began transducer logging

12:23 - Initial Water Level @ 17WW10 is 13.06 (btoc); Began transducer logging

12:30 - Initial Water Level @ 17WW19 is 13.12 (btoc); Began transducer logging

12:36 - Initial Water Level @ 17WW06 is 11.02 (btoc); Began transducer logging

12:41 - Began pump for 2nd pump test.

15:50 - Un hooked ~~to~~ pump power source pump off to connect to tractor.

(Continued from previous page)

15:52 - Reconnected to tractor.

1700 - Left Site.

00:30 Dumped 300 gallons

10:00 - Dumped 300 gallons

@ ~~Test~~ Have not heard from survey crew

Ray Wagner & Scott B. alternate changing pump overnight.

2:30 - Dumped 300 gallons

345 - Unhooked pump ~~to~~ power source from tractor to truck. Dumped 300 gallons

615 - Dumped 350 gallons

745 - Dumped 350 gallons

12:28 Pump off!! Test over!! Get RE-CHARGE INFORMATION FROM THIS POINT.

* All data logged w/ Level Troll 700 and will be downloaded for further evaluation

9/28/2010

00107323

22

17WW06 TEST 2

DATE	TIME	DTW	GPM
9/28/2010	13:14	15.84	~~2.0~~ 2.2
9/28/2010	14:06	16.37	2.2
9/28/2010	16:30	16.49	2.2
9/29/2010	08:55	17.09	2.5

*See TRANSDUCER INFORMATION

Associated Wells

23

	17WW08R		17WW10		17WW14	
	TIME	DTW	TIME	DTW	TIME	DTW
9/24/10	12:15	8.62	12:23	13.04	12:30	13.12
9/23/10	15:10	8.73	15:18	13.14	15:22	13.18
9/24/10	0859	8.87	9:02	13.53	9:07	13.19

00107324

96

7/30/10 SITE 47 Sampling
Clear/Sunny 95°F

09:40 - Setup on 47ww33 with a bladder pump. Disposable gloves were used and equipment was decon prior to sampling. Sample 47ww33-103007 Collected at 11:00 for VOC.

11:25 - Hand Bailed Dry well 47ww32. 2" well. Disposable gloves and disposable bailer used. Will come back and sample when recharges.

1:35 - Setup on LHSmw38 with bladder pump. Disposable gloves were used and decon'ed equipment before sampling - Sample LHSmw38-103007 Collected at 2:45 for VOC.

3:00 - Setup on LHSmw44 with a bladder pump. Used disposable gloves and decon'ed equipment before sampling. Sample LHSmw44-103007 collected at 4:15 for VOC.

Scott Beesley

7/30/10 Cont'd Site 47 Sampling

97

4:30 - Collected an Equipment Rinse sample to send to Lab.

7/31/10 Site 47 Sampling

7:55 - Collected Sample 47ww32-103107 for VOC.

8:20 - Bailed 105 Dry, ~~Sample to~~ used disposable gloves and disposable bailer. Sample 105-103107 collected at 1:10 for VOC.

8:40 - Bailed 47ww11 Dry. Used Disposable gloves and disposable bailer. ~~Sample 47ww11-103107 Collected at~~ DO NOT Recharge

9:10 - Bailed Dry 47ww27. Used disposable gloves & disposable bailer. Sample 47ww27-103107 collected at 9:45 for perchlorate & VOC

Scott Beesley

00107325

98 7/31/10 Cont SITE 47 Sampling

10:30 - Setup on 47ww21 with a bladder pump. Used disposable gloves and decon'ed equipment before sampling. Sample 47ww21-103107 collected at 12:00 for Perchlorate + VOC

1:30 - Setup on 47ww29 with a bladder pump. Equipment decon'ed before sampling and disposable gloves were used. Sample 47ww29-103107 collected at 2:50 for perchlorate and VOC. Field Dup was taken on this well.

3:00 - Setup on 47ww28 with a bladder pump. Decon'ed equipment prior to sampling + used disposable gloves. Sample 47ww28-103107 collected at 3:50 for perchlorate and VOC.

4:10 - Collected an Equipment Rinse sample for end of DAY.

Scott Beesley

8/3/10 SITE 47 MNA Sampling

99 Sunny @ 102°F

12:00 - Setup on 47ww34 with a bladder pump. Disposable gloves were used and equipment was decon'ed before sampling. Sample 47ww34-100803 Collected at 1:00 for MNA parameters.

1:35 - Setup on 47ww09 with a bladder pump. Used disposable gloves and decon'ed equipment before sampling. Sample 47ww09-100803 Collected at 2:50 for MNA parameters.

3:30 - COLLECTED AN Equipment Rinse Sample. Sample ID Equipment Rinse-100803.

Scott Beesley

00107326

100 Site 47 MNA Sampling
8/4/10 Sunny 85°F

7:15- 47ww30 Bailed Dry
When recharges will come back
and Sample. Disposable bailer
and gloves were used.

12:40- Sample 47ww30-100804
Collected for MNA parameters
using disposable bailer.

1:05 - Setup on 47ww13-100804
with bladder pump. Disposable
gloves were used and decon'd
equipment before sampling. Sample
47ww13 Collected at 2:15 for MNA
parameters.

2:40 - Setup on 47ww14 with bladder
pump. Disposable gloves used and
equipment decon'ed before sampling.
Sample 47ww14-100804 collected at
3:40 for MNA parameters and
Field dup also collected

Scott Baczyk

8/4/10 Site 47 MNA Sampling
Cont 101

4:30- Equipment Rinse Sample
Collected. Sample ID EquipmentRinse-100804

SITE 50 MNA Sampling
8/5/10 Sunny 100°F

12:10 - Setup on 50ww05 with a
bladder pump. Disposable
gloves were used and decon'ed
equipment before Sampling. Sample
50ww05-100805 Collected at 1:40
for MNA parameters.

00107327

Site 47 Sampling 8/6/10
Sunny 85°F

7:30 - LHSmw61 BAILED DRY USING Disposable bailer. Disposable gloves used. Sample LHSmw61-100608 collected at 11:00 for VOC's.

8:00 - Setup on LHSmw54 with bladderpump. Disposable gloves were used and equipment deconned before sampleng. Sample LHSmw54-100806 colkted at 9:00 for VOC + Perchlorate

9:30 - Setup on 47ww04 with a bladderpump. Disposable gloves were used and equipment deconned prior to sampling. Sample 47ww04 collected at 10:30 for VOC + Perchlorate.

12:15 - Setup on 47ww23 with bladder pump. Used disposable gloves. Deconned equipment before sampling. Sample 47ww23-100806 collected at 1:20 for VOC + Perchlorate.

Scott Basinger

Site 47 Sampling Cont'd
cloudy

1:35 - Setup on 67ww06 with bladderpump. Used disposable gloves and deconned equipment before Sampling. Sample 67ww06-100806 collected at 3:00 for VOC + perchlorate.

00107328

104

Site 47 Sampling 8/7/10
Site 50
Cloudy 85°F

7:45 - Setup on 48wwo1 with a bladder pump. Used disposable gloves and equipment decon'ed before Sampling. Sample 48wwo1-100807 Collected at 8:45 for VOC.

9:00 - Setup on 50wwo1 with a bladder pump. Disposable gloves were used, and equipment was decon'ed prior to Sampling. Sample 50wwo1-100708 Collected at 10:00 for VOC + perchlorate.

11:40 - Setup on 50wwo6 with bladder pump. Disposable gloves used and Equipment decon'ed before sampling - Sample 50wwo6-100807 Collected at 12:45 for VOC + perchlorate. Field Dup Collected.

Scott Beesley

Site 50 Sampling (cont) 8/7/10

105

1:00 - Setup on 50wwo7 with a bladder pump. Equipment was decon'ed and disposable gloves were used. Sample 50wwo7-100807 Collected at 2:15 for VOC + Perchlorate

00107329

106

8/13/10 DPT Sampling at Site 47

8:10 - Collect Samples at 47 DPT 03 for VOC + perchlorate. Disposable gloves were used and Disposable tubing

9:50 - Collect Samples at 47DPT05 for VOC + perchlorate. Disposable gloves and disposable tubing were used.

10:30 - Collect Samples at 47 DPT 06 for VOC + perchlorate. Disposable gloves and disposable tubing were used.

11:30 - Collect Samples at 47 DPT 01 for ~~VOC &~~ ~~Disposable~~ Perchlorate. Disposable gloves + Disposable tubing used.

Scott Berger

107

8/20/10 DPT water sampling

Clear 85°F

7:55 - Collected Sample ~~47DPT~~ 47DPT10-100820 for VOC.

8:00 - Collected Field Dup off of 47DPT10. Sample I.D. : Dupl - 100820

8:45 - Collected Sample 47DPT11-100820 for VOC

9:00 - Collected Sample 47DPT12-100820 for VOC.

9:25 - Collected Sample 47DPT08-100820 for VOC.

9:45 - Collected Sample 47DPT07-100820 for VOC.

10:00 Collected Sample 47DPT09-100820 for VOC.

10:20 - Collected Sample 47DPT13-100820 for perchlorate

Scott Berger

00107330

HOLE NO. 47 DPT 01

BORING LOG	DIVISION: LHAAP	INSTALLATION: LHAAP-47	SHEET 1 OF 2 SHEETS
1. PROJECT: LHAAP		9. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
2. LOCATION: LHAAP-47		10. MANUFACTURER'S DESIGNATION OF DRILL: 6610 DT	
3. DRILLING AGENCY: QRI		11. OVERBURDEN SAMPLES: DISTURBED —	UNDISTURBED —
4. HOLE NO. (As shown on drawing title and file number): 47 DPT 01		12. TOTAL NUMBER CORE BOXES: —	
		13. ELEVATION GROUND WATER: 11' (DTW)	
5. NAME OF DRILLER: J. New		14. DATE HOLE: STARTED 08/12/2010	COMPLETED 08/13/2010
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION TOP OF HOLE: —	
7. TOTAL DEPTH OF HOLE: 19.5'		16. TOTAL CORE RECOVERY FOR BORING: 100 %	
8. SIZE AND TYPE OF BIT: Direct Push		17. LOGGED BY: J Allen	QC: KR

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		TOPSOIL			
	1	CL	Clay, sandy, no plasticity hard, dry, brown			
	2					
0.0	3			100%		
	4					
	5					
	6					
	7		becomes moist, high plasticity			
0.0	8			100%		
	9	SC	Sandy, clayey, med grained, med sorting, damp, brown			
	10					
	11	CL	Clay, sandy, no plasticity hard, dry, brown			
	12		becomes more moist high plasticity			

00107331

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE — | Hole No. 47DPT01

PROJECT LHAAP | INSTALLATION LHAAP-47 | SHEET 2 OF 2 SHEETS

PID ELEVATION a	DEPTH b	USCS LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	13	CL		100%		
	14					
0.0	15			100%		
	16					
	17		becomes Saturated			▼
0.0	18			100%		
	19					Well Set @ 19.5 Screen 9.5 To 19.5
	20		END of Boring			
	21					
	22					
	23					
	24					
	25					
	26					
	27					

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PROJECT LHAAP | HOLE NO. 47DPT01

00107332

HOLE NO. 47DPT02

BORING LOG	DIVISION LHAAP	INSTALLATION LHAAP - 47	SHEET 1 OF 2 SHEETS
1. PROJECT LHAAP		9. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
2. LOCATION LHAAP-47		10. MANUFACTURER'S DESIGNATION OF DRILL 6610 DT	
3. DRILLING AGENCY QR1		11. OVERBURDEN SAMPLES — DISTURBED — UNDISTURBED	
4. HOLE NO. (As shown on drawing title and file number) 47DPT02		12. TOTAL NUMBER CORE BOXES —	
5. NAME OF DRILLER J. New		13. ELEVATION GROUND WATER 23' (DTW)	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		14. DATE HOLE STARTED 08/11/2010 COMPLETED 08/11/2010	
7. TOTAL DEPTH OF HOLE 25'		15. ELEVATION TOP OF HOLE —	
8. SIZE AND TYPE OF BIT Direct Push		16. TOTAL CORE RECOVERY FOR BORING 100 %	
		17. LOGGED BY [illegible] QC KR	

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	0–1	OH	Topsoil			
	1–2	CL	Clay, sandy, no plasticity, hard, dry, brown			
	2–3			100 %		
	3–4					
	4–5					
	5–6					
	6–7					
0.0	7–8			100%		
	8–9					
	9–10					
	10–11					Bit expansion clay. Will make 2-3' pushes @ 16'
0.0	11–12					

00107333

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE —	Hole No. 47DPT02
PROJECT LHAAP	INSTALLATION LHAAP-47	SHEET 2 OF 2 SHEETS

PTD ELEVATION (a)	DEPTH (b)	USCS LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
	13	CL				
	14			100%		
	15					
	16					
0.0	17			100%		
	18					
		SC	Sand, clayey, fine grain; med to well sorted, dry, white to grey			
	19					
0.0	20	CL	Clay, sandy, no plasticity hard, dry, brown	100%		
	21					
	22					
0.0	23		∇ - saturated	100%		∇
	24		- becomes dry and hard.			Temporary well set @ 25'
	25		End of Boring			
	26					
	27					

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PROJECT LHAAP | HOLE NO. 47DPT02

00107334

HOLE NO. 47DPT03

DRILLING LOG

DIVISION: LHAAP

INSTALLATION: LHAAP - 47

SHEET 1 OF 2 SHEETS

1. PROJECT: LHAAP
2. LOCATION (Coordinates or Station): LHAAP - 47
3. DRILLING AGENCY: QRI
4. HOLE NO. (As shown on drawing title and file number): 47DPT03
5. NAME OF DRILLER: J. New
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: —
8. DEPTH DRILLED INTO ROCK: —
9. TOTAL DEPTH OF HOLE: 26'
10. SIZE AND TYPE OF BIT: Direct Push
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: 6610 DT
13. OVERBURDEN SAMPLES: DISTURBED — UNDISTURBED —
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER: 24' (DTW)
16. DATE HOLE: STARTED 08/10/10 COMPLETED 08/10/10
17. ELEVATION TOP OF HOLE: —
18. TOTAL CORE RECOVERY FOR BORING: 100 % %
INSPECTOR: Susan Allen

ELEVATION PID (a)	DEPTH (b)	LEGEND USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
	0	OH	Topsoil			
	1	CL	Clay, sandy, no ~~plasticity~~ plasticity, hard, dry, brown	100%		
	2		- becomes ~~friable~~ friable			(crumbles very easily)
	3		- becomes more sandy			
	4		- becomes hard, dry	98%		
	5					
	6					
	7			100%		
	8					
	9					
	10		- becomes more sandy, softer			
	11					
	12					

00107335

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE — | Hole No. 47DPT03

PROJECT: LHAAP | INSTALLATION: LHAAP-47 | SHEET 2 OF 2 SHEETS

PID ELEVATION (a)	DEPTH (b)	USCS LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
	13	CL				
	14	SC	sand, clayey, med. grain med sorting, dry, brown	100%		
	15	CL	Clay, sandy, no plasticity hard; dry, brown			
	16					
	17			100%		
	18					
	19		– becomes more ~~plastic~~ plastic			
	20					Due to encounter w/ expansive clays, pushed have become 3' only.
	21					
	22			100%		
	23					
	24		– saturated			▼ @ 24'
	25			100%		
	26		End of Boring			
	27					

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PROJECT: LHAAP | HOLE NO. 47DPT03

00107336

HOLE NO. 47DPT04

BORING LOG	DIVISION LHAAP	INSTALLATION LHAAP	SHEET 1 OF 3 SHEETS
1. PROJECT LHAAP		9. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
2. LOCATION LHAAP-47		10. MANUFACTURER'S DESIGNATION OF DRILL 661D DT	
3. DRILLING AGENCY QR1		11. OVERBURDEN SAMPLES: DISTURBED —	UNDISTURBED —
4. HOLE NO. (As shown on drawing title and file number) 47DR 47DPT04		12. TOTAL NUMBER CORE BOXES —	
		13. ELEVATION GROUND WATER 26' (DTW)	
5. NAME OF DRILLER J. New		14. DATE HOLE STARTED 08/11/10	COMPLETED 08/11/10
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION TOP OF HOLE —	
7. TOTAL DEPTH OF HOLE 30 35'		16. TOTAL CORE RECOVERY FOR BORING 100 %	
8. SIZE AND TYPE OF BIT Direct Push		17. LOGGED BY Allen, S.	QC KE

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	OH	Topsoil			
	1	SC	Sand, clayey, medgrained, med sorting, dry brown			
00	2	CL	Clay, sandy, no plasticity, hard, dry, brown	100%		
	3					
	4					
	5					
	6					
00	7			100%		
	8					
	9					
	10					
00	11			100%		
	12					

00107337

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE — | Hole No. 47DPT04

PROJECT: LHAAP | INSTALLATION: LHAAP-47 | SHEET 2 OF 3 SHEETS

PID ELEVATION (a)	DEPTH (b)	USCS LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
	13	CL				
	14					
	15	SM	Sand, silty, fine grained med to. well ~~graded~~ sorted damp, grey to white			
	16	CL	Clay, sandy, no plasticity, hard, brown to grey			
0.0	17					
	18			100%		
	19					
	20					Hit expansive clay. Will start 2-3' pushes.
	21					
	22			100%		
0.0	23					
	24		- becomes more wet and softer - high plasticity			
	25					
	26		- saturated			
0.0	27		- becomes dryer - becomes dry and hard - no plasticity	100%		

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PROJECT LHAAP | HOLE NO. 47DPT04

00107338

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE — | Hole No. 47 DPT 04

PROJECT LHAAP | INSTALLATION LHAAP-47 | SHEET 3 OF 3 SHEETS

PID ~~ELEVATION~~ (a)	DEPTH (b)	USCS ~~LEGEND~~ (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
	28	CL				
	29					
0.0	30					
	31			100%		
	32					
0.0	33			100%		Well set @ 30' screened 30 to 20'
	34					
	35		END of Boring			

00107339

HOLE NO. 47DPT05

BORING LOG	DIVISION LHAAP	INSTALLATION LHAAP-47	SHEET 1 OF 2 SHEETS
1. PROJECT LHAAP		9. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
2. LOCATION LHAAP-47		10. MANUFACTURER'S DESIGNATION OF DRILL 6610 DT	
3. DRILLING AGENCY QR1		11. OVERBURDEN SAMPLES	DISTURBED — / UNDISTURBED
4. HOLE NO. (As shown on drawing title and file number) 47DPT05		12. TOTAL NUMBER CORE BOXES —	
		13. ELEVATION GROUND WATER 22' (DTW)	
5. NAME OF DRILLER J. New		14. DATE HOLE STARTED 08/12/2010	COMPLETED 08/12/2010
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION TOP OF HOLE —	
7. TOTAL DEPTH OF HOLE 25'		16. TOTAL CORE RECOVERY FOR BORING 100 %	
8. SIZE AND TYPE OF BIT Direct Push		17. LOGGED BY Allen, S.	QC KR

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	0–4	OH	Topsoil	100%		
		CL	Clay, sandy, no plasticity, hard, dry, brown			
0.0	8			100%		
0.0	12			100%		

00107340

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE — | Hole No. 47DPT05

PROJECT: LHAAP | INSTALLATION: LHAAP-47 | SHEET 2 OF 2 SHEETS

PID ELEVATION (a)	DEPTH (b)	USCS LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
	13	CL				
	14	SC	Sand, clayey, fine grained med to well sorted, dry white to gray			Silt expansive clay will start 2-3' pushes
	15	CL	Clay, sandy, no plasticity, hard, dry, brown			
0.0	16	SC	Sand, clayey, fine grained, med to well sorted dry, white	100%		
	17	CL	Clay, sandy, med plasticity dense, moist, brown			
	18					
0.0	19			100%		
	20	SC	Sand, clayey, med to fine grained, med to well sorted, moist, brown			
0.0	21			100%		
	22		becomes saturated			▼
	23					
0.0	24					
	25		END OF BORING			Well set @ 25 Screen 15-25'
	26					
	27					

00107341

HOLE NO. 47DPT06

BORING LOG	DIVISION LHAAP	INSTALLATION LHAAP-47	SHEET 1 OF 2 SHEETS
1. PROJECT LHAAP		9. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
2. LOCATION LHAAP-47		10. MANUFACTURER'S DESIGNATION OF DRILL 6610 DT	
3. DRILLING AGENCY QR1		11. OVERBURDEN SAMPLES	DISTURBED — UNDISTURBED —
4. HOLE NO. (As shown on drawing title and file number) 47DPT06		12. TOTAL NUMBER CORE BOXES —	
		13. ELEVATION GROUND WATER 21' (DTW)	
5. NAME OF DRILLER J. New		14. DATE HOLE STARTED 08/12/2010	COMPLETED 08/12/2010
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION TOP OF HOLE —	
7. TOTAL DEPTH OF HOLE 24'		16. TOTAL CORE RECOVERY FOR BORING 100 %	
8. SIZE AND TYPE OF BIT Direct Push		17. LOGGED BY Allen, S.	QC KE

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	0–1	OLT	TOPSOIL			
		CL	Clay, sandy, no plasticity, hard, dry, brown			
	2					
	3			100%		
—	4					
	5					
	6					
0.0	7					
	8			100%		
	9					
	10					
	11					
0.0	12			100%		

00107342

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE — | Hole No. 47DPT06

PROJECT: LHAAP | INSTALLATION: LHAAP-47 | SHEET 2 OF 2 SHEETS

PID ELEVATION a	DEPTH b	USCS LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	13					Dk expansive clay. Will start 2-3' pushes.
	14					
	15	SC	Sand, clayey, med to fine grained, mod to well sorted, moist, brown	100%		
0.0	16					
	17	CL	Clay, sandy, low plasticity, dense, damp, brown			
	18			100%		
0.0	19	SC	Sand, clayey, med grained, mod sorting moist, brown			
	20	CL	Clay, sandy, no plasticity, hard, dry brown			
	21		becomes ~~saturd~~ saturated	100%		
0.0	22					
	23					
	24		End of Boring			Set well @ 24' screen from 14-24'
	25					
	26					
	27					

00107343

HOLE NO. 47DPT07

DRILLING LOG	DIVISION Federal	INSTALLATION LHAAP	SHEET 1 OF 2 SHEETS
1. PROJECT Longhorn		10. SIZE AND TYPE OF BIT 2"	
2. LOCATION (Coordinates or Station) Karnack, Texas		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY QRI		12. MANUFACTURER'S DESIGNATION OF DRILL 6610 DT	
4. HOLE NO. (As shown on drawing title and file number) 47DPT07		13. OVERBURDEN SAMPLES: DISTURBED ✓	UNDISTURBED
5. NAME OF DRILLER Jason New		14. TOTAL NUMBER CORE BOXES NR	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION GROUND WATER NR	
7. THICKNESS OF OVERBURDEN NA		16. DATE HOLE STARTED 8/18/10	COMPLETED 8/19/10
8. DEPTH DRILLED INTO ROCK NR		17. ELEVATION TOP OF HOLE NR	
9. TOTAL DEPTH OF HOLE		18. TOTAL CORE RECOVERY FOR BORING NR %	
		Allen Willmore INSPECTOR	

~~ELEVATION~~ PID (a)	DEPTH (b)	~~LEGEND~~ USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
0.0	0	SM	SAND, SILTY, LT BROWN, DRY, NO ODOR, LOOSE	100%		1005 - Began advancing 47DPT07
		CL	CLAY, SANDY, NO PLASTICITY, DRY, NO ODOR, GRAY. - MOTTLING			
0.0	5			100%		
0.0	10	SP	SAND, SILTY, DENSE, MOTTLED, DAMP, GRAY, NO ODOR	100%		

00107344

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE NR	Hole No. 47DPT07
PROJECT LONGHORN AAP	INSTALLATION LHAAP	SHEET 2 OF 2 SHEETS

PID ELEVATION a	DEPTH b	USCS LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			(Same as above)			
0.0	15			100%		
0.0				100%		
	20		END OF Boring @ 20' bgs			

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PROJECT | HOLE NO.

00107345 HOLE NO. 47DPT08

DRILLING LOG

DIVISION: FEDERAL

INSTALLATION: LHAAP

SHEET 1 OF 2 SHEETS

1. PROJECT: LONGHORN AAP
2. LOCATION (Coordinates or Station): Karnack, Tx
3. DRILLING AGENCY: QR1
4. HOLE NO. (As shown on drawing title and file number): 47DPT08
5. NAME OF DRILLER: JASON NEW
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: NR
8. DEPTH DRILLED INTO ROCK: NA
9. TOTAL DEPTH OF HOLE: 20'
10. SIZE AND TYPE OF BIT: 2"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: GEOPROBE 6610 DT
13. OVERBURDEN SAMPLES: DISTURBED ✓ UNDISTURBED
14. TOTAL NUMBER CORE BOXES: NR
15. ELEVATION GROUND WATER: NR
16. DATE HOLE: STARTED 8/18/10 COMPLETED 8/18/10
17. ELEVATION TOP OF HOLE: NR
18. TOTAL CORE RECOVERY FOR BORING: 100% ×

INSPECTOR: ALLEN WILLMORE

ELEVATION PID (a)	DEPTH (b)	LEGEND USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
0.0	0	SM	SAND, SILTY, DRY, LT BROWN, LOOSE, NO ODOR	100%		0900- Began advancing 47DPT08
		CL	CLAY, SANDY, DARK BROWN, SOFT			0930- Began setting TMW 47DPT08 @ 20' bgs
0.0	5		- BECOMES HARD, MOTTLING, LT BROWN TO GRAY, STIFF	100%		
0.0	10	SP	SAND, SILTY, DENSE, GRAY, MOTTLING, WELL-SORTED, MOIST, NO ODOR	100%		
			- Becomes wet			
0.0						

00107346

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE NR	Hole No. 47DPT08
PROJECT LHAAP	INSTALLATION LONGHORN AAP	SHEET 2 OF 2 SHEETS

~~ELEVATION~~ PID (a)	DEPTH (b)	~~LEGEND~~ USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
0.0	15	SP	SAME AS ABOVE	100%		
0.0			END OF BORING @ 20' BGS	100%		

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PROJECT | HOLE NO.

00107347 HOLE NO. 47DPT09

DRILLING LOG

DIVISION: Federal

INSTALLATION: LHAAP

SHEET 1 OF 2 SHEETS

1. PROJECT: Longhorn AAP
2. LOCATION (Coordinates or Station): Karnack, Tx
3. DRILLING AGENCY: GRI
4. HOLE NO. (As shown on drawing title and file number): 47DPT09
5. NAME OF DRILLER: Jason New
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: NR
8. DEPTH DRILLED INTO ROCK: NA
9. TOTAL DEPTH OF HOLE: 20'
10. SIZE AND TYPE OF BIT: 2" DPT
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: 6610 DT
13. OVERBURDEN SAMPLES: DISTURBED ✓ UNDISTURBED
14. TOTAL NUMBER CORE BOXES: NA
15. ELEVATION GROUND WATER: NA
16. DATE HOLE: STARTED 8/19/10 COMPLETED 8/19/10
17. ELEVATION TOP OF HOLE: NA
18. TOTAL CORE RECOVERY FOR BORING: 100 %

INSPECTOR: Allen Willmore

ELEVATION PID (a)	DEPTH (b)	LEGEND USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
		SM	SAND, SILTY, DRY, LT BROWN, NO ODOR LOOSE, DRY			0745 - Began advancing 47DPT09
4.3			- Becomes clayey	100%		0810 - Began setting TMW @ 20' bgs
	5		CLAY, SANDY, DRY, LT BROWN, MOTTLED, NO PLASTICITY, STIFF, NO ODOR			
2.7				100%		
	10		SAND, ~~DENS~~ SILTY, DENSE, WELL-SORTED, MOIST, MOTTLING, NO ODOR			
3.1			- Becomes Wet	100%		

00107348

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE: NR

Hole No. 47DPT09

PROJECT: Longhorn AAP

INSTALLATION: LHAAP

SHEET 2 OF 2 SHEETS

ELEVATION PID (a)	DEPTH (b)	LEGEND USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
3.1	15	SM	SAME AS ABOVE	100%		
6.7	20		END OF BORING	100%		

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PROJECT

HOLE NO.

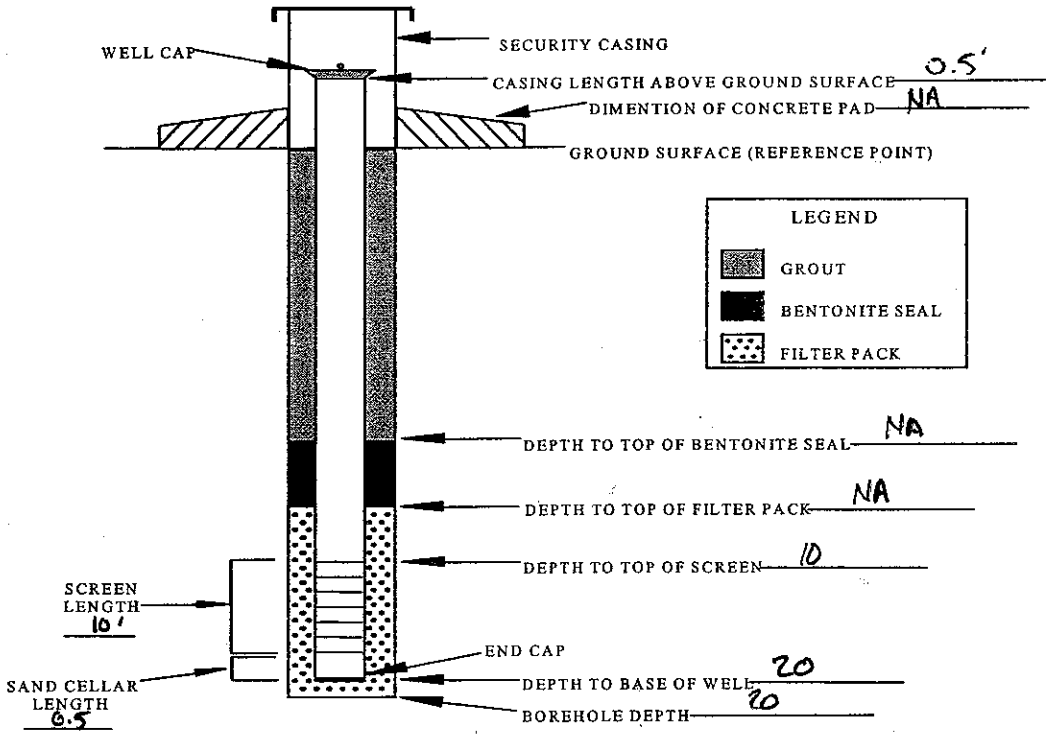
00107349 47DPT07

WELL COMPLETION FORM (Stickup or Above Grade Completion Well)

FIELD REPRESENTATIVE: Allen Willmore
DRILLING CONTRACTOR: QRI
DRILLING TECHNIQUE: Direct Push
AUGER SIZE AND TYPE:
BOREHOLE IDENTIFICATION: 47DPT
BOREHOLE DIAMETER: 2¼"
WELL IDENTIFICATION: 47DPT
WELL CONSTRUCTION START DATE: 8/19/10
WELL CONSTRUCTION COMPLETE DATE: 8/19/10
SCREEN MATERIAL: Sch. 40 PVC
SCREEN DIAMETER: 1"
STRATUM-SCREENED INTERVAL (FT): 10
CASING MATERIAL: Sch. 40 PVC
CASING DIAMETER: 1"

TYPE OF FILTER PACK: None
GRADIATION: NA
AMOUNT OF FILTER PACK USED: NA
TYPE OF BENTONITE: Pellets
AMOUNT BENTONITE USED: (.5-30 lb bags)
TYPE OF CEMENT: NA
AMOUNT CEMENT USED: NA
GROUT MATERIALS USED: NA
DIMENSIONS OF SECURITY CASING: NA
TYPE OF WELL CAP: 1" slip caps
TYPE OF END CAP: 1" threaded PVC cone stump
COMMENTS:

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: Jason New
INSTALLATION OBSERVED BY: Allen Willmore
DISCREPANCIES: Bentonite pellets ~~at~~ rest above a plastic bag set 6" deep.

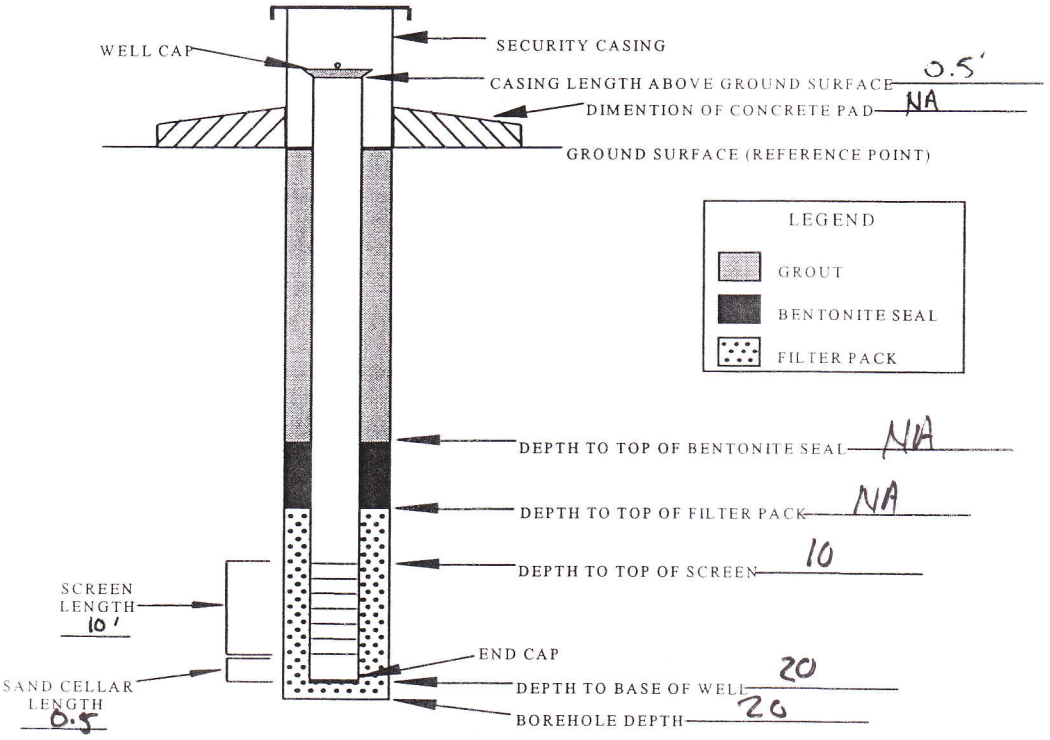
00107350 47DPT 08

WELL COMPLETION FORM (Stickup or Above Grade Completion Well)

FIELD REPRESENTATIVE: Allen Willmore
DRILLING CONTRACTOR: QRI
DRILLING TECHNIQUE: Direct Push
AUGER SIZE AND TYPE:
BOREHOLE IDENTIFICATION: 47DPT
BOREHOLE DIAMETER: 2¼"
WELL IDENTIFICATION: 47DPT
WELL CONSTRUCTION START DATE: 8/19/10
WELL CONSTRUCTION COMPLETE DATE: 8/19/10
SCREEN MATERIAL: Sch. 40 PVC
SCREEN DIAMETER: 1"
STRATUM-SCREENED INTERVAL (FT): 10
CASING MATERIAL: Sch. 40 PVC
CASING DIAMETER: 1"

TYPE OF FILTER PACK: None
GRADIATION: NA
AMOUNT OF FILTER PACK USED: NA
TYPE OF BENTONITE: Pellets
AMOUNT BENTONITE USED: 1.5-30 lb bags
TYPE OF CEMENT: NA
AMOUNT CEMENT USED: NA
GROUT MATERIALS USED: NA
DIMENSIONS OF SECURITY CASING: NA
TYPE OF WELL CAP: 1" slip caps
TYPE OF END CAP: 1" threaded PVC cone slump
COMMENTS:

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: Jason New
INSTALLATION OBSERVED BY: Allen Willmore
DISCREPANCIES: Bentonite pellets rest above a plastic Bag set 6" deep

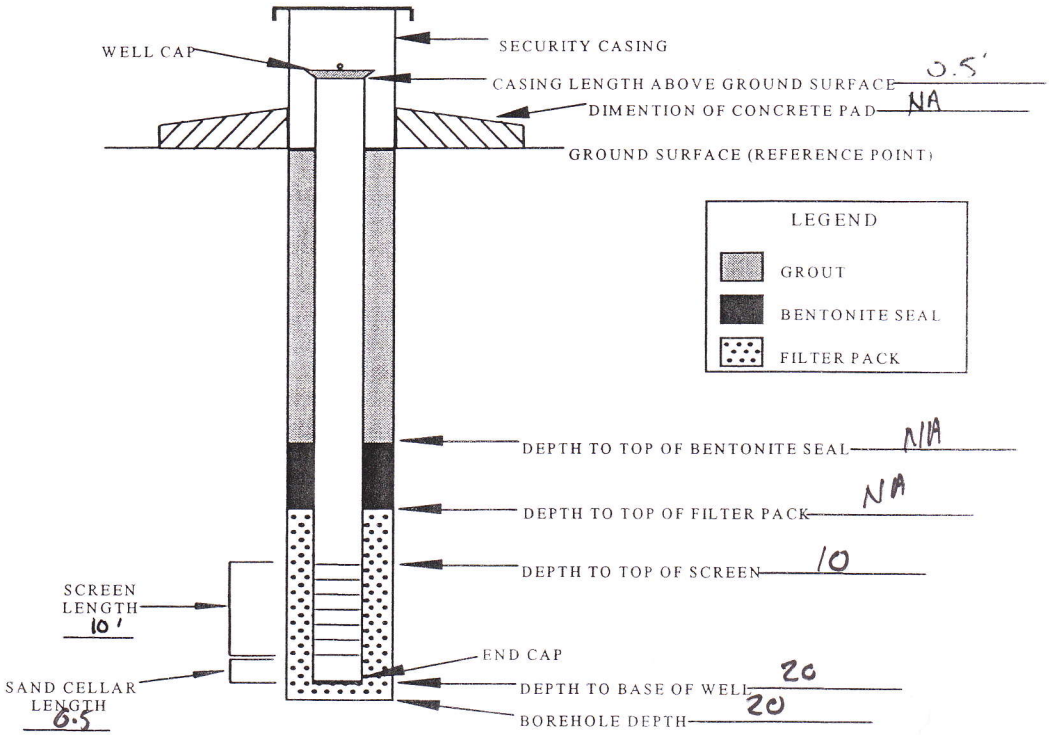
00107351 47DPT09

WELL COMPLETION FORM (Stickup or Above Grade Completion Well)

FIELD REPRESENTATIVE: Allen Willmore
DRILLING CONTRACTOR: ORI
DRILLING TECHNIQUE: Direct Push
AUGER SIZE AND TYPE:
BOREHOLE IDENTIFICATION: 47DPT
BOREHOLE DIAMETER: 2¼"
WELL IDENTIFICATION: 47DPT
WELL CONSTRUCTION START DATE: 8/19/10
WELL CONSTRUCTION COMPLETE DATE: 8/19/10
SCREEN MATERIAL: Sch. 40 PVC
SCREEN DIAMETER: 1"
STRATUM-SCREENED INTERVAL (FT): 10
CASING MATERIAL: Sch. 40 PVC
CASING DIAMETER: 1"

TYPE OF FILTER PACK: None
GRADIATION: NA
AMOUNT OF FILTER PACK USED: NA
TYPE OF BENTONITE: Pellets
AMOUNT BENTONITE USED: 1.5-30 lb bags
TYPE OF CEMENT: NA
AMOUNT CEMENT USED: NA
GROUT MATERIALS USED: NA
DIMENSIONS OF SECURITY CASING: NA
TYPE OF WELL CAP: 1" slip caps
TYPE OF END CAP: 1" threaded PVC cone slum
COMMENTS:

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: Jason New
INSTALLATION OBSERVED BY: Allen Willmore
DISCREPANCIES: Bentonite pellets rest above a plastic bag set 6" deep.

00107352

HOLE NO. 47DPT10

DRILLING LOG

DIVISION FEDERAL

INSTALLATION LHAAP

SHEET 1 OF 2 SHEETS

1. PROJECT LONGHORN AAP
2. LOCATION (Coordinates or Station) Karnack TX
3. DRILLING AGENCY QRI
4. HOLE NO. (As shown on drawing title and file number) 47DPT10
5. NAME OF DRILLER Jason New
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN —
8. DEPTH DRILLED INTO ROCK —
9. TOTAL DEPTH OF HOLE 25'
10. SIZE AND TYPE OF BIT Geoprobe
11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
12. MANUFACTURER'S DESIGNATION OF DRILL 6610 DT
13. OVERBURDEN SAMPLES — DISTURBED — UNDISTURBED ✓
14. TOTAL NUMBER CORE BOXES NA
15. ELEVATION GROUND WATER —
16. DATE HOLE STARTED 8/17/10 COMPLETED 8/17/10
17. ELEVATION TOP OF HOLE NA
18. TOTAL CORE RECOVERY FOR BORING 100 %

ALLEN WILLMORE — INSPECTOR

ELEVATION PID (a)	DEPTH (b)	LEGEND USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
		SP	SAND, SILTY, BROWN, DRY, LOOSE			0900 - Began drilling
						10:20 - Began Setting Temp monitoring well @ 25' bgs
16.8			CLAY, SANDY, MOTTLED, GRAY TO BROWN DRY	100%		
	5	CL				
2.6			- BECOMES SILTY, IRON STAINING MOTTLED	100%		
3.2				100%		
	10					
3.6				100%		

00107353 HOLE NO. 47DPT10

DRILLING LOG	DIVISION FEDERAL	INSTALLATION LHAAP	SHEET 2 OF 2 SHEETS

1. PROJECT: LONGHORN AAP		10. SIZE AND TYPE OF BIT: Geoprobe	
2. LOCATION (Coordinates or Station): KARNACK, TX		11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
3. DRILLING AGENCY: QRI		12. MANUFACTURER'S DESIGNATION OF DRILL: 6610 DT	
4. HOLE NO. (As shown on drawing title and file number): 47DPT10		13. OVERBURDEN SAMPLES	DISTURBED / UNDISTURBED ✓
5. NAME OF DRILLER: Jason New		14. TOTAL NUMBER CORE BOXES: NA	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: NA	
		16. DATE HOLE: STARTED 8/17/16	COMPLETED 8/17/16
7. THICKNESS OF OVERBURDEN: —		17. ELEVATION TOP OF HOLE	
8. DEPTH DRILLED INTO ROCK: —		18. TOTAL CORE RECOVERY FOR BORING: 100 %	
9. TOTAL DEPTH OF HOLE: 25'		A. Willmore	INSPECTOR

ELEVATION PID (a)	DEPTH (b)	LEGEND USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
4.6	15		- BECOMES MORE SILTY, MOIST	100%		
4.5		SC	SAND, VERY CLAYEY, MOTTLED MOIST TO WET, IRON STAINING, DENSE	100%		
3.1	20	SP	~~END OF BORING @ 19'~~ - BECOMES SILTY, MORE SAND CONTENT, GRAY, MOTTLED, WET TO SATURATED	100%		
			END OF BORING @ 25' BGS	100%		

00107354

HOLE NO. 47DPT11

DRILLING LOG

DIVISION

INSTALLATION: LHAAP

SHEET 1 OF 2 SHEETS

1. PROJECT: LONGHORN AAP
2. LOCATION (Coordinates or Station): KARNACK, TX
3. DRILLING AGENCY: GRI
4. HOLE NO. (As shown on drawing title and file number): 47DPT11
5. NAME OF DRILLER: JASON NEW
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: NR
8. DEPTH DRILLED INTO ROCK: NA
9. TOTAL DEPTH OF HOLE: 25'
10. SIZE AND TYPE OF BIT:
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: 6610 DT
13. OVERBURDEN SAMPLES: DISTURBED / UNDISTURBED ✓
14. TOTAL NUMBER CORE BOXES: NA
15. ELEVATION GROUND WATER: NA
16. DATE HOLE: STARTED 8/18/10 COMPLETED 8/18/10
17. ELEVATION TOP OF HOLE: NA
18. TOTAL CORE RECOVERY FOR BORING: 100 %

A. Willmore — INSPECTOR

ELEVATION PID (a)	DEPTH (b)	LEGEND USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
		SC	SAND, SILTY, DRY, BROWN, WELL SORTED, LOOSE, NO ODOR			1430 - Began drilling 1500 - Completed borehole 1505 - Began setting Temp Monitoring well @ 25' bgs.
2.3		CL	CLAY, SANDY, DRY, MOTTLED, NO PLASTICITY, STIFF	100%		
	5		- LOW PLASTICITY, GRAY			
4.2				100%		
	10		- BECOMES HARD			
11.1				100%		

00107355

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE NR

Hole No. 47 DPT 11

PROJECT LHAAD

INSTALLATION LONGHORN AAP

SHEET 2 OF 2 SHEETS

ELEVATION PID (a)	DEPTH (b)	LEGEND USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
0.0	15		-BECOMES SLIGHTLY DAMP, SOFTER, MORE SANDY -2" sand seam @ 14.5', MOIST	100%		
0.1			-2' Sand Seam MOIST	100%		
0.0	20	SC	SAND, CLAYEY, POORLY SORTED, BROWN MOTTLED, WET, NO ODOR, DENSE	100%		
0.1		SP	-BECOMES SILTY, WELL SORTED, WET, GRAY, NO ODOR, DENSE	100%		
	25		End of Boring 25'			TOOK H_2O sample

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PROJECT

HOLE NO.

00107356

HOLE NO. 47DP712

DRILLING LOG

DIVISION: FEDERAL

INSTALLATION: LHAAP

SHEET 1 OF 2 SHEETS

1. PROJECT: LONGHORN AAP
2. LOCATION (Coordinates or Station): Karnack, Tx
3. DRILLING AGENCY: QR1
4. HOLE NO. (As shown on drawing title and file number): 47DP712
5. NAME OF DRILLER: Jason New
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: NR
8. DEPTH DRILLED INTO ROCK: NA
9. TOTAL DEPTH OF HOLE: 25'
10. SIZE AND TYPE OF BIT: 2"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: 6610 DT
13. OVERBURDEN SAMPLES: DISTURBED 1 ; UNDISTURBED ✓
14. TOTAL NUMBER CORE BOXES: NR
15. ELEVATION GROUND WATER: NR
16. DATE HOLE: STARTED 8/17/10 COMPLETED 8/17/10
17. ELEVATION TOP OF HOLE: NR
18. TOTAL CORE RECOVERY FOR BORING: NR %

ALLEN WILLMORE — INSPECTOR

ELEVATION PID (a)	DEPTH (b)	LEGEND USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
0.0	0		SAND, SILTY, LOOSE, DRY, GRAY, POORLY SORTED, NO ODOR	100%		1535 - Began advancing 47DP712
		CL	CLAY, SANDY, GRAY, NO PLASTICITY, DRY, NO ODOR, SOFT, ~~AT~~ @			1600 - Began Setting TMW @ 25' bgs
0.0	5		- BECOMES MODERATELY STIFF	100%		
			- LOW PLASTICITY, MOTTLED			
0.0	10		- 2" Sand Seam @ 11.7' bgs.	100%		

00107357

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE | Hole No. 47DPT12

PROJECT: LHAAP | INSTALLATION: LHAAP | SHEET 2 OF 2 SHEETS

PID ELEVATION (a)	DEPTH (b)	USCS LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
		SC	SAND, CLAY, MOTTLED, DENSE, GRAY, MOIST, NO ODOR			
0.0	15	CL	CLAY, SILTY, HARD, MOTTLING, NO PLASTICITY	100%		
			-3" wet clay 707	100%		
0.0		SC	SAND, SILTY, DENSE, GRAY, MOTTLING, MOIST, NO ODOR			
	20					
NR		SP	-3" DRY CLAY SEAM	100%		
NR				100%		
	25		End of Boring 25'			

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PROJECT | HOLE NO.

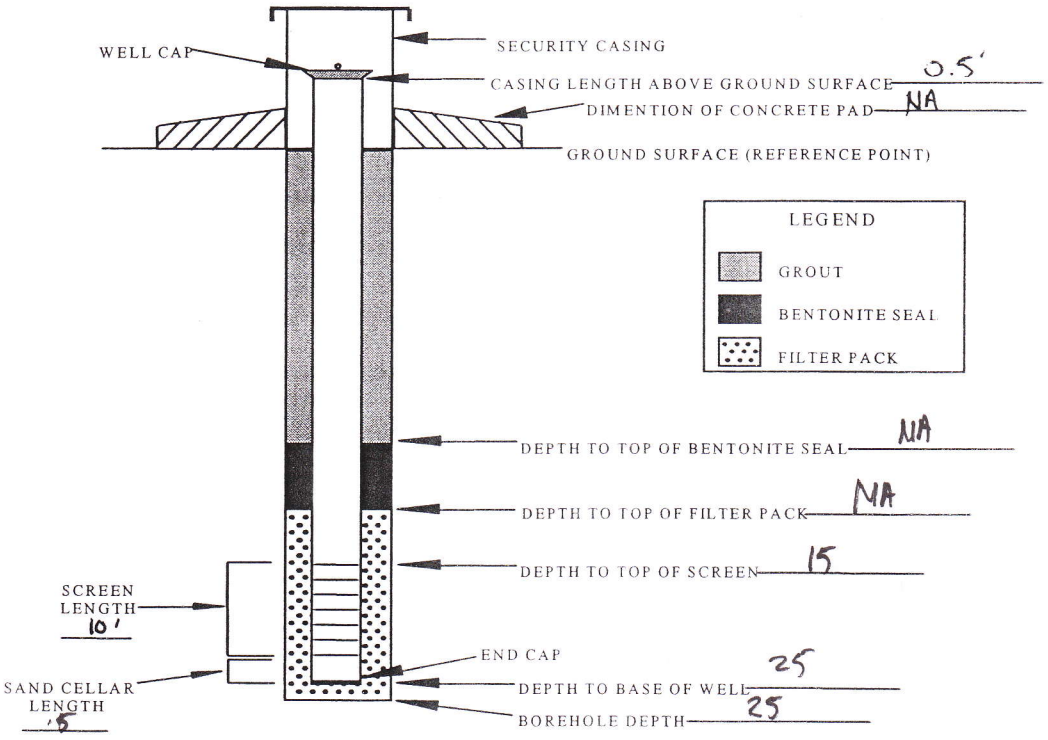
00107358 47DPT10

WELL COMPLETION FORM (Stickup or Above Grade Completion Well)

FIELD REPRESENTATIVE: Allen Willmore
DRILLING CONTRACTOR: QRI
DRILLING TECHNIQUE: Direct Push
AUGER SIZE AND TYPE:
BOREHOLE IDENTIFICATION: 47DPT
BOREHOLE DIAMETER: 2¼"
WELL IDENTIFICATION: 47DPT
WELL CONSTRUCTION START DATE: 8/17/10
WELL CONSTRUCTION COMPLETE DATE: 8/17/10
SCREEN MATERIAL: Sch. 40 PVC
SCREEN DIAMETER: 1"
STRATUM-SCREENED INTERVAL (FT): 10
CASING MATERIAL: Sch. 40 PVC
CASING DIAMETER: 1"

TYPE OF FILTER PACK: None
GRADIATION: NA
AMOUNT OF FILTER PACK USED: NA
TYPE OF BENTONITE: Pellets
AMOUNT BENTONITE USED: 1.5 - 50 lb bags
TYPE OF CEMENT: NA
AMOUNT CEMENT USED: NA
GROUT MATERIALS USED: NA
DIMENSIONS OF SECURITY CASING: NA
TYPE OF WELL CAP: 1" slip caps
TYPE OF END CAP: 1" threaded PVC cone slump
COMMENTS:

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: Jason New
INSTALLATION OBSERVED BY: Allen Willmore
DISCREPANCIES: Bentonite pellets rest above a plastic bag set 6" deep.

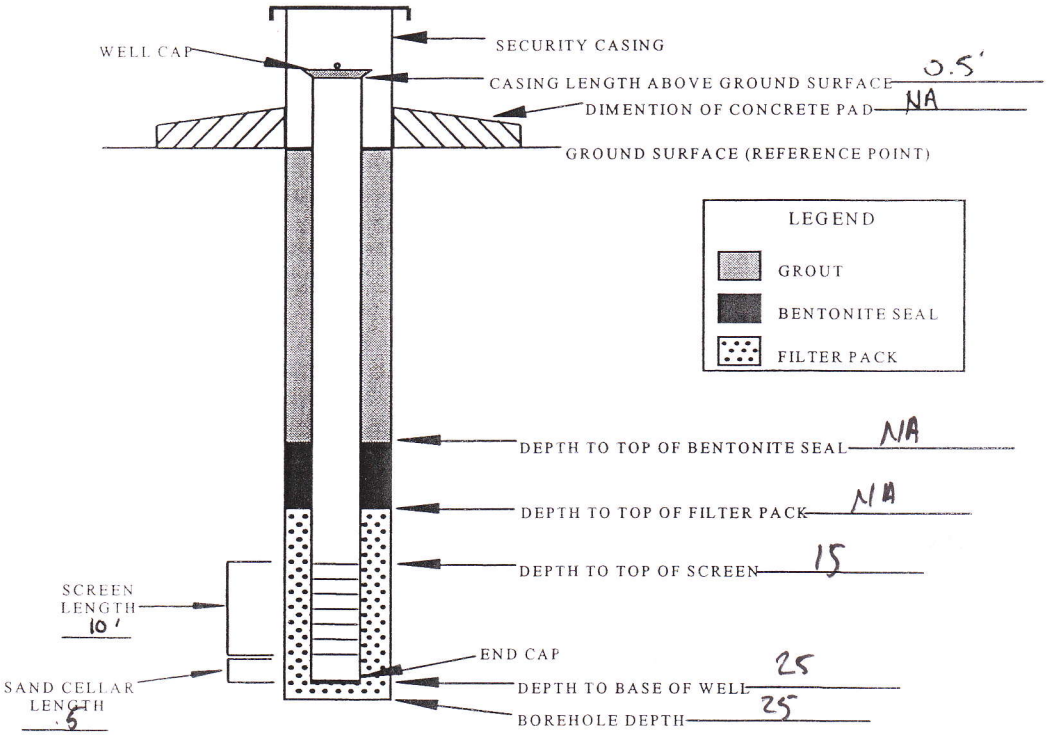
00107359 47DPT11

WELL COMPLETION FORM (Stickup or Above Grade Completion Well)

FIELD REPRESENTATIVE: Allen Willmore
DRILLING CONTRACTOR: QR1
DRILLING TECHNIQUE: Direct Push
AUGER SIZE AND TYPE:
BOREHOLE IDENTIFICATION: 47DPT
BOREHOLE DIAMETER: 2¼"
WELL IDENTIFICATION: 47DPT
WELL CONSTRUCTION START DATE: 8/18/10
WELL CONSTRUCTION COMPLETE DATE: 8/18/10
SCREEN MATERIAL: Sch. 40 PVC
SCREEN DIAMETER: 1"
STRATUM-SCREENED INTERVAL (FT): 10
CASING MATERIAL: Sch. 40 PVC
CASING DIAMETER: 1"

TYPE OF FILTER PACK: None
GRADIATION: NA
AMOUNT OF FILTER PACK USED: NA
TYPE OF BENTONITE: Pellets
AMOUNT BENTONITE USED: 1.5-50 lb bags
TYPE OF CEMENT: NA
AMOUNT CEMENT USED: NA
GROUT MATERIALS USED: NA
DIMENSIONS OF SECURITY CASING: NA
TYPE OF WELL CAP: 1" slip caps
TYPE OF END CAP: 1" threaded PVC cone slump
COMMENTS:

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: Jason New
INSTALLATION OBSERVED BY: Allen Willmore
DISCREPANCIES: Bentonite pellets rest above a plastic bag set 4" deep

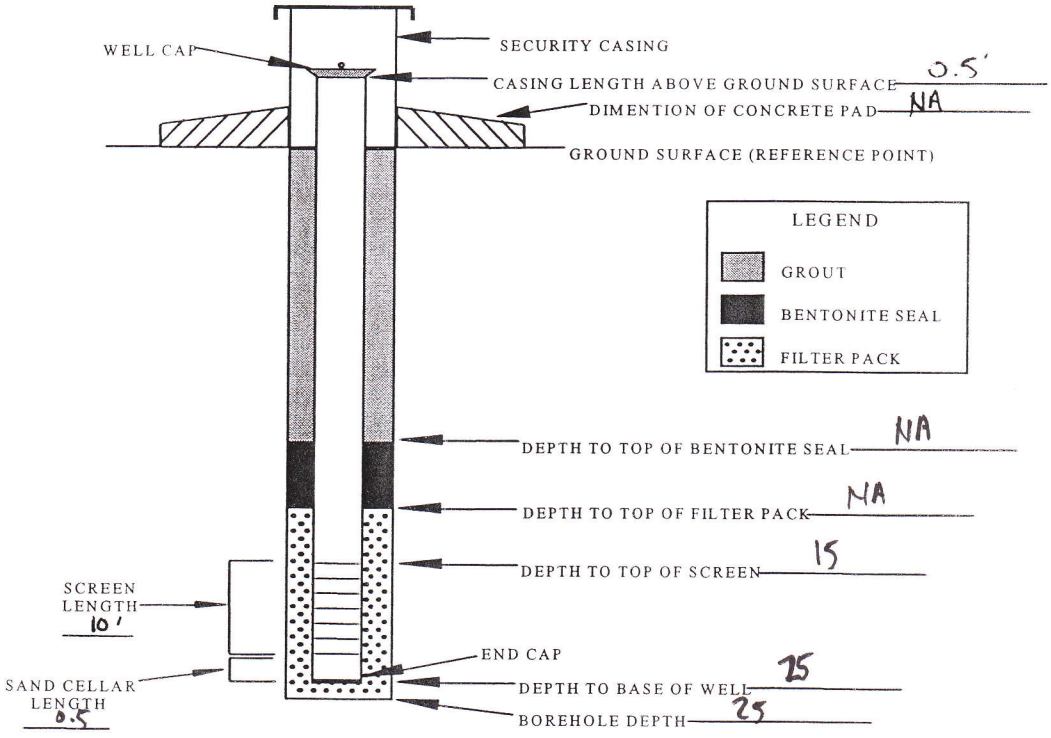
00107360 47DPT 12

WELL COMPLETION FORM (Stickup or Above Grade Completion Well)

FIELD REPRESENTATIVE: Allen Willmore
DRILLING CONTRACTOR: QRI
DRILLING TECHNIQUE: Direct Push
AUGER SIZE AND TYPE:
BOREHOLE IDENTIFICATION: 47DPT
BOREHOLE DIAMETER: 2¼"
WELL IDENTIFICATION: 47DPT
WELL CONSTRUCTION START DATE: 8/17/10
WELL CONSTRUCTION COMPLETE DATE: 8/17/10
SCREEN MATERIAL: Sch. 40 PVC
SCREEN DIAMETER: 1"
STRATUM-SCREENED INTERVAL (FT): 10
CASING MATERIAL: Sch. 40 PVC
CASING DIAMETER: 1"

TYPE OF FILTER PACK: None
GRADIATION: NA
AMOUNT OF FILTER PACK USED: NA
TYPE OF BENTONITE: Pellets
AMOUNT BENTONITE USED: 1.5 - 50 lb bags
TYPE OF CEMENT: NA
AMOUNT CEMENT USED: NA
GROUT MATERIALS USED: NA
DIMENSIONS OF SECURITY CASING: NA
TYPE OF WELL CAP: 1" slip caps
TYPE OF END CAP: 1" threaded PVC cone slump
COMMENTS:

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: Jason New
INSTALLATION OBSERVED BY: Allen Willmore
DISCREPANCIES: Bentonite pellets rest above a plastic bag set 6" deep

00107361

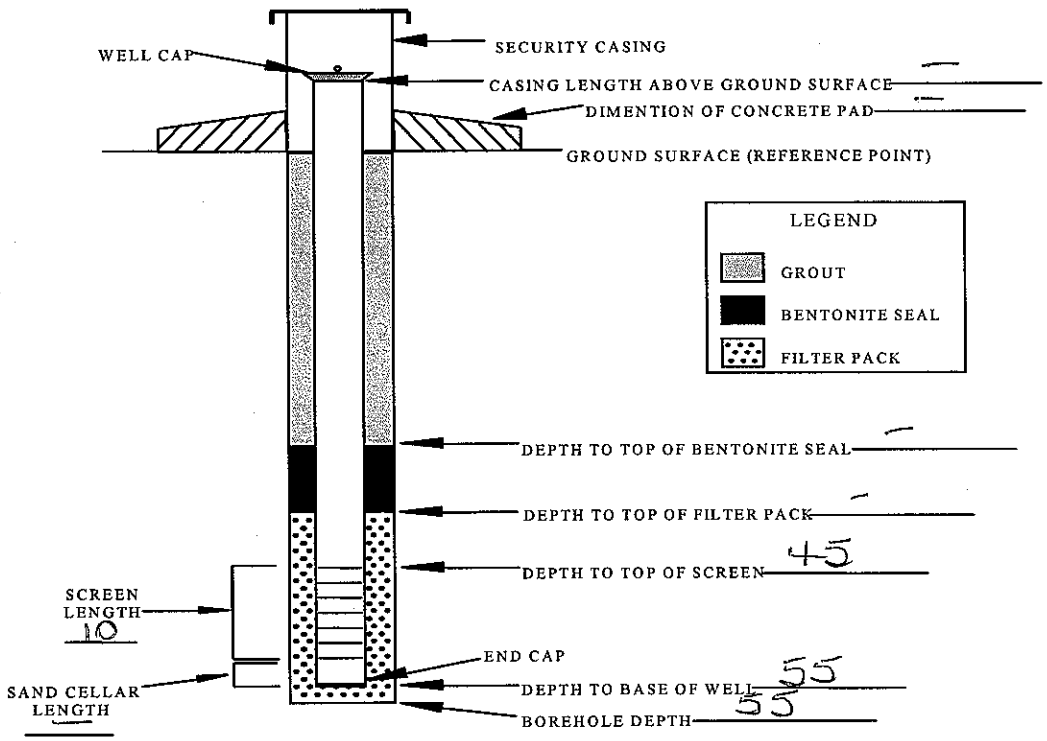
47 DPT 10 I

WELL COMPLETION FORM (Stickup or Above Grade Completion Well)

FIELD REPRESENTATIVE: Allen, Susan
DRILLING CONTRACTOR: QRI
DRILLING TECHNIQUE: Direct Push
AUGER SIZE AND TYPE: _____
BOREHOLE IDENTIFICATION: 47 DPT 10 I
BOREHOLE DIAMETER: 2.25
WELL IDENTIFICATION: 47 DPT 10 I
WELL CONSTRUCTION START DATE: 09/02/10
09/03/10 WELL CONSTRUCTION COMPLETE DATE: 09/02/10
SCREEN MATERIAL: Sch 40 PVC
SCREEN DIAMETER: 1"
STRATUM-SCREENED INTERVAL (FT): 45-55
CASING MATERIAL: N/A Sch 40 PVC
CASING DIAMETER: 1"

TYPE OF FILTER PACK: N/A
GRADIATION: _____
AMOUNT OF FILTER PACK USED: _____
TYPE OF BENTONITE: N/A
AMOUNT BENTONITE USED: _____
TYPE OF CEMENT: N/A
AMOUNT CEMENT USED: _____
GROUT MATERIALS USED: _____
DIMENSIONS OF SECURITY CASING: N/A
TYPE OF WELL CAP: —
TYPE OF END CAP: Sch 40 PVC
COMMENTS: Temporary Well

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: J. New
INSTALLATION OBSERVED BY: Susan Allen

DISCREPANCIES: Temporary well - due to heaving sands it was necessary to add ~10 gallons of water to well. Will be removed when developed Bentonite pellets placed above plastic bag placed 6" from ground surface.

Allen

00107362

HOLE NO. 47DPT101

BORING LOG

DIVISION

INSTALLATION: LONGHORN AAP

SHEET 1 OF 3 SHEETS

1. PROJECT: LHAAP	9. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
2. LOCATION: LHAAP-47	10. MANUFACTURER'S DESIGNATION OF DRILL: 6610DT
3. DRILLING AGENCY: QRI	11. OVERBURDEN SAMPLES: DISTURBED NA; UNDISTURBED NA
4. HOLE NO. (As shown on drawing title and file number): 47DPT101	12. TOTAL NUMBER CORE BOXES: NA
	13. ELEVATION GROUND WATER: 29' (DTW)
5. NAME OF DRILLER: JASON NEW	14. DATE HOLE: STARTED 09/01/10; COMPLETED 09/01/10
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.	15. ELEVATION TOP OF HOLE
7. TOTAL DEPTH OF HOLE: 55'	16. TOTAL CORE RECOVERY FOR BORING: 100 % See Notes *
8. SIZE AND TYPE OF BIT: DIRECT PUSH	17. LOGGED BY: Susan Oller; QC: KE

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			see remarks →			See Boring Log 47DPT10 for lithology to 25'
	25	CL	Clay, sandy, silty, high plasticity, soft, moist, brown			
1.0	26			100%		
	27		-becomes more sandy -becomes more dense			
	28					
1.2	29		- saturated	100%		
	30					
	31					
	32	SC	Sand, clayey, fine grained, med sort, damp, brown			
0.9	33			100%		
	34					
	35	SM/SP	- becomes more coarse grained			
0.9	36			100%		
	37					

00107363

HOLE NO. 47DPT101

BORING LOG *(cont sheet)*

ELEVATION TOP OF HOLE

SHEET 2 OF 3 SHEETS

1. PROJECT: LONGHORN AAP

2. INSTALLATION: LHAAP-47

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS g
0.9	38		Sand, clayey, coarse-grained, med soft, damp, brown	100%		
	39					
0.0	40			100%		
	41					
0.0	42	SC/ SP		100%		
	43					
	44					Could not collect samples – sand heaving into drillstem causing rods to lock up.
	45					
	46					
	47			NR		
NA	48					
	49					
	50					
	51					
	52					
	53					
	54					

HOLE NO. 00107364 47DPT101

BORING LOG *(cont sheet)* | ELEVATION TOP OF HOLE | SHEET 3 OF 3 SHEETS

1. PROJECT: Longhorn AAP | 2. INSTALLATION: LHAAP-47

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS g
	55		END OF BORING @ 55'			Set 1" Temp. Well @ 55'. Had to add ~10 gallons water to well because of heaving sands. Will remove water during development.
	56					

00107365

HOLE NO. 47 DPT 11 I

BORING LOG

DIVISION

INSTALLATION: LONGHORN AAP

SHEET 1 OF 2 SHEETS

1. PROJECT: LHAAP

2. LOCATION: LHAAP-47

3. DRILLING AGENCY: QRI

4. HOLE NO. (As shown on drawing title and file number): 47,DPT 11 I

5. NAME OF DRILLER: Jason New

6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.

7. TOTAL DEPTH OF HOLE: 55'

8. SIZE AND TYPE OF BIT: 2" DIRECT PUSH (Geoprobe)

9. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL

10. MANUFACTURER'S DESIGNATION OF DRILL: 6610 DT

11. OVERBURDEN SAMPLES: DISTURBED —; UNDISTURBED —

12. TOTAL NUMBER CORE BOXES: NA

13. ELEVATION GROUND WATER: 33' DTW

14. DATE HOLE: STARTED 09/13/10; COMPLETED 09/13/10

15. ELEVATION TOP OF HOLE: —

16. TOTAL CORE RECOVERY FOR BORING: 100 %

17. LOGGED BY: S. Oller; QC: KE

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	25–27	SC	SAND, Clayey, med to fine grained, med sorting, damp, brown - becomes saturated	100%		See 47DPT11 log for 0-25' lithology.
	27–28	CL	Clay, Sandy, no plasticity, dense, damp, brown			
0.0	28–31	SC	Sand, clayey, med grained, med sorting, damp, brown	100%		
	31–32	CL	Clay, sandy, high plasticity, soft, damp, brown to tan			
0.0	32–34	SC	Sand, clayey, med grained, mod sorting, saturated, brown	100%		
	34–35	CL	Clay, Sandy, high plasticity, mod dense, damp brown			Sand is beginning to heave up into drill stem.
0.0	36–38	SC	Sand, clayey, med grained, mod sorting, damp, brown w/ some staining -Saturated	60%		

00107366

HOLE NO. 47 DPT 11 I

BORING LOG *(cont sheet)*

ELEVATION TOP OF HOLE

SHEET 2 OF 2 SHEETS

1. PROJECT LHAAP-47

2. INSTALLATION Longhorn AAP

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS g
0.0	39	SC	Sand	100%		
	40					
	41		same as above			
0.0	42			100%		
	43					
	44					
	45					
0.0	46			100%		
	47	SC				
	48					
0.0	49					
	50			100%		
	51					
0.0	52					
	53			100%		
	54					
	55					

END OF BORING 55'

00107367

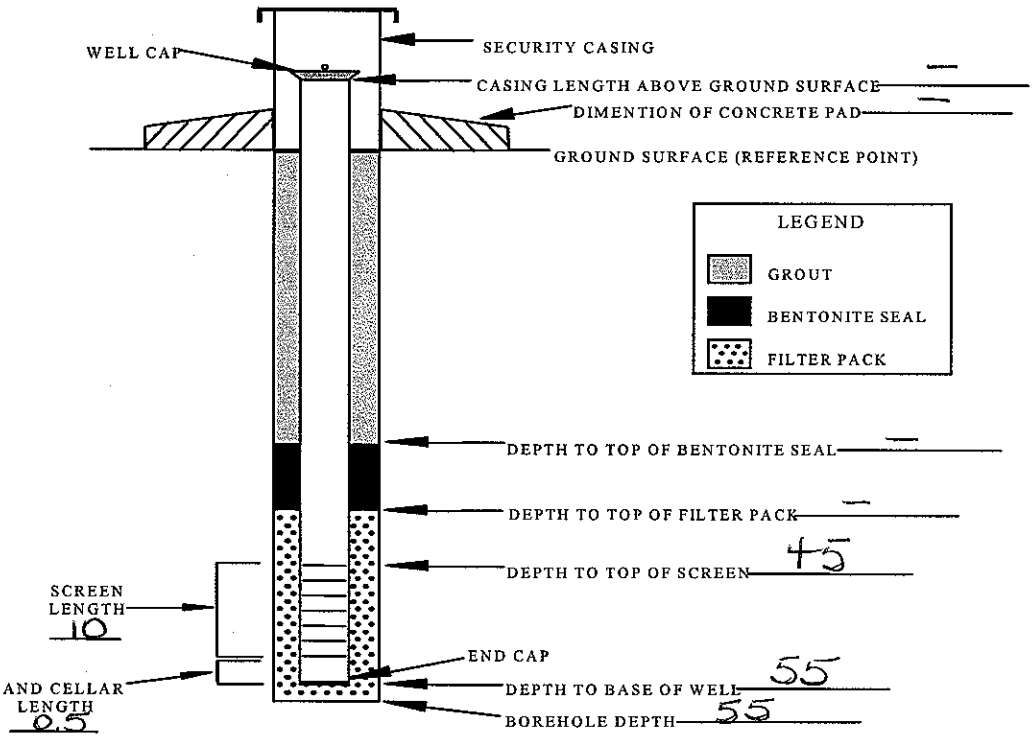
49 DPT 11I

WELL COMPLETION FORM (Stickup or Above Grade Completion Well)

FIELD REPRESENTATIVE: S. Oller
DRILLING CONTRACTOR: QR1
DRILLING TECHNIQUE: Direct Push
AUGER SIZE AND TYPE: —
BOREHOLE IDENTIFICATION: 49 DPT 11I
BOREHOLE DIAMETER: 2.25
WELL IDENTIFICATION: 49 DPT 11 I
WELL CONSTRUCTION START DATE: 09/13/10
WELL CONSTRUCTION COMPLETE DATE: 09/13/10
SCREEN MATERIAL: Sch 40 PVC
SCREEN DIAMETER: 1"
STRATUM-SCREENED INTERVAL (FT): —
CASING MATERIAL: Sch 40 PVC
CASING DIAMETER: 1"

TYPE OF FILTER PACK: —
GRADIATION: —
AMOUNT OF FILTER PACK USED: —
TYPE OF BENTONITE: —
AMOUNT BENTONITE USED: —
TYPE OF CEMENT: —
AMOUNT CEMENT USED: —
GROUT MATERIALS USED: —
DIMENSIONS OF SECURITY CASING: —
TYPE OF WELL CAP: Sch 40 PVC
TYPE OF END CAP: Sch 40 PVC
COMMENTS: Temporary well

SPECIAL CONDITIONS
(describe and draw)



INSTALLED BY: J. New
INSTALLATION OBSERVED BY: S. Oller
DISCREPANCIES: Temporary well - due to heaving sands was necessary to add ~ 4 gallons of water to well. Will be removed when developed. Bentonite pellets placed above plastic bag set about 6" from surface.

00107368

HOLE NO. 47DPT12I

BORING LOG

DIVISION

INSTALLATION: LHAAP

SHEET 1 OF 2 SHEETS

1. PROJECT: LHAAP	9. DATUM FOR ELEVATION SHOWN (TBM or MSL):
2. LOCATION: LHAAP-47	10. MANUFACTURER'S DESIGNATION OF DRILL: 6610DT
3. DRILLING AGENCY: QR1	11. OVERBURDEN SAMPLES: DISTURBED — UNDISTURBED —
4. HOLE NO. (As shown on drawing title and file number): 47DPT12I	12. TOTAL NUMBER CORE BOXES: NA
	13. ELEVATION GROUND WATER: 30.5 (DTW)
5. NAME OF DRILLER: Jason New	14. DATE HOLE: STARTED — COMPLETED —
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION TOP OF HOLE: NA
7. TOTAL DEPTH OF HOLE: 52'	16. TOTAL CORE RECOVERY FOR BORING: 100 %
8. SIZE AND TYPE OF BIT: 2" Direct Push (geoprobe)	17. LOGGED BY: Susan Oller QC: KE

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	26	SC	SAND Clayey, med to fine grained, mod sorting, damp, brown	100%		See 47DPT12 log for 0-25' lithology.
	27					
	28		- becomes finer sand; more clay			
	29					Sand is beginning to heave into rods.
0.0	30	CL	Clay, sandy, high plasticity, soft, moist, brown	100%		
	31	SC	Sand clayey, fine grained, well sorted, saturated, brown			▼
	32					
	33					
0.0	34	CL	Clay, sandy, low plasticity, dense moist, brown	100%		
	35	SC	Sand, clayey, med to fine grained, mod sorting, moist brown			
	36	CL	Clay, sandy, high plasticity, med dense, moist, brown.			
0.0	37			100%		
	38					

00107369

HOLE NO. ~~47DP~~ 12I

BORING LOG *(cont sheet)*

ELEVATION TOP OF HOLE

SHEET 2 OF 2 SHEETS

1. PROJECT LHAAP

2. INSTALLATION LHAAP

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS g
0.0	39	CL	Clay as above	100%		
	40					
	41					
0.0	42			100%		
	43					Clay is becoming expansive.
	44					
	45	CL				
0.0	46		- Color change from brown to gray	100%		
	47					
	48					
	49					
0.0	50			100%		
	51					
	52		End of Boring @ 52'			Temporary Well set @ 40' (Screen @ 30'-40') using 1" PVC casing and screen
	53					
	54					
	55					

00107370

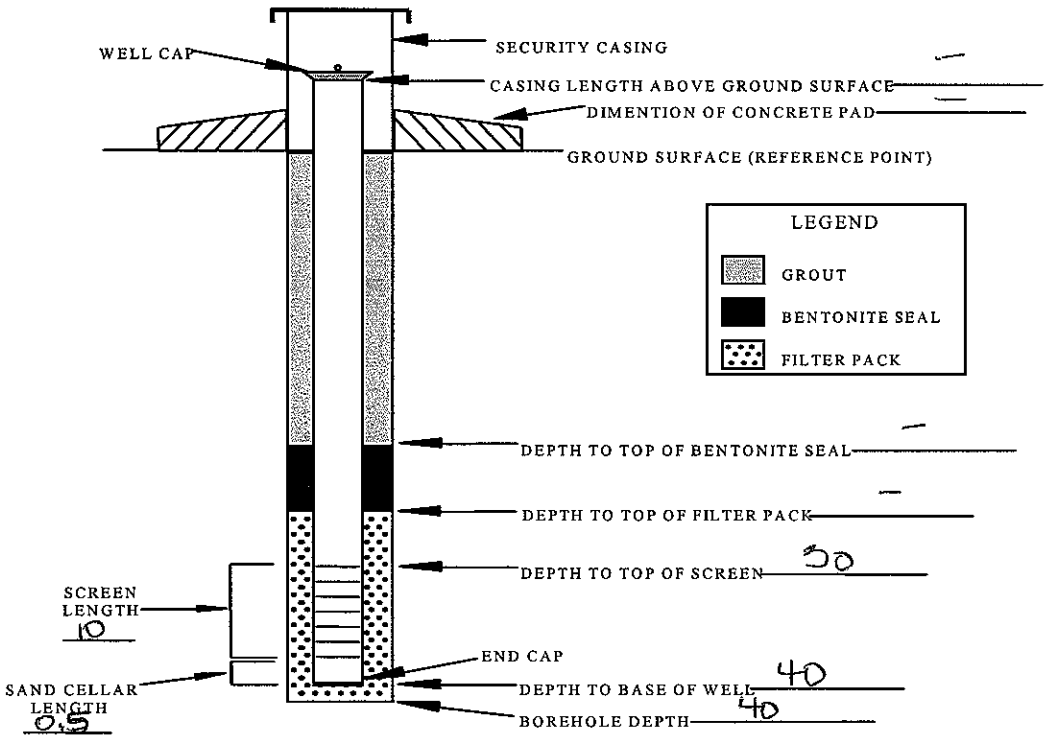
47 DPT 12 I

WELL COMPLETION FORM (Stickup or Above Grade Completion Well)

FIELD REPRESENTATIVE: S. Allen
DRILLING CONTRACTOR: QRI
DRILLING TECHNIQUE: Direct Push
AUGER SIZE AND TYPE: —
BOREHOLE IDENTIFICATION: 47 DPT 12 I
BOREHOLE DIAMETER: 2.25
WELL IDENTIFICATION: 47 DPT 12 I
WELL CONSTRUCTION START DATE: 09/14/10
WELL CONSTRUCTION COMPLETE DATE: —
SCREEN MATERIAL: Sch 40 PVC
SCREEN DIAMETER: 1"
STRATUM-SCREENED INTERVAL (FT): 30-40
CASING MATERIAL: Sch 40 PVC
CASING DIAMETER: 1"

TYPE OF FILTER PACK: —
GRADIATION: —
AMOUNT OF FILTER PACK USED: —
TYPE OF BENTONITE: —
AMOUNT BENTONITE USED: —
TYPE OF CEMENT: —
AMOUNT CEMENT USED: —
GROUT MATERIALS USED: —
DIMENSIONS OF SECURITY CASING: —
TYPE OF WELL CAP: Sch 40 PVC
TYPE OF END CAP: Sch 40 PVC
COMMENTS: Temporary well

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: J. New
INSTALLATION OBSERVED BY: S. Allen
DISCREPANCIES: none / Bentonite pellets placed above plastic bag set about 6" from surface.

00107371 HOLE NO. 47DPT13

DRILLING LOG

DIVISION: Federal

INSTALLATION: Longhorn Army Ammunition Pl.

SHEET 1 OF 2 SHEETS

1. PROJECT: LHAAP
2. LOCATION (Coordinates or Station): Karnack, Texas
3. DRILLING AGENCY: QRI
4. HOLE NO. (As shown on drawing title and file number): 47DPT13
5. NAME OF DRILLER: Jason New
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: NR
8. DEPTH DRILLED INTO ROCK: NR/NA
9. TOTAL DEPTH OF HOLE: 25'
10. SIZE AND TYPE OF BIT: 2"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: 6610 DT
13. OVERBURDEN SAMPLES: DISTURBED ☐ UNDISTURBED ☑
14. TOTAL NUMBER CORE BOXES: NR
15. ELEVATION GROUND WATER: NR
16. DATE HOLE: STARTED 8/18/10 COMPLETED 8/19/10
17. ELEVATION TOP OF HOLE: NR
18. TOTAL CORE RECOVERY FOR BORING ~~NR~~ 100% %

INSPECTOR: Allen Willmore

ELEVATION PID (a)	DEPTH (b)	LEGEND USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
4.3	0	SM	SAND, SILTY, LOOSE, DRY, GRAY,			1325- Begun advancing 47DPT13
			-MOTTLING			
			-BECOMES DENSE	100%		1410- Began setting TW 47DPT13 @ 25' bgs.
			-BECOMES SLIGHTLY DAMP			
	5					
6.2		CL	CLAY, VERY SANDY, DRY, NO PLASTICITY, GRAY, MOTTLING, NO ODOR, SLIGHTLY STIFF			
			-1' SAND SEAM @ 10'	100%		
	10					
4.6			-BECOMES MORE STIFF, SILTY	100%		
			-BECOMES HARD			

00107372

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE NR	Hole No. 47DPT13
PROJECT LHAAP	INSTALLATION LHAAP	SHEET 2 OF 2 SHEETS

PID ~~ELEVATION~~ (a)	DEPTH (b)	USCS LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
		CL	SAME AS ABOVE			
2.3	15	SP	SAND, SILTY, DENSE, WET, BROWN HEAVY IRON STAINING (MOTTLING) GRAY, well-sorted	100%		
1.4				100%		
3.4	20			100%		
3.3				100%		
	25		End of Boring @ 25' bgs			

00107373

14 Allen

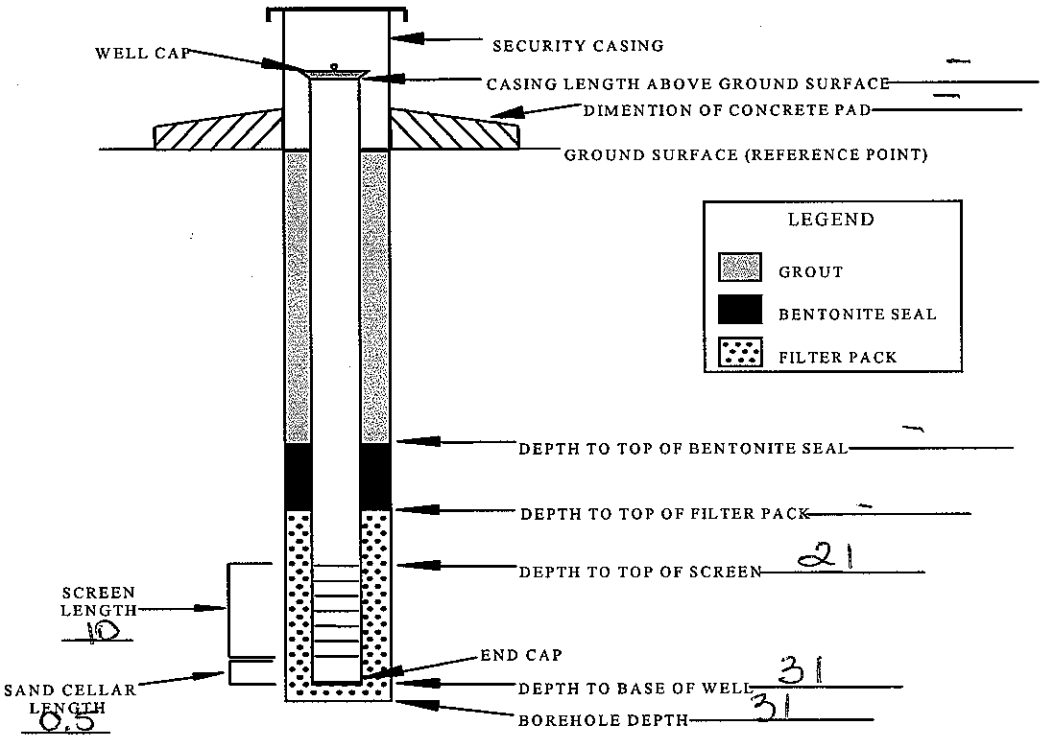
47DPT ~~13~~

WELL COMPLETION FORM (Stickup or Above Grade Completion Well)

FIELD REPRESENTATIVE: S. Oller
DRILLING CONTRACTOR: QBI
DRILLING TECHNIQUE: Direct Push
AUGER SIZE AND TYPE: —
BOREHOLE IDENTIFICATION: 47DPTB14
BOREHOLE DIAMETER: 2.25" (QW)
WELL IDENTIFICATION: 47DPTB14
WELL CONSTRUCTION START DATE: 09/14/10
WELL CONSTRUCTION COMPLETE DATE: —
SCREEN MATERIAL: Sch 40 PVC
SCREEN DIAMETER: 1"
STRATUM-SCREENED INTERVAL (FT): 21-31
CASING MATERIAL: Sch 40 PVC
CASING DIAMETER: 1"

TYPE OF FILTER PACK: —
GRADIATION: —
AMOUNT OF FILTER PACK USED: —
TYPE OF BENTONITE: —
AMOUNT BENTONITE USED: —
TYPE OF CEMENT: —
AMOUNT CEMENT USED: —
GROUT MATERIALS USED: —
DIMENSIONS OF SECURITY CASING: —
TYPE OF WELL CAP: Sch 40 PVC
TYPE OF END CAP: Sch 40 PVC
COMMENTS: Temporary well

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: J. New
INSTALLATION OBSERVED BY: S. Oller

DISCREPANCIES: none / Bentonite pellets placed above plastic bag set about 6" from surface.

00107374

HOLE NO. 47 DPT 14

BORING LOG

DIVISION	
INSTALLATION	LHAAP
SHEET	1 OF 3 SHEETS
1. PROJECT	LHAAP
2. LOCATION	LHAAP-47
3. DRILLING AGENCY	QRI
4. HOLE NO. (As shown on drawing title and file number)	47 DPT 14
5. NAME OF DRILLER	J. New
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.
7. TOTAL DEPTH OF HOLE	31'
8. SIZE AND TYPE OF BIT	Direct Push - 2"
9. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
10. MANUFACTURER'S DESIGNATION OF DRILL	6610 DT
11. OVERBURDEN SAMPLES	DISTURBED — UNDISTURBED —
12. TOTAL NUMBER CORE BOXES	—
13. ELEVATION GROUND WATER	29.5'
14. DATE HOLE	STARTED 09/14/10 COMPLETED 09/14/10
15. ELEVATION TOP OF HOLE	—
16. TOTAL CORE RECOVERY FOR BORING	100 %
17. LOGGED BY	S. Allen QC KE

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		Topsoil - disturbed			
	1	CL	Clay, silty, sandy, no plasticity, dense, dry, brown			
	2			100%		
0.0	3					
	4					
	5					
	6					
0.0	7			100%		
	8					
	9					
	10			100%		
0.0	11		- becomes more sandy w/ some mottling			
	12					

00107375

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE —	Hole No. 47DPT14
PROJECT LHAAP	INSTALLATION LHAAP-41	SHEET 2 OF 3 SHEETS

PID ELEVATION	DEPTH	USCS LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	13		Clay, silty, sandy, no plasticity, dense, dry, brown			
0.0	14			100%		
	15					
	16					
	17					
	18	CL		100%		
0.0	19					
	20					
	21		- becomes more moist			
	22					
0.0	23			100%		
	24					
	25					
	26			100%		
0.0	27					

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE: —

Hole No. 47 DPT 14

PROJECT: LHAAP

INSTALLATION: LHAAP-47

SHEET 3 OF 3 SHEETS

PID ELEVATION (a)	DEPTH (b)	USCS LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
	28					
0.0	29	SC	Sand, clayey, med grain, med sorting, damp brown			
			- saturated	100%		▼
	30					
		CL	Clay, sandy, no plasticity dense, moist, brown			
	31		END of Boring 31'			
	32					Well set at 31'. Screen 21-31'.

09/14/10

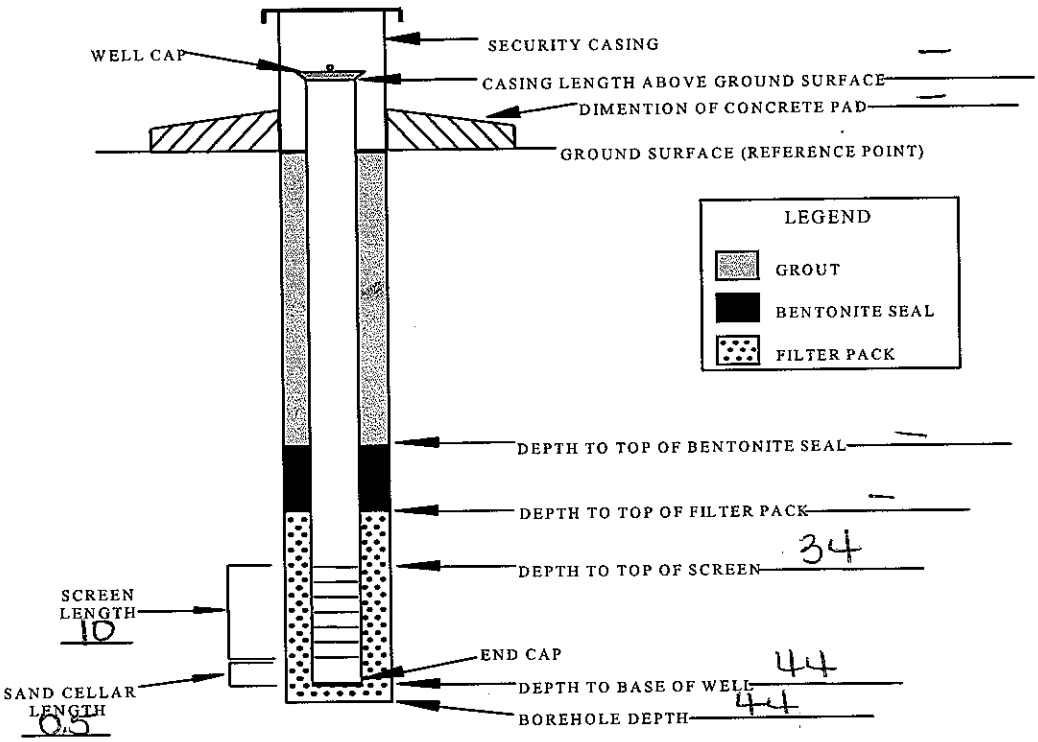
00107377
47DPT15
47DPP

WELL COMPLETION FORM (Stickup or Above Grade Completion Well)

FIELD REPRESENTATIVE: S. Allen
DRILLING CONTRACTOR: QRI
DRILLING TECHNIQUE: Direct Push
AUGER SIZE AND TYPE: —
BOREHOLE IDENTIFICATION: 47DPT15
BOREHOLE DIAMETER: 2.25'
WELL IDENTIFICATION: 47DPT15
WELL CONSTRUCTION START DATE: 09/15/10
WELL CONSTRUCTION COMPLETE DATE: 09/15/10
SCREEN MATERIAL: Sch 40 PVC
SCREEN DIAMETER: 1"
STRATUM-SCREENED INTERVAL (FT): 34-44
CASING MATERIAL: Sch 40 PVC
CASING DIAMETER: 1"

TYPE OF FILTER PACK: —
GRADIATION: —
AMOUNT OF FILTER PACK USED: —
TYPE OF BENTONITE: —
AMOUNT BENTONITE USED: —
TYPE OF CEMENT: —
AMOUNT CEMENT USED: —
GROUT MATERIALS USED: —
DIMENSIONS OF SECURITY CASING: —
TYPE OF WELL CAP: Sch 40 PVC
TYPE OF END CAP: Sch 40 PVC
COMMENTS: Temparary well

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: J. New
INSTALLATION OBSERVED BY: S Allen

DISCREPANCIES: None / Bentonite pellets are placed above plastic placed about 6" from surface.

00107378

HOLE NO. 47DPT15

BORING LOG

DIVISION	
INSTALLATION	LHAAP
SHEET	1 OF 4 SHEETS
1. PROJECT	LHAAP
2. LOCATION	LHAAP-47
3. DRILLING AGENCY	QRI
4. HOLE NO. (As shown on drawing title and file number)	47DPT15
5. NAME OF DRILLER	J. New
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.
7. TOTAL DEPTH OF HOLE	43.5
8. SIZE AND TYPE OF BIT	Direct Push 2"
9. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
10. MANUFACTURER'S DESIGNATION OF DRILL	6610 DT
11. OVERBURDEN SAMPLES	DISTURBED — UNDISTURBED —
12. TOTAL NUMBER CORE BOXES	—
13. ELEVATION GROUND WATER	36 (DTW)
14. DATE HOLE	STARTED 09/15/10 COMPLETED 09/15/10
15. ELEVATION TOP OF HOLE	—
16. TOTAL CORE RECOVERY FOR BORING	100 % See Notes
17. LOGGED BY	J. Oller QC KE

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		Topsoil - disturbed			
	1	CL	Clay, sandy, silty, no plasticity, dense, dry, brown			
0.0	2			100%		
	3		- becomes more moist, soft			
	4					
	5					
	6					
0.0	7		- becomes dry, dense	100%		
	8					
	9					
	10					
0.0	11			100%		
	12					

00107379

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE

Hole No. 41DPT15

SHEET 2 OF 4 SHEETS

PROJECT LHAAP

INSTALLATION LHAAP-47

ELEVATION PID (a)	DEPTH (b)	LEGEND USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
0.0	13 14 15			0%		No sample - Clay has become expansive. No sample. Will start short pushes. - decided to use dual tubes to continue 41 pushes
	16					
	17 18	SC	Sand, clayey, fine grain well sorted, damp to moist, beige to tan			
0.0	19			100%		
	20					
	21	CL	Clay, sandy, no plasticity, dense, moist, brown			
	22					
0.0		SC	Sand, clayey, fine grain, well sorted, moist, brown	100%		
	23	CL	Clay, sandy, low plasticity hard, dry, brown			
	24					
	25	SC	Sand, clayey, silty, fine grain, well sorted, damp brown			
	26		- clayey stringer ~2"			
	27		- clayey stringer ~2"			

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(Page 2 of 2)

PROJECT LHAAP

HOLE NO. 41DPT15

00107380

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE — | Hole No. 47DPT15

PROJECT LHAAP | INSTALLATION LHAAP-47 | SHEET 3 OF 4 SHEETS

ELEVATION PID	DEPTH	LEGEND USCS	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	28		Sand, clayey, silty, fine grained, well sorted, damp, brown			
	29					
0.0	30	SC		100%		
	31					
	32					
	33					
0.0	34	SC		100%		
	35					
	36		- Saturated			
	37					
0.0	38	SC		100%		
	39					
	40					
	41			99%		
0.0	42					
	43					

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PROJECT LHAAP | HOLE NO. 47DPT15

00107381

HOLE NO. 47DPT15

BORING LOG *(cont sheet)* | ELEVATION TOP OF HOLE | SHEET 4 OF 4 SHEETS

1. PROJECT: LHAAP-47 | 2. INSTALLATION: LONGHORN

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS g
0.0	44	SC	Refusal at 44'			Resistant Sand Well set at 44' Screen at 34' to 44'.

00107382

HOLE NO. 47SB-25D-01

BORING LOG	DIVISION: LHAAP	INSTALLATION: LHAAP-47	SHEET 1 OF 3 SHEETS
1. PROJECT: LHAAP		9. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
2. LOCATION: LHAAP-47		10. MANUFACTURER'S DESIGNATION OF DRILL: 6610 DT	
3. DRILLING AGENCY: QR1		11. OVERBURDEN SAMPLES: DISTURBED —	UNDISTURBED —
4. HOLE NO. (As shown on drawing title and file number): 47SB-25D-01		12. TOTAL NUMBER CORE BOXES: —	
		13. ELEVATION GROUND WATER: 25' (DTW)	
5. NAME OF DRILLER: J. New		14. DATE HOLE: STARTED 08/16/10	COMPLETED 08/16/10
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION TOP OF HOLE: —	
7. TOTAL DEPTH OF HOLE: 28'		16. TOTAL CORE RECOVERY FOR BORING: 100 %	
8. SIZE AND TYPE OF BIT: Direct Push		17. LOGGED BY: Olla, S.	QC: KA

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
		OH	Topsoil			
	1	SC	Sand, clayey, med grained med sorting, dry, brown		47SB-25D-01 (0-2)	
0.0	2					
	3		- becomes moist	100%		
	4					
	5	CL	Clay, sandy, low plasticity, dense, moist, brown		47SB-25D-01 (4-6)	
	6					
	7	SC	Sand, clayey, med grain, med sorting, moist, brown			
	8			100%		
0.0	9	CL	Clay, sandy, no plasticity, hard, dry, brown			
	10				47SB-25D-01 (9-11)	
	11	SC	Sand, clayey, med grained, med sorting moist, brown			
		CL	Clay, sandy, med plasticity soft, moist, brow	100%		
0.0	12					
		SC	Sand, clayey, med grained, med sorting, moist, brown			

00107383

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE — | Hole No. 47 SB-250-01

PROJECT LHAAP | INSTALLATION LHAAP-47 (25D) | SHEET 2 OF 3 SHEETS

PID ELEVATION	DEPTH	USCS-LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	13	CL/CH	Clay, sandy, high plasticity, dense, moist, beige			
	14					
0.0	15			100%		
	16					
	17		becomes more dense, no plasticity - hard			
0.0	18			100%		
	19					
	20					
0.0	21			100%		
	22					
	23			100%		
0.0	24	CL	becomes more sandy		47SB-25D-01	23-25' (GW/VZ)
	25		Saturated			
	26					
0.0	27			100%		

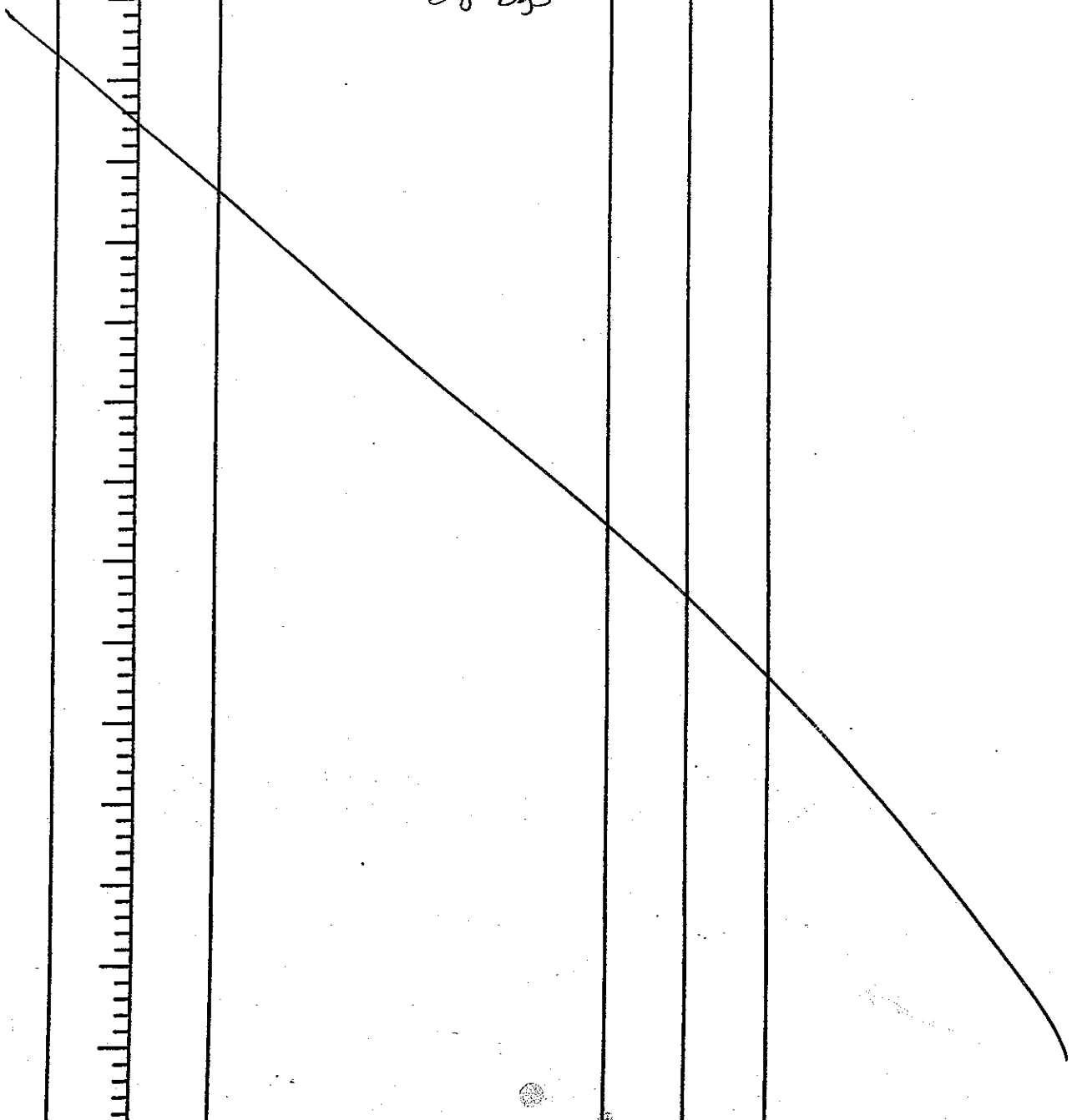
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PROJECT LHAAP | HOLE NO. 47SB-25D-01

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE — | Hole No. 47SB-25D-01

PROJECT: LHAAP | INSTALLATION: LHAAP-47 (25D) | SHEET 3 OF 3 SHEETS

PID ELEVATION (a)	DEPTH (b)	USCS LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
	28	CL	End of Boring 28' bgs			



ENG FORM 1836--APREVIOUS EDITIONS ARE OBSOLETE. MAR 71

PROJECT LHAAP | HOLE NO. 47SB-25D-01

00107385

HOLE NO. ~~47DP1~~ 47SB-25D-02

BORING LOG	DIVISION LHAAP	INSTALLATION LHAAP-47 (25D)	SHEET 1 OF 2 SHEETS
1. PROJECT LHAAP		9. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
2. LOCATION LHAAP-47 (25D)		10. MANUFACTURER'S DESIGNATION OF DRILL 6610 DT	
3. DRILLING AGENCY QR1		11. OVERBURDEN SAMPLES	DISTURBED — UNDISTURBED —
4. HOLE NO. (As shown on drawing title and file number) 47SB-25D-02		12. TOTAL NUMBER CORE BOXES —	
		13. ELEVATION GROUND WATER 231 (DTW)	
5. NAME OF DRILLER J New		14. DATE HOLE STARTED 08/13/2010	COMPLETED 08/13/10
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION TOP OF HOLE —	
7. TOTAL DEPTH OF HOLE 25'		16. TOTAL CORE RECOVERY FOR BORING 100 %	
8. SIZE AND TYPE OF BIT Direct Push		17. LOGGED BY Allen, S.	QC KE

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	OH	Topsoil			
	1	CL	Clay, sandy; low-plasticity, dense-hard, dry, brown			
	2				0-2	12:55 ~~47SB~~ 47SB-25D-02 (0-2)
0.0	3			100%		
	4		-becomes more plasticity, soft			
	5				4-6	13:00 47SB-25D-02 (4-6)
	6		-becomes more dense			
	7					
0.0	8					
	9			100%		
	10				9-11	13:05 47SB-25D-02 (9-11)
	11	CH	-becomes more plasticity, moist			
	12			100%		

00107386

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE

Hole No. 47SB-25D-02

PROJECT: LHAAD

INSTALLATION: LHAAP-47 (25D)

SHEET 2 OF 2 SHEETS

PID ELEVATION a	DEPTH b	USCS LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	13	CH				Lt expansive clay will start 2-3 pushes
	14					
	15	CL	becomes more sandy	100%		
	16					
	17					
	18			100%		
	19					
	20			100%		
	21					
	22		dry			47SB-25D-02 20-22' (GW/VZ)
	23		saturated			
	24	CL		100%		
	25		END of Boring			
	26					
	27					

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MAR 71

PROJECT: LHAAP

HOLE NO. 47SB-25D-02

00107387

HOLE NO. 47SB-25D-03

BORING LOG	DIVISION: LHAAP	INSTALLATION: LHAAP-47 (25D)	SHEET 1 OF 2 SHEETS
1. PROJECT: LHAAP		9. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
2. LOCATION: LHAAP-47 (25D)		10. MANUFACTURER'S DESIGNATION OF DRILL: 6610 DT	
3. DRILLING AGENCY: QR1		11. OVERBURDEN SAMPLES: DISTURBED —	UNDISTURBED —
4. HOLE NO. (As shown on drawing title and file number): 47SB-25D-03		12. TOTAL NUMBER CORE BOXES: —	
		13. ELEVATION GROUND WATER: 19.5, (DTW)	
5. NAME OF DRILLER: J. New		14. DATE HOLE: STARTED 08/16/10	COMPLETED 08/16/10
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION TOP OF HOLE: —	
7. TOTAL DEPTH OF HOLE: 22		16. TOTAL CORE RECOVERY FOR BORING: 100 %	
8. SIZE AND TYPE OF BIT: Direct Push		17. LOGGED BY: Allen, S	QC KR

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	OH	Topsoil			
	1	CL	Clay, Sandy, no plasticity, hard, dry, brown			47SB-25D-03 (0-2)
	2			100%		
0.0	3		- becomes more plastic & softer			
	4					
	5		- becomes more sandy			47SB-25D-03 (4-6)
	6					
	7					
0.0	8			100%		
	9					
	10					47SB25D-03 (9-11)
	11	SC	Sand, clayey, med grain, med sorting, moist, brown			
0.0	12			100%		

00107388

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE | Hole No. 47SB-25D-03

PROJECT: LHAAP | INSTALLATION: LHAAP-47 (25D) | SHEET 2 OF 2 SHEETS

PID ELEVATION a	DEPTH b	USCS LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	13	SC				
		CL	Clay, sandy, low plasticity, dense, moist, brown			
	14					
0.0	15	SC	Sand, clayey, med grain, med sorting, moist, grey	100%		
	16					
	17	CL	Clay, sandy, no plasticity, hard dry, brown			
0.0	18	SC	Sand, clayey med grained, med sorting, moist, grey	100%		
	19		saturated			47SB-25D-03 17-19' (GW/VZ)
	20			100%		
0.0	21					
	22		End of Boring			
	23					
	24					
	25					
	26					
	27					

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PROJECT: LHAAP | HOLE NO.: 47SB-25D-03

00107389

HOLE NO. 47SB-25D-04

BORING LOG	DIVISION: LHAAP	INSTALLATION: LHAAP-47 (25D)	SHEET 1 OF 2 SHEETS
1. PROJECT: LHAAP		9. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
2. LOCATION: LHAAP-47 (25D)		10. MANUFACTURER'S DESIGNATION OF DRILL: 6610 DT	
3. DRILLING AGENCY: QR1		11. OVERBURDEN SAMPLES: DISTURBED —	UNDISTURBED —
4. HOLE NO. (As shown on drawing title and file number): 47SB-25D-04		12. TOTAL NUMBER CORE BOXES —	
		13. ELEVATION GROUND WATER: 14.5' (DTW)	
5. NAME OF DRILLER: J. New		14. DATE HOLE: STARTED 08/16/10	COMPLETED 08/16/10
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION TOP OF HOLE —	
7. TOTAL DEPTH OF HOLE: 16'		16. TOTAL CORE RECOVERY FOR BORING: 100 %	
8. SIZE AND TYPE OF BIT: Direct Push		17. LOGGED BY: Allen, S.	QC: KR

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	OH	Topsoil			
	1	CL	Clay, sandy, low ~~plast~~ plasticity, dense, dry, brown to red			47SB-25D-04 (0-2)
	2					
0.0	3	SC	Sand, clayey, med to fine grained, med sorting, moist, brown	100%		
	4					
	5					47SB-25D-04 (4-6)
	6	CL	Clay, sandy, low plasticity, dense, moist, brown			
	7					
0.0	8			100%		
	9					
	10		becomes more sandy			47SB-25-04 (9-11
	11			100%		
0.0	12					
		SC	Sand, clayey, med grain			

00107390

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE ~~+/-~~ ——— | Hole No. 47SB-25D-04

PROJECT | INSTALLATION LHAAP | SHEET 2 OF 2 SHEETS

PID ELEVATION a	DEPTH b	USCS ~~LEGEND~~ c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	13	SC	med sorting, moist, brown			
	14					47SB-25D-04
	15		becomes saturated	100%		▼ 13-15' (GW)
	16		End of Boring			
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					

00107391

HOLE NO. 47SB-25D-05

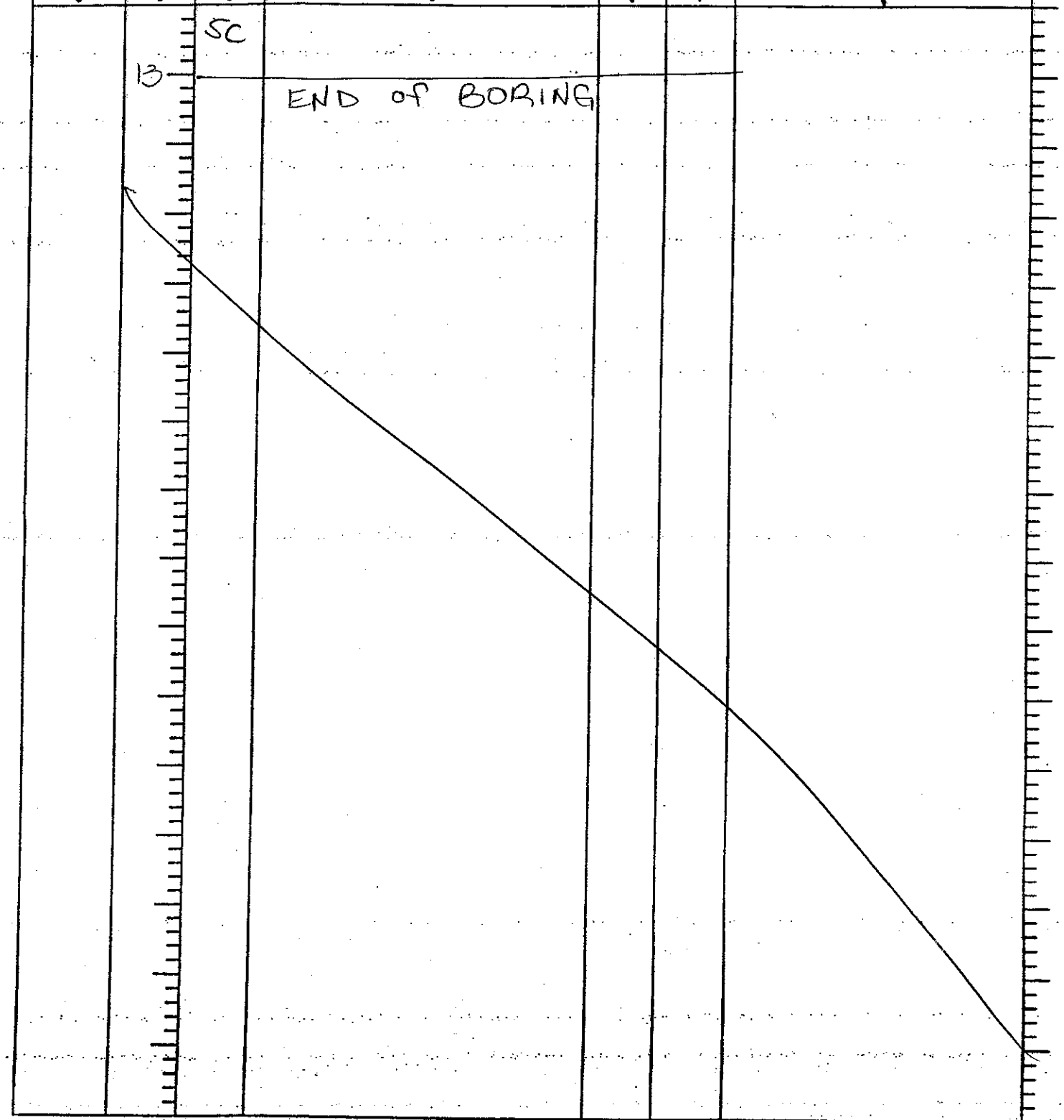
BORING LOG	DIVISION: LHAAP	INSTALLATION: LHAAP-47 (25D	SHEET 1 OF 2 SHEETS
1. PROJECT: LHAAP		9. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
2. LOCATION: LHAAP-47 (25D)		10. MANUFACTURER'S DESIGNATION OF DRILL: 661DDT	
3. DRILLING AGENCY: QRI		11. OVERBURDEN SAMPLES: DISTURBED —	UNDISTURBED —
4. HOLE NO. (As shown on drawing title and file number): 47SB-25D-05		12. TOTAL NUMBER CORE BOXES: —	
		13. ELEVATION GROUND WATER: 12.5' (DTW)	
5. NAME OF DRILLER: J. New		14. DATE HOLE: STARTED 08/16/10	COMPLETED 08/16/10
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION TOP OF HOLE: —	
7. TOTAL DEPTH OF HOLE: 13'		16. TOTAL CORE RECOVERY FOR BORING: 100 %	
8. SIZE AND TYPE OF BIT: Direct Push		17. LOGGED BY: [illegible], S	QC: KA

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	OH	Topsoil			
	1	CL	Clay, sandy, low plasticity, dense, dry, brown			47SB-25D-05 (0-2)
0.0	2					
	3	SC	Sand, clayey, fine grain well to med sorting, dry, brown	100%		
	4					
	5	CL	Clay, sandy, low plasticity, dense, dry, brown			47SB-25D-05 (4-6)
	6					
0.0	7	SC	Sand, clayey, med grain, med sorting, moist, brown	100%		
	8					
	9	CL	Clay, sandy, low plasticity dense, dry, brown			47SB-25D-05 (9-11)
	10					
	11	SC	Sand, clayey, med grain, med sorting damp, brown -becomes saturated	100%		47SB-25D-05 11-13' (GW/VZ)
0.0	12					

00107392

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE	Hole No. 47SB-250-05
PROJECT: LHAAP	INSTALLATION: LHAAP-47	SHEET 2 OF 2 SHEETS

PID ELEVATION (a)	DEPTH (b)	USCS LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
	13	SC	END of BORING			



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MAR 71

PROJECT: LHAAP

HOLE NO.: 47SB-250-05

00107393 HOLE NO. 475BA1

DRILLING LOG	DIVISION FEDERAL	INSTALLATION LONGHORN ARMY AMMUNITION	SHEET 1 OF 2 SHEETS

1. PROJECT	LHAAP	10. SIZE AND TYPE OF BIT	2"
2. LOCATION (Coordinates or Station)	6957629.00 ; 3308991.30	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
3. DRILLING AGENCY	QRI	12. MANUFACTURER'S DESIGNATION OF DRILL	6610 DT
4. HOLE NO. (As shown on drawing title and file number)	475B-A1	13. OVERBURDEN SAMPLES	DISTURBED ✓ / UNDISTURBED
5. NAME OF DRILLER	JASON NEW	14. TOTAL NUMBER CORE BOXES	NR
6. DIRECTION OF HOLE	☑ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.	15. ELEVATION GROUND WATER	NR
		16. DATE HOLE	STARTED 8/24/10 COMPLETED 8/24/10
7. THICKNESS OF OVERBURDEN	NR	17. ELEVATION TOP OF HOLE	NR
8. DEPTH DRILLED INTO ROCK	NA	18. TOTAL CORE RECOVERY FOR BORING	100 %
9. TOTAL DEPTH OF HOLE	17'	ALLEN WILLMORE	INSPECTOR

~~ELEVATION~~ PID (ft) a	DEPTH b	~~LEGEND~~ USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
1.4		SM	SAND, SILTY, DRY, GRAY TO BROWN, LOOSE, MOTTLING	100%		1350 - Began Advancing boring 1355 - Sample (0-2) 1405 - Sample (4-6) 1410 - Sample (9-11) 1415 - Sampled (GW/VE) [13-14]
2.6	5	CL	CLAY, SAND, GRAY, MOTTLING, DRY, NO PLASTICITY, NO ODOR	100%		
2.1	10			100%		
6.0				100%		

00107394

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE: NR

Hole No. 475B-A1

PROJECT: LHAAP

INSTALLATION: LONGHORN ARMY AMMUNITION PL.

SHEET 2 OF 2 SHEETS

~~ELEVATION~~ PID (a)	DEPTH (b)	LEGEND USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
0.0			SAME AS ABOVE	100%		
0.0	15	SP	SAND, CLAYEY, LOOSE, GRAY, WET TO SATURATED, DENSE, NO ODOR - BECOMES DENSE, WET	100%		
	20		END OF BORING @ 17' bgs			

ENG FORM 1836 – APPROVIOUS EDITIONS ARE OBSOLETE.

WOR 71

PROJECT

HOLE NO

00107395 HOLE NO. 475BA3

DRILLING LOG	DIVISION FEDERAL	INSTALLATION LONGHORN ARMY AMMUNITION	SHEET 1 OF 2 SHEETS
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 2"	
2. LOCATION (Coordinates or Station) 6957649.00, 3308641.30		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY QRI		12. MANUFACTURER'S DESIGNATION OF DRILL 6610 DT	
4. HOLE NO. (As shown on drawing title and file number) 475B-A3		13. OVERBURDEN SAMPLES: DISTURBED ✓	UNDISTURBED
5. NAME OF DRILLER JASON NEW		14. TOTAL NUMBER CORE BOXES NR	
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION GROUND WATER NR	
7. THICKNESS OF OVERBURDEN NR		16. DATE HOLE STARTED 8/25/10	COMPLETED 8/25/10
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE NR	
9. TOTAL DEPTH OF HOLE 16'		18. TOTAL CORE RECOVERY FOR BORING 100 %	
		ALLEN WILLMORE INSPECTOR	

ELEVATION PID (ft) a	DEPTH b	LEGEND USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.4	0	SM	SAND, SILTY, DRY, GRAY TO BROWN, LOOSE	100%		1435 - Began Advancing boring
						1440 - Sample (0-2)
						1445 - Sample (4-6)
						1450 - Sample (9-11)
						1455 - Sample (Grab GW/VOC) [14-15]
1.2	5		CLAY, SANDY, GRAY, MOTTLING, DRY, NO PLASTICITY, NO ODOR, STIFF	100%		
0.0				100%		
	10		- BECOMES HARD			
0.0				100%		

00107396

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE: NR

Hole No. 475B-A3

PROJECT: LHAAP

INSTALLATION: LONGHORN ARMY AMMUNITION PL.

SHEET 2 OF 2 SHEETS

~~ELEVATION~~ PID (a)	DEPTH (b)	~~LEGEND~~ USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
R			SAME AS ABOVE			
	15	SP	SAND, CLAYEY, GRAY, DENSE, WET, WELL-SORTED, NO ODOR	100%	X	
			END OF BORING @ 16' BGS			
	20					

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PROJECT

HOLE NO.

00107397 HOLE NO. 475BA5

DRILLING LOG	DIVISION FEDERAL	INSTALLATION LONGHORN ARMY AMMUNITION	SHEET 1 OF 2 SHEETS
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 2"	
2. LOCATION (Coordinates or Station) 6957669.50, 3308091.30		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY QRI		12. MANUFACTURER'S DESIGNATION OF DRILL 6610 DT	
4. HOLE NO. (As shown on drawing title and file number) 475B-A5		13. OVERBURDEN SAMPLES: DISTURBED ✓	UNDISTURBED
5. NAME OF DRILLER JASON NEW		14. TOTAL NUMBER CORE BOXES NR	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION GROUND WATER NR	
7. THICKNESS OF OVERBURDEN NR		16. DATE HOLE STARTED 8/29/10	COMPLETED 8/29/10
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE NR	
9. TOTAL DEPTH OF HOLE 16'		18. TOTAL CORE RECOVERY FOR BORING 100 %	
		ALLEN WILLMORE INSPECTOR	

~~ELEVATION~~ PID (ft) a	DEPTH b	~~LEGEND~~ USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	0	SM	SAND, SILTY, DRY, GRAY TO BROWN, LOOSE, NO ODOR	100%		1430 ~~1425~~ - Began Advancing boring 1440 - Sample (0-2) 1445 - Sample (4-6) 1450 - Sample (9-11) 1455 - Sample (GW/VZ) ~~13.5~~ (12.5-13.5)
0.0	5	CL	CLAY, SANDY, DRY, LT BROWN, SOFT, NO PLASTICITY, MOTTLING, NO ODOR	100%		
0.0	10		- Becomes hard, gray, organic	100%		
0.0						

00107398

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE: NR

Hole No. 475B-A5

PROJECT: LHAAP

INSTALLATION: LONGHORN ARMY AMMUNITION PL.

SHEET 2 OF 2 SHEETS

~~ELEVATION~~ PID	DEPTH	~~LEGEND~~ USCS	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0.0			Same as above			
			@ 8/24/10			
0.0	15	SP	SAND, loose, SATURATED, GRAY, WELL SORTED, NO ODOR			
			-Becomes WET			
			END OF BORING @ 16' bgs			
	20					

ENG FORM 1836 – PREVIOUS EDITIONS ARE OBSOLETE.

SEP 71

PROJECT

HOLE NO.

00107399 HOLE NO. 475BA7

DRILLING LOG	DIVISION FEDERAL	INSTALLATION LONGHORN ARMY AMMUNITION	SHEET 1 OF 2 SHEETS
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 2"	
2. LOCATION (Coordinates or Station) 695768950, 3308914.51		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY QRI		12. MANUFACTURER'S DESIGNATION OF DRILL 6610 DT	
4. HOLE NO. (As shown on drawing title and file number) 475B-A7		13. OVERBURDEN SAMPLES: DISTURBED ✓	UNDISTURBED
5. NAME OF DRILLER JASON NEW		14. TOTAL NUMBER CORE BOXES NR	
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION GROUND WATER NR	
7. THICKNESS OF OVERBURDEN NR		16. DATE HOLE STARTED 8/25/10	COMPLETED 8/25/10
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE NR	
9. TOTAL DEPTH OF HOLE 16'		18. TOTAL CORE RECOVERY FOR BORING 100 %	
		ALLEN WILLMORE INSPECTOR	

ELEVATION PID (ft) a	DEPTH b	LEGEND USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	0	SM	SAND, SILTY, DRY, GRAY TO BROWN, LOOSE	100%		1548 - Began Advancing boring
						1555 - Sample (0-2)
						1550 - Sample (4-6) [GW/WE]
						~~1555 Sample (9-11)~~
						~~1000 - Sample (10-12)~~
0.0	5			100%		
0.0		SP	- BECOME MOIST TO WET, WELL-SORTED, GRAY, MOTTLING			
0.0	10			100%		9/25/10
0.0		CL	CLAY, SAND, STIFF TO HARD, GRAY, NO PLASTICITY, NO ODOR			

00107400

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE NR

Hole No. 475B-117

PROJECT LHAAP

INSTALLATION LONGHORN ARMY AMMUNITION PL.

SHEET 2 OF 2 SHEETS

ELEVATION PID	DEPTH	LEGEND USCS	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0.0		CL	SAME AS ABOVE			
0.0	15					
			END OF BORING @ 16' bgs			
	20					

ENG FORM 1836 – PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT

HOLE NO

(Page 2 of 2)

00107401 HOLE NO. 475BA-9

DRILLING LOG	DIVISION FEDERAL	INSTALLATION LONGHORN ARMY AMMUNITION	SHEET 1 OF 1 SHEETS
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 2"	
2. LOCATION (Coordinates or Station) 6957709.50, 3308191.50		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY QRI		12. MANUFACTURER'S DESIGNATION OF DRILL 6610 DT	
4. HOLE NO. (As shown on drawing title and file number) 475B-A9		13. OVERBURDEN SAMPLES: DISTURBED ✓	UNDISTURBED
5. NAME OF DRILLER JASON NEW		14. TOTAL NUMBER CORE BOXES NR	
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION GROUND WATER NR	
7. THICKNESS OF OVERBURDEN NR		16. DATE HOLE STARTED 8/25/10	COMPLETED 8/25/10
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE NR	
9. TOTAL DEPTH OF HOLE 13'		18. TOTAL CORE RECOVERY FOR BORING 100 %	
		ALLEN WILLMORE INSPECTOR	

ELEVATION PID (ft) a	DEPTH b	LEGEND USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	0	SM	SAND, SILTY, DRY, GRAY TO BROWN, LOOSE	100%		1610 - Began Advancing boring
						1615 - Sample (0-2)
						1620 - Sample (4-6)
						1625 - Sample (GW/V2) [9-11]
0.0	5		- Becomes dense, gray, mottling	100%		
			- Becomes moist to damp			
0.0	10	CL	CLAY, SANDY, GRAY, DRY, NO PLASTICITY, NO ODOR	100%		
0.0		SP	SAND, CLAYEY, MOIST TO WET, VERY DENSE, GRAY, NO ODOR	100%		

END OF BORING @ 13' bgs

00107402

HOLE NO. 475BC1

DRILLING LOG

DIVISION: FEDERAL

INSTALLATION: LHAAP

SHEET 1 OF 1 SHEETS

1. PROJECT: LHAAP
2. LOCATION (Coordinates or Station): 6957699.00, 3308971.00
3. DRILLING AGENCY: QRI
4. HOLE NO. (As shown on drawing title and file number): 475B-C1
5. NAME OF DRILLER: Jason New
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: NR
8. DEPTH DRILLED INTO ROCK: NA
9. TOTAL DEPTH OF HOLE: 11'
10. SIZE AND TYPE OF BIT: 2"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: 6610 DT
13. OVERBURDEN SAMPLES: DISTURBED ✓ UNDISTURBED
14. TOTAL NUMBER CORE BOXES: NR
15. ELEVATION GROUND WATER: NR
16. DATE HOLE: STARTED 8/20/10 COMPLETED 8/20/10
17. ELEVATION TOP OF HOLE: NR
18. TOTAL CORE RECOVERY FOR BORING: ~~NR~~ 100% %

Allen Willmore — INSPECTOR

ELEVATION PID (a)	DEPTH (b)	LEGEND USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
0.4	0	SM	SAND, SILTY, BROWN, MOTTLING, NO ODOR	100%		10:30 - Began advancing 475BC1
0.2	5	CL	CLAY, SANDY, NO PLASTICITY, MOTTLING, HARD, NO ODOR	100%		1055 - Sampled (6-7) - Took DUP-01 1100 - Sample (4-6) - Took DUP-02 1110 - Sample (9 w/ 1/2) - Took DUP-03 * Noticed ~~green~~ dark organic substance @ 10' bgs.
0.0	10		END OF BORING @ 11' BGS	100%		

00107403 HOLE NO. 475B-C3

DRILLING LOG	DIVISION FEDERAL	INSTALLATION LONGHORN ARMY AMMUNITION	SHEET 1 OF 6 SHEETS
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 2"	
2. LOCATION (Coordinates or Station) 6957699.00, 3308962l.00		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY QBI		12. MANUFACTURER'S DESIGNATION OF DRILL 6610 DT	
4. HOLE NO. (As shown on drawing title and file number) 475B-C3		13. OVERBURDEN SAMPLES: DISTURBED ✓	UNDISTURBED
5. NAME OF DRILLER JASON NEW		14. TOTAL NUMBER CORE BOXES NR	
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION GROUND WATER NR	
7. THICKNESS OF OVERBURDEN NR		16. DATE HOLE STARTED 8/27/10	COMPLETED 8/27/10
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE NR	
9. TOTAL DEPTH OF HOLE 16'		18. TOTAL CORE RECOVERY FOR BORING 100 %	
		ALLEN WILLMORE INSPECTOR	

ELEVATION PID (FT) a	DEPTH b	LEGEND USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
2.1	0	SM	SAND, SILTY, DRY, GRAY TO BROWN, LOOSE DRY	100%		1245 - Began Advancing boring 1250 - Sample (0-2) 1255 - Sample (4-6) 1300 - Sample (9-11)
1.4	5		SLIGHTLY BECOMES MOIST, MORE DENSE	100%		1305 - Sample (GW/VZ) (13-14)
1.0	10	CL	CLAY SANDY, SLIGHTLY MOIST TO DRY, NO PLASTICITY, GRAY, MOTTLING, STIFF -BECOMES HARD	100%		
3.2						

00107404

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE: NR

Hole No. 475B-C3

PROJECT: LHAAP

INSTALLATION: LONGHORN ARMY AMMUNITION PL.

SHEET 2 OF 2 SHEETS

~~ELEVATION~~ PID	DEPTH	~~LEGEND~~ USCS	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
1.2						
4.1	15	SP	SAND, GRAVELLY AND SILTY, well-sorted, NO ODOR, GRAY, MOTTLING, MOIST TO WET	100%		
			END OF BORING @ 16' BGS			
	20					

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MAR 71

PROJECT

HOLE NO.

00107405 HOLE NO. 475B-C5

DRILLING LOG	DIVISION FEDERAL	INSTALLATION LONGHORN ARMY AMMUNITION	SHEET 1 OF 2 SHEETS
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 2"	
2. LOCATION (Coordinates or Station) 695709.50, 3308971.00		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY QRI		12. MANUFACTURER'S DESIGNATION OF DRILL 6610 DT	
4. HOLE NO. (As shown on drawing title and file number) 475B-C5		13. OVERBURDEN SAMPLES: DISTURBED ✓	UNDISTURBED
5. NAME OF DRILLER JASON NEW		14. TOTAL NUMBER CORE BOXES NR	
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION GROUND WATER NR	
7. THICKNESS OF OVERBURDEN NR		16. DATE HOLE STARTED 8/20/10	COMPLETED 8/20/10
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE NR	
9. TOTAL DEPTH OF HOLE 10		18. TOTAL CORE RECOVERY FOR BORING 100 %	
		ALLEN WILLMORE INSPECTOR	

ELEVATION PID (ft) a	DEPTH b	LEGEND USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0		SM	SAND, SILTY, DRY, GRAY TO BROWN, LOOSE, MOTTLED, NO ODOR	100%		1315 - Began Advancing boring
						1320 - Sample (0-2) * Trip Dupe
						1325 - Sample (4-6) (GW/VE)
						1330 - Sample (9-11) (WET SOIL)
0.0	5		- BECOMES SLIGHTLY DAMP	100%		
			- BECOMES VERY CLAYEY, WET			
0.0		SP	- BECOMES SATURATED	100%		
	10		- BECOMES MUSSY,			
0.0						

00107406

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE: NR

Hole No. 475B-C5

PROJECT: LHAAP

INSTALLATION: LONGHORN ARMY AMMUNITION PL.

SHEET 2 OF 2 SHEETS

~~ELEVATION~~ PID	DEPTH	~~LEGEND~~ USCS	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0.0			CLAY, SILTY, HARD, GRAY, MOTTLED MOIST TO DRY, NO ODOR			
	15	CL				
			END OF BORING @ 16' bgs			
	20					

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PROJECT

TASK NO.

00107407 HOLE NO. 475B-C7

DRILLING LOG	DIVISION FEDERAL	INSTALLATION LONGHORN ARMY AMMUNITION	SHEET 1 OF 2 SHEETS
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 2"	
2. LOCATION (Coordinates or Station) 695707 39.50 , 3309121.30		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY QRI		12. MANUFACTURER'S DESIGNATION OF DRILL 6610 DT	
4. HOLE NO. (As shown on drawing title and file number) 475B-C7		13. OVERBURDEN SAMPLES: DISTURBED ✓	UNDISTURBED
5. NAME OF DRILLER JASON NEW		14. TOTAL NUMBER CORE BOXES NR	
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION GROUND WATER NR	
7. THICKNESS OF OVERBURDEN NR		16. DATE HOLE STARTED 8/25/10	COMPLETED 8/25/10
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE NR	
9. TOTAL DEPTH OF HOLE 16'		18. TOTAL CORE RECOVERY FOR BORING 100 %	
ALLEN WILLMORE INSPECTOR			

~~ELEVATION~~ PID (ppm) a	DEPTH b	LEGEND USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0		SM	SAND, SILTY, DRY, ~~GRAY TO BROWN~~ (A2), LOOSE, ORANGISH,			1515 - Began Advancing boring
			CLAY, SILTY TO SANDY, MOIST, DARK GRAY, ORGANIC, NO ODOR, SOFT, NO TO (A2) PLASTICITY, - WETBEAD	100%		1520 - Sample (0-2)
		CL				1525 - Sample (4-6) * ~~(GW/VZ)~~ NO
			~~WET SEAM~~ (A2)			1530 - Sample (9-11)
	5					1535 - Sample (GW/VZ) (13-14)
0.0		SP	SAND, SILTY, WELL-SORTED, GRAY, MOIST TO WET, NO ODOR, DENSE	100%		
			~~END OF BORING @ 8' BGS~~			* 4-6' bgs MAY be GW/VZ
0.0		CL	CLAY, SAND TO SILTY, HARD (A2) GRAY, DRY, NO ODOR.	100%		
	10			~~100%~~		
0.0				100%		

00107408

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE: NR

Hole No. 475B C7

PROJECT: LHAAP

INSTALLATION: LONGHORN ARMY AMMUNITION PL.

SHEET 2 OF 2 SHEETS

ELEVATION PID (a)	DEPTH (b)	LEGEND USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
0.0		CL	SAME AS ABOVE		X	
0.0	15		SAND, CLAYEY, WELL SORTED, WET, GRAY, NO OBVIOUS ODOR, LOOSE - BECOMES DENSE	100%		
			END OF BORING @ 16' BGS			
	20					

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MAR 71

PROJECT

HOLE NO.

00107409 HOLE NO. 475B-C9

DRILLING LOG	DIVISION FEDERAL	INSTALLATION LONGHORN ARMY AMMUNITION	SHEET 1 OF 1 SHEETS
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 2"	
2. LOCATION (Coordinates or Station) 6957760.60 , 3308[illegible]9191.30		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY QRI		12. MANUFACTURER'S DESIGNATION OF DRILL 6610 DT	
4. HOLE NO. (As shown on drawing title and file number) 475B-C9		13. OVERBURDEN SAMPLES: DISTURBED ✓	UNDISTURBED
5. NAME OF DRILLER JASON NEW		14. TOTAL NUMBER CORE BOXES NR	
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION GROUND WATER NR	
7. THICKNESS OF OVERBURDEN NR		16. DATE HOLE STARTED 8/26/10	COMPLETED 8/26/10
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE NR	
9. TOTAL DEPTH OF HOLE 16'		18. TOTAL CORE RECOVERY FOR BORING 100 %	
		ALLEN WILLMORE INSPECTOR	

ELEVATION PID (ft) a	DEPTH b	LEGEND USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	0	SM	SAND, SILTY, DRY, GRAY TO BROWN, LOOSE	100%		0740 - Began Advancing boring 0745: Sample (0-2) 0750 - Sample (4-6) 0755 - Sample (GW/VZ) [9-11] * Took Dupe Took MS/MSD
0.0	5		- Became Mois	100%		
0.0		CL	CLAY, SANDY, GRAY, STIFF, NO PLASTICITY, ORGANIC, NO ODOR			
0.0	10			100%		
0.0		SC	SAND, CLAYEY, GRAY, DENSE, WET TO MOIST, NO ODOR	100%		
		CL	CLAY, SANDY, HARD, NO PLASTICITY, DRY, GRAY, NO ODOR			

00107410

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE NR

Hole No. 475B C9

PROJECT LHAAP

INSTALLATION LONGHORN ARMY AMMUNITION PL.

SHEET 2 OF SHEETS

~~ELEVATION~~ PID (a)	DEPTH (b)	~~LEGEND~~ USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
0.0			SAME AS ABOVE			
			- 6" MOIST SAND SEAM	100%		
0.0	15					
			END OF BORING @ 16' bgs.			
	20					

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PROJECT

HOLE NO.

00107411 HOLE NO. 475B-C11

DRILLING LOG	DIVISION FEDERAL	INSTALLATION LONGHORN ARMY AMMUNITION	SHEET 1 OF 2 SHEETS
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 2"	
2. LOCATION (Coordinates or Station) 6957[illegible]79.50, 330[illegible]220.50		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY QRI		12. MANUFACTURER'S DESIGNATION OF DRILL 6610 DT	
4. HOLE NO. (As shown on drawing title and file number) 475B-C11		13. OVERBURDEN SAMPLES: DISTURBED ✓	UNDISTURBED
5. NAME OF DRILLER JASON NEW		14. TOTAL NUMBER CORE BOXES NR	
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION GROUND WATER NR	
7. THICKNESS OF OVERBURDEN NR		16. DATE HOLE STARTED 8/26/10	COMPLETED 8/26/10
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE NR	
9. TOTAL DEPTH OF HOLE 6'		18. TOTAL CORE RECOVERY FOR BORING 100 %	
		ALLEN WILLMORE INSPECTOR	

ELEVATION PID (ft) a	DEPTH b	LEGEND USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	0	SM	SAND, SILTY, DRY, GRAY TO BROWN, LOOSE, MOTTLING.	100%		0820 - Began Advancing boring
			- BECOMES DENSE			0825 - Sample (0-2)
						0830 - Sample (4-6)
						0835 - Sample (9-11)
0.0	5			100%		0840 - Sample (GW/12) [12.5-17.5] Took DUP06 + MS/MSD
0.0			- SLIGHTLY DAMP			
0.0	10	CL	CLAY, SANDY, GRAY, DRY, STIFF, NO PLASTICITY NO ODOR, MOTTLING	100%		
0.0						

00107412

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE NR

Hole No. 475B-C11

PROJECT LHAAP

INSTALLATION LONGHORN ARMY AMMUNITION PL.

SHEET 2 OF 2 SHEETS

~~ELEVATION~~ PID (a)	DEPTH (b)	LEGEND USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
0.0			SAME AS ABOVE			
			SAND, CLAYEY, WET, DENSE, WELL-SORTED, MOTTLING, NO ODOR	100%		
0.0	15	SP		100%		
			END OF BORING @ 16' BGS	~~100%~~		
	20					

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PROJECT

HOLE NO

00107413 HOLE NO. 475SBA

DRILLING LOG

DIVISION: Federal

INSTALLATION: LHAAP

SHEET 1 OF 1 SHEETS

1. PROJECT: LHAAP
2. LOCATION (Coordinates or Station): 6957029.00, 3308991.30
3. DRILLING AGENCY: QRI
4. HOLE NO. (As shown on drawing title and file number): 475SBA-E1
5. NAME OF DRILLER: Jason New
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: NR
8. DEPTH DRILLED INTO ROCK: NR
9. TOTAL DEPTH OF HOLE: 11'
10. SIZE AND TYPE OF BIT:
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: 6610 DT
13. OVERBURDEN SAMPLES: DISTURBED ✓ UNDISTURBED
14. TOTAL NUMBER CORE BOXES: NR
15. ELEVATION GROUND WATER: NR
16. DATE HOLE: STARTED 8/20/10 COMPLETED 8/20/10
17. ELEVATION TOP OF HOLE:
18. TOTAL CORE RECOVERY FOR BORING: x

INSPECTOR: Allen Willmon

ELEVATION PID (a)	DEPTH (b)	LEGEND USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
0.0	0	SM	SAND, SILTY, MOIST, MOTTLING, BROWN, LOOSE,			0 1020 - Sample (0-2) 1025 - Sample (4-6) 1035 - Sample (GW/VZ) 9'-10' bgs
		CL	CLAY, SILTY, GRAY, LOW TO NO PLASTICITY, SOFT, NO ODOR, DRY	100%		
0.0	5			100%		
0.0	10	SP	SAND, SILTY, DENSE, MOIST, GRAY, MOTTLING	100%		
			END OF BORING @ 11' bgs.			

00107414 HOLE NO. 475B-E3

DRILLING LOG	DIVISION FEDERAL	INSTALLATION LONGHORN ARMY AMMUNITION	SHEET 1 OF 1 SHEETS
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 2"	
2. LOCATION (Coordinates or Station) 695767 49.00 , 3308 9000.80		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY QRI		12. MANUFACTURER'S DESIGNATION OF DRILL 6610 DT	
4. HOLE NO. (As shown on drawing title and file number) 475B-E3		13. OVERBURDEN SAMPLES: DISTURBED ✓	UNDISTURBED
5. NAME OF DRILLER JASON NEW		14. TOTAL NUMBER CORE BOXES NR	
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION GROUND WATER NR	
		16. DATE HOLE STARTED 8/20/10	COMPLETED 8/20/10
7. THICKNESS OF OVERBURDEN NR		17. ELEVATION TOP OF HOLE NR	
8. DEPTH DRILLED INTO ROCK NA		18. TOTAL CORE RECOVERY FOR BORING 100 %	
9. TOTAL DEPTH OF HOLE 13'		ALLEN WILLMORE INSPECTOR	

ELEVATION PID (ft) a	DEPTH b	LEGEND USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.4		SM	SAND, SILTY, DRY, GRAY TO BROWN, LOOSE			1400 - Began Advancing boring
				100%		1405 - Sample (0-2) Took Dup #4 Took MS/MSD's
						1410 - Sample (4-6)
						1415 - Sample GW/BZ (9-10)
1.2	5	CL	CLAY, SANDY, DARK GRAY, SOFT ORGANIC, DAMP	100%		
8.6	10		SILT, CLAYEY, MOIST, GRAY, DENSE SAND MOIST			
2.1						

END OF BORING @ 13' bgs

00107415 HOLE NO. 475B-E5

DRILLING LOG	DIVISION FEDERAL	INSTALLATION LONGHORN ARMY AMMUNITION	SHEET 1 OF 1 SHEETS
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 2"	
2. LOCATION (Coordinates or Station) 6957769.50, 3308905.00		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY QRI		12. MANUFACTURER'S DESIGNATION OF DRILL 6610 DT	
4. HOLE NO. (As shown on drawing title and file number) 475B-E5		13. OVERBURDEN SAMPLES: DISTURBED ✓	UNDISTURBED
5. NAME OF DRILLER JASON NEW		14. TOTAL NUMBER CORE BOXES NR	
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION GROUND WATER NR	
7. THICKNESS OF OVERBURDEN NR		16. DATE HOLE STARTED 8/20/10	COMPLETED 8/20/10
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE NR	
9. TOTAL DEPTH OF HOLE 12'		18. TOTAL CORE RECOVERY FOR BORING 100 %	
		ALLEN WILLMORE INSPECTOR	

~~ELEVATION~~ PID (ppm) a	DEPTH b	~~LEGEND~~ USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
2.1		SM	SAND, SILTY, DRY, GRAY TO BROWN, LOOSE, MOTTLING	100%		1445 - Began Advancing boring
						1450 - Sample (0-2)
						1455 - Sample (4-6)
						1500 - Sample (GW/VZ) (8-9)
1.4	5	ML	~~Becom~~ SILT, SANDY, MOIST, GRAY MOTTLING	100%		
4.1		CL	CLAY, SILTY, MOIST, ORGANIC, ~~DK~~ GRAY, NO ODOR, SOFT	100%		
	10			100%		
0.3			END OF BORING @ 12' BGS	100%		

00107416 HOLE NO. 475B-E7

DRILLING LOG

DIVISION: FEDERAL

INSTALLATION: LONGHORN ARMY AMMUNITION

SHEET 1 OF SHEETS

1. PROJECT: LHAAP
2. LOCATION (Coordinates or Station): 695707 89.50, 3308 9101.00
3. DRILLING AGENCY: QRI
4. HOLE NO. (As shown on drawing title and file number): 475B-E7
5. NAME OF DRILLER: JASON NEW
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: NR
8. DEPTH DRILLED INTO ROCK: NA
9. TOTAL DEPTH OF HOLE: 12'
10. SIZE AND TYPE OF BIT: 2"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: 6610 DT
13. OVERBURDEN SAMPLES: DISTURBED ✓ UNDISTURBED
14. TOTAL NUMBER CORE BOXES: NR
15. ELEVATION GROUND WATER: NR
16. DATE HOLE: STARTED 8/26/10 COMPLETED 8/26/10
17. ELEVATION TOP OF HOLE: NR
18. TOTAL CORE RECOVERY FOR BORING: 100 %

INSPECTOR: ALLEN WILLMORE

ELEVATION PID (ft) a	DEPTH b	LEGEND USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.4	0	SM	SAND, SILTY, DRY, GRAY TO BROWN, LOOSE	100%		0935 - Began Advancing boring
		CL	CLAY, VERY SANDY, MOIST, GRAY, ORGANIC, NO ODOR - BECOMES DRY			0940 - Sample (0-2) 0945 - Sample (4-6) [GW/ Took Dup at 1MS/MSD VE] ~~0950 - Sample (9-11)~~ (A) ~~0955 - Sample (GW/VE)~~ (A)
0.1	5			100%		
0.1		SP	SAND, CLAYEY, WET, WELL-SORTED, DENSE, NO ODOR			
	10		END OF BORING @ 11' bgs	100%		

00107417 HOLE NO. 475B-E9

DRILLING LOG	DIVISION FEDERAL	INSTALLATION LONGHORN ARMY AMMUNITION	SHEET 1 OF SHEETS
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 2"	
2. LOCATION (Coordinates or Station) 695710.00, 3309151.00		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY QRI		12. MANUFACTURER'S DESIGNATION OF DRILL 6610 DT	
4. HOLE NO. (As shown on drawing title and file number) 475B-E9		13. OVERBURDEN SAMPLES: DISTURBED ✓	UNDISTURBED
5. NAME OF DRILLER JASON NEW		14. TOTAL NUMBER CORE BOXES NR	
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION GROUND WATER NR	
7. THICKNESS OF OVERBURDEN NR		16. DATE HOLE STARTED 8/20/10	COMPLETED 8/20/10
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE NR	
9. TOTAL DEPTH OF HOLE		18. TOTAL CORE RECOVERY FOR BORING 100 %	
		ALLEN WILLMORE INSPECTOR	

ELEVATION PID (ft) a	DEPTH b	LEGEND USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0		SM	SAND, SILTY, DRY, GRAY TO BROWN, LOOSE			0910 0905 - Began Advancing boring
			- BECOMES DENSE			0915 - Sample (0-2)
			CLAY, SANDY, STIFF, BROWN TO GRAY, NO PLASTICITY, NO ODOR, DRY, MOTTLING	100%		0915 0920 (new) - Sample (4-6)
		CL				0920 - Sample (9-11)
	5					0925 - Sample (GW/VZ) [11-12]
0.0			- 18" MOIST SAND, CLAYEY, MOIST, NO ODOR, GRAY, MOTTLING	100%		Took DUP07 + MS/MSD
		SP				
			CLAY, SANDY, STIFF, BROWN TO GRAY, NO PLASTICITY, NO ODOR, DRY, MOTTLING			
		CL				
0.0	10		- 6" WELL-SORTED SAND SEAM	100%		
0.0			SAND, CLAYEY, WELL-SORTED, GRAY, MOTTLING	100%		
		SP	DENSE, MOIST TO WET			

00107418

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE NR

Hole No. 475B-E9

PROJECT LHAAP

INSTALLATION LONGHORN ARMY AMMUNITION PL.

SHEET 2 OF SHEETS

~~ELEVATION~~ PID (a)	DEPTH (b)	LEGEND USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
0.0			SAME AS ABOVE			
0.0	15	CL	CLAY, SANDY, GRAY, MOTTLING, DRY, ORGANIC, NO PLASTICITY, NO ODOR	100%		
			END OF BORING @ 16' BGS			
	20					

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PROJECT

TRACT NO.

00107419 HOLE NO. 475B-G5

DRILLING LOG	DIVISION FEDERAL	INSTALLATION LONGHORN ARMY AMMUNITION	SHEET 1 OF 2 SHEETS
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 2"	
2. LOCATION (Coordinates or Station) 695719.50 , 3308930.80		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY QRI		12. MANUFACTURER'S DESIGNATION OF DRILL 6610 DT	
4. HOLE NO. (As shown on drawing title and file number) 475B-G5		13. OVERBURDEN SAMPLES: DISTURBED ✓	UNDISTURBED
5. NAME OF DRILLER JASON NEW		14. TOTAL NUMBER CORE BOXES NR	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION GROUND WATER NR	
7. THICKNESS OF OVERBURDEN NR		16. DATE HOLE STARTED 8/26/10	COMPLETED 8/26/10
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE NR	
9. TOTAL DEPTH OF HOLE 16		18. TOTAL CORE RECOVERY FOR BORING 100 %	
		ALLEN WILLMORE INSPECTOR	

ELEVATION PID (ft) a	DEPTH b	LEGEND USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.5		SM	SAND, SILTY, DRY, GRAY TO BROWN, LOOSE	100%		1225 - Began Advancing boring
		CL	CLAY, SANDY, HARD, MOTTLING, GRAY, NO PLASTICITY, NO ODOR			1230 - Sample (0-2)
						1235 - Sample (4-6)
						1240 - Sample (GW11)
0.3	5			100%		12:45 - Sample (GW/VZ) [11-12]
			- BECOMES SOFT MORE SANDY, MOIST			
0.0	10			100%		
0.0		SP	SAND, CLAYEY, MOIST TO WET, GRAY MOTTLING, WELL-SORTED, NO ODOR, DENSE	100%		

00107420

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE: NR

Hole No. 475B-G5

PROJECT: LHAAP

INSTALLATION: LONGHORN ARMY AMMUNITION PL.

SHEET 2 OF 2 SHEETS

~~ELEVATION~~ PID	DEPTH	~~LEGEND~~ USCS	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0.0			SAME AS ABOVE			
0.0	15			100%.		
			END OF BORING @ 16' bgs			
	20					

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MAR 71

PROJECT

HOLE NO.

00107421 HOLE NO. 475B-G7

DRILLING LOG

DIVISION: FEDERAL

INSTALLATION: LONGHORN ARMY AMMUNITION PLANT

SHEET 1 OF 2 SHEETS

1. PROJECT	LHAAP
2. LOCATION (Coordinates or Station)	695789.50, 3309080.80
3. DRILLING AGENCY	QRI
4. HOLE NO. (As shown on drawing title and file number)	475B-G7
5. NAME OF DRILLER	JASON NEW
6. DIRECTION OF HOLE	☑ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	NR
8. DEPTH DRILLED INTO ROCK	NA
9. TOTAL DEPTH OF HOLE	16'
10. SIZE AND TYPE OF BIT	2"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	6610 DT
13. OVERBURDEN SAMPLES	DISTURBED ✓ UNDISTURBED
14. TOTAL NUMBER CORE BOXES	NR
15. ELEVATION GROUND WATER	NR
16. DATE HOLE	STARTED 8/26/10 COMPLETED 8/26/10
17. ELEVATION TOP OF HOLE	NR
18. TOTAL CORE RECOVERY FOR BORING	100 %

ALLEN WILLMORE — INSPECTOR

ELEVATION PID (ppm) a	DEPTH b	LEGEND USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0		SM	SAND, SILTY, DRY, GRAY TO BROWN, LOOSE			0955 - Began Advancing boring
			CLAY, SANDY, GRAY, moist, STIFF, ORGANIC, NO ODOR, NO PLASTICITY	100%		1000 - Sample (0-2)
			~~Becomes Not Stiff~~ (A) Becomes SOFT, WET, MUCH ORGANIC CONTENT			1005 - Sample (4-6)
0.0	5	CL				1010 - Sample (9-11) TOXIC DUP 09
				100%		1015 - Sample (GW/VZ) (14-15)
0.0						
	10		-BECOMES VERY HARD	100%		
0.0				100%		

00107422

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE NR

Hole No. 475B-G7

PROJECT LHAAP

INSTALLATION LONGHORN ARMY AMMUNITION PL.

SHEET 2 OF 2 SHEETS

~~ELEVATION~~ PID (a)	DEPTH (b)	LEGEND USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
0.0			SAME AS ABOVE			
				100%		
	15				~~100%~~ AW	
0.0		SC	SAND, CLAYEY, MOIST TO WET GRAY WELL-SORTED			
			END OF BORING @ 16' BGS			
	20					

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PROJECT

HOLE NO

(Page 2 of 2)

00107423 HOLE NO. 475B-13

DRILLING LOG

DIVISION: FEDERAL

INSTALLATION: LONGHORN ARMY AMMUNITION PLANT

SHEET 1 OF 1 SHEETS

1. PROJECT: LHAAP
2. LOCATION (Coordinates or Station): 695784 9.50 , 3308960.30
3. DRILLING AGENCY: QRI
4. HOLE NO. (As shown on drawing title and file number): 475B-13
5. NAME OF DRILLER: JASON NEW
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: NR
8. DEPTH DRILLED INTO ROCK: NA
9. TOTAL DEPTH OF HOLE: 6'
10. SIZE AND TYPE OF BIT: 2"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: 6610 DT
13. OVERBURDEN SAMPLES: DISTURBED ✓ UNDISTURBED
14. TOTAL NUMBER CORE BOXES: NR
15. ELEVATION GROUND WATER: NR
16. DATE HOLE: STARTED 8/27/10 COMPLETED 8/27/10
17. ELEVATION TOP OF HOLE: NR
18. TOTAL CORE RECOVERY FOR BORING: 100 %

INSPECTOR: ALLEN WILLMORE

ELEVATION PID (ft) a	DEPTH b	LEGEND USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
2.3	5	CL	~~SAND, SILTY, DRY, GRAY TO BROWN, LOOSE~~ CONCRETE (8" thick) CLAY, SANDY, BROWN, MOTTLING, HARD, NO PLASTICITY, DRY, NO ODOR	100%		~~1335~~ 0815 - Began Advancing boring 0815 - Sample (0-2) 0820 - Sample (4-6) ~~- Sample~~ Refusal @ 6' bgs due to obstruction
1.4						
	10		END OF BORING @ 6' BGS	100%		* Had to use concrete core to get through Concrete @ surface

00107424 HOLE NO. 475B-I5

DRILLING LOG

DIVISION: FEDERAL

INSTALLATION: LONGHORN ARMY AMMUNITION PLANT

SHEET 1 OF 2 SHEETS

1. PROJECT: LHAAP
2. LOCATION (Coordinates or Station): 695769.50 , 3308910.50
3. DRILLING AGENCY: QRI
4. HOLE NO. (As shown on drawing title and file number): 475B-I5
5. NAME OF DRILLER: JASON NEW
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: NR
8. DEPTH DRILLED INTO ROCK: NA
9. TOTAL DEPTH OF HOLE: 16'
10. SIZE AND TYPE OF BIT: 2"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: 6610 DT
13. OVERBURDEN SAMPLES: DISTURBED ✓ UNDISTURBED
14. TOTAL NUMBER CORE BOXES: NR
15. ELEVATION GROUND WATER: NR
16. DATE HOLE: STARTED 8/26/10 COMPLETED 8/26/10
17. ELEVATION TOP OF HOLE: NR
18. TOTAL CORE RECOVERY FOR BORING: 100 %

INSPECTOR: ALLEN WILLMORE

~~ELEVATION~~ PID (ppm) a	DEPTH b	LEGEND USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	0	SM	SAND, SILTY, DRY, GRAY TO BROWN, LOOSE	100%		1310 - Began Advancing boring
		CL	CLAY, SANDY, ORGANIC, GRAY, NO PLASTICITY, STIFF TO HARD, NO ODOR			1315 - Sample (0-2)
						1320 - Sample (4-6)
			- BECOMES MORE SILTY, MOIST			1325 - Sample (GW/VE) [9-10]
0.0	5		- BECOMES DRY, SANDY	100%		
0.0	10	SP	SAND, CLAYEY, WELL-SORTED, NON-PLASTIC, DENSE, NO ODOR, MOTTLING	100%		
0.0				100%		

00107425

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE: NR

Hole No. 475B-I5

PROJECT: LHAAP

INSTALLATION: LONGHORN ARMY AMMUNITION PL.

SHEET 2 OF 2 SHEETS

ELEVATION PID (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
0.0			SAME AS ABOVE			
	15			100%		
0.0		CL	CLAY, SANDY, DAMP TO DRY, HARD, NO PLASTICITY, NO ODOR			
			END OF BORING @ 16' BGS			
	20					

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SEP 71

PROJECT

HOLE NO

00107426 HOLE NO. 475B-17

DRILLING LOG

DIVISION: FEDERAL

INSTALLATION: LONGHORN ARMY AMMUNITION PLANT

SHEET 1 OF 2 SHEETS

1. PROJECT: LHAAP
2. LOCATION (Coordinates or Station): 695790.00, 3308060.50
3. DRILLING AGENCY: QRI
4. HOLE NO. (As shown on drawing title and file number): 475B-I7
5. NAME OF DRILLER: JASON NEW
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: NR
8. DEPTH DRILLED INTO ROCK: NA
9. TOTAL DEPTH OF HOLE: 16'
10. SIZE AND TYPE OF BIT: 2"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: 6610 DT
13. OVERBURDEN SAMPLES: DISTURBED ✓ UNDISTURBED
14. TOTAL NUMBER CORE BOXES: NR
15. ELEVATION GROUND WATER: NR
16. DATE HOLE: STARTED 8/26/10 COMPLETED 8/26/10
17. ELEVATION TOP OF HOLE: NR
18. TOTAL CORE RECOVERY FOR BORING: 100 %

INSPECTOR: ALLEN WILLMORE

ELEVATION PID (ft) a	DEPTH b	LEGEND USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0		SM	SAND, SILTY, DRY, GRAY TO BROWN, LOOSE	100%		1050 - Began Advancing boring
			CLAY, SANDY, BROWN, SOFT, NO PLAS. DRY, NO ODOR			1055 - Sample (0-2)
		CL	- BECOMES GRAY, ORGANIC			1100 - Sample (4-6)
			- MOTTLING			1105 - Sample (9-11)
0.0	5		- 8" DAMP SAND SEAM	100%		1110 - Sample (GW/VZ) [13.5-14.5]
0.0				100%		
	10					
0.0						

00107427

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE NR

Hole No. 475B-I7

PROJECT LHAAP

INSTALLATION LONGHORN ARMY AMMUNITION PL.

SHEET 2 OF 2 SHEETS

~~ELEVATION~~ PID	DEPTH	~~LEGEND~~ USCS	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0.0		CL	(Same as above)		X	
				100%		
	15		SAND, CLAYEY, DENSE, WET, GRAY, MOTTLING, NO ODOR			
0.0		SP		100%		
			END OF BORING @ 16' BGS			
	20					

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PROJECT

HOLE NO.

00107428 HOLE NO. 475B-K3

DRILLING LOG	DIVISION FEDERAL	INSTALLATION LONGHORN ARMY AMMUNITION	SHEET 1 OF 2 SHEETS
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 2"	
2. LOCATION (Coordinates or Station) 695767899.50, 3308940.30		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY QRI		12. MANUFACTURER'S DESIGNATION OF DRILL 6610 DT	
4. HOLE NO. (As shown on drawing title and file number) 475B-K3		13. OVERBURDEN SAMPLES: DISTURBED ✓	UNDISTURBED
5. NAME OF DRILLER JASON NEW		14. TOTAL NUMBER CORE BOXES NR	
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION GROUND WATER NR	
7. THICKNESS OF OVERBURDEN NR		16. DATE HOLE STARTED 8/26/10	COMPLETED 8/27/10
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE NR	
9. TOTAL DEPTH OF HOLE 24'		18. TOTAL CORE RECOVERY FOR BORING 100 %	
		ALLEN WILLMORE INSPECTOR	

ELEVATION PID (ft) a	DEPTH b	LEGEND USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	0	SM	SAND, SILTY, DRY, GRAY TO BROWN, LOOSE			1415 - Began Advancing boring
						1420 - Sample (0-2)
		CL	CLAY, SANDY, BROWN TO GRAY, DRY STIFF, NO PLASTICITY, NO ODOR, MOTTLING	100%		1425 - Sample (4-6)
						1430 - Sample (9-11)
0.0	5			100%		1435 - Sample (GW/62) [20.5-21.5]
			- BECOMES MORE SANDY, SOFT			
0.0	10			100%		
0.0				100%		

00107429

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE NR

Hole No. 475B-K3

PROJECT LHAAP

INSTALLATION LONGHORN ARMY AMMUNITION PL.

SHEET 2 OF 2 SHEETS

~~ELEVATION~~ PID (a)	DEPTH (b)	~~LEGEND~~ USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
0.0			Same as above			
0.0	15	CL	-6" Sand Seam, wet	100%		
0.0	20			100%		
0.0		SM/SP	SAND, VERY CLAYEY, DAMP, VERY DENSE, GRAY, NO ODOR, ~~BLEE~~ FE-	100%		
	25		END OF Boring @ 24' bgs			

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EWR 71

PROJECT

TRACT NO.

(Page 2 of 2)

00107430 HOLE NO. 475B-K5

DRILLING LOG

DIVISION: FEDERAL

INSTALLATION: LONGHORN ARMY AMMUNITION PLANT

SHEET 1 OF 2 SHEETS

1. PROJECT	LHAAP
2. LOCATION (Coordinates or Station)	695719.50 , 3308990.30
3. DRILLING AGENCY	QRI
4. HOLE NO. (As shown on drawing title and file number)	475B-K5
5. NAME OF DRILLER	JASON NEW
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	NR
8. DEPTH DRILLED INTO ROCK	NA
9. TOTAL DEPTH OF HOLE	24'
10. SIZE AND TYPE OF BIT	2"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	6610 DT
13. OVERBURDEN SAMPLES	DISTURBED ✓ UNDISTURBED
14. TOTAL NUMBER CORE BOXES	NR
15. ELEVATION GROUND WATER	NR
16. DATE HOLE	STARTED 8/26/10 COMPLETED 8/26/10
17. ELEVATION TOP OF HOLE	NR
18. TOTAL CORE RECOVERY FOR BORING	100 %
INSPECTOR	ALLEN WILLMORE

ELEVATION (PID) a	DEPTH b	LEGEND USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	0	SM	SAND, SILTY, DRY, GRAY TO BROWN, LOOSE	100%		1505 - Began Advancing boring
			CLAY, SANDY, GRAY, ORGANIC, NO PLASTICITY, SOFT, NO ODOR, DRY*			1510 - Sample (0-2)
			-MOTTLING, BECOMES STIFF			1515 - Sample (4-6)
0.0	5	CL				1520 - Sample (9-11)
				100%		1525 - Sample (GW/VE) [21.5-22.5]
0.0	10		-BECOMES SOFT, MORE SANDY, MOIST	100%		
			*BECOMES DRY	100%		

00107431

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE: NR

Hole No. 475B-K5

PROJECT: LHAAP

INSTALLATION: LONGHORN ARMY AMMUNITION PL.

SHEET 2 OF 2 SHEETS

~~ELEVATION~~ PID	DEPTH	LEGEND USCS	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0.0			same as above			
0.0	15	CL		100%		
			~3" wet sand seam			
0.0				100%		
			~6" wet sand seam			
	20					
0.0				100%		
		SP	SAND, CLAYEY, DENSE, WELL-SORTED, GRAY, MOTTLING, WET, NO ODOR			
			END OF BORING @ 24' BGS			
	25					

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PROJECT

HOLE NO.

00107432 HOLE NO. 475B-K7

DRILLING LOG

DIVISION: FEDERAL

INSTALLATION: LONGHORN ARMY AMMUNITION PLANT

SHEET 1 OF 2 SHEETS

1. PROJECT: LHAAP
2. LOCATION (Coordinates or Station): 6957940.00, 3309040.30
3. DRILLING AGENCY: QRI
4. HOLE NO. (As shown on drawing title and file number): 475B-K7
5. NAME OF DRILLER: JASON NEW
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: NR
8. DEPTH DRILLED INTO ROCK: NA
9. TOTAL DEPTH OF HOLE: 20'
10. SIZE AND TYPE OF BIT: 2"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: 6610 DT
13. OVERBURDEN SAMPLES: DISTURBED ✓ UNDISTURBED
14. TOTAL NUMBER CORE BOXES: NR
15. ELEVATION GROUND WATER: NR
16. DATE HOLE: STARTED 8/20/10 COMPLETED 8/20/10
17. ELEVATION TOP OF HOLE: NR
18. TOTAL CORE RECOVERY FOR BORING: 100 %

ALLEN WILLMORE — INSPECTOR

ELEVATION PID (ft) a	DEPTH b	LEGEND USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0		SM	SAND, SILTY, DRY, GRAY TO BROWN, LOOSE	100%		1540 - Began Advancing boring
		CL	CLAY, SANDY, DRY, NO PLASTICITY, BROWN, NO ODOR			1545 - Sample (0-2)
						1550 - Sample (4-6)
		SP	SAND, CLAYEY, WELL-SORTED, DENSE, GRAY, MOIST			1555 - Sample (9-11)
0.0	5		CLAY, SANDY, HARD TO STIFF, DRY, NO ODOR, MOTTLING, NO PLASTICITY	100%		1600 - Sample (18-19) [GW/VZ]
		CL				
0.0	10		- BECOMES SOFT, MORE SANDY	100%		
			- 2" Sand Seam, moist			
			- BECOMES HARD			

00107433

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE NR

Hole No. 475B-K7

PROJECT LHAAP

INSTALLATION LONGHORN ARMY AMMUNITION PL.

SHEET 2 OF 2 SHEETS

~~ELEVATION~~ PID	DEPTH	~~LEGEND~~ USCS	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0.0		CL	SAME AS ABOVE			
0.0	15			100%		
0.0		SC	SAND, CLAYEY, MOIST, GRAY, DENSE NO ODOR, WET TO MOIST	100%		
	20		END OF Boring @ 20' bgs			

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SEP 71

PROJECT

HOLE NO

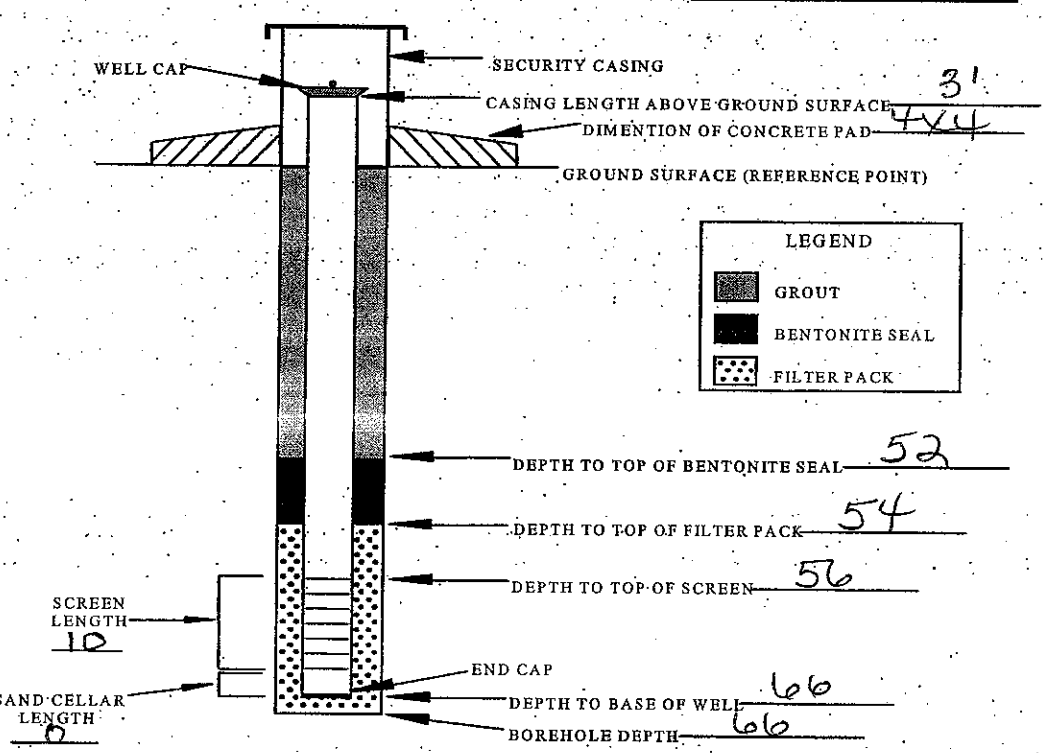
00107434

WELL COMPLETION FORM (Stickup or Above Grade Completion Well)

FIELD REPRESENTATIVE: Allen, Susan
DRILLING CONTRACTOR: ETTL
DRILLING TECHNIQUE: Mud Rotary
AUGER SIZE AND TYPE: ~~4" DOA~~ 6"
BOREHOLE IDENTIFICATION: 47WW37
BOREHOLE DIAMETER: 6"
WELL IDENTIFICATION: 47WW37
WELL CONSTRUCTION START DATE: 08/25/10
WELL CONSTRUCTION COMPLETE DATE: 08/25/10
SCREEN MATERIAL: Sch 40 PVC
SCREEN DIAMETER: 2"
STRATUM-SCREENED INTERVAL (FT): 56-66'
CASING MATERIAL: Sch 40 PVC
CASING DIAMETER: 2"

TYPE OF FILTER PACK: Sand
GRADIATION: 20/40
AMOUNT OF FILTER PACK USED: 8
TYPE OF BENTONITE: Pellets
AMOUNT BENTONITE USED: 1 bucket
TYPE OF CEMENT: Portland
AMOUNT CEMENT USED: —
GROUT MATERIALS USED: 7 bags
DIMENSIONS OF SECURITY CASING: 6X6
TYPE OF WELL CAP: Sch 40 PVC
TYPE OF END CAP: Sch 40 PVC
COMMENTS:

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: B. Cragun
INSTALLATION OBSERVED BY: Allen
DISCREPANCIES: None - Isolation casing set @ 1-30'

00107435

HOLE NO. 47WW37

BORING LOG

DIVISION

INSTALLATION: LHAAP

SHEET 1 OF 3 SHEETS

1. PROJECT: LHAAP
2. LOCATION: LHAAP-47
3. DRILLING AGENCY: ETTL
4. HOLE NO. (As shown on drawing title and file number): 47WW37
5. NAME OF DRILLER: B. Reagan
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.
7. TOTAL DEPTH OF HOLE: 66
8. SIZE AND TYPE OF BIT: 4" Rotary
9. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
10. MANUFACTURER'S DESIGNATION OF DRILL: B5500
11. OVERBURDEN SAMPLES: DISTURBED —; UNDISTURBED —
12. TOTAL NUMBER CORE BOXES: —
13. ELEVATION GROUND WATER: 531
14. DATE HOLE: STARTED 08/17/10; COMPLETED 08/25/10
15. ELEVATION TOP OF HOLE: ——
16. TOTAL CORE RECOVERY FOR BORING: 100 %
17. LOGGED BY: Allen S. QC KG

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	30–31	CL	Clay, sandy, low plasticity, dense damp, grey	100%		~~See~~ See Boring Logs for 47WW25 for lithology to 29.40
0.0	32–34	SC	Sand, clayey, med grained, med sorting, damp, brown w/ some red staining	100%		
0.0	35–36		- becomes more clayey	100%		
0.0	37–38			100%		
0.0	39–40	SC/SM	- becomes (all) ~~more~~ silty	100%		
	41					

00107436

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE — | Hole No. 47WW37

PROJECT: LHAAP | INSTALLATION: LHAAD-47 | SHEET 2 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	42 30	SC/SM	Same as noted above	100%		
0.0	43			100%		
0.0	44					
0.0	45			100%		
	46					
0.0	47			100%		
	48					
0.0	49			100%		
	50					
0.0	51			100%		
	52					
0.0	53	SM	— becomes wet, close to saturated	100%		▼
	54					
0.0	55			100%		
	56					

ENG FORM 1836—APREVIOUS EDITIONS ARE OBSOLETE. MAR 71

PROJECT LHAAP | HOLE NO. 47WW37

00107437

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE

Hole No. 47WW37

PROJECT: LHAAP

INSTALLATION: LHAAP-47

SHEET 3 OF 3 SHEETS

ELEVATION (a)	DEPTH (b)	LEGEND USCS (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
0.0	57	SM		100%		
	58					
0.0	59			100%		
	60					
0.0	61			100%		
	62					
0.0	63			100%		
	64					
0.0	65	CL	Clay, sandy, low plasticity dense moist, gray to brick	100%		Well set @ 66' Screen 55' to 66'.
	66		END of Boring			
	67					
	68					
	69					
	70					
	71					

ENG FORM 1836 – APREVIOUS EDITIONS ARE OBSOLETE. MAR 71

PROJECT: LHAAP

HOLE NO.: 47WW37

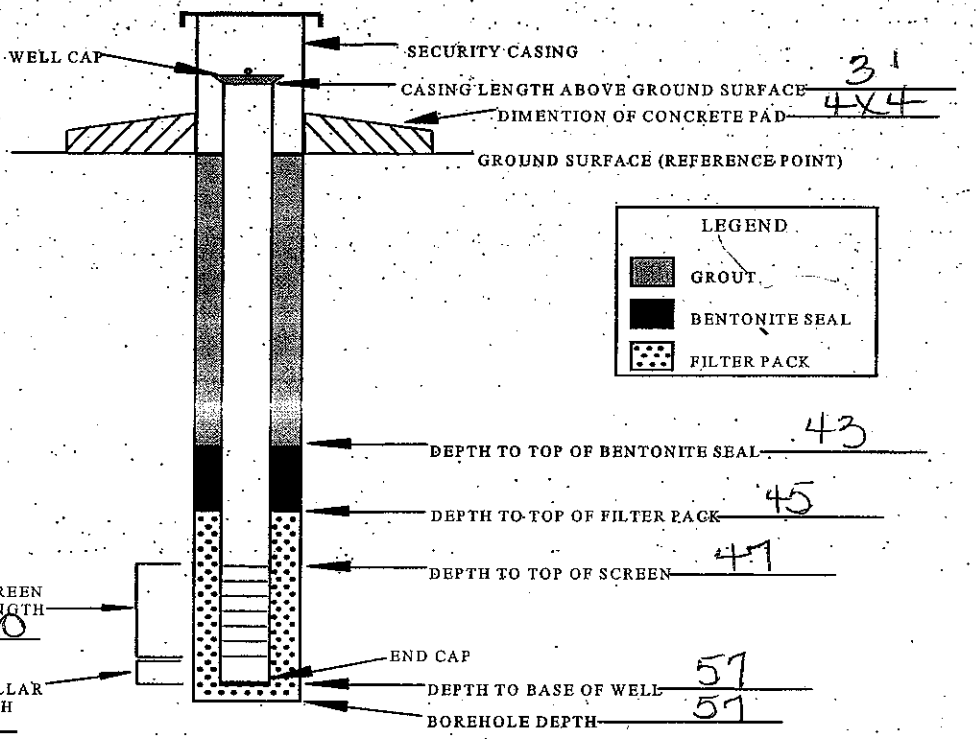
00107438

WELL COMPLETION FORM (Stickup or Above Grade Completion Well)

FIELD REPRESENTATIVE: Oller, Susan
DRILLING CONTRACTOR: ETTL
DRILLING TECHNIQUE: Rotary
AUGER SIZE AND TYPE: ~~Oller~~ 6"
BOREHOLE IDENTIFICATION: MW38
BOREHOLE DIAMETER: 6"
WELL IDENTIFICATION: 47WW38
WELL CONSTRUCTION START DATE: 08/17/10
WELL CONSTRUCTION COMPLETE DATE: 08/25/10
SCREEN MATERIAL: Sch 40 PVC
SCREEN DIAMETER: 2"
STRATUM-SCREENED INTERVAL (FT): 47 - 57
CASING MATERIAL: Sch 40 PVC
CASING DIAMETER: 2"

TYPE OF FILTER PACK: ~~Oller~~ 10/20 Sand
GRADIATION: 20/40
AMOUNT OF FILTER PACK USED: 7 bags
TYPE OF BENTONITE: Pellet
AMOUNT BENTONITE USED: 1 bucket
TYPE OF CEMENT: Portland
AMOUNT CEMENT USED: —
GROUT MATERIALS USED: 7 bags
DIMENSIONS OF SECURITY CASING: 6X6
TYPE OF WELL CAP: Sch 40 PVC
TYPE OF END CAP: Sch 40 PVC
COMMENTS:

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: B. Reagan
INSTALLATION OBSERVED BY: Oller

DISCREPANCIES: —

None - ~~no~~ Isolation casing set @ 1-30'

00107439

HOLE NO. 47WW38

BORING LOG	DIVISION LHAAP	INSTALLATION LHAAP	SHEET 1 OF 3 SHEETS
1. PROJECT LHAAP		9. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
2. LOCATION LHAAP-47		10. MANUFACTURER'S DESIGNATION OF DRILL B5500	
3. DRILLING AGENCY ETTL		11. OVERBURDEN SAMPLES	DISTURBED — UNDISTURBED —
4. HOLE NO. (As shown on drawing title and file number) 47WW38		12. TOTAL NUMBER CORE BOXES —	
		13. ELEVATION GROUND WATER 351	
5. NAME OF DRILLER B. Reagan		14. DATE HOLE	STARTED 08/17/10 COMPLETED 08/23/10
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED 0 DEG. FROM VERT.		15. ELEVATION TOP OF HOLE —	
7. TOTAL DEPTH OF HOLE 57'		16. TOTAL CORE RECOVERY FOR BORING 100 %	
8. SIZE AND TYPE OF BIT 4" Rotary		17. LOGGED BY S. Allen	QC KE

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			See notes -			See Boring log for LHSMW60 for lithology to 29.01
	30		- Sand, clayey, med to fine grained, med to well sorted, moist, grey			
	31	SC				
	32					
0.0				90%		
	33					
	34					
	35		- wet / Saturated			
		SC				
	36					
	37					
	38					
				100%		
0.0	39					
	40					
	41					

00107440

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE | Hole No. 47WW38

PROJECT: LHAAP | INSTALLATION: LHAAP-47 | SHEET 2 OF 3 SHEETS

ELEVATION	DEPTH	USCS LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	42 ~~30~~		Same as above			
	43			100%		
0.0	~~44~~					
	45					
	46	SC		100%		
0.0	47					
	48			100%		
0.0	49					
	50			100%		
	51					
0.0	52			100%		
	53					
0.0	54			100%		
	55		thin (7") seam of lignite			
0.0	56			100%		
		CL	Clay, sandy, low plasticity, dense, dry, black to grey			

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PROJECT: LHAAP | HOLE NO. 47WW38

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE | Hole No. 47WW38

PROJECT: LHAAP | INSTALLATION: LHAAP-47 | SHEET 3 OF 3 SHEETS

ELEVATION	DEPTH	USCS LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
a	b	c	d	e	f	g
0.0	57	CL	END of Boring			Well set @ 57' Screen 47' to 57'
	58					
	59					
	60					
	61					
	62					
	63					
	64					08/23/2010
	65					
	66					
	67					
	68		Allen			
	69					
	70					

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PROJECT: LHAAP | HOLE NO.: 47WW38

00107442

WELL DEVELOPMENT RECORD

WELL/PIEZOMETER ID 47WW37
SHEET 1 OF 1

PROJECT NAME: LHAAP PROJECT NO.: 117591, 0009A130 DATE: 8/27/10

LOCATION: Site 47 DATE INSTALLED:

TOTAL DEPTH (FTOC) 57.80 CASING DIAMETER 2"

METHODS OF DEVELOPMENT

☐ Swabbing ☐ Bailing ☑ Pumping ☐ Describe

Equipment decontaminated prior to development ☐ Yes ☐ No

Describe

EQUIPMENT NUMBERS

pH Meter YSI EC Meter YSI Turbidity Meter YSI Thermometer YSI

CASING VOLUME INFORMATION:

Casing ID (inch)	1.0	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (A) (gal/ft)	0.04	0.09	0.16	0.2	0.37	0.65	0.75	1.0	1.5	2.0	2.6

PURGING INFORMATION

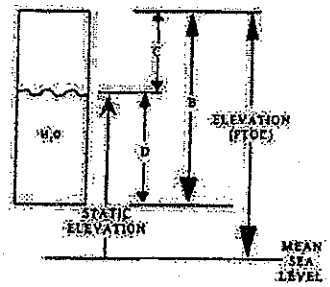
Measured Well Depth B 57.80 ft.

Measured Water Level Depth (C) 22.00 ft.

Length of Static Water Column (D) 57.80 (B) − 22.00 (C) = 35.80 ft.

Casing Water Volume (E) 35.80 (A) × .16 (D) = 5.73 gal

Total Purge Volume = 17.18 gal



Date	Time	Water Level (FTOC)	Volume Removed (gal)	pH	EC	Temperature F or C	Turbidity/ Sand (ppm)	Comments
8/27	11:18	31.95	3 gal.	12.12	7.34	21.22	1335.3	very muddy
8/27	11:32	55.12	5 gal.	12.20	7.71	24.38	1358.9	very muddy
8/27	11:45	53.20	8 gal.	11.47	1.82	23.40	1357.0	
8/27	11:52	53.00	11 gal.	11.84	1.91	22.86	727.6	
8/27	12:02	53.33	14 gal.	11.74	1.88	22.91	295.3	
8/27	12:15	53.50	17 gal	11.42	1.85	22.09	87.3	
8/27	12:30	53.48	20 gal	11.49	1.83	22.00	43.2	
8/27	12:45	53.45	23 gal.	11.50	1.82	21.95	15.9	

00107443

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: CLEAR 96°F
Sampling location ID: SITE47
Sample ID: 47MW37-100901
Collection Time/Date: 13:45 9/1/10

Pump Installation

Pump installation crew: Beesinger
PID/FID reading (well head/background): NA
Casing diameter (inches): 2"
Total well Depth (ft. BTOC): 66.50
Initial (pre-installation) DTW/time: 27.73
Final (after pump priming) DTW/time: 27.62
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): 100
Discharge tube length (ft.): NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

Installation date/beginning time: 9/1/10 12:10
Installation date/completion time: 9/1/10 12:30
Screen Interval (ft. BTOC): 56.50 to 66.50
Pump intake depth (ft BTOC): 61.50
Post-installation DTW/time: 27.55
Max. sustainable pump rate (mL/min): 100
Appearance of product: LIGHT MURKY
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	38								
Refill Setting	35								
Discharge Setting	38								
Flow rate (mL/min)	100								

Purging

Purging/sampling crew: Beesinger
Purge date/beginning time: 9/1/10 12:30
Initial (pre-purging) DTW (ft. BTOC): 27.62
Calculated tubing + pump volume: NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

PID/FID reading (well head/background): NA
Purge date/completion time: 9/1/10 13:45
Final (post-purging) DTW (ft. BTOC): 27.89
No. of tubing + pump volumes purged: NA

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	38	38	38	38	38	38	38	38	38
Refill Setting	35	35	35	35	35	35	35	35	35
Discharge Setting	38	38	38	38	38	38	38	38	38
Flow rate (mL/min)	100	100	100	100	100	100	100	100	100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
12:40	27.65	100	1.0	23.57	2.637	11.55	-39.5	0.90	43.9
12:45	27.68	100	1.5	22.85	2.513	11.52	-20.9	0.85	31.1
12:50	27.71	100	2.0	22.47	2.396	11.52	-6.4	0.91	18.3
12:55	27.73	100	2.5	22.36	2.178	11.43	8.7	0.94	17.1
13:00	27.75	100	3.0	22.21	2.043	11.33	24.5	0.95	15.0
13:05	27.77	100	3.5	22.22	1.961	11.24	36.1	0.97	8.9
13:10	27.79	100	4.0	22.42	1.867	11.11	48.9	0.96	2.0
13:15	27.81	100	4.5	22.34	1.808	10.95	63.6	0.95	3.5

00107444

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
13:20	27.83	100	5.0	22.04	1.765	10.73	81.8	0.94	3.9
13:25	27.85	100	5.5	21.93	1.721	10.56	95.9	0.94	2.1
13:30	27.86	100	6.0	21.90	1.686	10.40	108.3	0.95	-1.2
13:35	27.87	100	6.5	22.02	1.687	10.30	111.3	0.94	-2.4
13:40	27.88	100	7.0	21.97	1.685	10.29	112.3	0.93	0.2
13:45	27.89	100	7.5	21.95	1.684	10.29	113.1	0.93	0.5

Sampling

Sampling beginning time: 13:45 Sampling completion time: 14:00

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
13:50	27.90	100	8.0	21.92	1.683	10.28	115.2	0.92	1.2
14:00	27.91	100	9.0	21.90	1.683	10.28	116.0	0.92	1.0

Sample Information

Sample ID: 47WW37-100901 Sample collection date/time: 9/1/10 13:45

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s): 6017

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2-40ml glass			
SVOC		1-1 Liter Amber			
TAL metals		1-500ml plastic			
Perchlorate		1-250ml plastic			

Comments: DO meter readings in mg/L

12:40 - 1.2 12:55 - 1.1 13:10 - 1.1 13:25 - 1.0 13:40 -

12:45 - 1.1 13:00 - 1.1 13:15 - 1.0 13:30 - 1.0 13:45 -

12:50 - 1.1 13:05 - 1.1 13:20 - 1.0 13:35 -

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

Ferrous Iron - 0.71 mg/L

00107445

WELL DEVELOPMENT RECORD

WELL/PIEZOMETER ID 47WW38
SHEET 1 OF 1

PROJECT NAME: LHAAP PROJECT NO.: 117591.0009A130 DATE: 8/27/10

LOCATION: Site 47 DATE INSTALLED:

TOTAL DEPTH (FTOC) 57.20 CASING DIAMETER 2"

METHODS OF DEVELOPMENT

☐ Swabbing ☐ Bailing ☑ Pumping ☐ Describe

Equipment decontaminated prior to development ☑ Yes ☐ No

Describe

EQUIPMENT NUMBERS

pH Meter YSI EC Meter YSI Turbidity Meter YSI Thermometer YSI

CASING VOLUME INFORMATION:

Casing ID (inch)	1.0	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (A) (gal/ft)	0.04	0.09	0.16	0.2	0.37	0.65	0.75	1.0	1.5	2.0	2.6

PURGING INFORMATION

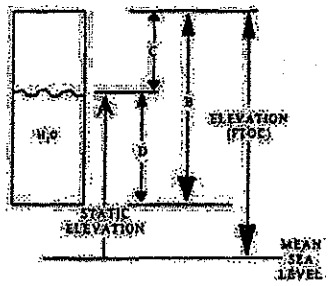
Measured Well Depth B 57.20 ft.

Measured Water Level Depth (C) 16.70 ft.

Length of Static Water Column (D) 57.20 (B) - 16.70 (C) = 40.5 ft.

Casing Water Volume (E) 40.5 (A) x 0.16 (D) = 6.48 gal

Total Purge Volume = 19.44 gal



Date	Time	Water Level (FTOC)	Volume Removed (gal)	pH	EC	Temperature F or C	Turbidity/ Sand (ppm)	Comments
8/27/10	9:26	25.20	3 gal	10.84	.914	21.68 C	1345.3	very muddy
8/27/10	9:43	27.55	9 gal	10.42	.848	20.92	1332.5	very muddy
8/27/10	9:50	31.33	13 gal	9.81	.819	20.24	825.7	very muddy
8/27/10	9:55	31.45	16 gal	9.13	.791	20.09	155.9	Clearing up
8/27/10	10:10	32.16	19 gal	8.95	.775	20.95	73.6	
8/27/10	10:25	33.07	24 gal	9.19	.834	20.81	60.6	
8/27/10	10:33	33.58	28 gal	8.43	.835	20.16	45.1	
8/27/10	10:45	33.87	34 gal	8.32	.835	20.01	26.3	
8/27/10	10:50	33.98	37 gal	8.30	.834	20.02	17.5	

00107446

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Site 47

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: CLEAR 96°F

Sampling location ID: ~~47WW38-100901~~
Sample ID: 47WW38-100901
Collection Time/Date: 15:30 9/1/10

Pump Installation

Pump installation crew: Beesinger
PID/FID reading (well head/background): N/A
Casing diameter (inches): 2"
Total well Depth (ft. BTOC): 58.30
Initial (pre-installation) DTW/time: 18.85
Final (after pump priming) DTW/time: 18.70
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): 100
Discharge tube length (ft.): N/A

Installation date/beginning time: 9/1/10 14:05
Installation date/completion time: 9/1/10 14:20
Screen Interval (ft. BTOC): 48.30 to 58.30
Pump intake depth (ft BTOC): 53.00
Post-installation DTW/time: 18.63
Max. sustainable pump rate (mL/min): 100
Appearance of product: MURKY
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = N/A psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	36								
Refill Setting	33								
Discharge Setting	36								
Flow rate (mL/min)	100								

Purging

Purging/sampling crew: Beesinger
Purge date/beginning time: 9/1/10 14:20
Initial (pre-purging) DTW (ft. BTOC): 18.70
Calculated tubing + pump volume: NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = N/A psi

PID/FID reading (well head/background): N/A
Purge date/completion time: 9/1/10 15:30
Final (post-purging) DTW (ft. BTOC): 18.79
No. of tubing + pump volumes purged: N/A

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	36	36	36	36	36	36	36	36	36
Refill Setting	33	33	33	33	33	33	33	33	33
Discharge Setting	36	36	36	36	36	36	36	36	36
Flow rate (mL/min)	100	100	100	100	100	100	100	100	100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
14:25	18.72	100	.5	22.91	0.902	9.76	71.4	1.39	88.3
14:30	18.74	100	1.0	22.15	0.874	9.10	108.7	1.03	97.7
14:35	18.76	100	1.5	21.73	0.870	8.90	123.5	1.10	86.4
14:40	18.77	100	2.0	21.41	0.875	8.70	136.5	1.05	78.0
14:45	18.78	100	2.5	21.28	0.882	8.51	147.5	0.98	69.2
14:50	18.79	100	3.0	21.25	0.888	8.37	155.7	0.95	67.5
14:55	18.79	100	3.5	21.33	0.887	8.31	158.4	0.92	32.5
15:00	18.79	100	4.0	21.38	0.897	7.81	168.1	0.90	22.3

00107447

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
15:05	18.79	100	4.5	21.40	0.894	7.52	162.8	0.89	13.3
15:10	18.79	100	5.0	21.39	0.895	7.16	167.7	0.88	10.1
15:15	18.79	100	5.5	21.38	0.895	7.01	165.3	0.87	9.6
15:20	18.79	100	6.0	21.37	0.895	6.99	166.0	0.87	9.0
15:25	18.79	100	6.5	21.35	0.896	6.98	165.5	0.87	8.5
15:30	18.79	100	7.0	21.35	0.895	6.98	165.7	0.87	8.5

Sampling

Sampling beginning time: 15:30 Sampling completion time: 16:00

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
15:40	18.79	100	8.0	21.32	0.895	6.97	165.0	0.87	7.0
15:50	18.79	100	9.0	21.31	0.895	6.97	165.9	0.87	7.1

Sample Information

Sample ID: 47WW38-100901
Sample collection date/time: 9/1/10 15:30
Duplicate sample collected (Y/N): YES
Duplicate sample ID: 47WW38-100901
Split sample collected (Y/N): NO
Split sample ID: N/A
COC No(s): 6017

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2-40 ml glass			
SVOC		1-1 Liter AMBER			
TAL METALS		1-500 mL plastic			
PERCHLORATE		1-250 mL plastic			

Comments: DO meter readings in mg/L
14:25 - 0.7 14:40 - 1.1 14:55 - 1.8 15:10 - 0.9 15:25 - 0.8
14:30 - 1.1 14:45 - 1.1 15:00 - 0.9 15:15 - 0.9 15:30 - 0.8
14:35 - 1.3 14:50 - 1.0 15:05 - 1.0 15:20 - 0.8

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

FERROUS IRON - 1.21 mg/L

00107448

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: CLEAR 95°F

Sampling location ID: Site 47
Sample ID: 47WW25-100830
Collection Time/Date: 8/30/10

Pump Installation

Pump installation crew: BEESINGER
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 28.30
Initial (pre-installation) DTW/time:
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.): NA

Installation date/beginning time: 8/30/10
Installation date/completion time: 8/30/10
Screen Interval (ft. BTOC): to
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: BEESINGER
Purge date/beginning time: 8/30/10
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): NA
Purge date/completion time: 8/30/10
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

00107449

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
DRY WELL									

Sampling

Sampling beginning time: _____ Sampling completion time: _____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID: 47WW25-100830 Sample collection date/time: 8/30/10

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s): 6014, 6015, 6016

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2-40 mL glass	ALKALINITY		1-250 mL plastic
GASES		3-40 mL glass	TAL METALS		1-500 mL plastic
ANIONS		1-250 mL plastic	SVOC		1-1 Liter Amber
TOC/NO3 NO2		1-250 mL plastic	DRO		1-1 Liter Amber
PERCHLORATE		1-250 mL plastic			

Comments: DO meter ONLY Readings in MG/L

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

FERROUS IRON -

00107450

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Shaw®

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: CLEAR 95°F
Sampling location ID: Site 47
Sample ID: LHSmw60-100830
Collection Time/Date: 13:30 8/30/10

Pump Installation

Pump installation crew: BEESINGER
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 29.45
Initial (pre-installation) DTW/time: 18.80
Final (after pump priming) DTW/time: 18.65
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.): NA
Installation date/beginning time: 8/30/10 12:15
Installation date/completion time: 8/30/10 12:30
Screen Interval (ft. BTOC): 19.45 to 29.45
Pump intake depth (ft BTOC): 24.50
Post-installation DTW/time: 18.70
Max. sustainable pump rate (mL/min): 100
Appearance of product: CLEAR
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	20								
Refill Setting	17								
Discharge Setting	20								
Flow rate (mL/min)	100								

Purging

Purging/sampling crew: BEESINGER
Purge date/beginning time: 8/30/10 12:30
Initial (pre-purging) DTW (ft. BTOC): 18.65
Calculated tubing + pump volume: NA
PID/FID reading (well head/background): NA
Purge date/completion time: 8/30/10 13:30
Final (post-purging) DTW (ft. BTOC): 18.79
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	20	20	20	20	20	20	20	20	20
Refill Setting	17	17	17	17	17	17	17	17	17
Discharge Setting	20	20	20	20	20	20	20	20	20
Flow rate (mL/min)	100	100	100	100	100	100	100	100	100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
								1.40	
12:35	18.68	100	.5	22.18	1.245	7.40	97.5	[illegible]	4.1
12:40	18.70	100	1.0	20.14	1.232	6.90	131.2	1.30	1.5
12:45	18.72	100	1.5	19.92	1.230	6.80	137.0	1.27	0.8
12:50	18.74	100	2.0	19.89	1.229	6.61	147.5	1.22	0.4
12:55	18.76	100	2.5	19.82	1.229	6.40	158.7	1.20	0.3
13:00	18.77	100	3.0	19.78	1.230	6.25	166.7	1.15	0.1
13:05	18.78	100	3.5	19.80	1.231	6.17	172.6	1.12	-0.2
13:10	18.79	100	4.0	19.70	1.231	6.10	179.8	1.10	0.1

00107451

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

Shaw®

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
13:15	18.79	100	4.5	19.57	1.231	6.01	190.0	1.10	-0.1
13:20	18.79	100	5.0	19.64	1.231	5.98	191.5	1.09	0.0
13:25	18.79	100	5.5	19.73	1.233	5.97	194.3	1.09	-0.3
13:30	18.79	100	6.0	19.75	1.233	5.96	195.7	1.09	-0.2

Sampling

Sampling beginning time: 13:30 Sampling completion time: 14:00

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
13:40	18.79	100	7.0	19.77	1.233	5.96	196.3	1.09	0.1
13:50	18.79	100	8.0	19.79	1.232	5.95	197.0	1.08	0.2

Sample Information

Sample ID: LHSMW60-100830 Sample collection date/time: 8/30/10 13:30

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s): 6014, 6015, 6016

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2-40 mL glass	ALKALINITY		1-250mL plastic
GASES		3-40 mL glass	TAL METALS		1-500mL plastic
ANIONS		1-250 mL plastic	SVOC		1-1Liter Amber
TOC/NO3 NO2		1-250mL plastic	DHC		1-1Liter Amber
PERCHLORATE		1-250mL plastic			

Comments: DO METER ONLY READINGS IN MG/L

12:35 - 1.5 12:50 - 1.1 13:05 - 1.0 13:20 - 1.0 13:40 - 1.0

12:40 - 1.2 12:55 - 1.1 13:10 - 1.0 13:25 - 1.0 13:50 - 1.0

12:45 - 1.2 13:00 1.0 13:15 - 1.0 13:30 - 1.0

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

FERROUS IRON - 0.11 mg/L

00107452

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: Sunny 102°F
Sampling location ID: Site 47
Sample ID: LHSMW39 - 100729
Collection Time/Date: 7/29/10

Pump Installation

Pump installation crew: Beesinger/Wagner
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 20.60
Initial (pre-installation) DTW/time:
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):
Installation date/beginning time:
Installation date/completion time:
Screen Interval (ft. BTOC): to
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew:
Purge date/beginning time:
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA
PID/FID reading (well head/background):
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:

Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

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00107453

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

LHSMW39

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY WELL

Sampling

Sampling beginning time:_____ Sampling completion time:_____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID:_____ Sample collection date/time:_____

Duplicate sample collected (Y/N):_____ Duplicate sample ID:_____

Split sample collected (Y/N):_____ Split sample ID:_____

COC No(s):_____

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107454

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: Sunny 102°F

Sampling location ID: Site 47
Sample ID: LHSMW42-100729
Collection Time/Date: 7/29/10

Pump Installation

Pump installation crew: Beesinger / WAGNER
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 21.85
Initial (pre-installation) DTW/time:
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):

Installation date/beginning time:
Installation date/completion time:
Screen Interval (ft. BTOC): to
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew:
Purge date/beginning time:
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA

PID/FID reading (well head/background):
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY WELL

00107455

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

LHSMW42

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY WELL

Sampling

Sampling beginning time:_____ Sampling completion time:_____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID:_____ Sample collection date/time:_____

Duplicate sample collected (Y/N):_____ Duplicate sample ID:_____

Split sample collected (Y/N):_____ Split sample ID:_____

COC No(s):_____

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107456

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: SUNNY 102°F

Sampling location ID: SITE 47
Sample ID: LHSMW43-100803
Collection Time/Date: 8/3/10

Pump Installation

Pump installation crew: Beesinger / Wagner
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 22.90
Initial (pre-installation) DTW/time:
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):

Installation date/beginning time:
Installation date/completion time:
Screen Interval (ft. BTOC): to
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew:
Purge date/beginning time:
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA

PID/FID reading (well head/background):
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY WELL

00107457

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

LHSMW43

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY WELL

Sampling

Sampling beginning time:_____ Sampling completion time:_____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID:_____ Sample collection date/time:_____

Duplicate sample collected (Y/N):_____ Duplicate sample ID:_____

Split sample collected (Y/N):_____ Split sample ID:_____

COC No(s):_____

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107458

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: Sunny 103 °F

Sampling location ID: Site 47
Sample ID: LHSMW46-100729
Collection Time/Date: 7/29/10

Pump Installation

Pump installation crew: Beasinger/Wagner
PID/FID reading (well head/background):
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 19.70
Initial (pre-installation) DTW/time:
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):

Installation date/beginning time:
Installation date/completion time:
Screen Interval (ft. BTOC): to
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew:
Purge date/beginning time:
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA

PID/FID reading (well head/background):
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY WELL

00107459

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

LH-SMW46

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY WELL

Sampling

Sampling beginning time:_____ Sampling completion time:_____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID:_____ Sample collection date/time:_____

Duplicate sample collected (Y/N):_____ Duplicate sample ID:_____

Split sample collected (Y/N):_____ Split sample ID:_____

COC No(s):_____

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107460

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP — Sampling location ID: SITE 47
Project Name/#: 117591.0009A130 — Sample ID: LHSMW47-100729
Weather: Sunny 103°F — Collection Time/Date: 7/29/10

Pump Installation

Pump installation crew: Beesinger/Wagner — Installation date/beginning time:
PID/FID reading (well head/background): — Installation date/completion time:
Casing diameter (inches): 4" — Screen Interval (ft. BTOC): ____ to ____
Total well Depth (ft. BTOC): 18.89 — Pump intake depth (ft BTOC):
Initial (pre-installation) DTW/time: — Post-installation DTW/time:
Final (after pump priming) DTW/time: — Max. sustainable pump rate (mL/min):
Free product (circle): LNAPL / DNAPL — Appearance of product:
Volume of water removed during priming (mL): — Discharge tube diameter (3/8" or 1/4"):
Discharge tube length (ft.): — Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: — PID/FID reading (well head/background):
Purge date/beginning time: — Purge date/completion time:
Initial (pre-purging) DTW (ft. BTOC): — Final (post-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA — No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY WELL

00107461

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

LH5MW47

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY WELL

Sampling

Sampling beginning time:_____ Sampling completion time:_____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID:_____ Sample collection date/time:_____

Duplicate sample collected (Y/N):_____ Duplicate sample ID:_____

Split sample collected (Y/N):_____ Split sample ID:_____

COC No(s):_____

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107462

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP — Sampling location ID: Site 47
Project Name/#: 117591.0009A130 — Sample ID: LHSmw48-100729
Weather: Sunny 103°F — Collection Time/Date: 7/29/10

Pump Installation

Pump installation crew: Boesen / Wagner — Installation date/beginning time:
PID/FID reading (well head/background): — Installation date/completion time:
Casing diameter (inches): 4" — Screen Interval (ft. BTOC): ____ to ____
Total well Depth (ft. BTOC): 15.71 — Pump intake depth (ft BTOC):
Initial (pre-installation) DTW/time: — Post-installation DTW/time:
Final (after pump priming) DTW/time: — Max. sustainable pump rate (mL/min):
Free product (circle): LNAPL / DNAPL — Appearance of product:
Volume of water removed during priming (mL): — Discharge tube diameter (3/8" or 1/4"):
Discharge tube length (ft.): — Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: — PID/FID reading (well head/background):
Purge date/beginning time: — Purge date/completion time:
Initial (pre-purging) DTW (ft. BTOC): — Final (post-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA — No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY WELL

00107463

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

LHSMW48

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY WELL

Sampling

Sampling beginning time:_____ Sampling completion time:_____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID:_____ Sample collection date/time:_____

Duplicate sample collected (Y/N):_____ Duplicate sample ID:_____

Split sample collected (Y/N):_____ Split sample ID:_____

COC No(s):_____

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107464

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: Sunny 102°F

Sampling location ID: SITE 47
Sample ID: LHSMW51-100729
Collection Time/Date: 7/29/10

Pump Installation

Pump installation crew: Beesley / WAGNER
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 21.53
Initial (pre-installation) DTW/time:
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):

Installation date/beginning time:
Installation date/completion time:
Screen Interval (ft. BTOC): _____ to _____
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew:
Purge date/beginning time:
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA

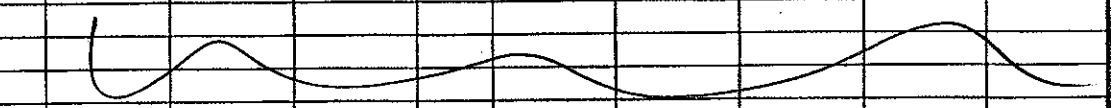
PID/FID reading (well head/background):
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
	DRY WELL								



00107465

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

LHSMW51

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY Well

Sampling

Sampling beginning time:_____ Sampling completion time:_____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID:_____ Sample collection date/time:_____

Duplicate sample collected (Y/N):_____ Duplicate sample ID:_____

Split sample collected (Y/N):_____ Split sample ID:_____

COC No(s):_____

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107466

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 11759.0009A130
Weather: Sunny 102°F
Sampling location ID: SITE H7
Sample ID: LHSMW52-100724
Collection Time/Date: 7/29/10

Pump Installation

Pump installation crew: Beasley / Wagew
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 25.11
Initial (pre-installation) DTW/time:
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):
Installation date/beginning time:
Installation date/completion time:
Screen Interval (ft. BTOC): to
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew:
Purge date/beginning time:
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA
PID/FID reading (well head/background):
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Dry well

00107467

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

LHSMW52

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY WELL

Sampling

Sampling beginning time:_____ Sampling completion time:_____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID:_____ Sample collection date/time:_____

Duplicate sample collected (Y/N):_____ Duplicate sample ID:_____

Split sample collected (Y/N):_____ Split sample ID:_____

COC No(s):_____

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107468

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: Sunny 102°F
Sampling location ID: Site 47
Sample ID: LHSMW53-100729
Collection Time/Date: 7/29/10

Pump Installation

Pump installation crew: Beesinger / Wagner
PID/FID reading (well head/background):
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 16.78
Initial (pre-installation) DTW/time:
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):
Installation date/beginning time:
Installation date/completion time:
Screen Interval (ft. BTOC): _____ to _____
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew:
Purge date/beginning time:
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA
PID/FID reading (well head/background):
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Dry well

00107469

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

LHSMW53

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Dried Well

Sampling

Sampling beginning time:_____ Sampling completion time:_____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID:_____ Sample collection date/time:_____

Duplicate sample collected (Y/N):_____ Duplicate sample ID:_____

Split sample collected (Y/N):_____ Split sample ID:_____

COC No(s):_____

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107470

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 177591.0009A130
Weather: Sunny 1830

Sampling location ID: SITE 47
Sample ID: LHSmw55-100729
Collection Time/Date: 7/29/10

Pump Installation

Pump installation crew: Reasyer / Wagner
PID/FID reading (well head/background):
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 20.15
Initial (pre-installation) DTW/time:
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):

Installation date/beginning time:
Installation date/completion time:
Screen Interval (ft. BTOC): _____ to _____
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew:
Purge date/beginning time:
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA

PID/FID reading (well head/background):
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY WELL

00107471

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

LH5MW55

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY WELL

Sampling

Sampling beginning time:_____ Sampling completion time:_____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID:_____ Sample collection date/time:_____

Duplicate sample collected (Y/N):_____ Duplicate sample ID:_____

Split sample collected (Y/N):_____ Split sample ID:_____

COC No(s):_____

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107472

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Shaw®

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: Sunny 101°F

Sampling location ID: Site 47
Sample ID: LHSMW56-100730
Collection Time/Date: 7/30/10

Pump Installation

Pump installation crew: Beasley / Wagner
PID/FID reading (well head/background):
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 21.72
Initial (pre-installation) DTW/time:
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):

Installation date/beginning time:
Installation date/completion time:
Screen Interval (ft. BTOC): _____ to _____
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew:
Purge date/beginning time:
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA

PID/FID reading (well head/background):
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY WELL

00107473

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

LHS MW56

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY WELL

Sampling

Sampling beginning time:_____ Sampling completion time:_____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID:_____ Sample collection date/time:_____

Duplicate sample collected (Y/N):_____ Duplicate sample ID:_____

Split sample collected (Y/N):_____ Split sample ID:_____

COC No(s):_____

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107474

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: SUNNY 92°F

Sampling location ID: Site 47
Sample ID: 105-103107
Collection Time/Date: 1:10 7/31/10

Pump Installation

Pump installation crew: Beesinger / Wagner
PID/FID reading (well head/background): NA
Casing diameter (inches): 2"
Total well Depth (ft. BTOC): 27.00
Initial (pre-installation) DTW/time: 21.90
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: 7/31/10 8:20
Installation date/completion time: 7/31/10 8:35
Screen Interval (ft. BTOC): 17.00 to 27.00
Pump intake depth (ft BTOC): NA
Post-installation DTW/time: NA
Max. sustainable pump rate (mL/min): NA
Appearance of product: Very Silty Murky
Discharge tube diameter (3/8" or 1/4"): NA
Inlet reducer used (Y/N): NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: Beesinger / Wagner
Purge date/beginning time: 7/31/10 8:20
Initial (pre-purging) DTW (ft. BTOC): 21.90
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): NA
Purge date/completion time: 7/31/10 8:35
Final (post-purging) DTW (ft. BTOC): 26.97
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

BAILED DRY

00107475

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

105

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

BAILED DRY

Sampling

Sampling beginning time: 1:10 Sampling completion time: 1:12

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1:10	21.90	2	2	21.40	6.605	6.88	84.2	4.72	22.0

Sample Information

Sample ID: 105-103107 Sample collection date/time: 7/31/10 1:10

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s): 58883

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2-40 ml glass			

Comments: DO meter reading 4.5 mg/L

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

FERROUS IRON = 0.37 mg/L

00107476

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LWMAP
Project Name/#: 117591.0009A130
Weather: Sunny 90°F
Sampling location ID: ~~SHC47~~ SHC47
Sample ID: ~~SHC47WW04-100806~~ 47WW04-100806
Collection Time/Date: 10:30 8/6/10

Pump Installation

Pump installation crew: Beesley/Wagner
PID/FID reading (well head/background): ~~NA~~ NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 21.67
Initial (pre-installation) DTW/time: 15.43
Final (after pump priming) DTW/time: 15.42
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): 100
Discharge tube length (ft.): NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

Installation date/beginning time: 8/6/10 9:30
Installation date/completion time: 8/6/10 9:40
Screen Interval (ft. BTOC): 11.67 to 21.67
Pump intake depth (ft BTOC): 18.50
Post-installation DTW/time: 15.38
Max. sustainable pump rate (mL/min): 100
Appearance of product: Little murky
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	17								
Refill Setting	14								
Discharge Setting	17								
Flow rate (mL/min)	100								

Purging

Purging/sampling crew: Beesley/Wagner
Purge date/beginning time: 8/6/10 9:40
Initial (pre-purging) DTW (ft. BTOC): 15.42
Calculated tubing + pump volume: NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

PID/FID reading (well head/background): NA
Purge date/completion time: 8/6/10 10:30
Final (post-purging) DTW (ft. BTOC): 15.54
No. of tubing + pump volumes purged: NA

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	17	17	17	17	17	17	17	17	17
Refill Setting	14	14	14	14	14	14	14	14	14
Discharge Setting	17	17	17	17	17	17	17	17	17
Flow rate (mL/min)	100	100	100	100	100	100	100	100	100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
9:45	15.45	100	.5	20.23	4.991	7.15	-26.9	4.26	33.0
9:50	15.46	100	1.0	19.68	5.024	7.07	-21.8	3.00	18.5
9:55	15.47	100	1.5	19.60	5.021	7.06	-20.9	2.22	15.6
10:00	15.48	100	2.0	19.70	5.010	7.06	-21.1	1.01	11.2
10:05	15.49	100	2.5	19.64	5.014	7.05	-22.8	0.91	9.5
10:10	15.50	100	3.0	19.62	5.007	7.04	-24.0	0.90	8.7
10:15	15.51	100	3.5	19.64	5.013	7.04	-25.3	0.89	4.9
10:20	15.52	100	4.0	19.65	5.010	7.04	-25.0	0.88	4.5

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47MW04

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
10:25	15.53	100	4.5	19.67	5.011	7.03	-25.1	0.88	3.1
10:30	15.54	100	5.0	19.66	5.012	7.03	-24.7	0.88	3.3

Sampling

Sampling beginning time: 10:30 Sampling completion time: 10:33

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID: 47MW04-100806 Sample collection date/time: 8/6/10 10:30

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s): 58995

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2-40ml glass			
Perchlorate		1-250 ml plastic			

Comments: DO Readings in mg/L

9:45 - 2.6 10:00 - 0.9 10:15 - 0.7 10:30 - 0.7

9:50 - 2.3 10:05 - 0.8 10:20 - 0.7

9:55 - 1.0 10:10 - 0.7 10:25 - 0.7

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

FERROUS IRON - 0.10 mg/L

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GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Shaw®

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: SUNNY 103°F

Sampling location ID: ~~47MW09-100803~~ SITE47
Sample ID: 47MW09-100803
Collection Time/Date: 2:50 8/3/10

Pump Installation

Pump installation crew: Beesinger / WAGNER
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 41.00
Initial (pre-installation) DTW/time: 23.09
Final (after pump priming) DTW/time: 23.11
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.): NA

Installation date/beginning time: 8/3/10 1:35
Installation date/completion time: 8/3/10 1:45
Screen Interval (ft. BTOC): 31.00 to 41.00
Pump intake depth (ft BTOC): 36.00
Post-installation DTW/time: 23.05
Max. sustainable pump rate (mL/min): 100
Appearance of product: CLEAR
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	25								
Refill Setting	22								
Discharge Setting	25								
Flow rate (mL/min)	100								

Purging

Purging/sampling crew: Beesinger / WAGNER
Purge date/beginning time: 8/3/10 1:45
Initial (pre-purging) DTW (ft. BTOC): 23.11
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): NA
Purge date/completion time: 8/3/10 2:50
Final (post-purging) DTW (ft. BTOC): 23.20
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	25	25	25	25	25	25	25	25	25
Refill Setting	22	22	22	22	22	22	22	22	22
Discharge Setting	25	25	25	25	25	25	25	25	25
Flow rate (mL/min)	100	100	100	100	100	100	100	100	100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1:50	23.15	100	.5	21.72	3.826	8.12	-8.1	1.51	2.9
1:55	23.17	100	1.0	21.04	3.815	7.75	-8.7	1.19	2.7
2:00	23.18	100	1.5	21.07	3.814	7.72	-16.2	0.89	2.6
2:05	23.19	100	2.0	20.54	3.813	7.69	-23.7	0.91	2.2
2:10	23.20	100	2.5	20.65	3.805	7.69	-28.3	0.95	2.1
2:15	23.20	100	3.0	20.72	3.799	7.69	-32.9	1.06	2.0
2:20	23.20	100	3.5	21.10	3.814	7.68	-39.0	0.81	1.6
2:25	23.20	100	4.0	21.09	3.803	7.64	-41.7	0.96	1.8

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47MW09

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
2:30	23.20	100	4.5	21.29	3.811	7.62	-42.1	1.18	1.8
2:35	23.20	100	5.0	21.31	3.811	7.59	-44.4	0.97	1.8
2:40	23.20	100	5.5	21.34	3.813	7.58	-45.4	0.96	1.8
2:45	23.20	100	6.0	21.30	3.811	7.58	-45.7	0.97	2.1
2:50	23.20	100	6.5	21.32	3.811	7.57	-46.4	0.96	2.0

Sampling

Sampling beginning time: 2:50 Sampling completion time: 3:20

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
3:00	23.20	100	7.0	21.33	3.811	7.57	-46.9	0.96	2.1
3:10	23.20	100	7.5	21.34	3.811	7.57	-46.7	0.95	1.9

Sample Information

Sample ID: 47WMW09-100803 Sample collection date/time: 8/3/10 2:50

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s): 5885, 5886 + 5890

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
DHE		1-1 liter Amber	Perchlorate		1-250ml plastic
SVOC		1-1 liter Amber	ALKALINITY		1-250ml plastic
VOC		2-40mL glass	NITRATE/NITRITE		1-250ml plastic
GASES		3-40 ml glass	TAL metals		1-500ml plastic
ANIONS		1-250mL plastic			

Comments: DO READING IN mg/L

1:50 - 0.9 2:05 - 0.7 2:20 - 0.7 2:35 - 0.7 2:50

1:55 - 0.8 2:10 - 0.7 2:25 - 0.7 2:40 - 0.6

2:00 - 0.7 2:15 - 0.7 2:30 - 0.7 2:45 - 0.6

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

FERROUS IRON -

00107480

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

47WW11

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: SUNNY 87°F

Sampling location ID: Site 47
Sample ID: 47WW11 - 103107
Collection Time/Date: 7/31/10

Pump Installation

Pump installation crew: Beesinger / Wagner
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 21.82
Initial (pre-installation) DTW/time: 20.87
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: 7/31/10 8:40
Installation date/completion time: 7/31/10 8:55
Screen Interval (ft. BTOC): 11.82 to 21.82
Pump intake depth (ft BTOC): NA
Post-installation DTW/time: NA
Max. sustainable pump rate (mL/min): NA
Appearance of product: Very Muddy
Discharge tube diameter (3/8" or 1/4"): NA
Inlet reducer used (Y/N): NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)			BAILED DRY						
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: Beesinger / Wagner
Purge date/beginning time: 7/31/10 8:48
Initial (pre-purging) DTW (ft. BTOC): 20.87
Calculated tubing + pump volume: NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

PID/FID reading (well head/background): NA
Purge date/completion time: 7/31/10 8:55
Final (post-purging) DTW (ft. BTOC): 20.85
No. of tubing + pump volumes purged: NA

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
			BAILED DRY						

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GROUNDWATER SAMPLING FORM

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47WW11

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

BAILED DRY

Sampling

Sampling beginning time:_____ Sampling completion time:_____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID: 47WW11-103107

Sample collection date/time: 7/31/10

Duplicate sample collected (Y/N): N

Duplicate sample ID: N

Split sample collected (Y/N): N

Split sample ID: N

COC No(s): 5883

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2-40 mL glass			

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

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GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHMAP
Project Name/#: 117591.0009A/130
Weather: SUNNY 102°F
Sampling location ID: Site 47
Sample ID: 47WW13-100804
Collection Time/Date: 2:15 8/4/10

Pump Installation

Pump installation crew: Beesinger/Wagner
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 19.07
Initial (pre-installation) DTW/time: 9.38
Final (after pump priming) DTW/time: 9.35
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): 100
Discharge tube length (ft.): NA
Installation date/beginning time: 8/4/10 1:05
Installation date/completion time: 8/4/10 1:15
Screen Interval (ft. BTOC): 9.07 to 19.07
Pump intake depth (ft BTOC): 14.00
Post-installation DTW/time: 9.30
Max. sustainable pump rate (mL/min): 100
Appearance of product: MURKY
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	17								
Refill Setting	14								
Discharge Setting	17								
Flow rate (mL/min)	100								

Purging

Purging/sampling crew: Beesinger/Wagner
Purge date/beginning time: 8/4/10
Initial (pre-purging) DTW (ft. BTOC): 9.35
Calculated tubing + pump volume: NA
PID/FID reading (well head/background): NA
Purge date/completion time: 8/4/10 2:15
Final (post-purging) DTW (ft. BTOC): 9.52
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	17	17	17	17	17	17	17	17	17
Refill Setting	14	14	14	14	14	14	14	14	14
Discharge Setting	17	17	17	17	17	17	17	17	17
Flow rate (mL/min)	100	100	100	100	100	100	100	100	100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1:20	9.37	100	.5	27.37	0.207	6.19	11.8	1.51	390.9
1:25	9.39	100	1.0	25.83	0.198	5.73	27.1	0.82	371.4
1:30	9.41	100	1.5	25.90	0.198	5.64	32.7	0.66	370.6
1:35	9.42	100	2.0	26.35	0.198	5.65	33.6	0.60	270.5
1:40	9.43	100	2.5	26.37	0.198	5.69	31.7	0.55	190.8
1:45	9.44	100	3.0	25.63	0.191	5.66	31.0	0.52	110.6
1:50	9.45	100	3.5	25.77	0.187	5.55	36.5	0.49	72.1
1:55	9.46	100	4.0	26.15	0.186	5.60	33.7	0.49	41.2

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47WW13

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
2:00	9.48	100	4.5	26.17	0.182	5.65	29.5	0.51	21.1
2:05	9.50	100	5.0	26.20	0.180	5.63	30.7	0.50	20.9
2:10	9.51	100	5.5	26.22	0.180	5.63	30.9	0.50	21.5
2:15	9.52	100	6.0	26.23	0.180	5.63	31.1	0.50	21.0

Sampling

Sampling beginning time: 2:15 Sampling completion time: 2:40

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
2:25	9.54	100	7.0	26.24	0.179	5.62	31.5	0.49	20.9
2:35	9.56	100	8.0	26.24	0.179	5.62	31.7	0.49	20.5

Sample Information

Sample ID: 47WW13-100804 Sample collection date/time: 8/4/10 2:15

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s): 5887, 5888, 5889

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2-40 mL glass	Perchlorate		1-250 ml plastic
Dissolved Gases		3-40 ml glass	ALKALINITY		1-250 ml plastic
SVOC		1-1 Liter Amber	Nitrate/Nitrite/TOC		1-250 ml plastic
TAL metals		1-500 ml plastic	DHC		1-1 Liter Amber
ANIONS		1-250 ml plastic			

Comments: DO Readings only in mg/L

1:20 - 0.7 1:35 - 0.5 1:50 - 0.4 2:05 - 0.4

1:25 - 0.6 1:40 - 0.6 1:55 - 0.4 2:10 - 0.4

1:30 - 0.5 1:45 - 0.8 2:00 - 0.4 2:15 - 0.4

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

Ferrous IRON - 0.69 mg/L

00107484

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: Sunny 103°F

Sampling location ID: Site 47
Sample ID: 47MW14-100804
Collection Time/Date: 3:40 8/4/10

Pump Installation

Pump installation crew: Beesinger / Wagner
PID/FID reading (well head/background): NA
Casing diameter (inches): 4
Total well Depth (ft. BTOC): 53.00
Initial (pre-installation) DTW/time: 24.30
Final (after pump priming) DTW/time: 24.31
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): 175
Discharge tube length (ft.): NA

Installation date/beginning time: 8/4/10 2:40
Installation date/completion time: 8/4/10 2:50
Screen Interval (ft. BTOC): 43.00 to 53.00
Pump intake depth (ft BTOC): 48.00
Post-installation DTW/time: 29.26
Max. sustainable pump rate (mL/min): 100
Appearance of product: Clear
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	38	40							
Refill Setting	35	37							
Discharge Setting	38	40							
Flow rate (mL/min)	75	100							

Purging

Purging/sampling crew: Beesinger / Wagner
Purge date/beginning time: 8/4/10 2:55
Initial (pre-purging) DTW (ft. BTOC): 24.31
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): NA
Purge date/completion time: 8/4/10 3:40
Final (post-purging) DTW (ft. BTOC): 24.33
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	40	40	40	40	40	40	40	40	40
Refill Setting	37	37	37	37	37	37	37	37	37
Discharge Setting	40	40	40	40	40	40	40	40	40
Flow rate (mL/min)	100	100	100	100	100	100	100	100	100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
2:55	24.31	100	.5	24.65	2.136	7.11	2.4	3.61	1.4
3:00	24.32	100	1.0	24.00	2.211	6.65	22.4	1.91	1.5
3:05	24.33	100	1.5	24.23	2.220	6.58	29.6	1.59	1.4
3:10	24.33	100	2.0	24.81	2.220	6.61	28.1	1.69	1.0
3:15	24.33	100	2.5	24.48	2.227	6.60	27.4	1.43	0.3
3:20	24.33	100	3.0	24.51	2.223	6.64	27.1	1.45	0.2
3:25	24.33	100	3.5	24.40	2.220	6.55	27.6	1.42	0.0
3:30	24.33	100	4.0	24.45	2.219	6.54	28.8	1.41	0.2

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GROUNDWATER SAMPLING FORM

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47WW14

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
3:35	24.33	100	4.5	24.47	2.220	6.54	28.3	1.42	0.2
3:40	24.33	100	5.0	24.48	2.220	6.54	28.5	1.41	0.1

Sampling

Sampling beginning time: 3:40 Sampling completion time: 4:15

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
3:50	24.33	100	6.0	24.48	2.220	6.53	28.0	1.40	0.0
4:00	24.33	100	7.0	24.50	2.221	6.53	28.1	1.40	0.1
4:10	24.33	100	8.0	24.51	2.221	6.53	27.9	1.40	0.1

Sample Information

Sample ID: 47WW14-100804
Duplicate sample collected (Y/N): Yes
Split sample collected (Y/N): ND
COC No(s): 5887, 5888, 5889

Sample collection date/time: 8/4/10 3:40
Duplicate sample ID: 47WW14-100804-FD
Split sample ID: NA

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		4-40ml glass	ALKALinity		2-250 ml plastic
Dissolved GASES		6-40 ml glass	NITRATE/NITRITE/TOC		2-250 ml plastic
SVOC		2-1 Liter Amber	TAL metals		1-500 ml plastic
ANIONS		2-250 ml plastic	DHC		2-1 Liter Amber
Perchlorate		2-250 ml plastic			

Comments: DO meter only readings in mg/L
2:55 - 7.0 3:10 - 5.9 3:25 - 6.0 3:40 - 5.7
3:00 - 6.8 3:15 - 5.9 3:30 - 5.8
3:05 - 6.8 3:20 - 5.6 3:35 - 5.8

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

Ferrous IRON - 0.01 mg/L

00107486

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP — Sampling location ID: SWL47
Project Name/#: 117591.0009A130 — Sample ID: 47WW21-103107
Weather: SUNNY 95°F — Collection Time/Date: 12:00 7/31/10

Pump Installation

Pump installation crew: Beesinger / Wagner — Installation date/beginning time: 7/31/10 10:30
PID/FID reading (well head/background): NA — Installation date/completion time: 7/31/10 10:40
Casing diameter (inches): 4" — Screen Interval (ft. BTOC): 13.70 to 23.70
Total well Depth (ft. BTOC): 23.70 — Pump intake depth (ft BTOC): 18.50
Initial (pre-installation) DTW/time: 11.78 — Post-installation DTW/time: 11.75
Final (after pump priming) DTW/time: 11.80 — Max. sustainable pump rate (mL/min): 100
Free product (circle): LNAPL / DNAPL — Appearance of product: MURKY
Volume of water removed during priming (mL): 100 — Discharge tube diameter (3/8" or 1/4"): 1/4"
Discharge tube length (ft.): NA — Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	17								
Refill Setting	14								
Discharge Setting	17								
Flow rate (mL/min)	100								

Purging

Purging/sampling crew: Beesinger / Wagner — PID/FID reading (well head/background): NA
Purge date/beginning time: 7/31/10 10:40 — Purge date/completion time: 7/31/10 12:00
Initial (pre-purging) DTW (ft. BTOC): 11.80 — Final (post-purging) DTW (ft. BTOC): 11.85
Calculated tubing + pump volume: NA — No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	17	17	17	17	17	17	17	17	17
Refill Setting	14	14	14	14	14	14	14	14	14
Discharge Setting	17	17	17	17	17	17	17	17	17
Flow rate (mL/min)	100	100	100	100	100	100	100	100	100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
10:50	11.82	100	1.0	20.73	0.203	5.94	80.4	1.57	296.1
10:55	11.83	100	1.5	20.37	0.208	5.69	103.2	0.70	255.0
11:00	11.84	100	2.0	20.18	0.209	5.59	104.8	0.54	227.3
11:05	11.85	100	2.5	20.14	0.209	5.63	100.1	0.47	179.7
11:10	11.85	100	3.0	20.16	0.209	5.66	97.5	0.44	156.3
11:15	11.85	100	3.5	20.14	0.209	5.68	95.3	0.41	141.3
11:20	11.85	100	4.0	20.24	0.208	5.71	92.9	0.39	115.7
11:25	11.85	100	4.5	20.27	0.208	5.73	91.0	0.38	100.5

00107487

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47MW21

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
11:30	11.85	100	5.0	20.16	0.208	5.72	88.7	0.36	35.7
11:35	11.85	100	5.5	20.35	0.206	5.73	86.7	0.37	30.1
11:40	11.85	100	6.0	20.51	0.206	5.75	84.1	0.38	17.3
11:45	11.85	100	6.5	20.50	0.206	5.75	83.8	0.38	15.2
11:50	11.85	100	7.0	20.52	0.206	5.76	83.5	0.38	14.5
11:55	11.85	100	7.5	20.53	0.207	5.76	83.1	0.37	12.9
12:00	11.85	100	8.0	20.53	0.207	5.76	82.9	0.38	10.0

Sampling

Sampling beginning time: 12:00 Sampling completion time: 12:02

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID: 47WW21-103107
Sample collection date/time: 7/31/10 ~~12:05~~ 12:00
Duplicate sample collected (Y/N): N
Duplicate sample ID: NA
Split sample collected (Y/N): N
Split sample ID: NA
COC No(s): 5883

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
Perchlorate		1-250ml plastic			
VOC		2-40ml glass			

Comments: DO meter only Reading in mg/L

10:50 - 1.5	11:05 - 0.7	11:20 - 0.8	11:35 - 0.9	11:50 - 0.7
10:55 - 0.9	11:10 - 0.7	11:25 - 0.8	11:40 - 0.9	11:55 - 0.6
11:00 - 0.7	11:15 - 0.8	11:30 - 0.9	11:45 - 0.8	12:00 - 0.6

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

Ferrous Iron — 3.30 mg/L

00107488

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: Sunny 101°F

Sampling location ID: Site 47
Sample ID: 47WW23-100806
Collection Time/Date: 1:20 8/6/10

Pump Installation

Pump installation crew: Beesinger/Wagner
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 34.72
Initial (pre-installation) DTW/time: 21.31
Final (after pump priming) DTW/time: 21.29
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): 100
Discharge tube length (ft.): NA

Installation date/beginning time: 8/6/10 12:15
Installation date/completion time: 8/6/10 12:25
Screen Interval (ft. BTOC): 24.72 to 34.72
Pump intake depth (ft BTOC): 29.50
Post-installation DTW/time: 21.25
Max. sustainable pump rate (mL/min): 100
Appearance of product: Clear
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	21								
Refill Setting	18								
Discharge Setting	21								
Flow rate (mL/min)	100								

Purging

Purging/sampling crew: Beesinger/Wagner
Purge date/beginning time: 8/6/10 12:25
Initial (pre-purging) DTW (ft. BTOC): 21.29
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): NA
Purge date/completion time: 8/6/10 1:20
Final (post-purging) DTW (ft. BTOC): 21.36
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	21	21	21	21	21	21	21	21	21
Refill Setting	18	18	18	18	18	18	18	18	18
Discharge Setting	21	21	21	21	21	21	21	21	21
Flow rate (mL/min)	100	100	100	100	100	100	100	100	100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
12:30	21.32	100	.5	25.60	1.065	6.91	-27.7	1.32	-2.1
12:35	21.33	100	1.0	23.19	0.986	6.71	-22.5	0.89	-4.3
12:40	21.34	100	1.5	22.70	0.977	6.58	-16.9	0.70	-4.3
12:45	21.35	100	2.0	22.72	0.966	6.55	-16.6	0.60	-4.9
12:50	21.35	100	2.5	23.08	0.968	6.57	-20.4	0.55	-5.1
12:55	21.35	100	3.0	22.87	0.968	6.54	-22.3	0.57	-4.8
1:00	21.36	100	3.5	22.83	0.968	6.52	-22.3	0.70	-5.0
1:05	21.36	100	4.0	22.72	0.969	6.49	-22.5	0.55	-5.0

00107489

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47mw23

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1:10	21.36	100	4.5	22.70	0.964	6.47	-22.4	0.54	-4.3
1:15	21.36	100	5.0	22.69	0.965	6.47	-22.6	0.54	-4.4
1:20	21.36	100	5.5	22.69	0.965	6.47	-22.5	0.54	-4.3

Sampling

Sampling beginning time: 1:20 Sampling completion time: 1:23

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID: 47ww23-100806
Sample collection date/time: 8/6/10 1:20
Duplicate sample collected (Y/N): NO
Duplicate sample ID: NA
Split sample collected (Y/N): NO
Split sample ID: NA
COC No(s): 5895

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2-40ml glass			
Perchlorate		1-250ml plastic			

Comments: DO meter only readings in mg/L
12:30 - 0.7 12:45 - 0.4 1:00 - 0.3 1:15 - 0.4
12:35 - 0.5 12:50 - 0.4 1:05 - 0.3 1:20 -
12:40 - 0.4 12:55 - 0.3 1:10 - 0.3

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

Ferrous Iron - 0.02 mg/L

00107490

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: Sunny 95°F
Sampling location ID: S.H.A7
Sample ID: A7WW27-103107
Collection Time/Date: 9:45 7/31/10

Pump Installation

Pump installation crew: Bressler / Wagner
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 22.65
Initial (pre-installation) DTW/time: 19.45
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA
Installation date/beginning time: 7/31/10 9:10
Installation date/completion time: 7/31/10 9:25
Screen Interval (ft. BTOC): 12.65 to 22.65
Pump intake depth (ft BTOC): NA
Post-installation DTW/time: NA
Max. sustainable pump rate (mL/min): NA
Appearance of product:
Discharge tube diameter (3/8" or 1/4"): NA
Inlet reducer used (Y/N): NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: Bressler / Wagner
Purge date/beginning time: 7/31/10 9:10
Initial (pre-purging) DTW (ft. BTOC): 19.45
Calculated tubing + pump volume: NA
PID/FID reading (well head/background): NA
Purge date/completion time: 7/31/10 9:25
Final (post-purging) DTW (ft. BTOC): 22.60
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
	BAILED DRY								

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47MW27

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

BAILED DRY

Sampling

Sampling beginning time: 9:45 Sampling completion time: 9:50

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
9:50	19.45	NA	NA	20.60	0.292	5.95	117.2	5.08	80.0

Sample Information

Sample ID: 47MW27-103107 Sample collection date/time: 7/31/10 9145

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s): 5883

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
Perchlorate		1-250mL glass			
VOC		2-40 mg glass			

Comments: DO meter Reading
9:50 - 5.1

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

Ferrous Iron - 1.56 mg/L

00107492

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: SUNNY 103°F
Sampling location ID: Site 47
Sample ID: 47MW28 - 103107
Collection Time/Date: 3:50 7/31/10

Pump Installation

Pump installation crew: Beesinger / WAGNER
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 24.95
Initial (pre-installation) DTW/time: 18.59
Final (after pump priming) DTW/time: 18.55
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): 100
Discharge tube length (ft.): NA
Installation date/beginning time: 7/31/10 3:00
Installation date/completion time: 7/31/10 3:10
Screen Interval (ft. BTOC): 14.95 to 24.95
Pump intake depth (ft BTOC): 22.00
Post-installation DTW/time: 18.50
Max. sustainable pump rate (mL/min): 100
Appearance of product: CLEAR
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	18								
Refill Setting	15								
Discharge Setting	18								
Flow rate (mL/min)	100								

Purging

Purging/sampling crew: Beesinger / WAGNER
Purge date/beginning time: 7/31/10 3:10
Initial (pre-purging) DTW (ft. BTOC): 18.55
Calculated tubing + pump volume: NA
PID/FID reading (well head/background): NA
Purge date/completion time: 7/31/10 3:50
Final (post-purging) DTW (ft. BTOC): 18.67
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	18	18	18	18	18	18	18	18	18
Refill Setting	15	15	15	15	15	15	15	15	15
Discharge Setting	18	18	18	18	18	18	18	18	18
Flow rate (mL/min)	100	100	100	100	100	100	100	100	100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
3:15	18.58	100	.5	20.41	2.013	6.30	111.5	3.33	20.8
3:20	18.60	100	1.0	20.76	2.407	6.40	97.2	0.84	2.4
3:25	18.62	100	1.5	20.64	2.404	6.30	102.8	0.58	2.1
3:30	18.64	100	2.0	20.47	2.401	6.30	103.1	0.51	2.5
3:35	18.65	100	2.5	20.37	2.402	6.31	103.6	0.45	2.9
3:40	18.66	100	3.0	20.30	2.406	6.32	104.2	0.42	2.9
3:45	18.67	100	3.5	20.32	2.403	6.32	105.4	0.42	3.4
3:50	18.67	100	4.0	20.34	2.403	6.32	104.9	0.42	3.4

00107493

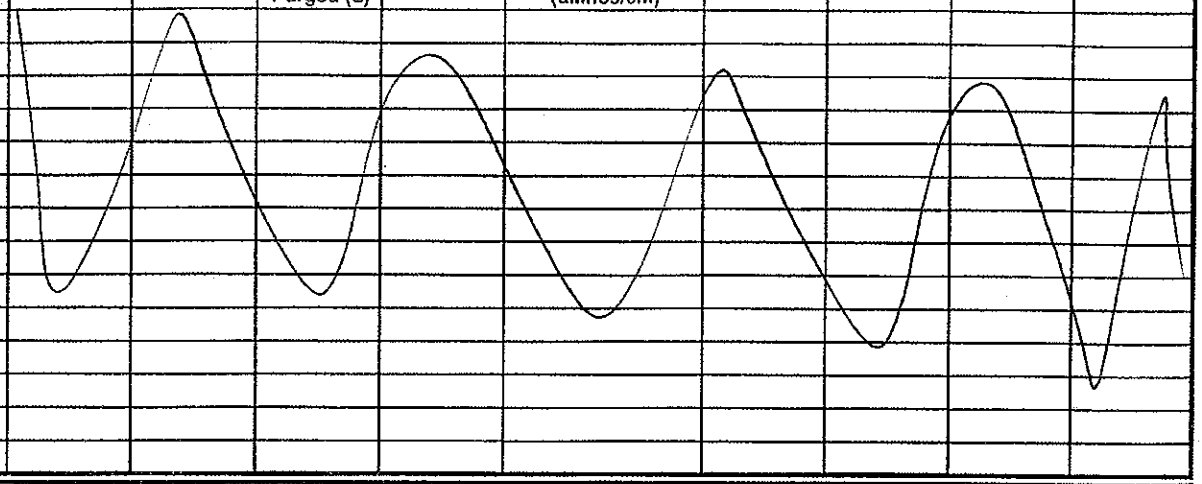
GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47MW28

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)



Sampling

Sampling beginning time: 3:50 Sampling completion time: 2:55

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
3:52	18.67	100	4.2	20.33	2.402	6.32	104.5	0.42	3.2

Sample Information

Sample ID: 47MW28-103107 Sample collection date/time: 7/31/10 3:50

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s): 58884

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
Perchlorate		1-250mL plastic			
VOC		2-40ml glass			

Comments: DO meter only Readings in mg/L

3:15 - 0.7 3:30 - 0.7 3:45 - 0.7

3:20 - 0.7 3:35 - 0.6 3:50 - 0.7

3:25 - 0.8 3:40 -

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

FERROUS IRON - 0.00 mg/L

00107494

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP — Sampling location ID: Site 47
Project Name/#: 117591.0009A130 — Sample ID: 47MW29-103107
Weather: Sunny 102°F — Collection Time/Date: 2150 7/31/10

Pump Installation

Pump installation crew: Beesinger/wagner — Installation date/beginning time: 7/31/10 1430
PID/FID reading (well head/background): NA — Installation date/completion time: 7/31/10 1540
Casing diameter (inches): 4" — Screen Interval (ft. BTOC): 54.06 to 64.06
Total well Depth (ft. BTOC): 64.06 — Pump intake depth (ft BTOC): 59.00
Initial (pre-installation) DTW/time: 17.55 — Post-installation DTW/time: 17.50
Final (after pump priming) DTW/time: 17.55 — Max. sustainable pump rate (mL/min): 100
Free product (circle): LNAPL / DNAPL — Appearance of product: Little murky
Volume of water removed during priming (mL): 100 — Discharge tube diameter (3/8" or 1/4"): 1/4"
Discharge tube length (ft.): NA — Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	40								
Refill Setting	37								
Discharge Setting	40								
Flow rate (mL/min)	100								

Purging

Purging/sampling crew: Beesinger/wagner — PID/FID reading (well head/background): NA
Purge date/beginning time: 7/31/10 1540 — Purge date/completion time: 7/31/10 2150
Initial (pre-purging) DTW (ft. BTOC): 17.55 — Final (post-purging) DTW (ft. BTOC): 17.57
Calculated tubing + pump volume: NA — No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	40	40	40	40	40	40	40	40	40
Refill Setting	37	37	37	37	37	37	37	37	37
Discharge Setting	40	40	40	40	40	40	40	40	40
Flow rate (mL/min)	100	100	100	100	100	100	100	100	100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1545	17.56	100	.5	22.98	1.576	8.46	85.4	4.99	8.6
1550	17.56	100	1.0	22.19	1.536	8.48	97.4	4.46	6.0
1555	17.56	100	1.5	22.01	1.528	8.50	102.1	4.33	6.0
2100	17.57	100	2.0	22.17	1.527	8.43	103.7	4.21	5.7
2105	17.57	100	2.5	22.17	1.523	8.35	103.6	4.07	5.5
2110	17.57	100	3.0	22.26	1.521	8.20	104.1	3.96	5.0
2115	17.57	100	3.5	22.41	1.514	7.96	104.7	3.90	4.8
2120	17.57	100	4.0	22.68	1.506	7.83	103.8	3.79	4.6

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GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47MW29

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
2:25	17.57	100	4.5	22.84	1.504	7.77	102.9	3.70	4.7
2:30	17.57	100	5.0	23.05	1.498	7.62	102.5	3.59	4.8
2:35	17.57	100	5.5	23.07	1,497	7.55	101.4	3.49	4.8
2:40	17.57	100	6.0	23.08	1.495	7.50	99.8	3.47	4.9
2:45	17.57	100	6.5	23.09	1.495	7.48	99.5	3.45	4.8
2:50	17.57	100	7.0	23.10	1.494	7.48	99.3	3.45	4.7

Sampling

Sampling beginning time: 2:50 Sampling completion time: 2:55

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
2:52	17.57	100	7.2	23.10	1.494	7.48	99.0	3.44	4.6

Sample Information

Sample ID: 47MW29-103107
Duplicate sample collected (Y/N): Yes
Split sample collected (Y/N): N
COC No(s): 58883

Sample collection date/time: 7/31/10 2:50
Duplicate sample ID: 47MW29-103107-FD
Split sample ID: NA

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
Perchlorate		2-250 mL plastic			
VOC		4-40 ml glass			

Comments: DO meter reading in mg/L
1:45 - 4.4
1:50 - 4.2
1:55 - 4.2
1:55 - 4.1
2:00 - 4.1
2:05 - 4.1
2:10 - 4.0
2:15 - 4.0
2:20 - 4.0
2:25 - 4.0
2:30 - 4.0
2:35 - 4.0
2:40 - 3.8
2:45 - 3.8
2:50 - 3.8

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

Ferrous Iron = 0.20 mg/L

00107496

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: Sunny 85°

Sampling location ID: SWMU 47
Sample ID: 47WW30-100804
Collection Time/Date: 12:40 8/4/10

Pump Installation

Pump installation crew: Beasley / Wagner
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 25.00
Initial (pre-installation) DTW/time: 22.67
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: 8/4/10 7:15
Installation date/completion time: 8/4/10 7:35
Screen Interval (ft. BTOC): 15.00 to 25.00
Pump intake depth (ft BTOC): NA
Post-installation DTW/time: NA
Max. sustainable pump rate (mL/min): NA
Appearance of product: MURKY
Discharge tube diameter (3/8" or 1/4"): NA
Inlet reducer used (Y/N): NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: Beasley / Wagner
Purge date/beginning time: 8/4/10 7:38
Initial (pre-purging) DTW (ft. BTOC): 22.67
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): NA
Purge date/completion time: 8/4/10 7:35
Final (post-purging) DTW (ft. BTOC): 24.95
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
		BAILED			DRY				

00107497

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47WW30

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
BAILED DRY									

Sampling

Sampling beginning time: 12:40 Sampling completion time: _____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
12:40	32.67	~~~	~~~	23.08	5.557	6.98	9.4	4.20	17.3

Sample Information

Sample ID: 47WW30-100804 Sample collection date/time: 8/4/10 12:40

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s): 5887, 5888, 5889

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2-40 ml glass	ALKALINITY		1-250 ml plastic
Dissolved Gases		3-40 ml glass			
Anions		1-250 ml plastic			
NITRATE/NITRITE/TOC		1-250 ml plastic			
Perchlorate		1-250 ml plastic			

Comments:

FERROUS IRON - 0.45 mg/L

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107498

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LMAMP
Project Name/#: 117591.0009A130
Weather: Sunny / 98°F

Sampling location ID: Site 47
Sample ID: 47WW32-103007
Collection Time/Date: 7:55 7/30/10

Pump Installation

Pump installation crew: Beesinger / Wagner
PID/FID reading (well head/background): NA
Casing diameter (inches): 2"
Total well Depth (ft. BTOC): 35.00
Initial (pre-installation) DTW/time: 29.65
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: 7/30/10 11:25
Installation date/completion time: 7/30/10
Screen Interval (ft. BTOC): 25.00 to 35.00
Pump intake depth (ft BTOC): NA
Post-installation DTW/time: NA
Max. sustainable pump rate (mL/min): NA
Appearance of product: NA
Discharge tube diameter (3/8" or 1/4"): NA
Inlet reducer used (Y/N): NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	BAILED DRY								
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: Beesinger / Wagner
Purge date/beginning time: 7/30/10
Initial (pre-purging) DTW (ft. BTOC): 29.65
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): NA
Purge date/completion time: 7/30/10 11:40
Final (post-purging) DTW (ft. BTOC): 34.95
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
	BAILED DRY								

00107499

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47WW32

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

BAILED DRY

Sampling

Sampling beginning time: 7:55 Sampling completion time: 7:57

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
7:55	29.65	〃	〃	19.50	5.384	7.01	94.7	3.32	13.6

Sample Information

Sample ID: 47WW32-103007 Sample collection date/time: 7/30/10 7:55

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s): 58803

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2-40 mL glass			

Comments: DO meter only reading 3.1 mg/L

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

Ferrous IRON - 0.22 mg/L

00107500

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: ~~SWMU~~ LHAAP — Sampling location ID: SWMU 47
Project Name/#: 117591.0009A130 — Sample ID: 47WW33-103007
Weather: Sunny 90°F — Collection Time/Date: 7/3/10 11:00

Pump Installation

Pump installation crew: Bressinger / Wagner — Installation date/beginning time: 7/30/10 9:40
PID/FID reading (well head/background): NA — Installation date/completion time: 7/30/10 ~~9:50~~
Casing diameter (inches): 4" — Screen Interval (ft. BTOC): 27.00 to 37.00
Total well Depth (ft. BTOC): 37.00 — Pump intake depth (ft BTOC): 32.00
Initial (pre-installation) DTW/time: ~~9.22~~ 9.22 — Post-installation DTW/time: 9.16
Final (after pump priming) DTW/time: ~~9.18~~ 9.18 — Max. sustainable pump rate (mL/min): 100
Free product (circle): LNAPL / DNAPL — Appearance of product: ~~Clear~~ MUNKY
Volume of water removed during priming (mL): 100 — Discharge tube diameter (3/8" or 1/4"): 1/4"
Discharge tube length (ft.): NA — Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	18								
Refill Setting	15								
Discharge Setting	18								
Flow rate (mL/min)	100								

Purging

Purging/sampling crew: Bressinger / Wagner — PID/FID reading (well head/background): NA
Purge date/beginning time: 7/30/10 ~~9:50~~ — Purge date/completion time: 7/30/10 11:00
Initial (pre-purging) DTW (ft. BTOC): 9.18 — Final (post-purging) DTW (ft. BTOC): 9.25
Calculated tubing + pump volume: NA — No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	18	18	18	18	18	18	18	18	18
Refill Setting	15	15	15	15	15	15	15	15	15
Discharge Setting	18	18	18	18	18	18	18	18	18
Flow rate (mL/min)	100	100	100	100	100	100	100	100	100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
10:00	9.20	100	1.0	26.49	0.575	6.70	101.2	3.31	95.6
10:05	9.22	100	1.5	23.59	1.017	6.03	105.9	1.65	106.8
10:10	9.23	100	2.0	23.12	0.996	5.66	118.9	1.04	104.5
10:15	9.24	100	2.5	23.09	0.993	5.52	120.7	0.89	87.5
10:20	9.25	100	3.0	23.35	0.994	5.44	119.9	0.81	61.6
10:25	9.25	100	3.5	23.91	0.986	5.42	120.6	0.73	52.8
10:30	9.25	100	4.0	24.75	0.984	5.48	121.0	0.70	49.5
10:35	9.25	100	4.5	25.42	0.984	5.49	116.3	0.68	47.5

00107501

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47WW33

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
10:40	9.25	100	5.0	26.21	0.983	5.46	112.7	0.67	40.0
10:45	9.25	100	5.5	26.30	0.981	5.47	112.3	0.66	32.7
10:50	9.25	100	6.0	26.33	0.981	5.48	112.7	0.66	20.1
10:55	9.25	100	6.5	26.35	0.980	5.48	112.5	0.66	15.3
11:00	9.25	100	7.0	26.37	0.980	5.48	111.9	0.66	10.1

Sampling

Sampling beginning time: 11:00 Sampling completion time: 11:02

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID: 47ww33-103007 Sample collection date/time: 7/30/10 11:00

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s): 58883

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		3-40ml glass			

Comments: DO meter only readings mg/L

10:00 - 1.3 mg/L
10:05 - 1.3
10:10 - 1.4
10:15 - 1.4
10:20 - 1.3
10:25 - 1.3
10:30 - 1.2
10:40 - 1.2
10:45 - 1.2
10:50 - 0.9
10:55 - 0.9
11:00 - 0.8

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107502

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP — Sampling location ID: Site 47
Project Name/#: 117591.0009A130 — Sample ID: 47WW34-100803
Weather: Sunny 95°F — Collection Time/Date: 1:00 8/3/10

Pump Installation

Pump installation crew: Beesinger — Installation date/beginning time: 8/3/10 12:00
PID/FID reading (well head/background): NA — Installation date/completion time: 8/3/10 12:10
Casing diameter (inches): 4" — Screen Interval (ft. BTOC): 35.00 to 45.00
Total well Depth (ft. BTOC): 45.00 — Pump intake depth (ft BTOC): 40.00
Initial (pre-installation) DTW/time: 17.30 — Post-installation DTW/time: 17.25
Final (after pump priming) DTW/time: 17.31 — Max. sustainable pump rate (mL/min): 100
Free product (circle): LNAPL / DNAPL — Appearance of product: CLEAR
Volume of water removed during priming (mL): 125 — Discharge tube diameter (3/8" or 1/4"): 1/4"
Discharge tube length (ft.): NA — Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	22	25							
Refill Setting	19	22							
Discharge Setting	22	25							
Flow rate (mL/min)	75	100							

Purging

Purging/sampling crew: Beesinger — PID/FID reading (well head/background): NA
Purge date/beginning time: 8/3/10 12:10 — Purge date/completion time: 8/3/10 1:00
Initial (pre-purging) DTW (ft. BTOC): 17.31 — Final (post-purging) DTW (ft. BTOC): 17.35
Calculated tubing + pump volume: NA — No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	25	25	25	25	25	25	25	25	25
Refill Setting	22	22	22	22	22	22	22	22	22
Discharge Setting	25	25	25	25	25	25	25	25	25
Flow rate (mL/min)	100	100	100	100	100	100	100	100	100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
12:15	17.33	100	.5	22.63	1.310	7.77	19.2	5.52	-0.2
12:20	17.35	100	1.0	21.35	1.297	7.48	53.0	5.39	0.0
12:25	17.35	100	1.5	21.03	1.291	7.43	60.0	5.28	-0.1
12:30	17.35	100	2.0	20.86	1.292	7.42	61.2	5.17	-0.1
12:35	17.35	100	2.5	20.96	1.287	7.42	61.6	5.02	-0.3
12:40	17.35	100	3.0	21.05	1.286	7.43	60.6	5.08	-0.5
12:45	17.35	100	3.5	21.07	1.281	7.44	59.3	4.95	-0.6
12:50	17.35	100	4.0	21.10	1.288	7.44	57.1	4.91	-0.5

00107503

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47WW34

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
12:55	17.35	100	4.5	21.11	1.287	7.43	58.3	4.96	-0.8
1:00	17.35	100	5.0	21.12	1.286	7.43	58.4	4.95	-0.7

Sampling

Sampling beginning time: 1:00 Sampling completion time: 1:20

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1:10	17.35	100	6.0	21.15	1.285	7.43	59.1	4.92	-0.5
1:20	17.35	100	7.0	21.18	1.286	7.42	58.7	4.93	-0.6

Sample Information

Sample ID: 47WW34-000803 Sample collection date/time: 8/3/10 1:00

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s): 5885 + 5886 + 5890

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
DHE		1-1 Liter Amber	Perchlorate		1-250 ml plastic
SVOC		1-1 Liter Amber	ALKALINITY		1-250 ml plastic
VOC		2-40 ml glass	NITRATE/NITRITE		1-250 ml plastic
GASES		3-40 ml glass	TAL Metals		1-500 ml plastic
ANIONS		1-250 mL plastic			

Comments: DO meter Readings in MG/L

12:15 - 4.0 12:25 - 3.9 12:40 - 3.7 12:55 - 3.8

12:20 - 4.0 12:30 - 3.9 12:45 - 3.8 1:00 - 3.8

12:25 - 3.9 12:35 - 3.9 12:50 - 3.8

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

Ferrous Iron - 0.17 mg/L

00107504

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: Sunny 100°F
Sampling location ID: Site 47
Sample ID: LHSMW38-103007
Collection Time/Date: 7/30/10

Pump Installation

Pump installation crew: Beesinger / Wagner
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 28.35
Initial (pre-installation) DTW/time: 21.62
Final (after pump priming) DTW/time: 21.62
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): 100
Discharge tube length (ft.): NA
Installation date/beginning time: 7/30/10 1:25
Installation date/completion time: 7/30/10 1:35
Screen Interval (ft. BTOC): 18.35 to 28.35
Pump intake depth (ft BTOC): 25.00
Post-installation DTW/time: 21.58
Max. sustainable pump rate (mL/min): 100
Appearance of product: MURKY
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	18								
Refill Setting	15								
Discharge Setting	18								
Flow rate (mL/min)	100								

Purging

Purging/sampling crew: Beesinger / Wagner
Purge date/beginning time: 7/30/10 1:35
Initial (pre-purging) DTW (ft. BTOC): 21.62
Calculated tubing + pump volume: NA
PID/FID reading (well head/background): NA
Purge date/completion time: 7/30/10
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	18	18	18	18	18	18	18	18	18
Refill Setting	15	15	15	15	15	15	15	15	15
Discharge Setting	18	18	18	18	18	18	18	18	18
Flow rate (mL/min)	100	100	100	100	100	100	100	100	100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1:45	21.65	100	1.0	22.43	0.118	5.95	111.2	1.10	156.4
1:50	21.67	100	1.5	21.36	0.114	5.25	143.7	0.65	134.9
1:55	21.69	100	2.0	21.18	0.114	5.16	144.2	0.54	126.1
2:00	21.71	100	2.5	20.87	0.114	5.19	139.1	0.46	115.5
2:05	21.73	100	3.0	20.85	0.114	5.23	136.6	0.43	108.6
2:10	21.75	100	3.5	21.02	0.115	5.28	134.4	0.44	107.1
2:15	21.76	100	4.0	21.10	0.116	5.39	128.0	0.39	100.6
2:20	21.77	100	4.5	21.30	0.115	5.42	126.2	0.38	63.4

00107505

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

LHSmw 38

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
2:25	21.78	100	5.0	21.36	0.116	5.49	127.5	0.38	53.0
2:30	21.78	100	5.5	21.40	0.116	5.53	122.4	0.39	52.0
2:35	21.78	100	6.0	21.42	0.116	5.52	120.6	0.37	29.3
2:40	21.79	100	6.5	21.45	0.115	5.50	122.3	0.34	17.3
2:45	21.79	100	7.0	21.52	0.115	5.50	123.0	0.34	8.7

Sampling

Sampling beginning time: 2:45 Sampling completion time: 2:47

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID: LHSmw38-103007
Sample collection date/time: 7/30/10 2:45
Duplicate sample collected (Y/N): N
Duplicate sample ID: NA
Split sample collected (Y/N): N
Split sample ID: NA
COC No(s): 5883

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2-40mg glass			

Comments: DO meter only readings in mg/L

1:45 - 0.7	2:00 - 0.7	2:15 - 0.8	2:30 - 0.6	2:45 - 0.6
1:50 - 0.7	2:05 - 0.6	2:20 - 0.8	2:35 - 0.6	
1:55 - 0.7	2:10 - 0.6	2:25 - 0.7	2:40 0.6	

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

Ferrous Iron - 0.66 mg/L

00107506

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: Sunny 102°F
Sampling location ID: Site 47
Sample ID: LHSMW44-100307
Collection Time/Date: 9:15 7/30/10

Pump Installation

Pump installation crew: Beesinger / Wagner
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 38.44
Initial (pre-installation) DTW/time: [illegible] 21.28
Final (after pump priming) DTW/time: 21.30
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): 100
Discharge tube length (ft.): NA
Installation date/beginning time: 7/30/10 3:00
Installation date/completion time: 7/30/10 3:10
Screen Interval (ft. BTOC): 28.44 to 38.44
Pump intake depth (ft BTOC): 33.50
Post-installation DTW/time: [illegible] 21.25
Max. sustainable pump rate (mL/min): 100
Appearance of product: MURKY
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	22								
Refill Setting	19								
Discharge Setting	22								
Flow rate (mL/min)	100								

Purging

Purging/sampling crew: Beesinger / Wagner
Purge date/beginning time: 7/30/10 3:10
Initial (pre-purging) DTW (ft. BTOC): 21.30
Calculated tubing + pump volume: NA
PID/FID reading (well head/background): NA
Purge date/completion time: 7/30/10 4:15
Final (post-purging) DTW (ft. BTOC): 21.40
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	22	22	22	22	22	22	22	22	22
Refill Setting	19	19	19	19	19	19	19	19	19
Discharge Setting	22	22	22	22	22	22	22	22	22
Flow rate (mL/min)	100	100	100	100	100	100	100	100	100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
3:15	21.32	100	[illegible] 0.5	22.76	[illegible] 3.476	6.95	117.5	2.65	326.1
3:20	21.35	100	[illegible] 1.0	[illegible]	3,495	6.72	102.3	0.79	255.9
3:25	21.37	100	1.5	20.85	3,505	6.67	105.4	0.57	198.4
3:30	21.38	100	2.0	20.81	3,507	6.68	104.9	0.48	176.0
3:35	21.39	100	2.5	20.71	3,506	6.69	103.3	0.41	133.7
3:40	21.40	100	3.0	20.75	3,504	6.69	103.0	0.38	113.1
3:45	21.40	100	3.5	20.63	3,506	6.70	101.1	0.34	85.9
3:50	21.40	100	4.0	20.56	3,505	6.70	100.1	0.35	78.7

00107507

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

LHSMW44

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
3:55	21.40	100	4.5	20.60	3,500	6.71	97.8	0.32	65.8
4:00	21.40	100	5.0	20.58	3,503	6.71	96.8	0.30	~~10.5~~
4:05	21.40	100	5.5	20.57	3,508	6.71	95.8	0.30	21.1
4:10	21.40	100	6.0	20.53	3,503	6.72	95.3	0.30	11.6
4:15	21.40	100	6.5	20.51	3,505	6.72	96.0	0.30	7.5

Sampling

Sampling beginning time: 4:15 Sampling completion time: 4:17

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID: LHSMW44-103007 Sample collection date/time: 7/30/10 4:15

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s): 58883

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2-40ml glass			

Comments: DO meter ~~daily~~ reading in mg/L

3:15-0.5 3:20-0.6 3:25-0.5 3:30-~~0.5~~0.5 3:35-0.5 3:40-0.5 3:45-0.5 3:50-0.5 3:55-0.5 4:00-0.5 4:05-0.5 4:10-0.5 4:15-0.5

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

Ferrous Iron - 0.66 mg/L

00107508

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: Sunny 88°F
Sampling location ID: SWD 47
Sample ID: LHSmw54-100806
Collection Time/Date: 9:00 8/6/10

Pump Installation

Pump installation crew: Beesinger / Wagner
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 45.50
Initial (pre-installation) DTW/time: 15.63
Final (after pump priming) DTW/time: 15.64
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): 100
Discharge tube length (ft.): NA
Installation date/beginning time: 8/6/10 8:00
Installation date/completion time: 8/6/10 8:15
Screen Interval (ft. BTOC): 35.50 to 45.50
Pump intake depth (ft BTOC): 40.50
Post-installation DTW/time: 15.59
Max. sustainable pump rate (mL/min): 100
Appearance of product: Little murky
Discharge tube diameter (3/8" or 1/4"): 1/4"
Inlet reducer used (Y/N): N

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	30								
Refill Setting	27								
Discharge Setting	30								
Flow rate (mL/min)	100								

Purging

Purging/sampling crew: Beesinger / Wagner
Purge date/beginning time: 8/6/10 8:15
Initial (pre-purging) DTW (ft. BTOC): 15.64
Calculated tubing + pump volume: NA
PID/FID reading (well head/background): NA
Purge date/completion time: 8/6/10 9:00
Final (post-purging) DTW (ft. BTOC): 15.67
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)	30	30	30	30	30	30	30	30	30
Refill Setting	27	27	27	27	27	27	27	27	27
Discharge Setting	30	30	30	30	30	30	30	30	30
Flow rate (mL/min)	100	100	100	100	100	100	100	100	100

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
8:25	15.65	100	1.0	20.32	1.516	6.86	-10.2	6.56	51.6
8:30	15.66	100	1.5	18.76	1.517	6.57	-19.0	2.25	41.5
8:35	15.67	100	2.0	18.60	1.515	6.55	-15.8	1.73	27.9
8:40	15.67	100	2.5	18.55	1.513	6.56	-16.0	0.80	21.6
8:45	15.67	100	3.0	18.50	1.514	6.57	-17.1	0.60	17.4
8:50	15.67	100	3.5	18.51	1.513	6.58	-18.0	0.59	10.0
8:55	15.67	100	4.0	18.49	1.513	6.58	-17.8	0.58	8.7
9:00	15.67	100	4.5	18.49	1.513	6.58	-18.1	0.58	7.9

00107509

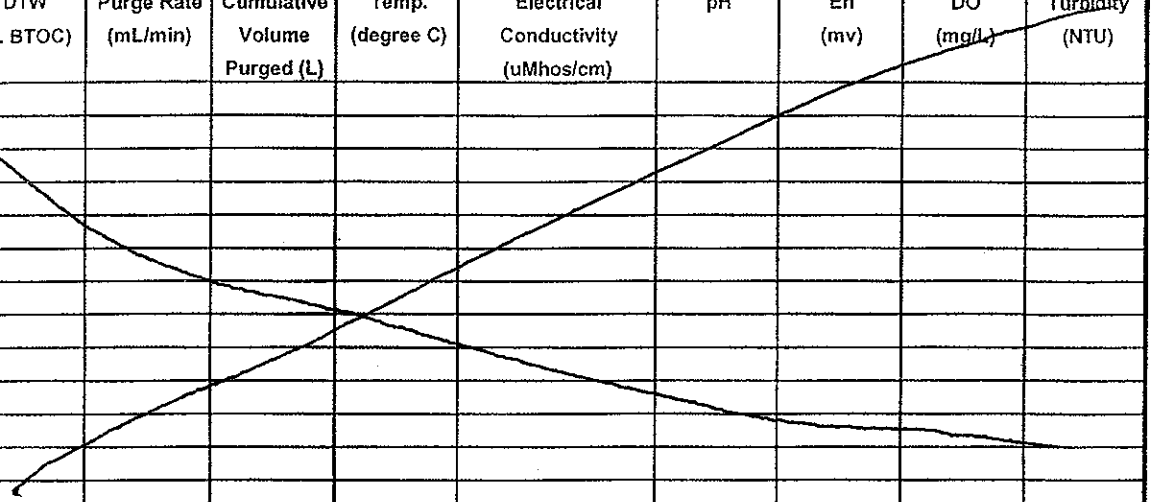
GROUNDWATER SAMPLING FORM

Sheet 2 of 2

LHSMW54

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

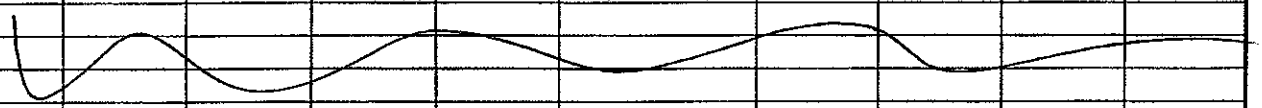


Sampling

Sampling beginning time: 9:00 Sampling completion time: 9:03

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)



Sample Information

Sample ID: LHSMW54-100806 Sample collection date/time: 8/6/10 9:00

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s): 5895

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2-40mg glass			
Perchlorate		1-250mg plastic			

Comments: DO meter only readings in mg/L

8:25-0.6 8:40-0.5 8:55-0.4

8:30-0.6 8:45-0.4 9:00-0.4

8:35-0.5 8:50-0.4

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

Ferrous Iron - 0.19 mg/L

00107510

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: Sunny 85°F

Sampling location ID: Site 61
Sample ID: LHSMW61-100806
Collection Time/Date: 11:00 8/6/10

Pump Installation

Pump installation crew: Beesinger/Wagner
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 28.4
Initial (pre-installation) DTW/time: 26.00
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: 8/6/10 7:30
Installation date/completion time: 8/6/10 7:40
Screen Interval (ft. BTOC): 18.4 to 28.4
Pump intake depth (ft BTOC): NA
Post-installation DTW/time: NA
Max. sustainable pump rate (mL/min): NA
Appearance of product: murky
Discharge tube diameter (3/8" or 1/4"): NA
Inlet reducer used (Y/N): NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: Beesinger/Wagner
Purge date/beginning time: 8/6/10 7:38
Initial (pre-purging) DTW (ft. BTOC): 26.00
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): NA
Purge date/completion time: 8/6/10 7:40
Final (post-purging) DTW (ft. BTOC): 28.1
No. of tubing + pump volumes purged: NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

BAILED DRY

00107511

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

LHSMW61

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

BAILED DRY

Sampling

Sampling beginning time: 11:00 Sampling completion time: 11:02

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
11:00	26.00	—	—	20.40	3.831	5.64	-11.8	5.57	29.5

Sample Information

Sample ID: LHSMW61-100806 Sample collection date/time: 8/6/10 11:00

Duplicate sample collected (Y/N): N Duplicate sample ID: NA

Split sample collected (Y/N): N Split sample ID: NA

COC No(s): 5895

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers
VOC		2-40ml glass			

Comments:

FERROUS IRON - 3.30 mg/L

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107512

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: SWMU
Project Name/#: 117591.0009A130
Weather: Sunny 101°F

Sampling location ID: Site 47
Sample ID: 47WW08-100729
Collection Time/Date: 7/29/10

Pump Installation

Pump installation crew: Beesinger / WAGNER
PID/FID reading (well head/background):
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 21.35
Initial (pre-installation) DTW/time: NA
Final (after pump priming) DTW/time: NA
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): NA
Discharge tube length (ft.): NA

Installation date/beginning time: NA
Installation date/completion time: NA
Screen Interval (ft. BTOC): to
Pump intake depth (ft BTOC): NA
Post-installation DTW/time: NA
Max. sustainable pump rate (mL/min): NA
Appearance of product: NA
Discharge tube diameter (3/8" or 1/4"): NA
Inlet reducer used (Y/N): NA

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = NA psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

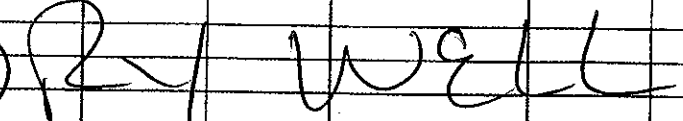
Purging/sampling crew:
Purge date/beginning time:
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA
Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = psi

PID/FID reading (well head/background):
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)
DRY WELL									



00107513

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47WW08

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY WELL

Sampling

Sampling beginning time:_____ Sampling completion time:_____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID:_____ Sample collection date/time:_____

Duplicate sample collected (Y/N):_____ Duplicate sample ID:_____

Split sample collected (Y/N):_____ Split sample ID:_____

COC No(s):_____

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107514

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: SUNNY 101 °F

Sampling location ID: Site 47
Sample ID: 47WW17-100729
Collection Time/Date: 7/29/10

Pump Installation

Pump installation crew: Beesinger / WAGNER
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 21.80
Initial (pre-installation) DTW/time:
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):

Installation date/beginning time:
Installation date/completion time:
Screen Interval (ft. BTOC): _____ to _____
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew:
Purge date/beginning time:
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA

PID/FID reading (well head/background):
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY WELL

00107515

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47WW17

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Dry Well

Sampling

Sampling beginning time:_____ Sampling completion time:_____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID:_____ Sample collection date/time:_____

Duplicate sample collected (Y/N):_____ Duplicate sample ID:_____

Split sample collected (Y/N):_____ Split sample ID:_____

COC No(s):_____

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107516

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009AH30
Weather: Sunny 102°F

Sampling location ID: SWSE 47
Sample ID: 47WW24 - 100729
Collection Time/Date: 7/29/10

Pump Installation

Pump installation crew: Beesinger / WAGNER
PID/FID reading (well head/background): NA
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 23.63
Initial (pre-installation) DTW/time:
Final (after pump priming) DTW/time:
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL):
Discharge tube length (ft.):

Installation date/beginning time:
Installation date/completion time:
Screen Interval (ft. BTOC): to
Pump intake depth (ft BTOC):
Post-installation DTW/time:
Max. sustainable pump rate (mL/min):
Appearance of product:
Discharge tube diameter (3/8" or 1/4"):
Inlet reducer used (Y/N):

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew:
Purge date/beginning time:
Initial (pre-purging) DTW (ft. BTOC):
Calculated tubing + pump volume: NA

PID/FID reading (well head/background):
Purge date/completion time:
Final (post-purging) DTW (ft. BTOC):
No. of tubing + pump volumes purged:

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY WELL

00107517

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47WW24

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY WELL

Sampling

Sampling beginning time:_____ Sampling completion time:_____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID:_____ Sample collection date/time:_____

Duplicate sample collected (Y/N):_____ Duplicate sample ID:_____

Split sample collected (Y/N):_____ Split sample ID:_____

COC No(s):_____

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107518

GROUNDWATER SAMPLING FORM

Sheet 1 of 2

Operable Unit/Site ID: LHAAP
Project Name/#: 117591.0009A130
Weather: Sunny 101°F

Sampling location ID: Site 47
Sample ID: 47WW26-100730
Collection Time/Date: 7/30/10

Pump Installation

Pump installation crew: Beesley / Wagner
PID/FID reading (well head/background): _____
Casing diameter (inches): 4"
Total well Depth (ft. BTOC): 22.65
Initial (pre-installation) DTW/time: _____
Final (after pump priming) DTW/time: _____
Free product (circle): LNAPL / DNAPL
Volume of water removed during priming (mL): _____
Discharge tube length (ft.): _____

Installation date/beginning time: _____
Installation date/completion time: _____
Screen Interval (ft. BTOC): _____ to _____
Pump intake depth (ft BTOC): _____
Post-installation DTW/time: _____
Max. sustainable pump rate (mL/min): _____
Appearance of product: _____
Discharge tube diameter (3/8" or 1/4"): _____
Inlet reducer used (Y/N): _____

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Purging

Purging/sampling crew: _____
Purge date/beginning time: _____
Initial (pre-purging) DTW (ft. BTOC): _____
Calculated tubing + pump volume: NA

PID/FID reading (well head/background): _____
Purge date/completion time: _____
Final (post-purging) DTW (ft. BTOC): _____
No. of tubing + pump volumes purged: _____

Pneumatic Controller Tuning:
Initial air pressure = H (ft.) X 0.43 = _____ psi

	Initial	2	3	4	5	6	7	8	Final
Pressure (psi)									
Refill Setting									
Discharge Setting									
Flow rate (mL/min)									

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY WELL

00107519

GROUNDWATER SAMPLING FORM

Sheet 2 of 2

47MW26

Water Quality Parameter Measurements (continued)

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

DRY WELL

Sampling

Sampling beginning time:_____ Sampling completion time:_____

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Electrical Conductivity (uMhos/cm)	pH	Eh (mv)	DO (mg/L)	Turbidity (NTU)

Sample Information

Sample ID:_____ Sample collection date/time:_____

Duplicate sample collected (Y/N):_____ Duplicate sample ID:_____

Split sample collected (Y/N):_____ Split sample ID:_____

COC No(s):_____

Requested Analysis	Method	Containers	Requested Analysis	Method	Containers

Comments:

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; H - head above pump intake; mL - milliliter; L - Liter

00107520

2

8/16/10 Weather: Clear 3

PRE-REMEDIATION INVESTIGATION DPT @ 90s

47

1330- ARRIVED @ SITE.

1415- MET SUSAN OLLER

1420- LOADED MAPS FROM E-MAIL (SITE 47 & 17)

1510- Spoke with Robert Duffield @ sampling & drilling strategy, said temp wells will be set @ 47 DPTs, no soil sampling for permanent wells @ 04 & 47.

1605- R. Wagner began clearing and locating 47DPT11. Showed GRI next days location.

1800- Left Site.

8/16/10

4 8/17/10 Weather: clear to ptly cloudy

PRE-REMEDIATION INVESTIGATION DPT @ 47 90s.

0600 - Arrived @ site.

0630 - Performed Tailgate H+S meeting w/ GRI + ETTL + Shaw.

Shaw	GRI	ETTL
Personnel: Susan Oller	Jason New	Billy Ragon
Allen Willmore	Jeremy Ruiz	Mark Calley
Ray Wagner		Johnathan Hart

0700 - Mobilized w/ Ray Wagner to begin clearing + locating 47DPT 12.

0800 - GRI arrives. Crew initially took wrong route to site location.

0815 - Located 47DPT12 w/ GPS. (TRIMBLE HAND-HELD)

0830 - Praveen Srivastav, Kay Everett + Susan Watson arrive @ site 47DPT 12.

0900 - P. Srivastav, K. Everett, + S. Watson leave site.

0910 - GRI Hand augers 47DPT16 to 5' bgs.

0940 - Kent , Rose Zeiler + Paul Brockwiki arrive @ 47DPT10 to observe.

5

(continued from previous page)

1000 - Faye Duke arrives @ site.

10:45 - Completed setting TW47DPT to 25' bgs.

1115 - Showed Ray Wagner where 47DPT09 was located, Drillers leave site to get some materials from trailer.

1245 - GRI drillers arrive back @ site.

1300 - DPT rig ~~breaks~~ 8/17/10 breaks down (track-rollers are sheared) / DPT is down for the day.

1320 - Mobilized to help Ray Wagner locate 47 DPT 07 + 08.

1645 - Left Site.

8/17/10

6

8/18/10 Pre-Remediation Investigation @ 47.

Weather: AM: clear to PM cloudy 90s PM: cloudy

0700 - Arrived @ Site. ARI drillers must wait on track rollers to be delivered.

0815 - Spoke w/ Mary Norris @ roll-off box delivery.

0820 - Spoke w/ Tom Coning & Tanya Harvael, was told to call Keith @ roll-off boxes.

0930 - Began doing expense report from previous project.

0945 - Took Susan Oller to get Ray Wagner to clear location for 04WW05.

10:30 - Continued Expense Report.

12:30 - Drillers arrive @ site, begin repairing rig.

1325 - Begins to rain

1415 - Mobilized to 47DPT11.

14:25 - Began advancing.

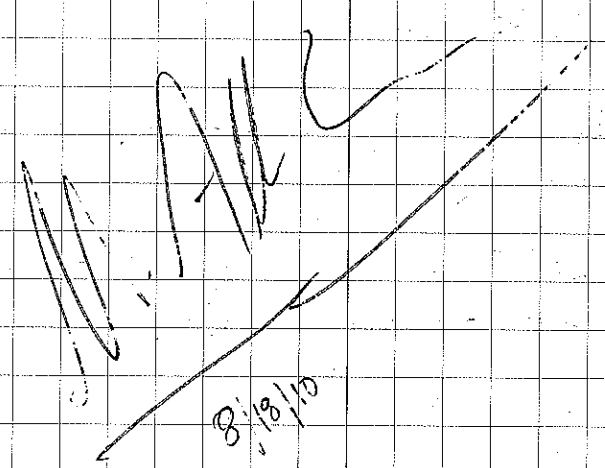
7

(continued from previous page).

1505 - Set temporary (1") well @ 47DPT11.

1520 - Mobilized to 47DPT12

1630 - Left Site.



Weather: clear 90s

8/19/10 Pre-Remediation Investigation @ 47

0640 - Arrived @ site.

0700 - Performed tailgate H&S meeting.
Attendees: Jeremy Rue (QRI) Allen Willmore (Shaw)
Jason New (QRI) Ray Wagner (Shaw)

0710 - Mobilized to 47DPT 04

0750 - Began advancing 47DPT04. See boring log.

0900 - Began advancing 47DPT08. See boring log.

1005 - Began advancing 47DPT07. See boring log.

1135 - Went to print out location to 47DPT13. Driller track rig out of location. 47DPT07

12:10 - Drillers take lunch, mobilize to get trailer.

12:35 - Began waiting for QRI drillers by rig.

1300 - Ray Wagner calls on behalf of the QRI drillers from plant. Not sure why drillers went to plant.

(Continued from previous page).

1325 - Began advancing 47DPT13.

1410 - Began setting well 47 DPT 13 @ 25' bgs

1445 - Mobilized to Site 50 (LHAAP-50)

1520 - Began advancing two foot borings w/ DPT rig

LHAAP 50 Sampler Time + Dates

	Time 0-1	Time 1-2	Date
A1	15:20 S	1525 S C	
A2	15:30 S	1535 S C	
A3	15:40 S	1545 S S	
A4	15:50 S	1555 C	
A5	1600 S	1605 C	
A6	1610 S	1615 S	
A7	1620 S	1625	

S - Sand
C - Clay

17:30 - Left Site.

10

8/20/10 Pre-Remediation Investigation @ 47 Weather: ptly cloudy 90s

0630 - Arrived @ site.

0645 - Performed tailgate H&S meeting
Shaw: Allen Willmon
QR1: Jeremy Ruiz, Jason New

0720 - Began advancing 50SB17R

0740 - Sampled 50SB17R (12-14) * Took Dup01-082010

0750 - Sampled 50SB17R (14-16)

0800 - Sampled 50SB17R (GW/VE) @ 17'-18' bgs

0830 - Began mobilizing to Bldg 25-C @ LHAAP-47

0900 - Staked out rows E & C @ 47.

1015 - Began advancing DPT @ Bldg 25-C. (see table on page 12)

10:30 - *Vadose Zone @ 47SBE1 was encountered @ 9'-10' bgs.

1105 - Creosote or tar observed @ 9'-11' interval @ E1, Took photo.

11:15 - Texted P. Srivastava/S. Watson photo.

11

(Continued from previous page)

11:30 - Talked to Susan Oliver @ Hollowsom/Rotary Sched.

11:45 - Lunch, Made copies of paperwork.

12:45 - Began advancing 47SB-C3

1315 - Began advancing 47SB-C5

1400 - Began advancing 47SB-E3

1445 - Began advancing 47SB-E5

1610 - Collected ER-082010 FOR PERC.

1715 - LEFT SITE

8/20/10

12 Samples @ 47	Date	(0-2) Time	(4-6) Time	(9-11) Time	(GW/VZ) Time
47SB A1	8/24/10	1355 S	1400 C	1410 C	1415 (13-14) C
Sh A3	8/24/10	1440 S	1445 C	1450 C	1455 S [14-15]
Sh A5	8/25/10	1440 S	1445 S/C	1450 C	1455 (18.5-19.5)
Sh A7	8/25/10	1545 S	~~1550~~ DUP	~~1555~~ NA	~~1600~~ 1545 (4-6)
Sh A9	8/25/10	1615 S	1620 S	NA	1625 C (9-11)
Sh C1	8/20/10	~~Dup02~~ 10:55 S	~~Dup01~~ 1100 C	~~Dup04~~ NA	~~Dup05~~ (9-10) 11:10 C/S
Sh C3	8/20/10	12:50 S	12:55 S	1300 C	1305 C/S (12-14)
Sh C5	8/20/10	Dup03 1320 S	(GW/VZ) 13:25 S	1330 wet soils	NA
Sh C7	8/25/10	1520 S	~~1525~~ ~~1530~~ 1530 MS/MSD	~~1535~~	~~1540~~ 1535 (13-14)
C9	8/26/10	07:45 S	07:50 S	07:55 Dup08 → [9-11]	
C11	8/26/10	08:25 S	08:30 S	~~0835~~ [12.5-13.5]	0840 Dup06 MS+MSD
Sh E1	8/20/10	1020 S MS/MSD Dup04	1025 C	NA	1035 C (9-10)
Sh E3	8/20/10	1405 S.	1410	NA	~~1415~~ 1435 (7-10)
Sh E5	8/20/10	1450	1455	NA	1500 (8-9)
E7	8/26/10	0940 S	~~0945~~	~~0950~~ Dup07 MS/MSD	~~0955~~ 0945 (4-6)
E9	8/26/10	0910 C	0915 C	0920 C	0925 S/C (11-12) [11-12]
G5	8/26/10	1230 C	1235 C	1240 C	1245 C
G7	8/26/10	1000 S	1005 C	1010 C Dup09	1015 S/C [14-15]
I3	8/27/10	0815 C S	0820 C	NA	NA Took Dup10
I5	8/26/10	1315	1320	NA	1325 [9-10]
I7	8/26/10	1055 C	1100 C/S	1105 C	1110 [13.5-14.5]
K3	8/26/10	1420 C	1425 C	1430 C	1435 [20.5-21.5]
K5	8/26/10	1510 C	1515 C	1520 C	1525 C [21.5-22.5]
K7	8/26/10	1545	1550 C	1555 C	1600 S [18-19]

S- sand C- clay Sh- Shipped

* All samples were analyzed for perc only

8/23/10 Pre-Remediation Investigation @ Plt 47

Weather clear-13 Plt cloudy 90s

0640- Arrived @ site.

0800- Began staking out locations @ Bldg 25-C.

1300- Showed Ray Wagner what areas needed to be cleared @ LHAAP-17.

1430- Began packing samples collected on Friday August 20th 2010 for shipment.

1600- Spoke to Ray Everett, informed that GRA drillers will not be on site until noon tomorrow

1845- Left Site.

8/23/10

14

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15

Clear to ptly cloudy 90s

8/24/10 Pre-Remediation Investigation @ 47.

0700 - Arrived @ site.

* Susan Giller decides to set well @ ~57' bgs.

0730 ~~0830~~ - ETTL DRILL RIG BREAKS DOWN.

0900 - Began taking GPS coordinates of 47 DPT locations.

11:30 - Lunch Break

12:30. QR4 Drill crew arrives. Crew goes to GWTP to get decon water and ice.

1355 - Began advancing 47SB-A1

1435 - Began advancing 47SB-A3

15:20 - Drillers notice something leaking up the tracks to the DPT rig.

1630 - Collected ER-082410 FOR PEPC.

1710 - Left Site.

16

8/25/10 Pre-Remediation Investigation @ 47.

Weather: p/cl cloudy low 90s

0900- Arrived @ site.

0930- J. Hang Hoang project chemist says lab never received samples

1015- Spoke to Stephanie Mossburg @ MicroBac. MicroBac locates samples.

1045- Began locating points for DPT @ 17.

12:30- QA arrives

12:45- Began working on 6610 DT rig.

1410- Rig is operational again. Track bearing was faulty.

1420- Began advancing 47DA5

1515- Began advancing 47SB-C7

1540- Began advancing 47SB-A7

1610- Began advancing 47SB-A9

17:30- LEFT SITE.

8/25/10

17

8/26/10 Pre-Remediation Investigation @ 47

Weather: clear 90s

0645- Arrived @ site.

0700- Performed Tailgate H&S

0750- Completed paperwork, e-mailed via S. Riesinger to Houston

0740- Began advancing 47SB-C9

08:20- Began advancing 47SB-C11

0900- Began advancing 47SB-E9

0935- Began advancing 47SB-E7

0955- Began advancing 47SB-G7

1050- Began advancing 47SB-I7

1225- Began advancing 47SB-G5

1310- Began advancing 47SB-I5

1330- Began advancing 47SB-I3, hit concrete refusal.

(continued from previous page).

1415 - Began advancing 47SB-K3

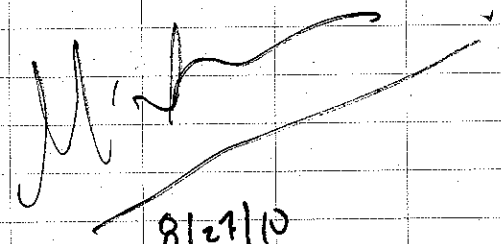
1480 - Spoke to Kay Everett who confirmed w/ P. Srivastav. Advancing 47 DPT 10, 11, 12 deeper can be done next week.

1505 - Began advancing 47SB-K5

1540 - Began advancing 47SB-K7

1700 - Began organizing samples (Susan Allen)

1745 - Left Site.



8/27/10

Weather: clear 60s-70s

Pre-Remedial Investigation @ 47

17

0730 - Arrived @ site

0745 - Performed tailgate H+S meeting.

0810 - Began advancing 47SB-I3

0900 - Began mobilizing to LHAAP-17.

1000 - Began advancing 17SB-D4

1025 - Began advancing 17SB-D3

1055 - Began advancing 17SB-D2

11:35 - Began advancing 17SB-D1

1150 - HANDLE ON DPT rig breaks.

12:35 - COLLECTED EQUIPMENT RINSATE ER-082710 FROM BARREL OF DPT. COLLECT 2 1-L AMBERS for explosives and 1-500 mL plastic for perchlorate

1330 - Packed Samples

1520 - Left Site

8/27/10

20 LHAAP-17 SAMPLES

	ID	DATE	(0-2)	Times (4-6)	(GW/BTZ)	(GW/VZ) Int.	
17SB-A1		08/31/10	0830	0835	0840 DUP3	5.0-6.0	
	A2	08/31/10	0800	0805	0810	5-6	
	A3	08/31/10	1455	1500	1505	5-6	
	A4	08/31/10	—	—	—	—	
	B1	08/30/10	1040	1045	1050	8-9	
	B2	08/30/10	1240	—	1245	4.5-5.5	
	B3	08/30/10	1305	1310	1315 DUP1	7.5-8.5	
	B4	08/30/10	1400	1405	1410 DUP2	6-7	
	C1	08/30/10	1000	1005	1010	8.5-9.5	
	C2	08/30/10	0935	0940	0945 ar 0940	6.5-6.5	
	C3	08/30/10	0915	0920	0925 ar Dup03	5.5-6.5	
	C4	08/30/10	0840	0850	0900	9.5-10.5	
	C5	08/31/10	1440	—	1450	2.5-3.5	
P/C	D1	8/27/10	1140	1145	1150 DUP 13 TMS/MED	[8.5-9.5]	
P/C	D2	8/27/10	1100 S	1105 C	1110 DUP12 C/S	[9.5-10.5]	
P/C	D3	8/27/10	1030 S	1035 C	1040 TOOL DRILL	[9.5-10.5]	
P/C	D4	8/27/10	1005 S	1010 C	1015 C TOOL MISSING	[7-8]	
17EXCO3SB01		08/30/10	1420	1425	1430	8-9	
17EXCO3SB08		08/31/10	0925	2-4 0930 4-0930	4-0935	5-6	
17EXCO3SB02		08/31/10	1010	—	1020	2-3	
17EXCO3SB03		08/31/10	1040	1045	1050	5-6	
17EXCO3SB06		08/31/10	1235	1240	1250	7.5-8.5	
17EXCO2SB03		8/31/10	1345	1350	1355	8-9	

See note pg 22 - Ola

Cont pg 22

E- sampled for explosives
P- Sampled for perchlorate

S- Sand C- Clay

21

08/31/2010 LHAAP-17

0630 Arrive on-site for Tailgate safety / JSA. Gather supplies and equipment.
0800 Arrive @ LHAAP-17
0830 Began advancing 17SB-C04
0910 Began advancing 17SB-C03
0935 Began advancing 17SB-C02
0955 Began advancing 17SB-C01
1035 Began advancing 17SB-B01
1215 Began advancing 17SB-B02
1300 Began advancing 17SB-B03
1355 Began advancing 17SB-B04
1415 Began advancing 17EXCO3-SB1
1445 Began advancing 17SB-A03
1500 Left site to pack / ship samples
1730 Left base for the day

08/30/10

Ola

08/31/10 LHAAP-17

0630 Arrive on site. Tailgate safety/JSA. Gather supplies and paperwork.
0800 Arrive at LHAAP-17.
0802 Began advancing 17SBA02
Note - Date ~~08/30~~ 08/31 for samples A3, B1, B2, B3, B4, C1, ~~C2~~ C2, C3, C4, 17EXC03 SB01 should read 08/31/10.
0825 Began advancing 17SBA01
0920 Began advancing 17EXC03-SB08
0950 Began advancing 17EXC03-SB02
1020 Began advancing 17EXC03-SB03
1225 Began advancing 17EXC02-SB06.
1300 Spotted lighting - stand down for 30 mins.
1330 Began advancing 17BXC02 SB03
1400 Began advancing 17EXC02SB03
1435 Began advancing 17SBC05
1450 Began advancing 17EXC02SB01
1500 Returned to GWTP to process samples
1700 Left site for the day

09/01/10 LHAAP-17

0630 Arrive on-site Tailgate safety/JSA.
0700 Arrive at LHAAP-17 to begin marking remaining locations
0715 After speaking w/ Kay Everett will move to 47 to resume/install new temp wells.
0935 Began drilling 47 DPT 10I.
1210 Experiencing difficulties w/ heaving sand. Will attempt to clear rods
1400 Resume drilling
15:45 Continued difficulties Will attempt to flush to clear w/o collecting samples.
1705 Rig down. Have decided to call day.
1800 Left site

ID	Date	O-B	(2-4)	GW/VZ	(GW/VZ) Int
17EXC025B02	08/31/10	1405	1410	1425	9-10 BPM
** 17EXC025B01	08/31/10	1500	1505	1510	4.25-5.25 (6-8)
** 17EXC015B01	9/16/10	1100	1105	1110	(6-4)
17EXC015B03	9/16/10	0950	NA	0935	(4-6)
17EXC015B04	9/16/10	0925	0930	0935	(5-7)
17EXC025B04	9/16/10	0830		0835 MS/MSD	(2-3)
17EXC035B05	09/15	1425	1430	1435	8.5-9.5 DUP30
17EXC035B04	09/15	1400	1405	1410	8.5-9.5
17EXC025B05	9/16/10	0900	0905	0910	(9-10)
17EXC035B06	09/15	1340	1345	1350	(5-6)
17EXC035B07	09/15	1320	1325	1330	(5-6)
17EXC015B02	9/16/10	1040	1045	1050	(4-6)
17EXC025B03		See page 20.			
** 17EXC035B01		See page 20.			
17EXC035B02		See page 20.			
17EXC035B03		See page 20.			
17EXC035B08					9/16/10
17EXC025B06		See page 20.			
17EXS035B08		See page 20.			
** 19SB-D0	9/16/10	1730	1735	1546	(12.5-13.5)
*** 17SB-E1	9/16/10	1410	1415	1420	(4-6)
*** 17SB-C0	9/16/10	1425	1455	1436	(9-10)

*** - Perchlorate only!

* S. Oller MUST complete table, A. Williamore RECEIVED NOTE 9/16/10.

All locations sampled and analyzed for explosives

** Sample Location sampled and analyzed for explosives AND Perchl.

09/02/10 LHAAP-47

0630 Arrive on-site. Driller will be late. Looking for parts to make repairs to rig.

0830 Driller on-site and rig repairs started.

1035 Driller Jeremy Ruiz has touched a screw on the muffler of rig. Treated w/ first aid. Reported to Ray Everitt.

12:00 Spoke w/ Shawn Swastara and Jim Joyce concerning injury. Will have drillers complete JSA, HARP and discuss care of wound w/ Jeremy.

12:45 Arrive at 47DPT101 to begin set up.

1310 Spoke w/ C. Swastara concerning well. Drilling has reached 55'. Still in bearing sand. Will set up at 65' per his

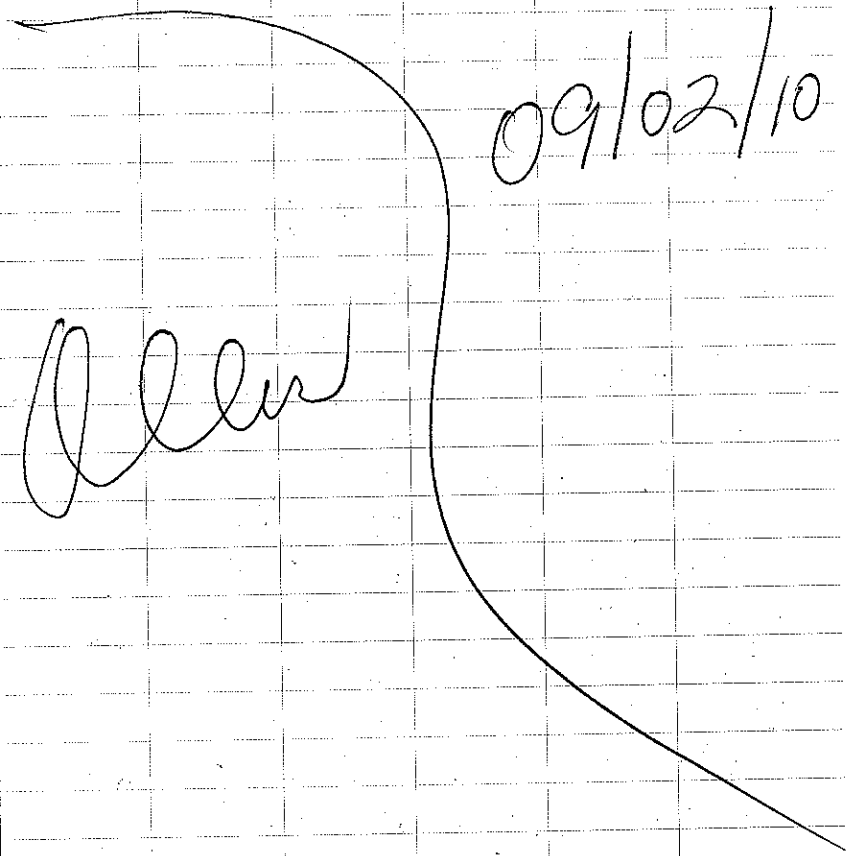
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09/02/10 LHAAP-47

instruction.
1345 Rain & Thunder have stopped work
1500 Left site for the day

09/02/10



27

09/03/10 LHAAP-47

0600 Arrive at GWTP. Tailgate safety / JSA. Decon equipment. Gather supplies load water tank & water.
0730 Arrive on site @ 47DPT101 and began set up
0800 Began drilling w/ water to deal w/ heaving sands.
0920 well was set @ 55'. Approx. 10 gallons of water ~~was~~ was added to the well during this process. Discussed this w/ G. Driscoll before. We will remove 2X the amount added plus 3 well volumes during development.
10:00 Cleaned site and returned to GWTP for decon and supply.

09/02/10 LHAAP-47

Drop ~~on~~ drop off.
12:00 Left site for the day

09/03/10

09/09/10 LHAAP-47

0630 Arrive GWTP. Drillers are not here. Will contact.
0700 Spoke with driller, Mew. They are not scheduled to be on-site until 09/13. Will contact home office (Houston)
0730 Will mark locations at LHAAP-17
08:30 Marked
17EXC03-SB07
17EXC03-SB06
17EXC03-SB05
17EXC03-SB04
17EXC02-SB05
17EXC02-SB04
17EXC01-SB01
17EXC01-SB03
17EXC01-SB04
Spoke w/Gay about clearing for next set of cores (Step-out)
0900 Left site for the day

30

09/13/10 LHAAP-47

0630 Arrive on-site. Tailgate safety / JSA. ~~Gather~~ Gather supplies.

0730 Site walk w/ Ray @ LHAAP-17 to discuss clearing

0830 Arrive at LHAAP-47 and began set up.

0900 Began drilling 47DPT11I

1310 Began setting well @ 55'

1430 Moved to 47DPT12I and began drilling.

1630 Hole is advanced to 28'. Will resume drilling tomorrow. Left site for the day

09/13/10

31

09/14/10 LHAAP-47

0630 Arrive @ GWTP for Tailgate safety / JSA. Discuss daily activities. Gather supplies

0730 Began drilling @ 47DPT13I

0930 After discussing lithology w/ Craven Drilling and Ray Everett decided to set well @ 40 ft. Screen from 30 to 40.

11:00 Will complete. Breaking down site, cleaning up & will return to GWTP to decon

1340 Arrived at LHAAP-47 to begin drilling 47DPT13

1440 Began setting well @ 31'

16:30 Left site for day

09/14/10

09/15/10 LHAAP-47

0630 Arrive @ GWTP for Tailgate Safety / JSA.

0730 Arrive at 47DPT15 and begin set up.

0800 Began driving 47DPT15.

1000 Refusal @ 43.5. Will set well.

1050 Well could not be set @ 43.5. Sand became packed and resistant to direct push. Well was set @ 40'. Screened 30-40'.

1055 Driller, J. New, corrected his earlier statement. Well was set @ 44'. Screened 34-44.

11:15 Returned to GWTP for decon

13:00 Arrive @ LHAAP-17 to begin soil sampling

13:15 Began advancing 17EXC03-SB01

1335 Began advancing 17EXC03-SB02

1355 Began advancing 17EXC03SB04

1420 Began advancing 17EXC03SB05

Collected Dup20

1500 Left site for the day Returned to GWTP

09/15/10 LHAAP-17

to pack samples.

1600 Left site

09/15/10

9/16/10 Pre-Remediation Investigation @ 17 Weather: clear

0630 - Arrived @ Site

0645 - Performed tailgate H/S meeting.

0715 - Began reviewin Susan Oles notes and logs for continuation of work.

0740 - E-mails from Robert Duffield requests that 3 add'l samples be collected from LHAAP-17 & 18 add'l samples be collected from LHAAP-47.

0830 - Began advancing boring @ 17EXC02SB04, See boring log for details for all borings.

0855 - Began advancing boring @ 17EXC02SB05.

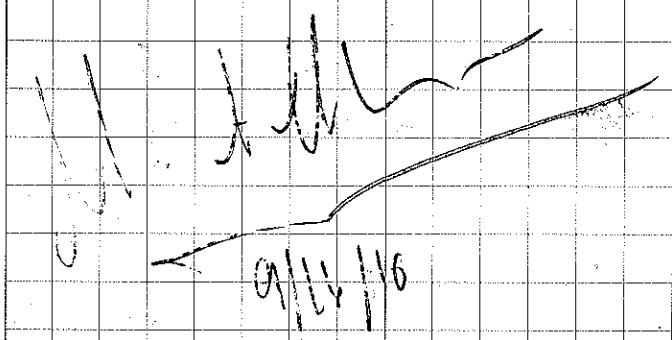
0915 - Due to standing water, relocated Boring 17EXC01SB01 12' away from 17EXC01SB04 (to North), bisecting 17EXC01SB01 & 03.

* See boring logs for time of DPT advancement.

(Continued from previous page).

1530 - Began preparing samples for shipment.

1710 - LEFT SITE.



36

9/17/10 Pre-Remediation Sampling @ LHAAP-47

0730 - Arrived @ site.

0850 - Began advancing 47SB-J5

0920 - Began advancing 47SB-H4

0950 - Began advancing 47SB-H6

10:35 - Began advancing 47SB-H7

11:25 - Began advancing 47SB-H8

1200 - Went to plant to prepr samples for shipping

1400 - Left Site.

9/17/10

37

00107538

38

LHAAP-47 STCB INS

Sample ID	(0-2)	(4-6)	(9-11)	GW/VZ	Interval GW/VZ
47SB-J5 9/17	8:35	8:40	8:45	8:50 DUP01	(17.5-18.5)
47SB-H4 9/17	9:25	9:30	9:35	9:40 DUP02	(12-13)
47SB-H6 9/17	9:55	10:00	10:05	10:10 DUP03	(20-21)
47SB-H7 9/17	10:40	10:45	10:50	10:55 DUP04	(18-19)
47SB-H8 9/17	11:30	11:35	11:40	11:45 DUP05	(14-15)

✓ - Took MS/MSD

*All dates are 2010

39

00107539

STATE OF TEXAS WELL REPORT for Tracking #233504

Owner:	**USACE - LHAAP**	Owner Well #:	**47WW37**
Address:	**Spur 449 @ Hwy 134** **Karnack , TX 75661**	Grid #:	**35-23-6**
Well Location:	**Hwy 143 @ Spur 449, LHAAP** **Karnack , TX 75661**	Latitude:	**32° 40' 58" N**
Well County:	**Harrison**	Longitude:	**094° 08' 44" W**
Elevation:	**No Data**	GPS Brand Used:	**Garmin 12 GPS**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date:	Started: **8/17/2010** Completed: **8/25/2010**
Diameter of Hole:	Diameter: **14 7/8 in From Surface To 30 ft** Diameter: **7 7/8 in From 30 ft To 66 ft**
Drilling Method:	**Mud Rotary**
Borehole Completion:	Gravel Packed From: **54 ft to 66 ft** Gravel Pack Size: **20/40**
Annular Seal Data:	1st Interval: **From 0 ft to 30 ft with 15 cement (#sacks and material)** 2nd Interval: **From 0 ft to 52 ft with 8 cement (#sacks and material)** 3rd Interval: **From 52 ft to 54 ft with 1 bentonite (#sacks and material)** Method Used: **Tremie pipe** Cemented By: **Driller** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**Surface Sleeve Installed**

Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**No Data**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**

Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No Data** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company	**ETTL Engineers & Consultants Inc.**

00107540

Information:	**1717 E. Erwin Tyler , TX 75702**
Driller License Number:	**54683**
Licensed Well Driller Signature:	**Wilburn Ragon, Jr.**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking **#233504**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-30 Not Logged
30-33 Sandy lean clay - gray
33-39 Clayey sand - brown & red
39-53 Clayey sand & silty sand - brown
53-65 Silty sand - brown
65-66 Lean clay - gray & black

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
10 New PVC Sch. 40 0 - 30
2 New PVC Sch. 40 0 - 56
2 New PVC Sch. 40 - slotted 56 - 66 0.010"

00107541

STATE OF TEXAS WELL REPORT for Tracking #233506

Owner:	**USACE - LHAAP**	Owner Well #:	**47WW38**
Address:	**Spur 449 @ Hwy 134** **Karnack , TX 75661**	Grid #:	**35-23-6**
Well Location:	**Hwy 143 @ Spur 449, LHAAP** **Karnack , TX 75661**	Latitude:	**32° 40' 46" N**
Well County:	**Harrison**	Longitude:	**094° 08' 25" W**
Elevation:	**No Data**	GPS Brand Used:	**Garmin 12 GPS**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date:	Started: **8/17/2010** Completed: **8/25/2010**
Diameter of Hole:	Diameter: **14 7/8 in From Surface To 30 ft** Diameter: **7 7/8 in From 30 ft To 57 ft**
Drilling Method:	**Mud Rotary**
Borehole Completion:	Gravel Packed From: **47 ft to 57 ft** Gravel Pack Size: **20/40**
Annular Seal Data:	1st Interval: **From 0 ft to 30 ft with 13 cement (#sacks and material)** 2nd Interval: **From 0 ft to 43 ft with 13 cement (#sacks and material)** 3rd Interval: **From 43 ft to 45 ft with 1 bentonite (#sacks and material)** Method Used: **Tremie pipe** Cemented By: **Driller** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**Surface Sleeve Installed**

Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**No Data**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**

Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No Data** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company	**ETTL Engineers & Consultants Inc.**

00107542

Information:	**1717 E. Erwin** **Tyler , TX 75702**
Driller License Number:	**54683**
Licensed Well Driller Signature:	**Wilburn Ragon, Jr.**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking **#233506**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-30 Not Logged
30-56.5 Clayey sand - gray
56.5-57 Sandy lean clay - black to gray

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
10 New PVC Sch. 40 0 - 30
2 New PVC Sch. 40 0 - 47
2 New PVC Sch. 40 - slotted 47 - 57 0.010"

00107543

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

August 24, 2011

DAIM-ODB-LO

Mr. Stephen Tzhone
US Environmental Protection Agency
Superfund Division (6SF-AT)
1445 Ross Avenue
Dallas, TX 75202-2733

Re: Final Remedial Design LHAAP-35B(37), Chemical Laboratory and LHAAP-67, Aboveground Storage Tank Farm, Longhorn Army Ammunition Plant, Karnack, Texas, August 2011

Dear Mr. Tzhone,

The above-referenced document is enclosed for your file.

The point of contact for this action is the undersigned. I may be contacted at 479-635-0110, or by email at rose.zeiler@us.army.mil.

Sincerely,

Rose M. Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Copies furnished:
F. Duke, TCEQ, Austin, TX (2)
D. Vodak, TCEQ, Tyler, TX
P. Bruckwicki, Caddo Lake NWR, TX
J. Lambert, USACE, Tulsa District, OK
A. Williams, USACE, Tulsa District, OK
M. Plitinik, USAEC, TX
P. Srivastav, Shaw – Houston, TX (Administrative Record)

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

August 24, 2011

DAIM-ODB-LO

Ms. Fay Duke (MC-136)
SSDAT/Superfund Section
Remediation Division
Texas Commission on Environmental Quality
12100 Park 35 Circle, Bldg D
Austin, TX 78753

Re: Final Remedial Design LHAAP-35B (37), Chemical Laboratory and LHAAP-67, Aboveground Storage Tank Farm, Longhorn Army Ammunition Plant, Karnack, Texas, August 2011

SUP 126

Dear Ms. Duke,

The above-referenced document is enclosed for your file.

The point of contact for this action is the undersigned. I may be contacted at 479-635-0110, or by email at rose.zeiler@us.army.mil.

Sincerely,

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Copies furnished:
S. Tzhone, USEPA Region 6, Dallas, TX (2)
D. Vodak, TCEQ, Tyler, TX
P. Bruckwicki, Caddo Lake NWR, TX
J. Lambert, USACE, Tulsa District, OK
A. Williams, USACE, Tulsa District, OK
M. Plitnik, USAEC, TX
P. Srivastav, Shaw, Houston, TX (Administrative Record)

FINAL
REMEDIAL DESIGN
LHAAP-35B (37), CHEMICAL LABORATORY AND LHAAP-67, ABOVEGROUND STORAGE TANK FARM
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS



Prepared by

U.S. Army Corps of Engineers
Tulsa District
1645 South 101st East Avenue
Tulsa, Oklahoma

August 1, 2011

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Acronyms and Abbreviations

µg/kg	micrograms per kilogram
Army	U.S. Army
ARAR	applicable or relevant and appropriate requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chemicals of concern
DCA	dichloroethane
DCE	dichloroethene
ECP	environmental condition of property
LHAAP	Longhorn Army Ammunition Plant
LHAAP-35B(37)	Chemical Laboratory
LHAAP-67	Aboveground Storage Tank Farm
LUC	land use control
MCL	maximum contaminant level
MNA	monitored natural attenuation
msl	mean sea level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
PCE	tetrachloroethene
RAO	remedial action objective
RD	remedial design
ROD	record of decision
TCA	Trichloroethane
TCE	Trichloroethene
TCEQ	Texas Commission on Environmental Quality
USEPA	U.S. Environmental Protection Agency
VC	vinyl chloride

1.0 Purpose

This remedial design (RD) document addresses the Chemical Laboratory [LHAAP-35B(37)] and the Aboveground Storage Tank Farm (LHAAP-67) at Longhorn Army Ammunition Plant (LHAAP). The purpose of this RD is to provide information on how the remedy of monitored natural attenuation (MNA) and the land use control (LUC) components remedy selected in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Record of Decision (ROD) for LHAAP-35B(37) and LHAAP-67 will be implemented and maintained to ensure that remedial action objectives are met.

In June 2010, the final ROD for LHAAP-35B(37) and LHAAP-67 was signed (U.S. Army, 2010). The remedy consists of LUCs in conjunction with MNA. The LUC is the restriction of groundwater use for the protection of human health.

The final remedies specified in the ROD, MNA and LUCs, were chosen in accordance with the CERCLA, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). They are intended to be protective of human health and the environment under the current and anticipated future land use of the site.

The LUC implementation and maintenance actions described herein will be effective immediately upon approval of this RD as the primary document by the USEPA Region VI with the concurrence of the Texas Commission on Environmental Quality (TCEQ), and shall be subject to the enforcement provisions of the September 11, 1991 Federal Facility Agreement. Once in effect, the requirements set forth in this RD will remain applicable to LHAAP-35B(37) and LHAAP-67 during the Army's administrative control and that of subsequent transferees.

2.0 Description of the Site

LHAAP-35B(37), Chemical Laboratory and LHAAP-67, Aboveground Storage Tank Farm, are located on the former Longhorn Army Ammunition Plant (LHAAP). The former LHAAP is an inactive, government-owned, formerly contractor-operated and maintained Department of Defense facility located in central east Texas in the northeast corner of Harrison County. As shown on **Figure 2-1,** LHAAP is approximately 14 miles northeast of Marshall, Texas, and approximately 40 miles west of Shreveport, Louisiana. The former U.S. Army installation occupied over 8,400 acres between State Highway 43 at Karnack, Texas, and the southwestern shore of Caddo Lake and is accessed by State Highways 43 and 134.

LHAAP was placed on the Superfund National Priorities List (NPL) on August 9, 1990. Activities to remediate contamination began in 1990. After its listing on the NPL, the U.S. Army, the USEPA, and the Texas Water Commission (currently known as the TCEQ) entered into a CERCLA Section 120 FFA for remedial activities at LHAAP. The FFA became effective December 30, 1991. LHAAP operated until 1997 when it was placed on inactive status and classified by the U.S. Army Armament, Munitions, and Chemical Command as excess property.

LHAAP-35B(37), the Chemical Laboratory, encompasses approximately 12.2 acres and is located in the north-central portion of LHAAP near the southwestern corner of LHAAP-47 and south of the intersection of Avenue P and 59th Street (**Figure 2-2**). The surface features at LHAAP-35B(37) include a mixture of asphalt-paved roads and parking area, several administration buildings, the former Chemical Laboratory (Building 29-A), and a mixture of wooded and grassy vegetation-covered areas. The topography in this area is relatively flat with the surface drainage flowing into Goose Prairie Creek. The creek runs perpendicular to the western border of the site and then turns south through the east-central portion of the site and eventually drains into Caddo Lake.

LHAAP-67, a former aboveground storage tank farm, covers an area of approximately 1.9 acres and is located in the central portion of LHAAP on the southeast corner of 48th Street and Ignatius Avenue (**Figure 2-2**). The site is relatively flat. The nearest significant surface water body to LHAAP-67 is Central Creek located approximately 870 feet southeast of the site.

These sites are surrounded by an area (nearly 7,000 acres) that was transferred by the U.S. Department of the Army to the U.S. Fish and Wildlife Service (USFWS) for management as the Caddo Lake National Wildlife Refuge. The U.S. Army, the lead agency for environmental response actions at LHAAP, is acting in partnership with USEPA Region 6 and TCEQ in planning and implementing remedial actions at LHAAP-35B(37) and LHAAP-67.

The LUC area associated with the groundwater use restriction at LHAAP-35B(37) is expected to extend beyond the site boundary at the northwestern boundary of the site, and encompass approximately 13.35 acres. The preliminary LUC boundary and the groundwater monitoring network at LHAAP 35B(37) are depicted in **Figure 2-3**. The LUC area associated with the groundwater use restriction at LHAAP-67 is expected to extend beyond the site boundaries along the eastern and southern boundaries of the site, and

encompass a total of 2.60 acres. The preliminary LUC boundary and the groundwater monitoring network at LHAAP-67 are depicted in **Figure 2-4.** The remedies of MNA and LUCs will be reviewed by the Army and the USEPA every five years to determine if they are still necessary or if a modification is appropriate in accordance with the terms of **Section 6.2.7** of this RD**.** To satisfy the requirements under 42 U.S.C. § 9621(c) [CERCLA § 121(c)], the remedies of MNA and LUCs will remain in place until the concentrations of the chemicals of concern (COCs) have met cleanup levels. The selected remedy finalized in the Record of Decision (ROD) (U.S. Army, 2010) was developed based on the assumption that future land use will be industrial/recreational (e.g., national wildlife refuge). The remedial action assumes that land use notification will be recorded at the Harrison County courthouse to indicate that the property is suitable for nonresidential use. It is also assumed that this remedial action will be the final action at the site.

2.1 Hydrogeological Setting

LHAAP-35B(37)

Topsoil at LHAAP-35B(37) ranges in thickness from 0 to 4 feet and consists of the Quaternary silty clay underlain by alternating layers of clayey sand, silty sand, and poorly sorted sand of the Wilcox Group. The sand layers are laterally discontinuous and separated by silty clay. Groundwater at the site was encountered at 12 to 33 feet below ground surface (bgs) in the upper shallow zone, to 47 feet in the lower shallow zone, and at about 70 feet in the intermediate zone. December 2007 shallow and intermediate groundwater data indicated that flow at the site was to the south-southeast, although the shallow groundwater flow direction may vary locally during high water table conditions due to the influence of Goose Prairie Creek. For the shallow groundwater zone, hydraulic conductivity values in the sand units ranged from a minimum value of 4.3×10^{-4} centimeters per second (cm/sec) in the northwest portion of the site to a maximum value of 7.7×10^{-4} cm/sec east of the site. The average groundwater flow rate is 0.0496 feet/day for LHAAP-35B(37), based on the average hydraulic conductivity, hydraulic gradient, and effective porosity (Shaw, 2007e).

LHAAP-67

Across the site, below the surficial fill, lies a silty clay of the Wilcox Group ranging in thickness from about 2 to 15 feet. The clay grades into a fine-grained silty sand thickening toward the east-southeast. Groundwater at the site, encountered at depths of 17 to 20 feet bgs, has an easterly and southeasterly flow. There is likely limited interconnectivity between the shallow and intermediate zones because of the laterally and vertically discontinuous nature of the channel sands, flow is predominantly horizontal through these units. For the shallow groundwater zone, hydraulic conductivity values of the sand units ranged from a minimum value of 1.2×10^{-5} cm/sec to a maximum value of 1.0×10^{-2} cm/sec. The average groundwater flow rate is 0.0172 feet/day for LHAAP-67, based on the average hydraulic conductivity (U.S. Army, 2008b), hydraulic gradient and effective porosity (Shaw, 2007e).

2.1.1 Groundwater and Surface Water Interaction

LHAAP-35B(37)

Groundwater at the LHAAP-35B(37) was encountered at 12 to 33 feet below ground surface (bgs) in the upper shallow zone, to 47 feet in the lower shallow zone, and at about 70 feet in the intermediate zone. Groundwater elevation contours based on shallow groundwater elevations measured in December 1998, September 2000, and December 2007 indicate that flow at the site is generally to the south-southeast **(Figure 2-3**), although the shallow groundwater flow direction may vary locally during high water table conditions due to the influence of Goose Prairie Creek. Although not indicated by the elevation data (discussed below), monitoring of the COCs present in shallow groundwater beneath LHAAP-35B(37) for potential discharge to surface water in Goose Prairie Creek which flows to Caddo Lake, a drinking water source, is planned. The surveyed elevation of the Goose Prairie Creek bed at location GPS shown in **Figures 2-3** and **2-5** is 186.86 feet above mean sea level (msl), and the water level elevation in the shallow groundwater zone is 186.31 feet msl (measured in September 2004). These data indicate that the shallow zone water table is below the creek and was not discharging to Goose Prairie Creek in September 2004. Additional creek and groundwater elevation data is provided in Table 2, Appendix M of the Shaw Final Modeling Report Derivation of Soil and Groundwater Concentrations Protective of Surface Water and Sediment LHAAP Revision I (Shaw, 2007e). However, due to uncertainties regarding the seasonal variations in the water table elevation it is assumed that the shallow groundwater may discharge into the creek when the water table is higher.

LHAAP-67

Groundwater at LHAAP-67, encountered at depths of 17 to 20 feet bgs, has an easterly and southeasterly flow based on shallow groundwater elevations measured in December 1998, September 2000, September 2004, and December 2007 (**Figure 2-4**). Although not indicated by the elevation data (discussed below), there is a concern that the COCs (1,1-DCE, 1,2-DCA, 1,1,1-TCA, 1,1,2-TCA, and TCE) present in groundwater beneath LHAAP-67 could potentially discharge to surface water in Central Creek located to the southeast of the site, which flows to Caddo Lake, a drinking water source. The shallow groundwater potentiometric surface indicates that the groundwater from LHAAP-67 has an easterly and southeasterly flow and may discharge into Central Creek as shown in **Figure 3** in **Appendix A**. The surveyed elevation of the Central Creek bed at location CC3 shown in **Figure 2-5** is 168.54 feet msl, and the water level elevation in the shallow groundwater zone is 168.05 feet msl (measured in September 2004). These data indicate that the shallow zone water table is below the creek and was not discharge to the Central Creek in September 2004. Additional creek and groundwater elevation data is provided in Table 3, Appendix M of the Shaw Final Modeling Report Derivation of Soil and Groundwater Concentrations Protective of Surface Water and Sediment LHAAP Revision I (Shaw, 2007e). However, due to uncertainties regarding the seasonal variations in the water table elevation it is assumed that the shallow groundwater may discharge into the creek when the water table is higher.

3.0 Remedy Performance Objectives

Army recognizes USEPA's policy to return all groundwater to beneficial uses, based upon the non-binding programmatic expectation in the NCP. The remedy performance objectives for the selected remedies at LHAAP-35B(37) and LHAAP-67 (U.S. Army, 2010), which address contamination associated with the media at the sites and take into account the reasonably anticipated future use as a national wildlife refuge include:

- Ensure protection of human health by preventing human exposure to the contaminated groundwater
- Ensure protection of human health and the environment by preventing contaminated groundwater from migrating into nearby surface water
- Ensure return of groundwater to its potential beneficial use as drinking water, wherever practicable

The final remedy for both LHAAP-35B(37) and LHAAP-67 includes utilizing land use controls (LUCs) and MNA. The remedy meets the performance objectives developed for these sites to protect human health and the environment by preventing human exposure to chlorinated solvents-contaminated groundwater [1,1-dichloroethene (DCE), trichloroethene (TCE), and tetrachloroethene (PCE) at LHAAP-35B(37) and 1,1,1-trichloroethane (TCA), 1,1,2-TCA, 1,2-dichloroethane (DCA), TCE, and 1,1-DCE at LHAAP-67], ensuring containment of the chlorinated solvents-contaminated groundwater for the protection of surface water, and returning the groundwater to its potential beneficial use as drinking water wherever practicable.

Due to the potential for chlorinated solvents-contaminated groundwater to migrate, MNA will be implemented to assure that the plumes will not migrate to nearby surface water bodies at levels that may present an unacceptable risk to human health and the environment. The monitoring and reporting associated with this remedy will continue until cleanup levels are achieved for COCs. Monitoring will be used to demonstrate that MNA is effective in meeting remedial action objectives. Due to the unacceptable risk posed by chlorinated solvents in groundwater during the MNA remedy, LUCs are needed in the impacted areas to ensure the protection of human health by preventing human exposure to the contaminated groundwater. The selected LUCs will prevent human exposure to chlorinated solvents-contaminated groundwater through the restriction of groundwater use. The LUCs will remain in place until cleanup levels are achieved.

4.0 Land Use Controls for the Site

The LUCs to be implemented by the Army or its representatives for LHAAP-35B(37) and LHAAP-67 to prevent human exposure to residual groundwater contamination presenting an unacceptable risk to human health include:

- Ensure no withdrawal or use of groundwater beneath the sites for anything other than environmental monitoring and testing until cleanup goals are met

Notification of the groundwater use restriction will accompany all transfer documents and will be recorded at the Harrison County Courthouse in accordance with Texas Administrative Code (TAC) Title 30, §335.566.The LUC addresses the areas of LHAAP-35B(37) and LHAAP-67 that include groundwater plumes at LHAAP-35B(37) and LHAAP-67 with levels of contamination that require implementation of a remedy (see **Section 2.0**). The U.S. Army is responsible for implementing, maintaining, monitoring, reporting on, and enforcing the LUC.

U.S. Army and regulators will consult to determine appropriate enforcement actions should there be a failure of an LUC objective at this site after it has transferred. U.S. Army shall obtain USEPA and TCEQ concurrence prior to termination or significant modification of the LUC, or implementation of a change in land use inconsistent with the LUC objectives and use assumptions of the remedy. Although not a remedy, the land use assumption for LHAAP-35B(37) and LHAAP-67 forms the basis for the remedy. The reasonably anticipated future use of the site as part of a national wildlife refuge is consistent with an industrial risk exposure scenario. Notification of the land use assumption of this site will be made in transfer documentation, will be recorded in the Harrison County Courthouse in accordance with TAC Title 30, §335.566 and compliance with the use assumption will be documented in the Five-Year Review reports.

5.0 Monitored Natural Attenuation

MNA is a passive remedial action that relies on natural biological, chemical, and physical processes that act to reduce the mass and concentration of the groundwater COCs under favorable conditions. These natural attenuation processes include biodegradation, dispersion, dilution, adsorption, volatilization, and abiotic destruction of contaminants. Based on groundwater modeling, groundwater MCLs are expected to be met through natural attenuation in 39 to 43 years for LHAAP-35B(37) and in 21 to 66 years for LHAAP-67. Monitoring of natural attenuation is required to assure the protection of human health and the environment by documenting the return of the groundwater to its potential beneficial use as a drinking water supply, by documenting reduction of the contaminant mass and protection of surface water through containment of the plume.

At LHAAP-35B(37), attenuation is indicated by the presence of TCE and 1,1-DCE, which indicate dechlorination of PCE and TCE. Historical volatile organic trends indicate the occurrence of complete reductive dechlorination by the presence of 1,1-DCE, cis-1,2-DCE, and ethene. Evaluation of the primary and secondary lines of evidence demonstrates that natural attenuation mechanisms including reductive biodegradation, dilution, dispersion, sorption, and volatilization, may all be contributing to the observed reduction in COC concentrations at LHAAP-35B(37). The presence of 1,1-DCE and 1,2-DCA at LHAAP-67 indicates that some degree of dechlorination has occurred from 1,1,1-TCA and 1,1,2-TCA, respectively. Degradation rates of literature-based half-life values, 10 times these values, and no degradation at all were used to obtain a more conservative estimate. The conservative degradation rate of 10 times the literature-based half-life (e.g. Half-life=45 years for TCE) was used for the natural attenuation modeling results reported below for LHAAP-35B(37) and LHAAP-67.

Natural attenuation of LHAAP-35B(37) and LHAAP-67 COCs in groundwater will be monitored to confirm that contaminant levels are being reduced thereby preventing migration of contaminated groundwater to surface water at levels that may present an unacceptable risk to human health and the environment. Based on groundwater modeling, groundwater MCLs are expected to be met through natural attenuation in 28 to 38 years for PCE, 39 to 43 years for TCE, and 16 to 21 years for 1,1-DCE at LHAAP-35B(37) (Shaw, 2007e; U.S. Army, 2008b). Considering the lithologic variability at LHAAP-35B(37), particularly the lateral and vertical change from sand to clay, the times to MCL may range to an order of magnitude greater. For LHAAP-67, MCLs would be met through natural attenuation in 17 to 66 years for TCE, 20 to 34 years for 1,1-DCE, and 21 to 43 years for 1,2-DCA. Although the times to MCL for 1,1,1-TCA and 1,1,2-TCA were originally modeled to be 22 and 20 years respectively, these two VOCs are no longer detected above MCLs at LHAAP-67 (Shaw, 2007b; U.S. Army, 2008b). The groundwater flow rates are within the normal range for the formation material at these sites, an average groundwater flow rate of 0.0496 feet/day for LHAAP-35B(37) and an average groundwater flow rate of 0.0172 feet/day for LHAAP-67.

Modeling calculations were completed to assess the potential for the COCs present in shallow groundwater at LHAAP-35B (37) and LHAAP-67 to migrate toward and discharge to surface water. Conservative literature half-life values were used (Shaw, 2007e).

The modeling for LHAAP-35B(37) assumes an instantaneous source and conservatively used the maximum historical TCE concentration of 330 ug/L detected at monitoring well LHSMW59. Based on the results of the instantaneous source model for LHAAP-35B(37), the maximum concentration of TCE (3.63 µg/L) appears at the point of entry of the groundwater into Goose Prairie Creek after approximately 11.59 years (Shaw, 2007e), and is below the MCL for TCE of 5 µg/L. TCE would be diluted further after entry into the surface water, most likely to undetectable levels. The modeling for LHAAP-67 used two different scenarios simulating a total period of 100 years, which was long enough to capture the maximum contaminant concentrations where groundwater discharges into Central Creek. The first scenario assumes an instantaneous source in which there is no contaminant leaching from vadose zone soil to groundwater. The second scenario, which is more conservative and less likely, assumes a continuous source of contaminant leaching from the vadose zone soil to groundwater over time. This scenario was considered in order to account for a case where a VOC source may be present in the soil in an area or depth that was not sampled during the RI. Based on the results of the instantaneous source model, the maximum COC concentrations were below their respective MCLs where groundwater discharges into Central Creek. Furthermore, based on the results of the continuous source model, multiple groundwater COCs could eventually exceed their respective MCLs where groundwater discharges into Central Creek in less than 16, but up to 29 years. Therefore, additional modeling was completed with calculated dilution within Central Creek. The resultant concentrations of the COCs in Central Creek after dilution were less than 3 percent of their respective MCLs. Thus, no adverse impact is expected to the surface water during the time it would take natural attenuation to reduce contaminant concentrations to MCLs.

6.0 Remedy Implementation Actions

6.1 Design Criteria

The design criteria for the RD are based on the RAOs of protection of human health by preventing human exposure to the contaminated groundwater, protection of human health and the environment by preventing contaminated groundwater from migrating into nearby surface water, and the return of groundwater to its potential beneficial use as drinking water, wherever practicable.

To prevent human exposure to contaminated groundwater, LUCs will be implemented to prevent access to the contaminated groundwater until all COCs and their by-products (daughter contaminants) in the groundwater attain the Safe Drinking Water Act MCLs. A LUC boundary will be established around the perimeter of each site which contains the contaminated groundwater plume. The LUC boundaries are generally depicted in Figure 2-3 and 2-4, but will be finalized and recorded after installation of new monitoring wells and subsequent to the first quarter of groundwater data. Restrictions will be placed on the property bound by the LUC boundary barring the use of groundwater for any purpose other than environmental monitoring and testing. The effectiveness of the restrictions will be documented with periodic certifications.

Protection of human health and the environment by preventing contaminated groundwater from migrating into nearby surface water, and the return of groundwater to its potential beneficial use as drinking water, wherever practicable will be accomplished by MNA. MNA at the sites will include the installation of additional monitoring wells within and downgradient of the contaminant plumes, and the monitoring of contaminant levels in a subset of the monitoring wells at the site. For LHAAP-35B(37), monitoring wells will be installed only in the shallow groundwater zone, which has been shown to be contaminated by past monitoring. The deeper intermediate groundwater zone will not be monitored, since past monitoring showed no contamination in the intermediate groundwater zone and the ROD concluded contaminants are confined in the shallow groundwater zone and have not migrated into the intermediate zone. For LHAAP-67, the intermediate groundwater zone will be monitored, since past monitoring showed some contamination in the intermediate zone. Although the contamination in the intermediate groundwater zone at LHAAP-67 was below MCL, the detection indicates the potential for vertical migration. Additional sampling of the intermediate groundwater zone, during installation of temporary borings at LHAAP-67, will be conducted to evaluate whether an additional monitoring well should be installed in the intermediate zone. Data from the monitoring wells within the contaminant plumes will be used to evaluate the natural attenuation of the COCs. Data from monitoring wells downgradient of the plumes will be used to verify that the plumes are not migrating to nearby surface water bodies at levels that may present unacceptable risk to human health and the environment. Surface water sampling will be conducted to confirm contaminated groundwater is not migrating to surface water. MNA will continue until MCLs are achieved. Monitoring wells not designated for long-term monitoring will be plugged and abandoned after the first Five-Year Review.

6.1.1 Basis Of Design

The interval of interest for LHAAP-35B(37) is 165 to 180 feet msl and for LHAAP-67 is 176 to 186 feet msl based on the screening interval where contamination was found at the sites (see cross sections and drilling logs [**Attachment 1** in **Appendix A**], plume maps [**Figure 2-3** and **Figure 2-4**], and historical COC concentrations[**Tables 6-1** and **Table 6-2**]). Criteria for well abandonment include the well's screened interval, location of the well with respect to the path of the plume based on potentiometric surface data, and whether it can be used to confirm the plume is not migrating.

LHAAP-35B(37)

Results of the groundwater sampling shown in **Table 6-1** indicate that the elevated VOC concentrations are located in the upper shallow groundwater zone at LHAAP-35B(37) at 165 to 180 feet msl. **Figure 2-3** shows the locations of the groundwater monitoring wells, estimated contaminant plume boundaries based on December 2006 sampling, and groundwater elevation contours from groundwater elevation measurements made in December 1998, September 2000 and December 2007. The December 2007 groundwater elevation contours are considered most accurate of the three sets of contours in the area around LHAAP-35B(37) because they were developed using measurements from a greater number of monitoring wells in the LHAAP35B(37) site than the other two events, however it should be noted that Longhorn has received low annual rainfall for the past several years with respect to historical rainfall at the site. December 2007 shallow groundwater data indicated that flow at the site was to the south-southeast. The center of mass of the TCE plume is considered to be in proximity to monitoring well 35BWW08 and the center of mass of the PCE plume is considered to be in proximity to monitoring well 35BWW04. Monitoring wells for the Long-Term Monitoring Program are located north-northwest of the plume (upgradient), within the plume and south-southwest of the plume (downgradient) to confirm the plume limits, to confirm natural attenuation is occurring, and to confirm the plume is not migrating.

LHAAP-67

Results of the groundwater sampling shown in **Table 6-2** indicate a relatively small area of contamination in the shallow groundwater at 176 to 186 feet msl. **Figure 2-4** shows the locations of the groundwater monitoring wells, estimated contaminant plume boundaries based on December 2006 sampling, and groundwater elevation contours from groundwater elevation measurements made in December 1998, September 2000, September 2004 and December 2007. The December 2007 groundwater elevation contours are considered the most accurate of the four sets of contours in the area around LHAAP-67 because they were developed using measurements from a greater number of monitoring wells in the LHAAP-67 site than the other three events. Groundwater at the site, encountered at depths of 17 to 20 feet bgs, has an easterly and southeasterly flow. The center of mass of the plume is considered to be in proximity to monitoring well 67WW01. Monitoring wells for the Long-Term Monitoring Program are located north-northwest (upgradient), within the plume, and south-southeast of the plume (downgradient) to confirm the plume limits, to confirm natural attenuation is occurring, and to confirm the plume is not migrating.

6.2 Land Use Control Implementation Actions

The Army or its representatives will be responsible for LUC implementation and certification, reporting and enforcement. The Army shall address LUC problems within its control that are likely to impact remedy integrity and shall address problems as soon as practicable.

As a condition of property transfer, the Army may require the transferee to assume responsibility for various implementation actions, as indicated below. Although the Army may transfer responsibility for various implementation actions, the Army shall retain its responsibility for remedy integrity. This means that the Army is responsible for addressing substantive violations of performance objectives that would undermine the Army's CERCLA remedy. The Army also will be responsible for: 1) incorporating RD information and outlining the transferee's LUC obligations into property transfer documentation; 2) recording groundwater use restriction and survey plat at the Harrison County Courthouse; and 3) notifying Texas Department of Licensing and Regulation of the groundwater restriction which includes the prohibition of water well installation for any purpose other than environmental monitoring and testing without prior approval from the Army, the USEPA, and the TCEQ. The following LUC implementation actions shall be undertaken by the Army in order to ensure that the aforementioned LUC performance objectives for LHAAP-35B(37) and LHAAP-67 are met and maintained:

6.2.1 Comprehensive Land Use Control Management Plan

Within 30 days of receiving USEPA and TCEQ approval of this RD, the Army will incorporate this document into the Comprehensive LUC Management Plan. The Comprehensive LUC Management Plan consists of LHAAP RD documents and a survey plat showing the locations where LUCs being implemented at LHAAP are applied. The purpose of this Comprehensive LUC Management Plan is to ensure all site specific LUCs are compiled into one comprehensive location for both pre-transfer use by the installation and for post-transfer use by the transferee. This document is also accessible to regulators, the local government and the public. The Comprehensive LUC Management Plan is located in the Marshall Public Library to accompany LHAAP's Administrative Record. As LUC RD documents for additional environmental sites are approved by USEPA and TCEQ, the Army shall likewise add those documents and survey plats to the Comprehensive LUC Management Plan as well as update the previous copy of the plan placed in the Marshall Public Library.

6.2.2 Site Certifications and Reporting

Beginning with finalization of this RD, the Army will undertake annual certifications to confirm continued compliance with the LUC objectives. The Army will retain the annual LUC Compliance Certification documents in the project files for incorporation into the Five-Year Review Reports, and these documents will be made available to USEPA and TCEQ upon request. The certification form will be consistent with the form attached as **Appendix B**. In addition, should any violations be found during the annual certification, the Army will provide to USEPA and TCEQ along with the document, a separate written explanation indicating the specific violations found and what efforts or measures have or will be taken to correct those violations**.** Upon transfer, such responsibilities may shift to the transferee via

appropriate provisions placed in the Environmental Condition of Property (ECP) or other environmental transfer document. The need to continue annual certifications will be revisited at Five-Year Reviews.

6.2.3 Notice of Planned Property Conveyances

The Army shall provide notice to USEPA and TCEQ of plans to convey LHAAP-35B(37) and LHAAP-67 acreage. The notice shall describe the mechanism by which LUCs will continue to be implemented, maintained, inspected, reported, and enforced.

6.2.4 Opportunity to Review Text of Intended Land Use Controls

Army will provide a copy of the groundwater use restriction notification to TCEQ for review and approval prior to its recordation in Harrison County. In addition, the Army will produce an ECP or other environmental document for transfer of LHAAP-35B(37) and LHAAP-67, but before executing transfer, the Army will provide USEPA and TCEQ with a draft copy of the ECP or other environmental document for transfer so that they may have reasonable opportunity, before document execution, to review all LUC-related provisions.

6.2.5 Notification Should Action(s) Which Interfere with Land Use Control Effectiveness Be Discovered Subsequent to Conveyance

Should the Army discover after conveyance of the site any activity on the property inconsistent with the LUC performance objectives, the Army shall notify USEPA and TCEQ within 72 hours of such discovery. Consistent with **Section 6.2.6** below, the Army will then work with USEPA, TCEQ and the transferee to correct the problem(s) discovered. This reporting requirement does not preclude the Army from taking immediate action pursuant to its CERCLA authorities to prevent any perceived risk(s) to human health or the environment.

6.2.6 Land Use Control Enforcement

Should the LUC remedy reflected in this LUC RD fail, the Army will coordinate with USEPA and TCEQ to ensure that appropriate actions are taken to reestablish its protectiveness. These actions may range from informal resolutions with the owner or violator, to the institution of judicial action under the auspices of Texas property law or CERCLA. Alternatively, should the circumstances warrant such, the Army could choose to exercise its response authorities under CERCLA, and then seek cost recovery after the fact from the person(s) or entity(ies) who violated a given LUC. Should the Army become aware that any future owner or user of the property has violated any LUC requirement over which a local agency may have independent jurisdiction, the Army will notify these agencies of such violation(s) and work cooperatively with them to re-achieve owner/user compliance with the LUCs.

6.2.7 Modification or Termination of Land Use Controls

The Army shall not, without USEPA and TCEQ concurrence, make a significant modification to, or terminate a LUC, or make a land use change inconsistent with the LUC objectives and use assumptions of the selected remedy. Likewise, the Army shall seek prior USEPA and TCEQ concurrence before commencing actions that may impact remedy integrity. In the case of an emergency action, the Army shall obtain prior USEPA and TCEQ concurrence as appropriate to the exigencies of the situation.

The LUCs shall remain in effect until such time as the Army, TCEQ and USEPA agree that the concentrations of COCs have met cleanup levels. When this occurs, the LUCs will be terminated as needed. The decision to terminate LUCs will be documented consistent with the NCP process for post-ROD changes, potentially including an explanation of significant differences or a remedial action completion report. If the property has been transferred and a determination by the Army, TCEQ and USEPA has been made to terminate one or more of the LUCs, the Army shall provide to the owner of the property an appropriate release for recordation pertaining to the site and will also timely advise other local stakeholders of the action.

6.3 Monitored Natural Attenuation Implementation Actions

Implementation actions include installation of additional monitoring wells, plugging and abandonment of monitoring wells not designated for long-term monitoring, implementation of a groundwater monitoring plan, monitoring, and reporting. The project schedule and cost summary for implementation actions are provided in **Appendix H**. Groundwater monitoring will be conducted to monitor the effectiveness of MNA in reducing contaminant concentrations over time. Monitoring will also be conducted to evaluate plume migration and ensure that chlorinated solvents-contaminated groundwater does not impact nearby surface water at unacceptable levels. Surface water sampling will be conducted to confirm contaminated groundwater is not migrating to surface water. The Groundwater Monitoring Plan, attached as **Appendix A**, describes the wells, their locations, analytical parameters, the frequency of the monitoring, surface water sampling, and presents a list of the monitored constituents and their respective MCLs. Groundwater monitoring and surface water sampling conducted at LHAAP-35B(37) and LHAAP-67 will follow the Health and Safety Plan (**Appendix E**), the Contractor Quality Control Plan (**Appendix F**), the Chemical Data Acquisition Plan (**Appendix G**), Field Activities (**Appendix C**) and Field Procedures (**Appendix D**) as contained in the appendices of the Remedial Design LHAAP-35B(37) and LHAAP-67.

Annual reports will be prepared for any year in which sampling occurs to document the monitoring program. The first year's annual report will include a review of the first four quarters of data, which include natural attenuation parameters and provide an evaluation for the evidence of MNA as a remedial method and a review of the first year's surface water sample data. The TCEQ provides guidance for MNA as a remedial action in *Monitored Natural Attenuation Demonstrations* (Texas Natural Resource Conservation Commission [TNRCC], RG-366/TRRP-33, October 2001). Although LHAAP is being addressed under the Risk Reduction Standards rather than Texas Risk Reduction Program (TRRP), this guidance is comparable to USEPA guidance and may be used as a guideline for the evaluation of the groundwater data. TRRP guidance specifies recommended lines of evidence to document the occurrence of natural attenuation at a site. For the first annual report, primary and secondary lines of evidence will be evaluated to document that attenuation is occurring at LHAAP-35B(37) and LHAAP-67. The primary line

of evidence uses historic groundwater data to demonstrate a trend of stable or decreasing COC concentrations over time and away from the source area. Secondary lines of evidence include geochemical parameters to document that the proper conditions are present for MNA to occur as well as the presence of daughter products. For the subsequent annual reports, the data evaluation presented will focus on trend analysis for the primary COCs. Additional information on the reporting procedures is provided in **Appendix A**.

6.4 CERCLA Five-Year Reviews

The Army shall conduct Five-Year Reviews of the LHAAP-35B(37) and LHAAP-67 remedy, as required by CERCLA and the NCP, because residual contamination in excess of established unrestricted use cleanup criteria will remain on site. As part of the CERCLA Section 121 (c) Five-Year Review, the Army shall prepare a report certifying the continued effectiveness of the remedy including the LUCs implemented at LHAAP-35B(37) and LHAAP-67.

The Five-Year Review Report will present summaries of information from the LUC inspection and certification forms and the annual MNA reports as from the five-year sampling event, evaluate that information, and recommend the future course of action. The Five-Year Review will include:

- A narrative of field activities for the past five years
- Figures of the site and wells locations
- Summary of groundwater sample results
- Site inspection with relevant photographs
- Evaluation of progress toward cleanup levels
- Evaluation of the effectiveness of the LUC
- Recommendations for future actions

The progress toward cleanup levels will be evaluated in the five-year report. The Five-Year Review offers the periodic opportunity to declare the site successfully and completely remediated, progressing satisfactorily toward remediation, or in need of more aggressive remedy. When cleanup levels are reached, monitoring may cease and the LUC may be terminated as recommended in the Five-Year Reviews.

7.0 Points of Contact

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  600 Army Pentagon
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- USEPA Region 6
  ATTN: Mr. Stephen Tzhone
  Superfund Division (6SF-AT)
  1445 Ross Avenue
  Dallas, Texas 75202
  Phone: 214-665-8409

- Texas Commission on Environmental Quality
  ATTN: Ms. Fay Duke
  TCEQ Environmental Cleanup Section II, Team 2(MC-221)
  12100 Park 35 Circle, Bldg. D
  Austin, Texas 78753
  Phone: 512-239-2443

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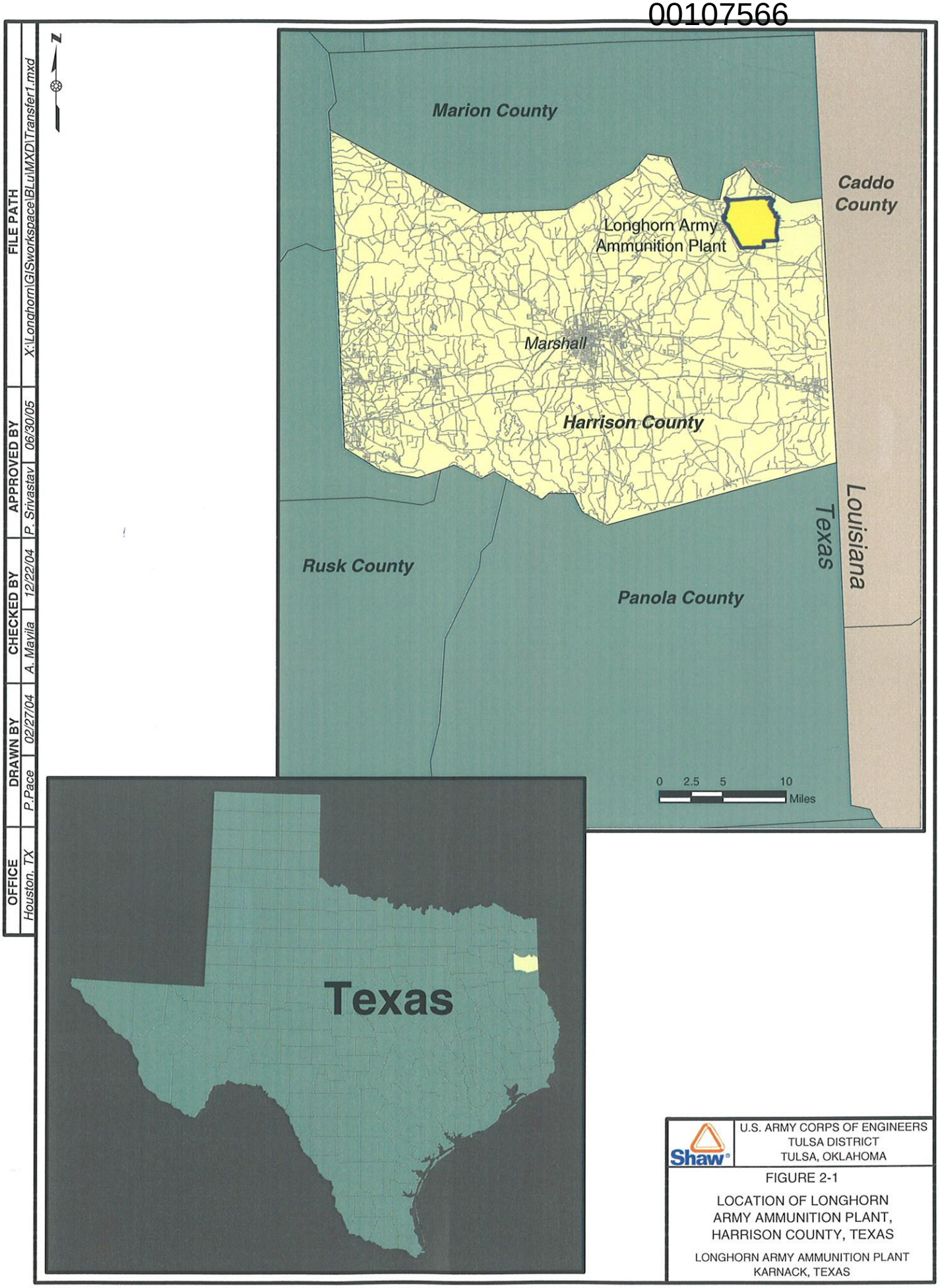
U.S. Army, 2008a, *Final Proposed Plan for LHAAP-35B(37), Chemical Laboratory and LHAAP-67, Aboveground Storage Tank Farm, Longhorn Army Ammunition Plant, Karnack,* Texas, June.

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Figures

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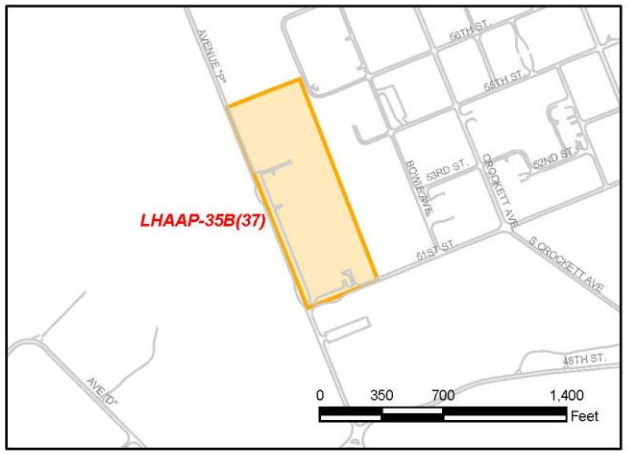
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TULSA DISTRICT
TULSA, OKLAHOMA

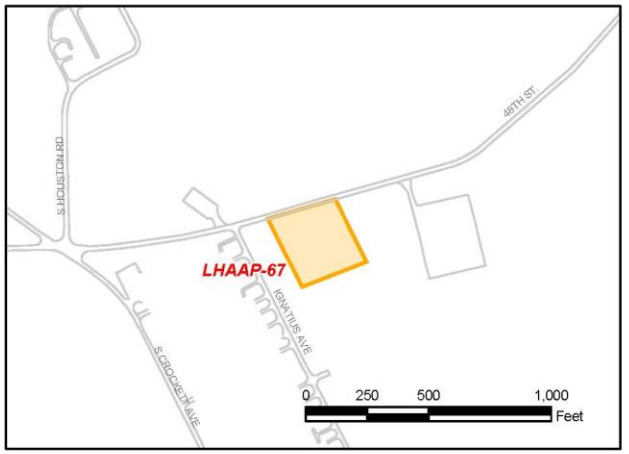
FIGURE 2-1

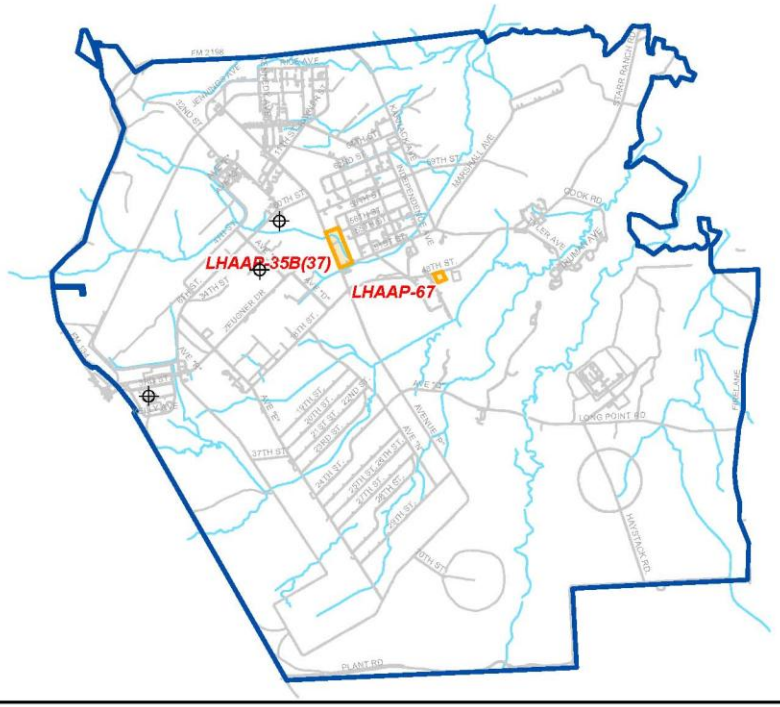
LOCATION OF LONGHORN ARMY AMMUNITION PLANT, HARRISON COUNTY, TEXAS

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

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LEGEND

- Approximate LHAAP Boundary
- Road
- Stream
- Site
- LHAAP Water Supply Well

LEGEND

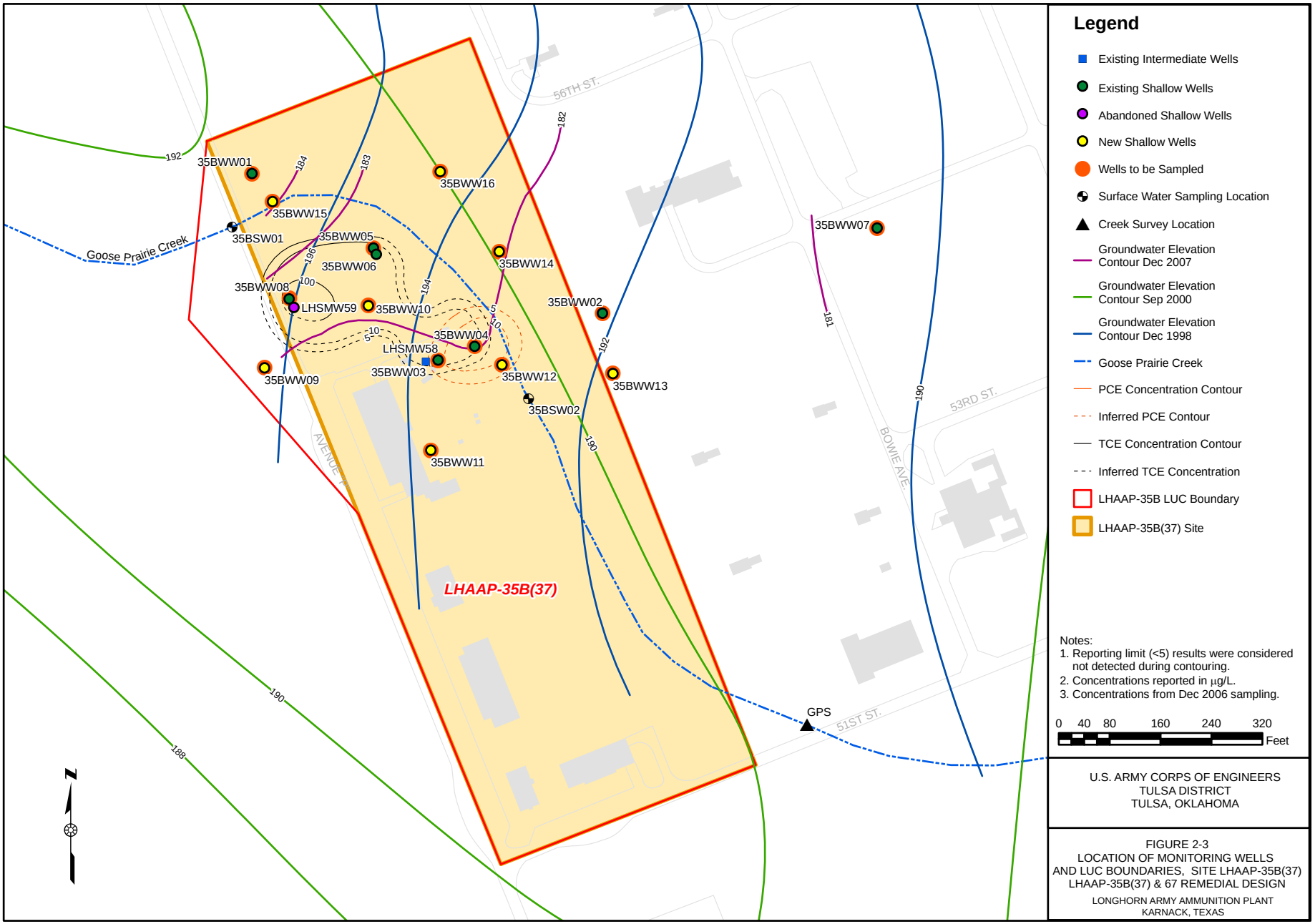
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- Stream
- Site
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- LHAAP Water Supply Well

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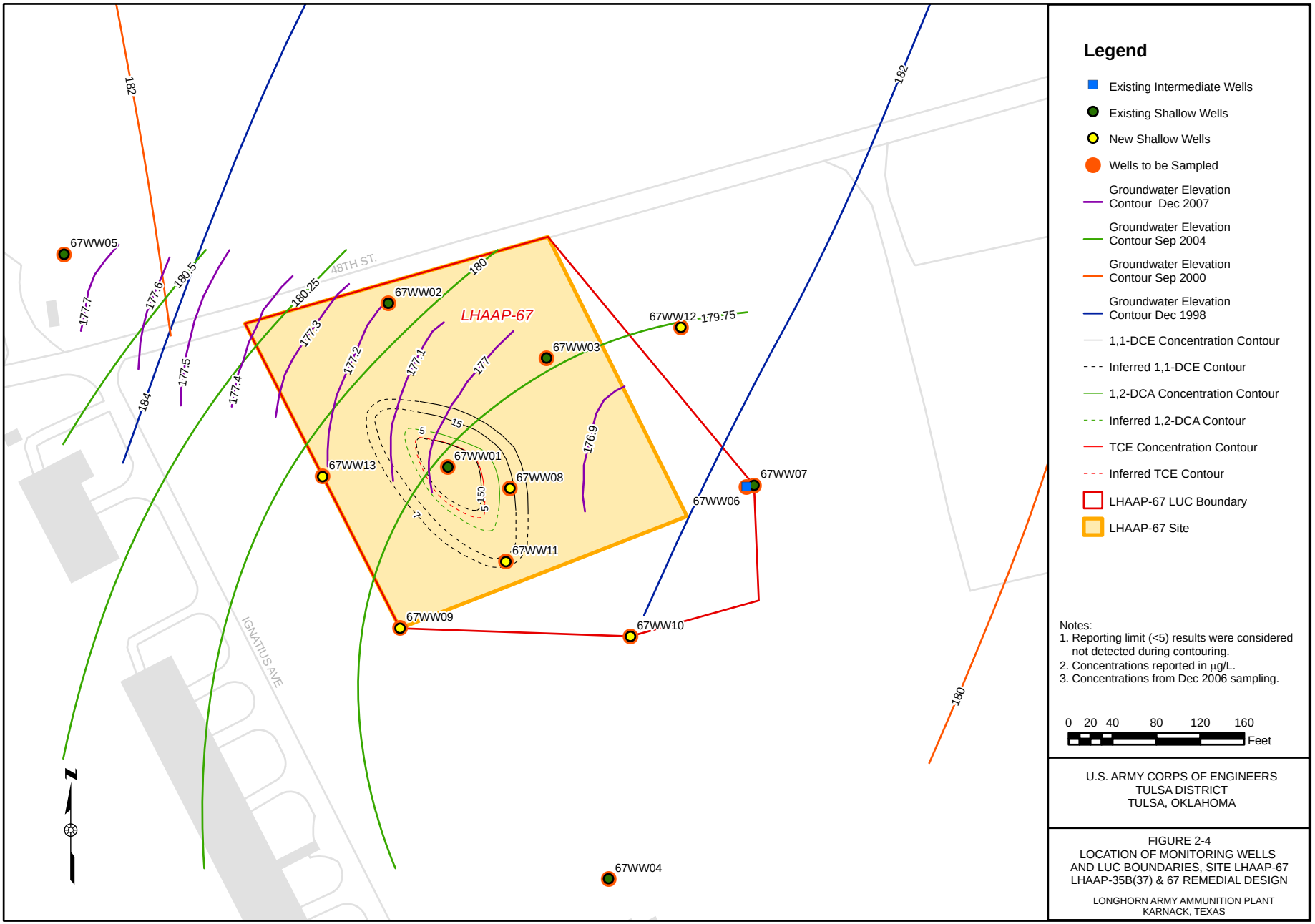
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TULSA, OKLAHOMA

FIGURE 2-2
SITE LOCATION MAP
REMEDIAL DESIGN
LHAAP-35B(37) AND LHAAP-67, GROUP 4
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS



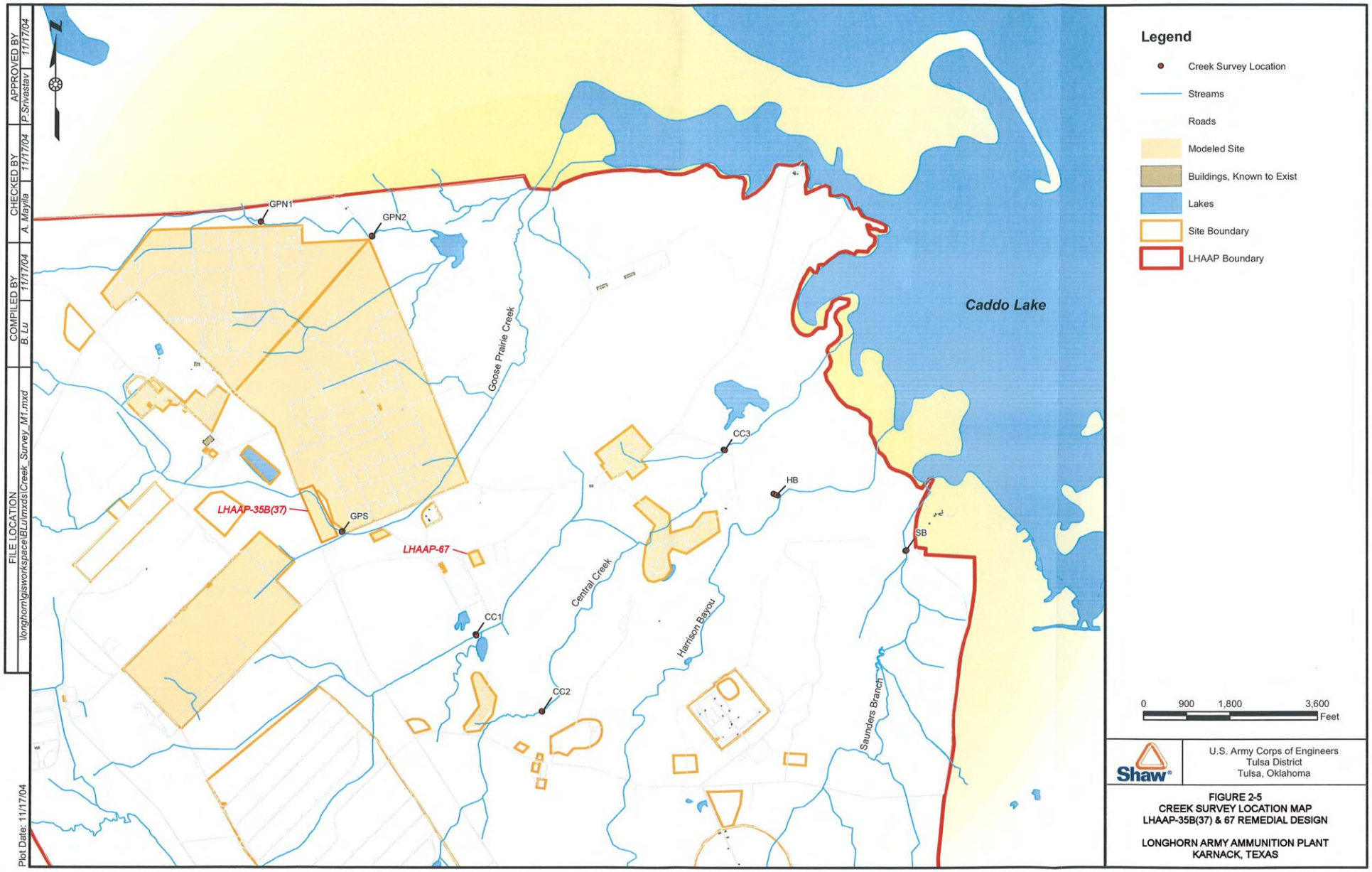
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LHAAP67_2-4.mxd 08/04/11

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U.S. Army Corps of Engineers
Tulsa District
Tulsa, Oklahoma

FIGURE 2-5
CREEK SURVEY LOCATION MAP
LHAAP-35B(37) & 67 REMEDIAL DESIGN

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Tables

Table 6-1
LHAAP-35B(37) Historical COC Concentrations

				COC Concentrations in µg/L								
				PCE MCL=5			TCE MCL=5			1,1-DCE MCL=7		
Well ID	Zone	Screened Interval (ft msl)	Date	Result	Qual	VQ	Result	Qual	VQ	Result	Qual	VQ
35BWW01	Shallow	181.2-191.2	8-Nov-98	1	U	U	1	U	U	1	U	U
			10-Sep-04	5	U	U	5	U	U	5	U	U
			10-Aug-06	5	U	U	5	U	U	5	U	U
			17-Dec-06	5	U	U	5	U	U	5	U	U
35BWW02	Shallow	187.1-192.1	8-Nov-98	1	U	U	1	U	U	1	U	U
			10-Sep-04	Dry			Dry			Dry		
			9-Aug-06	Dry			Dry			Dry		
35BWW03	Intermediate	121.3-131.3	10-Sep-04	5	U	U	5	U	U	5	U	U
			9-Aug-06	5	U	U	5	U	U	5	U	U
			16-Dec-06	5	U	U	5	U	U	5	U	U
35BWW04	Shallow	169.3-179.3	16-Dec-06	**30.1**			**10.8**			3.34	J	J
35BWW05	Upper Shallow	164-174	14-Dec-06	1	J	J	**12.9**			5	U	U
35BWW06	Lower Shallow	148-158	14-Dec-06	5	U	U	5	U	U	5	U	U
35BWW07	Shallow	172.9-182.9	14-Sep-07	1	U	-	1	U	-	1	U	-
35BWW08	Shallow	169.4-179.4	14-Sep-07	0.981	J	-	**150**			1	U	-
LHSMW58	Shallow	168.8-178.8	11-Dec-94	**21**			NR			**58**		
			21-Aug-96	**7.9**			**11.5**			**25.4**		
			20-May-98	**9.5**			**9.4**			4.2		
			10-Sep-04	**20**			**33**			4	J	J
			9-Aug-06	**21.8**		J	**21.8**		J	2.11	J	JH
			16-Dec-06	**9.01**			**13.7**			3.17	J	J
LHSMW59	Shallow Composite	153.5-173.5	11-Dec-94	**11**			NR			5	U	U
			21-Aug-96	**16.9**			**327**			2.2		
			20-May-98	**7**			**330**			1	U	U
			10-Sep-04	3	J	J	**180**	D		5	U	U
			10-Aug-06	1.19	J	J	**135**			5	U	U
			13-Dec-06	1.15	J	J	**166**			5	U	U

Notes and Abbreviations:

Shaded and bold values exceeded their MCLs

1,1-DCE	1,1-dichloroethene
COC	Chemical of Concern
D	Dilution
ft msl	feet above mean sea level
J	Estimated result detected above the method detection limit but below the reporting limit.
JH	Sample hold time exceeded. Result shown is estimated.
MCL	Maximum contaminant level
NR	not reported by laboratory
PCE	tetrachloroethene
Qual	laboratory qualifier
TCE	trichloroethene
U	Not detected. The reporting limit is shown.
VQ	Validation Qualifier
µg/L	micrograms per liter

Table 6-2
LHAAP-67 Historical COC Concentrations

				COC Concentrations in µg/L															
				TCE MCL=5			1,1-DCE MCL=7			1,2-DCA MCL=5			1,1,1-TCA MCL=200			1,1,2-TCA MCL=5		
Well ID	Zone	Screened Interval (ft msl)	Date	Result	Qual	VQ	Result	Qual	VQ	Result	Qual	VQ	Result	Qual	VQ	Result	Qual	VQ
67WW01	Shallow	176.3-186.3	8-Dec-98	**6.3**			**380**			**27**			**560**			**33**		
			12-Sep-04	**6**			**280**	D		**13**			5	U	U	1	J	J
			6-Aug-06	**5.38**		JH	**153**			**5.57**	Q	JH	5	U	U	0.305	J	JH
			18-Dec-06	**5.99**			**179**			**6.37**			5	U	U	0.28	J	J
67WW02	Shallow	171.7-181.7	8-Dec-98	1	U	U	2.4			1	U	U	100			**6.4**		
			12-Sep-04	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U
			6-Aug-06	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U
			18-Dec-06	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U
67WW03	Shallow	173.3-183.3	8-Dec-98	20	U	U	**36**			20	U	U	**1800**			**24**		
			12-Sep-04	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U
			9-Aug-06	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U
			17-Dec-06	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U
67WW04	Shallow	179-189	19-Dec-00	0.1	U	U	0.2	U	U	0.1	U	U	0.1	U	U	0.1	U	U
			12-Sep-04	1	J	J	5	U	U	5	U	U	5	U	U	5	U	U
67WW05	Shallow	171.5-181.5	19-Dec-00	0.1	U	U	0.2	U	U	0.1	U	U	0.1	U	U	0.1	U	U
			12-Sep-04	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U
			8-Aug-06	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U
			17-Dec-06	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U
67WW06	Intermediate	149-159	19-Dec-00	0.14		J	0.2	U	U	3.51			0.1	U	U	0.1	U	U
			12-Sep-04	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U
			8-Aug-06	5	U	U	5	U	U	3.02	J	J	5	U	U	5	U	U
			18-Dec-06	5	U	U	5	U	U	1.62	J	J	5	U	U	5	U	U
67WW07	Shallow	173-183	19-Dec-00	0.1	U	U	0.2	U	U	2.28			0.1	U	U	0.1	U	U
			12-Sep-04	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U
			8-Aug-06	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U
			18-Dec-06	5	U	U	5	U	U	1.65	J	J	5	U	U	5	U	U

Notes and Abbreviations:

Shaded and bold values exceeded their MCLs

1,1-DCE 1,1-dichloroethene
1,2-DCA 1,2-dichloroethane
1,1,1-TCA 1,1,1-trichloroethane
1,1,2-TCA 1,1,2-trichloroethane
COC Chemical of Concern
D Dilution
ft msl feet above mean sea level
J Estimated result detected above the method detection limit but below the reporting limit.
JH Sample hold time exceeded. Result shown is estimated.
MCL Maximum contaminant level
NR not reported by laboratory
PCE tetrachloroethene
Q One or more quality control fail
Qual Laboratory qualifier
TCE trichloroethene
U Not detected. The reporting limit is shown.
VQ Validation Qualifier
µg/L micrograms per liter

Appendix A

Groundwater Monitoring Plan

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Attachment 1 Existing Monitoring Well Information

Acronyms and Abbreviations

COC	chemicals of concern
DCA	Dichloroethane
DCE	Dichloroethene
LHAAP	Longhorn Army Ammunition Plant
LHAAP-35B(37)	Chemical Laboratory
LHAAP-67	Aboveground Storage Tank Farm
LUC	land use control
MCL	maximum contaminant level
MNA	monitored natural attenuation
PCE	Tetrachloroethene
TCA	Trichloroethane
TCE	Trichloroethene
TNRRC	Texas Natural Resource Conservation Commission
TRPP	Texas Risk Reduction Program
VOC	volatile organic chemicals

1.0 Purpose

The Groundwater Monitoring Plan describes the plan for the installation of additional monitoring wells at LHAAP-35(37) and LHAAP-67, and groundwater monitoring and reporting requirements at the sites. Groundwater monitoring will be used to monitor the effectiveness of monitored natural attenuation (MNA) in reducing contaminant concentrations over time, to evaluate plume migration and to ensure that contaminated groundwater does not impact nearby surface water.

2.0 Installation of New Monitoring Wells

Additional monitoring wells will be installed at LHAAP-35B(37) and LHAAP-67 to provide additional data in the evaluation of MNA at the sites, to ensure the contaminated groundwater does not migrate to nearby surface water at levels presenting an unacceptable risk, and to confirm the plume limits. Temporary borings will be installed and the groundwater sampled and analyzed using field instruments to provide additional information on the current extent of the contaminant plumes at the two sites. This additional information, along with sampling and analysis of all existing wells, will be used as guidance in the optimal placement of new monitoring wells. During installation of temporary borings at LHAAP-67 the intermediate groundwater zone will be sampled to determine if an additional intermediate groundwater well should be installed. Eight additional wells will be installed in the shallow groundwater zone at LHAAP-35B(37). **Figure 1** shows the location of the eight wells to be installed at LHAAP-35B(37). Six additional wells will be installed in the shallow groundwater zone at LHAAP-67. **Figure 2** shows the location of the six wells to be installed at LHAAP-67. **Tables 1a and 1b** provide a list of the monitoring wells to be installed at LHAAP-35B(37) and LHAAP-67 respectively, along with the approximate depths of the wells, and the locations of the wells based on the Texas State Plane coordinate system. **Table 5** provides a summary of well construction information. Available boring logs for existing monitoring wells and geologic cross sections at the two sites are included in **Attachment 1**.

3.0 Field and Analytical Program

Groundwater monitoring of monitoring wells at the two sites will be conducted to document the migration of the groundwater contamination and to ensure that the target contaminants do not discharge to nearby surface water bodies at such levels that applicable or relevant and appropriate requirements are exceeded. The location of the monitoring wells designated for long-term monitoring are shown on attached **Figure 1** for LHAAP-35B(37) and **Figure 2** for LHAAP-67 . Monitoring wells to be sampled are listed in **Tables 2a** and **2b** for LHAAP-35B(37) and LHAAP-67 respectively. **Tables 3a** and **3b** present a summary of the constituents of concern monitored at the two sites respectively, along with their respective MCLs. At the Five-Year Review, monitoring wells not in the long-term monitoring network will be considered for plugging and abandonment and are listed in **Table 4** for LHAAP-35B(37).

In addition to monitoring of the chemicals of concern (COCs) at the two sites, monitoring for antimony and thallium will take place at LHAAP-35B(37). Antimony and thallium were detected in groundwater at the site prior to the Remedial Investigation conducted 2002, but were determined not to be COCs due to

follow-on groundwater sampling results being non-detect for these metals, their non-detection in soils at the site, and the lack of their historical uses at the site. No subsequent sampling was conducted at LHAAP-35B(37) for antimony and thallium after 2002. Because previous detections of antimony and thallium were qualified results, sampling of the wells at the site for antimony and thallium will take place during the first monitoring event to confirm the previous decision to exclude these constituents as COCs. After the first sampling and analysis event for antimony and thallium at LHAAP-35B(37), the Army will evaluate the need for additional monitoring of these constituents.

At both sites the samples from the monitoring wells will be analyzed for volatile organic chemicals (VOCs) quarterly for the first two years, and analyzed for antimony and thallium during the first monitoring event at LHAAP-35B(37). The wells will be sampled semi-annually for VOCs at both sites for years three through five and annually thereafter until the next Five-Year Review. The results from monitoring will be reviewed during the Five-Year Review and the monitoring frequency evaluated. Unless otherwise indicated by the data, the wells will then be sampled at each Five-Year review.

Groundwater monitoring of the LHAAP-35B(37) onsite monitoring wells 35BWW04, 35BWW05, 35BWW08, 35BWW11, 35BWW15 and LHSMW58 and LHAAP-67 onsite monitoring wells 67WW01 and 67WW08 will be conducted to monitor the effectiveness of natural attenuation in reducing contaminant concentrations over time. For the first year of the sampling program, in addition to VOCs, the wells will be analyzed quarterly for nitrates, nitrites, sulfates, pH, Eh (redox potential), conductivity, temperature, dissolved oxygen, ferrous iron, chloride, methane, ethane, ethene, inorganic and organic carbon, and *Dehalococcoides*.

Surface water sampling for VOCs will take place quarterly for the first year and annually until the next Five-Year Review. to confirm contaminated groundwater is not migrating to surface water. The surface water will then be sampled every five years to support the Five-Year Reviews unless the sampling results indicate more frequent sampling is necessary. The locations of the surface water sampling are shown on attached **Figure 1** for LHAAP-35B(37) and **Figure 3** for LHAAP-67.

Groundwater monitoring and surface water sampling conducted at LHAAP-35B(37) and LHAAP-67 will follow the Health and Safety Plan (**Appendix E**), the Contractor Quality Control Plan (**Appendix F**), the Chemical Data Acquisition Plan (**Appendix G**), Field Activities (**Appendix C**) and Field Procedures (**Appendix D**) as contained in the appendices of the Remedial Design LHAAP-35B(37) and LHAAP-67.

Monitoring well plugging and abandonment conducted at LHAAP-35B(37) and LHAAP-67 will follow the Health and Safety Plan (**Appendix E**), Field Activities (**Appendix C**), Field Procedures (**Appendix D**), and Contractor Quality Control Plan (**Appendix F**) as contained in the appendices of the Remedial Design LHAAP-35B(37) and LHAAP-67.

4.0 Reporting

Annual reports will be prepared for any year in which sampling occurs to document the monitoring program. The first year annual report will include a review of the first four quarters of data which include natural attenuation parameters, and provide an evaluation for the evidence of MNA as a remedial method and a review of the first year's surface water sample data. The Texas Natural Resource Conservation Commission (TNRCC) provides guidance for MNA as a remedial action in *Monitored Natural Attenuation Demonstrations* (TNRCC RG-366/TRRP-33, October, 2001). Although LHAAP is being addressed under the Risk Reduction Standards rather than Texas Risk Reduction Program (TRRP), this guidance is comparable to USEPA guidance and may be used as a guideline for the evaluation of the groundwater data. TRRP guidance specifies recommended lines of evidence to document the occurrence of natural attenuation at a site.

For the first annual report, primary and secondary lines of evidence will be evaluated to document that degradation is occurring at LHAAP-35B(37) and LHAAP-67. The primary line of evidence uses historic groundwater data to demonstrate a trend of stable or decreasing chemicals of concern (COC) concentrations over time and away from the source area. All of the COCs identified at the two sites are chlorinated VOCs, with trichloroethene (TCE), tetrachloroethene (PCE) and 1,1-dichloroethene(1,1-DCE) being the COCs at LHAAP-35B(37) and 1,1,1-trichloroethane (TCA), 1,1,2-TCA, 1,2-dichloroethane (DCA), TCE, and 1,1-DCE being the COCs at LHAAP-67. Results for perimeter monitoring wells will be evaluated for indications of plume migration to ensure that COC-contaminated groundwater does not impact nearby surface water at unacceptable levels.

Secondary lines of evidence include geochemical parameters which may be used to document that the proper conditions are present for degradation of chlorinated compounds to occur as well as the presence of the daughter products of PCE, TCE and 1,1-DCE for LHAAP-35B(37) and TCA, DCA, TCE, and 1,1-DCE for LHAAP-67. Degradation of PCE, TCE and 1,1-DCE for LHAAP-35B(37) and TCA, DCA, TCE, and 1,1-DCE for LHAAP-67 are favored under anaerobic conditions. Results of the dissolved oxygen, oxidation-reduction potential, and methane conditions will be used to determine if anaerobic conditions exist at the site. Sulfate, nitrates, and ferrous iron will also be considered in the evaluation. For example, high levels of sulfate and nitrates may compete with the chlorinate reduction pathway, while elevated ferrous iron may indicate favorable conditions for reduction. The first four quarters of results will be reviewed to determine if daughter products such as cis-1,2-dichloroethene, vinyl chloride, ethene and ethane continue to be present.

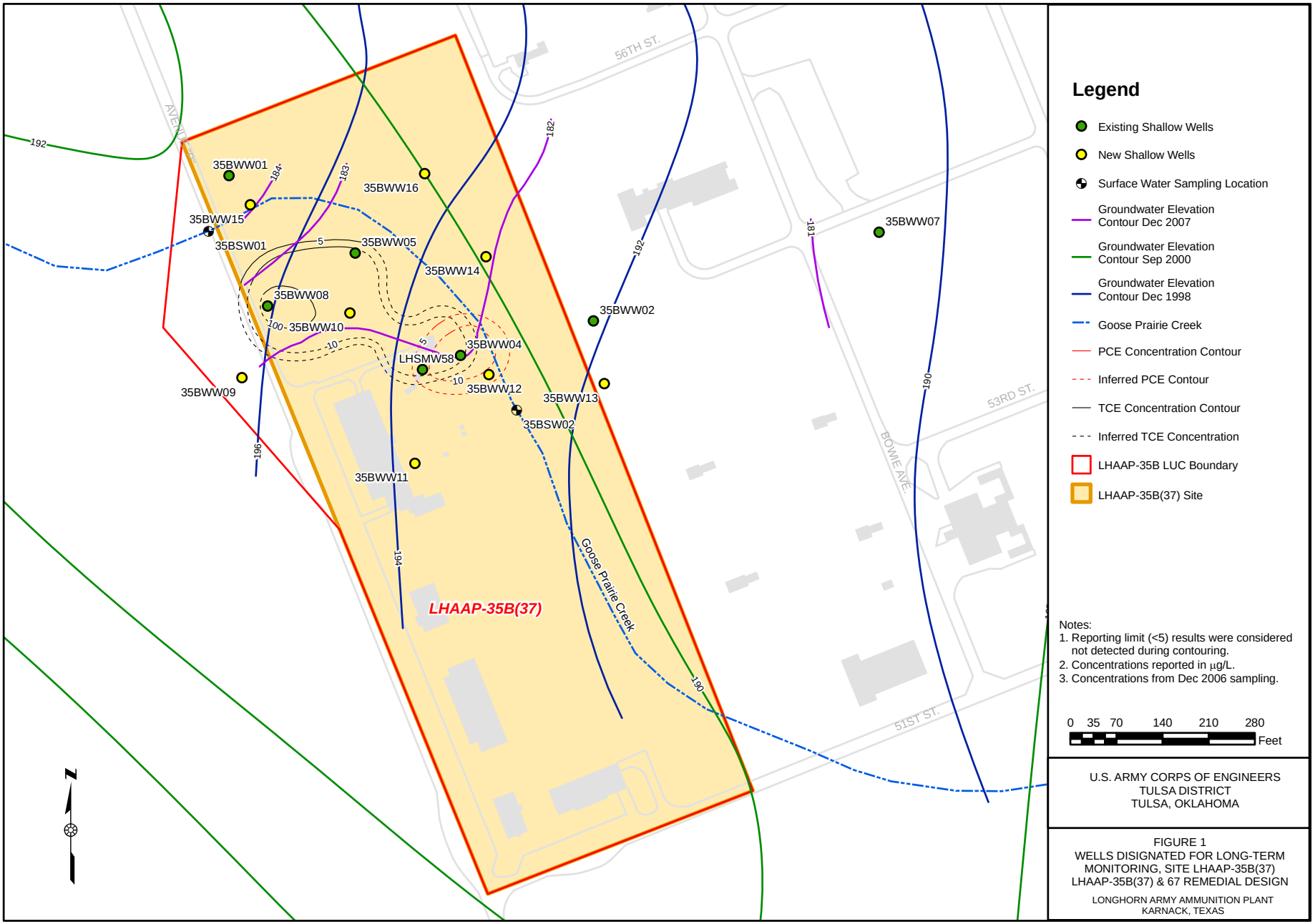
In addition, a site conceptual model will be presented including identification of source areas of contamination, groundwater flow directions, and potential receptors. Natural attenuation processes and evidence for dechlorination of the COCs will also be discussed.

For the subsequent annual reports and Five-Year Reviews, since geochemical conditions at LHAAP-35B(37) and LHAAP-67 will have already been established, the data evaluation presented in the reports will focus on primary lines of evidence or trend analysis for the primary COCs. Results for perimeter monitoring wells will be evaluated for indications of plume migration and to ensure that COC contaminated groundwater does not migrate into nearby surface water. Wells may be removed from the

Long-Term Monitoring Program if deemed to be no longer needed from the annual reports or Five-Year Reviews.

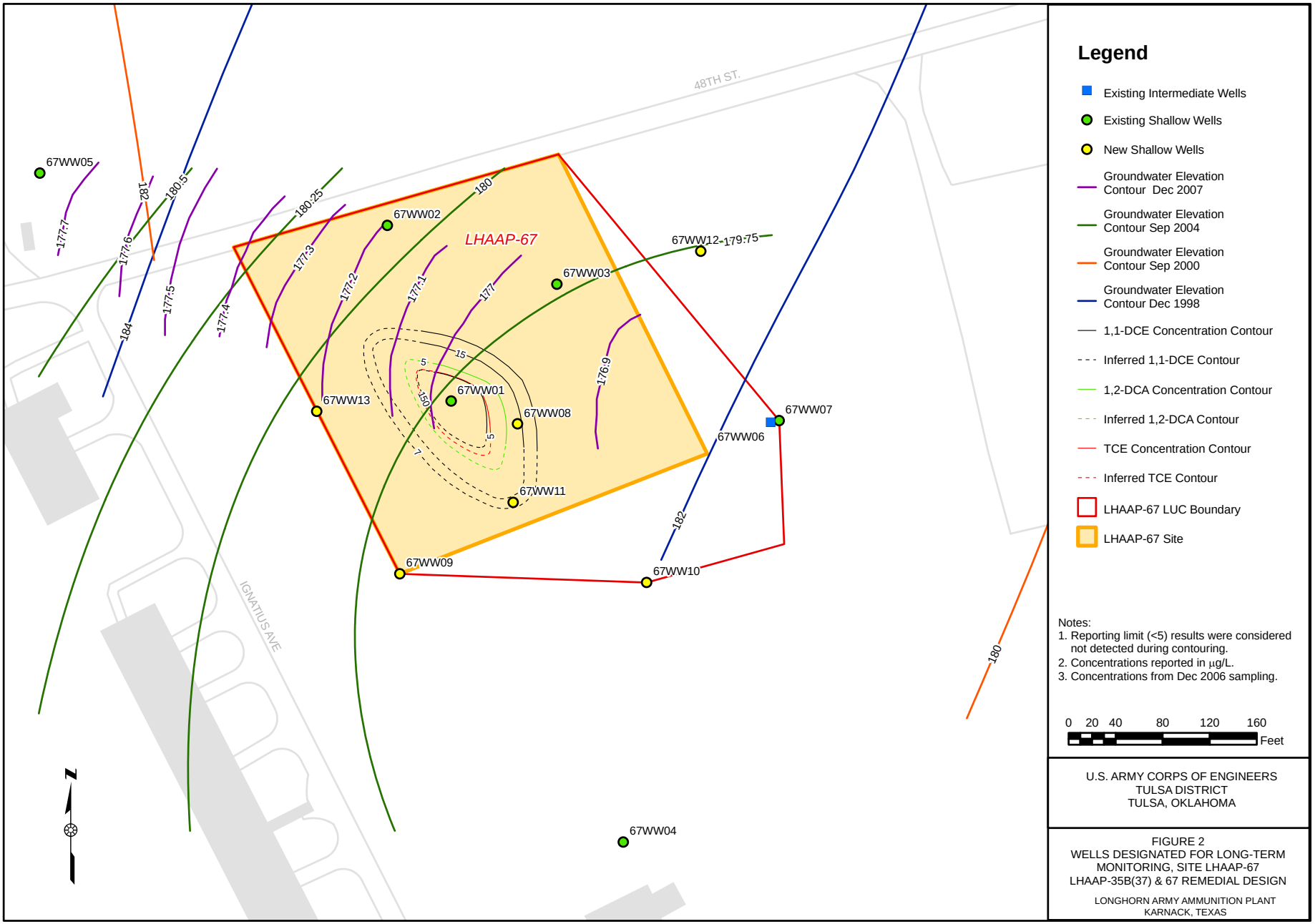
Figures

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LHAAP35BLTM.mxd 08/04/11

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LHAAP67LTM.mxd 08/04/11

Tables

Table 1a

New Monitoring Wells to be Installed at LHAAP-35B(37)

Well	Approximate Depth (feet bgs)	Groundwater Zone	Location East	Location North
35BWW09	29	Shallow	3307835	6958024
35BWW10*	35	Shallow	3307999	6958122
35BWW11	35	Shallow	3308097	6957894
35BWW12*	35	Shallow	3308209*	6958029*
35BWW13	30	Shallow	3308384	6958015
35BWW14	35	Shallow	3308205	6958208
35BWW15	35	Shallow	3307848	6958287
35BWW16	35	Shallow	3308111	6958334

Notes:

Coordinate system is State Plane, Texas North Central, FIPS 4202, Feet, NAD 1983

bgs – below ground surface

**To be installed after collecting samples from temporary borings to ensure installation at optimal location within the plume, locations given are approximate*

Table 1b

New Monitoring Wells to be Installed at LHAAP-67

Well	Approximate Depth (feet bgs)	Groundwater Zone	Location East	Location North
67WW08*	26	Shallow	3311501*	6956892*
67WW09	26	Shallow	3311401	6956765
67WW10	26	Shallow	3311611	6956757
67WW11*	26	Shallow	3311497*	6956825*
67WW12	26	Shallow	3311656	6957039
67WW13	26	Shallow	3311331	6956903

Notes:

Coordinate system is State Plane, Texas North Central, FIPS 4202, Feet, NAD 1983

bgs – below ground surface

** To be installed after collecting samples from temporary borings to ensure installation at optimal location within the plume, locations given are approximate*

Table 2a
Wells Designated for Long-Term Monitoring at LHAAP-35B(37)

Well	Groundwater Zone	Objectives
35BWW01	Shallow	2, 3
35BWW02	Shallow	3
35BWW04	Shallow	1, 2
35BWW05	Shallow	1, 2
35BWW07	Shallow	3
35BWW08	Shallow	1
35BWW09	Shallow	3
35BWW10	Shallow	1, 2
35BWW11	Shallow	2, 3
35BWW12	Shallow	1, 2, 3
35BWW13	Shallow	2, 3
35BWW14	Shallow	2, 3
35BWW15	Shallow	2, 3
35BWW16	shallow	2, 3
LHSMW58	Shallow	1, 2

Notes:

1- ***Provide data in the evaluation of MNA***
2- ***Ensure contaminated groundwater does not migrate to nearby surface water at levels presenting an unacceptable risk***
3- ***Confirm the plume limits***

Table 2b

Wells Designated for Long-Term Monitoring at LHAAP-67

Well	Groundwater Zone	Objectives
67WW01	Shallow	1
67WW02	Shallow	3
67WW03	Shallow	2, 3
67WW04	Shallow	2, 3
67WW05	Shallow	2, 3
67WW06	Intermediate	3
67WW07	Shallow	2, 3
67WW08	Shallow	1, 2, 3
67WW09	Shallow	2, 3
67WW10	Shallow	2, 3
67WW11	Shallow	1, 2, 3
67WW12	Shallow	2, 3
67WW13	Shallow	2, 3

Notes:

1- ***Provide data in the evaluation of MNA***
2- ***Ensure contaminated groundwater does not migrate to nearby surface water at levels presenting an unacceptable risk***
3- ***Confirm the plume limits***

Table 3a

Monitored Constituents at LHAAP-35B(37)

Constituent	MCL (mg/L)
1,1-Dichloroethene	0.007
Tetrachloroethene	0.005
Trichloroethene	0.005
Antimony	0.006
Thallium	0.002
Vinyl Chloride	0.002

Table 3b

Monitored Constituents at LHAAP-67

Constituent	MCL (mg/L)
1,1-Dichloroethene	0.007
1,2-Dichloroethane	0.005
1,1,1-Trichloroethane	0.02
1,1,2-Trichloroethane	0.005
Trichloroethene	0.005
Vinyl Chloride	0.002

Table 4

Wells Considered for Future Plugging and Abandonment at LHAAP-35B(37)

Well	Groundwater Zone	Depth (feet bgs)	Reason for Abandonment
35BWW03	Intermediate	81	Well doesn't address objectives
35BWW06	Shallow	52	Adjacent well 35BWW05 addresses more objectives

Notes:

bgs – below ground surface

Table 5
Well Construction Information

LHAAP-35B(37)	Well Diameter (in.)	Total Depth (ft bgs)	Screen Location (ft bgs)	Screen Length (ft)
35BWW01	4	19	9-19	10
35BWW02	4	43	9-14	5
35BWW03	-	81	70-80	10
35BWW04	4	30	20-30	10
35BWW05	2	36	26-36	10
35BWW06	-	52	42-52	10
35BWW07	2	28	18-28	10
35BWW08	2	32	22-32	10
35BWW09	TBD	TBD	TBD	TBD
35BWW10	TBD	TBD	TBD	TBD
35BWW11	TBD	TBD	TBD	TBD
35BWW12	TBD	TBD	TBD	TBD
35BWW13	TBD	TBD	TBD	TBD
35BWW14	TBD	TBD	TBD	TBD
35BWW15	TBD	TBD	TBD	TBD
35BWW16	TBD	TBD	TBD	TBD
LHSMW58	4	34	21.4-31.2	9.8

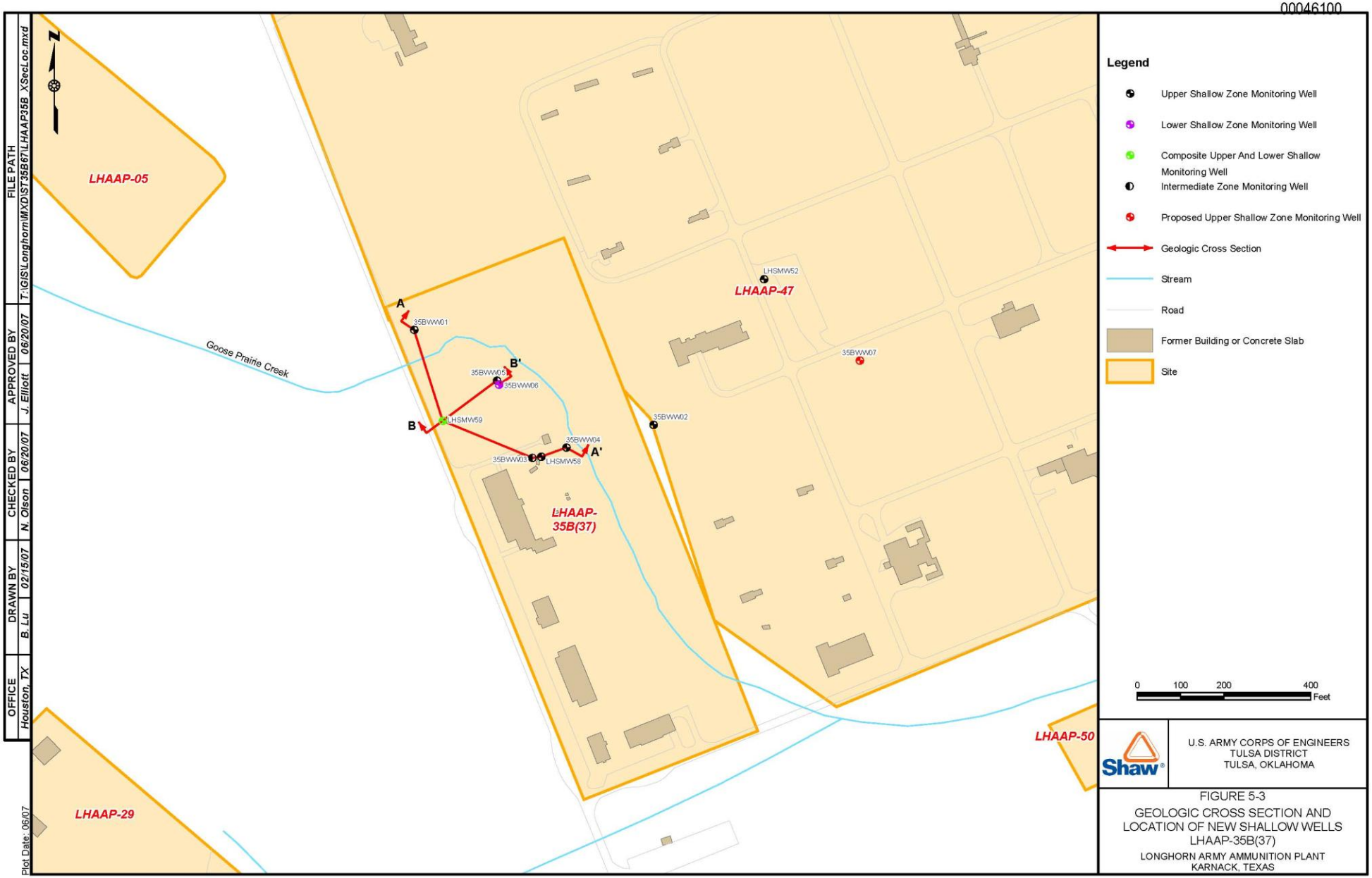
LHAAP-67	Well Diameter (in.)	Total Depth (ft bgs)	Screen Location (ft bgs)	Screen Length (ft)
67WW01	4	22	12-22	10
67WW02	4	25	15-25	10
67WW03	4	24	14-24	10
67WW04	4	23	11-21	10
67WW05	4	26	16-26	10
67WW06	4	51	38-48	10
67WW07	4	24	14-24	10
67WW08	TBD	TBD	TBD	TBD
67WW09	TBD	TBD	TBD	TBD
67WW10	TBD	TBD	TBD	TBD
67WW11	TBD	TBD	TBD	TBD
67WW12	TBD	TBD	TBD	TBD
67WW13	TBD	TBD	TBD	TBD

Attachment 1

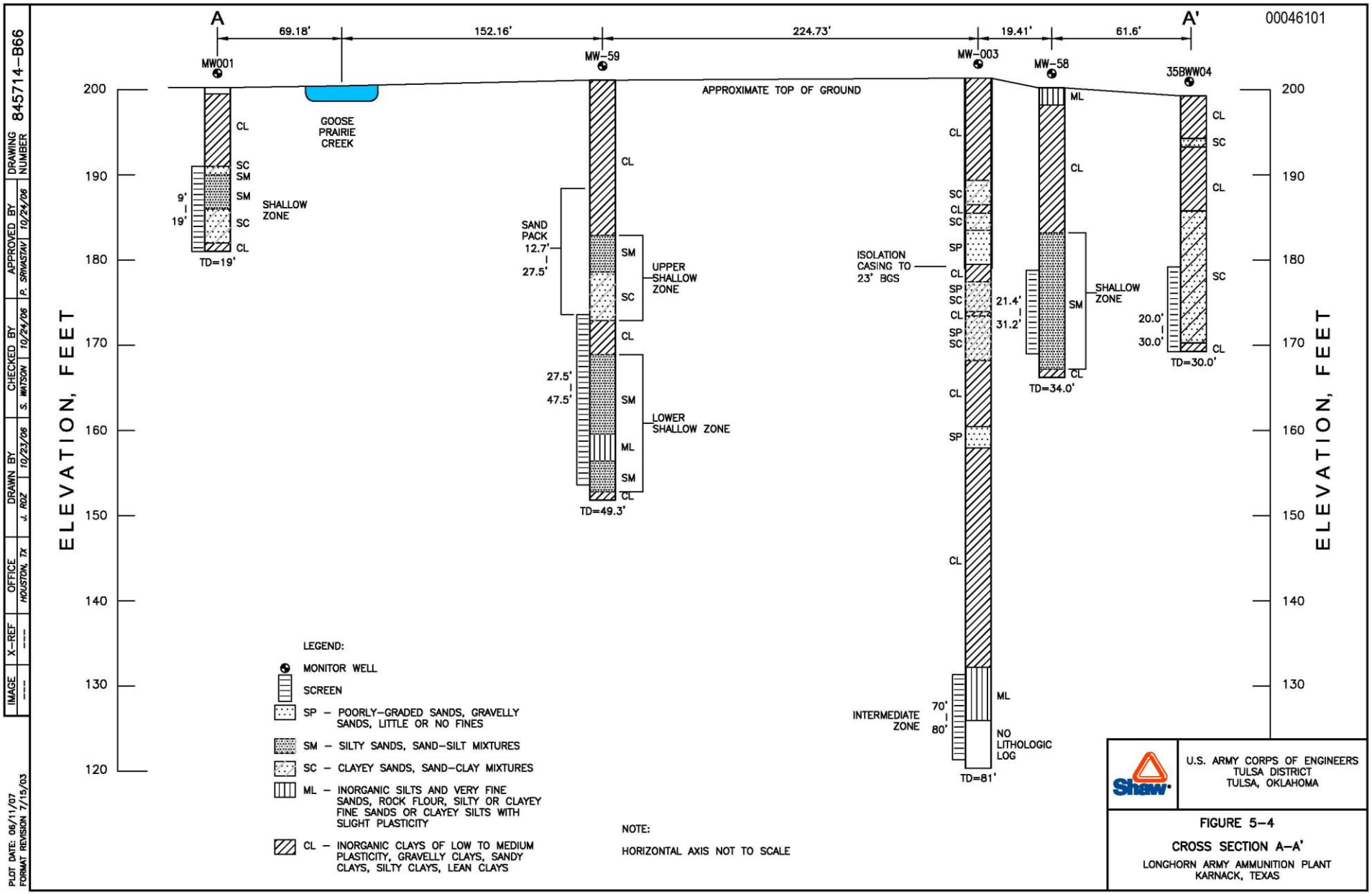
Existing Monitoring Well Information

LHAAP-35B(37) Drilling Logs and Geologic Cross Sections

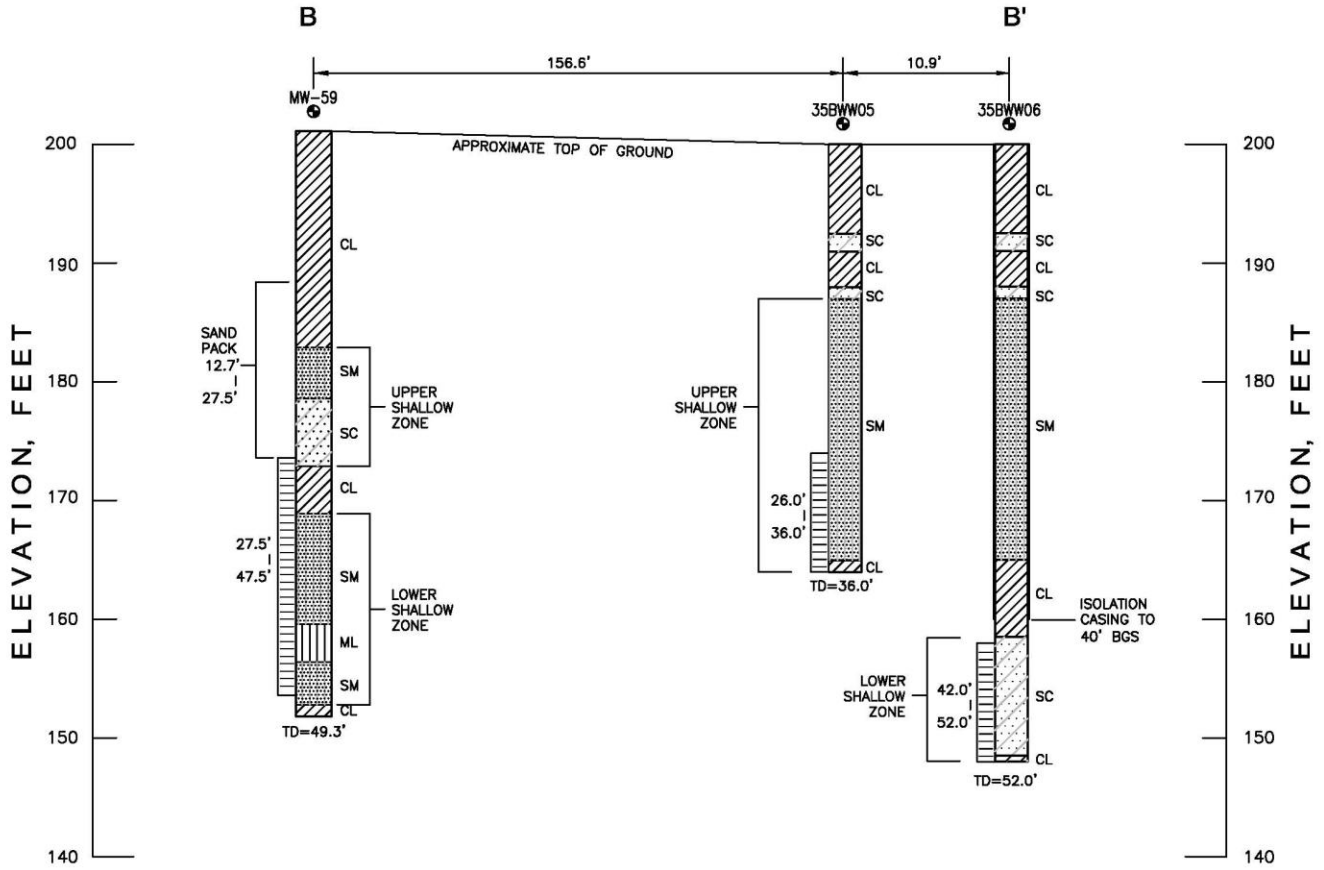
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LHAAP-05
LHAAP-47
LHAAP-35B(37)
LHAAP-50
LHAAP-29
Goose Prairie Creek
35BWW01
35BWW02
35BWW03
35BWW04
35BWW05
35BWW06
35BWW07
LHSMW52
LHSMW58
LHSMW59
A
A'
B
B'
Legend
Upper Shallow Zone Monitoring Well
Lower Shallow Zone Monitoring Well
Composite Upper And Lower Shallow Monitoring Well
Intermediate Zone Monitoring Well
Proposed Upper Shallow Zone Monitoring Well
Geologic Cross Section
Stream
Road
Former Building or Concrete Slab
Site
0 100 200 400
Feet
OFFICE Houston, TX
DRAWN BY B. Lu 02/15/07
CHECKED BY N. Olson 06/20/07
APPROVED BY J. Elliott 06/20/07
FILE PATH T:\GIS\Longhorn\MXD\ST35B67\LHAAP35B_XSecLoc.mxd
Plot Date: 06/07
U.S. ARMY CORPS OF ENGINEERS
TULSA DISTRICT
TULSA, OKLAHOMA
Shaw
FIGURE 5-3
GEOLOGIC CROSS SECTION AND LOCATION OF NEW SHALLOW WELLS
LHAAP-35B(37)
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

00107593


A
A'
00046101
69.18'
152.16'
224.73'
19.41'
61.6'
MW001
MW-59
MW-003
MW-58
35BWW04
APPROXIMATE TOP OF GROUND
GOOSE PRAIRIE CREEK
ELEVATION, FEET
200
190
180
170
160
150
140
130
120
CL
SC
SM
SC
CL
9'
19'
SHALLOW ZONE
TD=19'
SAND PACK
12.7'
27.5'
SM
SC
UPPER SHALLOW ZONE
CL
27.5'
47.5'
SM
ML
SM
CL
LOWER SHALLOW ZONE
TD=49.3'
ISOLATION CASING TO 23' BGS
SC
CL
SC
SP
CL
SP
SC
CL
SP
SC
21.4'
31.2'
CL
SP
CL
INTERMEDIATE ZONE
70'
80'
ML
NO LITHOLOGIC LOG
TD=81'
ML
CL
SM
CL
SHALLOW ZONE
TD=34.0'
CL
SC
CL
SC
CL
20.0'
30.0'
SC
CL
TD=30.0'
LEGEND:
MONITOR WELL
SCREEN
SP – POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
SM – SILTY SANDS, SAND-SILT MIXTURES
SC – CLAYEY SANDS, SAND-CLAY MIXTURES
ML – INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
CL – INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
NOTE:
HORIZONTAL AXIS NOT TO SCALE
IMAGE
X-REF
OFFICE
HOUSTON, TX
DRAWN BY
J. ROZ
10/23/06
CHECKED BY
S. WATSON
10/24/06
APPROVED BY
P. SRIVASTAV
10/24/06
DRAWING NUMBER
845714-B66
PLOT DATE: 06/11/07
FORMAT REVISION 7/15/03
Shaw
U.S. ARMY CORPS OF ENGINEERS
TULSA DISTRICT
TULSA, OKLAHOMA
FIGURE 5-4
CROSS SECTION A-A'
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

00046102



LEGEND:

- MONITOR WELL
- SCREEN
- SP – POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
- SM – SILTY SANDS, SAND-SILT MIXTURES
- SC – CLAYEY SANDS, SAND-CLAY MIXTURES
- ML – INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
- CL – INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS

NOTE:

HORIZONTAL AXIS NOT TO SCALE

U.S. ARMY CORPS OF ENGINEERS
TULSA DISTRICT
TULSA, OKLAHOMA

FIGURE 5-5

CROSS SECTION B-B'

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

IMAGE	X-REF	OFFICE	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
---	---	HOUSTON, TX	J. ROZ 10/23/06	S. WATSON 10/24/06	P. SRIVASTAV 10/24/06	845714-B66

PLOT DATE: 06/11/07
FORMAT REVISION 7/15/03

00107595

Hole No. 35BWL002(S)

DRILLING LOG	DIVISION USACE Tulsa	INSTALLATION LHAAP Karnack, TX	SHEET 1 OF 2 SHEETS
1. PROJECT LHAAP Site 35B		10. SIZE AND TYPE OF BIT Hyd. 5.5"	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY GPI, Inc Hurst, TX		12. MANUFACTURER'S DESIGNATION OF DRILL CME-75 3 1/4" ID HSA / 3 5/8" ID HSA / 11" OD HSA	
4. HOLE NO. (As shown on drawing title or file number) 35BWL002		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 12	UNDISTURBED —
5. NAME OF DRILLER José Landros		14. TOTAL NUMBER CORE BOXES NA	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER —	
7. THICKNESS OF OVERBURDEN		16. DATE HOLE STARTED 8-31-98 COMPLETED 8-31-98	
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE —	
9. TOTAL DEPTH OF HOLE		18. TOTAL CORE RECOVERY FOR BORING NA %	
		19. SIGNATURE OF INSPECTOR BB	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1	CL	silty clay - dark brown (moist) w/ some light brown (moist). stiff low plasticity (Dry)	3.5' of 4.0'	SS#1 0.0' to 4.0'	Commenced 1325 Hrs Rocks
	2					
	3		silty clay - ltgy to lt brown w/ some orange staining (moist) (stiff to friable) (Dry)			Sampler = 0ppm
	4	CL				
	5		silty sand - ltgry sand w/ high silt content low plasticity soft and friable throughout (Dry) high silt content from 7' to 8' fine micaceous sand from 8' down to 9' grades into CL at 10.5'	5.6' of 5.0'	SS#2 4.0' to 9.0'	Sampler =
	6	SM				
	7					
	8					
	9					
	10					
	11	CL	silty clay - gry to ltgy w/ orange staining (mottled) moderate plasticity (moist)	5.0' of 5.0'	SS#3 9.0' to 14.0'	Sampler = 4ppm
	12					
	13	SM	silty sand/sandy silt - gry to dark gry silt/sand. Non plasticity soft to very soft (free water) grades into CL around 14 to 14.1'			
	14					
	15	CL	silty sandy clay - med gry to ltgry w/ orange staining (moist) thin layer of hard shale like clay about 2" thick	2.5' of 5.0'	SS#4 14.0' to 19.0'	
	16					
	17	SP	poorly sorted sand - ltgry to gry sand w/ some silt non plasticity very soft + some orange staining. (free water)			
	18					
	19			2.0' of 5.0'	SS#5 (19.0' to 20.2')	

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT

HOLE NO.

00107596

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE | Hole No. 35Boring2

PROJECT | INSTALLATION | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	20	SM	silty sand - olive-gray-brown to ltgray (moist-wet) silty sand w/some regions around 20.2' (soft to stiff) w/plasticity (wet)	2.0' of 2.0'	SS#5 19.0' to 21.0'	
	21					
	22	SM/SC	silty clayey sand - ltgray to olive-brown - sand with lots of fines (some plasticity) soft to very soft (free water)	2.0' to 2.0'	SS#6 21.0' to 23.0'	
	23					
	24	SM	silty sand - ltgy to ltbrown silty sand no plasticity very soft (free water)	5.0' of 2.0'	SS#7 23.0 to 25.0	
	25					
	26	SM	as above	2.0' of 2.0'	SS#8 25.0 to 27.0	
	27					
	28	SM	As above	2.0' of 2.0'	SS#9 27.0 to 29.0	
	29					
	30					
	31			5.0' of 5.0'	SS#10 29.0' to 34.0'	
	32					
	33	SM/SC	silty clayey sand - ltgy to lt brown w/a purple tint soft (free water)			Clayey sands - ground. Appreciable amount of sandy silt and clayey "shale" Dark brown to gray becoming stiff to friable (wet) SP -68
	34					
	35	SM	silty sand lt brown m. sand w/some fines increase towards bottom (soft free water)	5.0' of 5.0'	SS#11 34.0' to 35.0'	
	36					
	37					
	38					
	39	SM	As above			
	40		free water	5.0' of 5.0'	SS#12 35.0' to 44.0	
	41					
	42					
		CL	m.-to dk gy lean clay - firm/stiff to stiff			
		SM	ltgy clay (wet) ltgy silty sand - soft free water w/plasticity			
	43					

ENG FORM 1836-A (ER 1110-1-1801) GPO 1980 OF - 628 - 603 | PROJECT | HOLE NO.

44 45 46 47

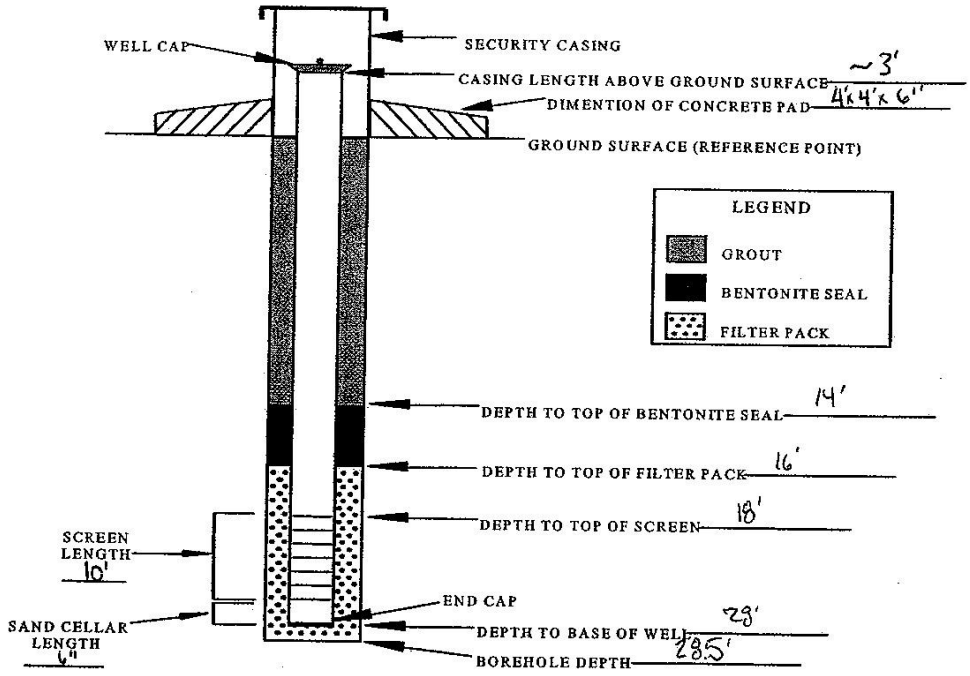
00107598

WELL COMPLETION FORM (Stickup or Above Grade Completion Well)

FIELD REPRESENTATIVE: A. Willmore
DRILLING CONTRACTOR: JEDI
DRILLING TECHNIQUE: HSA
AUGER SIZE AND TYPE: 8" Auger
BOREHOLE IDENTIFICATION: 35B WW07
BOREHOLE DIAMETER: 8"
WELL IDENTIFICATION: 35BWW07
WELL CONSTRUCTION START DATE: 9/8/07
WELL CONSTRUCTION COMPLETE DATE: 9/8/07
SCREEN MATERIAL: SCH 40 PVC
SCREEN DIAMETER: 2"
STRATUM-SCREENED INTERVAL (FT): 10'
CASING MATERIAL: SCH 40 PVC
CASING DIAMETER: 2"

TYPE OF FILTER PACK: 20/40 SILICA SAND
GRADIATION: 20/40
AMOUNT OF FILTER PACK USED: 5-50 lb bags
TYPE OF BENTONITE: pellets
AMOUNT BENTONITE USED: ~12.5 lbs
TYPE OF CEMENT: PORTLAND - CEMENT
AMOUNT CEMENT USED: 6-94 lb bags
GROUT MATERIALS USED: slurry
DIMENSIONS OF SECURITY CASING: 6" x 6"
TYPE OF WELL CAP: 2" well plugging cap
TYPE OF END CAP: SCH 40 PVC
COMMENTS:

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: Oscar Garcia - JEDI
INSTALLATION OBSERVED BY: Allen Willmore - Shaw

DISCREPANCIES:

00107599

SITE 35B(37)
HOLE NO. 35BWW07

BORING LOG	DIVISION: TERC Houston Federal	INSTALLATION: LHAAP	SHEET 1 OF SHEETS
1. PROJECT: LHAAP		9. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
2. LOCATION: KARNACK, TEXAS		10. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
3. DRILLING AGENCY: VEDI Drilling		11. OVERBURDEN SAMPLES: DISTURBED: YES	UNDISTURBED:
4. HOLE NO. (As shown on drawing title and file number): 35BWW07		12. TOTAL NUMBER CORE BOXES: NR	
5. NAME OF DRILLER: Oscar Garcia		13. ELEVATION GROUND WATER	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED 0° DEG. FROM VERT.		14. DATE HOLE: STARTED 9/18/07 COMPLETED 9/18/07	
7. TOTAL DEPTH OF HOLE: 28'		15. ELEVATION TOP OF HOLE: Not ORIGINALLY RECORDED, SEE SURVEY	
8. SIZE AND TYPE OF BIT: 8" O.D. HSA, 2" SPLIT SPOON		16. TOTAL CORE RECOVERY FOR BORING: %	
		17. LOGGED BY: A. Willmer	QC

PID (ppm) a	DEPTH b	USCS c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0		CL	CLAY, SANDY, NO PLASTICITY, STIFF, DRY, BROWN, NO ODOR	100%		
0.0	5	SM	SAND, SILTY, ~~DENSE~~ MAY SLIGHTLY DENSE, MODERATELY TO WELL SORTED, GRAY, MOIST, NO ODOR	75%		
0.0		ML	SILT, CLAYEY, DENSE, NO PLASTICITY, POORLY SORTED, MOIST, GRAY, NO ODOR	100%		
0.0	10	CL	CLAY, SANDY, LOW PLASTICITY, SOFT TO STIFF, MOIST, GRAY, NO ODOR	100%		

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE

Hole No. 35BKMW07

PROJECT: LHAAP-TERC

INSTALLATION: LHAAP

SHEET 2 OF SHEETS

PID ELEVATION (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
0.0		CL	SAME AS ABOVE	100%		
			-BECOMES SILTY, STIFF			
	15					
0.0				100%		
0.0		SC	SAND, CLAYEY, LOOSE TO MOD DENSE, POORLY-SORTED SATURATED, NO ODOR	100%		
	20	CL	CLAY, SILTY, LOW PLASTICITY, SOFT, MOIST, NO ODOR, GRAY			
			-BECOMES HARD TO STIFF			
0.0			-BECOMES DRY	0.0		
	25					
			END OF BORING @ 28' BGS			

PROJECT | HOLE NO.

ENG FORM 1836—APREVIOUS EDITIONS ARE OBSOLETE.
MAR 71

00107601

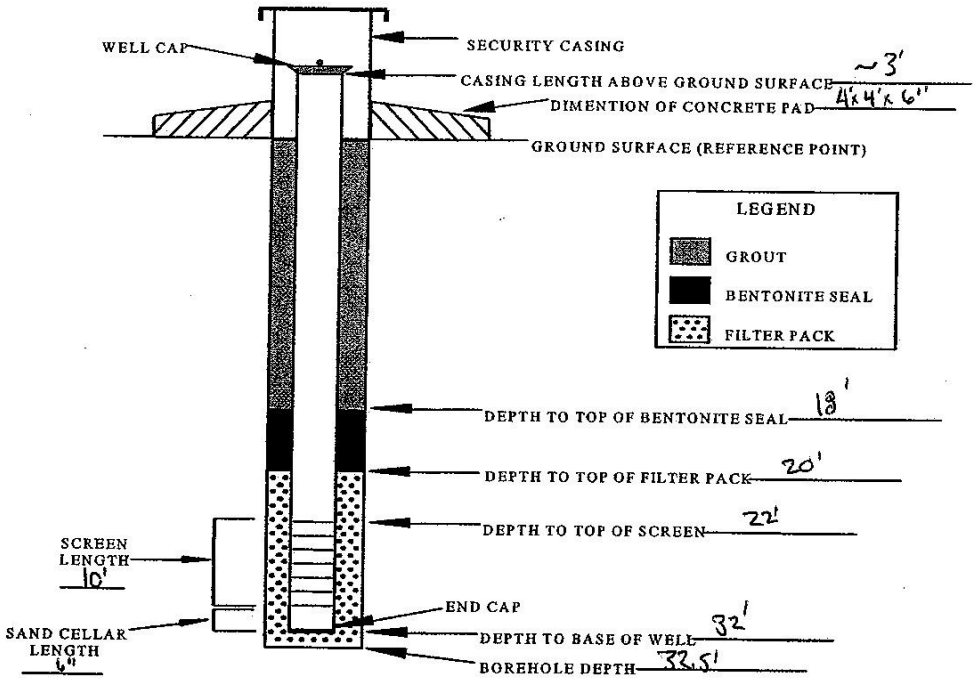
35BWW08

WELL COMPLETION FORM (Stickup or Above Grade Completion Well)

FIELD REPRESENTATIVE: A. Willmore
DRILLING CONTRACTOR: JEDI
DRILLING TECHNIQUE: HSA
AUGER SIZE AND TYPE: 8" Auger
BOREHOLE IDENTIFICATION: 35BWW08
BOREHOLE DIAMETER: 8"
WELL IDENTIFICATION: 35BWW08
WELL CONSTRUCTION START DATE: 9/7/07
WELL CONSTRUCTION COMPLETE DATE: 9/7/07
SCREEN MATERIAL: SCH 40 PVC
SCREEN DIAMETER: 2"
STRATUM-SCREENED INTERVAL (FT): 10'
CASING MATERIAL: SCH 40 PVC
CASING DIAMETER: 2"

TYPE OF FILTER PACK: 20/40 SILICA SAND
GRADIATION: 20/40
AMOUNT OF FILTER PACK USED: 5-50 lb bags
TYPE OF BENTONITE: pellets
AMOUNT BENTONITE USED: ~12.5 lbs
TYPE OF CEMENT: PORTLAND-CEMENT
AMOUNT CEMENT USED: 6- 94 lb bag
GROUT MATERIALS USED: slurry
DIMENSIONS OF SECURITY CASING: 6"x6"
TYPE OF WELL CAP: 2" well plugging cap
TYPE OF END CAP: SCH 40 PVC
COMMENTS:

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: Oscar Garcia - JEDI INSTALLATION OBSERVED BY: Allen Willmore - Shaw

DISCREPANCIES:

00107602

SITE 35B(37)

HOLE NO. 35BWW08

DRILLING LOG	DIVISION: FEDERAL - HOUSTON	INSTALLATION: LHAAP	SHEET OF SHEETS
1. PROJECT: LHAAP		10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinates or Station): KARNACK, TEXAS		11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
3. DRILLING AGENCY: JEDI DRILLING		12. MANUFACTURER'S DESIGNATION OF DRILL: CME 75	
4. HOLE NO. (As shown on drawing title and file number): 35B WW08		13. OVERBURDEN SAMPLES	DISTURBED / UNDISTURBED: YES
5. NAME OF DRILLER: OSCAR GARCIA		14. TOTAL NUMBER CORE BOXES: NR	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED 0° DEG. FROM VERT.		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN: NA		16. DATE HOLE STARTED: 9/7/07	COMPLETED: 9/7/07
8. DEPTH DRILLED INTO ROCK: NA		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE: 32'		18. TOTAL CORE RECOVERY FOR BORING: %	
		INSPECTOR	

ELEVATION PID (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
0.0		CL	CLAY, SANDY, BROWN TO GRAY, DRY, LOW PLASTICITY, SOFT	100%		
0.0	5		- BECOMES LESS SANDY	95%		
0.0	AD					
0.0	10			85%		

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE: NR | Hole No. 35BWW08

PROJECT: LHAAP-TCRC | INSTALLATION: ~~Hdq~~ LHAAP | SHEET OF SHEETS

PID ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	15	CL	SAME AS ABOVE	85%		
0.0				95%		
0.0	20		SAND, SILTY, DENSE, POORLY-SORTED, WET, BROWN TO GRAY			
0.0		SM		90%		
0.0	25			100%		
0.0				100%		

ENG FORM 1836—APREVIOUS EDITIONS ARE OBSOLETE. MAR 71

PROJECT | HOLE NO.

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE: NR | Hole No.: 35BWW08

PROJECT: LHAAP- TTCRC | INSTALLATION: LHAAP | SHEET: OF SHEETS

PID ELEVATION (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
0.0	30	CL	~~CLAY, SANDY, BROWN TO GRAY, MOIST, MEDIUM PLASTICITY, STIFF, NO ODOR~~ @ 9/7/07 SAME AS ABOVE	100%		
0.0	32		CLAY, SANDY, MEDIUM PLASTICITY, STIFF, MOIST, NO ODOR, BROWN TO GRAY	100%		
			END OF BORING @ 32' BGS.			

ENG FORM 1836—APREVIOUS EDITIONS ARE OBSOLETE. MAR 71

PROJECT | HOLE NO.

LHAAP-67 Drilling Logs

00107606

Hole No. G4WW01

DRILLING LOG | DIVISION: USACE. Tulsa | INSTALLATION: LHAAP- Karnack, TX | SHEET 1 OF 2 SHEETS

1. PROJECT	LHAAP - Group IV
2. LOCATION (Coordinates or Station)	
3. DRILLING AGENCY	GPI Inc. - Austin, TX
4. HOLE NO. (As shown on drawing title and file number)	G4WW01
5. NAME OF DRILLER	Amadore Hinojosa
6. DIRECTION OF HOLE	☑ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	Penetrated 23.0'
8. DEPTH DRILLED INTO ROCK	N/A
9. TOTAL DEPTH OF HOLE	23.0 ft below Grade
10. SIZE AND TYPE OF BIT	Auger Bit
11. DATUM FOR ELEVATION SHOWN (HDM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75 / 7 7/8" O.D. HSA / 5' CME Cont Sampler / 11" O.D. HSA
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED: 2 / UNDISTURBED: 0
14. TOTAL NUMBER CORE BOXES	N/A
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED: 12-2-98 / COMPLETED: 12-2-98
17. ELEVATION TOP OF HOLE	
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. SIGNATURE OF INSPECTOR	W. Mac Cikra P.G.

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) Time g
	1–20		Sand - Lt. tan, some Lt. gray & greenish-gray (mottled) fine grained, some sl. silty, poorly sorted - wet/saturated (soft)			5' offset Drill hole (HSA) for Drilling/Sampling installing 4" SS monitoring well (G4WW01)
						* NOTE: See Drilling Log for G4SB01 for Lithologic Descrip. of soils from grade to 19.0' below grade
	19	SP/CL	Silty clay - Lt. tomed. gray, tan & yellowish-orange (mottled) plastic, some fine sand moist - (Stiff)		SS# 1	0930

FORM 1836 R 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT | HOLE NO. G4WW01

00107607

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE | Hole No. G4WW01

PROJECT Group III | INSTALLATION LHAAP - Karnack, TX | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	20 21 22 23	CL	- Silty clay - Lt. gray (some blue-gray), tan and yellowish-orange mottled, streaked and stained, some v. thin black "root-like" structures, plastic, trace to some fine grained sand - moist (stiff)		19.0 to 23.0'	HNu Reading in Sample = 2 ppm
			T.D. @ 23.0 below grade in silty clay @ 0940			Overdrilled hole @ 11" HSA for G4WW01 (5' offset hole from G4SB01) to 22' below grade for GW monitoring well installation Monitoring well completion for G4WW01 Bent Grout 5' to grade Sugar Sand 6' - 5' Bent. Seal 9' to 6' Sugar Sand 10' to 9' Primary Sand (16-30) 22' to 10' 10 - 4" SS screen 22' to 12' T.D. @ 22.0' below grade in silty clay

ENG FORM 1836-A JUN 67 (ER 1110-1-1801) GPO 1980 OF - 628 - 603 | PROJECT LHAAP | HOLE NO. G4WW01

00107608

Hole No. G4WW02

DRILLING LOG	DIVISION USACE-Tulsa	INSTALLATION LHAAP-Kurnock, TX	SHEET 1 OF 2 SHEETS
1. PROJECT LHAAP - Group IV		10. SIZE AND TYPE OF BIT Auger Bit	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
DRILLING AGENCY GPI, Inc. - Austin, TX		12. MANUFACTURER'S DESIGNATION OF DRILL CME-75 / 7 7/8" O.D. HSA / 4" O.D. HSA	
4. HOLE NO. (As shown on drawing title and file number) G4WW02		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 2	UNDISTURBED 0
5. NAME OF DRILLER Amadore Hinojosa		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN 25.0' ft.		16. DATE HOLE STARTED 12-1-98	COMPLETED 12-1-98
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE Penetrated 25' below grade		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Dave Rich DG	

ELEVATION a	DEPTH (Ft) b	USC LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) Time g
	1					5' Offset Drill hole (HSA) for Drilling/ Sampling/Installing 4" SS monitoring well (G4WW02)
	2					
	3					
	4					*NOTE: See Drilling Log for G4SB02 for Lithologic description of soils from grade to 18' below grade.
	5					
	6					
	7					
	8					
	9					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18	SP	- Sand Lt grayish tan (mottled) fine grained sand, some sl. silty, poorly sorted - Wet/ Saturated (soft)	4.8'	SS# 1 18.0' to 23.0'	0930
	19					
	20					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT LHAAP HOLE NO. G4WW02

00107609

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE | **Hole No.** G4WW02

PROJECT: LHAAP - Group IV | INSTALLATION: LHAAP | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV. ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	21	SP	- Sand - Lt gray/greenish-gray and tan (mottled), fine grained, occ SI silty			HNu Reading in Sample = 3+ ppm
	22					
	23				SS# 2, 23.0 to 26.0'	
	24	CL	Silty clay - Lt. gray, Lt. blue-gray, brown, yellowish-orange and tan mottled, streaked, and stained, plastic, trace to some fine sand - Moist (med. stiff)	3.0'		HNu Reading in Sampler = 0 ppm
	25					
	26		T.D. 5' offset hole for G4WW02 @ 26.0' below grade in silty clay @ 0955			Overdrilled 11" HSA for G4WW02 (5' offset hole from G4SB02) to 25' below grade for GW Mon. Well Install.

Monitoring well Completion for G4WW02

Bent. grout	8' to grade
Sugar Sand	9' to 8'
Bent seal (Hyd.)	12' to 9'
Sugar Sand	13' to 12'
Primary Sand (16-30)	25' to 13'
10' SS 4" Screen	25' to 15'

T.D. @ 25' in silty clay

ENG FORM 1836-A JUN 67 (ER 1110-1-1801) GPO 1980 OF - 628 - 603 | PROJECT LHAAP | HOLE NO. G4WW02

00107610

Hole No. G4WW03

DRILLING LOG | DIVISION: USACE - Tulsa | INSTALLATION: LHAAP - Karnack, TX | SHEET 1 OF 2 SHEETS

1. PROJECT: LHAAP - Group II
2. LOCATION (Coordinates or Station):
3. DRILLING AGENCY: GPI - Austin, TX
4. HOLE NO. (As shown on drawing title and file number): G4WW03
5. NAME OF DRILLER: Amadore Landeros
6. DIRECTION OF HOLE: ☑ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: Penetrated 24.0'
8. DEPTH DRILLED INTO ROCK: N/A
9. TOTAL DEPTH OF HOLE: 24.0 Below Grade
10. SIZE AND TYPE OF BIT: Auger Bit
11. DATUM FOR ELEVATION SHOWN (TBM or MSL):
12. MANUFACTURER'S DESIGNATION OF DRILL: CME-75 / 7 1/4" O.D. HSA / 5' CME cont sampler / 11" O.D. HSA
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 2 | UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: N/A
15. ELEVATION GROUND WATER:
16. DATE HOLE: STARTED 12-1-98 | COMPLETED 12-1-98
17. ELEVATION TOP OF HOLE:
18. TOTAL CORE RECOVERY FOR BORING: N/A %
19. SIGNATURE OF INSPECTOR: David W. [illegible] C.K.A. P.G.

ELEVATION a	DEPTH (ft.) b	USC LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1–13					5' offset Drill hole (HSA) for Drilling / Sampling / installing 4" SS monitoring well (G4WW03) * Note = See Drilling Log for G4SB03 for Lithologic Descrp. of soils from grade to 14.0' below grade
	14	SP	- Sand - Lt. gray and tan (mottled) some brown staining, fine grained sand, trace to some silt - wet/saturated (soft)		SS# 1 14.0 to 19.0'	1435
	15	SM				
	16	SP	- Silty sand Lt. gray and tan (mottled), fine grained sand - wet/saturated (soft)	5.0'		
	17–18		- Sand - Lt. to med. gray and tan (mottled), fine grained, trace to some silt zones - wet/saturated (soft)			
	19				SS# 2	
	20					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT: LHAAP | HOLE NO.: G4WW03

00107611

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE | Hole No. G4WW03

PROJECT Group III | INSTALLATION LHAAP - Karnack, TX | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH (ft.) b	USC LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	21	SP	- Sand - Lt. to med. gray, some greenish-gray and tan (mottled), fine grained sand, trace to some silt - Wet/Saturated (Soft)	5.0'	19.0 to 24.0'	HNu Reading insufficient Oppm
	22					
	23	CL	- Silty clay - Lt. to med. gray, some blue gray, tan and yellowish-orange (mottled), plastic, trace to some fine grained sand - moist (V. stiff)			
	24		T.D.@ 24.0' Below grade in silty clay			Overdrilled hole @ 11" HSA for G4WW03 (5' offset hole from G4SB03) to 24' below grade for GW monitoring well installation
	25					Monitoring well completion for G4WW03 ↓ Bent. Grout 7' to grade; Sugar sand 8' to 7'; Bent seal (Hyd.) 11' to 8'; Sugar sand 12' to 11'; Primary Sand (16-30) 24' to 12'; 10' SS 4" screen 24' to 14'; T.D.@24.0' in silty clay

ENG FORM 1836-A JUN 67 (ER 1110-1-1801) GPO 1980 OF - 628 - 603 | PROJECT LHAAP | HOLE NO. G4WW03

00107612

HOLE NO. GTWW-004

DRILLING LOG	DIVISION USACE - Tulsa	INSTALLATION LHAAP	SHEET 1 OF 2 SHEETS
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 8" HSA	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY ETL		12. MANUFACTURER'S DESIGNATION OF DRILL FOREMOST R-5500	
4. HOLE NO. (As shown on drawing title and file number) GTWW-004		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 5	UNDISTURBED 0
5. NAME OF DRILLER Doug Hemts		14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN		16. DATE HOLE STARTED 12-1-09	COMPLETED
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE		18. TOTAL CORE RECOVERY FOR BORING ~1A %	
		19. SIGNATURE OF INSPECTOR Keith Hastad	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1	CL	BROWN SILTY CLAY, SOME GRAY FINE SAND LENSES, STIFF, DRY, ROOTLETS AND ORGANIC MATTER, TRACE GRAVEL, SMALL ROUNDED	22" / 24"	ST1	1330 START WITH 8" HSA TRICONE, WAITING AUGERS. HNU 4 PPM
	2	ML	BROWN SILTY CLAY, STIFF DRY, SOME ROOTLETS, SOME BLACK NODULES, TRACE FINE TO MED ROUNDED GRAVEL.	12" / 12"	ST2	HNU 7 PPM BREATHING ZONE HNU 0 PPM
	3					
	4					1450 RECEIVE CLEAN AUGERS
	5	SM	LT GRAY SILTY FINE SAND, DRY, VERY HARD, SOME FE STAIN, SOME BLACK NODULES AND BLACK MANGANESE STAIN	52" / 60"	CS1	HNU 0 PPM
	6					
	7					
	8					
	9		LT GRAY FINE SAND WITH BROWN MOTTLING, HARD, DRY, DECREASE OF SILT WITH DEPTH, TRACE BLACK NODULES			
	10			60" / 60"	CS2	HNU 0 PPM
	11	SM				
	12					
	13					
	14		LT BROWN WITH GRAY MOTTLING, HARD WET			HNU 0 PPM
	15			60" / 60"	CS3	
	16					
	17		SAME, INCREASE OF CLAY			
	18					LOST AT 17.5

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT | HOLE NO.

00107613

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE — Hole No. 67 MW 04

PROJECT: LHAAP — INSTALLATION: LHAAP — SHEET 2 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	18		LT GRAY, SILTY FINE SAND, HARD, WET, SOME FE STAIN, TRACE BLACK NODULES	60" / 60"	CS4	HNU 0 PPM 1540 DRILL C. AGREES GET WELL IN CLAY. WILL OVER DRILL DOWN TO 21 FT. 21 - 11 FT SCREEN 21 - 9 FT SAND 9 - 7 FT BENTONITE WILL OVER DRILL SAT 12-2-00
	19					
	20		GRAY CLAY, MOIST, HARD, PLASTIC, FE STAINS			
	21					
	22		LT GRAY, SILTY FINE SAND, HARD, WET			
	23		EOB 23 FT			12-2-00 0835 10 IN OD HS AUGER @ SITE. START DRILLING BORE. 0905 START SAND PACK PLACEMENT 0919 START BENTONITE PELLET PLACEMENT

ENG FORM 1836-A JUN 67 (ER 1110-1-1801) GPO 1980 OF - 626 - 603

PROJECT: LHAAP — HOLE NO. 67 MW 04

00107614

Hole No. 67WW05

DRILLING LOG

DIVISION: USACE-Tulsa
INSTALLATION: LHAAP - Karnack, TX
SHEET 1 OF 2 SHEETS

1. PROJECT: LHAAP - Supplemental RI Site 67
2. LOCATION (Coordinates or Station):
3. DRILLING AGENCY: ETTL - Tyler TX
4. HOLE NO. (As shown on drawing title and file number): 67WW05
5. NAME OF DRILLER: Tom Cook
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: Penetrated 27'
8. DEPTH DRILLED INTO ROCK: N/A
9. TOTAL DEPTH OF HOLE: 26' below grade
10. SIZE AND TYPE OF BIT: Auger Bits
11. DATUM FOR ELEVATION SHOWN (TBM or MSL):
12. MANUFACTURER'S DESIGNATION OF DRILL: Mobile B-51 / 5' Cont. sampler (SS = Split Spoon)
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 6; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: N/A
15. ELEVATION GROUND WATER:
16. DATE HOLE: STARTED 11-30-00; COMPLETED 11-30-00
17. ELEVATION TOP OF HOLE:
18. TOTAL CORE RECOVERY FOR BORING: N/A %
19. SIGNATURE OF INSPECTOR: PG

ELEVATION (a)	DEPTH (ft) (b)	USC LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
	1–3	CL	Silty Clay - Med. brown, tan, yellowish-orange and orange-brown - mottled, some roots, plastic, trace to some fine sand throughout - Moist (stiff)	3.8' / 4.0'	SS #1 0.0' to 4.0'	0920 Commenced HSA Pilot hole ± 4¼" I.D. Augers HNu (PID) Calib. to isob. (10.2 eV Lamp) HNu Reading in Sampler = 0 ppm HNu Reading @ Augers = 0 ppm
	4–6		Silty Clay - Lt. brown, Lt. to med. gray-tan, and some orange-brown - mottled streaked, and stained, Lt. gray color inc. with depth, trace to some fine sand throughout - Damp (V. stiff)	4.6' / 5.0'	0927 SS #2 4.0' to 9.0'	HNu Read in sampler = 5 ppm HNu Reading @ Augers = 0 ppm Ambient air = 0 ppm
	7–13		Clayey Silt - Lt. to med. gray, tan, and orange-brown - Mottled, some fine sand, becoming less plastic with depth - Moist (Soft to stiff)	4.3' / 5.0'	0935 SS #3 9.0' to 14.0'	HNu Reading in Sampler = 10 ppm HNu Reading @ Augers = 0 ppm No obvious odor back of rig/reamers Ambient air = 0 ppm
	13		SP sand @ 13.4' below grade			
	14–17	SP	Sand - Lt. gray-tan, and some yellow-orange streaking and staining, U. fine to fine grained, some silt throughout, Some apparent layering/bedding - Wet/saturated (Loose)	5.0' / 5.0'	SS #4 14.0 To 19.0'	HNu Reading in Sampler = 5 ppm HNu Reading @ Augers = 0 ppm
	17–18	SP-SM	Silt content increasing Wet/saturated (Gradational transition with depth)			Ambient air = 0 ppm
	19	SM			1002 SS #5	

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PROJECT: LHAAP

HOLE NO. 67WW05

00107615

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE | Hole No. 67WW05

PROJECT: LHAAP Supplemental RI Site 67 | INSTALLATION: LHAAP - Karnack, TX | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH (Ft.) b	USC LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	21	SM	Silty Sand Lt. gray, tan, and Lt. yellow-orange - mottled, V. fine to fine grained sand, poorly sorted - Wet/Saturated (Loose)	4.2'/5.0'	19.0' to 24.0'	HNu Reading in sampler = 3ppm HNu Read @ Augers = 0ppm No obvious odor back of Rig/ near auger
	22					
	23					
	24					
	25		Silty Clay Lt. gray and Lt. to med blue-gray, Very plastic, trace to some fine sand throughout, Damp to Sl. Moist	3.0'/3.0'	SS #6 24.0' to 27.0'	HNu Reading in Sampler = 2ppm HNu Reading @ Augers = 0ppm Ambient air = 0ppm
	26	CL				
	27		T.D. @ 27.0' in Lt. gray-blue-gray silty clay - rig torquing up			Commenced overdrilling pilot hole with 11" O.D. "plugged" HSA for 4" SS monitor well installation →
	28					
	29		T.D. @ 1023			
	30					- Bent./cement 10' to grade Grout - Bent. seal 13'-10' - Filterpack Sand (20-40) 26'-13' - 4" SS (304) #10 slot screen 26' to 16' T.D. @ 26.0' below grade

ENG FORM 1836-A JUN 67 (ER 1110-1-1801) GPO 1980 OF-628-603

PROJECT: LHAAP | HOLE NO. 67WW05

00107616

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE — **Hole No.** G7WW05

PROJECT: LHAAP Supplemental RI Site G7 | INSTALLATION: LHAAP - Karnack, TX | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH (Ft.) b	USC LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	21	SM	Silty Sand Lt. gray, tan, and Lt. yellow-orange - mottled, V. fine to fine grained sand, poorly sorted - Wet/Saturated (Loose)	4.2'/5.0'	19.0' to 24.0'	HNu Reading in sampler = 3 ppm HNu Read @ Augers = 0ppm No obvious odor back of Rig/near auger
	22					
	23					
	24		Silty Clay Lt. gray and Lt. to med blue-gray, very plastic, trace to some fine sand throughout, Damp to Sl. Moist	3.0'/3.0'	SS #6 24.0' to 27.0'	HNu Reading in sampler = 2ppm HNu Reading @ Augers = 0ppm Ambient air = 0ppm
	25					
	26	CL				
	27		T.D. @ 27.0' in Lt. gray-blue-gray silty clay - rig-torquing up T.D. @ 1023			Commenced overdrilling pilot hole with 11" O.D. "plugged" HSA for 4" SS monitor well installation →
	28					
	29					
	30					- Bent./cement 10' to grade Grout - Bent. seal 13'-10' - Filterpack (20-40) sand 26'-13' - 4" SS (304) #10 slot screen 26' to 16' T.D. @ 26.0' below grade

ENG FORM 1836-A JUN 67 (ER 1110-1-1801) GPO 1980 OF-628-603 — PROJECT: LHAAP — HOLE NO. G7WW05

00107617

DRILLING LOG	DIVISION USACE - Tulsa	INSTALLATION CHARP	SHEET 1 OF 3 SHEETS
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 8 in OD HS / 10 in OD HS	
2. LOCATION (Coordinates or Station) Site 67		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY ETTL		12. MANUFACTURER'S DESIGNATION OF DRILL FOREMOST B-55 O	
4. HOLE NO. (As shown on drawing title and file number) 67WW06(I)		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 10 / UNDISTURBED 2	
5. NAME OF DRILLER DOUG HENTS		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN		16. DATE HOLE: STARTED 11-30-00 / COMPLETED 12-1	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE 51 FT		18. TOTAL CORE RECOVERY FOR BORING n/a %	
		19. SIGNATURE OF INSPECTOR Gail Hackel	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1	CL	BROWN AND GRAY MOTTLED CLAY WITH FINE SAND, WET, FIRM, ROOTS. RUST STAINING	24" / 24"	ST1	1422 START BORING HNU 0 ppm
	2					
	3	ML	GRAY CLAYEY SILT, HARD DRY, RUST STAIN, SOME BLACK NODULES.	12" / 12"	ST2	HNU 0 PPM
	4					HNU 0 PPM
	5	SM	LT GRA FINE SANDY SILT, LOOSE, DRY, NON PLASTIC, SOME RUST STAIN	60" / 60"	CS1	
	6					
	7					
	8					
	9		SAME AS ABOVE			HNU 0 ppm
	10	SM	LT GRAY SAND, FINE, LOOSE, MOIST, TRACE CLAY, ORGANIC MATTER, SOME RUST STAIN	60" / 60"	CS2	
	11					
	12					
	13	SP	LT GRAY CLAYEY FINE SAND, FIRM, MOIST, ORGANIC MATTER			
	14		LT GRAY FINE SAND, loose WET/MOIST, HORIZONTAL BANDS OF RUST STAIN 1 TO 3 mm THICK THROUGHOUT			HNU 0 PPM
	15			37" / 60"	CS3	
	16					
	17					
	18					

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PROJECT LHAAP HOLE NO. 67WW06

00107618

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE | Hole No. 67WW06

PROJECT: LHAAP | INSTALLATION | SHEET 2 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	18					
	19	SP	LT GRAY FINE SAND, LOOSE, WET, HORIZ. TAL, TRACE IRON STAIN	60" / 60"	CS4	HNU 0 ppm
	20					
	21	SP	LT GRAY FINE SAND, LOOSE, WET, TRACE IRON STAIN			
	22					
	23	SC	BROWN AND GRAY MOTTLED CLAYEY FINE SAND, LOOSE WET, IRON STAINS LENSE OF VERY WET SAND			HNU 0 ppm
	24					
	25	SC	BROWN AND GRAY MOTTLED CLAYEY FINE SAND, LOOSE, WET, IRON STAIN	60" / 60"	CS5	
	26					
	27					
	28					
	29		BROWN & GRAY FINE SAND, TRACE CLAY, WET FE STAINING			HNU 0 ppm
	30	SC		60" / 60"		
	31				CS6	
	32					
	33					
	34					HNU 0 ppm
	35		GRAY FINE SAND, TRACE CLAY, WET	60" / 60"	CS7	
	36		BROWN WITH SOME GRAY MOTTLING FINE SAND WET			
	37					
	38					

00107619

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE | Hole No. 67WW06

PROJECT LHAAP | INSTALLATION | SHEET 3 OF 3 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV. ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	38		LIGHT GRAY FINE SAND			
	39	SC	FINE SAND WET, OCCASIONAL IRON STAIN HORIZONTAL BEDDING [illegible] WATER	60" / 60"		HNU 0 PPM
	40					
	41				CS8	
	42					
	43		SAME DENSER PACK TO SAND			1421 AWAITING MOR AUGERS
	44			36" / 36"		1450 START DRILLING Drilling resistance increases. Thought maybe clay
	45				CS9	
	46					
	47					
	48			60" / 60"	CS10	
	49	ML-CL	GRAY SILTY CLAY, DENSE VERY STIFF, DRY, HORIZ. BEDDING LIGHT GRAY FINE SAND BETWEEN LAYERS			
	50					
	51		EOB 51 FT			1520 COMPLETE BORING. PULL AUGERS. COULD BORING W/ 10 IN OD AUGER TO SECURE WELL. WILL OVERDRILL IN MORNING.
						12-1-00 0800 ALL ON SITE. REAM BORING W/ 10 IN OD HS TO 48 FT. WILL INSTALL 10 FT SCREEN (NOT OVERDRILL) 48-38 SCREEN 48-35 SAND, 35-32 BENTONITE, 32-0 GROUT. 0852 INSTALL WELL EQAL WATER ADDED DUE TO HEAV. SAND.

ENG FORM 1836-A (ER 1110-1-1801) GPO 1980 OP-628-603 | PROJECT LHAAP | HOLE NO. 67WW06

00107620

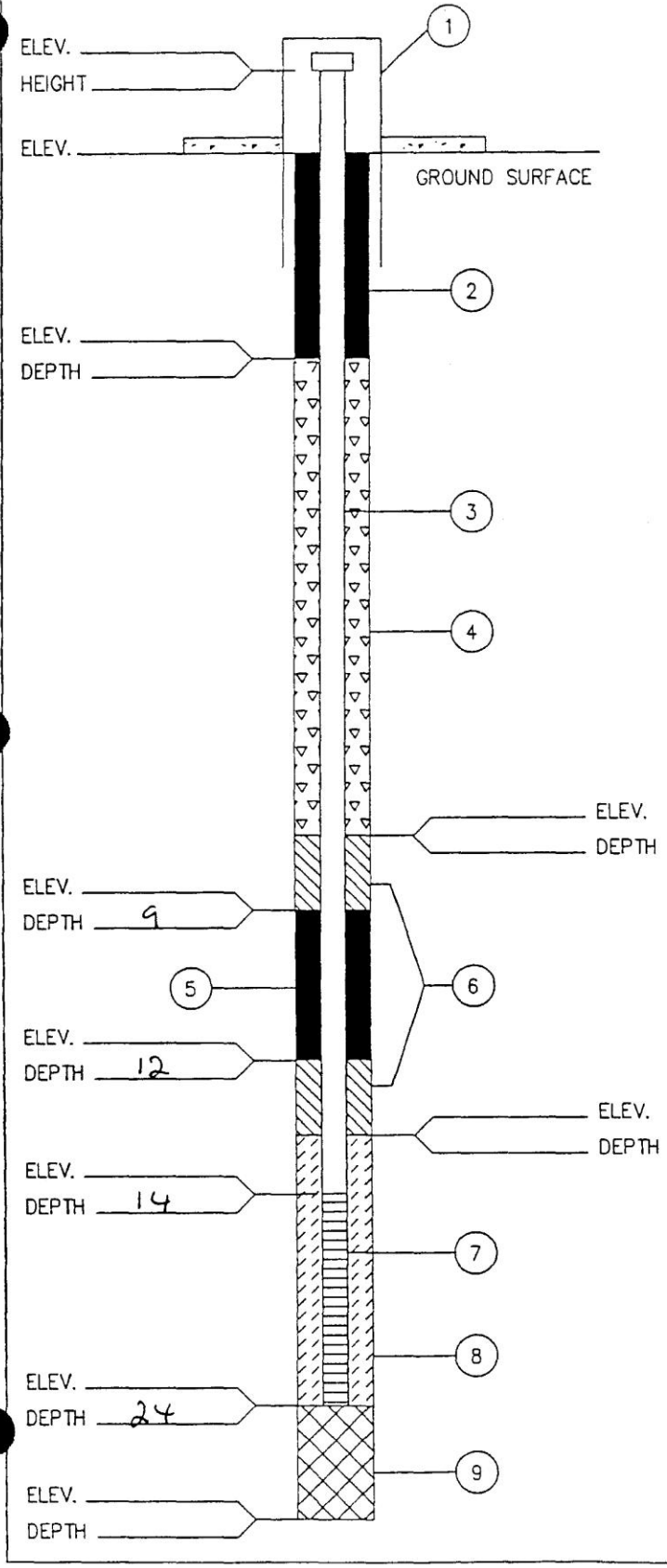
DRILLING LOG	DIVISION USACE	INSTALLATION LHAAP	SHEET 1 OF 1 SHEETS
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT MUD 00 #5	
2. LOCATION (Coordinates or Station) SITE 67		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY ETTL		12. MANUFACTURER'S DESIGNATION OF DRILL FOREMOST B-5500	
4. HOLE NO. (As shown on drawing title and file number) 67WW07(S)		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED — UNDISTURBED —	
5. NAME OF DRILLER Doug Henote		14. TOTAL NUMBER CORE BOXES Ø	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
		16. DATE HOLE: STARTED 12-1-00 COMPLETED 12-1-00	
7. THICKNESS OF OVERBURDEN —		17. ELEVATION TOP OF HOLE	
8. DEPTH DRILLED INTO ROCK —		18. TOTAL CORE RECOVERY FOR BORING N/A %	
9. TOTAL DEPTH OF HOLE 24 FT		19. SIGNATURE OF INSPECTOR Sol. Foster	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			SHALLOW WELL INSTALLED AFTER COMPLETION OF 67WW06. NO LOGGING CONDUCTED. OFF SET 8 FT NORTH OF 67WW06. SEE log for 67WW06 FOR SITE LITHOLOGY.			

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PROJECT LHAAP HOLE NO. 67WW07

00107621



MONITORING WELL CONSTRUCTION INFORMATION

JOB. NO. C5018700

BORING/WELL NO. 67WW07

DATE 12-1-00

CHIEF UNIT Wilcox

1. PROTECTIVE CASING YES NO

LOCKING YES NO

2. TYPE OF SURFACE SEAL (IF INSTALLED)
bentonite

3. SOLID PIPE TYPE 304 S.S.

SOLID PIPE LENGTH 14 ft.

JOINT TYPE SLIP/GLUED/THREADED

4. TYPE OF BACKFILL Cement/bentonite

HOW INSTALLED – TREMIE

FROM SURFACE

5. TYPE OF LOWER SEAL (IF INSTALLED)
bentonite Chip

6. TYPE OF SECONDARY FILTER PACK
NA

7. SCREEN TYPE 304 S.S.

SCREEN LENGTH 10 ft.

SLOT SIZE #10 Wire Wound in.

SCREEN DIAMETER 4" I.D. in.

8. TYPE OF PRIMARY FILTER PACK
20-40 Silica Sand

9. TYPE OF BACKFILL

10. DRILLING METHOD HSA

WATER LEVEL _____ DATE _____

*ALL DEPTHS MEASURED FROM GROUND SURFACE

JACOBS ENGINEERING

Appendix B

Sample Annual Land Use Control Compliance Certification Documentation

Sample Annual Land Use Control Compliance Certification Documentation

In accordance with the Remedial Design Addendum dated _____ for LHAAP-35B(37), a certification of site was conducted by _____ [indicate transferee] on_____.

A summary of land use control mechanisms is as follows:

- Groundwater restriction – [Indicate whether groundwater restrictions are still required at LHAAP-35B(37)]

A summary of compliance with land use and restriction covenants is as follows:

- No use of groundwater, installation of new groundwater wells, or tampering with existing wells at LHAAP-35B(37)

I, the undersigned, do document that the certification was performed as indicated above, and that the above information is true and correct to the best of my knowledge, information, and belief.

Date: _____

Name/Title: _____

Signature: _____

Completed annual compliance certification forms shall be sent no later than March 1 of each year for the previous calendar year.

U.S. Department of the Army
TCEQ
USEPA Region 6

Sample Annual Land Use Control Compliance Certification Documentation

In accordance with the Remedial Design Addendum dated _____ for LHAAP-67, a certification of site was conducted by _____ [indicate transferee] on_____.

A summary of land use control mechanisms is as follows:

- Groundwater restriction – [Indicate whether groundwater restrictions are still required at LHAAP-67]

A summary of compliance with land use and restriction covenants is as follows:

- No use of groundwater, installation of new groundwater wells, or tampering with existing wells at LHAAP-67

I, the undersigned, do document that the certification was performed as indicated above, and that the above information is true and correct to the best of my knowledge, information, and belief.

Date: _____

Name/Title: _____

Signature: _____

Completed annual compliance certification forms shall be sent no later than March 1 of each year for the previous calendar year.

U.S. Department of the Army
TCEQ
USEPA Region 6

Appendix C

Field Activities

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1.0 Common Field Activities

The field activities that may be required at LHAAP-35B(37) and LHAAP-67 are described in the following major tasks. These activities are based on the LHAAP *Final Installation-Wide Work Plan* (Shaw, 2006). Each task is described in the succeeding sections.

Task 1	Mobilization and Site Setup
Task 2	Monitoring Well/Compliance Well Installation
Task 3	Survey of Monitoring Well Locations
Task 4	Groundwater Sampling
Task 5	Soil Sampling
Task 6	Surface Water/Sediment Sampling
Task 7	Investigation-Derived Waste Management

Additional information regarding these activities can be found in **Appendices D-G**. The field procedures described in this document are consistent with those employed previously at the site (Shaw, 2004a,b).

1.1 Task 1 - Mobilization and Site Setup

Prior to the mobilization of subcontractors to the installation, the contractor will inspect drilling locations for overhead and ground level accessibility. In areas that have excessive vegetation and/or tree growth, a backhoe or excavator will be used to clear the areas to allow rig equipment access. After coordinating with underground utility locators for utility clearances, drilling locations and areas that require surface soil removal will be located and staked.

The contractor will mobilize the appropriate personnel, subcontractors, and equipment necessary for the specific task(s). A permanent decontamination station is located at the on-site groundwater treatment plant (GWTP) at LHAAP-18/24 and can accommodate large equipment. Temporary decontamination pads will be constructed at approved on-site locations as needed to decontaminate drilling equipment and prevent cross contamination between sites. The decontamination pad will be approximately 15 feet in length and width, bermed, and covered with high-density polyethylene (HDPE) sheeting. The pad can be constructed in a staging area that can be used between sites. Wash water will be contained and transported to the GWTP for disposal when necessary.

1.2 Task 2 - Monitoring Well/Compliance Well Installation

Monitoring and compliance wells will be drilled and installed using a high-torque-stem auger or mud rotary drill rig depending upon site conditions. Each well will be constructed with flushjoint threaded, schedule 40, polyvinyl chloride (PVC). If necessary, soil samples will be collected continuously using a split barrel core sampler advanced ahead of the drill bit. The soil (or sediment) samples will be described according to American Society for Testing and Materials (ASTM) D2488-00, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), and logged on USACE Engineering

Form 1836 (Drilling Log) or equivalent. Additional details for well installation are found in Attachment 13 of **Appendix D**, Field Procedures.

The monitoring wells will be installed in the annulus of hollow-stem augers. The PVC well screen for each well will be 0.01-inch slotted and 10 feet in length. A threaded PVC bottom cap will be secured to the bottom of the screen interval. Solid PVC casing will be installed from the top of the screen interval to approximately 3 feet above surface grade. A filter pack consisting of clean silica sand (20-40 size) will be placed in the auger-well annulus from approximately 0.5 feet below the well bottom to approximately 2 feet above the screen interval. A 3-foot thick bentonite seal (pellets or chips) will be placed above the sand filter pack and hydrated with potable water. The annular space from the top of the bentonite seal to the surface will be filled with a bentonite-cement grout. The screen length and sealing criteria may be adjusted on a site specific basis.

For the wells installed in the intermediate groundwater zone, the shallow groundwater zone will be isolated using a suitable diameter, schedule 40 steel casing. The casing will be installed from near surface grade to the top of the first confining layer. Upon grouting and setting of the isolation casing, drilling will proceed into the intermediate zone. For any wells installed in the deep groundwater zone, both the shallow and intermediate groundwater zones will be isolated using suitable diameter steel casings for each string.

The drilling equipment will be decontaminated prior to the arrival at the site and between wells. Additional information on decontamination procedures can be found in **Attachment 9** of **Appendix D**. Core samplers will be washed between sampling intervals in a detergent/water solution and double rinsed with tap water in clean buckets. The decontamination wastewater and drill cuttings will be placed in 55-gallon drums and handled as described in Task 7.

Aboveground surface completions will be constructed for each monitoring/compliance well installed (**Appendix D**). The surface completion will consist of protective steel casing, with a hinged, lockable lid set in a concrete pad. Concrete-filled steel bollards will be installed at the corners of the concrete pad.

The monitoring wells and surface completions will be installed in general accordance with USACE and State of Texas requirements by a drilling subcontractor licensed in the State of Texas. At the end of the field work, a State of Texas Well Report will be submitted to the Texas Department of Licensing and Regulations for construction of each well.

1.2.1 Well Development

The newly installed monitoring wells will be developed to remove drilling fines and enhance hydraulic communication between the well and the groundwater zone. The wells will be developed no sooner than 48 hours and no later than 7 days after installation of the well. Well development will be performed by pumping and gentle surging of the screened interval using a rubber-lined surge block. A minimum of three well borehole volumes of water will be removed. The volume of groundwater removed from each well will be calculated from the static water level measurement referenced from the top-of-casing. An

electronic interface probe will be used to measure the water levels. As an alternative to pumping, a bottom-filling bailer may be used to remove water from low-yielding wells. Water quality parameters (temperature, pH, conductivity, and turbidity) of the development discharge water will be monitored. Development will continue until the water quality parameters have stabilized to within 10 percent and the water is visually clear. Additional guidance on well development is provided in **Attachment 3** of **Appendix D**.

A contractor hydrogeologist will supervise well development, and document the development process and measurements in a Well Development Record specific to each well. Downhole development equipment will either be disposed after each use or will be decontaminated prior to and following use at each well location by cleaning in a detergent/water solution and double rinsing with tap water in clean buckets. The development and decontamination wastewater will be placed in 55-gallon drums and handled as described in **Section 1.7**.

1.3 Task 3 - Surveying

A State of Texas-licensed professional land surveyor will survey the locations and elevations of the newly installed monitoring wells. The horizontal coordinates (northing and easting) of the wells will be surveyed to the nearest foot and will be based on the North American Datum of 1983. The vertical elevations of the top of the wells (top-of-casing) will be surveyed to nearest 0.01 feet. The ground surface elevation at each well location will be surveyed to the nearest 0.1 feet. To ensure compatibility with pre-existing well elevations, the top-of-casing for one of the existing wells at each site will be surveyed. If discrepancies are noted, the USACE will be consulted for resolution.

For identifying locations of soil confirmation samples and limits of excavation, either land surveying or Global Positioning System (GPS) may be used. The contractor will coordinate with the USACE prior to the use of GPS.

1.4 Task 4 - Groundwater Sampling

Monitoring wells will be sampled using the low flow method. The only exceptions would be slow recharging wells that go dry or proceed to drawdown significantly whereby equilibrium cannot be maintained. Procedures for purging and sampling the monitoring wells with the low flow method or alternative means are detailed in **Attachment 2** of **Appendix D**. Detailed information on groundwater sampling can also be found in the Chemical Data Acquisition Plan (CDAP) (**Appendix G**). Analytical parameters and the frequency of sampling are discussed in the Groundwater Monitoring Plan, **Appendix A**.

1.5 Task 5 - Soil Sampling

Surface soil is defined as that which exists from the land surface extending approximately one foot bgs. Surface soil samples may be collected during various investigation or remediation activities. Surface soil sampling equipment and procedures are detailed in **Attachment 6** of **Appendix D**.

Subsurface soil samples may be collected during various activities including drilling of soil borings, test pits, or installation of monitoring wells for investigation activities. Soils samples will be collected during drilling activities and will be described according to the ASTM D2488- 00, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Each boring will be logged on USACE drilling forms or equivalent. Soil samples will be screened using an organic vapor monitor (OVA) and headspace readings will be taken and entered on the drilling form. Generally, samples collected for chemical analysis will be from the highest OVA reading, from the first two feet of the boring or well, and at boring terminus unless otherwise specified by the site-specific work plan addendum. More information regarding subsurface soil samples can be found in **Attachment 5** of **Appendix D**.

Test pits may be dug at the facility to fulfill specific objectives relating to site investigations or for confirmation purposes. Generally, test pits will be utilized in order to identify the location of pipelines, the condition of pipelines, and to characterize the surrounding soil to determine if there have been any impacts to the soil during past operations. Additional procedural criteria and sampling protocols will be defined in future addenda to this plan.

1.6 Task 6 - Surface Water/Sediment Sampling

During various phases of work, surface water and sediment samples may be collected to satisfy specific requirements. Using clean disposable gloves, surface water sample bottles should be totally submerged with a slight tilt to effectively fill the bottle without displacing any preservatives, if any. The bottle should be tightly capped immediately after filling. Other sampling equipment may be utilized depending on sample objectives and site conditions (e.g., Kemmerer samplers, etc.). Sampling after a heavy rain is not recommended, since sediments can be stirred up by agitation and the result would not be a representative sample. Sampling should be postponed until better conditions are present. Surface water samples should be collected prior to any sediment sampling at the same location. Additional information regarding surface water sampling can be found in **Attachment 7** of **Appendix D**.

Sediment samples are usually collected in conjunction with a surface water sample, and as close as possible to the location the surface water sample was collected. Sediments should be collected using clean disposable gloves, a decontaminated trowel or shovel to loosen and remove the sediment and placed in a laboratory-supplied soil jar. As with other media, samples should first be collected from the point suspected to be the least contaminated and later from more contaminated points to minimize the risk of cross-contamination (e.g., collection near a pipe outfall should not be the first sample if several samples are planned for the water body).

1.7 Task 7 - Investigation-Derived Waste Management

Wastes generated during installation and sampling of monitoring wells will include drill cuttings; wastewater from equipment decontamination, well development, or purging; and miscellaneous wastes. Management of the waste streams is described below.

1.7.1 Drill Cuttings

Drill cuttings may initially be placed in 55-gallon drums or similar containers, or directly placed in an HDPE-lined roll-off container. Upon completion of each well, drums will be sealed and transported to a staging area. Drill cuttings in drums will be transferred to an HDPE-lined rolloff container if the quantity of drill cuttings is large. Composite samples will be collected from drums or roll-off boxes for characterization before disposal. The procedures for sampling the drill cuttings in drums or roll-offs are detailed in the CDAP (**Appendix G**). A procedure for handling of investigation-derived waste is presented in **Attachment 10** of **Appendix D**.

Following characterization, drill cuttings will be disposed on site if they are determined to be non-hazardous. The cuttings will be transported to a permitted landfill if they are determined to be hazardous.

1.7.2 Wastewater

Wastewater generated from equipment decontamination, well development, sampling, and purging activities will be stored in 55-gallon drums or larger containers. Containers will be transported to the GWTP at LHAAP-18/24 for disposal and will be released in the influent stream of the plant.

1.7.3 Miscellaneous Wastes

Miscellaneous wastes include spent personnel protective equipment, HDPE sheeting, rags, paper towels, etc. These wastes will not be characterized and will be placed in plastic bags for disposal as municipal solid waste.

1.8 Task 8 - Well Abandonment

The abandonment procedures used at a site are dependent upon specific regulatory requirements and generally fall into two different methods – abandonment of the well in place or removal of the well and associated materials from the aquifer. Abandonment in place will be considered when contamination cannot enter from the surface and cross-contamination cannot occur between various zones. In other circumstances, removal of the well materials will be implemented by overdrilling the well casing using a

hollow stem auger drill. The auger is centered over the casing with the center plug and pilot bit removed, or a small guide plug is inserted in the casing, guiding the drill string downhole and bringing well completion materials to the surface.

Several goals should be met while conducting well abandonment activities. These include the prevention of vertical migration of fluids in the borehole and prevention of intermixing of waters from different water-bearing zones. In addition, any physical hazards that may be present, such as an open borehole, should be eliminated after conducting well abandonment procedures. Lastly, well abandonment activities should be conducted in such a way to preserve aquifer properties. Additional information is in **Appendix D**, Attachment 11, Monitoring Well and Borehole Abandonment.

2.0 Site Restoration and Demobilization

Following completion of remediation activities, the contractor will restore the site and demobilize. Disturbed areas will be graded, if necessary, for proper drainage and reseeded with native vegetation. Equipment and personnel will be demobilized from the project site immediately following completion of field operations. Equipment will be decontaminated before leaving the site.

3.0 Safety and Health

The Health and Safety Plan (HASP) defines and establishes the policies and procedures that protect workers and the public from potential hazards posed by planned project activities during this installation-wide investigation and remediation effort at LHAAP. The HASP incorporates health and safety policies and safe operating procedures for individual project site activities proposed under this contract. These procedures allow work activities to be carried out in a controlled, effective manner.

Prior to initiating work at the facility for any site, workers will have signed the HASP in the designated area to indicate they have read and understood the document. Also, daily safety meetings will be held with all field crew members prior to starting work each day in order to review the day's scope of work, any site conditions expected, and any hazards that need to be addressed or acknowledged. The HASP is in **Appendix E**.

4.0 Quality Assurance/Quality Control

The Contractor Quality Control Plan in **Appendix F** provides additional information on QA/QC procedures. This plan identifies personnel, procedures, controls, instructions, tests, verifications, documents, and forms to be used and what type of records to be maintained. The USACE Three-Phase QC process will be used to enforce QA/QC requirements and include preparatory inspections, initial inspections, and follow-up inspections. The three phases of inspections will target each definable feature of work during execution of project activities.

The contractor will coordinate with the USACE to meet the requirements of the Quality Assurance Surveillance Plan (QASP). The QASP, developed by the USACE, will incorporate key quality control activities that the USACE will use to assess progress toward milestones as described in the PWS.

5.0 References

ASTM International, 2003, ASTM D2488-00, *Standard Practice for Description and Identification of Soils,* West Conshohocken, PA 19428-2959.

Jacobs Engineering Group (Jacobs), 2001, *Final Remedial Investigation Report for the Group 2 Sites (Sites 12, 17, 18/24, 29, and 32) at Longhorn Army Ammunition Plant, Karnack, Texas,* St. Louis, Missouri, April.

Jacobs, 2002, *Final Remedial Investigation Report Volume 1: Report for the Group 4 Sites, Sites 35A, 35B, 35C, 46, 47, 48, 50, 60, and Goose Prairie Creek, Longhorn Army Ammunition Plant, Karnack, Texas*, Oak Ridge, Tennessee, January.

Shaw Environmental, Inc. (Shaw), 2004a, *Final Work Plan, Installation-Wide Background Study, Longhorn Army Ammunition Plant, Karnack, Texas*, Houston, Texas.

Shaw, 2004b, *Final Work Plan, Groundwater Data Gaps Investigation, Groups 2 and 4, Longhorn Army Ammunition Plant, Karnack, Texas*, Houston, Texas.

Shaw, 2005, *Draft Project Management Plan for Site Closure of Multiple Sites, Longhorn Army Ammunition Plant, Karnack, Texas*, Houston, Texas.

Shaw, 2006. *Final Installation-Wide Work Plan, Longhorn Army Ammunition Plant, Karnack, Texas*, Houston, Texas.

Appendix D

Field Procedures

List of Attachments

Attachment 1	Collection and Field Screening of Soil Samples
Attachment 2	Groundwater Sampling
Attachment 3	Well Development
Attachment 4	Groundwater Level Measurements
Attachment 7	Surface Water Sampling
Attachment 8	Non-Hazardous Sample Handling, Packaging and Shipping
Attachment 9	Field Equipment Decontamination
Attachment 10	Investigation Derived Wastes
Attachment 11	Monitoring Well and Borehole Abandonment
Attachment 13	Monitoring Well Installation Procedures

Attachment 1

Collection and Field Screening of Soil Samples

SHAW STANDARD OPERATING PROJECT PROCEDURE

LONGHORN ARMY AMMUNITION PLANT

ATTACHMENT 1

Subject: COLLECTION AND FIELD SCREENING OF SOIL SAMPLES

1.0 PURPOSE AND SUMMARY

This Standard Operating Project Procedure (SOPP) establishes guidelines and procedures for use by field personnel in collection and field screening of hand-augered, grab, and sleeve-lined split-spoon soil samples from surface or subsurface soils, or sediments.

The use of field screening methods for hand-augered, grab, or sleeve-lined split-spoon samples allows field teams to develop a general understanding of contaminant profiles with the objective of optimizing confirmation sampling activities. Consistent sampling procedures help to ensure uniformity of results and to reduce either false positives or negatives.

2.0 TABLE OF CONTENTS

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  3.2 Field Team
3.1 Site Contractor Quality Control Systems Manager (CQCSM)
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  5.1 Required Records and Forms
  5.2 Required Material, Equipment, or Supplies
  5.3 General Requirements
  5.4 Specific Requirements for Hand Augering
  5.5 Specific Requirements for Split-Spoon Sampling
  5.6 Records
6.0 Exception Provision
7.0 Cross Reference
8.0 Tables
9.0 Attachments

3.0 RESPONSIBILITY MATRIX

3.1 Site Manager

The Site Manager or Field Team Leader, is responsible for ensuring that field activities are completed to meet the project objectives, are conducted in accordance with the project plans and requirements, and all activities are performed according to the respective procedures. This will be accomplished by staff training, by maintaining quality assurance/quality control (QA/QC), and proper documentation.

3.2 Field Team

All members of the field team (samplers, technicians, field geologists, engineers, etc.) are responsible for understanding and implementing this field procedure as well as ensuring all team members also perform work in accordance with this procedure.

3.3 Site Contractor Quality Control Systems Manager (CQCSM)

The site CQCSM is responsible for ensuring that this procedure is correctly implemented and that data collected meet the requirements of the project work plan.

4.0 DEFINITIONS

En Core® Sampler. A disposable volumetric sampling device used for collecting, storing and delivery of a soil sample.

Hand Auger. A hand-operated device used for collecting shallow subsurface soil samples. Several types of hand augers are available: screw-type augers, barrel augers, tube type augers, and hand-held power augers. The basic operation of a hand auger involves turning the auger repeatedly while applying pressure so that it goes down into the soil. Soil samples are collected either from the cuttings (screw-type) or the barrel (barrel or tube-type) of the auger.

Split Spoon Sampler. The split-spoon sampler consists of two split-barrel halves, a drive shoe, and a sampler head containing a ball 'n check valve, all of which are threaded together. The sampler is commonly 2 to 3 inches in outside diameter and 2-feet in length. The sampler is threaded to a driving rod and either pushed or hammered into the ground to obtain a soil sample.

5.0 TEXT

5.1 Required Records And Forms

1. Field Activity Daily Log (FADL)
2. Sample labels and chain-of-custody forms
3. Sample collection log (SCL)
4. Material safety and data sheets (MSDS).

5.2 Required Materials, Equipment, Or Supplies

1. Indelible black-ink pens and markers
2. Personal protective clothing and gear
3. Gloves, nitrile
4. Keys for locking well caps
5. Paper towels
6. Radio, two-way, hand held or cellular phone
7. Safety glasses with side shields
8. Hard hat
9. Aluminum Foil
10. Portable organic vapor detector (i.e., photoionization detector [PID] or flame ionization detector [FID])
11. Clean stainless steel spoon or spatula

12. Certified clean glass sample container or zip-top type bags
13. End caps, and Teflon® tape
14. Stainless steel, brass, Lexan® or Teflon® inserts (liners) for split-spoons. Liners must be sized appropriately for the diameter of the split spoon used.

5.3 General Requirements

The collection of field-screening samples can be accomplished by several types/sizes of sampling devices (e.g., hand auger, Geoprobe sampler system, or split-spoon samplers). However, the greater the number of analyses to be performed in the field, the greater the volume of soil that will be required for on-site and potential off-site laboratory analyses. The following procedures outline the collection methods from three of the most common sample retrieval devices that allow for both on-site and off-site analyses.

1. Verify that all personnel have read and understood the approved site-specific health and safety plan and have the proper training and certifications required under OSHA.

2. Sample locations are to be marked and proper utility clearances obtained prior to sampling event.

3. Verify the site location by existing maps and surface features. Mark off the boundaries of the work site with flagging or other means to prohibit access to unauthorized personnel.

4. Check to see that all the necessary equipment (including PPE) is available at the site, is in good working condition, and has been properly decontaminated.

5. Check that all monitoring equipment is properly calibrated and operating.

6. The use of biochemical field devices (e.g., immunoassay kits) may be used to augment the field screening for total petroleum hydrocarbons and specific VOCs.

7. Dispose of the soils/sediment and containers as stated in the Work Plan and Attachment 10 of Appendix D, Investigation Derived Waste.

5.4 Specific Requirements for Hand Augering

1. Follow the general procedures for collection of subsurface soil samples as defined Attachment 5 of Appendix D, Subsurface Soil Sampling.

2. Using gloved hands and spatula/spoon, fill either a clean container or zip-top bag approximately one-half to two-thirds full with soil/sediment and tightly seal the zip-top type bag or tightly cap the clean container with a piece of aluminum foil.

3. Properly identify the sample.

4. Allow the sample to set for approximately 15 min in a warm environment (e.g., the sun or a heated car).

5. Pierce the aluminum foil or the zip-tip type bag with the sample probe of the organic vapor detector and record the highest initial reading from the container's headspace on the FADL.

5.5 Specific Requirements for Split-Spoon Sampler (24-inch or 5-foot [CME])

1. Follow the general procedures for collection of subsurface soil samples as defined in Attachment 5. The split-spoon sampler may be used when a large volume of soil is needed for samples or an extra liner is needed for lithologic description.

2. Place the liners in the split spoon as illustrated in the attached diagram (**Figure 1**). Prepare labels, or label the liners, with all pertinent sampling information and liner designations.

3. Collect soil sample following Attachment 5.

4. Take appropriate hand-held meter measurements (PID or FID) from the ends of liners and record on the FADL.

5. If all liners have approximately the same PID/FID readings, seal liners C1 and C2 (see Fig. 1) with Teflon tape and end caps. If a particular liner section has a significantly higher PID/FID reading, this liner should be selected as the off-site VOC sample.

6. Extrude total petroleum hydrocarbons (TPH) sample from liner B for on-site laboratory analysis, if necessary. If there is no TPH analysis, proceed to next step.

7. Collect additional sample volume for other on-site analyses [e.g., metals or semivolatile organic compounds (SVOCs)] from liner D and place in the appropriate container for shipping to the on-site laboratory. Cap liners A, B, and D with Teflon tape and end caps. Liner A, the topmost liner, may contain slough from the previous sample run's drilling activities. Use liner A only if there is insufficient sample volume and collect from the bottom of the liner first. Place liners A, B, and D and C2 in plastic bags and store on ice in coolers.

8. Field-screening analysis must be completed before a decision can be made on whether the stored liners (i.e., A, B, D, and C2) are to be sent to the off-site laboratory for analysis, archived for future use, or discarded. The decision to send samples to the off-site laboratory must be consistent with the decision criteria set forth in the SFSP and the samples must arrive at the laboratory at least 5 working days before the holding times expire.

9. If samples are to be sent to the off-site laboratory, remove the necessary sample volume from liners A, B, and D, composite the samples, and place in appropriate

containers for shipment to laboratory. Ensure each sample is clearly labeled. A liner from which on-site samples were collected will not be shipped.

10. If samples are to be archived or discarded, procedures must be consistent with those set forth in the SFSP or work plan.

5.6 Records

All information will be recorded in the FADL for the subject site. The FADL entries will be recorded chronologically and the time of the entry recorded first. All FADL continuation pages will be sequentially numbered and the last page recorded for the day will be signed and dated by the recording technician.

Records generated as a result of this SOPP will be controlled and maintained in the project record files.

6.0 EXCEPTION PROVISIONS

Headspace analysis is limited by potential loss of volatile organic compounds during method execution.

7.0 CROSS REFERENCE

Attachment 5 - Subsurface Soil Sampling
Attachment 9 - Field Equipment Decontamination

Annual Book of ASTM Standards, *Standard Guide for Soil Gas Monitoring in the Vadose Zone*, D5314.

HAZWRAP, 1996. *Document No. DOE/HWP-100, Standard Operating Procedure 2A and 2B, Collection and Field Screening of Hand-Augered and Grab Samples and Sampling and Field Screening of Sleeved Soil Samples.*

8.0 TABLES

None

9.0 ATTACHMENTS

Figure 1 - Lining the Split-Spoon Sampler
Figure 2 – Field Activity Daily Log

Figure 1

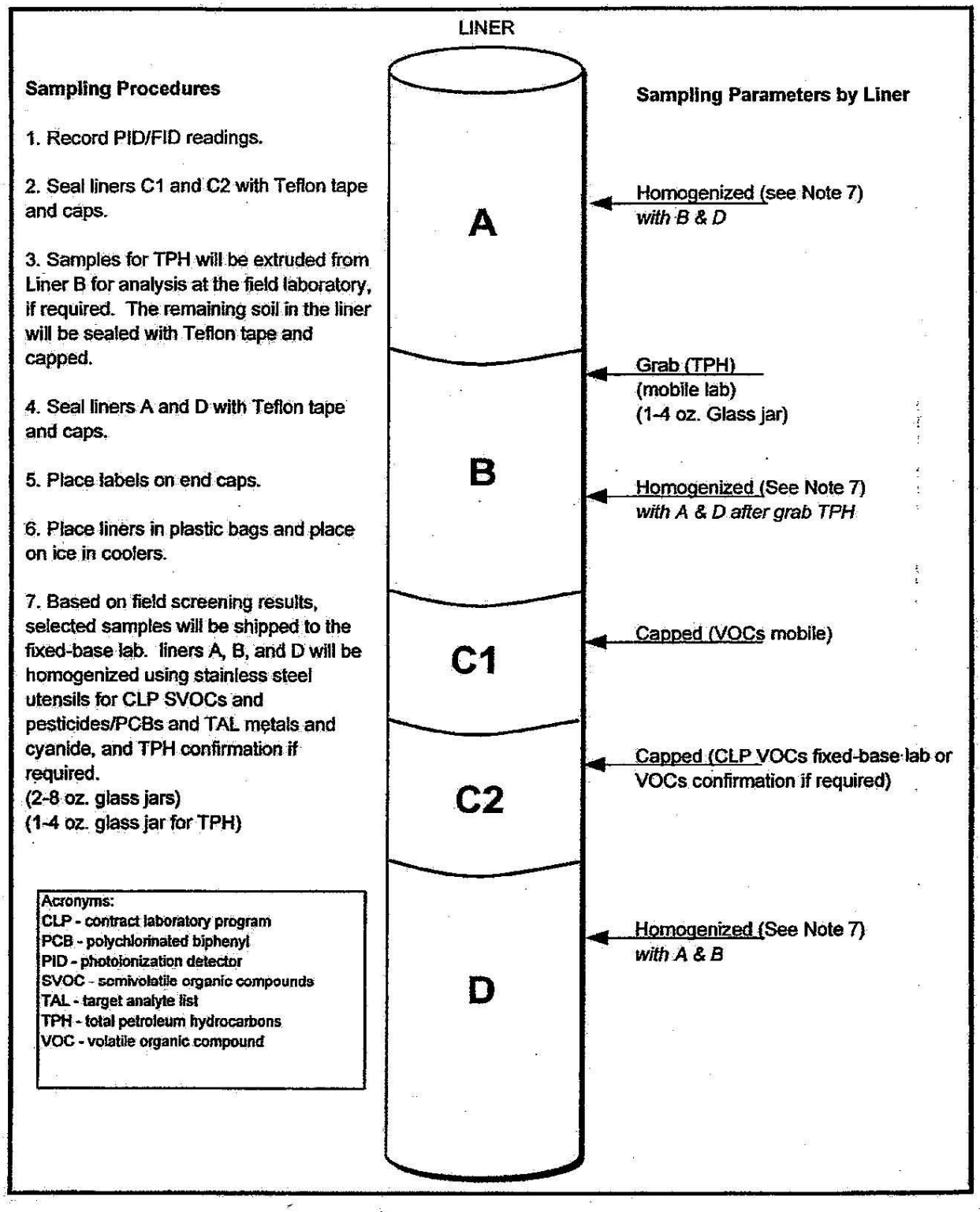

LINER
Sampling Procedures
1. Record PID/FID readings.
2. Seal liners C1 and C2 with Teflon tape and caps.
3. Samples for TPH will be extruded from Liner B for analysis at the field laboratory, if required. The remaining soil in the liner will be sealed with Teflon tape and capped.
4. Seal liners A and D with Teflon tape and caps.
5. Place labels on end caps.
6. Place liners in plastic bags and place on ice in coolers.
7. Based on field screening results, selected samples will be shipped to the fixed-base lab. liners A, B, and D will be homogenized using stainless steel utensils for CLP SVOCs and pesticides/PCBs and TAL metals and cyanide, and TPH confirmation if required.
(2-8 oz. glass jars)
(1-4 oz. glass jar for TPH)
Acronyms:
CLP - contract laboratory program
PCB - polychlorinated biphenyl
PID - photoionization detector
SVOC - semivolatile organic compounds
TAL - target analyte list
TPH - total petroleum hydrocarbons
VOC - volatile organic compound
A
B
C1
C2
D
Sampling Parameters by Liner
Homogenized (see Note 7) with B & D
Grab (TPH) (mobile lab) (1-4 oz. Glass jar)
Homogenized (See Note 7) with A & D after grab TPH
Capped (VOCs mobile)
Capped (CLP VOCs fixed-base lab or VOCs confirmation if required)
Homogenized (See Note 7) with A & B

Figure 2

Shaw
Shaw Environmental & Infrastructure, Inc.

DAILY LOG	
	DATE:
	NO.
	SHEET OF

FIELD ACTIVITY DAILY LOG

PROJECT NAME	PROJECT NO.
FIELD ACTIVITY SUBJECT:	
DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:	

Attachment 2

Groundwater Sampling

SHAW STANDARD OPERATING PROJECT PROCEDURE

LONGHORN ARMY AMMUNITION PLANT

ATTACHMENT 2

Subject: GROUNDWATER SAMPLING

1.0 PURPOSE AND SUMMARY

This Standard Operating Project Procedure (SOPP) establishes guidelines and procedures for use by field personnel in sampling monitoring well groundwater.

A consistently implemented groundwater sampling procedure will help ensure data comparability between different sampling events and between sites. One of the following methods shall be used to collect groundwater samples. The method to be used shall depend upon the site conditions or requirements of the work plan. The low-flow method shall be used unless other methods are specified or approved for special circumstances.

(a) Low-flow purge and sample using a submersible bladder pump.
The method involves purging the well at low-flow rates until water quality parameters stabilize or are within acceptable ranges, and collecting the sample at the same low flow rates. This method should be used by default unless the site conditions or the work plan require using a different method. A bladder pump is preferred for low flow sampling; however, other pumps (e.g., peristaltic pump) may be acceptable depending upon the objective of the sampling.

(b) Volume purge and sample using a bailer or submersible pump.
The method involves purging a fixed number of well volumes using a bailer or submersible pump. Purging is continued until at least 3 well volumes are purged and the parameters have stabilized. This method shall be used in lieu of the low-flow method, only if warranted by the site conditions (e.g., exceptionally low recharge rate). A bailer may be used for collecting sample from a well that goes dry even at the slowest pumping rate during low-flow purging. In such a case, the well is pumped dry and sample is collected with a bailer within 24 hours. This method shall be used only if specified in the work plan or approved by a task manager or the technical lead.

The low-flow purge and sample method shall be used as a default method for collecting groundwater samples for chemical analysis. The use of method (b) will be restricted only to special circumstances, either if specified in the work plan or if warranted by site conditions. If site conditions warrant the use of method (b), prior approval from the technical lead is required and the approving person must be identified in the sample collection log.

1.1 Low-Flow Purge and Sample

Introduction. The low-flow (minimum drawdown, micropurging) sampling method is based upon the premise that a pump located within the screened interval of a well and pumping at a rate corresponding to the hydraulic conductivity of the formation, will rapidly establish a horizontal laminar flow of groundwater and withdraw fresh

formation water without significant mixing or dewatering of the stagnant casing water in the well (U.S. Army Corps of Engineers, 1995). The low flow method aims to minimize well water turbidity which may be caused by resuspension of well sediments or additional development of the formation during high speed pumping.

Establishment of a low flow regime will be ensured by carefully monitoring the drawdown because excessive drawdown indicates that the pump is withdrawing stagnant casing water. The maximum drawdown allowed will be 0.3 feet (4 inches). During purging, the flow rate will typically be maintained within the range of 0.1-0.5 liter/minute (L/min). The flow rate will be decreased further if the drawdown exceeds 0.3 feet. Flow rates up to 1 L/min may be used in purging some high yielding residuum aquifers, if the drawdown remains within the allowable limit of 0.3 feet. Flow rates greater than 1 L/min may be allowed in bedrock wells where the well may be screened across a cavity, with the limitation of the maximum drawdown. However, the flow rate in all cases must be slowed down to 0.1 to 0.3 L/min during sampling to prevent turbulence and aeration of water.

If excessive drawdown is noted using the lowest possible pump rate, then the low-flow method is not applicable. In such a case, the well will be pumped dry once and sample will be collected with a bailer as soon as adequate quantity of water for samples is available.

2.0 RESPONSIBILITY MATRIX

2.1 Site Manager

The Site Manager or Field Team Leader, is responsible for ensuring that field activities are completed to meet the project objectives, that they are conducted in accordance with the project plans and requirements, and that all activities are performed according to the respective procedures. The Site Manager is responsible for ensuring that all site personnel are trained in the procedures, that the procedures are adhered to, and that all activities are documented.

2.2 Field Team

All members of the field team (samplers, technicians, field geologists, engineers, etc.) are responsible for understanding and implementing this field procedure as well as ensuring that all team members also perform work in accordance with this procedure.

3.0 DEFINITIONS

Bailer. A bailer is an enclosed cylindrical tube containing a floating ball check-valve at the bottom. Lowering the bailer into water causes the ball to float allowing water to enter the cylinder. Raising the bailer through the water causes the ball to settle, creating a seal to trap the water so that it can be brought to the surface.

Bladder Pump. A bladder pump is an enclosed cylindrical tube containing a flexible membrane bladder. Well water enters the bladder through a one-way check-valve at the bottom. Gas is forced into the annular space (positive displacement) surrounding the bladder through a gas supply line. The gas displaces the well water through a one-way check-value at

the top. The water is brought to the surface through a water discharge line. The gas (air or nitrogen) is provided by compressors or compressed gas cylinders.

Peristaltic Pump. A peristaltic pump is a self-priming, low volume pump consisting of a rotor and ball bearing rollers. Tubing placed around the rotors is squeezed by the rotors as they revolve. The squeezing produces a wavelike contractual movement which causes water to be drawn through the tubing. The peristaltic pump is limited to sampling at depths of less than 25 feet.

Purging. The process of evacuation of the static water in the monitoring well to allow formation water to flow into the well. The aim of purging a well before sampling is to obtain a sample that is representative of the groundwater in the soil or rock formation. Purging can be accomplished either by utilizing low-flow purge or volume purge methods. In the low-flow purge method, water is pumped at a slow rate to establish a horizontal laminar flow to draw water from the formation without drawing in the stagnant casing water. Volume purge involves evacuating 3-5 well volumes of water to ensure that all stagnant water has been removed from the well.

Water Quality Parameters. Chemical and physical properties of groundwater measured during purging and sampling to ensure that a representative groundwater sample has been collected and to document the ambient subsurface conditions at the time of sampling. The parameters normally measured include pH, Eh, temperature, dissolved oxygen, conductivity, and turbidity. The measurements are made at specified intervals and documented in appropriate sample collection logs completed in the field.

4.0 PROCEDURE

4.1 Required Records And Forms

1. Groundwater Sampling Log (Attachment 1.0)
2. Chain-of-Custody Form
3. Sampling and Analysis Plan
4. Material Safety Data Sheets (MSDS)
5. Field Activity Daily Log (FADL).

4.2 Required Materials, Equipment, Or Supplies

The following supplies are required for low-flow purge and sample method. Other supplies as needed in addition or in-lieu of those listed below are specified in respective sections.

1. Personal protective equipment (PPE) as required by the site-specific health and safety plan
2. Calculator
3. Decontamination solutions; nonphosphate detergent, rinse water, deionized water
4. Compressor, air
5. Container, 1-gal clear glass
6. Controller Box
7. Cooler with ice and packing materials
8. Cylinder, graduated, 2-liter

9. Drum, 55-gallon
10. Filters, high capacity, in-line sample filter, 0.45 micron
11. Filtration units, (disposable) and hand-operated vacuum pump (if needed in-lieu of in-line filtration)
12. Flow-through cell or equivalent
13. Gasoline
14. Gloves, nitrile or latex
15. Keys for locking well caps
16. Labels, sample bottles
17. Litmus paper or pH indicator strips
18. Paper towels
19. Pens, waterproof
20. Pipettes
21. Pump, bladder
22. Radio, two-way, hand-held or cellular phone
23. Safety glasses with side shields
24. Sample containers
25. Sheeting, polyethylene
26. Steel tape, weighted
27. Stop watch
28. Thermometer
29. Photoionization Detector (PID)
30. Trash bags, large plastic
31. Trash can, 32-gallon plastic
32. Tubing, Teflon®-lined polyethylene discharge bundled with polyethylene air tube
33. Water Level Indicator.

4.3 General Requirements

Decontamination:

1. All field sampling equipment (pump, bailer, water discharge tubing, support cables, water level indicator, flow-through cells, etc) likely to come in contact with the sampled groundwater shall be decontaminated before and after each use or between wells. The pump shall be initially dissembled and decontaminated. Refer to the decontamination SOPP for complete procedures.

2. The water discharge tubing shall then be attached and the pump used to twice circulate detergent solution followed by potable water and deionized water rinses. Only Teflon® or Teflon®-lined tubing shall be reused after decontamination. Polyethylene or tygon tubing shall be discarded after each use and shall not be decontaminated for reuse.

Other Requirements

3. Provide shade for the spooled tube when a sampling event occurs during summer months in full sun. Otherwise, the tube may act as an effective heater, warming the groundwater sample and creating a potential for volatilization.

4. The portable generator/compressors shall be placed downwind from the well being sampled.

5. Store field parameter measurement "instruments" in shade during transportation and at the sampling site. The instruments may give inaccurate readings if left under full sun.

6. To the extent possible, groundwater sampling shall be conducted so as to sample upgradient, presumably "clean" wells first.

7. All personnel involved in sampling shall wear appropriate health and safety clothing and gear, including clean nitrile gloves, in accordance with the site-specific health and safety plan.

8. In order to minimize turbidity in the well, pump and tubing assemblages shall be lowered into the well as slowly as possible to minimize turbidity.

4.4 Specific Requirements for Low-Flow Sampling

Follow steps given below:

Pump Installation

1. Measure the static water level and the total well depth with an electric water level indicator.

2. Based on the well design information, subsurface geology, and the measured water level, determine the location of the pump intake using the guidelines given below:

   a. If a zone with a relatively high hydraulic conductivity (K) is present in the screened interval, place the pump intake within this zone. A high K zone may be a sandy or gravel unit within an overall clayey unit or a fracture zone within the bedrock. If the high K zone is near the bottom of the screen, the pump intake should be as much above the well bottom as possible.

   b. If a high K zone is not present and the screen is completely submerged, place the pump intake near the middle or slightly above the middle of the screen.

   c. If a high K zone is not present and if the water level is below the top of the screen, place the pump near the middle of the water column. The pump intake should be as much above the well bottom as possible.

3. Connect the safety cable, discharge tube, and air tube to the bladder pump. The discharge tube will be Teflon®-lined polyethylene and its length will be appropriate for the well being sampled. For example, a 100-foot long tube may not be used in sampling a 30-foot deep well; instead a 50-foot length will be used.

   Using an appropriate length of tube will minimize the amount of decontamination fluids generated and lessen the opportunity for chemical and physical changes in the water due to contact with the spooled tube.

4. Gently lower the pump to the appropriate sampling depth so as to minimize mixing of stagnant casing water with the screen water and resuspension of bottom sediments. Secure the pump at the desired depth by clamping the support cable to the 4-inch non-locking well cap.

5. Lower an electric water level indicator (with an audio and visual alarm) again into the well, measure and record the water level. The water level may be temporarily elevated because of the insertion of the pump into the well. Wait for a few minutes until the water level returns to the static level.

6. Make proper connections for the pump. Attach the air supply line to the pump controller. Connect the pump discharge tube to a "T" insert with a valve. Connect two sections of Teflon® -lined tube to the two remaining ends of the "T". Connect one tube to the flow through cell of the water quality meter and place the discharge from the flow cell into the purge water container. The third tube from the "T" will be used for sample collection.

7. Calibrate water quality meters and place probes into the flow through cell.

8. Measure the water level in the well. Secure the water level probe 0.3 foot (4 inches) below the water level and keep the instrument on.

9. Start the pump at the lowest setting. Gradually increase the flow rate.

10. Constantly monitor the drawdown as the flow rate is increased. If the drawdown exceeds 0.3 foot, indicated by visual or audio alarms on the water level indicator, decrease the flow rate appropriately.

11. Monitor the pump flow rate in mL/min using a stop watch and a graduated measuring cylinder. The targe flow rate is 100 to 500 mL/min (0.1 to 0.5 L/min), which may be increased in the case of a rapid recharging well to 1 L/min (residuum well) or greater (bedrock well), with the maximum drawdown limitation of 0.3 foot.

12. Measure water quality indicator parameters every 3 to 5 minutes. The parameters and their tolerance limits are provided in **Table 1** and discussed further in a subsequent section. The measurements shall be recorded on the groundwater

sampling form. All measurements shall be recorded in units shown on the form. If measurements are made in different units, these units must be clearly shown on the form.

13. Once water quality indicator parameters stabilize (four consecutive readings within acceptable variability), turn the valve at the "T" junction so that the water is diverted from the flow cell to the tube designated for sample collection. Collect samples at 100 to 500 mL/min purging rate.

    A bailer should be used for sampling in the case where a well is extremely slow to recharge (i.e., the recovery rate is below the minimum possible pump rate) and has to be pumped dry. Follow the procedures given below under these circumstances.

14. If the recharge rate of a well fails to sustain the lowest possible flow rate of the pump, causing an excessive drawdown, purge the well dry once. Remove the pump from the well and allow the well to recover until adequate water for samples is available.

15. Use a bailer to collect samples within 24 hours. Collect samples for different parameters as the water becomes available, in the order specified in section 4.8. This is especially important for wells that have historically yielded turbid samples. Up to 24 hours may elapse between purge dry and sample collection to allow silt to settle out.

4.5 Specific Requirements for Volume Purge and Sampling Using a Bailer or Submersible Pump

The following procedures shall be applicable to the volume purge and sampling of a well. The volume purge method shall be used only under special circumstances. However, prior approval from the technical lead or the remediation manager shall be obtained and documented on the sample collection form before using this method.

1. Prepare and decontaminate equipment as per general procedures.

2. Measure the static water level and the total well depth with an electric water level indicator.

Bailer

3. Use Teflon® bailers, if the bailers are to be decontaminated between wells and reused, or disposable bailers.

4. Use disposable twine with the bailer. Do not decontaminate and reuse plastic twine. Only Teflon®-covered steel cable may be decontaminated and reused at another well.

5. To start purging, gently lower and raise the bailer in the water column.

Submersible Pump

6. Lower the pump gently to the bottom of the well.

7. Complete power connections and begin purging.

8. Record water quality parameters at least twice for each well volume evacuated.

9. Purge until at least 3 well volumes have been evacuated and the well parameters have stabilized or the well is bailed dry. Proceed with sample collection once parameter stabilization and low turbidity values (**Table 1**) have been achieved. If the well is bailed dry, wait until adequate water is available in the well and proceed with sample collection.

10. Collect the samples in the analyte order provided in a subsequent section.

11. If collecting a filtered sample, use a disposable filtration unit with a hand-operated vacuum pump. Alternatively, send an unpreserved (no nitric acid added) sample to the laboratory. The sample will be filtered in the laboratory before analysis.

12. Record all pertinent information on the groundwater sampling form, identifying the sampling method used (i.e., volume purge and sample with a bailer) in the "Comments" field. Any fields in the form not applicable to the method used shall be marked "NA."

4.6 Disposal of Purge Water

The water purged from the well is considered investigation-derived waste (IDW). All purge water shall be containerized and handled according to the work plan.

4.7 Specific Requirements for Water Quality Parameter Measurements

Water quality parameters to be monitored during the purge process shall include pH, temperature, conductivity, redox potential (Eh), dissolved oxygen (DO), and turbidity. Measurements shall be made at intervals required by the specific method used. If using a pump, a flow-through cell will be used to measure field parameters at the discharge from the pump at a frequency specified in the sample collection log. If using a bailer for purging, field parameters shall be measured at least twice per well volume evacuated.

The goal of the purging process is to obtain a groundwater sample that is representative of the surrounding aquifer. Field parameters are the simplest indicators for determining when the formation water is being removed. The normal ranges of field parameters are indicated in **Table 1**. Stabilization of parameters is required for before analytical samples may be collected, irrespective of the method used. Field parameter stabilization is defined as four consecutive readings within the criteria presented in **Table 1**.

Professional judgment should be used in evaluating field measurements. For example, if DO readings are in the 5 to 7 milligrams per liter (mg/L0 range, then 10

percent is a reasonable fluctuation. But if DO is in the o.5 to 1 mg/L range, then fluctuations within 10 percent are perhaps overly stringent and 20-50 percent variations may be allowed. The same is true for conductivity and the 10 mV goal for redox. If after 3 well volumes have been purged, all but one or two parameters have stabilized, but are relatively close to their respective target bounds, then this may be an adequate indication that formation water is being removed and sample may be collected. Rationale for samples collected when field parameters are outside of the target fluctuations will be documented on the sample collection logs.

Under low-flow sampling conditions, no minimum volume of water is required to be removed from a well prior to sampling. Under volume purge techniques (pump or bailer), at least 3 well volumes of water should be purged before sampling. Up to 5 well volumes may be purged if parameters do not stabilize after purging 3 volumes and there is an indication that the parameters may stabilize with further purging. However, if field measurements have not stabilized after 5 well volumes have been removed, then the task manager or technical lead shall be contacted to determine whether collecting a sample is appropriate.

Turbidity measurements should be treated differently for different situations. When the analytical program specifies metals (total or unfiltered) for laboratory analysis, then the target turbidity shall be less than 10 NTU, and consecutive turbidity readings less than 10 NTU will be considered equivalent. When metals are not an analytical parameter, then turbidity is not as great a concern, and the target shall be less than 20 NTU. However, in both cases, these goals may not be attainable due to silty or clayey sections of the aquifer matrix. If each parameter has stabilized, but turbidity is still above the target NTU value, then purging shall continue in an effort to attain the target NTU. Decisions to continue purging will be based on how far out of compliance the values are (e.g., 15 versus 100 NTU), and will be made by the technical lead on a case-by-case basis.

During purging, the field parameter values shall be periodically compared to the normal parameter ranges (**Table 1**). Parameters outside the normal range may indicate a problem with instrument calibration or a faulty well construction. The accuracy of certain instruments tends to drift with time and such instruments may require frequent calibration. An example of a faulty well construction is the presence of cement grout in the screen interval due to a poor bentonite seal. The cement grout causes the pH of the groundwater to be abnormally high (11-13 range). If the parameters are observed to be outside the normal range, the instruments shall be recalibrated and the measurement repeated. If the parameters are still outside the normal range for 4 consecutive readings during purging, the well construction may be faulty and the task manager or technical lead must be contacted for further direction. No samples shall be collected from a well with questionable construction until further direction.

4.8 Sample Collection

Regardless of the purging technique used, samples shall be collected at flow rates in the range 0.1-0.5 L/min or poured gently to avoid aeration, bubble formation, or turbulent filling of sample bottles.

Samples shall be collected in the following order of target analytes, if adequate amount of water is available in the well:

- Volatile organic compounds (VOC)
- Semivolatile organic compounds (SVOC)
- Turbidity
- Major water quality cations and anions
- Carbonate/bicarbonate
- Total suspended solids
- Total dissolved solids
- Kjeldahl nitrogen
- Total metals
- Dissolved metals
- Total petroleum hydrocarbons
- Cyanide
- Ammonia, nitrogen.

Samples for any target analytes not listed above shall be collected in the order of decreasing volatility within the framework of this list. If the amount of water available in the well is low, minimum volume requirements provided in **Table 2** should be implemented or certain target analytes may be omitted, upon approval from the task manager and project chemist.

Filtered Samples. Filtered groundwater samples are normally not needed if a successful low-flow sampling program is implemented. However, if specified in the work plan, filtered groundwater samples will be collected according to the following procedures:

1. If using a flow cell, connect an inline, disposable 0.45 µm filter to the discharge flow tube attached to the "T" junction upstream from the flow cell. If a flow cell is not being used, connect the filter to the discharge tube of the pump. Collect the water discharging from the filter in the sample container.

2. If the low rate is too slow to allow filtration through an in-line filter or if samples are collected by a bailer, an alternative filtration method may be required. A disposable filtration unit and a hand-operated vacuum pump will be used to filter the sample in the field.

3. If filtration can not be accomplished in the field, an unpreserved sample (no nitric acid added) cooled to 4°C shall be shipped to the laboratory along with the preserved sample for unfiltered analysis. The unpreserved sample shall be filtered

upon receipt and the filtrate preserved with nitric acid. The data from the laboratory filtered sample will be reported as "dissolved metals."

4.9 Records

For each monitoring well purged, the technician shall complete a groundwater sampling form (Attachment A). This form prompts the technician to identify and record information such as: site ID, well ID, sample number, depth of well, depth to water, and well diameter. The technician can then use the information on the form to perform a well casing volume calculation. The form also includes spaces to record the field parameters that are measured during purging and any comments and observations. This form also prompts the technician to record the sample number, collection date, and time, sample containers, and associated QC sample information.

All well purging and sampling data and information shall be recorded in the Field Activity Data Log (FADL) for the site sampled. The FADL entries shall be recorded chronologically and the time of the entry recorded first. All FADL continuation pages shall be sequentially numbered and the last page recorded for the day shall be signed and dated by the recording technician.

5.0 CROSS REFERENCE

U.S. Environmental Protection Agency (USEPA), 1986, *Resource Conservation and Recovery Act (RCRA) Groundwater Monitoring Technical Enforcement Guidance Document,* OSWER-9950.1, September.

U.S. Army Corps of Engineers (USACE), 1994, *Requirements for the Preparation of Sampling and Analysis Plans*, EM 200-1-3, September.

U.S. Environmental Protection Agency (USEPA), 1996, *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*, Region 4, May.

U.S. Environmental Protection Agency (USEPA), 1995, *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures, Groundwater Issue*, EPA/540/S-95/504, December.

6.0 TABLES

Table 1 - Water Quality Indicator Parameters
Table 2 - Water Sample Volume Requirements

7.0 FIGURES

Figure 1 - Groundwater Sampling Form
Figure 2 – Water Sample Field Collection Report

Table 1
Water Quality Indicator Parameters

Measurement	Normal Range	Acceptable Variability[a]
PH	4.6 to 8.5	± 0.1
Temperature (°C)	10 to 18	± 10%
Specific Conductivity (µS/cm)	10 to 8,000	± 3%
Redox (mV)	+400 to -300	± 10
Dissolved oxygen (mg/L)	<10	± 10%
Turbidity (NTU)	variable	± 10%[b]

Notes and Abbreviations:

[a] acceptable variability for four consecutive readings
[b] values of less than 10 NTU are considered to be equivalent

°C degrees celsius
µS/cm micro siemens per centimeter
mV millivolt
mg/L milligrams per liter
NTU nephelometric turbidity unit

Table 2
Water Sample Volume Requirements

Analysis	Standard Volume (mL)	Minimum Volume (mL)*	Minimum Volume Option*
Volatile organics	120	40	X
Semivolatile organics	1000	1000	
Pesticides/PCBs	1000	1000	
Herbicides	1000	1000	
Metals – Total	500	125	X
Metals – Dissolved	500	125	X
Mercury – Total Mercury – Dissolved	Included with metals (100)	Included with metals (100)	
Cyanide	500	125	X
Anions	250	100	X
Nitrate-nitrite	100	50	X
Total suspended solids and total dissolved solids (TSS and TDS)	500	200	X
Total organic carbon (TOC) RCRA 4/well	4 x 25	4 x 25	
Total organic halides (TOX) RCRA 4/well	4 x 100	4 x 100	
Total petroleum hydrocarbon (TPH)	1000	1000	X
Gasoline range organics (GRO)	80	40	X
Diesel range organics (DRO)	1000	1000	

Notes:

* Quantitation limits (detection levels) may be affected when operating with minimum sample volumes. If volumes are lowered below the minimum sample volumes, quantitation limits will be raised.

Figure 1

Water Level Measurement/Groundwater Sampling Log Form

Well No. _____ Date _____

Sample ID No. _____

Project ID _____ Measured/Sampled By: _____

Time: Start _____ End: _____

Measuring Point Elevation: _____ Ft. Well Construction Material: _____

Well Depth Ft: 1) _____ 2) _____ 3) _____ 4) _____

Avg. _____ (of valid measurements*)

Water Depth Ft: 1) _____ 2) _____ 3) _____ 4) _____

Avg. _____ (of valid measurements*)

(*Minimum of three measurements, last two within 0.01 feet.)

Well Internal Diameter: _____ Ft.

Riser Above/Below Pad Elevation Marker: _____ Ft.

Pad Elevation: _____ Ft.

Sampling Equipment Used:

_____

_____

Equipment Numbers:

pH Meter _____ EC Meter _____ Turbidity Meter _____ Thermometer _____

Casing Volume Information:

Casing ID (inch)	1.0	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (A) (gal/ft)	0.04	0.09	0.16	0.2	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Purging Information:

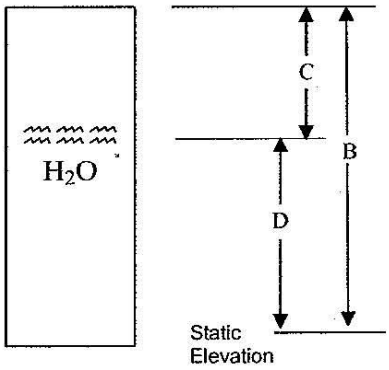
Measured Well Depth (B): _____ Ft.

Measured Water Level Depth (C): _____ Ft.

Length of Static Water Column (D) : (B) - (C) = _____ ft.

Casing Water Volume (E): (A) x (D) = _____ gal.

Total Purge Volume = _____ (gal) (minimum of three casing volumes)



These standard project procedures are applicable to all members of Shaw Environmental, Inc.

Figure 1 (*continued*)

Water Level Measurement/Groundwater Sampling Log Form (Continued)

Field Indicator Parameter Measurements During Purging:

pH _____ _____ _____ _____

Temp.°C _____ _____ _____ _____

Specific Conductance: µmhos/cm _____ _____ _____ _____

Turbidity: NTU _____ _____ _____ _____

Visual Appearance of Water: _____ _____ _____ _____

Comments:

Field Indicator Parameter Measurements After Sampling:

pH _____ _____ _____ _____

Temp.°C _____ _____ _____ _____

Specific Conductance: µmhos/cm _____ _____ _____ _____

Turbidity: NTU _____ _____ _____ _____

Visual Appearance of Water:

Comments:

Laboratory Analysis Requested:

Sample ID No.	Parameter	Method	Preservation	Duplicate	No. of Containers

These standard project procedures are applicable to all members of Shaw Environmental, Inc.

Figure 2

Shaw Environmental & Infrastructure, Inc.	WATER SAMPLE FIELD COLLECTION REPORT	Project Number: _____ Project Name: _____ Site Location: _____

Sample ID Number	_____	Date Collected	_____
Sample Location(7)	_____	Time Collected	_____
Diameter of Well	_____ (in.)	Sampler	I.D. #_____
Depth to Bottom of Well	_____ (ft.)	Casing Stick Up	_____
Static Water Level	_____ (ft.)	Measured From(1)	_____ (ft.)
Well Volumes Purged	_____	Purging Method(2)	_____
Type of Sample(3)	_____	Sampling Method(4)	_____
Depth of Sample	_____ (ft.)	Measured From(1)	_____
Sample Collection Order			

FIELD SCREENING AND TEST RESULTS

Water Temperature _____ °C pH _____ Units

Specific Conductance _____ umho/cm at _____ °C

OVA ☐ HNU PID ☐ Reading _____ PPM

Photovac GC (P/GC) Probable Compound _____ Reading_____PPM

METER CALIBRATION

pH STD	METER READING	SP. COND. STD	METER READING	_____/STD (8)	METER READING

SAMPLE TYPES COLLECTED

CONTAINER #	TYPE (5)	CONTAINER TYPE	VOLUME	FILTERED			
		P ☐ G ☐		Y ☐ N ☐	Y		N ☐
		P ☐ G ☐		Y ☐ N ☐	Y		N ☐
		P ☐ G ☐		Y ☐ N ☐	Y		N ☐
		P ☐ G ☐		Y ☐ N ☐	Y		N ☐
		P ☐ G ☐		Y ☐ N ☐	Y		N ☐

WEATHER CONDITIONS: TEMP._____ °F CLEAR ☐ CLOUDY ☐ RAIN ☐ SNOW ☐ WINDY ☐

(1) T.O.C. = Top of Protective Casing; T.O.W. = Top of Well Casing; G.S. = Ground Surface
(2) Bailed, Pumped, Air Lift, Etc.
(3) Stream, Pond, Spring, Well, Seep, Supply, Etc.
(4) Bailer, Kemmerer, Grab, Pump, Etc.
(5) General Chem., Metal, VOA, Organics, Etc.
(6) HNO^3, NaOH, H^2SO^4, $Na^2O^3S^2$, Etc.
(7) If Well, give Well I.D. Number.
(8) OVA, PID, P/GC or Other.

Attachment 3

Well Development

SHAW STANDARD OPERATING PROJECT PROCEDURE

LONGHORN ARMY AMMUNITION PLANT

ATTACHMENT 3

Subject: WELL DEVELOPMENT

1.0 PURPOSE AND SUMMARY

The objective of this Standard Operating Project Procedure (SOPP) is to define the procedural requirements for developing monitoring wells.

Monitoring wells are developed to create an effective filter pack around the well screen; to repair damage to the formation caused by drilling; to remove the "skin" from the borehole wall; to claim liquids introduced during drilling; and to remove fine-grained particles from the filter pack and the adjacent formation. When a cement-bentonite grout is used to seal the annular space, wells shall not be developed for a minimum of 48 hours (hr) after grouting. Further, the development shall be initiated within 7 days after the final grouting of the well. Timely development of a well is essential to remove fine-grained silt and clay particles that may become permanently lodged in the filter pack with time. Further, the borehole wall "skin" may also become more difficult to remove with time.

Depending upon the amount of water in a monitoring well, well development may be accomplished during an initial attempt or may have to be completed in multiple stages over several months. Specific cases and required procedures are addressed in subsequent sections. A successful well development requires an active participation of the task manager or designate in following the well development process. As addressed in the following sections, wells with an inadequate amount of water to accomplish full development during the initial attempt would have to be redeveloped if the water level rises in the well during the next wet season. The task manager or designate shall schedule water level measurements in the *wet season* in wells that are candidates for redevelopment, so that a decision regarding a redevelopment effort may be made.

There are many well development methods currently in use within the industry:

- Pumping
- Overpumping
- Surging and pumping
- Bailing
- Mechanical surging using a surge block
- Backwashing
- Airlifting (not recommended when the well will be sampled for volatile organic compounds within 7 days of development).

The well development method to be used for this project is a modified surging and pumping method. Water quality indicator parameters of the produced water should be monitored to assist in the proper development of monitoring wells. The indicator parameters monitored

should include pH, specific conductance, temperature, and turbidity.

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3.0 RESPONSIBILITY MATRIX

3.1 Site Manager

The Site Manager or Field Team Leader, is responsible for ensuring that field activities are completed to meet the project objectives, that they are conducted in accordance with the project plans and requirements, and that all activities are performed according to the respective procedures. The Site Manager is responsible for ensuring that all site personnel are trained in the procedures, that the procedures are adhered to, and that all activities are documented.

3.2 Field Team

All members of the field team (samplers, technicians, field geologists, engineers, etc.) are responsible for understanding and implementing this field procedure as well as ensuring that all team members perform work in accordance with this procedure. The team members are responsible for communication with the task manager and technical lead to address issues or key decision points.

3.3 Site Contractor Quality Control Systems Manager (CQCSM)

The Site CQCSM is responsible for ensuring that this procedure is correctly implemented and that the quantity and quality of well development activities meet the requirements of the project.

4.0 DEFINITIONS

Bailer. A long, narrow tubular device with an open top and a check valve at the bottom that is used to remove water and sediment from a borehole or well.

Drilling Fluid. A fluid introduced into the borehole in the well drilling operation to remove cuttings from the borehole, to clean and cool the bit, to reduce friction between the drill string and the sides of the borehole and to hold the borehole open during the drilling operation.

Formation Damage. Reduction of formation hydraulic conductivity at the borehole wall caused by the drilling process. May consist of compaction, clay smearing, clogging of pores with drilling mud filtrate, or other drilling-related damage.

Indicator Parameters. Chemical parameters, including pH, specific conductance, temperature and dissolved oxygen content, which are used to determine when formation water is entering a monitoring well.

Monitoring Well. A well that is constructed by one of a variety of techniques that may serve a variety of purposes: (1) extracting ground water for physical, chemical, or biological testing; (2) measuring water levels; (3) measuring formation fluid chemical or physical parameters.

Surge Block. A plunger-like tool consisting of disks of flexible material (for example, neoprene) sandwiched between rigid (for example, metal) disks that may be solid or valved, and that is used in well development. The surge block should have a vent hole to let the air escape as the block is lowered. See surging.

Surging. A well-development technique in which a surge block is alternately raised and lowered within the well casing or screen, or both, to create a strong inward and outward movement of water through the well screen.

Turbidity. Cloudiness in water due to suspended and colloidal material; measured in nephelometric turbidity units (NTU).

Well Development. The act of repairing damage to the borehole caused by the drilling process and removing fine-grained materials or drilling fluids, or both, from formation materials so that natural hydraulic conditions are restored and well yields are enhanced.

5.0 TEXT

5.1 Required Records And Forms

1. Well development Log (**Figure 1**)
2. Field Activity Daily Log (FADL)

5.2 Required Materials, Equipment, Or Supplies

The following equipment is needed to develop a monitoring well:

1. bailer
2. surge block

3. pump, bottom filling (bladder) or peristaltic (Note: All pumps used should have check valves to prevent backflow.)
4. controller
5. pump tubing
6. Teflon®-coated stainless-steel wire
7. power source (e.g., generator), if required
8. water-level meter
9. temperature, specific conductivity, Eh, DO, and pH meters
10. turbidity meter
11. container or flow-through cell to measure field parameters
12. personal protective equipment (PPE) as specified in the site-specific health and safety plan
13. decontamination supplies, if required on-site
14. disposal drums to contain produced water.

5.3 General Requirements

Well development procedures will vary depending upon the amount of water available in the monitoring well. Scenarios likely to be encountered and required procedures are as follows:

1. The screen is 80-100 percent submerged. Proceed with well development in accordance with procedures provided in Sections 5.4 and 5.5.

2. The height of the water column in the well is between 2 feet and 80 percent of screen length (8 feet for a 10-foot screen, and 4 feet for a 5-foot screen). Proceed with well development in accordance with procedures provided in Sections 5.4 and 5.5. Measure the water level in the well again during the wet season. Redevelop the well if the water level is significantly higher than the level at the time of the initial development. The task manager or the technical lead will evaluate the benefit of a redevelopment effort and instruct the field staff accordingly.

3. The height of the water column in the well is less than 2 feet. The well shall not be surged. A minimum 2 feet of water is necessary for the surge operation to be effective. Sections 5.4 and 5.6 provide the procedure to be followed when less than 2 feet of water is present in the well. Measure the water level in the well again during the wet season. Redevelop the well if the water level is significantly higher than the level at the time of the initial development. The task manager or the technical lead will evaluate the benefit of redevelopment and instruct the field staff accordingly.

5.4 General Requirements for Developing Wells

The following steps shall be followed when developing wells:

1. Don PPE as specified in the site-specific health and safety plan.

2. Calibrate all meters in accordance with standard operating procedures and manufacturer's guidelines.

3. Open, check, and note the condition of the wellhead, including the condition of the surveyed reference mark.

4. Decontaminate and prepare the necessary equipment for developing the well.

5. Using a decontaminated electric water level indicator, determine the static water level and depth to the bottom of the well (from the surveyed reference mark). Record on the appropriate field forms. Compare measured total depth to reported total depth and document the accumulation of silt at the well bottom, if any.

6. Compare the depth to water with depths to the top and bottom of the screen. Determine the applicable scenario from those listed above based on the height of the water column in the well. Follow the steps given in Section 5.5 if Scenarios 1 or 2 are applicable. For Scenario 3 (water column less than 2 feet), follow procedures given in Section 5.6.

5.5 Specific Requirements for Well Development by Surge and Pump

The intent of this procedure is to effectively develop the well through mechanical surging and removal of settleable fines while minimizing overall volume of water removed from the well.

1. Slowly lower a bottom-check valve bailer into the well and remove a bailer full of water from mid-screen. Empty the contents into a vessel large enough to contain the well probes. Measure and record water quality parameters (T, SC, pH, turbidity, DO, Eh).

2. Evacuate any sediment present at the well bottom using a bottom intake pump or bailer. If the well is shallow, a peristaltic pump may be used to evacuate sediments. Minimize the water volume removed.

3. Measure static water level after removing sediment; allow equalization if water level drops within screened interval.

4. Insert the surge block so that it is within the screen interval of the well. Surge the water column gently with 2 feet strokes working towards the bottom of the screen. Remove the surge block and rods from the well slowly.

5. Using a bailer or submersible pump, evaluate the turbid water. Periodically measure and record water quality parameters.

6. Repeat steps 1 through 5 until water quality parameters stabilize and are within the normal range of values observed for the site. The criteria for parameter stabilization are the normal ranges of values provided in **Table 1**. If the well

dewaters before desired parameter values are reached, allow time to recharge and continue.

7. Water quality parameters are considered stabilized if they are within the ranges provided in **Table 1** for 4 consecutive measurements.

8. Periodically, compare the parameter readings with the normal range of values (**Table 1**). If the parameters are significantly outside the normal range, the field crew shall recalibrate the instruments and repeat the measurement. If the readings are consistently outside the range for 4 consecutive measurements, a faulty well construction may be the cause (e.g., grout in the filter pack). Contact the technical lead for further instructions.

9. Following a minimum of 3 surge and pump cycles, a minimum of one well volume should be removed. At least 3 well volumes should be removed and (depending upon depth and static water level) upon direction of the task manager or technical lead.

10. Collect 0.5 liters of the last batch of water evacuated from the well and place it into a clean jar. The jar should be labeled with development date and well number. Each sample should be individually agitated and immediately photographed with a 35-mm camera in a backlit setting so that the clarity of the water is visible. The photographs will be a minimum 5 inch x 7 inch in size, and will be individually identified with the project name, well number, and photo date. The photograph will become a part of the well development documentation and will be included in the report along with the development log.

11. Record pertinent data in the FADL and well development log form (Well Development, **Figure 1**).

12. Remove the development equipment from the well, decontaminate (as required), and clean up the site. Lock the well cover before leaving. Dispose of produced water as required by the project work plan.

5.6 Specific Requirements for Minimal Well Development

This procedure is applicable to situations where the height of the water column in the well is less than 2 feet. The surging operation is not considered effective under these conditions and the development process would essentially involve using a pump to evacuate sediments and extremely turbid water near the well bottom. Follow the steps given below:

1. Using a bailer remove a small quantity of water from the well. Empty contents into a container and measure water quality parameters.

2. Lower a bottom-filling pump into the well and evacuate the sediments and turbid water. If possible, maintain the pumping at a rate that would not cause the well to run dry. If the well goes dry even at the lowest possible pumping rate, allow it to

recharge and repeat pumping. A bailer may also be used for sediment evacuation.

3. Measure water quality parameters every 3 to 5 minutes during pumping, preferably using a flow-through cell if a pump is used.

4. Record pertinent data in a well development form (**Figure 1**) and a FADL.

5. Collect the 0.5-liter of the last batch of water evacuated from the well and place it into a clear jar. The jar should be labeled with development date and well number. Each sample should be individually agitated and immediately photographed with a 35-mm in a backlit setting so that the clarity of the water is visible. The photographs will be a minimum 5-inch x 7-inch in size and will be individually identified with project name, well number and photo date. The photograph will be become a part of the well development documentation and will be included in the report along with the development log.

6. Remove the development equipment from the well, decontaminate (as required), and clean up the site. Lock the well cover before leaving. Dispose of produced water as required by the project work plan.

7. Water level shall be measured in the well during the following wet season. The well shall be redeveloped if the water level appears to have risen significantly. The task manager or technical lead will evaluate the benefit of redevelopment and instruct the field staff accordingly.

5.7 Well Volume Calculation

The well's volume must be calculated to estimate how many drums or other containers may be required and how many well volumes were removed.

$$Well\ Volume = A + B$$

Where:

$$A\ (Riser\ \ Volume\ ) = \left(H \times r^2 \times \pi\right) \times 7.4805$$

Where:

H = static water column (total depth - depth to water) (in feet)
R = radius of riser or screen (in feet)
$\pi = 3.1416$

and

$$B\ (Sand\ Pack\ Volume) = 0.25 \times \left(\left(\left(R^2 \times \pi \times L\right) - \left(r^2 \times \pi \times L\right)\right) \times 7.4805\right)$$

Where:

R = Borehole radius (in feet)
$\pi = 3.1416$
L = Filter pack length (in feet)
R = radius of riser or screen (in feet)

Porosity is assumed to be 25 percent. Record these data and calculations in the FADL or well development form (Well Development Attachment 1).

5.8 Development and Sampling Break

A period of at least 14 days will be allowed between well development and sampling. The intent of this hiatus is to allow the newly installed and developed well to equilibrate to the ambient conditions, thus enabling the collection of a representative sample.

5.9 Restrictions/Limitations

Where flammable light, nonaqueous phase liquid (LNAPL) or emulsified LNAPL is expected or known to exist on or in groundwater, use only intrinsically safe electrical devices and place portable power sources (e.g., generators) 50 feet (or more) from the wellhead and disposal drums. Effort should be made to remove LNAPL (bailer) prior to surging to prevent spreading/dispensing of product into sand pack/screen interval.

6.0 EXCEPTION PROVISIONS

This SOPP implements a modified surge-and-pump method that emphasizes the removal of sediments from the well in an efficient manner and is not driven by evacuation of a specified volume of water that may or may not remove all the sediments from the well.

7.0 CROSS REFERENCE

American Society for Testing of Materials (ASTM), 1994. *Standard Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers*, ASTM D5521-94.

U.S. Army Corps of Engineers (USACE), 1990, *Monitor Well Installation at Hazardous and Toxic Waste Sites*, EM 1110-7-XX(FR) (Draft), November.

U.S. Army Corps of Engineers (USACE), 1998, *Monitoring Well Design, Installation, and Documentation at Hazardous, Toxic and Radioactive Waste Sites*, EM 1110-1-4000, November.

U.S. Environmental Protection Agency (EPA), 1996, *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual,* Region 4, May.

U.S. Environmental Protection Agency (EPA), 1986, *Resource Conservation and Recovery Act (RCRA) Groundwater Monitoring Technical Enforcement Guidance Document*, OSWER-9950.1, September.

8.0 TABLES

Table 1 - Water Quality Indicator Parameters

9.0 FIGURES

Figure 1 - Well Development Log Form

Table 1
Water Quality Indicator Parameters

Measurement	Normal Range	Acceptable Variability[a]
PH	4.6 to 8.5	± 0.1
Temperature (°C)	10 to 18	± 10%
Specific Conductivity (µS/cm)	10 to 8,000	± 3%
Redox (mV)	+400 to -300	± 10
Dissolved oxygen (mg/L)	<10	± 10%
Turbidity (NTU)	Variable	±10%[b]

[a] Acceptable variability for four consecutive readings.
[b] Values of less than 10 NTU are considered to be equivalent.

°C - Degrees Celsius.
µS/cm - MicroSiemens per centimeter
mV - Millivolt
mg/L - Milligrams per liter.
NTU - Nephelometric turbidity unit

Figure 1

WELL DEVELOPMENT RECORD

WELL/PIEZOMETER ID_____
SHEET _____ OF _____

PROJECT NAME: _____ PROJECT NO.: _____ DATE: _____

LOCATION: _____ DATE INSTALLED: _____

TOTAL DEPTH (FTOC) _____ CASING DIAMETER _____

METHODS OF DEVELOPMENT

☐ Swabbing ☐ Bailing ☐ Pumping ☐

Describe_____

Equipment decontaminated prior to development ☐ Yes ☐ No

Describe_____

EQUIPMENT NUMBERS

pH Meter _____ EC Meter _____ Turbidity Meter _____ Thermometer _____

CASING VOLUME INFORMATION:

Casing ID (inch)	1.0	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (A) (gal/ft)	0.04	0.09	0.16	0.2	0.37	0.65	0.75	1.0	1.5	2.0	2.6

PURGING INFORMATION

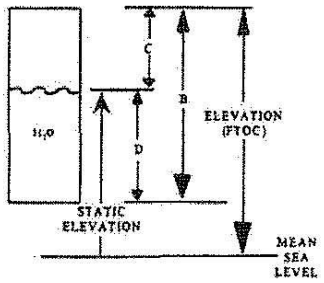
Measured Well Depth B _____ ft.

Measured Water Level Depth (C) _____ ft.

Length of Static Water Column (D) _____ (B) - _____ (C) = _____

Casing Water Volume (E) _____ (A) x _____ (D) = _____

Total Purge Volume = _____ gal



Date	Time	Water Level (FTOC)	Volume Removed (gal)	pH	EC	Temperature F or C	Turbidity/ Sand (ppm)	Comments

Attachment 4

Groundwater Level Measurements

SHAW STANDARD OPERATING PROJECT PROCEDURE

LONGHORN ARMY AMMUNITION PLANT

ATTACHMENT 4

Subject: GROUNDWATER LEVEL MEASUREMENTS

1.0 PURPOSE AND SUMMARY

This Standard Operating Project Procedure (SOPP) establishes guidelines and procedures for use by field personnel in determining the groundwater level in monitoring wells.

Proper recording procedures are necessary to assure the quality and integrity of all groundwater level measurements. Prior to collecting groundwater levels, a strategy should be developed based on the objectives of the investigation.

The measurement of the ground water level in a well is frequently conducted in conjunction with ground water sampling to determine the "free" water surface. This potentiometric surface measurement can be used to establish ground water flow direction and gradients. Total well depth and ground water level measurements are needed to determine the volume of water in the well casing prior to purging the well for sampling purposes.

All ground water level and total depth measurements should be made relative to an established reference point on the well casing and should be documented in the field records. To be useful for establishing ground water gradient, the reference point should be tied in with the NGVD (National Geodetic Vertical Datum) or a local datum.

When measuring wells for water table or potentiometric surface analysis, and if the contaminant history is known for each of the wells, it is advisable to monitor water levels beginning with the least contaminated wells first and progressing to the most contaminated wells last, where practical.

Documents other than those required by the contract and consulted in the preparation of this SOPP are listed under "Cross Reference."

The details within this SOPP should be used in conjunction with the Work Plan which will generally provide the following information:

- Data collection objectives;
- Locations for data collection;
- Types of data to be collected; and
- Specific quality control (QC) procedures required.

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3.0 RESPONSIBILITY MATRIX

3.1 Site Manager

The Site Manager or Field Team Leader, is responsible for ensuring field activities are completed to meet the project objectives, are conducted in accordance with the project plans and requirements, and all activities are performed according to the respective procedures. The Site Manager is responsible for ensuring all site personnel are trained in the procedures, the procedures are adhered to, and all activities are documented.

3.2 Field Team

All members of the field team (samplers, technicians, field geologists, engineers, etc.) are responsible for understanding and implementing this field procedure as well as ensuring all team members also perform work in accordance with this procedure.

3.3 Site Contractor Quality Control Systems Manager (CQCSM)

The Site CQCSM is responsible for ensuring that this procedure is correctly implemented and that data collected meet the requirements of the Project Work Plan.

4.0 DEFINITIONS

Electronic Water Level Indicator. This instrument consists of a spool of dual wire, a probe attached to the end, and an indicator. When the probe comes in contact with the water, the circuit is closed and a meter light and/or buzzer attached to the spool will signal the contact. Penlight or 9-volt batteries are normally used as a power source. Measurements should be made and recorded to the nearest 0.01 foot.

5.0 TEXT

5.1 Required Records And Forms

1. Field Activity Daily Log (FADL)
2. Instrument operation manual.

5.2 Required Materials, Equipment, Or Supplies

1. Indelible black-ink pens and markers
2. Personal protective clothing and gear
3. Gloves, nitrile
4. Keys for locking well caps
5. Paper towels
6. Radio, two-way, hand held or cellular phone
7. Safety glasses
8. Appropriate equipment and meters for obtaining field measurements as specified in the Work Plan (i.e., water quality)
9. Linear measuring device (e.g., tape measure)
10. Electronic water indicator (appropriate length)
11. Organic vapor analyzer (FID/PID).

The equipment must be capable of recording a measurement to the accuracy required by the Work Plan. Project data quality objectives and site characteristics must be taken into account when determining the groundwater level measurement equipment to use. The total number of wells to be measured, weather, tidal influences, pumping, and construction can all affect water level measurements.

5.3 General Requirements

Operation manuals provide operation and calibration procedures to be followed. Several standard steps should be taken before beginning any depth measurement of groundwater level measurement activity is performed.

1. Verify that all personnel have read and understood the approved site-specific health and safety plan and have the proper training and certifications required under OSHA.

2. Verify the site location by existing maps and surface features. Mark off the boundaries of the work site with flagging or other means to prohibit access to unauthorized personnel.

3. Check to see that all the necessary equipment (including PPE) is available at the site, is in good working condition, and has been properly decontaminated.

4. Check that all monitoring equipment is properly calibrated and operating. Measuring tapes should be checked a minimum of every six months against a surveyor's tape to determine if shrinking or stretching has occurred.

5. Visually inspect the well to ensure that it is undamaged, properly labeled and secured. Any damage or problems with the well head should be noted on the FADL and the site manager notified for repair or replacement of the equipment.

6. Uncap the well and monitor the air space for organic vapors immediately above the open casing with an FID/PID. (Observe if any air is flowing into or out of the casing. In the event such conditions are observed, they should be noted on the

FADL. If air is observed to be entering or flowing out of the casing, the sounder should not be placed inside the well until the air flow stops and pressure equalizes.

5.4 Specific Requirements

The specific procedure for determining groundwater level using an electronic water level indicator is described below.

1. Lower the electronic water level indicator into the well until the water surface is encountered as indicated by an audible (beep) or visual (light) signal.

2. When the water surface is reached, give the tape a short, sharp jerk to ensure that the probe is not responding to condensation along the well casing.

3. Measure the distance from the water surface to the permanent reference point. For aboveground "stickup" completions, the reference point is usually a groove cut into the north side of the casing. If no permanent reference point is available for an aboveground completion, measure from another permanently fixed structure or from ground level. The point of measurement should then be noted on the FADL and the appropriate form on which the water level is recorded. For flush mount completions, such as street boxes, the groundwater level measurement should be referenced to a steel grate placed across the rim of the street box and over the casing. Any aboveground completions without permanent reference points or marks should be brought to the attention of the appropriate supervisory personnel.

4. Collect measurements until two consecutive measurements are identical or within the specified tolerance (usually 0.01 ft). Record all appropriate information on the FADL. At a minimum, the following information must be recorded:

   - project name and number;
   - unique well identification number;
   - date and time of measurement collection;
   - depth to water to the specified tolerance;
   - weather conditions; and any problems encountered.

5. Once the water level measurement is completed, turn the device in the off position and slowly lower the probe to the bottom of the well to sound the depth. Record the depth to the bottom of the well to the nearest 0.01 feet and document the bottom condition (i.e., soft, silty, hard).

6. Cap and relock the well.

7. Perform all equipment decontamination procedures as specified in the field procedures in Attachment 9 of Appendix D. Measuring **equipment must be decontaminated** prior to utilizing for well measurements.

5.5 Records

All information will be recorded on a FADL for the subject site. The FADL entries will be recorded chronologically and the time of the entry recorded first. All FADL continuation pages will be sequentially numbered and the last page recorded for the day will be signed and dated by the recording technician. Records generated as a result of this SOPP will be controlled and maintained in the project record files.

6.0 EXCEPTION PROVISIONS

None.

7.0 CROSS REFERENCE

Annual Book of ASTM Standards, 1987 *Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well)*, D4750.

EPA, 1996, *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*, Region 4, Athens, GA.

EPA, 1986, *RCRA Groundwater Monitoring Technical Enforcement Guidance Document*, OSWER-9950.1, U.S. Government Printing Office, Washington, D.C.

U.S. Army Corp of Engineers, 1998, *Monitoring Well Design, Installation, and Documentation at Hazardous, Toxic, and Radioactive Waste Sites,* EM 1110-1-4000.

8.0 TABLES

None

9.0 ATTACHMENTS

None.

Attachment 7

Surface Water Sampling

SHAW STANDARD OPERATING PROJECT PROCEDURE

LONGHORN ARMY AMMUNITION PLANT

ATTACHMENT 7

Subject: SURFACE-WATER SAMPLING

1.0 PURPOSE AND SUMMARY

The objective of this Standard Operating Project Procedure (SOPP) is to define requirements and methodologies for collecting surface-water samples. The sampler should refer to the work plan and work plan addenda when appropriate for project specific requirements and objectives. Documents other than those required by contract and used in the preparation of this SOPP are listed in the "Cross Reference" section.

Surface water sampling techniques and equipment are designed to minimize effects on the physical and chemical integrity of the sample.

Because data quality objectives (DQO), contaminant types, and surface-water body configurations vary from site to site, a variety of sampling equipment and techniques will be necessary. The procedures described herein define the methods and equipment required to collect surface-water samples in a variety of environments.

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  - 5.3.3 Shallow Surface-Water Sample Collection
    - 5.3.3.1 Method of Collecting Samples of Near-Shore Surface Water for Volatile Organic Analysis
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- 5.4 Collection of Samples for Oil and Grease, Total Petroleum Hydrocarbons, etc.
- 5.5 Deep Surface-Water Sample Collection
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5.6 Surface-Water Sample Compositing
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5.7 Marking of Surface-Water Sample Locations
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3.0 RESPONSIBILITIES

3.1 Site Manager

The Site Manager, or Field Team Leader, is responsible for ensuring field activities are completed to meet the project objectives, are conducted in accordance with the project plans and requirements, and all activities are performed according to the respective procedures. The Site Manager is responsible for ensuring all site personnel are trained in the procedures, the procedures are adhered to, and all activities are documented.

3.2 Field Team

All members of the field team (samplers, technicians, field geologists, engineers, etc.) are responsible for understanding and implementing this field procedure as well as ensuring all team members also perform work in accordance with this procedure.

3.3 Site Contractor Quality Control Systems Manager (CQCSM)

The Site CQCSM is responsible for ensuring that this procedure is correctly implemented and that the quantity and quality of field measurable physical characteristic samples collected meet the requirements of the project.

4.0 DEFINITIONS

Surface water: Water that flows over or rests on the land and is open to the atmosphere; it includes ditches, streams, rivers, lakes, pools, ponds, basins, or any other that fits the definition of surface water.

Grab samples: Discrete aliquots representing a specific location at a given point in time. The sample is collected all at once and at only one particular point in the sample medium. Grab samples are not mixed or composited with other samples.

Composite samples: Nondiscrete samples composed of more than one specific aliquot collected at various locations or at different points in time. Analytical results from this type sample represent an average value for the locations or time periods incorporated into the sample. Composite samples can be collected where investigative goals indicate that is

appropriate; otherwise, grab samples should be collected.

5.0 TEXT

5.1 Required Records and Forms

1. Field activity daily log (FADL)
2. Sample collection log (SCL)
3. Sample tags/label and the appropriate forms/documentation for sample shipment
4. Material safety data sheets (MSDS)

5.2 Required Materials, Equipment, and Supplies

The list of potential sampling equipment and supplies needed for collection of surface water samples includes but is not limited to the items listed below. The specific requirements for each sampling project should be identified from the results of the pre-sampling field reconnaissance.

1. Life preservers
2. Polyethylene safety line (floatable)
3. Cellular phone or radio
4. Site maps
5. Pond sampler or extended dipper with 1-liter (L) beaker, clamp, and telescoping heavy duty pole, sample collection vessels- bucket, bailer, beakers- composed of Teflon, glass, stainless steel, or other inert material
5. Weighted bottle sampler, Wheaton bottle, or Kemmerer sampler
6. Peristaltic pump (or equivalent) with tubing and power supply
7. Syringe sampler device
8. Horiba U-10 Water Quality Checker (for measurement of pH, specific conductivity, temperature, and dissolved oxygen), redox meter (for measurement of oxygen reduction potential), or a Horiba U-22 Water Quality Checker (for measurement of pH, specific conductivity, temperature, dissolved oxygen and oxygen reduction potential) and DRT meter (for measurement of turbidity).
9. Sample bottles with preservative
10. Sample coolers with ice or blue ice
11. Sample labels and tape
12. Black pens
13. Permanent marker pens
14. Sample collection logs
15. pH paper
16. Paper towels
17. Plastic trash bags
18. Folding ruler or yardstick
19. 100 m measuring tape
20. Stopwatch
21. Camera and film
22. Wooden stakes

23. Flagging tape
24. Sledge hammer
25. Boat or canoe if needed
26. Waders
27. Mudders

5.3 Procedures

5.3.1 General Considerations

Regardless of the sampling methods or equipment selected, several general procedures are applicable to the collection of all surface-water samples.

1. If surface water is extremely silty or muddy, sampling should be postponed until better conditions prevail.

2 Plan to collect samples first from those areas suspected of being the least contaminated so areas of suspected contamination are collected last, thus minimizing the risk of cross-contamination.

3. If sediment samples are to be collected at the same location as surface water samples, the surface water samples must be collected first. In general, surface water samples should be collected from near the base of the water column, as near to the sediment/surface water interface as possible. The exception would be when sampling to assess a floating layer or sheen.

4. Surface water sampling from flowing bodies should be coordinated so as to reflect base flow conditions, and not during or immediately after a rainfall event.

5. The flow rate in a flowing water body should be measured or estimated.

6. When sampling in flowing water, the sample locations will depend upon the flow conditions and channel geometry relative to location of the suspected release. Stagnant pools should be avoided unless they are adjacent to a suspected discharge point. Samples are to be collected from the active flow tube within the stream. If the channel is linear, the sample should be collected from the same side of the stream as the source or suspected discharge point. When sampling for VOCs, avoid sampling below waterfalls or riffles or in shallow water in direct sunlight, where volatility effects could impact sample integrity.

7. Where possible, take field measurements (pH, temperature, conductivity, etc.) directly from the surface water body (not the sample) in the location from which the sample was collected.

8. Whenever possible, surface-water samples should be collected directly into the sample container. Samples for oil and grease, total petroleum hydrocarbons (TPH), etc., must be collected directly into the sample container. This procedure reduces any loss of volatiles, cross-contamination, or other alteration that could occur during transfer from a collection vessel into the sample container.

9. Samples collected for analysis of volatile organic compounds (VOCs) and some semivolatile organic compounds (SVOCs) must not be composited.

10. For any given stream, sampling should begin with the sampling point located farthest downstream and proceed upstream to prevent cross-contamination of downstream samples by upstream activities. For lakes and ponds, sampling should begin with the sampling point located closest to the discharge point and proceed around the lake or pond in an orderly fashion.

11. If wading is required, one should approach the sample site from downstream, being careful not to disturb any bottom sediment. The mouth of the sample container should be positioned so it faces upstream while the sampling personnel are standing downstream. In water bodies with little or no current, the sampling personnel should not enter the actual sample area. A pond sampler with an extendable handle should be used to reach the sample site.

12. Unless required otherwise, samples should be collected from below the water surface. The sample container should be submerged and then opened underwater to expel air.

13. Sample packaging, handling, and shipping shall be conducted in accordance with Sampling Handling Procedures in Attachment 8.

14. The collection of surface-water samples should be documented on the appropriate FADL and/or a sample collection form.

5.3.2 Preparation

The following steps should be taken when preparing for sampling surface water.

1. Conduct a presampling field reconnaissance to verify the presence of surface water and to assess field conditions. The

field reconnaissance will assist in the selection of appropriate equipment for health and safety and sampling requirements. The sampling locations should be assessed to 1) verify the surface water body is not excessively silty or muddy, and 2) for flowing water bodies, to verify that baseflow conditions prevail.

2. Calibrate field equipment and instruments as required and ensure they are in proper working order.

3. Record on the FADL a description of the site and sampling location. Include description of the water body (size, depth, flow, bottom materials).

4. Put on required protective clothing and gear as specified in the SAP and/or the Health and Safety Plan.

5. Prepare sampling site by laying out plastic sheeting on the ground and on any tables used. Segregate sampling equipment and supplies from the decontamination area.

6. Sampling equipment must be decontaminated prior to, between, and after sample locations in accordance with Attachment 9, Decontamination Procedures.

5.3.3 Shallow Surface-Water Sample Collection

5.3.3.1 Method of Collecting Samples of Near-Shore Surface Water for Volatile Organic Analysis

The following steps must be taken when collecting samples of near-shore surface water for volatile organic analysis (VOA).

1. Slowly dip VOA vial completely beneath the water and fill. Do not disturb bottom sediments. The open end of the vial should be pointed upstream in undisturbed, gently flowing water. The vial should be inverted so that only water from the desired sample point enters when turning the vial upright, expelling air (Otherwise, the sample contains the water that first enters the vial as it enters the water.

2. Be sure to dislodge any air bubbles from the vial before sealing with the cap.

3. If the VOA vial contains a preservative, carefully submerge a portion of the lip of the vial. Slowly fill the container while being careful not to overfill the vial Use

the vial cap to finish filling the vial. Ensure a meniscus is raised above the lip of the vial before capping.

4. Place cap with Teflon septum on each vial as it is filled.

5. Turn the vial upside down and check for air bubbles. Tap the bottom of the vials to dislodge any bubbles that may have formed around the cap or sides. If bubbles are present, remove the cap and refill the vial. If the vial contains a preservative, a new vial will be used.

6. Wipe dry the sample vials and label.

7. Place sample container(s) in zip-top or other plastic bags and immediately place into a sample cooler with ice and cool to 4 ± 2 ° Celsius (°C).

5.3.3.2 Method for Shallow Surface-Water Sample Collection for Nonvolatile Organic and Inorganic Compounds

The following steps must be followed when collecting shallow, surface-water samples for nonvolatile organic and inorganic compounds.

1. Use the appropriate flask, dipper, pail, or pond sampler (if required) to collect samples.

2. Immerse sample container into the water and fill. Do not disturb underlying sediments.

3. When collecting grab samples, the sample containers should be filled directly underwater.

4. If the Work Plan requires the collection of composite samples, collect a sufficient volume of water to fill all sample containers and place pooled samples into a stainless steel or glass mixing bowl. Homogenize the sample by stirring and pour into the appropriate sample containers.

5. Seal sample containers, wipe dry, and label.

6. Place sample container(s) in zip-top plastic bags and immediately place into a sample cooler with ice and cool to 4 ± 2 °C.

5.4 Collection of Samples for Oil and Grease, Total Petroleum Hydrocarbons, etc.

Samples collected for oil and grease, TPH, etc., must be collected directly into the sample containers from the water surface. Never composite samples collected for oil and grease, TPH, etc. These analytes will coat out on automatic samplers.

5.5 Deep Surface-Water Sample Collection

Numerous methods and devices have been used to collect discrete, at-depth samples from surface waters. The most practical methods incorporate the use of either a weighted bottle, Wheaton bottle, Kemmerer bottle, or a peristaltic pump.

The weighted bottle and the Wheaton bottle are very similar. The device is lowered to the desired depth, at which time a mechanism is activated to open the sampler. When the sampler is full, the device is raised to the surface and the contents are transferred to the appropriate sample containers.

The Kemmerer bottle is a messenger-activated water-sampling device. In the open position, water or other sample fluid flows through the device. Once lowered to the desired depth, a weighted messenger is dropped down the sample line, thus tripping the release mechanism and closing the bottle. In the closed position the bottle is sealed, allowing retrieval of the sample.

The peristaltic pump sampling system can be used to obtain surface-water samples at depths up to approximately 26 feet (ft). The peristaltic pump is suitable for most physical, chemical, or radiological parameters. If the flow rate of the pump is reduced to minimize sample agitation, this method may permit VOC sampling for definitive confirmation (if permitted by the appropriate regulatory agencies).

Note: All sampling equipment should be constructed of material that will not compromise the integrity of the sample (e.g., Teflon, stainless steel, or glass).

5.5.1 Method for Specified Depth Collection of Surface-Water Samples Using a Weighted Bottle Sampler

The basic operation of the weighted bottle sampler, the Wheaton bottle, and the Kemmerer bottle are similar; therefore, to avoid repetition, only the procedure for use of the weighted bottle is detailed here. The following steps must be followed when collecting (specified depth) surface water samples using a weighted bottle sampler.

1. Lower the weighted sampler to the specified depth.

2. Remove the stopper by pulling on the sampler line; this will fill the sampler.

3. Release the sampler line to reseat the stopper and retrieve to the surface.

4. Fill the appropriate sample containers. Samples may be composited in stainless steel or Teflon containers if required.

5. Seal each container as it is filled. Check for air bubbles in VOC samples. If bubbles are present, remove the cap and refill the container. If the vial contains a preservative, a new vial will be used.

6. Wipe dry the sample containers and label.

7. Place sample container(s) in zip-top plastic bags and immediately place in a sample cooler with ice and cool to 4 ± 2 °C.

5.5.2 Method for Deep Surface Water Sample Collection by Peristaltic Pump

The following steps must be followed when collecting deep, surface-water samples by peristaltic pump.

1. Install clean, medical-grade silicon or Tygon tubing on the pump head. Leave sufficient tubing on the discharge side for convenient dispensing of liquid directly into sample containers.

2. Select the appropriate length of Teflon intake tubing necessary to reach the specified sampling depth. Attach the intake sampling tube to the intake pump tube.

3. Lower the intake tube to the specified depth.

4. Start the pump and allow at least three volumes of liquid to flow through and rinse the system before actual sampling. Collect the purged liquid and then return it to the source after sample collection is complete.

5. If VOC samples are to be collected, reduce the flow rate of the pump to minimize sample agitation. Disconnect the Teflon tubing from the intake side of the pump. Seal the end of the tubing with the thumb and remove the Teflon tubing from the surface body of water. Slowly fill the VOA bottles from the end of the tubing. For VOC samples, allow a meniscus to form at the top before capping.

6. Fill the appropriate sample containers-for all analyses except VOCs-directly from the discharge line. Allow the liquid to flow

gently down the side of the sample bottle to minimize entry turbulence.

7. Cap and seal sample containers. Wipe dry the sample containers and label

8. Place sample container(s) in zip-top plastic bags and immediately place in a sample cooler with ice and cool to 4° ± 2°C.

9. Drain pump system and properly decontaminate and/or dispose of used materials.

5.5.3 Method for Deep Surface Water Sample Collection by Syringe Sampler (VOC Only)

1. Install clean, medical-grade silicon tubing on the 60 milliliter (ml) sterile medical catheter syringe. Leave sufficient tubing on to allow for sample collection depth with respect to the sample collection personnel (i.e., if a sample is being collected at the bottom of a sink hole that is 6 feet in depth and the sides of the sink hole are 4 feet from the center, then you will need approximately 11 feet of silicon tubing). A pole and cable ties will be needed to attach the syringe sampler in order to collect the sample at the desired location.

2. Attach a disposable polyethylene tubing connector to the silicon tubing. Attach a three foot section of clean disposable teflon tubing. The volume of the tubing will be approximately 90 ml. Attach the other disposable polyethylene tubing connector to the end of the Teflon® tubing in order to retain the sample volume.

3. Lower the syringe sampler intake tube to the specified depth.

4. Draw a vacuum by pulling back the syringe plunger. Collect the surface water drawn into the Teflon tubing and fill the appropriate VOC sample containers from the intake line. Allow the liquid to flow gently down the side of the sample bottle to minimize entry turbulence. Slowly push in the plunger which will slowly fill the VOA bottle from the end of the tubing. Allow a meniscus to form at the top before capping.

5. Return any excess volume to the surface water body after the sample collection is complete.

6. Cap and seal sample containers. Wipe dry the sample containers and label.

7. Place sample container(s) in zip-lock bags and immediately place in a sample cooler with ice and cool to 4 ± 2 °C.

8. If the dedicated materials come in contact with the sampling medium, decontamination or disposal is required to prevent cross-contamination.

5.6 Surface-Water Sample Compositing

Surface water samples can be composited on a spatial or temporal basis.

5.6.1 Surface Water Spatial Compositing

The following steps are to be followed when collecting spatially composited surface-water samples.

1. Determine where composite sample(s) will be obtained as detailed in the Work Plan.

2. Note: VOC and, in some cases, SVOC samples must be collected and contained immediately as discrete samples and, therefore, cannot be composited.

3. Collect a minimum of three equal-volume samples from the specified sample location. The volume of each sample must be at least the amount required for a single sample.

4. Place the samples in a stainless steel bowl and homogenize the pooled samples with a stainless steel spoon or dipper.

5. Transfer aliquots of the composited sample into the appropriate sample containers. Seal, rinse, label sample containers, and immediately place in a cooler with ice and cool to 4 ± 2 °C.

5.6.2 Time Averaged Compositing

Time averaged composite sampling is used to determine mass-per-unit time concentrations and to identify sporadically discharged contaminants from outfalls or streams. The system can be used for basins, ponds, pools, lakes, or streams. Time averaged composite samples can be collected with an automated sampler (i.e. ISCO sampler) or manually. Factor influencing the selection of the time averaged sampling method (automated sampler or manual sample collection) include, but are not limited to considerations such as sampling frequency, location accessibility, security, and budget constraints.

The following steps are to be followed when collecting time-averaged composite surface water samples with an automated sampler:

1. Place the automated sampler with the refrigerated sample-collection jar near the specified sample point. Appropriate

cleanliness applies here as it does for other surface-water sample collection.

2. Set mechanisms on the sampler to collect a selected volume at the desired time frequency (e.g., 250 milliliters of the total discharge at the same time each hour).

3. At the end of the period of sampling specified in the Work Plan, decant the samples, (including VOCs) into the appropriate sample containers.

4. Seal, rinse, label sample containers, and place in a cooler with ice and cool to 4 ± 2 °C. Handle with the same care as other samples from the site.

For each surface water sample collected, the technician will complete a SCL. This form prompts the technician to identify and record information such as: site ID, sample location ID, sample number, collection date and time, sample containers, and associated QC sample information. Other pertinent information to be recorded includes an estimate of flow rate (if applicable), diagram of sampling site, channel configuration, and height of water column. All sampling data and information will be recorded on the FADL for the site sampled. The FADL entries will be recorded chronologically and the time of the entry recorded first. All FADL continuation pages will be sequentially numbered and the last page recorded for the day will be signed and dated by the recording technician.

Records generated as a result of this SOPP will be controlled and maintained in the project record files.

5.7 Marking of Surface-Water Sample Locations

Sampling locations will be marked by a spray painted and labeled wooden stake that will be pounded into the bank deep enough to ensure it will remain during periods of high water or high flow. If the sampling location cannot be staked, the stake should be placed at the bank of the water body and the distance from the sampling location to the stake noted on the FADL or sample collection form.

If the staked location is not easily seen, flagging tape will be used to clearly mark the path to the sampling location. Prior to leaving the site, a sketch of the sampling location will be drawn, depicting all relevant landmarks. Photographs depicting the labeled stake may also be required to document the sample location.

6.0 EXCEPTION PROVISION

1. Surface water samples should not be collected if the area has received a significant amount of rainfall, and surface water bodies do not reflect baseflow conditions.

2. Surface water samples should not be collected if the surface water body is excessively muddy or silty.

3. Peristaltic pumps generally are not capable of collecting samples from depths exceeding 20-25 ft.

7.0 CROSS REFERENCE

Department of Energy, Environmental Survey Manual, DOE/EH-0053,19. Lockheed Martin Energy Systems, Inc., Quality Control Requirements for Field Methods, DOE/HWP-69/R2. , Hazardous Waste Remedial Actions Program, Oak Ridge, Tennessee, 1996.

Martin Marietta Energy Systems, Inc., *Grab Sampling with Kemmerer Bottles,* Environmental Surveillance Procedures, Method No. ESP 3014, 1988.

PEER Consultants, P.C., *Water Sampling With Wheaton Bottle,* Field Sampling Procedures, Method No. F-18, ESP-A-002B-1, 1990.

U.S. Environmental Protection Agency, *Practical Guide for Groundwater Sampling,* EPA/600/2-85/104, 1985.

U.S. Environmental Protection Agency, *A Compendium of Superfund Field Operations Methods,* EPA/540K/P-87/001, 1987/

U.S. Environmental Protection Agency, *Data Quality Objectives Process for Superfund,* EPA/540/G-93/071, 1993.

U.S. Environmental Protection Agency, Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, 1996.

8.0 TABLES

None.

9.0 ATTACHMENTS

None.

Attachment 8

Non-Hazardous Sampling Handling, Packaging and Shipping

SHAW STANDARD OPERATING PROJECT PROCEDURE

LONGHORN ARMY AMMUNITION PLANT

ATTACHMENT 8

Subject: NON-HAZARDOUS SAMPLE HANDLING, PACKAGING AND SHIPPING

1.0 PURPOSE AND SUMMARY

This Standard Operating Project Procedure (SOPP) establishes guidelines and procedures for field personnel to use in the packaging and shipping of environmental samples for chemical and physical analysis.

This SOPP only applies to the packaging and shipping of low concentration environmental samples. This procedure does not apply to those samples considered hazardous materials, hazardous waste, mixed waste, radioactive waste, or dangerous goods. Those requirements are specified in the Department of Transportation (DOT) 49 CFR 171-178 and the most current edition of the International Air Transport Association (IATA) Dangerous Goods Regulations. The details within this SOPP are only applicable to the general requirements for sample packaging and shipping and should only be used as a guide for developing more job-specific work plans.

The details within this SOPP should be used in conjunction with the Work Plan, which will generally provide the following information:

- Sample collection objectives
- Locations and depths of soil samples to be collected
- Numbers and volumes of soil samples to be collected
- Types of analyses to be conducted for the samples
- Specific quality control (QC) procedures and sampling required

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3.0 RESPONSIBILITY MATRIX

3.1 Site Manager: The Site Manager or Field Team Leader, is responsible for ensuring field activities are completed to meet the project objectives, are conducted in accordance with the project plans and requirements, and all activities are performed according to the respective procedures. The Site Manager is responsible for ensuring all site personnel are trained in the procedures, the procedures are adhered to, and all activities are documented.

3.2 Field Team: All members of the field team (samplers, technicians, field geologists, engineers, etc.) are responsible for understanding and implementing this field procedure as well as ensuring all team members also perform work in accordance with this procedure.

3.3 Site Contractor Quality Control Systems Manger (CQCSM): The Site CQCSM is responsible for the periodic review of documentation generated during sample handling, packaging, and shipping and the periodic review and audit of field personnel as they perform the work. If problems arise, the site CQCSM is also responsible for swift implementation of corrective action (i.e., retraining personnel, additional review of work plans and procedures, variances to requirements, issuing nonconformances).

4.0 DEFINITIONS

Environmental Sample - A low concentration sample that does not meet DOT or IATA definitions for a regulated shipment.

Hazardous Materials/Dangerous Goods Sample - Medium or high concentration sample regulated by either DOT or IATA.

Hazardous Waste - Any substance listed in 40 CFR Subpart D (260.30 et seq.) or otherwise characterized as ignitable, corrosive, reactive, or toxic as specified in Subpart C (261.20 et seq.) that would be subject to manifest and packaging requirements specified in 40 CFR 262. Hazardous waste is defined and regulated by the U.S. Environmental Protection Agency (USEPA).

Hazardous Material/Dangerous Good - A material in a quantity or form which may pose an unreasonable risk to health, safety, and/or property as defined by DOT when transported in commerce. Hazardous materials are defined by DOT (49 CFR 171.8), and dangerous goods are defined by IATA (Section 3).

Sample - Physical evidence collected from a facility or the environment which is representative of conditions at the point and time at which the sample is collected.

U. S. DOT Regulations – Requirements for shipping hazardous materials by highway domestically found at 49 CFR 171-178.

IATA Regulations, current edition – Requirements for shipping dangerous goods by air both domestically and internationally.

5.0 TEXT

5.1 Supplies and Equipment

The following is a list of the supplies and equipment needed to implement this SOPP in the field.

5.1.1 Required Records and Forms

1. Sample Collection Log (SCL)
2. Field Activity Daily Log (FADL)
3. Sample tags/labels and the appropriate forms/documentation for sample shipment
4. Material Safety Data Sheets (MSDS)
5. Site-Specific Field Sampling Plan.
6. CFR 171-178 for ground shipping or the IATA regulations for air shipping.

5.1.2 Materials, Equipment, or Supplies

1. Indelible black-ink pens and markers
2. Plastic or metal coolers (typically provided by the laboratory)
3. Waterproof sealing tape
4. Ice (double bagged)
5. Fiberglass packing tape
6. Nitrile or Latex gloves
7. Plastic Zip-Loc® bags
8. Bubble wrap, styrofoam packing material, vermiculite (or other absorbent)

5.2 Procedures

The following steps must be followed when packaging and shipping non-regulated environmental samples:

1. Properly label (with indelible ink) sample container with the site, unique sample identifier, matrix type, time and date of collection, analytical method, preservatives, and sampling personnel at the time of sample collection. Clear tape should be placed over the label to minimize damage to sample label caused by moisture.

2. As soon as possible after sample collection, tightly seal the container, and place a piece of custody tape over or around the cap. The custody tape should be placed over the cap so that any attempt to remove the cap will cause the tape to be

broken. Do not place custody tape over a volatile organic analysis (VOA) vial septum.

3. Prepare chain-of-custody and request for analyses forms as required by the Quality Control Plan.

4. Place all containers in separate, appropriately sized, airtight, seam sealing polyethylene bags (e.g., Ziploc®). Seal the bag, removing any excess air and wrap with bubble wrap or similar material.

5. Place the bagged container inside an insulating shipping container, such as a common plastic picnic cooler (not styrofoam).

6. Surround the bagged container with absorbent material (e.g., vermiculite).

7. Samples must be packed so they are surrounded and covered by a sufficient volume of ice to maintain a 4 ± 2 degrees Celsius (°C) temperature immediately following collection of the samples in the field and during the entire shipping period. Ice used in the cooler must be contained in two sealed, leak-proof plastic bags to prevent contact of the sample containers with melted ice.

8. Samples labels must be compared to the COC forms to ensure proper documentation. Sample labels must be attached so they will not come loose from sample containers during shipment or if they become wet (the use of clear tape wrapped around the label will prevent this).

9. Place additional packing material (e.g. bubble wrap, vermiculite, or styrofoam) on top of the samples to eliminate the potential for samples to shift during shipment. Cushioning materials may be used to inhibit breakage of sample containers; however, cushioning material must not interfere with maintaining sample cooling.

10. Record the air bill number or other shipping information on the COC.

11. Place the original COC in a resealable bag and tape to inside of top of cooler. A copy of the COC must be retained for the field file.

12. Place custody seals on shipping container. Use custody seals on individual bottles if coolers might be opened during transport (customs, etc.).

13. Seal cooler with strapping tape over the custody seals. Place address label on cooler. Mark the container "THIS END UP," or apply arrow labels that indicate the proper position to be maintained during shipping.

14. If samples are shipped via commercial overnight delivery service, a copy of the shipping bill must be retained in the appropriate files. All pertinent information

must also be recorded on the FADL. If sampling personnel are delivering samples to the laboratory, this should be noted on the COC. In this case, the cooler need not have custody seals during transport.

15. The laboratory should be contacted to confirm safe arrival of all samples. If delivery of samples will occur at the laboratory on weekends or holidays, the laboratory will be notified to have someone available to receive them. Any problems occurring after sample shipment should be recorded on the FADL along with the names of personnel at the laboratory who explained the problem.

16. For packages containing preserved samples or sample containers with preservative inside, shipping details are provided in Section 7.0, "Restrictions/Limitations".

6.0 EXCEPTION PROVISIONS

1. Blue ice or similar products are not allowed for shipping because it/they do not maintain the 4°C standard required for sample shipping, it should only be used while in the field collecting samples.

2. Samples must be packed so they are surrounded and covered by a sufficient volume of ice to maintain a 4 ± 2 °C temperature immediately following collection of the samples in the field and during the entire shipping period. Ice used in the cooler must be contained in sealed, leak-proof plastic bags to prevent contact of the sample containers with melted ice.

3. When shipping packages containing samples preserved with corrosives such as hydrochloric acid, sulfuric acid, and sodium hydroxide, the samples will not meet DOT's definition of Class 8 – Corrosives <u>because of the preservative</u> as long as these limitations are met:

   - hydrochloric acid in water solution at a concentration of 0.04% or less by weight ($pH \geq 1.96$),
   - nitric acid in water solution at a concentration of 0.15% or less by weight ($pH \geq 1.62$),
   - sulfuric acid in water solution at a concentration of 0.35% or less by weight ($pH \geq 1.15$), and
   - sodium hydroxide in water solution at a concentration of 0.08% or less weight ($pH \geq 12.30$).

4. After it has been established that the samples do not meet DOT's definition of Class 8 – Corrosive <u>because of the preservative</u>, it must still be determined if the contaminant of concern causes the sample to meet any of DOT's hazard class definitions. If it does, appropriate identification, classification, packaging, marking, labeling, and documentation must be performed accordingly.

5. When shipping bottles that contain only preservatives, the trained shipper will attempt to meet the small quantity/excepted quantity or limited quantity requirements detailed in the DOT or IATA regulations in order to reduce preparation time, materials costs, handling hazards, and shipping costs. Complete instructions and found in the appropriate sections of the applicable regulations.

6. Per 49 CFR 172 Subpart H, an employee who performs hazardous materials (or dangerous goods) shipping is required to complete General Awareness and Function-Specific Training covering his or her particular shipping responsibilities to be updated at least every three years for domestic shipping or every two years for international shipping.

7.0 RECORDS

All sample packaging and shipment data will be recorded on the book or FADL for the samples shipped. The FADL entries will be recorded chronologically and the time of the entry recorded first. All FADL continuation pages will be sequentially numbered and the last page recorded for the day will be signed and dated by the recording technician.

Records generated as a result of this SOPP will be controlled and maintained in the project record files.

8.0 CROSS REFERENCE

Department of Transportation, *Hazardous Materials Regulations*, 49 CFR Parts 171-180.

EPA, 1996, *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*, Region 4, Athens, GA.

HAZWRAP, 1996. *Document No. DOE/HWP-100, Standard Operating Procedure 5C, Packing and Shipping Environmental Samples.*

International Air Transport Association, *Dangerous Goods Regulations*, current edition.

9.0 TABLES

None.

10.0 ATTACHMENTS

None.

Attachment 9

Field Equipment Decontamination

SHAW STANDARD OPERATING PROJECT PROCEDURE

LONGHORN ARMY AMMUNITION PLANT

ATTACHMENT 9

Subject: FIELD EQUIPMENT DECONTAMINATION

1.0 PURPOSE AND SUMMARY

The objective of this procedure is to describe the proper methods for decontaminating downhole and sampling equipment used to perform field investigations.

Decontamination of field equipment is necessary to ensure that chemical analyses reflect actual concentrations at sampling locations by maintaining the quality of samples and preventing cross-contamination. Furthermore, decontamination reduces the health hazards to field personnel and prevents the spread of contaminants off-site.

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- 5.2 Required Materials Equipment, or Supplies
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3.0 RESPONSIBILITY MATRIX

3.1 Site Manager

The Site Manager or Field Team Leader, is responsible for ensuring that field activities are completed to meet the project objectives, that they are conducted in accordance with the project plans and requirements, and that all activities are performed according to the respective procedures. The Site Manager is responsible for ensuring that all site personnel are trained in the procedures, that the procedures are adhered to, and that all activities are documented.

3.2 Field Team

All members of the field team (samplers, technicians, field geologists, engineers, etc.) are responsible for understanding and implementing this field procedure as well as ensuring that all team members perform work in accordance with this procedure. The field team members are also responsible for communication of issues with task managers and technical leads, and for documenting change orders and directions.

3.3 Site Contractor Quality Control System Manager

The site CQCSM is responsible for ensuring that this procedure is correctly implemented and that the quantity and quality of field equipment decontamination activities meet the requirements of the project Work Plan.

4.0 DEFINITIONS

Decontamination. The process of removing or reducing undesirable physical and chemical constituents, from equipment or materials that come into direct contact with the sample media. Decontamination minimizes the potential for cross-contamination and ensures the representativeness of physical or chemical analyses proposed for a given sample.

Sampling Equipment. Sampling equipment includes split spoons, hand augers, bailers, submersible pumps, bowls, knives, scoops, water samplers, non-disposable filtration equipment, or any equipment that directly contacts samples.

Sample Contacting Equipment. Equipment that comes in direct contact with the sample or portion of the sample that will undergo chemical analyses or physical testing (for example, bailer, split-spoon sampler).

Potable water. Tap water used for drinking purposes by general population.

Deionized water. Deionized, solvent-free water (ASTM Type II or equivalent). Deionized water can be provided by the laboratory.

Detergent. Laboratory grade detergent for washing equipment is recommended such as Liquinox® or Alconox®.

5.0 TEXT

5.1 Required Forms and Documentation

- Field Activity Daily Log (FADL)
- Material safety data sheets (MSDS).

5.2 Required Materials, Equipment, or Supplies

Decontamination procedures for small equipment; downhole and heavy equipment; pumps; and downhole probes are described below separately. Each section also includes the required materials, equipment, and supplies.

5.3 Specific Requirement for Small Sampling Equipment

Before samples are collected, small sample-contacting equipment will be decontaminated appropriately. Small sampling equipment includes split spoons, bailers, knives, mixing bowls, etc. Equipment necessary to complete decontamination procedures includes:

- 5-gallon (gal) or larger plastic buckets or troughs
- Laboratory-grade detergent; Liquinox® recommended
- Three stiff-bristle brushes capable of cleaning the inside and outside of equipment
- Teflon® sprayers or wash bottles, or 2 - to 5 - gallon manual pump sprayer (pump sprayer material must be compatible with the solution used)
- Plastic sheeting
- Disposable wipes
- Aluminum foil
- Potable water
- Deionized water
- 10 % Nitric acid solution made from reagent grade nitric acid and deionized water (use only on glass, Teflon®, or stainless steel)
- Gloves, goggles, and other protective clothing as specified in the site-specific health and safety plan.

The following decontamination procedures will be followed:

1. Set up a decontamination line on plastic sheeting covering the ground or on a table covered by plastic sheeting or aluminum foil (shiny side away from equipment). At a minimum, clean plastic sheeting must be used to cover the ground beneath decontamination equipment and plastic sheeting or aluminum foil must cover tables or other surfaces where decontaminated equipment is to be placed. The decontamination area should be located away from potential contaminant sources (e.g., construction areas) to reduce or eliminate potential cross-contamination during decontamination. The decontamination area should progress from "dirty" to "clean" and end with an area for drying equipment.

2. The decontamination line should consist of several buckets or troughs in one line. The first bucket will contain a detergent solution. The next two buckets will contain potable water for rinses. A final liberal rinse of deionized laboratory grade water with a bottle sprayer completes the line.

3. Dislodge as much loose dirt as possible from equipment before beginning the decontamination process. Wash the item thoroughly in the bucket or trough of

detergent solution. Use a stiff-bristle brush to dislodge any clinging dirt. Before washing, disassemble any items that might trap contaminants internally.

4. Rinse in second bucket or trough containing potable water. Rinse water shall be replaced as necessary (generally when water is cloudy).

5. Repeat step 3 in the third bucket or trough for a second rinse. A rinse with nitric acid in a spray bottle may be added before this step if sampling for metals.

6. Using a hand sprayer, rinse the item with deionized water over the fourth bucket.

7. If the equipment will have time to fully air dry before its next use, allow to air dry. If the equipment will not be allowed to fully air dry, rinse with deionized water over the last rinse bucket before reassembling or using any equipment.

8. If equipment will not be used immediately after drying, wrap in aluminum foil (shiny side out) for storage and transport.

9. Record decontamination protocol, equipment types, and date on the FADL at each occurrence.

10. After the decontamination activities are complete, collect all contaminated waters, plastic sheeting, aluminum foil, disposable gloves, boots, and clothing. Place contaminated items in properly labeled containers for disposal. Liquids and solids must be drummed separately. Decontamination water can be taken to the on site groundwater treatment system for disposal.

5.4 Specific Requirement for Downhole and Heavy Equipment

Downhole equipment consists of nonsampling tools such as hollow-stem augers, drill pipe, bits, casing, and screen. Drill rigs, backhoes, and other heavy machinery are also included. Equipment necessary to complete decontamination procedures includes:

- Plastic sheeting or steel, prefabricated decontamination pad. See below for decontamination pad construction requirements.
- Metal, wooden, or plastic sawhorses or other stands
- Laboratory-grade detergent, Liquinox® recommended
- Steam cleaner or high pressure hot water washer capable of generating 2,500 pounds per square inch of pressure and producing steam or hot water (200 °F), with soap compartment
- Stiff-bristle brushes
- 2- to 5-gal manual pump sprayer (pump sprayer must be compatible with the solution used)

- Potable water
- Gloves, goggles, boots, and other protective clothing as specified in the site-specific health and safety plan.

Before drilling, sampling, excavating, leaving the site, and in between each location, all drilling equipment used in field sampling activities must be decontaminated. All downhole augering, drilling, and sampling equipment shall be sandblasted (off-site) if it is new, painted, (such as split spoons or auger flights) or exhibits build-up of rust or caked material. Heavy equipment not directly used for sampling will be decontaminated at a designated area designed to contain decontamination wastes and waters. The area designated is located at the on site wastewater treatment plant decontamination pad. If a decontamination pad is needed for site-specific requirements, a temporary pad can be constructed. The following steps must be taken when decontaminating this equipment.

1. Set up a decontamination pad that is large enough (up to the size of the drill rig) to fully contain the equipment to be cleaned. If practical, a centralized decontamination area should be established. This area should be set up to contain contaminated rinse waters and may be constructed using one or more layers of heavy plastic sheeting, 6mm or heavier, with bermed sides, a lined excavated pit, or a bermed concrete or asphalt pad. If possible, the area should be constructed to eliminate or minimize any overspray or wind-blown spray from decontamination activities (e.g., plastic sheeting secured to a wood frame surrounding the area). The decontamination area must be constructed so that fluids can be easily pumped from the area to holding containers.

2. Set up a "clean" area upwind of the decontamination pad to receive cleaned equipment for air drying. At a minimum, clean plastic sheeting must be used to cover surfaces on which decontaminated equipment is to be placed.

3. Don personal protective equipment as specified in the site-specific health and safety plan before beginning cleaning activities.

4. For heavy equipment, areas exposed to contaminated soil should be sprayed using a steam spray unit. Be sure to spray down all surfaces, including the undercarriage. It is also good practice to clean the motor, hydraulic lift, oil fill, and fuel tank area to avoid introducing contamination at the work site.

5. For smaller equipment such as augers, place the objects to be cleaned on metal or plastic-covered wooden sawhorses, supports, or decontamination trays. Using the steam-spray unit, spray the contaminated equipment. Be sure to spray inside corners and gaps especially well; use a brush, if necessary, to dislodge dirt.

6. For steps 4 and 5, aim the sprayer downward as much as possible to avoid spraying outside the decontamination area.

7. If the condition of downhole or heavy equipment warrants using hot soapy water in the steam-spray unit, rinse the equipment with clean, clear potable water following the steam spray. If using steam spray without a detergent the potable water rinse is not necessary.

8. Remove the equipment from the decontamination area to the "clean" area to dry.

9. Record decontamination protocol, equipment types, and date on the FADL.

10. After decontamination procedures are complete, or any time the decontamination fluids fill the bermed or contained area, decontamination fluids will be collected and transferred to appropriate containers. Place all plastic and personal protective equipment into appropriate containers. All containers must be labeled properly for disposal. Liquids and solids must be drummed separately.

5.5 Specific Requirement for Pump and Pump Assemblies

Any pump in which potentially contaminated fluids come into contact with any part of the pump equipment requires decontamination. This requirement does not apply to peristaltic pumps because water does not contact any part of the pump. Only Teflon® or Teflon®-lined tubing should be reused for sampling after decontamination. If using PVC or polyethylene tubing, discard the tubing after each use unless the tubing is used for well development, where properly-decontaminated tubing may be reused. Polyethylene or PVC tubing can not be properly decontaminated and potential for cross-contamination during sampling remains high. This requirement also applies to the tygon tubing attached to the rollers of a peristaltic pump. The tygon tubing shall be discarded after use at a well.

The procedure provided below applies primarily to the decontamination of bladder pumps. A field setup may be implemented while decontaminating pumps other than bladder pumps or if frequent trips to the field office are not practical or cost effective. Equipment needed to complete decontamination procedures include:

- Deionized water
- Plastic sheeting
- Source of electricity (generator or direct line)
- Compressor and controller for bladder pumps
- Three to five decontamination cells (4-inch diameter PVC) for pumps and tubing
- Laboratory-grade detergent, Liquinox® recommended
- Gloves, goggles, boots, and other protective clothing as specified in the site-specific work plan.

Following the use of a pump for development, purging, or sampling, the pump should be decontaminated by the following method.

1. Set up decontamination cells in a line on the plastic. Only three cells are required for normal decontamination.

2. Add potable water with a small amount of detergent to the first container; add potable water alone to the second container. Add deionized water to the third container. There should be sufficient water in each container to accomplish the decontamination procedure.

3. Place one drum close enough to the decontamination area to collect the spent decontamination fluids.

4. Place the pump in the first container and pump enough water through it to equal at least three pump-and-tube-volumes. Pump the water into the waste drum. Move the pump to the second container and repeat. Repeat again with deionized water in the third cell. However, one volume of deionized water is the minimum amount required for this rinse.

5. If necessary, the pump can be disassembled and each part can be decontaminated using several buckets as described in the equipment decontamination method above.

6. Record decontamination protocol, equipment types, and date on the FADL.

7. After decontamination activities are complete, collect all contaminated water; solvents; plastic sheeting; aluminum foil; and disposable gloves, boots, and clothing. Place contaminated items in properly labeled drums for disposal. Liquids and solid wastes must be drummed separately and handled in accordance with the investigation-derived waste procedure. (Liquids will be disposed at the on site wastewater treatment plant.)

5.6 Specific Requirement for Downhole Probes

Decontamination of downhole probes, such as water level indicators, pressure transducers, Trolls®, etc. shall be based on the contamination expected in a well and on professional judgment.

5.6.1 Water Level Indicator

For decontaminating water level indicators during snapshot water level sweeps, follow the steps given below:

1. Carry a detergent solution and deionized water in two separate spray bottles.

2. Spray detergent solution in a piece of paper towel and deionized water in another piece of paper towel.

3. This method involves wiping the water level indicator cable as it is pulled out of a well.

4. Grab the water level indicator cable with the two paper towels in your hands such that the detergent paper towel is below the deionized water paper towel.

5. The cable should be pulled out slowly by a second person and rolled onto the carrying wheel.

6. Once the probe is out of the well, spray it first with the detergent solution and then with deionized water. Wipe with a clean paper towel and store in the carrying case.

Records generated as a result of this written procedure will be controlled and maintained in the project record files.

5.7 Restrictions and Limitations

- Fluids decontamination rinses must be stored separately until disposal is made at the on site wastewater treatment plant.

- All deionized or distilled water must have field-blank samples collected and analyzed at the proper frequency to ensure the purity of the water.

6.0 EXCEPTION PROVISIONS

None.

7.0 REFERENCES

American Society for Testing of Materials (ASTM), 1990, *Standard Practice for Decontamination of Field Equipment Used at Radioactive Waste Sites*, D 5088-90, September.

U.S. Environmental Protection Agency (EPA), 1991, *Handbook of Suggested Practices for the Design and Installation of Around-Water Monitoring Wells*, EPA/600/4-89/034, PB 92-216886, March.

U.S. Environmental Protection Agency (EPA), 1996, *Standard Field Cleaning Procedures, Appendix B, Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*, USEOA Region 4, May.

8.0 TABLES

None

9.0 ATTACHMENTS

None.

Attachment 10

Investigation Derived Waste

SHAW STANDARD OPERATING PROJECT PROCEDURE
LONGHORN ARMY AMMUNITION PLANT
ATTACHMENT 10
Subject: INVESTIGATION DERIVED WASTE

1.0 PURPOSE AND SUMMARY

This Standard Operating Project Procedure (SOPP) establishes specific management practices for the handling and subsequent disposition of environmental media generated as a result of investigation actions.

Longhorn Army Ammunition Plant (LHAAP) is conducting investigation activities that generate waste materials. The waste materials typically consist of environmental media (drill cuttings, monitor well purge and development water), and project-related trash (spent PPE and other inert materials such as plastic, rope, tape, paper, etc. that are generated during well installation and sampling activities and associated site activities. When accumulated, the waste materials must be managed appropriately to minimize the exposure to human health and the environment while adhering to applicable regulatory requirements.

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3.0 RESPONSIBILITIES

3.1 Site Manager

The Site Manager or Field Team Leader, is responsible for ensuring that field activities are completed to meet the project objectives, that they are conducted in accordance with the project plans and requirements, and that all activities are performed according to the respective procedures. The Site Manager is responsible for ensuring that all site personnel are trained in the procedures, that the procedures are adhered to, and that all activities are documented.

3.2 Field Team

Members of the field team (samplers, technicians, field geologists, engineers, etc.) are responsible for understanding and implementing this field procedure as well as ensuring that all team members also perform work in accordance with this procedure.

3.3 Site Contractor Quality Control Systems Manager (CQCSM)

The Site CQCSM is responsible for ensuring that this procedure is correctly implemented and that the quantity and quality of field measurable physical characteristic samples collected meet the requirements of the project.

4.0 DEFINITIONS

None.

5.0 TEXT

5.1 Required Records and Forms

- Sample Collection Log (SCL)
- Field Activity Daily Log (FADL)
- Sample tags/labels and the appropriate forms/documentation for sample shipment
- Material Safety Data Sheets (MSDS)
- Field Sampling Plan/Work Plan.

5.2 Required Materials, Equipment, or Supplies

- Indelible black ink pens and markers
- Appropriate sample containers
- Insulated cooler and water proof sealing tape
- Nitrile or latex gloves
- Decontamination equipment and supplies, including rinse bottles and deionized water
- Personal protective clothing and gear
- Appropriate equipment and meters for obtaining field measurements (i.e., PID/FID).

5.3 Procedures

5.3.1 Preparation

The following steps must be followed when preparing for management of IDW:

- Verify that all personnel have read and understand the approved site-specific health and safety plan and have the proper training and certifications required under OSHA.
- Don the appropriate personal protective clothing as dictated by the site-specific health and safety plan.
- Document the sampling events, recording the information on the SCL or equivalent form as specified. Document any and all deviations from standard operating procedures on the FADL and include rationale for changes.

5.3.2 Specific Preparation

The following paragraphs detail the planned methodologies for dealing environmental media once generated during site activities

Initial Handling Requirements

All environmental media will be managed in an effort to minimize exposure to human health and the environment. Typically, the media will be generated as a result of two major activities, drilling soil-test borings and constructing and sampling ground-water monitoring wells. In instances where soil test borings are advanced, either for the sole purpose of retrieving soil samples or to allow for the retrieval of a ground-water sample via a hydropunch or similar sampling device, including obtaining a sample from an open borehole, the following handling protocols for investigation-derived waste (IDW) soil will be used:

- All soil cuttings will be placed adjacent to the borehole on plastic or other suitable material capable of precluding contact with the ground surface.
- All cuttings will be covered daily or during rainfall events to prevent contact with moisture.
- Upon completion of the downhole activity (i.e., drilling, groundwater sampling, etc.), the soil cuttings will be placed back into the borehole from which they were generated.
- Replaced cuttings will be compacted to the extent practical and a 1- by 1-foot by three inches thick grout cap will be placed over the top of the borehole to prevent vertical migration of surface water.

In cases where a soil-test boring is advanced for the purposes of installing a groundwater monitoring well, all environmental media accumulated will be containerized to allow for characterization upon generation and situated at a

designated staging area or near the point of generation. As solids are generated, they will first be placed into 55-gallon drums, or other approved containers including roll-off boxes, until they are characterized as hazardous or nonhazardous. Pending further characterization, solids may be bulked into larger approved containers situated within the work area. Liquids may be bulked upon generation unless directed otherwise. All solids and liquids will be separated prior to disposal.

After each container (i.e., drum, roll-off box, etc.) has been filled, the container and lid, if appropriate, will be labeled indicating a description of the media (i.e., soil, purge water, decon water, PPE), origin of media (i.e., sample identification such as boring or well), date the media was placed in the container, site identification (i.e., LHAAP-##), date container was sealed and sampled, and any other pertinent information (i.e., hazardous versus nonhazardous). The containers may be labeled using a paint pen or other indelible marker that will not fade when exposed to weather. A record of the number of containers and their contents will be completed at each generation site and will be included in the logbook before leaving each site.

At the end of each day and/or field activity, all containers will be sealed or covered in such a way to prevent the introduction of rain water or surface run-off.

A centralized staging area will be assigned for each site prior to initiation of any site work. Unless directed otherwise, the staging area will be located within the boundaries of the site where field work will take place. All filled containers generated for a given site will be placed in the central location. The containers will be moved from their original filling location to the staging area within 5 days of filling. In the event that conditions indicate the potential for reactive wastes, special handling and storage precautions will be utilized. The integrity of containers moved to the staging area will be monitored routinely, as required.

Waste may be transported between sites when required or in preparation for disposal activities without specific regulatory concurrence.

5.4 Characterization of Environmental Media

The characterization of environmental media will be determined by a two-step process. First, the materials will be characterized using analytical data obtained during the activity from which the materials were generated previously. As stated, it is anticipated that specific generation activities will include soil-test borings, monitoring well installations, and monitoring well purge and development actions. Water obtained from specific monitor well sampling points (i.e., purge and development water) will be characterized using groundwater sampling data taken from the specific well site from which the water was obtained. Analytical data

obtained from a particular borehole reflecting soil contaminant levels will be used to characterize solids generated from that borehole. Other solids such as rock and other environmental media generated during field activities will be characterized for disposal based on the analytical results of the soil and water sampled at the specific location where the solids were generated. Analytical results from both soils and water will be used to characterize decon water. When appropriate, analytical data will be extrapolated to reflect toxicity characteristic leaching procedure (TCLP) values (i.e., 20x divisor rule for soils). Generator's knowledge may be used to evaluate the media potential for corrosivity, ignitability, and reactivity.

If analytical results indicate contaminant levels below 75 percent of TCLP values, no additional analytical testing will be performed and the media will be considered nonhazardous. When analytical results indicate that elevated contaminant levels (i.e., more than 75 percent of TCLP) are present, additional analyses will be performed. In these cases, composite samples will be taken for each type of media generated (i.e., soil, water) and for each specific generation location (i.e., monitoring well, soil boring, etc.). Samples will be taken directly from the containers. Where multiple numbers of containers are generated for a particular media and generation site, the samples will be taken to ensure that the volume of soil from which one composite sample is prepared is equivalent to no more than the volume contained by ten 55-gallon drums. The suite of analyses to be run will be determined based on suspected contaminants and any prior available analytical data. Generator knowledge may be used to minimize the volume of analytical test required to adequately characterize the media. Hazardous versus nonhazardous determinations will be made utilizing those parameters outlined in the Texas Administrative Code. All sampling and analytical testing protocols will be consistent with TCEQ/EPA requirements and methodologies.

5.5 Management and Disposition

Once adequately characterized, the containers will be labeled as described. U.S. Department of Transportation (DOT) approved labels will be used if transportation outside of LHAAP boundaries is required or anticipated. Waste materials may also be bulked on site (within the staging area), with like waste streams possessing compatible nonreacting characteristics. Hazardous and nonhazardous materials will be segregated and all liquids and solids will be separated. Other specific management requirements are as follows:

5.6 Waste Water

In general, all waste water (including decontamination water) generated during the described site activities will be disposed within the confines of LHAAP at the onsite groundwater treatment plant (GWTP). Other specifics are as follows:

5.6.1 Nonhazardous Wastewater

Wastewater determined to be nonhazardous (Section 40 Code of Federal Regulations [CFR] Part 261), but possessing some level of contaminants, will be disposed directly into LHAAP's GWTP.

5.6.2 Hazardous Wastewater

Hazardous wastewater will be transported, when required, and treated at an appropriate treatment facility when the following conditions are met:

1. The treatment facility meets the definition of a waste water treatment unit as defined in the Texas Administrative Code.

2. The treatment facility is capable of (a) rendering characteristically hazardous wastes nonhazardous or (b) removing listed wastes from the contaminated media so that the media no longer contains the listed waste for which the media was originally considered hazardous. If after treatment, analytical tests show the listed waste is not present above laboratory detection limits, then the contaminated media will be considered to no longer contain the listed waste and will no longer be considered hazardous.

Wastewater determined to be hazardous may be transported between sites and within LHAAP boundaries for treatment/disposition in accordance with the previously outlined provisions without specific regulatory concurrence.

In the event that LHAAP does not have a facility on-line capable of treating the hazardous wastewater, the water will be taken to a fully permitted, off-site treatment/disposal facility in accordance with state and federal regulations.

Unless specifically mandated by TCEQ and the EPA, the treatment and disposal of hazardous and nonhazardous wastewater will be performed as previously described. The wastes will be treated and disposed in a timely manner so as to expedite site activities and to ensure the protection of human health and the environment. Except where noted, specific written concurrence from TCEQ and EPA prior to those actions previously described is not required.

5.7 Solids

Solids may include soil cuttings, rock, grout, and other environmental media generated during field activities. All solids will be containerized at or near the point of generation and staged as described in Section 5.3.2. Other specific management practices are as follows:

5.7.1 Nonhazardous Solids

Soil cuttings and rock determined to be nonhazardous will be staged within the confines of the site from which they were generated. After characterizations (hazardous versus nonhazardous) are finalized and depending upon site conditions, nonhazardous cuttings will be removed from containers and replaced "at or near" the location from which they were derived. "At or near" infers a media will be placed as near to its point of origin as is practical. Examples would be placing monitoring well cuttings

around the monitoring well from which they originated as opposed to within it. However, when not practical, the media may be centrally located within the confines of the originating site in an area of minimal traffic and where the media could be managed in a manner protective of human health and the environment.

In the event that site conditions are not conducive to the replacement of the materials, soils exhibiting contaminant levels below analytical detection limits are considered non-regulated and will be disposed at the discretion of LHAAP representatives.

5.7.2 Hazardous Solids

For management and disposition purposes, the solids will be broken into two major categories: those exhibiting hazardous characteristics and those containing listed hazardous waste.

Solids exhibiting hazardous characteristics or that contain a listed hazardous waste will be stored upon generation "at or near" the point of generation within the site of origin or bulked in anticipation of disposal activities at a centralized location at LHAAP. Secondary containment will not be required for the storage of hazardous solids as long as the containers are secure and monitored routinely for releases. Unless otherwise directed, the solids will not be subject to 90-day storage requirements.

Whenever practical and depending upon actual site conditions, containerized solids that do not possess hazardous characteristics but do contain listed wastes, will be removed from their storage containers and replaced "at or near" the location from which they were derived. The solids may be replaced anytime after characterization is complete, but most likely at the end of the project phase. Once replaced, the materials will be managed in a manner as to minimize surface erosion. Because of the known presence of contaminants, the solids will be managed in a manner protective of human health and the environment.

The disposition of solids possessing hazardous characteristics will be determined on a case-by-case basis depending on specific contaminants, concentrations, and site conditions. The solids will be returned (i.e., from storage containers) to the site from which they were generated and the remediation of the media, if required, will be addressed, at which time a remedial plan is prepared for other contaminated soil at the site. Prior to this replacement, a request detailing the planned placement procedures with a site sketch indicating the planned placement location will be provided.

In the event that hazardous solids are not allowed to be returned to the site and on site treatment is not available, the media will be disposed off-site in

accordance with state and federal requirements in a permitted disposal facility, as required.

5.8 Trash

Trash includes nonhazardous solids such as spent PPE, plastic sheeting, rope and unused monitor well construction materials generated during field activities. These materials will be placed into dumpsters or roll-offs for disposal at a permitted solid waste disposal facility.

6.0 EXCEPTION PROVISION

None.

7.0 CROSS REFERENCES

U.S. Environmental Protection Agency (EPA), 1992a, ***Guide to Management of Investigative-Derived Wastes***, Office Of Solid Waste and Emergency Response, Publication 9345.3-03FS, April 1992.

U.S. Environmental Protection Agency (EPA), 1992b, ***Management of Contaminated Media***, Region IV EPA, Guidance Number TSC-92-02, December 28, 1992.

U.S. Environmental Protection Agency (EPA), 1991, ***Management of Investigative-Derived Wastes During Site Inspections***, Office Of Research and Development, Publication, EPA/540/G-91/009, May 1991.

8.0 TABLES

None.

9.0 ATTACHMENTS

None

Attachment 11

Monitoring Well and Borehole Abandonment

SHAW STANDARD OPERATING PROJECT PROCEDURE

LONGHORN ARMY AMMUNITION PLANT

ATTACHMENT 11

Subject: MONITORING WELL AND BOREHOLE ABANDONMENT

1.0 PURPOSE AND SUMMARY

This Standard Operating Project Procedure (SOPP) establishes guidelines and procedures for field personnel to use in the supervision of borehole or soil boring abandonment and groundwater monitoring well abandonment (destruction) activities. Any exceptions to the requirements are addressed in the section entitled "Exception Provision." Documents other than those required by the contract and consulted in the preparation of this SOPP are listed under "Cross Reference."

The goals of borehole and monitoring well abandonment are to:

- Prevent vertical migration of fluids in the borehole or monitoring well being abandoned;
- Prevent intermixing of waters from different water-bearing zones;
- Eliminate physical hazards (e.g. open boreholes); and
- Preserve aquifer properties.

The exact type of methodology that is used at a site is dependent upon specific regulatory requirements, and may actually be negotiated with the applicable regulatory agencies. Two general types of abandonment are applicable to address the goals and objectives stated above.

- Abandonment of a well in place
- Removing the well and associated materials from the aquifer

Abandoning the well in place basically consists of filling and isolating the screened interval and cementing the casing in place, usually with a cement bentonite grout. The grout is commonly pumped through a tremie pipe inside the well. Abandonment in place can be considered when no cross-contamination can occur between various zones and contamination can not enter from the surface.

Certain conditions may require perforating prior to grouting the well in place. Such conditions include excess sand pack interval (i.e., behind blank casing), and/or intervals of poor cement seal (as determined from a cement bond log run inside the casing). The grouting is then conducted in successive stages across the perforated intervals. Microfine grout facilitates the passage of grout from the well into the surrounding borehole to provide a good seal. In other instances, the regulatory agencies may require in-place abandonment be conducted using pressure grouting techniques.

Removal of the well materials is most commonly performed by overdrilling. Hollow stem auger drilling is most commonly used, but air rotary drilling with a washover casing, and drilling with a tricone bit are other options. The drill string size is selected so that the inside

diameter of the drill string is slightly greater than the well casing and screen. Using hollow stem augers as an example, the auger is centered over the casing with the center plug and pilot bit removed, or a small guide plug inserted in the casing. The cement seal, bentonite seal, and sand pack is then drilled out with the augers as they are advanced or washed over the well casing and screen. Once the cement seal, bentonite seal, and sand have been drilled out and circulated to the surface, the well casing and screen are then pulled from the hole. The remaining boring is then usually sealed with a tremied cement grout.

The above methodologies also commonly incorporate the removal of the well head and surface completion materials down to a pre-specified depth. The surface is then sealed and a permanent marker or monument may also be emplaced at the surface.

Any of the above methodologies are effective in rendering the wells inoperable and preventing them from becoming conduits for enhanced vertical transport.

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3.0 RESPONSIBILITY MATRIX

3.1 Site Manager

The Site Manager is responsible for ensuring that all abandonment activities are conducted and documented in accordance with this SOPP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

3.2 Field Team

All field team members assigned to borehole and well abandonment activities are responsible for completing their tasks according to specifications outlined in this SOPP and other appropriate procedures. All staff are responsible for reporting deviations from the procedures to the Site Manager or Task Manager.

3.3 Site Contractor Quality Control Systems Manager (CQCSM)

The CQCSM is responsible for periodic review of field generated documentation associated with this SOPP. The CQCSM is also responsible for the implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPPs, variances to the abandonment requirements, issuing nonconformances, etc.) if problems occur.

4.0 DEFINITIONS

Borehole Abandonment - The process whereby boreholes or soil borings are grouted or sealed following completion of drilling, sampling and/or logging.

Bridging - The process where material poured or dropped from the ground surface down a borehole or tremie pipe jams and causes a blockage. This impedes the material from reaching the bottom of the borehole.

Casing splitter - A device attached to the drill string that breaches the well casing allowing communication between the inside of the well and the annular space.

Grout - sealing material that is composed of cement, bentonite, or a cement-bentonite mixture.

Native material - Naturally occurring geologic materials found at the site.

Overdrilling - Drilling where the existing well passes up the inside diameter of the drill string and the material in the annular space is removed from the boring.

Perforation - a breach (slot or hole) created in the well casing to allow communication between the inside of the well and the annular space.

Plugging - The process of placing a material in the well or borehole that has a lower hydraulic conductivity than the surrounding geologic formation.

PVC - Polyvinyl chloride is the material of which monitoring wells are constructed.

Tremie Pipe - a pipe that is inserted into a well or borehole to transport grout or other well materials from the ground surface to a specified depth. The specification of a side-exiting tremie pipe is often made. A side exiting tremie pipe has a fitting on the end that causes the material being pumped through the tremie pipe to exit in a lateral direction.

Well Abandonment - For the purposes of this SOPP "well abandonment" will refer to the abandonment of groundwater monitoring wells only. Well abandonment is the process of formally destroying the well such that it may never be used again.

5.0 TEXT

5.1 Required Records And Forms

1. Field Activity Daily Log (FADL)
2. Site-Specific Field Sampling Plan
3. Well Abandonment Forms (Well Abandonment Procedures Attachment 1)
4. Site Specific Health and Safety Plan
5. Installation-Wide Safety and Health Plan
6. Appropriate Standard Operating Procedures

5.2 Required Materials, Equipment, Or Supplies

1. Indelible black-ink pens and markers
2. Copies of the Well Construction form and/or boring log.
3. Latex or Nitrile gloves
4. Decontamination equipment and supplies
5. Personal protective clothing and gear
6. Drill Rig with appropriate drill rods, bits, and tools
7. Grout Mixing Equipment
8. Grout Pumping Equipment
9. Tremie Pipe equipped with a side-discharging tip
10. Bentonite
11. Portland Cement (ASTM Type I or Type II)

5.3 General Requirements

This section contains responsibilities, procedures and requirements for borehole and well abandonment. Abandonment procedures to be used at a particular site must incorporate project-specific regulatory requirements. Consequently, the Work Plan will identify the following:

- Abandonment objectives
- Boreholes to be abandoned
- Monitoring wells to be abandoned
- Specific procedures for borehole and well abandonment beyond those covered in this SOPP.

- Applicable site-specific regulatory requirements for monitoring well abandonment

5.4 Specific Requirements for Abandonment of Boreholes

Methods of borehole abandonment differ based on the diameter of the boring and the material into which the boring is completed. Soil borings that are of small diameter (e.g., hydropunch) will be backfilled with bentonite pellets; larger diameter soil borings (e.g. auger holes) will be backfilled with the cuttings from that location; and boreholes that extend into rock and are not completed as wells will be grouted to the surface.

5.4.1 Hydropunch Boreholes

1. Upon removal of the direct push rods from the soil, the open borehole will be filled with bentonite pellets. These pellets will be dropped from the surface and allowed to fall by gravity; therefore, care should be taken to assure that the feed rate of the bentonite pellets is sufficiently slow to avoid bridging.

2. The bentonite pellets will be inserted into the borehole until they reach the surface.

3. If the boring is completed into asphalt or cement (e.g. parking lots or sidewalks, or runways) The upper 1 foot of the boring will be completed with a like material. For example, if the boring was advanced through an asphalt parking lot, the upper 1 foot will be completed with asphalt patching material.

5.4.2 Auger Boreholes

1. Upon removal of the augers from the open borehole, the soil cuttings will be used to backfill the borehole. Because the soil is dropped from the surface and allowed to fall by gravity, care should be taken to assure that the feed rate of the soil is slow to avoid bridging.

2. The soil will be shoveled into the borehole until the tamped soil is at the ground surface.

3. If the boring is completed into asphalt or cement (e.g. parking lots or sidewalks, or runways). The upper 1 foot of the boring will be completed with a like material. For example, if the boring was advanced through an asphalt parking lot, the upper 1 foot will be completed with asphalt patching material.

5.4.3 Bedrock Boreholes

1. Using a decontaminated weighted tape, measure the total depth of the borehole.

2. Calculate the volume of the borehole using the formula found in MW and Borehole Abandonment Procedures Attachment 1. This calculation should

be performed on the FADL. This volume will be useful to determine the volume of neat cement needed and should be compared to the volume of cement actually used to document that bridging did not occur.

3. Mix the neat grout to be used for sealing the well. Neat grout is a mixture of Portland American Society for Testing and Materials (ASTM) Type I or II cement, water, and bentonite. Type II cement should be used in applications where the groundwater contains high concentrations of dissolved sulfates. The organic-free bentonite (granular) will be added at a rate of 2 to 5 pounds of bentonite per 94 pound sack of cement to produce a grout that is 2 to 5 % bentonite by weight. This will be mixed with 5 to 7.5 gallons of water to create a pumpable slurry. Refer to the table in Attachment 2 to determine exact grout volumes for differing bentonite/water/cement ratios.

4. Measure the grout weight using a mud balance if available. The weight will be recorded on the FADL.

5. Assemble and insert a decontaminated tremie pipe with a side-discharging tip into the borehole.

6. When the grout is thoroughly mixed begin pumping the grout down the tremie pipe. The tremie pipe should be raised as the borehole fills with grout; however, the tip of the tremie pipe should remain submerged in the top of the grout column.

7. Raise the drill casing as the boring fills with grout. The casing should be slowly extracted during grouting such that the bottom of the casing does not come above the top of the grout column.

8. The rise of the grout column should also be visually monitored or sounded with a weighted tape.

9. In the event that highly cavernous bedrock conditions are encountered and there is significant grout loss, additional measures may be taken. These may include, but are not limited too: addition of bentonite pellets to plug the borehole, use of additives such as calcium chloride to speed up the grout setting time, use of grout baskets or the addition of lost-circulation materials to plug the borehole. All of these procedures may be used to plug the borehole so that it can be grouted according to the procedures listed in steps 1-8.

10. During the grouting process, the drilling hands performing the task should be supervised to assure that potentially contaminating material (oil, grease, or fuels from gloves, pumps, hoses, et. al) does not enter the grout mix and that personnel are properly wearing personal protective equipment as specified in the project Health and Safety Plan.

11. After grouting, barriers should be placed over grouted boreholes as the grout is likely to settle in time, creating a physical hazard. Grouted boreholes will typically require at least a second visit to "top off" the hole. Repeat visits as necessary.

12. The surface hole condition should match the pre-drilling condition (asphalt, concrete, or smoothed flush with native surface), unless otherwise specified in the project work plans.

5.5 Specific Requirements for Abandonment (destruction) of Wells

The aquifer properties well materials, well construction type, and status and type of contamination at the site should be considered when selecting a method of well abandonment. In general, two methods of monitoring well abandonment are presented here. The first involves leaving the well materials in the ground and either grouting the casing intact or splitting the casing and grouting with microfine grout under pressure. The second method involves the removal of the casing, and well materials (sandpack, bentonite seal, and annular seal) and grouting the remaining boring to the surface.

5.6 Specific Requirements for Pre-Abandonment Activities

Plans for abandonment presented should be reviewed by the field crew. The procedures for the abandonment within the plan should be consistent with applicable regulatory requirements

Certain information may be required prior to the abandonment activities. This information may include the following:

- The subsurface lithology/soil types in the immediate vicinity of the well, as derived from the boring, soil core and/or borehole geophysical logs compiled from the particular well.

- Knowledge of depth to bedrock, cavities/fractures in bedrock or prior well construction problems.

- The well condition information based upon historical or operations records (including sample collection forms) and previous inspection activities (e.g., tape soundings, video camera logging, borehole geophysical logging, etc.).

- The well construction information, including type and diameter of casing and well screen, and depths, composition and thicknesses of sand packs, bentonite seals and cement seals.

- Past analytical results of groundwater samples collected from the well.

5.7 Specific Requirements for In-Place Well Abandonment

Two general methods of in-place well abandonment (cementing) are discussed in this section. One method leaves the well intact and can be used when the construction details of the well are known and the well is known to have a competent annular seal. The second method of in-place abandonment involves breaching the well casing and pumping microfine grout into the well and into the surrounding formation around the well.

5.7.1 In-Place Abandonment with the Casing Intact

1. Upon initiation of abandonment activities, all downhole sampling (e.g., dedicated purge pumps, sample pumps, etc.) and monitoring equipment must be removed from the well.

2. Obtain a measurement of the total depth of the well and compare to the existing well construction information. Record this information on the well abandonment log and the FADL.

3. If granular material (e.g., sand pack, formation sediment, etc.) is believed present inside the well based upon the sounding, a bailer may be run to bottom to attempt to ascertain the type of debris.

4. The granular well debris should then be removed from the well by bailing, pumping or other appropriate techniques.

5. If the condition of the well casing is suspect or of concern it may be advisable to run a video log of the well, if it has not already been done. However, judgment and caution will need to be exercised to prevent sticking the camera inside the well during the video logging.

6. If significant scaling or encrustation of the well is observed the well should then be brushed, cleaned, and the free material removed by pumping or bailing

7. Calculate the volume of the screened interval, as determined from the construction log, using the formula provided in MW and Borehole Abandonment Procedures **Figure 1** of this SOPP. This calculation should be documented on the FADL.

8. Fill the screened interval with clean silica sand so that sand is two feet above the top of the screen. The sand should be poured slowly to ensure that bridging does not occur.

9. Sound the top of the clean silica sand with a decontaminated weighted tape. Record this measurement on the abandonment form and on the FADL. Sufficient time should be allowed to ensure that all of the sand has settled prior to this final measurement.

10. Add a two-foot-thick bentonite seal above the silica sand. Bentonite pellets are recommended and shall be poured slowly to avoid bridging.

11. Sound the top of the bentonite seal with a decontaminated tape and record this measurement on the abandonment form and the FADL.

12. Allow the bentonite seal to hydrate per the manufacturer's instructions.

13. Mix the neat grout to be used for sealing the well. Neat grout is a mixture of Portland American Society for Testing and Materials (ASTM) Type I or II cement, water, and bentonite. Type II cement should be used in applications where the groundwater contains high concentrations of dissolved sulfates. The organic-free bentonite (granular) will be added at a rate of 2 to 5 pounds of bentonite per 94 pound sack of cement to produce a grout that is 2 to 5 % bentonite by weight. This will be mixed with 5 to 7.5 gallons of water to create a pumpable slurry. Refer to the table in Attachment 2 to determine exact grout volumes for differing bentonite/water/cement ratios.

14. Measure the grout weight using a mud balance. The weight will be recorded on the FADL.

15. Assemble and insert a decontaminated tremie pipe with a side-discharging tip into the borehole.

16. When the grout is thoroughly mixed begin pumping the grout down the tremie pipe. The tremie pipe should be raised as the borehole fills with grout; however, the tip of the tremie pipe should remain submerged in the top of the grout column.

17. The rise of the grout column should also be visually monitored or sounded with a weighted tape.

18. Remove pads, posts and cut off casings to one foot below grade and seal with bentonite or cement grout.

19. After grouting, barriers should be placed over grouted boreholes as the grout is likely to settle in time, creating a physical hazard. Grouted boreholes will typically require at least a second visit to "top off" the hole. Repeat visits as necessary

20. The surface hole condition should match the pre-drilling condition (asphalt, concrete, or smoothed flush with native surface), unless otherwise specified in the project work plans.

5.7.2 In-Place Abandonment with Breached Casing

1. Upon initiation of abandonment activities, all downhole sampling (e.g., dedicated purge pumps, sample pumps, etc.) and monitoring equipment must be removed from the well.

2. Obtain a measurement of the total depth of the well and compare to the existing well construction information. Record this information on the well abandonment log and the FADL.

3. If granular material (e.g., sand pack, formation sediment, etc.) is believed present inside the well based upon the sounding, a bailer may be run to bottom to attempt to ascertain the type of debris.

4. The granular well debris should then be removed from the well by bailing, pumping or other appropriate techniques.

5. If the condition of the well casing is suspect or of concern it may be advisable to run a video log of the well, if it has not already been done. However, judgment and caution will need to be exercised to prevent sticking the camera inside the well during the video logging.

6. If significant scaling or encrustation of the well is observed the well should then be brushed, cleaned, and the free material removed by pumping or bailing

7. Calculate the volume of the screened interval, as determined from the construction log, using the formula provided in MW and Borehole Procedure Attachment 1 of this SOPP. This calculation should be performed on the FADL.

8. Fill the screened interval with clean silica sand so that sand is two feet above the top of the screen. The sand should be poured slowly to ensure that bridging does not occur.

9. Sound the top of the clean silica sand with a decontaminated weighted tape. Record this measurement on the abandonment form and on the FADL. Sufficient time should be allowed to ensure that all of the sand has settled prior to this final measurement.

10. Install a two-foot-thick bentonite seal above the silica sand. Bentonite pellets are recommended and shall be poured slowly to avoid bridging.

11. Sound the top of the bentonite seal with a decontaminated tape and record this measurement on the abandonment form and on the FADL.

12. Allow the bentonite seal to hydrate per the manufacturer's instructions.

13. Install the casing splitter into the well riser and advance it to a depth 3 to 5 feet above the top of the bentonite seal. This should result in a well casing that is breached on multiple sides at a point near the bentonite seal.

14. Mix microfine grout composed of Portland Cement and bentonite to create a pumpable slurry.

15. Measure the grout weight using a mud balance. The weight will be recorded on the FADL.

16. Pressure grout the casing until grout is returned at the surface.

17. After grouting, barriers should be placed over grouted boreholes as the grout is likely to settle in time, creating a physical hazard. Grouted boreholes will typically require at least a second visit to "top off" the hole. Repeat visits as necessary.

18. The surface hole condition should match the pre-drilling condition (asphalt, concrete, or smoothed flush with native surface), unless otherwise specified in the project work plans.

5.8 Specific Requirements for Abandonment with Well Removal

This section describes basic requirements for monitoring well abandonment by drilling the well out. The drilling technique used depends on the well material. For PVC wells, hollow-stem auger drilling techniques are most commonly employed. For stainless and mild steel casings a washover casing and air-rotary drill rig will be used.

5.8.1 PVC, Teflon, And Other Plastic-Type Casings

1. Upon initiation of abandonment activities, all downhole sampling (e.g., dedicated purge pumps, sample pumps, etc.) and monitoring equipment must be removed from the well.

2. Obtain a measurement of the total depth of the well and compare to the existing well construction information. Record this information on the well abandonment form and on the FADL.

3. If granular material (e.g., sand pack, formation sediment, etc.) is believed present inside the well based upon the sounding, a bailer may be run to bottom to attempt to ascertain the type of debris.

4. The granular well debris should then be removed from the well by bailing, pumping or other appropriate techniques.

5. If significant scaling or encrustation of the well is observed the well should then be brushed, cleaned, and the free material removed by pumping or bailing

6. If the condition of the well casing or screen is suspect (e.g. parting is suspected) a video log may be run inside the well. If parting of the casing or screen is evident, drilling the well out may not be feasible and abandoning the well in-place may need to be considered as a more viable option.

7. Prepare the site for drill rig access so that the rig can be centered over the well. The lead auger is positioned such that it will wash over the well casing during drilling. A small guide plug may then be positioned through the inside of the auger and into the casing.

8. The cement seal and sand pack are then drilled out by advancing the augers and adding auger joints to the drill string. Drilling should be conducted following procedures specified in applicable drilling method SOPPs and regulatory guidance.

9. Advance the borehole to at least the depth equal to the total depth of the boring containing the well. If possible the overdrilling should continue to 0.5 ft beyond the well. The boring should be cleaned by circulating the augers. This will remove the cement, sand pack and cuttings.

10. The well casing is then removed using casing jacks, drill line or other appropriate methods. If the casing is disconnected during removal it is advisable to suspend and hold the casing with slips. Care should be taken to prevent the remaining casing from falling back into the hole.

11. Using a decontaminated weighted tape, measure the total depth of the borehole.

12. Calculate the volume of the borehole using the formula in Attachment 1. This calculation should be performed on the FADL. This volume will be useful to determine the volume of neat cement needed and should be compared to the volume of cement actually used to assure that bridging did not occur. For rough calculation assume that one 94 Lb. sack of cement (when mixed with 5 gallons of water) will fill approximately one cubic foot of space. The addition of 2 to 5 pounds of granular bentonite (2-5% bentonite by weight) and additional water will change the volumes. A table containing water, cement, and bentonite rations and associated volumes is located in Attachment 2.

13. Measure the grout weight using a mud balance. The weight will be recorded on the FADL.

14. Assemble and insert a decontaminated tremie pipe with a side-discharging tip into the borehole.

15. When the grout is thoroughly mixed begin pumping the grout down the tremie pipe. The tremie pipe should be raised as the borehole fills with grout; however, the tip of the tremie pipe should remain submerged in the top of the grout column.

16. The rise of the grout column should also be visually monitored or sounded with a weighted tape until undiluted grout is at the surface

17. After grouting, barriers should be placed over grouted boreholes as the grout is likely to settle in time, creating a physical hazard. Grouted boreholes will typically require at least a second visit to "top off" the hole. Repeat visits as necessary.

18. The surface hole condition should match the pre-drilling condition (asphalt, concrete, or smoothed flush with native surface), unless otherwise specified in the project work plans.

19. The final well surface disposition should be completed as stated in the abandonment and/or project work plans.

20. Any problems or unusual conditions observed during the entire abandonment process should be recorded on the FADL. A well abandonment form (Attachment 1) should also be completed for the well during and upon completion of abandonment activities to provide appropriate documentation.

5.8.2 Stainless Steel and Mild Steel Casings

1. Upon initiation of abandonment activities, all downhole sampling (e.g., dedicated purge pumps, sample pumps, etc.) and monitoring equipment must be removed from the well.

2. Obtain a measurement of the total depth of the well and compare to the existing well construction information. Record this information on the well abandonment form and on the FADL.

3. If granular material (e.g., sand pack, formation sediment, etc.) is believed present inside the well based upon the sounding, a bailer may be run to bottom to attempt to ascertain the type of debris.

4. The granular well debris should then be removed from the well by bailing, pumping or other appropriate techniques.

5. If significant scaling or encrustation of the well is observed the well should then be brushed, cleaned, and the free material removed by pumping or bailing

6. If the condition of the well casing or screen is suspect (e.g. parting is suspected) a video log may be run inside the well. If parting of the casing or screen is evident, drilling the well out may not be feasible and abandoning the well in-place may need to be considered as a more viable option.

7. Prepare the site for drill rig access so that the rig can be centered over the well. Center the well casing inside the washover casing.

8. Advance the washover casing over the well casing using an air-rotary drill rig. The washover casing should be advanced to at least the depth equal to the total depth of the boring containing the well.

9. Remove the washover casing from the borehole.

10. The well casing is then removed using casing jacks, drill line, crane or other appropriate methods. If the casing is disconnected during removal it is advisable to suspend and hold the casing with slips. Care should be taken to prevent the remaining casing from falling back into the hole.

11. Using a decontaminated weighted tape, measure the total depth of the borehole.

12. Calculate the volume of the borehole using the formula in MW and Borehole Procedures Attachment 1. This calculation should be performed on the FADL. This volume will be useful to determine the volume of neat cement needed and should be compared to the volume of cement actually used to that bridging did not occur. Assume that one 94 Lb. sack of cement (when mixed with 5 gallons of water) will fill approximately one cubic foot of space. The addition of 2 to 5 pounds of granular bentonite (2-5% bentonite by weight) and additional water will change the volumes. A table containing water, cement, and bentonite rations and associated volumes is located in MW and Borehole Procedures Attachment 2.

13. Measure the grout weight using a mud balance. The weight will be recorded on the FADL.

14. Assemble and insert a decontaminated tremie pipe with a side-discharging tip into the borehole.

15. When the grout is thoroughly mixed begin pumping the grout down the tremie pipe. The tremie pipe should be raised as the borehole fills with grout; however, the tip of the tremie pipe should remain submerged in the top of the grout column.

16. The rise of the grout column should also be visually monitored or sounded with a weighted tape.

17. After grouting, barriers should be placed over grouted boreholes as the grout is likely to settle in time, creating a physical hazard. Grouted boreholes will typically require at least a second visit to "top off" the hole. Repeat visits as necessary.

18. The surface hole condition should match the pre-drilling condition (asphalt, concrete, or smoothed flush with native surface), unless otherwise specified in the project work plans.

19. Any problems or unusual conditions observed during the entire abandonment process should be recorded on the FADL. A well abandonment form (Attachment 1) should also be completed for the well during and upon completion of abandonment activities to provide appropriate documentation.

For each well abandoned, the activities, calculations, locations, and materials used should be recorded on the FADL. A well abandonment form will also be completed. Portions of this form are taken directly from existing boring and construction logs and may be completed prior to arriving at the site. The remaining information is to be competed while on site during the abandonment process. Entries to the FADL, or well abandonment form are should be completed in a timely manner. The general guidelines of documentation will be followed. Records generated as a result of this SOPP will be controlled and maintained in the project record files.

5.9 Records

All information pertinent to the collection of sediment samples should be recorded on the FADLs and/or the Sample Collection Forms. At a minimum, the following information shall be recorded in the FADL and abandonment logs.

- Project name (include site name and Longhorn identification number)
- Date and times of activities
- Well locations
- Level of PPE required
- Weather or other environmental conditions
- Equipment used (include serial numbers of field instruments)
- Any deviation to the approved work plan
- Notation of any visitors to the site

6.0 EXCEPTION PROVISIONS

None.

7.0 CROSS REFERENCE

Texas Administrative Code, Title 16, Part 4, Chapter 76, Rule §76.1004, Technical Requirements – Standards for Capping and Plugging Wells that Penetrate Undesirable Water

or Constituent Zones <http://info.sos.tx.us/pls/pub/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p...>

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8.0 TABLES

None

9.0 FIGURES

Figure 1 - Formulas and other Useful Information
Figure 2 - Well Abandonment Forms (1 coversheet plus 2 pages of forms)

Monitoring Well and Borehole Abandonment Procedures
Figure 1

Formulas and Other Useful Information

Formulas and Other Useful Information

Grout Slurry Densities (HAZWRAP, 1996)

Percentage (by weight) Bentonite	Water to Cement Ratio	Minimum Density in Pounds per Gallon	Volume in Ft^3 per Sack of Cement
2	6.0 gal / Sack of Cement	14.7	1.36
3	6.5 gal / Sack of Cement	14.4	1.45
4	7.2 gal / Sack of Cement	14.1	1.55
5	7.8 gal / Sack of Cement	13.8	1.64

Conversions

7.481 Gallons of water in 1 cubic foot (Gallons/7.481) = cubic feet of water
8.345 Pounds per Gallon (Gallons * 8.345) = pounds of *water*

1 SACK OF CEMENT DRY = 0.48 FT^3
1 94 LB SACK OF CEMENT MIXED WITH 5 GALLONS OF WATER = ABOUT 1 FT^3

The formula for calculating the borehole volume is

$$V = [(D^2(()/4](L$$

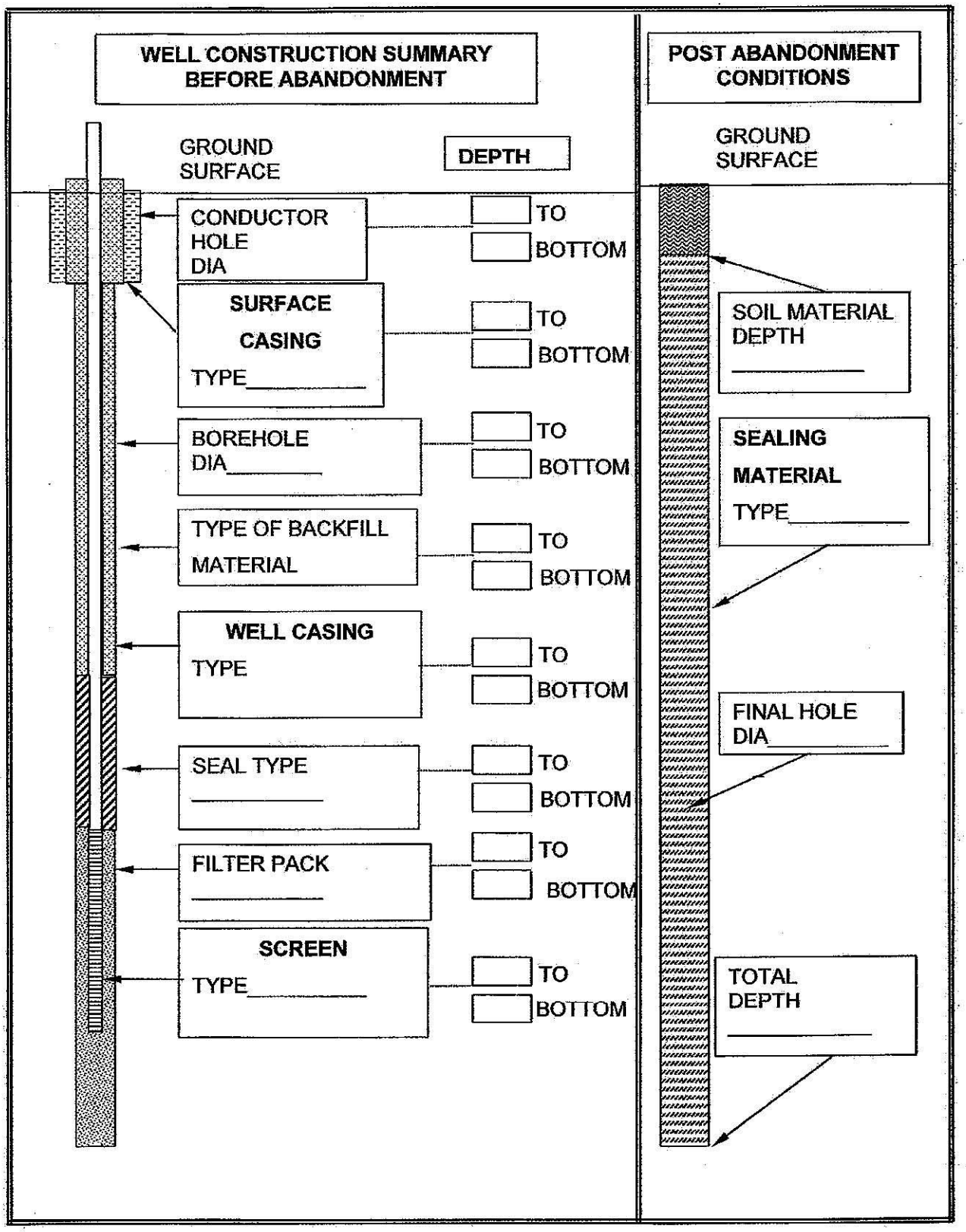
Where: V = Well volume in cubic feet (ft^3)
D = Well diameter in feet (ft)
L = Length of borehole in feet (ft)

Monitoring Well and Borehole Abandonment Procedures
Figure 2

Well Abandonment Forms

		Well Abandonment Form	
Project:		Well No.	
Client:		Coordinates:	
Project No.		N	E
Date Begun:	Date Completed	Prepared By	Reference Point for Measurements
Well Type: (circle one) Overburden Bedrock Extraction Temporary Other_____		NOTES:	
BEFORE ABANDONMENT		**AFTER ABANDONMENT**	
WELL CONSTRUCTION SUMMARY (SEE DIAGRAM ON BACK OF FORM)			**NO YES N/A**
Well No.	Location	**Concrete Pad Removed**	
TD	Drilled By	**Protective Posts Removed**	
Date Completed	Ground EL.	**Surface Casing Removed**	
	TOC EL.	**Flush Mount Removed**	
		(SEE DIAGRAM ON BACK OF FORM)	

SITE SKETCH


WELL CONSTRUCTION SUMMARY BEFORE ABANDONMENT
POST ABANDONMENT CONDITIONS
GROUND SURFACE
DEPTH
GROUND SURFACE
CONDUCTOR HOLE DIA
TO
BOTTOM
SURFACE CASING
TYPE_____
TO
BOTTOM
BOREHOLE DIA_____
TO
BOTTOM
TYPE OF BACKFILL MATERIAL
TO
BOTTOM
WELL CASING
TYPE
TO
BOTTOM
SEAL TYPE
_____
TO
BOTTOM
FILTER PACK
_____
TO
BOTTOM
SCREEN
TYPE_____
TO
BOTTOM
SOIL MATERIAL DEPTH
_____
SEALING MATERIAL
TYPE_____
FINAL HOLE DIA_____
TOTAL DEPTH
_____

<<Prev Rule

Texas Administrative Code

Next Rule>>

TITLE 16 ECONOMIC REGULATION

PART 4 TEXAS DEPARTMENT OF LICENSING AND REGULATION

CHAPTER 76 WATER WELL DRILLERS AND WATER WELL PUMP INSTALLERS

RULE §76.1004 Technical Requirements--Standards for Capping and Plugging of Wells and Plugging Wells that Penetrate Undesirable Water or Constituent Zones

(a) All wells which are required to be plugged or capped under Texas Occupations Code Chapters 1901 and 1902 or this Chapter shall be plugged and capped in accordance with the following specifications:

(1) all removable casing shall be removed from the well;

(2) any existing surface completion shall be removed;

(3) the entire well pressure filled via a tremie pipe with cement from bottom up to the land surface ;

(4) In lieu of the procedure in paragraph (3) of this section, the well shall be pressure filled via a tremie tube with clean bentonite grout of a minimum 9.1 pounds per gallon weight followed by a cement plug extending from land surface to a depth of not less than two (2) feet, or if the well to be plugged has one hundred 100 feet or less of standing water the entire well may be filled with a solid column of 3/8 inch or larger granular sodium bentonite hydrated at frequent intervals while strictly adhering to the manufacturers' recommended rate and method of application. If a bentonite grout is used, the entire well from not less than two (2) feet below land surface may be filled with the bentonite grout. The top two (2) feet above any bentonite grout or granular sodium bentonite shall be filled with cement as an atmospheric barrier.

(5) Undesirable water or constituents shall be isolated from the fresh water zone(s) with cement plugs and the remainder of the wellbore filled with neat cement or clean bentonite grout of a minimum 9.1 weight followed by a cement plug extending from land surface to a depth of not less than two (2) feet.

(b) Large hand dug and bored wells 36-inches or greater in diameter to one hundred (100) feet in depth may be plugged by back filling with compacted clay or caliche to surface. All removable debris shall be removed from the well. If the well contains standing water, it shall be chlorinated by adding chlorine bleach at a rate of one (1) gallon of bleach for every five hundred (500) gallons of standing water. Leave mounded to compensate for settling.

(c) Wells which do not encounter groundwater (dry holes) may be plugged by backfilling with drill cuttings from total depth to within two (2) feet of the surface; where a two (2) feet cement plug shall be poured.

(d) Drillers may petition the Department, in writing, for a variance from the methods stated in subsection (a) of this section. The variance should state in detail, an alternative method proposed and all conditions applicable to the well that would make the alternative method preferable to those methods stated in subsection (a) of this section.

(e) A non-deteriorated well which contains casing in good condition and is beneficial to the landowner can be capped with a covering capable of preventing surface pollutants from entering the well and sustaining weight of at least four hundred (400) pounds and constructed in such a way that the covering cannot be easily removed by hand.

Source Note: The provisions of this §76.1004 adopted to be effective November 8, 2001, 26 TexReg 8814; amended to be effective December 1, 2003, 28 TexReg 10468

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Attachment 13

Monitoring Well Installation Procedures

STANDARD OPERATING PROJECT PROCEDURE
LONGHORN ARMY AMMUNITION PLANT
ATTACHMENT 13
Subject: MONITORING WELL INSTALLATION PROCEDURES

1.0 PURPOSE AND SUMMARY

The purpose of this Standard Operating Project Procedure (SOPP) is to define the requirements for the installation of monitoring wells at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas. The procedures and equipment requirements contained in this SOPP are subject to modification, based upon project specific requirements and site conditions. Drilling conditions at LHAAP can vary significantly from location to location. The procedures in this SOPP have been modified from multiple guidance documents listed in the reference section to reflect the typical field conditions encountered at LHAAP. The procedures are subject to change if unusual or unanticipated field conditions are encountered; however, all deviations must be approved by one of the following: the LHAAP technical lead or the LHAAP project manager before implementation.

The purpose of monitoring well installation is to provide access to groundwater for collecting samples, as well as for obtaining water levels and other data. Monitoring wells are potential contaminant migration routes between aquifers or from the surface to the subsurface. Construction procedures and standards must ensure that neither passive nor active introduction of contaminants can occur. Properly installed hydraulic seals and locking well covers reduce the potential for cross-contamination of monitoring wells.

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3.0 RESPONSIBILITY MATRIX

3.1 Site Manager

The Site Manager is responsible for ensuring that field personnel are properly trained in monitoring well installation and for verifying that monitoring wells are installed in accordance with this SOPP. Some projects may have site-specific sampling plan attachments (work plan) or a drilling subcontractor Statement of Work (SOW). In general, these documents will take precedence over the SOPP.

3.2 Field (or rig) Geologist

The field geologist is responsible for documenting that the drilling subcontractor complies with the procedures and equipment requirements contained in this SOPP. The field geologist is responsible for recording all information relevant to the construction and materials used in monitoring well installation. All phases of well construction and installation, with the exception of surface completions, require oversight by the field geologist. If a field geologist or other authorized contractor representative is not present for the surface completion activities, the surface completions shall be inspected after installation to document that criteria set forth in this SOPP or other project specific documents such as a SFSP or SOW are met. Any deviations from this SOPP, or the site specific work plan, or the subcontractor's SOW require approval from either the technical lead or project manager. All deviations shall be documented in writing.

3.3 Site Contractor Quality Control Systems Manager (CQCSM)

The Site CQCSM is responsible for ensuring that this procedure is correctly implemented and that data collected meet the requirements of the contract.

4.0 DEFINITIONS

Bentonite. Swelling clay minerals, commonly sodium montmorillinite, that are used as a sealing material and are added to cement to create neat grout. Bentonite is typically found in granular, powdered or pellet forms.

Filter Pack. Sand and gravel that is smooth, uniform, clean well rounded, and siliceous. It is placed in annulus of the wall between the borehole wall and the well screen to prevent formation material from entering the well screen.

PID. Photoionization detector

FID. Flame ionization detector

Tag. Tag is a measurement below ground surface to the top of the item being measured (e.g. tag the top of the sandpack).

Shallow monitoring well. A monitoring wel1 with a monitoring interval (top of filter pack to base of filter pack) instal1ed completely in the shallow zone at LHAAP (base approximately 15-25 feet bgs).

Intermediate monitoring well. A monitoring wel1 with the monitoring interval straddling the intermediate zone at LHAAP (base approximately 30-40 feet bgs).

Deep monitoring well. A monitoring well with the monitoring interval (top of filter pack to base of filter pack) in the deep zone at LHAAP (base approximately 70-90 feet bgs).

5.0 TEXT

5.1 Required Records and Forms

1. HASP
2. Field Activity Daily Logs (FADL)
3. Boring log
4. Wel1 construction form.

5.2 Required Materials, Equipment, or Supplies

5.2.1 Drilling Subcontractor Equipment

Potential equipment for monitoring well installation includes but is not limited to the fol1owing:

1. Drilling or augering equipment appropriate to site conditions, drilling depth, and other project requirements.
2. Drill bits appropriate for the expected rock type(s) to be encountered.
3. Sufficient threaded flush-joint riser pipe. Currently, Schedule 40 PVC is the accepted riser material. (Note: No glues are permitted.)
4. Sufficient threaded flush-joint continuous slot Schedule 40 PVC well screen. (Note: No glues are permitted). Prepack screens may be required at some locations. Well screens are typically of the slot size 0.010 (10 slot). The typical length is 10 feet, however, some wells may contain a longer screened interval, depending upon the purpose and location of the monitoring well.
5. Properly sized and washed filter pack material (# 1 quartz sand) in sufficient volume to meet the required well design criteria)
6. Bentonite or polymer-bentonite pellets, chips, or granules.
7. Powdered bentonite.
8. Portland cement [American Society for Testing and Materials (ASTM) Types I or II].
9. Black carbon steel surface casing (if required).
10. Steel protective casing with locking cap or flush mount junction boxes with manhole covers.
11. Tremie pump/box and pipe.
12. Steel or aluminum protective casing with locking cap or flush mounted junction boxes with manhole covers.
13. Grout baskets.
14. Centralizers.
15. Mud balance.
16. Grout mixer and pump (may be combined with tremie equipment).
17. Assorted tools (wrenches, shovels, etc.).
18. Personal protective clothing, as required by the site-specific health and safety plan.
19. Stainless steel weighted tape.
20. Decontamination supplies.

5.2.2 Field Geologist Equipment

- Straight edge or engineering ruler
- Calculator
- Munsell soil color charts
- Water level indicator
- Surveyor's measuring tape with weight for tagging depths of installed well materials

- Required Health and Safety Equipment- PPE, monitoring equipment cell phone or radio

5.3 General Materials Requirement

Monitoring wells that are installed are typically constructed of the materials listed below. This list of materials is subject to modification, based upon project specific requirements and objectives.

Casing (riser) and sump: 4-inch diameter Schedule 40 Polyvinyl Chloride (PVC) with threaded ends Casing length is dependent upon the completion depth of the borehole.

Well screen: 4-inch diameter Schedule 40 PVC continuous wrap screen, with threaded ends. Typical screen length is 10 feet, however the length may vary depending on the specific project objectives.

Surface casing: (For bedrock well installation) 6-inch inside diameter steel casing. The length of surface casing will depend upon depth to bedrock and project specific objectives.

Filter pack: - # 1 sand or equivalent.

Bentonite: 1/8 inch or ¼ inch diameter pellets. Bentonite chips are not acceptable for annular seal material.

Grout: - the grout mixture should consist of Portland cement, powdered bentonite, and potable water in the following proportions: for each 94-pound sack of Portland cement, add 2-5% (approximately 2 to 5 pounds) powdered bentonite, and 6 ½ to 7 gallons of potable water. Certain field conditions, such as highly solutioned or fractured bedrock, may require that accelerants, such as calcium chloride be added to reduce the grout curing time.

Well caps: - expanding well caps.

Locks: - well locks will be installed.

Surface Completion: - either stickup completion with protective steel casing or flush mounted.

5.4 Specific Requirements for Monitoring Well Installation

The typical drilling method for overburden monitoring wells is hollow stem augering. The inside diameter of the augers should be at least 4 inches greater than the outside diameter of the well materials.

5.4.1 Installation of Shallow Monitoring Wells

The typical drilling method for shallow monitoring wells at LHAAP is hollow stem augering. The inside diameter of the augers should be at least 4 inches greater than the outside diameter of the well materials.

1. When the total depth (TD) of the borehole is reached, the borehole should be cleaned out to remove excess drill cuttings. Because the overburden materials are primarily fine-grained silts and clays, care should be taken to prevent sealing of the borehole by excessive raising and lowering of the augers. Installation of the well should begin within 12 hours of reaching TD, except when it is necessary to pull up the augers slightly to determine the static water level prior to setting a well. Record the borehole TD and the depth to water prior to installation of well materials. Verify that the measured TD is desired completion depth. If the hole has partially collapsed or heaved, options for

cleaning, redrilling, or installation in the open section of the borehole should be discussed with the task manager or technical lead.

2. In the event that the well completion depth is desired across an interval depth less than the total depth, the well should be plugged to the base of the desired interval, grout, bentonite pellets, or bentonite chips as specified by the work plan may be added to the bottom of the boring to raise the bottom of the hole to the desired depth. The grout should be pumped through a tremie pipe and fill from the bottom of the boring upward. During grouting, the tremie pipe should be submerged below the top of the grout column in the borehole to prevent free-fall and bridging. Well installation will not commence until the grout has cured, approximately 24 hours. Curing of the grout will be verified by a "hard tag". Generally, an overnight curing period will be sufficient for an adequate cure. If bentonite is used, it should be added gradually to prevent bridging. Grout or bentonite addition will stop when its level has reached approximately one foot below the bottom of the desired string depth. A fine sand layer should be placed immediately above the bentonite/grout plug prior to filter pack placement. The bentonite plug will be hydrated for at least one hour before installation of a filter pack.

3. Verity the cleanliness of the well materials to be installed. If the materials are precleaned, wrapped in polyethylene bags, and documentation of precleaning is confirmed, then decontamination is not necessary. If the wrappings are not intact, and/or precleaning cannot be documented, then the well materials shall be decontaminated in accordance with SOPP 3.0.

4. Determine if the surface completion of the well will be above ground or flush mount to calculate the quantity of well riser required. Assemble the well string (sump, screen, and riser) by screwing together the various sections according to the manufacturer's instructions. No solvents or glues are to be used to assemble the sump, screen, and casing. All well materials shall be handled with clean latex or nitrile gloves or comparable substitutes. The well materials will be installed inside the augers. There should be a minimum of 6 inches and a maximum of 3 feet below the bottom of the well sump and the bottom of the borehole. Centralizers are required for wells with depths exceeding 50 feet bgs. At a minimum, centralizers shall be placed below the well screen, above the top of the bentonite seal, and every 30 to 50 feet thereafter. The field geologist shall record the location of all centralizers on the well construction diagram and the field notes.

5. Carefully lower the well string through the inside of the augers until the well string is at the desired depth. The well string should be suspended by the drill rig and should not rest on the bottom of the boring. In the event that the well string was dropped, lowered abruptly, or for any other reason is suspected of being damaged during placement, the string should be removed from the boring and inspected. In certain instances, the well string may rise after being placed in the borehole due to heaving sand. If this occurs, the driller must not place any drilling equipment, (drill pipe, hammers, etc.) to prevent the well string from rising. The amount of rise should be noted by the rig geologist who should then consult the task manager, technical lead, or project manager for an appropriate course of action. The field geologist shall document the start and finish time for installation of the well string and depths of sump, well screen, and riser.

6. Filter pack may be placed in the well annulus through the augers by gravity if the borehole is less than 50 feet deep. The filter pack should be poured from both sides of the augers to ensure an even distribution of filter pack material in the annulus. In wells

greater than 50 feet or the water in the borehole has abundant silt and clay sized particles, the filter pack will be by the tremie method. The augers will be pulled up as the filter pack is installed for settling below the well and against the borehole walls. The filter pack will extend from the bottom of the borehole to 3 to 5 feet above the top of the screen unless otherwise specified in the drilling plan. The filter pack location shall not cross any confining layers. Periodic tagging of the filter pack during installation is recommended to prevent overfilling of the annulus. The field geologist shall document the quantity of filter pack used and compare the actual volume and calculated volume. Significant discrepancies between actual and calculated filter pack volumes should be explained as well as possible (loss of formation, borehole sloughing, etc.). Surging with a surge block may be used to compact the filter pack around the well screen. A minimum of 15 minutes between completion of the filter pack installation and initiation of the bentonite placement shall be observed to allow for settling of any filter pack through the water column. When installation of the filter pack is complete, both the drilling subcontractor and the field geologist shall tag and record the depth to the top of filter pack. Additional filter pack will be added as necessary until the necessary volume is emplaced. The rig geologist shall document base of filter pack, top of filter pack, and start and finish times for filter pack installation.

7. Bentonite pellets will be placed in the well annulus above the filter pack through the augers by gravity if the borehole is less than 50 feet deep. If the borehole is greater than 50 feet deep, the bentonite pellets should be installed by the tremie method. The bentonite should be added slowly and tamped to prevent bridging. If the augers have been removed completely from the borehole, the bentonite will be emplaced by the tremie method. A bentonite seal placed above the water table will be installed in 6-inch lifts, with each lift being hydrated and allowed to sit 15 minutes before the next lift is installed. A minimum of 3 feet to a maximum of 5 feet of bentonite will be placed in the annular space between the borehole and the well casing. The field geologist shall document the quality of bentonite used, the manufacturer, lot number, and compare the actual volume versus the calculated volume. Potable water shall be added to the borehole to hydrate bentonite emplaced above the water table. If approved by the task manager, technical lead, or project manager, a bentonite slurry, such as Volclay grout, may be used for seals above the water table. The manufacturer's instruction should be consulted to determine the optimal hydration time required. At a minimum, hydration time for the bentonite seal will be 8 hours. The top of the bentonite seal shall be tagged and recorded by the drilling subcontractor and the field geologist after installation and after hydration. Six-inches of fine filter sand maybe placed above the bentonite seal to prevent grout infiltration. The field geologist shall document the base of the bentonite seal, top of the bentonite seal, and start and finish times for bentonite placement.

8. After the bentonite seal has hydrated, the top of the seal should be tagged again to document the amount of swelling after hydration. The post-hydration measurement will be recorded on the well construction diagram as the top of the bentonite seal. The grout mixture will be mixed as specified in Section 5.0 of this SOPP, and pumped through a tremie pipe with a side discharge port from the top of the bentonite seal upward. The side discharge is required to prevent damage to the bentonite seal and/or the filter pack. The bottom of the tremie pipe should be maintained below the top of the grout to prevent free fall and bridging. Grout the well annulus to within 2 to 3 feet of the surface. The field geologist shall document the quantity of grout added to the borehole and compare the actual volume versus the theoretical calculated volume. Significant discrepancies between actual and theoretical volumes should be explained as well as possible. The base of the grout seal, the top of the grout seal, and start and finish times for grouting shall be

documented by the field geologist. After the grout is cured, the top of grout should be measured and recorded again to estimate slumping or loss to the formation.

9. Grout may be required to be placed in lifts (approximately 25 foot/lift) for deeper wells (>75 feet deep) to minimize the head of the grout and prevent compacting of the bentonite seal and filter pack or grout loss in the aquifer.

10. The grout should cure a minimum of 24 hours before starting surface completions. Requirements for above ground and flush mount surface completions are contained in Section 5.4.3.1 and 5.4.3.2 of this SOPP, respectively.

5.4.2 Installation of Intermediate and Deep Monitoring Wells

Drilling the well boreholes for intermediate or deep wells is done in two phases. The boreholes are advanced through the unconsolidated materials by hollow stem augering or by the mud rotary method. A surface casing is grouted in the aquitard or clay zone below the first shallow water boring zone. Surface casing should extend at least 3 feet into the aquitard. To complete the bedrock borehole, the drill string is advanced inside the surface casing by air or mud rotary method or by coring.

1. When the TD of the borehole is reached, the borehole should be cleaned out to remove excess drill cuttings and to condition the hole. Installation of the well should begin within 12 hours of reaching TD. However, it is recommended that well installation begins immediately, or as soon as reasonably possible after the borehole is cleaned out to avoid collapse of unconsolidated materials in the overburden. Record the borehole TD and the depth to water prior to installation of well materials. Verify that the measured TD is the desired completion depth. If the hole has partially collapsed, options for cleaning, redrilling, or installation in the open section of the borehole should be discussed with the technical lead or project manager.

2. In the event that the well completion depth is desired across an interval depth less than the total depth, the well should be plugged to the base of desired interval, grout, bentonite pellets, or bentonite chips may be added to the bottom of the boring to raise the bottom of the hole to the desired depth.

   Well installation will not commence until the grout has cured, approximately 24 hours.

   Grout or bentonite addition will stop when its level has reached approximately one foot below the bottom of the desired well string depth. A fine sand layer should be placed immediately above the bentonite/grout plug prior to filter pack placement.

3. Verify the cleanliness of the well materials. If the materials are precleaned, wrapped in intact polyethylene bags, and documentation of precleaning is confirmed, then decontamination is not necessary. If the wrappings are not intact, and/or precleaning cannot be documented, then the well materials shall be decontaminated in accordance with Attachment 9.

4. Determine if the surface completion of the well will be above ground or flush mount to calculate the quantity of well riser required. Assemble the well string (sump, screen, and riser) by screwing together the sections and tightening according the manufacturer's instructions. No solvents or glues are to be used to assemble the sump, screen, and casing. All well materials shall be handled with clean latex or nitrile gloves or comparable substitutes. There should be a minimum of 6 inches and a maximum of 3 feet

below the bottom of the borehole and the bottom of the well sump. Centralizers for wells with depths exceeding 50 feet bgs. Centralizers shall be placed below the well screen, above the top of the bentonite seal, and every 30 to 50 feet thereafter. The field geologist shall record the location of all centralizers on the well construction diagram and the field notes.

5. Carefully lower the well string until it is at the desired depth. The well string should be suspended by the drill rig and should not rest on the bottom of the boring. In the event that the well string was dropped, lowered abruptly, or for any other reason is suspected of being damaged during placement, the string should be removed from the boring and inspected. In certain instances, the well string may rise after being placed in the borehole due to heaving sand. If this occurs, the driller must not place any drilling equipment, (drill pipe, hammers, etc.) to prevent the wellstring from rising. The amount of rise should be noted by the rig geologist who should then consult the task manager, technical lead, or project manager for an appropriate course of action. The field geologist shall document the start and finish time for installation of the well string, and depths of sump, well screen, and riser.

6. The filter pack will be installed by the tremie method, except where cavities or highly fractured intervals are encountered that preclude the placement of a filter pack. At highly fractured intervals and cavities prepack screens should be used.

   The tremie pipe should be moved around the borehole annulus to ensure an even distribution of the filter pack material in the annulus. The filter pack will extend from the bottom of the borehole to 3 to 5 feet above the top of the screen unless otherwise specified in the drilling plan. The filter pack location shall not cross any confining layers. Periodic tagging of the filter pack during installation is recommended to prevent overfilling of the annulus. The field geologist shall document the quantity of filter pack used and compare the actual volume and calculated volume. Significant discrepancies between actual and calculated filter pack volumes should be explained as well as possible (loss of formation, borehole sloughing, etc.). Surging with a surge block may be used to compact the filter pack around the well screen. A minimum of 15 minutes between completion of the filter pack installation and initiation of the bentonite placement shall be observed to allow for settling of any filter pack through the water column. When installation of the filter pack is complete, both the drilling subcontractor and the field geologist shall tag and record the depth to the top of filter pack. Additional filter pack will be added as necessary until the necessary volume is emplaced. The rig geologist shall document base of filter pack, top of filter pack, and the start and finish times for filter pack installation.

7. Bentonite pellets will be placed in the well annulus above the filter pack by the tremie method. The bentonite should be added slowly and tamped to prevent bridging. A minimum of 3 feet and a maximum of 5 feet of bentonite will be placed in the annular space above the filter pack. If a prepack screen was utilized during well construction, a grout basket will then be used to support the bentonite above the cavernous interval. The field geologist shall document the quantity of bentonite used and compare the actual volume versus the calculated volume. Significant discrepancies between actual and calculated volumes should be explained as well as possible. Potable water shall be added to the borehole to hydrate bentonite emplaced above the water table. If approved by the task manager or technical lead, a bentonite slurry, such as Volclay grout, maybe used for seals above the water table. The manufacturer's instruction should be consulted to determine the optimal hydration time required. At a minimum, hydration time for the

bentonite seal will be 8 hours. The top of the bentonite seal shall be tagged and recorded by the drilling subcontractor and the field geologist after installation and after hydration. The field geologist shall document the base of the bentonite, top of bentonite, and start and finish times for bentonite placement.

8. After the bentonite seal has hydrated, the top of the seal should be tagged again to document the amount of swelling after hydration. The post-hydration measurement will be recorded on the well construction diagram as the top of the bentonite seal.

9. The grout will be mixed as specified in Attachment 11, and pumped through a tremie pipe with a side discharge port and filled from the top of the bentonite seal upward. The side discharge is required to prevent damage to the bentonite seal and/or the filter pack. The bottom of the tremie pipe should be maintained below the top of the grout to prevent free fall and bridging. Other alternative grouting methods may be necessary if karst or highly permeable conditions are encountered (i.e., grout baskets above a cavernous interval). The grout may be required to be placed in lifts of approximately 25 feet for deeper wells (>75 feet deep) and the wells that require a grout basket. The lifts of grout are to prevent compacting of the bentonite seal and filter pack and to lessen the loss of grout into the formation. Grout the well to within 2 to 3 feet of the ground surface. The field geologist shall document the quantity of grout added to the borehole and compare the actual volume versus the calculated volume. Significant discrepancies between the actual and calculated should be explained as well as possible. The base of the grout seal, the top of the grout seal, and start and finish times for grouting shall be documented by the field geologist. After the grout is cured, the top of grout should be measured and recorded again to estimate slumping or loss to the formation.

10. A minimum grout cure time of 24 hours is required prior to above ground and flush mounted surface completion activities.

5.4.3 Surface Completions

The majority of the surface completions for monitoring wells installed are above ground completions, however some monitoring wells are located in high traffic areas and will require flush mount completions. The purpose of the surface completions is to prevent downward migration of surface water or rainfall through the monitoring well annulus.

Any cutting of the PVC riser during surface completion or any other phase of monitoring well installation will be done with a pipe cutter to ensure an even cut and to prevent PVC shavings from entering the well. Hacksaws are not an acceptable alternative to pipe cutters.

5.4.3.1 Above Ground Surface Completions

Above ground surface completions consist of an expanding well cap, concrete pad, protective casing with locking cap and 4 guard posts.

Concrete pad: The concrete pad will be a minimum of a 3-foot square and 4 inches thick. Approximately half of the pad thickness will be below land surface. The pad will be constructed so that it slopes away from the wellhead. If applicable, the freshly poured concrete should be protected from rain by covering with plastic until the concrete is cured. If forms are used, they are to be removed after the concrete has cured.

Protective Casing: The PVC well riser will be surrounded by aluminum (preferred) or steel protective casing with a locking cap. The protective casing will be five feet in length with a diameter a minimum of 4-inches larger than the riser pipe. An internal mortar collar will be

placed within the protective casing and outside the PVC well casing to a height of approximately 6-inches above the ground surface inside the protective casing. The protective casing will be installed to a depth of approximately 2 ½, feet bgs. Two weep holes shall be drilled in the protective casing above the mortar collar for drainage approximately 6 to 8-inches above ground surface. The monitoring well will be stenciled in black on the protective casing. Additionally, a brass plate containing the well number and horizontal and vertical coordinates will be attached to the protective casing with screws. The PVC riser may have to be cut to accommodate the expansion well cap and locked inside the protective casing.

Guard posts: Four 3-inch diameter, 6-foot long steel guard posts will be installed on each corner of the concrete pad. The posts will be installed approximately 4 feet from the well head to approximately 3 feet bgs, and cemented in. The posts will be filled with concrete and painted fluorescent orange with a paintbrush.

5.4.3.2 Flush Mount Well Completion

Flush mount well completions will be necessary at locations where an aboveground well completion would interfere with facility operation. Flush mount completions consist of a an expanding well cap, concrete pad, below ground traffic box or equivalent and an 8 or 12-inch steel, flush mount, bolt down traffic bearing cover.

Concrete pad: The concrete pad will be a minimum of 3-foot square and 4 inches thick. Approximately half of the pad thickness will be below land surface. If the pad is located in a roadway or parking lot, the edge of the pad shall be even with the existing concrete or asphalt surface to prevent vehicle damage. The pad will be constructed so that it slopes away from the wellhead. If applicable, the freshly poured concrete should be protected from rain by covering with plastic until the concrete is cured. If forms are used, they are to be removed after the concrete has cured.

Traffic box and manhole cover: The traffic box should be installed slightly above grade. The concrete pad will be flush with the top of the traffic box and slope to grade to promote surface drainage away from the well. The manhole cover shall be equipped with a gasket to prevent leakage of rainwater or surface water into the traffic box. The PVC riser may have to be cut to accommodate the expansion well cap and lock.

5.5 Special Considerations

- Perched Water. Where present, screen lengths and well construction should be adjusted to insure the monitored interval (including the filter pack) does not span or include both the perched water and water table in the overburden. Conversely, if a perched interval is the desired monitoring objective, wells should be drilled and installed with a short 5-foot screen across the perched zone only, with the base of the well and screen set no deeper than the underlying perched horizon (i.e. does not allow for migration below perched aquifer).

- Light Nonaqueous Phase Liquid (free product) considerations. There LNAPL is expected, screen interval lengths should be adjusted or constructed so as to straddle the water table (free product will not be detectable in a well screened below the water table horizon).

5.6 Records

At a minimum, the field geologist for well installation shall document the following information: The information is to be recorded in the FADL, field form, and well construction diagrams. The start and finish times for each phase of the well installation process shall be recorded. Additional relevant information may be recorded at the field geologist's discretion.

- Total depth of borehole [feet below ground surface (ft bgs)]
- Diameter of borehole (inches)
- Length, diameter, and material of surface casing
- Depth surface casing installed to (ft bgs)
- Location, diameter, and depth of any centralizers.
- Quantity of grout used to cement surface casing (type of grout, number of sacks, sack weight, type and quantity of any additives used- (i.e. used 12 - 50 pound sacks of Lonestar Type I Portland Cement mixed with approximately 25 pounds of Wyo-Ben powdered bentonite)
- Material, length, diameter, and slot size of the well screen
- Installation depth of well screen (ft bgs)
- Length, diameter, and material of casing
- Installation depth of casing (ft bgs)
- Casing stickup (if applicable)
- Quantity of filter pack (include manufacturer's name, sand size, number of sacks used, and sack weight)
- Tagged depth of filter pack (ft bgs)
- Quantity of bentonite used (include manufacturer name, diameter if pellets used, number of buckets, and weight of bucket)
- Tagged depth of bentonite (ft bgs) (Before and after hydration)
- Quantity of grout used to cement well casing (include manufacturer name, # of sack, sack weight, type and quantity of any additives used)
- Tagged depth of grout after installation and after curing (if multiple lifts are performed, record data for each lift)
- Surface completion information.

Any deviations from this SOPP, or the site-specific work plan will require approval from one of the following personnel: the technical lead or the project manager. All deviations shall be documented in writing.

6.0 EXCEPTION PROVISIONS

None.

7.0 CROSS REFERENCE

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U.S. Environmental Protection Agency (EPA), *Procedure Manual for Ground Water Monitoring at Solid Waste Disposal Facilities,* SW-611, December 1980.

U.S. Environmental Protection Agency (EPA), *Resource Conservation and Recovery Act (RCRA) Ground-Water Monitoring Technical Enforcement Guidance Document,* EPA/PB87-107751,1986.

8.0 TABLES

None

9.0 ATTACHMENTS

A- Field Facts
B - Well Completion Form
C – Drilling Log

ATTACHMENT A
Field Facts

Volume of Schedule 40 PVC Pipe				
Diameter (inches)	O.D. (inches)	I.D. (inches)	Volume (gal/linear ft.)	Weight of Water (lbs/linear ft.)
1¼	1.660	1.380	0.08	0.64
2	2.375	2.067	0.17	1.45
3	3.500	3.068	0.38	3.20
4	4.500	4.026	0.56	5.51
6	6.625	6.065	1.5	12.5
8	8.625	7.981	2.6	21.65
12	12.750	11.938	5.81	48.44

Hole Diameter	Volume/Linear Ft. of Hole		Nominal Casing Diameter	Volume/Linear Ft. of Annulus		Pounds Sand/ Linear Ft. of Annulus	Pounds ½" Pellets per Linear Ft. of Annulus
	Gal.	Cu. Ft.		Gal.	Cu. Ft.		
7¼"	2.14	0.29	1¼"	2.03	0.27	27	21
7¼"	2.14	0.29	2"	1.91	0.26	26	20
7¾"	2.45	0.33	2"	2.22	0.30	30	23
8¼"	2.78	0.37	2"	2.55	0.34	34	26
10¼"	4.29	0.57	2"	4.05	0.54	54	41
8¼"	2.78	0.37	3"	2.28	0.30	30	23
10¼"	4.29	0.57	3"	3.79	0.51	51	38
12¼"	6.13	0.82	3"	5.62	0.75	75	57
8¼"	2.78	0.37	4"	1.95	0.26	26	20
10¼"	4.29	0.57	4"	3.46	0.46	46	35
12¼"	5.13	0.82	4"	5.30	0.71	71	54
12¼"	6.13	0.82	6"	4.33	0.58	58	44

Miscellaneous Data:

1 Cu. Ft. = 7.5 gal. (approx.)
1 Gallon = 0.134 Cu. Ft. (approx.)
1 Cu. Yd. = 202 gal. (approx.)
1 Gallon = 0.005 Cu. Yd. (approx.)
1 Gallon of Water = 8.34 lbs. (approx.)
1 Cu. Ft. of Fresh Water – 62.4 lbs. (approx.)
PSI = 0.434 x the height of the water column in feet
Feet of Head = PSI x 2.304
1 Barrel = 42 gallons (approx.)
1 Sack of Sand = 1 Cu Ft. and approx. 100 lbs.
1 Sack of Cement = 1 Cu. Ft. and approx. 96 lbs.
1 Pail of Bentonite Pellets = 50 lbs. (approx.)

ATTACHMENT B

WELL COMPLETION FORM (Stickup or Above Grade Completion Well)

FIELD REPRESENTATIVE: _____
DRILLING CONTRACTOR: _____

DRILLING TECHNIQUE: _____
AUGER SIZE AND TYPE: _____

BOREHOLE IDENTIFICATION: _____
BOREHOLE DIAMETER: _____
WELL IDENTIFICATION: _____

WELL CONSTRUCTION START DATE: _____
WELL CONSTRUCTION COMPLETE DATE: _____

SCREEN MATERIAL: _____
SCREEN DIAMETER: _____
STRATUM-SCREENED INTERVAL (FT): _____

CASING MATERIAL: _____
CASING DIAMETER: _____

TYPE OF FILTER PACK: _____
GRADIATION: _____
AMOUNT OF FILTER PACK USED: _____

TYPE OF BENTONITE: _____
AMOUNT BENTONITE USED: _____

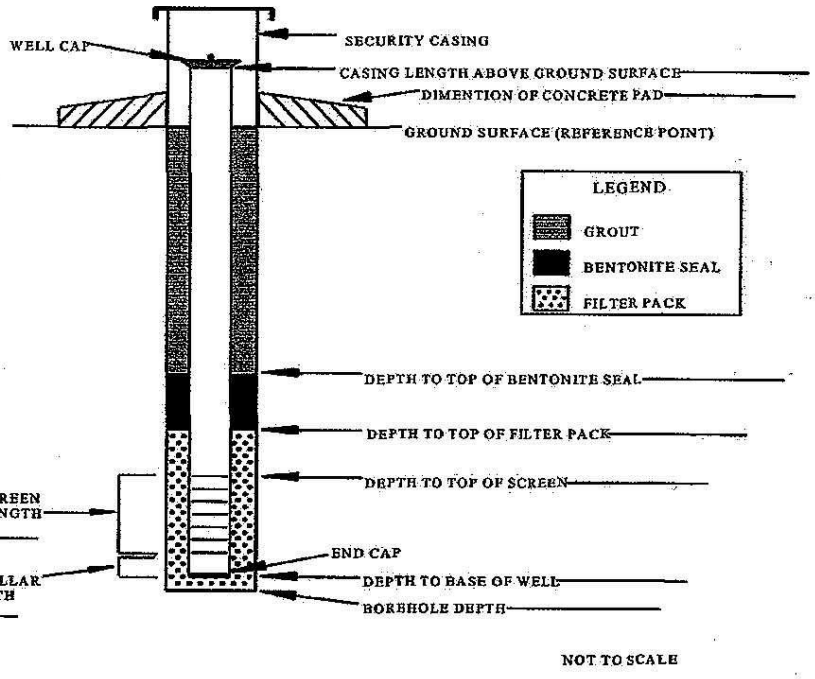
TYPE OF CEMENT: _____
AMOUNT CEMENT USED: _____
GROUT MATERIALS USED: _____

DIMENSIONS OF SECURITY CASING: _____

TYPE OF WELL CAP: _____
TYPE OF END CAP: _____

COMMENTS:

SPECIAL CONDITIONS
(describe and draw)



INSTALLED BY: _____ INSTALLATION OBSERVED BY: _____

DISCREPANCIES: _____

Hole No. 00107761

DRILLING LOG	DIVISION	INSTALLATION	SHEET OF SHEETS

1. PROJECT		10. SIZE AND TYPE OF BIT		
2. LOCATION *(Coordinates or Station)*		11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*		
3. DRILLING AGENCY		12. MANUFACTURERS DESIGNATION OF DRILL		
4. HOLE NO. *(As shown on drawing title and title number)*		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED	UNDISTURBED
5. NAME OF DRILLER		14. TOTAL NUMBER CORE BOXES		
		15. ELEVATION GROUND WATER		
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		16. DATE HOLE	STARTED	COMPLETED
		17. ELEVATION TOP OF HOLE		
7. THICKNESS OF OVERBURDEN		18. TOTAL CORE RECOVERY FOR BORING		
8. DEPTH DRILLED INTO ROCK		19. SIGNATURE OF INSPECTOR		
9. TOTAL DEPTH OF HOLE				

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS *(Description)* d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth of weathering, etc., if significant)* g

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT HOLE NO.
MAR 71 (TRANSLUCENT)

Appendix E

Health and Safety Plan

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Attachment 2	Health and Safety Forms
Attachment 3	Material Safety Data Sheets
Attachment 4	Activity Hazard Analysis Table

Acronyms and Abbreviations

AHA	activity hazard analysis
CFR	Code of Federal Regulations
CGI	combustible gas indicator
CPR	cardiopulmonary resuscitation
CRZ	contamination reduction zone
EMS	emergency medical services
EO	equipment operator
ERCP	Emergency Response and Contingency Plan
eV	electron volts
EZ	exclusion zone
F/B	flash/bang
FM	Factory Mutual
GFCI g	round fault circuit interrupter
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HSM	Health and Safety Manager
IP	ionization potential
kV	kilovolt
LEL	lower explosive limit
LEPC	Local Emergency Planning Committee
LHAAP	Longhorn Army Ammunition Plant
LSP	lightning safety position
mm	millimeters
mph	miles per hour
MSDS	material safety data sheets
NIOSH	National Institute for Occupational Safety and Health
NLSI	National Lightning Safety Institute
O_2	oxygen
OSHA	Occupational Safety and Health Administration
PM	Project Manager
PPE	personal protective equipment

Acronyms and Abbreviations (continued)

ppm	parts per million
PSO	Project Safety Officer
PVC	polyvinyl chloride
SZ	support zone
TBD	to be determined
TCE	trichloroethene
TCEQ	Texas Commission on Environmental Quality
TNT	trinitrotoluene
TO	task order
UL	Underwriters Laboratories
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
UV	ultraviolet
XRF	X-ray fluorescence

1.0 Introduction

This Health and Safety Plan (HASP) defines and establishes the policies and procedures that protect workers and the public from potential hazards posed by planned project activities at the former Longhorn Army Ammunition Plant (LHAAP) Karnack, Texas. The plan incorporates health and safety policies and safe operating procedures for individual project activities. These project activities will comply, at a minimum, with the *Safety and Health Requirements Manual* (EM-385-1-1) (USACE, 2008), which define the minimum health and safety requirements for project site activities under this TO.

Note: This HASP has been designed for the methods presently anticipated for the execution of the proposed work. Each company or contractor is responsible for the safety and health of their personnel, for their actions, and for the work they perform. It is highly recommended that each company or contractor working at LHAAP perform their work under the supervision of their internal health and safety professionals. In addition, as the work is performed, conditions different from those anticipated may be encountered and the HASP may have to be modified.

2.0 Site-Specific Environmental Safety and Health Plan

Project activities will be conducted in a manner that minimizes the probability of injury, accident, or incident occurrence. The contractor employees, subcontractors, and visitors are required to be familiar with the HASP prior to site entry and to sign the Health and Safety Plan Worker Acknowledgment (**Attachment 1**).

The HASP and site activities will be in compliance with the following regulations, contract requirements, and guidelines:

- *Safety and Health Requirements Manual* (EM 385-1-1) (USACE, 2008)
- U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) standards, specifically:

  √ Title 29 Code of Federal Regulations (CFR) 1910 – Safety and Health Regulations for General Industry

  √ Title 29 CFR 1910.1200 – Hazard Communication

  √ Title 29 CFR 1926.59 – Hazard Communication

  √ Title 29 CFR 1926 – Safety and Health Regulations for Construction

- U.S. Environmental Protection Agency (USEPA), 1988, Standard Operating Safety Guidelines
- State-specific safety and health regulations

Although the HASP focuses on the specific work activities planned for this project site, it must remain flexible because of the nature of the work. Conditions may change and unforeseen situations may arise that require deviations from the original plan. This flexibility allows modification by the Project Safety Officer (PSO) who take into account changing site conditions, such as new data on chemical hazards, weather, and changes in scope of work. Changes to the HASP must be approved by the Health and Safety Manager (HSM).

This HASP is based on the scope of work, project work plan, and site-specific information provided in the TO that includes the following:

- Background information on previous site operations
- Location and approximate size of the site

- Site description and site map
- Anticipated contaminants and characteristics
- Applicable federal, state, and local regulations and codes

2.1 Scope of Work

The contractor will perform the following site work tasks to complete the project scope of work. The activity hazard analysis (AHA) for the tasks listed are included as **Attachment 4** to this HASP.

- Mobilization and Site Setup
- Monitoring Well Installation/Development/Abandonment
- Surveying
- Groundwater / Soil Sampling
- Surface Water/Sediment Sampling
- Investigation Derived Waste Management
- Soil Excavation and Disposal
- Field Screening (e.g., X-Ray Fluorescence [XRF])
- Site Restoration and Demobilization

2.2 Site Description

LHAAP is located in central-east Texas, in Harrison County, between State Highway 43 at Karnack, Texas, and Caddo Lake. **Figure 2-1** in the Remedial Design shows the location of LHAAP and surrounding communities. The former installation occupied nearly 8,500 acres. The nearest cities are Marshall, Texas, approximately 14 miles to the southwest, and Shreveport, Louisiana, approximately 40 miles to the east.

The LHAAP was established in 1941 when the Army issued a contract to build a six-line production facility for manufacturing trinitrotoluene (TNT). From 1942 to 1945, the facility produced 414 million pounds of TNT. From 1952 to 1956, the facility produced 3.4 million pyrotechnic devices, photoflash bombs, simulators, hand signals, and 40-millimeter (mm) tracers. During the Vietnam conflict, pyrotechnic and illuminating ammunition was produced. From 1954 to 1980, solid-fuel rocket motors for tactical missiles were produced. During this period, the LHAAP manufactured approximately 50 million pounds of propellant and 200,000 rocket motors. From 1988 to 1991, LHAAP was also used for the static firing and elimination of Pershing I and II rocket motors.

Various media have been contaminated by past industrial operations and waste management practices at LHAAP. LHAAP was placed on the National Priorities List on August 9, 1990. A Federal Facility Agreement among USEPA, the Army, and the Texas Commission on Environmental Quality (TCEQ) (formerly Texas Natural Resource Conservation Commission), became effective December 30, 1991.

3.0 Key Personnel and Management

The HSM and the PSO are responsible for formulating and enforcing health and safety requirements, and for implementing this HASP. The following summarizes the health and safety responsibilities of the site management.

3.1 Project Safety Management Responsibilities

The PM has the overall responsibility for the project and assures that the requirements of the contract are attained in a manner consistent with the HASP requirements. The PM will coordinate with the PSO to assure that the work is completed in a manner consistent with the HASP. The PSO is responsible for field implementation of the HASP. The PSO will be the main contact in any on-site emergency situation. The PSO is authorized to administer this HASP. The PSO is authorized to stop work when an imminent health or safety risk exists. The HSM is responsible for reviewing the HASP and determining that the HASP is complete and accurate.

3.2 Equipment Operators

Equipment operators (EOs) will be responsible for the maintenance, inspection, and safe operation of their equipment. EOs are responsible for daily inspection of the equipment and verifying that it is in safe operating condition.

3.3 Employee Safety Responsibility

Each employee is responsible for his own safety as well as the safety of those around him. The employee shall use the equipment provided in a safe and responsible manner as directed by his supervisor.

3.4 Responsible Contractor Health and Safety Personnel

The following contractor personnel will be responsible for health and safety on site.

- Project Manager
- Project Health and Safety Manager
- Project Safety Officer

4.0 Project Hazard Analysis

This section outlines the potential chemical and physical hazards that workers may be exposed to during work on this project. **Table 4-1** lists primary contaminants known to be present at the LHAAP. A list and material safety data sheets (MSDSs) for chemicals anticipated to be found at LHAAP-35B(37) and LHAAP-67 are included in **Attachment 3** of this HASP.

Table 4-1
Potential Chemical Hazards

Chemical	Exposure Routes	PEL/TLV	Health Hazards/Physical Hazards
Lead	Inhalation, ingestion	0.050 mg/m^3	Weakness, insomnia; loss of appetite, loss of weight, abdominal pain; anemia; tremors; weakness of wrists/ankles; kidney damage; low blood pressure. Incompatible with strong oxidizers, hydrogen peroxide and acids
Mercury	Inhalation, skin contact	0.025 mg/m^3 SKIN alkyl compounds 0.01 mg/m^3	Cough, chest pain, shortness of breath; tremor, insomnia, irritability, headache, weakness, stomach pain, loss of appetite; kidney damage. Reacts with acetylene, ammonia, chlorine dioxide, copper and other metals
Trichloroethene	Skin, eye, inhalation, ingestion	50 ppm	A skin and eye irritant; dermatitis, headache, vertigo, visual distortion, fatigue, nausea, vomiting, irregular heart rhythm. A dangerous fire hazard, reacts with strong caustics and chemically reactive metals, will emit toxic phosgene gas when heated.
Trinitrotoluene	Skin, eye, inhalation, ingestion	0.5 mg/m^3	A skin and eye irritant; headache, weakness, anemia, liver injury, hallucinations, visual distortions, cyanosis. A severe explosion hazard, will explode on heating or strong shock; thermal decomposition will emit NO_X gases and/or detonation.
Methylene Chloride	Skin, eye, inhalation, ingestion	50 ppm	A suspected human carcinogen; headache, narcosis, fatigue, tingling in the limbs, stupor; a strong skin, eye irritant. Can react violently with strong oxidizers, light metals, potassium hydroxide; low combustability, flammable at elevated (>100 C) temperatures; emits toxic gases when burned

Chemical	Exposure Routes	PEL/TLV	Health Hazards/Physical Hazards
Ammonium Perchlorate	Skin, eye, inhalation, ingestion		Can irritate the nose causing coughing and wheezing and can interfere with the ability of the blood to carry oxygen causing headache, fatigue, dizziness, and a blue color to the skin and lips. Is a powerful oxidizer. Stable in pure form, but decomposes at a temperature 150 degrees C or above. It becomes explosive when mixed with finely divided organic materials and can exhibit explosive sensitivity to shock and friction when contaminated with small amounts of some impurities such as sulfur, powdered metals and carbonaceous materials. May explode in fire.

Abbreviations:

CNS	*central nervous system*	*STEL*	*short-term exposure limit*
PEL/TLV	*permissible exposure limit/threshold limit value*	*mg/m^3*	*milligrams per cubic meter*
ppm	*parts per million*	*NO_x*	*nitrogen oxides*

4.1 Chemical Hazards

Chlorinated Solvents

Chlorinated solvents include trichloroethene (TCE), methylene chloride, and other similar compounds. TCE is irritating and toxic to the central nervous system. Inhalation of high concentrations have led to death due to ventricular fibrillation. Chronic exposure may lead to heart, liver, and kidney damage. The liquid is absorbed through the skin. Although it has a relatively low flash point, TCE burns with difficulty. Methylene chloride can cause irritation to the respiratory and gastrointestinal tract. Skin contact can result in irritation, redness, and pain. Chronic exposure can cause headache, mental confusion, depression, liver effects, among other effects. Methylene chloride may cause cancer in humans. Avoid exposure to methylene chloride through engineering controls and wearing personal protective equipment (PPE).

Lead

Exposure to lead can be from inhalation of dusts or from skin exposure. Symptoms are nonspecific and can be hard to distinguish from minor seasonal illnesses. The symptoms are decreased physical fitness, fatigue, sleep disturbance, headache, aching bones and muscles, digestive disorders (particularly constipation), abdominal pains, and decreased appetite.

Mercury

Mercury is a naturally occurring element that is found in air, water and soil. It exists in several forms that include elemental or metallic mercury, inorganic mercury compounds, and organic mercury compounds. Pure mercury is a liquid metal that volatizes readily to become an invisible, odorless toxic vapor.

Mercury exposure at high levels can harm the brain, heart, kidneys, lungs, and immune system of people of all ages. Mercury in the air eventually settles into water or onto land where it can be washed into water. Once deposited, certain microorganisms can change it into methylmercury, a highly toxic form that bioaccumulates in fish, shellfish and animals that eat these fish. At high levels of exposure, methylmercury's harmful effects on these animals include death, reduced reproduction, slower growth and development, and abnormal behavior.

Symptoms of methylmercury poisoning may include:

- impairment of the peripheral vision;
- “pins and needles” feelings, usually in the hands, feet, and around the mouth;
- lack of coordination of movements;
- impairment of speech, hearing, walking; and muscle weakness.

Perchlorate

Perchlorate is both a naturally occurring and man-made chemical. Most of the perchlorate manufactured in the United States is used as the primary ingredient of solid rocket propellant. Wastes from the manufacture and improper disposal of perchlorate-containing chemicals are increasingly being discovered in soil and water. Perchlorate is associated with the disruption of thyroid function, which can potentially lead to thyroid tumor formation. The USEPA, federal, state, and water suppliers are already actively addressing perchlorate in drinking water and surface water.

Residual amounts of these chemicals may be present during soil excavation, well installation and groundwater sampling activities; however, potential for worker exposure to these substances is remote. Airborne dust and particulate at well installation sites will be closely controlled. Real-time air monitoring will be conducted during these activities to monitor potential exposure and action levels established to initiate PPE upgrades. Workers will undergo initial personal monitoring to determine actual exposure levels, and confirm PPE levels.

The following general symptoms may indicate exposure to a hazardous chemical. Personnel will be removed from the work site and provided immediate medical attention if the following symptoms occur:

- Dizziness or stupor
- Nausea, headaches, or cramps
- Irritation of the eyes, nose, or throat
- Euphoria
- Chest pains and coughing
- Rashes or burns

4.2 Hazard Communication

The purpose of hazard communication (employee right-to-know) is to verify that the chemical hazards located at this field project site are communicated according to 29 CFR 1926.59 to all contractor personnel and subcontractors. Hazard communication will include the following elements.

4.2.1 Container Labeling

Contractor personnel will ensure that all drums and containers are labeled according to contents. These drums and containers will include those from manufacturers and those produced on site by operations. All incoming and outgoing labels shall be checked for identity, hazard warning, and name and address of responsible party.

4.2.2 Material Safety Data Sheets

There will be MSDSs located on site for each chemical used on site. Hazardous chemical MSDSs are located in **Attachment 3** of the HASP.

4.2.3 Employee Information and Training

Training employees on chemical hazards should be accomplished through ongoing contractor training programs. Additionally, chemical hazards will communicated to employees through daily safety meetings held at the field project site and by an initial site orientation program.

At a minimum, the contractor and subcontractor employees will be instructed about the following:

- Chemicals and their hazards in the work area
- How to prevent exposure to these hazardous chemicals
- What the company has done to prevent workers' exposure to these chemicals
- Procedures to follow if they are exposed to these chemicals
- How to read and interpret labels and MSDSs for hazardous substances
- Emergency spill procedures
- Proper storage and labeling

Before a new chemical is introduced on-site, each contractor and related subcontractor employee will be given information in the same manner as during the initial site orientation program. The PSO will be responsible for seeing that the MSDS for the new chemical is available for review by on-site personnel. The information pertinent to the chemical hazards will be communicated to project personnel.

Morning safety meetings will be held and the hazardous materials used on site will be discussed. Attendance is mandatory for all on-site employees.

Refer to **Attachment 3** of this HASP for a list of hazardous chemicals anticipated to be found at the site and their MSDS.

4.3 Physical Hazards

To minimize physical hazards, standard safety protocols should be followed. Failure to follow safety protocols will result in removal of an employee from the site and appropriate disciplinary actions.

The PSO will observe the general work practices of each crew member and EO, and enforce safe procedures. Work areas will be inspected by the crew leaders and PSO. Hazards will be corrected in a timely manner. A variety of physical hazards may be encountered during work activities at this site. An AHA Table, **Attachment 4**, has been developed for each principal activity, and will identify the major hazards to which employees may be exposed. Hard hats, safety glasses, and steel toe safety boots are required in all areas of the site. Site-specific hazards and the necessary precautions will be discussed at the daily safety meetings.

Physical hazards include safety and environmental hazards. The following physical hazards may be present during project activities:

- Heat stress
- Cold stress
- Biological hazards (poison ivy, ticks, Lyme disease)
- Manual lifting/back strain
- Noise
- Fire/explosion
- Vehicle traffic

Heat and cold stress prevention procedures will be implemented according to EM 385-1-1 (USACE, 2008). Personal noise exposures will be controlled by a Hearing Conservation Program established by the contractor.

4.3.1 Safety Hazards

Site personnel shall become familiar with the field activities that shall be conducted at the site and trained to work safely under various field conditions. In addition, the PSO shall observe the general work practices of each crew member and EO and enforce safe procedures to minimize safety hazards. The following sections shall be typical safety hazards and the relevant hazard control procedures.

4.3.1.1 Heavy and Bulky Loads

Load size and weight shall be considered before heavy and bulky loads are lifted or handled manually by personnel. Mechanical equipment such as forklifts, wheelbarrows, hand-trucks, loaders, and cranes shall

be utilized when possible and needed.

Employees shall make certain the load can be safely handled by considering the size, weight, and shape of the load. No loads over 60 pounds shall be lifted by a single person. Proper lifting techniques shall be utilized: feet shall be shoulder width apart, one foot shall be placed alongside the load, bend at knees, maintain arch in back, keep the load close to the body, lift with the legs not the back.

4.3.1.2 Heavy Equipment Operation and Inspection

Heavy construction EOs present construction safety hazards to operating and ground personnel. Only trained and qualified operators shall be authorized to operate heavy construction equipment.

The operators shall be responsible for performing and documenting daily equipment inspections to identify, take out of service, and correct equipment defects of non-functioning safety devices that would render the equipment unsafe to operate. Standard safety devices and equipment required to be inspected and functional during use includes the following:

- Seat belts
- Safety glass in enclosed cab
- Braking system
- Back-up alarms
- Portable fire extinguisher
- Horn
- Tires
- Steering and hydraulic systems

Operators shall be required to wear seat belts when operating equipment and shall be responsible for the location of ground personnel (i.e., spotters) in their work area.

4.3.1.3 Bulk Fuel Storage

At least one dry chemical, ABC-type fire extinguisher will be positioned in this area.

4.3.1.4 Flame, Heat, or Spark-Producing Operations

Because of the possibility of flammable materials being present at this site, flame, heat, or spark-producing operations shall be limited. If a case arises where hot work is necessary, it shall be performed in accordance with an contractor established hot work procedure.

This procedure requires a hot work permit and shall be inspected by the PSO prior to commencing hot work. Combustible materials shall be removed from the area before the start of hot work. A fire watch shall be posted and the atmosphere shall be tested for combustible gases. A hot work permit shall be

completed by the PSO. The permit shall indicate the area, the employees involved, air monitoring results, fire protection systems, and fire department phone number. All flammable materials/fuels shall be stored in safety containers and backflow preventers shall be required for welding/cutting torches.

4.3.1.5 Small Quantity Flammable Liquids

Small quantities of flammable liquids shall be stored in safety cans and properly labeled as to their contents.

4.3.1.6 Electrical Hazards

Overhead power lines, downed electrical wires, and buried cables pose a danger of shock or electrocution if workers contact or sever them during site operations

To help minimize the hazard posed to workers by electrical equipment, low-voltage equipment with ground-fault interrupters and water-tight, corrosion-resistant connecting cables shall be used on site. In addition, lightning is a hazard during outdoor operations, particularly for workers handling metal containers or equipment. To eliminate this hazard, weather conditions shall be monitored and work shall be suspended during electrical storms. An additional electrical hazard involves capacitors that may retain a charge. Such items shall be properly grounded before handling. OSHA's standard in Title 29, CFR 1910.137 describes clothing and equipment for protection against electrical hazards.

Electrical work shall be performed only by approved electricians. No electrical work should be performed on an energized circuit. Single-phase electrical hand tools must be approved by a recognized testing agency, and all exposed non-current carrying metal parts must be grounded or double insulated. Electrical equipment cannot be used if there are deficiencies in the appliance, cord, or plug.

4.3.1.7 Underground/Overhead Utilities

Intrusive activities are defined as any activity that produces a man-made cut, cavity, trench, or depression into the earth's surface formed by earth removal or any activity that results in an object placed into the earth below the surface. These activities include excavating, drilling, augering, boring, shoveling, fence post driving, driving stakes, etc. Intrusive activities can be dangerous and can result in severe personal injury or death. Intrusive activities can also cause significant property damage to both utilities/structures and operational equipment. Breaching underground utilities can result in electrocution from damaged electric lines, fires from broken fuel/gas lines, and disruption of telephone service.

Before any intrusive activity at the site begins, positive steps shall be taken to determine if the area contains underground utilities or overhead hazards. It is important to understand that underground utilities have been found in areas that have been properly investigated and thought not to have utilities present. Personnel shall always be alert for marking tape, wires, pipes, previously disturbed soils, crushed stone or sand bedding/backfill, containers, discolored soil, or anything else unusual.

4.3.1.8 Slip/Trip/Fall Hazards

Some areas may have wet surfaces that greatly increase the possibility of inadvertent slips. Caution must be exercised when using steps and stairs.

Use of handrails when climbing stairs shall be enforced, and handrails shall remain secure until the support itself is removed and lowered to ground level. Good housekeeping practices are essential to minimize trip hazards. Full body harnesses shall be used by personnel working 4 feet or more above surfaces, including man lifts.

The work area shall be kept clean and orderly. Tools and debris must be picked up and placed in the proper place to prevent a tripping hazard. Walkways and grating shall be kept in good condition. Spills shall be cleaned up immediately. Personnel shall not walk or climb on piping, valves, fittings, or any other equipment not designed as walking surfaces

4.3.1.9 Ground Personnel

All ground personnel should be constantly aware of the possibility of slips, trips, and falls due to poor and possibly slippery footing in the work areas. Before crossing either in front of or behind a piece of heavy equipment, ground personnel shall signal the EO and receive confirmation before moving.

4.3.1.10 Head and Back Injuries

As minimum requirements, hard hats and safety glasses shall be donned prior to performing site activities. At the daily safety meeting, personnel shall be instructed in proper lifting techniques and reminded not to lift heavy items without assistance.

4.3.1.11 Heavy Equipment and Vehicle Traffic

The use of heavy equipment for excavation presents the greatest potential for injury to personnel. In order to minimize these hazards, designated routes shall be established for mobilization through the facility, and specific traffic patterns shall be established. Trucks and other heavy equipment shall have spotters for backing maneuvers. Those crew members directly involved with spotting for the operator shall be the only personnel allowed in the vicinity of the heavy equipment. Other personnel shall remain a safe distance away from these operations. Personnel who need to approach heavy equipment while in operation shall observe the following protocols:

- Make eye contact with the operator (and spotter)
- Signal the operator to cease heavy equipment activity
- Approach the equipment and inform the operator of intentions

The contractor and subcontractor personnel shall follow traffic rules. Company vehicles shall yield to

bikes, pedestrians, and railroad crossings. Vehicles must come to a complete stop at railroad crossings. Vehicles must be operated in a safe and legal manner. Motor vehicles that are defective or not operating properly must be reported immediately. Seat belts must be worn while driving. Personnel shall drive at posted speed limits or at speeds consistent with prevailing road, traffic, or weather conditions.

4.3.2 Heat Stress

With the possible combination of ambient factors such as high air temperature, high relative humidity, low air movement, high radiant heat, and protective clothing, the potential for heat stress is a concern. The potential exists for the following:

- Heat rash
- Heat cramps
- Heat exhaustion
- Heat stroke

Heat stroke, heat cramps, and heat exhaustion shall be discussed during safety tailgate meetings, which shall be conducted before each workday. Workers shall be encouraged to increase consumption of water and electrolyte-containing beverages such as Gatorade™ during warm weather. Water and electrolyte-containing beverages shall be provided on site and shall be available for consumption during work breaks. Site personnel shall follow the contractor established procedures for heat stress prevention.

4.3.3 Cold Stress

With outdoor work in the winter months, the potential exists for hypothermia and frostbite. Protective clothing greatly reduces the possibility of hypothermia in workers. Personnel shall be instructed to wear warm clothing and to stop work to obtain more clothing if they become too cold. Employees shall also be advised to change into dry clothes if their clothing becomes wet from perspiration or from exposure to precipitation. In cold weather, the potential for frostbite exists, especially in body extremities. Personnel shall be instructed to pay particular attention to hands, feet, and exposed skin when dressing. Personnel shall obtain more clothing if they begin to experience loss of sensation due to cold exposure.

Employees shall be encouraged to use heated shelters on site at regular intervals depending upon the severity of exposure. Symptoms of cold stress, including heavy shivering, excessive fatigue, drowsiness, irritability, or euphoria should be treated with an immediate return to the shelter.

4.3.4 Hearing Conservation Program

On projects where noise levels may exceed a time-weighted average of 85 dBA (decibels, A-scale), hearing protection shall be made available to all exposed employees. Additionally, sound level monitoring shall be conducted on-site. Contractor personnel shall be restricted from high noise exposure without appropriate hearing protection. The contractor Hearing Conservation Program should be in

compliance with OSHA regulations found in Title 29 CFR 1910.95.

4.3.5 Excavation Procedures

Any excavation 5 feet deep or greater into which persons will enter and perform work must be shored, sloped, or otherwise made safe for entry. Excavations less than 5 feet in depth and which a competent person examines and determines there to be no potential for cave-in do not require protective systems. Excavations will be done in compliance with OSHA regulation 29 CFR 1926.650.

All excavations shall be performed from a stable ground position. Daily inspections of the excavation shall be made by a competent person, one who has received training in excavation safety. The inspector shall determine the likelihood of a cave-in, and remedial action such as sloping or shoring shall be taken if the walls appear to be unstable. The inspector shall verify that adequate means of egress are in place.

All spoil shall be located at least 2 feet from the edge of the excavation to prevent it from falling back into the excavation and surcharging the excavation face. Perimeter protection will be used for all excavation activities at the site, consisting of warning barricades or fencing placed at a distance not closer than 6 feet from the edge of the excavation, and displays adequate warning at an elevation of 3 feet to 4 feet above ground.

All project personnel shall participate in the site-specific training session and be instructed on the following requirements. Before excavating, the existence and location of underground pipe, electrical equipment, and gas lines will be determined and documented. If the locations of any lines are in question, a cable-avoiding tool will be used to positively locate them.

No ignition sources are permitted if the ambient airborne concentration of flammable vapors exceeds 10 percent of the lower explosive limit (LEL) during the excavation. A combustible gas indicator (CGI) will be used to make this determination.

Operations must be suspended and the area vented if the airborne flammable concentration reaches 10 percent of the LEL in the area of an ignition source (i.e., sparks from bucket of excavator).

Combustible gas readings of the general work area will be made regularly.

If excavating equipment is located in the vicinity of overhead power lines, maintain at least 10 feet from overhead power lines, up to 50 kilovolt (kV). For voltages over 50 kV, add 0.4 inches per kV to obtain the safe distance between equipment and power lines.

Ladders will be provided and placed at an angle not more than 30 degrees from vertical, and secured as necessary. Ladder side rails shall extend at least 3 feet above the ground surface.

Excavations greater than four feet in depth that require personnel to enter shall have sufficient means of entry and egress (stairs, ladders, ramps). Means of entry/egress shall not require personnel to travel

laterally more than 25 feet.

Excavations occurring within 3 feet of communication cables will be performed by hand digging until the cable is exposed.

4.3.6 Drilling and Well Installation

All drillers performing work must possess required state or local licenses to perform such work. All members of the drill crew must receive site-specific safety training prior to beginning work. The lead driller is responsible for the safe operation of the drill rig as well as the drill crew's adherence to the requirements of this HASP.

The lead driller must ensure that all safety equipment is in proper condition and is properly used. The members of the crew must follow all instructions for the lead driller, wear all required PPE, and be aware of all hazards and control procedures. The drill crews must participate in the daily tailgate safety meeting and be aware of all emergency procedures.

Rig Inspection. Each day, prior to the start of work, the drill rig and associated equipment must be inspected by the driller and/or drill crew. The following items must be inspected:

- Vehicle/equipment condition
- Proper storage of equipment
- Condition of all wire rope and pulleys
- Location of fire extinguisher and first aid kit.

Rig Set Up. The drill rig must be properly blocked and leveled prior to raising the derrick. The wheels which remain on the ground must be chocked. The rig can only be moved after the derrick has been lowered. The leveling jacks must not be raised until the derrick is lowered.

Site drilling will comply with the following rules:

- Before drilling, the existence and location of underground pipe, electrical equipment, and gas lines will be determined. The Utility Line Protection Law requires that anyone planning borings call the state's ONE-CALL number at least three, but not more than ten business days prior to conducting drilling activities.
- If drilling is conducted in the vicinity of overhead power lines, maintain at least 10 feet from overhead power lines, up to 50 kV. For voltages over 50 kV, add 0.4 inches per kV to obtain the safe distance between equipment and power lines.
- Restricting work area access from vehicular/pedestrian traffic by utilizing temporary fencing or warning tape will be required.

- If lubrication fittings are not accessible with guards in place, machinery must be stopped before oiling and greasing. Fuel, hydraulic fluid, or oil will not be refilled in the drill rig unless the engine has been turned off.
- All drilling will occur a minimum of 3 feet from any known or suspected location of an underground structure or utility. A hand auger or posthole digger must be utilized to advance through the first 5 feet of the subsurface.
- Rigging equipment for material handling must be checked prior to use on each shift and as often as necessary to ensure it is safe. Defective rigging must be removed from service immediately.
- Drillers will not add or remove pipe from the drill stem without the assistance of the driller's helper.
- Lifting and transporting of drums should be completed using the appropriate equipment and following safe loading and unloading procedures.

Hoisting Operations

- Drillers must never engage the rotary clutch without watching the rotary table and ensuring it is clear of personnel and equipment.
- Unless the drawworks is equipped with an automatic feed control, the brake must not be left unattended without first being tied down.
- Casing or pipe must not be picked up suddenly.
- Drill pipe must not be hoisted until the driller is sure that the pipe is latched and the drilling assistant has signaled that he/she may safely hoist the load.
- During instances of unusual loading of the derrick or mast, such as when making an unusually hard pull, only the driller will be on the rig floor and no one will be on the rig or derrick.
- The brakes on the drawworks of every drilling rig must be tested by each driller at the beginning of each shift to determine whether they are in good order. The brakes must be thoroughly inspected by a competent individual each week.
- A hoisting line with a load imposed will not be permitted to be in direct contact with any derrick member or stationary equipment unless it has been specifically designed for line contact.
- Hoisting control stations must be kept clean and controls labeled as to their functions.

Riding Hoisting Equipment. Under no circumstances will personnel be permitted to ride the traveling block or elevators, nor will be the cat line be used as a personnel carrier.

Cat Line Operations

- Only experienced workers will be allowed to operate the cathead controls. The kill switch must be clearly labeled and operational prior to operation of the cat line.
- The cathead area must be kept free of obstruction and entanglements.
- The operator will not use more wraps than necessary to pick up the load. More than one layer of wrapping is not permitted.

- Personnel must not stand near, step over, or go under a cable or cat line which is under tension.
- Employees rigging loads on cat lines must:
- Keep out from under the load
- Keep fingers and feet where they will not be crushed
- Be sure to signal clearly when the load is being picked
- Make sure that the load is properly rigged, since a sudden jerk in the cat line will shift or drop the load.

Pipe Handling

- Pipe must be loaded and unloaded, layer by layer, with the bottom layer pinned or blocked securely on all four corners. Each successive layer must be effectively blocked or chocked.
- Workers will not be permitted to top off the load during loading, unloading, or transferring or pipe or rolling stock.
- Employees must be instructed never to try to stop rolling pipe or casing; they must be instructed to stand clear of rolling pipe.
- When pipe is being hoisted, personnel will not stand where the bottom end of the pipe could whip and strike them

4.3.7 Confined Space Entry

A confined space is defined as a space large enough and so configured that an employee can bodily enter and perform assigned work, has limited means for entry or exit, and is not designed for continuous employee occupancy. Contaminated soil excavations, storage vessel entries, and other confined space work may pose additional hazards such as air contamination, flammable or explosive atmosphere, and oxygen deficiency. Excavation entry may pose the possibility of engulfment.

Only personnel properly trained shall supervise and participate in confined space entry procedures or serve as standby attendants. All confined spaces are initially considered permit required. Under certain conditions, a space may be reclassified as a non-permit confined space provided the HSM approves the reclassification.

4.3.8 Fire Prevention and Protection

Clothes, cotton waste, and other combustible materials that might constitute a fire hazard will be placed in closed metal containers and placed outside or destroyed at the end of each day. The contractor will provide and maintain portable fire extinguishers in the following manner:

Portable fire extinguishers will be provided, where needed, and inspected on a monthly basis. A visual inspection will be made to ensure that extinguishers are fully charged and in an operable condition.

Hoses, nozzles, brackets, and supports will be inspected for deficiencies and corrected. Gauge pressure

will be checked on pressurized units on a monthly basis to ensure units are fully charged and non-pressurized units will have their cartridges weighed on an annual basis. The chemical within dry chemical extinguishers will be inspected on an annual basis to ensure that it is powdery and in a free-running condition. An inspection tag will be attached to all extinguishers to designate that they have received an annual inspection. Fire extinguishers will be suitably placed, distinctly marked, and readily accessible.

A fire extinguisher with a rating of not less than 10-B will be located within 50 feet or wherever more than 5 gallons of flammable gas are being used on the work site (this does not apply to integral fuel tanks of motor vehicles).

A fire extinguisher with a rating of not less than 20-B will be located outside of and within 10 feet of the door opening into any room, building, or trailer used for storage of more than 60 gallons of flammable or combustible liquids.

If flammable liquids are being stored in an outside location, at least one portable fire extinguisher with a rating of not less than 20-B will be located at least 25 feet from the storage area, but not more than 75 feet away.

All tank trucks or vehicles used for transporting and/or dispensing flammable or combustible liquids will have a portable fire extinguisher with not less than a 20-BC rating.

A portable fire extinguisher with a rating of not less than 20-BC will be placed within 50 feet of each service or fueling area.

Fire extinguishers will be placed in storage areas so they are capable of extinguishing materials being stored.

All fire extinguishers will be approved by a nationally recognized testing laboratory.

A fire extinguisher with a rating of not less than 2-A will be provided where torches or open flames are in use.

At least one dry chemical or carbon dioxide fire extinguisher, with a 5-BC rating minimum, will be available for placement on each unit of heavy equipment, and each site vehicle (excluding rental cars).

Fuel handling is another hazard which will be present during this task. Refueling of the mechanical equipment poses burn hazards. All refueling and fuel handling equipment must be Underwriters Laboratories (UL) listed and Factory Mutual (FM) approved. The refueling must be done in a designated area to prevent contamination from minor spills and to reduce the risk of fires. The following guidelines must be followed whenever personnel are dispensing flammable and combustible liquids:

Flammable liquid dispensing systems will be electrically bonded and grounded. All tanks, hoses, and containers of 5 gallons or less will be kept in metallic contact while flammable liquids are being transferred; transfer of flammable liquids in containers in excess of 5 gallons will be done only when the containers are electrically bonded.

Flammable or combustible liquids will be drawn from, or transferred into, vessels, containers, or tanks within a building or outside only through a closed piping system, from safety cans, by means of a device drawing through the top, or from a container, or portable tanks, by gravity or pump, through an approved self closing valve. Transferring by means of air pressure on the container or portable tanks is prohibited.

Areas in which flammable or combustible liquids are transferred in quantities greater than 5 gallons from one tank or container to another will be separated from other operations by at least 25 feet or a barrier having a fire resistance of at least 1 hour. Drainage or other means will be provided to control spills.

Natural or mechanical ventilation will be provided to maintain the concentration of flammable vapor at or below 10% of the lower explosive level.

Dispensing units will be protected against collision damage.

Dispensing nozzles and devices for flammable liquids will be of an approved type.

Lamps, lanterns, heating devices, and similar equipment will not be filled while hot: these devices will be filled only in well-ventilated rooms free of open flames or in open air and shall not be filled in storage buildings.

4.3.9 Electrical Power

All electrical equipment must have a ground fault circuit interrupter (GFCI) as part of the circuit. All equipment must be suitable and approved for the class of hazard. Temporary wiring conductors installed for operation of construction tools and equipment will be either Type TW or THW contained in metal raceways, or will be hard usage or extra hard usage multiconductor cord. Temporary wiring will be secured above the ground or floor in a workmanlike manner and will not present an obstacle to persons or equipment. Applicable OSHA standards for electrical power, 29 CFR 1926 Subpart K, shall apply.

4.3.10 Ladder Safety

The following safe work practices will be adhered to during use of ladders:

- Assess work areas for fall hazards. A fall protection system is required if work is conducted 6 feet or over.
- Use Type 1A rated ladders.
- Make sure ladder rungs are sturdy and free of cracks.

- Use ladders with secure safety feet.
- Pitch ladders at a 4:1 ratio.
- Secure ladders at the top or have another person at the bottom to help stabilize it.
- Ladders used to access an upper landing surface shall extend at least three (3) feet above the upper landing surface.
- Use non-conductive ladders near electrical wires.
- The top step of a stepladder should not be used as a step.
- Do not carry any object or load that could cause a loss of balance or a fall.

4.3.11 Manual Material Lifting

Many different types of objects may be handled manually during site operations. Care should be taken when lifting and handling heavy or bulky items because they are the cause of many back injuries. The following fundamentals address the proper lifting techniques that are essential in preventing back injuries:

The size, shape, and weight of the object to be lifted must first be considered. No individual employee is permitted to lift any object that weights over 60 pounds. Multiple employees or the use of mechanical lifting devices are required for objects over the 60-pound limit. The anticipated path to be taken by the lifter should be inspected for the presence of slip, trip, and fall hazards.

The feet shall be placed far enough apart for good balance and stability (typically shoulder width). THE FOOTING SHALL BE SOLID. The worker shall get as close to the load as possible. The legs shall be bent at the knees. The back shall be kept as straight as possible and abdominal muscles should be tightened.

To lift the object, the legs are straightened from their bending position.

A worker shall never carry a load that cannot be seen over or around.

When placing an object down, the stance and position are identical to that for lifting. The legs are bent at the knees and the object lowered.

When two or more workers are required to handle the same object, coordination is essential to ensure that the load is lifted uniformly and that the weight is equally divided between the individuals carrying the load. When carrying the object, each worker, if possible, shall face the direction in which the object is being carried. In handling bulky or heavy items, the following guidelines shall be followed to avoid injury to the hands and fingers:

A firm grip on the object is essential; leather gloves shall be used if necessary.

The hands and object shall be free of oil, grease, and water which might prevent a firm grip, and the fingers shall be kept away from any points that could cause them to be pinched or crushed, especially when setting the object down.

The item shall be inspected for metal slivers, jagged edges, burrs, and rough or slippery surfaces prior to being lifted.

4.3.12 Clearing - General Practices

If personnel are clearing brush using machetes, the following rules apply:

When employees are using a machete to clear the area, no one is permitted within 30 feet of the person swinging the machete. Personnel will be instructed to not stand with their backs toward the active machete work area. All personnel must wear leg chaps and wrist thongs and be familiar with the use of a machete. When trees are being felled, the following rules must be adhered to: Before beginning the operation, alert all personnel in the area that the operation is about to commence. Then check that the area around the landing point of the tree is clear. Use a spotter to make sure that area remains clear. Check that there are no overhead power lines or obstructions that may catch or deflect the tree as it falls.

Never turn your back on the tree while it is being felled. Watch for kickback from the saw and do not force the saw if it becomes stuck in the tree. Make use of wedges to insure fall direction and prevent saw binding on larger diameter trees.

4.3.13 Lockout/Tagout of Hazardous Energy Sources

Lockout/tagout procedures will be implemented to assure the safety of personnel during servicing or maintenance of machines and equipment where the unexpected release of stored energy or the energization of these machines or equipment could cause employee injury. These procedures shall comply with the requirements established in 29 CFR 1926.417. All portable electrical equipment and extension cords shall be protected with a GFCI as part of the circuit. The applicable requirements found in 29 CFR 1926, Subpart K, *Electrical* shall be implemented.

Subcontractors may implement their own lockout/tagout procedure if the HSM has approved its use and verifies that it is no less protective than the primary contractor’s procedure.

4.3.14 Vehicle Safety Management

Motor vehicle incidents are the number one cause of occupational fatalities, accounting for one in three deaths. Fifty percent or more of vehicle safety incidents occur while backing up. The contractor will require employees to use seat belts at all times when traveling in contractor owned or leased/rented vehicles. The PSO will develop a parking area plan, including backing vehicles into parking spaces, using spotters for backing vehicles and policy mandated vehicle inspections.

All contractor personnel and subcontractors shall obey all vehicle traffic safety requirements imposed by local and state agencies. Designated routes for parking and truck traffic relating to construction activities must be established before doing the work. An emergency contact person must be established before work to ensure proper notifications in the event of an incident.

Contractor employees are expected to incorporate safe actions and preparations to avoid vehicle accidents and personal injury during work and off-hours. Breaks should be planned into lengthy job mobilizations and demobilizations, including rotation of drivers at regular intervals. If parking areas are busy or crowded and more than one worker is traveling in the same vehicle, one worker should remain outside the vehicle as it leaves the parking space to assist the driver with traffic observation. Vehicles traveling before dawn and at dusk in rural or wooded areas should be prepared to brake for wildlife, e.g. deer crossing roadways.

Contractor employees arriving at work areas should park vehicles away from delivery, heavy equipment and vehicle loading/unloading locations to prevent parked vehicles from damage by various deliveries. Heavy EOs should inspect areas and request vehicles to be moved or spotters used if necessary, to maneuver equipment in tight areas. Employees who observe near misses or potential risks to parked or moving vehicles must report these to the PSO or HSM immediately.

Contractor employees are expected to use the vehicle inspection form and check/test the safety systems on the vehicle on a daily basis. Check the following: brakes, mirrors, seat belts, tires, leakage from the undercarriage, lights and turn signals. Vehicles with safety deficiencies must be reported immediately and not driven until properly repaired. Vehicles running errands from different project sites should have telephone numbers of the job site in the vehicle in case calls for assistance are required.

Because of the different ways alcohol can affect behavior, even in very small amounts, the best and safest course is not to drink before driving. Personnel involved in motor vehicle incidents are subject to drug and alcohol testing.

Weather conditions can have a profound effect on driving. On slippery roads, drive more slowly. Stop and turn with care. Keep several car lengths from other vehicles. At speeds in excess of 35 miles per hour (mph), the chances of hydroplaning increase with speed. In general, keep back 1 car length for every 10 mph to prevent striking the car ahead.

Vehicles will be operated in accordance with the requirements listed below:

- Seatbelt use is mandatory for all passengers;
- Personnel may not ride in the back of cargo vehicles;
- The driver must make a 360 degree walk around the assigned vehicle prior to vehicle movement;
- A ground guide is used to back up any vehicle;
- Vehicle speed is limited to the posted speed limits for developed roadways, 25 mph maximum on dirt roads and 10 mph maximum off-road (based on conditions);

- Vehicle driven in four wheel low and low gear when on dirt roads or off road driving where steep grades dictate;
- All operators must possess a valid driver's license;
- Fuel or gasoline are not transported inside the passenger compartment;
- No vehicle is left running when unattended; and
- Parking brakes are used when vehicles are parked.

In the event of a vehicle incident, the PSO will be notified ***immediately*** and all required reports completed.

4.3.15 Heavy Equipment Safety

There may be various types of heavy construction equipment that the contractor may be using during the execution of this project. All operators of this equipment will be familiar with the requirements for inspection and operation of the equipment they will be using. Before equipment is placed into use, it will be inspected by the operator to ensure that it is in safe operating condition. The following guidelines will be adhered to while operating heavy construction equipment:

- Equipment will not be operated in a manner that will endanger persons or property nor will the safe operating speeds or loads be exceeded.
- Getting off or on any equipment while it is in motion is prohibited.
- Use the three-point contact rule when getting on and off of equipment.
- Always clear the tracks with debris to ensure good footing and to prevent slippage, especially in wet conditions.
- Spotters will be used to back-up equipment and direct traffic in all "blind" areas.
- Equipment will be operated in accordance with the manufacturer's instructions and recommendations.
- Determinations of road conditions and structures will be made in advance to assure that clearances and load capacities are safe for the passage of equipment.
- All machinery or equipment will be shut down and positive means taken to assure that clearances and load capacities are safe for the passage of equipment.
- Bulldozer and scraper blades, end-loader buckets, dump bodies, and similar equipment will be either fully lowered or blocked when being serviced. Equipment designed to be serviced while running are exempt from this requirement.
- Bulldozer and scraper blades, end-loader buckets, dump bodies, and similar equipment will be either fully lowered or blocked when being repaired or when not in use. All controls shall be in a neutral position, with the engines stopped and brakes set, unless work being performed on the machine requires otherwise.
- No guard, safety appliance, or device will be removed from machinery or equipment, or made ineffective except for making immediate repairs, lubrications, or adjustments, and them only after

the power has been shut off. All guards and devices will be replaced immediately after completion of repairs and adjustments and before power is turned on.

- Mechanized equipment will be shut down prior to and during fueling operations. Closed systems, with automatic shut-off which will prevent spillage if connections are broken, may be used to fuel diesel powered equipment left running.
- Each bulldozer, scraper, dragline, crane, motor grader, front-end loader, mechanical shovel, backhoe, and other similar equipment will be equipped with at least one dry chemical or carbon dioxide fire extinguisher with a minimum rating of 5-B:C.
- Personnel will not work or pass under or ride in the buckets or booms of loaders in operations.
- All self-propelled construction equipment, whether moving alone or in combination, be equipped with a reverse signal alarm.
- Standard hand signals will be used to communicate between operators and ground crew.
- All heavy equipment will be equipped with operable seat belts; belts will be used by all operators.

4.3.16 Knife Safety

The following requirements will be adhered to for protection of employee cut injuries during sampling activities or other activities where knives are used:

- Ensure that hand knives are actually the most practical tool for the task. Where possible use the safest cutting tool for the job (e.g. scissors, snips or wire strippers).
- Cutting tools, such as scissors, snips, side cutters, etc., are also to be used in lieu of box cutters.
- If box cutters are determined to be the appropriate tool for the job, the only type that should be used are the designs that have a self retracting blade capability and employees must utilize appropriate PPE to allow for further protection
- If the knife happens to be the correct tool, keep the knife sharp and clean. A dull blade can cause accidents because more force is needed to cut an object. However, a knife or any other unprotected blade tool must be the last resort when choosing a cutting tool.
- Have a supply of either replacement knives and/or blades and make them readily available.
- Cut away from yourself, ending the knife stroke away from your body. Hold the item you're cutting firmly, and don't cut downwards and towards your body. Cut into the air or onto something hard.
- Confirm that appropriate PPE (e.g. gloves) specific to the task is available to employees and mandate the use of gloves when the possibility of injury exists.
- Personal knives (e.g. pocket knives) shall not be considered as a tool for any type of work-related cutting. This must be communicated to employees such that they are required to ask for a cutting tool from site / project / office supervision, thereby resulting in an additional review of using the right cutting tool for the job.
- The PSO should inspect all material handling activities to assure that leather gloves are being used to protect hands.

There are many cutting tool manufacturers and they offer a variety of safety knives that are available for all types of cutting.

4.4 Biological Hazards

4.4.1 Ticks

Ticks are vectors of many different diseases, including Rocky Mountain spotted fever, Q fever, tularemia, Colorado tick fever, and Lyme disease. They attach to their host's skin and intravenously feed on blood, creating an opportunity for disease transmission. Covering exposed areas of the body and the use of tick repellent are two ways to prevent tick bites. Periodically during the workday, employees will inspect themselves for the presence of ticks. If a tick is discovered, the following procedure should be used to remove it:

- Do not try to detach a tick with bare fingers; bacteria from a crushed tick may be able to penetrate even unbroken skin. Fine-tipped tweezers should be used.
- Grip the tick as close to the skin as possible and gently pull it straight away from the skin until it releases its hold.
- Do not twist the tick while pulling, and do not squeeze its bloated body. That may actually inject bacteria into the skin.
- Thoroughly wash hands and the bite area with soap and water, and apply an antiseptic to the bite area.
- Save the tick in a small container and note the date, the body location of the bite, and where the tick came from.
- Notify the PSO of tick bites as soon as possible.

Recently, Lyme disease has been the most prevalent type of disease transmitted by ticks in the United States.

4.4.2 Poisonous Plants

Toxic plants are found among trees, shrubs, vegetables, and vines. The largest number of plant poisonings occurs from ingestion. However, the largest concern for field workers comes from contact poisons that are most irritating to the skin: poison ivy, poison oak, and poison sumac; all plants native to Texas.

Poison Ivy

Physical Description. Poison ivy is a woody shrub or vine that climbs high in trees or along the ground, having alternate leaves with three leaflets. Small greenish flowers hang in clusters and form globe-shaped, yellowish, berry-like fruits. The leaf margins may be smooth or finely-toothed, or may be variously lobed.

Habitat. Poison ivy is found growing in rocky fields, pastures, thickets, woods, and waste places, often climbing trees, fences, and dwellings.

Symptoms. Contact results in a burning, itching rash that develops into broken blisters; the rash and blisters spread rapidly when scratched.

Treatment. Blisters may be drained, but tops should not be removed. Topical medication may be applied to the infected area.

Poison Oak

Physical Description. Poison oak is a perennial shrub with slender stems that are erect and woody, with one or a few erect branches. It does not climb nor does it have aerial roots. The leaves are three-parted on long erect stems, and found mostly near the top. The leaflets are found to be elliptic, rhombic, or obviate, and are hairy on the top surface and velvety beneath, with three to seven deep teeth, suggesting oak leaves. The fruit is greenish to buff and approximately 5 mm in diameter.

Habitat. Poison oak grows in dry barrens, sandy wastes, pine woods, and sandy woods.

Symptoms. Contact results in a burning, itching rash that develops into broken blisters; the rash and blisters spread rapidly when scratched.

Treatment. Blisters may be drained, but tops should not be removed. Topical medication may be applied to the infected area.

Poison Sumac

Physical Description. Poison sumac is a shrub or tree growing to 25 feet. It has compound leaves with 7 to 11 pointed leaflets without marginal teeth, and the leaf and leaflet stalks are reddish with clustered whitish fruits that resemble poison ivy.

Habitat. Poison sumac is found growing in the swamps of eastern North America.

Symptoms. Contact results in a burning, itching rash that develops into broken blisters; the rash and blisters spread rapidly when scratched. In severe cases, the infection covers the entire body, producing swelling and fever.

Treatment. Blisters may be drained, but tops should not be removed. Topical medication may be applied to the infected area.

If the work sites are located in areas where poisonous plants may be encountered, personnel should wear long pants, long sleeves, and gloves to minimize the possibility of exposure. In some areas, the use of a Tyvek® or other protective suit may be advisable.

4.4.3 Venomous Arthropods

Many of the organisms in the phylum Arthropoda can produce venomous bites. The black widow and brown recluse spiders are included in the phylum.

Black Widow Spider

Physical Description. The adult female is glossy black with short, almost microscopic hairs. Most female black widow spiders have a crimson hourglass marking on the underside of the abdomen. The spider reaches an overall length equal to 40 mm or 1.5 inches.

Habitat. The female spider is found with her web and egg sacs in protected places such as vacant rodent burrows and under stones, logs, long grass, hollow stumps, and brush piles. They are also found in dark corners of barns, stables, garages, and piles of boxes and crates.

Symptoms. After the bite, a dull, numbing pain in the affected extremity occurs. Also, pain and some muscular rigidity in the abdomen, back, and chest occur. The bite may also produce pain on inspiration (inhalation), headache, dizziness, skin rash, nausea, vomiting, anxiety, and weakness. Increased skin temperature over the affected area may be observed.

Treatment. Ice may be placed over the bite to reduce the pain. Seek immediate medical attention.

Brown Recluse Spider

Physical Description. The brown recluse is a spider of medium size (body 10 to 15 mm in length). It is brown in color, and the legs are long and lack unpaired claws.

Habitat. This spider is found outdoors under rocks and rubble.

Symptoms. After the bite, some localized pain develops within an hour. The bite area becomes swollen and skin temperature increases. The lesion has the appearance of a bull's eye and often becomes larger, ruptures, and leaves an ulcer that may involve underlying tissues, including muscle. Systemic symptoms and signs may develop, including nausea and vomiting.

Treatment. Ice may be placed over the bite to reduce the pain. Seek immediate medical attention.

4.4.4 Snakes

The degree of toxicity resulting from snakebites depends on the potency of the venom, the amount of venom injected, and the size of the person bitten. Poisoning may occur from injection or absorption of venom through cuts or scratches. The most effective way to prevent snakebites is to avoid snakes. Personnel should avoid walking at night or in high grass and underbrush. Visual inspection of work areas should be performed prior to activities. The use of leather boots and long pants will be required, since

more than half of all bites are on the lower part of the leg. No attempts at killing snakes should be made; many people are bitten in these attempts.

If someone is bitten by a potentially poisonous snake, the following treatment should be initiated:

- Keep patient calm
- Notify emergency medical services (EMS)
- Wash the wound and keep the affected body part still
- Apply direct pressure to site of bite if bleeding is extreme
- Keep the affected area lower than the heart
- Carry a victim who must be transported, or have him/her walk slowly
- Transport to closest medical facility

If work sites at LHAAP are such that the possibility of encountering snakes exists, all personnel shall be cautioned to be alert. Should a snake bite occur, attempts should be made to kill the snake for positive identification. The victim should be transported to the nearest hospital within 30 minutes. Snake venoms are complex and include proteins, some of which have enzymatic activity. The effects produced by venoms include neurotoxic effects with sensory, motor, cardiac, and respiratory difficulties; cytotoxic effects on red blood cells, blood vessels, heart muscle, kidneys, and lungs; defects in coagulation; and effects from local release of substances with enzymatic actions. Other noticeable effects of snake bites include swelling, edema, and pain around the bite, and the development of ecchymosis (the escape of blood into tissues from ruptured blood vessels).

4.4.5 Rodents

Rodents, such as rats and deer mice, can potentially carry hantavirus. Rats differ from related mice by their larger size and teeth. Deer mice, such as mesas, usually live at higher elevations, and can be distinguished from other rodents by their small size (2 $^{4}/_{5}$ inches to 4 inches long) and by their bicolored tail. However, the Centers for Disease Control believes that other rodents also have the potential to carry the virus, so precautions must be taken when dealing with any species of rodent. It is not possible to distinguish whether a rodent carries the hantavirus by observation.

Hantavirus affects the respiratory system in humans. The first symptoms of infection can occur at any time up to 45 days after exposure, and includes one or more of the following: fever, muscle aches, headache, or coughing. These symptoms progress rapidly into a severe lung disease that often requires intensive care treatment. Hantavirus can be transferred to humans, primarily from breathing infected rodent excreta particles that have become airborne or ingesting excreta particles that cling to hands or clothing. It can also be contracted from rodent bites or transferred through broken skin. Though the illness caused by hantavirus is severe, it is relatively rare and can be prevented by simple precautions and common sense.

The best way to avoid contact with the hantavirus is to avoid contact with rodents and their excreta. Do

not leave food or garbage where rodents have access to them; this includes leaving food items and wrappers in vehicles. When possible, seal any opening greater than ¼ inch diameter with steel wool to prevent rodent access in vehicles or structures.

Minor amounts of rodent excreta and rodents caught in mouse traps may be disposed of by personnel, provided precautions are taken. A suggested procedure is:

- When excreta or dead rodents are discovered in an enclosed area, ventilate the area for 30 minutes; the more air flow the better.
- Wear the proper PPE.
- Implement dust suppression techniques (such as use of a "bug" sprayer filled with water and a small amount of detergent to lightly spray the floor prior to entry).
- To dispose of wastes, place the rodent excreta or dead rodents in a plastic bag. Rinse gloved hands with bleach solution of 1 part bleach or 10 parts water, then doff any PPE in proper order, placing disposable items such as boot covers and respirator cartridges, in with the wastes. Place the respirator, if any, into a plastic bag, and mark the bag as "POTENTIALLY INFECTIOUS." Wet the wastes with the bleach solution, seal the plastic bag, place it into a second bag, and seal this bag also. Spray the outside of the plastic bag with commercial spray disinfectant. The waste may be disposed of as regular garbage.
- After the wastes are properly bagged, spray the surfaces where the wastes originally were found with disinfectant.
- Thoroughly wash hands, face, and forearms with soap and water.

4.4.6 Scorpions

Several species of scorpions are found in the south. Only one species, the Bark Scorpion, is regarded as life threatening. The Bark Scorpion may be distinguished from other less toxic species by its more slender tail segments and pincers. Reaching only 1.5 inches at maturity, it is a relatively small scorpion. Scorpions are relatively inactive during the daylight hours. The majority of scorpion bites occur at night during warm summer months. The most effective way to prevent scorpion bites is to avoid conducting work at night, visually inspect work areas prior to activities, and protect hands and legs by wearing the proper PPE.

Symptoms. Scorpion stings can cause immediate local pain with minimal swelling. Numbness and tingling are frequently reported. The injured area may be hypersensitive to touch, pressure, heat, and cold. Small children are at highest risk, as demonstrated by "roving eye" symptoms and hyperactivity.

Treatment. Most scorpion stings can be treated in the field. Clean the bitten area with soap and press a cool compress on the sting. Elevate the stricken limb to the approximate heart level. Take an analgesic to relieve minor pain, as needed. If symptoms are severe, seek immediate medical assistance at an emergency room or urgent care facility.

4.5 Explosive Hazard

Explosive materials produced and handled at LHAAP included cyclonite, TNT, and black powder, rocket propellants, and pyrotechnics. Rocket propellants contained a rubber binder, an oxidizer (ammonium perchlorate), and a powdered aluminum fuel. Pyrotechnics were generally composed of sodium nitrate, magnesium powder, and a binder. The sites of explosive concern include Sites 29, 46, and 47.

Avoidance will be practiced if explosive materials or objects are suspected or encountered. All work will be immediately halted, personnel will move upwind away from the suspected material, and the contractor PM will be immediately notified for further instructions. Work shall not be resumed until clearance has been obtained for the specific sampling location or a different sampling location is selected with no visible explosive concern.

4.6 Task-Specific Activity Hazard Analyses

The AHA for primary tasks provides a breakdown of the hazards and control measures for each principal task. Pre-mobilization AHA are located in **Attachment 4** of this HASP and are general in nature. They must be made project specific prior to each task by the PSO who must list specific equipment and any changes to principle steps. The AHA will be field-checked by the PSO on an ongoing basis and will be revised as necessary. Revisions will be communicated to the work crew and posted to **Attachment 4** of this plan.

5.0 Site Control and Work Zones

To prevent migration of contamination caused through tracking by personnel or equipment, work zones and PPE are clearly specified prior to beginning field operations. The contractor will designate work zones as suggested by *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (National Institute for Occupational Safety and Health [NIOSH], 1985). Each work site will be divided into three zones as follows:

- Exclusion (or "hot") zone
- Contamination reduction zone
- Support zone

A site map will be on site identifying the following:

- Exclusion zone
- Work staging areas
- Contamination reduction zone
- Location of alarms
- Location of emergency response equipment
- Site access control points (entrances and exits)
- Evacuation routes
- Location of telephones

5.1 Exclusion Zone

The exclusion zone (EZ) is the area suspected of contamination and presents the greatest potential for worker exposure. Personnel entering the area must wear the mandated level of protection for that area. In certain instances, different levels of protection will be required depending on the tasks performed and air monitoring results obtained within that zone. The EZ will be demarcated using barrier tape and/or high-visibility fencing. The PSO will establish the EZ for each task/operation. The EZ boundary will be posted with signs to warn on-site personnel of the construction, safety, and health hazards, and to keep unauthorized personnel out of the EZ.

5.2 Contamination Reduction Zone

The contamination reduction zone (CRZ) or transition zone will be established between the EZ and Support Zone (SZ). In this area, personnel will begin the sequential decontamination process required to exit the EZ. To prevent off-site migration of contamination and for personnel accountability, site personnel will enter and exit the EZ through the CRZ.

5.3 Support Zone

The SZ serves as a clean control area. Operational support facilities are located within the SZ. Normal work clothing and support equipment is appropriate in this zone. Contaminated equipment or clothing will not be allowed in the SZ. The support facilities should be located upwind of site activities. There will be a clearly marked controlled access point from the SZ into the CRZ and EZ that is monitored closely by the PSO to verify that proper safety protocols are followed.

5.4 Site Control Log

A log of personnel visiting, entering, or working on the site will be maintained at the site by the PSO. The log will list the time, date, company or agency, and name of persons entering or exiting the site.

5.5 Safe Work Practices

The following items are requirements to protect the health and safety of workers and will be discussed in the safety briefing prior to initiating work on the site.

- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of contaminants is prohibited in the site area.
- Hands and face must be washed upon leaving the site and before eating, drinking, chewing gum or tobacco, smoking, or other activities that may result in ingestion of contaminants.
- During site operations, each worker will consider himself as a safety backup to his partner. Off-site personnel provide emergency assistance. Site personnel will be aware of dangerous situations that may develop.
- Visual contact will be maintained between buddies on site when performing hazardous duties.
- No one will be admitted to the site without the proper safety equipment, training, and medical certification.
- Personnel must comply with established safety procedures. Any staff member who does not comply with safety policy as established by the PSO may be immediately dismissed from the site.
- Proper decontamination procedures must be followed before leaving the site.

- Employees and visitors must sign in and out of the site.

5.6 Visitor Access

Visitors should check in immediately upon arrival. Only authorized visitors will be allowed access to the contaminated areas. Visitors and subcontractors with access to contaminated areas must submit proof of current 40-Hour OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) Training and current medical certification to the contractor PSO. Each visitor will be required to provide and wear the necessary protective equipment during the visits and shall be escorted by contractor personnel. Visitors, subcontractors, and personnel entering the site area will be required to sign a safety plan acknowledgement form to certify that they have read, understand, and will comply with the HASP.

Failure to comply with this site entry procedure will result in expulsion from the site. A visitor's log will be kept by the PSO or his designee.

5.7 Buddy System

A "buddy system" will be implemented when conditions represent a risk to personnel that can be either physical or chemical. A buddy system requires that two or three people work as a team, each looking out for the other. "Buddies" must always be in each other's line of sight and should maintain verbal or visual communication. No one must enter into the site area alone because hazards are likely to exist, which could render the employee helpless and prevent self-rescue.

5.8 Site Communications

On-site communications will be established between site work zones and will consist of verbal communications or line-of-sight observations. Off-site communications will be established in the site area to summon off-site emergency services and will consist of either on-site cellular telephones or identification of the nearest telephone to the site. (Air horns will be available for emergency conditions in the site area.)

5.9 Health and Safety Inspections

The PSO or designee will perform regular health and safety inspections. A report including results of the inspection and any corrective actions taken will be placed in the project files, with a copy sent to both the USACE project manager and the HSM.

5.10 Accident Investigation

All injuries including cases that require only minor first aid will be reported to the PSO. All first aid cases, near miss incidents, occupational injuries or illnesses, and vehicle and equipment damage must be investigated.

6.0 Protective Equipment

This section specifies the levels of PPE, which are or may be required for each principal activity performed at this site. Site personnel must be trained in the use of PPE.

6.1 Anticipated Protection Levels

The protection levels shown in **Table 6-1** have been established for the site work activities based on the level of site contaminants and the scope of work. Results of site air monitoring and visual inspection of the work activities may indicate the need for changes in PPE level(s).

Table 6-1
Personal Protection Equipment

Task	Initial PPE Level	Upgrade PPE Level	Skin Protection	Level C Respiratory Protection	Other PPE
Mobilization/ site preparation	D	—	Coveralls, work gloves	None	Hard-hat, steel-toe work boots, safety glasses, and hearing protection > 85 dBA
Monitoring well installation	D+	C	Tyvek® suit, surgical gloves (minimum of two pairs)	APR with acid gases/organic vapors/P100 filter cartridge	Hard-hat, steel-toe work boots, and hearing protection >85 dBA
Survey wells	D	D+	Tyvek® suit, nitrile gloves, surgical inner gloves	None	Hard-hat, steel-toe work boots, safety glasses, hearing protection >85 dBA
Soil excavation	D+	C	Tyvek® suit, nitrile gloves, surgical inner gloves	APR with acid gases/organic vapors/P100 filter cartridge	Hard-hat, steel-toe work boots, safety glasses
Groundwater/soil/ surface water/ sediment sampling and analysis	D+	C	Tyvek® suit, nitrile gloves, surgical inner gloves	APR with acid gases/organic vapors/P100 filter cartridge	Hard-hat, steel-toe work boots, safety glasses
XRF Survey	D	D+	Tyvek® suit, nitrile gloves, surgical inner gloves	None	Hard-hat, steel-toe work boots, safety glasses, hearing protection >85 dBA
Equipment decontamination	D+		PVC rain suit or Tyvek® coveralls	None	Hard-hat, steel-toe work boots, goggles/face shield, latex gloves, latex boots, and hearing protection >85 dBA
General site activities	D	—	None	None	Hard-hat, steel-toe work boots, safety glasses, and hearing protection > 85 dBA

Abbreviations:

APR air-purifying respirator PPE personal protective equipment XRF x-ray fluorescence
dBA decibels, A-scale PVC polyvinyl chloride

6.2 Protection Level Descriptions

This section lists the minimum requirements for each protection level. Modification to these requirements may have been noted above.

6.2.1 Level D

Level D consists of the following:

- Safety glasses with side shields
- Hard hat
- Safety-toe work boots
- Work clothing as prescribed by weather

6.2.2 Modified Level D

Modified Level D (D+) consists of the following:

- Safety glasses with side shields
- Hard hat
- Safety-toe work boots
- Nitrile, neoprene, or polyvinyl chloride (PVC) gloves over latex sample gloves
- Tyvek® coverall

6.2.3 Level C

Level C consists of the following:

- Full-face, air-purifying respirator with organic vapors/acid gases cartridge P100 filter cartridges
- Tyvek® coveralls (polyethylene-coated Tyveks® required when workers have a potential to be exposed to contaminated liquids or sludges)
- Hard hat
- Steel-toe work boots (use PVC overboots when the potential for exposure to contaminated liquids/sludges exist)
- Nitrile, neoprene, or PVC gloves over latex sample gloves

6.3 Respiratory Protection Program

Respiratory protection is an integral part of employee health and safety at hazardous waste sites where contamination is present or suspected. The site respiratory protection program will consist of the following:

- All site personnel who may use respiratory protection will have an assigned respirator.
- All site personnel who may use respiratory protection will have been fit-tested and qualified in the use of an air-purifying/air-supplied respirator within the past 12 months.
- All site personnel who may use respiratory protection must within the past year have been medically certified as being capable of wearing a respirator. Documentation of the medical certification must be provided to the PSO or HSM prior to commencement of site work.

- Only cleaned, maintained, NIOSH/Mine Safety and Health Administration-approved respirators are to be used on this site.
- If full-face air purifying respirators are used, the respirator cartridge is to be properly disposed of at the end of each work shift, or when load-up or breakthrough occurs.
- All site personnel who may use respiratory protection will be clean-shaven. Mustaches and side burns are permitted, but they must not touch the sealing surface of the respirator.
- Respirators will be inspected, and a positive negative pressure test performed prior to each use.

After each use, the respirator will be wiped with a disinfectant, cleansing wipe. When used, the respirator will be thoroughly cleaned at the end of the work shift. The respirator will be stored in a clean plastic bag.

6.4 Air-Purifying Respirators

A NIOSH-approved full-face respirator with appropriate air purifying cartridges will be used for Level C work. The crew members working in Level C will wear respirators equipped with organic vapors/acid gases cartridge/P100 filter air-purifying cartridges approved for organic vapors, chlorine, hydrogen chloride, chlorine dioxide or sulfur dioxide, hydrogen fluoride or hydrogen sulfide (escape only), and at least 99.97% efficiency against all types of particulate aerosols.

6.5 Respirator Cartridges

The crew members working in Level C will wear respirators equipped with air-purifying cartridges approved for the following contaminants:

- Organic vapors <1,000 parts per million (ppm)
- Chlorine gas <10 ppm
- Hydrogen chloride <50 ppm
- Sulfur dioxide <50 ppm
- Dusts, fumes, and mists with a threshold limit value <0.05 mg/m^3
- Asbestos-containing dusts and mists
- Radionuclides

6.6 Cartridge Changes

All cartridges will be changed a minimum of once weekly or more frequently if personnel begin to experience increased inhalation resistance. The HSM will establish a cartridge changeout schedule if air monitoring indicates action levels requiring respirator protection are achieved (see **Section 8.0**).

6.7 Inspection and Cleaning

Respirators are checked periodically by the PSO and inspected before each use by the wearer. Respirators and associated equipment will be decontaminated and hygienically cleaned after use.

6.8 Fit Testing

Annual respirator fit tests are required of personnel wearing negative pressure respirators. The test will utilize isoamyl acetate or irritant smoke. The fit test must be for the style and size of the respirator to be used. Additionally, a positive and negative fit test shall be conducted each time a respirator is donned.

6.9 Facial Hair

No personnel who have facial hair that interferes with the respirator's sealing surface will be permitted to wear a respirator.

6.10 Corrective Lenses

Normal eyeglasses cannot be worn under full-face respirators because the temple bars interfere with the respirator's sealing surfaces. For workers requiring corrective lenses, special spectacles designed for use with respirators will be provided.

6.11 Medical Certification

Only workers who have been certified by a physician as being physically capable of respirator usage will be issued a respirator. Personnel unable to pass a respiratory fit test or without medical clearance for respirator use will not be permitted to enter or work in areas on-site that require respiratory protection. Employees receive a written physician's opinion that they are fit for general hazardous waste operations as per 29 CFR 1910.120(f)(7).

7.0 Decontamination Procedures

This section describes the procedures necessary to ensure that both personnel and equipment are free from contamination when they leave the work site. A step-by-step description of decontamination procedures for Level D Modified and C has been delineated below.

Air monitoring instruments may be wrapped while using them in the EZ to avoid contamination in very messy conditions. Where conditions are relatively clean, instruments may be wiped down with a damp cloth in the CRZ.

7.1 Personnel Decontamination

Decontamination of personnel shall be performed to ensure that any material that personnel may have contacted in the EZ is removed in the CRZ. All personnel will use the CRZ decontamination sequence listed below during egress from the CRZ.

PPE removed from the decontamination corridor will either be decontaminated or properly bagged to contain any contamination. All used disposable clothing will be placed in polyethylene bags, identified, dated, and stored at the property site pending disposal. Waterproof, non-disposable PPE will be properly decontaminated. Decontamination of personnel exiting the EZ will utilize the following steps as appropriate to the specific work area:

Modified Level D

Step 1: Remove gross contamination from outer boots. Remove and stack boots.
Step 2: Remove outer gloves.
Step 3: Remove hard hat.
Step 4: Remove and discard outer suit.
Step 5: Remove and discard one pair of inner gloves in 55-gallon trash drum (when multiple pairs of inner gloves are used).
Step 6: Remove and discard inner suit (when used).
Step 7: Discard final pair of inner gloves into 55-gallon trash drum.
Step 8: Depart transition zone in work clothes and boots.
Step 9: Wash hands, face, and neck before breaks and lunch.

Level C

Step 1: Remove gross contamination from outer boots. Remove and stack boots.
Step 2: Scrub and remove outer gloves.

Step 3: Remove the hard hat.
Step 4: Remove and discard outer suit.
Step 5: Remove and discard one pair of inner gloves into 55-gallon trash drum (when multiple pairs of gloves used).
Step 6: Remove and discard inner suit (when used).
Step 7: Remove respirators and suitably store while on breaks and during lunch. At the end of shift, discard the cartridges and then clean, disinfect, rinse, and air dry the respirator.
Step 8: Discard final pair of inner gloves into 55-gallon trash drum.
Step 9: Depart transition zone in work clothes and boots.
Step 10: Wash hands, face, and neck before breaks and lunch

7.2 Personal Hygiene

Before eating, smoking, or drinking, personnel will wash hands, arms, neck, and face. Washing facilities with soap will be available in the SZ and in the CRZ.

7.3 Equipment Decontamination

Heavy equipment will be cleaned prior to leaving.

8.0 Air Monitoring

Air monitoring will be conducted in order to characterize personnel exposures and fugitive emissions from site contaminants. The principal contaminants of concern are listed in **Section 4.0** of this HASP. Results of air monitoring will be used to ensure the proper selection of protective clothing and equipment, including respiratory protection, to protect on-site personnel and off-site receptors from exposure to unacceptable levels of site contaminants. Descriptions of air monitoring strategies, procedures, and equipment are provided below. Modification of this plan, including additional monitoring, may be judged necessary by the HSM, in conjunction with the PSO.

8.1 Work Area Air Monitoring

Work area air monitoring during site investigations at LHAAP will include direct reading methods as well as integrated sampling strategies. Air monitoring will be conducted during well installation and groundwater sampling activities.

During well installation, and groundwater sampling activities, direct reading air monitoring will be performed to determine exposure to workers. A summary of air monitoring information is provided in **Table 8-1**.

Table 8-1
Direct Reading Air Monitoring Summary

Monitoring Device	Monitoring Location/ Personnel	Monitoring Frequency	Action Level[a]	Action
PID/OVA (breathing zone)	Soil excavation and sampling, well installation, and groundwater sampling	At start-up, minimum four times daily in work area and breathing zone	>1 ppm for 5 minutes >5 ppm for 5 minutes	Test for benzene (colorometric detector tubes) Upgrade to Level C
LEL/O_2 meters	Soil excavation and sampling, well installation, and groundwater sampling	At start-up, minimum four times daily in work area.	>10% LEL <20.8% 0_2	Stop operations; allow vapors to vent <10% before continuing Upgrade to Level B
Colorometric detector tube (benzene)	Soil excavation and sampling, well installation, and groundwater sampling	Periodic when PID/OVA readings exceed action level	> 0.5 ppm benzene > 25 ppm benzene	Upgrade to Level C Upgrade to Level B

Notes and Abbreviations:

[a] *Sustain levels above background for 5 minutes in breathing zone*
ppm *parts per million*
PID/OVA *photo ionization detector/organic vapor analyzer*
LEL/O_2 *lower explosive limit/oxygen*

8.2 Instrumentation

The following is a description of the air monitoring equipment to be used at this site.

8.2.1 Lower Explosive Limit/Oxygen Meter

8.2.1.1 Types and Operational Aspects

- MSA Watchman LEL/Oxygen (O_2) Meter or equivalent
  - Principle of Operation
- Oxygen detector uses an electrochemical sensor and produces a minute electric current proportional to the oxygen content.
- CGIs use a combustion chamber containing a filament that ignites flammable vapors. The filament is heated or coated with a catalyst (platinum) to facilitate combustion.

- Filament is part of a balanced resistor circuit. Combustion in the chamber causes the filament temperature to increase which results in increased filament resistance.
- Change in the filament's resistance causes an imbalance in the circuit proportional to the percent of the LEL.
- At concentrations lower than the LEL, the meter will read the approximate percent of combustible atmosphere present.
- Concentrations greater than the LEL will have a meter response greater than 100% LEL. This type of response indicates the gas mixture is then in the flammable range, or is too rich to burn and is not combustible. The danger is that the addition of air to the gas mixture could bring it into the flammable range (less than the upper explosive limit) and an explosion will result.
- Oxygen meter set at the factory to alarm at 19.5% (oxygen deficient atmosphere). Combustible gas meter set by the user to alarm at 10% LEL.

8.2.1.2 Calibration Methods/Frequencies

Before the calibration of the CGI can be checked, the unit must be in operating condition. The CGI LEL is normally calibrated on pentane as representative of the flammability characteristics of most commonly encountered combustible gases. The meter scale is calibrated from zero to 100% LEL, which corresponds in actual volume concentrations of 0 to approximately 14% pentane in air. A booklet of response curves is supplied with the Watchman Meter. These curves may be used to interpret meter readings when sampling combustible gases other than pentane. It is recommended that calibration be checked before and after using each time. The PSO will record and log such calibration information into an air monitoring notebook. The O_2 meter is calibrated by adjusting the O_2 control knob to 20.8% while the meter is operated in a fresh air atmosphere.

8.2.1.3 Preventive Maintenance

The primary maintenance of the unit is the rechargeable 2.4-volt nickel cadmium battery. Recommended charging time is 16 hours. It may be left on charge for longer periods without damaging the battery. The battery sometimes will not supply full power capacity after repeated partial use between charging. Therefore, it is recommended that the battery be exercised at least once a month by running for eight to 10 hours before recharge. If the instrument has not been used for 30 days, the battery should be charged prior to use.

8.2.2 Photoionization Detector

8.2.2.1 Type and Operational Aspects

Photovac Model 20/20 or equivalent

- Principle of Operation
  - Ionization potential (IP) – The energy required to remove the outermost electron from a molecule; measured in electron volts (eV); characteristic property of a specific chemical.

- Photoionization – Using ultraviolet (UV) light to remove the outermost electron from a molecule.
  - Energy of UV light (10.6, 9.5, 11.7 eV) must be equal to or greater than the IP to photoionize the molecule.
  - Fan or pump is used to draw air into the detector where the contaminants are exposed to a UV light source (lamp).
  - Ions are collected on a charged plate and produce a current directly proportional to the number of ionized molecules; current is amplified and displayed on the meter.

8.2.2.2 Calibration Method/Frequencies

The Photovac Model 20/20 is designed for trace gas analysis in ambient air and is calibrated at the manufacturer (HNU) with certified standards of benzene, vinyl chloride, and isobutylene. Other optional calibrations are available (e.g., ammonia, ethylene oxide, H_2S, etc.).

The contractor will use a photoionization detector with a 10.6 eV lamp. This lamp has been determined to be responsive to monitor the contaminants on site. Optional probes containing lamps of 9.5 and 11.7 eV are interchangeable in use within individual read-out assemblies for different applications.

It is recommended that calibration be checked twice each day (beginning and end of shift). The PSO will record and log such calibration information into an air monitoring notebook.

8.2.2.3 Preventive Maintenance

Maintenance of the Photovac Model 20/20 consists of cleaning the lamp and ion chamber, and replacement of the lamp or other component parts or sub-assemblies.

9.0 Emergency Response

9.1 Pre-Emergency Planning

Prior to engaging in investigation activities at the site, the contractor will plan for possible emergency situations and have available adequate supplies and manpower to respond. In addition, site personnel will receive training during the site orientation concerning proper emergency response procedures. The Marshall Fire Department will be contacted when the magnitude of the anticipated emergency conditions warrant.

The situations shown in **Table 9-1** would warrant implementation of the Emergency Response and Contingency Plan (ERCP).

Table 9-1
Situations Warranting Implementation of the Emergency Response and Contingency Plan

Type Hazard	Hazard
Fire/explosion	• The potential for human injury exists • Toxic fumes or vapors are released • The fire could spread on-site or off-site and possibly ignite other flammable materials or cause heat-induced explosions • The use of water and/or chemical fire suppressants could result in contaminated run-off • An imminent danger of explosion exists
Spill or release of hazardous materials	• The spill could result in the release of flammable liquids or vapors, thus causing a fire or gas explosion hazard • The spill could cause the release of toxic liquids or fumes in sufficient quantities or in a manner that is hazardous to or could endanger human health
Natural disaster	• A rain storm exceeds the flash flood level • The facility is in a projected tornado path or a tornado has damaged facility property • Lightning • Severe wind gusts are forecasted or have occurred and have caused damage to the facility
Medical emergency	• Overexposure to hazardous materials • Trauma injuries (broken bones, severe lacerations/ bleeding, burns) • Eye/skin contact with hazardous materials • Loss of consciousness • Heat stress (heat stroke) • Cold stress (hypothermia) • Heart attack • Respiratory failure • Allergic reaction

The following measures will be taken to assure the availability of adequate equipment and manpower resources:

- Sufficient equipment and materials will be kept on site and dedicated for emergencies only. The inventory will be replenished after each use.
- On-site emergency responders will be current in regards to training and medical surveillance programs. Copies of all applicable certificates will be kept on file for on-site personnel required to respond.

- It will be the responsibility of the PSO to brief the on-site response team on anticipated hazards at the site. The PSO shall also be responsible for anticipating and requesting equipment that will be needed for response activities.
- Emergency response activities will be coordinated with the Local Emergency Planning Committee (LEPC) in compliance with Superfund Amendments and Reauthorization Act Title III requirements.

Communications will be established with LEPC prior to commencement of any activities at the remediation site. Communication will be established so that responders on-site have access to pertinent information to allow them to conduct their activities in a safe and healthful manner. Air horns may be used to alert personnel of emergency conditions. A telephone will be located at the command post to summon assistance in an emergency.

Primary communication with local responders in the event of an emergency will be accomplished using commercial telephone lines.

9.2 Emergency Recognition and Prevention

Because unrecognized hazards may result in emergency incidents, it will be the responsibility of the PSO, through daily site inspections and employee feedback (Safety Observation Program, daily safety meetings, and activity hazard analyses), to recognize and identify the hazards that may be found at the site. Potential hazards are shown in **Table 9-2**.

Table 9-2
Potential Hazards

Type Hazard	Hazard
Chemical	Materials at the site Materials brought to the site IDLH atmospheres
Physical	Fire/explosion Slip/trip/fall Electrocution Confined space Excessive noise
Mechanical	Heavy equipment Stored energy system Pinch points Electrical equipment Vehicle traffic
Environmental	Electrical storms High winds Heavy rain/snow Temperature extremes (heat/cold stress) Poisonous plants/animals

Abbreviations:

IDLH immediately dangerous to life or health

Once a hazard has been recognized, the PSO will take immediate action to prevent the hazard from becoming an emergency. This may be accomplished by the following:

- Daily safety meeting
- Task-specific training prior to commencement of activity
- Lockout/tag-out
- PPE selection/use
- Written and approved permits for hot work, confined space
- Trenching/shoring procedure
- Air monitoring
- Following applicable contractor standard operating procedures
- Practice drills for fire, medical emergency, and hazardous substance spills

9.3 Personnel Roles, Lines of Authority, and Communications

This section describes the various roles, responsibilities, and communication procedures that will be followed by personnel involved in emergency responses.

In the event an emergency occurs and the PSO is not on site, the highest-ranking employee on site will serve as the PSO until the PSO arrives. The PSO will determine the nature of the emergency and take appropriate action as defined by the ERCP in **Section 9.7**. The PSO will implement the ERCP immediately as required. The decision to implement the plan will depend upon whether the actual incident threatens human health or the environment. Immediately after being notified of an emergency incident, the PSO or his designee, will evaluate the situation to determine the appropriate action.

9.3.1 Responsibilities and Duties

This section describes the responsibilities and duties assigned to the PSO.

It is recognized that the structure of the "Incident Command System" will change as additional response organizations are added. The contractor will follow procedures as directed by the fire department, LEPC, state, and federal agencies as required. The contractor will defer to the local Fire Department Chief to assume the role of Incident Commander upon arriving on-site. Additional on-site personnel may be added to the Site Emergency Response Team as required to respond effectively.

9.3.2 On-Site Emergency Coordinator Duties

The on-site PSO is responsible for implementing and directing the emergency procedures. Emergency personnel and their communications will be coordinated through the PSO. Specific duties are as follows:

- Identify the source and character of the incident, type, and quantity of any release. Assess possible hazards to human health or the environment that may result directly from the problem or its control.
- Discontinue operations in the vicinity of the incident, if necessary, to ensure that fires, explosions, or spills do not recur or spread to other parts of the site. While operations are dormant, monitor for leaks, pressure build-up, gas generation, or ruptures in valves, pipes, or other equipment, where appropriate.
- Notify local emergency response teams if their help is necessary to control the incident. **Table 9-3** provides telephone numbers for emergency assistance.
- Direct on-site personnel to control the incident until, if necessary, outside help arrives.
- Verify that the building, or area where the incident occurred, and the surrounding area are evacuated, and shut off possible ignition sources, if appropriate. The emergency response team is responsible for directing site personnel such that they avoid the area of the incident and leave emergency control procedures unobstructed.
- If fire or explosion is involved, notify the Marshall Fire Department.

- Notify contractor PM
- Have protected personnel, in appropriate PPE, on standby for rescue

If the incident may threaten human health or the environment outside of the site, the PSO should immediately determine whether evacuation of the area outside of the site may be necessary and, if so, notify the Marshall Fire Department and the Office of Emergency Management.

When required, notify the National Response Center. The emergency telephone number for the National Response Center is 800-424-8802. The following information should be provided to the National Response Center:

- Name and telephone number
- Name and address of facility
- Time and type of incident
- Name and quantity of materials involved, if known
- Extent of injuries
- Possible hazards to human health or the environment outside of the facility

Table 9-3 provides emergency telephone numbers.

Table 9-3
Emergency Telephone Numbers

Emergency Contacts	Phone Numbers
Marshall Fire Department	911 or (903) 935-4580
Police Department	(903) 935-4525
Hospital – Marshall Regional Medical Center	(903) 927-6000
Regional Poison Control Center	(800) 552-4611
State Agencies (TCEQ)	(210) 490-3096
USEPA Region 6 (EPA Regional Branch Response Center)	(214) 665-2222
Agency for Toxic Substances and Disease Registry	(404) 639-0515 (24-hour)
Designated USACE Site Rep (John Lambert)	(918) 669-4992
Longhorn AAP Site Manager – Rose M. Zeiler	(479) 635-0110
U.S. Coast Guard	(804) 484-8192
National Response Center	(800) 424-8802
Chem-TEL	(800) 255-3924 (24-hour)
Project Manager – TBD	
Project HSM – TBD	
Project PSO – TBD	

If hazardous waste has been released or produced through control of the incident, ensure the following:

- Waste is collected and contained.
- Containers of waste are removed or isolated from the immediate site of the emergency.
- Treatment or storage of the recovered waste, contaminated soil or surface water, or any other material that results from the incident or its control is provided.
- Ensure that no waste that is incompatible with released material is treated or stored in the facility until cleanup procedures are completed.
- Ensure that emergency equipment used is decontaminated, recharged, and fit for its intended use before operations are resumed.
- Notify the USEPA Regional Administrator that cleanup procedures have been completed and that emergency equipment is fit for its intended use before resuming operations in the affected area of the facility. The USEPA Regional Administrator's telephone number is included in the emergency contacts above.
- Record time, date, and details of the incident, and submit a written report to the USEPA Regional Administrator. Report is due to USEPA within 15 days of the incident.

9.4 Safe Distances and Places of Refuge

No single recommendation can be made for evacuation or safe distances because of the wide variety of emergencies that could occur. Safe distances can be determined only at the time of an emergency based on a combination of site and incident-specific criteria. However, the following measures are established to serve as general guidelines.

In the event of minor hazardous material releases (small spills of low toxicity), workers in the affected area will report initially to the site. Small spills or leaks (generally less than 55 gallons) will require initial evacuation of at least 50 feet in all directions to allow for cleanup and to prevent exposure. After initial assessment of the extent of the release and potential hazards, the PSO or his designee will determine the specific boundaries for evacuation. Appropriate steps such as caution tape, rope, traffic cones, barricades, or personal monitors will be used to secure the boundaries. In the event of a major hazardous material release (large spills of high toxicity/greater than 55 gallons), workers will be evacuated from the building/site. Workers will assemble at the entrance to the site for a head count by their foremen and await further instruction.

If an incident may threaten the health or safety of the surrounding community, the public will be informed and, if necessary, evacuated from the area. The PSO or his designee will inform the proper agencies, if necessary. Emergency contact telephone numbers are listed in **Table 9-3**.

Places of refuge will be established prior to the commencement of activities. These areas must be identified for the following incidents:

- Chemical release
- Fire/explosion
- Power loss
- Medical emergency
- Hazardous weather

In general, evacuation will be made to the crew trailers unless the PSO determines otherwise. It is the responsibility of the PSO to determine when it is necessary to evacuate personnel to off-site locations. In the event of an emergency evacuation, employees will gather at the entrance to the site until a head count establishes that all are present and accounted for. No one is to leave the site without notifying the PSO.

9.5 Evacuation Routes and Procedures

Emergencies require prompt and deliberate action. In the event of an emergency, it will be necessary to follow an established set of procedures. Such established procedures will be followed as closely as possible. However, in specific emergency situations the PSO may deviate from the procedures to provide a more effective plan for bringing the situation under control. The PSO is responsible for determining which situations require site evacuation.

9.5.1 Evacuation Signals and Routes

An air horn will be used to notify employees of the necessity to evacuate an area or building involved in a release/spill of a hazardous material. Total site evacuation will be initiated only by the PSO; however, in his absence, decision to preserve the health and safety of employees will take precedence and may be initiated by the next highest ranking employee. Evacuation routes will be posted in each outside work area. Signs inside buildings will be posted on walls or other structural elements of a building. Periodic drills will be conducted to familiarize each employee with the proper routes and procedures.

9.5.2 Evacuation Procedures

In the event evacuation is necessary, the following actions will be taken:

- The emergency signal will be activated.
- No further entry of visitors, contractors, or trucks will be permitted. Vehicle traffic within the site will cease in order to allow safe exit of personnel and movement of emergency equipment.
- Shut off all machinery if safe to do so.
- On-site personnel, visitors, and contractors in the site area will assemble at the entrance to the site for a head count and await further instruction from the PSO.
- Persons in the site area will be accounted for by their immediate crew leaders (e.g., foreman). Leaders will determine the safest exits for employees and will also choose an alternate exit if the first choice is inaccessible.

- During exit, the crew leader should try to keep the group together. Immediately upon exit, the crew leader will account for the employees in his crew.
- Upon completion of the head count, the crew leader will provide the information to the PSO.
- Contract personnel and visitors will also be accounted for.
- The names of emergency response team members involved will be reported to the emergency spill control coordinator.
- A final tally of persons will be made by the PSO or designee. No attempt to find persons not accounted for will involve endangering lives of the contractor or other employees by re-entry to emergency areas.
- In all questions of accountability, immediate crew leaders will be held responsible for those persons reporting to them. Visitors will be the responsibility of those employees they are visiting. Contractors and truck drivers are the responsibility of the PSO. The security guard will aid in accounting for visitors, contractors, and truckers by reference to sign-in sheets available field office trailer.
- Personnel will be assigned by the PSO to be available at the main gate to direct and brief emergency responders.
- Re-entry into the site will be made only after clearance is given by the PSO. At his direction, a signal or other notification will be given for re-entry into the facility.
- Drills will be held periodically to practice all of these procedures and will be treated with the same seriousness as an actual emergency.

9.6 Emergency Spill Response Procedures and Equipment

In the event of an emergency involving a hazardous material spill or release, the following general procedures will be used for rapid and safe response and control of the situation. Emergency contacts found in **Table 9-3** provide a quick reference guide in the event of a major spill.

9.6.1 Notification Procedures

If an employee discovers a chemical spill or process upset resulting in a vapor or material release, he or she will immediately notify the PSO and the Marshall Fire Department. Report details of a release upon discovery to the Marshall Fire Department at phone number (903) 935-4580.

The PSO will obtain the following information:

- The material spilled or released
- Location of the release or spillage of hazardous material
- An estimate of quantity released and the rate at which it is being released
- The direction in which the spill, vapor, or smoke release is heading
- Injuries involved

- Fire and/or explosion or possibility of these events
- The area and materials involved and the intensity of the fire or explosion

This information will help the PSO to assess the magnitude and potential seriousness of the spill or release.

9.6.2 Procedure for Containing/Collecting Spills

The initial response to any spill or discharge will be to protect human health and safety, and then the environment. Identification, containment, treatment, and disposal assessment will be the secondary response.

If a chemical spill is not contained within a dike or sump area, an area of isolation will be established around the spill. The size of the area will generally depend on the size of the spill and the materials involved. If the spill is large (greater than 55 gallons) and involves a tank or pipeline rupture, an initial isolation of at least 100 feet in all directions will be used. Small spills (less than or equal to 55 gallons) or leaks from a tank or pipe will require evacuation of at least 50 feet in all directions to allow cleanup and repair, and to prevent exposure. When spill occurs, only those persons involved in overseeing or performing emergency operations will be allowed within the designated hazard area. If possible, the area will be roped or otherwise blocked off. If the spill results in the formation of a toxic vapor cloud (by reaction with surrounding materials or by outbreak of fire) and its release (due to high vapor pressures under ambient conditions), further evacuation will be enforced. In general, an area at least 500 feet wide and 1,000 feet long will be evacuated downwind if volatile materials are spilled. (Consult the North American Emergency Response Guide for isolation distances for listed hazardous materials.)

If an incident may threaten the health or safety of the surrounding community, the public will be informed and possibly evacuated from the area. The PSO will inform the local Fire Department who will, in turn, inform the proper agencies in the event this is necessary (refer to **Table 9-3**).

As called for in regulations developed under the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund), the contractor shall report a spill of a pound or more of any hazardous material for which a reportable quantity has not been established and which is listed under the Solid Waste Disposal Act, Clean Air Act, Clean Water Act, or Toxic Substances Control Act. The contractor shall also follow the same practice for any substances not listed in the Acts noted above but which can be classified as a hazardous waste under the Resource Conservation and Recovery Act.

Cleanup personnel will take the following measures:

- Verify all unnecessary persons are removed from the hazard area.
- Put on protective clothing and equipment.
- If a flammable material is involved, remove all ignition sources and use spark and explosion-proof equipment for recovery of material.

- Remove all surrounding materials that could be especially reactive with materials in the waste. Determine the major components in the waste at the time of the spill.
- If wastes reach a storm sewer, try to dam the outfall by using sand, earth, sandbags, etc. If this is done, pump this material out into a temporary holding tank or drums as soon as possible.
- Place all small quantities of recovered liquid wastes (55 gallons or less) and contaminated soil into drums for incineration or removal to an approved disposal site.
- Spray the spill area with foam, if available, if volatile emissions may occur.
- Apply appropriate spill control media (e.g., clay, sand, lime, etc.) to absorb discharged liquids.
- For large spills, establish diking around leading edge of spill using booms, sand, clay or other appropriate material. If possible, use a diagram pump to transfer discharged liquid to drum or holding tank.

9.6.3 Emergency Response Equipment

The following equipment will be staged in the site area and throughout the site, as needed, to provide for safety and first aid during emergency responses:

- ABC-type fire extinguisher
- First aid kit, industrial size
- Eyewash/safety shower
- Emergency signal horn

9.6.4 Personal Protective Equipment

Emergency response personnel will have respirators available for use with cartridge selection determined by the PSO, based on the results of direct reading instruments. Emergency response personnel will also be provided with protective clothing as warranted by the nature of the hazardous material and as directed by the PSO.

9.6.5 Emergency Spill Response Cleanup Materials and Equipment

A sufficient supply of appropriate emergency response cleanup and PPE will be inventoried and inspected visually on a weekly basis. The materials will be kept on-site for spill control depending on the types of hazardous materials present on-site. The majority of this material will be located in the supply trailer, or storage area.

Contaminated soils, absorbent materials, solvents, and other materials resulting from the cleanup of spilled or discharged substances shall be properly stored, labeled, and disposed off site.

9.7 Emergency Response Contingency Plan

This section details the contingency measures the contractor will take to prepare for and respond to fires, explosions, spills, and releases of hazardous materials, hazardous weather, and medical emergencies.

The procedures listed below will be used to respond to medical emergencies. The PSO will contact the local hospital and inform them of the site hazards and potential emergency situations. A minimum of two First Aid/cardiopulmonary resuscitation (CPR)-trained personnel will be retained on site.

Response

The nearest workers will immediately assist a person who shows signs of medical distress or who is involved in an accident. The crew foreman will be summoned. The crew foreman will immediately make radio contact with the PSO to alert him of a medical emergency situation. The foreman will relay the following information:

- Location of the victim at the work site
- Nature of the emergency
- Whether the victim is conscious
- Specific conditions contributing to the emergency, if known

The following actions will then be taken depending on the severity of the incident:

- Life-Threatening Incident – If an apparent life-threatening condition exists, the crew foreman will call (903) 935-4580 and the Marshall Fire Department will send a rescue truck with EMS personnel. Additionally, the crew foreman will inform the PSO. An on-site person will be appointed to meet the rescue truck and direct the truck to the victim. Contractor personnel will evacuate any injured person within the site to a clean area for treatment by EMS personnel arriving with the rescue truck.
- Non Life-Threatening Incident – If it is determined that no threat to life is present, the PSO will direct the injured person through decontamination procedures (see below) appropriate to the nature of the illness or accident. Appropriate first aid or medical attention will then be administered. Injuries will be reported to the USACE Inspector or, in his absence, the Technical Manager.

  Note: The area surrounding an accident site must not be disturbed until the scene has been cleared by the PSO.

Any personnel requiring emergency medical attention will be evacuated from the site if doing so would not endanger the life of the injured person or otherwise aggravate the injury. Personnel will not enter the area to attempt a rescue if their own lives would be threatened.

The decision whether or not to decontaminate a victim prior to evacuation is based on the type and severity of the illness or injury and the nature of the contaminant. For some emergency victims, immediate decontamination may be an essential part of life-saving first aid. For others, decontamination may aggravate the injury or delay life-saving first aid. Decontamination will be performed if it does not interfere with essential treatment. If decontamination can be performed, observe the following procedures:

- Wash external clothing and cut it away.

If decontamination cannot be performed, observe the following procedures:

- Wrap the victim in blankets or plastic to reduce contamination of other personnel.
- Alert emergency and off-site medical personnel to potential contamination, and instruct them about specific decontamination procedures.
- Send site personnel familiar with the incident and chemical safety information such as MSDSs, with the affected person.

Any injuries, no matter how small, will be reported to the PSO. An accident/injury/illness report will be completely and properly filled out and submitted to the HSM. A list of emergency telephone numbers is given in **Table 9-3**.

Notification The following personnel/agencies will be notified in the event of a medical emergency:

- Local Fire Department or EMS
- PSO
- Workers in the affected areas
- USACE Representative

Directions to Hospital

Written directions (see **Figure 9-1**) to the hospital are as follows: exit base, head southwest on Hwy 449. Hwy 449 will turn into Hwy 43 (Karnack Hwy). Turn left on Hwy 59. Turn right on E. Travis Street. Turn left on S. Washington Avenue. Marshall Regional Medical Center is located at 811 S. Washington Avenue.

For non emergencies:
Longview Occupational Medicine
950 N 4th Street
Longview, Texas 75601
903-757-0577

Figure 9-1
Route to Hospital – Marshall Regional Medical Center, 811 S. Washington Avenue



9.8 Fire Contingency Measures

Contractor personnel and subcontractors are not trained professional firefighters. Therefore, if there is any doubt that a fire cannot be quickly contained and extinguished, personnel will notify the PSO and vacate the structure or area. The PSO will immediately notify the local fire department.

The following procedures will be used to prevent the possibility of fires and resulting injuries:

- Sources of ignition will be distant from areas where flammable materials are handled or stored.
- The air will be monitored for explosivity before and during hot work and periodically where flammable materials are present. Hot work permits will be required for all such work.
- "No Smoking" signs will be conspicuously posted in areas where flammable materials are present.
- Fire extinguishers will be placed in areas where a fire hazard may exist.
- Before workers begin operations in an area, the foreman will give instructions on egress procedures and assembly points. Egress routes will be posted in work areas and exit points clearly marked.

The following procedures will be used in the event of a fire:

- Anyone who sees a fire will notify his supervisor, who will then contact the PSO by radio. The PSO will activate the emergency air horns and contact the local Fire Department.
- When the emergency siren sounds, workers will disconnect electrical equipment in use (if possible) and proceed to the nearest fire exit.
- Work crews will be comprised of pairs of workers (buddy system) who join each other immediately after hearing the fire alarm and remain together throughout the emergency. Workers will assemble at a predetermined rally point for a head count.
- When a small fire has been extinguished by a worker, the PSO will be notified.

9.9 Hazardous Weather Contingency Measures

Operations will not be started or continued when the following hazardous weather conditions are present:

- Lightning
- Heavy rains/snow
- High winds

9.9.1 Response

In the event contingency measures are put into effect, the following response(s) will be implemented:

- Excavation/soil stockpiles will be covered with a plastic liner.
- Equipment will be shut down and secured to prevent damage.
- Personnel will be moved to safe refuge. The PSO will determine when it is necessary to evacuate personnel to off-site locations and will coordinate efforts with fire, police, and other agencies.

9.9.2 Notification

The PSO will be responsible for assessing hazardous weather conditions and notifying personnel of specific contingency measures. Notifications will include the following:

- Contractor employees and subcontractors
- Client representative
- Local civil defense organization

9.9.3 Lightning Safety

As per recommendations of the National Lightning Safety Institute (NLSI), lightning safety should be practiced during thunderstorms. Measuring lightning's distance is useful. Using the flash/bang (F/B) technique, for every five seconds (from the time of seeing the lightning flash to hearing the associated thunder), lightning is 1 mile away. A F/B of 10 seconds equals 2 miles; a F/B of 20 seconds equals 4 miles, etc. The span of a lightning strike can be as much as 6 to 8 miles from the same point of origin. The NLSI recommends the 30/30 rule: suspend activities at the F/B of 30 (6 miles) or when first hearing thunder. Outdoor activities should not be resumed until 30 minutes have passed from the last observable thunder or lightning. If you are suddenly exposed to nearby lightning, adopt the so-called Lightning Safety Position (LSP). LSP means stay away from other people, take off all metal objects, crouch with feet together and head bowed, and place hands on ears to reduce acoustic shock from nearby thunder. When lightning threatens, standard safety measures should include: avoid water and all metal objects; get off the high ground including rooftop, platforms, and heavy equipment; avoid solitary trees; stay off the telephone**.**

9.10 Spill/Release Contingency Measures

In the event of release or spill of a hazardous material, the following measures will be taken.

- A person observing a spill or release will act to remove and/or protect injured/contaminated persons from any life-threatening situation. First aid and/or decontamination procedures will be implemented as appropriate

- First aid will be administered to injured/contaminated personnel. Unsuspecting persons/vehicles will be warned of the hazard. Personnel will act to prevent any unsuspecting persons from coming in contact with spilled materials by alerting other nearby persons of the spill hazard. Without taking unnecessary risks, personnel will attempt to stop the spill at the source. This may

involve activities such as uprighting a drum, closing a valve, or temporarily sealing a hole with a plug

- The PSO will be notified of the spill/release, including information on material spilled, quantity, personnel injuries, and immediate life-threatening hazards. Air monitoring will be implemented by the PSO to determine the potential impact on the surrounding community. Notification procedures will be followed to inform on-site personnel and off-site agencies. The PSO will make a rapid assessment of the spill/release and direct confinement, containment, and control measures

Depending upon the nature of the spill, measures may include the following:

- Construction of a temporary containment berm utilizing on-site clay absorbent earth
- Digging a sump, installing a polyethylene liner, and diverting the spill material into the sump
- Placing drums under the leak to collect the spilling material before it flows over the ground
- Transferring the material from its original container to another container

The PSO will notify the designated Emergency Response Coordinator of the spill and of the steps taken to institute cleanup. Emergency response personnel will clean up all spills in accordance with the spill cleanup plan developed by the PSO. Supplies necessary to clean up a spill will be immediately available on site. Such items may include, but are not limited to, the following:

- Shovel, rake
- Clay absorbent
- Polyethylene liner
- PPE
- Steel drums
- Pumps and miscellaneous hand tools

The major supply of material and equipment will be located in the site area. Smaller supplies will be kept at active work locations. The PSO will inspect the spill site to determine if the spill has been cleaned up to the satisfaction of the designated Emergency Response Coordinator. If necessary, soil, water, or air samples may be taken and analyzed to demonstrate the effectiveness of the spill cleanup effort. The PSO will determine the cause of the spill and determine remedial steps to ensure that recurrence is prevented. The PSO will review the cause with the designated Emergency Response Coordinator and obtain his concurrence with the interim remedial action plan.

10.0 Training Requirements

As a requirement for work at this site, in a hazardous waste work area all field personnel will have completed a 40-hour HAZWOPER training class prior to job assignment. This training must cover the requirements in 29 CFR 1910.120, entitled Hazardous Waste Operations and Emergency Response, which includes PPE, toxicological effects of various chemicals, hazard communication, blood borne pathogens, handling of unknown tanks and drums, confined-space entry procedures, electrical safety, etc. In addition, all personnel must receive annual 8-hour refresher training and 3-day on-site training under a trained, experienced supervisor. Supervisory personnel shall have received an additional 8-hour training in handling hazardous waste operations.

All personnel entering the EZ will be trained in the provisions of this site safety plan and be required to sign the Site Safety Plan Acknowledgment in **Attachment 1** of this HASP.

Site-specific safety and health training for this project will be held at the site location by the PSO before any site work activities begin, and will include potential site contaminants, site physical and environmental hazards, emergency response and evacuation procedures, and emergency telephone numbers.

10.1 Daily and Periodic Safety Training

Daily "Tailgate" safety meetings will be held prior to each shift where health and safety problems and issues are discussed. "Phase Safety" briefings will be held prior to the commencement of a new task where task-specific risks and precautions are discussed. Attendance is mandatory and will be documented.

11.0 Medical Surveillance Program

Contractor personnel shall participate in a medical and health monitoring program meeting the requirements of OSHA Standard 29 CFR 1910.120/1926.65(f). The contractor HSM will be immediately notified of any suspected exposures to hazardous materials/wastes.

12.0 References

National Institute for Occupational Safety and Health (NIOSH)/U.S. Coast Guard/U.S. Environmental Protection Agency/U.S. Occupational Safety and Health Administration, 1985, *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, DHAS/NIOSH Publication Number 85-115, Washington, D.C.

U.S. Army Corps of Engineers, 2008, *Safety and Health Requirements Manual*, EM-385-1-1, Washington, D.C.

U.S. Environmental Protection Agency, 1998, *Standard Operating Safety Guidelines*, Washington, D.C.

Attachment 1

Site Safety and Health Plan Worker Acknowledgement

WORKER ACKNOWLEDGMENT TO HEALTH AND SAFETY PLAN

I HAVE BEEN TRAINED ON THE SAFETY PLAN FOR THIS SITE AND FULLY UNDERSTAND ITS CONTENTS

NAME	SIGNATURE	EMP. No.	DATE

Attachment 2

Health and Safety Forms

00107836

(For Safety Staff only)	REPORT NO.	EROC CODE	UNITED STATES ARMY CORPS OF ENGINEERS ACCIDENT INVESTIGATION REPORT *(For Use of this Form See Help Menu and USACE Suppl to AR 385-40)*	REQUIREMENT CONTROL SYMBOL: CEEC-S-8(R2)

1. ACCIDENT CLASSIFICATION

PERSONNEL CLASSIFICATION	INJURY/ILLNESS/FATAL	PROPERTY DAMAGE	MOTOR VEHICLE INVOLVED	DIVING
GOVERNMENT ☐ CIVILIAN ☐ MILITARY	☐	☐ FIRE INVOLVED ☐ OTHER	☐	☐
☐ CONTRACTOR	☐	☐ FIRE INVOLVED ☐ OTHER	☐	☐
☐ PUBLIC	☐ FATAL ☐ OTHER		☐	

2. PERSONAL DATA

a. Name *(Last, First, MI)*	b. AGE	c. SEX ☐ MALE ☐ FEMALE	d. SOCIAL SECURITY NUMBER	e. GRADE

f. JOB SERIES/TITLE	g. DUTY STATUS AT TIME OF ACCIDENT	h. EMPLOYMENT STATUS AT TIME OF ACCIDENT
	☐ ON DUTY ☐ TDY ☐ OFF DUTY	☐ ARMY ACTIVE ☐ ARMY RESERVE ☐ VOLUNTEER ☐ PERMANENT ☐ FOREIGN NATIONAL ☐ SEASONAL ☐ TEMPORARY ☐ STUDENT ☐ OTHER *(Specify)*

3. GENERAL INFORMATION

a. DATE OF ACCIDENT *(month/day/year)*	b. TIME OF ACCIDENT *(Military time)* hrs	c. EXACT LOCATION OF ACCIDENT	d. CONTRACTOR'S NAME (1) PRIME: (2) SUBCONTRACTOR:

e. CONTRACT NUMBER	f. TYPE OF CONTRACT	g. HAZARDOUS/TOXIC WASTE ACTIVITY
☐ CIVIL WORKS ☐ MILITARY ☐ OTHER *(Specify)*	☐ CONSTRUCTION ☐ SERVICE ☐ A/E ☐ DREDGE ☐ OTHER *(Specify)*	☐ SUPERFUND ☐ DERP ☐ IRP ☐ OTHER *(Specify)*

4. CONSTRUCTION ACTIVITIES ONLY *(Fill in line and corresponding code number in box from list - see help menu)*

a. CONSTRUCTION ACTIVITY	(CODE)	b. TYPE OF CONSTRUCTION EQUIPMENT	(CODE)
	#		#

5. INJURY/ILLNESS INFORMATION *(Include name on line and corresponding code number in box for items e, f & g - see help menu)*

a. SEVERITY OF ILLNESS/INJURY	(CODE)	b. ESTIMATED DAYS LOST	c. ESTIMATED DAYS HOSPITALIZED	d. ESTIMATED DAYS RESTRICTED DUTY
	#			

e. BODY PART AFFECTED	(CODE)	g. TYPE AND SOURCE OF INJURY/ILLNESS	(CODE)
PRIMARY	#	TYPE	#
SECONDARY	#	SOURCE	#
f. NATURE OF ILLNESS/INJURY	(CODE)		
	#		

6. PUBLIC FATALITY *(Fill in line and correspondence code number in box - see help menu)*

a. ACTIVITY AT TIME OF ACCIDENT	(CODE)	b. PERSONAL FLOATATION DEVICE USED?
	#	☐ YES ☐ NO ☐ N/A

7. MOTOR VEHICLE ACCIDENT

a. TYPE OF VEHICLE	b. TYPE OF COLLISION	c. SEAT BELTS	USED	NOT USED	NOT AVAILABLE
☐☐ PICKUP/VAN ☐☐ AUTOMOBILE ☐☐ TRUCK ☐☐ OTHER *(Specify)*	☐ SIDE SWIPE ☐ HEAD ON ☐ REAR END ☐ BROADSIDE ☐ ROLL OVER ☐ BACKING ☐ OTHER *(Specify)*	(1) FRONT SEAT			
		(2) REAR SEAT			

8. PROPERTY/MATERIAL INVOLVED

a. NAME OF ITEM	b. OWNERSHIP	c. $ AMOUNT OF DAMAGE
(1)		
(2)		
(3)		

9. VESSEL/FLOATING PLANT ACCIDENT *(Fill in line and correspondence code number in box from list - see help menu)*

a. TYPE OF VESSEL/FLOATING PLANT	(CODE)	b. TYPE OF COLLISION/MISHAP	(CODE)
	#		#

10. ACCIDENT DESCRIPTION *(Use additional paper, if necessary)*

11. CAUSAL FACTOR(S) *(Read Instruction Before Completing)*

a. (Explain YES answers in item 13)	YES	NO
DESIGN: Was design of facility, workplace or equipment a factor?	☐	☐
INSPECTION/MAINTENANCE: Were inspection & maintenance procedures a factor?	☐	☐
PERSON'S PHYSICAL CONDITION: In your opinion, was the physical condition of the person a factor?	☐	☐
OPERATING PROCEDURES: Were operating procedures a factor?	☐	☐
JOB PRACTICES: Were any job safety/health practices not followed when the accident occurred?	☐	☐
HUMAN FACTORS: Did any human factors such as, size or strength of person, etc., contribute to accident?	☐	☐
ENVIRONMENTAL FACTORS: Did heat, cold, dust, sun, glare, etc., contribute to the accident?	☐	☐

a. *(CONTINUED)*	YES	NO
CHEMICAL AND PHYSICAL AGENT FACTORS: Did exposure to chemical agents, such as dust, fumes, mists, vapors or physical agents, such as, noise, radiation, etc., contribute to accident?	☐	☐
OFFICE FACTORS: Did office setting such as, lifting office furniture, carrying, stooping, etc., contribute to the accident?	☐	☐
SUPPORT FACTORS: Were inappropriate tools/resources provided to properly perform the activity/task?	☐	☐
PERSONAL PROTECTIVE EQUIPMENT: Did the improper selection, use or maintenance of personal protective equipment contribute to the accident?	☐	☐
DRUGS/ALCOHOL: In your opinion, was drugs or alcohol a factor to the accident	☐	☐

b. WAS A WRITTEN JOB/ACTIVITY HAZARD ANALYSIS COMPLETED FOR TASK BEING PERFORMED AT TIME OF ACCIDENT?

☐ YES *(If yes, attach a copy.)* ☐ NO

12. TRAINING

a. WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK?	b. TYPE OF TRAINING.	c. DATE OF MOST RECENT FORMAL TRAINING.
☐ YES ☐ NO	☐ CLASSROOM ☐ ON JOB	(Month) (Day) (Year)

13. FULLY EXPLAIN WHAT ALLOWED OR CAUSED THE ACCIDENT; INCLUDE DIRECT AND INDIRECT CAUSES *(See instruction for definition of direct and indirect causes.)* *(Use additional paper, if necessary)*

a. DIRECT CAUSE

b. INDIRECT CAUSE(S)

14. ACTION(S) TAKEN, ANTICIPATED OR RECOMMENDED TO ELIMINATE CAUSE(S).

DESCRIBE FULLY:

15. DATES FOR ACTIONS IDENTIFIED IN BLOCK 14.

a. BEGINNING (Month/Day/Year)	b. ANTICIPATED COMPLETION (Month/Day/Year)

c. SIGNATURE AND TITLE OF SUPERVISOR COMPLETING REPORT	d. DATE *(Mo/Da/Yr)*	e. ORGANIZATION IDENTIFIER *(Div, Br, Sect)*	f. OFFICE SYMBOL
CORPS _____			
CONTRACTOR _____			

16. MANAGEMENT REVIEW *(1st)*

a. ☐ CONCUR b. ☐ NON CONCUR c. COMMENTS

SIGNATURE	TITLE	DATE

17. MANAGEMENT REVIEW *(2nd - Chief Operations, Construction, Engineering, etc.)*

a. ☐ CONCUR b. ☐ NON CONCUR c. COMMENTS

SIGNATURE	TITLE	DATE

18. SAFETY AND OCCUPATIONAL HEALTH OFFICE REVIEW

a. ☐ CONCUR b. ☐ NON CONCUR c. ADDITIONAL ACTIONS/COMMENTS

SIGNATURE	TITLE	DATE

19. COMMAND APPROVAL

COMMENTS

COMMANDER SIGNATURE	DATE

*U.S. GOVERNMENT PRINTING OFFICE: 1993-0-791-757

10.	ACCIDENT DESCRIPTION *(Continuation)*

13a.	DIRECT CAUSE *(Continuation)*

13b.	INDIRECT CAUSES *(Continuation)*

14.	ACTION(S) TAKEN, ANTICIPATED, OR RECOMMENDED TO ELIMINATE CAUSE(S) *(Continuation)*

00107840

OPERATORS DAILY MEMO
AND
SAFETY INSPECTION

Equipment Type: _____ No. _____

Shift: _____ Date: _____

Adjustment or repairs needed: _____

_____

_____

_____

_____

_____

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_____

REVERSE SIDE MUST BE COMPLETED

00107841

SAFETY INSPECTION

ITEM INSPECTED	CHECK ONE ONLY		
Service, Parking & Emergency Brakes	OK	N/A	REPAIR
Steering Mechanism			
Tires, Wheel Nuts			
Lights, Reflectors			
Coupling Device			
Operating Controls			
Windshield Wiper			
Horn			
Back Up Alarm			
Seat Belts			
Fire Extinguisher			
Roadside Reflectors or Flares			

_____ _____

Operator Date

AUTOMOTIVE: AUTOMOBILE AND PICKUP
Safety and Preventive Maintenance Inspection

Number:	Hours/Miles:	Contract Number:	Date:

Item	Check One Only			Explain Deficiencies
	OK	N/A	Repair	
Hom & Mirrors				
Lights/Tum Signals				
Cab/Glass/Wipers				
Emergency Brake				
Service Brakes				
Clutch Operation				
Seat ConditionlBelts				
Gauges				
Radiator & Hoses				
Fluid Levels/Condition				
Belts - Wear & Tension				
Smog System & Hoses				
Intake System				
Battery & Wiring				
Line Operation				
Engine Leaks				
Front Suspension				
Exhaust System				
Rear Suspension				
Transmission Leaks				
Transfer Case Leaks				
Differential Seal(s)				
U-Joints				
Body Condition/Paint				
Wheels & Tires				
Jack and Lug Wrench				
Road Test				
CONDITION: Average percent of wear remaining				**%**

Additional items or information:

This is a visual inspection of machines to check for obvious safety and mechanical deficiencies. Minor adjustments, loose bolts or brackets, light bulb changes, etc., should be taken care of at time of inspection. Defects observed but not on checklist should be noted at bottom of inspection form.

Horn/Mirror	Check condition and operation
Lights/Turn Signals	Check condition and operation
Cab/Glass/Wipers	Check condition, operation and cleanliness
Emergency Brake	Check operation
Service Brakes	Check operation
Clutch Operation	Check operation, automatic or manual
Seat Condition/Belts	Check seat belts and seat
Gauges	Check for operation and normal readings
Radiator and Hoses	Check condition and for leaks
Fluid Levels	Check all fluid levels and condition of fluids
Belts/Wear/Tension	Check adjustment and condition of belts
Smog System and Hoses	Look for cracked or uncoupled vacuum hoses
Air Intake System	Check filter lamps and for leaks
Battery and Wiring	Check electrolyte for clean terminals and cuffed or mislocated wiring
Engine Operation	Check at idle and during road test
Engine Leaks	Check for oil, water and vacuum leaks
Front Suspension	Look for abnormal tire wear, shock, tie rod and steering component wear
Exhaust System	Check for exhaust leaks, muffler and exhaust pipe brackets and clamps
Rear Suspension	Check shocks, springs and shackles
Transmission	Check for leaks an mounts
Transfer Case	Check for leaks and mounting bolts
Differential Seal	Check clamp bolts and bearings
U-Joints	Check clamp bolts and bearings
Body Condition/Paint	Check for dents, loose body parts and paint condition
Wheels & Tires	Check wheel condition and for sufficient tread for driving conditions
Jack and Lug Wrench	Are they in vehicle?
Road Test	Check operation of vehicle systems including steering, suspension, brake and drive train operation

Additional items or information not included:

Note any unsafe condition or mechanical deficiencies on items not covered above.

Inspected By:_____ Date:_____

DRILL RIG INSPECTION CHECK LIST

Inspection Item	Adequate	Requires Attention	Not Applicable	Action Taken to Effect Repair
RIG SET-UP				
Emergency				
Communication				
Layout Provides Safe Access				
Fire Breaks				
Flood/Storm Protection				
Combustible Materials Cleared				
Pipe Rack Stability				
Steps and Ladders Secure				
Platforms and Decks Clean				
COLLAR STABILITY				
Collar Installation				
Seal Around Collar				
Flow Line and Trough Condition				
WARNING EQUIPMENT				
Gas Detectors				
Pressure Gauges				
Pit Level Float Indicators				
Mast Power Line Warning Device				
SAFETY				
Regular Safety Meetings				
Safety and First Aid Training				
First Aid Kit				
Regular Fire Drill				
Fire Extinguisher				
Personnel Issued Safety Equipment				
Safety Belts and Lifelines				
General Housekeeping				
General Servicing				
MAST				
Pivots and Locks				
Conditions of Structures				
Condition of Guy Ropes and Anchors				
Fingers and Racking Platform				
Alignment with Hole				
Emergency Escape Device				
HOISTING EQUIPMENT				
Cable Condition and Fixing				
Sheaves and Blocks				
Wireline Equipment				

DRILL RIG INSPECTION CHECK LIST

Inspection Item	Adequate	Requires Attention	Not Applicable	Action Taken to Effect Repair
Hoist Drums and Brakes				
Hook Latch and Clevis				
Hoist Mountings				
Guards and Mountings				
HANDLING EQUIPMENT				
Hoist Plugs and Elevators				
Slips and Clamps				
Slings and Shackles				
Safety Clamps				
Rig Tongs and Wrenches				
Casing Handling Equipment				
DRIVE AND POWER SYSTEMS				
Fuel Lines and Filters, Oil Filters				
Guards on Moving Parts				
Engine Starting				
Clutches and Clutch Adjustment				
Chain and Belt Condition				
Chain and Belt Drive Adjustment				
Universal Joints				
Control Linkage and Lines				
Hydraulic Controls and Lines				
Emergency Engine Shut Down				
ROTATING AND DRILLING SYSTEM				
Rotary Head and Pitman Bearings				
Table Bushings and Chuck Jaws				
Alignment with Hole				
Bushes				
Kelly Drive Pins and Bushings				
Kelly Sub Treads				
Drill Pipe				
Thread Adaptors				
Stabilizers and Reamers				
Drill Bits				
CIRCULATING SYSTEM				
Pressure Rating of Fittings				
Guards on Pump and Relief Valve				
Condition of Mixing Equipment				
Hoses and Safety Chains				

DRILL RIG INSPECTION CHECK LIST

Inspection Item	Adequate	Requires Attention	Not Applicable	Action Taken to Effect Repair
Compressor Unloading Valve				
Air Tank Drains				
Swivel Packings and Bearings				
Pump Gland Packings				
Mud Test Equipment				
Mud Tank and Water Tank Condition				
HAND AND POWER TOOLS				
Wrench Handles and Jaws				
Condition of Spanners, Hammers, etc.				
Inventory and Storage				
Guards on Power Tools				
Cables and Hoses to Power Tools				
Earth Leakage Circuit Breakers				

DAILY SAFETY TRAINING MEETINGS

Date of Training:	
Crew:	**Craft(s):**
BRIEFLY DESCRIBE SPECIFIC TRAINING TOPICS COVERED	
1.	
2.	
3.	
REMARKS	
Total Employees on Crew(s):	**Total in Attendance:**
SIGNATURE OF EMPLOYEES ATTENDING	
Complete all sections fully and submit to the Project Supervisor or Safety Representative	
Supervisor:	**Job Title:**

WEEKLY SAFETY TRAINING MEETINGS

Date of Training:	
Crew:	**Craft(s):**
BRIEFLY DESCRIBE SPECIFIC TRAINING TOPICS COVERED	
1.	
2.	
3.	
REMARKS	
Total Employees on Crew(s):	**Total in Attendance:**
SIGNATURE OF EMPLOYEES ATTENDING	
Complete all sections fully and submit to the Project Supervisor or Safety Representative	
Supervisor:	**Job Title:**

MONTHLY SAFETY TRAINING MEETINGS

Date of Training:	
Crew:	**Craft(s):**
BRIEFLY DESCRIBE SPECIFIC TRAINING TOPICS COVERED	
1.	
2.	
3.	
REMARKS	
Total Employees on Crew(s):	**Total in Attendance:**
SIGNATURE OF EMPLOYEES ATTENDING	
Complete all sections fully and submit to the Project Supervisor or Safety Representative	
Supervisor:	**Job Title:**

Project Name: _____
Project Location: _____

AIR SAMPLING DATA FORM

SAMPLING INFORMATION

Date Started: _____
Date Completed: _____

Type of Meter: _____
Date Calibrated: _____
Other Notes: _____

	STATION NO. 1	STATION NO. 2	STATION NO. 3	STATION NO. 4	STATION NO. 5	STATION NO. 6	STATION NO. 7	STATION NO. 8
TIME								
READING								
TIME								
READING								
TIME								
READING								
TIME								
READING								
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TIME								
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TIME								
READING								
TIME								
READING								
TIME								
READING								
TIME								
READING								

Comments:

NR= Not Recorded

00107850

Attachment 3

Material Safety Data Sheets

Tetrachloroethene

Trichloroethene

1,1,1-Trichloroethane

1,1,2-Trichloroethane

1,1-Dichloroethene

1,2-Dichloroethane

Antimony

Thallium

International Chemical Safety Cards

TETRACHLOROETHYLENE

ICSC: 0076

TETRACHLOROETHYLENE
1,1,2,2-Tetrachloroethylene
Perchloroethylene
Tetrachloroethene
$C_2Cl_4/Cl_2C=CCl_2$
Molecular mass: 165.8

CAS # 127-18-4
RTECS # KX3850000
ICSC # 0076
UN # 1897
EC # 602-028-00-4

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible. Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION			
EXPOSURE		STRICT HYGIENE!	
• **INHALATION**	Incoordination. Exhilaration. Dizziness. Drowsiness. Headache. Nausea. Weakness. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	Dry skin. Redness. Skin burns. Blisters.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• **EYES**	Redness. Pain.	Safety goggles, face shield.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	Abdominal pain (further see Inhalation).	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Do NOT induce vomiting. Give plenty of water to drink. Rest.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Ventilation. Collect leaking and spilled	Separated from metals (see Chemical	Do not transport with food and feedstuffs.

liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place.	Dangers), food and feedstuffs. Keep in the dark. Ventilation along the floor.	IMO: Marine Pollutant Xn symbol R: 40 S: 23-36/37 UN Hazard Class: 6.1 UN Packing Group: III

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0076

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993

TETRACHLOROETHYLENE

ICSC: 0076

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
The vapour is heavier than air.

CHEMICAL DANGERS:
On contact with hot surfaces or flames this substance decomposes forming toxic and corrosive fumes (hydrogen chloride, phosgene, chlorine). The substance decomposes slowly on contact with moisture producing trichloroacetic acid and hydrochloric acid. Reacts with metals such as aluminium, lithium, barium, berrylium.

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV: 50 ppm; 339 mg/m^3 (STEL): 200 ppm; 1357 mg/m^3 (ACGIH 1992-1993).

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

INHALATION RISK:
A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance irritates the eyes, the skin and the respiratory tract. Swallowing the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis. The substance may cause effects on the central nervous system.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the liver and kidney. Tumours have been detected in experimental animals but may not be relevant to humans (see Notes).

PHYSICAL PROPERTIES

Boiling point: 121°C
Melting point: -22°C
Relative density (water = 1): 1.6
Solubility in water, g/100 ml at 20°C: 0.015

Vapour pressure, kPa at 20°C: 1.9
Relative vapour density (air = 1): 5.8
Relative density of the vapour/air-mixture at 20°C (air = 1): 1.09
Octanol/water partition coefficient as log Pow: 2.6

ENVIRONMENTAL DATA

This substance may be hazardous to the environment; special attention should be given to indoor air and water.

NOTES

Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is indicated. The odour warning when the exposure limit value is exceeded is insufficient. Do NOT use in the vicinity of a fire or a hot surface, or during welding. Technical grades may contain small amounts of carcinogenic stabilizers.

Transport Emergency Card: TEC (R)-722
NFPA Code: H2; F0; R0;

ADDITIONAL INFORMATION

ICSC: 0076 **TETRACHLOROETHYLENE**

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IMPORTANT LEGAL NOTICE:	Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use.

International Chemical Safety Cards

TRICHLOROETHYLENE

ICSC: 0081

TRICHLOROETHYLENE
1,1,2-Trichloroethylene
Trichloroethene
Ethylene trichloride
C_2HCl_3/ClCH=CCl_2
Molecular mass: 131.4

CAS # 79-01-6
RTECS # KX4550000
ICSC # 0081
UN # 1710
EC # 602-027-00-9

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible under specific conditions. See Notes.		In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION	Risk of fire and explosion (see Chemical Dangers).		In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE			
• **INHALATION**	Dizziness. Drowsiness. Headache. Weakness. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	Dry skin. Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• **EYES**	Redness. Pain.	Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	Abdominal pain (further see Inhalation).	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Do NOT induce vomiting. Give plenty of water to drink. Rest.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING

Ventilation. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place (extra personal protection: self-contained breathing apparatus).	Separated from metals (see Chemical Dangers), strong bases, food and feedstuffs. Dry. Keep in the dark. Ventilation along the floor.	Do not transport with food and feedstuffs. IMO: Marine Pollutant Xn symbol R: 40 S: 23-36/37 UN Hazard Class: 6.1 UN Packing Group: III

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0081

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TRICHLOROETHYLENE

ICSC: 0081

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
The vapour is heavier than air. As a result of flow, agitation, etc., electrostatic charges can be generated.

CHEMICAL DANGERS:
On contact with hot surfaces or flames this substance decomposes forming toxic and corrosive fumes (phosgene, hydrogen chloride, chlorine). The substance decomposes on contact with strong alkali producing dichloroacetylene , which increases fire hazard. Reacts violently with metals such as lithium, magnesium aluminium, titanium, barium and sodium. Slowly decomposed by light in presence of moisture, with formulation of corrosive hydrochloric acid.

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV: 50 ppm; 269 mg/m^3 (STEL): 200 ppm; 1070 mg/m^3 (ACGIH 1992-1993).

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

INHALATION RISK:
A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20°C.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance irritates the eyes and the skin. Swallowing the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis. The substance may cause effects on the central nervous system. Exposure could cause lowering of consciousness.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the liver and kidney (see notes).

PHYSICAL PROPERTIES

Boiling point: 87°C
Melting point: -73°C
Relative density (water = 1): 1.5
Solubility in water, g/100 ml at 20°C: 0.1
Vapour pressure, kPa at 20°C: 7.8

Relative vapour density (air = 1): 4.5
Relative density of the vapour/air-mixture at 20°C (air = 1): 1.3
Auto-ignition temperature: 410°C
Explosive limits, vol% in air: 8-10.5
Octanol/water partition coefficient as log Pow: 2.42

ENVIRONMENTAL DATA

This substance may be hazardous to the environment; special attention should be given to water organisms.

NOTES

Combustible vapour/air mixtures difficult to ignite, may be developed under certain conditions. Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is indicated. The odour warning when the exposure

limit value is exceeded is insufficient. Do NOT use in the vicinity of a fire or a hot surface, or during welding. Technical grades may contain small amounts of carcinogenic stabilizers.

Transport Emergency Card: TEC (R)-723
NFPA Code: H2; F1; R0;

ADDITIONAL INFORMATION

ICSC: 0081 **TRICHLOROETHYLENE**

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International Chemical Safety Cards

1,1,1-TRICHLOROETHANE

ICSC: 0079

1,1,1-TRICHLOROETHANE
Methyl chloroform
Methyltrichloromethane
alpha-Trichloroethane
$C_2H_3Cl_3$ / CCl_3CH_3
Molecular mass: 133.4

CAS # 71-55-6
RTECS # KJ2975000
ICSC # 0079
UN # 2831
EC # 602-013-00-2

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible under specific conditions. Heating will cause rise in pressure with risk of bursting. See Notes. Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION			In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		PREVENT GENERATION OF MISTS!	
• **INHALATION**	Ataxia. Dizziness. Drowsiness. Headache. Nausea. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	Dry skin. Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• **EYES**	Redness.	Safety goggles, or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	Diarrhoea. Nausea. Vomiting (further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Give a slurry of activated charcoal in water to drink. Do NOT induce vomiting. Refer for

			medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Ventilation. Collect leaking and spilled liquid in sealable, suitable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT let this chemical enter the environment (extra personal protection: self-contained breathing apparatus).	Provision to contain effluent from fire extinguishing. Separated from food and feedstuffs and incompatible materials (see Chemical Dangers). Cool. Dry. Ventilation along the floor.	Do not transport with food and feedstuffs. Xn symbol N symbol R: 20-59 S: (2-)24/25-59-61 Note: F UN Hazard Class: 6.1 UN Packing Group: III Marine pollutant.
SEE IMPORTANT INFORMATION ON BACK		
ICSC: 0079	Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993	

1,1,1-TRICHLOROETHANE

ICSC: 0079

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
The vapour is heavier than air.

CHEMICAL DANGERS:
The substance decomposes on heating or on burning producing toxic and corrosive fumes including phosgene and hydrogen chloride. Reacts violently with aluminium, manganese and their alloys, alkalis, strong oxidants, acetone and zinc. Attacks natural rubber. Mixtures of 1,1,1-trichloroethane with potassium or its alloys are shock sensitive. Reacts slowly with water releasing corrosive hydrochloric acid.

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV: 350 ppm; 1910 mg/m^3 (as TWA); 450 ppm; 2460 mg/m^3 (as STEL) (ACGIH 1994-1995).

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation of its vapour and by ingestion.

INHALATION RISK:
A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20°C.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance irritates the eyes, the skin and the respiratory tract. The substance may cause effects on the heart and central nervous system, kidneys and liver , resulting in cardiac disorders and respiratory failure. Exposure at high level may result in death. Medical observation is indicated.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
The liquid defats the skin. The substance may have effects on the liver.

PHYSICAL PROPERTIES	Boiling point: 74°C Melting point: -30°C	Relative vapour density (air = 1): 4.6 Flash point: see Notes°C

	Relative density (water = 1): 1.34 Solubility in water: none Vapour pressure, kPa at 20°C: 13.3	Auto-ignition temperature: 537°C Explosive limits, vol% in air: 8-16 Octanol/water partition coefficient as log Pow: 2.49
ENVIRONMENTAL DATA	The substance is harmful to aquatic organisms. This substance may be hazardous to the environment; special attention should be given to air and ground water.	

N O T E S

Combustible vapour/air mixtures difficult to ignite, may be developed under certain conditions. The substance burns only in excess oxygen or if a strong source of ignition is present. Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is indicated. An added stabilizer or inhibitor can influence the toxicological properties of this substance, consult an expert. Do NOT use in the vicinity of a fire or a hot surface, or during welding. Aerothene, Algylen, Trichloran, Chlorylen, Genklene, Chlorothene NU, Chlorothene VG, and Solvent 111 are trade names.

Transport Emergency Card: TEC (R)-721
NFPA Code: H2; F1; R0

ADDITIONAL INFORMATION

ICSC: 0079 **1,1,1-TRICHLOROETHANE**

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International Chemical Safety Cards

1,1,2-TRICHLOROETHANE

ICSC: 0080

1,1,2-TRICHLOROETHANE
Vinyl trichloride
Beta-trichloroethane
$C_2H_3Cl_3$ / $CHCl_2CH_2Cl$
Molecular mass: 133.4

CAS # 79-00-5
RTECS # KJ3150000
ICSC # 0080
UN # 3082
EC # 602-014-00-8

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible under specific conditions. Heating will cause rise in pressure with risk of bursting. See Notes.	NO open flames. NO contact with hot surfaces.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	See Notes.		In case of fire: cool drums, etc., by spraying with water but avoid contact of the substance with water.
EXPOSURE		PREVENT GENERATION OF MISTS!	
• **INHALATION**	Dizziness. Drowsiness. Headache. Nausea. Shortness of breath. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
• **SKIN**	MAY BE ABSORBED! Dry skin.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention.
• **EYES**		Safety spectacles, or face shield.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	(Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical

			attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT let this chemical enter the environment (extra personal protection: self-contained breathing apparatus).	Provision to contain effluent from fire extinguishing. Separated from strong oxidants, strong bases, many metals. Well closed. Ventilation along the floor.	Xn symbol R: 20/21/22 S: (2-)9 UN Hazard Class: 9 UN Packing Group: III Marine pollutant.
SEE IMPORTANT INFORMATION ON BACK		
ICSC: 0080	Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993	

1,1,2-TRICHLOROETHANE

ICSC: 0080

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
The vapour is heavier than air.

CHEMICAL DANGERS:
On contact with hot surfaces or flames this substance decomposes forming hydrogen chloride (see ICSC # 0163), phosgene (see ICSC # 0007), and other toxic gases. Reacts with strong oxidizers, strong bases and metals such as sodium, potassium, magnesium and powdered aluminium. Attacks many plastics, rubber, steel and zinc.

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV: 10 ppm; 55 mg/m^3 (as TWA) (skin) (ACGIH 1993-1994).

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation of its vapour, through the skin and by ingestion.

INHALATION RISK:
A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20°C .

EFFECTS OF SHORT-TERM EXPOSURE:
The substance may cause effects on the central nervous system, kidneys, liver , resulting in central nervous depression, liver impairment and kidney impairment. Exposure at high levels may result in unconsciousness.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
The liquid defats the skin.

PHYSICAL PROPERTIES

Boiling point: 114°C
Melting point: -36°C
Relative density (water = 1): 1.44
Solubility in water: none

Relative vapour density (air = 1): 4.6
Relative density of the vapour/air-mixture at 20°C (air = 1): 4.6
Explosive limits, vol% in air: 6-15.5

	Vapour pressure, kPa at 20°C: 2.5	Octanol/water partition coefficient as log Pow: 2.35
ENVIRONMENTAL DATA	The substance is harmful to aquatic organisms.	

N O T E S

Flash point unknown in literature. Combustible vapour/air mixtures difficult to ignite, may be developed under certain conditions. Use of alcoholic beverages enhances the harmful effect. The relation between odour and the occupational exposure limit cannot be indicated. Do NOT use in the vicinity of a fire or a hot surface, or during welding.

NFPA Code: H 3; F 1; R 0;

ADDITIONAL INFORMATION

ICSC: 0080 **1,1,2-TRICHLOROETHANE**

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International Chemical Safety Cards

VINYLIDENE CHLORIDE

ICSC: 0083

VINYLIDENE CHLORIDE
1,1-Dichloroethene
1,1-Dichloroethylene
VDC
$C_2H_2Cl_2/H_2C=CCl_2$
Molecular mass: 97

CAS # 75-35-4
RTECS # KV9275000
ICSC # 0083
UN # 1303 (inhibited)
EC # 602-025-00-8

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Extremely flammable. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames, NO sparks, and NO smoking.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Vapour/air mixtures are explosive. Vinyl chloride monomer vapours are uninhibited and may form polymers in vents or flame arresters of storage tanks, resulting in blockage of vents.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Use non-sparking handtools.	In case of fire: keep drums, etc., cool by spraying with water. Combat fire from a sheltered position.
EXPOSURE		STRICT HYGIENE!	
• **INHALATION**	Dizziness. Drowsiness. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	Redness. Skin burns.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• **EYES**	Redness. Pain.	Safety goggles, or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	Abdominal pain. Sore throat (further see Inhalation).	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Do NOT induce vomiting. Give plenty of water to drink. Rest.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area! Consult an expert! Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place (extra personal protection: complete protective clothing including self-contained breathing apparatus).	Fireproof. Separated from incompatible materials (see Chemical Dangers). Cool. Keep in the dark. Store only if stabilized.	Airtight. Unbreakable packaging; put breakable packaging into closed unbreakable container. IMO: Marine Pollutant F+ symbol Xn symbol R: 12-20-40 S: 7-16-29 Note: D UN Hazard Class: 3 UN Packing Group: I

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0083

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VINYLIDENE CHLORIDE

ICSC: 0083

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
VOLATILE COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
The vapour is heavier than air and may travel along the ground; distant ignition possible.

CHEMICAL DANGERS:
The substance can readily form explosive peroxides. The substance will polymerize readily due to heating or under the influence of oxygen, sunlight, copper or aluminium, with fire or explosion hazard. May explode on heating or on contact with flames. The substance decomposes on burning producing toxic and corrosive fumes (hydrogen chloride, phosgene and chlorine). Reacts violently with oxidants.

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV: 5 ppm; 20 mg/m^3 (STEL): 20 ppm; 79 mg/m^3 (ACGIH 1992-1993).

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

INHALATION RISK:
A harmful contamination of the air can be reached very quickly on evaporation of this substance at 20°C.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance irritates the eyes, the skin and the respiratory tract. Swallowing the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis. The substance may cause effects on the central nervous system.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the liver and kidneys.

PHYSICAL PROPERTIES

Boiling point: 32°C
Melting point: -122°C
Relative density (water = 1): 1.2
Solubility in water, g/100 ml at 25°C: 0.25
Vapour pressure, kPa at 20°C: 66.5
Relative vapour density (air = 1): 3.3
Relative density of the vapour/air-mixture at 20°C (air = 1): 2.5
Flash point: 5.6°C
Auto-ignition temperature: 570°C
Explosive limits, vol% in air: 5.6-16
Octanol/water partition coefficient as log Pow: 1.32

ENVIRONMENTAL DATA

This substance may be hazardous to the environment; special attention should be given to water organisms. In the food chain important to humans, bioaccumulation takes place, specifically in plants.

NOTES

Contains inhibitors (e.g. methoxyphenol). Depending on the degree of exposure, periodic medical examination is indicated. The odour warning when the exposure limit value is exceeded is insufficient. Do NOT use in the vicinity of a fire or a hot surface, or during welding.

Transport Emergency Card: TEC (R)-641
NFPA Code: H2; F4; R2;

ADDITIONAL INFORMATION

ICSC: 0083 **VINYLIDENE CHLORIDE**

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International Chemical Safety Cards

1,2-DICHLOROETHANE

ICSC: 0250

1,2-DICHLOROETHANE
Ethylene dichloride
1,2-Ethylene dichloride
Ethane dichloride
$ClCH_2CH_2Cl$ / $C_2H_4Cl_2$
Molecular mass: 98.96

CAS # 107-06-2
RTECS # KI0525000
ICSC # 0250
UN # 1184
EC # 602-012-00-7

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Highly flammable. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames, NO sparks, and NO smoking.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Vapour/air mixtures are explosive.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Prevent build-up of electrostatic charges (e.g., by grounding). Do NOT use compressed air for filling, discharging, or handling.	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		AVOID ALL CONTACT!	IN ALL CASES CONSULT A DOCTOR!
• **INHALATION**	Abdominal pain. Cough. Dizziness. Drowsiness. Headache. Nausea. Sore throat. Unconsciousness. Vomiting. Symptoms may be delayed (see Notes).	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Half-upright position. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention.
• **EYES**	Redness. Pain. Blurred vision.	Safety goggles, face shield, or eye protection in combination with	First rinse with plenty of water for several minutes (remove contact

		breathing protection.	lenses if easily possible), then take to a doctor.
• **INGESTION**	Abdominal cramps. Diarrhoea (further see Inhalation).	Do not eat, drink, or smoke during work. Wash hands before eating.	Give nothing to drink. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area! Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT wash away into sewer (extra personal protection: self-contained breathing apparatus).	Fireproof. Separated from strong oxidants, food and feedstuffs and other incompatible substances (see Chemical Dangers). Cool. Dry.	Unbreakable packaging; put breakable packaging into closed unbreakable container. Do not transport with food and feedstuffs. F symbol T symbol R: 45-11-22-36/37/38 S: 53-45 Note: E UN Hazard Class: 3 UN Subsidiary Risks: 6.1 UN Packing Group: II Marine pollutant.

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0250

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1,2-DICHLOROETHANE

ICSC: 0250

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS, VISCOUS LIQUID , WITH CHARACTERISTIC ODOUR. TURNS DARK ON EXPOSURE TO AIR, MOISTURE AND LIGHT.

PHYSICAL DANGERS:
The vapour is heavier than air and may travel along the ground; distant ignition possible. As a result of flow, agitation, etc., electrostatic charges can be generated.

CHEMICAL DANGERS:
The substance decomposes on heating and on burning producing toxic and corrosive fumes including hydrogen chloride (ICSC # 0163) and phosgene (ICSC # 0007). Reacts violently with aluminium, alkali metals, alkali amides, ammonia, bases, strong oxidants. Attacks many metals in presence of water. Attacks plastic.

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV: 10 ppm; 40 mg/m^3 (as TWA) (ACGIH 1994-1995).

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation of its vapour, through the skin and by ingestion.

INHALATION RISK:
A harmful contamination of the air can be reached very quickly on evaporation of this substance at 20°C.

EFFECTS OF SHORT-TERM EXPOSURE:
The vapour irritates the eyes, the skin and the respiratory tract. Inhalation of the vapour may cause lung oedema (see Notes). The substance may cause effects on the central nervous system, kidneys, liver , resulting in impaired functions.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
Repeated or prolonged contact with skin may cause dermatitis. This substance is probably carcinogenic to humans.

T **A**	
PHYSICAL PROPERTIES	Boiling point: 83.5°C Melting point: -35.7°C Relative density (water = 1): 1.235 Solubility in water, g/100 ml: 0.87 Vapour pressure, kPa at 20°C: 8.7 Relative vapour density (air = 1): 3.42 Relative density of the vapour/air-mixture at 20°C (air = 1): 1.2 Flash point: 13°C c.c. Auto-ignition temperature: 413°C Explosive limits, vol% in air: 6.2-16 Octanol/water partition coefficient as log Pow: 1.48
ENVIRONMENTAL DATA	

N O T E S

Depending on the degree of exposure, periodic medical examination is indicated. The symptoms of lung oedema often do not become manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation are therefore essential. Immediate administration of an appropriate spray, by a doctor or a person authorized by him/her, should be considered.

Transport Emergency Card: TEC (R)-605
NFPA Code: H 2; F 3; R 0;

ADDITIONAL INFORMATION

ICSC: 0250 **1,2-DICHLOROETHANE**

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MSDS Number: **A7152** * * * * * *Effective Date:* ***08/02/00*** * * * * * *Supercedes:* ***09/08/97***

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

J.T.Baker®

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. And Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

Antimony

1. Product Identification

Synonyms: Stibium, C.I. 77050
CAS No.: 7440-36-0
Molecular Weight: 121.75
Chemical Formula: Sb
Product Codes: 0848

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Antimony	7440-36-0	90 - 100%	Yes

3. Hazards Identification

Emergency Overview

POISON! DANGER! MAY BE FATAL IF INHALED. CAUSES IRRITATION. TARGET ORGAN(S): Respiratory system, cardiovascular system, eyes, skin.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 1 - Slight
Reactivity Rating: 2 - Moderate
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES
Storage Color Code: Blue (Health)

Potential Health Effects

Inhalation:
Is harmful may be fatal.
Ingestion:
None identified.
Skin Contact:
Prolonged contact may cause dermatitis.
Eye Contact:
None identified.
Chronic Exposure:
Kidney damage, liver damage.
Aggravation of Pre-existing Conditions:
No information found.

4. First Aid Measures

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Prompt action is essential.
Ingestion:
If large amounts were swallowed, give water to drink and get medical advice.
Skin Contact:
In case of contact, flush skin with water.
Eye Contact:
In case of eye contact, immediately flush with plenty of water for at least 15 minutes.

5. Fire Fighting Measures

Fire:
Not expected to be a fire hazard.
Explosion:
Can be an explosion hazard, especially when heated.
Fire Extinguishing Media:
Use extinguishing media appropriate for surrounding fire.
Special Information:
No information found.

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6. Accidental Release Measures

Wear self-contained breathing apparatus and full protective clothing. With clean shovel, carefully place material into clean, dry container and cover; remove from area. Flush spill area with water.

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7. Handling and Storage

Keep container tightly closed. Store in secure poison area. Keep product out of light. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

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8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
0.5 mg/m3 (TWA)

-ACGIH Threshold Limit Value (TLV):
0.5 mg/m3 (TWA)
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
For conditions of use where exposure to the substance is apparent, consult an industrial hygienist. For emergencies, or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Silvery-white metal.
Odor:
No information found.
Solubility:
Negligible (< 0.1%)
Specific Gravity:
6.68
pH:
No information found.
% Volatiles by volume @ 21C (70F):
0
Boiling Point:
1635C (2975F)
Melting Point:
630C (1166F)
Vapor Density (Air=1):
4.2
Vapor Pressure (mm Hg):
Not applicable.
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
No information found.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizing agents, strong acids, halogen acids, chlorine, fluorine.
Conditions to Avoid:
Heat, Light.

11. Toxicological Information

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Antimony (7440-36-0)	No	No	None

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia
Antimony (7440-36-0)	Yes	Yes	No	Yes

--------\Chemical Inventory Status - Part 2\----------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Antimony (7440-36-0)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.

Ingredient	CAS	Mass%	Mass%	Mass%	Mass%
Antimony (7440-36-0)	7440-36-0	No	No	Yes	Antimony com

\Federal, State & International Regulations - Part 2\

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Antimony (7440-36-0)	5000	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Pure / Solid)

Australian Hazchem Code: None allocated.
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

Label Hazard Warning:
POISON! DANGER! MAY BE FATAL IF INHALED. CAUSES IRRITATION. TARGET ORGAN(S): Respiratory system, cardiovascular system, eyes, skin.
Label Precautions:
Avoid contact with eyes, skin, clothing.
Do not breathe dust. Keep in tightly closed container. Use with adequate ventilation. Wash thoroughly after handling.
Label First Aid:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Prompt action is essential. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse.
Product Use:
Laboratory Reagent.
Revision Information:
No changes.
Disclaimer:
****

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****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

International Chemical Safety Cards

THALLIUM

ICSC: 0077

THALLIUM
Ramor
Thallium (metal)
Tl
Atomic mass: 204.4

CAS # 7440-28-0
RTECS # XG3425000
ICSC # 0077

EC # 081-001-00-3

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION			
EXPOSURE		PREVENT DISPERSION OF DUST! AVOID ALL CONTACT! AVOID EXPOSURE OF (PREGNANT) WOMEN!	IN ALL CASES CONSULT A DOCTOR!
• **INHALATION**	Abdominal pain. Diarrhoea. Nausea. Vomiting. Loss of hair, pain in legs and chest, and dry skin. Symptoms may be delayed (see Notes).	Local exhaust or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	(Further see Inhalation).	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention.
• **EYES**		Safety goggles, or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	Loss of vision, polyneuritis, psychic disturbances, delirium, convulsions, respiratory paralysis, coma, cardiac disturbances (further see Inhalation).	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Give a slurry of activated charcoal in water to drink. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into sealable containers. Carefully collect remainder, then remove to safe place.	Separated from strong acids, fluorine, other halogens, food and feedstuffs.	Do not transport with food and feedstuffs. T+ symbol R: 26/28-33 S: (1/2-)13-28-45

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0077

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993

THALLIUM

ICSC: 0077

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
BLUISH-WHITE, VERY SOFT METAL. TURNS GREY ON EXPOSURE TO AIR.

PHYSICAL DANGERS:

CHEMICAL DANGERS:
Reacts violently with fluorine. Reacts with other halogens at room temperature.

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV (as Tl (soluble compounds)): ppm; 0.1 mg/m^3 (as TWA) (skin) (ACGIH 1994-1995).
MAK not established.

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation of its aerosol, through the skin and by ingestion.

INHALATION RISK:
Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly especially if powdered.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance may cause effects on the peripheral and the central nervous system, liver and kidneys, the gastrointestinal tract, skin (hair) and the cardiovascular system , resulting in polyneuritis, optic nerve atrophy, encephalopathy, cardiac disturbances, liver and kidney damage, alopecia. Exposure may result in death. The effects may be delayed. Medical observation is indicated.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
The substance may have effects on the vision, nervous system, skin (hair), heart, gastrointestinal tract. Animal tests show that this substance possibly causes toxic effects upon human reproduction.

PHYSICAL PROPERTIES

Boiling point: 1457°C
Melting point: 304°C
Relative density (water = 1): 11.9
Solubility in water: none

ENVIRONMENTAL DATA

The substance is toxic to aquatic organisms. This substance may be hazardous to the environment; special attention should be given to plants. It is strongly advised not to let the chemical enter into the environment because it persists in the environment.

NOTES

Depending on the degree of exposure, periodic medical examination is indicated. The symptoms of acute thallium poisoning (except for gastrointestinal symptoms) do not become manifest until 12 hours to 4 days after exposure. Do NOT take working clothes home. Refer to cards for specific thallium compounds (e.g., thallous sulfate - see ICSC # 0336).

ADDITIONAL INFORMATION

ICSC: 0077 **THALLIUM**

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Attachment 4

Activity Hazard Analysis Table

ACTIVITY HAZARD ANALYSIS FOR MOBILIZATION/SITE PREPARATION				
Principle Steps	**Potential Safety/Health Hazards**	**Hazard Control Measures**	**Personal Protective Equipment**	**Monitoring Devices**
Mobilization/site setup and survey/ layout	Slips, trips, falls	• Clear walkways, work areas of equipment, tools, vegetation, excavated material and debris • Mark, identify, or barricade other obstructions • Ensure footing. Look before you step	—	—
	Electrical shock	• De-energize or shut off utility lines at their source before work begins • Use double insulated or properly grounded electric power-operated tools • Maintain tools in a safe condition • Provide an equipment-grounding conductor program or employ ground-fault circuit interrupters • Use qualified electricians to hook up electrical circuits • Inspect extension cords daily for structural integrity, ground continuity, and damaged insulation • Cover or elevate electric wire or flexible cord passing through work areas to protect from damage • Keep all plugs and receptacles out of water • Use approved waterproof, weather-proof equipment if exposure to moisture is likely • Inspect electrical power circuits prior to commencing work • Follow appropriate lockout-tagout procedures	—	—
	Handling heavy objects	• Observe proper lifting techniques • Obey sensible lifting limits (60 lb maximum per person manual lifting) • Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads	—	—
	Sharp objects	• Wear cut-resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects • Maintain hand and power tools in a safe condition • Keep guards in place during use	Leather gloves with reinforced palm	—

ACTIVITY HAZARD ANALYSIS FOR MOBILIZATION/SITE PREPARATION				
Principle Steps	**Potential Safety/Health Hazards**	**Hazard Control Measures**	**Personal Protective Equipment**	**Monitoring Devices**
Mobilization/site setup and survey/ layout (*cont*.)	High noise levels	• Use hearing protection when exposed to excessive noise levels (greater than 85 decibels, A-scale (dBA) over an 8-hour work period)	Ear plugs	—
	High/low ambient temperature	• Monitor for heat/cold stress • Provide fluids to prevent worker dehydration	Insulated clothing (subject to ambient temperature)	Meteorological equipment

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
• Hand tools	• Daily heavy equipment inspections • Small equipment as specified by operations manual	• Review Site Safety and Health Plan (HASP) Review site-specific Activity Hazard Analysis (AHA) with all task personnel. • Review equipment safety operations manual • Safe driver's training

ACTIVITY HAZARD ANALYSIS FOR WELL INSTALLATION, DEVELOPMENT, AND GROUNDWATER/SOIL SAMPLING				
Task Breakdown	**Potential Hazards**	**Hazard Control Measures**	**Personal Protective Equipment**	**Monitoring Devices**
Well installation, development, and abandonment	Struck by/against flying particles, protruding objects	• Wear hard hats, safety glasses with side shields and steel-toe safety boots at all times • Wear splash shields and safety goggles when cleaning, decontaminating drilling equipment	Hard hat, safety glasses	—
	Handling heavy objects	• Observe proper lifting techniques • Obey sensible lifting limits (60 lb maximum per person manual lifting) • Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads	—	—
	Caught in/between moving parts	• Identify and understand parts of equipment which may cause crushing, pinching, rotating or similar injuries • Assure guards are in place to protect from these parts of equipment during operation • Provide and use proper work gloves when the possibility of pinching, or other injury may be caused by moving/ handling large or heavy objects • Maintain all equipment in a safe condition • Keep all guards in place during use • De-energize and lock-out machinery before maintenance or service	—	—
	Sharp objects	• Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects • Maintain all tools in a safe condition • Keep guards in place during use	Leather gloves, with reinforced palm	—
	Inhalation and contact with hazardous substances	• Provide workers proper skin, eye and respiratory protection based on the exposure hazards present • Review hazardous properties of site contaminants before starting work	Tyvek® coveralls, nitrile gloves	LEL/O_2, photoionization detector (PID)
	High noise levels	• Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period) • Assess noise level with sound level meter if possibility exists that level may exceed 85 dBA time-weighted average (TWA)	Ear plugs	Sound level meter

ACTIVITY HAZARD ANALYSIS FOR WELL INSTALLATION, DEVELOPMENT, AND GROUNDWATER/SOIL SAMPLING				
Task Breakdown	**Potential Hazards**	**Hazard Control Measures**	**Personal Protective Equipment**	**Monitoring Devices**
Well installation, development, and abandonment *(cont.)*	Fire/explosion	• Test atmosphere with combustible gas meter • Eliminate sources of ignition from the work area • Prohibit smoking in well drilling area • Provide ABC (or equivalent) fire extinguishers for all work and flammable storage areas, fuel powered generators and compressors • Store flammable liquids in well ventilated areas • Prohibit storage, transfer of flammable liquids in plastic containers • Post "NO SMOKING" signs • Store combustible materials away from flammables • Store all compressed gas cylinders upright, caps in place when not in use • Separate flammables and oxidizers by 20 feet minimum	—	LEL/O_2
Groundwater/soil sampling	Inhalation and contact with hazardous substances	• Provide workers proper skin, eye and respiratory protection based on the exposure hazards present • Review hazardous properties of site contaminants with workers before sampling operations begin	Latex inner gloves, Tyvek® coveralls, nitrile gloves	LEL/O_2, PID
	Flammable, explosive atmospheres	• Test well head atmosphere for flammable/toxic vapors • Wear proper level of PPE for the type of atmospheric contaminants • Eliminate sources of ignition from the work area • Prohibit smoking in development area	Tyvek® coveralls, nitrile gloves	LEL/O_2, PID
	Struck by/against flying particles, protruding objects, liquid splash	• Wear Hard hats, safety glasses with side shields and steel-toe safety boots at all times • Wear splash shields and safety goggles when sampling, cleaning, decontaminating test equipment	Hard hat, safety glasses	—
	Handling heavy objects	• Observe proper lifting techniques • Obey sensible lifting limits (60 lb maximum per person manual lifting) • Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads	—	—
	Sharp objects	• Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects • Maintain all tools in a safe condition • Keep guards in place during use	Cut resistant gloves	—

ACTIVITY HAZARD ANALYSIS FOR WELL INSTALLATION, DEVELOPMENT, AND GROUNDWATER/SOIL SAMPLING				
Task Breakdown	**Potential Hazards**	**Hazard Control Measures**	**Personal Protective Equipment**	**Monitoring Devices**
Groundwater sampling *(cont.)*	High/low ambient temperature	• Monitor for heat/cold stress • Provide fluids to prevent worker dehydration	Insulated clothing (subject to ambient temperature)	Meteorological equipment

EQUIPMENT TO BE USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
• Drill rig • Hand tools	• Daily heavy equipment inspections • Daily drill rig Inspections • Small equipment as specified by operations manual	• 40 hour Hazardous Waste Training • Review HASP • Review site-specific AHA with all task • personnel. • Review equipment safety operations manual Safe driver's training

ACTIVITY HAZARD ANALYSIS FOR SAMPLING				
Task Breakdown	**Potential Hazards**	**Hazard Control Measures**	**Personal Protective Equipment**	**Monitoring Devices**
Surface water and sediment sampling	Inhalation and contact with hazardous substances	• Provide workers proper skin, eye and respiratory protection based on the exposure hazards present • Review hazardous properties of site contaminants with workers before sampling operations begin	Latex inner gloves, Tyvek® coveralls, nitrile gloves	LEL/O_2, PID
	Flammable, explosive atmospheres	• Test atmosphere for flammable/toxic vapors • Wear proper level of personal protective equipment for the type of atmospheric contaminants • Eliminate sources of ignition from the work area • Prohibit smoking in development area	Tyvek® coveralls, nitrile gloves	LEL/O_2, PID
	Struck by/against flying particles, protruding objects, liquid splash	• Wear hard hats, safety glasses with side shields, and steel-toe safety boots at all times • Wear splash shields and safety goggles when sampling, cleaning, decontaminating test equipment	Hard hat, safety glasses	—
	Handling heavy objects	• Observe proper lifting techniques • Obey sensible lifting limits (60 lb maximum per person manual lifting) • Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads	—	—
	Sharp objects	• Wear cut-resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects • Maintain all tools in a safe condition • Keep guards in place during use	Leather gloves, with reinforced palms	—
	High/low ambient temperature	• Monitor for heat/cold stress • Provide fluids to prevent worker dehydration	Insulated clothing (subject to ambient temperature)	Meteorological equipment
	Underground hazards	• Before beginning intrusive activities, the field supervisor shall ensure that underground utilities are located • Look at underground drawings if available • When underground utilities are exposed, they shall be protected to avoid damage • Personnel on the ground will assist in probing the soils to find the exact location of the lines and will use hand shovels to carefully remove the soil adjacent to the lines • Identify the work area to be sampled	—	—

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
• Hand tools • Monitoring equipment	• Daily heavy equipment inspections • Daily drill rig Inspections • Small equipment as specified by operations manual	• 40-hour Hazardous Waste Training • Review HASP • Review site-specific AHA with all task personnel. • Review equipment safety operations manual • Safe driver training

ACTIVITY HAZARD ANALYSIS FOR SITE RESTORATION				
Principal Steps	**Potential Safety/Health Hazards**	**Hazard Control Measures**	**Personal Protective Equipment**	**Monitoring Devices**
Site restoration and demobilization	Struck by/against heavy equipment, protruding objects	• Use reflective warning vests when exposed to vehicular traffic • Avoid equipment swing areas • Make eye contact with operators before approaching equipment • Wear hard hats, safety glasses with side shields, or splash/face shields and goggles, and steel-toe safety boots at all times • Understand and review hand signals	Warning vests, hard hat, safety glasses	—
	Slips, trips, falls	• Clear, walkways of equipment, tools, debris, other materials • Mark, identify, or barricade other obstructions • Look before you step, ensure safe and secure footing	—	—
	High noise levels	• Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period)	Ear plugs	—
	Handling heavy objects	• Observe proper lifting techniques • Obey sensible lifting limits (60 lb per person for manual lifting) • Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads	—	—
	Contact dermatitis	• Wear PPE to avoid skin contact with contaminated soil, plants, or other skin irritants • Identify and review poisonous plants with workers	Tyvek® coveralls, duct tape bottom of coveralls to boots or latex boot covers	—
	High/low ambient temperature	• Monitor for heat/cold stress • Provide fluids to prevent worker dehydration	Insulated clothing (subject to ambient temperature)	—

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
• Hand tools	• Daily equipment documented inspections	• Review AHA with task personnel • Review equipment safe operating manual • Safe driver's training

Appendix F

Contractor Quality Control Plan

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Acronyms and Abbreviations

CDAP	Chemical Data Acquisition Plan
CQC	contractor quality control
CQCP	Contractor Quality Control Plan
CQCSM	Contractor Quality Control System Manager
GPS	Global Positioning System
LHAAP	Longhorn Army Ammunition Plant
OSHA	Occupational Safety and Health Administration
PPE	personal protection equipment
QAR	quality assurance representative
QC	quality control
HASP	Health and Safety Plan
PSO	Project Safety Officer
TO	task order
USACE	U.S. Army Corps of Engineers

1.0 Introduction

This Contractor Quality Control Plan (CQCP) documents quality control (QC) requirements that will be implemented during investigation and remediation of the multiple sites. This CQCP will be supplemented as needed to address site-specific issues and specialized technologies.

2.0 Contractor Quality Control Plan Purpose and Scope

2.1 Contractor Quality Control Plan Purpose

This CQCP establishes procedures that enable common project field activities to be completed successfully and documents QC requirements for services provided by the contractor and its subcontractors during various project activities at multiple sites at Longhorn. This plan describes requirements for organizing, planning, performing, reviewing, documenting, and reporting activities that may affect the quality of the work. This CQCP applies the specific requirements of the contractor's Contractor Quality Control (CQC) System to this project by establishing controls for:

- QC staff organization and authority
- Workmanship
- Construction activities for major definable features of work
- Records
- Inspections and tests
- Documentation
- Audits
- Subcontractor performance

This plan references standard field procedures, policies, regulations, and practices required to implement the work. A controlled copy of applicable Field Procedures (**Appendix D**) will be available as a reference document.

2.2 Contractor Quality Control Plan Scope

This CQCP is applicable to work that may be required by the contract including the major definable features of site work (or major project tasks) identified below:

Task 1 – Mobilization and Site Setup

Task 2 – Monitoring Well/Compliance Well Installation

Task 3 – Survey of Monitoring Well Locations

Task 4 – Groundwater Sampling

Task 5 – Soil Sampling

Task 6 – Surface Water/Sediment Sampling

Task 7 – Investigation-Derived Waste Management

2.3 Acceptance of Contractor Quality Control Plan

Work within the scope of this plan will not be started prior to providing this CQCP to USACE, unless otherwise permitted by USACE. Any proposed changes to this CQCP will require notification to USACE in writing. Proposed changes are subject to the approval of USACE.

3.0 Organization and Responsibilities

3.1 Personnel and Structure

The Contractor Quality Control System Manager (CQCSM) coordinates implementation of this CQCP with the Site Superintendent, Remediation Manager, and the Project Manager.

3.2 Duties and Responsibilities

The duties and responsibilities of personnel with regard to the CQC program are briefly outlined below. Duties and responsibilities of health and safety personnel are presented in **Appendix E**, Health and Safety Plan (HASP).

Project Manager: The Project Manager is responsible for all activities on the project, and directs and monitors the Site Superintendent in planning, coordinating, and controlling the work. The Project Manager has overall responsibility for establishing the CQCP and for its implementation, and he has the authority to access the available resources required to ensure compliance with the contract requirements.

Remediation Manager: The Remediation Manager will direct investigation and remediation activities and will be responsible for the overall preparation of submittals related to investigation and remediation activities. This individual will direct the technical staff during daily operations. He/she will coordinate and supervise human health/ecological risk assessment activities, feasibility studies, and decision documents and will ensure that regulatory requirements are met and will support the Project Manager with regulatory interaction. Other responsibilities include overseeing drilling, geologic interpretation, and required modeling.

Project Hydrogeologist: The Project Hydrogeologist reports to the Remediation Manager and is responsible for site investigation technical assurance. This individual will oversee the site investigation activities. The project hydrogeologist has the following duties and authorities:

- Plan and oversee site drilling and monitoring well installation
- Select the well screening intervals
- Perform and/or oversee the purging and sampling of newly installed monitoring wells and existing monitoring wells
- Perform and/or oversee the preservation, packaging, and shipping of samples to an off-site, fixed laboratory for environmental analyses
- Ensure documentation accuracy, completeness, and consistency among field team members
- Stop work that deviates from the contract documents or is otherwise nonconforming or unsafe.

CQCSM: The CQCSM is responsible for the overall management of the project CQC program during field activities. Depending on the extent of on-going field work, the CQCSM may perform dual roles of CQC management and site safety management. When serving as CQCSM/Project Safety Officer (PSO), this individual receives administrative and day-to-day direction from the Remediation Manager. This individual is responsible to the contractor Program QC Manager for direction on matters that may affect the QC requirements for the project and to the contractor Program Health and Safety Manager for safety-related matters. The CQCSM/PSO is assigned the following duties:

- Monitor and verify that the work is performed in accordance with the contract requirements
- Review and verify the disposition of discrepancy and corrective action reports
- Perform QC inspections and surveillance, and report daily on project QC
- Monitor project submittals in accordance with submittal register requirements
- Submit QC reports to the USACE Field Representative/Quality Assurance Representative on a daily basis, unless other arrangements are agreed to by the USACE

The CQCSM has the authority to reject materials and workmanship that do not comply with project requirements, and to stop nonconforming work activities (see **Figure 3-1**). This individual will also verify conformance with the HASP.

Site Superintendent: The Site Superintendent is responsible to the Remediation Manager and the Project Manager for day-to-day supervision of the on-site remedial activities. The Site Superintendent's involvement in QC includes communicating the necessity of quality workmanship in all remedial activities to the on-site project staff.

Program QC Manager: The Program QC Manager is responsible to review, monitor, and report the conformance to QC requirements set forth in the CQCP. He may also advise the CQCSM on QC methods and practices. He will maintain a record of his quality monitoring activities and will inform the CQCSM of his monitoring activities. He shall also be responsible for performing periodic internal audits, and reporting his findings to the CQCSM.

Subcontractors: The contractor assumes overall responsibility for conformance to the quality requirements for the subcontracted items and services. Subcontractors are responsible to the Project Manager and Remediation Manager for completing the portion of work assigned to them, and to the CQCSM for CQCP activities. They shall verify that their construction and materials comply with the requirements of the contract plans and specifications. Subcontractors include organizations supplying quality-related items or services to the project.

3.3 Qualification of Personnel

Contractor personnel assigned to the project are qualified to perform the tasks to which they are assigned. The Project Manager and the Remediation Manager will appraise the qualification of professional and/or

technical personnel assigned to the project. The appraisal will include the comparison of the requirements of the job assignment with the relevant experience and training of the prospective assignee.

To: To Be Determined

From: Contractor QC Manager

Date: November 15, 2005

Subject: Contractor Quality Control System Manager, Letter of Authority

U.S. Army Corps of Engineers, Tulsa District

LHAAP 35B(37) and LHAAP 67

This letter describes the responsibilities and authority delegated to you in your capacity as the Contractor Quality Control System Manager for Sites LHAAP 35B(37) and LHAAP 67 at Longhorn Army Ammunition Plant, Karnack, Texas.

In this position, you are responsible for the implementation and enforcement of the CQCP and site specific addenda. You will use the plan to verify that the quality of materials, workmanship, operations, and safety monitoring conforms to the Work Plan, its appendices, and addenda.

Your responsibilities include identifying and reporting quality problems, rejecting nonconforming materials, initiating corrective actions, and requesting solutions for nonconforming activities. You have the authority to control or stop project activities until satisfactory disposition and implementation of corrective actions are achieved. Detailed responsibilities and guidelines are given in the Work Plan, its appendices, and addenda.

Figure 3-1

Letter of Authority

4.0 Contractor Quality Control Systems

4.1 Control Measures

The CQCP provides measures to verify and document that the work performed complies with the requirements specified in the contract documents. These measures include:

- CQC inspections
- Document control
- Submittals
- Completion inspection
- Records

Procedures for implementing the above measures are included throughout the CQCP. The CQCP may be supplemented by additional guidelines or instructions for implementing the work and/or verifying compliance with the contract requirements.

4.2 Quality Control Monitoring

The project CQC program is monitored to verify that the program is in compliance with the CQCP. Monitoring activities are performed by the contractor Program QC Manager, or his representative, and include the review of daily QC reporting and instructions, or directions given to the CQCSM on QC matters. If required, an assessment of the project's CQC system is performed. If performed, the assessment includes the following items:

- Subcontractor performance
- Field operation and records
- CQC and health and safety inspections, testing, and records
- Document control
- Training records

4.3 Quality Control Testing

As applicable, the CQCSM monitors the equipment/materials testing firm and/or analytical laboratory activities to verify the following:

- Execution of required tests
- Location of tests
- Timely and accurate reporting of test results
- Correct frequency of tests
- Completeness of documentation

5.0 Inspection Plan

QC inspections include inspection of equipment, materials, testing procedures, documentation/submittals, and workmanship before, during, and after each definable feature of work. QC inspections are performed by the CQCSM in accordance with the Three-Phase Contractor Quality Control System. The CQCSM gives the USACE Quality Assurance Representative advance notification (at least 24 hours) of formal inspections.

Definable features of site work (or major work tasks) for which QC inspections will be performed are addressed below.

Definable Features of Site Work:

Task 1 – Mobilization and Site Setup

Task 2 – Monitoring Well/Compliance Well Installation

Task 3 – Surveying of Monitoring Well Locations

Task 4 – Groundwater Sampling

Task 5 – Soil Sampling

Task 6 – Surface Water/Sediment Sampling

Task 7 – Investigation-Derived Waste Management

Other site remediation activities that constitute definable features of site work will be defined within site-specific addenda to the work plan. Those addenda will also identify related QC inspection requirements.

5.1 Task 1 – Mobilization and Site Setup

Following approval of the Work Plan, the contractor will mobilize the necessary personnel and equipment to prepare the site for investigation activities. Using the Three-Phase CQC system, the CQCSM will monitor this task to affirm the following:

- Site personnel have the necessary Occupational Safety and Health Administration (OSHA) training and medical surveillance statements/certifications
- Heavy equipment (e.g., drilling rig) has undergone safety and preventive maintenance checks, and is suitable for the task for which it will be used.
- Measuring and test equipment has undergone calibration and/or calibration checks to assure accuracy and precision.
- The project team understands the investigation/remediation requirements.
- Site personnel have received a HASP by the PSO and have acknowledged this review by signing the HASP acknowledgment form.

- Installed government property plan (when applicable) is reviewed and implemented for the equipment to be installed on site.
- Work zones and decontamination facilities are established in accordance with the HASP.
- Material storage areas are kept orderly.
- Site security measures are adequately maintained to prevent unauthorized access.
- Work zones are clearly demarcated using temporary barricading or fencing as required.
- Once the site is mobilized and set up, field activities will commence.

5.2 Task 2 – Monitoring Well/Compliance Well Installation

Groundwater monitoring well construction materials and specifications are provided in **Appendix D**. The specifications conform to the following:

- Engineering and Design – *Monitoring Well Design, Installation, and Documentation at Hazardous, Toxic, and Radioactive Waste Sites*, EM 1110-1-4000 (USACE, 1998)
- Technical Requirements – *Locations and Standards of Completion for Wells*, Texas Administrative Code Title 16, Part 4, Chapter 76, Section 76.1000 (State of Texas, 2001)
- Monitor-Well Construction Specifications, Texas Administrative Code Title 30,
- Part 1, Chapter 330, Subchapter I, Section 330.242 (State of Texas, 1993)

Using the Three-Phase CQC system, the CQCSM will monitor this task to affirm the following:

- Drilling locations are marked/staked in the field and verified against those in the approved drawings prior to well drilling.
- Underground utilities that transect the sites are located and marked, and their depths are known, so as to avoid damaging them during drilling activities.
- Digging permits (when applicable) are obtained prior to the start of work.
- Qualified drilling firms are procured to perform this task.
- The driller is licensed by the Texas Department of Licensing and Regulation and maintains a current license, in good standing.
- Personnel associated with this task have applicable OSHA training and medical surveillance certifications.

- The CQCSM/PSO has briefed personnel on task-specific hazards and the appropriate personal protection equipment (PPE) to be worn and performed a job safety analysis for well drilling and installation.
- Drilling personnel have reviewed the HASP and signed the acknowledgement form.
- Task crews undergo preparatory briefing to verify their understanding of the scope of work and health and safety issues.
- Drilling team leader (i.e., the contractor Hydrogeologist) instructs the drilling crew of the depth of the well and its construction, and documents those instructions in the field notes.
- Drilling team leader documents the suitability of the construction materials.
- Construction materials meet specifications, are contaminant-free, and shipped/received in good order.
- Well construction details are properly logged on forms and in the site logbook.
- Incomplete construction is protected from surface-water infiltration.
- Completed construction conforms to work plan requirements, specifications and drawings for well installation and surface completion.
- Generated soil cuttings, decontamination fluids, and contaminated PPE are handled and disposed of in accordance with the waste disposal requirements described in **Section 1.7** of **Appendix C** and **Attachment 10** of **Appendix D**, and state and federal regulations.
- Adjacent ground surfaces are protected from spillage during drilling operations.
- Well filter pack, bentonite, and grout volumes are calculated and documented in the field log book.
- Bentonite seal and grout is allowed to hydrate/cure sufficiently prior to beginning well development.
- Monitoring well development equipment, methods, and stabilization measurements are performed in accordance with the Work Plan and Chemical Data Acquisition Plan (CDAP).
- Well development fluids are handled, characterized, and disposed of in accordance with the requirements addressed in Task 7 of the Work Plan, and state and federal regulations. Field screening requirements are listed in **Section 5.8.1** of this CQCP. Additional information on field screening procedures is found in **Appendix D**, **Attachment 1**.
- Disturbance of property surrounding drilling site is minimized. Ground water sampling will commence following monitoring well installation and development.

5.3 Task 3 – Surveying

Using the Three-Phase CQC system, the CQCSM will monitor this task to affirm the following:

- A qualified land surveyor licensed by the State of Texas is employed to perform well surveying.
- Survey datum (vertical and horizontal) used is consistent with the work plan requirements and/or historical datum.
- Survey team undergoes preparatory meeting to verify their understanding of the scope of work.
- Surveying equipment is operative and properly calibrated.
- Instrument calibration is performed per manufacturer instructions.
- Survey points are clearly marked or labeled (e.g., notch in the top of casing and/or brass surveying marker embedded in surface pad).
- Field documentation is legible, accurate, and complete.
- Worker protection is adequate for the associated task hazards. For identifying locations of soil samples and limits of excavation, a Global Positioning System (GPS) may be used in lieu of land surveying. Using the Three-Phase CQC system, the CQCSM will monitor this task to affirm the following:
- Survey team undergoes preparatory meeting to verify their understanding of the scope of work.
- Surveying equipment is operative and properly calibrated.
- Instrument calibration is performed per manufacturer instructions.
- Survey points are clearly marked or labeled
- Field documentation is legible, accurate, and complete.
- Worker protection is adequate for the associated task hazards.

5.4 Task 4 – Groundwater Sampling

Following the installation of groundwater monitoring wells, the contractor will collect groundwater samples for laboratory analyses. Using the Three-Phase CQC system, the CQCSM will monitor this task to affirm the following:

- Sampling personnel have reviewed the CDAP and Work Plan and understand the scope of work.
- The CQCSM/PSO has briefed sampling personnel on task hazards and the appropriate PPE level before sampling begins.

- A sampling equipment checklist is developed for this task and is reviewed with sampling personnel before sampling begins.
- Well depth and depth-to-water measurements are performed consistently from a common location at top-of-well casing (e.g., notch in top of casing or northern lip of casing).
- Well water volume is calculated accurately using well measurements.
- Well is purged of the required quantity of well water and water quality is stabilized as defined by the CDAP prior to sample collection.
- Purged water is contained in drums and managed in accordance with Work Plan waste handling requirements. Field screening procedures is found in **Appendix D**, **Attachment 1**.
- The specified sampling equipment and materials are used for sample collection.
- The sampling team leader (i.e., the contractor Hydrogeologist) has instructed samplers on the sampling procedures and protocols and has assigned specific duties and responsibilities to each team member.
- Sampling equipment decontamination procedures are performed according to the CDAP.
- Sampling documentation procedures in the CDAP are followed and field documentation is legible, accurate, and complete.
- Quality assurance and QC samples are collected at prescribed frequencies in accordance with CDAP protocols and procedures.
- Sample labels, custody seals, and chain-of-custody forms contain pertinent sampling and analytical information before samples are packaged and shipped off site for laboratory analysis.
- Sampling and analytical records are maintained in the project file (in secured area).
- All field instruments are calibrated at the start of the testing day.

5.5 Task 5 – Soil Sampling

Using the Three-Phase CQC system, the CQCSM will monitor this task to affirm the following:

- Sampling personnel have reviewed the CDAP, Work Plan, and any related documents regarding the scope of work.
- The CQCSM/PSO has briefed sampling personnel on task hazards and the appropriate PPE level before sampling begins.
- A sampling equipment checklist is developed for this task and is reviewed with sampling personnel before sampling begins.
- The specified sampling equipment and materials are used for sample collection.

- Sampling equipment decontamination procedures are performed according to the CDAP.
- Sampling documentation procedures in the CDAP are followed and field documentation is legible, accurate, and complete.
- Quality assurance and QC samples are collected at prescribed frequencies in accordance with CDAP protocols and procedures.
- Sample labels, custody seals, and chain-of-custody forms contain pertinent sampling and analytical information before samples are packaged and shipped off site for laboratory analysis.
- Sampling and analytical records are maintained in the project file (in secured area).
- All field instruments are calibrated at the start of the testing day.

5.6 Task 6 – Surface Water/Sediment Sampling

Using the Three-Phase CQC system, the CQCSM will monitor this task to affirm the following:

- Sampling personnel have reviewed the CDAP, Work Plan, and any related documents regarding the scope of work.
- The CQCSM/PSO has briefed sampling personnel on task hazards and the appropriate PPE level before sampling begins.
- A sampling equipment checklist is developed for this task and is reviewed with sampling personnel before sampling begins.
- The specified sampling equipment and materials are used for sample collection.
- The sampling team leader (i.e., the contractor Hydrogeologist or Sample Technologist) has instructed samplers on the sampling procedures and protocols and has assigned specific duties and responsibilities to each team member.
- Sampling equipment decontamination procedures are performed according to the CDAP.
- Sampling documentation procedures in the CDAP are followed and field documentation is legible, accurate, and complete.
- Quality assurance and QC samples are collected at prescribed frequencies in accordance with CDAP protocols and procedures.
- Sample labels, custody seals, and chain-of-custody forms contain pertinent sampling and analytical information before samples are packaged and shipped off site for laboratory analysis.
- Sampling and analytical records are maintained in the project file (in secured area).
- Field instruments are calibrated at the start of the testing day.

5.7 Task 7 – Investigation-Derived Waste Management

Using the Three-Phase CQC system, the CQCSM will monitor this task to affirm the following:

- Waste generated during the project activities will be segregated by type (e.g., soil cuttings, PPE, well development and purging liquids, trash/debris) and stored in approved 55-gallon drums or other containers.
- Waste containers are labeled with a waterproof marker according to the Work Plan, indicating the content, accumulation date, waste code(s) (if known) and pertinent analytical information.
- Waste handling activities are documented in the field logbook and a tracking log is prepared that indicates waste type, point of waste generation (i.e., well number) container size and type, accumulation date, storage location, disposal destination, transporter name, shipping paper/manifest number, and transportation and disposal dates.
- Waste containers are leak proof and stored in a secure storage area.
- Waste storage area is clearly demarcated using barricade tape and/or temporary barricade fencing, as required.
- Waste container and storage area inspections are performed on a weekly basis (at a minimum) and documented in the field logbook and/or in a standard inspection form.

5.7.1 Field Screening

The soil and groundwater samples will be screened in the field for confirmation and will be sent to a laboratory for confirmation analyses. Using the Three-Phase CQC system, the CQCSM will monitor this task to affirm the following:

- Sampling personnel have reviewed the CDAP and understand the scope of work.
- The CQCSM/PSO has briefed sampling personnel on task hazards and the appropriate PPE level before sampling screening begins.
- A sampling equipment checklist is developed for this task and is reviewed with sampling personnel before sampling begins.
- Field screening instrumentation is calibrated before the start of the work and at the end of the sampling day.
- Calibrated equipment will be uniquely identified by using either the manufacturer’s serial number or other means.

Calibration records traceable to the equipment will be readily available for reference. In addition, the results of calibrations and records of repairs will be recorded in a logbook.

5.8 Task 8 – Monitoring Well Abandonment

The contractor will abandon monitoring wells that were installed during any investigation and remediation activities as needed. Using the Three-Phase CQC system, the CQCSM will monitor this task to affirm the following:

- Preparatory meetings are held with work crews to discuss the regulatory requirements for well abandonment.
- Personnel associated with this task have applicable OSHA training and medical surveillance certifications.
- Worker protection is adequate for the associated task hazards.
- Abandonment activities will employ a well driller licensed in the state of Texas.
- Well abandonment materials and equipment are suitable and approved for use prior to starting the work.
- Well locations and top of casing elevations are verified and recorded in a logbook prior to abandonment.
- Required agency permits and/or notifications are completed prior to starting abandonment activities.
- Waste generated during abandonment activities is handled and disposed according to the waste management plan.
- Quantity and depth measurements are made and recorded accurately the amount of grout used, depth below ground surface of the top of the grout once the grout has settled and hardened, and the amount of cover soil placed and compacted above the top of the grout to re-establish a level ground surface.
- A multi-purpose completion report and/or well abandonment log is accurately completed for each abandoned well and submitted to the State of Texas. Copies are maintained in the project file until submitted to the USACE with the final report.

6.0 Document Control

6.1 Documentation

The CQCSM maintains current records of QC activities and tests performed, including those of suppliers and subcontractors. The records will be maintained as evidence that required control measures and tests have been performed, and indicate the results of the activities. Photographic documentation is also maintained for this project in accordance with **Section 6.4** of this plan.

6.2 Daily CQC Report

A Daily CQC Report is completed and maintained by the CQCSM using a standard form. The form is provided in **Attachment 1**. As applicable, standard forms used to document safety, technical, and operations aspects of daily field activities will be attached to the Daily CQC Report.

6.3 Daily Weather Conditions/Lost Time Report

A Daily Weather Conditions/Lost Time Report is prepared daily by the CQCSM. A report form is provided at the end of this section. Lost time will be logged into the report in increments of 25% (in other words, 0%, 25%, 50%, 75% or 100%). The amount of lost time incurred will be agreed upon and initialed by the CQCSM and the Corps of Engineers' quality assurance representative (QAR) or Technical Manager overseeing the project work. Upon completion of the report for the specified period of time, one copy of the report should be submitted to the QAR/Technical Manager once each month during fieldwork and an extra copy should be maintained by the CQCSM for future reference.

6.4 Photographs

The CQCSM will photograph the project activities. Photographs will be taken on a regular basis during the course of the project to document the work, events, and equipment used. The frequency and number of pictures taken will depend upon the activities occurring and the amount of documentation needed. The Project Manager or Remediation manager will use judgment to determine the frequency and number of pictures taken; however, a sufficient quantity of pictures will be taken to effectively document the TO.

Pictures will be taken using 35mm film or digital medium (using a digital camera or video camera). Photos will be documented on a project log (see standard form in **Attachment 1**), which includes the photo number, date, time, description of the task depicted, and the view direction (e.g., facing northwest). A copy of the photo log, pictures, slides/videos, and digital media will be maintained in Project Files.

6.5 Review of Vendor Submittals

Vendors and subcontractors are required to expeditiously submit items such as drawings, test data, and specifications to the contractor for review to enable timely submittals to USACE. The contractor technical and CQC personnel review each submittal for compliance with contract documents. If acceptable, the item is stamped or indicated as such, and forwarded to USACE for review and acceptance.

If unacceptable, errors or deficiencies are identified and returned to the vendor or subcontractor for correction. The corrected document is resubmitted to the contractor for review until it meets contract requirements.

6.6 Government Property Accounting and Control

If applicable, the contractor will acquire, manage, and dispose of government property. At the completion of the project, all real property (removed and/or installed) will be listed on a Property Inventory Sheet.

6.7 Submittals

The Project Manager, Remediation Manager, the Program Controls Engineer, and the CQCSM are responsible for project submittals. A submittal register prepared for this project is given in **Figure 6-1**.

SUBMITTAL REGISTER																									
TITLE AND LOCATION: **Longhorn Army Ammunition Plant –**														CONTRACTOR:											
				TYPE OF SUBMITTAL									CLASSI-FICATION			CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVT. ACTION		
TRANSMITTAL NO	ITEM NO	SPEC PARA NO	DESCRIPTION OF ITEM SUBMITTED	DATA	DRAWINGS	INSTRUCTIONS	SCHEDULES	STATEMENTS	REPORTS	CERTIFICATES	SAMPLES	RECORDS	INFO ONLY	GOVT. APPROVED	REVIEWER	SUBMIT	APPROVAL NEEDED BY	MAT'L NEEDED BY	CODE	DATE	SUBMIT TO GOVT	CODE	DATE	REMARKS
a.	b.	c.	d.	e.	f.	g.	h.	i.	j.	k.	l.	m.	n.	o.	p.	q.	r.	s.	t.	u.	v.	w.	x.	
			Project Work Plan (and Appendices)		X	X	X							X		Per Project Schedule								
			Cost/Schedule Reports										X			Monthly								
			Site Personnel OSHA Medical & Training Certificates							X		X	X			Prior to start of work								
			CQC and Safety Reports						X				X			Daily								
			Well Construction Methods/Specifications	X	X								X			Per Work Plan								
			Transporter ID, Insurance Cert							X			X			Prior to subcontract award								
			Manifests/Shipping Papers									X	X			Prior to shipment								
			Disposal Facility ID	X									X			Prior to subcontract award								
			Environmental Inspection Sheets									X	X			Per Work Plan								
			Groundwater Sampling Results	X					X				X			Upon data evaluation and with Background Groundwater Report								
			Survey Drawings (As-built)		X									X		Upon completion								
			Well Construction Completion Forms									X		X		To State of Texas within 30 days of construction completion and with Background Groundwater Report								
			Well Abandonment Forms									X		X		To the State of Texas within 30 days of construction completion								
			Drilling Logs & Groundwater Sampling Forms									X				With Daily QC Reports and Background Groundwater Report								
			Background Groundwater Report	X	X				X			X		X		Per Project Schedule								

Figure 6-1
Submittal Register

7.0 Subcontractor Quality Control

Subcontractors for this project are responsible for compliance with the QC requirements of their respective subcontract. Subcontractors include organizations supplying quality related items or services to the project. The contractor assumes overall responsibility for conformance to the quality requirements for the subcontracted items and services.

Subcontract documents should include the requirements for personnel qualifications, technical performance levels, QC procedures, acceptability criteria, and documentation. The CQCSM, or his designee, reviews the subcontract procurement documents to verify that the QC requirements are communicated to the subcontractor.

Each subcontractor is required to identify an adequately qualified individual within the organization to perform QC duties. The qualifications of this individual are submitted to the CQCSM for review and approval. The CQCSM coordinates the QC functions with the designated subcontractor QC representative. The Project Manager, or his authorized designee, assists the CQCSM in managing subcontractor QC.

The CQCSM is responsible for the performance of inspections, surveillance, document reviews, audits, and other QC functions to verify compliance with the subcontract requirements. These activities are documented on inspection reports, checklists, audit reports, field logs, or other forms appropriate to the function performed.

For field operations, the CQCSM performs QC inspections before, during, and after the subcontractor activities, to the extent required, to verify that the subcontractor is in compliance with the QC requirements of the contract and the applicable subcontract documents.

Audits of subcontractor activities are conducted by the CQCSM as necessary to verify compliance with the CQCP. Objective evidence of conformance to the subcontract documents is reviewed during the audits.

8.0 References

Shaw Environmental and Infrastructure, Inc. (Shaw), 2005, *Standard Operating Procedures* (Intranet), (Headquarters) Baton Rouge, Louisiana, November 9.

Shaw Environmental and Infrastructure, Inc. (Shaw), 2006, *Final Installation-Wide Work Plan, Longhorn Army Ammunition Plant, Karnack*, Texas, Houston, Texas.

State of Texas, 2001, Administrative Code Title 16, Part 4, Chapter 76, Section 76.1000, *Technical Requirements – Locations and Standards of Completion for Wells*, Austin, Texas.

State of Texas, 1993, Texas Administrative Code Title 30, Part 1, Chapter 330, Subchapter I, Section 330.242, *Monitor-Well Construction Specifications*, Austin, Texas.

U.S. Army Corps of Engineers, 1998, *Engineering and Design - Monitoring Well Design, Installation, and Documentation at Hazardous, Toxic, and Radioactive Waste Sites*, EM 1110-1-4000.

Attachment 1

Field Forms

- Preparatory Inspection Check List
- Initial/Follow-Up Inspection
- Final Inspection Form(s)
- Daily Contractor Quality Control Report
- Daily Weather Conditions/Lost Time Report
- Photo Log Form
- Corrective Action Report

PREPARATORY INSPECTION CHECKLIST

Project Name:_____
Project Location_____
Project No.:_____

Plan or Specification Title/Section:_____ Drawing Nos.:_____

A. Personnel present *(use back of form to list additional personnel)*

Name	Position	Company

B. Submittals involved: *(use back of form to list additional submittals)*

Number and Type	Description	Indicate Contractor of Government Approval

C. Are all materials on hand and in accordance with approvals: ☐ Yes ☐ No
List all deficiencies:

D. Test required: (list/reference all quality control tests with their required frequencies):

E. Accident prevention preplanning (list all health and safety items discussed):

CQCSM: _____

INITIAL/FOLLOW-UP INSPECTION FORM

Project Name:_____
Project Location_____
Project No.:_____

(check one)

INITIAL PHASE CHECK LIST ☐ OR
FOLLOW-UP PHASE CHECK LIST ☐

Plan or Specification Section:_____ Drawing Nos.:_____

A. Personnel present:

Name	Position	Company

B. Materials are in strict conformance with contract specifications: ☐ Yes ☐ No
If no, explain:

C. Work being performed is in strict conformance with contract specifications: ☐ Yes ☐ No
If no, explain:

D. Workmanship is acceptable: ☐ Yes ☐ No
If improvement is needed, explain:

CQCSM: _____

FINAL INSPECTION FORM

Project Name:_____
Project Location_____
Project No.:_____

FINAL INSPECTION FORM

Plan or Specification Title/Section:_____Drawing Nos.:_____

Inspected Work (list feature(s) of work inspected):

1. 6.
2. 7.
3. 8.
4. 9.
5. 10.

Performance Specification by Contract Delivery Order Reference	Status of Inspection

I certify that the work inspected is complete and meets the performance specifications cited above and that all material and equipment used and work performed was completed in accordance with approved plans and work instructions and meets contract delivery order requirements.

CQCSM _____ **Date**_____/_____/_____

Site Manager_____ **Date**_____/_____/_____

FINAL INSPECTION FORM

Project Name:_____
Project Location_____
Project No.:_____

FINAL INSPECTION FORM

Plan or Specification Title/Section:_____Drawing Nos.:_____

Inspected Work (list feature(s) of work inspected):

1. 6.
2. 7.
3. 8.
4. 9.
5. 10.

Performance Specification by Contract Delivery Order Reference	Status of Inspection

I certify that the work inspected is complete and meets the performance specifications cited above and that all material and equipment used and work performed was completed in accordance with approved plans and work instructions and meets contract delivery order requirements.

CQCSM _____ **Date**_____/_____/_____

Site Manager_____ **Date**_____/_____/_____

DAILY CONTRACTOR QUALITY CONTROL REPORT

Project Name:_____
Project Location:_____
Report No.:_____

WEATHER: ( ) Clear ( ) P. Cloudy ( ) Cloudy
Wind_____
Temperature: High _____ Low_____
Precipitation: Today_____ Previous Period (i.e., weekend)_____
Site Conditions:_____
Lost Time Due to Inclement Weather: _____%

PRIME CONTRACTOR/SUBCONTRACTORS AND AREAS OF RESPONSIBILITY/LABOR COUNT:
(Include number, trade, hours, employer, location, and description of work.)
a.

b.

c.

d.

e.

f.

WORK PERFORMED: (Include location and description of work performed including equipment used. Refer to work performed by prime and/or subcontractors as previously designated by letter above. Attached subcontractor daily activity reports when applicable):

MATERIALS AND/OR EQUIPMENT DELIVERED: (Include a description of materials and/or equipment, quantity, date/hours used, date of safety check, and supplier)

RESULTS OF SURVEILLANCE: (Include satisfactory work completed or deficiencies with action to be taken.)
a. Preparatory Inspection: (Attach Minutes)

b. Initial Inspection: (Attach Minutes)

c. Follow-up Inspection: (List results of inspection compared to specification requirements.)

d. Safety Inspection: (Include safety violations and corrective actions taken.)

OFF-SITE SURVEILLANCE ACTIVITIES: (Include action taken.)

QC TESTS PERFORMED AND RESULTS: (As required by plans and/or specifications.)

VERBAL INSTRUCTIONS RECEIVED OR GIVEN: (List any instructions received from government personnel or given by Shaw on construction deficiencies identified, required retesting, etc., and the corresponding action to be taken.)

CHANGED CONDITIONS/DELAYS/CONFLICTS ENCOUNTERED: (List any conflicts with the delivery order [i.e., Scope of Work and/or drawings], delays to the project attributable to site, and weather conditions, etc.)

SUBMITTALS REVIEWED: (Include submittal number, specification reference, and name of submitter.)

MEETINGS: (List the meetings, i.e., Health and Safety, Site Operations, Cost/Schedule, etc.)

VISITORS:

REMARKS: (Any additional information pertinent to the project not defined by the previous entries.)

CONTRACTOR'S VERIFICATION: The above report is complete and correct. All material and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications except as noted above.

CQCSM (or designee)

_____/_____/_____
Date

DAILY WEATHER CONDITIONS/LOST TIME REPORT

DAILY WEATHER CONDITIONS/LOST TIME REPORT FOR WEEK/MONTH OF_____

Contract No.:_____ Delivery Order No.:_____ Project:_____

Contractor:_____

DAY	DATE	W/C. L/T	% LOST	ACTIVITY DELAYED	REMARKS	CONCUR	
						CQCR	QAR
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							

Weather Conditions (W/C): R - Precipitation, C - Extreme Temperature, M - Muddy Site Conditions W - Extreme Winds
Other Lost Time Conditions (L/T): D - Demobilized, S - Standby

Representative of the Contractor_____

Representative of the Government_____

PHOTO LOG FORM

PROJECT PHOTO LOG

Project Name:_____ **Project Location:**_____ **Project No.:**_____

Photo No.	Date	Time	Task and Description	View Direction

00107922

CORRECTIVE ACTION REPORT

Project Name:_____
Project Location:_____
Report No.:_____

DESCRIPTION OF PROBLEM:_____

PERSONNEL RESPONSIBLE FOR INVESTIGATIVE PROCESS:_____

RECOMMENDED CORRECTIVE ACTIONS:_____

PERSONNEL RESPONSIBLE FOR IMPLEMENTATION OF CORRECTIVE ACTIONS:_____

RESULTING ACTIONS AND EFFECTIVENESS OF THOSE ACTIONS:_____

PERSONNEL RESPONSIBLE FOR MONITORING EFFECTIVENESS OF CORRECTIVE ACTIONS:_____

FINAL DISPOSITION APPROVED BY:

Name:_____ Title:_____

Date:_____

Name:_____ Title:_____

Date:_____

COPIES TO:

Appendix G

Chemical Data Acquisition Plan

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Attachment 1 Analytical Methods and Constituent/Detection Limits

Acronyms and Abbreviations

^{o}C	degrees centigrade
CAR	Corrective Action Report
CDAP	Chemical Data Acquisition Plan
COC	chain-of-custody
CQCSM	Contractor Quality Control System Manager
EDT	Electronic Data Transfer
GC	gas chromatography
GC/MS	gas chromatography/mass spectrometer
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LHAAP	Longhorn Army Ammunition Plant
LQMP	Laboratory Quality Management Plan
mL	milliliter
MS	matrix spike
MSD	matrix spike duplicate
PARCC	precision, accuracy, representativeness, comparability & completeness
PID	photoionization detector
ppb	parts per billion
ppm	parts per million
PWS	Project Work Statement
QA	quality assurance
QC	quality control
RPD	relative percent difference
SQCR	Sample Quality Control Report
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

1.0 Introduction

This Chemical Data Acquisition Plan (CDAP) describes the analytical and field activities, as well as the quality assurance (QA)/quality control (QC) protocols associated with the site investigations, remediation, and site restoration activities at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas. The figures referenced in this CDAP are included at the end of each respective section.

The ultimate accuracy of any data generation begins with a sampling and measurement procedure that is fully conceived and implemented. This CDAP is designed to delineate the methods that will be used to accomplish the chemical data quality objectives. Data quality objectives include the data quality indicators of precision, accuracy, and completeness addressed in **Section 7.1**. A conscious effort has been made to provide relevant information with minimal duplication of information that is discussed in detail in other project planning documents.

Sampling and analytical activities will be documented in accordance with this plan. Analytical methods and constituents of potential concern and their detection limits are provided in **Attachment 1**. A database will be utilized for data management and to produce data summary tables.

2.0 Project Description

2.1 Site Description

LHAAP is located in central-east Texas, in Harrison County, between State Highway 43 at Karnack, Texas, and Caddo Lake. **Figures 2-1 and 2-2** of the LHAAP-35B(37) and LHAAP-67 Remedial Design show the location of LHAAP and the location of the two sites within the larger LHAAP site.

2.2 Project Objective

The objective of this installation-wide project is to focus on an expedited path toward site closure and bring as many sites to closure or, where needed, into a long term monitoring or long term operation stage as early as possible. In order to accomplish these objectives, more investigations are needed to delineate the nature and extent of contamination and initiate the appropriate remediation at designated sites.

3.0 Project Organization and Responsibility

The project management organization is based on specific project requirements. The key project team members and their responsibilities are listed in **Section 3.1** below.

The Project Manager is the primary focal point for control of project activities. The Project Manager will be supported by the program management support team, which will provide reviews, guidance, and technical advice on project execution issues. The Project Manager is to be supported by a supervisory, safety and health, and QA/QC staff to ensure that the project is executed in compliance with all applicable laws, regulations, statutes, and industry codes.

3.1 Responsibilities of Key Personnel

3.1.1 Project Manager

The Project Manager is responsible for the overall direction of this project, which is executed under his supervision. The Project Manager is ultimately accountable for all work activities undertaken on this project and provides the managerial and administrative skills to ensure resource allocations, planning, execution, and reporting to meet contract requirements. The individual responsibilities of the Project Manager include, but are not limited to, the following:

- Participation in project QA reviews
- General supervision of the project
- Approval, as required, of project specific QA documents
- Approval of procurement documents
- Stopping work on a project, if necessary, because the project cannot be completed to the required quality levels, safety specifications, the schedule, or budget to permit successful completion
- Communication to the project staff of project-specific client and regulatory requirements
- Identification and documentation (and notification to the contracting officer and project staff) of changes in scope of work, regulatory requirements, or QA practices

3.1.2 Remediation Manager

The Remediation Manager will direct investigation and remediation activities and will be responsible for the overall preparation of submittals related to investigation and remediation activities. This individual will direct the technical staff during daily operations. He/she will coordinate and supervise human health/ecological risk assessment activities, feasibility studies, and decision documents and will ensure

that regulatory requirements are met and will support the Project Manager with regulatory interaction. Other responsibilities include overseeing drilling, geologic interpretation, and required modeling.

3.1.3 Site Superintendent

The Site Superintendent will be the on-site operational manager of the project and is responsible for its day-to-day operation. He is in charge of the on-site operational and technical staff. He is responsible for maintaining clear, effective, up-to-date communications with the Contracting Officer concerning project scoping and planning. Responsibilities include coordination of subcontractors, including their compliance with contractor policies and procedures and contractual requirements, implementing and maintaining all site-specific plans, health and safety, and controlling cost and schedule aspects of all site activities. Some of the quality-related responsibilities for the Site Superintendent include:

- Notifying the Remediation Manager and Project Manager if the project cannot be completed with regard to quality, schedule, health and safety, or cost.
- Determining that changes, revisions, and reworks are required of the CDAP, and documenting changes.
- Serving as a reviewer prior to release of project information to the client.

3.1.4 Project Contractor Quality Control System Manager

The Project Contractor Quality Control System Manager (CQCSM) will serve as the on-site QC officer. This individual will monitor field personnel engaged in chemical data acquisition. Some of the quality related responsibilities include:

- Determining that changes, revisions, and reworks are required of the Work Plan and CDAP.
- Serving as the final reviewer prior to release of project information to the client.
- Monitor the field investigation activities for compliance with contract documents.
- Stopping work that is nonconforming or deficient.

3.1.5 Project Safety Officer

The Project Safety Officer will be primarily responsible for:

- Assessing the potential health and safety hazards at the site
- Developing/implementing site-specific safety and health plans
- Performing daily safety checks

3.1.6 Project Chemist

A Project Chemist will be assigned to this project. He/she, or his/her designee, will be responsible for the following:

- Manage production and quality of data generated from sampling and analytical activities
- Verify that the CDAP quality objectives are met
- Review data prior to release to site
- Provide for contact between site and the subcontract analytical laboratory

3.1.7 Field Sampling Personnel

The Field Chemist and Sample Technicians report to the Site Superintendent and are responsible for the following:

- Obtain samples and document sampling tasks
- Package and ship samples to the off-site laboratory

3.2 Qualifications of Personnel

Contractor team personnel assigned to this project will be qualified to perform the task to which they are assigned. All members of the team are qualified to perform work on this task order. The Project Manager will make appraisal of the qualifications of additional personnel assigned to the project.

3.3 Analytical Laboratory

The contractor will select an analytical laboratory to provide subcontract analytical services for this task order. The laboratory will be USACE validated to perform project analyses. USACE Chemistry and Industrial Hygiene Section, Louisville District, will be notified upon the procurement of the analytical services laboratory. A copy of the Laboratory Quality Management Plan (LQMP) from the lab will be supplied to USACE as a submittal prior to execution of task order. The selected laboratory will be provided a copy of the final CDAP for their reference.

4.0 Sampling and Analysis

Samples expected to be collected for this project include groundwater, soil, surface water, sediment, and waste characterization samples. Sampling procedures are addressed in **Appendix D**, Field Procedures.

4.1 Types of Sampling

In general, two basic types of sampling techniques are recognized for solid media (soil and sediments): composite samples and grab samples.

4.1.1 Composite Sampling

Composite samples are a combination of more than one subsample collected at various sampling locations and/or different points in time. Area composite samples are composited from individual grab samples that are collected on an area or cross-sectional basis. Area composites will be made up of equal volumes of grab samples; each grab sample will be collected in an identical manner. Analysis of composites yields an average value. In certain instances, a composite can be used as an alternative to analyzing a number of individual grab samples and calculating an average value. However, compositing of samples can mask problems by diluting isolated concentrations of some hazardous compounds to below detection limits. Also, a small sample size may be removed for analysis, and if the composite is not homogeneous, an error in reporting results may occur. When compositing for trace organics and/or metals, only stainless steel, glass, or Teflon bowls and spatulas will be used for sampling. Samples for volatile analysis will not be composited in the field, due to potential for analyte loss during the compositing process.

4.1.2 Grab Samples

A grab sample is defined as a single sample that is collected all at once and is representative of the specific location in the sample medium at a given point in time. The representativeness of such samples is defined by the nature of the materials being sampled. In general, as sources vary over time and distance, the representativeness of grab samples decreases.

4.2 Soil/Sediment Sampling

Soil sampling may involve collection of surface soil and subsurface soil samples. Sediment samples may be collected from the creeks within the installation. Procedures for surface and subsurface soil and sediment sampling are provided in **Appendix D**. Soil and sediment samples will be collected from locations related to sites covered under the Project Work Statement (PWS).

4.3 Surface Water Sampling

Surface water samples may be collected from the creeks within the installation as it relates to sites under the PWS. Procedures for surface water sampling are provided in **Appendix D**.

4.4 Groundwater Monitoring Well Sampling

Groundwater samples will be collected from newly installed monitoring wells and existing monitoring wells of various depths and construction as it relates to sites under the PWS.

4.4.1 Water Level Measurement

Before samples are collected, the static water level will be measured to the nearest 0.01 foot using a battery operated electronic water level probe. Static water level measurements will be recorded on the Field Sampling Report **(Figure 4-1)** or equivalent. Immiscible layers are not anticipated but, if present, an interface probe will be used to measure the level of the immiscible surface and apparent thickness. A sample will also be collected using a transparent, disposable bailer to visually confirm the immiscible layer.

4.4.2 Monitoring Well Purging

Well sampling will be accomplished using the low flow sampling method. In the event the low flow sampling method is not used due to insufficient well recharge, wells will be purged before groundwater samples are collected. **Appendix D** provides the groundwater sampling procedure for this project.

4.4.3 Groundwater Sample Collection

Wells will be sampled using a submersible bladder pump as discussed in the previous section. Only in extreme cases will a bailer be used where a slow recharging well had to be purged dry. In such a case, after a bailer will be lowered gently into the well and sample collected, as soon as sufficient recovery has occurred. Pre-cleaned sample containers will be filled directly from the pump outflow port or bailer. Preservatives will be added to the sample bottle by the laboratory before the containers are shipped to the site. Groundwater sampling analytical parameters and methods are given in **Table 4-1**. Individual analytical constituents and associated detection limits are given in **Attachment 1**. The appropriate sample containers, preservation methods, and holding times for all project aqueous samples are given in **Table 4-2**. QC sample types and minimum sampling frequencies are as follows:

- 10 percent QC replicates
- One trip blank set for each cooler containing volatile organic compounds (VOC) samples

QA sampling and analysis will be performed when requested by the USACE. Additional information on groundwater sampling and handling is found in **Appendix D**, Field Procedures.

4.5 Contaminated Soil in Drums or Roll-off Boxes for Disposal Sampling

Drill cuttings will be staged in drums or roll-off boxes for subsequent disposal analysis. At the completion of the drilling, the drill cuttings will be sampled and sent to the subcontract analytical laboratory for analysis of disposal parameters as listed in **Table 4-1**. The sample technician shall note the drum or roll-off number in the sample logbook. The procedure for collecting a sample from a drum or roll-off box is summarized below:

- Decontaminate equipment:
  – Stainless steel spatula
  – Trowel or trier
  – Stainless steel bowl
- Don a clean pair of sample gloves.
- Remove drum lid.
- Insert trowel into material and remove sample. For roll-off box use a trier and position the trier at the corner of the roll-off and at an angle (i.e., 30 degrees) and push the trier into the soil as far as possible.
- Begin sampling with the acquisition of grab samples for VOCs, conducting sampling with as little disturbance as possible to the media. The sample container shall be filled with no headspace.
- Collect a five point composite sample for all parameters other than VOCs.
- Thoroughly mix the soil in a stainless steel bowl and fill the remaining containers.
- Label the sample container with the appropriate sample label.
- Place the sample containers in a cooler containing ice.
- Complete all chain-of-custody (COC) documents and record in field logbook.

4.6 Sampling and Analytical Requirements

Table 4-1 summarizes the sampling and analytical requirements for the site. **Table 4-2** summarizes the preservation methods, holding times, and sample size/containers for the required analysis. A complete list of the parameters and methods is provided in **Attachment 1**. Ten percent of the field samples collected at the site will be QC Samples.

4.7 Equipment Decontamination

Sampling equipment (core samplers, trowels, triers, and stainless-steel bowls) will be decontaminated prior to the collection of each sample. The electronic interface probe, used to measure depth to groundwater in monitoring wells and pump(s) used for well development and purging, will be

decontaminated prior to use at each well. The equipment will be decontaminated using a non-phosphate detergent (such as Alconox, Liquinox, or equivalent), followed by two potable water rinses, one deionized water rinse, and air dried. Decontamination fluids will be containerized for subsequent disposal. Further information and instructions on decontamination procedures are given in **Appendix D**, Field Procedures. Drilling rigs will be brought onto the installation in a clean condition with no mud on the undercarriage or vehicle. The drilling rig and equipment, including augers, bits, and drilling and sampling rods, will be steam-cleaned or hot water pressure-cleaned prior to use at each borehole or monitoring well construction site. Well construction materials will be brought to the site in their original packaging and will remain in the factory-sealed containers until use. If these materials contact the ground during assembly, they will be cleaned with low-sudsing soap and potable water prior to use. A decontamination pad will be established for the washing of drilling equipment. Wash waters from decontamination activities will be contained in the decontamination pad and transferred to containers for proper disposal.

4.8 Sample Handling

4.8.1 Field Documentation

The field geologist (and/or sample technologist) will maintain daily field notes on sampling activities. Items that must be included are sampling protocol, any changes to the procedures, meetings, instructions, safety precautions, level of personnel protection, and other activities pertaining to the samples. The person taking notes must be knowledgeable enough about these activities to know which details are important. Repetition of information recorded in other pertinent logs should be avoided, but enough information should be recorded to present a clear and accurate picture of technical activities. Should a question arise later concerning a specific event or procedure used, it will be answered from these notes. Some items that would be considered noteworthy are as follows:

- Termination of a sample point or parameter and reasons (i.e., terminating a well drilling due to encountering water)
- Unusual appearance or odor of a sample
- Lithologic description of soil samples
- Measurements, volumes of flow, temperature, and weather conditions
- Additional samples and reasons for obtaining them
- Levels of protection (with justification)
- Details concerning any samples split with another party (i.e., USACE)
- Details of QA/QC samples obtained

These notes must be dated and signed (each page) for validity in a court of law. All logbook entries will be made with blue or black waterproof ink and legibly written. Field notes will be entered into a hardbound logbook and the pages will be consecutively numbered. All entries will be in chronological order. The language will be factual and objective. In addition, field sketches may be made in the field

logbooks when appropriate, with reference points tied to existing permanent structures in the area (i.e., trees, fence posts, benchmarks, facilities). No erasures will be allowed. If an incorrect entry is made, the information will be crossed out with a single strike-mark and the change initialed and dated by the team member initiating the change. Each page in the field logbook will be signed and dated at the bottom by all persons making entries on that page. Field logbooks will be identified by a project-specific number (i.e., Logbook Number 1 for Project Number 117591, etc.) and stored in the field project files when not in use. At the completion of the field activities, the logbooks will be maintained in the permanent project file. Information on all samples will be entered in the logbook and associated field data collection sheets. The following information items are standard for all projects, recorded on the Field Sampling Report **(Figure 4-1)** or equivalent and entered in a column format where possible:

1. DATE – date sample was obtained
2. SAMPLE NUMBER – consecutive series of numbers assigned to every sample
3. LOCATION – description of area sampled
4. TIME – (military) time sampled (i.e., 24-hour format)
5. SAMPLERS – full name and initials of persons obtaining sample (usually two persons with at least one witnessing, if not involved in the actual sampling task)
6. TYPE OF SAMPLE – water, sediment, sludge, etc.
7. DESCRIPTION OF SAMPLE – physical description of sample (e.g., clear, cloudy, etc.)
8. ANALYSIS – the name of the analytical test or series of analytical tests to be performed on the collected environmental sample
9. WEIGHT OR VOLUME – size of sample (500 milliliters [mL], 32 oz)
10. PRESERVATIVES – preservatives used or included by lab, including cooling to 4 degrees centigrade (°C)
11. LABORATORY – off-site laboratory who performed analytical work
12. FIELD RESULTS – on-site or field analysis will vary according to project requirements; should be in consistent units (i.e., parts per million [ppm], parts per billion [ppb], etc.)
13. CHAIN-OF-CUSTODY NUMBER – for samples sent to the subcontract laboratory
14. ADDITIONAL COMMENTS – space reserved for any other information concerning a particular sample or special procedure or analysis
15. DATE SAMPLES SENT – date samples were sent to subcontract laboratory
16. OVERNIGHT CARRIER AIRBILL NUMBER

4.8.2 Sample Identification and Labeling

A coding system will be used to identify each sample collected during the sampling program. The contractor Sample Technologist will maintain a listing of the project and sample identification numbers. Pre-printed sample labels will include the monitoring well location and a sample number. The sample name will use the following format:

Sample Name: Database ID number-well identification - cc
Where:
Database ID number = L0001

L0001 = Longhorn Army Ammunition Plant and sequential number
Well identification, for example
35BWW03 = site 35B, water well number 03
Disposal samples will be identified as AAAxxx
Where AAA = source of sample:
RO = Roll-off box
DML = Drummed Liquid Sample
DMS = Drummed Soil Sample
TK = Tank
xxx = identification number of the drum or roll-off.
cc = QC sample indicator:
QC = QC (Quality Control) Replicate
QA = QA (Quality Assurance) Replicate
Trip blanks will be coded separately in sequence as follows:
Sample Name: TB – mmyy - xx
Where:
TB = Trip Blank
mmyy = month/year
xx = sequential number

The following are examples of the sample identification scheme for various samples:

L0002-04WW01-QC	A QC replicate of a monitoring well sample collected from LHAAP-04 monitoring well WW01.
DMS005	A soil sample taken from drum number 5.

Environmental samples are identified by a sample label attached to the sample container. Included on the label are the following items:

1. PROJECT # 117591
2. PROJECT NAME (Longhorn Multiple Site)
3. LOCATION (Site identification)
4. SAMPLER (Sampler initials, cross referenced to full names in the field logbook).
5. WITNESS (Witness initials, cross referenced to full names in the field logbook).
6. PRESERVATIVE (Whenever applicable)
7. Database identification code
8. SAMPLE location
9. DATE (DD-MM-YYYY)
10. TIME (24-hour format)
11. ANALYSES (Analytical parameters and methods; i.e., VOC-8260B)

The information described above will be printed neatly using a waterproof marker. After the sample is taken and the label is securely attached, the sample will be logged into the sample logbook. An example of a completed label for VOC analysis is included as **Figure 4-2**.

4.8.3 Custody Seals

Custody seals are narrow strips of adhesive paper or glass fiber used to demonstrate that no tampering of the sample container, equipment and sample cooler has occurred. The custody seal will be signed and dated by the Sample Technician and placed across the opening of the lid and body of the sample transport container (e.g., cooler) on one side and the front (cover the custody seal with wide, clear tape). A custody seal should also be placed from one side, across the top (lid), and to the other side of the sample container. A sample Custody Seal is shown on **Figure 4-3**.

4.9 Chain-of-Custody Procedures

Because of the evidentiary nature of samples collected, the possession of samples must be traceable from the time the samples are collected until they are introduced as evidence in legal proceedings, if necessary. To maintain and document sample possession, COC procedures are followed as described below.

The contractor COC is printed with a unique control number in the upper right-hand corner. The COC form will be signed by each individual who has the samples in his or her possession. The COC forms will be completed in the field by the person collecting the samples. Each sample number, time of sampling, description, requested analysis name and method number, and turn-around-time shall be entered on the COC form. When samples are shipped to the subcontract analytical laboratory, the courier name, and waybill (or airbill) number should be noted on the COC form prior to sealing the cooler. Upon arrival at the subcontract analytical laboratory, the person accepting delivery will sign the COC form(s) with a date, time, and initials. Next, the samples in the cooler will be checked against the COC forms for sample number, description, time and date of sampling, and analysis. Any samples in question will be segregated and the field personnel will be notified immediately. The person responsible for checking the samples in the cooler against the COC form shall also complete and sign a cooler receipt form. The COC and cooler receipt forms will be provided in the final data package. If a fast turn-around-time is required for some samples, these samples will be submitted to the subcontract analytical laboratory with a separate COC. In the lower right-hand section of the COC form labeled “remarks”, write the word “**RUSH**” using large letters and underline. The next day, contact the subcontract analytical laboratory and confirm that the samples were received and are processed for the rapid turn-around-time. A sample is under your custody if any of the following conditions is met:

1. It is in your actual possession.
2. It is in your view, after being in your physical possession.
3. It was in your physical possession and they/you lock it up to prevent tampering.
4. It is in a designated secure area.

It is very important that the information on the COC record form match the information on the sample container label; especially sample number, time taken, description and analysis requested. A COC is shown in **Figure 4-4**.

4.10 Shipment of Samples

Samples will be shipped via an overnight carrier to the subcontract laboratory. COCs will be prepared accordingly and are organized by sampling events and matrix; soil samples separate from water samples. All field samples will be placed in appropriately labeled, pre-cleaned sample containers, and enclosed within a plastic sealable bag. The bottom of the shipping cooler will be lined with absorbent material. A sufficient quantity of ice will then be placed on the absorbent material to cover the bottom of the cooler. All ice utilized inside the cooler will be containerized within two plastic freezer bags of 1 quart or larger size. All four sides of the cooler will then be lined with ice packs. Each sample container will be wrapped with bubble pack material to prevent breakage. The wrapped sample container will then be placed in a plastic, sealable bag and sealed. The bagged sample containers will then be placed in the space created by placement of the ice. Any remaining void space will then be filled with bubble pack, styrofoam peanuts, or absorbent material to prevent movement of the sample containers during transport. Once the samples are secured, ice will be placed on top of the sample containers, thereby completely surrounding the sample containers with ice packs. The remaining headspace in the cooler, if any, will be filled with bubble pack, Styrofoam peanuts, or absorbent material.

THE SHIPPING INSTRUCTIONS ARE AS FOLLOWS.

1. Samples must be shipped in strong outer packaging (a plastic cooler is acceptable).
2. Both contractor and the subcontract Laboratory's addresses must appear on the container.
3. The following information must be printed on the container: “FRAGILE” (if glass containers are shipped) with “This Side Up” arrows on two sides of the cooler.
4. A typical contractor shipping label, which also includes contractor and the subcontract analytical laboratory’s addresses, must be attached to top of cooler.
5. Inner packages cannot exceed 1 gallon each, and the entire shipment (cooler, samples, absorbent) cannot exceed 66 pounds.
6. Coolers must be packed with absorbent.
7. 40-mL vials with reagent water will be used as temperature blanks. Temperature conditions will be checked and reported in the Cooler Receipt Form upon arrival at the laboratory.
8. Inner containers should have their lids secured with tape or wire.
9. Prior to sealing the cooler with Custody Seal and Tape, a contractor Shipment Checklist will be completed and reviewed. A sample Shipment Checklist is shown in **Figure 4-5**.
10. A standard airbill is completed to the satisfaction of the selected shipping company.

The completed COC forms shall be enclosed in plastic, sealable bags and taped to the underside of the lid of the cooler. The drain of the cooler will be taped shut. On the day of shipment, fresh ice will be added to the coolers to ensure the preservation criteria are met, the lid will be taped shut using strapping tape (filament type), and a minimum of two custody seals or evidence tape will be fixed to the coolers. The

coolers will then be sent to the subcontract laboratory. For liquid samples, a "**THIS SIDE UP**" placard is required.

Table 4-1
Sampling and Analytical Requirements

Matrix	Parameter	Method	Turnaround Time
Groundwater	VOCs	SW-846 8260B	14 Days
Groundwater	Perchlorate	EPA 314	14 Days
Groundwater	Explosives	SW-846 8330	14 Days
Groundwater	Antimony	SW-846 6020	14 Days
Groundwater	Thallium	SW-846 6020	14 Days
Groundwater	Metals	SW-846 6020	14 Days
Groundwater	Dioxin/Furans	SW-846 8290	14 Days
Soil	VOCs	SW-846 8260B	14 Days
Soil	Perchlorate	EPA 314	14 Days
Soil	Explosives	SW-846 8330	14 Days
Soil	Metals	EPA 6010B/7470A	14 Days

Type	Matrix	Parameter	Method	Turnaround Time
Disposal	Soil	TCLP VOCs TCLP SVOC TCLP metals Reactivity Corrosivity Ignitability	SW-846 8260B EPA 314 SW-846 8330 SW-846 7.3 SW-846 9045C 1010	14 Days
Disposal	Water	TCLP VOCs TCLP SVOC TCLP metals Reactivity Corrosivity Ignitability	SW-846 8260B EPA 314 SW-846 8330 SW-846 7.3 SW-846 9040B 1010	14 Days

Notes and Abbreviations:

[1] *United States Environmental Protection Agency (USEPA), 1997.* **Test Methods for Evaluating Solid Waste, Physical Chemical Methods (SW-846)**, *Update III. Office of Solid Waste and Emergency Response, Washington, D.C.*

[2] *USEPA, 1983.* ***Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020****. Environmental Monitoring and Support Laboratory, Office of Research and Development, Cincinnati, Ohio.*

SVOC semivolatile organic compound
TBD to be determined based on volume of material collected in the field
TCLP toxicity characteristic leaching procedure
VOC volatile organic compound

Table 4-2
Sample Volume, Preservation, Holding Times

Parameter	Minimum Sample Volume	Holding Time	Preservation
Water (Groundwater, Surface Water Rinse Blanks)			
Volatiles	3 X 40 mL vial with PTFE septa cap	14 days	HCl to pH < 2 4 °C no headspace
Explosives	2 X 1L AG	7 days to extraction 40 days to analysis	4 °C
Metals	1 X 500 mL HDPE bottle	6 months except mercury, 28 days	HNO_3 to pH < 2 4 ºC
Perchlorate	250 mL HPDE bottle	28 days	4 °C
Dioxin/Furans	2 X 1L AG	30 days to extraction 45 days to analysis	4 °C
TCLP Semivolatiles	1L AG	7 days to extraction 40 days to analysis	4 °C
TCLP Volatiles	2 X 40 mL vial with PTFE septa cap	14 days	4 °C
TCLP Metals	1 L HDPE bottle	6 months except mercury, 28 days	4 °C
Reactivity, Corrosivity, (pH), Ignitability	1 L HDPE bottle	28 days except pH, immediate	4 °C
Soil/Sediments			
Volatiles	2- or 4-ounce CWM (or 5g – Encore)	2 days to extraction 14 days to analysis	4 °C
Perchlorate	1 X 8-ounce CWM with Teflon-lined cap	180 days to analysis	4 °C
Explosives	1 X 4-ounce CWM with Teflon-lined cap	14 days to extraction 40 days to analysis	4 °C
Metals	1 X 4-ounce CWM with Teflon-lined cap	180 days to analysis (EPA Method 6010B) 28 days to analysis (EPA Method 7471A)	4 °C
TCLP Volatiles	4-ounce CWM with PTFE septa cap	14 days to analysis	4 °C no headspace
TCLP Semivolatiles	8-ounce CWM jar	14 days to extraction 40 days to analysis	4 °C
TCLP Metals	4-ounce CWM jar	6 months to analysis except mercury, 28 days	4 °C
Reactivity, Corrosivity, (pH), Ignitability	4-ounce CWM jar	28 days except pH, immediate	4 °C

Notes and Abbreviations:

The above listed volumes provide an adequate quantity of sample to analyze a matrix spike (MS) and matrix spike duplicate (MSD).Multiple analytes, except volatiles may be combined into one 8-ounce jar for soils.

AG amber glass jug
°C degrees centigrade
CWM clear wide mouth jar
EPA U.S. Environmental Protection Agency
HCl hydrochloric acid
HDPE high-density polyethylene
HNO_3 nitric acid
L liter
mL milliliter
pH potential hydrogen
PTFE polytetrafluoroethylene
TCLP toxicity characteristic leaching procedure

LOCATION: _____ PROJECT: _____

SITE: _____

SAMPLE INFORMATION

MATRIX _____ SAMPLE ID: _____

SAMPLING METHOD _____ DUP/REP OF: _____

BEGINNING DEPTH _____ MATRIX SPIKE/MATRIX SPIKE DUPLICATE
YES ( ) NO ( )

END DEPTH _____

GRAB ( ) COMPOSITE ( ) DATE: _____ TIME _____

CONTAINER SIZE/TYPE #		PRESERVATIVE/ PREPARATION	EXTRACTION METHOD	ANALYTICAL METHOD	ANALYSIS

NOTABLE OBSERVATIONS
SAMPLE CHARACTERISTICS

PID READINGS		MISCELLANEOUS
1st	COLOR:	
2nd	ODOR:	
	OTHER:	

pH ____ Temperature ____ Dissolved oxygen _____ Specific Conductivity _____ Turbidity _____

GENERAL INFORMATION

WEATHER: SUN/CLEAR _____ OVERCAST/RAIN _____ WIND DIRECTION _____
AMBIENT TEMP: _____

SHIPMENT VIA: FED-X _____ HAND DELIVER _____ COURIER _____ OTHER _____

SHIPPED TO: _____

COMMENTS:

Figure 4-1
Field Sampling Report

PROJECT #: 117591	SAMPLE NO: L0002-04WW01
PROJECT NAME: LONGHORN AAP	DATE: 16-FEB-2004
LOCATION: LHAAP-04 WW01	TIME: 1415
SAMPLER: RBW	ANALYSIS: SW8260B
WITNESS: JTR	
PRESERVATIVE: ICE	

Figure 4-2
Sample Label

CUSTODY SEAL	
PERSON COLLECTING SAMPLE BW	**SAMPLE # L002-04WW01**
DATE COLLECTED 16-FEB-2004	**TIME COLLECTED 1415**

NOTE: The "Sample #" and "Time Collected" blocks would not be filled in when placing Custody Seals on the outside of the shipping container.

Figure 4-3
Custody Seal

CHAIN-OF-CUSTODY RECORD

PROJ. NO.	PROJECT NAME					NO. OF CON-TAINERS							REMARKS
SAMPLERS: (Signature)													
STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION								

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks	

Figure 4-4
Chain of Custody

SHIPMENT CHECKLIST

Project Name _____ Project No. _____
Street Address _____ Date:_____ Time:_____
City/State/Zip _____
Phone Number (xxx) _____ Fax Number (xxx)_____

SAMPLE CHECKLIST

	Yes	No	Comments
Sample lids are tight and custody seals in place?	☐	☐	
Are sample numbers, dates, times and other label information legible and complete?	☐	☐	
Have all sample numbers, dates, times and other sample data been logged into sample logbook?	☐	☐	
Do sample numbers and sample description on the labels match with those on the Chain-of-Custody (COC)?	☐	☐	
Have the samples been properly preserved?	☐	☐	
Have the COCs been filled out completely and correctly?	☐	☐	
Are the labels filled out in the indelible ink and/or label taped over with clear tape?	☐	☐	
Have the COCs been properly signed in the transfer section?	☐	☐	

PACKAGING CHECKLIST

Has each sample been placed into an individual plastic bag?	☐	☐	
Has the drain plug of the cooler been taped closed with waterproof tape from the inside?	☐	☐	
Has the cooler been adequately lined with cushioning absorbent pads?	☐	☐	
Have all the samples been placed into the cooler in an upright position?	☐	☐	
Is there adequate spacing of samples so that they will not touch during shipment?	☐	☐	
Have an adequate number of blue ice packs been placed around and on top of samples?	☐	☐	
Has the COC been placed in a plastic sealable bag and taped to the inside of the lid of the cooler?	☐	☐	
Is an analytical request form needed and is it in a plastic sealable bag under the lid of the cooler?	☐	☐	
Have custody seals been placed over the lid?	☐	☐	
Has the cooler been properly labeled with correct address and proper certification?	☐	☐	
Has the laboratory performing the analysis been notified of the shipment of samples?	☐	☐	

PROBLEMS/RESOLUTIONS

Prepared by:_____ Signature:_____

Figure 4-5
Shipment Checklist

5.0 Field Screening Methods

Several field screening methods will be utilized based on site-specific objectives and soil collection methods. During the collection of soil samples from surface soils and subsurface (drilling) soils, basic field screening methods using an organic vapor analyzer (OVA) or photoionization detector (PID) will be employed. The samples will be collected using a clean trowel, trier, or shovel and scooping the appropriate quantity of soil or sediment into a stainless steel bowl. A sufficient quantity of soil will be collected for both the field and laboratory sample requirements. Each sample will be composited and the sample for field analysis will be removed. If the field results indicate that a sample should be submitted to the laboratory for confirmatory analysis, the remaining composited soil will be used for the analyses. For samples requiring VOC analysis, a discrete grab sample will be collected from each of the sample locations. The remaining composited soil will be disposed with the excavated soil.

Excavation sampling, while using the same or similar screening equipment and basic procedures as described above, may require the use of other screening tools or field sampling kits. By guiding the excavation limits at certain sites with the use of these screening tools, soil excavation limits can be delineated horizontally and vertically. If the field analysis results indicate that concentrations of chemicals of interest exceed the cleanup criteria, excavation will continue in the direction from where the sample was collected until exceedances are not detected. When the four sidewall samples and the center "floor" sample(s) do not exceed the cleanup criteria, the excavation will be considered temporarily complete pending the results of the laboratory confirmation results.

Should subsequent laboratory analysis indicate that the concentrations of chemicals of interest in a sample are less than the cleanup criteria, then the excavation from which that sample was collected will be back-filled. Should the sample indicate a concentration greater than or equal to the cleanup criteria, then excavation in the area will recommence and the sample program for that area will proceed from there. If applicable, multi-incremental sampling will be used to delineate compliance with closure criteria.

Sampling devices will be inspected prior to use to ensure that there is no corrosion or wear that would increase the likelihood of contaminant sorption to the sampling equipment. Reusable sample equipment will be thoroughly decontaminated between uses. See **Appendix D**, **Attachment 9**, Decontamination Procedures. **Table 5-1** summarizes the field screening method for this sampling project. Health and safety screening methods are described in the Site Safety and Health Plan.

Table 5-1
Field Screening Procedures

Parameter	Techniques	Field Method
Volatile Organic Compounds	Photoionization Detector	Portable, real-time meter. Operate according to manufacturer instructions.
Groundwater Quality Parameters: pH, temperature, conductivity, and turbidity	Electronic sensors	Portable, real-time meters. Operate according to manufacturer instructions.
Soil Screening and Delineation Parameters: Metals	X-Ray Fluorescence Instrument	Portable, real-time meters. Operate according to manufacturer instructions.

6.0 Off-Site Laboratory

The contractor will notify USACE of the selected laboratory prior to starting the sampling program. The analytical tables in **Attachment 1** summarize the analytical methods, analytes, and detection limits for off-site analysis.

6.1 Data Quality Objectives

The following sections summarize the data quality objectives for the analytical laboratory procedures that can be found in **Attachment 1**. Detection limits for these analytes shall be as stated in either the subcontract analytical laboratory's LQMP or **Attachment 1**, whichever are/is more stringent as compared to the listed groundwater standards.

6.1.1 Method Blanks

The method blank is used to document contamination resulting from the analytical process. As stated in SW-846, Chapter One, Section 5.0, 1994 Edition of *Methods for Chemical Analysis of Water and Wastes*, and U.S. Environmental Protection Agency (USEPA) 600 Methods, for a method blank to be acceptable for use with this site's samples, the concentration in the blank of any analyte of concern should not be higher than the highest of either:

- The method detection limit, or
- 5 percent of the regulatory limit for that analyte, or
- 5 percent of the measured concentration in the sample

A method blank shall be analyzed with each batch of samples that are analyzed from this site by matrix.

6.1.2 Matrix Spikes

A matrix spike (MS) is defined as an aliquot of sample spike with a known concentration of target analytes. The spiking occurs prior to sample preparation and analysis. MSs are used to document the precision and bias of a method in a given sample matrix.

The acceptable criteria (control limits) for use with this site's samples shall be provided in the subcontract analytical laboratory's LQMP, and shall be provided with each set of data and final report. A MS and matrix spike duplicate (MSD) shall be analyzed with each batch of samples analyzed from this site. Site samples must be utilized for an MS/MSD analysis at a minimum of once each 20 samples received by the laboratory, by matrix.

The laboratory is directed by appropriate sections of SW-846 and other USEPA methodologies on the procedure to establish QC limits for each target analyte of interest. These QC control limits

shall be provided with all laboratory data, regardless of the turn-around-time requested, for each target analyte requested.

6.1.3 Laboratory Control Sample

A Laboratory Control Sample (LCS) is a volume of reagent water or inert solid spiked with known concentrations of analytes and carried through the preparation and analysis procedure as a sample. The purpose of the LCS is to monitor method loss and recovery data on a sample with no matrix effects. An LCS shall be analyzed with each batch of samples by matrix. NOTE: If there is not a sufficient quantity of sample to perform an MS/MSD, an LCS/Laboratory Control Sample Duplicate (LCSD) analysis shall be analyzed to provide QC data.

The laboratory is directed by appropriate sections of SW-846 and other USEPA methodologies on the procedure to establish QC limits for the LCS for each target analyte of interest in reagent water. These QC control limits shall be provided with all laboratory data, regardless of the turnaround-time requested, for each target analyte requested.

6.1.4 Surrogate Compounds (Organic Methods)

A surrogate compound is an organic compound which is similar to the target analytes in chemical composition and behavior in the analytical process, but which is not normally found in environmental samples. Surrogate compounds are added to monitor the extraction process and method efficiency. Surrogates are to be added to gas chromatography/mass spectrometer (GC/MS) methods and those GC methods that specifically require surrogate compound(s).

In the case of SW-846 GC/MS methods, surrogate QC acceptance recoveries for each compound are established and provided in the method. The subcontract analytical laboratory must meet these surrogate QC acceptance criteria. If the GC/MS and/or GC surrogate QC acceptance criteria is not provided in the method, the laboratory shall establish surrogate QC acceptance criteria as described in the MS section above **(Section 6.1.2)**.

6.1.5 Laboratory Duplicates

Laboratory duplicates are two aliquots of the same sample taken through the whole sample preparation and analysis process in the same manner. The purpose is to monitor system performance and sample homogeneity. Laboratory duplicates are normally specified for metals and water quality parameters. The QC acceptance criteria shall be within 20 percent relative percent difference (RPD).

6.2 Method Quality Control

All calibration and instrument tuning will follow SW-846, EPA 600, or manufacturer's specifications when this is not available. Laboratory blanks, spikes (LCS, LCSD, MS, MSD),

duplicates and standard reference materials analyses that are required by the method will be reported.

6.3 Sample Quality Control

Subcontract analytical laboratory's LQMP will be provided to USACE upon request. The LQMP covers QC functions, including, but not limited to:

- Tuning
- Internal Standards
- Surrogate spikes
- Detection limit study
- Analyte identification and tentatively identified compounds
- Serial dilutions
- Duplicate injections
- Post digestion spikes
- Sample dilution
- Method blank
- LCS

The above-mentioned items are also covered in the pertinent methods manual.

7.0 Quality Control Parameters

The quality of analytical data will be assessed in terms of its precision, accuracy, representativeness, comparability, and completeness (PARCC) parameters. Because accuracy and precision information may be expressed in several ways, data obtained from this project will be carefully reviewed and evaluated by either an analytical chemist or a statistician. The application of PARCC parameters is described in the following sections.

7.1 PARCC Parameters

7.1.1 Precision

Precision will be assessed by comparing the analytical results between MS and MSD. The RPD between the MS and MSD (or LCS and LCSD) will be calculated using **Equation 7-1**. This information will be used to determine whether the analytical results received provide equal or greater precision data generated by the applicable method validation on similar matrices.

$$\text{RPD} = \frac{\text{MS Result} - \text{MSD Result}}{(\text{MS Result} + \text{MSD Result})} \times 100 \qquad \textbf{Equation (7-1)}$$

The precision of the field sample and the QC field sample will be considered to be outside QC limits under the following circumstances: (1) if at least one of the results exceed the analysis detection limit by a factor of five or greater, and (2) if the ratio of the results (field sample/QC sample or QC sample/field sample) exceed a factor of 2.0 for water samples or 5.0 for soil samples. A major disagreement is apparent when concentration ratios exceed 5.0 for water and 10 for soil. The ratios do not apply when both the QC sample and field sample results are less than 5 times the analytical detection limit. If there is not a sufficient quantity of sample available to conduct an MS and MSD spike analyses, LCS and LCSD analyses must be completed to provide required QC data.

7.1.2 Accuracy

The accuracy of the measured data is evaluated by the comparison of the percent recovery of QC reference materials of known or established concentrations, independent of the routine calibration. Statistically based control limits are established for each method of analysis and sample matrix. Accuracy is determined by the analysis of method spikes (blank spike, LCS) and MS/MSD samples. A blank spike is prepared in the laboratory using an inert matrix such as deionized water or certified clean, inert sand which is spiked with target analytes. When one of the samples in the batch has two additional aliquots prepared and spiked with target analytes, these two aliquots are referred to as the MS and MSD. Spiked samples are routinely analyzed on each batch of up to 20 samples. Note that a batch may also contain less than 20 samples. Recoveries are assessed to determine method efficiency and any matrix interference effects.

Analytical accuracy is expressed as the percent recovery of the spike added. **Equation 7-2** is used to calculate the percent recovery.

$$\text{Percent} = \frac{\text{Spike Sample Results} - \text{Sample Results}}{\text{Amount of Spike Added}} \times 100 \qquad \textbf{Equation (7-2)}$$

7.1.3 Completeness

Completeness is defined as the percentage of measurement taken for analysis in order to make site decisions compared to the total valid results available. **Equation 7-3** defines completeness. The highest percentage possible (minimum of 90 percent) will be achieved between the number of samples in control compared to the total number of samples received by the subcontract analytical laboratory. The results will be calculated following data reduction, review, and assessment.

$$\text{Completeness} = \frac{\text{Valid Data Obtained}}{\text{Total Data Planned}} \times 100 \qquad \textbf{Equation (7-3)}$$

A value of 90 percent or higher is the goal. For values less than 90 percent, problems in the sampling or analytical procedures should be examined and explained.

7.1.4 Representativeness

Unlike accuracy, precision, and completeness that can be expressed in quantitative terms, representativeness is a qualitative parameter. Representativeness is the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is address throughout this CDAP and the Design/Work Plan by describing the rational for sample locations, collection methods, frequency of sampling, and QA/QC procedures. **Table 4-1** summarizes analytical methods and turnaround times. **Table 4-2** summarizes analytical sample volume, holding times, and preservation method. **Table 7-1** presents field QA/QC requirements.

QC considerations including method blank results, sample holding times, sample preservation and sample conditions (i.e., during shipment and upon arrival at the lab) play an important role in sample representativeness. Sample results are not to be corrected for blank contamination. Samples may be rejected before analyzing if preservation requirements are not met, causing undue resampling in the field. If sample holding times are exceeded and samples are received in poor condition at the laboratory, the USACE must be notified immediately for problem resolution.

7.2 Sensitivity / Detection Limits

The detection limits for each test listed in **Table 4-1** are outlined in **Attachment 1** and are covered in subcontract analytical laboratory's LQMP. The more stringent detection limits shall apply.

7.3 Field Quality Control

Field QC samples will be collected and analyzed throughout the field phases of this Task Order. The number and type of field QA/QC samples, as a minimum, are shown in **Table 7-1**.

7.3.1 Trip Blanks

Blanks, which are collected in the field, are an important link in the QC data chain for each set of samples. The analytical data derived from these blanks are necessary to assess quality of field sampling operations. Blanks are used to verify that sample containers, preserving reagents, and equipment are contaminant-free prior to and between different sampling points. Blanks are also used as a check for potential on-site environmental contamination, to evaluate personnel expertise in sample collection, and to reveal problems that may occur in sample storage and transport.

Therefore, the field QC blanks will not be isolated from actual samples. They must be considered as samples and treated identically (preserved with the same reagents, stored and transported in the same containers as the samples, etc.).

PURPOSE: The trip blank will be used when water samples, and soils in Septa jars, are being requested for volatile contaminants. Trip blanks will be analyzed for VOCs to ensure the integrity of the collection and shipping process.

PROCEDURE: Trip blanks will be prepared prior to the sampling event by the subcontract analytical laboratory, which is responsible for the initial preparation of sample containers. The water will be free of volatile organic contaminants. Any appropriate preservatives will be added at the time that the blanks are prepared. The sample containers (vials) will be sealed (custody seal), labeled appropriately, and transported to the site in the same sampling kits as the sample vials. These blanks will not be opened in the field. The trip blank remains with the corresponding field samples at all times during the collection, handling, and shipping of field samples.

FREQUENCY: A set of trip blanks will accompany the storage and transport of all field water samples, and soils collected in Septa jars being requested to be analyzed for volatile contaminants. One set of trip blanks will be placed into every cooler that contains water samples and soils in Septa jars for volatile analysis.

7.3.2 QC Replicate Samples

PURPOSE: QC samples are collected by the Sample Technologist and are used to verify the reproducibility of the subcontract laboratory data. The purpose of the samples is to provide site specific field originated checks that the data generated by the subcontract laboratory are of suitable quality.

Groundwater QC samples will be collected as a single sample using an acceptable sampling device and poured/pumped into separate but identical containers. Volatile samples will be collected first. One sample will be labeled as the field sample and the other sample will be labeled as the QC sample. The QC samples will be contained, preserved, and transported in the same manner as the samples of interest. QC samples will be analyzed for the same parameter groups as the associated field samples of interest.

FREQUENCY: One QC sample will be collected for every 10 or less field samples (for each sample matrix) collected at the site.

The precision of the field sample and the QC field sample will be considered to be outside QC limits under the following circumstances: (1) if at least one of the results exceed the analysis detection limit by a factor of five or greater, and (2) if the ratio of the results (field sample/QC sample or QC sample/field sample) exceed a factor of 2 for water samples or 5 for soil samples. A major disagreement is apparent when concentration ratios exceed 5 for water and 10 for soil. The ratios do not apply when both the QC sample and field sample results are less than 5 times the analytical detection limit.

7.3.3 QA Replicate Samples

PURPOSE: QA samples are used by the USACE to evaluate the performance of the subcontract laboratory.

Groundwater QC samples will be collected as a single sample using an acceptable sampling device and poured/pumped into separate but identical containers. Volatile samples will be collected first. One sample will be labeled as the field sample, one sample will be labeled as the QC sample, and the other sample will be labeled as the QA sample. The QA samples will be contained, preserved, and transported in the same manner as the samples of interest. QA samples will be analyzed for the same parameter groups as the associated field samples of interest.

FREQUENCY: One QA sample will be collected for every 10 or less field samples (for each sample matrix) collected at the site.

7.3.4 Field Measurement Duplicates

PURPOSE: Field measurement duplicate samples (photoionization detector [PID] readings) are used to verify reproducibility of data on field instruments.

PROCEDURE: Field measurement duplicate readings will be collected every ten samples.

FREQUENCY: One QA sample will be collected for every 10 or less field samples (for each sample matrix) collected at the site.

7.4 Sample Quality Control Report

To supplement the information recorded in the field logbook, Sample Quality Control Reports (SQCRs) will also be maintained for every sampling location. An example of the SQCR to be used at the site is shown in **Figure 7-1**. SQCRs will be maintained by the Sample Technologist and cross-checked for completeness at the end of each day by the CQCSM. Each form will be signed and dated by individuals making entries and initialed by the CQCSM upon completion. Copies of the SQCR will be attached to the Daily Quality Control Report and forwarded to USACE.

Table 7-1
Field QA/QC Samples

Quality Control	Frequency of Occurrence	Percent Objective	Minimum Number
Trip Blank	1 per cooler containing waters and soils (in jars with PTFE septa caps) for volatile analysis	100	1
QA Replicate Samples	As requested by the USACE	100	1
QC Replicate Samples	1 per 10 or fewer field samples	100	1

Abbreviations:

PTFE polytetrafluoroethylene
QA quality assurance
QC quality control

	Date							
	Day	S	M	T	W	TH	F	S
USACE Project Manager	**Weather**	Bright Sun	Clear		Overcast		Rain	Snow
Project	**Temp**	<32	32-50		50-70		70-85	>85
Project #	**Wind**	Still	Moderate		High		Report #	
Contract #	**Humidity**	Dry	Moderate		Humid			

Subcontractors on Site:
Equipment on Site:
Visitors on Site:
Contractor Personnel on Site:
Work Performed (including sampling):
Quality Control Activities (including field calibrations):
Health and Safety Levels and Activities:
Problems Encountered/Corrective Actions Taken:
Downtime/Standby:
Special Notes:
By: Title:

Figure 7-1
Sampling Quality Control Report Form

8.0 Data Analysis Reporting

8.1 Field Instrument Data Reduction

The Sample Technician will be responsible for the proper use and calibration of the PID instruments used in the field to collect chemical data. All raw data collected for the field survey instruments will be entered into the logbook for the site.

8.2 Field Data Reduction

8.2.1 Responsibilities of the Analyst-Sample Technician

Each analyst will be responsible for converting raw data into reportable values. These specific duties include:

- Proper identification of the analyte
- Checking calibrations to ensure support of data
- Ensuring QA/QC checks are supportive of data
- Ensuring documentation is complete and accurate in respective logbooks

8.2.2 Analytical Records from On-Site Field Analytical

The Sample Technician will maintain a bound, numbered logbook for all PID samples analyzed. The following column headings will be entered, as applicable, for each item of sample information:

- Date – Date sample was collected
- Sample Number
- Location – Description of area sampled (abbreviated form if sampled twice or more - log explaining locations and abbreviations should be attached to or written in front of the logbook).
- Time – Time sample was collected
- Samplers – Persons collecting sample (always two-one at least witnessing even if not involved in the actual act)
- Type of Sample – Water, Soil, Air, etc.
- Analysis by – Person who performed analytical work

- Additional Comments – Space reserved for any other information concerning a particular sample or special procedure or analysis and COC of samples that leave the site

8.3 Field Data Verification

All field equipment will be checked and calibrated prior to use. Each instrument calibration is recorded in the field instrument calibration notebook. Field personnel using the equipment (sample technician, safety and health personnel, project hydrogeologist) are responsible for the following information:

- Internal calibration, complete and accurate
- Field data integrity
- All documentation is complete and accurate in a logbook
- Acknowledging historical data

8.4 Project Data Review

All data produced for the project will be given to the CQCSM and the Remediation Manager for final data review. All logbooks, COC, laboratory reports, etc. are reviewed to ensure all QC protocols have been met. All information will be archived for data storage.

8.5 Data Reporting by Contract Laboratory

8.5.1 Original Laboratory Report

Once the data have been reviewed, it is ready for report production. The report will typically contain the following information:

- Narrative discussing QC problems encountered by analytical method and matrix
- Project Number
- Original COC forms
- Cooler Receipt Form
- Description of sample types
- Tests performed and method number
- Date sampled
- Date received
- Date extracted
- Date analyzed
- Analytical results
- Dilution factor

- Percent solids (if applicable)
- Moisture content (soils)
- Field identification number and corresponding lab identification number
- Actual laboratory detection limit
- QC information
  – Blanks analyzed
  – Matrix spikes (MS/MSD)
  – Method spike (LCS, blank spike)
  – Surrogates, when applicable
  – Percent recovery
  – Control limits
  – RPD
  – any other special QC information
- Methodology
- Table cross-referencing field sample numbers and lab identification numbers, when these numbers are not included on each individual lab report form
- Table cross-referencing field samples to the associated method blanks, blank spike, MS, and MSD when more than one batch is included in the lab report package

The hard copy report will be checked by the off-site Project Chemist/Laboratory Coordinator, Remediation Manager and QC Manager before it is released. The original copy of the laboratory report, including the COC and cooler receipt form, will be provided to USACE as an integral part of the final submittal after all review comments have been resolved. A copy of each final laboratory report will be placed in the project file for future reference.

8.5.2 Diskette Deliverable

The analytical laboratory will also provide all project analytical data in an electronic data format. The contractor will specify an appropriate file structure compatible with the contractor's database. The laboratory will complete the files by downloading the appropriate analytical results and data. The laboratory data files will be added to a database that can be used to produce analytical results tables.

8.6 Contractor Review of Diskette Deliverable

Upon receipt of the laboratory diskette deliverable listed in **Section 8.5.2**, the diskette will be reviewed by contractor technical personnel. The review will consist of reviewing the format and files to ensure that they also comply with the contractor database format. The review will also consist of a review of the diskette contents for completeness; all analytical data has been entered correctly. If problems are encountered in the analytical data, the diskette will be returned to the analytical lab for a correction.

8.7 Data Storage and Deliverables

All documentation used and generated will be given to the Project Manager at the completion of the project. All logbooks, laboratory reports, and support documentation will be submitted to USACE. When available, the data will also be uploaded on the project specific portal provided by the contractor. This information will be accessible to both the Army and regulators for their use. Deliverables to the Army will be in a format compatible with the ERIS and AEDB-R databases in accordance with the terms of the PWS (USACE, 2005).

9.0 Assessments and Response Actions

9.1 Site Audits

Under this task, the CQCSM, or his designee, will conduct a field audit to check the implementation of this CDAP. Site audits will assess the following:

- Personnel performance
- Sampling methods and techniques
- Decontamination methods and techniques
- QC program
- Data review program
- Recordkeeping procedures
- Document control system
- Data storage
- Corrective action responses

Upon completion of the site audit, the CQCSM will generate a report citing the deficiencies found as well as the progress achieved since the last site audit. Any deficiencies will be promptly corrected. Copies of the audit report will be given to the Project Chemist, Remediation Manager, and Project Manager. One copy will also be placed in the project files for reference.

9.2 Data Review System

9.2.1 Laboratory Analyst's Data Review Responsibilities

The laboratory analyst at the subcontract analytical laboratory is responsible for the initial review of the project data. Any errors, or deficiencies, will be addressed at this time.

9.2.2 Laboratory QA Officer Data Review Responsibilities

The QA Officer at subcontract analytical laboratory will be responsible for the final data review prior to sending the initial and final report to the contractor. Any errors, or deficiencies, will be addressed at this time.

9.2.3 Project Chemist Data Review Responsibilities

The Project Chemist is responsible for the initial contractor review of the data from the subcontract analytical laboratory. This review shall include the following:

- Verify that all requested data are reported (indicate any data gaps)

- Verify that samples are analyzed according to the contract specified methods
- Verify that the holding times have not been exceeded
- Verify that MS, MSD, method spike (LCS or blank spike), and surrogate recoveries fall within the laboratory's, or method, acceptable criteria
- Review blank data for gross, or unacceptable, contamination
- Review laboratory corrective actions discussed in narrative
- Provide a comparison of the field and QC sample results
- Provide an evaluation of data acceptability and usability for each sampling episode
- Verify receipt of QC validated database data diskette

The Project Chemist will be responsible for informing the Project Manager and CQCSM of any laboratory and/or sampling deficiencies or issues. The Project Chemist will immediately inform the Project Manager, and/or CQCSM, of any data that do not fall within clean-up or closure criteria. The USACE will make the final decision regarding data acceptability and usability based on review of the data.

9.3 Corrective Action Reports

The Corrective Action Report (CAR) should include, but not limited to, the following:

- A description of the problem, deficiency, or issue
- Proposed resolution
- Resulting action

Depending on the issues, this report may be generated by the laboratory, Project Chemist, or Sample Technician. Copies of the CAR will be given to the Project Chemist, Remediation Manager, Project Manager, CQCSM, and USACE point-of-contact. A copy will also be placed in the project file for future reference. A sample CAR is shown in **Figure 9-1**.

CORRECTIVE ACTION REPORT

TO:
FROM:
PC:
DATE:
PROJECT: **PROJECT NUMBER:**

NATURE OF EVENT:

RECOMMENDED CORRECTIVE ACTION:

CORRECTIVE ACTION TAKEN:

DATE:_____ TIME:_____ CORRECTIVE ACTION TAKEN:_____

SIGNATURE of person implementing corrective action:_____

Figure 9-1
Corrective Action Report Form

10.0 References

U. S. Army Corps of Engineers (USACE), 2001, *Engineering and Design - Requirements for the Preparation of Sampling and Analysis Plans*, Document EM-200-1-3.

USACE, 2005, *Performance Work Statement (PWS), Longhorn Army Ammunition Plant*, July 22.

Attachment 1

Analytical Methods and Constituent/Detection Limits

Comparison of Typical Laboratory Detection Limits to Screening Levels of Aqueous Samples
Volatile Organic Compounds - Method 8260B
Longhorn Army Ammunition Plant, Karnack, Texas

Analyte	Units	Reporting Limit[1]	Groundwater Standard (MCL)[2]
1,1,1,2-Tetrachloroethane	mg/L	0.0005	0.00328
1,1,1-Trichloroethane	mg/L	0.0008	0.2
1,1,2,2-Tetrachloroethane	mg/L	0.0004	0.000426
1,1,2-Trichloroethane	mg/L	0.001	0.005
1,1-Dichloroethane	mg/L	0.0004	0.365
1,1-Dichloroethylene	mg/L	0.0012	0.007
1,1-Dichloropropene	mg/L	0.001	0.000852
1,2,3-Trichlorobenzene	mg/L	0.0003	0.011
1,2,3-Trichloropropane	mg/L	0.0032	1.22E-05
1,2,4-Trichlorobenzene	mg/L	0.0004	0.07
1,2-Dibromoethane	mg/L	0.0006	0.00005
1,2-Dichlorobenzene	mg/L	0.0003	0.6
1,2-Dichloroethane	mg/L	0.0006	0.005
1,2-Dichloropropane	mg/L	0.0004	0.005
1,3-Dichlorobenzene	mg/L	0.0012	0.11
1,3-Dichloropropane	mg/L	0.0004	0.000852
1,4-Dichlorobenzene	mg/L	0.0003	0.075
1,4-Dioxane	mg/L	--	0.00774
2,2-Dichloropropane	mg/L	0.0035	--
2-Hexanone	mg/L	0.005	0.219
Acetone	mg/L	0.005	0.365
Acrolein	mg/L	0.0004	0.018
Benzene	mg/L	0.0004	0.005
Benzene, 1,2,4-trimethyl	mg/L	0.0013	0.183
Benzene, 1,3,5-trimethyl	mg/L	0.0005	0.183
Benzene, 1-methylethyl	mg/L	--	0.365
Bromobenzene	mg/L	0.0003	0.073
Bromodichloromethane	mg/L	0.0008	0.1
Bromoform	mg/L	0.0012	0.1
Carbon tetrachloride	mg/L	0.0021	0.005
Carbondisulfide	mg/L	0.005	0.365
Chlorobenzene	mg/L	0.0004	0.1
Chlorobromomethane	mg/L	0.0004	0.146
Chlorodibromomethane	mg/L	0.0005	0.1
Chloroethane	mg/L	0.001	1.46
Chloroform	mg/L	0.001	0.1
cis-1,2-Dichloroethene	mg/L	0.0012	0.07
cis-1,3-Dichloropropene	mg/L	0.001	0.000158

Comparison of Typical Laboratory Detection Limits to Screening Levels of Aqueous Samples
Volatile Organic Compounds - Method 8260B
Longhorn Army Ammunition Plant, Karnack, Texas
(continued)

Analyte	Units	Reporting Limit[1]	Groundwater Standard (MCL)[2]
Dichlorodifluoromethane	mg/L	0.001	0.73
Ethylbenzene	mg/L	0.0006	0.7
Hexachlorobutadiene	mg/L	0.0011	0.00073
Isobutyl Alcohol	mg/L	--	1.1
Methyl chloride	mg/L	--	0.00655
Methyl ethyl ketone	mg/L	0.005	2.19
Methyl iodide	mg/L	0.001	0.00511
Methyl isobutylketone (MIBK)	mg/L	0.0015	0.292
Methyl tert-butyl ether	mg/L	0.001	0.015
Methylene bromide	mg/L	0.001	0.0114
Methylene chloride	mg/L	0.0003	0.005
Naphthalene	mg/L	0.0004	0.073
n-Butylbenzene	mg/L	0.0011	0.146
n-Propylbenzene	mg/L	0.0004	0.146
o-Chlorotoluene	mg/L	0.0004	0.073
p-Chlorotoluene	mg/L	0.0006	0.073
p-Cymene	mg/L	--	0.365
sec-Butylbenzene	mg/L	0.0013	0.146
Styrene	mg/L	0.0004	0.1
tert-Butylbenzene	mg/L	0.0014	0.146
Tetrachloroethylene	mg/L	0.0014	0.005
Toluene	mg/L	0.0011	1
trans-1,2-Dichloroethene	mg/L	0.0005	--
trans-1,3-Dichloropropene	mg/L	0.001	0.000852
Trichloroethylene	mg/L	0.001	0.005
Trichlorofluoromethane	mg/L	0.0008	1.1
Vinyl Acetate	mg/L	0.0075	0.107
Vinyl chloride	mg/L	0.0011	0.002
Xylene (total)	mg/L	0.003	8.93

Note:
[1]Reporting limits are laboratory-specific and will vary. The laboratory will be instructed to report to the method detection limit, which is a laboratory-specific limit less than the reporting limit, in an attempt to meet the groundwater risk standard.
[2]Safe Drinking Water Act, 40 CFR 141 and 30 Texas Administrative Code 290

Comparison of Typical Laboratory Detection Limits to Screening Levels of Aqueous Samples
Explosives - Method 8260
Longhorn Army Ammunition Plant, Karnack, Texas

Analyte	Units	Reporting Limit[1]	Groundwater Risk Standard
2,4-Dinitrotoluene	mg/L	0.001	0.000125
2,6-Dinitrotoluene	mg/L	0.001	0.000125
2-Amino-4,6-dinitrotoluene	mg/L	0.001	0.000608
4-Amino-2,6-dinitrotoluene	mg/L	0.001	0.000608
HMX	mg/L	0.001	0.183
m-Dinitrobenzene	mg/L	0.001	0.000365
m-Nitrotoluene	mg/L	0.001	0.0365
Nitrobenzene	mg/L	0.001	0.00183
o-Nitrotoluene	mg/L	0.001	0.0365
I p-Nitrotoluene	mg/L	0.001	0.0365
RDX	mg/L	0.001	0.000774
sym-Trinitrobenzene	mg/L	0.001	0.11
Tetryl	mg/L	0.001	0.0365
Trinitrotoluene, 2,4,6-(TNT)	mg/L	0.001	0.00183

Note:
[1]Reporiing limits are laboratory-specific and will vary. The laboratory will be instructed to report to the method detection limit, which is a laboratory-specific limit less than the reporting limit, in an attempt to meet the groundwater risk standard.

Comparison of Typical Laboratory Detection Limits to Screening Levels of Aqueous Samples
Perchlorate - Method 314
Longhorn Army Ammunition Plant, Karnack, Texas

Analyte	Units	Reporting Limit[1]	Groundwater Standard
Perchlorate	mg/L	0.005	0.004[2]

Note:
[1]Reporting limits are laboratory-specific and will vary. The laboratory will be instructed to report to the method detection limit, which is a laboratory-specific limit less than the reporting limit, in an attempt to meet the groundwater risk standard.
[2]30 Texas Administrative Code 290. Texas has promulgated the federal secondary maximum contaminant levels into Texas Administrative Code

Comparison of Typical Laboratory Detection Limits to Screening Levels of Aqueous Samples
Metals - Method 7841 or 6020
Longhorn Army Ammunition Plant, Karnack, Texas

Analyte	Units	Reporting Limit[1]	Groundwater Risk Standard
Thallium	mg/L	0.002	0.002[2]
Antimony	mg/L	0.002	0.006[2]

Note:
[1]Reporting limits are laboratory-specific and will vary. The laboratory will be instructed to report to the method detection limit, which is a laboratory-specific limit less than the reporting limit, in an attempt to meet the groundwater risk standard.
[2]Safe Drinking Water Act, 40 CFR 141 and 30 Texas Administrative Code 290

Appendix H

Project Schedule and Cost Summary

Table 1
Project Schedule

Project Activity	Activity Duration	Project Schedule (Week)	Year
Mobilization and site preparation	2 days	1	1
Install monitoring wells	1 week	1-2	
Site restoration	2 days	4	
Demobilization	2 days	4	
Annual site inspection/document	2 days	4	
Conduct first quarterly groundwater sampling	8 days	4-5	
Develop and submit Institutional Control documents to County and State	1 month	6-10	
Conduct second quarterly groundwater sampling	8 days	13-14	
Conduct third quarterly groundwater sampling	8 days	38-39	
Conduct fourth quarterly groundwater sampling	8 days	51-52	
Annual site inspection/document	2 days	53	2
MNA analysis	3 weeks	55-57	
Prepare year 1 annual report	3 weeks	58-60	
Conduct first quarterly groundwater sampling	8 days	64-65	
Conduct second quarterly groundwater sampling	8 days	77-78	
Conduct third quarterly groundwater sampling	8 days	90-91	
Conduct fourth quarterly groundwater sampling	8 days	103-104	
Annual site inspection/document	2 days	105	3
Prepare year 2 annual report	2 weeks	107-108	
Conduct first semi-annual groundwater sampling	8 days	129-130	
Conduct second semi-annual groundwater sampling	8 days	155-156	
Annual site inspection/document	2 days	157	4
Prepare year 3 annual report	2 weeks	159-160	
Conduct first semi-annual groundwater sampling	8 days	181-182	

Project Activity	Activity Duration	Project Schedule (Week)	Year
Conduct second semi-annual groundwater sampling	8 days	207-208	4
Annual site inspection/document	2 days	209	5
Prepare year 4 annual report	2 weeks	211-212	
Conduct first semi-annual groundwater sampling	8 days	233-234	
Conduct second semi-annual groundwater sampling	8 days	259-260	
Annual site inspection/document	2 days	261	6
Prepare year 5 annual report	2 weeks	263-264	
Prepare first Five-Year Review	1 month	265-268	
Plug and abandon wells	1 day	268	

Table 2

Cost Summary for LHAAP-35B(37)

	Capital Costs	O&M Costs		
Year	Install Wells	LTM	LUC	Total
1	84442	118736	16050	219228
2	0	44716	0	44716
3	3845	25160	0	29005
4	0	25160	0	25160
5	0	44600	0	44600
6	0	15382	0	15382
7	0	15382	0	15382
8	0	15382	0	15382
9	0	15382	0	15382
10	0	34822	0	34822
11	0	0	0	0
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0
15	0	34822	0	34822
16	0	0	0	0
17	0	0	0	0
18	0	0	0	0
19	0	0	0	0
20	0	34822	0	34822
21	0	0	0	0
22	0	0	0	0
23	0	0	0	0
24	0	0	0	0
25	0	34822	0	34822
26	0	0	0	0
27	0	0	0	0
28	0	0	0	0
29	0	0	0	0
30	0	34822	0	34822
	88288	494006	16050	598343

Table 3

Cost Summary for LHAAP-67

	Capital Costs	O&M Costs		
Year	Install Wells	LTM	LUC	Total
1	43068	94037	16050	153155
2	0	33393	0	33393
3	1146	16728	0	17874
4	0	16728	0	16728
5	0	38938	0	38938
6	0	12551	0	12551
7	0	12551	0	12551
8	0	12551	0	12551
9	0	12551	0	12551
10	0	31991	0	31991
11	0	0	0	0
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0
15	0	31991	0	31991
16	0	0	0	0
17	0	0	0	0
18	0	0	0	0
19	0	0	0	0
20	0	31991	0	31991
21	0	0	0	0
22	0	0	0	0
23	0	0	0	0
24	0	0	0	0
25	0	31991	0	31991
26	0	0	0	0
27	0	0	0	0
28	0	0	0	0
29	0	0	0	0
30	0	31991	0	31991
	44214	409979	16050	470243

Table 4

Cost Breakdown for LHAAP-35B(37)

Item NO	LHAAP-35B(37) Capital Costs Description	QTY	UNIT	2010 dollars $/UNIT	2010 dollars TOTAL
	Install temporary borings, sample and analyze				
	Install 9 new monitoring wells				
	Plug and abandon 2 wells				
	General Conditions				
1	Safety, training, waste, health plans, ect - 80 hrs	1	ea	5778	5778
2	Mob/demob drilling rig- 16 hrs	1	ea	1862	1862
3	Survey crew wells and LUC boundary	1	ea	2500	2500
4	Site orientation - 24 hrs	1	ea	738	738
5	Hazardous material technician -24 hrs	1	ea	1348	1348
6	Geologist - 64 hrs	1	ea	4451	4451
7	Port-let rental - 3	1	ea	343	343
8	Health and Safety/QC officers - 24 hrs	1	ea	1192	1192
9	Site superintendent - 24 hrs	1	ea	1711	1711
	Field Work - temporary borings, sampling, analysis				
1	Mob/demob direct push rig and crew	1	ea	350	350
2	Direct push rig, crew, sampling, decontamination	1	day	610	610
3	Well sampling equipment rental	1	day	60	60
4	Plug temporary borings	11	ea	30	330
5	Portable GC/MS rental	1	day	500	500
6	Operational costs	1	day	150	150
7	Field chemist	8	hours	125	1000
8	Per diem	1	day	110	110

Table 4

Cost Breakdown for LHAAP-35B(37)

Item NO	LHAAP-35B(37) Capital Costs Description	QTY	UNIT	2010 dollars $/UNIT	2010 dollars TOTAL	
9	Car rental + other	1	day	100	100	
	Field Work - install wells					
1	Clear & prepare well site	9	ea	1500	13500	
2	Install shallow wells, 33' ave depth, 4" dia PVC ($82/ft)	9	ea	2706	24354	
3	Well surface completion	9	ea	500	4500	
4	Well drill waste disposal	15	drum	268	4013	
	Subtotal				**69500**	
	Indirects@21.5%				14942	
	Total				**84442**	**year 1**
	Field Work - plug and abandon wells					
2	Mob/demob drilling rig- 16 hrs	1	ea	1862	1862	
1	Plug and abandon wells, 40' ave depth ($12/ft)	2	ea	480	960	
2	Waste disposal	1	ea	343	343	
	Subtotal				3165	
	Indirects@21.5%				680	
	Total				**3845**	**year 3**

Table 4

Cost Breakdown for LHAAP-35B(37)

Item NO	**LHAAP-35B(37)** **Long Term Monitoring** Description	QTY	UNIT	2010 dollars $/UNIT	2010 dollars TOTAL	Annual Cost
	Number of monitoring wells	16				
	Number of surface water sample locations	2				
	Year 1 (4 sampling events)					
1	Establish initial database, licenses, coordinate well characterization & other well info, develop work plans	1	ea	31565	31565	
2	Collect and prepare samples quarterly (GW) (4 man hrs/sample)	64	ea	306	19584	
3	Collect and prepare samples quarterly (SW) (1 man hr/sample)	8	ea	76	608	
4	Sample analysis (6 wells - natural attenuation parameters - $550)	24	ea	550	13200	
5	Sample analysis (VOCs - $ 100)	72	ea	100	7200	
6	QC/QA analysis (VOCs - 12/sampling event)	48	ea	100	4800	
7	Sample analysis (antimony and thallium - $92 for both)	16	ea	92	1472	
8	QC/QA analysis (metals - 8/sampling event)	8	ea	92	736	
9	MNA analysis	1	ea	10000	10000	
10	Annual report	1	ea	8560	8560	
	Subtotal				**97725**	
	Indirects@21.5%				21011	
	Year 1 Totals				**118736**	**118736**

Table 4

Cost Breakdown for LHAAP-35B(37)

Item NO	LHAAP-35B(37) Long Term Monitoring Description	QTY	UNIT	2010 dollars $/UNIT	2010 dollars TOTAL	Annual Cost
	Year 2 (4 sampling events)					
1	Collect and prepare samples quarterly (GW)	64	ea	306	19584	
2	Collect and prepare samples quarterly (SW)	8	ea	76	608	
3	Sample analysis (VOCs - $ 100)	72	ea	100	7200	
4	QC/QA analysis (VOCs - 12/sampling event)	48	ea	100	4800	
5	Annual report	1	ea	4612	4612	
	Subtotal				**36804**	
	Indirects@21.5%				7913	
	Year 2 Totals				**44716**	**44716**
	Year 3-4 (4 sampling events)					
1	Collect and prepare samples semi-annually (GW)	64	ea	306	19584	
2	Collect and prepare samples semi-annually (SW)	8	ea	76	608	
3	Sample analysis (VOCs - $ 100)	72	ea	100	7200	
4	QC/QA analysis (VOCs - 12/sampling event)	48	ea	100	4800	
5	Annual report	2	ea	4612	9223	
	Subtotal				**41415**	
	Indirects@21.5%				8904	
	Year 3-4 Totals				**50320**	**25160**
	Year 5 (2 sampling events)					
1	Collect and prepare samples semi-annually (GW)	32	ea	306	9792	

Table 4

Cost Breakdown for LHAAP-35B(37)

Item NO	**LHAAP-35B(37)** **Long Term Monitoring** Description	QTY	UNIT	2010 dollars $/UNIT	2010 dollars TOTAL	Annual Cost
2	Collect and prepare samples semi-annually (SW)	4	ea	76	304	
3	Sample analysis (VOCs - $ 100)	36	ea	100	3600	
4	QC/QA analysis (VOCs - 12/sampling event)	24	ea	100	2400	
5	Annual report	1	ea	4612	4612	
6	CERCLA 5-yr review	1	ea	16000	16000	
	Subtotal				**36708**	
	Indirects@21.5%				7892	
	Year 5 Totals				**44600**	**44600**
	Year 6-9 (4 sampling events)					
1	Collect and prepare samples annually (GW)	64	ea	306	19584	
2	Collect and prepare samples annually (SW)	8	ea	76	608	
3	Sample analysis (VOCs - $ 100)	72	ea	100	7200	
4	QC/QA analysis (VOCs - 12/sampling event)	48	ea	100	4800	
5	Annual report	4	ea	4612	18447	
	Subtotal				**50639**	
	Indirects@21.5%				10887	
	Year 6-9 Totals				**61526**	**15382**
	Cost for 1 Year: Year 10, 15, 20, 25, 30 (1 sampling event)					
1	Collect and prepare samples annually (GW)	16	ea	306	4896	
2	Collect and prepare samples annually (SW)	2	ea	76	152	
3	Sample analysis (VOCs - $ 100)	18	ea	100	1800	

Table 4

Cost Breakdown for LHAAP-35B(37)

Item NO	LHAAP-35B(37) Long Term Monitoring Description	QTY	UNIT	2010 dollars $/UNIT	2010 dollars TOTAL	Annual Cost
4	QC/QA analysis (VOCs - 12/sampling event)	12	ea	100	1200	
5	Annual report	1	ea	4612	4612	
6	CERCLA 5-yr review	1	ea	16000	16000	
	Subtotal				**28660**	
	Indirects@21.5%				6162	
	Cost each Year, Year 10, 15, 20, 25, 30				**34822**	**34822**

Table 4

Cost Breakdown for LHAAP-35B(37)

Item NO	LHAAP-35B(37) Land Use Controls Description	QTY	UNIT	2010 dollars $/UNIT	2010 dollars TOTAL	
1	Allowance for Legal Fees, Administration Controls and Documentation	1	lot	16050	16050	
					16050	Year 1 cost

Table 5

Cost Breakdown for LHAAP-67

Item NO	LHAAP-67 Capital Costs Description	QTY	UNIT	2010 dollars $/UNIT	2010 dollars TOTAL
	Install temporary borings, sample and analyze				
	Install 6 new monitoring wells				
	Plug and abandon 2 wells				
	General Conditions				
1	Hazardous material technician - 24 hrs	1	ea	1348	1348
2	Geologist - 52 hrs	1	ea	3617	3617
	Field Work - temporary borings, sampling, analysis				
1	Direct push rig, crew, sampling, decontamination	1	day	610	610
2	Well sampling equipment rental	1	day	60	60
3	Plug temporary borings	8	ea	30	240
4	Portable GC/MS rental	1	day	500	500
5	Operational costs	1	day	150	150
6	Field chemist	8	hours	125	1000
7	Per diem	1	day	110	110
8	Car rental + other	1	day	100	100
	Field Work - install wells				
1	Clear & prepare well site	6	ea	1500	9000
2	Install shallow wells, 26' ave depth, 4" dia PVC ($82/ft)	6	ea	2262	13572
3	Well surface completion	6	ea	500	3000
4	Well drill waste disposal	8	drum	268	2140
	Subtotal				**35447**

Table 5

Cost Breakdown for LHAAP-67

Item NO	LHAAP-67 Capital Costs Description	QTY	UNIT	2010 dollars $/UNIT	2010 dollars TOTAL	
	Indirects@21.5%				7621	
	Total				**43068**	**year 1**
	Field Work - plug and abandon wells					
1	Plug and abandon wells, 25' ave depth ($12/ft)	2	ea	300	600	
2	Waste disposal	1	ea	343	343	
	Subtotal				**943**	
	Indirects@21.5%				203	
	Total				**1146**	**year 3**

Table 5

Cost Breakdown for LHAAP-67

Item NO	**LHAAP-67** **Long Term Monitoring** Description	QTY	UNIT	2010 dollars $/UNIT	2010 dollars TOTAL	Annual Cost
	Number of monitoring wells	11				
	Number of surface water sample locations	2				
	Year 1 (4 sampling events)					
1	Establish initial database, licenses, coordinate well characterization & other well info, develop work plans	1	ea	31565	31565	
2	Collect and prepare samples quarterly (GW)(4 man hrs/ sample)	44	ea	306	13464	
3	Collect and prepare samples quarterly (SW)(1 man hr/ sample)	8	ea	76	608	
4	Sample analysis (2 wells -natural attenuation parameters - $550)	8	ea	550	4400	
5	Sample analysis (VOCs - $100)	52	ea	100	5200	
6	QA/QC analysis (VOCs - 9/sampling event)	36	ea	100	3600	
7	MNA analysis	1	ea	10000	10000	
8	Annual report	1	ea	8560	8560	
	Subtotal				**77397**	
	Indirects@21.5%				16640	
	Year 1 Totals				**94037**	**94037**
	Year 2 (4 sampling events)					
1	Collect and prepare samples quarterly (GW)	44	ea	306	13464	
2	Collect and prepare samples quarterly (SW)	8	ea	76	608	

Table 5

Cost Breakdown for LHAAP-67

Item NO	LHAAP-67 Long Term Monitoring Description	QTY	UNIT	2010 dollars $/UNIT	2010 dollars TOTAL	Annual Cost
3	Sample analysis (VOCs - $100)	52	ea	100	5200	
4	QA/QC analysis (VOCs - 9/sampling event)	36	ea	100	3600	
5	Annual report	1	ea	4612	4612	
	Subtotal				**27484**	
	Indirects@21.5%				5909	
	Year 2 Totals				**33393**	**33393**
	Year 3-4 (4 sampling events)					
1	Collect and prepare samples semi-annually (GW)	44	ea	306	13464	
2	Collect and prepare samples semi-annually (SW)	8	ea	76	608	
3	Sample analysis (VOCs - $100)	52	ea	100	5200	
4	QA/QC analysis (VOCs - 9/sampling event)	36	ea	100	3600	
5	Annual report	2	ea	4612	9223	
	Subtotal				**32095**	
	Indirects@21.5%				1360	
	Year 3-4 Totals				**33456**	**16728**
	Year 5 (2 sampling events)					
1	Collect and prepare samples semi-annually (GW)	22	ea	306	6732	
2	Collect and prepare samples semi-annually (SW)	4	ea	76	304	
3	Sample analysis (VOCs - $100)	26	ea	100	2600	
4	QA/QC analysis (VOCs - 9/sampling event)	18	ea	100	1800	
5	Annual report	1	ea	4612	4612	

Table 5

Cost Breakdown for LHAAP-67

Item NO	LHAAP-67 Long Term Monitoring Description	QTY	UNIT	2010 dollars $/UNIT	2010 dollars TOTAL	Annual Cost
6	CERCLA 5-yr review	1	ea	16000	16000	
	Subtotal				**32048**	
	Indirects@21.5%				6890	
	Year 5 Totals				**38938**	**38938**
	Year 6-9 (4 sampling events)					
1	Collect and prepare samples annually (GW)	44	ea	306	13464	
2	Collect and prepare samples annually (SW)	8	ea	76	608	
2	Sample analysis (VOCs - $100)	52	ea	100	5200	
3	QA/QC analysis (VOCs - 9/sampling event)	36	ea	100	3600	
4	Annual report	4	ea	4612	18447	
	Subtotal				**41319**	
	Indirects@21.5%				8884	
	Year 6-9 Totals				**50202**	**12551**
	Cost for 1 Year on Years 10, 15, 20, 25, 30 (1 sampling event)					
1	Collect and prepare samples annually (GW)	11	ea	306	3366	
2	Collect and prepare sample annually (SW)	2	ea	76	152	
3	Sample analysis (VOCs - $100)	13	ea	100	1300	
4	QA/QC analysis (VOCs - 9/sampling event)	9	ea	100	900	
5	Annual report	1	ea	4612	4612	
6	CERCLA 5-yr review	1	ea	16000	16000	
	Subtotal				**26330**	

Table 5

Cost Breakdown for LHAAP-67

Item NO	LHAAP-67 Long Term Monitoring Description	QTY	UNIT	2010 dollars $/UNIT	2010 dollars TOTAL	Annual Cost
	Indirects@21.5%				5661	
	Cost each Year: Year 10, 15, 20, 25, 30				**31991**	**31991**

Table 5

Cost Breakdown for LHAAP-67

Item NO	LHAAP-67 Land Use Controls Description	QTY	UNIT	2010 dollars $/UNIT	2010 dollars TOTAL	
1	Allowance for Legal Fees, Administration Controls and Documentation	1	lot	16050	16050	Year 1 cost

Appendix D

Basis of Estimate for LHAAP-47 Remediation

Alternative 2 - Excavation, In Situ Bioremediation, MNA and LUC
Present Value

COMPANY NAME: **Shaw Environmental, Inc.**
PROJECT LOCATION: **Karnack, Texas** **Date:** **July, 2011**

Year	FY	Capital Costs				O & M Costs			Present Value (NPV)		
		Bioremediation	Design	Excavation	Monitoring	Monitoring	5-Yr Review	Total	Discount Rate	Capital	O & M
									2.8%		
1	2011	591,970	163,122	1,385,818	59,439	440,364		440,364	**NPV**	**2,980,000**	**2,110,000**
2	2012					440,364		440,364			
3	2013	160,900				200,944		200,944			
4	2014					200,944		200,944	**Total Capital and O&M**		**$5,090,000**
5	2015					200,944	42,525	243,469			
6	2016	418,191				81,244		81,244			
7	2017					81,244		81,244			
8	2018					81,244		81,244			
9	2019					81,244		81,244			
10	2020					81,244	42,525	123,769			
11	2021	418,191						0			
12	2022							0			
13	2023							0			
14	2024							0			
15	2025					81,244	42,525	123,769			
16	2026							0			
17	2027							0			
18	2028							0			
19	2029							0			
20	2030					81,244	42,525	123,769			
21	2031							0			
22	2032							0			
23	2033							0			
24	2034							0			
25	2035					81,244	42,525	123,769			
26	2036							0			
27	2037							0			
28	2038							0			
29	2039							0			
30	2040					81,244	42,525	123,769			
		1,589,253	163,122	1,385,818	59,439	2,214,759	255,150	2,469,909			

Alternative 2 - Excavation, In Situ Bioremediation, MNA and LUC
Plans and Designs

COMPANY NAME: **Shaw Environmental, Inc.**
PROJECT LOCATION: **Karnack, Texas** **DATE:** **July, 2011**

DESCRIPTION	QTY	UNIT	LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT		TOTAL ($)
			UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	
Year 1 - Design Activities														
Excavation Work Plans/Design	1	ea	250	250	eng	81.60	20,400	500	500					20,900
	1	ea	250	250	geol	71.20	17,800							17,800
Allowance for Legal Fees,	1	lot										15,000	15,000	15,000
Controls, Well Documentation														
Establish database, licenses,	1	ea	150	150	eng	81.60	12,240	500	500					12,740
monitoring work plans, etc.	1	ea	150	150	geol	71.20	10,680							10,680
DPT Study	1	ls										20,000	20,000	20,000
Pilot Study	1	ls										20,000	20,000	20,000
Direct Injection and Biobarrier	5	dy	10	50	vendor	98.31	4,916							4,916
Design Activities	8	dy	10	80	eng	81.60	6,528							6,528
	4	dy	10	40	geol	71.20	2,848	250	1,000					3,848
	5	dy	10	50	tech	34.30	1,715							1,715
Capital Costs Subtotal							**77,127**		**2,000**		**0**		**55,000**	**134,127**
Taxes @ 6.5 %									130					130
Subtotal														**134,257**
Indirects @ 21.5%														28,865
Design Capital costs														**$ 163,122**

Alternative 2 - Excavation, In Situ Bioremediation, MNA and LUC
Excavation

COMPANY NAME: **Shaw Environmental, Inc.**
PROJECT LOCATION: **Karnack, Texas** **DATE:** **July, 2011**

DESCRIPTION	QTY	UNIT	LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT		TOTAL ($)
			UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	
	9000	**cubic yards**		**Excavate soil with perchlorate**										
Year 1														
Waste Characterization	1	ea	4	4	chem	71.20	285	50	50					335
	2	ea	4	8	tech	34.30	274	400	800	200	400	1,500	3,000	4,474
Mobilization/Demobilization	1	ea	10	10	super	72.30	723	350	350	500	500	5,000	5,000	6,573
	1	ea	10	10	h/s	55.70	557							557
	2	ea	10	20	tech	34.30	686							686
Clear and Grub & Erosion Control	1	ea	10	10	h/s	55.70	557	1,000	1,000			10,000	10,000	11,557
Soil Excavation Activities	100	dy	10	1000	super	72.30	72,300	129	12,900	500	50,000			135,200
	100	dy	10	1000	tech	34.30	34,300	129	12,900					47,200
	100	dy	10	1000	h/s	55.70	55,700	129	12,900					68,600
	100	dy	10	1000	op	33.80	33,800	129	12,900					46,700
Port-o-let Rental	4	months								320	1,280			1,280
Transport and Disposal (non-haz)	780	load						50	39,000			600	468,000	507,000
Confirmation Sampling	50	ea						50	2,500			275	13,750	16,250
Site Restoration Backfill	11700	cy						10	117,000					117,000
Site Restoration Surface Cover	20000	sf										0.13	2,600	2,600
Per Diem, PPE, Hotel Rooms	408	m-dy						175	71,400			77	31,416	102,816
Two Crew Trucks	101	dy								150	15,150			15,150
Survey Crew	5	dy										1,000	5,000	5,000
Closeout Report	1	ea	400	400	eng	81.60	32,640	500	500					33,140
Capital Costs Subtotal							**231,822**		**284,200**		**67,330**		**538,766**	**1,122,118**
Taxes @ 6.5 %									18,473					18,473
Subtotal														**1,140,591**
Indirects @ 21.5%														245,227
Excavation Capital costs														**$ 1,385,818**

Alternative 2 - Excavation, In Situ Bioremediation, MNA and LUC
In Situ Bioremediation - Direct Injection

COMPANY NAME: Shaw Environmental, Inc.
PROJECT LOCATION: Karnack, Texas **DATE:** July, 2011

DESCRIPTION	QTY	UNIT	LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT		TOTAL ($)
			UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	
Perform Direct Injection Bioremediation in Year 1 - near 47WW25														
Site Clearing for Injection Access														
Superintendent	4	dy	10	40	super	72.30	2,892							2,892
Geologist	4	dy	10	40	geol	71.20	2,848							2,848
Technician	4	dy	10	40	tech	34.30	1,372							1,372
Equipment Rental	1	wk								1000	1,000			1,000
Injection Activities														
Superintendent	11	dy	10	110	super	72.30	7,953							7,953
Geologist	11	dy	10	110	geol	71.20	7,832							7,832
Technician	11	dy	10	110	tech	34.30	3,773							3,773
Bioaugmentation Materials, ESO and SDC-9	100	pts	Emulsified Soybean Oil (ESO)					83.62	8,362					8,362
	1	ea	Shipping ESO, Trailer, Mob/Demob					5,000	5,000	10,000	10,000	5,000	5,000	20,000
	100	pts	Bacterial Culture (SDC-9)					79	7,930	cost	280	shipping		8,210
Injection System - Equipment, materials	2	week						1,250	2,500	1,250	2,500			5,000
and flush water	100	pts	Injection Chase Water					4	400					400
DPT Injections	100	ea										500	50,000	50,000
Airfare	2	ea										500	1,000	1,000
Per Diem and PPE, Crew Truck, Lodging	45	m-day						175	7,875	75	3,375	77	3,465	14,715
Subtotal							**26,670**		**32,067**		**17,155**		**59,465**	**135,357**
Taxes @ 6.5 %									2,084					2,084
Subtotal														**137,441**
Indirects @ 21.5%														29,550
Total Cost Per Injection														**$ 166,991**

Alternative 2 - Excavation, In Situ Bioremediation, MNA and LUC
In Situ Bioremediation - Direct Injection

COMPANY NAME: Shaw Environmental, Inc.
PROJECT LOCATION: Karnack, Texas **DATE:** July, 2011

DESCRIPTION	QTY	UNIT	LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT		TOTAL ($)
			UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	
Perform Direct Injection Bioremediation in Year 3														
		Assumptions:	Repeat Direct Injection Bioremediation for one area, less effort required to clear vegetation.											
Site Clearing for Injection Access														
Superintendent	1	dy	10	10	super	72.30	723							723
Geologist	1	dy	10	10	geol	71.20	712							712
Technician	1	dy	10	10	tech	34.30	343							343
Equipment Rental	1	wk								1000	1,000			1,000
Injection Activities														
Superintendent	11	dy	10	110	super	72.30	7,953							7,953
Geologist	11	dy	10	110	geol	71.20	7,832							7,832
Technician	11	dy	10	110	tech	34.30	3,773							3,773
Bioaugmentation Materials, ESO and SDC-9	100	pts	Emulsified Soybean Oil (ESO)					74.46	7,446					7,446
	1	ea	Shipping ESO, Trailer, Mob/Demob					5,000	5,000	10,000	10,000	5,000	5,000	20,000
	100	pts	Bacterial Culture (SDC-9)					118	11,800	cost	500	shipping		12,300
Injection System - Equipment, materials	2	week						1,250	2,500	1,250	2,500			5,000
and flush water	100	pts	Injection Chase Water					4	400					400
DPT Injections	100	ea										500	50,000	50,000
Airfare	2	ea										500	1,000	1,000
Per Diem and PPE, Crew Truck, Lodging	36	m-day						175	6,300	75	2,700	77	2,772	11,772
Subtotal							**21,336**		**33,446**		**16,700**		**58,772**	**130,254**
Taxes @ 6.5 %									2,174					2,174
Subtotal														**132,428**
Indirects @ 21.5%														28,472
Total Cost Per Injection														**$ 160,900**

Alternative 2 - Excavation, In Situ Bioremediation, MNA and LUC
In Situ Bioremediation - Biobarriers

COMPANY NAME: Shaw Environmental, Inc.

PROJECT LOCATION: Karnack, Texas **DATE:** July, 2011

				LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT		
DESCRIPTION	QTY	UNIT	UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	TOTAL ($)
Install 7 Biobarriers in Year 1 near Target Areas														
Site Clearing for Injection Access														
Superintendent	4	dy	10	40	super	72.30	2,892							2,892
Geologist	4	dy	10	40	geol	71.20	2,848							2,848
Technician	4	dy	10	40	tech	34.30	1,372							1,372
Equipment Rental	1	wk								1000	1,000			1,000
Injection Activities														
Superintendent	26	dy	10	260	super	72.30	18,798							18,798
Geologist	26	dy	10	260	geol	71.20	18,512							18,512
Technician	26	dy	10	260	tech	34.30	8,918							8,918
Bioaugmentation Materials, ESO and SDC-9	140	pts	Emulsified Soybean Oil (ESO)					382	53,480					53,480
	1	ea	Shipping ESO, Trailer, Mob/Demob					5,000	5,000	10,000	10,000	5,000	5,000	20,000
	140	pts	Bacterial Culture (SDC-9)					494	69,160	cost	3,000	shipping		72,160
Injection System - Equipment, materials	6	week						5,000	30,000	1,250	7,500			37,500
and flush water	140	pts	Injection Chase Water					4	560					560
DPT Injections	140	ea										500	70,000	70,000
Airfare	2	ea										500	1,000	1,000
Per Diem and PPE, Crew Truck, Lodging	90	m-day						175	15,750	75	6,750	77	6,930	29,430
Subtotal							**53,340**		**173,950**		**28,250**		**82,930**	**338,470**
Taxes @ 6.5 %									11,307					11,307
Subtotal														**349,777**
Indirects @ 21.5%														75,202
Total Cost Per Injection														**$ 424,979**

Alternative 2 - Excavation, In Situ Bioremediation, MNA and LUC
In Situ Bioremediation - Biobarriers

COMPANY NAME: Shaw Environmental, Inc.

PROJECT LOCATION: Karnack, Texas **DATE:** July, 2011

				LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT		
DESCRIPTION	QTY	UNIT	UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	TOTAL ($)
Renew Biobarriers in Years 6 and 11														
Assumes that a reduced level of clearing will be required, and no further design work will be needed.														
Site Clearing for Injection Access														
Superintendent	2	dy	10	20	super	72.30	1,446							1,446
Geologist	2	dy	10	20	geol	71.20	1,424							1,424
Technician	2	dy	10	20	tech	34.30	686							686
Equipment Rental	1	wk								1000	1,000			1,000
Injection Activities														
Superintendent	26	dy	10	260	super	72.30	18,798							18,798
Geologist	26	dy	10	260	geol	71.20	18,512							18,512
Technician	26	dy	10	260	tech	34.30	8,918							8,918
Bioaugmentation Materials, ESO and SDC-9	140	pts	Emulsified Soybean Oil (ESO)					382	53,480					53,480
	1	ea	Shipping ESO, Trailer, Mob/Demob					5,000	5,000	10,000	10,000	5,000	5,000	20,000
	140	pts	Bacterial Culture (SDC-9)					494	69,160	cost	3,000	shipping		72,160
Injection System - Equipment, materials	6	week						5,000	30,000	1,250	7,500			37,500
and flush water	140	pts	Injection Chase Water					4	560					560
DPT Injections	140	ea										500	70,000	70,000
Airfare	2	ea										500	1,000	1,000
Per Diem and PPE, Crew Truck, Lodging	84	m-day						175	14,700	75	6,300	77	6,468	27,468
Subtotal							**49,784**		**172,900**		**27,800**		**82,468**	**332,952**
Taxes @ 6.5 %									11,239					11,239
Subtotal														**344,191**
Indirects @ 21.5%														74,001
Total Cost Per Biobarrier Renewal Event														**$ 418,191**

Alternative 2 - Excavation, In Situ Bioremediation, MNA and LUC
Monitoring 40 Wells

COMPANY NAME: Shaw Environmental, Inc.
PROJECT LOCATION: Karnack, Texas **DATE:** July, 2011

DESCRIPTION	QTY	UNIT	LABOR UNIT MH	LABOR TOTAL MH	LABOR CRAFT	LABOR $/MH	LABOR $ VALUE	MATERIAL $/UNIT	MATERIAL $ VALUE	EQUIPMENT $/UNIT	EQUIPMENT $ VALUE	SUBCONTRACT $/UNIT	SUBCONTRACT $ VALUE	TOTAL ($)
Install 5 Monitoring Wells														
Year 1														
Supervise Well Installation, Log Boring	10	dy	10	100	geo	71.20	7,120			100	1,000			8,120
Per Diem, PPE, and Hotel	10	m-dy						175	1,750			77	770	2,520
Geoprobe install additional monitoring wells	5	ea						1,500	7,500	36	180	6000	30,000	37,680
Subtotal							**7,120**		**9,250**		**1,180**		**30,770**	**48,320**
Taxes @ 6.5 %									601					601
Subtotal														**48,921**
Indirects @ 21.5%														10,518
Year 1 total (Capital)														**$ 59,439**
Monitoring of 40 wells (and 20% for QC)														
Years 1 and 2														
Collect and prepare samples quarterly (GW)	192	ea	16	3,072	tech	34.30	105,370	110	21,120	36	6,912			133,402
Sample analysis (VOC, perchlorate, MNA)	192	ea										700	134,400	134,400
Sample analysis (SVOC, metals, explosives)	192	ea										400	76,800	76,800
Surface water analysis (perchlorate, VOC)	16	ea	1	16	tech	34.30	550	50	800	20	320	500	8,000	9,670
Annual report	1	ea	80	80	eng	81.60	6,530	200	200					6,730
Subtotal							**112,450**		**22,120**		**7,232**		**219,200**	**361,002**
Taxes @ 6.5 %									1,438					1,438
Subtotal														**362,440**
Indirects @ 21.5%														77,925
Years 1 and 2 Annual Total														**$ 440,364**
Combined Years 1 and 2 Total														880,729
Years 3, 4 and 5														
Collect and prepare samples semiannually	96	ea	16	1,536	tech	34.30	52,685	110	10,560	36	3,456			66,701
Sample analysis (VOCs, perchlorate)	96	ea										500	48,000	48,000
Sample analysis (SVOC, metals, explosives)	96	ea										400	38,400	38,400
Surface water analysis (perchlorate, VOC)	8	ea	1	8	tech	34.30	270	50	400	20	160	500	4,000	4,830
Annual report	1	ea	80	80	eng	81.60	6,530	200	200					6,730
Subtotal							**59,485**		**11,160**		**3,616**		**90,400**	**164,661**
Taxes @ 6.5 %									725					725
Subtotal														**165,386**
Indirects @ 21.5%														35,558
Years 3, 4 and 5 Annual Total														**$ 200,944**
Combined Years 3, 4 and 5 Total														602,833

Alternative 2 - Excavation, In Situ Bioremediation, MNA and LUC
Monitoring 40 Wells

COMPANY NAME: Shaw Environmental, Inc.
PROJECT LOCATION: Karnack, Texas **DATE:** July, 2011

			LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT		
DESCRIPTION	**QTY**	**UNIT**	**UNIT MH**	**TOTAL MH**	**CRAFT**	**$/MH**	**$ VALUE**	**$/UNIT**	**$ VALUE**	**$/UNIT**	**$ VALUE**	**$/UNIT**	**$ VALUE**	**TOTAL ($)**
Years 6 through 10														
Collect and prepare samples annually	48	ea	16	768	tech	34.30	26,342	110	5,280	36	1,728			33,350
Sample analysis (VOCs, perchlorate)	48	ea										500	24,000	24,000
Surface water analysis (perchlorate, VOC)	4	ea	1	4	tech	34.30	140	50	200	20	80	500	2,000	2,420
Annual report	1	ea	80	80	eng	81.60	6,528	200	200					6,728
Subtotal							**33,010**		**5,680**		**1,808**		**26,000**	**66,498**
Taxes @ 6.5 %									369					369
Subtotal														**66,868**
Indirects @ 21.5%														14,377
Years 6 through 10 Annual Total														**$ 81,244**
Combined Years 6 through 10 Total														406,221
Years 15, 20, 25, 30														
Collect and prepare samples	48	ea	16	768	tech	34.30	26,342	110	5,280	36	1,728			33,350
Sample analysis (VOCs, perchlorate)	48	ea										500	24,000	24,000
Surface water analysis (perchlorate, VOC)	4	ea	1	4	tech	34.30	140	50	200	20	80	500	2,000	2,420
Event report	1	ea	80	80	eng	81.60	6,528	200	200					6,728
Subtotal							**33,010**		**5,680**		**1,808**		**26,000**	**66,498**
Taxes @ 6.5 %									369					369
Subtotal														**66,868**
Indirects @ 21.5%														14,377
Years 15, 20, 25, 30 Event Total														**$ 81,244**
Combined Years 15, 20, 25, 30 Total														324,977
Five Year Review Report, Years 5, 10, 15, 20, 25, 30														
Five Year Inspection/Report	1	ea										35000	35,000	35,000
Subtotal							**0**		**0**		**0**		**35,000**	**35,000**
Taxes @ 6.5 %									0					0
Subtotal														**35,000**
Indirects @ 21.5%														7,525
Total for A Five Year Inspection / Report														**$ 42,525**
Combined Total for Years 5, 10, 15, 20, 25, 30														255,150

Alternative 3 - Excavation, Recirculating Bioremediation, MNA and LUC
Present Value

COMPANY NAME: **Shaw Environmental, Inc.**
PROJECT LOCATION: **Karnack, Texas** **Date:** **July, 2011**

Year	FY	Capital Costs				O & M Costs			Present Value (NPV)		
		Bioremediation	Design	Excavation	Monitoring	Monitoring	5-Yr Review	Total	Discount Rate	Capital	O & M
									2.8%		
1	2011	3,605,914	169,887	1,385,818	59,439	440,364		440,364	**NPV**	**5,510,000**	**2,110,000**
2	2012					440,364		440,364			
3	2013	313,683				200,944		200,944			
4	2014					200,944		200,944	**Total Capital and O&M**		**$7,620,000**
5	2015	157,355				200,944	42,525	243,469			
6	2016					81,244		81,244			
7	2017					81,244		81,244			
8	2018					81,244		81,244			
9	2019					81,244		81,244			
10	2020					81,244	42,525	123,769			
11	2021							0			
12	2022							0			
13	2023							0			
14	2024							0			
15	2025					81,244	42,525	123,769			
16	2026							0			
17	2027							0			
18	2028							0			
19	2029							0			
20	2030					81,244	42,525	123,769			
21	2031							0			
22	2032							0			
23	2033							0			
24	2034							0			
25	2035					81,244	42,525	123,769			
26	2036							0			
27	2037							0			
28	2038							0			
29	2039							0			
30	2040					81,244	42,525	123,769			
		4,076,952	169,887	1,385,818	59,439	2,214,759	255,150	2,469,909			

Alternative 3 - Excavation, Recirculating Bioremediation, MNA and LUC
Plans and Designs

COMPANY NAME: **Shaw Environmental, Inc.**
PROJECT LOCATION: **Karnack, Texas** **DATE:** **July, 2011**

DESCRIPTION	QTY	UNIT	LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT		TOTAL ($)
			UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	
Year 1 - Design Activities														
Excavation Work Plans/Design	1	ea	250	250	eng	81.60	20,400	500	500					20,900
	1	ea	250	250	geol	71.20	17,800							17,800
Allowance for Legal Fees,	1	lot										15,000	15,000	15,000
Controls, Well Documentation														
Establish database, licenses,	1	ea	150	150	eng	81.60	12,240	500	500					12,740
monitoring work plans, etc.	1	ea	150	150	geol	71.20	10,680							10,680
DPT Study	1	ls										20,000	20,000	20,000
Pilot Study	1	ls										20,000	20,000	20,000
Direct Injection Bioremediation	2	dy	10	20	vendor	98.31	1,966							1,966
Design Activities	4	dy	10	40	eng	81.60	3,264							3,264
	1	dy	10	10	geol	71.20	712	250	250					962
	2	dy	10	20	tech	34.30	686							686
Recirculating Bioremediation	4	dy	10	40	vendor	98.31	3,932	250	1,000					4,932
Design Activities	8	dy	10	80	eng	81.60	6,528							6,528
	4	dy	10	40	geol	71.20	2,848							2,848
	4	dy	10	40	tech	34.30	1,372							1,372
Capital Costs Subtotal							**82,429**		**2,250**		**0**		**55,000**	**139,679**
Taxes @ 6.5 %									146					146
Subtotal														**139,825**
Indirects @ 21.5%														30,062
Design Capital costs														**$ 169,887**

Alternative 3 - Excavation, Recirculating Bioremediation, MNA and LUC
Excavation

COMPANY NAME: **Shaw Environmental, Inc.**
PROJECT LOCATION: **Karnack, Texas** **DATE:** **July, 2011**

DESCRIPTION	QTY	UNIT	LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT		TOTAL ($)
			UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	
	9000	**cubic yards**		**Excavate soil with perchlorate**										
Year 1														
Waste Characterization	1	ea	4	4	chem	71.20	285	50	50					335
	2	ea	4	8	tech	34.30	274	400	800	200	400	1,500	3,000	4,474
Mobilization/Demobilization	1	ea	10	10	super	72.30	723	350	350	500	500	5,000	5,000	6,573
	1	ea	10	10	h/s	55.70	557							557
	2	ea	10	20	tech	34.30	686							686
Clear and Grub & Erosion Control	1	ea	10	10	h/s	55.70	557	1,000	1,000			10,000	10,000	11,557
Soil Excavation Activities	100	dy	10	1000	super	72.30	72,300	129	12,900	500	50,000			135,200
	100	dy	10	1000	tech	34.30	34,300	129	12,900					47,200
	100	dy	10	1000	h/s	55.70	55,700	129	12,900					68,600
	100	dy	10	1000	op	33.80	33,800	129	12,900					46,700
Port-o-let Rental	4	months								320	1,280			1,280
Transport and Disposal (non-haz)	780	load						50	39,000			600	468,000	507,000
Confirmation Sampling	50	ea						50	2,500			275	13,750	16,250
Site Restoration Backfill	11700	cy						10	117,000					117,000
Site Restoration Surface Cover	20000	sf										0.13	2,600	2,600
Per Diem, PPE, Hotel Rooms	408	m-dy						175	71,400			77	31,416	102,816
Two Crew Trucks	101	dy								150	15,150			15,150
Survey Crew	5	dy										1,000	5,000	5,000
Closeout Report	1	ea	400	400	eng	81.60	32,640	500	500					33,140
Capital Costs Subtotal							**231,822**		**284,200**		**67,330**		**538,766**	**1,122,118**
Taxes @ 6.5 %									18,473					18,473
Subtotal														**1,140,591**
Indirects @ 21.5%														245,227
Excavation Capital costs														**$ 1,385,818**

Alternative 3 - Excavation, Recirculating Bioremediation, MNA and LUC
In Situ Bioremediation - Direct Injection Bioremediation

COMPANY NAME: Shaw Environmental, Inc.
PROJECT LOCATION: Karnack, Texas **DATE:** July, 2011

DESCRIPTION	QTY	UNIT	LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT		TOTAL ($)
			UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	
Perform Direct Injection Bioremediation in Year 1 - near 47WW11, 47WW25, and LHSMW56														
Site Clearing for Injection Access														
Superintendent	4	dy	10	40	super	72.30	2,892							2,892
Geologist	4	dy	10	40	geol	71.20	2,848							2,848
Technician	4	dy	10	40	tech	34.30	1,372							1,372
Equipment Rental	1	wk								1000	1,000			1,000
Injection Activities														
Superintendent	25	dy	10	250	super	72.30	18,075							18,075
Geologist	25	dy	10	250	geol	71.20	17,800							17,800
Technician	25	dy	10	250	tech	34.30	8,575							8,575
Bioaugmentation Materials, ESO and SDC-9	200	pts	Emulsified Soybean Oil (ESO)					97.55	19,510					19,510
	1	ea	Shipping ESO, Trailer, Mob/Demob					5,000	5,000	10,000	10,000	5,000	5,000	20,000
	200	pts	Bacterial Culture (SDC-9)					155	31,000	cost	840	shipping		31,840
Injection System - Equipment, materials	4	week						1,250	5,000	1,250	5,000			10,000
and flush water	200	pts	Injection Chase Water					4	800					800
DPT Injections	200	ea										500	100,000	100,000
Airfare	2	ea										500	1,000	1,000
Per Diem and PPE, Crew Truck, Lodging	87	m-day						175	15,225	75	6,525	77	6,699	28,449
Subtotal							**51,562**		**76,535**		**23,365**		**112,699**	**264,161**
Taxes @ 6.5 %									4,975					4,975
Subtotal														**269,136**
Indirects @ 21.5%														57,864
Total Cost Per Injection														**$ 327,000**

Alternative 3 - Excavation, Recirculating Bioremediation, MNA and LUC
In Situ Bioremediation - Direct Injection Bioremediation

COMPANY NAME: Shaw Environmental, Inc.
PROJECT LOCATION: Karnack, Texas **DATE:** July, 2011

DESCRIPTION	QTY	UNIT	LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT		TOTAL ($)
			UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	
Perform Direct Injection Bioremediation in Year 3														
		Assumptions:	Repeat Direct Injection Bioremediation for two areas, less effort required to clear vegetation.											
Site Clearing for Injection Access														
Superintendent	1	dy	10	10	super	72.30	723							723
Geologist	1	dy	10	10	geol	71.20	712							712
Technician	1	dy	10	10	tech	34.30	343							343
Equipment Rental	1	wk								1000	1,000			1,000
Injection Activities														
Superintendent	25	dy	10	250	super	72.30	18,075							18,075
Geologist	25	dy	10	250	geol	71.20	17,800							17,800
Technician	25	dy	10	250	tech	34.30	8,575							8,575
Bioaugmentation Materials, ESO and SDC-9	200	pts	Emulsified Soybean Oil (ESO)					97.55	19,510					19,510
	1	ea	Shipping ESO, Trailer, Mob/Demob					5,000	5,000	10,000	10,000	5,000	5,000	20,000
	200	pts	Bacterial Culture (SDC-9)					155	31,000	cost	840	shipping		31,840
Injection System - Equipment, materials	3	week						1,250	3,750	1,250	3,750			7,500
and flush water	200	pts						4	800					800
DPT Injections	200	ea										500	100,000	100,000
Airfare	2	ea										500	1,000	1,000
Per Diem and PPE, Crew Truck, Lodging	78	m-day						175	13,650	75	5,850	77	6,006	25,506
Subtotal							**46,228**		**73,710**		**21,440**		**112,006**	**253,384**
Taxes @ 6.5 %									4,791					4,791
Subtotal														**258,175**
Indirects @ 21.5%														55,508
Total Cost Per Injection														**$ 313,683**

Alternative 3 - Excavation, Recirculating Bioremediation, MNA and LUC
In Situ Bioremediation - Recirculation

COMPANY NAME: Shaw Environmental, Inc.

PROJECT LOCATION: Karnack, Texas **DATE:** July, 2011

				LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT		
DESCRIPTION	QTY	UNIT	UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	TOTAL ($)
Recirculation Activities at 4 Target Areas														
Site Clearing for Recirculation Access														
Superintendent	2	dy	10	20	super	72.30	1,446							1,446
Geologist	2	dy	10	20	geol	71.20	1,424							1,424
Technician	2	dy	10	20	tech	34.30	686							686
Equipment Rental	1	wk								1000	1,000			1,000
Install Electrical Drop	1	ls										130000	130,000	130,000
Recirculation Activities														
Superintendent	62	dy	10	620	super	72.30	44,826							44,826
Geologist	62	dy	10	620	geol	71.20	44,144							44,144
Technician	62	dy	10	620	tech	34.30	21,266							21,266
Bioaugmentation Materials	51	well	Sodium Lactate 60% Substrate					9,595	489,345					489,345
for each injection well	51	well	Shipping									1,039	52,989	52,989
	51	well	Bioaugmentation					19,426	990,726	cost	26,670	shipping		1,017,396
Injection Wells	51	ea										3,000	153,000	153,000
Extraction Wells	71	ea										4,000	284,000	284,000
Installation of Recirculation Systems	1	ls								80,000	80,000	190,000	190,000	270,000
Operation and Maintenance of Recirculation Systems	1	ls										25,000	25,000	25,000
Airfare	2	ea										500	1,000	1,000
Per Diem and PPE, Crew Truck, Lodging	192	m-day						175	33,600	75	14,400	77	14,784	62,784
Subtotal							**113,792**		**1,513,671**		**122,070**		**850,773**	**2,600,306**
Taxes @ 6.5 %									98,389					98,389
Subtotal														**2,698,695**
Indirects @ 21.5%														580,219
Total Cost														**$ 3,278,914**
Recirculation Areas to be Decommissioned in Year 5														
Decommissioning Systems														
Superintendent	12	dy	10	120	super	72.30	8,676							8,676
Geologist	12	dy	10	120	geol	71.20	8,544							8,544
Technician	12	dy	10	120	tech	34.30	4,116							4,116
Abandon Injection Wells	51	ea						100	5,100			500	25,500	30,600
Abandon Extraction Wells	71	ea						100	7,100			500	35,500	42,600
Removal of Recirculation Systems	1	ls								1,000	1,000	20,000	20,000	21,000
Airfare	2	ea										500	1,000	1,000
Per Diem and PPE, Crew Truck, Lodging	36	m-day						175	6,300	75	2,700	77	2,772	11,772
Subtotal							**21,336**		**18,500**		**3,700**		**84,772**	**128,308**
Taxes @ 6.5 %									1,203					1,203
Subtotal														**129,511**
Indirects @ 21.5%														27,845
Total Cost														**$ 157,355**

Alternative 3 - Excavation, Recirculating Bioremediation, MNA and LUC
Monitoring 40 Wells

COMPANY NAME: Shaw Environmental, Inc.
PROJECT LOCATION: Karnack, Texas **DATE:** July, 2011

DESCRIPTION	QTY	UNIT	LABOR UNIT MH	LABOR TOTAL MH	LABOR CRAFT	LABOR $/MH	LABOR $ VALUE	MATERIAL $/UNIT	MATERIAL $ VALUE	EQUIPMENT $/UNIT	EQUIPMENT $ VALUE	SUBCONTRACT $/UNIT	SUBCONTRACT $ VALUE	TOTAL ($)
Install 5 Monitoring Wells														
Year 1														
Supervise Well Installation, Log Boring	10	dy	10	100	geol	71.20	7,120			100	1,000			8,120
Per Diem, PPE, and Hotel	10	m-dy						175	1,750			77	770	2,520
Geoprobe install additional monitoring wells	5	ea						1,500	7,500	36	180	6000	30,000	37,680
Subtotal							**7,120**		**9,250**		**1,180**		**30,770**	**48,320**
Taxes @ 6.5 %									601					601
Subtotal														**48,921**
Indirects @ 21.5%														10,518
Year 1 total (Capital)														**$ 59,439**
Monitoring of 40 wells (and 20% for QC)														
Years 1 and 2														
Collect and prepare samples quarterly (GW)	192	ea	16	3,072	tech	34.30	105,370	110	21,120	36	6,912			133,402
Sample analysis (VOC, perchlorate, MNA)	192	ea										700	134,400	134,400
Sample analysis (SVOC, metals, explosives)	192	ea										400	76,800	76,800
Surface water analysis (perchlorate, VOC)	16	ea	1	16	tech	34.30	550	50	800	20	320	500	8,000	9,670
Annual report	1	ea	80	80	eng	81.60	6,530	200	200					6,730
Subtotal							**112,450**		**22,120**		**7,232**		**219,200**	**361,002**
Taxes @ 6.5 %									1,438					1,438
Subtotal														**362,440**
Indirects @ 21.5%														77,925
Years 1 and 2 Annual Total														**$ 440,364**
Combined Years 1 and 2 Total														880,729
Years 3, 4 and 5														
Collect and prepare samples semiannually	96	ea	16	1,536	tech	34.30	52,685	110	10,560	36	3,456			66,701
Sample analysis (VOCs, perchlorate)	96	ea										500	48,000	48,000
Sample analysis (SVOC, metals, explosives)	96	ea										400	38,400	38,400
Surface water analysis (perchlorate, VOC)	8	ea	1	8	tech	34.30	270	50	400	20	160	500	4,000	4,830
Annual report	1	ea	80	80	eng	81.60	6,530	200	200					6,730
Subtotal							**59,485**		**11,160**		**3,616**		**90,400**	**164,661**
Taxes @ 6.5 %									725					725
Subtotal														**165,386**
Indirects @ 21.5%														35,558
Years 3, 4 and 5 Annual Total														**$ 200,944**
Combined Years 3, 4 and 5 Total														602,833

Alternative 3 - Excavation, Recirculating Bioremediation, MNA and LUC
Monitoring 40 Wells

COMPANY NAME: Shaw Environmental, Inc.
PROJECT LOCATION: Karnack, Texas **DATE:** July, 2011

DESCRIPTION	QTY	UNIT	LABOR UNIT MH	LABOR TOTAL MH	LABOR CRAFT	LABOR $/MH	LABOR $ VALUE	MATERIAL $/UNIT	MATERIAL $ VALUE	EQUIPMENT $/UNIT	EQUIPMENT $ VALUE	SUBCONTRACT $/UNIT	SUBCONTRACT $ VALUE	TOTAL ($)
Years 6 through 10														
Collect and prepare samples annually	48	ea	16	768	tech	34.30	26,342	110	5,280	36	1,728			33,350
Sample analysis (VOCs, perchlorate)	48	ea										500	24,000	24,000
Surface water analysis (perchlorate, VOC)	4	ea	1	4	tech	34.30	140	50	200	20	80	500	2,000	2,420
Annual report	1	ea	80	80	eng	81.60	6,528	200	200					6,728
Subtotal							**33,010**		**5,680**		**1,808**		**26,000**	**66,498**
Taxes @ 6.5 %									369					369
Subtotal														**66,868**
Indirects @ 21.5%														14,377
Years 6 through 10 Annual Total														**$ 81,244**
Combined Years 6 through 10 Total														406,221
Years 15, 20, 25, 30														
Collect and prepare samples	48	ea	16	768	tech	34.30	26,342	110	5,280	36	1,728			33,350
Sample analysis (VOCs, perchlorate)	48	ea										500	24,000	24,000
Surface water analysis (perchlorate, VOC)	4	ea	1	4	tech	34.30	140	50	200	20	80	500	2,000	2,420
Event report	1	ea	80	80	eng	81.60	6,528	200	200					6,728
Subtotal							**33,010**		**5,680**		**1,808**		**26,000**	**66,498**
Taxes @ 6.5 %									369					369
Subtotal														**66,868**
Indirects @ 21.5%														14,377
Years 15, 20, 25, 30 Event Total														**$ 81,244**
Combined Years 15, 20, 25, 30 Total														324,977
Five Year Review Report, Years 5, 10, 15, 20, 25, 30														
Five Year Inspection/Report	1	ea										35000	35,000	35,000
Subtotal							**0**		**0**		**0**		**35,000**	**35,000**
Taxes @ 6.5 %									0					0
Subtotal														**35,000**
Indirects @ 21.5%														7,525
Total for A Five Year Inspection / Report														**$ 42,525**
Combined Total for Years 5, 10, 15, 20, 25, 30														255,150

Alternative 4 - Excavation, Pump and Treat, In Situ Bioremediation, MNA and LUC
Present Value

COMPANY NAME: **Shaw Environmental, Inc.**
PROJECT LOCATION: **Karnack, Texas** **Date:** **July, 2011**

Year	FY	Capital Costs					O & M Costs				Present Value (NPV)		
		Bioremediation	Design	Excavation	Pump & Treat	Monitoring	Monitoring	Pump & Treat	5-Yr Review	Total	Discount Rate	Capital	O & M
											2.8%		
1	2011	437,540	217,164	1,385,818	766,288	59,439	440,364	132,957		573,322	**NPV**	**3,040,000**	**4,860,000**
2	2012						440,364	132,957		573,322			
3	2013	286,024					200,944	132,957		333,902			
4	2014						200,944	132,957		333,902	**Total Capital and O&M**		**$7,900,000**
5	2015						200,944	132,957	42,525	376,427			
6	2016						81,244	132,957		214,202			
7	2017						81,244	132,957		214,202			
8	2018						81,244	132,957		214,202			
9	2019						81,244	132,957		214,202			
10	2020						81,244	132,957	42,525	256,727			
11	2021				56,262			132,957		132,957			
12	2022							132,957		132,957			
13	2023							132,957		132,957			
14	2024							132,957		132,957			
15	2025						81,244	132,957	42,525	256,727			
16	2026							132,957		132,957			
17	2027							132,957		132,957			
18	2028							132,957		132,957			
19	2029							132,957		132,957			
20	2030						81,244	132,957	42,525	256,727			
21	2031				56,262			132,957		132,957			
22	2032							132,957		132,957			
23	2033							132,957		132,957			
24	2034							132,957		132,957			
25	2035						81,244	132,957	42,525	256,727			
26	2036							132,957		132,957			
27	2037							132,957		132,957			
28	2038							132,957		132,957			
29	2039							132,957		132,957			
30	2040						81,244	132,957	42,525	256,727			
		723,564	217,164	1,385,818	878,813	59,439	2,214,759	3,988,724	255,150	6,458,632			

Alternative 4 - Excavation, Pump and Treat, In Situ Bioremediation, MNA and LUC
Plans and Designs

COMPANY NAME: **Shaw Environmental, Inc.**
PROJECT LOCATION: **Karnack, Texas** **DATE:** **July, 2011**

DESCRIPTION	QTY	UNIT	LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT		TOTAL ($)
			UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	
Year 1 - Design Activities														
Excavation Work Plans/Design	1	ea	250	250	eng	81.60	20,400	500	500					20,900
	1	ea	250	250	geol	71.20	17,800							17,800
Allowance for Legal Fees,	1	lot										15,000	15,000	15,000
Controls, Well Documentation														
Establish database, licenses,	1	ea	150	150	eng	81.60	12,240	500	500					12,740
monitoring work plans, etc.	1	ea	150	150	geol	71.20	10,680							10,680
DPT Study	1	ls										20,000	20,000	20,000
Pilot Study	1	ls										20,000	20,000	20,000
Pump Tests	7	wells										3,000	21,000	21,000
Direct Injection Bioremediation	2	dy	10	20	vendor	98.31	1,966							1,966
Design Activities	3	dy	10	30	eng	81.60	2,448							2,448
	1	dy	10	10	geol	71.20	712	250	250					962
	2	dy	10	20	tech	34.30	686							686
Pump and Treat Design Activities	10	dy	10	100	vendor	98.31	9,831							9,831
	20	dy	10	200	eng	81.60	16,320							16,320
	5	dy	10	50	geol	71.20	3,560	250	1,250					4,810
	10	dy	10	100	tech	34.30	3,430							3,430
Capital Costs Subtotal							**100,073**		**2,500**		**0**		**76,000**	**178,573**
Taxes @ 6.5 %									163					163
Subtotal														**178,736**
Indirects @ 21.5%														38,428
Design Capital costs														**$ 217,164**

Alternative 4 - Excavation, Pump and Treat, In Situ Bioremediation, MNA and LUC
Excavation

COMPANY NAME: **Shaw Environmental, Inc.**
PROJECT LOCATION: **Karnack, Texas** **DATE:** **July, 2011**

DESCRIPTION	QTY	UNIT	LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT		TOTAL ($)
			UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	
	9000	**cubic yards**		**Excavate soil with perchlorate**										
Year 1														
Waste Characterization	1	ea	4	4	chem	71.20	285	50	50					335
	2	ea	4	8	tech	34.30	274	400	800	200	400	1,500	3,000	4,474
Mobilization/Demobilization	1	ea	10	10	super	72.30	723	350	350	500	500	5,000	5,000	6,573
	1	ea	10	10	h/s	55.70	557							557
	2	ea	10	20	tech	34.30	686							686
Clear and Grub & Erosion Control	1	ea	10	10	h/s	55.70	557	1,000	1,000			10,000	10,000	11,557
Soil Excavation Activities	100	dy	10	1000	super	72.30	72,300	129	12,900	500	50,000			135,200
	100	dy	10	1000	tech	34.30	34,300	129	12,900					47,200
	100	dy	10	1000	h/s	55.70	55,700	129	12,900					68,600
	100	dy	10	1000	op	33.80	33,800	129	12,900					46,700
Port-o-let Rental	4	months								320	1,280			1,280
Transport and Disposal (non-haz)	780	load						50	39,000			600	468,000	507,000
Confirmation Sampling	50	ea						50	2,500			275	13,750	16,250
Site Restoration Backfill	11700	cy						10	117,000					117,000
Site Restoration Surface Cover	20000	sf										0.13	2,600	2,600
Per Diem, PPE, Hotel Rooms	408	m-dy						175	71,400			77	31,416	102,816
Two Crew Trucks	101	dy								150	15,150			15,150
Survey Crew	5	dy										1,000	5,000	5,000
Closeout Report	1	ea	400	400	eng	81.60	32,640	500	500					33,140
Capital Costs Subtotal							**231,822**		**284,200**		**67,330**		**538,766**	**1,122,118**
Taxes @ 6.5 %									18,473					18,473
Subtotal														**1,140,591**
Indirects @ 21.5%														245,227
Excavation Capital costs														**$ 1,385,818**

Alternative 4 - Excavation, Pump and Treat, In Situ Bioremediation, MNA and LUC
In Situ Bioremediation - Direct Injection Bioremediation

COMPANY NAME: Shaw Environmental, Inc.
PROJECT LOCATION: Karnack, Texas **DATE:** July, 2011

DESCRIPTION	QTY	UNIT	LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT		TOTAL ($)
			UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	
Perform Direct Injection Bioremediation in Year 1 - near 47WW11, 47WW25, LHSMW43, and LHSMW56														
Site Clearing for Injection Access														
Superintendent	4	dy	10	40	super	72.30	2,892							2,892
Geologist	4	dy	10	40	geol	71.20	2,848							2,848
Technician	4	dy	10	40	tech	34.30	1,372							1,372
Equipment Rental	1	wk								1000	1,000			1,000
Injection Activities														
Superintendent	33	dy	10	330	super	72.30	23,859							23,859
Geologist	33	dy	10	330	geol	71.20	23,496							23,496
Technician	33	dy	10	330	tech	34.30	11,319							11,319
Bioaugmentation Materials, ESO and SDC-9	300	pts	Emulsified Soybean Oil (ESO)					83.62	25,086					25,086
	1	ea	Shipping ESO, Trailer, Mob/Demob					5,000	5,000	10,000	10,000	5,000	5,000	20,000
	300	pts	Bacterial Culture (SDC-9)					133	39,900	cost	1,050	shipping		40,950
Injection System - Equipment, materials	5	week						1,250	6,250	1,250	6,250			12,500
and flush water	300	pts	Injection Chase Water					4	1,200					1,200
DPT Injections	300	pts										500	150,000	150,000
Airfare	2	ea										500	1,000	1,000
Per Diem and PPE, Crew Truck, Lodging	111	m-day						175	19,425	75	8,325	77	8,547	36,297
Subtotal							**65,786**		**96,861**		**26,625**		**164,547**	**353,819**
Taxes @ 6.5 %									6,296					6,296
Subtotal														**360,115**
Indirects @ 21.5%														77,425
Total Cost Per Injection														**$ 437,540**

Alternative 4 - Excavation, Pump and Treat, In Situ Bioremediation, MNA and LUC
In Situ Bioremediation - Direct Injection Bioremediation

COMPANY NAME: Shaw Environmental, Inc.
PROJECT LOCATION: Karnack, Texas **DATE:** July, 2011

DESCRIPTION	QTY	UNIT	LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT		TOTAL ($)
			UNIT MH	TOTAL MH	CRAFT	$/MH	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	$/UNIT	$ VALUE	
Perform Direct Injection Bioremediation in Year 3														
		Assumptions:	Repeat Direct Injection Bioremediation for two areas, less effort required to clear vegetation.											
Site Clearing for Injection Access														
Superintendent	1	dy	10	10	super	72.30	723							723
Geologist	1	dy	10	10	geol	71.20	712							712
Technician	1	dy	10	10	tech	34.30	343							343
Equipment Rental	1	wk								1000	1,000			1,000
Injection Activities														
Superintendent	20	dy	10	200	super	72.30	14,460							14,460
Geologist	20	dy	10	200	geol	71.20	14,240							14,240
Technician	20	dy	10	200	tech	34.30	6,860							6,860
Bioaugmentation Materials, ESO and SDC-9	200	pts	Emulsified Soybean Oil (ESO)					81.90	16,380					16,380
	1	ea	Shipping ESO, Trailer, Mob/Demob					5,000	5,000	10,000	10,000	5,000	5,000	20,000
	200	pts	Bacterial Culture (SDC-9)					130	26,000	cost	700	shipping		26,700
Injection System - Equipment, materials	3	week						1,250	3,750	1,250	3,750			7,500
and flush water	200	pts						4	800					800
DPT Injections	200	pts										500	100,000	100,000
Airfare	2	ea										500	1,000	1,000
Per Diem and PPE, Crew Truck, Lodging	63	m-day						175	11,025	75	4,725	77	4,851	20,601
Subtotal							**37,338**		**62,955**		**20,175**		**110,851**	**231,319**
Taxes @ 6.5 %									4,092					4,092
Subtotal														**235,411**
Indirects @ 21.5%														50,613
Total Cost Per Injection														**$ 286,024**

Alternative 4 - Excavation, Pump and Treat, In Situ Bioremediation, MNA and LUC
Pump and Treat

COMPANY NAME: Shaw Environmental, Inc.

PROJECT LOCATION: Karnack, Texas **DATE:** July, 2011

				LABOR				MATERIAL		EQUIPMENT		SUBCONTRACT		
DESCRIPTION	**QTY**	**UNIT**	**UNIT MH**	**TOTAL MH**	**CRAFT**	**$/MH**	**$ VALUE**	**$/UNIT**	**$ VALUE**	**$/UNIT**	**$ VALUE**	**$/UNIT**	**$ VALUE**	**TOTAL ($)**
Prepare Program and Install 7 Extraction Wells and Extraction System														
Year 1														
Mobilization/Demobilization	1	ls		140	tech	34.30	4,802					5,000	5,000	9,802
Clear and Grub for extraction system installation	1	ls		140	super	72.30	10,122			500	500	10,000	10,000	20,622
Clear and Grub for pipeline to Existing GWTP	1	ls		100	eng	81.60	8,160			500	500	20,000	20,000	28,660
Collection Tank	1	ea		140	op	33.80	4,732	1,000	1,000	500	500	20,000	20,000	26,232
Piping from Extraction Wells to Collection Tank	8,000	LF		100	h/s	55.70	5,570					8	64,000	69,570
Piping from Collection Tank to Existing GWTP	14,000	LF		100	geo	71.20	7,120					10	140,000	147,120
Install Electrical Drop	1	ls		40	h/s	81.60	3,264					130,000	130,000	133,264
Install Control Wiring	8,000	LF		40	eng	81.60	3,264					2	16,000	19,264
Improvements to Existing GWTP	1	ls						4,000	4,000	1000	1,000	50,000	50,000	55,000
Airfare	3	ea										500	1,500	1,500
Per Diem and PPE, Crew Truck, Lodging	84	m-day	6 people, 14 days					175	14,700	75	6,300	77	6,468	27,468
Install Extraction Wells	7	ea		40	geo	71.20	2,848	75	525	2500	17,500	10000	70,000	90,873
Subtotal							**49,882**		**20,225**		**26,300**		**532,968**	**629,375**
Taxes @ 6.5 %									1,315					1,315
Subtotal														**630,690**
Indirects @ 21.5%														135,598
Year 1 total (Capital)														**$ 766,288**
Repairs to Extraction System Every 10 years														
Years 11 and 21														
Clear and Grub for Access to Repair systems	1	ls		80	super	72.30	5,784					10,000	10,000	15,784
Repairs to Piping	1,000	LF		80	tech	34.30	2,744					8	8,000	10,744
Repairs to Wiring and Electric System	1,000	LF		80	h/s	55.70	4,456					2	2,000	6,456
Airfare	2	ea		40	geo	71.20	2,848					500	1,000	3,848
Per Diem and PPE, Crew Truck, Lodging	28	m-day	3 people for 8 days, 1 person for 4 days					175	4,900	75	2,100	77	2,156	9,156
Subtotal							**15,832**		**4,900**		**2,100**		**23,156**	**45,988**
Taxes @ 6.5 %									319					319
Subtotal														**46,307**
Indirects @ 21.5%														9,956
Repair Episode total (Capital)														**$ 56,262**
Combined Years 11 and 21														**$ 112,525**
Partial Cost of Operation and Maintenance of Groundwater Treatment Plant														
GWTP O&M: GW Extraction, Plant Ops, Incidental	1	ea	500	500	tech	34.30	17,150		20,000		10,000		40,000	87,150
two person crew, Tech and Op	1	ea	500	500	op	33.80	16,900							16,900
25% of costs assigned to LHAAP-47	1	ea	50	50	eng	81.60	4,080							4,080
Subtotal							**38,130**		**20,000**		**10,000**		**40,000**	**108,130**
Taxes @ 6.5 %									1,300					1,300
Subtotal														**109,430**
Indirects @ 21.5%														23,527
Annual total O&M Costs for 10% of Groundwater Treatment Plant Operation														**$ 132,957**
Cost for 30 years of operation														**$ 3,988,724**

Alternative 4 - Excavation, Pump and Treat, In Situ Bioremediation, MNA and LUC
Monitoring 40 Wells

COMPANY NAME: Shaw Environmental, Inc.
PROJECT LOCATION: Karnack, Texas **DATE:** July, 2011

DESCRIPTION	QTY	UNIT	LABOR UNIT MH	LABOR TOTAL MH	LABOR CRAFT	LABOR $/MH	LABOR $ VALUE	MATERIAL $/UNIT	MATERIAL $ VALUE	EQUIPMENT $/UNIT	EQUIPMENT $ VALUE	SUBCONTRACT $/UNIT	SUBCONTRACT $ VALUE	TOTAL ($)
Install 5 Monitoring Wells														
Year 1														
Supervise Well Installation, Log Boring	10	dy	10	100	geol	71.20	7,120			100	1,000			8,120
Per Diem, PPE, and Hotel	10	m-dy						175	1,750			77	770	2,520
Geoprobe install additional monitoring wells	5	ea						1,500	7,500	36	180	6000	30,000	37,680
Subtotal							**7,120**		**9,250**		**1,180**		**30,770**	**48,320**
Taxes @ 6.5 %									601					601
Subtotal														**48,921**
Indirects @ 21.5%														10,518
Year 1 total (Capital)														**$ 59,439**
Monitoring of 40 wells (and 20% for QC)														
Years 1 and 2														
Collect and prepare samples quarterly (GW)	192	ea	16	3,072	tech	34.30	105,370	110	21,120	36	6,912			133,402
Sample analysis (VOC, perchlorate, MNA)	192	ea										700	134,400	134,400
Sample analysis (SVOC, metals, explosives)	192	ea										400	76,800	76,800
Surface water analysis (perchlorate, VOC)	16	ea	1	16	tech	34.30	550	50	800	20	320	500	8,000	9,670
Annual report	1	ea	80	80	eng	81.60	6,530	200	200					6,730
Subtotal							**112,450**		**22,120**		**7,232**		**219,200**	**361,002**
Taxes @ 6.5 %									1,438					1,438
Subtotal														**362,440**
Indirects @ 21.5%														77,925
Years 1 and 2 Annual Total														**$ 440,364**
Combined Years 1 and 2 Total														880,729
Years 3, 4 and 5														
Collect and prepare samples semiannually	96	ea	16	1,536	tech	34.30	52,685	110	10,560	36	3,456			66,701
Sample analysis (VOCs, perchlorate)	96	ea										500	48,000	48,000
Sample analysis (SVOC, metals, explosives)	96	ea										400	38,400	38,400
Surface water analysis (perchlorate, VOC)	8	ea	1	8	tech	34.30	270	50	400	20	160	500	4,000	4,830
Annual report	1	ea	80	80	eng	81.60	6,530	200	200					6,730
Subtotal							**59,485**		**11,160**		**3,616**		**90,400**	**164,661**
Taxes @ 6.5 %									725					725
Subtotal														**165,386**
Indirects @ 21.5%														35,558
Years 3, 4 and 5 Annual Total														**$ 200,944**
Combined Years 3, 4 and 5 Total														602,833

Alternative 4 - Excavation, Pump and Treat, In Situ Bioremediation, MNA and LUC
Monitoring 40 Wells

COMPANY NAME: **Shaw Environmental, Inc.**
PROJECT LOCATION: **Karnack, Texas** **DATE:** **July, 2011**

			LABOR					MATERIAL		EQUIPMENT		SUBCONTRACT		
DESCRIPTION	**QTY**	**UNIT**	**UNIT MH**	**TOTAL MH**	**CRAFT**	**$/MH**	**$ VALUE**	**$/UNIT**	**$ VALUE**	**$/UNIT**	**$ VALUE**	**$/UNIT**	**$ VALUE**	**TOTAL ($)**
Years 6 through 10														
Collect and prepare samples annually	48	ea	16	768	tech	34.30	26,342	110	5,280	36	1,728			33,350
Sample analysis (VOCs, perchlorate)	48	ea										500	24,000	24,000
Surface water analysis (perchlorate, VOC)	4	ea	1	4	tech	34.30	140	50	200	20	80	500	2,000	2,420
Annual report	1	ea	80	80	eng	81.60	6,528	200	200					6,728
Subtotal							**33,010**		**5,680**		**1,808**		**26,000**	**66,498**
Taxes @ 6.5 %									369					369
Subtotal														**66,868**
Indirects @ 21.5%														14,377
Years 6 through 10 Annual Total														**$ 81,244**
Combined Years 6 through 10 Total														406,221
Years 15, 20, 25, 30														
Collect and prepare samples	48	ea	16	768	tech	34.30	26,342	110	5,280	36	1,728			33,350
Sample analysis (VOCs, perchlorate)	48	ea										500	24,000	24,000
Surface water analysis (perchlorate, VOC)	4	ea	1	4	tech	34.30	140	50	200	20	80	500	2,000	2,420
Event report	1	ea	80	80	eng	81.60	6,528	200	200					6,728
Subtotal							**33,010**		**5,680**		**1,808**		**26,000**	**66,498**
Taxes @ 6.5 %									369					369
Subtotal														**66,868**
Indirects @ 21.5%														14,377
Years 15, 20, 25, 30 Event Total														**$ 81,244**
Combined Years 15, 20, 25, 30 Total														324,977
Five Year Review Report, Years 5, 10, 15, 20, 25, 30														
Five Year Inspection/Report	1	ea										35000	35,000	35,000
Subtotal							**0**		**0**		**0**		**35,000**	**35,000**
Taxes @ 6.5 %									0					0
Subtotal														**35,000**
Indirects @ 21.5%														7,525
Total for A Five Year Inspection / Report														**$ 42,525**
Combined Total for Years 5, 10, 15, 20, 25, 30														255,150