ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Well H17-AF107 Project/No. HAA-17 Page 1 of 2

Site Location Savannah, GA

Drilling Started 12/17/2009 Drilling Completed 12/17/2009

Drilling Contractor ARM

Driller Josh

Helper Mike

Drilling Fluid Used N/A

Drilling Method DPT

Total Depth Drilled 45 Feet

Hole Diameter 2 "

Coring Device MacroCore

Prepared By JDF

Hammer Weight N/A

Hammer Drop N/A ins.

Soil Characterization:

Sample/Core Depth (Feet bls) From	To		PID Reading (ppm)	Sample/Core Description
0	1			10 YR 4/2 dark grayish brown silty well sorted fine sand
1	2			10 YR 7/3 very pale brown poorly sorted medium to coarse subangular sand
2	3		0.0	
3	4			10 YR 6/1 gray poorly sorted medium to coarse subangular sand, wet @ 4'
4	5		0.2	
5	6			10 YR 4/2 dark grayish brown medium firm high plasticity clay
6	7		0.3	
7	8			
8	9		0.3	
9	10			10 YR 6/1 gray medium firm high plasticity clay, some medium sand and
10	11		0.2	wood fragments
11	12			
12	13		0.1	
13	14			10 YR 4/2 dark grayish brown silty to clayey poorly sorted fine to coarse
14	15		0.5	subangular sand, some wood fragments
15	16			
16	17		0.2	10 YR 5/1 silty poorly sorted fine to medium subangular sand, some muscovite
17	18			
18	19		0.3	
19	20			10 YR 5/1 gray soft high plasticity clay
20	21		0.2	10 YR 5/1 gray clayey poorly sorted fine to medium subangular sand,
21	22			some muscovite
22	23		0.2	
23	24			
24	25		0.4	

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Well H17-AF107 Project/No. HAA-17 Page 2 of 2

Site Location Savannah, GA Drilling Started 12/17/2009 Drilling Completed 12/17/2009

Drilling Contractor ARM Driller Josh Helper Mike

Drilling Fluid Used N/A Drilling Method DPT

Total Depth Drilled 45 Feet Hole Diameter 2 " Coring Device MacroCore

Prepared By JDF Hammer Weight N/A Hammer Drop N/A ins.

Soil Characterization:

Sample/Core Depth (Feet bls) From	To		PID Reading (ppm)	Sample/Core Description
25	26			10 YR 5/1 gray poorly sorted medium to very coarse subangular sand with some
26	27		0.3	subrounded fine gravel and interbedded 10 YR 5/1 gray soft high plasticity
27	28			clay
28	29		0.3	
29	30			
30	31		0.3	
31	32			
32	33		0.2	
33	34			
34	35		0.2	
35	36			10 YR 5/1 gray silty poorly sorted fine to very coarse subangular sand, ~1" thick
36	37		0.2	sandy clay lens @ 37', 38.5' and 39'
37	38			
38	39		0.3	
39	40			
40	41		0.4	10 YR 5/1 gray silty poorly sorted medium to very coarse subangular sand
41	42			
42	43		0.2	
43	44			
44	45		0.4	
45	46			END OF BORING
46	47			
47	48			
48	49			
49	50			

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Well H17-AF108 Project/No. HAA-17 Page 1 of 2

Site Location Savannah, GA Drilling Started 12/17/2009 Drilling Completed 12/17/2009

Drilling Contractor ARM Driller Josh Helper Mike

Drilling Fluid Used N/A Drilling Method DPT

Total Depth Drilled 45 Feet Hole Diameter 2 " Coring Device MacroCore

Prepared By JDF Hammer Weight N/A Hammer Drop N/A ins.

Soil Characterization:

Sample/Core Depth (Feet bls)			PID Reading (ppm)	Sample/Core Description
From	To			
0	1			10 YR 5/2 grayish brown silty to clayey well sorted fine sand
1	2			
2	3		0.3	10 YR 3/1 very dark gray medium firm high plasticity clay with wood
3	4			fragments, wet @ 5'
4	5		0.3	
5	6			
6	7		0.2	
7	8			10 YR 7/2 ligh gray clayey well sorted fine sand, trace muscovite
8	9		0.2	
9	10			
10	11		0.1	10 YR 7/2 light gray clayey poorly sorted fine to coarse subangular sand, trace
11	12			muscovite
12	13		0.3	
13	14			
14	15		0.1	10 YR 5/1 gray clayey poorly sorted fine to coarse subangular sand
15	16			
16	17		0.2	
17	18			
18	19		0.2	
19	20			
20	21		0.3	
21	22			10 YR 5/1 gray soft high plasticity sandy clay
22	23		0.3	
23	24			
24	25		0.3	

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Well H17-AF108 Project/No. HAA-17 Page 2 of 2

Site Location Savannah, GA

Drilling Started 12/17/2009 Drilling Completed 12/17/2009

Drilling Contractor ARM

Driller Josh Helper Mike

Drilling Fluid Used N/A

Drilling Method DPT

Total Depth Drilled 45 Feet

Hole Diameter 2 "

Coring Device MacroCore

Prepared By JDF

Hammer Weight N/A

Hammer Drop N/A ins.

Soil Characterization:

Sample/Core Depth (Feet bls)			PID Reading (ppm)	Sample/Core Description
From	To			
25	26			
26	27		0.3	10 YR 5/1 gray interbedded poorly sorted fine to coarse subangular sand
27	28			and soft high plasticity clay
28	29		0.3	
29	30			
30	31		0.2	10 YR 5/1 gray soft high plasticity clay
31	32			
32	33		0.3	
33	34			
34	35		0.3	
35	36			10 YR 5/1 gray silty poorly sorted medium to very coarse subangular sand,
36	37		0.3	some well rounded fine gravel, ~1" thick soft high plasticity clay lens @ 38'
37	38			
38	39		0.3	
39	40			
40	41		0.2	
41	42			
42	43		0.4	10 YR 5/1 gray silty poorly sorted fine to coarse subangular sand with shell
43	44			fragments interbedded with 10 YR 5/1 gray soft high plasticity clay
44	45		0.3	
45	46			END OF BORING
46	47			
47	48			
48	49			
49	50			

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Well H17-FD1 Project/No. HAA-17 Page 1 of 2

Site Location Savannah, GA

Drilling Started 12/14/2009 Drilling Completed 12/14/2009

Drilling Contractor ARM

Driller Josh Helper Mike

Drilling Fluid Used N/A

Drilling Method DPT

Total Depth Drilled 45 Feet

Hole Diameter 2 "

Coring Device MacroCore

Prepared By JDF

Hammer Weight N/A

Hammer Drop N/A ins.

Soil Characterization:

Sample/Core Depth (Feet bls) From	To		PID Reading (ppm)	Sample/Core Description
0	1			10 YR 5/3 brown silty well sorted fine sand
1	2			10 YR 8/3 very pale brown silty well sorted fine sand
2	3		0.7	
3	4			
4	5		0.8	
5	6			5 YR 6/6 reddish yellow silty well sorted fine sand
6	7		0.5	
7	8			10 YR 7/2 light gray well sorted medium sand, subangular
8	9		0.3	
9	10			
10	11		0.2	
11	12			
12	13		0.3	10 YR 8/3 very pale brown well sorted subangular medium sand
13	14			
14	15		0.3	
15	16			
16	17		0.3	10 Y 8/1 light greenish gray silty well sorted fine sand
17	18			
18	19		0.3	
19	20			
20	21		0.2	
21	22			
22	23		0.2	
23	24			10 YR 7/1 gray well sorted fine sand
24	25		0.2	

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Well H17-FD2 Project/No. HAA-17 Page 2 of 2

Site Location Savannah, GA

Drilling Started 12/14/2009 Drilling Completed 12/14/2009

Drilling Contractor ARM

Driller Josh Helper Mike

Drilling Fluid Used N/A

Drilling Method DPT

Total Depth Drilled 45 Feet

Hole Diameter 2 "

Coring Device MacroCore

Prepared By JDF

Hammer Weight N/A

Hammer Drop N/A ins.

Soil Characterization:

Sample/Core Depth (Feet bls) From	To		PID Reading (ppm)	Sample/Core Description
25	26			
26	27		0.3	
27	28			
28	29		0.3	
29	30			
30	31		0.1	
31	32			10 YR 8/1 white silty well sorted subangular medium sand
32	33		0.4	
33	34			10 Y 8/1 light greenish gray well sorted fine sand
34	35		0.4	
35	36			
36	37		0.2	
37	38			
38	39		0.4	
39	40			39.0'-39.5' is 7.5 YR 7/6 reddish yellow silty well sorted fine sand, 39.5' begins
40	41		0.3	10 YR 6/1 gray silty to clayey well sorted fine sand
41	42			10 YR 6/1 gray silty well sorted fine sand
42	43		0.2	
43	44			
44	45		0.4	
45	46			END OF BORING
46	47			
47	48			
48	49			
49	50			

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Well H17-FD2 Project/No. HAA-17 Page 1 of 2

Site Location Savannah, GA

Drilling Started 12/14/2009 Drilling Completed 12/14/2009

Drilling Contractor ARM

Driller Josh Helper Mike

Drilling Fluid Used N/A

Drilling Method DPT

Total Depth Drilled 45 Feet

Hole Diameter 2 "

Coring Device MacroCore

Prepared By JDF

Hammer Weight N/A

Hammer Drop N/A ins.

Soil Characterization:

Sample/Core Depth (Feet bls) From	To		PID Reading (ppm)	Sample/Core Description
0	1			10 YR 5/4 yellowish brown silty well sorted fine sand, roots
1	2			10 YR 7/6 yellow silty well sorted fine sand
2	3		0.1	10 YR 4/3 brown medium firm sandy clay, moderate plasticity
3	4			10 YR 6/3 pale brown silty well sorted fine sand
4	5		0.1	10 YR 3/1 very dark gray silty well sorted fine sand, wood fragments
5	6			10 YR 7/3 very pale brown silty well sorted fine sand, wet
6	7		1.4	
7	8			10 YR 7/1 light gray silty well sorted fine sand
8	9		0.2	
9	10			
10	11		0.2	
11	12			
12	13		0.4	10 YR 5/6 yellowish brown silty well sorted fine sand
13	14			10 Y 8/1 light greenish gray firm moderate plasticity clay
14	15		0.4	10 Y 8/1 light greenish gray silty well sorted fine sand
15	16			
16	17		0.2	
17	18			
18	19		0.2	
19	20			
20	21		0.0	
21	22			
22	23		0.2	
23	24			
24	25		0.2	

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Well H17-FD2 Project/No. HAA-17 Page 2 of 2

Site Location Savannah, GA

Drilling Started 12/14/2009 Drilling Completed 12/14/2009

Drilling Contractor ARM

Driller Josh

Helper Mike

Drilling Fluid Used N/A

Drilling Method DPT

Total Depth Drilled 45 Feet

Hole Diameter 2 "

Coring Device MacroCore

Prepared By JDF

Hammer Weight N/A

Hammer Drop N/A ins.

Soil Characterization:

Sample/Core Depth (Feet bls) From	To		PID Reading (ppm)	Sample/Core Description
25	26			
26	27		0.3	
27	28			
28	29		0.3	
29	30			
30	31		0.1	
31	32			10 YR 8/1 white silty well sorted subangular medium sand
32	33		0.4	
33	34			10 Y 8/1 light greenish gray well sorted fine sand
34	35		0.4	
35	36			
36	37		0.2	
37	38			
38	39		0.4	
39	40			39.0'-39.5' is 7.5 YR 7/6 reddish yellow silty well sorted fine sand, 39.5' begins
40	41		0.3	10 YR 6/1 gray silty to clayey well sorted fine sand
41	42			10 YR 6/1 gray silty well sorted fine sand
42	43		0.2	
43	44			
44	45		0.4	
45	46			END OF BORING
46	47			
47	48			
48	49			
49	50			

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Well H17-FD3 Project/No. HAA-17 Page 1 of 2

Site Location Savannah, GA

Drilling Started 12/14/2009 Drilling Completed 12/14/2009

Drilling Contractor ARM

Driller Josh Helper Mike

Drilling Fluid Used N/A

Drilling Method DPT

Total Depth Drilled 45 Feet

Hole Diameter 2 "

Coring Device MacroCore

Prepared By JDF

Hammer Weight N/A

Hammer Drop N/A ins.

Soil Characterization:

Sample/Core Depth (Feet bls) From	To		PID Reading (ppm)	Sample/Core Description
0	1			10 YR 4/2 dark grayish brown well sorted silty fine sand, roots
1	2			10 YR 7/3 very pale brown firm high plasticity clay
2	3		0.0	10 YR 3/1 very dark gray silty well sorted fine sand, roots
3	4			10 YR 4/4 dark yellowish brown silty well sorted fine sand
4	5		0.0	10 YR 7/3 very pale brown silty well sorted fine sand, wood fragments
5	6			
6	7		0.0	
7	8			
8	9		0.2	wet @ ~8'
9	10			
10	11		3.0	
11	12			
12	13		0.7	
13	14			
14	15		0.5	10 YR 7/1 light gray to 10 YR 7/3 very pale brown silty well sorted fine sand
15	16			(to 15.5') 15.5' is 10 GY 8/1 light greenish gray firm clayey well sorted fine sand,
16	17		0.4	low plasticity
17	18			16' is 10 YR 7/1 light gray well sorted silty fine sand
18	19		0.3	
19	20			
20	21		0.1	
21	22			
22	23		0.1	
23	24			
24	25		0.3	

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Well H17-FD3 Project/No. HAA-17 Page 2 of 2

Site Location Savannah, GA

Drilling Started 12/14/2009 Drilling Completed 12/14/2009

Drilling Contractor ARM

Driller Josh Helper Mike

Drilling Fluid Used N/A

Drilling Method DPT

Total Depth Drilled 45 Feet

Hole Diameter 2 "

Coring Device MacroCore

Prepared By JDF

Hammer Weight N/A

Hammer Drop N/A ins.

Soil Characterization:

Sample/Core Depth (Feet bls) From	To		PID Reading (ppm)	Sample/Core Description
25	26			
26	27		0.0	
27	28			10 Y 8/1 light greenish gray clayey well sorted fine sand
28	29		0.2	
29	30			
30	31		0.2	10 YR 7/1 light gray silty well sorted fine sand
31	32			
32	33		0.1	
33	34			
34	35		0.2	
35	36			
36	37		0.3	
37	38			
38	39		0.3	
39	40			10 YR 8/1 white silty well sorted fine sand
40	41		0.2	
41	42			
42	43		0.3	
43	44			
44	45		0.3	10 YR 8/1 white silty well sorted fine sand and interbedded 10 YR 6/1 gray sandy
45	46			soft clay
46	47			END OF BORING
47	48			
48	49			
49	50			

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Well H17-PF3 Project/No. HAA-17 Page 1 of 1

Site Location Savannah, GA

Drilling Started 12/11/2009 Drilling Completed 12/11/2009

Drilling Contractor ARM

Driller Josh

Helper Mike

Drilling Fluid Used N/A

Drilling Method DPT

Total Depth Drilled 10 Feet

Hole Diameter 2 "

Coring Device MacroCore

Prepared By JDF

Hammer Weight N/A

Hammer Drop N/A ins.

Soil Characterization:

Sample/Core Depth (Feet bls) From	To		PID Reading (ppm)	Sample/Core Description
0	1			10 YR 5/6 yellowish brown silty fine sand, roots
1	2			10 YR 7/2 light gray silty fine sand, roots
2	3		479.0	10 YR 3/3 dark brown silty well sorted fine sand, wet, strong fuel odor,
3	4			oily sheen
4	5		719.0	
5	6			
6	7		1019.0	10 YR 7/3 very pale brown well sorted fine sand, some reddish brown mottling
7	8			
8	9		64.5	
9	10			
10	11			END OF BORING
11	12			
12	13			
13	14			
14	15			
15	16			
16	17			
17	18			
18	19			
19	20			
20	21			
21	22			
22	23			
23	24			
24	25			

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Well H17-PF1 Project/No. HAA-17 Page 1 of 2

Site Location Savannah, GA Drilling Started 12/11/2009 Drilling Completed 12/11/2009

Drilling Contractor ARM Driller Josh Helper Mike

Drilling Fluid Used N/A Drilling Method DPT

Total Depth Drilled 45 Feet Hole Diameter 2 " Coring Device MacroCore

Prepared By JDF Hammer Weight N/A Hammer Drop N/A ins.

Soil Characterization:

Sample/Core Depth (Feet bls) From	To		PID Reading (ppm)	Sample/Core Description
0	1			10 YR 3/3 dark brown silty well sorted fine sand, roots
1	2			
2	3		0.5	10 YR 8/3 very pale brown well sorted fine sand
3	4			
4	5		0.3	
5	6			10 YR 3/3 dark brown silty fine well sorted sand, grades to 7.5 YR 5/6
6	7		8.0	strong brown with dark brown mottling, wet
7	8			
8	9		1.1	
9	10			
10	11		1.4	
11	12			
12	13		1.9	
13	14			10 YR 7/1 light gray well sorted fine sand
14	15		0.5	
15	16			10 YR 7/2 gray to 10 Y 8/1 light greenish gray silty well sorted fine sand,
16	17		0.5	yellowish red color/amination @ 22'
17	18			
18	19		0.2	
19	20			
20	21		0.5	
21	22			
22	23		0.6	
23	24			10 YR 7/6 reddish silty well sorted fine sand
24	25		0.6	

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Well H17-PF1 Project/No. HAA-17 Page 2 of 2

Site Location Savannah, GA

Drilling Started 12/11/2009 Drilling Completed 12/11/2009

Drilling Contractor ARM

Driller Josh Helper Mike

Drilling Fluid Used N/A

Drilling Method DPT

Total Depth Drilled 45 Feet

Hole Diameter 2 "

Coring Device MacroCore

Prepared By JDF

Hammer Weight N/A

Hammer Drop N/A ins.

Soil Characterization:

Sample/Core Depth (Feet bls) From	To		PID Reading (ppm)	Sample/Core Description
25	26			10 YR 7/1 light gray well sorted silty fine sand
26	27		0.3	
27	28			
28	29		0.2	7.5 YR 7/6 reddish yellow silty well sorted fine sand
29	30			
30	31		0.2	7.5 YR 7/6 reddish yellow poorly sorted fine-coarse silty subangular sand
31	32			
32	33		0.3	10 YR 6/1 gray silty well sorted fine sand
33	34			
34	35		0.2	
35	36			
36	37			
37	38			10 YR 6/1 gray interbedded silty fine sand, silty coarse sand, and soft, high
38	39			plasticity clay
39	40			
40	41			
41	42			
42	43			
43	44			
44	45			
45	46			END OF BORING
46	47			
47	48			
48	49			
49	50			

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Well H17-PF2 Project/No. HAA-17 Page 1 of 2

Site Location Savannah, GA

Drilling Started 12/10/2009 Drilling Completed 12/10/2009

Drilling Contractor ARM

Driller Josh Helper Mike

Drilling Fluid Used N/A

Drilling Method DPT

Total Depth Drilled 45 Feet

Hole Diameter 2 "

Coring Device MacroCore

Prepared By JDF

Hammer Weight N/A

Hammer Drop N/A ins.

Soil Characterization:

Sample/Core Depth (Feet bls) From	To		PID Reading (ppm)	Sample/Core Description
0	1			10 YR 3/1 very dark gray silty fine sand, roots
1	2			10 YR 7/2 very pale brown silty fine sand
2	3		0.0	10 YR 2/1 black clayey well sorted fine sand, wet
3	4			
4	5		0.0	
5	6			10 YR 4/3 brown silty well sorted fine sand, roots
6	7		0.0	10 YR 7/3 very pale brown silty poorly sorted fine to medium coarse subangular
7	8			sand
8	9		0.0	
9	10			
10	11		0.0	10 YR 7/4 very pale brown well sorted fine sand, trace muscovite
11	12			
12	13		0.2	10 YR 7/2 very pale brown well sorted fine sand, 10 YR 6/6 brownish yellow
13	14			staining from 17-17.5'
14	15		3.7	
15	16			
16	17		1.2	
17	18			10 YR 6/1 gray silty poorly sorted sub angular fine to medium sand
18	19		0.3	
19	20			
20	21		0.1	10 YR 6/1 gray silty well sorted fine sand
21	22			
22	23		0.1	
23	24			
24	25		0.1	

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Well H17-PF2 Project/No. HAA-17 Page 2 of 2

Site Location Savannah, GA Drilling Started 12/10/2009 Drilling Completed 12/10/2009

Drilling Contractor ARM Driller Josh Helper Mike

Drilling Fluid Used N/A Drilling Method DPT

Total Depth Drilled 45 Feet Hole Diameter 2 " Coring Device MacroCore

Prepared By JDF Hammer Weight N/A Hammer Drop N/A ins.

Soil Characterization:

Sample/Core Depth (Feet bls) From	To		PID Reading (ppm)	Sample/Core Description
25	26			10 YR 6/1 gray clayey fine well sorted sand, 2" thick lens of soft
26	27		0.3	10 YR 6/1 high plasticity clay @ 28'
27	28			
28	29		0.5	10 YR 6/1 gray silty well sorted fine sand
29	30			
30	31		0.1	
31	32			
32	33		0.2	
33	34			
34	35		0.2	
35	36			
36	37		0.3	
37	38			
38	39		0.5	10 YR 6/1 gray interbedded silty poorly sorted medium to coarse sand
39	40			and soft high plasticity clay
40	41		0.4	
41	42			
42	43		0.5	
43	44			
44	45		0.4	
45	46			END OF BORING
46	47			
47	48			
48	49			
49	50			

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Well H17-PF4 Project/No. HAA-17 Page 1 of 2

Site Location Savannah, GA Drilling Started 12/14/2009 Drilling Completed 12/14/2009

Drilling Contractor ARM Driller Josh Helper Mike

Drilling Fluid Used N/A Drilling Method DPT

Total Depth Drilled 45 Feet Hole Diameter 2 " Coring Device MacroCore

Prepared By JDF Hammer Weight N/A Hammer Drop N/A ins.

Soil Characterization:

Sample/Core Depth (Feet bls) From	To		PID Reading (ppm)	Sample/Core Description
0	1			10 YR 5/2 grayish brown silty well sorted fine sand, roots
1	2			10 YR 8/3 very pale brown silty well sorted fine sand
2	3		0.0	10 YR 4/2 dark grayish brown silty well sorted fine sand
3	4			
4	5		0.0	
5	6			10 YR 4/4 dark yellowish brown silty well sorted fine sand, with wood
6	7		0.0	fragments, wet
7	8			
8	9		0.0	10 YR 8/2 very pale brown well sorted fine sand with wood fragments
9	10			
10	11		0.0	
11	12			
12	13		0.0	10 Y 8/1 light greenish gray firm sandy clay, slight plasticity
13	14			10 Y 8/1 light greenish gray well sorted fine sand
14	15		0.0	10 YR 8/2 very pale brown well sorted fine sand
15	16			
16	17		0.0	
17	18			
18	19		0.0	
19	20			
20	21		0.0	10 YR 7/2 gray well sorted fine sand, sand composed of ~10% black fine
21	22			sand grains
22	23		0.0	
23	24			
24	25		0.0	

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Well H17-PF4 Project/No. HAA-17 Page 2 of 2

Site Location Savannah, GA

Drilling Started 12/14/2009 Drilling Completed 12/14/2009

Drilling Contractor ARM

Driller Josh

Helper Mike

Drilling Fluid Used N/A

Drilling Method DPT

Total Depth Drilled Feet

Hole Diameter 2 "

Coring Device MacroCore

Prepared By JDF

Hammer Weight N/A

Hammer Drop N/A ins.

Soil Characterization:

Sample/Core Depth (Feet bls)			PID Reading (ppm)	Sample/Core Description
From	To			
25	26			10 YR 8/2 very pale brown poorly sorted clayey fine to medium sand
26	27		0.0	
27	28			
28	29		0.0	
29	30			
30	31		0.0	10 YR 7/2 light gray silty well sorted fine sand
31	32			
32	33		0.0	
33	34			
34	35		0.2	
35	36			
36	37		0.2	
37	38			
38	39		0.4	10 YR 7/2 light gray silty to clayey well sorted fine sand, 2" thick lens of
39	40			7/5 YR 7/6 reddish yellow clayey well sorted fine sand @ 39'
40	41		0.3	
41	42			10 YR 6/1 gray clayey well sorted fine sand, 1"thick
42	43		0.2	10 YR 6/1 gray soft high plasticity clay lens @ 44'
43	44			
44	45		0.2	
45	46			END OF BORING
46	47			
47	48			
48	49			
49	50			

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Well H17-MW-24 Project/No. HAA-17 Page 1 of 1

Site Location Savannah, GA

Drilling Started 12/19/2011 (outer casing)

Drilling Completed 12/21/2011 (inner casing)

Drilling Contractor Parratt Wolff, Inc.

Driller Joshua Ellingworth

Helper Jim Robertson

Drilling Fluid Used Bentonite Drilling Mud

Drilling Method Mud Rotary, Split spoon samples

Total Depth Drilled 65 Feet

Hole Diameter 2 "

Coring Device Truck Mounted CME 55, split spoon

Prepared By VMP

Hammer Weight N/A*

Hammer Drop N/A* ins.

*Split spoons advanced with Direct Push Technology hammer

Soil Characterization:

Sample/Core Depth (Feet bls) From	To	Sample/Core Description
43	45	gray, wet, poorly sorted medium grained sand with trace subangluar coarse sand
48	50	gray, wet, fine grained sand with little sandy clay
53	55	gray, wet, fine grained sand with little clay to 54.7', soft, medium plasticity clay with little fine grained sand to 55'
58	60	gray, wet, fine grained sand
63	65	gray, wet, fine grained sand

END OF BORING @ 65.0'

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF HAA-17
Project No. GP08HAFS
Well ID: MW-8D
Date: 2-16-10
Sampled By: Ryan Kontos
Sampling Time: 1548
Recorded By: Ryan Kontos
Weather: Clear ~50°
Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI 556/E°10222	Lamotte 2020/ R9151

Purging Information

Casing Material: PVC
Casing Diameter: 1"
Total Depth: 24.5
Depth to Water: 4.03
Water Column: 20.47
Gallons/Foot: 0.04
Gallons in Well: 0.81

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 14.5 To: 24.5
Pump Intake Setting: ~19.5
Volumes to be Purged: Low Flow
Total Volume Purged: ~1.75
Pump On: 1511 Off: 1546

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (μmhos/cm)	Temp ([✓ °C] or °F)	Diss. Oxygen	Comments ORP
1516	5	200ml	1000	4.21	16.3	5.89	190	18.67	0.79	118.9
1521	10	↓	↓	4.22	9.11	5.97	191	19.31	0.53	105.1
1526	15			4.22	5.15	6.02	193	19.30	0.47	90.4
1531	20			4.22	4.89	6.00	195	19.37	0.42	78.3
1536	25			4.22	3.71	5.98	196	19.41	0.39	71.2
1541	30			4.22	3.36	5.99	196	19.40	0.36	67.5
1546	35			4.22	3.54	6.00	198	19.38	0.27	65.1

Observations During Sampling

Well Condition: PVC
Color: Clear
Odor: NONE
Purge Water Disposal: Drum
Turbidity(qualitative): <10NTUs
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ___ ARCADIS ___	Preservative
VOCs	3x 40ml CG	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF HAA-17
Date: 2-16-10
Sampling Time: 1453
Weather: Clear ~50°
Project No. GP08HAFS
Sampled By: Ryan Kontos
Recorded By: Ryan Kontos
Duplicate/QA/QC: N/A
Well ID: MW-8S

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI 556/R10222	Lamotte 2020/R9151

Purging Information

Casing Material: PVC
Casing Diameter: 1"
Total Depth: 15.4
Depth to Water: 3.83
Water Column: 11.57
Gallons/Foot: 0.04
Gallons in Well: 0.46

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 5.4 To: 15.4
Pump Intake Setting: 10.4
Volumes to be Purged: Low Flow
Total Volume Purged: ~1.75
Pump On: 1416 Off: 1451

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (μmhos/cm)	Temp ([✓ °C] or °F)	Diss. Oxygen	~~Comments~~ ORP
1421	5	200ml	1000	3.90	19.0	5.85	188	17.69	0.97	115.1
1426	10	↓	↓	3.90	13.8	5.93	191	18.06	0.67	116.0
1431	15			3.90	12.6	5.92	193	18.11	0.39	125.0
1436	20			3.90	5.14	5.91	194	18.20	0.30	130.4
1441	25			3.90	3.71	5.93	193	18.15	0.26	128.5
1446	30			3.90	2.96	5.95	193	18.23	0.21	125.9
1451	35			3.90	3.35	5.98	193	18.29	0.25	129.3

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: NONE
Purge Water Disposal: Drum
Turbidity(qualitative): <10 NTUs
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ___ ARCADIS ___	Preservative
VOC	3x 40ml CG	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF HAA 17
Project No. GP08HAFS
Well ID: MW-90
Date: 2-16-10
Sampled By: Ryan Kontos
Sampling Time: 1337
Recorded By: Ryan Kontos
Weather: Clear ~50°
Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI 556/ R10222	Lamotte 2020/ R9151

Purging Information

Casing Material: PVC
Casing Diameter: 1"
Total Depth: 30.39
Depth to Water: 7.23
Water Column: 23.16
Gallons/Foot: 0.04
Gallons in Well: 0.92

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 20.39 To: 30.39
Pump Intake Setting: 25'
Volumes to be Purged: Low Flow
Total Volume Purged: ~1.75gal
Pump On: 1300 Off: 1335

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (μmhos/cm)	Temp ([✓ °C] or °F)	Diss. Oxygen	Comments ORP
1305	5	200ml	1000	7.51	84.1	6.06	98	19.51	0.80	-55.1
1310	10			7.52	25.1	5.85	96	19.53	0.54	-57.2
1315	15			7.52	12.1	5.81	96	19.60	0.45	-59.2
1320	20			7.52	11.7	5.80	96	19.66	0.43	-61.3
1325	25			7.52	8.41	5.79	95	19.70	0.50	-63.3
1330	30			7.52	7.03	5.79	95	19.73	0.51	-67.4
1335	35	↓	↓	7.52	5.95	5.78	95	19.70	0.48	-68.1

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: NONE
Purge Water Disposal: Drum
Turbidity(qualitative): <10NTU's
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ____ ARCADIS ____	Preservative
VOC	3x 40ml CG	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF HAA-17
Project No. GP08HAFS
Well ID: MW-9S
Date: 2-16-10
Sampled By: Ryan Kontes
Sampling Time: 1247
Recorded By: Ryan Kontes
Weather: Cold ~40°
Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI 556/ R10222	Lamotte 2020/ R9151

Purging Information

Casing Material: PVC
Casing Diameter: ~~2~~1"
Total Depth: 15.55
Depth to Water: 5.61
Water Column: 9.94
Gallons/Foot: 0.04
Gallons in Well: 0.39

Purge Method:(circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 5.55 To: 15.55
Pump Intake Setting: 10.5
Volumes to be Purged: Low Flow
Total Volume Purged: ~1.75gal
Pump On: 1210 Off: 1245

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	Diss. Oxygen	~~Comments~~ ORP
1215	~~1215~~ 5	200ml	1000	5.66	276	5.55	160	16.72	2.70	89.3
1220	10	↓	↓	5.66	17.5	5.63	162	16.89	2.36	72.1
1225	15			5.66	8.21	5.69	162	17.38	2.48	33.3
1230	20			5.66	6.69	5.73	163	17.25	2.28	3.7
1235	25			5.66	6.91	5.67	162	17.43	2.25	-6.4
1240	30			5.66	5.23	5.69	163	17.39	2.19	-10.7
1245	35			5.66	4.51	5.73	163	17.35	2.15	-13.6

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: Slight
Purge Water Disposal: Drum
Turbidity(qualitative): <10 NTU
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ____ ARCADIS ____	Preservative
VOC	3x40ml	HCl

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF HAA-17 Project No. GP08HAFS **Well ID:** MW-13S
Date: 2-16-10 Sampled By: Ryan Kontos
Sampling Time: 1148 Recorded By: Ryan Kontos
Weather: cold ~35° Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	~~PID~~	Water Quality Meter(s)
Serial #:	YSI 556/R10222	Lamotte 2020/R9151

Purging Information

Casing Material: PVC
Casing Diameter: 1"
Total Depth: 15.59
Depth to Water: 4.73
Water Column: 10.86
Gallons/Foot: 0.04
Gallons in Well: 0.43

Purge Method:(circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 5.59 To: 15.59
Pump Intake Setting: 10.6
Volumes to be Purged: Low Flow
Total Volume Purged:
Pump On: 1116 Off: 1146

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	Diss. Oxygen	Comments ORP
1121	5	200ml	1000	4.77	3.81	5.86	74	18.72	0.72	57.4
1126	10	↓	↓	4.77	3.27	5.71	75	19.52	0.56	65.0
1131	15			4.77	2.83	5.75	75	20.32	0.48	57.1
1136	20			4.77	2.69	5.81	75	20.56	0.40	42.5
1141	25			4.77	2.55	5.79	74	20.45	0.33	30.5
1146	30			4.77	2.59	5.78	74	20.34	0.31	18.1

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: Slight

Purge Water Disposal: Drum
Turbidity(qualitative): <10NTU's
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ARCADIS	Preservative
VOC	3 x 40ml CG	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF HAA-17
Project No. GP08HAFS
Well ID: MW-13D
Date: 2-16-10
Sampled By: Ryan Kontos
Sampling Time: 1103
Recorded By: Ryan Kontos
Weather: Cold ~35°
Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI 556 / R10222	Lamotte 2020 / R9151

Purging Information

Casing Material: PVC
Casing Diameter: 1"
Total Depth: 30.01
Depth to Water: 4.41
Water Column: 25.6
Gallons/Foot: ~~0.16~~ 0.04
Gallons in Well: 1.0

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 20.01 To: 30.01
Pump Intake Setting: 25'
Volumes to be Purged: Low Flow
Total Volume Purged: ~3.5 gal
Pump On: 0951 Off: 1101

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (μmhos/cm)	Temp ([✓ °C] or °F)	Diss. Oxygen	Comments ORP
0956	5	200ml	1000	4.45	214	3.45	82	17.02	1.60	263.2
1001	10			4.45	168	4.20	85	17.06	0.97	196.7
1006	15			4.45	108.7	4.74	87	17.18	0.84	162.5
1011	20			4.45	71.6	4.83	88	17.39	0.79	141.5
1016	25			4.45	66.3	4.98	89	17.56	0.66	126.3
1021	30			4.45	58.1	5.13	91	17.85	0.60	105.6
1026	35			4.45	53.6	5.35	92	18.07	0.50	90.0
1031	40			4.45	49.4	5.42	93	17.99	0.47	74.2
1036	45			4.45	35.1	5.42	95	18.04	0.45	85.5
1041	50			4.45	25.0	5.44	94	18.16	0.41	41.6
1046	55			4.45	13.4	5.45	95	18.31	0.36	37.1
1051	60			4.45	8.54	5.46	96	18.48	0.38	32.0
1056	65			4.45	7.11	5.49	95	18.50	0.43	23.9
1101	70	↓	↓	4.45	9.55	5.51	95	18.51	0.39	17.8

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: Slight
Purge Water Disposal: Drum
Turbidity(qualitative): <10 NTUs
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ______ ARCADIS ______	Preservative
VOC	3x 40ml CG	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF HAA-17
Project No. GP08HAFS
Well ID: MW-5S
Date: 2-16-10
Sampled By: Ryan Kontos
Sampling Time: 0932
Recorded By: Ryan Kontos
Weather: Cold ~30°
Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI R10222	Lamotte 2020/ R9151

Purging Information

Casing Material: PVC
Casing Diameter: 1"
Total Depth: 15.8
Depth to Water: 4.44
Water Column: 11.36
Gallons/Foot: 0.04
Gallons in Well: 0.45

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 5.8 To: 15.8
Pump Intake Setting: 10.8
Volumes to be Purged: Low Flow
Total Volume Purged: ~1.75 gal
Pump On: 0855 Off: 0930

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	Diss. Oxygen	~~Comments~~ ORP
0900	05	200ml	1000	4.47	8.29	4.91	104	17.14	1.13	244.7
0905	10			4.47	6.69	4.94	104	17.23	0.84	217.6
0910	15			4.47	5.23	4.99	104	17.38	0.69	200.4
0915	20			4.47	4.41	5.04	105	17.41	0.55	188.5
0920	25			4.47	5.38	5.08	103	17.46	0.49	175.1
0925	30			4.47	3.91	5.05	103	17.48	0.45	161.3
0930	35	↓	↓	4.47	3.86	5.04	103	17.50	0.44	158.5

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: Slight
Purge Water Disposal: Drum
Turbidity(qualitative): <10 NTUS
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ______ ARCADIS ______	Preservative
VOC	3x 40ml CG	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF HAA-17
Project No. GP08HAFS
Well ID: MW-5D
Date: 2-16-10
Sampled By: Ryan Kontos
Sampling Time: 0839
Recorded By: Ryan Kontos
Weather: Cold ~30°
Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI R10222	Lamotte 2020/ R9151

Purging Information

Casing Material: PVC
Casing Diameter: 1"
Total Depth: 30
Depth to Water: 4.50
Water Column: 25.5
Gallons/Foot: 0.04
Gallons in Well: 1.02

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 20 To: 30
Pump Intake Setting: Middle of screen 25'
Volumes to be Purged: Low Flow
Total Volume Purged: ~1.75 gal
Pump On: 0802 Off: 0837

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	Diss. Oxygen	~~Comments~~ ORP
0807	5	200ml	1000	4.60	13.0	4.72	124	18.39	1.65	307.2
0812	10	↓	↓	4.61	9.81	4.64	125	18.30	1.04	331.1
0817	15	↓	↓	4.61	12.9	4.56	123	18.36	0.90	321.4
0822	20	↓	↓	4.61	10.56	4.59	122	18.41	0.79	318.6
0827	25	↓	↓	4.61	9.11	4.61	122	18.44	0.66	311.1
0832	30	↓	↓	4.61	8.19	4.62	121	18.51	0.49	308.4
0837	35	↓	↓	4.61	8.88	4.64	121	18.53	0.45	303.5

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: NONE

Purge Water Disposal: Drum
Turbidity(qualitative): <10 NTUs
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ______ ARCADIS ______	Preservative
VOC	3x 40ml C6	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

Table 1. Summary of Well Construction and Groundwater Level

MW-ID	Installation Date	Installer	Well Material	Screen Length (ft)	Total Depth (ft BGS)	Screen Interval (ft BGS)	Northing	Easting	Top of Casing (AMSL)	Ground Elevation (AMSL)
1290-MW-01D	05/07	STEP	1-in. PVC	10	29.95	19.95 - 29.95	735508.85	977102.38	36.40	36.6
1290-MW-01S		STEP	1-in. PVC	10	15.72	5.72 - 15.72	735513.98	977100.64	36.43	36.7
1290-MW-02D		STEP	1-in. PVC	10	29.90	19.90 - 29.90	735420.23	977197.88	36.05	36.3
1290-MW-02S		STEP	1-in. PVC	10	14.3	4.3 - 14.3	735423.99	977200.20	36.05	36.3
1290-MW-03D		STEP	1-in. PVC	10	29.58	19.59 - 29.58	735289.03	977078.47	[a]	36.54
1290-MW-03S		STEP	1-in. PVC	5	11.70	6.70 - 11.70	735288.83	977069.78	[a]	36.59
1290-MW-04D		STEP	1-in. PVC	10	29.91	19.91 - 29.91	735425.92	977010.12	36.25	36.5
1290-MW-04S		STEP	1-in. PVC	10	15.66	5.66 - 15.66	735420.53	977010.17	36.23	36.5
1290-MW-05D		STEP	1-in. PVC	10	30.0	20.0 - 30.0	735980.30	977154.14	36.16	36.4
1290-MW-05S		STEP	1-in. PVC	10	15.80	5.80 - 15.80	735978.23	977150.92	36.14	36.4
1290-MW-06S		STEP	1-in. PVC	5	9.0	4.0 - 9.0	736237.28	977477.86	36.03	36.3
1290-MW-07D		STEP	1-in. PVC	10	34.6	24.6 - 34.6	734742.41	975723.20	36.93	37.2
1290-MW-07S		STEP	1-in. PVC	10	17.89	7.89 - 17.89	734738.23	975725.28	36.92	37.3
1290-MW-08D		STEP	1-in. PVC	10	24.50	14.50 - 24.50	735083.08	977800.64	36.72	37.0
1290-MW-08S		STEP	1-in. PVC	10	15.40	5.40 - 15.40	735078.48	977799.65	36.53	36.9
1290-MW-09D		STEP	1-in. PVC	10	30.39	20.39 - 30.39	734986.65	978528.67	37.35	37.7
1290-MW-09S		STEP	1-in. PVC	10	15.55	5.55 - 15.55	734989.07	978523.22	37.39	37.8
1290-MW-12D		STEP	1-in. PVC	10	34.3	24.3 - 34.3	735583.27	976441.49	37.27	37.5
1290-MW-12S		STEP	1-in. PVC	10	17.6	7.6 - 17.6	735576.76	976442.09	37.29	37.5
1290-MW-13D		STEP	1-in. PVC	10	30.01	20.01 - 30.01	734833.43	977242.99	36.81	37.1
1290-MW-13S		STEP	1-in. PVC	10	15.59	5.59 - 15.59	734827.57	977244.61	36.63	36.9
1290-MW-16	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	734429.82	978718.65	30.33	30.4
1290-MW-15	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	734550.89	978703.92	31.30	31.4

[a] Monitoring wells 1290-MW-03S and 1290-MW-03D unable to open well plug. Ground shots reported are on rim of protective cover of well.

AMSL = Above mean sea level.

BGS = Below ground surface.

D= Deep well.

PVC = Polyvinyl chloride.

S= Shallow well.

STEP = Solutions to Environmental Problems, Inc.

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF HAA-17
Project No. GP08HAFS
Well ID: MW-16S
Date: 2-17-10
Sampled By: Ryan Kontos
Sampling Time: 1012
Recorded By: Ryan Kontos
Weather: Clear ~35°
Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI 556/R10222	Lamotte 2020/R9151

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: 12.9
Depth to Water: 1.65
Water Column: 11.25
Gallons/Foot: 0.16
Gallons in Well: 1.8

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 2.9 To: 12.9
Pump Intake Setting: 8'
Volumes to be Purged: Low Flow
Total Volume Purged: ~1.75 gal
Pump On: 0935 Off: 1010

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	ORP (mV)	Diss. Oxygen	Comments
0940	5 ~~0940~~	200ml	1000ml	1.68	13.2	5.62	147	14.10	132.0	1.31	
0945	10			1.68	12.2	5.79	148	15.80	32.6	0.67	
0950	15			1.68	10.13	5.85	150	16.54	-1.9	0.45	
0955	20			1.68	9.15	5.93	155	17.09	-25.4	0.37	
1000	25			1.68	8.65	5.99	156	17.24	-32.1	0.36	
1005	30			1.68	7.75	6.04	155	17.28	-31.5	0.34	
1010	35	↓	↓	1.68	7.01	6.07	154	17.31	-29.1	0.31	

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: None
Purge Water Disposal: Drum
Turbidity(qualitative): <10 NTUs
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ______ ARCADIS ______	Preservative
VOC's	3x40ml CG	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

pg. 1 of 2

Site Location: Fort Stewart/HAAF HAA-17
Project No. GP08HAFS
Well ID: AT-MW-3
Date: 2-17-10
Sampled By: Ryan Kontos
Sampling Time: 1314
Recorded By: Ryan Kontos
Weather: Clear ~ 45°
Duplicate/QA/QC: Collected DUP-2

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI-556/R00222	Lamotte 2020/R9151

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: 12.2
Depth to Water: 1.04
Water Column: 10.98
Gallons/Foot: 0.16
Gallons in Well: 1.75

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 2.2 To: 12.2
Pump Intake Setting: 7'
Volumes to be Purged: Low Flow
Total Volume Purged: 6.25gal
Pump On: 1100 Off: 1305

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	ORP (mV)	Diss. Oxygen	Comments
1105	05	200ml	1000ml	1.08	408	5.74	43	14.51	69.0	2.30	Brown H2O
1110	10	↓	↓	1.08	130	5.56	63	14.32	36.4	0.51	
1115	15			1.08	111	5.55	63	14.41	22.1	0.48	
1120	20			1.08	123	5.56	62	14.47	17.3	0.45	
1125	25			1.08	96.9	5.56	62	14.52	8.7	0.41	
1130	30			1.08	81.9	5.45	60	14.71	1.5	0.40	
1135	35			1.08	77.3	5.41	58	14.80	-11	0.37	
1140	40			1.08	61.0	5.45	58	14.85	-18.3	0.25	
1145	45			1.08	49.6	5.49	59	14.92	-26.1	0.19	
1150	50			1.08	45.1	5.41	58	15.02	-29.6	0.27	
1155	55			1.08	40.1	5.43	58	15.15	-31.5	0.21	
1200	60			1.08	34.4	5.45	57	15.35	-36.0	0.15	
1205	65			1.08	31.1	5.44	56	15.40	-36.9	0.14	
1210	70			1.08	29.5	5.42	56	15.46	-37.5	0.14	
1215	75	↓	↓	1.08	30.6	5.41	55	15.50	-37.9	0.13	

1 vol

2 vol

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: Slight
Purge Water Disposal: Drum
Turbidity(qualitative): <10 NTUs
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description: From Lab ______ ARCADIS ______	Preservative
VOC's	6 x 40ml CG	HCL
6010 Metals	2x250cc PL	HNO3

Boring/Casing Volumes
2" = 0.16 4" = 0.65

pg. 1 of 2

ARCADIS

Groundwater Sampling Form

Pg. 2 of 2

Site Location: Fort Stewart/HAAF HAA-17
Project No. GP08HAFS
Well ID: AT-MW-3
Date: 2-17-10
Sampled By: Ryan Kontos
Sampling Time: 1314
Recorded By: Ryan Kontos
Weather: Clear Breezy ~45°
Duplicate/QA/QC: DUP-2 / Time 1200

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI 556/ R10222	Lamotte 2020/ R9951

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: 12.2
Depth to Water: 1.04
Water Column: 10.98
Gallons/Foot: 0.16
Gallons in Well: 1.75

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 2.2 To: 12.2
Pump Intake Setting: 7'
Volumes to be Purged: Low Flow
Total Volume Purged: 6.25gal
Pump On: 1100 Off: 1305

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	ORP (mV)	Diss. Oxygen	Comments
1220	80	200ml	1000ml	1.08	23.5	5.39	55	15.54	-38.0	0.13	
1225	85			1.08	21.6	5.37	55	15.57	-36.1	0.14	
1230	90			1.08	20.2	5.36	55	15.58	-34.9	0.15	
1235	95			1.08	18.3	5.37	54	15.61	-33.0	0.13	
1240	100			1.08	16.0	5.38	54	15.66	-31.3	0.11	
1245	105			1.08	14.1	5.39	54	15.70	-30.3	0.19	
1250	110			1.08	11.5	5.39	54	15.72	-30.0	0.15	
1255	115			1.08	9.91	5.40	53	15.75	-29.5	0.16	
1300	120			1.08	9.27	5.40	53	15.80	-29.1	0.14	
1305	125			1.08	8.38	5.40	53	15.83	-28.7	0.12	

— 3 vol

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: Slight
Purge Water Disposal: Drum
Turbidity(qualitative): <10 NTUs
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ______ ARCADIS ______	Preservative
VOCs	6x40ml CG	HCL
6010 Metals	2x250cc PL	HNO3

Boring/Casing Volumes
2" = 0.16 4" = 0.65

Pg. 2 of 2

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF HAA-17
Project No. GP08HAFS
Well ID: AT-MW-5
Date: 2-17-10
Sampled By: Ryan Kontos
Sampling Time: 1408
Recorded By: Ryan Kontos
Weather: Clear Breezy ~45°
Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI 556/ R10222	Lamotte 2020/ R9157

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: 12.3
Depth to Water: 2.11
Water Column: 10.21
Gallons/Foot: 0.16
Gallons in Well: 1.6

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 2.3 To: 12.3
Pump Intake Setting: 8'
Volumes to be Purged: Low Flow
Total Volume Purged: ~1.75 gal
Pump On: 1329 Off: 1404

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (μmhos/cm)	Temp ([✓ °C] or °F)	ORP (mV)	Diss. Oxygen	Comments
1334	5	200ml	1000ml	2.15	16.5	5.87	105	13.89	39.1	2.43	
1339	10			2.16	14.1	5.94	108	13.61	39.8	2.50	
1344	15			2.16	11.9	5.94	109	13.63	33.7	2.43	
1349	20			2.16	9.56	5.96	109	13.70	20.1	2.31	
1354	25			2.16	8.99	5.98	110	13.77	11.6	2.23	
1359	30			2.16	8.23	6.00	110	13.83	-8.0	2.20	
1404	35			2.16	4.71	6.03	111	13.88	-15.6	2.23	

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: NONE
Purge Water Disposal: Drum
Turbidity(qualitative): <10NTUs
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ____ ARCADIS ____	Preservative
VOCs	3x 40ml G	HCL
6010 Metals	1 x 250 cc PL	HNO3

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF
Project No. GP08HAFS
Well ID: AT-MW-02
Date: 2-17-10
Sampled By: Ryan Kontos
Sampling Time: 1516
Recorded By: Ryan Kontos
Weather: Clear Cold ~45°
Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI/556 R10222	Lamotte 2020/R9151

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: 12.3
Depth to Water: 1.40
Water Column: 10.9
Gallons/Foot: 0.16
Gallons in Well: 1.7

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 2.3 To: 12.3
Pump Intake Setting: 7'
Volumes to be Purged: Low Flow
Total Volume Purged:
Pump On: 1422 Off: 1512

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	ORP (mV)	Diss. Oxygen	Comments
1427	5	200ml	1000ml	1.45	29.7	5.36	53	14.17	52.9	2.64	
1432	10			1.45	24.2	5.36	55	14.31	55.5	2.39	
1437	15			1.45	21.1	5.36	58	14.46	58.0	2.21	
1442	20			1.45	20.2	5.42	60	14.50	30.2	2.00	
1447	25			1.45	18.5	5.49	61	14.54	15.8	1.75	
1452	30			1.45	12.6	5.49	61	14.59	12.1	1.66	
1457	35			1.45	10.98	5.48	61	14.62	8.8	1.61	
1502	40			1.45	8.71	5.48	62	14.69	6.6	1.55	
1507	45			1.45	8.54	5.47	62	14.65	7.4	1.48	
1512	50	↓	↓	1.45	9.68	5.47	62	14.68	8.1	1.51	

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: slight
Purge Water Disposal: Drum
Turbidity(qualitative): <10 NTUs
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ______ ARCADIS ______	Preservative
VOCs	3x40ml CG	HCL
6010 Metals	1x1250ml PL	HNO3

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF
Project No. GP08HAFS
Well ID: AT-MW-1
Date: 2-17-10
Sampled By: Ryan Kontos
Sampling Time: 1615
Recorded By: Ryan Kontos
Weather: Clear Breezy ~45°
Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI 556/ R10222	Lamotte 2020/ R9151

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: ~~45.3~~ 45.3
Depth to Water: ~~45.3~~ 1.75
Water Column: 43.55
Gallons/Foot: 0.16
Gallons in Well: 6.9

Purge Method:(circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 40.3 To: 45.3
Pump Intake Setting: ~42.3'
Volumes to be Purged: Low Flow
Total Volume Purged: ~ 1.62
Pump On: 1530 Off: 1610

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	ORP (mV)	Diss. Oxygen	Comments
1535	5	200ml	1000	2.16	368	6.63	67	16.06	36.4	2.51	Iron Deposits
1540	10	200ml	1000	3.10	289	6.41	77	16.21	45.1	1.89	In H2O
1545	15	150ml	750	3.21	57.1	6.35	86	16.16	42.8	1.64	small particles
1550	20	150ml	750	3.28	30.1	6.34	86	16.40	22.8	1.45	Particles
1555	25			3.30	17.2	6.37	86	16.51	12.6	1.54	Clearing
1600	30			3.31	6.66	6.40	85	16.40	6.93	1.38	
1605	35			3.31	7.31	6.43	83	16.35	1.54	1.30	
1610	40	↓	↓	3.31	7.27	6.45	82	16.31	-2.9	1.21	↓

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: NONE
Purge Water Disposal: Drum
Turbidity(qualitative): <10 NTUs / small Orange Particles
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ____ ARCADIS ____	Preservative
VOC's	3x 40ml CG	HCL
6010 metals	1 x 250cc PL	HNO3

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF
Project No. GP08HAFS
Well ID: AT-MW-4
Date: 2-17-10
Sampled By: Ryan Kontas
Sampling Time: 1726
Recorded By: Ryan Kontas
Weather: Breezy ~
Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI 556/ R10222	Lamotte 2020/R9151

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: 12.3
Depth to Water: 2.50
Water Column: 9.80
Gallons/Foot: 0.16
Gallons in Well: 1.56

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer Peristaltic
Screen Interval: From: 2.3 To: 12.3
Pump Intake Setting: ~ 7.3
Volumes to be Purged: Low Flow
Total Volume Purged: ~2.75
Pump On: 1627 Off: 1722

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp (ºC or ºF)	ORP (mV)	Diss. Oxygen	Comments
1632	5	200ml	1000ml	2.56	49.1	5.96	188	16.51	52.7	2.14	
1637	10			2.56	41.1	5.96	181	16.83	109	1.77	
1642	15			2.57	30.0	5.95	176	17.03	176	1.50	
1647	20			2.57	28.1	5.90	169	17.21	21.3	1.27	
1652	25			2.57	23.4	5.86	161	17.37	-95.6	0.95	
1657	30			2.57	19.9	5.84	152	17.37	-94.3	0.96	
1702	35			2.57	15.1	5.83	148	17.39	-98.6	0.90	
1707	40			2.57	11.5	5.81	147	17.45	-99.2	0.94	
1712	45			2.57	8.99	5.79	145	17.53	-100.5	0.91	
1717	50			2.57	8.00	5.98	143	17.58	-101.1	0.95	
1722	55	↓	↓	2.57	9.15	5.77	140	17.61	-102.3	0.80	

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: Slight
Purge Water Disposal: Drum
Turbidity(qualitative): <10 NTUs
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ____ ARCADIS ____	Preservative
VOCs	3x 40ml CG	HCL
6010 metals	1x 250cc PL	HNO3

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF
Project No. GP08HAFS
Well ID: AF-55
Date: 2/10/10
Sampled By: Robby Sheely
Sampling Time: 1240
Recorded By: Robby Sheely
Weather: Sunny Windy 40°
Duplicate/QA/QC: Dup-1 (021010)

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:		07F100306

Purging Information

Casing Material: PVC
Casing Diameter: 2
Total Depth: 34'
Depth to Water: 2.28'
Water Column: 31.72
Gallons/Foot:
Gallons in Well:

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 24' To: 34'
Pump Intake Setting: 29' bgs
Volumes to be Purged:
Total Volume Purged: 2.4
Pump On: 1145 Off: 1247

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	ORP (mV)	Diss. Oxygen	Comments
1155	10	150	0.3 gal	2.46	18.34	6.42	207	19.94	19.7	0.78	
1200	15	150		2.47	26.5	6.41	210	20.14	15.7	0.50	
1205	20	150		2.48	56.1	6.41	212	20.44	10.1	0.37	
1215	30	150		2.49	32.3	6.36	204	20.37	3.8	0.35	
1220	35	150		2.49	23.6	6.35	207	20.55	-2.9	0.33	
1225	40	150		2.49	19.6	6.36	206	20.67	-5.0	0.32	
1230	45	150		2.49	16.8	6.36	208	20.83	-8.4	0.31	
1235	50	150		2.49	16.2	6.38	206	20.89	-8.9	0.32	
1240	55	150	2.4 gal	2.49	15.7	6.39	205	20.90	-9.4	0.30	

Observations During Sampling

Well Condition: OK
Color: Clear
Odor: None
Purge Water Disposal: Drum
Turbidity(qualitative): C
Other (OVA, HNU,etc.):

Constituents Sampled	Container Description From Lab SHEALY ARCADIS	Preservative
VOC	6- 40ml VOAs	HCl

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF
Project No. GP08HAFS
Well ID: AF-23
Date: 2/10/10
Sampled By: Robby Shealy
Sampling Time: 1120
Recorded By: Robby Shealy
Weather: Sunny Windy 40°F
Duplicate/QA/QC: MS/MSD Taken : AF-23 (021010)

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:		07F100306

Purging Information

Casing Material: PVC
Casing Diameter: RS ~~2~~ 3/4"
Total Depth: 13
Depth to Water: 2.95
Water Column: 10.05
Gallons/Foot: 0.02
Gallons in Well: 0.20

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 3 To: 13'
Pump Intake Setting: 8' btoc
Volumes to be Purged: Low Flow
Total Volume Purged: 2.3gal
Pump On: 1042 Off: 1128

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	ORP (mV)	Diss. Oxygen	Comments
1045	3	200	0	3.85	38.8	7.05	490	15.33	170.2	2.11	
1050	8	200		3.83	29.9	7.17	495	15.62	144.6	2.23	
1055	13	200		3.85	11.5	7.19	496	15.70	122.2	1.54	
1100	18	200		3.85	8.02	7.20	495	15.82	117.5	1.25	
1105	23	200		3.85	7.38	7.20	493	15.78	106.1	1.06	
1110	28	200		3.85	3.44	7.21	493	15.61	96.7	1.00	
1115	33	200		3.85	3.71	7.20	494	15.60	96.8	1.03	
1120	38	200	2.3gal	3.85	3.81	7.20	494	15.54	97.5	1.04	

Observations During Sampling

Well Condition: Ok
Color: Clear
Odor: None
Purge Water Disposal: Drum
Turbidity(qualitative): <10 NTUs
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab SHEALY ARCADIS	Preservative
VOC	9- 40ml VOAs	HCl

Boring/Casing Volumes
2" = 0.16 4" = 0.65

Collected MS/MSD

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF - 17
Project No. GP08HAFS
Well ID: AF-68
Date: 2/10/10
Sampled By: Robby Shealy
Sampling Time: 1347
Recorded By: Robby Shealy
Weather: Sunny Windy 40°
Duplicate/QA/QC:

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:		07F100306

Purging Information

Casing Material: PVC
Casing Diameter: 2
Total Depth: 39.5
Depth to Water: 3.04
Water Column: 36.16
Gallons/Foot: 0.16
Gallons in Well: 5.7

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 34.5 To: 39.5
Pump Intake Setting: 37'
Volumes to be Purged: Low Flow
Total Volume Purged: 2.0 gal
Pump On: 1302 Off: 1351

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	ORP (mV)	Diss. Oxygen	Comments
1306	4	160	0	3.11	0.41	6.79	143	20.39	-15.9	1.09	
1322	20	150		3.11	0.15	6.82	143	20.18	-51.8	0.49	
1327	25	150		3.11	0.19	6.79	141	20.24	-49.2	0.37	
1337	35	150		3.11	0.05	6.77	137	20.39	-37.8	0.31	
1342	40	150		3.11	0.01	6.79	138	20.38	-39.2	0.29	
1347	45	150	2.0	3.11	0.03	6.77	136	20.32	-41.8	0.31	

Observations During Sampling

Well Condition: OK
Color: Clear
Odor: None
Purge Water Disposal: Drum
Turbidity(qualitative): <10 NTUS
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab SHEALY ARCADIS ____	Preservative
VOC	3-40ml VOA	HCl

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF -17
Date: 2/11/10
Sampling Time: 0940
Weather: Partly Cloudy 40°
Project No. GP08HAFS
Well ID: AF-35
Sampled By: Robby Shealy
Recorded By: Robby Shealy
Duplicate/QA/QC:

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:		07F100306

Purging Information

Casing Material: PVC
Casing Diameter: 3/4"
Total Depth: 10.7
Depth to Water: Artesian
Water Column:
Gallons/Foot:
Gallons in Well:

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 1.2 To: 10.7 bgs
Pump Intake Setting: 5.7' bgs
Volumes to be Purged:
Total Volume Purged: 2.4 gal
Pump On: 0845 Off: 0945

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	ORP (mV)	Diss. mg/l Oxygen	Comments
0849	4	140	0	0.91	21.6	5.25	461	9.32	84.7	3.95	
0905	20	150		1.61	12.5	5.42	521	9.30	-24.1	1.17	
0910	25	150		1.63	11.2	5.47	521	9.56	-45.1	0.93	
0915	30	150		1.64	9.8	5.56	504	9.96	-40.8	0.89	
0925	40	150		1.64	9.5	5.60	512	9.98	-63.1	0.88	
0930	45	150		1.64	8.9	5.60	520	10.00	-64.5	0.80	
0935	50	150		1.64	9.2	5.61	521	9.98	-65.8	0.77	
0940	55	150		1.64	9.5	5.61	523	9.92	-67.4	0.76	

Observations During Sampling

Well Condition: OK
Color: Clear
Odor: None
Purge Water Disposal:
Turbidity(qualitative):
Other (OVA, HNU,etc.):

Constituents Sampled	Container Description From Lab SHEALY ARCADIS	Preservative
VOC	3 - 40ml VOA	HCl

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF HAA-17
Project No. GP08HAFS
Well ID: MW-15S
Date: 2-19-10
Sampled By: Ryan Kontos
Sampling Time: 0922
Recorded By: Ryan Kontos
Weather: Clear Cool ~35°
Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	556 YSI R10222	Lamotte 2020/R9152

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: 11.65
Depth to Water: 2.31
Water Column: 9.34
Gallons/Foot: 0.16
Gallons in Well: 1.49

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 2 To: ~~8.7~~ RK 11.65
Pump Intake Setting: ~7'
Volumes to be Purged: Low Flow
Total Volume Purged:
Pump On: 0830 Off: 0920

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or ml)	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	Diss. Oxygen	Comments ORP
0835	~~0835~~	200ml	1000ml	2.36	65.1	4.38	228	14.51	1.56	262.3
0840	10	↓	↓	2.36	56.0	4.78	201	15.28	1.25	194.5
0845	15			2.36	39.9	4.89	197	16.00	0.71	169.3
0850	20			2.36	31.7	5.11	184	16.26	0.59	140.1
0855	25			2.36	25.4	5.21	170	16.60	0.41	65.4
0900	30			2.36	19.2	5.39	161	16.77	0.35	39.8
0905	35			2.36	11.1	5.45	155	16.82	0.34	26.5
0910	40			2.36	9.03	5.50	150	16.89	0.33	20.1
0915	45			2.36	7.24	5.53	147	16.93	0.28	10.5
0920	50			2.36	6.69	5.56	142	16.98	0.25	5.1

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: Slight

Purge Water Disposal: Drum
Turbidity(qualitative): <10
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ____ ARCADIS ____	Preservative
8260	3 x 40mL CG	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF ~ 17
Project No. GP08HAFS
Well ID: AF-26
Date: 2/11/10
Sampled By: Robby Shealy
Sampling Time: 1049
Recorded By: Robby Shealy
Weather: Partly Cloudy 40°
Duplicate/QA/QC:

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:		07F100306

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: 12'
Depth to Water: Artesian
Water Column:
Gallons/Foot:
Gallons in Well:

Purge Method:(circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: ~~1012~~ RS 2' To: 12' bgs
Pump Intake Setting: 7' bgs
Volumes to be Purged:
Total Volume Purged:
Pump On: 1012 Off: 1052

Field Parameter Measurements During Purging

Added 3.38' riser to stop flow

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	ORP (mV)	Diss. Oxygen	Comments
1019	7	140	0.1gal	1.69	0.62	6.98	200	16.69	-68.0	0.63	
1029	17	150		1.69	0.33	6.98	199	16.57	-67.8	0.44	
1034	22	150		1.69	0.35	6.95	199	16.52	-68.1	0.47	
1039	27	150		1.70	0.16	6.94	199	16.48	-67.7	0.33	
1044	32	150		1.70	0.21	6.94	199	16.45	-62.5	0.32	
1049	37	150		1.70	0.04	6.94	199	16.32	-63.7	0.31	

Observations During Sampling

Well Condition: OK
Color: Clear
Odor: None
Purge Water Disposal: DRUM
Turbidity(qualitative): CIONTUS
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab SHEALY ARCADIS	Preservative
VOC	3 - 40ml VOA	HCl

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF - 17
Project No. GP08HAFS
Well ID: MV-2D
Date: 2/11/10
Sampled By: Robby Shealy
Sampling Time: 1652
Recorded By: Robby Shealy
Weather: Cloudy 43°
Duplicate/QA/QC:

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:		07F100306

Purging Information

Casing Material: PVC
Casing Diameter: 1"
Total Depth: 29.9
Depth to Water: 4.43
Water Column: 25.47
Gallons/Foot: 0.04
Gallons in Well: 1.02

Purge Method:(circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 19.9 To: 29.9
Pump Intake Setting: 24.9
Volumes to be Purged: Low Flow
Total Volume Purged: 2.4 gal
Pump On: 1604 Off: 1653

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	Diss. Oxygen	Comments ORP
1607	3	160	0	4.58	147	5.07	95	20.33	1.43	96.5
1612	8	160		4.61	82.9	5.29	95	20.92	0.87	66.5
1622	18	160		4.60	108.5	5.30	95	21.05	0.52	47.4
1627	23	160		4.60	126	5.29	96	21.11	0.37	45.8
1632	28	180		4.60	101.1	5.32	96	21.26	0.31	40.9
1637	33	160		4.60	92.9	5.36	96	21.29	0.27	39.3
1642	38	160		4.60	92.1	5.29	96	21.29	0.26	40.8
1647	43	160		4.60	94.6	5.29	97	21.26	0.25	39.2
1652	48	160	2.4	4.60	89.1	5.27	96	21.27	0.26	41.3

Observations During Sampling

Well Condition: Ok
Color: Cloudy White
Odor: None
Purge Water Disposal: Drum
Turbidity(qualitative): 89.1
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab SHEALY ARCADIS	Preservative
VOC	3 - 40 ml VOA	HCl

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF -17
Date: 2/11/10
Sampling Time: 1548
Weather: Overcast 45°

Project No. GP08HAFS
Sampled By: Robby Shealy
Recorded By: Robby Shealy
Duplicate/QA/QC:

Well ID: MW-35

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:		07F100306

Purging Information

Casing Material: PVC
Casing Diameter: 1"
Total Depth: 11.7
Depth to Water: 4.96
Water Column: 6.74
Gallons/Foot: 0.04
Gallons in Well: 0.26

Purge Method:(circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 6.7 To: 11.7 bgs
Pump Intake Setting: 9.2 bgs
Volumes to be Purged: ~~Low Flow~~ RS Purged 5 Well Volumes
Total Volume Purged: 1.4 gal
Pump On: 1514 Off: 1546

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (μmhos/cm)	Temp ([✓ °C] or °F)	Diss. mg/L Oxygen	Comments ORP
1518	4	200	0	4.99	63.3	5.67	82	17.92	1.90	144.8
1528	14	200		4.99	20.1	6.01	85	18.42	1.42	129.2
1533	19	200		4.99	9.10	6.02	87	18.42	1.18	97.9
1538	24	200		4.99	5.47	5.97	88	18.53	1.09	88.3
1543	29	200		4.99	3.37	5.99	88	18.57	0.99	78.4
1548	34	200	1.4	4.99	3.02	5.99	88	18.61	0.96	73.1

Observations During Sampling

Well Condition: Ok
Color: Clear
Odor: None

Purge Water Disposal: Drum
Turbidity(qualitative): <10 NTUs
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab SHEALY ARCADIS	Preservative
VOC	3-40ml VOA	HCl

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF - 17
Project No. GP08HAFS
Well ID: MW-7D
Date: 2/11/10
Sampled By: Robby Shealy
Sampling Time: 1423
Recorded By: Robby Shealy
Weather: Partly Cloudy 45°
Duplicate/QA/QC:

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:		07F100306

Purging Information

Casing Material: PVC
Casing Diameter: 1"
Total Depth: 29.6
Depth to Water: 4.46
Water Column: 25.14
Gallons/Foot: 0.04
Gallons in Well: 1.00

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 24.6 To: 34.6' bgs
Pump Intake Setting: 29.6' bgs
Volumes to be Purged: 0 Low Flow
Total Volume Purged: 1.8 gallons
Pump On: 1348 Off: 1425

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	Diss. Oxygen	Comments ORP
1353	5	200	0	4.94	16.6	5.13	39	19.17	1.14	160
1358	10	160		4.85	14.2	5.26	40	19.01	1.13	136.6
1403	15	160		4.86	10.47	5.22	40	18.85	0.74	126.1
1408	20	160		4.86	7.29	5.21	42	18.86	0.77	117.3
1413	25	160		4.85	5.34	5.21	42	18.73	1.01	110.0
1418	30	160		4.85	4.43	5.21	41	18.88	0.99	106.8
1423	35	160	1.8	4.85	3.58	5.22	41	18.93	0.97	102.1

Observations During Sampling

Well Condition: ok
Color: Clear
Odor: None

Purge Water Disposal: Drum
Turbidity(qualitative): <10 NTUs
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab SHEALY ARCADIS	Preservative
VOC	3 - 40ml VOA	HCl

Boring/Casing Volumes
2" = 0.16 4" = 0.65

Low Flow GW Sample.XLS.xls - 12/9/2008

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF · 17
Date: 2/11/10
Sampling Time: 1330
Weather: Partly Cloudy 45°

Project No. GP08HAFS
Well ID: MW-12D
Sampled By: Robby Shealy
Recorded By: Robby Shealy
Duplicate/QA/QC:

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:		07F100306

Purging Information

Casing Material: PVC
Casing Diameter: 1"
Total Depth: 34.3
Depth to Water: 5.93
Water Column: 28.37
Gallons/Foot: 0.04
Gallons in Well: 1.13

Purge Method:(circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 24.3 To: 34.3 bgs
Pump Intake Setting: 29.3' bgs
Volumes to be Purged: Low Flow
Total Volume Purged: 2.0 gal
Pump On: 1249 Off: 1333

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	Diss. Oxygen	~~Comments~~ ORP
1255	6	150	0.1	6.70	9.95	5.92	54	21.62	11.8	151.2
1305	16	150		6.29	8.81	5.88	54	22.34	0.52	112.6
1310	21	150		6.29	5.26	5.84	56	22.47	0.41	101.2
1315	26	150		6.29	3.86	5.85	56	22.59	0.44	99.4
1320	31	150		6.29	2.84	5.82	56	22.67	0.34	104.0
1325	36	150		6.29	2.53	5.79	56	22.71	0.32	100.1
1330	41	150	2.0	6.29	1.98	5.76	57	22.82	0.31	98.6

Observations During Sampling

Well Condition: Ok
Color: Clear
Odor: None

Purge Water Disposal: Drum
Turbidity(qualitative): <10 NTUS
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab SHEALY ARCADIS	Preservative
VOC	3 - 40ml VOA	HCl

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location:	Fort Stewart/HAAF	Project No.	GP08HAFS	**Well ID:**	MW-2S
Date:	2-11-10	Sampled By:	Ryan Kontos		
Sampling Time:	1646	Recorded By:	Ryan Kontos		
Weather:	Clear Cool ~45°	Duplicate/QA/QC:	~~N/A~~ MS/MSD		

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI 556/ R8740	Lamotte 2020/R8767

Purging Information

Casing Material:	PVC	Purge Method: (circle one)	Submersible Centrifugal Bladder Bailer [✓ Peristaltic]		
Casing Diameter:	1''	Screen Interval: From:	4.3	To:	14.3
Total Depth:	14.3	Pump Intake Setting:	9.3'		
Depth to Water:	4.33	Volumes to be Purged:	Low Flow		
Water Column:	9.97	Total Volume Purged:	~1.75		
Gallons/Foot:	0.04	Pump On:	1605	Off:	1640
Gallons in Well:	0.39				

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	Diss. Oxygen	~~Comments~~ ORP
1610	5	200ml	1000ml	4.38	25.9	6.41	104	17.57	2.02	109.2
1615	10			4.38	17.3	6.45	104	17.58	1.53	107.0
1620	15			4.38	14.0	6.47	105	17.53	1.54	102.6
1625	20			4.38	9.72	6.47	106	17.61	1.68	101.0
1630	25			4.38	8.80	6.47	107	17.66	1.65	100.6
1635	30			4.38	6.94	6.48	107	17.68	1.69	100.2
1640	35			4.38	5.26	6.48	107	17.70	1.75	100.0

Observations During Sampling

Well Condition:	Good	Purge Water Disposal:	Drum
Color:	Clear	Turbidity(qualitative):	<10 NTUS
Odor:	NONE	Other (OVA, HNU,etc.):	N/A

Constituents Sampled	Container Description From Lab ______ ARCADIS ______	Preservative
VOC	9x 40ml CG	HCL

Boring/Casing Volumes

2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF HAA-17
Project No. GP08HAFS
Well ID: MW-3D
Date: 2-11-10
Sampled By: Ryan Kontos
Sampling Time: 1552
Recorded By: Ryan Kontos
Weather: Clear Cool ~45°
Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI 556/R8740	Lamotte 2020/R8767

Purging Information

Casing Material: PVC
Casing Diameter: 1"
Total Depth: 29.58
Depth to Water: 5.05
Water Column: 24.53
Gallons/Foot: 0.04
Gallons in Well: 0.98

Purge Method:(circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 19.59 To: 29.58
Pump Intake Setting: 25'
Volumes to be Purged: Low Flow
Total Volume Purged: ~1.3
Pump On: 1515 Off: 1550

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (μmhos/cm)	Temp ([✓ °C] or °F)	Diss. Oxygen	~~Comments~~ ORP
1520	5	150ml	750ml	5.20	7.56	5.69	74	19.00	0.54	66.2
1525	10	↓	↓	5.20	5.09	5.70	75	19.92	0.28	69.3
1530	15	↓	↓	5.20	3.18	5.70	75	20.43	0.37	61.5
1535	20	↓	↓	5.20	3.01	5.69	74	20.69	0.30	58.1
1540	25	↓	↓	5.20	3.26	5.68	74	20.87	0.19	60.3
1545	30	↓	↓	5.20	2.88	5.68	73	21.00	0.17	51.2
1550	35	↓	↓	5.20	2.76	5.67	73	21.03	0.15	47.0

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: NONE
Purge Water Disposal: Drum
Turbidity(qualitative): <10 NTUs
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ______ ARCADIS ______	Preservative
VOC	3x40ml CG	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF *HAA-17* Project No. GP08HAFS **Well ID:** *AF-58*
Date: *2-11-10* Sampled By: *Ryan Kontos*
Sampling Time: *0937* Recorded By: *Ryan Kontos*
Weather: *Cold ~35°* Duplicate/QA/QC: *N/A*

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	*YSI 556 R8740*	*Lamotte 2020/ R8767*

Purging Information

Casing Material: *PVC*
Casing Diameter: *2"*
Total Depth: *13.0*
Depth to Water: *4.94*
Water Column: *8.06*
Gallons/Foot: *0.16*
Gallons in Well: *1.28*

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: *3* To: *13*
Pump Intake Setting: *8'*
Volumes to be Purged: *Low Flow*
Total Volume Purged: *~2.5 gal*
Pump On: *0845* Off: *0935*

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (μmhos/cm)	Temp ([✓ °C] or °F)	ORP (mV)	Diss. Oxygen	Comments
0850	5	200ml	1000	5.46	46.7	5.85	263	11.44	98.5	0.46	
0855	10			5.46	42.1	5.85	245	12.00	71.1	0.95	
0900	15			5.49	33.8	5.85	237	12.02	44.1	0.72	
0905	20			5.50	28.6	5.83	231	11.82	30.0	0.73	
0910	25			5.50	23.2	5.83	232	12.07	27.1	0.61	
0915	30			5.50	18.4	5.82	233	12.17	24.9	0.50	
0920	35			5.50	12.1	5.82	229	12.29	24.5	0.37	
0925	40			5.50	8.11	5.82	229	12.35	24.1	0.35	
0930	45			5.50	9.03	5.83	229	12.41	24.2	0.29	
0935	50	↓	↓	5.50	8.81	5.83	229	12.45	24.0	0.25	

Observations During Sampling

Well Condition: *Good* Purge Water Disposal: *Drum*
Color: *Clear* Turbidity(qualitative): *<10 NTUs*
Odor: *NONE* Other (OVA, HNU,etc.): *N/A*

Constituents Sampled	Container Description From Lab ____ ARCADIS ____	Preservative
RK ~~VOCs~~ VOCs	3x 40ml CG	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF HAA+17
Project No. GP08HAFS
Well ID: AF-25
Date: 2-11-10
Sampled By: Ryan Kontos
Sampling Time: 1027
Recorded By: Ryan Kontos
Weather: Clear Cold ~35°
Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI 556/R8740	Lamotte 2020/R8767

Purging Information

Casing Material: PVC
Casing Diameter: 3/4
Total Depth: 10.10
Depth to Water: 0.10
Water Column: 10.00
Gallons/Foot: 0.02
Gallons in Well: RK ~~0.60~~ 0.20

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 0.1 To: 10.1
Pump Intake Setting: Middle of screen 5'
Volumes to be Purged: Low Flow
Total Volume Purged: 1.25 gal
Pump On: 1000 Off: 1025

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp (°C or °F)	ORP (mV)	Diss. Oxygen	Comments	
1005	5	200ml	1000	0.28	349	6.09	283	13.65	13.6	0.43		1 vol
1010	10	↓	↓	0.29	351	6.19	301	13.57	1.6	0.26		2 vol
1015	15			0.29	303	6.24	309	13.63	-23.1	0.19		3 vol
1020	20			0.29	321	6.36	317	13.50	-27.2	0.16		4 vol
1025	25			0.29	333	6.39	327	13.43	-29.1	0.15		5 vol

Observations During Sampling

Well Condition: Good
Color: Cloudy
Odor: Slight

Purge Water Disposal: Drum
Turbidity(qualitative): 333 at sample collection
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ______ ARCADIS ______	Preservative
VOC	3X 40ml CG	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF HAA-17 Project No. GP08HAFS **Well ID:** MW-12S
Date: 2-11-10 Sampled By: Ryan Kontos
Sampling Time: 1321 Recorded By: Ryan Kontos
Weather: clear ~45° Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI 556 / R8740	Lamotte 2020 / R8767

Purging Information

Casing Material: PVC
Casing Diameter: 1"
Total Depth: 17.6
Depth to Water: 5.80
Water Column: 12.52
Gallons/Foot: 0.04
Gallons in Well: 0.50

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 7.6 To: 17.6
Pump Intake Setting: 12.6'
Volumes to be Purged: Low Flow
Total Volume Purged: ~1.5 gal
Pump On: 1249 Off: 1319

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (μmhos/cm)	Temp ([✓ °C] or °F)	Diss. Oxygen	~~Comments~~ ORP
1254	5	200ml	1000	5.87	5.97	5.93	94	19.03	1.72	60.3
1259	10	↓	↓	5.87	8.11	5.92	92	19.89	1.63	63.7
1304	15			5.87	6.02	5.92	92	20.22	1.62	70.4
1309	20			5.87	3.04	5.91	92	20.62	1.31	77.7
1314	25			5.87	2.96	5.92	92	20.40	1.31	79.3
1319	30			5.87	2.25	5.90	91	20.42	1.20	82.4

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: NONE

Purge Water Disposal: Drum
Turbidity(qualitative): <10 NTUs
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ____ ARCADIS ____	Preservative
VOC	3x 40ml CG	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

Low Flow GW Sample.XLS.xls - 12/9/2008

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF HAA-17 Project No. GP08HAFS **Well ID:** MW-07S
Date: 2-11-10 Sampled By: Ryan Kontos
Sampling Time: 1437 Recorded By: Ryan Kontos
Weather: Clear ~45° Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI 556/R8740	Lamotte 2020/ R8767

Purging Information

Casing Material: PVC
Casing Diameter: 1"
Total Depth: 17.89
Depth to Water: 4.31
Water Column: 13.58
Gallons/Foot: 0.04
Gallons in Well: 0.54

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 7.89 To: 17.89
Pump Intake Setting: 13'
Volumes to be Purged: Low Flow
Total Volume Purged: ~1.68 gal
Pump On: 1350 Off: 1435

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	Diss. Oxygen	~~Comments~~ ORP
1355	5	150ml	~~1000~~ 750ml RK	4.36	48.6	6.36	71	17.15	1.73	79.4
1400	10			4.36	30.9	6.32	69	16.92	1.07	74.8
1405	15			4.36	25.0	6.32	67	16.89	1.04	70.5
1410	20			4.36	20.2	6.29	66	16.90	1.08	70.9
1415	25			4.36	13.7	6.26	65	16.92	1.02	71.5
1420	30			4.36	13.9	6.27	64	17.00	1.15	71.6
1425	35			4.36	9.39	6.27	64	17.06	1.20	72.2
1430	40			4.36	8.44	6.26	64	17.14	1.19	73.6
1435	45	↓	↓	4.36	8.89	6.28	64	17.18	1.15	71.7

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: None

Purge Water Disposal: Drum
Turbidity(qualitative): <10 NTUs
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ARCADIS	Preservative
VOC	3x40ml CG	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF HAA-17
Project No. GP08HAFS
Well ID: AF-56
Date: 2/10/10
Sampled By: R.K, R.S.
Sampling Time: 0859
Recorded By: R.K
Weather: Clear Breezy ~30°
Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	Y61556 R8748	Lamotte 2020 R8767

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: 29.9
Depth to Water: 1.96
Water Column: 27.98
Gallons/Foot: 0.16
Gallons in Well: 4.47

Purge Method:(circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 19.9 To: 29.9
Pump Intake Setting: 25'
Volumes to be Purged: Low Flow
Total Volume Purged: ~1.5 gal
Pump On: 0827 Off: 0857

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (μmhos/cm)	Temp ([✓ °C] or °F)	ORP (mV)	Diss. Oxygen	Comments
0832	5	200ml	1000ml	2.15	8.89	5.29	321	18.76	110.1	1.77	
0837	10	↓	↓	2.15	6.83	5.32	317	19.56	82.4	0.91	
0842	15			2.15	7.36	5.31	315	20.77	69.1	0.78	
0847	20			2.15	5.21	5.31	315	20.81	65.3	0.61	
0852	25			2.15	6.89	5.30	314	20.87	60.5	0.42	
0857	30			2.15	5.02	5.29	315	20.95	56.9	0.34	

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: None
Purge Water Disposal: Drum
Turbidity(qualitative): < 10 NTU's
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ____ ARCADIS ____	Preservative
VOC	3x 40ml CG	HCl

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF HAA-17
Date: 2/10/10
Sampling Time: 0955
Weather: Breezy ~35°

Project No. GP08HAFS
Sampled By: RK, R.S.
Recorded By: RK
Duplicate/QA/QC: N/A

Well ID: AF-69

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI 556 R8740	Lamotte 2020 R8767

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: RK ~~3.77~~ 45.0
Depth to Water: 3.77
Water Column: 41.23
Gallons/Foot: 0.16
Gallons in Well: 6.59

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 40 To: 45
Pump Intake Setting: 42.5'
Volumes to be Purged: Low Flow
Total Volume Purged: 1.75
Pump On: 0918 Off: 0953

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (μmhos/cm)	Temp ([✓ °C] or °F)	ORP (mV)	Diss. Oxygen	Comments
0923	5	200ml	1000	3.79	41.1	6.04	146	21.67	53.2	1.48	
0928	10			3.79	20.7	6.07	145	21.61	37.5	0.68	
0933	15			3.79	17.7	6.04	143	21.64	31.2	0.43	
0938	20			3.79	13.2	6.02	143	21.92	26.5	0.62	
0943	25			3.79	9.56	6.06	143	22.01	24.3	0.29	
0948	30			3.79	7.23	6.01	143	22.15	21.3	0.27	
0953	35			3.79	7.96	6.00	143	22.22	18.9	0.23	

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: Slight

Purge Water Disposal: Drum
Turbidity(qualitative): <10 NTUs
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ______ ARCADIS ______	Preservative
VOC	3x40ml CG	HCl

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF HAA-17
Project No. GP08HAFS
Well ID: AF-14
Date: 2-10-10
Sampled By: Ryan Kontos
Sampling Time: 1043
Recorded By: Ryan Kontos
Weather: Breezy ~35°
Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI 556 / R8740	Lamotte 2020 / R8767

Purging Information

Casing Material: PVC
Casing Diameter: 3/4
Total Depth: 11.4
Depth to Water: 1.60
Water Column: 9.80
Gallons/Foot: 0.06
Gallons in Well: 0.58

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 1.4 To: 11.4
Pump Intake Setting: 6.4'
Volumes to be Purged: Low Flow
Total Volume Purged: ~1.5 gal
Pump On: 1011 Off: 1041

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	ORP (mV)	Diss. Oxygen	Comments
1016	5	200ml	1000	2.14	14.9	5-60	173	15-63	-19.4	0.36	
1021	10	↓	↓	2.17	10.02	5.57	174	15-74	-30.1	0.23	
1026	15			2.19	10.67	5.56	173	15-86	-38.1	0.31	
1031	20			2.20	9.88	5.55	175	15-70	-56.0	0.17	
1036	25			2.20	9.01	5.55	175	15-67	-61.0	0.14	
1041	30			2.20	8.88	5.54	176	15.64	-66.1	0.13	

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: NONE
Purge Water Disposal: Drum
Turbidity(qualitative): <10 NTUs
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ____ ARCADIS ____	Preservative
VOC	3x40ml LG	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF HAA-17
Project No. GP08HAFS
Well ID: AF-13
Date: 2-10-10
Sampled By: Ryan Kouros
Sampling Time: 1210
Recorded By: Ryan Kouros
Weather: Breezy ~35°
Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI 556/ R8740	Lamotte 2020/ R8767

Purging Information

Casing Material: PVC
Casing Diameter: 3/4"
Total Depth: 12.5
Depth to Water: 1.70
Water Column: 10.8
Gallons/Foot: 0.06
Gallons in Well: 0.64

Purge Method:(circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 2.5 To: 12.5
Pump Intake Setting: 7.5'
Volumes to be Purged: Low Flow
Total Volume Purged: 3.75
Pump On: 1053 Off: 1208

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (μmhos/cm)	Temp ([✓ °C] or °F)	ORP (mV)	Diss. Oxygen	Comments	
1058	5	200ml	1000	1.75	1068	5.26	143	16.14	10.6	0.28		
1103	10			1.77	811	5.27	143	16.09	5.1	0.25		
1108	15			1.77	685	5.28	142	16.07	0.4	0.29		1 vol
1113	20			1.78	681	5.28	142	16.06	-1.9	0.23		
1118	25			1.78	689	5.28	142	16.09	-3.4	0.22		
1123	30			1.78	695	5.28	142	16.12	-8.3	0.19		2 vol
1128	35			1.78	669	5.27	142	16.09	-9.5	0.14		
1133	40			1.78	642	5.28	141	16.08	-10.1	0.15		
1138	45			1.78	633	5.28	141	16.06	-12.6	0.11		3 vol
1143	50			1.78	624	5.28	141	16.05	-18.9	0.07		
1148	55			1.78	601	5.28	141	16.10	-20.1	0.10		
1153	60			1.78	431	5.28	141	16.14	-21.8	0.11		4 vol
1158	65			1.78	393	5.28	141	16.19	-25.6	0.08		
1203	70			1.78	354	5.28	141	16.23	-27.7	0.07		
1208	75	↓	↓	1.78	346	5.29	141	16.27	-29.1	0.07	5 vol	5 vol

Observations During Sampling

Well Condition: ~~PVC~~ Good
Color: Cloudy
Odor: slight
Purge Water Disposal: Drum
Turbidity(qualitative): 346 NTU's After 5 vol
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab _____ ARCADIS _____	Preservative
VOC	3x40ml Lb	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF HAA-17 Project No. GP08HAFS **Well ID:** AF-54

Date: 2-10-10 Sampled By: Ryan Kontos

Sampling Time: 1302 Recorded By: Ryan Kontos

Weather: Breezy ~45 Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI 556/ R8740	Lamotte 2020 / R8767

Purging Information

Casing Material: PVC

Casing Diameter: 2"

Total Depth: 42.4

Depth to Water: 1.79

Water Column: 40.61

Gallons/Foot: 0.16

Gallons in Well: 6.49

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]

Screen Interval: From: 32.4 To: 42.4

Pump Intake Setting: 37.4'

Volumes to be Purged: Low Flow

Total Volume Purged: 1.75

Pump On: 1225 Off: 1300

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	ORP (mV)	Diss. Oxygen	Comments
1230	5	200ml	1000	1.80	18.0	5.90	344	19.75	31.6	1.62	
1235	10			1.80	11.2	5.71	390	20.31	33.3	1.01	
1240	15			1.80	7.37	5.58	425	20.65	34.6	0.43	
1245	20			1.80	5.99	5.55	459	20.73	30.1	0.40	
1250	25			1.80	4.86	5.51	456	20.88	28.3	0.38	
1255	30	↓	↓	1.80	4.27	5.53	450	20.95	24.9	0.27	
1300	35	↓	↓	1.80	4.99	5.53	447	20.98	22.5	0.23	

Observations During Sampling

Well Condition: Good

Color: Clear

Odor: Slight

Purge Water Disposal: Drum

Turbidity(qualitative): <10 NTU's

Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ______ ARCADIS ______	Preservative
VOC	3x40ml CG	HCL

Boring/Casing Volumes

2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF HAA-17
Project No. GP08HAFS
Well ID: AF-57
Date: 2-10-10
Sampled By: Ryan Kowtos
Sampling Time: 1442
Recorded By: Ryan Kowtos
Weather: Breezy ~45°
Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI 556 / R8740	Lamotte 2020 / R8767

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: 62.8
Depth to Water: 1.22
Water Column: 61.58
Gallons/Foot: 0.16
Gallons in Well: 9.85

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 57.8 To: 62.8
Pump Intake Setting: 60'
Volumes to be Purged: Low Flow
Total Volume Purged: 1.75
Pump On: 1405 Off: 1440

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp ([✓ °C] or °F)	ORP (mV)	Diss. Oxygen	Comments
1410	5	200ml	1000	1.50	8.31	7.25	258	15.17	46.1	2.30	
1415	10			1.50	4.15	7.24	260	15.31	21.1	1.01	
1420	15			1.50	3.81	7.23	262	15.52	-2.5	0.60	
1425	20			1.50	3.15	7.23	262	15.60	-22.1	0.40	
1430	25			1.50	3.00	7.22	263	15.66	-40.4	0.35	
1435	30			1.50	2.83	7.22	263	15.72	-50.1	0.27	
1440	35	↓	↓	1.50	3.03	7.22	264	15.78	-56.6	0.25	

Observations During Sampling

Well Condition: Good
Color: ~~None~~ Clear
Odor: None

Purge Water Disposal: Drum
Turbidity(qualitative): < 10 NTUs
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ______ ARCADIS ______	Preservative
VOC	3 x 40ml CG	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF HAA-17
Project No. GP08HAFS
Well ID: AF-41
Date: 2-10-10
Sampled By: Ryan Kontos
Sampling Time: 1552
Recorded By: Ryan Kontos
Weather: Breezy ~50°
Duplicate/QA/QC: N/A

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:	YSI 556/ R8740	Lamotte 2020 R8767

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: 33.0
Depth to Water: 3.00
Water Column: 30.0
Gallons/Foot: 0.16
Gallons in Well: 4.8

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 28.5 To: 33.0
Pump Intake Setting: 30'
Volumes to be Purged: Low Flow
Total Volume Purged: 1.75
Pump On: 1515 Off: 1550

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or [✓ ml])	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (μmhos/cm)	Temp ([✓ °C] or °F)	ORP (mV)	Diss. Oxygen	Comments
1520	5	200ml	1000ml	3.25	9.93	6.07	164	19.75	21.1	1.08	
1525	10	↓	↓	3.26	5.24	6.01	165	19.96	17.7	0.60	
1530	15			3.26	4.91	6.01	164	20.21	13.2	0.54	
1535	20			3.27	4.30	6.00	166	20.30	8.4	0.76	
1540	25			3.27	4.10	6.00	167	20.36	6.9	0.56	
1545	30			3.27	3.56	5.99	167	20.41	4.1	0.45	
1550	35			3.27	3.04	5.99	168	20.46	2.9	0.41	

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: NONE

Purge Water Disposal: Drum
Turbidity(qualitative): <10 NTUs
Other (OVA, HNU,etc.): N/A

Constituents Sampled	Container Description From Lab ______ ARCADIS ______	Preservative
VOL	3x 40ml Clr	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

17S

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF
Project No. GP08HAFS
Well ID: H17-MW-17S
Date: 5/25/10
Sampled By: Erica Maddox
Sampling Time: 0912
Recorded By: Erica Maddox
Weather: Partly Cloudy, 80's
Duplicate/QA/QC: NONE

Instrument Identification

Instrument:	PID	Water Quality Meter(s) Lamotte 2020 (R3597)
Serial #:	— —	YSI 556 (R8526)

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: 18
Depth to Water: 6.44
Water Column: 11.56
Gallons/Foot: 0.16
Gallons in Well: 1.85

Purge Method:(circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 8 To: 18
Pump Intake Setting: Mid screen ≈ 13
Volumes to be Purged: Low Flow
Total Volume Purged: 1.5
Pump On: 0835 Off: 0912

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or ml)	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp (ºC or ºF)	ORP (mV)	Diss. Oxygen	Comments
0840	5	180	0	6.46	2.12	6.15	255	22.06	31.7	5.01	
0845	10	180	0.25	6.46	2.38	5.90	228	21.32	35.4	1.80	
0850	15	180	0.5	6.48	1.58	5.87	221	21.15	36.4	1.43	
0855	20	180	0.75	6.48	1.74	5.88	222	21.08	37.6	1.26	
0900	25	180	1.0	6.48	1.60	5.90	217	21.09	38.7	1.16	
0905	30	180	1.25	6.48	1.66	5.89	213	21.04	40.6	1.14	
0910	35	180	1.5	6.48	1.53	5.90	210	21.08	41.1	1.12	

Erica Maddox 5/25/10

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: NONE
Purge Water Disposal: Drum
Turbidity(qualitative): — —
Other (OVA, HNU,etc.): — —

Constituents Sampled	Container Description From Lab ✓ ARCADIS ____	Preservative
VOCs (8260)	40 mL VOA vial	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

Low Flow GW Sample.xls - 12/7/2009

Page 1 of 2

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF
Project No. GP08HAFS
Well ID: M-17-MW-17D
Date: 5/25/10
Sampled By: Erica Maddox
Sampling Time:
Recorded By: Erica Maddox
Weather: Partly Cloudy, 80's
Duplicate/QA/QC: NONE

Instrument Identification

Instrument:	PID	Water Quality Meter(s) Lamotte 2020 (R3597)
Serial #:	——	YSI 556 (R8526)

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: 42
Depth to Water: 8.30
Water Column: 33.7
Gallons/Foot: 0.16
Gallons in Well: 5.40

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 32 To: 42
Pump Intake Setting: Midscreen ≈ 37
Volumes to be Purged: Low flow
Total Volume Purged: 6.5
Pump On: 0925 Off: 1130

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or ml)	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp (ºC or ºF)	ORP (mV)	Diss. Oxygen	Comments
0930	5	180	0	8.70	82.8	6.42	260	22.05	7.2	1.63	
0935	10	180	0.25	8.75	80.1	6.20	258	21.97	7.5	0.74	
0940	15	180	0.5	8.76	79.3	6.04	234	22.00	11.5	0.45	
0945	20	180	0.75	8.74	77.5	6.00	225	22.03	11.8	0.39	
0950	25	180	1.0	8.74	73.7	5.98	220	22.07	3.9	0.39	
0955	30	180	1.25	8.76	68.4	5.91	210	22.03	8.0	0.36	
1000	35	180	1.5	8.74	51.1	5.90	206	22.20	8.5	0.74	
1005	40	180	1.75	8.76	49.8	5.89	204	22.17	8.9	0.68	
1010	45	180	2.0	8.76	49.0	5.89	203	22.16	9.5	0.89	
1015	50	180	2.25	8.76	51.7	5.88	202	22.12	10.0	0.69	
1020	55	180	2.75	8.76	40.5	5.87	200	22.09	11.5	0.79	
1025	60	180	3.0	8.76	42.3	5.85	199	22.06	12.0	0.80	
1030	65	180	3.25	8.74	39.2	5.84	198	22.07	12.0	0.80	
1035	70	180	3.5	8.75	37.1	5.83	196	22.12	12.4	0.78	
1040	75	180	3.75	8.75	35.8	5.83	195	22.08	12.8	0.82	

Observations During Sampling

Well Condition: Good
Color: Clear (Cloudy)
Odor: NONE
Purge Water Disposal: Drum
Turbidity(qualitative): Cloudy
Other (OVA, HNU,etc.): ——

Constituents Sampled	Container Description From Lab ✓ ARCADIS	Preservative
VOCs (8260)	40 mL VOA vial	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF
Project No. GP08HAFS
Well ID: H17-MW-17D
Date: 5/25/10
Sampled By: Erica Maddox
Sampling Time: 1135
Recorded By: Erica Maddox
Weather: Cloudy, 80's
Duplicate/QA/QC: None

Instrument Identification

Instrument:	PID	Water Quality Meter(s) Lamotte 2020 (R3597)
Serial #:	NA	YSI 556 (R8526)

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: 42
Depth to Water: ~~8.30~~ EM 8.30
Water Column: ~~33.7~~ EM 33.7
Gallons/Foot: 0.16
Gallons in Well: 5.40

Purge Method:(circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 32 To: 42
Pump Intake Setting: midscreen 37
Volumes to be Purged: Low Flow
Total Volume Purged: 6.5
Pump On: 0925 Off: 1130

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or ml)	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (μmhos/cm)	Temp (°C or °F)	ORP (mV)	Diss. Oxygen	Comments
1045	80	180	4.0	8.50	22.7	5.88	194	22.39	16.1	0.59	
1050	85	180	4.25	8.50	20.8	5.89	191	22.38	17.6	0.67	
1055	90	180	4.5	8.50	19.1	5.87	192	22.35	18.2	0.67	
1100	95	180	4.75	8.50	19.5	5.84	188	22.79	19.0	0.66	
1105	100	180	5.0	8.50	6.5	5.84	187	22.80	19.9	0.63	
1110	105	180	5.25	8.50	5.2	5.88	187	22.82	21.0	0.61	
1115	110	180	5.75	8.50	5.9	5.89	188	22.85	21.2	0.55	
1120	115	180	6.0	8.50	4.7	5.89	188	22.89	21.5	0.54	
1125	120	180	6.25	8.50	4.3	5.89	188	22.96	22.0	0.55	
1130	125	180	6.50	8.50	3.1	5.89	188	23.01	21.8	0.54	

Maddox

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: None

Purge Water Disposal: Drum
Turbidity(qualitative): --
Other (OVA, HNU,etc.): --

Constituents Sampled	Container Description From Lab ✓ ARCADIS	Preservative
VOCs (8260)	40 mL VOA	HCl

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF
Project No. GP08HAFS
Well ID: H7-MW-18D
Date: 5-25-10
Sampled By: Erica Maddox
Sampling Time: 1947
Recorded By: Erica Maddox
Weather: Sunny, 90's (windy)
Duplicate/QA/QC: None.

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:		

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: 42
Depth to Water: 5.77
Water Column: 36.23
Gallons/Foot: 0.16
Gallons in Well: 5.80

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 32 To: 42
Pump Intake Setting: Midscreen 37
Volumes to be Purged: Low Flow
Total Volume Purged:
Pump On: 1850 Off: 1945

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or ml)	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (μmhos/cm)	Temp (°C or °F)	ORP (mV)	Diss. Oxygen	Comments
1855	5	180	0	5.89	33.0	6.16	85	22.68	37.1	4.09	
1900	10	180	0.25	5.90	32.5	6.00	85	22.67	39.1	0.99	
1905	15	180	0.5	5.90	20.1	6.00	85	22.66	38.7	0.58	
1910	20	180	1.0	5.90	15.11	5.99	85	22.61	39.1	0.43	
1915	25	180	1.25	5.90	10.35	6.05	85	23.13	38.3	0.36	
1920	30	180	1.5	5.90	5.51	6.04	85	23.14	39.4	0.39	
1925	35	180	1.75	5.89	5.30	6.05	85	23.16	39.7	0.34	
1930	40	180	2.0	5.89	3.27	6.06	85	23.17	39.9	0.20	
1935	45	180	2.25	5.89	2.19	6.06	85	23.20	39.1	0.21	
1940	50	180	2.5	5.89	2.10	6.06	85	23.19	38.9	0.23	
1945	55	180	2.75	5.89	2.30	6.06	85	23.17	39.3	0.25	

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: None
Purge Water Disposal: Drum
Turbidity(qualitative): Cloudy
Other (OVA, HNU,etc.): —

Constituents Sampled	Container Description From Lab ✓ ARCADIS	Preservative
VOCs (8260)	40mL VOA Vial	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF
Project No. GP08HAFS
Well ID: H17-MW-19S
Date: 5-25-10
Sampled By: Erica Maddox
Sampling Time: 1827
Recorded By: Erica Maddox
Weather: Sunny, 90's
Duplicate/QA/QC: NONE

Instrument Identification

Instrument:	PID	Water Quality Meter(s) Lamotte 2020 (R3597)
Serial #:	— —	YSI 556 (R8526)

Purging Information

Casing Material: PVC
Casing Diameter: 2''
Total Depth: 15
Depth to Water: 5.40
Water Column: 9.6
Gallons/Foot: 0.16
Gallons in Well: 1.54

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 5 To: 15
Pump Intake Setting: Midscreen 10
Volumes to be Purged: Low Flow
Total Volume Purged: 1.25
Pump On: 1755 Off: 1825

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or ml)	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp (°C or °F)	ORP (mV)	Diss. Oxygen	Comments
1800	5	180	0	5.60	9.15	5.80	73	21.07	43.3	5.48	
1805	10	180	0.25	5.60	7.25	5.64	72	20.93	45.2	2.85	
1810	15	180	.50	5.62	6.37	5.58	71	20.76	45.3	0.79	
1815	20	180	.75	5.63	6.13	5.57	72	20.70	45.3	0.60	
1820	25	180	1.0	5.63	5.35	5.55	72	20.71	45.4	0.47	
1825	30	180	1.25	5.43	5.13	5.53	72	20.73	45.3	0.41	

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: None
Purge Water Disposal: Drum
Turbidity(qualitative): — —
Other (OVA, HNU,etc.): — —

Constituents Sampled	Container Description From Lab ✓ ARCADIS	Preservative
40mL VOA vials	VOCs (8260)	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF
Project No. GP08HAFS
Well ID: H17-MW-20D
Date: 5-25-10
Sampled By: Erica Maddox
Sampling Time: 1735
Recorded By: Erica Maddox
Weather: Sunny, 80's
Duplicate/QA/QC: None

Instrument Identification

Instrument:	PID	Water Quality Meter(s) Lamotte 2020 (R3597)
Serial #:	— —	YSI 556 (R8526)

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: 28
Depth to Water: 2.39
Water Column: 25.61
Gallons/Foot: 0.16
Gallons in Well: 4.1

Purge Method:(circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 18 To: 28
Pump Intake Setting: Midscreen ≈ 23
Volumes to be Purged: Low Flow
Total Volume Purged: 1.25
Pump On: 1700 Off: 1730

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or ml)	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp (°C or °F)	ORP (mV)	Diss. Oxygen	Comments
1705	5	180	0	3.09	4.78	6.64	187	21.67	34.9	1.54	
1710	10	180	0.25	3.11	3.87	6.28	179	20.68	40.4	0.43	
1715	15	180	0.5	3.11	1.91	6.21	179	20.53	40.8	0.36	
1720	20	180	0.75	3.11	2.23	6.21	179	20.56	40.1	0.32	
1725	25	180	1.0	3.11	1.99	6.22	180	20.58	40.3	0.31	
1730	30	180	1.25	3.11	2.13	6.22	179	20.62	40.2	0.30	
				3.11 EM							

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: None
Purge Water Disposal: Drum
Turbidity(qualitative):
Other (OVA, HNU,etc.):

Constituents Sampled	Container Description From Lab ✓ ARCADIS	Preservative
VOCs (8260)	40mL VOA Vial	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF
Project No. GP08HAFS
Well ID: H17-mw-21D
Date: 5-25-10
Sampled By: Erica Maddox
Sampling Time: 1233
Recorded By: Erica Maddox
Weather:
Duplicate/QA/QC: H17-DUP-1

Instrument Identification

Instrument:	PID	Water Quality Meter(s) Lamotte 2020 (R3597)
Serial #:	— —	YSI 556 (R8526)

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: 35.0
Depth to Water: 2.10
Water Column: 32.9
Gallons/Foot: 0.16
Gallons in Well: 5.3

Purge Method:(circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 25 To: 35
Pump Intake Setting: Midscreen 30'
Volumes to be Purged: Low Flow
Total Volume Purged: 1.5
Pump On: 1155 Off: 1233

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or ml)	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp (°C or °F)	ORP (mV)	Diss. Oxygen	Comments
1200	5	180	0	2.31	13.8	7.45	283	21.79	25.7	5.32	
1205	10	180	0.25	2.29	3.75	7.23	280	21.30	27.6	0.98	
1210	15	180	0.50	2.29	1.90	7.21	280	21.30	27.7	0.60	
1215	20	180	0.75	2.29	2.12	7.23	280	21.36	23.2	0.48	
1220	25	180	1.0	2.29	2.71	7.23	280	21.25	22.4	0.37	
1225	30	180	1.25	2.29	2.76	7.25	280	21.14	24.1	0.32	
1230	35	180	1.5	2.29	2.87	7.25	280	21.12	23.9	0.31	

Erica Maddox 5/25/10

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: None

Purge Water Disposal: Drum
Turbidity(qualitative): — —
Other (OVA, HNU,etc.): — —

Constituents Sampled	Container Description From Lab ✓ ARCADIS	Preservative
VOCs (8260)	40 mL VOA vial	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF
Project No. GP08HAFS
Well ID: H17-MW-21S
Date: 5-25-10
Sampled By: Erica Maddox
Sampling Time: 1325
Recorded By: Erica Maddox
Weather: Cloudy 80's
Duplicate/QA/QC:

Instrument Identification

Instrument:	PID	Water Quality Meter(s) Lamotte 2020
Serial #:	— —	YSI 556

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: 17
Depth to Water: 4.60
Water Column: 12.4
Gallons/Foot: 0.16
Gallons in Well: 1.98

Purge Method:(circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 7 To: 17
Pump Intake Setting: Midscreen ≈12
Volumes to be Purged: Low Flow
Total Volume Purged: 1.75
Pump On: 1240 Off: 1325

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or ml)	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp (°C or °F)	ORP (mV)	Diss. Oxygen	Comments
1245	5	180	0	4.65	4.66	6.98	208	20.94	28.3	1.93	
1250	10	180	0.25	4.65	3.11	6.88	208	20.84	29.7	0.73	
1255	15	180	0.5	4.69	2.70	6.82	207	20.69	29.4	0.48	
1300	20	180	0.75	4.69	2.05	6.82	207	20.69	28.2	0.43	
1305	25	180	1.0	4.69	2.98	6.84	207	20.75	26.8	0.39	
1310	30	180	1.25	4.69	1.67	6.86	207	20.90	28.0	0.34	
1315	35	180	1.5	4.69	1.88	6.86	206	20.85	28.3	0.34	
1320	40	180	1.75	4.69	1.35	6.87	206	20.97	28.5	0.32	

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: None
Purge Water Disposal: DRUM
Turbidity(qualitative): —
Other (OVA, HNU,etc.): —

Constituents Sampled	Container Description From Lab ✓ ARCADIS	Preservative
VOCs (8260)	40ml VOA vial	HCl

Boring/Casing Volumes
2" = 0.16 4" = 0.65

Page 1 of 2

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF
Project No. GP08HAFS
Well ID: H17-MW-22S
Date: 5-25-10
Sampled By: Erica Maddox
Sampling Time:
Recorded By: Erica Maddox
Weather: Sunny 90's
Duplicate/QA/QC: None

Instrument Identification

Instrument:	PID	Water Quality Meter(s) Lamotte 2020 (3597)
Serial #:	— —	YSI 556 (R8526)

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: 17
Depth to Water: 3.71
Water Column: 13.29
Gallons/Foot: 0.16
Gallons in Well: 2.13

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 7 To: 17
Pump Intake Setting: Midscreen
Volumes to be Purged: Low Flow
Total Volume Purged: 6.0
Pump On: 1340 Off: 1540

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or ml)	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp (°C or °F)	ORP (mV)	Diss. Oxygen	Comments
1345	5	160	0	4.70	86.5	7.63	305	2298	33.0	1.18	
1350	10	180	0.25	4.88	99.2	7.52	308	22.94	39.4	1.11	
1355	15	180	0.5	4.74	108.3	7.53	317	23.04	38.2	0.82	
1400	20	180	0.75	4.74	105.1	7.52	323	23.42	37.5	0.75	
1405	25	180	1.0	4.74	66.3	7.49	327	23.36	37.8	0.62	
1410	30	180	1.25	4.74	47.2	7.48	333	23.34	37.9	0.49	
1415	35	180	1.5	4.74	41.1	7.46	335	23.44	36.9	0.44	
1420	40	180	1.75	4.74	35.6	7.47	337	23.55	37.9	0.37	
1425	45	180	2.0	4.74	31.1	7.44	339	23.33	38.6	0.36	
1430	50	180	2.25	4.74	27.6	7.44	342	23.71	38.3	0.33	
1435	55	180	2.5	4.74	23.2	7.48	348	24.05	38.1	0.30	
1440	60	180	2.75	4.74	19.8	7.45	352	23.42	38.0	0.29	
1445	65	180	3.0	4.74	17.3	7.42	352	23.56	38.2	0.26	
1450	70	180	3.25	4.74	15.8	7.43	354	23.68	38.4	0.23	
1455	75	180	3.5	4.74	14.5	7.43	356	24.13	37.8	0.23	

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: None
Purge Water Disposal: Drum
Turbidity(qualitative): — —
Other (OVA, HNU,etc.): — —

Constituents Sampled	Container Description From Lab √ ARCADIS	Preservative
VOCs (8260)	40mL VOA Vial	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

Low Flow GW Sample.xls - 12/7/2009

Page 2 of 2

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF
Date: 5-25-10
Sampling Time: 1542
Weather: Sunny, 90's

Project No. GP08HAFS
Well ID: H17-MW-22S
Sampled By: Erica Maddox
Recorded By: Erica Maddox
Duplicate/QA/QC: NONE

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
		Lamotte 2020 (R3597)
Serial #:	— —	YSI 556 (R8526)

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: 17
Depth to Water: 3.71
Water Column: 13.29
Gallons/Foot: 0.16
Gallons in Well: 2.13

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 7 To: 17
Pump Intake Setting: Midscreen
Volumes to be Purged: Low Flow
Total Volume Purged: 6.0
Pump On: 1340 Off: 1540

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or ml)	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp (°C or °F)	ORP (mV)	Diss. Oxygen	Comments
1500	80	180	3.75	3.75	14.0	7.47	357	23.91	37.9	0.22	
1505	85	180	4.25	3.75	12.3	7.45	357	24.04	38.0	0.21	
1510	90	180	4.5	3.75	12.6	7.43	359	24.19	37.8	0.20	
1515	95	180	4.75	3.75	10.75	7.44	361	24.36	37.9	0.20	
1520	100	180	5.0	3.75	9.74	7.43	363	24.19	37.5	0.19	
1525	105	180	5.25	3.15	9.10	7.42	364	24.08	38.1	0.19	
1530	110	180	5.5	3.74	8.86	7.42	365	23.84	36.6	0.19	
1535	115	180	5.75	3.74	7.90	7.42	365	23.87	37.8	0.18	
1540	120	180	6.0	3.75	7.80	7.41	366	23.56	38.2	0.18	

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: None

Purge Water Disposal: Drum
Turbidity(qualitative): Cloudy
Other (OVA, HNU,etc.): —

Constituents Sampled	Container Description From Lab ✓ ARCADIS	Preservative
VOCs (8260)	40mL VOA vials	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF
Project No. GP08HAFS
Well ID: H17-MW-22D
Date: 5-25-10
Sampled By: Erica Maddox
Sampling Time: 1642
Recorded By: Erica Maddox
Weather: Sunny, 80's
Duplicate/QA/QC: NONE

Instrument Identification

Instrument:	PID	Water Quality Meter(s) Lamotte 2020 (R3597)
Serial #:	— —	YSI 556 (R8526)

Purging Information

Casing Material: PVC
Casing Diameter: 2"
Total Depth: 35
Depth to Water: 2.23
Water Column: 32.77
Gallons/Foot: 0.16
Gallons in Well: 5.24

Purge Method: (circle one) Submersible Centrifugal Bladder Bailer [✓ Peristaltic]
Screen Interval: From: 25 To: 35
Pump Intake Setting: Midscreen 30
Volumes to be Purged: Low Flow
Total Volume Purged: 2.0
Pump On: 1555 Off: 1640

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or ml)	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp (°C or °F)	ORP (mV)	Diss. Oxygen	Comments
1600	5	180	0	2.57	19.7	8.50	291	26.07	39.6	1.29	
1605	10	180	0.25	2.57	18.0	8.43	288	24.43	40.6	0.55	
1610	15	180	0.5	2.57	15.6	8.22	286	22.99	41.6	0.24	
1615	20	180	0.75	2.57	13.1	8.22	286	23.12	41.0	0.21	
1620	25	180	1.0	2.57	10.29	8.19	286	23.02	38.7	0.19	
1625	30	180	1.25	2.57	9.49	8.15	285	23.09	38.8	0.18	
1630	35	180	1.5	2.57	9.50	8.12	286	23.17	39.3	0.17	
1635	40	180	1.75	2.57	8.86	8.11	286	2308	39.6	0.17	
1640	45	180	2.0	2.57	8.66	8.08	285	23.11	39.8	0.17	

Observations During Sampling

Well Condition: Good
Color: Clear
Odor: NONE
Purge Water Disposal: Drum
Turbidity(qualitative): — —
Other (OVA, HNU,etc.): — —

Constituents Sampled	Container Description From Lab ✓ ARCADIS	Preservative
VOCs (8260)	40mL VOA vials	HCL

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

WATER SAMPLING LOG

Project No. G/POSHAFS. H17

Site Location: Savannah, GA

Rep./Field Blank No. ______

Weather Sunny, 60's

Date 12-14-11

Monitoring Well Number H17-MW-2LD

Sample Collection Time [illegible] 1630

Sampling Method Low Flow

Evacuation Data:

Depth to bottom of well (ft bls) 35

Depth to water from top of casing 3.35'

Water Column ___ (ft) Gallons in well ______

Evacuation Volume (x 3) = 15.19

Casing stick-up above concrete (feet) ______

Screened Interval (ft bls) ______

Casing Diameter: ______

Casing Volume 1"=0.04 gal gal/ft, 2"=0.16 gal/ft

Field Parameters:

Time	Gallons Purged	Temp (°C)	pH (SU)	DO (mg/L)	Cond. (µmhos/cm)	Turb (NTU)	Redox (mV)	Depth to Water (ft)
1555	1	20.42	7.08	0.22	0.232	2.60	-61.5	—
1559	2	20.44	7.08	0.20	0.232	129	-62.6	—
1604	3.5	20.55	7.30	0.18	0.233	104	-77.0	—
1609	5	20.56	7.35	0.16	0.232	17.4	-829	—
1614	7	20.54	7.35	0.16	0.232	4.92	-90.8	—
1619	9	20.54	7.35	0.14	0.232	4.21	-85.9	—
1624	11	20.48	7.33	0.13	0.232	3.41	-88.5	—

V.P. 12-14-11

Analyses:

Analytical Parameter	Sample Bottles	Preservative

Remarks ______

Sampling Personnel ______

C:\Users\vpaouncic\Documents\Forms\gw_log.docx

ARCADIS

WATER SAMPLING LOG

Project No. GPOSHAFS. H17

Date 12-14-11

Site Location: Savannah, GA

Monitoring Well Number H17-MW-26S

Rep./Field Blank No.

Sample Collection Time 1545

Weather Sunny, 60's

Sampling Method Low Flow

Evacuation Data:

Depth to bottom of well (ft bls) 17'

Casing stick-up above concrete (feet) Flushmount

Depth to water from top of casing 4.85

Screened Interval (ft bls) 7 - 17

Water Column (ft) Gallons in well

Casing Diameter: 2"

Evacuation Volume (x 3) = 5.96

Casing Volume 1"=0.04 gal gal/ft, 2"=0.16 gal/ft

Field Parameters:

Time	Gallons Purged	Temp (°C)	pH (SU)	DO (mg/L)	Cond. (μmhos/cm)	Turb (NTU)	Redox (mV)	Depth to Water (ft)
1530	0.5	21.19	7.36	1.50	0.278	8.20	-64.3	—
1532	1	21.19	7.27	0.76	0.282	2.46	-69.7	—
1536	2	21.21	7.25	0.61	0.292	3.15	-64.1	—
1540	3	21.18	7.28	0.50	0.295	2.60	-67.9	—

VP 12-14-11

Analyses:

Analytical Parameter	Sample Bottles	Preservative

Remarks

Sampling Personnel Valyn Paouncic

ARCADIS

WATER SAMPLING LOG

Project No. GFCSHAFS. H17

Date 12-14-11

Site Location: Savannah, GA

Monitoring Well Number H17-MW-25D

Rep./Field Blank No.

Sample Collection Time 1445

Weather Sunny, 60's

Sampling Method Low Flow

Evacuation Data:

Depth to bottom of well (ft bls) 35'

Casing stick-up above concrete (feet) Flush mount

Depth to water from top of casing 0,95

Screened Interval (ft bls) 25 - 35

Water Column 34.05 (ft) Gallons in well

Casing Diameter: 2"

Evacuation Volume (x 3) = 16.34

Casing Volume 1"=0.04 gal gal/ft, 2"=0.16 gal/ft

Field Parameters:

Time	Gallons Purged	Temp (°C)	pH (SU)	DO (mg/L)	Cond. (μmhos/cm)	Turb (NTU)	Redox (mV)	Depth to Water (ft)
1405	1	19.57	4.54	1.34	0.148mS	220	94.8	—
1408	2	19.56	4.48	0.63	0.145mS	45.7	80.8	—
1411	3	19.56	5.16	0.38	0.145mS	20.6	48.2	—
1415	~~5~~ 4	19.55	5.46	0.32	0.145	28.8	27.9	—
1418	~~7~~ 5	19.56	5.62	0.28	0.145	21.8	20.2	—
1421	7	19.56	5.80	0.23	0.145	5.98	12.8	—
1430	8	19.60	5.85	0.20	0.144	9.47	4.4	—
1435	9.5	19.61	5.92	0.17	0.144	3.81	-5.9	—
1440	10.5	19.58	5.91	0.17	0.145	9.70	-11.6	—
				V.P.	12-14-11			

Analyses:

Analytical Parameter	Sample Bottles	Preservative

Remarks

Sampling Personnel Vahn Paouncic

C:\Users\vpaouncic\Documents\Forms\gw_log.docx

Page 1 of 2

ARCADIS

WATER SAMPLING LOG

Project No. GP09HAFS H17

Date 12-12-11

Site Location: Savannah, GA H17

Monitoring Well Number H17-MW-23D

Rep./Field Blank No.

Sample Collection Time 1630

Weather raining, cloudy

Sampling Method Low Flow

Evacuation Data:

Depth to bottom of well (ft bls) 45.1

Casing stick-up above concrete (feet) Flush mount

Depth to water from top of casing 9.6'

Screened Interval (ft bls) 40' - 45'

Water Column 35.5 (ft) Gallons in well

Casing Diameter: 2"

Evacuation Volume (x 3) = 17.04 gal

Casing Volume 1"=0.04 gal gal/ft, 2"=0.16 gal/ft

Field Parameters:

Time	Gallons Purged	Temp (°C)	pH (SU)	DO (mg/L)	Cond. (µmhos/cm)	Turb (NTU)	Redox (mV)	Depth to Water (ft)
1523	1	25.33	6.78	1.62	0.523mS	233	-3.2	—
1528	2	25.30	6.74	1.30	0.477mS	230	-5.1	—
1533	2.5	25.32	6.61	1.22	0.471mS	221	-5.5	—
1538	3	25.33	6.58	1.36	0.466mS	193	-5.7	—
1543	4.5	2544	6.44	2.11	0.359mS	108	-24.3	—
1548	6.5	25.38	6.33	1.72	0.273mS	108	-41.5	—
1553	7.5	25.37	6.20	2.03	0.213mS	35.2	-96.7	—
1558	8	25.39	6.11	1.44	0.183mS	25.5	-113.3	—
1603	9	25.37	6.05	1.54	0.167mS	22.9	-110.0	—
1608	11	25.38	6.02	2.18	0.158mS	21.0	-110.5	—
1613	13	25.36	5.98	1.21	0.152mS	18.4	-116.2	—

Analyses:

Analytical Parameter	Sample Bottles	Preservative

Remarks

Sampling Personnel Valyn Paouncic

C:\Users\vpaouncic\Documents\Forms\gw_log.docx

Page 2 of 2

ARCADIS

WATER SAMPLING LOG

Project No. GA08HAES. H17

Date 12-12-11

Site Location: Savannah, GA

Monitoring Well Number H17-MW-23D

Rep./Field Blank No.

Sample Collection Time 1630

Weather raining, Cloudy

Sampling Method Low flow

Evacuation Data:

Depth to bottom of well (ft bls) 45.1'

Casing stick-up above concrete (feet) Flush mount

Depth to water from top of casing 9.6

Screened Interval (ft bls) 40' - 45'

Water Column 35 (ft) Gallons in well

Casing Diameter: 2"

Evacuation Volume (x 3) = 17.04

Casing Volume 1"=0.04 gal gal/ft, 2"=0.16 gal/ft

Field Parameters:

Time	Gallons Purged	Temp (°C)	pH (SU)	DO (mg/L)	Cond. (μmhos/cm)	Turb (NTU)	Redox (mV)	Depth to Water (ft)
1618	14	25.35	5.95	2.21	0.146mS	18.0	-121.2	—
1622	16.	25.32	5.93	0.93	0.141 mS	17.7	-124.4	—
1627	16.5	25.38	5.90	1.17	0.134 mS	16.2	-127.9	—

V.P. 12-12-11

Analyses:

Analytical Parameter	Sample Bottles	Preservative

Remarks

Sampling Personnel Valyn Paouncic

ARCADIS

WATER SAMPLING LOG

Project No. ~~FST-26~~ HAA-17

Date 12-20-2011

Site Location: ~~Ft. Stewart, GA~~ Hunter Army Airfield

Monitoring Well Number AF-72

Rep./Field Blank No. N/A

Sample Collection Time 1400

Weather cloudy, 70's

Sampling Method Peristaltic/Flow Cell/YSI556

Evacuation Data:

Depth to bottom of well (ft bls) 12.5

Casing stick-up above concrete (feet) Flush Mount

Depth to water from top of casing 5.52

Screened Interval (ft bls) 2.5-12.5

Water Column 6.98 (ft) Gallons in well 1.12

Casing Diameter: 2"

Evacuation Volume (x 3) = Low Flow

Casing Volume 1"=0.04 gal gal/ft, 2"=0.16 gal/ft

Field Parameters: Start @ 1325

Time	Gallons Purged	Temp (°C)	pH (SU)	DO (mg/L)	Cond. (µmhos/cm)	Turb (NTU)	Redox (mV)	Depth to Water (ft)
1330	0.1	19.37	6.25	1.07	302	9.14	-81.0	5.92
1335	0.2	19.34	6.17	0.99	286	11.3	-79.0	5.98
1340	0.3	19.41	6.15	0.69	275	11.0	-76.8	5.98
1345	0.4	19.37	6.14	0.54	273	8.81	-75.1	5.97
1350	0.5	19.34	6.14	0.42	272	7.12	-74.9	5.98
1355	0.6	19.33	6.15	0.46	272	6.16	-74.3	5.98

JDF 12-20-2011

Analyses:

Analytical Parameter	Sample Bottles	Preservative
~~Field Parameters Only~~ VOCs	3X 40mL Glass	HCl

Remarks

Sampling Personnel Josh Frizzell

C:\Users\jfrizzell\Desktop\FORMS\gw_log.docx

ARCADIS

WATER SAMPLING LOG

Project No. GP08HAFS H17C

Date 1-5-12

Site Location: Savannah GA

Monitoring Well Number H17-MW-29D

Rep./Field Blank No.

Sample Collection Time 1050

Weather Sunny, 50's, windy

Sampling Method

Evacuation Data:

Depth to bottom of well (ft bls) 45'

Casing stick-up above concrete (feet) Flush-mount

Depth to water from top of casing 7.8'

Screened Interval (ft bls) 40'-45'

Water Column ___ (ft) Gallons in well

Casing Diameter: 2"

Evacuation Volume (x 3) = 17.86

Casing Volume 1"=0.04 gal gal/ft, 2"=0.16 gal/ft

Field Parameters:

Time	Gallons Purged	Temp (°C)	pH (SU)	DO (mg/L)	Cond. (µmhos/cm)	Turb (NTU)	Redox (mV)	Depth to Water (ft)
1-5-12/1023	0.25	23.63	6.70	1.12	0.353mS	457	-10.1	—
1-5-12/1028	0.5	24.18	6.50	0.38	0.372mS	258	-16.9	—
1-5-12/1033	0.75	24.37	6.35	0.30	0.324mS	11.7	-8.5	—
1-5-12/1038	1	2444	6.31	0.29	0.304mS	89.8	18.3	—
1-5-12/1043	1.25	24.50	6.31	0.25	0.298	66.0	-1.5	—
1-5-12/1048	1.5	24.46	6.31	0.22	0.292	47.3	-5.2	—

VP 1-5-12

Analyses:

Analytical Parameter	Sample Bottles	Preservative

Remarks

Sampling Personnel Valyn Paouncic

C:\Users\vpaouncic\Documents\Forms\gw_log.docx

ARCADIS

WATER SAMPLING LOG

Project No. GROSHAFS. H17C

Date 1-5-12

Site Location: Savannah, GA

Monitoring Well Number H17-MW-24

Rep./Field Blank No. ______

Sample Collection Time 1210

Weather Sunny, 50's windy

Sampling Method ______

Evacuation Data:

Depth to bottom of well (ft bls) 65.0"

Casing stick-up above concrete (feet) Flush-mount

Depth to water from top of casing 5.3

Screened Interval (ft bls) 55' - 65'

Water Column 59.7 (ft) Gallons in well ______

Casing Diameter: 2" inner casing

Evacuation Volume (x 3) = 28.7

Casing Volume 1"=0.04 gal gal/ft, 2"=0.16 gal/ft

Field Parameters:

Time	Gallons Purged	Temp (°C)	pH (SU)	DO (mg/L)	Cond. (µmhos/cm)	Turb (NTU)	Redox (mV)	Depth to Water (ft)
1-5-12/1143	0.25	24.22	6.93	3.08	0.2858	554	-81.6	—
1148 1-5-12/	0.50	24.53	7.18	1.52	0.281mS	45.9	-97.4	—
1-5-12/1153	0.75	24.47	7.26	1.18	0.278	25.1	-102.3	—
1-5-12/1158	1	24.55	7.31	0.96	0.275	14.3	-106.1	—
1-5-12/1203	1.25	24.54	7.33	0.71	0.273	11.0	-108.2	—
1-5-12/1208	1.5	24.50	7.31	0.57	0.272	10.1	-107.9	—

VP 1-5-12

Analyses:

Analytical Parameter	Sample Bottles	Preservative

Remarks ______

Sampling Personnel Valyn Paouncic

C:\Users\vpaouncic\Documents\Forms\gw_log.docx

ARCADIS

WATER SAMPLING LOG

Date 1-5-12

Project No. GP09HAFS. H17C

Site Location: Savannah, GA

Rep./Field Blank No.

Weather Sunny, 50's

Monitoring Well Number H17-MW-27D

Sample Collection Time 0946

Sampling Method

Evacuation Data:

Depth to bottom of well (ft bls) 35.2'

Depth to water from top of casing 4.8'

Water Column ___ (ft) Gallons in well

Evacuation Volume (x 3) = 14.5'

Casing stick-up above concrete (feet) Flush mount

Screened Interval (ft bls) 25'-35'

Casing Diameter: 2"

Casing Volume 1"=0.04 gal gal/ft, 2"=0.16 gal/ft

Field Parameters:

Time	Gallons Purged	Temp (°C)	pH (SU)	DO (mg/L)	Cond. (μmhos/cm)	Turb (NTU)	Redox (mV)	Depth to Water (ft)
1-5-12/0930	0.25	18.96	7.15	0.34	0.269mS	37.7	-88.6	—
1-5-12/0935	0.5	19.66	7.41	0.26	0.258mS	97.6	-98.6	—
1-5-12/0940	0.75	19.60	7.44	0.26	0.258mS	95.8	-98.6	—
1-5-12/0945	1	19.69	7.45	0.248	0.257mS	70.9	-99.2	—

VP 1-5-12

Analyses:

Analytical Parameter	Sample Bottles	Preservative

Remarks

Sampling Personnel Valyn Paouncic

ARCADIS

WATER SAMPLING LOG

Project No. GPOBHAFS.H17C

Date 1-5-12

Site Location: Savannah, GA

Monitoring Well Number H17-MW-27S

Rep./Field Blank No.

Sample Collection Time 0920

Weather Sunny 50's

Sampling Method

Evacuation Data:

Depth to bottom of well (ft bls) 17.0'

Casing stick-up above concrete (feet) Flush mount

Depth to water from top of casing 8.15

Screened Interval (ft bls) 7' - 17'

Water Column ___ (ft) Gallons in well

Casing Diameter: 2"

Evacuation Volume (x 3) = ~~4~~ 4.25

Casing Volume 1"=0.04 gal gal/ft, 2"=0.16 gal/ft

Field Parameters:

Time	Gallons Purged	Temp (°C)	pH (SU)	DO (mg/L)	Cond. (µmhos/cm)	Turb (NTU)	Redox (mV)	Depth to Water (ft)
1-5-12/0908	0.25	20.84	7.05	0.32	0.210mS	4.12	-100.3	—
1-5-12/0913	0.5	20.84	7.04	0.31	0.210mS	3.11	-88.9	—
1-5-12/0918	0.75	20.88	7.04	0.31	0.210mS	2.42	-89.9	—

VP 1-5-12

Analyses:

Analytical Parameter	Sample Bottles	Preservative

Remarks

Sampling Personnel Valyn Paouncic

C:\Users\vpaouncic\Documents\Forms\gw_log.docx

ARCADIS

DAILY LOG

Project No. GP08HAFS.H17B.D60FI Page 1 of 2

Site Location Hunter AAF, Savannah, GA

Prepared By C. Forman

Date/Time	Description of Activities
5/11/10 0745	On-site to meet EMC to give them keys for unlocking
	wells at Fort Stewart.
0800	Met ARM behind environmental building... ARCADIS
	to set up road signs and cones while ARM fills
	rig with water. Drum generated: H-259
0900	After signing H&S and reviewing traffic-hazards began
	drilling at 0915.
0945	Mud rotary bit clogged at 0945... forced to remove all
	rods and bit until clear and begin redrilling.
1005	At 28 feet (where stopped last time); well in hole, set at
	35 feet at 1015; IDW sample at 1020; H-259-IDW-051110
1030	Sand pack in hole up to 23 feet (35 bags #2 Sand)
1035	Bentonite in hole up to 19 feet (3/4 bag 3/8" inch bentonite)
1115	ARM going to fill up with water and get set up on hole
	at H17-MW-20D. ARCADIS taking Rusty with ARM to
	drum storage area to get loader in case rig gets stuck.
1215	Off-site for lunch.
1300	Back from lunch to complete well to 28 feet.
1405	well drilling complete, set at 28 feet; IDW sample H-260-IDW-051110 @ 1410.
1420	After adding 3 bags of sand to screen (16-28) and 1 bag
	of bentonite (14-16), mixed 30 gallons of grout (portland)
	and tremied into annular space; Drum generated: H-260.
1445	went to H17-MW-21D and tremied grout into annular

ARCADIS

DAILY LOG

Project No. GP08HAFS. H17B. DG8FI Page 2 of 2

Site Location Hunter AAF - Savannah, GA

Prepared By C. Forman

Date/Time	Description of Activities
	space. hole took only 10 gallons... will check for settling
	tomorrow.
1500	After setting up on H17-MW-19S and H17-MW-22S,
	well development started. at each well (ARM has 2 pumps).
	Both wells going dry after ~ 5 minutes. Are surging both
	wells and pumping till dry and letting recover for 10
	minutes. Drums generated: H-261, H-262
	H-261 - H17-MW-19S, H17-MW-17S
	H-262 - H17-MW-22S, H17-MW-21S
1700	Total gallons per well pumped H17-MW-19S - 10 gallons
	H17-MW-22S - 15 gallons, H17-MW-21S - 15 gallons, H17-MW-17S - 40 gallons
	IDW samples collected: H-261-IDW-051110 @ 1755
	H-262-IDW-051110 @ 1725
1805	ARCADIS offsite.

ARCADIS

DAILY LOG

Project No. GP08 HAFS. H17B. D60FI Page 1 of 2

Site Location Hunter AAF, Savannah, GA

Prepared By C. Forman

Date/Time	Description of Activities
5/12/10	On-site... met with ARM and reviewed H&S for day.
800 820	Began developing H17-MW-20D. Well continually going
	dry, but recovering quickly. After pumping dry ~ 15 times,
	water clear. Pumped approximately 20 gallons.
915	Set well within a protective cover (stick-up). Used
	sand inside of cover b/w well and cover to stabilize.
	Drum generated: H-263; will use this drum on
	H17-MW-21D as well.
950	Began developing H17-MW-21D. Pumped 30 gallons
	until water became clear while surging. Used drum
	H-263. IDW sample @ 1020 H-263-IDW-051210.
1030	Set well pad at H17-MW-21D and loaded drums.
1130	Drums unloaded at storage area by Env. building.
1230	ARM loaded and offsite.
1245	ARCADIS off-site for lunch and to drop off camera
1330	ARCADIS on-site and at drum storage area. A&D
	Environmental on-site loading drums
1545	After loading 58 drums, A&D offsite. Will send
	Erica M. list of drums collected and drums to
	be picked up on Friday
1600	ARCADIS to Ft. Stewart FST-39 to help surveyors
	find wells.
1715	ARCADIS off Ft. Stewart and in transit to Hunter AAF

ARCADIS

DAILY LOG

Project No. see previous
Page 2 of 2
Site Location Hunter AAF, Savannah GA
Prepared By C. Forman

Date/Time	Description of Activities
1800	C. Forman on-site at HAAF after picking up pictures.
1815	wells at HAA-13 PHIRI marked for surveyors.
1850	After packing HAA-17 IDW samples, ARCADIS offsi
	to ship samples Fed-Ex
1900	Samples dropped off. End of day.

ARCADIS

WELL DEVELOPMENT LOG

Project No. GP08HAFS.AI7

Well ID H17-MW-26S

Site Location Savannah, GA

Evacuation Data:

Depth to bottom of well (ft bls) 17.1'

Depth to water from top of casing 4.9'

Water Column ______ (ft) Gallons in well______

Casing Volume 1"=0.04 gal gal/ft, 2"=0.16 gal/ft

Casing stick-up above concrete (feet) Flush mount

Screened Interval (ft bls) 7-17

Casing Diameter: 2"

Date/Time	Gallons Removed	pH	Temperature (°C)	Specific Conductance (µmhos/cm)	Appearance
12-13-11/1045	5	7.17	19.19	0.253 mS	Gray/cloudy
12-13-11/1047	10	5.99	20.64	0.307	Gray/cloudy
12-13-11/1049	15	7.55	20.64	0.310	Cloudy
12-13-11/1101	20	7.82	20.63	0.303	Gray/cloudy
	DRY @	20 gal.			
12-13/11 1109	25	7.57	20.82	0.298	Cloudy
12·	DRY	@	25 gal		
12-13-11/1128	30	7.61	19.96	0.290	Gray/cloudy
12-13-11/1130	35	6.82	20.95	0.296	Cloudy
	DRY	@	35 gal		
12-13-11/1225	40	7.54	21.05	0.297	Slightly Cloudy
12-13-11/1233	45	7.10	21.22	0.307	Slightly Cloudy
12/13/11 1239	50	7.62	20.69	0.222	Slightly cloudy
	DRY	@ 50	gal		

Prepared By Vaughn Paouncic Date 12-13-11

Prepared By ____________________ Date__________

Remarks____________________

ARCADIS

WELL DEVELOPMENT LOG

Project No. GP08HAFS. H17

Well ID H17-MW-26B

Site Location Savannah, GA

Evacuation Data:

Depth to bottom of well (ft bls) 35

Depth to water from top of casing ~~4~~ 3.2'

Water Column ______ (ft) Gallons in well______

Casing Volume 1”=0.04 gal gal/ft, 2”=0.16 gal/ft

Casing stick-up above concrete (feet) Flush mount

Screened Interval (ft bls) 25-35

Casing Diameter: 2"

Date/Time	Gallons Removed	pH	Temperature (°C)	Specific Conductance (µmhos/cm)	Appearance
12-13-11/1146	2.5	6.61	19.49	0.224 mS	Cloudy/GRAY
12-13-11/1148	5	7.24	20.56	0.232mS	cloudy
12-13-11/1151	10	6.09	20.28	0.227mS	Cloudy
12-13-11/1153	15	7.29	20.35	0.206 mS	Slightly cloudy
12-13-11/1157	20	7.49	19.77	0.226mS	Clear
12-13-11/1159	25	5.98	20.26	0.227mS	clear
12-13-11/1201	30	7.66	20.35	0.231mS	Clear
12-13-11/1204	35	7.58	20.75	0.228mS	clear
12-13-11/1206	40	7.63	20.39	0.221mS	Clear
12-13-11/12	45	7.66	20.38	0.228mS	clear
					12-13-11
				V.P.	

Prepared By ______________________ Date______________

Prepared By ______________________ Date______________

Remarks ____

ARCADIS

WELL DEVELOPMENT LOG

Project No. GP08HAFS. H17

Well ID H17-MW-25D

Site Location Savannah, GA

Evacuation Data:

Depth to bottom of well (ft bls) 35.2

Casing stick-up above concrete (feet) Flush mount

Depth to water from top of casing 0.9'

Screened Interval (ft bls) 25 - 35

Water Column 34.3 (ft) Gallons in well

Casing Diameter: 2"

Casing Volume 1"=0.04 gal gal/ft, 2"=0.16 gal/ft

Date/Time	Gallons Removed	pH	Temperature (°C)	Specific Conductance (μmhos/cm)	Appearance
12-13-11/ 0924	10	5.38	18.71	0.146 mS	cloudy white
12-13-11/0929	15	6.43	17.31	0.143 mS	Slightly cloudy
12-13-11/0930	20	6.40	18.77	0.143mS	Slightly cloudy
12-13-11/0933	25	5.89	18.30	0.144mS	slightly cloudy
12-13-11/0936	30	6.38	18.89	0.145mS	Slightly cloudy
12-13-11/0940	35	6.35	18.99	0.143mS	clear
12-13-11/0942	40	6.35	18.62	0.142mS	Clear
12-13-11/	45	6.37	17.98	0.143mS	Clear

V.P. 12-13-11

Prepared By Valyn Paouncic Date 12-13-11

Prepared By Date

Remarks

C:\Users\vpaouncic\Documents\Forms\Well development_log.doc

ARCADIS

WELL DEVELOPMENT LOG

Project No. GP08HAFS.17C　　　Well ID H17-MW-27S

Site Location Savannah, GA

Evacuation Data:

Depth to bottom of well (ft bls) ______

Depth to water from top of casing ______

Water Column ______ (ft)　Gallons in well______

Casing Volume 1"=0.04 gal gal/ft, 2"=0.16 gal/ft

Casing stick-up above concrete (feet) Flush mount

Screened Interval (ft bls) 7' – 17'

Casing Diameter: 2"

Date/Time	Gallons Removed	pH	Temperature (°C)	Specific Conductance (µmhos/cm)	Appearance
12/22/11 0825	5	6.20	21.32	0.240mS	Cloudy
12/22/11 0828	10	6.55	21.51	0.209 mS	Cloudy
	18	– went	DRY		
12/22/11/0905	20	7.11	21.89	0.209mS	Slightly cloudy
12/22/11/0909	25	6.96	21.33	0.211mS	Clear
	27	Dry			
12/22/11/0918	30	6.96	21.37	0.209mS	Clear

VP 12-22-11

Prepared By Vlyn Paouncic　　　Date 12-22-11

Prepared By ______　　　Date ______

Remarks ______

C:\Users\vpaouncic\Documents\Forms\Well development_log.doc

ARCADIS

WELL DEVELOPMENT LOG

Project No. GP09HAFS. 17C

Well ID H17 - MW-27D

Site Location Savannah, GA

Evacuation Data:

Depth to bottom of well (ft bls) 35

Casing stick-up above concrete (feet) Flush mount

Depth to water from top of casing

Screened Interval (ft bls) 25' - 35'

Water Column (ft) Gallons in well

Casing Diameter: 2"

Casing Volume 1"=0.04 gal gal/ft, 2"=0.16 gal/ft

Date/Time	Gallons Removed	pH	Temperature (°C)	Specific Conductance (µmhos/cm)	Appearance
12-22-11/0844	5	6.87	21.04	0.263 mS	Cloudy Gray
12-22-11/0847	10	3.42	20.98	0.259 mS	Slightly cloudy
12-22-11/0851	15	7.34	21.08	0. 259 mS	Slightly cloudy
12-22/11 0854	20	7.33	20.74	0.258 mS	Clear
12-22/11 0857	25	7.28	21.01	0.258 mS	clear
12-22/11 0900	30	7.32	20.97	0.255 mS	Clear
12-22-11/0903	35	7.27	21.00	0.252 mS	clear

V.P. 12-22-11

Prepared By Valyn Paouncic

Date 12-22-11

Prepared By

Date

Remarks

ARCADIS

WELL DEVELOPMENT LOG

Project No. GPOSHAES. H17C

Well ID H17-MW-29

Site Location Savannah, GA

Evacuation Data:

Depth to bottom of well (ft bls) 42.5'

Casing stick-up above concrete (feet) Flush-mount

Depth to water from top of casing 39.95'

Screened Interval (ft bls) 40'-45'

Water Column 2.55 (ft) Gallons in well

Casing Diameter: 2"

Casing Volume 1"=0.04 gal gal/ft, 2"=0.16 gal/ft

Date/Time	Gallons Removed	pH	Temperature (°C)	Specific Conductance (µmhos/cm)	Appearance
1/4/12/0941	1	YSI	NOT OPERABLE		Cloudy/silty
1/4/12/0944	5	YSI	NOT OPERABLE		Cloudy/silty
1/4/12/0947	10	YSI	NOT OPERABLE		Cloudy/silty
1/4/12/0950	15	YSI	NOT OPERABLE		Cloudy/silty
1/4/12/0954	20	YSI	NOT OPERABLE		Cloudy/silty
1/4/12/1001	25	YSI	NOT OPERABLE		Slightly cloudy
1/4/12/1005	30	YSI	NOT OPERABLE		Slightly cloudy
1/4/12/[illegible]	35	YSI	NOT OPERABLE		Clear
1/4/12/1015	40	YSI	NOT OPERABLE		Clear
1/4/12 1020	45	YSI	NOT OPERABLE		Clear
			V.P	1-4-12	

Prepared By Valyn Paouncic

Date 1-4-12

Prepared By

Date

Remarks

C:\Users\vpaouncic\Documents\Forms\Well development_log.doc

ARCADIS

WELL DEVELOPMENT LOG

Project No. GP08HAFS. H17C

Well ID H17-MW-24

Site Location Savannah, GA

Evacuation Data:

Depth to bottom of well (ft bls) 61.0'

Casing stick-up above concrete (feet) Flush mount

Depth to water from top of casing 1.9'

Screened Interval (ft bls) 55'-65'

Water Column 59.1 (ft) Gallons in well

Casing Diameter: 2" inner casing

Casing Volume 1"=0.04 gal gal/ft, 2"=0.16 gal/ft

Date/Time	Gallons Removed	pH	Temperature (°C)	Specific Conductance (µmhos/cm)	Appearance
1-4-12/1420	70	7.35	21.87	0.256 mS	Clear
1-4-12/1430	~83	7.33	21.50	0.269 mS	Clear
1-4-12/1438	~100	7.42	19.95	0.269 mS	Clear
1-4-12/1446	120	7.42	21.46	0.262 mS	Clear
1-4-12/1454	135	7.44	20.89	0.262 mS	Clear
1-4-12/1504	145	7.42	21.69	0.260 mS	Clear

VP 1-4-12

Prepared By Valyn Paouncic Date 1-4-12

Prepared By Date

Remarks

C:\Users\vpaouncic\Documents\Forms\Well development_log.doc

RECEIVED
AUG 26 2008
PAGE 1 OF 1

Georgia Department of Natural Resources
Environmental Protection Division
Underground Storage Tank Management Program
4244 International Parkway, Suite 104, Atlanta, Georgia 30354
Noel Holcomb, Commissioner
Carol A. Couch, Ph.D., Director
(404) 362-2687

August 19, 2008

Mr. Thomas C. Fry
U.S. Army/HQ, 3d Inf. Div. (Mech)
Directorate of Public Works, Bldg.1137
1550 Frank Cochran Drive
Fort Stewart, Georgia 31314-4927

SUBJECT: Corrective Action Plan (CAP)-Part B Monitoring Report
No Further Action Required:
Hunter AAF, Former UST # 25 and # 26
Building 1343
Hunter Army Airfield, Chatham County, GA
Facility ID: 9025008*1

Dear Mr. Fry:

The Georgia Underground Storage Tank Management Program (USTMP) has received your consultant's letter, dated July 25, 2008, that forwarded a properly certified CAP-Part B Monitoring Report. The report was prepared by SpecPro Environmental Services LLC (SES).

Based on current requirements of the Georgia Underground Storage Tank Act, the Georgia Rules for Underground Storage Tank Management (GUST Rules) and the data submitted, the USTMP has determined that **no further action is required for the reference release.**

However, further corrective action may be required if mandated through more stringent State or Federal statutory or regulatory changes. Additional measures may also be required if existing or future drinking water systems or surface water bodies within two miles of the site are impacted by any dissolved contamination resulting from this release, or if previously unidentified soil contamination, dissolved contamination or free product are identified as originating from this site.

Please submit a Completion Report and Certification, documenting that the associated monitoring wells have been properly abandoned, by **November 30, 2008**. If you have any questions, please contact William E. Logan at 404.362.4529.

Sincerely,

Ronald J. Wallace for LLL

Lisa L. Lewis
Unit Coordinator
Corrective Action Unit II

WEL;
S: land/landdocs/williaml/Pend08/9025008. 34
cc: Jeffery C. Williams, P.E., SES
William E. Logan, GA EPD
File (CA): CHATHAM; 9025008

Appendix H

Lithologic Comparison for Soil Background Concentrations Evaluation

On October 27, 2011 the Georgia Environmental Protection Division (EPD) provided comments on the *Final Compliance Status Report, HAA-17 Installation-Wide Groundwater Including TCE Groundwater Contamination, Hunter Army Airfield, Savannah, Georgia* (HAA-17 CSR) (HSI Site #10903), dated April 25, 2011. Comment 15 of the October 27, 2011 document addresses Section 5.9.2 and Appendix H, Background Data of the HAA-17 CSR. Appendix H references a soils background study (background study) that was included in *Revised Final Compliance Status Report, Former HAAF Fire Training Area, HSI Number 10395, February 2002* (2002 HAA-01 CSR). In the comment EPD requested a lithologic comparison between HAA-17 and HAA-01 sites. This document describes similar lithology at the HAA-01 and HAA-17 sites and provides evidence that lithology and background values at HAA-01 are representative of background values at HAA-17.

In November 2009 ARCADIS, U.S., Inc. (ARCADIS) coordinated with ARM Environmental Services, Inc. to install new groundwater monitoring wells at the HAA-01 site. Lithology was logged by an ARCADIS field geologist during the well installations. The most vertically comprehensive lithologies were recorded at monitoring well pair MW-12/MW-12D, monitoring well pair MW-14/MW-14D and monitoring well MW-18. Soil samples were recovered and logged at these locations to total depths of 50 to 66 feet below ground surface (bgs). Lithologic logs for the boring locations referenced above are attached.

Soils at the monitoring well locations referenced above are consistently characterized by tan to brown well sorted fine sand with minor silts and clays underlain by gray fine sand with increasing interbedded clay and fine to coarse sand content with depth. Within the gray sandy unit interbedded very fine to coarse materials are generally observed beginning at approximately 30 to 40 feet bgs.

Numerous soil borings were a performed at HAA-17. As noted at HAA-01, lithology at HAA-17 is characterized by brown light brown to brown to reddish brown fine sands underlain by gray fine sand and interbedded sands and clays. Representative lithology logs from across the HAA-17 site are attached.

Based on lithologic logs from the HAA-01 and HAA-17 sites, the vertical color sequence, shallow fine sands, and interbedded sands and clays at depth are ubiquitous at the HAA-01 and HAA-17 sites. Furthermore, the lithologies recorded these sites are consistent with the Hunter Army Airfield Depositional Model presented in the *Compliance Status Report, HAA-01 (Former Fire Training Area and DAACG Chlorinated Solvents Area)*, October 2011 (2011 HAA-01 CSR). In the 2011 HAA-01 CSR, the depositional environment is described as fine to medium-grained beach sand deposits. Interbedded sands and clays are also observed in soil borings performed at these sites and are consistent with marsh and bay deposits described in the depositional model. Similar lithologic sequences, each consistent with a similar depositional environment, support consistent representative background values across the three sites.

United States Department of Agriculture (USDA) Web Soil Survey maps were also reviewed and compared for the HAA-01 and HAA-17 sites. Soil survey maps indicate that both sites are dominated by the Ellabelle loamy sand and Chipley-Urban land complex. A soil map depicting aerial extents of soil units and descriptions of relevant soil units are attached.

The USDA Web Soil Survey describes the Ellabelle loamy sand as loamy sand to a depth of 27 inches bgs and sandy clay loam to a depth of 72 inches. The Chipley-Urban land complex is described as fine sand to a depth of 77 inches bgs. Although the background study was based on soil samples collected from up to approximately 10.5 feet bgs, the majority of the soil samples used in the background study were collected from depths shallower than six feet. The depth range provided by the USDA Web Soil Survey, therefore, is largely representative of soils included in the background study.

Lithology information collected during site assessments at the HAA-01and and HAA-17 sites indicates the presence of sands and silty to clayey sands and is consistent with the fine sands and sandy loams cited in the USDA Web Soil Survey. The USDA Web Soil Survey depicts the HAA-01 and HAA-17 sites as dominated by the same soil units and soil types over the majority of the depth range included in the background study, providing further evidence that the background study conducted at the HAA-01 site is also pertinent to the HAA-17 site.

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Wel MW-12 / MW-12D Project/No. GP08HAFS.H01B.DG0FI Page 1 of 2

Site Location Hunter AAF (HAA-01) Drilling Started 9:10 Drilling Completed 10:20 (11/6/09)

Drilling Contractor ARM Environmental Services, Inc. Driller M. Carey Helper J. Watson

Drilling Fluid Used None Drilling Method Hand-Auger, Direct Push (Geoprobe)

Length and Diameter of Coring Device 1.5' x 3" (Hand-Auger), 5' x 2.25" (MacroCore) Sampling Interval 1.0'-2.0', 3.0'-4.0' feet

Land-Surface Elev. _____ feet ☐ Surveyed ☐ Estimated Datum _____

Total Depth Drilled 50.0 Feet Hole Diameter 2.25 Coring Device Hand-Auger (to 3'), MacroCore (3' - 40')

Prepared By B. Wolf Hammer Weight _____ Hammer Drop _____ ins.

Sampling Data:

Depth	Grab/Composite	Time	Laboratory Analysis
1.0' - 2.0'	Grab	11:00	VOCs, Metals, Pesticides
3.0' - 4.0'	Grab	11:10	VOCs, Metals
3.0' - 4.0'	Grab		VOCs, Metals (MS collected at 11:15, MSD collected at 11:20)

Soil Characterization:

Sample/Core Depth (Feet bls)		Core Recovery (Feet)	OVM Reading (ppm)	Blow Counts per 6 Inches	Sample/Core Description
From	To				*Soil type, %, Grain Size, Angularity, Grading, Consistency, Plasticity, Color, etc.*
0.0	1.0	1.0	0.0	N/A	Dark brown, fine grained, poorlly graded, silty SAND, loose, organic matter present
1.0	2.5	1.5	0.0	N/A	Brown/gray, fine grained, poorly graded, silty SAND, loose
2.5	4.5	2.0	0.0	N/A	Brown, fine grained, poorly graded, silty SAND, loose to medium dense, moist at approximately 3'
4.5	7.5	3.0	0.0	N/A	Brown, fine grained, silty SAND, with alternating bands of brown, medium stiff, plastic, sandy CLAY, wet
7.5	9.75	2.25	0.0	N/A	Tan, fine grained, poorly graded, silty SAND, medium dense, saturated
9.75	10.0	0.25	0.0	N/A	Gray, fine grained, poorly graded, SAND, medium dense, saturated
10.0	12.0	2.0	0.0	N/A	Tan, very fine grained, poorly graded, SAND, loose, saturated
12.0	15.0	3.0	0.0	N/A	Gray, fine grained, poorly graded, SAND with silt, loose, saturated
15.0	22.0	7.0	0.0	N/A	Same as above
22.0	22.25	0.25	0.0	N/A	Gray, fine to medium grained, silty SAND, loose, saturated
22.25	24.5	2.25	0.0	N/A	Gray, clayey SAND, loose, moderately plastic, saturated
24.5	27.0	2.5	0.0	N/A	Gray, fine grained, poorly graded, SAND with silt, medium dense, saturated
27.0	28.5	1.5	0.0	N/A	Gray, fine grained, poorly graded, SAND with silt, with alternating bands of gray, fine grained, silty SAND, saturated
28.5	30.0	1.5	0.0	N/A	Gray, fine to medium grained, moderately well graded, SAND with silt, loose, sub-angular to sub-rounded grains, saturated
30.0	35.0	0.5	0.0	N/A	Gray, fine to medium grained, sandy CLAY, stiff, plastic, lost most of core
35.0	37.5	2.5	0.0	N/A	Gray/tan, fine to medium to coarse grained, well graded, SAND, sub-angular to sub-rounded grains, saturated
37.5	40.0	2.5	0.0	N/A	Gray, CLAY, stiff, plastic, some fine to medium grained sand present
					Geoprobe encounters refusal at 40', resume coring with split spoons advanced through hollow-stem augers.

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Wel MW-12 / MW-12D Project/No. GP08HAFS.H01B.DG0FI Page 2 of 2

Site Location Hunter AAF (HAA-01) Drilling Started 9:10 Drilling Completed 10:20 (11/6/09)

Drilling Contractor ARM Environmental Services, Inc. Driller B. Ewing Helper J. Watson

Drilling Fluid Used None Drilling Method Hollow stem auger

Length and Diameter of Coring Device 2.0' x 2.0" Sampling Interval ____ feet

Land-Surface Elev. ____ feet ☐ Surveyed ☐ Estimated Datum ____

Total Depth Drilled 50.0 Feet Hole Diameter 2.0" Coring Device Split spoon sampler (40'-42' and 45'-47')

Prepared By B. Wolf Hammer Weight 180 lbs Hammer Drop 36 ins.

Sampling Data:

Depth	Grab/Composite	Time	Laboratory Analysis
1.0' - 2.0'	Grab	11:00	VOCs, Metals, Pesticides
3.0' - 4.0'	Grab	11:10	VOCs, Metals
3.0' - 4.0'	Grab		VOCs, Metals (MS collected at 11:15, MSD collected at 11:20)

Soil Characterization:

Sample/Core Depth (Feet bls)		Core Recovery (Feet)	OVM Reading (ppm)	Blow Counts per 6 Inches	Sample/Core Description Soil type, %, Grain Size, Angularity, Grading, Consistency, Plasticity, Color, etc.
From	To				
40.0	42.0	2.0	0.0	8,8,8,6	Gray, sandy CLAY, stiff, plastic
45.0	47.0	2.0	0.0	1,1,1,1	Tan/green, fine to medium to coarse grained, well graded, clayey SAND, medium dense, saturated

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Wel MW-14 / MW-14D Project/No. GP08HAFS.H01B.DG0FI Page 1 of 2

Site Location Hunter AAF (HAA-01) Drilling Started 14:45 Drilling Completed 17:20 (11/5/09)

Drilling Contractor ARM Environmental Services, Inc. Driller M. Carey Helper J. Watson

Drilling Fluid Used None Drilling Method Hand-Auger, Direct Push (Geoprobe)

Length and Diameter of Coring Device 1.5' x 3" (Hand-Auger), 5' x 2.25" (MacroCore) Sampling Interval 1.0'-2.0', 3.0'-4.0' feet

Land-Surface Elev. ____ feet ☐Surveyed ☐Estimated Datum ____

Total Depth Drilled 50.0 Feet Hole Diameter 2.25 Coring Device Hand-Auger (to 3'), MacroCore (3' - 45')

Prepared By B. Wolf Hammer Weight ____ Hammer Drop ____ ins.

Sampling Data:

Depth	Grab/Composite	Time	Laboratory Analysis
1.0' - 2.0'	Grab	9:00	VOCs, Metals, Pesticides
3.0' - 4.0'	Grab	9:10	VOCs, Metals
			Samples collected from boring advanced at MW-14 on 11/6/09

Soil Characterization:

Sample/Core Depth (Feet bls) From	To	Core Recovery (Feet)	OVM Reading (ppm)	Blow Counts per 6 Inches	Sample/Core Description Soil type, %, Grain Size, Angularity, Grading, Consistency, Plasticity, Color, etc.
0.0	2.0	2.0	0.0	N/A	Brown, fine grained, poorly graded, SAND with silt, loose, organic matter present
2.0	3.0	1.0	0.0	N/A	Tan, fine grained, poorly graded, SAND with silt, loose
3.0	5.0	2.0	0.0	N/A	Dark brown and gray, fine grained, poorly graded, silty SAND, loose
5.0	5.5	0.5	0.0	N/A	Same as above, but moist
5.5	8.5	3.0	0.0	N/A	Same as above, but more silt and clay present near 8.5', and wet.
8.5	10.0	1.5	0.0	N/A	Tan, fine grained, poorly graded, SAND, loose, saturated
10.0	12.0	2.0	0.0	N/A	Same as above
12.0	13.0	1.0	0.0	N/A	Gray, fine grained, poorly graded, silty SAND, loose, saturated
13.0	15.0	2.0	0.0	N/A	Gray, fine grained, poorly graded, SAND with silt, loose, saturated
15.0	20.0	5.0	0.0	N/A	Same as above
20.0	25.0	5.0	0.0	N/A	Same as above
25.0	30.0	5.0	0.0	N/A	Same as above, but gray, fine grained, clayey SAND from 26.0' to 28.5'
30.0	32.0	2.0	0.0	N/A	Same as above
32.0	34.0	2.0	0.0	N/A	Alternating bands of gray, fine grained SAND and gray, fine grained, clayey SAND. Fine to medium to coarse grained SAND and rounded pebbles from 33.0' to 33.5'.
34.0	35.0	1.0	0.0	N/A	Tan/Gray, fine to medium to coarse grained, well graded, SAND, medium dense, sub-angular to sub-rounded grains and rounded quartz pebbles present, saturated
35.0	39.0	4.0	0.0	N/A	Same as above
39.0	40.0	1.0	0.0	N/A	Gray, fine to medium grained, SAND with alternating bands of gray, fine grained, clayey SAND, loose to medium dense, saturated
40.0	43.5	3.5	0.0	N/A	Gray, fine to medium grained, SAND with alternating bands of gray, fine to medium grained, clayey SAND, loose to medium dense, saturated

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Wel MW-14 / MW-14D Project/No. GP08HAFS.H01B.DG0FI Page 2 of 2

Site Location Hunter AAF (HAA-01) Drilling Started 14:45 Drilling Completed 17:20 (11/5/09)

Drilling Contractor ARM Environmental Services, Inc. Driller M. Carey Helper J. Watson

Drilling Fluid Used None Drilling Method Hand-Auger, Direct Push (Geoprobe)

Length and Diameter of Coring Device 1.5' x 3" (Hand-Auger), 5' x 2.25" (MacroCore) Sampling Interval 1.0'-2.0', 3.0'-4.0' feet

Land-Surface Elev. ______ feet ☐ Surveyed ☐ Estimated Datum ______

Total Depth Drilled 50.0 Feet Hole Diameter 2.25 Coring Device Hand-Auger (to 3'), MacroCore (3' - 45')

Prepared By B. Wolf Hammer Weight ______ Hammer Drop ______ ins.

Sampling Data:

Depth	Grab/Composite	Time	Laboratory Analysis
1.0' - 2.0'	Grab	9:00	VOCs, Metals, Pesticides
3.0' - 4.0'	Grab	9:10	VOCs, Metals
			Samples collected from boring advanced at MW-14 on 11/6/09

Soil Characterization:

Sample/Core Depth (Feet bls)		Core Recovery (Feet)	OVM Reading (ppm)	Blow Counts per 6 Inches	Sample/Core Description Soil type, %, Grain Size, Angularity, Grading, Consistency, Plasticity, Color, etc.
From	To				
43.5	44.0	0.5	0.0	N/A	Gray, CLAY with fine to medium grained sand, stiff, plastic
44.00	44.5	0.5	0.0	N/A	Gray, sandy CLAY, stiff, plastic, sand is fine to medium grained
					Geoprobe encounters refusal at 44.5'. Borehole completed to 50.0' using hollow-stem augers. Material recovered from bottom auger was a gray fine to medium grained, clayey SAND

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Wel MW-18 Project/No. GP08HAFS.H01B.DG0FI Page 1 of 2

Site Location Hunter AAF (HAA-01) Drilling Started 9:31 Drilling Completed 14:57 (11/12/09)

Drilling Contractor ARM Environmental Services, Inc. Driller B. Ewing Helper J. Watson

Drilling Fluid Used None Drilling Method Hollow-stem Auger

Length and Diameter of Coring Device 2.0' x 2.0" Sampling Interval feet

Land-Surface Elev. feet ☐ Surveyed ☐ Estimated Datum

Total Depth Drilled 66.0 Feet Hole Diameter 8.0" Coring Device Split Spoon Sampler

Prepared By B. Wolf Hammer Weight 180 lbs Hammer Drop 36 ins.

Sampling Data:

Depth	Grab/Composite	Time	Laboratory Analysis

Soil Characterization:

Sample/Core Depth (Feet bls)		Core Recovery (Feet)	OVM Reading (ppm)	Blow Counts per 6 Inches	Sample/Core Description Soil type, %, Grain Size, Angularity, Grading, Consistency, Plasticity, Color, etc.
From	To				
3.0	5.0	2.0	0.0	11,9,8,6	Brown, fine grained, poorlly graded, SAND with silt, loose, asphalt and concrete fragments present throughout core
7.0	9.0	2.0	0.0	8,6,1,3	7.0' - 7.5': Slough
					7.5' - 8.75': Tan, fine grained, poorly grade, SAND with silt, loose
					8.75' - 9.0': Dark brown, fine grained, poorly graded, silty SAND, medium dense, moist
12.0	14.0	2.0	0.0	6,4,17,13	12.0' - 13.5': Dark brown, fine grained, poorly graded, silty SAND, medium dense, saturated
17.0	19.0	2.0	0.0	4,3,3,10	17.0' - 18.5': Tan/gray mottled, fine grianed, poorly graded, silty SAND, medium dense, saturated
					18.5' - 19.0': Tan/gray, fine grained, poorly graded, SAND with silt, loose, saturated
22.0	24.0	0.0	0.0	9,9,5,12	No recovery
27.0	29.0	2.0	0.0	4,3,3,5	Gray, fine grained, poorly graded, SAND with silt, medium dense, saturated. Slightly more silt and clay between 27.5' and 28.0', few sub-rounded coarse grains near 29.0'.
32.0	34.0	1.25	0.0	2,1,3,3	Gray, fine grained, poorly graded, silty SAND, loose, saturated
37.0	39.0	2.0	0.0	5,4,4,13	37.0' - 38.0': Gray, sandy CLAY, soft, moderately plastic, saturated
					38.0' - 38.5': Gray, fine grained, poorly graded, SAND with silt, medium dense
					38.5' - 39.0': Gray, fine to medium to coarse grained, well graded, silty SAND, medium dense, coarse grains are rounded to sub-rounded quartz, sub-rounded quartz pebbles present, saturated
42.0	44.0	2.0		8,15,15,12	42.0' - 43.0': Tan/gray, fine grained, poorly graded, SAND with silt, medium dense, saturated
					43.0' - 43.25': Gray, fine grained, clayey SAND, loose, plastic

ARCADIS

SOIL CORE / SAMPLING LOG

Boring/Wel MW-18 Project/No. GP08HAFS.H01B.DG0F1 Page 2 of 2

Site Location Hunter AAF (HAA-01) Drilling Started 9:31 Drilling Completed 14:57 (11/12/09)

Drilling Contractor ARM Environmental Services, Inc. Driller B. Ewing Helper J. Watson

Drilling Fluid Used None Drilling Method Hollow-stem Auger

Length and Diameter of Coring Device 2.0' x 2.0" Sampling Interval ______ feet

Land-Surface Elev. ______ feet ☐ Surveyed ☐ Estimated Datum ______

Total Depth Drilled 66.0 Feet Hole Diameter 8.0" Coring Device Split Spoon Sampler

Prepared By B. Wolf Hammer Weight 180 lbs Hammer Drop 36 ins.

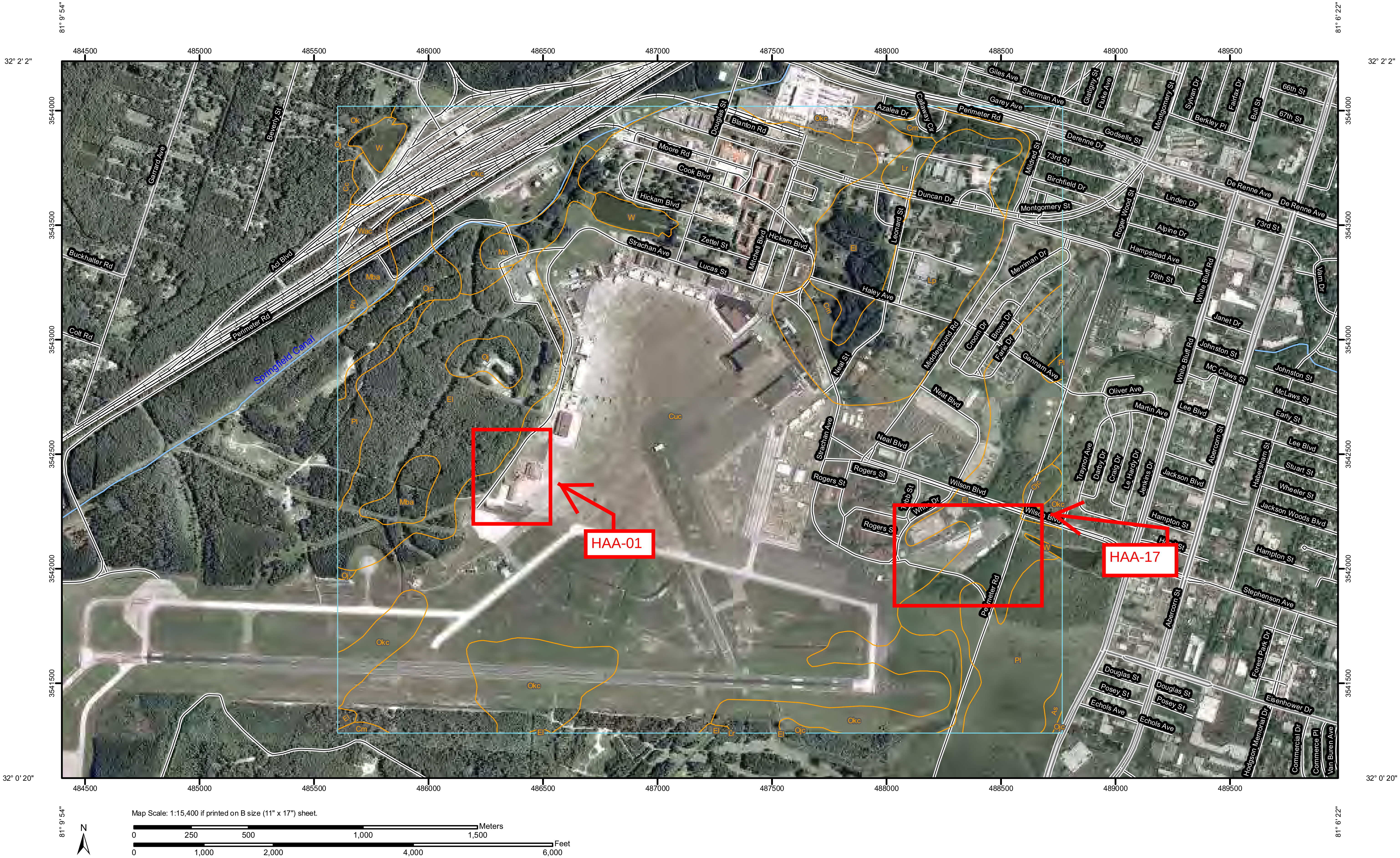
Sampling Data:

Depth	Grab/Composite	Time	Laboratory Analysis

Soil Characterization:

Sample/Core Depth (Feet bls)		Core Recovery (Feet)	OVM Reading (ppm)	Blow Counts per 6 Inches	Sample/Core Description Soil type, %, Grain Size, Angularity, Grading, Consistency, Plasticity, Color, etc.
From	To				
					43.25' - 43.5': Tan/gray, fine grained, SAND with silt, rounded quartz pebbles present
					43.5' - 44.0': Light gray, fine to medium to coarse grained, well graded, SAND, medium dense, greenish clay stringers present, coarser grains are rounded to sub-rounded
47.0	49.0	2.0	0.0	6,3,5,10	47.0' - 47.75': Tan/gray, fine grained, poorly graded, silty SAND, medium dense, saturated
					47.75' - 48.25': Gray, sandy CLAY, soft, plastic, saturated
17.0	19.0	2.0	0.0	4,3,3,10	48.25' - 48.5': Tan/orange, fine to medium to coarse grained, well graded, clayey SAND, dense, saturated, rounded pebbles present
					48.5' - 49.0': Gray, fine to medium to coarse grained, well graded, silty SAND, medim dense, saturated
52.0	54.0	2.0	0.0	7,10,22,27	52.0' - 52.75': Gray, fine grained, poorly graded, SAND with silt, medium dense, saturated
					52.75' - 53.0': Gray, sandy CLAY, soft, plastic, saturated
					53.0' - 54.0': Gray, fine to medium to coarse grained, well graded, SAND with silt, medium dense, saturated
57.0	59.0	2.0	0.0	9,12,40,50	Gray, fine grained, moderately poorly graded, SAND, dense, few sub-angular to sub-rounded medium and coarse grains present, saturated
62.0	64.0	2.0	0.0	11,14,20,30	Same as above
64.0	66.0				Soils observed on two bottom flights of hollow-stem augers (advanced to 66.0') consisted of gray, sandy (fine grained) CLAY, soft, plastic, with rounded quartz pebbles present

Soil Map—Bryan and Chatham Counties, Georgia
(Soils at HAA-01, HAA-15, and HAA-17 Sites)



Map Scale: 1:15,400 if printed on B size (11" x 17") sheet.

MAP LEGEND

Area of Interest (AOI)
- ☐ Area of Interest (AOI)

Soils
- 🟧 Soil Map Units

Special Point Features
- ☉ Blowout
- ☒ Borrow Pit
- ✳ Clay Spot
- ◆ Closed Depression
- ✕ Gravel Pit
- ∴ Gravelly Spot
- ⊚ Landfill
- ʎ Lava Flow
- ⩫ Marsh or swamp
- ⚒ Mine or Quarry
- ◎ Miscellaneous Water
- ◉ Perennial Water
- ∨ Rock Outcrop
- + Saline Spot
- ⁘ Sandy Spot
- ≡ Severely Eroded Spot
- ◇ Sinkhole
- ⋑ Slide or Slip
- ø Sodic Spot
- ≣ Spoil Area
- ◊ Stony Spot
- ꝏ Very Stony Spot
- ♆ Wet Spot
- ▲ Other

Special Line Features
- ∾ Gully
- ⋯ Short Steep Slope
- ⌃ Other

Political Features
- ● Cities

Water Features
- ∼ Streams and Canals

Transportation
- ┼┼┼ Rails
- ∼ Interstate Highways
- ∼ US Routes
- ≈ Major Roads
- ∼ Local Roads

MAP INFORMATION

Map Scale: 1:15,400 if printed on B size (11" × 17") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Bryan and Chatham Counties, Georgia
Survey Area Data: Version 7, Mar 28, 2011

Date(s) aerial images were photographed: 7/19/2007; 9/5/2007

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Bryan and Chatham Counties, Georgia (GA613)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
As	Albany fine sand	3.0	0.1%
Cc	Cape Fear soils	4.3	0.2%
Cm	Chipley fine sand	24.1	1.1%
Cuc	Chipley-Urban land complex	1,149.5	53.7%
El	Ellabelle loamy sand	344.9	16.1%
Lp	Lakeland sand	131.3	6.1%
Lr	Leon fine sand	8.1	0.4%
Mba	Meggett loam	23.2	1.1%
Mn	Mascotte sand	6.3	0.3%
Oj	Ocilla complex	13.1	0.6%
Ojc	Ocilla-Urban land complex	45.2	2.1%
Ok	Ogeechee loamy fine sand	7.7	0.4%
Okc	Ogeechee-Urban land complex	257.3	12.0%
Pl	Pelham loamy sand	84.8	4.0%
Pn	Pooler fine sandy loam	5.1	0.2%
W	Water	19.1	0.9%
Wac	Wahee-Urban land complex	14.9	0.7%
Totals for Area of Interest		**2,141.8**	**100.0%**

Bryan and Chatham Counties, Georgia

El—Ellabelle loamy sand

Map Unit Setting

Elevation: 10 to 350 feet
Mean annual precipitation: 44 to 52 inches
Mean annual air temperature: 64 to 70 degrees F
Frost-free period: 230 to 290 days

Map Unit Composition

Ellabelle and similar soils: 100 percent

Description of Ellabelle

Setting

Landform: Depressions, drainageways
Down-slope shape: Concave, linear
Across-slope shape: Concave
Parent material: Marine deposits

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water capacity: Moderate (about 6.8 inches)

Interpretive groups

Land capability (nonirrigated): 5w

Typical profile

0 to 27 inches: Loamy sand
27 to 64 inches: Sandy clay loam
64 to 72 inches: Sandy clay loam

Data Source Information

Soil Survey Area:	Bryan and Chatham Counties, Georgia
Survey Area Data:	Version 7, Mar 28, 2011

Bryan and Chatham Counties, Georgia

Cuc—Chipley-Urban land complex

Map Unit Setting

Elevation: 20 to 450 feet
Mean annual precipitation: 44 to 52 inches
Mean annual air temperature: 64 to 70 degrees F
Frost-free period: 230 to 290 days

Map Unit Composition

Chipley and similar soils: 60 percent
Urban land: 35 percent
Minor components: 5 percent

Description of Chipley

Setting

Landform: Flats
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Marine deposits

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.7 inches)

Interpretive groups

Land capability (nonirrigated): 3s

Typical profile

0 to 6 inches: Fine sand
6 to 77 inches: Fine sand

Minor Components

Osier

Percent of map unit: 5 percent
Landform: Depressions, swales, flats
Landform position (three-dimensional): Dip
Down-slope shape: Concave, linear

Across-slope shape: Concave, linear

Data Source Information

Soil Survey Area: Bryan and Chatham Counties, Georgia
Survey Area Data: Version 7, Mar 28, 2011

Bryan and Chatham Counties, Georgia

Cm—Chipley fine sand

Map Unit Setting

Elevation: 10 to 350 feet
Mean annual precipitation: 44 to 52 inches
Mean annual air temperature: 64 to 70 degrees F
Frost-free period: 230 to 290 days

Map Unit Composition

Chipley and similar soils: 95 percent
Minor components: 5 percent

Description of Chipley

Setting

Landform: Flats
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Marine deposits

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.7 inches)

Interpretive groups

Land capability (nonirrigated): 3s

Typical profile

0 to 6 inches: Fine sand
6 to 77 inches: Fine sand

Minor Components

Ellabelle

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Down-slope shape: Concave, linear
Across-slope shape: Concave

Data Source Information

Soil Survey Area: Bryan and Chatham Counties, Georgia
Survey Area Data: Version 7, Mar 28, 2011

Bryan and Chatham Counties, Georgia

Lp—Lakeland sand

Map Unit Setting

Elevation: 40 to 300 feet
Mean annual precipitation: 44 to 52 inches
Mean annual air temperature: 64 to 70 degrees F
Frost-free period: 230 to 290 days

Map Unit Composition

Lakeland and similar soils: 100 percent

Description of Lakeland

Setting

Landform: Rises
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Marine deposits

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.9 inches)

Interpretive groups

Land capability (nonirrigated): 4s

Typical profile

0 to 43 inches: Sand
43 to 80 inches: Sand

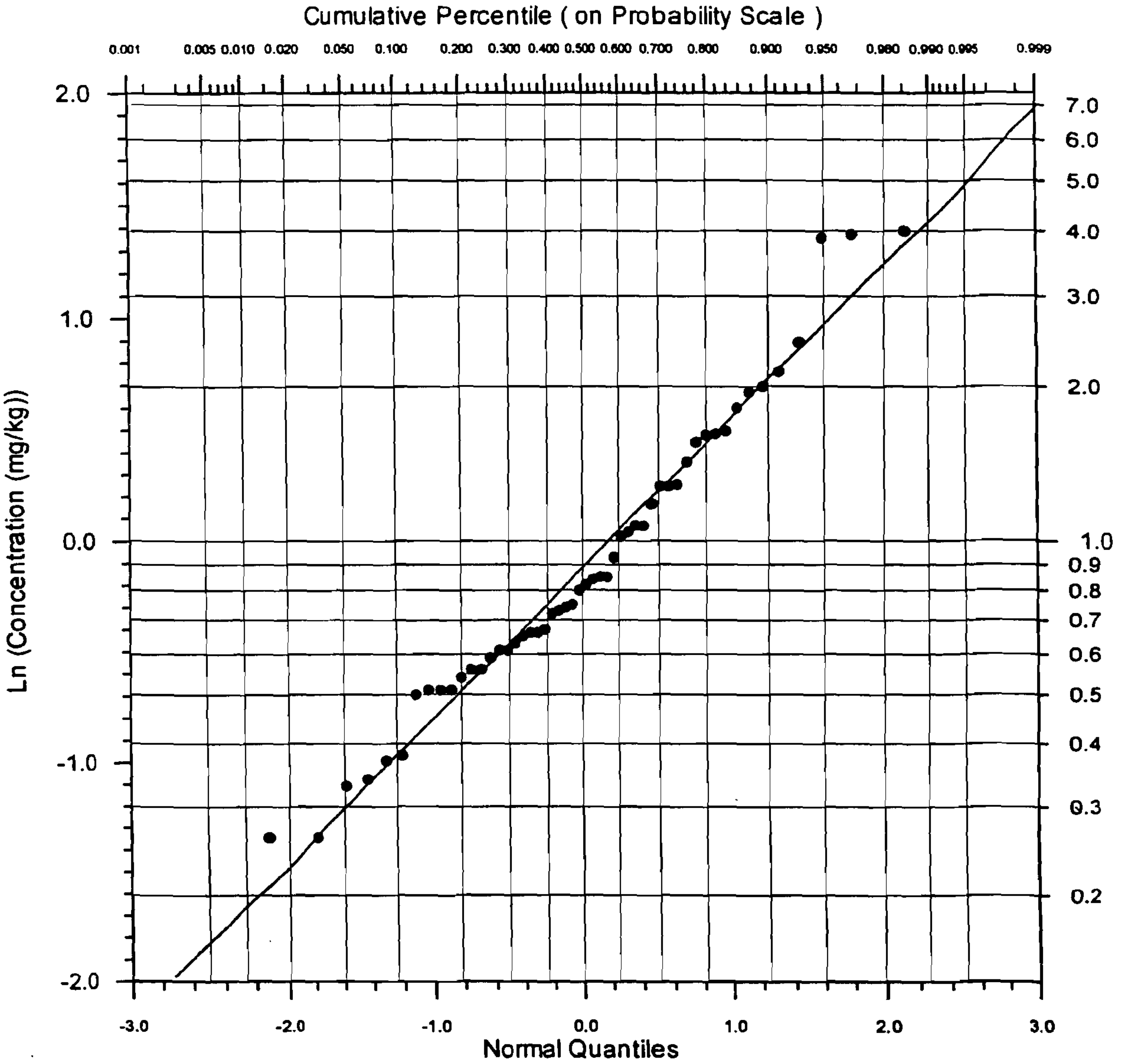
Data Source Information

Soil Survey Area: Bryan and Chatham Counties, Georgia
Survey Area Data: Version 7, Mar 28, 2011

Appendix H: Soil Background Data

(Pages 4 – 8 and Appendix H from “Revised Final Compliance Status Report, Former Fire training Area [HIS Number 10395] at Hunter Army Airfield, Georgia”)

STATISTICAL DATA AND STATISTICAL PLOTS



LEGEND:

● Arsenic (mg/kg)

LN(Data) Passed the Shapiro-Francia Normality Test indicating the Data are Lognormal.
Probability Plot is Detects-Only. 7.9% ND. NDs/2 were included in UBC calculation.

Upper Background Concentration: 2.6 mg/kg
Based on LN(Data) mean + 1.645 Standard Deviations
LN (Data) Mean: -0.2018 SD: 0.7012

Total 63 samples, of which 57 data points were used for UBC and 52 for Probability Plot.
Two data points, BH-11(13.90) and BH-13(11.98), are statistical outliers
By ASTM Designation E178-75, 1975.
5% significance level.
Four data points, BH-10 (5.99), BH-13 (7.75), FTASB-11 (0.86),and HMW-13 (0.6),
are rejected due to being outliers in other metals data sets.

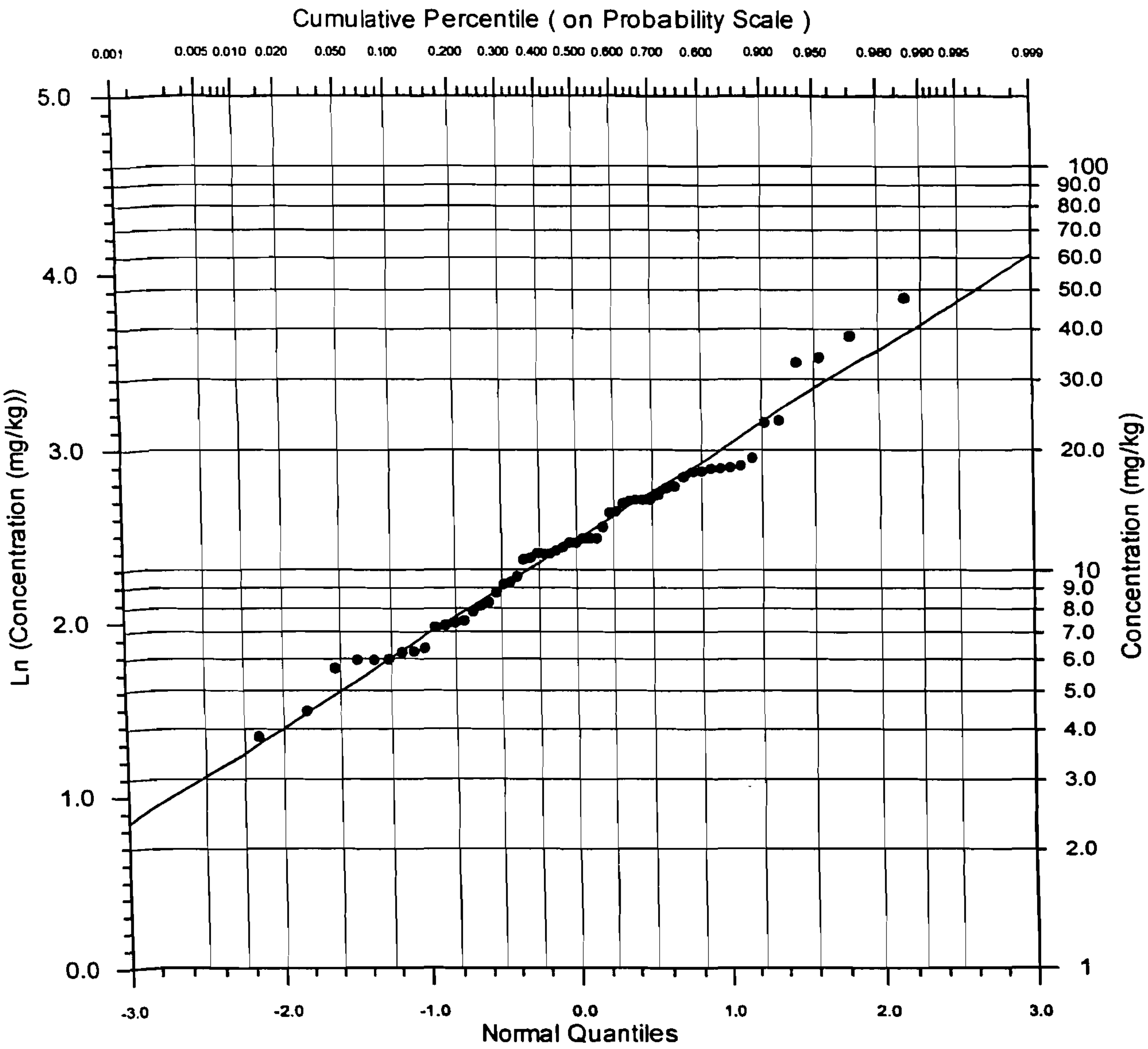
Distribution of Background Arsenic
in Soils at Hunter Army Airfield

ARSENIC

Sample ID	Sample Depth (feet)		Concentration (mg/kg)	Outlier Test Statistic				Data (-Outliers +ND/2)	LN (Data)				LN data	Test Statistic for LN data		Txx for outlier
BH-10	0 - 1		5.99	1.773	Rejected	*All Data w/DLs*		2.000	0.693147	*LN Data*			1.790091			2.08367308
BH-10	7.5-8.5		2.00	0.148				3.880	1.355835				0.693147			0.8039484
BH-11	0 - 1		13.90	4.996	Outlier	Mean	1.636984	4.000	1.386294	Mean	-0.20181		2.631889			3.06573663
BH-11	7.5-8.5		3.88	0.914		Std. Error	0.309251	0.980	-0.0202	Std. Error	0.092878		1.355835	*Column1*		1.57705804
BH-12	0 - 1		4.00	0.963		Median	0.82	3.940	1.371181	Median	-0.28768		1.386294			1.61259257
BH-12	6.5-7.5	<	1.96	0.132		Mode	0.51	0.240	-1.42712	Mode	-1.34707		0.672944	Mean	0.004025	0.78037938
BH-13			11.98	4.214	Outlier	Std. Dev.	2.4546	0.260	-1.34707	Std. Dev.	0.701217		2.483239	Standard E	0.107994	2.89231725
BH-13	0 - 1		7.75	2.490	Rejected	Variance	6.025063	0.270	-1.30933	Variance	0.491705		2.047693	Median	-0.19845	2.38419785
BH-13	6.0-7.5		3.94	0.938		Kurtosis	14.44536	0.650	-0.43078	Kurtosis	-0.20525		1.371181	Mode	-0.67334	1.59496059
HSB-1	8 - 10	<	0.48	0.471		Skewness	3.664717	0.850	-0.16252	Skewness	0.292822		-0.73397	Standard D	0.857172	0.86096397
HSB-2	3 - 5	<	0.52	0.455		Range	13.64	0.275	-1.29098	Range	2.813411		-0.65393	Sample Va	0.734744	0.76758399
HSB-3	6 - 8	<	0.54	0.447		Minimum	0.26	1.020	0.019803	Minimum	-1.42712		-0.61619	Kurtosis	1.438998	0.72355511
HSB-4	2 - 4		0.65	0.402		Maximum	13.9	0.630	-0.46204	Maximum	1.386294		-0.43078	Skewness	1.174989	0.50725871
HSB-5	5 - 8		0.85	0.321		Sum	103.13	1.280	0.24686	Sum	-11.5034		-0.16252	Range	3.978962	0.19429472
HSB-6	8-10	<	0.55	0.443		Count	63	2.440	0.891998	Count	57		-0.59784	Minimum	-1.34707	0.70214851
HS-1	0 - 1		1.02	0.251		Crit. Val.	3.044	0.510	-0.67334				0.019803	Maximum	2.631889	0.01840652
HS-2	3 - 4		0.63	0.410				0.340	-1.07881				-0.46204	Sum	0.25358	0.54371877
HS-3	0 - 1		1.28	0.145				0.330	-1.10866				0.24686	Count	63	0.28329785
HS-4	3 - 4		2.44	0.327				0.540	-0.61619				0.891998			1.03593317
HS-10	0 - 1		0.51	0.459				0.590	-0.52763				-0.67334			0.79023765
HS-11	3.5 - 4		0.34	0.528				0.610	-0.4943				-1.07881			1.26326416
HS-12	0 - 1		0.33	0.532				0.560	-0.57982				-1.10866			1.29809143
HS-13	3.5 - 4		0.54	0.447				0.500	-0.69315				-0.61619			0.72355511
HS-14	5.5 - 6.5		0.59	0.427				0.930	-0.07257				-0.52763			0.62024633
HS-18	0 - 1		0.61	0.418				0.370	-0.99425				-0.4943			0.58135516
HS-19	3.5 - 4		0.56	0.439				1.610	0.476234				-0.57982			0.68112763
HS-7	0 - 1		0.5	0.463				1.180	0.165514				-0.69315			0.81333993
HS-8	3 - 4		0.93	0.288				0.850	-0.16252				-0.07257			0.08935869
HS-9	7.5 - 8.5		0.37	0.516				0.820	-0.19845				-0.99425			1.16461724
HS-15	0 - 1		1.61	0.011				0.560	-0.57982				0.476234			0.55089185
HS-16	3 - 4		1.18	0.186				0.660	-0.41552				0.165514			0.18839784
HS-17	6 - 7		0.85	0.321				1.820	0.598837				-0.16252			0.19429472
FTASB-04	0.5 - 1.0		0.82	0.333				1.070	0.067659				-0.19845			0.23621397
FTASB-06	0.5 - 1.0		0.56	0.439				1.560	0.444686				-0.57982			0.68112763
FTASB-09	0.5 - 1.0		0.66	0.398				1.280	0.24686				-0.41552			0.48944727
FTASB-10	0.5 - 1.0		1.82	0.075				1.950	0.667829				0.598837			0.69392302
FTASB-11	0.5 - 1.0		0.86	0.317	Rejected			1.430	0.357674				-0.15082			0.18064981
FTASB-12	0.5 - 1.0		1.07	0.231				2.140	0.760806				0.067659			0.07423664
FRASB-13	0.5 - 2.5		1.56	0.031				1.640	0.494696				0.444686			0.51408669
FTASB-14	0.5 - 2.5		1.28	0.145				0.510	-0.67334				0.24686			0.28329785
FTASB-15	0.5 - 2.5		1.95	0.128				0.660	-0.41552				0.667829			0.77441197
FTASB-16	0.5 - 2.5		1.43	0.084				0.740	-0.30111				0.357674			0.41257687
FTASB-17	0.5 - 2.5		2.14	0.205				1.070	0.067659				0.760806			0.8828808
HMW-10	0.0 - 2.0		1.64	0.001				0.670	-0.40048				0.494696			0.57243019

ARSENIC

Sample ID	Sample Depth (feet)	Concentration (mg/kg)		Outlier Test Statistic		Data (-Outliers +ND/2)	LN (Data)	LN data	Test Statistic for LN data	Txx for outlier
HMW-12	1.5 - 3.0	0.51		0.459		0.380	-0.96758	-0.67334		0.79023765
FTASB-04	9.0 - 10.5	0.66	J	0.398		0.800	-0.22314	-0.41552		0.48944727
FTASB-06	8.5 - 10.5	0.74	J	0.365		1.620	0.482426	-0.30111		0.35597307
FTASB-09	6.0 - 7.0	1.07	J	0.231		0.730	-0.31471	0.067659		0.07423664
FTASB-10	9.1 - 10.4	0.67	J	0.394		0.610	-0.4943	-0.40048		0.47190368
FTASB-11	9.5 - 10.0	0.38	J	0.512		1.290	0.254642	-0.96758		1.13350534
FTASB-12	8.0 - 10.0	0.8	J	0.341		0.260	-1.34707	-0.22314		0.26502104
FTASB-13	2.5 - 4.5	1.62	J	0.007		0.260	-1.34707	0.482426		0.55811557
FTASB-14	4.5 - 6.5	0.73	J	0.370		0.840	-0.17435	-0.31471		0.37184579
FTASB-15	4.5 - 6.5	0.61	JQ	0.418		0.750	-0.28768	-0.4943		0.58135516
FTASB-16	6.5 - 8.1	1.29	JQ	0.141		0.510	-0.67334	0.254642		0.29237671
FTASB-17	4.5 - 6.5	0.26	JQ	0.561		1.040	0.039221	-1.34707		1.57622815
HMW-10	2.0 - 4.0	0.26	JQ	0.561		0.720	-0.3285	-1.34707		1.57622815
HMW-11	2.0 - 4.0	0.84	JQ	0.325				-0.17435		0.20810112
HMW-11	6.0 - 8.0	0.75	JQ	0.361				-0.28768		0.34031342
HMW-12	1.5 - 3.0	0.51	JQ	0.459				-0.67334		0.79023765
HMW-12	4.5 - 6.0	1.04	JQ	0.243				0.039221		0.04106018
HMW-13	2.0 - 4.0	0.72	JQ	0.374				-0.3285		0.38793745
HMW-13	8.0 - 10.0	0.6	JQ	0.422	Rejected			-0.51083		0.60063869



LEGEND:

● Barium (mg/kg)

LN(Data) Passed Shapiro-Francia Test of Normality Indicating the Data are Lognormal.
Probability Plot is Detects-Only. 0% ND.

Upper Background Concentration: **28.3 mg/kg**
Based on Ln (Data) mean + 1.645 Standard Deviations.
LN (Data) Mean: 2.4788 SD: 0.5257

Total 63 samples, of which 57 data points were used for UBC and Probability Plot.
Two data points, BH-10(64.4) and FTASB-11(69), are statistical outliers
By ASTM Designation E178-75, 1975.
5% significance level.
Four data points, BH-11 (33.50), BH-13 (27.10), BH-13 (19.80), and HMW-13 (27), are rejected due to being outliers in other metals data sets.

Distribution of Background Barium
in Soils at Hunter Army Airfield

BARIUM

Sample ID	Sample Depth (feet)	Concentration (mg/kg)	Outlier Test Statistic	
BH-10	0 - 1	64.4	3.807	Outlier
BH-10	7.5-8.5	9.19	0.560	
BH-11	0 - 1	33.50	1.363	Rejected
BH-11	7.5-8.5	18.10	0.145	
BH-12	0 - 1	7.19	0.718	
BH-12	6.5-7.5	8.12	0.645	
BH-13		27.10	0.857	Rejected
BH-13	0 - 1	19.80	0.279	Rejected
BH-13	6.0-7.5	8.28	0.632	
HSB-1	8 - 10	3.83	0.984	
HSB-2	3 - 5	5.97	0.815	
HSB-3	6 - 8	6.21	0.796	
HSB-4	2 - 4	4.44	0.936	
HSB-5	5 - 8	15.40	0.069	
HSB-6	8-10	11.20	0.401	
HS-1	0 - 1	11.40	0.385	
HS-2	3 - 4	12.80	0.275	
HS-3	0 - 1	14.90	0.108	
HS-4	3 - 4	23.40	0.564	
HS-10	0 - 1	18.30	0.161	
HS-11	3.5 - 4	13.90	0.188	
HS-12	0 - 1	9.60	0.528	
HS-13	3.5 - 4	14.70	0.124	
HS-14	5.5 - 6.5	17.70	0.113	
HS-18	0 - 1	16.20	0.006	
HS-19	3.5 - 4	19.10	0.224	
HS-7	0 - 1	23.70	0.588	
HS-8	3 - 5	15.00	0.101	
HS-9	7.5 - 8.5	17.10	0.066	
HS-15	0 - 1	47.60	2.478	
HS-16	3 - 4	38.40	1.751	

All Data w/DLs	
Mean	16.27095
Std. Error	1.592632
Median	12
Mode	15
Std. Dev.	12.64112
Variance	159.798
Kurtosis	7.129523
Skewness	2.473057
Range	65.17
Minimum	3.83
Maximum	69
Sum	1025.07
Count	63
Crit. Val.	3.044

Data (-Outliers +ND/2)	LN (Data)
9.19	2.218116
18.1	2.895912
7.19	1.972691
8.12	2.09433
8.28	2.113843
3.83	1.342865
5.97	1.786747
6.21	1.826161
4.44	1.490654
15.4	2.734368
11.2	2.415914
11.4	2.433613
12.8	2.549445
14.9	2.701361
23.4	3.152736
18.3	2.906901
13.9	2.631889
9.6	2.261763
14.7	2.687847
17.7	2.873565
16.2	2.785011
19.1	2.949688
23.7	3.165475
15	2.70805
17.1	2.839078
47.6	3.862833
38.4	3.648057
17.6	2.867899
11	2.397895
7.45	2.008214
11	2.397895

LN Data	
Mean	2.478789
Std. Error	0.069626
Median	2.459589
Mode	2.70805
Std. Dev.	0.525668
Variance	0.276327
Kurtosis	0.204707
Skewness	0.30929
Range	2.519968
Minimum	1.342865
Maximum	3.862833
Sum	141.2909
Count	57

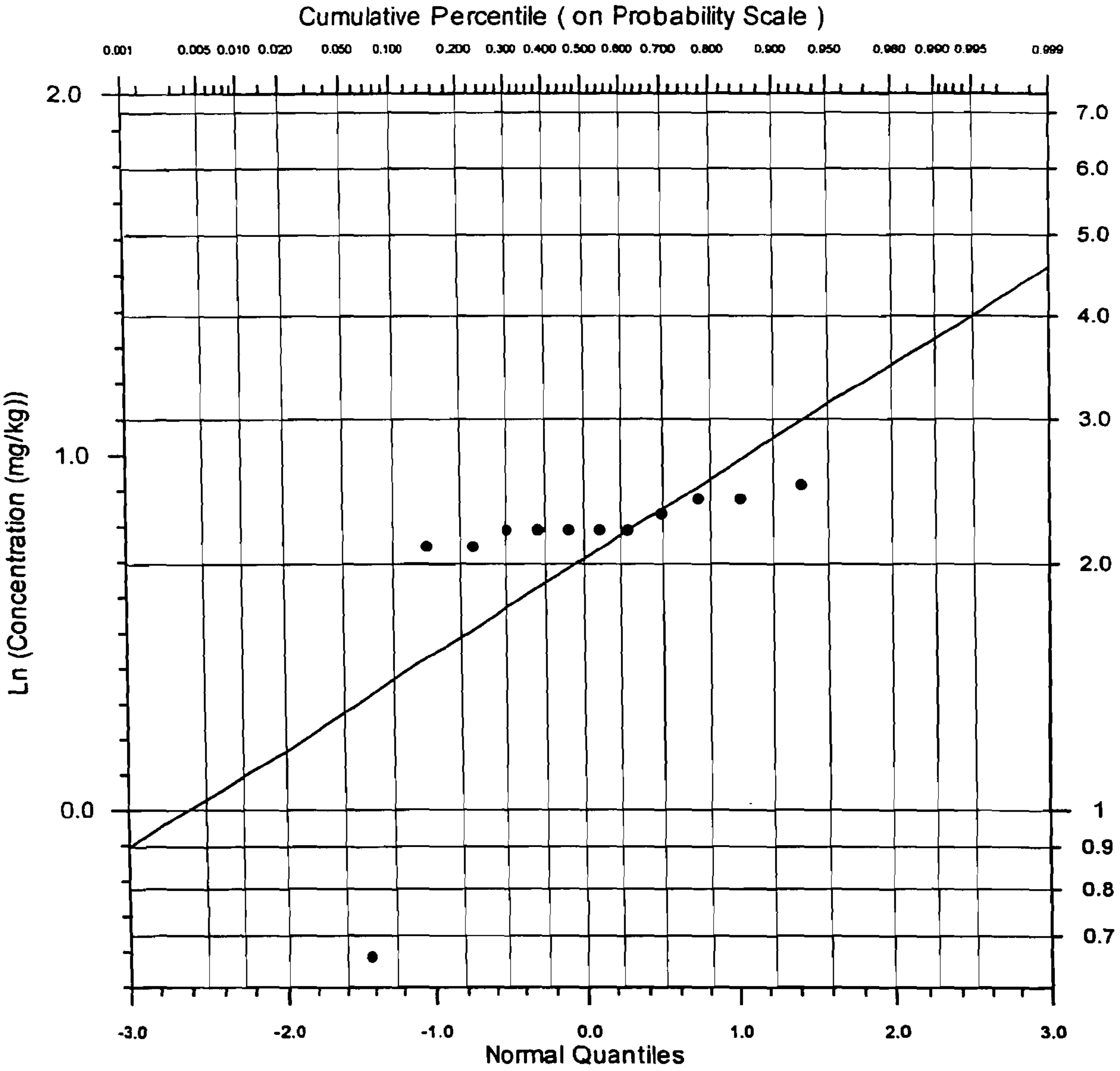
LN data	Txx for outlier
4.165114	2.575636
2.218116	0.595731
3.511545	1.511071
2.895912	0.508296
1.972691	0.995492
2.09433	0.79736
3.299534	1.165736
2.985682	0.654518
2.113843	0.765576
1.342865	2.021384
1.786747	1.298367
1.826161	1.234167
1.490654	1.780657
2.734368	0.245165
2.415914	0.273548
2.433613	0.244719
2.549445	0.056046
2.701361	0.191403
3.152736	0.926624
2.906901	0.526196
2.631889	0.078242
2.261763	0.524637
2.687847	0.169391
2.873565	0.471896
2.785011	0.327656
2.949688	0.59589
3.165475	0.947374
2.70805	0.202298
2.839078	0.415723
3.862833	2.083265
3.648057	1.733429

Column1	
Mean	2.583853
Standard E	0.077348
Median	2.484907
Mode	2.70805
Standard D	0.61393
Sample Va	0.37691
Kurtosis	0.341383
Skewness	0.541552
Range	2.891242
Minimum	1.342865
Maximum	4.234107
Sum	162.7828
Count	63

110

BARIUM

Sample ID	Sample Depth (feet)	Concentration (mg/kg)	Outlier Test Statistic	Data (-Outliers +ND/2)	LN (Data)	LN data	Txx for outlier
HS-17	6 - 7	17.60	0.105	34	3.526361	2.867899	0.462667
FTASB-04	0.5 - 1.0	11	0.417	9.3	2.230014	2.397895	0.302898
FTASB-06	0.5 - 1.0	7.45	0.698	12	2.484907	2.008214	0.93763
FTASB-09	0.5 - 1.0	11	0.417	12	2.484907	2.397895	0.302898
FTASB-10	0.5 - 1.0	34	1.402	18	2.890372	3.526361	1.535203
FTASB-11	0.5 - 1.0	69	4.171 Outlier	11	2.397895	4.234107	2.688015
FTASB-12	0.5 - 1.0	9.3	0.551	18	2.890372	2.230014	0.576351
FRASB-13	0.5 - 2.5	12	0.338	16	2.772589	2.484907	0.161169
FTASB-14	0.5 - 2.5	12	0.338	5.96	1.78507	2.484907	0.161169
FTASB-15	0.5 - 2.5	18	0.137	12	2.484907	2.890372	0.499272
FTASB-16	0.5 - 2.5	11	0.417	11.7	2.459589	2.397895	0.302898
FTASB-17	0.5 - 2.5	18	0.137	15	2.70805	2.890372	0.499272
HMW-10	0.0 - 2.0	16	0.021	14	2.639057	2.772589	0.307421
HMW-12	1.5 - 3.0	5.96	0.816	10.6	2.360854	1.78507	1.301098
FTASB-04	9.0 - 10.5	12	0.338	15	2.70805	2.484907	0.161169
FTASB-06	8.5 - 10.5	11.7 J	0.362	33	3.496508	2.459589	0.202408
FTASB-09	6.0 - 7.0	15	0.101	8.77	2.171337	2.70805	0.202298
FTASB-10	9.1 - 10.4	14	0.180	7.27	1.983756	2.639057	0.089919
FTASB-11	9.5 - 10.0	10.6 J	0.449	10.7	2.370244	2.360854	0.363233
FTASB-12	8.0 - 10.0	15	0.101	6.38	1.853168	2.70805	0.202298
FTASB-13	2.5 - 4.5	33	1.323	6.25	1.832581	3.496508	1.486577
FTASB-14	4.5 - 6.5	8.77 J	0.593	11.7	2.459589	2.171337	0.671928
FTASB-15	4.5 - 6.5	7.27 JQ	0.712	7.37	1.997418	1.983756	0.977468
FTASB-16	6.5 - 8.1	10.7 J	0.441	5.96	1.78507	2.370244	0.347938
FTASB-17	4.5 - 6.5	6.38 JQ	0.782	5.68	1.736951	1.853168	1.190177
HMW-10	2.0 - 4.0	6.25 JQ	0.793	7.85	2.060514	1.832581	1.223709
HMW-11	2.0 - 4.0	11.7 J	0.362			2.459589	0.202408
HMW-11	6.0 - 8.0	7.37 JQ	0.704			1.997418	0.955216
HMW-12	1.5 - 3.0	5.96 JQ	0.816			1.78507	1.301098
HMW-12	4.5 - 6.0	5.68 JQ	0.838			1.736951	1.379477
HMW-13	2.0 - 4.0	7.85 JQ	0.666			2.060514	0.852442
HMW-13	8.0 - 10.0	27	0.849 Rejected			3.295837	1.159714



LEGEND:

- ● Cadmium (mg/kg)

Due to high percentage of non-detects the data can not be validly normalized.
Probability Plot is Detects-Only. 79% NDs.

Upper Background Concentration: 2.6 mg/kg
Based on non-parametric analysis, UBC is set equal to the maximum observed value.
5% Significance Level and 98% expected coverage.

Total of 63 samples, of which 57 data points were used for UBC and 12 for Probability Plot.
No Data Points are determined to be statistical outliers.
By ASTM Designation E178-75, 1975.
5% significance level.
Six data points, BH-10 (<1.98), BH-11 (1.99), BH-13 (0.02), BH-13 (3.87), FTASB-11 (2.2), and HMW-13 (<2.3), are rejected due to being outliers in other metals data sets.

Distribution of Background Cadmium
in Soils at Hunter Army Airfield

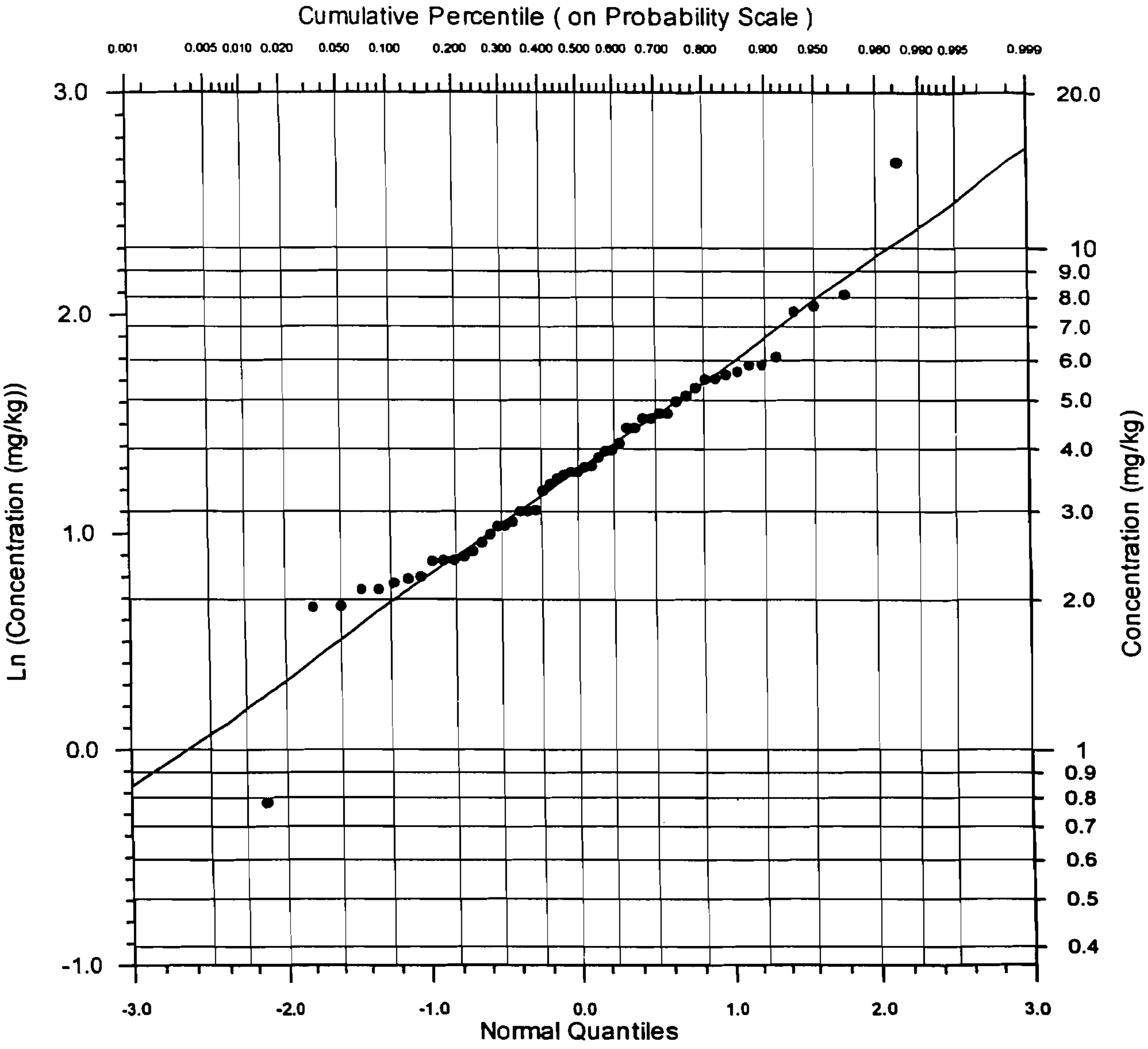
CADMIUM

Sample ID	Sample Depth (feet)	Concentration (mg/kg)		Outlier Test Statistic
BH-10	0 - 1	<	1.98	0.415
BH-10	7.5-8.5	<	1.98	0.415
BH-11	0 - 1		1.99	0.425
BH-11	7.5-8.5	<	1.98	0.415
BH-12	0 - 1	<	1.98	0.415
BH-12	6.5-7.5	<	1.98	0.415
BH-13			0.02	1.675
BH-13	0 - 1		3.87	2.430
BH-13	6.0-7.5	<	1.98	0.415
HSB-1	8 - 10	<	0.37	1.302
HSB-2	3 - 5	<	0.40	1.270
HSB-3	6 - 8	<	0.42	1.249
HSB-4	2 - 4	<	0.41	1.259
HSB-5	5 - 8	<	0.45	1.217
HSB-6	8-10	<	0.42	1.249
HS-1	0 - 1	<	0.52	1.142
HS-2	3 - 4	<	0.57	1.089
HS-3	0 - 1	<	0.54	1.121
HS-4	3 - 4	<	0.55	1.110
HS-10	0 - 1	<	0.51	1.153
HS-11	3.5 - 4	<	0.54	1.121
HS-12	0 - 1	<	0.51	1.153
HS-13	3.5 - 4	<	0.54	1.121
HS-14	5.5 - 6.5	<	0.54	1.121
HS-18	0 - 1	<	0.50	1.163
HS-19	3.5 - 4	<	0.55	1.110
HS-7	0 - 1	<	0.54	1.121
HS-8	3 - 5	<	0.54	1.121
HS-9	7.5 - 8.5	<	0.53	1.131
HS-15	0 - 1	<	0.51	1.153
HS-16	3 - 4	<	0.52	1.142

Column1	
Mean	1.591111
Standard E	0.118161
Median	1.99
Mode	2.4
Standard D	0.937875
Sample Va	0.87961
Kurtosis	-1.34677
Skewness	-0.17072
Range	3.85
Minimum	0.02
Maximum	3.87
Sum	100.24
Count	63
Crit. Val.	3.044

CADMIUM

Sample ID	Sample Depth (feet)	Concentration (mg/kg)		Outlier Test Statistic
HS-17	6 - 7	<	0.54	1.121
FTASB-04	0.5 - 1.0		2.2	0.649
FTASB-06	0.5 - 1.0		2.1	0.543
FTASB-09	0.5 - 1.0		2.5	0.969
FTASB-10	0.5 - 1.0		0.66	0.993
FTASB-11	0.5 - 1.0		2.2	0.649
FTASB-12	0.5 - 1.0		2.4	0.862
FRASB-13	0.5 - 2.5		2.2	0.649
FTASB-14	0.5 - 2.5		2.2	0.649
FTASB-15	0.5 - 2.5		2.2	0.649
FTASB-16	0.5 - 2.5		2.1	0.543
FTASB-17	0.5 - 2.5		2.2	0.649
HMW-10	0.0 - 2.0		2.3	0.756
HMW-12	1.5 - 3.0		2.4	0.862
FTASB-04	9.0 - 10.5	<	2.4	0.862
FTASB-06	8.5 - 10.5	<	2.6	1.076
FTASB-09	6.0 - 7.0	<	2.3	0.756
FTASB-10	9.1 - 10.4	<	2.4	0.862
FTASB-11	9.5 - 10.0	<	2.4	0.862
FTASB-12	8.0 - 10.0	<	2.5	0.969
FTASB-13	2.5 - 4.5	<	2.6	1.076
FTASB-14	4.5 - 6.5	<	2.3	0.756
FTASB-15	4.5 - 6.5	<	2.3	0.756
FTASB-16	6.5 - 8.1	<	2.4	0.862
FTASB-17	4.5 - 6.5	<	2.2	0.649
HMW-10	2.0 - 4.0	<	2.4	0.862
HMW-11	2.0 - 4.0	<	2.4	0.862
HMW-11	6.0 - 8.0	<	2.6	1.076
HMW-12	1.5 - 3.0	<	2.4	0.862
HMW-12	4.5 - 6.0	<	2.4	0.862
HMW-13	2.0 - 4.0	<	2.4	0.862
HMW-13	8.0 - 10.0	<	2.3	0.756



LEGEND:

● Chromium (mg/kg)

LN(Data) Passed the Coefficient of Skewness Test of Normality Indicating the Data are Lognormal. Probability Plot is Detects-Only. 7.0% ND. NDs/2 were included in UBC calculation.

Upper Background Concentration: **7.7 mg/kg**
Based on LN(Data) mean + 1.645 Standard Deviations
LN (Data) Mean: 1.2527 SD: 0.4792

Total 63 samples, of which 57 data points were used for UBC and 53 for Probality Plot.
One data point, HMW-13 (31.7),is a statistical outlier.
By ASTM Designation E178-75, 1975.
5% significance level.
Five data points, BH-10 (12.80), BH-11 (4.16), BH-13 (2.84), BH-13 (9.10) and FTASB-11 (4.8), are rejected due to being outliers in other metals data sets.

Distribution of Background Chromium
in Soils at Hunter Army Airfield

CHROMIUM

Sample ID	Sample Depth (feet)	Concentration (mg/kg)	Outlier Test Statistic				Data (-Outliers +ND/2)	LN (Data)			LN data			Txx for outlier
BH-10	0 - 1	12.80	1.928	Rejected	*All Data ^{w} /DLs*		1.98	0.683097	*LN Data*		2.549445			2.142766
BH-10	7.5-8.5	< 3.96	0.184				3.96	1.376244			1.376244			0.007909
BH-11	0 - 1	4.16	0.136	Rejected	Mean	4.729524	2.595	0.953587	Mean	1.252719	1.425515			0.097567
BH-11	7.5-8.5	3.96	0.184		Std. Error	0.527314	1.98	0.683097	Std. Error	0.063466	1.376244	*Column1*		0.007909
BH-12	0 - 1	< 5.19	0.110		Median	3.96	1.98	0.683097	Median	1.266948	1.646734			0.500115
BH-12	6.5-7.5	< 3.96	0.184		Mode	3.96	0.78	-0.24846	Mode	0.683097	1.376244	Mean	1.371898	0.007909
BH-13		2.84	0.451	Rejected	Std. Dev.	4.185428	3.49	1.249902	Std. Dev.	0.479155	1.043804	Standard E	0.069236	0.597027
BH-13	0 - 1	9.10	1.044	Rejected	Variance	17.5178	3.85	1.348073	Variance	0.229589	2.208274	Median	1.376244	1.521942
BH-13	6.0-7.5	< 3.96	0.184		Kurtosis	28.39077	5.87	1.769855	Kurtosis	1.36858	1.376244	Mode	1.376244	0.007909
HSB-1	8 - 10	0.78	0.944		Skewness	4.767239	1.93	0.65752	Skewness	0.057575	-0.24846	Standard D	0.549546	2.948543
HSB-2	3 - 5	3.49	0.296		Range	30.92	2.39	0.871293	Range	2.936309	1.249902	Sample Va	0.302	0.221994
HSB-3	6 - 8	3.85	0.210		Minimum	0.78	5.61	1.724551	Minimum	-0.24846	1.348073	Kurtosis	3.390369	0.043353
HSB-4	2 - 4	5.87	0.272		Maximum	31.7	2.81	1.033184	Maximum	2.687847	1.769855	Skewness	0.799956	0.724156
HSB-5	5 - 8	1.93	0.669		Sum	297.96	5.88	1.771557	Sum	71.405	0.65752	Range	3.704778	1.299943
HSB-6	8 - 10	2.39	0.559		Count	63	5.51	1.706565	Count	57	0.871293	Minimum	-0.24846	0.910942
HS-1	0 - 1	5.61	0.210		Crit. Val.	3.044	3.55	1.266948			1.724551	Maximum	3.456317	0.641717
HS-2	3 - 4	2.81	0.459				2.16	0.770108			1.033184	Sum	86.42956	0.616351
HS-3	0 - 1	5.88	0.275				3.02	1.105257			1.771557	Count	63	0.727254
HS-4	3 - 4	5.51	0.186				2.44	0.891998			1.706565			0.608988
HS-10	0 - 1	3.55	0.282				2.22	0.797507			1.266948			0.190976
HS-11	3.5 - 4	2.16	0.614				3.68	1.302913			0.770108			1.095067
HS-12	0 - 1	3.02	0.408				3.98	1.381282			1.105257			0.485202
HS-13	3.5 - 4	2.44	0.547				4.97	1.60342			0.891998			0.873266
HS-14	5.5 - 6.5	2.22	0.600				2.8	1.029619			0.797507			1.04521
HS-18	0 - 1	3.68	0.251				1.94	0.662688			1.302913			0.125531
HS-19	3.5 - 4	3.98	0.179				5.29	1.665818			1.381282			0.017076
HS-7	0 - 1	4.97	0.057				6.1	1.808289			1.60342			0.421297
HS-8	3 - 5	2.80	0.461				2.86	1.050822			1.029619			0.622839
HS-9	7.5 - 8.5	1.94	0.666				3	1.098612			0.662688			1.290538
HS-15	0 - 1	5.29	0.134				5.1	1.629241			1.665818			0.534843
HS-16	3 - 4	6.10	0.327				2.4	0.875469			1.808289			0.794094

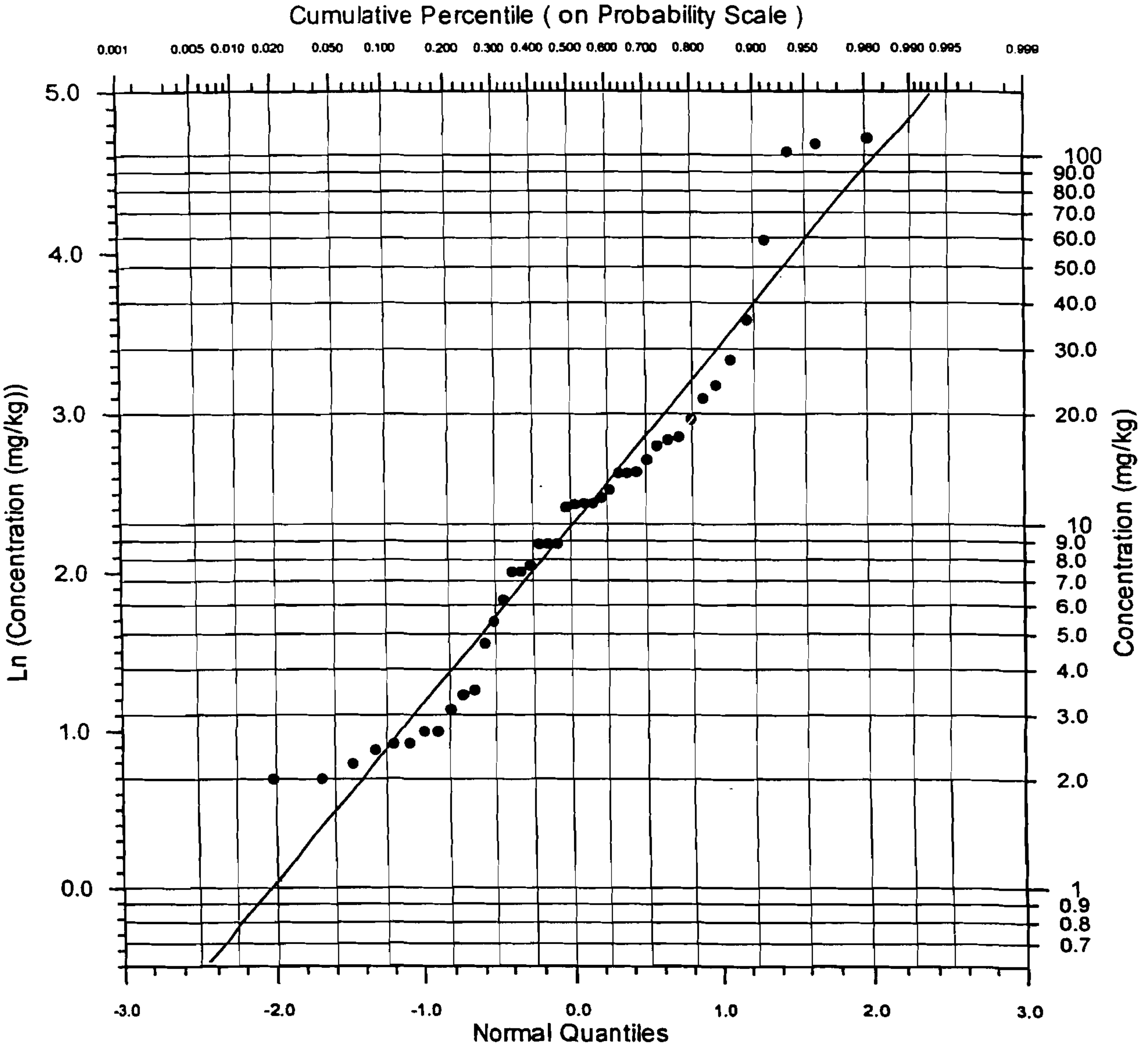
H-14

726

CHROMIUM

Sample ID	Sample Depth (feet)	Concentration (mg/kg)	Outlier Test Statistic	Data (-Outliers +ND/2)	LN (Data)	LN data	Txx for outlier
HS-17	6 - 7	2.86	0.447	14.7	2.687847	1.050822	0.584257
FTASB-04	0.5 - 1.0	3.0	0.413	4.6	1.526056	1.098612	0.497293
FTASB-06	0.5 - 1.0	5.10	0.089	5.7	1.740466	1.629241	0.468283
FTASB-09	0.5 - 1.0	2.4	0.557	4.4	1.481605	0.875469	0.903344
FTASB-10	0.5 - 1.0	14.7	2.382	4.1	1.410987	2.687847	2.394614
FTASB-11	0.5 - 1.0	4.8	0.017 Rejected	3.4	1.223775	1.568616	0.357965
FTASB-12	0.5 - 1.0	4.6	0.031	4.7	1.547563	1.526056	0.28052
FRASB-13	0.5 - 2.5	5.7	0.232	7.7	2.04122	1.740466	0.670679
FTASB-14	0.5 - 2.5	4.4	0.079	3.6	1.280934	1.481605	0.199632
FTASB-15	0.5 - 2.5	4.1	0.150	2.4	0.875469	1.410987	0.07113
FTASB-16	0.5 - 2.5	3.4	0.318	2.2	0.788457	1.223775	0.269536
FTASB-17	0.5 - 2.5	4.7	0.007	5.5	1.704748	1.547563	0.319655
HMW-10	0.0 - 2.0	7.7	0.710	2.1	0.741937	2.04122	1.217956
HMW-12	1.5 - 3.0	3.6	0.270	2.7	0.993252	1.280934	0.165526
FTASB-04	9.0 - 10.5	2.4 J	0.557	2.5	0.916291	0.875469	0.903344
FTASB-06	8.5 - 10.5	2.2 J	0.604	4.4	1.481605	0.788457	1.061678
FTASB-09	6.0 - 7.0	5.5	0.184	4.7	1.547563	1.704748	0.605683
FTASB-10	9.1 - 10.4	2.1 J	0.628	2.6	0.955511	0.741937	1.14633
FTASB-11	9.5 - 10.0	2.7 J	0.485	3.7	1.308333	0.993252	0.689016
FTASB-12	8.0 - 10.0	2.5 J	0.533	2.1	0.741937	0.916291	0.829061
FTASB-13	2.5 - 4.5	4.4 J	0.079	3.3	1.193922	1.481605	0.199632
FTASB-14	4.5 - 6.5	4.7	0.007	8.1	2.091864	1.547563	0.319655
FTASB-15	4.5 - 6.5	2.6 JQ	0.509	7.5	2.014903	0.955511	0.757692
FTASB-16	6.5 - 8.1	3.7 JQ	0.246	3.6	1.280934	1.308333	0.115668
FTASB-17	4.5 - 6.5	2.1 JQ	0.628	4.6	1.526056	0.741937	1.14633
HMW-10	2.0 - 4.0	3.3 JQ	0.342	3	1.098612	1.193922	0.323859
HMW-11	2.0 - 4.0	8.1	0.805			2.091864	1.310112
HMW-11	6.0 - 8.0	7.5	0.662			2.014903	1.170067
HMW-12	1.5 - 3.0	3.6 JQ	0.270			1.280934	0.165526
HMW-12	4.5 - 6.0	4.6 J	0.031			1.526056	0.28052
HMW-13	2.0 - 4.0	3.0 JQ	0.413			1.098612	0.497293
HMW-13	8.0 - 10.0	31.7	6.444 Outlier			3.456317	3.792986

75-8



LEGEND:

● Lead (mg/kg)

LN (Data) Passed The Coefficient of Skewness Test of Normality Indicating the data are lognormal. Probability Plot is Detects-Only. 25% ND. Aitchison's Adjustment used for UBC calculation.

Upper Background Concentration: **53 mg/kg**
Based on LN (Data) Adjusted Mean + 1.645 Adjusted Standard Deviations.
LN (Data) Adjusted Mean: 1.7158 SD: 1.3668

Total of 62 samples, of which 56 data points were used for UBC and 42 for Probability Plot.
Three Data Points, BH-11 (1163.00), BH-13 (1179.00) and BH-13 (1185.00), are statistical outliers.
By ASTM Designation E178-75, 1975.
5% significance level.
Three data points, BH-10 (645.00), FTASB-11 (15.0), and HWM-13 (3.2),
are rejected due to being outliers in other metals data sets.

Distribution of Background Lead
in Soils at Hunter Army Airfield

LEAD

Sample ID	Sample Depth (feet)	Concentration (mg/kg)	Outlier Test Statistic				Detects-only Data	LN (Detects-only data)			LN data	Test Statistic for LN data		Txx for outlier
BH-10	0 - 1	645.00	2.148	Rejected	*All Data w/DLs*		35.9	3.580737	*LN Detects-only Data*		6.46925			2.675076
BH-10	7.5-8.5	35.9	0.174				102	4.624973			3.580737			0.735288
BH-11	0 - 1	1163.00	4.124	Outlier	Mean	81.65452	19.3	2.960105	Mean	2.287776	7.058758			3.070961
BH-11	7.5-8.5	NRQ			Std. Error	33.30281	13.8	2.624669	Std. Error	0.166591		*Column1*		1.669364
BH-12	0 - 1	102	0.078		Median	7.66	7.4	2.00148	Median	2.415874	4.624973			1.436547
BH-12	6.5-7.5	19.30	0.238		Mode	13.8	28	3.332205	Mode	2.624669	2.960105	Mean	2.485829	0.318501
BH-13		1179.00	4.185	Outlier	Std. Dev.	262.2266	17.3	2.850707	Std. Dev.	1.079635	7.072422	Standard E	0.189114	3.080137
BH-13	0 - 1	1185.00	4.208	Outlier	Variance	68762.79	8.82	2.177022	Variance	1.165612	7.077498	Median	2.035998	3.083546
BH-13	6.0-7.5	13.80	0.259		Kurtosis	13.68489	7.39	2.000128	Kurtosis	-0.078331	2.624669	Mode	2.624669	0.093238
HSB-1	8 - 10	< 5.26	0.291		Skewness	3.839575	23.9	3.173878	Skewness	0.474948	1.660131	Standard D	1.489087	0.554499
HSB-2	3 - 5	< 5.71	0.290		Range	1183	8.83	2.178155	Range	4.016383	1.742219	Sample Va	2.217381	0.499373
HSB-3	6 - 8	< 5.97	0.289		Minimum	2	13.8	2.624669	Minimum	0.693147	1.786747	Kurtosis	3.196304	0.46947
HSB-4	2 - 4	< 5.81	0.289		Maximum	1185	107	4.672829	Maximum	4.70953	1.759581	Skewness	1.750325	0.487714
HSB-5	5 - 8	7.40	0.283		Sum	5062.58	2.7	0.993252	Sum	96.0866	2.00148	Range	6.384351	0.325266
HSB-6	8 - 10	< 5.97	0.289		Count	62	15	2.70805	Count	42	1.786747	Minimum	0.693147	0.46947
HS-1	0 - 1	28.00	0.205		Crit. Val.	3.037	4.7	1.547563			3.332205	Maximum	7.077498	0.568385
HS-2	3 - 4	< 7.62	0.282				111	4.70953			2.030776	Sum	154.1214	0.305592
HS-3	0 - 1	17.30	0.245				11.4	2.433613			2.850707	Count	62	0.245034
HS-4	3 - 4	8.82	0.278				7.7	2.04122			2.177022			0.20738
HS-10	0 - 1	7.39	0.283				11.4	2.433613			2.000128			0.326174
HS-11	3.5 - 4	< 7.28	0.284				13.9	2.631889			1.985131			0.336245
HS-12	0 - 1	< 6.90	0.285				3.4	1.223775			1.931521			0.372246
HS-13	3.5 - 4	< 7.29	0.284				12.4	2.517696			1.986504			0.335323
HS-14	5.5 - 6.5	< 7.27	0.284				17	2.833213			1.983756			0.337168
HS-18	0 - 1	< 6.70	0.286				2.5	0.916291			1.902108			0.391999
HS-19	3.5 - 4	< 7.31	0.284				3.5	1.252763			1.989243			0.333483
HS-7	0 - 1	23.90	0.220				2.4	0.875469			3.173878			0.462061
HS-8	3 - 5	8.83	0.278				59	4.077537			2.178155			0.206619
HS-9	7.5 - 8.5	< 7.16	0.284				11.1	2.406945			1.96851			0.347407
HS-15	0 - 1	13.80	0.259				6.2	1.824549			2.624669			0.093238
HS-16	3 - 4	107.00	0.097				11.3	2.424803			4.672829			1.468685

LEAD

Sample ID	Sample Depth (feet)	Concentration (mg/kg)	Outlier Test Statistic	Test Statistic for LN data LN data	Txx for outlier
HS-17	6 - 7	< 7.19	0.284	1.972691	0.344599
FTASB-04	0.5 - 1.0	2.7	0.301	0.993252	1.002344
FTASB-06	0.5 - 1.0	15	0.254	2.70805	0.149233
FTASB-09	0.5 - 1.0	4.7	0.293	1.547563	0.630095
FTASB-10	0.5 - 1.0	111	0.112	4.70953	1.493332
FTASB-11	0.5 - 1.0	15	0.254 Rejected	2.70805	0.149233
FTASB-12	0.5 - 1.0	11.4	0.268	2.433613	0.035065
FRASB-13	0.5 - 2.5	7.7	0.282	2.04122	0.298578
FTASB-14	0.5 - 2.5	11.4	0.268	2.433613	0.035065
FTASB-15	0.5 - 2.5	13.9	0.258	2.631889	0.098087
FTASB-16	0.5 - 2.5	3.4	0.298	1.223775	0.847535
FTASB-17	0.5 - 2.5	12.4	0.264	2.517696	0.021401
HMW-10	0.0 - 2.0	17	0.247	2.833213	0.233287
HMW-12	1.5 - 3.0	2.5	0.302	0.916291	1.054027
FTASB-04	9.0 - 10.5	3.5	0.298	1.252763	0.828068
FTASB-06	8.5 - 10.5	2.4	0.302	0.875469	1.081441
FTASB-09	6.0 - 7.0	59	0.086	4.077537	1.068915
FTASB-10	9.1 - 10.4	11.1	0.269	2.406945	0.052975
FTASB-11	9.5 - 10.0	6.2	0.288	1.824549	0.444084
FTASB-12	8.0 - 10.0	11.3	0.268	2.424803	0.040982
FTASB-13	2.5 - 4.5	22	0.227	3.091042	0.406433
FTASB-14	4.5 - 6.5	8.8	0.278	2.174752	0.208905
FTASB-15	4.5 - 6.5	5.4	0.291	1.686399	0.536859
FTASB-16	6.5 - 8.1	3.1	0.300	1.131402	0.909568
FTASB-17	4.5 - 6.5	2	0.304	0.693147	1.203879
HMW-10	2.0 - 4.0	11.8	0.266	2.4681	0.011906
HMW-11	2.0 - 4.0	2.7	0.301	0.993252	1.002344
HMW-11	6.0 - 8.0	2.2	0.303	0.788457	1.139874
HMW-12	1.5 - 3.0	2.5	0.302	0.916291	1.054027
HMW-12	4.5 - 6.0	2	0.304	0.693147	1.203879
HMW-13	2.0 - 4.0	16.4	0.249	2.797281	0.209157
HMW-13	8.0 - 10.0	3.2	0.299 Rejected	1.163151	0.888247

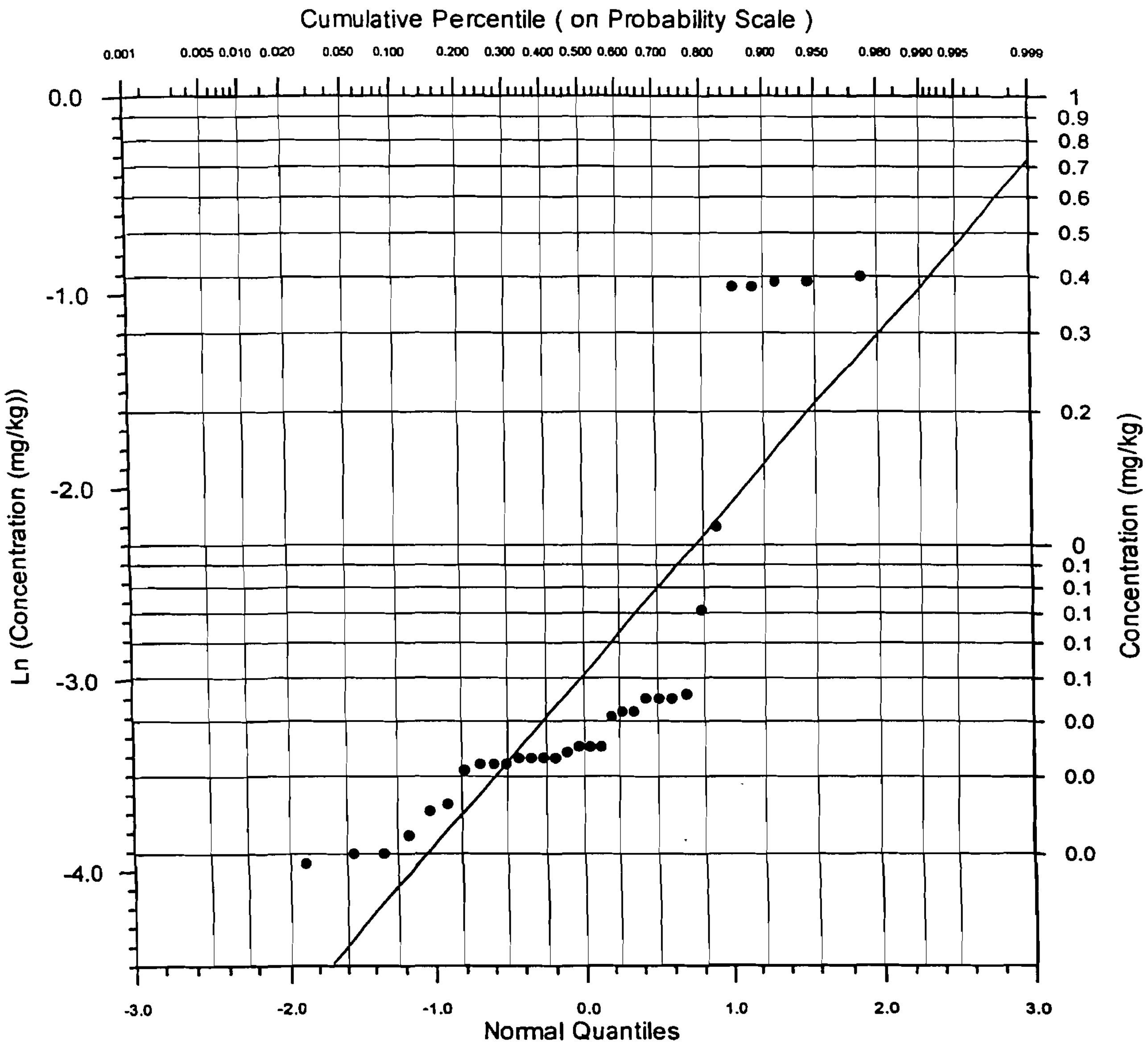
Detects-only Data	LN (Detects-only data)
22	3.091042
8.8	2.174752
5.4	1.686399
3.1	1.131402
2	0.693147
11.8	2.4681
2.7	0.993252
2.2	0.788457
2.5	0.916291
2	0.693147
16.4	2.797281

AITCHISON'S ADJUSTMENT FOR NONDETECTS

Mean (Detect-Only)	2.288		
Std. Dev. (Detect-Only)	1.080		
Total no. of samples	56		
Number of NDs	14		
Adjusted Mean	1.716	mg/kg	log-transformed
Adjusted Std. Dev.	1.367	mg/kg	log-transformed

ubc	3.964201
exp ubc	52.67815

092



LEGEND:

- ● Mercury (mg/kg)

The Data Failed all Tests of Normality.
Probability Plot is Detects-Only. 44% NDs.

Upper Background Concentration: **0.39 mg/kg**
The maximum observed value, 0.40mg/kg, was not used for the UBC,as it was from a sample location that exceeded the UBC for another parameter. Based on non-parametric analysis, the UBC was set equal to the next highest value detected.
5% Significance Level and 98% Expected Coverage.

Total of 63 samples, of which 57 data points were used for UBC and 32 for Probability Plot.
One Data Point, BH-13 (0.79), is a statistical outlier.
By ASTM Designation E178-75, 1975.
5% Significance Level.
Five data points, BH-10 (0.40), BH-11 (0.38), BH-13 (0.38), FTASB-11 (0.034), and HWM-13 (0.03), are rejected due to being outliers in other metals data sets.

Distribution of Background Mercury
in Soils at Hunter Army Airfield

MERCURY

Sample ID	Sample Depth (feet)		Concentration (mg/kg)	Outlier Test Statistic		LN data	Txx for outlier
BH-10	0 - 1		0.40	1.986	Rejected	-0.916291	1.847174
BH-10	7.5-8.5		0.39	1.915		-0.941609	1.819113
BH-11	0 - 1		0.38	1.844	Rejected	-0.967584	1.790323
BH-11	7.5-8.5		0.38	1.844		-0.967584	1.790323
BH-12	0 - 1		0.40	1.986		-0.916291	1.847174
BH-12	6.5-7.5		0.38	1.844		-0.967584	1.790323
BH-13			0.79	4.743	Outlier	-0.235722	2.601478
BH-13	0 - 1		0.38	1.844	Rejected	-0.967584	1.790323
BH-13	6.0-7.5		0.39	1.915		-0.941609	1.819113
HSB-1	8 - 10	<	0.10	0.135		-2.302585	0.310683
HSB-2	3 - 5	<	0.11	0.064		-2.207275	0.416319
HSB-3	6 - 8	<	0.11	0.064		-2.207275	0.416319
HSB-4	2 - 4	<	0.11	0.064		-2.207275	0.416319
HSB-5	5 - 8	<	0.12	0.007		-2.120264	0.512758
HSB-6	8 - 10	<	0.12	0.007		-2.120264	0.512758
HS-1	0 - 1	<	0.09	0.205		-2.407946	0.193907
HS-2	3 - 4	<	0.10	0.135		-2.302585	0.310683
HS-3	0 - 1	<	0.10	0.135		-2.302585	0.310683
HS-4	3 - 4	<	0.10	0.135		-2.302585	0.310683
HS-10	0 - 1	<	0.09	0.205		-2.407946	0.193907
HS-11	3.5 - 4	<	0.10	0.135		-2.302585	0.310683
HS-12	0 - 1	<	0.09	0.205		-2.407946	0.193907
HS-13	3.5 - 4	<	0.09	0.205		-2.407946	0.193907
HS-14	5.5 - 6.5	<	0.10	0.135		-2.302585	0.310683
HS-18	0 - 1	<	0.09	0.205		-2.407946	0.193907
HS-19	3.5 - 4	<	0.10	0.135		-2.302585	0.310683
HS-7	0 - 1	<	0.10	0.135		-2.302585	0.310683
HS-8	3 - 5	<	0.10	0.135		-2.302585	0.310683
HS-9	7.5 - 8.5	<	0.09	0.205		-2.407946	0.193907
HS-15	0 - 1	<	0.09	0.205		-2.407946	0.193907
HS-16	3 - 4	<	0.09	0.205		-2.407946	0.193907
HS-17	6 - 7	<	0.09	0.205		-2.407946	0.193907
FTASB-04	0.5 - 1.0		0.02	0.700		-3.912023	1.473128
FTASB-06	0.5 - 1.0		0.035	0.594		-3.352407	0.852881
FTASB-09	0.5 - 1.0		0.025	0.665		-3.688879	1.225808
FTASB-10	0.5 - 1.0		0.042	0.545		-3.170086	0.650806
FTASB-11	0.5 - 1.0		0.034	0.601	Rejected	-3.381395	0.885009
FTASB-12	0.5 - 1.0		0.042	0.545		-3.170086	0.650806
FRASB-13	0.5 - 2.5		0.045	0.524		-3.101093	0.574338
FTASB-14	0.5 - 2.5		0.032	0.615		-3.442019	0.952202
FTASB-15	0.5 - 2.5		0.026	0.658		-3.649659	1.182338
FTASB-16	0.5 - 2.5		0.019	0.707		-3.963316	1.529979
FTASB-17	0.5 - 2.5		0.045	0.524		-3.101093	0.574338
HMW-10	0.0 - 2.0		0.046	0.516		-3.079114	0.549978

All Data w /DLs	
Mean	0.119063
Std. Error	0.017824
Median	0.09
Mode	0.1
Std. Dev.	0.141471
Variance	0.020014
Kurtosis	7.759826
Skewness	2.585037
Range	0.771
Minimum	0.019
Maximum	0.79
Sum	7.501
Count	63
Crit. Val.	3.044

Test Statistic for LN data

Column1	
Mean	-2.582898
Standard E	0.113672
Median	-2.407946
Mode	-2.302585
Standard D	0.902247
Sample Va	0.814049
Kurtosis	-0.194112
Skewness	0.630629
Range	3.727594
Minimum	-3.963316
Maximum	-0.235722
Sum	-162.7226
Count	63

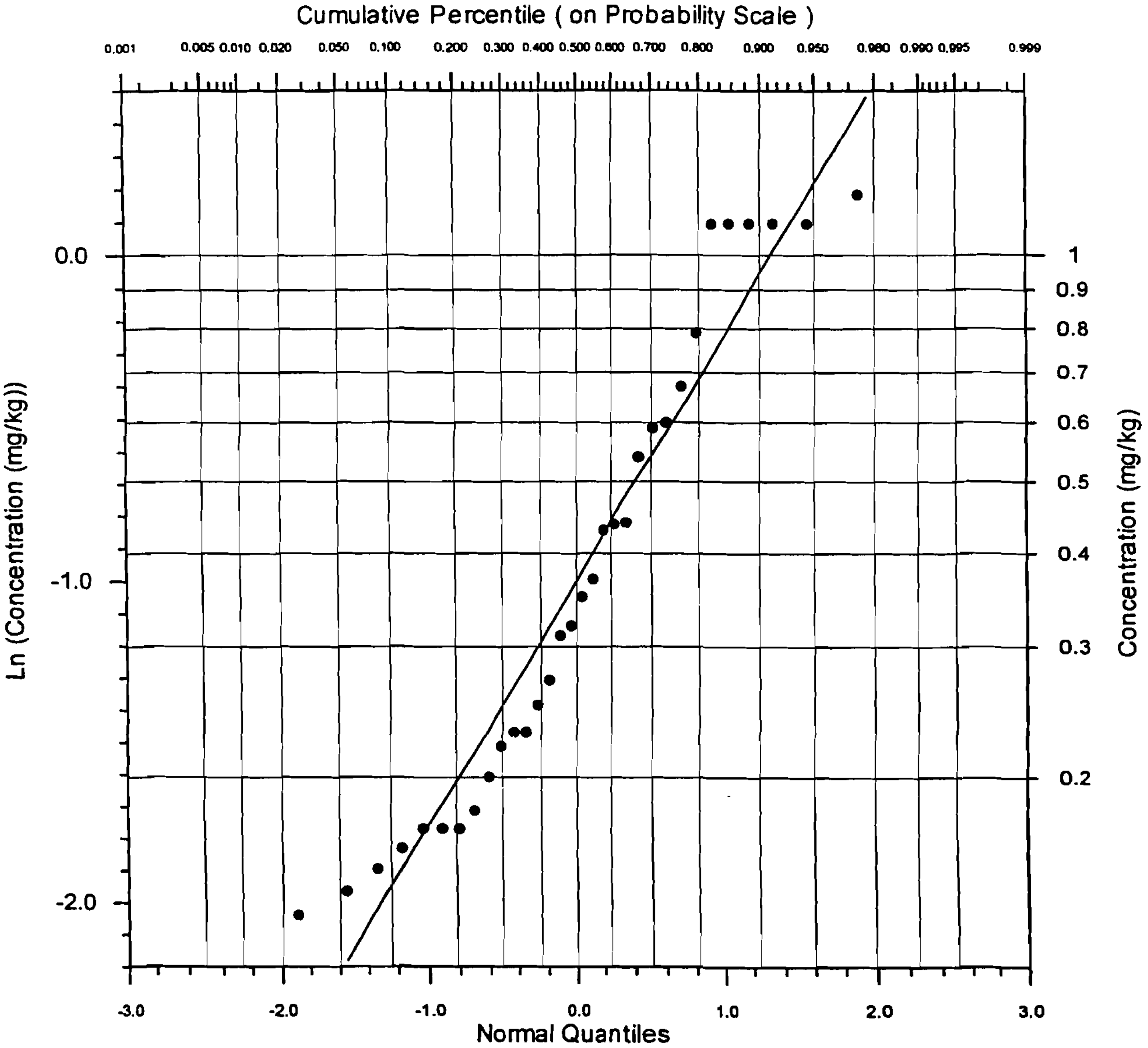
11-26

MERCURY

Sample ID	Sample Depth (feet)	Concentration (mg/kg)	Outlier Test Statistic
HMW-12	1.5 - 3.0	0.035	0.594
FTASB-04	9.0 - 10.5	0.022 J	0.686
FTASB-06	8.5 - 10.5	< 0.13	0.077
FTASB-09	6.0 - 7.0	0.033 J	0.608
FTASB-10	9.1 - 10.4	0.033 J	0.608
FTASB-11	9.5 - 10.0	< 0.12	0.007
FTASB-12	8.0 - 10.0	0.02 J	0.700
FTASB-13	2.5 - 4.5	0.071 JQ	0.340
FTASB-14	4.5 - 6.5	0.041 JQ	0.552
FTASB-15	4.5 - 6.5	0.045	0.524
FTASB-16	6.5 - 8.1	0.031	0.622
FTASB-17	4.5 - 6.5	0.11	0.064
HMW-10	2.0 - 4.0	0.033	0.608
HMW-11	2.0 - 4.0	0.034	0.601
HMW-11	6.0 - 8.0	0.032	0.615
HMW-12	1.5 - 3.0	0.035	0.594
HMW-12	4.5 - 6.0	0.032	0.615
HMW-13	2.0 - 4.0	0.033	0.608
HMW-13	8.0 - 10.0	0.03	0.630 Rejected

	Test Statistic for LN data
LN data	Txx for outlier
-3.352407	0.852881
-3.816713	1.367491
-2.040221	0.601473
-3.411248	0.918097
-3.411248	0.918097
-2.120264	0.512758
-3.912023	1.473128
-2.645075	0.068914
-3.194183	0.677514
-3.101093	0.574338
-3.473768	0.987391
-2.207275	0.416319
-3.411248	0.918097
-3.381395	0.885009
-3.442019	0.952202
-3.352407	0.852881
-3.442019	0.952202
-3.411248	0.918097
-3.506558	1.023733

764



LEGEND:

- Selenium (mg/kg)

LN(Data) Passed The Filliben Test of NormalityIndicating the Data are Lognormal.
Probability Plot is Detects-Only. 44% NDs. Aitchison's Adjustment used for UBC calculation.

Upper Background Concentration: **1.9 mg/kg**
LN(Data) Adjusted mean + 1.645 Adjusted Standard Deviations.
LN(Data) Adjusted Mean: -0.561 SD: 0.735.

Total of 63 samples, of which 57 data points were used for UBC and 32 for Probability Plot.
No Data Points are statistical outliers.
By ASTM Designation E178-75, 1975.
5% Significance Level.
Six data points, BH-10 (<0.20), BH-11 (<0.20), BH-13 (0.22), BH-13(0.33), FTASB-11 (0.28), and HWM-13 (0.23), are rejected due to being outliers in other metals data sets.

Distribution of Background Selenium
in Soils at Hunter Army Airfield

SELENIUM

11-77

Sample ID	Sample Depth (feet)	Concentration (mg/kg)		Outlier Test Statistic
BH-10	0 - 1	<	0.20	0.676
BH-10	7.5-8.5	<	0.20	0.676
BH-11	0 - 1	<	0.20	0.676
BH-11	7.5-8.5	<	0.20	0.676
BH-12	0 - 1		0.79	1.486
BH-12	6.5-7.5		0.60	0.789
BH-13			0.22	0.603
BH-13	0 - 1		0.33	0.200
BH-13	6.0-7.5	<	0.20	0.676
HSB-1	8 - 10	<	0.42	0.130
HSB-2	3 - 5	<	0.45	0.240
HSB-3	6 - 8	<	0.47	0.313
HSB-4	2 - 4	<	0.46	0.276
HSB-5	5 - 8		0.67	1.046
HSB-6	8 - 10	<	0.47	0.313
HS-1	0 - 1	<	0.27	0.420
HS-2	3 - 4	<	0.29	0.347
HS-3	0 - 1	<	0.28	0.383
HS-4	3 - 4	<	0.29	0.347
HS-10	0 - 1	<	0.26	0.456
HS-11	3.5 - 4	<	0.28	0.383
HS-12	0 - 1	<	0.27	0.420
HS-13	3.5 - 4	<	0.28	0.383
HS-14	5.5 - 6.5	<	0.28	0.383
HS-18	0 - 1	<	0.26	0.456
HS-19	3.5 - 4	<	0.28	0.383
HS-7	0 - 1	<	0.28	0.383
HS-8	3 - 5	<	0.28	0.383
HS-9	7.5 - 8.5	<	0.27	0.420
HS-15	0 - 1	<	0.27	0.420
HS-16	3 - 4	<	0.26	0.456
HS-17	6 - 7	<	0.28	0.383
FTASB-04	0.5 - 1.0		0.35	0.127
FTASB-06	0.5 - 1.0		0.438	0.196
FTASB-09	0.5 - 1.0		0.59	0.753
FTASB-10	0.5 - 1.0		0.32	0.237
FTASB-11	0.5 - 1.0		0.28	0.383
FTASB-12	0.5 - 1.0		0.27	0.420
FRASB-13	0.5 - 2.5		0.17	0.786
FTASB-14	0.5 - 2.5		1.1	2.622
FTASB-15	0.5 - 2.5		1.1	2.622
FTASB-16	0.5 - 2.5		1.1	2.622
FTASB-17	0.5 - 2.5		1.1	2.622

All Data ʷ /DLs	
Mean	0.384571
Std. Error	0.034383
Median	0.28
Mode	0.28
Std. Dev.	0.272904
Variance	0.074477
Kurtosis	2.695918
Skewness	1.891535
Range	1.07
Minimum	0.13
Maximum	1.2
Sum	24.228
Count	63
Crit. Val.	3.044

Detects-only Data	LN (Detects-only data)
0.790	-0.235722
0.600	-0.510826
0.670	-0.400478
0.350	-1.049822
0.438	-0.825536
0.590	-0.527633
0.320	-1.139434
0.270	-1.309333
0.170	-1.771957
1.100	0.09531
1.100	0.09531
1.100	0.09531
1.100	0.09531
0.200	-1.609438
0.230	-1.469676
0.170	-1.771957
0.150	-1.89712
0.430	-0.84397
0.140	-1.966113
0.130	-2.040221
0.180	-1.714798
0.310	-1.171183
0.170	-1.771957
0.160	-1.832581
1.200	0.182322
1.100	0.09531
0.220	-1.514128
0.250	-1.386294
0.370	-0.994252
0.230	-1.469676
0.540	-0.616186
0.440	-0.820981

LN Detects-only Data	
Mean	-1.000075
Std. Error	0.127877
Median	-1.094628
Mode *	0.09531
Std. Dev.	0.723383
Variance	0.523283
Kurtosis	-1.227867
Skewness	0.313246
Range	2.222542
Minimum	-2.040221
Maximum	0.182322
Sum	-32.0024
Count	32

LN data	Txx for outlier
-1.609438	0.857429
-1.609438	0.857429
-1.609438	0.857429
-1.609438	0.857429
-0.235722	1.608772
-0.510826	1.114885
-1.514128	0.686321
-1.108663	0.041602
-1.609438	0.857429
-0.867501	0.474555
-0.798508	0.598416
-0.755023	0.676484
-0.776529	0.637874
-0.400478	1.312991
-0.755023	0.676484
-1.309333	0.318658
-1.237874	0.190369
-1.272966	0.253368
-1.237874	0.190369
-1.347074	0.386412
-1.272966	0.253368
-1.309333	0.318658
-1.272966	0.253368
-1.272966	0.253368
-1.347074	0.386412
-1.272966	0.253368
-1.272966	0.253368
-1.272966	0.253368
-1.309333	0.318658
-1.309333	0.318658
-1.347074	0.386412
-1.272966	0.253368
-1.049822	0.147237
-0.825536	0.549892
-0.527633	1.084712
-1.139434	0.013642
-1.272966	0.253368
-1.309333	0.318658
-1.771957	1.149196
0.09531	2.203067
0.09531	2.203067
0.09531	2.203067
0.09531	2.203067

Test Statistic for LN data

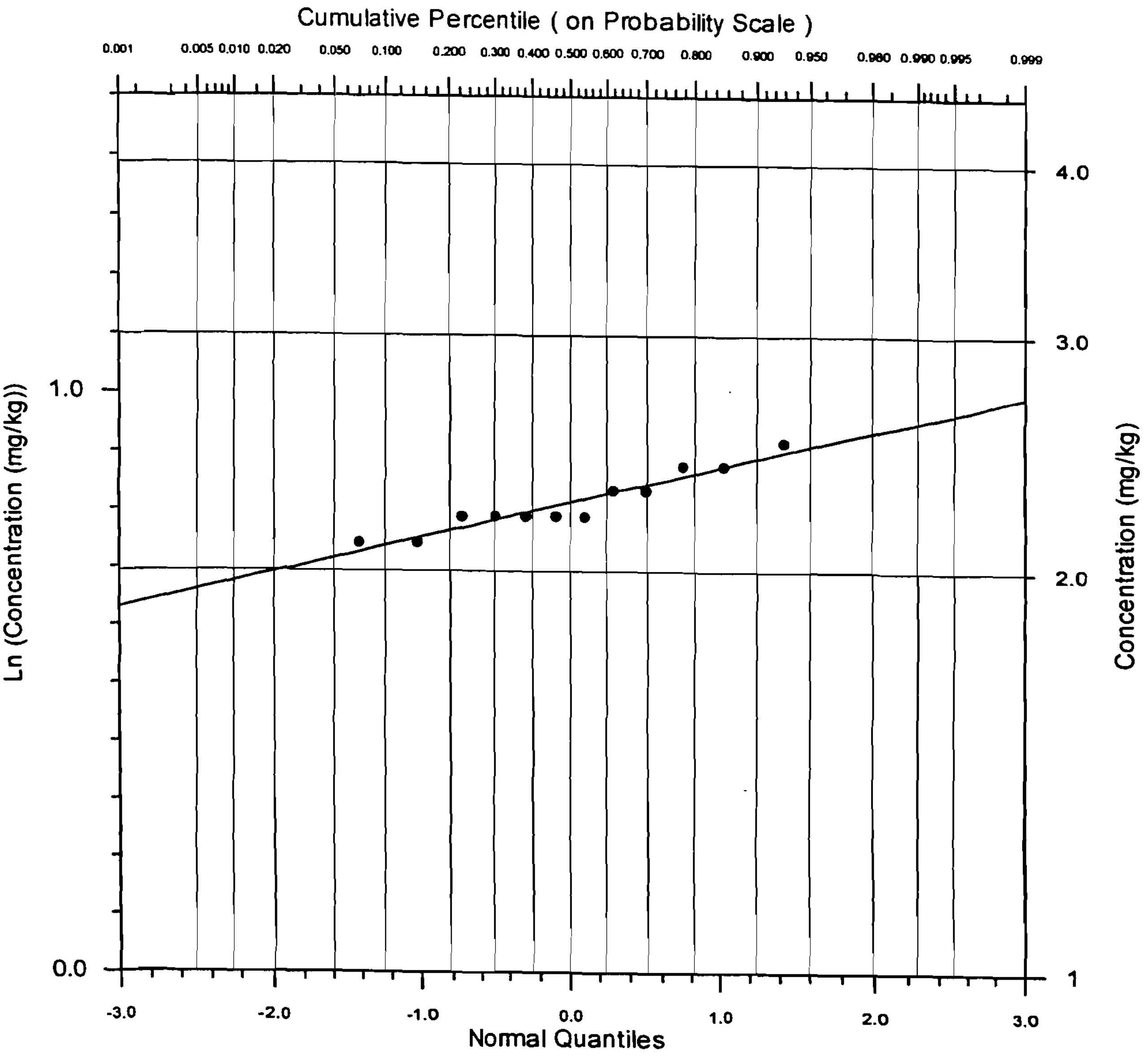
Column1	
Mean	-1.131835
Standard E	0.070178
Median	-1.272966
Mode	-1.272966
Standard D	0.557017
Sample Va	0.310268
Kurtosis	0.261177
Skewness	0.907926
Range	2.222542
Minimum	-2.040221
Maximum	0.182322
Sum	-71.30563
Count	63

AITCHISON'S ADJUSTMENT FOR NONDETECTS

Mean (Detect-Only)	-1.000		
td. Dev. (Detect-Only)	0.723		
Total no. of samples	57		
Number of NDs	25		
Adjusted Mean	**-0.561**	mg/kg	log-transformed
Adjusted Std. Dev.	**0.735**	mg/kg	log-transformed

SELENIUM

Sample ID	Sample Depth (feet)	Concentration (mg/kg)	Outlier Test Statistic		Detects-only Data	LN (Detects-only data)	LN data	Test Statistic for LN data	Txx for outlier
HMW-10	0.0 - 2.0	0.2	0.676	ubc	0.6477564		-1.609438		0.857429
HMW-12	1.5 - 3.0	0.23	0.566	exp ubc	1.9112479		-1.469676		0.606518
FTASB-04	9.0 - 10.5	0.17 J	0.786				-1.771957		1.149196
FTASB-06	8.5 - 10.5	0.15 J	0.860				-1.89712		1.373898
FTASB-09	6.0 - 7.0	0.43 J	0.166				-0.84397		0.516798
FTASB-10	9.1 - 10.4	0.14 J	0.896				-1.966113		1.49776
FTASB-11	9.5 - 10.0	0.13 J	0.933				-2.040221		1.630804
FTASB-12	8.0 - 10.0	0.18 J	0.750				-1.714798		1.046581
FTASB-13	2.5 - 4.5	0.31 JQ	0.273				-1.171183		0.07064
FTASB-14	4.5 - 6.5	0.17	0.786				-1.771957		1.149196
FTASB-15	4.5 - 6.5	0.16	0.823				-1.832581		1.258034
FTASB-16	6.5 - 8.1	1.2	2.988				0.182322		2.359277
FTASB-17	4.5 - 6.5	1.1	2.622				0.09531		2.203067
HMW-10	2.0 - 4.0	0.22	0.603				-1.514128		0.686321
HMW-11	2.0 - 4.0	0.25	0.493				-1.386294		0.456824
HMW-11	6.0 - 8.0	0.37	0.053				-0.994252		0.247
HMW-12	1.5 - 3.0	0.23	0.566				-1.469676		0.606518
HMW-12	4.5 - 6.0	0.54	0.570				-0.616186		0.925734
HMW-13	2.0 - 4.0	0.44	0.203				-0.820981		0.558071
HMW-13	8.0 - 10.0	0.23	0.566				-1.469676		0.606518



LEGEND:

- ● Silver (mg/kg)

Due to high percentage of non-detects the data can not be validly normalized.
Probability Plot is Detects-Only. 79% NDs.

Upper Background Concentration: **2.6 mg/kg**
Based on non-parametric analysis, UBC is set equal to the maximum observed value.
5% Significance Level and 98% expected coverage.

Total of 63 samples, of which 57 data points were used for UBC and 12 for Probability Plot.
One Data Point, BH-13 (<7.98), is determined to be a statistical outlier.
By ASTM Designation E178-75, 1975.
5% significance level.
Five data points, BH-10 (<3.99), BH-11 (<3.99), BH-13 (<3.99), FTASB-11 (2.2), and HMW-13 (<2.3), are rejected due to being outliers in other metals data sets.

Distribution of Background Silver
in Soils at Hunter Army Airfield

SILVER

Sample ID	Sample Depth (feet)	Concentration (mg/kg)		Outlier Test Statistic
BH-10	0 - 1	<	3.99	1.468595
BH-10	7.5-8.5	<	3.99	1.468595
BH-11	0 - 1	<	3.99	1.468595
BH-11	7.5-8.5	<	3.99	1.468595
BH-12	0 - 1	<	3.99	1.468595
BH-12	6.5-7.5	<	3.99	1.468595
BH-13		<	7.98	4.51297
BH-13	0 - 1	<	3.99	1.468595
BH-13	6.0-7.5	<	3.99	1.468595
HSB-1	8 - 10	<	0.60	1.117978
HSB-2	3 - 5	<	0.65	1.079828
HSB-3	6 - 8	<	0.68	1.056938
HSB-4	2 - 4	<	0.66	1.072198
HSB-5	5 - 8	<	0.73	1.018788
HSB-6	8 - 10	<	0.68	1.056938
HS-1	0 - 1	<	0.78	0.980638
HS-2	3 - 4	<	0.86	0.919598
HS-3	0 - 1	<	0.81	0.957748
HS-4	3 - 4	<	0.83	0.942488
HS-10	0 - 1	<	0.77	0.988268
HS-11	3.5 - 4	<	0.82	0.950118
HS-12	0 - 1	<	0.77	0.988268
HS-13	3.5 - 4	<	0.82	0.950118
HS-14	5.5 - 6.5	<	0.82	0.950118
HS-18	0 - 1	<	0.75	1.003528
HS-19	3.5 - 4	<	0.82	0.950118
HS-7	0 - 1	<	0.81	0.957748
HS-8	3 - 5	<	0.80	0.965378
HS-9	7.5 - 8.5	<	0.80	0.965378
HS-15	0 - 1	<	0.76	0.995898
HS-16	3 - 4	<	0.78	0.980638
HS-17	6 - 7	<	0.81	0.957748
FTASB-04	0.5 - 1.0		2.2	0.102823
FTASB-06	0.5 - 1.0		2.1	0.026523
FTASB-09	0.5 - 1.0		2.5	0.331724
FTASB-10	0.5 - 1.0		2.3	0.179124
FTASB-11	0.5 - 1.0		2.2	0.102823
FTASB-12	0.5 - 1.0		2.4	0.255424
FRASB-13	0.5 - 2.5		2.2	0.102823
FTASB-14	0.5 - 2.5		2.2	0.102823
FTASB-15	0.5 - 2.5		2.2	0.102823
FTASB-16	0.5 - 2.5		2.1	0.026523
FTASB-17	0.5 - 2.5		2.2	0.102823
HMW-10	0.0 - 2.0		2.3	0.179124

All Data ʷ /DLs	
Mean	2.065238
Std. Error	0.165122
Median	2.2
Mode	2.4
Std. Dev.	1.310614
Variance	1.717709
Kurtosis	5.285285
Skewness	1.585052
Range	7.38
Minimum	0.6
Maximum	7.98
Sum	130.11
Count	63
Crit. Val.	3.044

LN data	Test Statistic for LN data		Txx for outlier
1.383791			1.311066
1.383791			1.311066
1.383791			1.311066
1.383791	*Column1*		1.311066
1.383791			1.311066
1.383791	Mean	0.527662	1.311066
2.076938	Standard E	0.08227	2.372545
1.383791	Median	0.788457	1.311066
1.383791	Mode	0.875469	1.311066
-0.510826	Standard E	0.653002	1.590329
-0.430783	Sample Va	0.426411	1.467753
-0.385662	Kurtosis	-1.136188	1.398656
-0.415515	Skewness	-0.139387	1.444372
-0.314711	Range	2.587764	1.290001
-0.385662	Minimum	-0.510826	1.398656
-0.248461	Maximum	2.076938	1.188548
-0.150823	Sum	33.24273	1.039025
-0.210721	Count	63	1.130753
-0.18633			1.0934
-0.261365			1.208308
-0.198451			1.111962
-0.261365			1.208308
-0.198451			1.111962
-0.198451			1.111962
-0.287682			1.24861
-0.198451			1.111962
-0.210721			1.130753
-0.223144			1.149776
-0.223144			1.149776
-0.274437			1.228326
-0.248461			1.188548
-0.210721			1.130753
0.788457			0.399379
0.741937			0.328138
0.916291			0.595141
0.832909			0.467451
0.788457			0.399379
0.875469			0.532627
0.788457			0.399379
0.788457			0.399379
0.788457			0.399379
0.741937			0.328138
0.788457			0.399379
0.832909			0.467451

SILVER

Sample ID	Sample Depth (feet)	Concentration (mg/kg)	Outlier Test Statistic	LN data	Test Statistic for LN data	Txx for outlier
HMW-12	1.5 - 3.0	2.4	0.255424	0.875469		0.532627
FTASB-04	9.0 - 10.5	< 2.4	0.255424	0.875469		0.532627
FTASB-06	8.5 - 10.5	< 2.6	0.408024	0.955511		0.655203
FTASB-09	6.0 - 7.0	< 2.3	0.179124	0.832909		0.467451
FTASB-10	9.1 - 10.4	< 2.4	0.255424	0.875469		0.532627
FTASB-11	9.5 - 10.0	< 2.4	0.255424	0.875469		0.532627
FTASB-12	8.0 - 10.0	< 2.5	0.331724	0.916291		0.595141
FTASB-13	2.5 - 4.5	< 2.6	0.408024	0.955511		0.655203
FTASB-14	4.5 - 6.5	< 2.3	0.179124	0.832909		0.467451
FTASB-15	4.5 - 6.5	< 2.3	0.179124	0.832909		0.467451
FTASB-16	6.5 - 8.1	< 2.4	0.255424	0.875469		0.532627
FTASB-17	4.5 - 6.5	< 2.2	0.102823	0.788457		0.399379
HMW-10	2.0 - 4.0	< 2.4	0.255424	0.875469		0.532627
HMW-11	2.0 - 4.0	< 2.4	0.255424	0.875469		0.532627
HMW-11	6.0 - 8.0	< 2.6	0.408024	0.955511		0.655203
HMW-12	1.5 - 3.0	< 2.4	0.255424	0.875469		0.532627
HMW-12	4.5 - 6.0	< 2.4	0.255424	0.875469		0.532627
HMW-13	2.0 - 4.0	< 2.4	0.255424	0.875469		0.532627
HMW-13	8.0 - 10.0	< 2.3	0.179124	0.832909		0.467451

H-27

Georgia Department of Natural Resources
205 Butler Street, SE, Suite 1462, Atlanta, Georgia 30334
Lonice C. Barrett, Commissioner
Environmental Protection Division
Harold F. Reheis, Director
404/657-8600

May 8, 2001

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Col. Gregory V. Stanley
Department of the Army
1550 Cochran Drive
Fort Stewart, GA 31314

Re: Response to 3/19/01 Meeting Letter
Hunter Army Airfield
HSI #10105

Dear Col. Stanley:

The Georgia Environmental Protection Division (EPD) has received your compliance status report (CSR) response letter dated March 5, 2001 and your April 16, 2001 correspondence following up on our March 19, 2001 meeting regarding the above referenced site. EPD was asked to address issues raised during our meeting pertaining to calculated background concentrations, the methodology used to calculate the background concentrations, and future sampling locations:

1. Background Concentrations - The proposed background concentrations presented on page 5 of CSR response are acceptable to EPD. It should be noted that although Table 2 of Appendix III should not be used for determining site-specific background concentrations, it is useful for comparative purposes in that most background concentrations will be below those levels.

2. Statistical Calculations – The statistical methods described can be used for determining background concentrations; however, they do not necessarily apply to all sites due to variations in site-specific data. The method used to determine multiple outliers in a dataset should be stated in the revised CSR and included in an appendix along with the other statistical methods used in the CSR.

3. Proposed Sampling Locations – The sample locations shown in Figure 1 of the CSR response surrounding SB-30 appear sufficient to delineate the site with the following exceptions. Two more sample locations (in addition to SB-45) are needed to delineate the southern boundary near SB-35. One location is needed to the west of SB-45 and south of SB-36. The other location to be added is to the east of SB-45 across Lightning Road. The purpose of proposed sampling locations SB-47 and SB-48 is unclear and needs to be explained before EPD can comment on them.

For specific answers to questions concerning risk assessment calculations and ecological evaluations, you may contact Michelle Burgess or Ahmet Bulbakaya at (404) 656-7802. Please contact David Brownlee of the Hazardous Site Response Program at (404) 657-8600 if you have questions regarding this letter.

Sincerely,

Jane Hendricks
Unit Coordinator
Hazardous Sites Response Program

c: Melanie Little

File: Site #10105

S:\RDRIVE\DAVIDB\CSR\Hunter Army Airfield Fire Training Area\March 19 Meeting Letter Response.doc

REVISED GA EPD TABLE, REVISED VOLATILIZATION FACTORS (VF) REVISED RISK REDUCTION STANDARDS FOR RESPONSE TO COMMENT

Regulated Substance in Soil	**Type RRS**	**Previous Hunter AAF Criteria (mg/kg)**	**Updated Hunter AAF Criteria (mg/kg) ***	**GaEPD Criteria (mg/kg)**	**Comment**
Benzene	Type 2 Type 4	1.4 3.9	14 69	5 ?	Unable to recreate EPD values. Per prior discussion with Dr. Cliff Opdyke, LAW is using mid-range value of oral cancer slope factor. Recently (February 2001), Michelle Burgess confirmed this decision.
Benzo(k)fluoranthene	Type 2	120	125	14	Unable to recreate EPD value.
Chrysene	Type 2	1200	1250	125	Unable to recreate EPD value.
2 [illegible] Dinitrotoluene	Type 1	0.66	0.66	100	See written response under Comment 11c.
Ethylbenzene	Type 2	550	3340	1562	Unable to recreate EPD value.
Naphthalene	Type 1	93	100	100	Updated VF resulted in agreement with EPD value.
Trichlorofluoromethane	Type 1	150	200	200	Agree with EPD.

Regulated Substance in GW	**Type RRS**	**Previous Hunter AAF Criteria (mg/kg)**	**Updated Hunter AAF Criteria (mg/kg) ***	**GaEPD Criteria (mg/L)**	**Comments**
Benzene	Type 4	0.014	NA	0.009	LAW used mid-range of oral cancer slope factor.
Lead	Type 4	0.015	NA	Background	LAW used Type 1 criteria for all Types.

*Updated soil criteria use revised volatilization factors.

NA Not applicable

TABLE 1

VOLATILIZATION FACTOR CALCULATION

	MW g/mol	Di cm²/sec	Dei cm²/sec	K_d cm³/g	H atm-m³/mol	K_{as} g/cm³	Y cm²/sec	VF m³/kg
2,4-Dinitrotoluene	182.14	2.03E-01	0.0163	1.38	9.26E-08	2.75E-06	9.11E-09	1.51E+06
2-Butanone	72.12	0.0872	0.0070	0.038	5.59E-05	6.03E-02	8.48E-05	1.55E+04
Acenaphthene	154.21	0.0421	0.0034	141.6	1.55E-04	4.49E-05	3.08E-08	8.23E+05
Acenaphthylene	152.2	0.05441461	0.0044	62	1.10E-04	7.27E-05	6.46E-08	5.69E+05
Acetone	58.1	0.124	0.0100	0.012	3.88E-05	1.33E-01	2.61E-04	8.71E+03
Anthracene	178.24	0.0324	0.0026	590	6.50E-05	4.52E-06	2.39E-09	2.96E+06
Benzene	78.11	0.088	0.0071	1.18	5.55E-03	1.93E-01	2.66E-04	8.52E+03
Benzo(a)anthracene	228.3	0.051	0.0041	7960	3.35E-06	1.73E-08	1.44E-11	3.82E+07
Benzo(a)pyrene	252.32	0.043	0.0035	20400	1.13E-06	2.27E-09	1.59E-12	1.15E+08
Benzo(b)fluoranthene	252.32	0.0226	0.0018	24600	1.11E-04	1.85E-07	6.82E-11	1.75E+07
Benzo(g,h,i)perylene	276.34	0.04742653	0.0038	77000	1.40E-07	7.45E-11	5.77E-14	6.02E+08
Benzo(k)fluoranthene	252.32	0.0226	0.0018	24600	8.29E-07	1.38E-09	5.09E-13	2.03E+08
bis(2-Ethylhexyl)phthalate	390.6	0.0351	0.0028	302000	1.02E-07	1.38E-11	7.93E-15	1.62E+09
Chlorobenzene	112.56	0.073	0.0059	4.38	3.70E-03	3.46E-02	4.10E-05	2.24E+04
Chloromethane	50.48	0.13	0.0104	0.13	8.80E-03	2.78E+00	3.76E-03	1.51E+03
Chrysene	228.3	0.0248	0.0020	7960	9.46E-05	4.87E-07	1.97E-10	1.03E+07
Dibenzo(a,h)anthracene	278.36	0.0202	0.0016	76000	1.47E-08	7.93E-12	2.61E-15	2.83E+09
Dibutyl phthalate	278.4	0.0438	0.0035	678	9.38E-10	5.67E-11	4.05E-14	7.18E+08
cis-1,2-Dichloroethene	96.94	0.0736	0.0059	0.71	4.08E-03	2.36E-01	2.70E-04	8.40E+03
Dieldrin	380.91	0.0125	0.0010	428	1.51E-05	1.45E-06	2.95E-10	8.42E+06
Diethyl phthalate	222.24	0.0256	0.0021	5.76	4.50E-07	3.20E-06	1.34E-09	3.95E+06
Ethylbenzene	106.17	0.075	0.0060	7.26	7.88E-03	4.45E-02	5.40E-05	1.95E+04
Fluoranthene	202.26	0.0302	0.0024	2140	1.61E-05	3.08E-07	1.52E-10	1.17E+07
Fluorene	166.22	0.0363	0.0029	276	6.36E-05	9.45E-06	5.60E-09	1.93E+06
Indeno(1,2,3-cd)pyrene	276.34	0.019	0.0015	69400	1.60E-06	9.45E-10	2.93E-13	2.67E+08
Methoxychlor	345.66	0.0156	0.0013	1954	1.58E-05	3.32E-07	8.44E-11	1.57E+07
Methylene Chloride	84.93	0.101	0.0081	0.234	2.19E-03	3.84E-01	5.87E-04	5.54E+03
Naphthalene	128.18	0.059	0.0047	40	4.83E-04	4.95E-04	4.77E-07	2.09E+05
Phenanthrene	178.24	0.0574	0.0046	590	2.30E-05	1.60E-06	1.50E-09	3.74E+06
Pyrene	202.26	0.0272	0.0022	2100	1.10E-05	2.15E-07	9.53E-11	1.48E+07
Tetrachloroethylene	165.83	0.072	0.0058	3.1	1.84E-02	2.43E-01	2.72E-04	8.35E+03

Prepared by: EFC 2/15/01
Checked by: LM 16/01

TABL

VOLATILIZATION FACTOR CALCULATION

	MW g/mol	Di cm^2/sec	Dei cm^2/sec	K_d cm^3/g	H atm-m^3/mol	K_{as} g/cm^3	Y cm^2/sec	VF m^3/kg
Toluene	92.14	0.087	0.0070	3.64	6.64E-03	7.48E-02	1.05E-04	1.39E+04
trans-1,2-Dichloroethene	96.94	0.0707	0.0057	1.05	9.39E-03	3.67E-01	3.94E-04	6.78E+03
Trichlorofluoromethane	137.37	0.087	0.0070	2.4	9.70E-02	1.66E+00	1.76E-03	2.58E+03
Xylenes	106.17	0.078	0.0063	7.72	6.73E-03	3.57E-02	4.52E-05	2.14E+04

Equation is from USEPA, 1991b.

VF = Volatilization Factor (m^3/kg)

$$VF = (LS \times V \times DH) / (A) * \frac{(3.14 \times Y \times T)^{1/2}}{(2 \times Dei \times P \times Kas \times 0.001)}$$

$$Y = \frac{Dei \times P}{P + (p(1-P)/Kas)}$$

LS = Length of side of contaminated area = 45 m (default)

V = wind speed in mixing zone = 2.25 m/s (default)

DH = diffusion height = 2 m

A = area of contamination = 20,250,000 cm^2 (default)

T = exposure interval = 790000000 s = 25 yrs

Dei = effective diffusivity (cm^2/s) = Chemical Specific

P = air filled soil porosity (unitless) = 0.35 (default)

Kas = soil/air partition coefficient (g soil/cm^3 air) = Chemical Specific

Conversion factor = 0.001 kg/g

p = True soil density or particulate density = 2.65 g/cm^3 (default)

NC = Not Calculable

Prepared by: EFC 2/15/01
Checked by: LMS 2/16/01

Hunter AAF, Savannah, Georgia
Summary of Soil Risk Reduction Standards

Substance	Type 1	Type 2	Subsurface Type 3	Overall Type 3	Overall Type 4 RRS
2,4-Dinitrotoluene	6.60E-01	1.34E+01	6.60E-01	6.60E-01	8.42E+01
2-Butanone	2.00E+02	4.26E+03	2.00E+02	2.00E+02	2.25E+04
Acenaphthene	3.00E+02	4.69E+03	3.00E+02	3.00E+02	1.23E+05
Acenaphthylene	1.30E+02	2.35E+03	1.30E+02	1.30E+02	6.13E+04
Acetone	4.00E+02	7.30E+04	4.00E+02	4.00E+02	2.04E+05
Anthracene	5.00E+02	2.35E+04	5.00E+02	5.00E+02	6.13E+05
Benzene	5.00E-01	1.42E+01	5.00E-01	5.00E-01	6.87E+01
Benzo(a)anthracene	5.00E+00	1.25E+01	5.00E+00	5.00E+00	7.84E+01
Benzo(a)pyrene	1.64E+00	1.25E+00	1.64E+00	1.64E+00	7.84E+00
Benzo(b)fluoranthene	5.00E+00	1.25E+01	5.00E+00	5.00E+00	7.84E+01
Benzo(ghi)perylene	5.00E+02	2.35E+03	5.00E+02	5.00E+02	6.13E+04
Benzo(k)fluoranthene	5.00E+00	1.25E+02	5.00E+00	5.00E+00	7.84E+02
bis(2-Ethylhexyl) phthalate	5.00E+01	6.52E+02	5.00E+01	5.00E+01	4.09E+03
Chlorobenzene	1.00E+01	1.23E+02	1.00E+01	1.00E+01	6.43E+02
Chloromethane	3.00E-01	2.01E+01	3.00E-01	3.00E-01	3.40E+01
Chrysene	5.00E+00	1.25E+03	5.00E+00	5.00E+00	7.84E+03
DCE, trans-1,2-	1.00E+01	1.56E+03	1.00E+01	1.00E+01	4.09E+04
Dibenzo(a,h)anthracene	2.05E+00	1.25E+00	5.00E+00	5.00E+00	7.84E+00
Dibutyl phthalate	4.00E+02	7.82E+03	4.00E+02	4.00E+02	2.04E+05
Dichloroethylene, N.O.S.	5.30E-01	7.82E+02	5.30E-01	5.30E-01	2.04E+04
Dieldrin	6.60E-01	5.70E-01	6.60E-01	6.60E-01	3.58E+00
Diethyl phthalate	5.00E+02	8.26E+04	5.00E+02	5.00E+02	1.64E+06
Ethylbenzene	7.00E+01	3.34E+03	7.00E+01	7.00E+01	2.50E+04
Fluoranthene	5.00E+02	3.13E+03	5.00E+02	5.00E+02	8.18E+04
Fluorene	3.60E+02	3.13E+03	3.60E+02	3.60E+02	8.18E+04
Indeno(1,2,3-cd)pyrene	5.00E+00	1.25E+01	5.00E+00	5.00E+00	7.84E+01
Methoxychlor	1.00E+01	3.91E+02	1.00E+01	1.00E+01	1.02E+04
Methylene chloride	5.00E-01	2.55E+02	5.00E-01	5.00E-01	4.55E+02
Naphthalene	1.00E+02	1.67E+02	1.00E+02	1.00E+02	8.98E+02
Phenanthrene	1.10E+02	2.35E+03	1.10E+02	1.10E+02	6.13E+04
Pyrene	5.00E+02	2.35E+03	5.00E+02	5.00E+02	6.13E+04
Tetrachloroethene	5.00E-01	1.30E+02	5.00E-01	5.00E-01	3.87E+02
Toluene	1.00E+02	1.49E+03	1.00E+02	1.00E+02	7.94E+03
Trichlorofluoromethane	2.00E+02	5.26E+02	2.00E+02	2.00E+02	2.63E+03
Xylenes	1.00E+03	1.56E+05	1.00E+03	1.00E+03	4.09E+06

Hunter AAF, Savannah, Georgia
Type 1 and 3 Soil Calculations

	Appendix I	Type 1 GW x 100	Risk-Based Residential Type 1			Risk-Based Nonresidential Type 3		Subsurface Soil	Overall Soil
SUBSTANCE			NC-Type 1	C-Type 1	Type 1 RRS	NC-Type 3	C-Type 3	Type 3 RRS	Type 3 RRS
2,4-Dinitrotoluene	6.6E-01	5.0E-03	1.3E+03	2.2E+01	6.6E-01	4.1E+03	8.4E+01	6.6E-01	6.6E-01
2-Butanone	7.9E-01	2.0E+02	2.1E+04	ND	2.0E+02	2.3E+04	ND	2.0E+02	2.0E+02
Acenaphthene	3.0E+02	2.0E+02	3.8E+04	ND	3.0E+02	1.2E+05	ND	3.0E+02	3.0E+02
Acenaphthylene	1.3E+02	1.0E+00	1.9E+04	ND	1.3E+02	6.1E+04	ND	1.3E+02	1.3E+02
Acetone	2.7E+00	4.0E+02	2.0E+05	ND	4.0E+02	2.0E+05	ND	4.0E+02	4.0E+02
Anthracene	5.0E+02	1.0E+00	1.9E+05	ND	5.0E+02	6.1E+05	ND	5.0E+02	5.0E+02
Benzene	2.0E-02	5.0E-01	6.8E+01	5.0E+01	5.0E-01	7.3E+01	6.9E+01	5.0E-01	5.0E-01
Benzo(a)anthracene	5.0E+00	1.0E-02	ND	2.0E+01	5.0E+00	ND	7.8E+01	5.0E+00	5.0E+00
Benzo(a)pyrene	1.6E+00	2.0E-02	ND	2.0E+00	1.64E+00	ND	7.8E+00	1.64E+00	1.64E+00
Benzo(b)fluoranthene	5.0E+00	2.0E-02	ND	2.0E+01	5.0E+00	ND	7.8E+01	5.0E+00	5.0E+00
Benzo(ghi)perylene	5.0E+02	1.0E+00	1.9E+04	ND	5.0E+02	6.1E+04	ND	5.0E+02	5.0E+02
Benzo(k)fluoranthene	5.0E+00	1.0E+00	ND	2.0E+02	5.0E+00	ND	7.6E+02	5.0E+00	5.0E+00
bis(2-Ethylhexyl) phthalate	5.0E+01	6.0E-01	1.3E+04	1.1E+03	5.0E+01	4.1E+04	4.1E+03	5.0E+01	5.0E+01
Chlorobenzene	4.2E+00	1.0E+01	5.9E+02	ND	1.0E+01	6.4E+02	ND	1.0E+01	1.0E+01
Chloromethane	4.0E-02	3.0E-01	6.3E+02	2.7E+01	3.0E-01	6.6E+02	3.4E+01	3.0E-01	3.0E-01
Chrysene	5.0E+00	2.0E-02	ND	2.0E+03	5.0E+00	ND	7.8E+03	5.0E+00	5.0E+00
DCE, trans-1,2-	5.3E-01	1.0E+01	1.3E+04	ND	1.0E+01	4.1E+04	ND	1.0E+01	1.0E+01
Dibenzo(a,h)anthracene	5.0E+00	3.0E-02	ND	2.0E+00	2.0E+00	ND	7.8E+00	5.0E+00	5.0E+00
Dibutyl phthalate	1.4E+01	4.0E+02	6.4E+04	ND	4.0E+02	2.0E+05	ND	4.0E+02	4.0E+02
Dichloroethylene, N.O.S.	5.3E-01		6.4E+03	ND	5.3E-01	2.0E+04	ND	5.3E-01	5.3E-01
Dieldrin	6.6E-01	2.0E-03	3.2E+01	9.3E-01	6.6E-01	1.0E+02	3.6E+00	6.6E-01	6.6E-01
Diethyl phthalate	7.4E-01	5.0E+02	5.1E+05	ND	5.0E+02	1.6E+06	ND	5.0E+02	5.0E+02
Ethylbenzene	2.0E+01	7.0E+01	1.9E+04	ND	7.0E+01	2.5E+04	ND	7.0E+01	7.0E+01
Fluoranthene	5.0E+02	1.0E+02	2.6E+04	ND	5.0E+02	8.2E+04	ND	5.0E+02	5.0E+02
Fluorene	3.6E+02	1.0E+02	2.6E+04	ND	3.6E+02	8.2E+04	ND	3.6E+02	3.6E+02
Indeno(1,2,3-cd)pyrene	5.0E+00	4.0E-02	ND	2.0E+01	5.0E+00	ND	7.8E+01	5.0E+00	5.0E+00
Methoxychlor	1.0E+01	4.0E+00	3.2E+03	ND	1.0E+01	1.0E+04	ND	1.0E+01	1.0E+01
Methylene chloride	8.0E-02	5.0E-01	1.4E+04	3.2E+02	5.0E-01	2.0E+04	4.5E+02	5.0E-01	5.0E-01
Naphthalene	1.0E+02	2.0E+00	8.2E+02	ND	1.0E+02	9.0E+02	ND	1.0E+02	1.0E+02
Phenanthrene	1.1E+02		1.9E+04	ND	1.1E+02	6.1E+04	ND	1.1E+02	1.1E+02
Pyrene	5.0E+02	1.0E+02	1.9E+04	ND	5.0E+02	6.1E+04	ND	5.0E+02	5.0E+02
Tetrachloroethene	1.8E-01	5.0E-01	6.4E+03	1.8E+02	5.0E-01	2.0E+04	3.9E+02	5.0E-01	5.0E-01
Toluene	1.4E+01	1.0E+02	7.3E+03	ND	1.0E+02	7.9E+03	ND	1.0E+02	1.0E+02
Trichlorofluoromethane	7.0E-01	2.0E+02	2.5E+03	ND	2.0E+02	2.6E+03	ND	2.0E+02	2.0E+02
Xylenes	2.0E+01	1.0E+03	1.3E+06	ND	1.0E+03	4.1E+06	ND	1.0E+03	1.0E+03

Hunter AAF, Savannah, Georgia
Type 2 Soil Calculations

	Residential Child		Residential Adult		Overall
SUBSTANCE	NC-Type 2	C-Type 2	NC-Type 2	C-Type 2	Type 2 RRS
2,4-Dinitrotoluene	1.6E+02	1.3E+01	1.5E+03	2.5E+01	1.3E+01
2-Butanone	4.3E+03	ND	1.6E+04	ND	4.3E+03
Acenaphthene	4.7E+03	ND	4.4E+04	ND	4.7E+03
Acenaphthylene	2.3E+03	ND	2.2E+04	ND	2.3E+03
Acetone	7.3E+04	ND	7.3E+04	ND	7.3E+04
Anthracene	2.3E+04	ND	2.2E+05	ND	2.3E+04
Benzene	1.4E+01	4.9E+01	5.2E+01	3.9E+01	1.4E+01
Benzo(a)anthracene	ND	1.2E+01	ND	2.3E+01	1.2E+01
Benzo(a)pyrene	ND	1.2E+00	ND	2.3E+00	1.2E+00
Benzo(b)fluoranthene	ND	1.2E+01	ND	2.3E+01	1.2E+01
Benzo(ghi)perylene	2.3E+03	ND	2.2E+04	ND	2.3E+03
Benzo(k)fluoranthene	ND	1.2E+02	ND	2.3E+02	1.2E+02
bis(2-Ethylhexyl) phthalate	1.6E+03	6.5E+02	1.5E+04	1.2E+03	6.5E+02
Chlorobenzene	1.2E+02	ND	4.5E+02	ND	1.2E+02
Chloromethane	1.4E+02	2.8E+01	4.7E+02	2.0E+01	2.0E+01
Chrysene	ND	1.2E+03	ND	2.3E+03	1.2E+03
DCE, trans-1,2-	1.6E+03	ND	1.5E+04	ND	1.6E+03
Dibenzo(a,h)anthracene	ND	1.2E+00	ND	2.3E+00	1.2E+00
Dibutyl phthalate	7.8E+03	ND	7.3E+04	ND	7.8E+03
Dichloroethylene, N.O.S.	7.8E+02	ND	7.3E+03	ND	7.8E+02
Dieldrin	3.9E+00	5.7E-01	3.7E+01	1.1E+00	5.7E-01
Diethyl phthalate	6.3E+04	ND	5.8E+05	ND	6.3E+04
Ethylbenzene	3.3E+03	ND	1.6E+04	ND	3.3E+03
Fluoranthene	3.1E+03	ND	2.9E+04	ND	3.1E+03
Fluorene	3.1E+03	ND	2.9E+04	ND	3.1E+03
Indeno(1,2,3-cd)pyrene	ND	1.2E+01	ND	2.3E+01	1.2E+01
Methoxychlor	3.9E+02	ND	3.7E+03	ND	3.9E+02
Methylene chloride	2.4E+03	3.1E+02	1.2E+04	2.6E+02	2.6E+02
Naphthalene	1.7E+02	ND	6.3E+02	ND	1.7E+02
Phenanthrene	2.3E+03	ND	2.2E+04	ND	2.3E+03
Pyrene	2.3E+03	ND	2.2E+04	ND	2.3E+03
Tetrachloroethene	7.8E+02	1.3E+02	7.3E+03	1.7E+02	1.3E+02
Toluene	1.5E+03	ND	5.6E+03	ND	1.5E+03
Trichlorofluoromethane	5.3E+02	ND	1.9E+03	ND	5.3E+02
Xylenes	1.6E+05	ND	1.5E+06	ND	1.6E+05

Hunter AAF, Savannah, Georgia
Type 4 Soil Calculations

	Industrial Worker		Overall
SUBSTANCE	NC-Type 4	C-Type 4	Type 4 RRS
2,4-Dinitrotoluene	4.09E+03	8.42E+01	8.42E+01
2-Butanone	2.25E+04	ND	2.25E+04
Acenaphthene	1.23E+05	ND	1.23E+05
Acenaphthylene	6.13E+04	ND	6.13E+04
Acetone	2.04E+05	ND	2.04E+05
Anthracene	6.13E+05	ND	6.13E+05
Benzene	7.31E+01	6.87E+01	6.87E+01
Benzo(a)anthracene	ND	7.84E+01	7.84E+01
Benzo(a)pyrene	ND	7.84E+00	7.84E+00
Benzo(b)fluoranthene	ND	7.84E+01	7.84E+01
Benzo(ghi)perylene	6.13E+04	ND	6.13E+04
Benzo(k)fluoranthene	ND	7.84E+02	7.84E+02
bis(2-Ethylhexyl) phthalate	4.09E+04	4.09E+03	4.09E+03
Chlorobenzene	6.43E+02	ND	6.43E+02
Chloromethane	6.64E+02	3.40E+01	3.40E+01
Chrysene	ND	7.84E+03	7.84E+03
DCE, trans-1,2-	4.09E+04	ND	4.09E+04
Dibenzo(a,h)anthracene	ND	7.84E+00	7.84E+00
Dibutyl phthalate	2.04E+05	ND	2.04E+05
Dichloroethylene, N.O.S.	2.04E+04	ND	2.04E+04
Dieldrin	1.02E+02	3.58E+00	3.58E+00
Diethyl phthalate	1.64E+06	ND	1.64E+06
Ethylbenzene	2.50E+04	ND	2.50E+04
Fluoranthene	8.18E+04	ND	8.18E+04
Fluorene	8.18E+04	ND	8.18E+04
Indeno(1,2,3-cd)pyrene	ND	7.84E+01	7.84E+01
Methoxychlor	1.02E+04	ND	1.02E+04
Methylene chloride	2.03E+04	4.55E+02	4.55E+02
Naphthalene	8.98E+02	ND	8.98E+02
Phenanthrene	6.13E+04	ND	6.13E+04
Pyrene	6.13E+04	ND	6.13E+04
Tetrachloroethene	2.04E+04	3.87E+02	3.87E+02
Toluene	7.94E+03	ND	7.94E+03
Trichlorofluoromethane	2.63E+03	ND	2.63E+03
Xylenes	4.09E+06	ND	4.09E+06

Metal	UBC (mg/kg)	Statistical Method	HSRA Table 2, Appendix III Values
Arsenic	2.6	Log-normal data Mean + 1.645 std. Dev	20
Barium	28	Log-normal data Mean + 1.645 std. Dev	1000
Cadmium	2.6	Non-Parametric, Max observed value	2
Chromium	7.7	Log-normal data Mean + 1.645 std. Dev	100
Lead	53	Log-normal data Mean + 1.645 std. Dev	75
Mercury	0.39	Non-Parametric, Max observed value	0.5
Selenium	1.9	Log-normal data Mean + 1.645 std. Dev	2
Silver	2.6	Non-Parametric, Max observed value	2

As indicated above, the UBC for arsenic, barium, chromium, lead, mercury, and selenium are below the HSRA Table 2, Appendix III values (which are based on GAEPD's estimate of statewide background). The UBCs were then used to evaluate where metals concentrations exceeded background and if the extent of metals could be delineated using the existing data. The results of the evaluation indicated that most of the exceedences of the background concentration (i.e., UBCs) were within the excavated area and areas immediately adjacent to the excavated area. The evaluation also indicated that the extent of the metals in soils was not completely delineated to the north and west of the excavated area. Additional delineation for chromium was conducted to the north of HMW-13 and to the west of HMW-11, for barium to the west of SB-13 (Figure 4.11).

Groundwater

Background groundwater samples from off-site locations were not collected during the 1999/2000 CSR assessment activities. However, review of previous groundwater analytical data collected during 1995 indicated that VOCs, PAHs, and metals (except barium) were not detected in groundwater samples

ARCADIS
Infrastructure, environment, facilities

Imagine the result

Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP)

Fort Stewart Military Reservation and Hunter Army Airfield, Georgia

February 2009

ARCADIS

Jane Kennedy
Project Chemist

Shelley D. Gibbons
Associate Project Manager

Charles A. Bertz, PE
Senior Project Manager

Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP)

Fort Stewart Military Reservation and Hunter Army Airfield, Georgia

Prepared for:
US Army Environmental Command

Prepared by:
ARCADIS
801 Corporate Center Drive
Suite 300
Raleigh
North Carolina 27607
Tel 919.854.1282
Fax 919.854.5448

Our Ref.:
GP08HAFS.SW00

Date:
February 5, 2009

Table of Contents

1. Introduction **1-1**

2. Site Preparation and Mobilization Procedures **2-1**

- 2.1 Initial Coordination 2-1
- 2.2 Mobilization and Subcontractor Coordination 2-1
- 2.3 Utility Clearance 2-1
- 2.4 Site Reconnaissance 2-2
- 2.5 Field Operations Contingency Plans 2-2
- 2.6 On-Site ARCADIS Representative 2-3
- 2.7 Contractor Compliance and Permitting 2-3
- 2.8 Adherence to Technical Specifications 2-4

3. Field Investigation Procedures **3-1**

- 3.1 Lithologic Logging 3-1
- 3.2 Direct Push Borings and Sample Collection 3-2
  - 3.2.1 Soil Sample Collection 3-2
  - 3.2.2 Groundwater Sample Collection 3-3
  - 3.2.3 Membrane Interface Probe Borings 3-4
  - 3.2.4 Temporary Piezometer Installation 3-4
  - 3.2.5 Temporary Piezometer Fluid Gauging 3-5
  - 3.2.6 Direct Push Boring Abandonment 3-6
  - 3.2.7 Temporary Piezometer Abandonment 3-6
- 3.3 Drilling Techniques 3-6
  - 3.3.1 Hollow-Stem Auger Techniques in Soil 3-6
  - 3.3.2 Mud Rotary Drilling 3-7
  - 3.3.3 Rotasonic Drilling Methodology 3-8
- 3.4 Collection of Samples for Geotechnical and Chemical Analyses 3-9
  - 3.4.1 Geotechnical Samples in Soil and Unconsolidated Deposits 3-9
  - 3.4.2 Geotechnical Samples in Sediment 3-10

3.4.3 Samples for Chemical Analyses 3-11

3.5 Monitoring Well Construction 3-12

3.5.1 Shallow and Intermediate Well Construction 3-12

3.5.2 Pre-pack Screen Monitoring Well Construction 3-14

3.5.3 Monitoring Well Construction Beneath a Confining or Semi-Confining Layer 3-14

3.5.4 Borehole and Well Abandonment 3-16

3.5.5 Temporary Well Abandonment 3-16

3.5.6 Soil Boring Abandonment 3-16

3.6 Groundwater Level Measurements and Sampling 3-17

3.6.1 Groundwater Level Measurements 3-17

3.6.2 Low-Flow Groundwater Purging and Sample Collection 3-18

3.6.3 Slug Test 3-21

3.6.4 Constant Rate Pump Test 3-22

3.6.5 LNAPL Bail Down Test 3-23

3.7 Test Pit Excavations 3-24

3.8 Sediment Sampling 3-24

3.8.1 Shallow Ditch Sediment Sampling 3-24

3.8.2 Deep Ditch Sediment Sampling 3-25

3.8.3 Shallow Stream Sediment Sampling 3-27

3.9 Surface Water Sampling 3-28

3.10 Field Analytical Measurements 3-30

3.11 Quality Control Samples 3-30

3.12 Field Equipment Decontamination 3-32

3.12.1 Cleaning Materials 3-32

3.12.2 Marking and Segregation of Used Field Equipment 3-33

3.12.3 Safety Procedures to be Utilized During Cleaning Operations 3-33

3.12.4 Storage of Field Equipment and Sample Containers 3-33

3.12.5 Cleaning Procedures 3-34

3.12.5.1 Drilling and Direct Push Equipment 3-34

3.12.5.2 Teflon^{TM}, Stainless Steel, or Glass Field Sampling Equipment 3-34

3.12.5.3 Other Sampling Equipment 3-35

3.12.5.4 Trace Organic Sampling Equipment 3-35

3.12.5.5 Field Analytical Equipment and Other Field Instruments 3-36

3.12.5.6 Ice Chests and Shipping Containers 3-36

3.12.6 Disposable Materials 3-36

3.13 Characterization and Disposal of Investigative Derived Wastes 3-37

3.13.1 Soils/Sediment/Waste 3-37

3.13.2 Water 3-37

3.14 Site Survey 3-37

4. Field Documentation Procedures 4-1

4.1 Sample Designation 4-1

4.2 Field Activity Documentation 4-3

4.2.1 Utilities and Structures Checklist 4-4

4.2.2 Location Sketch 4-4

4.2.3 Boring/ Well Construction Logs 4-4

4.2.4 Water Level Measurement Form 4-4

4.2.5 Sample Key 4-4

4.2.6 Sampling Location Survey Summary 4-5

4.2.7 Water Sample Log 4-5

4.2.8 Groundwater Sampling Form 4-5

4.2.9 Well Sampling Summary 4-5

4.2.10 Water Level/Pumping Test Record 4-5

4.2.11 Soil/Sediment Sample Log 4-5

4.2.12 Soil Sampling Summary 4-6

4.2.13 Surface Water Sample Log 4-6
4.2.14 Field Instrument Calibration Form 4-6
4.2.15 Daily Log 4-6
4.2.16 Sample Label 4-7
4.2.17 Chain-of-Custody Form 4-7
4.2.18 Chain-of-Custody Seal 4-8
4.2.19 Bill of Lading 4-8
4.3 Chain-of-Custody Procedures 4-8
4.3.1 Transfer of Custody 4-9
4.3.2 Sample Preparation and Shipment 4-9
4.3.3 Laboratory Sample Receiving 4-9
5. References 5-1

Figure

3-1 Well Schematic for Prepacked Screens

Appendices

A Site-Wide QAPP
B Field Forms
- Utilities and Structures Checklist
- Location Sketch
- Boring/Well Construction Log
- Well Construction Log (Unconsolidated)
- Well Construction Log - Telescoping
- Well Development Form
- Geoprobe® Groundwater Sample Form
- Well Sampling Summary
- Water Level Measurement Form
- Water Level/Pumping Test Record
- Sample Key

- Sampling Location Survey Summary
- Soil/Sediment Sample Log
- Soil Sampling Summary
- Groundwater Sample Form
- Surface Water Sample Log
- PID Calibration Form
- Field Instrument Calibration Log
- Daily Log
- Chain-of-Custody Record

Acronyms and Abbreviations

amsl	above mean sea level
ARCADIS	ARCADIS U.S., Inc.
ASTM	American Society for Testing and Materials
bgs	below ground surface
COC	chain of custody
DPW	Department of Public Works
FID	flame ionization detector
ft	feet
GAEPD	Georgia Environmental Protection Division
gpm	gallons per minute
GPS	global positioning system
HASP	Health and Safety Plan
HSRA	Hazardous Site Response Act
IDW	investigative derived waste
MIP	membrane interface probe
mL/min	milliliters per minute
MS/MSDs	matrix spike/matrix spike duplicates
NAPL	non-aqueous phase liquid
NTUs	nephelometric turbidity units
O.D.	outside diameter
ORP	oxidation reduction potential
OCGA	Official Code of Georgia Annotated
PBC	Performance Based Contract

PCB	polychlorinated biphenyl
PID	photoionization detector
PVC	polyvinyl chloride
QAPP	Quality Assurance Project Plan
QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
SAP	Sampling and Analysis Plan
TCLP	Toxicity Characteristic Leaching Procedure
UPC	Utility Protection Center
USEPA	United States Environmental Protection Agency
USCS	Unified Soil Classification System
VOC	volatile organic compound

1. Introduction

This Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) was prepared by ARCADIS U.S., Inc. (ARCADIS) to provide field personnel with detailed instructions and procedures regarding field activities to be performed in support of Resource Conservation and Recovery Act (RCRA) and Hazardous Site Response Act (HSRA) remedial activities and to document the performance of all environmental field activities at the Fort Stewart Military Reservation and Hunter Army Airfield in Georgia.

This site-wide SAP provides a detailed description of the field investigation methodologies that will be used to complete the RCRA and HSRA remedial process at the Sites included in ARCADIS' Performance Based Contract (PBC) contract. The QAPP, included as Appendix A, presents the policies, organization, objectives, functional activities, and specific quality assurance/ quality control (QA/QC) procedures. The QA/QC procedures will be employed by ARCADIS to ensure that all technical data generated are accurate and representative, and the data will be of known and usable quality for the intended purpose. Site-specific work plans that further define the scope of activities to be performed at each individual Site will reference this plan for the general procedures to be used in completing the prescribed field activities.

ARCADIS field personnel will use the procedures described in this SAP to produce accurate, comparable, and reproducible data for reduction and evaluation. This SAP is divided into four sections. A brief description of each section is provided below:

- **Section 1, Introduction** – Summarizes the purpose and organization of the plan.

- **Section 2, Site Preparation and Mobilization Procedures** – Describes the tasks to be performed prior to mobilization to the field, including notification and coordination requirements.

- **Section 3, Field Investigation Procedures** – Presents a detailed discussion of the procedures to be used in completing the field tasks, including information on drilling, well construction, sampling, decontamination, investigation derived waste, and the site survey.

- **Section 4, Field Documentation Procedures** – Outlines the methods to be used for sample designation, chain-of-custody (COC) procedures, and field documentation.

Throughout this SAP, reference is made to standard forms and logs used by ARCADIS field personnel to record field observations and measurements. Examples of each of these forms are provided in Appendix B of this SAP.

2. Site Preparation and Mobilization Procedures

Initial project coordination, subcontractor coordination, and utility clearance activities will be conducted prior to initiating the field sampling activities. These pre-mobilization activities are discussed in the following subsections.

2.1 Initial Coordination

The Fort Stewart and Hunter Army Airfield environmental staff will be notified at least 2 weeks before the start of any field work.

2.2 Mobilization and Subcontractor Coordination

The subcontractors, including drillers, laboratories, and surveyors, will be selected and contracts will be executed in advance of beginning the field activities.

2.3 Utility Clearance

Prior to mobilization, all underground utility lines, and other underground structures will be clearly marked. ARCADIS personnel will be responsible for making certain the underground utilities and structures are located and marked. ARCADIS is responsible for submitting a utility locate request through the Georgia Utility Protection Center (UPC). UPC will accept these locate request either by phone or internet. The phone number is (800) 282-7411. The UPC web address is www.gaupc.com and click on IRTH login to make the request. In order to submit a request using the website, pre-registration will be required. The contractor must mark the boundaries of the proposed work site using either white paint, flags or stakes. Department of Public Works (DPW) will accept responsibility for accuracy of the locates pertaining to gas and fuel lines, water lines, electrical lines to include secondary electricity, airfield lighting, low voltage, fire systems, sewer lines, roof drain lines, storm drain lines, industrial waste lines, chilled water lines, high temperature water lines, irrigation systems, and DPW non-fiber computer lines. These requests will be forwarded to all utility companies with services present within the proposed work site.

Permits will be issued within 48 hours of the next business day following the receipt of the request by UPC. The permits will only be valid for 21 days and renewal requests should be submitted a minimum of 3 days prior to expiration. Requesting contractors are responsible for maintaining marks during the 21-day period. If, after acquiring a permit, a utility is damaged during field activities, the appropriate utility company must be notified. DPW's utilities are listed above and the points of contact are:

Fort Stewart	Carletha Joyce	(912) 767-6669
HAAF	Tony West	(912) 315-5523

The contractor should be prepared to submit proof of a valid permit at that time.

ARCADIS personnel will be responsible for notifying the Fort Stewart and Hunter Army Airfield environmental office of planned intrusive activities at least 2 weeks prior to the initiation of field activities. Upon arrival at the installation, the field operations leader will check the proposed drilling, sampling, and trenching locations for marked underground utilities, other underground structures, and above-ground pipe racks or power lines. A Utilities and Structures Checklist (Appendix B) will be completed by the Field Operations Leader for each area to be sampled prior to commencement of field activities. A copy of the completed checklist will be retained in the ARCADIS project file.

2.4 Site Reconnaissance

Prior to startup of drilling or sampling activities in a particular area, field personnel will conduct a brief site reconnaissance to determine if any problems with the drilling or sampling locations will be encountered. The sampling locations will be sketched on the Location Sketch Form (Appendix B). In addition, at the start of field activities at each Site, the field personnel will notify the Fort Stewart and Hunter Army Airfield environmental staff of the work schedule, and sampling and drilling locations.

2.5 Field Operations Contingency Plans

If during the field program, any unforeseen problems or conditions are encountered that require re-evaluation or corrective action, such as, but not limited to, extreme precipitation events, site emergencies that require evacuation of field personnel, changes in site conditions, security problems, loss of power or communications, or community relations problems, the following contingencies will be put into place:

- For any problem or condition encountered by the field team, the team personnel will immediately notify the Fort Stewart and Hunter Army Airfield environmental staff and/or the ARCADIS Project Manager for direction or approval of corrective action.

- If the problem or condition requires downtime at the site and re-evaluation of any site conditions, assumptions made about the site conditions, or plans prepared for the site, the field team will contact the ARCADIS Project Manager and the Fort Stewart and Hunter Army Airfield environmental staff for consultation.

- If after consultation, the problem or condition continues, the field program will remain on hold until direction is received from the Fort Stewart and Hunter Army Airfield representative and/or ARCADIS Project Manager. The field program will not continue until the problem is resolved.

- Any time these contingency procedures are implemented, the following will be documented in the daily log of activities:

    - Problem or condition encountered;
    - Personnel involved;
    - Management personnel contacted;
    - Corrective actions taken, if any; and
    - Dates and times involved.

2.6 On-Site ARCADIS Representative

A qualified ARCADIS representative will be on-site during all probing, drilling and sample collection activities. The ARCADIS representative will have in their possession a copy of the Site-Specific Work Plan and the associated Site-Wide Work Plans, including the SAP, QAPP, and Health and Safety Plan (HASP). The Site-Wide Work Plans encompass work at all Fort Stewart and Hunter Army Airfield PBC sites. The ARCADIS representative will also have on-site any equipment, tools, references, and documentation necessary to collect, describe, and document the information generated from the field activities.

2.7 Contractor Compliance and Permitting

The contractors selected for this project shall comply with any and all installation, local, state, and federal health and safety regulations and requirements. The contractors are responsible, per ARCADIS' contractual agreements, for securing and/or complying with permits required by state or local authorities. The selected contractors will have the necessary license(s) or certifications required to perform such work in Georgia.

2.8 Adherence to Technical Specifications

All work performed by ARCADIS or a contractor, whether it be drilling, sampling, equipment decontamination or other related activities will be in accordance with the procedures described in this SAP, and properly and completely documented by the on-site ARCADIS representative on forms provided herein (Appendix B).

3. Field Investigation Procedures

A detailed discussion of the field procedures that will be employed to complete the field tasks is provided in the following sections. All field procedures are in accordance with the United States Environmental Protection Agency (USEPA) Field Branches Quality System Technical Procedures (USEPA, 2008).

All soil, groundwater, and surface water samples collected will be analyzed by a certified Georgia Laboratory as listed in the Site-Wide QAPP (Appendix A). Samples will be preserved according to the selected analytical method. Specific method preservation requirements, size and type of sample containers to be used, and holding times for each parameter are listed in the Site-Wide QAPP (Appendix A).

3.1 Lithologic Logging

The lithology of the soil and bedrock samples collected will be described through visual observations of the soil/bedrock cores using the Unified Soil Classification System (USCS) and/or the American Society for Testing and Materials (ASTM) International Standard D 2488 for Description and Identification of Soils. The Boring/Well Construction Log (Appendix B) will be used to record lithologic logging observations. The following logging sequence will be used for the description of unconsolidated materials:

- Describe major soil type and percentage;

- Describe composition of the soil;

- Describe the moisture, texture, and color of the soil;

- Document other geologic observations such as bedding characteristics, structure and orientation, and primary and secondary permeability/porosity (if possible); and

- Document observations on drilling progress including sample interval loss and recovery.

3.2 Direct Push Borings and Sample Collection

Direct-push soil sampling consists of hydraulically pushing or driving a small diameter, hollow steel rod to a target depth and collecting a soil or groundwater sample. The equipment necessary for the collection of samples using the direct push technique is mounted on a regular van or truck for ease of mobility. The steel probe rods, 3 feet (ft) to 4 ft in length, are threaded for easy connection and have tight seals to provide a continuous length of rod. The rods are hydraulically driven or hammered to target depths. The steel rods can be driven to depths of up 150 ft through unconsolidated sediments.

3.2.1 Soil Sample Collection

The following procedures will be used during the collection of soil samples from direct push borings:

1. Record borehole location and intended sample depth intervals on the Boring/Well Construction Log (Appendix B).
2. Line the 3-ft or 4-ft steel soil sampler core barrel with an acetate, polyethylene or Teflon liner and attach sampler to end of steel rods.
3. Hydraulically push or drive the 3-ft or 4-ft soil sampler and rods to intended depth. Soil samples will be collected from intervals specified in the Site-Specific Work Plan.
4. Open the core barrel and disassemble revealing the soil core sample within the liner. Label the depths on each end of liner and mark the top and bottom to maintain proper core orientation
5. Remove a portion of the liner over the entire length of the core using an appropriate cutting tool.
6. Screen soils immediately in the field using a photoionization detector (PID) or flame ionization detector (FID) to document the levels of organic vapors present. To collect volatile organic headspace readings, place the soil sample in a sealed plastic bag approximately two-thirds full allowing for approximately 30 percent headspace. Place the bag in a dry area, which is as close to room temperature (70º F) as practical. After 10 minutes, use a PID or FID to measure the vapors that accumulate in the bag due to off-gassing from the sample. Base PID/FID usage on the target analytes. If a PID is used, select

the appropriate lamp based on the target analyte. Record the measurement on the Sample/Core Log.

7. Collect soil sample(s) for laboratory analysis. Don a clean pair of disposable gloves immediately prior to sample collection. VOC samples will be collected directly from the target depth interval of the soil core to minimize disturbance using an EnCore™ sampler or equivalent (Terra Core). Transfer the remaining soil from the target depth interval to a stainless steel bowl. Mix the soil using a stainless steel spoon until the sample is visually uniform. Remove any debris or larger rocks observed during mixing using the spoon. Collect non-VOC analysis samples from the bowl and place in appropriate sample container, label the container, and place on ice. Note on the field sample log the depth interval from which the sample aliquot was collected. The container and preservative requirements for soil samples are outlined in the Site-Wide QAPP (Appendix A). Double-bag the ice used for sample shipment in self-sealing bags prior to placement in the cooler.
8. Extract from the liners the portion of the soil core not submitted to the laboratory for analysis and use for logging purposes.
9. Describe the soil samples in the field. The lithology of the soil will be described by a qualified and experienced ARCADIS representative through visual observations of the soil core using the USCS or ASTM designation.
10. Place all soil cuttings in drums or roll-off box.
11. Properly decontaminate all down-hole sampling equipment prior to subsequent use in consecutive sample collection. Decontamination procedures are described in Section 3.12.

3.2.2 Groundwater Sample Collection

The following procedures will be used during the collection of shallow groundwater samples from direct push borings. When sampling for metals from direct push borings, both total and dissolved metals will be analyzed to assess the effect of turbidity on the sample results. Polychlorinated biphenyl (PCB) samples will not be collected from direct push borings.

1. Record sampling location and intended sample depth intervals on the Geoprobe® Groundwater Sampling Form (Appendix B).

2. Drive a stainless steel retractable screen attached to the bottom of the hollow steel rods to the target depth beneath the groundwater table. Target depths will be specified in the Site-Specific Work Plan for each Site.
3. Raise rods to approximately 2 to 4 ft to allow the screen to be exposed at the target depth, thus allowing collection of groundwater samples at the target depth.
4. Insert polyethylene or Tygon tubing (1/4-inch diameter) into the hollow rods to allow for collection of grab groundwater samples with a peristaltic pump or dedicated tubing with a check valve assemblage. The tubing with check valve method will be used as the sole means of collecting samples for volatiles organic analysis.
5. Don a clean pair of disposable gloves immediately prior to sample collection. Collect groundwater samples directly into laboratory-prepared, preserved sample bottles and place directly on ice. Fill the sample bottles in the following order: volatile organic compounds (VOCs) first, then remaining analytes.
6. Prepare sample containers according to the container and preservative requirements outlined in the QAPP (Appendix A). Include on the sample label the following: sample identifier, laboratory methodology requested, the sample matrix, date, time, project name, and name of sampler.

3.2.3 Membrane Interface Probe Borings

The Membrane Interface Probe (MIP) is a type of direct push tool, advanced by a standard direct push rig that logs both total VOC concentrations and soil conductivity with depth. The following procedures will be used during the completion of direct push borings using the MIP.

1. Record borehole location on the Boring/Well Construction Log (Appendix B).
2. Hydraulically push the MIP and rods to intended target depth, typically not greater than 60 ft below ground surface (bgs). Because the MIP probe cannot be hydraulically hammered, the MIP probe cannot be driven as deep as conventional Geoprobe® borings.

3.2.4 Temporary Piezometer Installation

Temporary piezometers may be installed in selected Geoprobe® groundwater boring locations in accordance with the Official Code of Georgia Annotated (OCGA) Well

Standards 12-5-134 (State of Georgia, 2008). The temporary piezometer installation procedures are discussed below.

1. After the collection of groundwater samples from the selected Geoprobe® groundwater borings, a temporary piezometer will be installed in the borehole and will be constructed with 10 ft sections of 1-inch to 1¼-inch diameter polyvinyl chloride (PVC) screen and riser.
2. The natural formation will be allowed to collapse around the piezometers.
3. The annular space around the upper 10 ft of the piezometer will be filled with granular bentonite and then hydrated to prevent possible interference from surface water leakage.
4. Because the piezometer is considered temporary, a concrete surface pad will not be installed. Unless otherwise approved by the Georgia Environmental Protection Division (GAEPD), temporary piezometers will be converted to permanent monitoring points or abandoned within 5 days.
5. Each piezometer will be closed with a PVC cap.

3.2.5 Temporary Piezometer Fluid Gauging

Static fluid levels in each temporary piezometer will be gauged using an electronic water-level indicator. Fluid-level measurements will be documented on the Water Level Measurement Form (Appendix B) and will later be converted to mean sea level for reporting purposes.

The following procedures will be implemented when collecting fluid-level measurements:

1. Remove the piezometer cap and document the general condition of the piezometer. In areas where non-aqueous phase liquids (NAPLs) are known to exist or have been present in the past, a PID or FID will be used to check the well for build-up of potentially hazardous gases.
2. Measure static fluid-level elevation using an electronic water-level indicator from fixed reference point (generally the north side of the top of the PVC casing).
3. Repeat the measurements every 5 minutes until two consecutive measurements are obtained that are within 0.01 ft.

Fluid-level measurements will be referenced to a surveyed elevation point located on the top of the piezometer casing. All fluid-level measurements will be taken at least two times to check the reproducibility of the measurement data. If it is found that the measurement cannot be reproduced, a second set of data will be collected. Fluid levels will be collected until the data can be reproduced. This measurement validation process ensures the accuracy of the fluid-level data.

Equipment used to measure the fluid level will be properly decontaminated before first use and between use at each well using the procedures described in Section 3.12.

3.2.6 Direct Push Boring Abandonment

Direct push soil borings installed at the site will be abandoned by allowing the saturated portion of the formation (i.e., unconsolidated sands and gravel) to collapse back into the 2-inch diameter borehole as the Geoprobe® rods are retracted. The upper 10 ft of the borehole will be plugged with granular bentonite and hydrated with potable water to make an impermeable seal.

3.2.7 Temporary Piezometer Abandonment

After the well casing and screen materials from the temporary piezometers have been pulled out of the ground, the borehole will either be filled with granular bentonite or a high solids bentonite-cement slurry mix to within at least three feet of ground surface. If bentonite is used, it will be hydrated with potable water, and the remainder of the borehole will be filled with native soil or clay.

3.3 Drilling Techniques

All soil borings and monitoring wells will be drilled and installed by a Georgia licensed water well driller.

3.3.1 Hollow-Stem Auger Techniques in Soil

Dependent on subsurface soil conditions at the Sites, shallow soil borings may be drilled using hollow-stem auger techniques (ASTM 1452). Soil samples can be collected continuously (if so scoped in a site-specific work plan) using a continuous sampler, or split-spoon sampler (ASTM 1586 and 1587) depending upon percent recovery realized using the continuous core sampler. The following steps outline the procedures that will be used to drill a shallow borehole for geotechnical or analytical purposes and for the installation of a monitoring well.

1. Record borehole location on the Location Sketch form and intended sample depth intervals on a Boring/Well Construction Log (Appendix B).

2. Clean and assemble the continuous sampler. The continuous core sampler (5 ft in length by 6 inches outside diameter (O.D.) is advanced in the borehole ahead of the augers (8-inch O.D.) and retrieved through the hollow-stem portion of the augers after each 5 ft drilled.

3. Disassemble the core barrel, revealing the soil core sample. Screen the soil samples with a PID/FID and describe in the field using the logging method described in Section 3.1.

4. Collect discrete samples from the core sample based on field screening data (prior to logging) and place in laboratory-prepared glass jars for analytical purposes. The preservation and handling of the samples is discussed in Section 3.4.3.

5. If continuous core sampling is not possible due to the character of the subsurface material encountered, collect samples every 5 ft using a standard split-spoon sampler (2 ft by 2 inch O.D.). Attach the split spoon to the drill rods, insert within the hollow-stem auger, and drive into the unconsolidated deposits using a standard 140-pound drop hammer and rig-driven cathead. Record blow counts for each 6-inch penetration of the split spoon. Drive each split spoon a total of 24 inches.

6. Collect all soil cuttings generated during the drilling of the boreholes and store temporarily on plastic or in a drum or roll-off box while awaiting characterization.

3.3.2 Mud Rotary Drilling

The mud-rotary system consists of a drilling fluid mixture of potable water and bentonite that is pumped down the inside of the drill pipe, and then returned to the surface through the annulus between the drill pipe and the borehole wall. This fluid cools the drill bit, carries the cuttings to the surface, prevents excessive fluid loss into the formation, and prevents the formation from collapsing. The drilling fluid flows into a mud pit where the cuttings settle out and then is pumped back down the drill rods.

The following steps outline the procedures that will be used for mud rotary drilling.

1. Record borehole location and intended sample depth intervals (if appropriate) on the Boring/Well Construction Log (Appendix B).

2. Drill the deep boreholes from the surface to 1 to 2 ft into the bedrock using a mud rotary drilling rig equipped with a six-inch bit and stabilizer. No formation sampling will be conducted in the deep boreholes.

3. Record any significant or sudden fluid loss or production and soil cutting observations from drilling mud on the Boring/Well Construction Log (Appendix B).

4. Terminate the borehole within the upper 1 to 2 ft of the bedrock surface, which will be determined by the detection of the bedrock fragments in the return mud.

5. Collect all drill cuttings generated during the deep borehole drilling and temporarily stage in either 55-gallon steel drums or a roll-off box while awaiting chemical characterization as discussed in Section 3.13.

3.3.3 Rotasonic Drilling Methodology

Monitoring wells and the soil borings (other than those drilled using direct push methods) will have the option to also be drilled using rotasonic drilling methods. The rotasonic drilling method uses a combination of rotary power, hydraulic pull down pressure, and mechanically generated oscillations to advance a dual line of drill pipe. The top mounted hydraulically powered drill head transmits the rotary power, hydraulic down pressure, and vibratory power directly to the dual line of pipe. The inner drill pipe, measuring from 3-inch to 9-inch I.D., contains a core bit and represents the core barrel sampler. The outer pipe, measuring 4 inches to 12 inches, is used to prevent the collapse of the borehole and is therefore used in the construction of monitoring wells from 1 inch to 8 inches in diameter. This combination of forces advances the inner core barrel sampler through typically difficult unconsolidated deposits and some consolidated formations without the use of mud or air.

Water is not necessary during drilling but may be used in small quantities to help lubricate the drill pipe as it is advanced. Drilling rates are equal to or greater than other conventional rotary methods when they include some method of continuous sampling. The inner drill pipe is always advanced in front of the outer drill pipe. Continuous core samples of 1 foot to 20 ft can be completed depending on job specifications and site conditions.

During typical borehole advancement, the first step is to advance the inner drill pipe and core bit about 6 ft or 10 ft into the ground. Once the inner drill pipe is set, the outer drill pipe is advanced down over the inner drill pipe to hold the boring open. The inner drill pipe is mechanically lifted by the drill head to the surface for core sample recovery. The core sample is vibrated out of the inner drill pipe into a plastic sheath or a stainless steel sample tray. The core sample also can be collected in a split stainless steel or a lexan core barrel liner. The inner drill pipe is then advanced to the top of the next sample interval. These steps are repeated until the desired total depth is reached. Installation of a well would be performed inside the outer drill pipe, which would be removed as the well materials are installed. This will keep the borehole walls from collapsing and ensure that a good sand pack is installed. Monitoring well construction details are discussed in Section 3.5.

All drilling and sampling equipment will be decontaminated according to the procedures outlined in Section 3.12 of this report between each borehole location.

3.4 Collection of Samples for Geotechnical and Chemical Analyses

The procedures for the collection of soil samples during hollow stem auger drilling for geotechnical and chemical analyses are described below.

3.4.1 Geotechnical Samples in Soil and Unconsolidated Deposits

1. Record the soil sample location, depth, date and time of collection, sample identification, name of sampling personnel, and type of drilling and sampling equipment on the Boring/Well Construction Log (Appendix B).

2. Clean and assemble the continuous or split-spoon sampler. The sampler will be fitted with 6-inch long California (brass) rings or equivalent sampler liners, so that soil samples can be retrieved with minimum disturbance for geotechnical analyses.

3. Lower the sampler through the drill stem to the desired sampling depth. If using a split-spoon sampler, drive the sampler with a standard 140-pound hammer free-falling 30 inches in accordance with ASTM Method D1586. Record the number of blows per foot required to drive the split spoon.

4. After the continuous core barrel or split-spoon sampler is retrieved and opened, mark with indelible ink the depths of the sample at the top and bottom of each brass ring. Don a clean pair of disposable gloves immediately prior to sample collection. Using a stainless steel spatula or knife, cut the soil sample between the brass rings. Using plastic caps, cap each end of each ring. Label each ring with the appropriate sample designation.

5. The geotechnical samples do not have to be placed on ice or chilled.

6. Submit to geotechnical laboratory using COC procedures (Section 4.3).

7. From the remaining soil core, conduct field screening and describe soil sample lithology using procedures outlined in Section 3.1.

8. Alternate methodologies that may be used to obtain geotechnical samples, such as the use of a Shelby tube, will be described in the Site-Specific Work Plan for each Site.

3.4.2 Geotechnical Samples in Sediment

The procedures for the collection of geotechnical samples from shallow and deep sediments are outlined below.

1. If standing water is located over the sampling location and a deep sediment sample is to be collected, then the upper sediment and surface water should be removed prior to sample collection. Drive a minimum 4-inch O.D. schedule 40 PVC blank casing into sediment sampling location. Place a wooden board on top of PVC casing while driving casing into sediment to prevent breaking the casing. Use peristaltic pump to remove surface water from casing.

2. If collecting the geotechnical sample at 1.5 to 2.0 ft bgs, remove overburden with a decontaminated stainless steel bucket auger to a depth just above top of sampling depth (i.e., 1.5 ft bgs).

3. Drive a decontaminated 1 to 2-inch diameter stainless steel soil sampler lined with a plastic or acetate liner to depth required. A disposable acetate or thin walled stainless steel soil probe may also be used.

4. If a gravelly substrate is encountered, a decontaminated bucket auger may be used to collect the sample from 1.5 to 2.0 ft bgs.

5. Cap the liner and retract the sampler. The sample core may not remain in the sampler or tube if the top is not capped.

6. Cap the bottom of the sample. If a liner is used, remove the liner from the sampler, then cap the bottom of the sample.

7. If freestanding water was also captured in the sampling tube or liner, remove the top cap and gently pour off the water without disturbing the sediment sample.

8. Don a clean pair of disposable gloves immediately prior to sample collection. If using a bucket auger to collect the geotechnical sample, remove sample from bucket and pack into laboratory container.

9. Document the sample on a Soil/Sediment Sample Log (Appendix B).

10. The geotechnical samples do not have to be placed on ice or chilled.

11. Submit to geotechnical laboratory using COC procedures (Section 4.3).

3.4.3 Samples for Chemical Analyses

The procedures for collection of samples for chemical analyses are outlined below.

1. Record the soil sample location, depth, date and time of collection, sample identification, name of sampling personnel, and type of drilling and sampling equipment on the Boring/Well Construction Log (Appendix B).

2. Clean and assemble the continuous core barrel or split-spoon sampler.

3. Lower the sampler through the drill stem to the desired sampling depth. If using a split-spoon sampler, drive the sampler with a standard 140-pound

hammer free-falling 30 inches in accordance with ASTM Method D1586. Record the number of blows per foot required to drive the split spoon sampler.

4. After the continuous core barrel or split-spoon sampler is retrieved and opened, collect soil samples for chemical analysis. Don a clean pair of disposable gloves immediately prior to sample collection. Collect VOC samples directly from the core barrel or spit spoon sampler using an EnCore™ sampler or equivalent (Terra Core) to minimize sample disturbance. Place the remaining soil sample volume into a stainless steel bowl. Mix the soil using a stainless steel spoon until the sample is visually uniform. Remove any debris or larger rocks from the soil during the mixing process using the spoon. Place the remaining soil samples into their appropriate containers. If the sample material is of size or consistency that an EnCore sampler cannot be used, place the material in a glass 4-ounce container. Immediately store the containers in a cooler on ice at 4º C. Complete the sample label for soil samples selected for analyses.

5. Document the sample on a Soil/Sediment Sample Log.

3.5 Monitoring Well Construction

3.5.1 Shallow and Intermediate Well Construction

The shallow and intermediate wells will be installed in boreholes drilled using hollow-stem auger techniques. Monitoring well construction details will be documented on the appropriate Well Construction Log (Appendix B). No water will be introduced during monitoring well construction unless the borehole conditions require stabilization. If required, the water will be obtained from the Fort Stewart or Hunter Army Airfield potable water system.

1. The screened interval for all monitoring wells is anticipated to be 5- to 10 foot-sections of factory-milled 10-slot, 2-inch O.D., schedule 40 PVC screen, placed in the bottom of each well. The well screen attached to threaded, flush joint, 2-inch O.D., schedule 40 PVC casing will be inserted in the borehole through the minimum 6.25-inch O.D. hollow-stem auger.

2. The screened interval of the monitoring wells will be specified in the Site-Specific Work Plan for each Site.

3. PVC casing will be threaded to the screen and brought to a height of 3 ft above ground level for completion.

4. The annular space between the well and the borehole wall will be backfilled with a clean, graded, size 20 to 40 silica sand pack that will extend from the bottom of the borehole to a minimum of 2 ft above the top of the screened interval. The sand pack will be placed by tremie pipe from the bottom of the borehole through the hollow-stem augers to ensure complete placement around the well screen. The hollow stem auger will be retrieved as the sand pack is emplaced and can typically serve as the tremie pipe for filter pack placement.

5. Approximately 1 ft of very fine sand grade size 50 or smaller may be emplaced above the filter pack to prevent the migration of the bentonite slurry into the well screen.

6. A minimum thickness of 3 ft of bentonite pellets or chips will be placed on top of the filter pack as a seal. If the seal is within the unsaturated zone at the time of installation, granular bentonite will be placed in one-foot lifts, saturated with potable water, and allowed to hydrate. Hydration time will conform to the manufacturer’s recommendations before further work on the well is performed.

7. The annular space from the top of the bentonite seal to within 1 foot beneath the frost line (approximately 30 to 36 inches bgs) will be filled with a cement and bentonite slurry containing high solids mixed to the manufacturer’s specifications. Alternatively, cement/bentonite slurry consisting of 8 gallons water and 5 percent bentonite by weight per bag of Portland cement will be used, with a target density of 14 to 15 pounds per gallon. The bentonite slurry will be placed with a tremie pipe from the bottom of the annular area to be grouted to ensure proper placement of the slurry.

8. The remaining annular space near land surface will be filled with concrete. All wells will be completed above grade using a protective steel cover. A concrete apron will be installed around the cover. The apron will be a minimum of 2 ft by 2 ft and 6 inches in thickness, and shall be sloped to promote drainage away from the well. The wells will also be equipped with locking caps.

9. At selected locations, steel guard posts or protective barriers will be installed around the wells in a manner designed to prevent vehicles from accidentally damaging the well.

3.5.2 Pre-pack Screen Monitoring Well Construction

For shallow to intermediate monitoring wells where heaving (flowing) sands are expected to be encountered, an alternative method of monitoring well construction would include the use of pre-packed screens during well construction. Figure 3-1 shows the well schematic for the prepacked screens. The construction of these wells would follow the same steps detailed in Section 3.5.1 with the following exceptions.

1. The screened portion of the monitoring well will consist of 5- to 10-foot sections of pre-packed screen. In the case of 2-inch diameter well, the screen will have a 2.0-inch I.D. and a 3.63-inch O.D. Previous site investigations have shown that the 12-slot screen with a 10 by 20 sand pack will be more than adequate for construction of the monitoring well.

2. Formation material will be allowed to collapse around the screen upon removal of the augers to a point 2 ft above the screened interval.

3.5.3 Monitoring Well Construction Beneath a Confining or Semi-Confining Layer

Installation of monitoring wells beneath a confining or semi-confining layer is outlined in the procedures below. Monitoring well construction details will be documented on the appropriate Well Construction Log.

1. An 8-inch PVC casing will be set 1 foot into the top of the confining unit. The casing will then be grouted around the annulus of the casing to the land surface to seal off the casing from the aquifer. The grout will be allowed to set for a period of time in accordance with the manufacturer’s specifications to ensure a proper seal is set.

2. Inside of the casing the bore hole will be completed through the confining layer to the aquifer below to the target depth.

3. Inside of the 8-inch casing, the well will be constructed with 2-inch threaded flush joint, Schedule 40 PVC casing and 2-inch threaded flush joint, Schedule 40 PVC, 0.010-inch continuously mill-slotted screen. Schedule 80 well material

will be used for monitoring wells deeper than 100 ft. Pipe joint compound (glue) will not be used in constructing the monitoring wells. If the depth of the well is to be greater than 50 ft, centralizers above the screened interval may be used to aid in well construction.

4. Casing will be added to the well screen and brought from the top of the screened interval to a height of 3 ft above ground level for completion.

5. The annular space between the well and the borehole wall will be backfilled with a clean, graded, size 20 to 40 silica (or alternative gradation based on site-specific data) sand pack that will extend from the bottom of the borehole to a minimum of 2 ft above the top of the screened interval. The sand pack will be placed by tremie pipe from the bottom of the borehole through the hollow-stem augers to ensure complete placement around the well screen.

6. Approximately 1 ft of very fine sand may be emplaced above the filter pack to prevent the migration of the bentonite slurry into the well screen.

7. A minimum thickness of 3 ft of bentonite pellets or chips will be placed on top of the filter pack as a seal. If the seal is within the unsaturated zone at the time of installation, the bentonite will be saturated with potable water and allowed to hydrate. Hydration time will conform to the manufacturer’s recommendations before further work on the well is performed.

8. The annular space from the top of the bentonite seal to within 1 foot beneath the frost line will be filled with a cement and bentonite slurry containing high solids mixed to the manufacturer’s specifications. The bentonite slurry will be placed with a tremie pipe from the bottom of the annular area to be grouted to ensure proper placement of the slurry.

9. The remaining annular space near land surface will be filled with concrete. All wells will be completed above grade using a protective steel cover. A concrete apron will be installed around the cover. The apron will be a minimum of 2 ft by 2 ft and 6 inches in thickness, and shall be sloped to promote drainage away from the well. The wells will also be equipped with locking caps.

10. At selected locations, steel guard posts or protective barriers will be installed around the well in a manner designed to prevent vehicles from accidentally damaging the well.

3.5.4 Borehole and Well Abandonment

A Georgia licensed water well driller will abandon all boreholes not used for monitoring well installation, temporary wells, or permanent wells in accordance with the OCGA Georgia Well Standards 12-5-134 (State of Georgia, 2008).

3.5.5 Temporary Well Abandonment

Temporary wells will be abandoned by the following procedures.

1. The monitoring well riser pipe and well screen will be removed from each borehole. The riser pipe and screen will be decontaminated by steam cleaning at the designated decontamination area and will be discarded in a sanitary waste landfill.

2. The entire borehole will be grouted with a cement and bentonite slurry containing high solids mixed to the manufacturer’s specifications. The bentonite slurry will be placed with a tremie pipe from the bottom of the annular area to be grouted to ensure proper placement of the slurry.

3. The abandoned borehole will be marked with a flag or stake.

3.5.6 Soil Boring Abandonment

The procedures for abandoning boreholes are as follows:

1. The entire borehole will be grouted with a cement and bentonite slurry containing high solids mixed to the manufacturer’s specifications. The bentonite slurry will be placed with a tremie pipe from the bottom of the annular area to be grouted to ensure proper placement of the slurry.

2. The abandoned borehole will be marked with a flag or stake to allow for surveying.

3.6 Groundwater Level Measurements and Sampling

3.6.1 Groundwater Level Measurements

Water level measurements will be referenced to a surveyed elevation point located on the top of the well casing. This measurement point will be surveyed by a Certified Land Surveyor and referenced to ft above mean sea level (amsl). An electronic water level probe will be used to gauge the water level in the new wells, in addition to the existing monitoring wells and piezometers at the facility.

Water levels will be recorded in the new monitoring wells, existing monitoring wells and piezometers within 24 hours prior to each groundwater sampling event. The total well depth may also be measured at this time to determine if sediment has accumulated in the well thereby reducing the effective well depth. Water level measurements at each Site will begin with the upgradient wells (i.e., inferred least contaminated wells) and proceed to the downgradient wells (i.e., inferred most contaminated wells). Water-level measurements will be collected within a single 24-hour period and will be measured twice to check the reproducibility of the measurement data. This measurement validation helps ensure accuracy with regard to the water level data collection. The procedure for obtaining water level measurements is as follows:

1. Describe the area surrounding the well, whether or not the lock was secure (if applicable), if the well could have been impacted by surface water runoff, ambient weather conditions and other factors that could affect the final data analysis. This documentation is recorded on a Water Level Measurement Form) Appendix B).

2. Decontaminate the electronic water probe prior to initiating water level measurements and between all wells and piezometers. Decontamination procedures are described in Section 3.12.

3. Unlock the protective casing and remove the inner cap on the riser.

4. Check the probe to verify that it is operational, then lower down the monitoring well.

5. If the well is not vented, allow the water level to equilibrate for a few minutes prior to collecting the first measurement. Take fluid level measurements from a

fixed reference point (the north side of the top of the PVC riser) using an electric tape graduated in 0.01-foot intervals.

6. Repeat the measurements until two measurements are obtained that are within 0.01 ft.

7. Remove and decontaminate the probe, replace the inner cap, and lock the protective casing.

3.6.2 Low-Flow Groundwater Purging and Sample Collection

The following protocol has been developed to obtain groundwater samples that are representative of formation conditions and is intended for use in sampling monitoring wells during the field activities. New monitoring wells will not be sampled for at least 24 hours following non-stressful means of well development (e.g., purging with submersible pump or bailer) and 48 hours following stressful means of well development (e.g., air lift, surge and purge). Monitoring wells will be purged prior to collecting groundwater samples to ensure that representative formation water is being sampled. The monitoring wells will be purged and sampled in the same order as that for water-level measurements (upgradient to downgradient, or least contaminated to most contaminated where known based upon prior sampling results). Prior to introduction into the well, all non-dedicated equipment and materials will be decontaminated in accordance with the procedures outlined in Section 3.12.

The following procedures will be implemented when performing well purging prior to sample collection:

1. Put on clean latex or vinyl surgical gloves or nitrile gloves.

2. Unlock the metal protective casing, remove the well cap, and document the general condition of the well.

3. Determine static fluid-level elevation using electronic probe. Record on Groundwater Sampling Form (Appendix B).

4. Compute the volume of water in the well (0.162 gallon/foot for a 2-inch diameter well). The volume of water to be purged will be computed based on the total well depth recorded upon the completion of well installation. The total depth will be measured periodically during the monitoring program to determine if

sediment has accumulated in the well thereby reducing the effective well volume. If it is determined that sediment has accumulated in the well, then the new well depth will be used to compute the volume of water to be purged.

5. Insert the pre-cleaned bladder (or peristaltic) pump and tubing into the well to the midpoint of the well screen. Record installation time in field notes. Dedicated Teflon and/or PVC bailers may be used to facilitate sample collection where site conditions warrant, such as low recovery wells.

6. Start pump at the lowest possible flow rate and adjust the pumping rate to approximately 100 milliliters per minute (mL/min). Record pump start time in field notes. Verify the flow rate with the graduated cylinder or equivalent by collecting the water from the discharge line for one minute. Record results in field notes. Based on the recovery rate of the well, the pump may need to be raised or lowered to adequately purge the entire well column. Adjustments will be recorded in the field notes.

7. Monitor water level to verify that little or no drawdown (0 to 0.3 ft) is occurring in the well. If desired, the flow rate may be increased to up to 300 mL/min in more permeable formations as long as little or no drawdown is observed in the well. Record measurements and flow rates in field notes.

8. Obtain field parameter measurements (temperature, specific conductance, pH, dissolved oxygen, oxidation-reduction potential [ORP], and turbidity) every 5 minutes and record on the Groundwater Sample Log. Purge until the criteria listed below have been met (unless low well recovery precludes this):

   - The field parameters stabilize to within +/- 10 percent of three consecutive meter readings taken at least 5 minutes apart.

   - The measured turbidity is less than 10 nephelometric turbidity units (NTUs), unless low recovery precludes this.

9. Collect VOC samples for laboratory analysis (if required) at a low flow rate (100 mL/min) directly into the appropriate sample container. If a peristaltic pump is used, the downhole tubing will be filled using suction and removed from the well to prevent the sample from contacting the pump head. The pump speed is reduced and the direction reversed to push the sample out of the tubing and into the sample containers. Ensure that no air bubbles are present in the vial.

Secure sample container lid and store sample containers in chilled cooler after filling out the sample label.

10. Collect additional samples for non-VOC analysis (collecting in the order of explosives, metals, and indicator parameters). If samples are being collected usig a persitaltic pump following VOC sample collection, repeat steps 1 through 8. Collect non-VOC samples at low flow rate (100 mL/min). Flow rates of up to 500 mL/min can be used if all stabilization criteria are achieved. Unless specified in the site-specific work plan, metals samples will be collected unfiltered. If site conditions require filtration for metals analysis, an in-line 45 micron filter will be used. Secure sample container lids and store sample containers in chilled cooler.

11. Complete sampling documentation on the Groundwater Sampling Form, record the collection date and time on the sample key, and fill out the Well Sampling Summary form (Appendix B).

12. If inadequate water is present in the well to fill the required sample containers, return periodically within 24 hours until adequate sample volume is obtained and field parameters measured. Collect groundwater for individual analyses in the appropriate sample order. If required, collect VOCs and store first, then metals and other indicator parameters.

13. If drawdown in the well cannot be maintained within the 0.3-foot requirement, sample collection will be performed after three well volumes of groundwater have been purged. Begin sample collection with VOC analysis unless otherwise noted in the site-specific work plan. For wells that purge dry before all of the samples are collected, allow the well to recover and then make one more attempt to collect the remaining samples within a 24-hour period.

14. Turn off pump. Remove portable pump from well and decontaminate or dispose. Tubing will be left as dedicated tubing in the well or disposed of after use.

15. Determine the total depth of the well. Compare the measurement of the total depth of the well with previous measurements and well construction log to determine available screen length. Record on water sampling log. If more than 20 percent of a well screen is occluded by sediment, the well must be redeveloped prior to collecting future groundwater quality samples. Samples

collected prior to the total well depth measurement will be representative only if the field data indicate that the well met stabilization criteria prior to sampling.

16. Replace cap on well and protective casing lock well.

3.6.3 Slug Test

This procedure defines the requirements for conducting a slug test in a monitoring well. The purpose of this procedure is to provide a uniform basis for conducting slug tests and to ensure the continuity between field personnel. A water level indicator will be used to measure the change in water levels versus time during the slug test. However, for slug tests completed in wells screened in very permeable formations, a transducer and data logger may be used to measure and record water level changes over time.

1. Open the locking and vented caps and inspect the wellhead. Note in particular the condition of the surveyed reference mark, if any.

2. Measure and record the static water level and the depth to the bottom of the well. Record this data on the Water Level/Pumping Test Record (Appendix B).

3. Lower the slug into the water until it is fully submerged. Allow the well to equilibrate to static water level.

4. Verify the static water level has been reestablished with an electronic water-level indicator.

5. Withdraw the slug quickly, but avoid surging. Record the time of withdrawal to the second. Start the stopwatch, if used, at the instant the slug is withdrawn.

6. Using an electronic water level indicator, measure and record the initial displacement of water as soon as the slug has been withdrawn.

7. Measure and record the rise in water level vs. time. Using the water-level indicator and a stopwatch, record depth-time data at the fastest rate possible for the first 5 minutes of well recovery. Generally the water levels should be recorded every 30 seconds for the first 5 minutes, then every minute for the next 5 minutes. Subsequent recording intervals may be adjusted to suit the rate of well recovery. An electronic data logger and pressure transducer may be used in lieu of manual water level measurements.

8. Continue recording depth-time data until the well has recovered to nearly the static water level or at least 90 percent of the static water level. If 90 percent of the static water level has not been achieved within 2 hours, then field personnel may return periodically within the next 24 hours to record the water level.

9. Record the time of test completion in the field data forms.

10. Decontaminate all equipment according to the procedures outlined in Section 3.12. Close and lock the well before leaving.

3.6.4 Constant Rate Pump Test

1. Upon arriving at the site, collect a round of static water levels from all site monitoring wells. Record this data on the Water Level/Pumping Test Record (Appendix B).

2. Place the pump in the pumping well and connect to the electrical service. The pump discharge will be connected to 1) a control valve, 2) inline filter (optional), and 3) flow meter. Dependent on site conditions, treatment systems (i.e., flow-through vessels, carbon units) may be used prior to water storage or discharge.

3. Initiate a short step test beginning at 2 gallons per minute (gpm). The initial step test pumping rate may be altered depending on site specific conditions. The pumping rate will be increased in two subsequent steps (the amount of increase will be determined in the field based on the drawdown achieved at 2 gpm). Measure water levels in the pumping well and the three closest monitoring wells during the step test.

4. Based on the results of the step test, determine a pumping rate that will 1) achieve significant drawdown in the pumping well, and 2) will not result in dewatering the well during the pumping test.

5. Begin the pumping test after the water levels in the pumping well and observation wells have returned to static conditions.

6. Turn on the pump in the test well and operate at a constant rate during the remainder of the test.

7. Collect water levels at a logarithmic interval in the pumping well, monitoring wells within 100 ft of the pumping well, piezometers within 100 ft of the pumping well, and at least one background well. Collect the water levels using a handheld electronic water level indicator or through the use of pressure transducers.

8. After the test has been conducted for a period of 24 hours, evaluate the pump test data to determine if continuation of the pump test is justified. If so, continue the test for a total of 48 hours, or until the data indicate that asymptotic conditions were achieved.

9. When the determination has been made to stop the pumping test, initiate the recovery portion of the test.

10. After the pump has been shut off, measure water levels at a logarithmic interval in the pumping well, monitoring wells within 100 ft of the pumping well, piezometers within 100 ft of the pumping well, and the selected background well. Continue measurements until the water level in the pumping well has recovered at least 90 percent.

3.6.5 LNAPL Bail Down Test

This procedure defines the requirements for conducting an LNAPL Bail Down Test in a monitoring well. The purpose of this procedure is to measure the thickness and depth to free product in the well as it recovers. The results of these tests are analyzed in accordance with techniques described in “How to Effectively Recover Free Product at Leaking Underground Storage Tank Sites,” (EPA 510-R-96-001) to assist choice of potential free product recovery methods. The following steps will be used:

1. Measure the depth to LNAPL and groundwater.

2. Remove as much LNAPL from the well as possible using a weighted disposal bailer.

3. Measure the recovery rate of free product and groundwater using a hydrocarbon probe. Record the LNAPL thickness and recovery time in the well at regular intervals until the recovery rate has stabilized.

4. Determine 80 percent of the maximum LNAPL recovery thickness.

5. Interpolate the recovery time for 80 percent recovery.

6. Compute gallons per foot of LNAPL thickness in the well screen.

7. Compute the average recovery rate in gallons per day to 80 percent recovery.

3.7 Test Pit Excavations

The following procedures may be used to install test trenches, if deemed necessary to characterize waste materials.

1. Complete a trench to approximately 4 ft bgs with a track hoe or equivalent piece of excavation equipment.

2. Describe the profile of waste based on visual observations of the material removed from the trench and record on a Boring/Well Construction Log (Appendix B).

3. Backfill the trench with waste material after the trench has been completed.

4. Cover the trench with compacted soil.

5. Mark the trench area with a stake for surveying purposes.

3.8 Sediment Sampling

The following procedures will be used to collect sediment samples during the field activities at the Fort Stewart and Hunter Army Airfield.

3.8.1 Shallow Ditch Sediment Sampling

1. Sediment samples will be collected with a decontaminated stainless steel trowel or hand auger. Decontamination procedures are outlined in Section 3.12. A stainless steel hand auger or trowel will be used to collect sedimentsoils from the 0 to 0.5-foot (6-inch) interval.

2. The sediment sample will be placed directly into a stainless steel bowl. The sediment will be mixed using a stainless steel spoon until the sample is

visually uniform. During the mixing process any debris or larger rocks will be removed using the spoon.

3. The sample will be transferred from the bowl into a laboratory-prepared sampling containers supplied by the laboratory.

4. The sample will be documented on a Soil/Sediment Sample Log and the Soil Sample Summary Form.

Surficial soil samples will be collected from ditch areas that may be dry or have no freestanding water at the time of sampling. The following dry ditch sediment sampling procedures should be used only if the ditch is dry or has no freestanding water:

1. Prior to sample collection, any rocks, vegetation or debris will be removed with a stainless steel trowel.

2. Surficial soil samples will be collected with a decontaminated stainless steel trowel or hand auger. Decontamination procedures are outlined in Section 3.13. A stainless steel hand auger or trowel will be used to collect soils from the 0 to 0.5-foot (6-inch) interval.

3. The soil sample will be placed directly into a stainless steel bowl. The soil will be mixed using a stainless steel spoon until the sample is visually uniform. During the mixing process any debris or larger rocks will be removed using the spoon.

4. The sample will then be transferred from the container into the laboratory-prepared sampling containers supplied by the laboratory. The sampling activities will be documented on a Soil/Sediment Sample Log and the Soil Sample Summary Form.

5. Following sampling, the sample location will be filled in and any removed rocks or vegetation replaced.

3.8.2 Deep Ditch Sediment Sampling

1. Remove overburden with a decontaminated stainless steel bucket auger to just above the top of the prescribed sampling depth.

2. Drive a decontaminated 1 to 2-inch diameter stainless steel soil sampler lined with a plastic or acetate liner an additional 6 inches in depth. A disposable acetate or thin walled stainless steel soil probe may also be used.

3. Use a decontaminated bucket auger to collect the sample from 1.5 to 2.0 ft bgs if a gravelly substrate is encountered.

4. Cap the liner and retract the sampler. The sample core may not remain in the sampler or tube if the top is not capped.

5. Cap the bottom of the sample. If a liner is used, remove the liner from the sampler, then cap the bottom of the sample.

6. If freestanding water was also captured in the sampling tube or liner, remove the top cap and gently pour off the water without disturbing the sediment sample. Place the sediment sample directly into a stainless steel bowl. Mix the sediment using a stainless steel spoon until the sample is visually uniform. Remove any debris or larger rocks from the sediment during the mixing process using the spoon.

7. The sample will then be transferred from the container into the laboratory-prepared sampling containers supplied by the laboratory.

8. Document the sample on a Soil/Sediment Sample Log and the Soil Sample Summary Form.

Subsurface soil samples may be collected from ditch areas that may be dry or have no freestanding water at the time of sampling. The following dry ditch sediment sampling procedures described below should be used only if the ditch is dry or has no freestanding water:

1. Prior to sample collection, any rocks, vegetation or debris will be removed with a stainless steel trowel.

2. A decontaminated stainless steel hand auger will be used to collect soils from the prescribed depth interval. The collected soil sample will be placed directly into a stainless steel bowl. The soil will be mixed using a stainless steel spoon until the sample is visually uniform. During the mixing process any debris or larger rocks will be removed from the soil using the spoon.

3. The sample will then be transferred from the container into the laboratory-prepared sampling containers supplied by the laboratory. The sampling activities will be documented on a Soil/Sediment Sample Log and the Soil Sampling Summary Form.

4. Following sampling, the sample location will be filled in with surrounding sediment.

3.8.3 Shallow Stream Sediment Sampling

Stream sediment samples may be collected along predetermined transects upstream, adjacent to, and downstream of the area of interest in conjunction with surface water sampling for the characterization of the aquatic environment. Please note that the sediment samples may have to be collected by personnel outfitted with waders.

The sediment sampling procedures are described below and assume that all samples can be collected by personnel outfitted with waders that can access all sampling locations on a transect.

1. Position identification markers for the sediment and surface sampling locations along the stream bank prior to sampling. At each transect, mark and stake opposite banks of the stream to support a rope premarked at least at 10-foot intervals or measuring tape pulled taut across the stream slightly above water level. Each tape mark will become a station for a depth sounding of the river and a point for flow velocity measurements. For streams that are 10 ft in width or less, only one sampling station is required at the stream mid-point.

2. Measure the water velocity and flow using a current meter. Measure flow velocity at each station and at each 5-foot depth interval to the base of the stream. In every case, collect a flow measurement at the base and upper surface of the stream.

3. Briefly describe the substrate beneath each station as marked on the rope, such as silt, sand, gravel, and bedrock. In this manner, select the site for sediment sampling. Preferred sediment sample collection locations are areas of deposition, where fine-grained materials, such as clay, silt, or fine sand, collect. In addition, collect samples in pools, rather than riffles. The dredge sampler may not function properly if the substrate being sampled contains a large amount or large pieces of gravel.

4. Approach the sampling location from downstream to avoid disturbing the sediment prior to sampling.

5. Collect the sediment samples using an Ekman or Ponar dredge or equivalent. Gently advance the dredge approximately 6 inches into the sediment. The dredge closes with a messenger weight and the spring-loaded jaws shut to collect the sediment sample. A minimum of three aliquots will be collected at each sampling location.

6. Place the sediment samples directly into a clean stainless steel bowl. If VOC samples are to be collected, they should be taken directly from the sampling device using an EnCore™ sampler or equivalent (Terra Core). If the VOC samples cannot be collected from the sample device, they can be collected immediately after placement of the sediment in the stainless steel bowl. Following VOC sample collection, the remaining sediment will be mixed using a stainless steel spoon until the sample is visually uniform. During the mixing process any debris or larger rocks will be removed using the spoon.

7. Fill the appropriate laboratory jars for the non-VOC parameters specified in the Site-Specific Work Plan. Attach the lids and label appropriately. Complete the Soil Sample Summary Log (Appendix B).

8. With the remaining sediment sample, record the sediment characteristics, such as texture, odor, color, and other distinguishing factors on a Soil/Sediment Sample Log (Appendix B).

9. Remove the rope marking the transect, if not collecting deep sediment samples. Do not remove the stakes marking the transect. Survey the elevation of the stakes to a known elevation datum to provide a depth profile of the river.

3.9 Surface Water Sampling

Surface water samples may be collected along predetermined transects upstream, adjacent to, and downstream of the area of interest in conjunction with stream sediment sampling for the characterization of the aquatic environment. Please note that the surface water samples will have to be collected using a small boat or by personnel outfitted with waders. The optimum time to collect the surface water samples will be at a low stream flow so that personnel outfitted with waders can collect the samples.

Using a boat to collect the samples introduces special health and safety concerns and typically doubles the amount of time required to complete the task.

The surface water sampling procedures are described below and assume that all samples can be collected by personnel outfitted with waders that can access all sampling locations on a transect.

1. Follow steps 1 and 2 outlined in the stream sediment sampling procedure outlined in Sections 3.8.3.

2. At each transect, collect a surface water sample near the top of the water column with a clean Pyrex sampling cup or equivalent for field measurement of temperature, pH, specific conductance, and dissolved oxygen. An equivalent flow-through meter may also be used for each field parameter.

3. At locations that are deeper than 5 ft, collect the field measurements at each 5-foot depth interval using a Van Dorn or Kemmerer Type sampler.

4. Record the field measurements in a Surface Water Sample Log (Appendix B).

5. If the stream does not exhibit thermal or chemical stratification as determined by the field measurements (temperature and pH), collect a surface water sample with a clean Pyrex sampling cup or equivalent near the top of the water column. Immerse the Pyrex cup at an angle such that water gently flows in with minimal disturbance. Use the sample to fill laboratory-prepared sample bottles for analysis.

6. If the stream exhibits thermal or chemical stratification as determined by the field measurements (temperature and pH), then collect surface water samples every 5 ft using a Van Dorn or Kemmerer style water sampler.

7. Record the sampling location, date and time of collection, sample collection method, sample identification, sample preservative, methods of analysis, and initials of the sampling personnel on the Surface Water Sample Log (Appendix B).

8. Decontaminate the sampling equipment as described in Section 3.12.

3.10 Field Analytical Measurements

Several instruments may be used to collect field analytical data. These instruments include a pH meter, specific conductance meter, a thermometer, dissolved oxygen meter, and turbidity meter (nephelometer). The following equipment (including model number and manufacturer) will be used:

- pH meter (model SA-230) manufactured by Orion Research, Inc. or equivalent;
- Specific conductivity meter (model 0148-40) manufactured by Cole-Palmer Instrument Company or equivalent;
- Digital thermometer that meets the National Bureau of Standards requirements;
- Dissolved oxygen meter (model 810) manufactured by Orion Research, Inc. or equivalent; and
- Turbidity meter (model 800) manufactured by Engineered Systems or equivalent.

Field instruments will be calibrated at least once a day, and more often if conditions warrant. Calibration procedures will follow manufacturer’s specifications and will be documented by field personnel on the Field Instrument Calibration Log (Appendix B).

3.11 Quality Control Samples

To monitor sampling and laboratory performance it may be necessary to collect several types of field QA/QC samples. The field QA/QC samples include trip blanks, equipment rinsate blanks, and field duplicates. The specific number and type of QA/QC samples that will be collected at each Site are outlined in the Site-Specific Work Plans and may be more or less than the criteria stated below based upon data quality objectives and professional judgment.

A trip blank is a container filled with distilled and organic-free water prepared in, and provided by, the analytical laboratory. A trip blank is sent from the analytical laboratory to the field-sampling site, and is returned to the laboratory for analysis. The trip blank results are used to evaluate whether contamination by VOCs occurred during shipment of samples and/or during container transport. One trip blank is required in each sample cooler transporting samples for VOC analysis.

An equipment rinsate blank is a sample of organic free water (for VOC analyses) poured into, or over, or pumped through the sampling device, collected in the sample bottle, and transported to the laboratory for analysis. Equipment rinsate blanks are used to assess the effectiveness of equipment decontamination procedures.

Equipment rinsate blanks are collected immediately after the equipment has been decontaminated. Equipment rinsate blanks are collected by gently pouring distilled or deionized water over selected clean non-dedicated equipment and collected for laboratory analysis. For example, the equipment rinsate blank for soil and sediment sampling programs will be collected by gently pouring distilled or deionized water over clean core barrels or soil core samplers. The equipment rinsate blank for surface water and groundwater sampling programs will be collected by gently pouring distilled or deionized water over clean non-dedicated bailers or sampling cups. Equipment rinsate blanks will be collected at a frequency of 5 percent of the field samples at critical points in the sampling program, such as the sampling of a background well or the end of the sampling program.

The frequency requirements for collecting equipment rinsate blanks are a minimum of five percent of the environmental samples. The blank shall be analyzed for all laboratory analyses requested for the environmental samples collected at the Site. When an analyte is detected in the equipment rinsate blank the appropriate validation flag, as described in the data validation section, shall be applied to all sample results from samples collected. It should be noted that the laboratory will supply the organic free water. A sample aliquot of the organic free water will be submitted for the analysis of all parameters of interest.

A field duplicate sample is a second sample collected at the same location as the original sample. Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. The sample containers are assigned an identification number in the field such that they cannot be identified (blind duplicate) as duplicate samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field duplicate samples prior to the beginning of sample collection. A field duplicate will be collected at a rate of one per twenty samples or one per sampling event, if less than twenty samples.

Field duplicate sample results are used to assess precision, including variability associated with both the laboratory analysis and the sample collection process. Field duplicates will be collected at a frequency of 5 percent of samples collected. Analytical results for field duplicate will be assessed during the data validation process. Specific locations will be designated for collection of field duplicate samples prior to the beginning of sample collection. Control limits for evaluation of precision for field duplicates will be 40 percent for aqueous samples and 70 percent for soil/sediment samples.

Laboratory quality assurance protocols including the performance of laboratory control samples and matrix spikes relating to method acceptance criteria are included in Section 2.7 of the Site-Wide QAPP (Appendix A). The QAPP also defines the data qualification guidelines for evaluating potential matrix interferences identified during matrix spike analyses. The parent and field duplicate sample will be included in all reporting.

3.12 Field Equipment Decontamination

The cleaning procedures outlined in this section will be used by all personnel to clean sampling and other field equipment to prevent cross-contamination during separate phases of the investigation. Documentation regarding decontamination will be recorded on the Daily Log (Appendix B). Specific cleaning procedures are presented in the following section.

A decontamination area will be established where steam cleaning of the drilling and well construction equipment and materials can occur and containment and proper disposal of wash water is possible. An impervious decontamination area will be utilized and the water used to clean the equipment will be containerized for offsite disposal.

3.12.1 Cleaning Materials

The laboratory detergent used to wash the equipment will be a standard brand of phosphate-free laboratory-grade detergent such as Micro or Liquinox. The use of any other detergent must be justified and documented in the field logbooks and inspection or investigative reports.

Potable water is defined as tap water fit for human consumption from a known source. Deionized water is defined as tap water that has been treated by passing through a standard deionizing resin column. The deionized water should contain no metals or other inorganic compounds (i.e., at or above analytical detection limits). The brushes used to clean equipment as outlined in the following sections, will be stiff plastic bristled and will not be wire-wrapped.

3.12.2 Marking and Segregation of Used Field Equipment

Field or sampling equipment that needs to be repaired shall be identified with a tag indicating date repair requested, problem if known, personnel requesting repair, and if the equipment has been decontaminated. Field equipment needing cleaning or repairs will not be stored with clean equipment or sample containers. Field equipment and/or disposable sample containers that are not used during the course of an investigation may not be placed in storage without being recleaned unless it is the opinion of the field investigator that the materials have not become contaminated during the course of the field investigation. However, equipment and sample containers must be labeled as such.

3.12.3 Safety Procedures to be Utilized During Cleaning Operations

The materials used to implement the cleaning procedures outlined in this section can be dangerous if improperly handled. Caution must be exercised by all personnel, and all applicable safety procedures shall be followed. At a minimum, the following precautions will be taken in the field during these cleaning operations:

- Safety glasses with side shields or goggles, and latex or vinyl surgical gloves or nitrile rubber gloves will be worn during all cleaning operations;

- All rinsing operations will be conducted in the open (never in a closed room); and

- No eating, smoking, drinking, chewing, or any hand-to-mouth contact shall be permitted during cleaning operations.

3.12.4 Storage of Field Equipment and Sample Containers

Decontaminated field and sampling equipment will be stored in covered containers or wrapped in aluminum foil to minimize contamination. All decontaminated equipment, when not in use, will be kept in a designated storage area. Sampling equipment and sample containers will not be stored or transported with any gasoline, diesel, or other fuel containers or gasoline or diesel fuel powered equipment. Decontaminated equipment shall be clearly identified by labeling the wrapping material. Field equipment and reusable sampling containers requiring cleaning or repairs shall not be stored with clean equipment. Instead, equipment requiring repairs will be clearly identified and the repairs documented on the daily field log. Field equipment that requires cleaning will be segregated from clean equipment and will be stored on plastic sheeting pending cleaning.

3.12.5 Cleaning Procedures

3.12.5.1 Drilling and Direct Push Equipment

All drilling and direct push equipment used during completion of soil borings or installation of the monitoring wells will be steam-cleaned prior to initiating drilling or direct push activities. This will include, but is not limited to, the drill stem, augers, drill bits, direct push rods, core barrels, and tools utilized by the contractor.

The drill rig or direct push rig utilized for the installation of the borings and wells will be decontaminated at the decontamination area prior to the initiation of the drilling or direct push activities. The drill rig or direct push rig itself will not be decontaminated between soil boring or monitoring well locations. Augers and other drilling, direct push, or sampling equipment will be returned to the decontamination area to be cleaned after each use. Cleaning of equipment will be performed using a high-pressure steam cleaner to prevent cross-contamination of the soil borings and monitoring wells. Potable water for steam cleaning will be obtained from the installation water supply system.

Tools and equipment used to measure the depth of well completion materials and water levels (i.e., measuring tapes, electric/electronic probes, tampers, tremie pipes) also will be decontaminated by steam cleaning between well locations to avoid cross-contamination. All equipment and tools will be isolated from contact with the ground by placing them onto sheets of polyethylene plastic.

3.12.5.2 Teflon^{TM}, Stainless Steel, or Glass Field Sampling Equipment

When Teflon™, stainless steel, or glass sampling equipment is used to collect samples that contain hard to remove materials, it may be necessary to steam clean the field equipment before proceeding with Step 1. If the field equipment cannot be cleaned utilizing these procedures, it should be discarded.

1. Wash equipment thoroughly with laboratory detergent and tap water using a plastic brush to remove any particulate matter or surface film.

2. Teflon™, stainless steel, or glass sampling equipment will be rinsed thoroughly with potable water from an approved onsite source.

3. Rinse thoroughly with analyte free water.

4. Rinse thoroughly with solvent. Do not solvent rinse PVC or plastic items.

5. Rinse thoroughly with organic/analyte free water. If organic/analyte free water is not available, equipment should be allowed to completely dry. Do not apply a final rinse with analyte water.

6. Wrap equipment completely with aluminum foil or store in Ziploc™ plastic bags to prevent contamination during storage and/or transport to the field.

3.12.5.3 Other Sampling Equipment

Miscellaneous sampling equipment will be washed with laboratory detergent, rinsed with potable water, followed by a thorough deionized water rinse, and dried before being stored. This procedure is not used for any equipment utilized for the collection of samples for trace organic compounds analyses.

3.12.5.4 Trace Organic Sampling Equipment

The following procedures are to be used for all sampling equipment used to collect routine samples undergoing trace organic or inorganic constituent analyses:

- Clean with tap water and soap using a brush if necessary to remove particulate matter and surface films. Equipment may be steam cleaned (soap and high pressure hot water) as an alternative to brushing. Sampling equipment that is steam cleaned should be placed on racks or saw horses at least two ft above the floor of the decontamination pad. PVC or plastic items should not be steam cleaned;

- Rinse thoroughly with tap water;

- Rinse thoroughly with analyte free water;

- Rinse thoroughly with solvent. Do not solvent rinse PVC or plastic items;

- Rinse thoroughly with organic/analyte free water. If organic/analyte free water is not available, equipment should be allowed to completely dry; and

- Remove the equipment from the decontamination area and cover with plastic. Equipment stored overnight should be wrapped in aluminum foil and covered with clean, unused plastic.

3.12.5.5 Field Analytical Equipment and Other Field Instruments

The exterior of sealed, watertight equipment should be washed with a mild detergent (for example, liquid dishwashing detergent) and rinsed with tap water before storage. The interior of such equipment may be wiped with a damp cloth if necessary. Other field instrumentation should be wiped with a clean, damp cloth. Conductivity probes, pH meter probes, etc., should be rinsed with deionized water before storage.

3.12.5.6 Ice Chests and Shipping Containers

If the ice chests (labeled accordingly for sampling use) and reusable containers that will be used to store or ship samples and sample containers are believed to be contaminated, the containers should be washed with laboratory detergent (interior and exterior) and rinsed with potable water and air dried before storage. In the event that an ice chest or other reusable container becomes severely contaminated with concentrated waste or suspected hazardous material, it shall be cleaned as thoroughly as possible, rendered unusable, and disposed of properly.

3.12.6 Disposable Materials

Disposable materials generated from the decontamination and sampling activities will be contained in plastic garbage bags. These materials include, but are not limited to gloves, Tyvek suits, latex booties, paper and plastic. A waste determination will be made on a site by site basis for the disposable materials generated during the sampling programs. The waste determination will be based on both process knowledge of the contents of the site and on existing analytical data from the site, if available. The wastes will be disposed off-site in accordance with all applicable federal and state regulations.

3.13 Characterization and Disposal of Investigative Derived Wastes

Investigative derived wastes (IDW) including soil and waste cuttings and decontamination, development, and purge water will be collected and characterized with the procedures described below.

3.13.1 Soils/Sediment/Waste

Soil, sediment, and waste cuttings (not including material excavated from test trenches during waste characterization) will be collected at the borehole and stockpiled on plastic sheeting or placed in appropriate containers, such as a roll-off box or 55-gallon drum for temporary storage. The temporarily stored solid material will be covered to prevent runoff.

Specific disposal options will be made on a site by site basis, taking into account the types of compounds known to be present, and will conform to applicable installation, local, state, and federal requirements.

3.13.2 Water

Investigative derived water, which will consist of decontamination wash, well development, and purge water, will be temporarily containerized in a portable poly tank. Based on previous and/or current analyses, liquids that would not fail Toxicity Characteristic Leaching Procedure (TCLP) analysis will be properly disposed of in accordance with Georgia State laws. Disposal options will be evaluated on a site by site basis.

3.14 Site Survey

A site survey will be conducted by a registered land surveyor to measure elevations (X, Y, and Z coordinates) of any new monitoring wells. The north side of the top of the casing and the land surface adjacent to each well will be surveyed relative to mean sea level to the nearest 0.01 ft. The horizontal location of each monitoring point and well will also be determined relative to the Georgia state plane system and the Fort Stewart and Hunter Army Airfield installation grid to the nearest 1.0 foot. All surveying will be performed by a certified land surveyor, and will be tied into the existing on-site benchmark.

The location of each soil and waste boring, test pit location, sediment, surface water, and stream gauging location may also be surveyed by hand-held global positioning system (GPS) equipment, as conventional land surveying will be difficult to complete at these areas.

4. Field Documentation Procedures

Information on the sample designation, field documentation, COC, and sample shipment activities are discussed in the following three sections.

4.1 Sample Designation

A numbering system was developed for each type of environmental sample collected during the field investigation for the unique identification of each individual sample. This number system will provide a tracking procedure to allow ease of data retrieval, reduction, and evaluation, and to ensure that sample identifiers are not duplicated. The most important aspect of any sample numbering system that is developed is ensuring the uniqueness of an individual sample number. A listing of the sample identification numbers will be maintained by the project manager and the field task supervisor will ensure that it is universally applied to samples collected during the project.

The numbering system for this project consists of the following components described below:

- The Site number in the format “HA##” for Hunter Army Airfield and “FS##” for Fort Stewart;
- The location type;
- The sample number;
- Water and sediment sample IDs will end with the date (in “mmddyy” format); or
- Soil samples will end with the depth range (in ft).

Blind duplicate samples will be labeled sequentially starting at 1 in the form D1(mmddyy).

Examples of the numbering system are provided below:

- Surface water sample 1 taken from HAA-01 on November 8, 2009 would be: HA01SW001(110809);

- Surface soil sample 4 taken from FST-13 at a depth of 0 to 6 inches would be: FS13SS004(0-0.5).

The location type codes are listed below:

MW – monitoring well;
TW – temporary well;
SB – soil boring (by drilling);
SS – surface soil by trowel or other hand collection method;
SW – surface water by any collection method; and
SE – sediment by any collection method.

In addition to the above nomenclature, the COC will be completed to include both the Sample Type and Sample Matrix using the codes defined below:

Acceptable sample type codes are listed below:

N = normal or primary sample;
FD = field duplicate;
EB = equipment blank;
MS = matrix spike;
SD = matrix spike duplicate; and
TB = trip blank.

The sample matrix will be identified using the following codes:

SO = soil sample;
SE = sediment sample;
WG = groundwater;
WS = surface water;
WB = water collected from borehole or during Geoprobe® investigation; and
WL = leachate.

Field duplicate samples will be given a unique number that is completely different from the original sample following the normal sample pattern. Duplicate samples will be labeled sequentially starting at 1 in the form D1(mmddyy). This number will be recorded in the field logbook, so that the duplicates can be identified at a later date. Samples collected with an additional volume for matrix spike/matrix spike duplicates (MS/MSDs) will be designated on the COC in the remarks column.

Equipment and trip blanks will be identified using the sample type code (i.e., EB or TB) followed by the date as MMDDYY. For trip blanks, if more than one trip blank is submitted to the laboratory on a given day, the sample code will be followed by the a number starting with 1. For example the second trip blank submitted on December 1, 2003 would be identified as follows: TB2(120103).

4.2 Field Activity Documentation

Documentation of field operations and sample custody is achieved through use of ARCADIS pre-printed forms and a bound field logbook. The field log consists of notes and drawings describing the location, field conditions, and method of sample collection and identification. Examples of the pre-printed forms that will be used for this project are provided in Appendix B.

All aspects of sample collection and handling as well as visual observations shall be documented on the forms or in the field logbooks. All sample collection equipment (where appropriate), field analytical equipment, and equipment utilized to make physical measurements shall be identified in the field logbooks. All calculations, results, and calibration data for field sampling, field analytical, and field physical measurement equipment shall be recorded on the forms or in the field logbooks.

In addition, the Field Operations Leader will fill out a daily site activity log that details the activities and/or issues that occurred that day.

All entries in field logbooks or the preprinted sampling logs shall be dated, legible, and contain accurate and inclusive documentation of an individual’s project activities. At the end of each day’s activity, or of a particular event as appropriate, all documents in the field will be secured by the Field Operations Leader for each task. Once completed, these field logbooks and/or preprinted forms will be maintained as a part of the project files.

All data forms will be completed in indelible black ink. Make an entry in each blank. Where there is no data entry, enter "UNK" for Unknown, "NA" for Not Applicable, or "ND" for Not Done. To change an entry, the person making the change will draw a single line through the mistake, add the correct information above or adjacent to it, and initial the change.

4.2.1 Utilities and Structures Checklist

The Field Operations Leader will check the proposed drilling, sampling, and trenching locations for marked underground utilities, other underground structures and above-ground pipe racks or power lines. A Utilities and Structures Checklist will be completed by the Field Operations Leader for each area to be sampled prior to commencement of field activities.

4.2.2 Location Sketch

All drilling, sampling, and trenching locations will be drawn on a Location Sketch, if a reasonable site map is not available for the area of interest.

4.2.3 Boring/ Well Construction Logs

All soil borings, boreholes, and monitoring well installations completed by the field team will be documented on Boring/Well Construction Logs. The logs document the drilling location, drilling dates and times, drilling personnel, logging personnel, soil descriptions, sample depths, recovery, boring location and volatile organic vapor content. The log also documents the well identification, drilling method, development technique, well construction materials, material depths, and abandonment, if any.

4.2.4 Water Level Measurement Form

All water level measurements will be recorded on a Water Level Measurement Form. The log identifies the measurement location, and measurement date and time.

4.2.5 Sample Key

All samples to be collected will be recorded on the Sample Key. The form identifies all sample locations, sample date and time, and analytical parameters to be collected.

4.2.6 Sampling Location Survey Summary

The sampling location survey summary is to be completed prior to field activities. It will provide northing, easting, and elevation information for site monitoring wells.

4.2.7 Water Sample Log

All surface water samples collected by the field team will be documented on a Water Sample Log. The log identifies the sample identification, duplicate identification, if any, sampling times, location, equipment used, color, odor, appearance, sample parameters, container description, sample preservative, and sampling personnel.

4.2.8 Groundwater Sampling Form

The results of field measurements while purging monitoring wells, prior to collecting a groundwater sample, will be recorded on the Groundwater Sampling Form. This form records time series measurements of conductivity, temperature, turbidity, redox potential, and dissolved oxygen. The form also provides a record of the volume of water purged prior to sample collection.

4.2.9 Well Sampling Summary

A summary of the results of field measurements while purging monitoring wells, prior to collecting a groundwater sample, will be recorded on the Well Sampling Summary Form. This form records collection date and time and the final measurements of conductivity, temperature, turbidity, redox potential, and dissolved oxygen. The form also provides a record of the volume of water purged prior to sample collection.

4.2.10 Water Level/Pumping Test Record

The data from slug tests and pumping tests completed in monitoring wells will be documented on a Water Level/Pumping Test Record. The log identifies the well the test is conducted in, the static water level, the initial displacement, and changes in the water level versus time.

4.2.11 Soil/Sediment Sample Log

All soil samples collected by the field team will be documented on a Soil/Sediment Sample Log. The log identifies the sample identification number, soil type, duplicate identification, if any, sampling times, depth and location of sample, sampling equipment used, color, odor, appearance, sample parameters, container description, sample preservative, and sampling personnel.

4.2.12 Soil Sampling Summary

All soil samples collected by the field team will be documented on Soil Sampling Summary form. The form identifies the sample identification, sampling times, depth and location of the sample.

4.2.13 Surface Water Sample Log

All surface water samples collected by the field team will be documented on a Surface Water Sample Log. The log identifies the sample identification, duplicate identification, if any, sampling times, sampling location, equipment used, color, odor, appearance, sample parameters, container description, sample preservative, and sampling personnel.

4.2.14 Field Instrument Calibration Form

The field team will record all daily calibration results for field instrumentation on the Field Instrument Calibration Form.

4.2.15 Daily Log

The Daily Log form is used by the Site Manager to record all pertinent sampling events, field observations or other information pertinent to the field effort. The following types of information are generally entered into the Daily Log:

- Date
- Client
- Field Location
- Ambient Weather Conditions
- Field Team
- Instrument Problems
- Site Visitors
- Delays
- Unusual Situations
- Well Damage
- Accidents
- Work Progress
- Quality Control
- Site Schedule

4.2.16 Sample Label

All samples collected by the field team will be properly identified by labeling. Labels will be affixed to the sample bottle prior to the filling of the container(s). Labels are never affixed to lids or caps, although the sample identification information may duplicated on the cap for ease of sample identification. The following labeling information is supplied for every sample bottle.

- Sample Identification Number
- Initials of Sample Collector
- Date and Time of Collection
- Project Number
- Project Location
- Requested Analyses

4.2.17 Chain-of-Custody Form

The COC form is a multi-copy record, which documents the custody of the samples from sample collection through laboratory analysis. It has spaces for signatures of those receiving and relinquishing the samples. The sampler, the individual preparing the samples for shipment, and the receiving individual at the laboratory normally sign the form. An example of this form is provided in Appendix B.

The field personnel collecting the sample will fill out the COC forms. The COC process will be initiated upon sample collection. The field personnel who sign the form will be responsible for the samples until they are transferred to the custody of the laboratory or another custodian. Once the form has been completed, all remaining field sample identification spaces will be crossed through to prevent unauthorized addition of sample information.

The information required on the COC form includes the complete sample identification, date and time of sample collection, number of sample containers, analyses and method required, container type, project number, sample collection personnel, complete name, address, and telephone number of the person analytical reports will be sent to, turnaround time, and signatures of all sample custodians, excluding shippers, such as Federal Express. In addition, the method of shipment, courier name and air bill number must be included. The back copy of the form will be retained. The original form will accompany the sample shipment to the laboratory.

4.2.18 Chain-of-Custody Seal

All coolers submitted to analytical laboratories containing samples collected during the field investigations will be sealed with two signed and dated COC seals. The seals ensure that the samples have not been tampered with during shipment.

4.2.19 Bill of Lading

A bill of lading (air bill) documents receipt of the samples by the carrier. It is not possible for the carrier's representative to sign the COC because it is sealed in the ice chest. Bills of lading are kept on file as part of the sample COC documentation.

4.3 Chain-of-Custody Procedures

The primary objective of the COC process is to create an accurate written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis. A sample is considered to be in custody when one of the criteria listed below has been satisfied:

- The sample is in one's actual possession.
- The sample is in one's view after being in one's physical possession.
- The sample is in one's physical possession and is then locked up so that no one can tamper with it.
- The sample is kept in a secured area that is restricted to authorized personnel.

Strict COC procedures will be followed for all collection, handling, and shipping of environmental samples. The field personnel are responsible for the care and custody of the sample collected until the samples are properly and formally transferred to another person or a courier for shipment to the laboratory. To simplify the COC record, as few people as possible will handle the sample during the investigation or inspection and an inventory of the sample containers will be maintained.

A COC form will be completed for all samples collected. A separate COC record will be utilized for each cooler of samples shipped to each laboratory used during this investigation. During the data validation activities, it will be determined whether these procedures were adequately followed.

4.3.1 Transfer of Custody

A COC form will accompany all samples. Prior to shipment or transfer of custody, all samples will be maintained in the custody of the Field Operations Leader. Upon transfer of custody, the Field Operations Leader will verify the information on each sample label and assure that each container is intact and sealed. The Field Operations Leader will then sign and date the COC form. The individuals receiving the samples shall sign, date, and note the time that they reviewed the samples on the COC form. This form documents transfer of custody of samples from the field investigator to another person to the laboratory.

4.3.2 Sample Preparation and Shipment

All samples will be stored at approximately 4°C from immediately after collection until analysis. In the field and during transportation to the laboratory, samples will be kept in coolers on ice, not "blue ice". Ice for coolers will be double-bagged in self-sealing plastic bags. Protective foam or Styrofoam packing will be used to minimize the risk of breakage during transport. When packaging samples for commercial transport, individual bottles will be wrapped separately in padded materials.

The samples are then placed in an ice chest, in direct contact with the ice, lined with a plastic trash bag or other barrier to prevent leakage and Styrofoam, bubble wrap, or similar packaging to prevent breakage. The top two copies of the original COC form will be placed in a plastic bag secured inside the shipping container closed with a chain-of-custody seal.

4.3.3 Laboratory Sample Receiving

After the ice chests are delivered to the laboratory, the samples are logged in, the COC is signed, and the samples are checked for breakage or leakage. The temperature of the ice bath is checked. If the temperature exceeds 4º C or if any other problems are noted, this information is recorded on the COC and the Field Operations Leader or Project Manager will be notified of the problem.

5. References

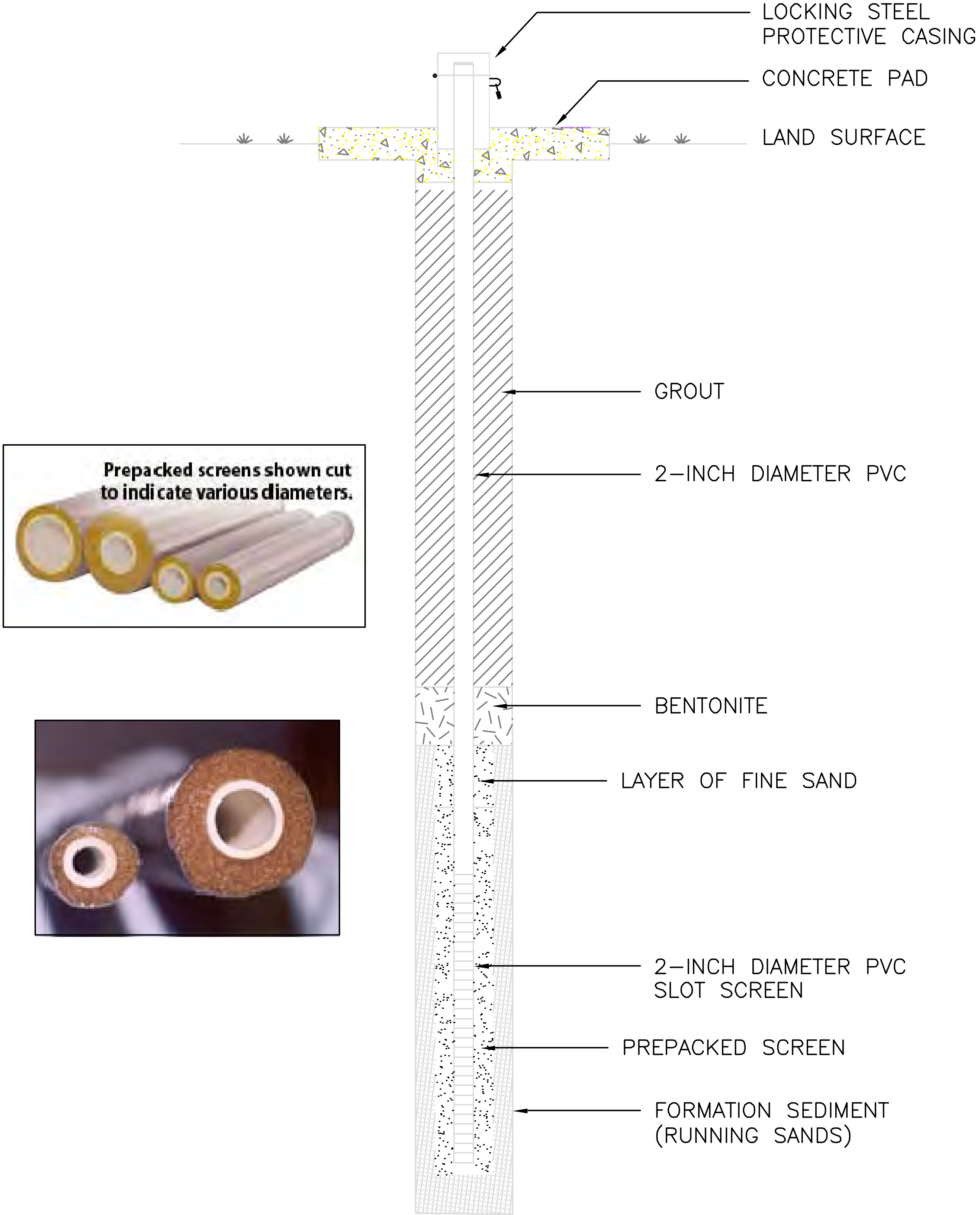
American Society for Testing and Materials (ASTM) International, 1991. *ASTM D-2488-84, Practice for Description and Identification of Soils (Visual – Manual Procedures), Annual Book of ASTM Standards, American Society for Testing and Materials, Philadelphia, vol. 04.08* 1991*.*

Oficial Code of Georgia Annotated (OCGA), 2008. *Georgia Well Standards 12-5-134* (State of Georgia, 2008).

United States Environmental Protection Agency (USEPA), 2008. Field Branches Quality Systems and Technical Procedures, http://www.epa.gov/region4/sesd/fbqstp/. November 2008.

USEPA, 1996. *"How to Effectively Recover Free Product at Leaking Underground Storage Tank Sites*," (EPA 510-R-96-001), September 1996.

Figure



NOT TO SCALE

ARCADIS

PRJT MANAGER:
CHECKED BY:
DRAWING:
PRJT NO:
DWG DATE:
DRAFTER:

WELL SCHEMATIC FOR WELL
WITH PREPACKED SCREEN

FIG–NO
3-1

Appendix A

Site-Wide QAPP

ARCADIS
Infrastructure, environment, facilities

Appendix A:

Quality Assurance Project Plan (QAPP)

Fort Stewart Military Reservation and Hunter Army Airfield, Georgia

February 2009

ARCADIS

Appendix A: Quality Assurance Project Plan

Fort Stewart Military Reservation
and Hunter Army Airfield
Georgia

Jane Kennedy
Project Chemist

Charles A. Bertz, PE
Senior Project Manager

FOR

Kurt Beil, PE
Quality Assurance Manager

Prepared by:
ARCADIS
801 Corporate Center Drive
Suite 300
Raleigh
North Carolina 27607
Tel 919.854.1282
Fax 919.854.5448

Our Ref.:
GP08HAFS.SW00

Date:
February 3, 2009

Table of Contents

1. Project Management 1

1.1 Project 1

Technical Staff 4

Laboratories 4

1.2 Problem Definition/Background 6

1.3 Project Description 6

1.4 Data Quality Objectives for Measurement Data 7

1.4.1 Precision, Accuracy, Representativeness, Completeness, and Comparability 7

1.4.2 Objectives for Laboratory Analyses 9

1.4.3 Objectives for Field Measurements 9

1.5 Specialized Training and Certification 10

1.6 Documents and Records 11

1.6.1 Document Control 11

1.6.2 Field Documentation 11

1.6.3.1 Corrections to Field Documentation 12

1.6.3.2 Photographs 12

1.6.3 Laboratory Data Reporting/Record Retention 12

1.6.4 Electronic Data Retention 13

2. Data Generation and Acquisition Elements 14

2.1 Sampling Process Design 14

2.2 Sampling Methods 14

2.3 Sample Handling and Custody 14

2.4 Sample Containers 15

2.5 Sample Preservation and Holding Times 15

2.6 Analytical Methods 16

2.6.1 Standard Laboratory Analytical Procedures 16

2.7 Elements of Quality Control 17

2.7.1 Laboratory Control Samples 18

2.7.2 Matrix Spike and Matrix Spike Duplicate 18

2.7.3 Surrogates 19

2.7.4 Internal Standards 19

2.7.5 Retention Windows 20

2.7.6 Method Blank 20

2.7.7 Equipment Blank 21

2.7.8 Trip Blank 21

2.7.9 Field Duplicates 21

2.8 Instrument/Equipment Testing, Inspection, and Maintenance 22

2.8.1 Maintenance Schedules 22

2.8.2 Spare Parts 22

2.9 Instrument/Equipment Calibration and Frequency 23

2.10 Inspection/Acceptance of Supplies and Consumables 23

2.11 Non-Direct Measurements 23

2.12 Data Management 24

2.12.1 Electronic Data Management 24

2.12.2 Field Data Review 25

2.12.3 Laboratory Data Review 25

2.12.3.1 Laboratory Internal Review 26

2.12.3.2 Analytical Report and Data Management 26

2.12.4 Archiving 27

3. Assessment and Oversight 28

3.1 Assessment and Response Actions 28

3.1.1 Peer Review 28

3.2 Corrective Action 28

3.3 Performance and Data Quality Reports 29

4. Data Validation and Usability 30

4.1 Data Review, Verification, and Validation 30

4.2 Verification and Validation Methods 30

4.2.1 Evaluation of Completeness 31

4.2.2 Evaluation of Compliance 32

4.2.2.1 Tier 2 Verification 32

4.2.2.2 Tier 3 Validation 33

4.2.3 Data Validation Reporting 34

4.2.4 Validation Reports 34

4.3 Reconciliation with Data Usability Requirements 35

5. References 37

Tables

A-1 ARCADIS Technical Team Contact Information

A-2 Project Data Quality Objectives

A-3 Statistical Calculations

A-4 Field Data Quality Objectives and Field QC Collection Frequency

A-5 Method, Containers, Preservation, and Holding Times

A-6 Laboratory Quality Control Sample Frequency

Figure

A-1 Project Organization

Acronyms and Abbreviations

Air Toxics	Air Toxics, Ltd.
ARCADIS	ARCADIS U.S., Inc.
AOC	Area of Concern
APM	Associate Project Manager
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COC	Chain-of-Custody
DoD	Department of Defense
DQO	Data Quality Objectives
DQM	Data Qualification Module (Earthsoft ®)
DRMO	Defense Reutilization Market Office
EB	Equipment blank
EDD	Electronic data deliverable
FHSO	Field Health and Safety Officer
GA EPD	Georgia Environmental Protection Division
GIS	Geographic Information System
HAAF	Hunter Army Airfield
HSP	Health and Safety Plan
HSRA	Hazardous Site Response Act
HSWA	Hazardous and Solid Waste Amendments
IRP	Installation Restoration Program
LCS	Laboratory control sample
LCSD	Laboratory control sample duplicate
LTO	Laboratory Task Order
MDL	Method detection limit
Microseeps	Microseeps Laboratories, Inc.
MNA	Monitored natural attenuation
MS	Matrix spike
MSD	Matrix spike duplicate
NELAP	National Environmental Laboratory Accreditation Program
NFG	National Functional Guidelines
PARCC	Precision, accuracy, representativeness, completeness, and comparability

PBA	Performance Based Acquisition
PM	Project Manager
PMP	Project Management Plan
PT	Performance Testing
QA	Quality Assurance
QAO	Quality Assurance Officer
QAM	Quality Assurance Manual
QAPP	Quality Assurance Project Plan
QC	Quality Control
QCP	Quality Control Plan
% R	Percent recovery
RCRA	Resource Conservation and Recovery Act
RL	Reporting Limit
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SDG	Sample Delivery Group
SOPs	Standard Operating Procedures
SOW	Scope of Work
SWMU	Solid Waste Management Unit
TB	Trip blank
USAEC	United States Army Environmental Command
USEPA	United States Environmental Protection Agency
USTMP	Underground Storage Tank Management Program
VOCs	Volatile organic compounds

Introduction

The Installation Restoration Program (IRP) activities at Fort Stewart and Hunter Army Airfield (HAAF) are performed in accordance with the provisions of the Resource Conservation and Recovery Act (RCRA) as amended by the Hazardous and Solid Waste Amendments (HSWA) of 1984. The Georgia Environmental Protection Division (GA EPD) issued Hazardous Waste Management Permit No, HW-045(S) which addresses the corrective action requirements for all Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) at Fort Stewart. Hazardous wastes generated at HAAF are transferred to the Fort Stewart Defense Reutilization Market Office (DRMO) yard. Corrective action activities performed at HAAF are executed under either the Georgia Hazardous Site Response Act (HSRA) or the Georgia Underground Storage Tank Management Program (USTMP). The goal of the Performance Based Acquisition (PBA) contract is to meet the corrective action requirements for all sites, as defined in the contract and summarized in the Project Management Plan (PMP) (ARCADIS 2008). The full scope of services for this contract is defined in the Contract W91ZLK-05-D-0015: Task 0003 as executed between the Army Environmental Command (USAEC) and ARCADIS U.S., Inc. (ARCADIS). All work performed under the contract will be consistent with all applicable regulatory requirements, and relevant Department of Defense (DoD) and Army policy.

This Quality Assurance Project Plan (QAPP) presents the policies, organization, functions, and Quality Assurance (QA) requirements designed to achieve the data quality objectives for additional contaminant delineation, groundwater monitoring, and remedial attainment to be performed in support of the environmental restoration as identified in the PBA contract This QAPP has been prepared for use by field personnel, data quality reviewers, and laboratories who perform environmental activities to ensure that the data are scientifically valid and usable for the intended purpose. Analytical protocols and documentation requirements will ensure that the data are collected, reviewed, and analyzed in a consistent manner. The method performance criteria and the analytical laboratory quality management program, as well as the protocols set forth in this QAPP, will be employed to establish data usability.

The general guidelines followed in the preparation of this QAPP are presented in EPA Requirements for QAPPs for Environmental Data Operations, EPA QA/R-5 (United States Environmental Protection Agency [USEPA], March 2001). The EPA document was used as guidance and this QAPP presents only the applicable components. Other documents that have been referenced in this QAPP are presented in Section 5.

Personnel participating in the work effort will review this document. All personnel are required to comply with procedures documented in this QAPP and supporting project documents to ensure usability of the data produced.

1. Project Management

1.1 Project

This section provides a description of the ARCADIS organizational structure of personnel involved with this project. The lines of authority are defined and key personnel identified for various activities of the project. The project organization is illustrated in Figure A-1. Table A-1 presents contact information for key ARCADIS personnel. The Project Manager will communicate with the client and regulatory agencies and oversee project execution. The Associate Project Manager and Site Managers will implement project tasks and coordinate with the technical personnel.

<u>ARCADIS, Project Manager</u>

Mr. Charles A. Bertz, P.E.. The ARCADIS Project Manager (PM) is responsible for the overall implementation of the project. The Project Manager is responsible for allocating resources to assure successful execution and completion of the scope of work (SOW). Other duties, as required, may include:

- Approving project-specific procedures and internally prepared plans, drawings, and reports;
- Ensuring technical, schedule, and budget requirements are met;
- Coordinating manpower and other necessary resources with ARCADIS Assistant Project Manager, Site Managers, and technical personnel;
- Reviewing project progress;
- Reviewing all final documents, plans, and drawings; and
- Coordinating document delivery and attaining project milestones.

ARCADIS, Associate Project Manager

Ms. Shelley Gibbons. The ARCADIS Assistant Project Manager (APM) will support the Project Manager in contract management as well as task implementation, document preparation, personnel coordination, and budget management. Ms. Gibbons will perform a key role in ensuring compliance with quality performance objectives. Other duties, as required, may include:

- Coordinating schedules and deliverables with the Site Managers and the Project Manager;
- Ensuring project budget and deliverable schedule compliance;
- Assisting with quality program implementation and coordinating document preparation and submittals;
- Serving as the "collection point" for the project staff reporting any changes or deviations from the project work plan;
- Determining the significance of these changes or deviations to specific work plans and the appropriateness of reporting such items to the corresponding regulatory and facility representatives;
- Arranging subcontractor services; and
- Preparing status update reports and revisions to the project work plan.

ARCADIS, Site Managers

Mr. Andy Davis, P.E. and Mr. Scott Bostian, P.E.. The ARCADIS Site Managers are principally responsible for overseeing day-to-day of task performance including all technical and administrative operations. Other duties required may include:

- Preparing the work plans;
- Selecting and monitoring technical staff;
- Assigning duties to the project staff and orienting the staff to the requirements of the project;
- Coordinating and scheduling field activity resources;

- Performing assessment and oversight duties as described in the PMP, Sampling and Analysis Plan (SAP), and QAPP;
- Reviewing and approving all final reports and other work products;
- Monitoring staff and subcontractor progress; and
- Distributing the QAPP to the ARCADIS technical staff.

ARCADIS, Quality Assurance Officer

Mr. Kurt Beil, P.E.. The ARCADIS Quality Assurance Officer (QAO) is responsible for oversight of all QA/QC activities. He will remain independent of day-to-day direct project involvement, but will have the responsibility for ensuring that all project and task-specific QA/QC requirements are met. He will have direct access to corporate staff, as necessary, to resolve any QA/QC problems, disputes, or deficiencies. The QA Officer's duties include:

- Reviewing and approving the Site-Wide QAPP and site-specific work plans;
- Reviewing and approving substantive changes to the QAPP, SAP, and work plans;
- Reviewing any new work orders with the Project Manager to determine if the QAPP requires modification;
- Providing external review of field and analytical activities by performance of assessment and oversight duties as described in the QCP; and
- Conducting or delegating responsibility for field audits in conjunction with the corporate QA office and maintaining written records of those audits.

ARCADIS, Health and Safety Officer

Mr. Sam Moyers. The ARCADIS Health and Safety Manager reviews and internally approves the Health and Safety Plan (HSP) that will be designed to the specific needs and operations associated with this project. In consultation with the PM, the Health and Safety Manager will ensure that an adequate level of personal protection exists for anticipated potential hazards for field personnel. Identify the Field Health and Safety Officer (FHSO) for each field operation. On-site health and safety will be the responsibility of the FHSO. The FHSO will work in coordination with the PM and the project Health and Safety Manager to ensure that all activities are conducted safely and in accordance with the HSPA as well as facility requirements.

ARCADIS, Project Chemist

Ms. Jane Kennedy. The Project Chemist is responsible for laboratory selection and oversight, data validation and verification, and hard copy and electronic analytical data oversight. The Project Chemist's specific duties include:

- Developing the Site-Wide QAPP and QA aspects of site-specific work plans;
- Providing external review of analytical activities by performance of assessment and oversight duties;
- Coordinating with the Project Manager, Task Managers, and laboratory management to ensure that QA objectives appropriate to the project are set and that laboratory and field personnel are aware of these objectives;
- Recommending, implementing, and/or reviewing corrective actions taken in the event of QA/QC failures in the laboratory or field;
- Reporting nonconformance with either QC criteria or QA objectives (including an assessment of the impact on data quality or work assignment objectives) to the appropriate managers; and
- Assisting with preparation of reports summarizing data quality.

Technical Staff

The technical staff for this program will be drawn from a pool of technical resources within ARCADIS. The technical staff will implement project and site tasks, analyze data, and prepare reports/support materials. All technical personnel assigned will be experienced professionals who possess the degree of specialization and technical competence required to perform the required work effectively and efficiently. All technical staff will be familiar with the HASP and all relevant Work Plans, standard operating procedures (SOPs), and policies applicable to the field work performed.

Laboratories

Independent laboratories providing analytical services will be chosen as appropriate for the various project requirements including routine monitoring, confirmation sampling, remedial system monitoring, air analyses, and pilot/benchscale studies. Geotechnical laboratories may be selected based on project requirements and will be identified in the site-specific work plans. Selection criteria for geotechnical laboratories will be based on previous performance on ARCADIS projects or satisfactory recommendations. Analytical chemistry laboratories shall be accredited under the National Environmental Laboratory Accreditation Program (NELAP) and in accordance with Georgia requirements for the project analytical parameters for which accreditation is available through the primary accrediting state. The laboratory QA programs will be reviewed by the ARCADIS Project Chemist, as appropriate. The laboratory will assign an experienced Project Manager to coordinate analytical support for field operations with the ARCADIS Field Operations Manager and Project Chemist.

The analytical chemistry laboratories will provide services under a specified SOW and contractual agreement with ARCADIS. This QAPP incorporates by reference the laboratory, reporting and detection limits, and quality control limits. SOPs will be evaluated by the project chemist to ensure that method performance is acceptable. Appropriate data will be uploaded to the electronic project database for use by the ARCADIS Project Manager and task managers.

The laboratory staff will include a qualified QA Manager, who reports directly to laboratory management independently of the technical operations of the laboratory, to oversee technical adherence to the laboratory QA programs and this QAPP.

The specific duties of the laboratory Project Manager and QA Manager include:

- Reviewing the QAPP and other project requirements to verify that analytical operations will meet project requirements as defined in the project documents;

- Documenting and implementing project QA/QC requirements in the laboratory and reviewing analytical data (10 percent for the QA Manager) to verify that the requirements were met;

- Reviewing receipt of all sample shipments and notifying the Project Chemist of any discrepancies within 1 day of receipt;

- Conducting internal laboratory audits to assess implementation of the laboratory Quality Assurance Manual (QAM) and procedures and providing written records of those audits;

- Rapidly notifying the Project Chemist regarding laboratory nonconformance with the QAPP or analytical QA/QC problems affecting project samples; and

- Coordinating with the project and laboratory management to implement corrective actions as required by the QAPP and internal laboratory QAM.

The principal contract laboratory QAM will be incorporated in this QAPP by reference when the laboratory subcontract is executed. Microseeps Laboratories, Inc. (Microseeps), will provide analytical support for the monitored natural attenuation (MNA) dissolved gas and biogeochemical parameters, and Air Toxics, Ltd. (Air Toxics), will provide analysis of air samples as required. The QAMs for these laboratories shall be retained by the ARCADIS Project Chemist. Ozark Underground Laboratories will provide dye tracer analyses associated with remedial system performance assessments.

Other Subcontractors

Other subcontractors will provide services under the direct supervision or direction of the ARCADIS Project Manager or Task Managers or appropriate designated staff. The drilling, surveying, geotechnical laboratory, and other subcontractors are responsible for performance in accordance with the individual subcontracts and applicable portions of the QAPP and Quality Control Plan (QCP) as defined in each subcontract package. Subcontractors are responsible for rapidly notifying the Site Manager regarding nonconformance with the QAPP or QA/QC problems encountered or observed. Subcontractors must coordinate with the Site Managers to implement corrective actions.

1.2 Problem Definition/Background

Detailed project information is included in the PMP, the SAP, and the PBA contract or, if necessary, will be included in the appropriate work plans that define a particular SOW to be completed.

1.3 Project Description

The field sampling program and field procedures are described in detail in the SAP, and therefore are not repeated in this QAPP. Additional work plans will be prepared as sampling and analytical requirements are defined. Any additional specific QA requirements will be included in specific plans.

The purpose of this QAPP is to provide field, laboratory, and quality assessment personnel with general instructions regarding activities to be performed before, during, and after each sampling effort to ensure generation of usable data. This QAPP contains general and specific details regarding field sampling, laboratory analytical methods, and data management that apply to the Site. The collection and documentation of data will be performed as described in the following sections to ensure the quality of the collected data.

1.4 Data Quality Objectives for Measurement Data

Table A-2 presents the overall project Data Quality Objectives (DQOs). Additional analytical performance and data review DQOs include precision, accuracy, representativeness, completeness, and comparability (PARCC). These criteria represent qualitative and quantitative objectives that ensure the data are generated that are scientifically valid and usable for the intended purpose. As discussed in *USEPA Guidance on Systematic Planning Using the Data Quality Objectives Process; USEPA QA/G-4*, dated February 2006 and *USEPA Requirements for Quality Assurance Project Plans; USEPA QA/G-5*, dated March 2001, the DQOs are dependent on the intended uses of the data and are based on the premise that the ultimate use(s) of a particular data set should dictate the quantity and quality of these data. These DQOs in conjunction with criteria set forth in this QAPP will be used as a guide for data quality assessment by establishing analytical protocols and documentation requirements that will allow the analytical data to be collected, analyzed, and verified/validated in a consistent manner.

1.4.1 Precision, Accuracy, Representativeness, Completeness, and Comparability

The basis for assessing the elements of data quality is discussed in the following subsections. The contract analytical laboratory precision and accuracy QC limits will be incorporated into the QAPP and updated as appropriate.

Precision measures the reproducibility of repetitive measurements. It is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions.

Analytical precision is a measurement of the variability associated with duplicate (two) or replicate (more than two) analyses of the same sample in the laboratory and is determined by analysis of laboratory control samples/laboratory control sample duplicate (LCS/LCSD), matrix spikes/matrix spikes duplicate (MS/MSD), laboratory duplicates and field duplicates. If the recoveries of analytes in the LCS are comparable within established control limits, then laboratory precision is within limits. The contract laboratory control limits will be utilized to evaluate analytical precision.

Total precision is a measurement of the variability associated with the entire sampling and analysis process. It is determined by analysis of duplicate or replicate field samples and measures variability introduced by both the laboratory and field operations. Field duplicate samples and matrix duplicate spike samples are analyzed to assess field and analytical precision. Field duplicate samples will be collected at a minimum 5 percent frequency.

Duplicate results are assessed using the relative percent difference (RPD) between duplicate measurements. The formulas for the calculation of precision are provided in Table A-3 as RPD (used for two measurements), average RPD, relative standard deviation (RSD), and pooled RSD (used for more than two measurements). The proposed precision objective for soil and sediment field duplicates is an RPD of 70 percent and the precision objective for groundwater and surface water field duplicates is an RPD of 40 percent for all parameters analyzed.

Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systematic error. It reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ from the true value or known concentration of the spike or standard. Analytical accuracy is measured by determining the percent recovery (%R) of known target analyses that are spiked into a LCS to a control limit. For organic parameters analyzed by GC and GC/MS surrogate compound recoveries are also used to assess accuracy and method performance for each sample analyzed.

Both accuracy and precision are calculated for preparation or analytical batches, and the associated sample results are interpreted by considering these specific measurements. The formula for the calculation of accuracy is included in Table A-3 as %R from pure and sample matrices. Laboratory precision and accuracy control limits will be incorporated by reference into this QAPP upon selection of the contract laboratory.

Representativeness is achieved through use of the standard field, sampling, and analytical procedures. Representativeness is also determined or influenced by appropriate program design, with consideration of proper sampling locations and collection techniques.

Completeness is calculated for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set. For completeness requirements, valid results are all results not qualified with an "R" flag/reject or unusable data. For any instances of samples that could not be analyzed for any reason (e.g., holding time violations in which re-sampling and analysis were not possible, or samples spilled or broken), the numerator of this calculation becomes the number of valid results minus the number of possible results not reported.

The formula for calculation of completeness is presented, as follows:

$$\% \text{ completeness} = \frac{\text{number of valid results}}{\text{number of possible results}}$$

The completeness objective for sample matrices collected during these investigations will be at least 90 percent.

Comparability is the confidence with which one data set can be compared to another data set. The objective for this aspect of the QA/QC program is to produce data with the greatest possible degree of comparability. The number of matrices that are sampled and the range of field conditions encountered are considered in determining comparability. Comparability is achieved using standard methods for sampling and analysis, reporting data in standard units, and using standard and comprehensive reporting formats. Complete field documentation using standardized data collection forms shall support the assessment of comparability. Historical comparability is achieved through consistent use of methods throughout the project. EPA approved methods will be utilized for analytical chemistry determinations as available.

1.4.2 Objectives for Laboratory Analyses

The laboratory DQOs include method performance and reporting consistent with criteria presented in the USEPA document entitled "Test Methods for Evaluating Solid Waste-Physical/Chemical Methods," SW-846, Third Edition (as updated) the laboratory QAM and SOPs, this QAPP, and other applicable performance requirements published in EPA method guidance.

1.4.3 Objectives for Field Measurements

Field measurement DQOs for precision, accuracy, and completeness criteria presented in Table A-4 are consistent with the industry acceptance criteria.

Trip blanks (TBs) will accompany samples to be analyzed for volatile organic compounds (VOCs). Field duplicate samples will be collected at a frequency of 5 percent for each analysis and each sample matrix collected. Equipment blanks (EBs) and additional sample volume for MS analysis will be collected at a minimum five percent frequency for each analysis. Temperature blanks will be placed in each sample cooler and the temperature recorded upon laboratory receipt. Frequency for collection of field QC samples is presented in Table A-4.

The field sampling team will also be responsible for collecting additional sample quantities at a frequency of five percent for MS and MSD analyses.

1.5 Specialized Training and Certification

Training shall be provided to all project personnel to ensure compliance with the site specific Health and Safety Plan and technical competence in performing the work effort. Documentation of this training shall be maintained in the records of the contracted organizations. ARCADIS employees who participate in the types of activities defined in the Occupational Safety and Health Administration (OSHA) requirements under Code of Federal Regulations (CFR) 1910.120 complete the 40-hour health and safety training program. Each employee must successfully complete a minimum of 8 hours of refresher training annually to maintain the certification. Employee training records are maintained in the ARCADIS office where the employee resides. Any special requirements for personal possession of certification cards will be adhered to as program appropriate.

All analytical chemistry laboratories performing analyses will be required to maintain current NELAP accreditation for the parameters of interest if accreditation is available. Accreditation certificates, audit reports, and performance testing (PT) data will be reviewed by the Project Chemist, as appropriate to ensure that laboratory capabilities meet or exceed project requirements. Laboratories must also maintain internal training records for technical staff in accordance with standard laboratory practices and certification requirements. The laboratory will provide the applicable training records, including Initial Demonstration of Competence documentation, for review, as deemed necessary, by the ARCADIS Project Chemist.

All subcontractors and their employees will have current and applicable performance and certifications required to perform the assigned SOW. Subcontract agreements will include the specific training and certification requirements and applicable records will be reviewed as appropriate. Subcontractor training and certification documentation will be maintained at the subcontractors’ offices.

1.6 Documents and Records

The primary documentation for the project includes field records, analytical data packages, and summary reports. This section describes the level of documentation and record keeping for the central project file that will be maintained by the ARCADIS office in Raleigh, North Carolina.

1.6.1 Document Control

All planning documents will be clearly identified by the document title, revision number, date, and page number in the header of each document page. Planning documents currently in use will be reviewed on an annual basis and any necessary revisions or updates will be amended and distributed to each participating party. Documents prepared in support of the PBA contract will be prepared and distributed as required.

Original field records and laboratory analytical data will be maintained in the ARCADIS Raleigh, NC office.

1.6.2 Field Documentation

Field documentation will include field logbook or daily logs, field sampling logs, instrument calibration logs, and data forms as necessary to provide sufficient information to allow review of field conditions, performance, and sample collection, to evaluate potential impacts to sample and data integrity, and to enable participants to reconstruct events that occurred during the field operations when necessary. Daily logs will also document any deviations from the SAP, QAPP, site or task specific work plans or other applicable planning documents and describe the rationale for the changes.

All entries will be made in waterproof ink, and the time of the entry will be recorded. The top of each page of the field documents will contain the date that the entries on that page were recorded. No pages will be removed from a bound logbook for any reason. Additional details on field documentation are provided in the SAP.

All documentation associated with field activities will be retained in the project file in accordance with the document retention policy stated in this QAPP and the QCP as applicable to the document type.

1.6.3.1 Corrections to Field Documentation

As with all bound data logbooks, no pages will be removed for any reason. If corrections are necessary on any field documentation, they will be made by drawing a single line through the original entry (so that the original entry can still be read) and writing the corrected entry alongside it. The correction must be initialed and dated. As necessary, corrected errors will include a footnote explaining the correction.

1.6.3.2 Photographs

Photographs will be taken as directed by the Site Manager. Documentation by a photograph will ensure the validity as a visual representation of an existing situation. A log will be developed to track the media that the photos are filed on (e.g., compact disc, floppy disk). Photographs, as developed or transferred to electronic media, shall be compiled into a photograph log and information recorded in field notebooks added to the log with appropriate photographs.

1.6.3 Laboratory Data Reporting/Record Retention

Analytical data reports for all samples will be prepared by the laboratory as a Level II Data Package. The Level II Data Packages will include a fully-executed COC Record, sample receipt checklist, cross-reference table of field samples with laboratory sample number, preparation and analytical batch numbers, analytical results, collection and analysis dates and times, reporting limits (RLs), dilution factors, surrogate recoveries, method blank data. Summary QC data will be provided for LCS, MS accuracy and precision, laboratory replicate precision, laboratory control limits. The analytical report shall include the method detection limits (MDL), and the quantitative RLs. Appropriate data flags identifying any QC result reported outside control limits and an explanation of all data flags applied by the laboratory. The case narrative will present an explanation of all QC results reported outside control limits and samples analyzed at dilutions where all results are non-detect.

Where detailed data validation is required, analytical data reports will include the following items in addition to the elements of the Level II data package, sample aliquots, final extract volumes, run logs, quantitation reports, ion spectra, chromatograms, batch identification report clearly linking all QC results to field sample results, and instrument calibration and tuning information. The laboratory report will include copies of any nonconformance or corrective action forms associated with data generation. This level of analytical report components will be defined as a Level IV data package.

The RLs will be corrected for percent moisture (soils only) and all dilution factors. Any compounds found less than the RL, but greater than the MDL will be reported and qualified with a “J” flag as estimated. Soils will be reported on a dry weight basis.

The laboratory will provide an electronic data deliverable (EDD) that matches all data reported on the hard copy analytical report. Electronic data report requirements are described in Section 2.12.

The laboratory is required to retain all information associated with the analytical operations for samples associated with this project for a minimum of 6 years.

1.6.4 Electronic Data Retention

Electronic data and media retention policies will correlate with hard copy data retention at the laboratories as well as other points of electronic data generation. Additionally, electronic data will be subject to back-up routines that will enable recovery of data that may become corrupted or lost due to instrument, computer, and/or power failures. Electronic media will be stored in climate-controlled areas to minimize potential for degradation. Storage areas will be access limited.

2. Data Generation and Acquisition Elements

2.1 Sampling Process Design

The sampling process design will be presented in future work plans and in the SAP.

2.2 Sampling Methods

The field sampling procedures, sampling methods and equipment are also discussed in detail in the associated SAP. Calibration will be documented on a Field Equipment Calibration form, where each instrumented calibrated is identified along with the date, time, calibration reading, and field staff initials. The field sampling methods are referenced in the following section.

2.3 Sample Handling and Custody

Procedures to insure the custody and integrity of the samples begin at the time of sampling and continue through transport, sample receipt, preparation, analysis and storage, data generation and reporting, and sample disposal. Records concerning the custody and condition of the samples are maintained in field and laboratory records. All samples will be uniquely identified, labeled, and documented in the field at the time of collection and recorded on the Chain-of-Custody (COC) form. Samples collected for laboratory QC will be clearly identified on the COC (e.g. MSs). Details for completing the COC are included in Section 4.2.17 of the SAP. Field custody procedures are presented in Section 4.3 of the SAP.

Samples collected in the field will be transported to the laboratory or field testing site as expeditiously as possible. Samples requiring preservation at 4 degrees +/- 2 degrees Celsius (^{o}C) will be packed in ice or chemical refrigerant to keep them cool during collection and transportation. Any concerns and/or deviations will be reported to the contractor immediately.

Once the samples reach the laboratory, they will be checked against information on the COC form for anomalies. The condition, temperature, and appropriate preservation of the samples will be recorded by the laboratory on a sample receipt checklist, and will be made part of the permanent project custody records. The occurrence of any anomalies in the received samples and their resolution shall be documented in laboratory records. All sample information shall then be entered into the laboratory tracking and data management system. The laboratory PM shall review the log-in for accuracy and compliance with project requirements. Procedures ensuring internal laboratory COC shall also be implemented and documented by the laboratory. Specific instructions concerning the analysis specified for each sample shall be communicated to the analysts. Analytical batches shall be created, and laboratory QC samples shall be introduced into each batch.

While in the laboratory, samples shall be stored in limited access, temperature controlled areas. Refrigerators, coolers and freezers used for sample storage will be monitored for temperature 7 days a week. Acceptance criteria for the temperatures of the refrigerators and coolers are 4^{o}C to 2^{o}C. Acceptance criteria for the temperatures of the freezers shall be less than 0^{o}C. All of the cold storage areas shall be monitored by thermometers that have been calibrated with a NIST traceable thermometer. As indicated by the findings of the calibration, correction factors shall be applied to each thermometer. Records that include acceptance criteria shall be maintained. Samples shall be stored separately from standards. Samples shall be stored after analysis until disposed of in accordance with applicable local, state, and federal regulations. Disposal records shall be maintained by the laboratory. SOPs describing sample control, custody, and disposal shall be maintained by the laboratory.

2.4 Sample Containers

The volumes and containers required for the sampling activities are listed in Table A-5. The laboratory will provide new, pre-cleaned sample containers. The laboratory shall use an approved specialty container supplier that prepares the containers in accordance with USEPA bottle preparation procedures. TBs will be transported to the site inside the same cooler/box as the VOC vials.

Sample container lids will not be mixed. All sample lids must stay with the original containers as provided by the supplier. Bottle lids (with any associated bottle) exhibiting cracks, splits, or chips shall be appropriately discarded.

2.5 Sample Preservation and Holding Times

New and pre-preserved (as appropriate) containers obtained from the laboratory shall be used for all samples requiring preservation. Chemicals used by the laboratory for preservation will be reagent-grade chemicals. The laboratory shall maintain traceability records for all preservatives in the event of potential contamination of samples. The laboratory must ensure that preservatives used in containers supplied will not expire within the anticipated time of sample collection completion. Each bottle received from the laboratory must be clearly labeled with the type of chemical preservative in the bottle and the test parameters that will be determined from the sample collected in the container. Sample containers will not be stored at the site for longer than 30 days. Bottle orders and any additional preservative requirements will be submitted to the laboratory 5 working days prior to commencement of field operations to allow supplies of clean, fresh containers and preservatives to be shipped to the facility.

Sample preservation will be verified on receipt at the laboratory with the exception of aqueous VOC samples. VOC sample preservation shall be verified prior to analysis. The preservation or pH check will be recorded on the sample receipt form or other appropriate logbook. If the samples are improperly preserved, a corrective action form will be submitted to the laboratory project manager for follow-up action. The laboratory will notify the ARCADIS Site Manager or Project Chemist to implement corrective actions in the field to ensure sufficient preservative is added at the time of sample collection.

Sample holding times will be based on published USEPA guidance and will be calculated for the date and time of collection. A list of preservatives and holding times for each type of analysis are presented in Table A-5. Additional preservation requirements and holding times for non-target analyses are listed in 40 CFR Part 136. Preservatives and holding times not listed in Table A-5 applicable to a specific task will be listed in the applicable SAP or work plan.

2.6 Analytical Methods

The primary analytical methods anticipated to be utilized for samples collected Table A-5. All methods will be USEPA approved/published. Additional USEPA approved methods, which may be utilized, are published in references listed below. Specific performance criteria, including QA protocols, for each analytical method, are documented in the published methods, laboratory SOPs, and the laboratory QAM. The QAM for each analytical laboratory performing work be reviewed as part of the procurement process and laboratory SOPs will be examined during onsite audits or as necessary. QAM is a generic term for the laboratory QA document, which describes the laboratory program to ensure data of known quality are generated. The contracted laboratory QAM will be incorporated by reference into this QAPP upon execution of the contract for analytical support.

2.6.1 Standard Laboratory Analytical Procedures

All standard analytical methods performed will be USEPA approved. The analytical methods are referenced in:

- *Test Methods for Evaluating Solid Waste, Physical Chemical Methods*, 3rd edition, SW-846, 1997.

- 40 CFR Part 136, *Guidelines Establishing Test Procedures for the Analysis of Pollutants under the Clean Water Act*; and

- *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, Revised March 1983.

The laboratory will perform all methods in accordance with the appropriate USEPA-approved methods and the laboratory specific SOPs for compliance with this QAPP and other project-specific requirements. The laboratory shall have method specific SOPs for all methods performed. The SOPs will detail method set-up, calibration, performance, and reporting criteria in accordance with SOP preparation under NELAP guidance and requirements. Method performance will be in strict compliance with the SOP and referenced method. Laboratory SOPs will include any modifications to the published method and will indicate actual performance protocols performed by the laboratory. The laboratory will update SOPs in accordance with NELAP requirements. The ARCADIS Project Chemist must approve any changes to the method performance acceptance criteria

The laboratory must notify the Project Chemist of any updated or revised RLs or performance control criteria prior to initiation of field operations. Required sample or extract dilutions to complete the analyses within method performance criteria may impact RLs. All required sample dilutions will be noted in the analytical report and explained in the case narrative. The laboratory shall make every effort to report all compounds/analytes at the lowest technically achievable limit to meet the risk screening standard requirements. The changes/elevations in limits will be evaluated to determine potential impact on DQOs. Any additional methods required for future projects will be specified in the SAP or Work Plan.

2.7 Elements of Quality Control

This section presents QC requirements relevant to analysis of environmental samples that shall be followed. The purpose of this QC program is to produce data of known quality that satisfy the project objectives and that meet or exceed the requirements of the standard methods of analysis. This program provides a mechanism for ongoing control and evaluation of data quality measurements through the use of QC materials.

Laboratory QC samples (e.g., blanks and LCSs) shall be included in the preparation batch with the field samples. Preparation batch is a number of samples (not to exceed 20 samples) similar in composition (matrix) and that are extracted or digested at the same time and with the same lot of reagents. MS and MSD samples do not count as environmental samples. The term analytical batch also extends to cover samples that do not need separate extraction or digestion (e.g., VOCs analysis by purge and trap). The identity of each preparation batch will be unambiguously reported with the analyses so that a reviewer can identify the QC samples and the associated environmental samples. The type of QC samples and the frequency of use of these samples are discussed in the following section. The laboratory will provide spike results from site-specific field samples of groundwater and soil, not from another client or site. Additional QC samples may be added to those required by the method to ensure accurate and precise data. The frequency of analysis of laboratory QC samples is presented in Table A-6.

2.7.1 Laboratory Control Samples

The LCS is analyte free water (aqueous samples) or clean sand (soil/sediment matrix) spiked with known concentrations of specific analytes. The LCS shall be carried through the complete sample preparation and analysis procedure. The LCS is used to evaluate each preparation batch and to determine if the method is in statistical control. One LCS will be included with every analytical batch. All target analytes will be spiked in the LCS.

In accordance with method criteria and laboratory SOPs, an LCS analyte outside the recovery acceptance limit mandates corrective action unless the out of control scenario does not impact data usability. Where corrective action is required and after the system problems have been resolved with system control re-established, all samples in the analytical batch will be reanalyzed for the out of control analyte(s). When an analyte in an LCS exceeds the upper or lower control limit and no corrective action is performed, the appropriate validation flag, as described in the data validation section, will be applied to all affected results. LCS results will be compared to the laboratory LCS control limits.

2.7.2 Matrix Spike and Matrix Spike Duplicate

An MS is an aliquot of sample spiked with known concentrations of specific compounds. The spiking occurs prior to sample preparation and analysis. The laboratory will provide the results at a minimum of one MS and one MSD sample for every 20 environmental samples. The MS and MSD samples will be designated on the chain of custody (COC) form. Additional sample quantities will be collected so that MS and MSD analyses can be performed on the environmental samples collected at the Site. The full list of target analytes will be spiked into the samples utilized for the MS and MSD.

An MS is used to document the bias of a method in a given sample matrix. MS and MSD results are used to evaluate the matrix effect, not to control the analytical process. The recoveries of analytes in the MS/MSD will be compared to the laboratory QC acceptance limits 2. If the recoveries for the MS or the MSD are outside the QC acceptance limits, sample data will be evaluated by the Project Chemist to determine extent of impact.

2.7.3 Surrogates

Surrogates are organic compounds that are similar to the target analyte(s) in chemical composition and behavior in the analytical process, but that are not normally found in environmental samples. Surrogates are used to evaluate accuracy, method performance, and extraction efficiency. Surrogates are added to samples, controls, and blanks, in accordance with the method requirements.

When the recovery of a surrogate is outside the acceptance limits, corrective action steps must be taken. After the system problems have been resolved and system control has been re-established, the sample is re-prepared and re-analyzed. Re-preparation and re-analysis is not required if the laboratory is able to provide objective evidence with the case narrative of the final report documenting matrix interference (that is, unresolved co-eluting peaks on reconstructed ion chromatograms, or observations about visibly oily samples). If corrective actions are not performed or are ineffective, the appropriate validation flags are applied to the sample results. Re-extractions will be done within the holding times. Laboratory surrogate recovery limits will be included in each analytical report.

2.7.4 Internal Standards

Internal Standards (ISs) are measured amounts of certain compounds added after preparation or extraction of a sample. They are used in an IS calibration method to correct sample results affected by column injection losses, purging losses, or viscosity effects. ISs are added to samples, controls, and blanks, in accordance with the method requirements.

When the IS results are outside of the acceptance limits, corrective actions shall be performed. After the system problems have been resolved and system control has been re-established, samples analyzed while the system was malfunctioning are re-analyzed. If corrective actions are not performed, the appropriate validation flag, as described in the data validation section of this QAPP.

2.7.5 Retention Windows

Retention time windows are used in GC analysis for qualitative identification of analytes. They are calculated from replicate analyses of a standard on multiple days. The procedure and calculation method are given in SW-846 Method 8000A.

When the retention time is outside of the acceptance limits, corrective actions will be performed. After the system problems have been resolved and system control has been re-established, samples analyzed since the last acceptable retention time check are re-analyzed. If corrective actions are not performed, the appropriate validation flag, as described in the validation section, will be applied to the sample results.

2.7.6 Method Blank

A method blank is an analyte free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank will be carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination resulting from the analytical process. A method blank will be included in every analytical batch and representative for each sample matrix.

The presence of analytes in a method blank at concentrations greater than the MDL or RL for common laboratory contaminants indicates a need for corrective action. Corrective actions will be performed to eliminate the source of contamination prior to proceeding with analysis. After the source of contamination has been eliminated, all samples in the analytical batch will be re-prepared and re-analyzed. No analytical data will be corrected for the presence of analytes in blanks. When an analyte is detected in the method blank, but not in the associated samples, no corrective action is necessary. When an analyte is detected in the blank and in the associated samples and corrective actions are not performed, the appropriate validation flag, as described in the data validation section, will be applied to the sample results.

2.7.7 Equipment Blank

An EB is a sample of organic free water (for VOCs analyses) poured into, or over, or pumped through the sampling device, collected in the sample bottle, and transported to the laboratory for analysis. EBs are used to assess the effectiveness of equipment decontamination procedures.

EBs are collected immediately after the equipment has been decontaminated. The frequency requirements for collecting EBs are a minimum of five percent of the environmental samples. The blank shall be analyzed for all laboratory analyses requested for the environmental samples collected at the Site. When an analyte is detected in the EB the appropriate validation flag, as described in the data validation section, shall be applied to all sample results from samples collected. It should be noted that the laboratory will supply the organic free water. A sample aliquot of the organic free water will be submitted for the analysis of all parameters of interest.

2.7.8 Trip Blank

The TB consists of a VOC sample vial filled in the laboratory with ASTM Type II reagent grade water, transported to the sampling site, handled like an environmental sample and returned to the laboratory for analysis. TBs are not opened in the field. TBs are prepared only when VOC samples are taken and are analyzed only for VOC analytes. TBs are used to assess the potential introduction of contaminants from sample containers or during the transportation and storage procedures.

When an analyte is detected in the TB the appropriate validation flag as described in the validation section, shall be applied to all sample results from samples in the cooler with the affected TB. One TB of either soil or liquid matrix shall accompany each cooler of samples submitted to the laboratory for VOC analysis.

2.7.9 Field Duplicates

A field duplicate sample is a second sample collected at the same location as the original sample. Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. The sample containers are assigned an identification number in the field such that they cannot be identified (blind duplicate) as duplicate samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field duplicate samples prior to the beginning of sample collection.

Field duplicate sample results are used to assess precision, including variability associated with both the laboratory analysis and the sample collection process. Field duplicates will be collected at a frequency of 5 percent of samples collected. Analytical results for field duplicate will be assessed during the data validation process. Specific locations will be designated for collection of field duplicate samples prior to the beginning of sample collection. Control limits for evaluation of precision for field duplicates will be 40 percent for aqueous samples and 70 percent for soil/sediment samples.

2.8 Instrument/Equipment Testing, Inspection, and Maintenance

Field equipment testing (calibration) and inspection will be completed daily and documented on the daily calibration form. Field equipment maintenance will be completed on an as needed basis.

Maintenance responsibilities for laboratory instruments are assumed by the respective Laboratory Facility Manager. The managers then establish maintenance procedures and schedules for each major equipment item. This responsibility may be delegated to field or laboratory personnel, although the managers retain responsibility for ensuring adherence to the prescribed protocols. All field instrument/equipment will be inspected prior to the project initiation.

2.8.1 Maintenance Schedules

The effectiveness of any maintenance program depends to a large extent on adherence to specific maintenance schedules for each major equipment item. Other maintenance activities are conducted as needed. Manufacturers' recommendations provide the primary basis for the established maintenance schedules, and manufacturers' service contracts provide the primary maintenance for many major instruments.

2.8.2 Spare Parts

Along with a schedule for maintenance activities, an adequate inventory of spare parts is required to minimize equipment downtime. The inventory includes those parts (and supplies) that are subject to frequent failure, have limited useful lifetimes, or cannot be obtained in a timely manner should failure occur.

Field sampling task leaders and the respective laboratory managers are responsible for maintaining an adequate inventory of spare parts. In addition to spare parts and supply inventories, the contractor shall maintain an in house source of backup equipment and instrumentation.

2.9 Instrument/Equipment Calibration and Frequency

Field equipment will be calibrated at the frequency recommended by the manufacturer’s specifications and/or described by the analytical method.

Analytical instruments will be calibrated in accordance with the procedure specified in the analytical methods. All analytes that are reported shall be present in the initial and continuing calibrations, and these calibrations must meet the acceptance criteria specified in the analytical method. Records of standard preparation and instrument calibration will be maintained by the laboratory. Records shall unambiguously trace the preparation of standards and their use in calibration and quantitation of sample results. Instrument calibration will be checked using all of the analytes. All calibration criteria will satisfy SW-846 requirements at a minimum. The initial calibration will be checked at the frequency specified in the methods using materials prepared independently of the calibration standards.

2.10 Inspection/Acceptance of Supplies and Consumables

The laboratory will inspect supplies and consumables prior to their use in analysis. The materials description in the methods of analysis shall be used as a guideline for establishing the acceptance criteria for these materials. Introduction of interfering compounds into the analytical process will be monitored by analysis of method blanks. Purity and efficiency of reagents shall be monitored by analysis of LCSs. An inventory and storage system for these materials will assure use before manufacturers' expiration dates and storage under safe and chemically compatible conditions.

Sample containers will be laboratory supplied. All containers will be certified clean and the certificates will be retained by the laboratory. Containers are stored in clean areas to prevent exposure to fuels, solvents, and other contaminants.

2.11 Non-Direct Measurements

Non-direct measurement data will be entered into the project file. Data will be entered from forms, tables and data packages as presented in the documents/reports. All data entry will be peer reviewed prior to finalization.

2.12 Data Management

The data reduction, review, reporting, and validation procedures described in this section will ensure that (1) complete documentation is maintained, (2) transcription and data reduction errors are minimized, (3) the data are reviewed and documented, and (4) the reported results are qualified, as necessary. Laboratory data reduction and verification procedures are required to ensure that the overall objectives of analysis and reporting meet method and project specifications.

2.12.1 Electronic Data Management

Data management protocols track samples and results from work plan implementation to the final report. The field data include approved work planning tables, labels, field sampling forms, COC, and logbooks. Geographic coordinates will be generated for all sample locations in electronic format. The Field Operations Leader or designee will review all field data for accuracy. Field data will be collected using portable data acquisition (PDA) devices or manually entered into a database or spreadsheet.

The laboratory will provide an EDD for all analytical reports. The EDD will be in the format required for the project environmental database and include, at a minimum, the following information:

- Laboratory information – Laboratory name, client name, laboratory work order, client project number, and date received;

- Sample information – Laboratory project number, sample identification, laboratory sample identification, date sampled, time sampled, matrix;

- Analytical Data – Sample Delivery Group (SDG), test code, test name, analyte, analyte type, sample type, CAS number, date and time prepared, date and time analyzed, preparation batch identification, analytical batch identification, result, laboratory qualifier, MDL, RL, and dilution factor; and

- QC Data – All fields provided for analytical data will also be populated for method blanks, surrogates for all samples, LCS, MS/MSD, and laboratory replicates. QC sample data will also include QC Sample Type, recoveries, RPDs, control limits, and any associated qualifiers. Calibration data are not required.

The Project Chemist, Data Manager, or designee will review approximately 5 percent of electronic laboratory and field data to verify the results against the hard copy and check for transcription errors. A greater than 15 percent discrepancy rate in two consecutive datasets will require additional review and verification. Electronic data will match the hard copy data for all results. Significant figures and rounding routines may differ slightly based on the program utilized to generate hard copy reports and electronic files, but may not differ to the point of impacting data integrity or usability. The results will be transferred to a centralized database. The ARCADIS Data Manager or data validator will add any data qualifiers. The Data Manager will generate data tables for the project team as required. The Project Chemist and Site Manager will resolve discrepancies between the planned activities and actual data collected and document the findings in the data report. The central database will be stored in a secure area with access limited to data management specialists designated by the Project Manager. The central database will be electronically linked to a geographic information system/computer-aided design (GIS/CAD) systems, risk assessment programs, and other final data user models and statistical programs. Data users may enter additional electronic data such as risk-based criteria for comparison of the results. This data will be stored in separate tables in the database and linked to the actual results. Any data from outside sources will include a description of the data, a reference to the source, and the date updated. The outside data will be checked prior to use in order to verify that the most current values are used.

2.12.2 Field Data Review

All field data and the required forms will be reviewed by the author prior to submittal to the Site Manager or designee for review. Any field forms or documentation requiring amendments and/or corrections will be clearly documented on the corresponding day's field form or logs and initialed. Corrections will be made by a single line, followed by initials. The Site Manager or designee will verify the field review then submit the documents for data entry and/or retention in the project file.

2.12.3 Laboratory Data Review

The analytical laboratory will perform a series of internal reviews/audits prior to submittal of the final data package.

2.12.3.1 Laboratory Internal Review

In each laboratory analytical section, the analyst performing the tests shall review 100 percent of the data. After the analyst's review has been completed, 100 percent of the data shall be reviewed independently by a senior analyst or by the supervisor of the respective analytical section using the same criteria.

Data qualifiers shall be added by the laboratory supervisor of the respective analytical section, after the first and second level of laboratory data reviews have been performed. Analytical batch comments shall be added to the first page/Case Narrative of the data report packages to explain any non-conformance or other issues. When data are qualified, the laboratory supervisor shall apply a final qualifier to any data that have been affected by multiple qualifiers. This final qualifier shall reflect the most severe qualifier that was applied to the data, that is, all data will have only one data qualifying flag associate with it.

The laboratory QA section shall review 10 percent of the completed data packages, and the laboratory project manager shall perform a sanity check review on all the completed data packages. The laboratory shall apply appropriate data qualifying flags to any impacted field sample including field QC samples.

The laboratory will submit the analytical data package and EDD to ARCADIS via email and on compact disk. The analytical report will be complete and signed and submitted in portable document format (pdf). The EDD shall be prepared in accordance with the protocols defined by ARCADIS for input into the electronic data management system.

2.12.3.2 Analytical Report and Data Management

Upon submittal of the data package (report and EDD), the data will be logged in by the data manager as received and the EDD loaded into the project database. The Data Manager will forward the analytical data to the Project Chemist or designee for review and validation in accordance with Section 3 of this QAPP. The data package, at a minimum, will be reviewed to assure completeness and that the EDD matches the report. Once the analytical data package is determined to be final and complete and as validated, the data with any applicable data qualifiers will be added to the project database. Any data validation reports will be submitted to the Data Manager archiving with the analytical report. The data will then be available for distribution to the project team. Upon completion, the analytical data package, EDD, and validation report will be submitted to the project file.

2.12.4 Archiving

The laboratory shall maintain electronic and hardcopy records sufficient to re-create each analytical event conducted for a minimum of 6 years. Data will be accessible within 7 working days upon request. ARCADIS will retain the project files for at least 6 years.

3. Assessment and Oversight

3.1 Assessment and Response Actions

Assessment activities include management and assessments, technical systems audits, and performance evaluations. Management assessments include routinely scheduled meetings and conference calls to evaluate staff utilization. Assignment of qualified personnel to projects, maintenance of schedules and budgets, and quality of project deliverables are verified as part of these assessments. Performance evaluations are used to ensure that trained and qualified staff is utilized for the project. Technical assessment activities include peer review, data quality reviews, and technical system audits (i.e., laboratory and field). Technical systems audits include review and evaluation of field and laboratory performance to assess the implementation of quality programs and directives specifically for the project. Procedures for assessment and audit of data quality are described in Section 4 of this QAPP. Procedures for peer review and technical assessments are summarized briefly below. Both the overall and direct technical assessment activities may result in the need for corrective action. The procedure for corrective action response is summarized below.

3.1.1 Peer Review

All project deliverables including work plans, SAPs, draft and final reports, and technical memoranda will be peer reviewed by ARCADIS. The peer review process provides for a critical evaluation of the deliverable by an individual or team to determine whether the deliverable will meet the established criteria, DQOs, technical standards, and contractual obligations. The PM or APM will assign peer reviewers, depending on the nature and complexity of the project, when the publication schedule is established. The PM will be responsible for ensuring all peer reviewers participate in the review process and approve all final deliverables. The QA Manager is responsible for verifying that project documents were generated in accordance with the project requirements.

3.2 Corrective Action

Corrective actions will be implemented as necessary to insure that project activities are performed and data are generated in accordance with the project quality documents. In conjunction with the QA Manager and Project Chemist, the Project Manager and Site Managers are responsible for initiating and implementing corrective action in the field and in the office. The laboratory project manager, in conjunction with the laboratory technical staff and QA manager, is responsible for implementing corrective action in the laboratory. It is the combined responsibility to insure that all analytical procedures are followed as specified and that the data generated meet the prescribed acceptance criteria. Specific corrective actions necessary will be clearly documented in the logbooks or analytical reports.

In all cases in which corrective actions of field procedures are required, a written report describing the nature of the problem, an evaluation of the cause, if known, and the action taken will be prepared by the ARCADIS Site Manager or the ARCADIS QAO. The report will be distributed to the ARCADIS PM, the ARCADIS QAO (if not preparing the report), and the ARCADIS Project Director.

Any corrective actions taken by the contract laboratory will be reported to the ARCADIS Project Chemist. The laboratory will include in each data package a discussion of the problems encountered and corrective actions taken. In addition, the laboratory will maintain a file that documents all corrective actions taken. Reports of corrective actions undertaken during laboratory analysis will be documented, as appropriate, in the Data Validation Report.

3.3 Performance and Data Quality Reports

Data Validation Reports - Data validation reports will be completed by the Project Chemist as soon as possible after receipt of the data from the laboratory (i.e., the goal is within 3 weeks). Impacts on the usability of the data will be tracked by adding qualifiers to individual data points as described in Section 4.

Serious analytical problems will be reported immediately to the ARCADIS Project Chemist by the laboratory PM. The ARCADIS Project Chemist will notify the ARCADIS Site Manager and PM to evaluate necessity for resampling or additional sample collection. Time and type of corrective action (if needed) will depend on the severity of the problem and will be related to overall project importance of the data points. Corrective actions may include altering procedures in the field, conducting an audit, resampling or modifying laboratory protocol.

Project Status Reports - Project status reports are completed by the PM to document the overall assessment of the project on a monthly basis. The Project Status Report tracks the overall quality of performance relative schedule, budgets and other issues.

4. Data Validation and Usability

The general procedures for data validation and usability are described below. These procedures will be adapted, if necessary, to meet project-specific or activity-specific requirements. Data validation and usability criteria set forth in this QAPP shall be followed unless otherwise amended in the SAPs or Work Plans which will address any modifications to data review criteria not included in this QAPP.

4.1 Data Review, Verification, and Validation

Data generated will be reviewed for conformance with the QAPP, SAP and other applicable work plans, as well as specific project requirements. QA information provided by the laboratory will be evaluated relative to the methods performed, the laboratory SOPs, the laboratory QAM, COC requests, Laboratory Task Orders (LTOs) or similar directive document, and this QAPP, as appropriate. The laboratory will be responsible for internal review of all calibrations, raw data, and calculations. The final analytical report will be reviewed by the laboratory PM and other appropriate laboratory management personnel for compliance with the above listed documents including peer and supervisory review prior to releasing data to ARCADIS.

The ARCADIS Project Chemist and data validation team will perform additional verification and validation of laboratory data to assess the quality and usability of the data generated. Field record review will include instrument calibration logs, sampling logs, COC records, field notes, and field parameter results. The field information assessment will evaluate the potential for impact to sample integrity and chemical data quality.

Chemical analytical data collected will be reviewed and, as appropriate, qualified using guidelines established in the USEPA National Functional Guidelines (NFGs) modified to incorporate method and project-specific requirements. The analytical data review will be performed under either of two levels: Tier 2 or Tier 3. The frequency and components included in each tier are defined in Sections 4.2.2.1 and 4.2.2.2.

4.2 Verification and Validation Methods

The data review scheme for analytical results from the receipt of the analytical data through the validated report is described below. The laboratory is responsible for performing internal data review. The data review by the analytical laboratory will include 100 percent analyst review, 100 percent peer review, and 100 percent review by the laboratory project manager to verify that all project-specific requirements are met. The laboratory QA Officer will perform a review on 10 percent of the data packages. All levels of laboratory review will be fully documented and available for review if requested or if a laboratory audit is performed.

After receipt from the laboratory, project data will be verified and validated by ARCADIS or experienced contract personnel using the following steps.

4.2.1 Evaluation of Completeness

The Project Chemistry Team will verify the following report content for all data, as appropriate, for the required level of data validation:

- Laboratory information matches the field information;
- Fully executed COC records;
- Report completeness and conformance with COC, LTO, QAPP, Site-Specific Work Plan, and other project requirements;
- Case narrative describing any out-of-control events and summarizing analytical observation or non-conformances;
- Sample receipt information;
- Data report forms;
- QA/QC summary data;
- Initial and continuing calibration information (Tier 3 validation);
- Instrument tuning data (Tier 3 validation);
- Quantitation reports (Tier 3 validation);
- Batch and/or run logs (Tier 3 validation);
- Chromatograms (Tier 3 validation); and
- Documentation of any QC problems.

If the data package is incomplete, the Project Chemist will contact the laboratory, which must provide all missing information within a reasonable timeframe (i.e., 1 to 2 days).

4.2.2 Evaluation of Compliance

The data validation procedures are briefly outlined below:

- Electronic checking routines (Tier I validation) will be utilized to check 100 percent of the field and laboratory QC data (LCS, MS/MSD, blanks) to verify that holding times and acceptance and performance criteria were met and to note any anomalous values. Appropriate data qualifiers (Section 4.3) will be applied to the data where deficiencies are identified;

- All chemistry data generated with the exception of waste characterization, storm water discharge, and remedial system operational monitoring will undergo a Tier 2 validation. Initially, one SDG for each matrix will undergo the detailed Tier 3 validation to ensure laboratory performance;

- All data will be checked to ensure all analytical problems and corrections are reported in the case narrative and that appropriate laboratory qualifiers are added; and

- For any problems identified, review concerns with the laboratory, obtain additional information if necessary, and check all related data to determine the extent of the error. Data qualifiers will be applied to the analytical results to indicate potential limitations on data usability.

The data validation team will follow qualification guidelines in USEPA *Contract Laboratory Program (CLP) National Functional Guidelines for Organic Data Review*, EPA 540/R-99/008, October 1999; USEPA *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA 540/R-01/008, July 2002; USEPA *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA 540/R-04/004, October 2004; Laboratory QAM; Laboratory Methods; and the QAPP with performance criteria based on the published analytical methods and laboratory established control limits.

4.2.2.1 Tier 2 Verification

Tier 2 data verification includes a review of all sample documentation coupled with electronic data screening and manual review. The analytical report will be assessed for completeness and for compliance with COC requests, LTO, SAP, and any additional work plan documents. The electronic data compliance will be conducted utilizing the EQuIS Data Qualification Module (DQM), a module within the Earthsoft suite of environmental data management products. All analytical data will be managed within the EQuIS Chemistry database via electronic uploading of laboratory data. The DQM is written in Visual Basic for the EQuIS database and checks for the following parameters:

- Blank contamination;
- MS and MSD recoveries;
- MS/MSD RPD;
- LCS and LCSD recoveries;
- LCS/LCSD RPDs (when available);
- Surrogate recoveries;
- Field duplicate RPDs; and
- Holding times.

The DQM routines apply appropriate qualifiers to the data. Select manual reviews will verify appropriate qualifier application. Data Qualifiers will not be manually applied to original hard copy analytical reports. The validation reports will be included with any submittal of analytical reports to agencies or other required party

4.2.2.2 Tier 3 Validation

One SDG for each matrix collected during the initial phases of the project will undergo a detail data validation which will include the complete Tier 2 assessment and review of the additional following information relative to target compounds/analytes:

- Instrument tune;
- Initial calibration;
- Continuing calibration;
- Interference check standards (metals only);
- Serial dilutions (metals only);
- Quantitation reports;

- Internal standard area (organics only);
- Retention times (as applicable by method);
- Chromatograms (as applicable by method);
- Ion spectra for compound identification;
- Data transcription from instrument report to hard copy report; and
- A subset of calculations will be verified for each sample.

4.2.3 Data Validation Reporting

The Project Chemist will perform the following reporting functions:

- Alert the QA Manager and the Site Manager to any QC problems, obvious anomalous values, or discrepancies between the field and laboratory data and resolve any issues;
- Discuss QC problems in a data validation memo for each laboratory report;
- Review the laboratory EDD and electronic field data, enter the data qualifiers into the database, and oversee preparation of analytical data summary tables. The tables will summarize those samples and analytes for which detectable concentrations were exhibited as well as complete analytical summary tables. The tables will include field QC samples; and
- Prepare a summary of the quality control information at the completion of all field and laboratory efforts for the site. The report will summarize planned versus actual field and laboratory activities and data usability concerns.

The Project or Task Manager provides the final Data Quality Assessment during the technical review of the data report.

4.2.4 Validation Reports

Reports will be generated for each data package or combination of data packages for a single sampling event to record the results of the validation effort. The reports will identify all deficiencies and the impact on the results. The data validator or the Database Manager will append qualifiers generated during the verification/validation process to the EQuIS database and a summary table of the data qualifiers will be included with the analytical report.

4.3 Reconciliation with Data Usability Requirements

For routine assessments of data quality, ARCADIS will implement the data verification/validation procedures described in Section 4.2 and assign appropriate data qualifiers to indicate limitations on the data. The Project Chemist will be responsible for evaluating precision, accuracy, representativeness, comparability, and completeness of the data using procedures described in Section 1.4. Any deviations from the analytical DQOs for the project will be documented in the data verification/validation memo and provided to the data users for the project. The Project Chemist will work with the final users of the data in performing data quality assessments. The data quality assessment may include some or all the following steps:

- Data that are determined to be incomplete or not usable for the project will be discussed with the project team. If critical data points are involved which impact the ability to complete the project objectives, the data users will report immediately to the Site Manager. The Site Manager will discuss the resolution of the issue with the ARCADIS Project Manager and implement the necessary corrective actions (for example, resampling);

- Data that are non-detect but have RLs elevated due to blank contamination or matrix interference will be compared to screening values (see Appendices B and C). If RLs exceed the screening values, then the results will be handled as appropriate for data use; and

- Data qualified as estimated will be utilized if it is determined that the data are useable for their intended purpose. If an estimated result is close to a screening value, then there is uncertainty in any conclusions as to whether the result exceeds the screening value. The data user must evaluate the potential uncertainty in developing recommendations for the site. If estimated results become critical data points in making final decisions on the site, the Site Manager should evaluate the use of the results and may consider the data point incomplete.

In the validation process there are two types of data validation codes that may be applied, those related to identification (confidence concerning the presence or absence of compounds) and those related to quantitation. Each of the standard data validation codes is defined below:

R	Data point is unusable due to serious deficiencies in analytical and QC criteria. The presence or absence of the analyte/compound cannot be verified
UB	Not detected substantially above the level reported in laboratory or field blanks. For organics - 5X (10X for common lab contaminants) or for metals - 10X. Data point considered non-detect at the value qualified.
U	Analyte/Compound not detected. The associated value indicates the concentration above which the result would be considered a quantitative value.
J	Reported value is considered an approximate concentration.
UJ	Analyte/compound not detected above the quantitation limit. However, the reported quantitation limit is approximate.

The ultimate data assessment process involves comparing analytical results to screening values and background concentrations to determine whether the contamination present is site related (i.e., above background levels) or significant (i.e., above screening values). Additional data assessment may be performed on site-by-site basis. Any additional procedures for data quality assessment will be provided in the OU-Specific Work Plan.

5. References

40 CFR Part 136, Guidelines Establishing Test Procedures for the Analysis of Pollutants under the Clean Water Act.

ARCADIS. 2009. Project Management Plan, ARCADIS, February.

USEPA. 1983. Methods for Chemical Analysis of Water and Wastes, Environmental Monitoring and Support Laboratory, Cincinnati, OH, EPA-600/4-79-020, March.

USEPA. 1997. Test Methods for Evaluation Solid Waste: Physical/Chemical Methods, Update IIIA. SW-846, Office of Solid Waste and Emergency Response, Washington, DC.

USEPA. 1999. USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. Office of Emergency and Remedial Response, EPA540/R-99/008 (OSWER 9240.1-05A-P), October.

USEPA. 2001. Requirements for Quality Assurance Project Plans for Environmental Data Operations, EPA QA/R-5, Office of Environmental Information, EPA/240/B-01/003, March.

USEPA. 2002. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, Office of Emergency and Remedial Response, EPA 540-R-01-008 (OSWER 9240.1-35), July.

USEPA. 2002. Guidance for Quality Assurance Project Plans, EPA QA/G-5,Office of Environmental Information, EPA/240/R-02/009, December.

USEPA. 2004. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, Office of Superfund Remediation and Technology Innovation, EPA 540-R-04-004 (OSWER 9240.1-45), October.

USEPA. 2006. Guidance on Systematic Planning and Using the Data Quality Objectives Process; EPA /240/B-06 QA/G-4.

Tables

Table 1: ARCADIS Technical Team Contact Information

Name and Contact Information	Telephone/E-Mail	Project Function
Chuck Bertz, P.E. ARCADIS U.S., Inc. 801 Corporate Center Dr., Suite 300 Raleigh, NC 26707	Phone: 919-854-1282 ext. 187 Cell: 919-607-3498 chuck.bertz@arcadis-us.com	ARCADIS Project Manager
Shelley Gibbons ARCADIS U.S., Inc. 30 Patewood Dr. ,Suite 155 Greenville, SC 29615	Phone: 864-987-3914 Cell: 864-704-3752 shelley.gibbons@arcadis-us.com	ARCADIS Associate Project Manager
Kurt Beil ARCADIS U.S., Inc. 6 Terry Drive Suite 300 Newtown, PA 18940	Phone: 267-685-1800 Cell: 215-680-2310 kurt.beil@arcadis-us.com	ARCADIS QA Manager
Scott Bostian, P.E. ARCADIS U.S., Inc. 801 Corporate Center Dr., Suite 300 Raleigh, NC 26707	Phone: 919-854-1282 Cell: 919-417-2643 curtis.bostian@arcadis-us.com	ARCADIS Site Manager
Andrew Davis ARCADIS U.S., inc. 30 Patewood Dr. ,Suite 155 Greenville, SC 29615	Phone: 864-987-3917 Cell: 864-561-5833 andrew.davis@arcadis-us.com	ARCADIS Site Manager
Jane Kennedy ARCADIS U.S., Inc. 3850 N. Causeway Blvd. Metairie, LA 70002	Phone: 504-832-4174 ext 106 Cell: 225-205-8256 jane.kennedy@arcadis-us.com	ARCADIS Project Chemist
Sam Moyers ARCADIS U.S., Inc. 114 Lovell Rd., Suite 202 Knoxville, TN	Phone: 865-675-6700 Cell: 865-621-2117 sam.moyers@arcadis-us.com	ARCADIS Health and Safety Manager
Janet Christy ARCADIS U.S., Inc. 6 Terry Drive, Suite 300 Newtown, PA 18940	Phone: 864-906-5001 Cell: 864-906-5001 janet.christy @arcadis-us.com	ARCADIS Database Manager

Table A-2. Data Quality Objectives for Site Characterization.

Data Quality Objective	Project Specific Action
Problem statement	Historical activities have contributed to environmental impacts to surface and subsurface soil, surface water and groundwater at the military facilities. The project goals include delineation of environmental impacts and achieving remedy in place or response complete in accordance with the timeline set forth in the performance based contract. To achieve these goals, characterization activities shall be performed in accordance with the sampling and analysis plans, implementation of remedial actions, monitoring of remedial performance, and confirmation of attainment of clean-up goals.
Identify the decisions	• Do constituent concentrations exceed the screening criteria? • Has the Site been delineated? • What remedial system will be used to reduce constituent concentrations? • Does the remedial system meet the performance goals?
Identify the inputs to the decision	• Complete additional delineation sampling and compare identified CoC data to screening levels; and define extent of contamination. • Design and implement remedial systems • Monitor remedial system performance • Confirm reduction in contaminant levels to below clean-up goals.
Develop the decision rule	• If soil and groundwater quality data indicate concentrations above screening levels, the affected media will be addressed by additional site investigation to delineate the nature and extent of impact to the affected media. • When the Site is delineated, the soil and groundwater quality data will be evaluated to determine if an active remediation is required to reduce the concentrations below the clean-up goals. • If the remedial system does not meet the performance goals, modifications to the existing system and/or an additional or alternative remedial system will be implemented.
Specify limits on decision errors	Data quality and usability will be determined in accordance with the criteria set forth in the QAPP. Rejected data will not be used for decision-making purposes.

CoC	Constituent of Concern.
QAPP	Quality Assurance Project Plan.

Table A-3 Statistical Calculations

Statistical	Symbol	Formula	Definition	Uses
Mean	X	$\frac{\left(\sum_{i=1}^{\eta} x_i\right)}{\text{n}}$	Measure of central tendency	
Standard Deviation	S	$S_x = \left(\frac{n\Sigma\chi 2-(\Sigma\chi)^2}{n(n-1)}\right)^{1/2}$	Measure of relative scatter of the data	
Relative Standard Deviation		(S / $\overline{\text{X}}$) x 100	Relative standard deviation, adjusts for magnitude of observations	Used to assess precision for replicate results
Pooled RSD	RSD_p	$\left(\frac{\sum_{i=1}^{\eta}\left(RSDi\right)^2\ df\,i}{\sum_{i=1}^{\eta} dfi}\right)^{1/2}$	Measure of overall variability of a series	Used to assess overall performance for compounds with multiple measurements
Relative Percent Difference	RPD	$\left(\frac{(X_1 - X_2}{(X_1 + X_2)/2}\right) \times 100$	Measure of variability that adjusts for the magnitude of observations	Used when there are only two observations; mathematically related to RSD

Table A-3 Statistical Calculations

Statistical	Symbol	Formula	Definition	Uses
Average Relative Percent Difference	RPD	$\frac{\underline{RPD}}{n}$	Average relative percent difference - analogous to pooled RSD for duplicate measurements	Used to assess overall performance for compounds with multiple measurements
Confidence Interval	CI	$\frac{X \pm t\langle \alpha , n-1\rangle^{S}}{n^{1/2}}$	Interval about X that contains the true value, with probability α	Assign intervals or error bars to measurement data
Percent Recovery	R	$\left(\frac{X_{meas}}{X_{true}}\right) \text{ x } 100$	Recovery of spiked compound in pure matrix	Recovery of Quality Control check sample, method spikes
Percent Recovery	R	$\frac{\begin{pmatrix}\text{value of} & & \text{value of} \\ \text{spiked} & - & \text{unspiked} \\ \text{sample} & & \text{sample}\end{pmatrix}}{\text{Value of added spike}} \times 100$	Recovery of spiked compound in sample matrix	Matrix spike and matrix spike/matrix spike duplicate recovery

X = Observation (concentration)
n = Number of observations
df = Degrees of freedom, usually
t   = Statistical from students' "t" distribution

Table A-4. Field Quality Control Sample Collection Guidelines.

QC Sample	Description
Field Duplicate	One per matrix per 20 samples for each analysis.
Equipment Rinsate Blank	One per equipment set per 20 samples collected for each analysis. Only equipment sets that are dedicated or disposed of do not require equipment blanks.
Trip Blank	One per shipment for each cooler in which samples for volatile analysis are shipped. Trip blanks are analyzed for all volatile methods designated for the samples. Trip blanks are shipped for both solid and aqueous matrices.
Field Blank	One per 20 samples collected for each analysis if/when field conditions warrant evaluation of air borne contaminants. Collection decision by the Site Manager.

Field Analyses Data Quality Objectives

Parameter	Method	Precision	Accuracy % Recovery	Completeness %
pH	150.1	0.05 units	±0.2 units	95
Conductivity	120.1	7.6 umhos/cm	±2%	95
Temperature	--	0.1°C	±2°C	95

Calibration Frequency

Analysis	Initial Calibration	Calibration Check	Sample Duplicate
pH	Daily	Every 4 Hours	Daily
Conductivity	Daily	Every 4 Hours	Daily
Turbidity	Daily	Every 4 Hours	Daily

QA	Quality Assurance
umhos/cm	micromhos per centimeter

Table A-5. Summary of Methods, Containers, Preservatives, and Holding Times.

Parameter	Matrix	Preparation Method	Analytical Method (a)	Container (b)	Preservative	Holding Time (c)
Organic and Metals Methods						
VOCs	Water	5030, 5032	8260	4 x 40-mL vial with Teflon-lined septum	pH < 2 with HCl, Cool 4°C	14 days
	Water	5030, 5032	8260	4 x 40-mL vial with Teflon-lined septum	If effervescence is observed, eliminate HCl preservative and Cool 4°C	7 days
	Solid	5035	8260	3 x Encore™ OR 2 x Sodium Bisulfate vial and 1 x Methanol vial	Cool 4°C	48 hours to preservation for Encore™, then 14 days to analysis
SVOCs	Water	3510, 3520 (d)	8270 (Low Level)	2 x 1-L amber G	Cool 4°C (e)	7 days to extraction and 40 days to analysis
	Solid	3540, 3550 (d)	8270 (Low Level)	1 x 4-oz or 8-oz G	Cool 4°C	14 days to extraction and 40 days to analysis
PAHs	Water	3510, 3520 (d)	8270 SIM)	2 x 1-L amber G	Cool 4°C (e)	7 days to extraction and 40 days to analysis
	Solid	3540, 3525 (d)	8270 SIM	2 x 1-L amber G	Cool 4°C (e)	7 days to extraction and 40 days to analysis
Organochlorine Pesticides	Water	3510, 3520 (d)	8081/608	2 x 1-L amber G	Cool 4°C (e)	7 days to extraction and 40 days to analysis
	Solid	3540, 3550 (d)	8081	1 x 4-oz or 8-oz G	Cool 4°C	14 days to extraction and 40 days to analysis
Organochlorine Herbicides	Water	8151 (d)	8151	2 x 1-L amber G	Cool 4°C (e)	7 days to extraction and 40 days to analysis
	Solid	8151 (d)	8151	1 x 4-oz or 8-oz G	Cool 4°C	14 days to extraction and 40 days to analysis
Metals (except Mercury)	Water	3005, 3010	6010/6020	1 x 500mL HDPE	pH < 2 with HNO_3, Cool 4°C	6 months
	Solid	3050, 3051	6010	1 x 8-oz G	Cool 4°C	6 months
Mercury	Water	NA	7470	1 x 500mL HDPE	pH < 2 with HNO_3, Cool 4°C	28 days
	Solid	NA	7471	1 x 8-oz G	Cool 4°C	28 days

Table A-5. Summary of Methods, Containers, Preservatives, and Holding Times.

Parameter	Matrix	Preparation Method	Analytical Method (a)	Container (b)	Preservative	Holding Time (c)
Total Petroleum Hydrocarbons as GRO	Water	5030, 5032	8015 Modified	4 x 40-mL vial with Teflon-lined septum	pH < 2 with HCl, Cool 4°C	14 days
	Solid	5035	8015 Modified	3 x Encore™ OR 2 x Sodium Bisulfate vial and 1 x Methanol vial	Cool 4°C	48 hours to preservation for Encore™, then 14 days to analysis
Total Petroleum Hydrocarbons as DRO/ORO	Water	3510, 3520 (d)	8015 Modified	2 x 1-L amber G	Cool 4°C (e)	7 days to extraction and 40 days to analysis
	Solid	3540, 3550 (d)	8015 Modified	1 x 4-oz or 8-oz G	Cool 4°C	14 days to extraction and 40 days to analysis
Waste Characterization Parameters						
TCLP Metals (f) (including Mercury)	Solid Waste Material	1311 for Leach/ 3005, 3010	6010 and 7470 (for Leachate)	1 x 8-oz wide-mouth G	Cool 4°C	28 days from collection to Leach; 28 days to analysis of Leachate
TCLP VOCs (f)	Solid Waste Material	1311 for Leach/ 5030	8260 for Leachate	1 x 4-oz G packed full	Cool 4°C	14 days from collection to Leach; 14 days to analysis of Leachate when preserved with HCl to pH < 2
TCLP SVOCs (f)	Solid Waste Material	1311 for Leach/ 3510, 3520	8270 for Leachate	1 x 8-oz wide-mouth G	Cool 4°C	14 days from collection to Leach; 40 days to analysis of Leachate
TCLP Pesticides (f)	Solid Waste Material	1311 for Leach/ 3510, 3520	8081 for Leachate	1 x 8-oz wide-mouth G	Cool 4°C	14 days from collection to Leach; 40 days to analysis of Leachate
TCLP Herbicides (f)	Solid Waste Material	1311 for Leach/ 8151	8151 for Leachate	1 x 8-oz wide-mouth G	Cool 4°C	14 days from collection to Leach; 40 days to analysis of Leachate
Ignitability	Aqueous Waste	NA	1010	500 mL G	NA	NA
	Solid Waste Material	NA	ASTM D-92	1 x 8-oz wide-mouth G	NA	NA

Table A-5. Summary of Methods, Containers, Preservatives, and Holding Times.

Parameter	Matrix	Preparation Method	Analytical Method [(a)]	Container [(b)]	Preservative	Holding Time [(c)]
Reactivity	Aqueous Waste	NA	USEPA Region 4 Guidance for Sulfide	500 mL HDPE	pH > 9 with 2 mL ZnAc and NaOH, Cool 4°C	7 days
	Aqueous Waste	NA	9010/9012/9014 for Cyanide	1 x 120 mL HDPE	pH > 12 with NaOH	14 days
	Solid Waste Material	NA	USEPA Region 4 Guidance for Sulfide	1 x 8-oz wide-mouth G	Cool 4°C	7 days
	Solid Waste Material	NA	9010/9012/9014 for Cyanide	1 x 1-L HDPE	Cool 4°C	Sulfide 7 days
Corrosivity (pH)	Aqueous Waste	NA	9040	120 mL HDPE	NA	24 hours
	Solid Waste Material	NA	9045	1 x 8-oz wide-mouth G	NA	24 hours
General Chemistry Parameters						
Alkalinity	Water	NA	SM 2320 B	500 mL HDPE	Cool 4°C	14 days
Ammonia	Water	NA	SM 4500-NH3 D	500 mL HDPE	pH < 2 with H_2SO_4, Cool 4°C	28 days
Biochemical Oxygen Demand (BOD)	Water	NA	405.1	1 x 1-L HDPE	Cool 4°C	48 hours
Chloride	Water	NA	SM4500-CL/300.0/9056	500 mL HDPE/ 2 x 40 mL vial	Cool 4°C	28 days
Cyanide	Water	NA	9010/9012/9014	1 x 120 mL HDPE	pH > 12 with NaOH, Cool °4C	14 days
	Solid	NA	9010/9012/9014	1 x 4-oz or 8-oz G	Cool 4°C	14 days
Hardness	Water	NA	SM 2340B/6010	500 mL HDPE	Cool 4°C for 130.2/ pH < 2 with HNO_3, Cool 4°C for 6010	6 months
Nitrate	Water	NA	353.2/300.0/9056	120 mL HDPE/	Cool 4°C	2 days
Nitrite	Water	NA	353.2/300.0/9056	120 mL HDPE/	Cool 4°C	2 days
Nitrate/Nitrite	Water	NA	353.2	500 mL HDPE	pH < 2 with H_2SO_4	28 days

Table A-5. Summary of Methods, Containers, Preservatives, and Holding Times.

Parameter	**Matrix**	**Preparation Method**	**Analytical Method [(a)]**	**Container [(b)]**	**Preservative**	**Holding Time [(c)]**
Phosphate	Water	NA	365.3/300.0/9056	500 mL HDPE/ 2 x 40 mL vial	pH < 2 with H_2SO_4	28 days
Sulfate	Water	NA	ASTM 516-90/300.0/9056	500 mL HDPE/ 2 x 40 mL vial	Cool 4°C	28 days
Sulfide	Water	NA	SM 4500-SULFIDE	1-L HDPE	2 mL ZnAc and NaOH to pH > 9, Cool 4°C	7 days
Total Dissolved Solids (TDS)	Water	NA	SM 2540C	500 mL HDPE	Cool 4°C	7 days
Total Suspended Solids (TSS)	Water	NA	SM 2540D	1-L HDPE	Cool 4°C	7 days
Total Organic Carbon (TOC)	Water	NA	415.2/9060	500 mL HDPE	pH < 2 with HCl or H_2SO_4, Cool 4°C	28 days
Dissolved Organic Carbon (DOC)	Water	NA	415.2/9060	500 mL HDPE	AFTER FILTRATION: pH < 2 with HCl or H_2SO_4, Cool 4°C	28 days
Chemical Oxygen Demand	Water	NA	410.4	500 mL HDPE	pH <2 with H_2SO_4	28 days

(a) The 8000 series methods will be used for assessment and remediation; the 600 series methods will be used only for wastewater.
(b) Sample volumes may be combined for parameters where preservatives are the same and adequate sample volume is supplied to the laboratory. Volumes listed are based on sample containers and not minimum volumes required for some of the General Chemistry Parameters listed. All other volumes are minimum volumes required to be submitted to the laboratory.
(c) Maximum holding time allowed from date of collection.
(d) Cleanup methods may be applicable if matrix interference is encountered. Cleanup methods may include alumina (Method 3610), florisil (Method 3620), silica gel (Method 3630), gel permeation chromatography (GPC) (Method 3640), and sulfur (Method 3660). Selection of appropriate method is based on nature of interference and target compounds.
(e) If residual chlorine is present, requires sodium thiosulfate in each sample container.
(f) Waste Characterization addresses solid (soils, drilling mud) material analysis for waste disposal purposes. Liquid (aqueous or organic) wastes will be characterized using the appropriate methods for determination of total constituent concentrations in accordance with waste disposal requirements under the Resource Conservation and Recovery Act (RCRA). TCLP analyses will be performed as required on wastes containing > 0.5% solids in accordance with RCRA waste characterization and disposal requirements.

°C – Degrees Centigrade.
DRO – Diesel Range Organics
GRO – Gasoline Range Organics
H_2SO_4 – Sulfuric acid.
HCl – Hydrochloric acid.
HDPE – High Density Polyethylene.
HNO_3 – Nitric acid.
L – Liter.
mL – Milliliter.

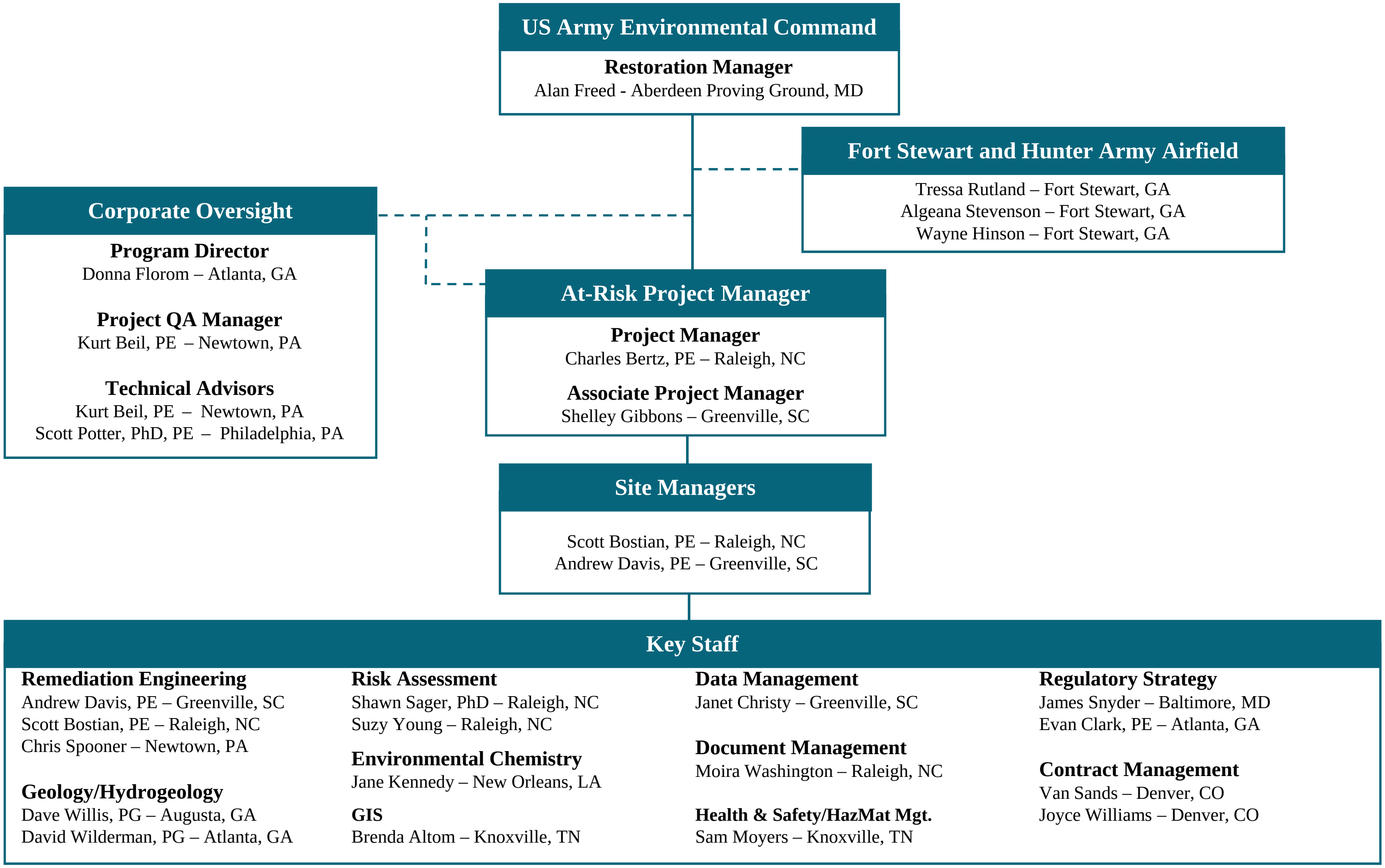
NA – Not Applicable.
NaOH – Sodium hydroxide.
ORO – Oil Range Organics
PAHs – Polycyclic Aromatic Hydrocarbons
SVOCs – Semivolatile Organic Compounds.
TAL – Target Analyte List.
TCL – Target Compound List.
TCLP – Toxicity Characteristic Leaching Procedure.
VOCs – Volatile Organic Compounds.
ZnAc – Zinc acetate.

Table A-6. Laboratory Quality Control Sample Analysis Guidelines.

QC Sample	Description
Method Blank	One per matrix per preparation batch for each analysis.
Lab Replicate	One per matrix per preparation batch for each analysis.
Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD)	One LCS per matrix per preparation batch for each analysis. LCSD performance is optional.
Surrogate Spiking	All samples analyzed for organic methods as method and Standard Operating Procedure (SOP) appropriate.
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One pair per matrix per preparation batch for each analysis. The spike solution will contain a broad range of the analytes of concern, but may not contain all due to incompatibility, interaction, breakdown, availability, or multi-component compounds. The overall frequency of MS/MSD on the project samples must be at least 1 set per 20 samples.

Figures

Figure A-1
Project Organization
Environmental Restoration PBA
Fort Stewart and Hunter Army Airfield
Georgia



US Army Environmental Command

Restoration Manager
Alan Freed - Aberdeen Proving Ground, MD

Fort Stewart and Hunter Army Airfield

Tressa Rutland – Fort Stewart, GA
Algeana Stevenson – Fort Stewart, GA
Wayne Hinson – Fort Stewart, GA

Corporate Oversight

Program Director
Donna Florom – Atlanta, GA

Project QA Manager
Kurt Beil, PE – Newtown, PA

Technical Advisors
Kurt Beil, PE – Newtown, PA
Scott Potter, PhD, PE – Philadelphia, PA

At-Risk Project Manager

Project Manager
Charles Bertz, PE – Raleigh, NC

Associate Project Manager
Shelley Gibbons – Greenville, SC

Site Managers

Scott Bostian, PE – Raleigh, NC
Andrew Davis, PE – Greenville, SC

Key Staff

Remediation Engineering
Andrew Davis, PE – Greenville, SC
Scott Bostian, PE – Raleigh, NC
Chris Spooner – Newtown, PA

Geology/Hydrogeology
Dave Willis, PG – Augusta, GA
David Wilderman, PG – Atlanta, GA

Risk Assessment
Shawn Sager, PhD – Raleigh, NC
Suzy Young – Raleigh, NC

Environmental Chemistry
Jane Kennedy – New Orleans, LA

GIS
Brenda Altom – Knoxville, TN

Data Management
Janet Christy – Greenville, SC

Document Management
Moira Washington – Raleigh, NC

Health & Safety/HazMat Mgt.
Sam Moyers – Knoxville, TN

Regulatory Strategy
James Snyder – Baltimore, MD
Evan Clark, PE – Atlanta, GA

Contract Management
Van Sands – Denver, CO
Joyce Williams – Denver, CO

ARCADIS

Appendix B

Field Forms

ARCADIS

Utilities and Structures Checklist

Project: Fort Stewart / Hunter Army Airfield

Prepared By: ________________

Location: ________________

Date: ________________

Instructions: This checklist must be completed by an ARCADIS staff member as a safety measure to insure that all underground utility lines, other underground structures, as well as aboveground power lines are clearly marked out in the area selected for boring or excavation. **DRILLING OR EXCAVATION WORK MAY NOT PROCEED UNTIL LINES ARE MARKED AND THIS CHECKLIST HAS BEEN COMPLETED.** Arrangements for underground utility markouts are best made at the time of the preliminary site visit to allow client and/or utility company sufficient time. Keep completed checklist and maps onsite; send copy to Project Manager.

Assignment of Responsibility: ARCADIS is responsible for having underground utilities and structures located and marked. Preferably, the utilities themselves should mark out the lines.

Emergency Procedures: Follow emergency procedures outlined in site-specific Health and Safety Plan.

Utilities and Structures

Type	Not Present	Present	How Marked? (flags, paint, wooden stakes, etc.)
Natural Gas Line			
Electric Power Line			
Telephone Cable			
Sewer Line			
Storm Drain			
Water Line			
Steam Line			
Petroleum Product Lines			
Product Tank			
Septic Tank/Drain Field			
Overhead Power Line			

Name and Affliation of person who marked or cleared underground lines or structures

ORGANIZATION	NAME	PHONE

Comments:

ARCADIS

Location Sketch

Well(s) ____________ Project No. GP08HAFS Page ____________ of ____________

Site Location ____________

Prepared by ____________

(Locate all wells, borings, etc. with reference to three permanent reference points: tape all distances: clearly label all wells, roads, and permanent features)

N

0 ft ft

g:\aproject\admin\forms\field\Location Sketch.XLS\2/5/2009

ARCADIS

Boring/Well Construction Log

JOB NUMBER GP08HAFS	CLIENT Fort Stewart / HAAF	LOCATION	WELL NO.	PAGE 1 OF ______	WELL LOCATION N
DRILLING METHOD		SAMPLING METHOD			
DRILLING START FINISH		DEVELOP START FINISH			
STATIC DTW DTO	TIME DATE	DRILLED BY			
ELEVATION TOC GL		LOGGED BY			

WELL CONSTRUCTION	DEPTH FEET	CLASS	NAME	COLOR	DESCRIPTION: GRADATION, SECONDARY CHARACTERISTICS, ODOR, REMARKS.	M.C.	PID/FID (PPM)	SAMPLE NO.	SAMPLE DEPTH	BLOWS	RECOV %	TYPE
	1											
	2											
	3											
	4											
	5											
	6											
	7											
	8											
	9											
	10											
	11											
	12											
	13											
	14											
	15											
	16											
	17											
	18											
	19											

ARCADIS

Boring/Well Construction Log

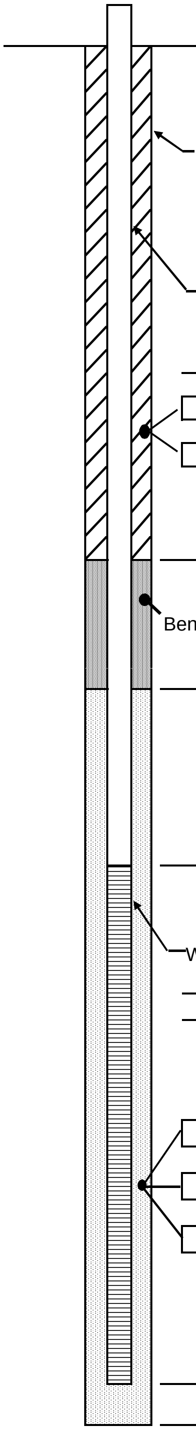
JOB NUMBER GP08HAFS	CLIENT Fort Stewart / HAAF	LOCATION	WELL NO.	PAGE 1 OF ______	WELL LOCATION N
DRILLING METHOD		SAMPLING METHOD			
DRILLING START FINISH		DEVELOP START FINISH			
STATIC DTW TIME DTO DATE		DRILLED BY			
ELEVATION TOC GL		LOGGED BY			

WELL CONSTRUCTION	DEPTH FEET	CLASS	NAME	COLOR	DESCRIPTION: GRADATION, SECONDARY CHARACTERISTICS, ODOR, REMARKS.	M.C.	PID/FID (PPM)	SAMPLE NO.	SAMPLE DEPTH	BLOWS	RECOV %	TYPE
	1											
	2											
	3											
	4											
	5											
	6											
	7											
	8											
	9											
	10											
	11											
	12											
	13											
	14											
	15											
	16											
	17											
	18											
	19											

ARCADIS

Well Construction Log

(Unconsolidated)



_____ inch diameter drilled hole

Well casing,

_____ inch diameter,

_____

☐ Backfill

☐ Grout _____

_____ ft*

Bentonite ☐ slurry

_____ ft* ☐ pellets

_____ ft*

Well Screen.

_____ inch diameter

_____ , _____ slot

☐ Gravel Pack

☐ Sand Pack

☐ Formation Collapse

_____ ft*

_____ ft*

Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project GP08HAFS Well _____

Town/City _____

County _____ State GA

Permit No. _____

Land-Surface (LS) Elevation and Datum:

_____ feet ☐ Surveyed

☐ Estimated

Installation Date(s) _____

Drilling Method _____

Drilling Contractor _____

Drilling Fluid _____

Development Technique(s) and Date(s)

Fluid Loss During Drilling _____ gallons

Water Removed During Development _____ gallons

Static Depth to Water _____ feet below M.P..

Pumping Depth to Water _____ feet below M.P.

Pumping Duration _____ hours

Yield _____ gpm Date _____

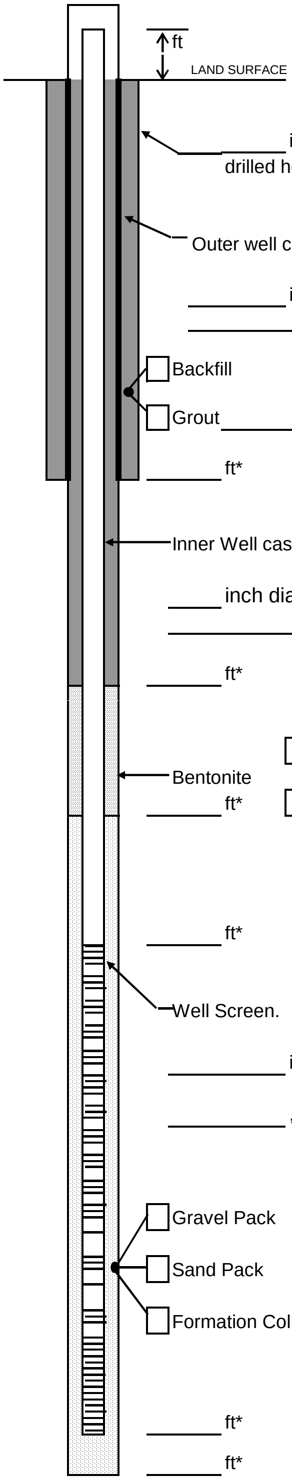
Specific Capacity _____ gpm/ft

Well Purpose Monitoring

Remarks _____

Prepared by _____

WELL CONSTRUCTION LOG- TELESCOPING



_______ inch diameter drilled hole

Outer well casing,

_________ inch diameter,

____

☐ Backfill

☐ Grout ________________

_______ ft*

Inner Well casing

_____ inch diameter,

____

_______ ft*

Bentonite

_______ ft*

☐ slurry

☐ pellets

_______ ft*

Well Screen.

___________ inch diameter

___________ , ____ slot

☐ Gravel Pack

☐ Sand Pack

☐ Formation Collaspse

_______ ft*

_______ ft*

Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project ________________________ Well ________

Town/City ________________________________

County ________________________ State ________

Permit No. ________________________________

Land-Surface Elevation and Datum:

_________ feet ☐ Surveyed

☐ Estimated

Installation Date(s) ____________________

Drilling Method ____________________

Drilling Contractor ____________________

Drilling Fluid ____________________

____

Development Technique(s) and Date(s)

____

____

____

Fluid Loss During Drilling ________________ gallons

Water Removed During Development ______ gallons

Static Depth to Water ______________ feet below M.P.

Pumping Depth to Water ______________ feet below M.P.

Pumping Duration ___________ hours

Yield ____________ gpm Date ________

Specific Capacity ___________ gpm/ft

Well Purpose ____________________

____

____

Remarks ________________________________

____

____

____

____

Prepared by ____________________

G:\Env\Common\Field Forms\Well Const- Telescoping.xls

ARCADIS

Well Development Form

Page ____ of ____

Project/No. GP08HAFS
Fort Stewart/HAAF

Well ID ____________

Date ____________

Screened Interval ____________

Measuring Point Description ____________

Well Materials: ____ PVC
____ St. Steel

Static Water Level ____________

Casing Diameter (in) ____________

Pump On ____________

Pump Off ____________

Total depth ____________

Boring Diameter (in) ____________

Pump Intake ____________

Water Column ____________

Development Method:

Volume Purged (g) ____________

Gallons Per Foot ____________

Centrifugal ____________
Submersible ____________
Surge Block ____________
Bailed ____________
Other ____________

Development Criteria: X Boring Vol.
____ Casing Vol.
X Parameters

Gallons in Casing/Boring ____________

Developed By: ____________

Time	Minutes Relapsed	Rate (gpm) or (ML)	DTW (ft)	Gallons Purged	pH	Cond. (umhos) (ms/cm)	Turb (NTUs)	Redox (mV)	Diss. O2 (mg/L)	TEMP. (C) or (F)	Remarks

Boring/Casing Volumes

2" = 0.16 3" = 0.37 4" = 0.65 6" = 1.47 8" = 2.61 10 " = 4.08 12" = 5.88

ARCADIS

Geoprobe Groundwater Sampling Form

Project No. GP08HAFS **Boring ID:** **DP-**

Site Location: Fort Stewart / Hunter Army Airfield Date Sampled

Site Description

Weather

Duplicate/QA/QC:

Purging/Sample Collection Information

Casing Material: St. Steel Geoprobe rods Purge Method:(circle one) Bailer Peristaltic Check Valve

Casing Diameter: Geoprobe rods Sample Method: (circle one) Slotted Rods Retractable Screen

Sample ID Boring ID-GW (depth)	Sample Time	Water Column	Gallons/ Foot	Volume Purged	Turbidity	Color	Odor	Lab	Other

Lab Analysis

Constituents Sampled	Container Description	Preservative

Remarks

Sample Personnel

Purge volume = Water Column (ft) x 0.02

Water Column = Sample Depth - Depth to Water

WELL SAMPLING SUMMARY

ARCADIS Project Number: GP08HAFS		***Collection Date (mm/dd/yy)***	***Collection Time (hr.min)***	***Initial Depth to Water (ft btoc)***	***Well Volume (gallons)***	***Total Depth (ft)***	***Total Volume Removed (gallons)***	***Final***							***Comment***
Project Name: Fort Stewart / HAAF								***pH***	***Cond. (umhos)***	***Temp. (oC)***	***Turb. (NTU)***	***ORP***	***DO***	***TDS***	
Sampler:															
Sample ID	***Location ID***														

(   ) = Enter the collection date within the parenthesis (ie. 011904)

ARCADIS

Water Level Measurement Form

Page 1 of ___

Project No: GP08HAFS

Location: Fort Stewart / Hunter Army Airfield

Date: ____________________

Recorded By: ____________________

Well Number	Time	TOC Elevation (ft)	Static Depth to Water (ft btoc)	Duplicate Reading (ft btoc)	GW Elevation (ft msl)	Total Depth (ft btoc)	Comments

ft btoc Feet below top of casing.

ARCADIS

WATER LEVEL/PUMPING TEST RECORD

PROJECT ____________ WELL ____________ SITE ____________

SCREEN SETTING ____________ MEASURING POINT DESCRIPTION ____________ HEIGHT ABOVE GROUND SURFACE ____________

STATIC WATER LEVEL ____________ MEASURED WITH ____________ DATE/TIME ____________

DRAWDOWN ____________ START OF TEST ____________ PUMPING WELL ____________

RECOVERY ____________ END OF TEST ____________

DISTANCE FROM WELL MEASURED TO PUMPING WELL [r] ____________ DISCHARGE RATE ____________ ORIFICE ____________

DATE & TIME	WELL OR t (mins)	HELD (ft)	WET (ft)	DEPTH TO WATER (ft)	s (ft)	DEW. CORR.[1] (ft)	ART.[2] s' (ft)	Q (gpm)	MANO-METER (in)	REMARKS[3]

ARCADIS

PAGE_____ OF _____

WATER LEVEL/PUMPING TEST RECORD

PROJECT ____________________________ WELL ________________________ SITE ______________________________________

DATE & TIME	WELL OR t (mins)	HELD (ft)	WET (ft)	DEPTH TO WATER (ft)	s (ft)	DEW.[1] CORR. (ft)	ART.[2] s' (ft)	Q (gpm)	MANO-METER (in)	REMARKS[3]

Sample Key

				Analysis/Parameters																					
ARCADIS Project Number: GP08HAFS				Lab														Field							
Project Name: Fort Stewart / Hunter Army Airfield																									
Sampler:																									
Laboratory:																									
Sample ID	Location ID	Collection Date (mm/dd/yy)	Collection Time (hr:min)	*TOC (9060)*	*Aluminum (6010B)*	*Metals (App IX) (6010B)*	*SVOCs (8270C)*	*VOCs (8260B)*	*Alkalinity (310.1)*	*Pesticides (8081A)*	*Hex Chrome (7196A)*	*Total Iron (6010)*	*Carbon Dioxide (AM20G)*	*Sulfate (9056)*	*Nitrate and Nitrite (9056)*	*Chlorides (9056)*	*Methane, Ethane, and Ethene (AM20G)*	*pH*	*DO,ORP,temp., turbidity, conductivity*	Sample Type	Matrix Code	Location Description	Chain of Custody	Parent Sample ID	Comment

(   ) = Enter the collection date within the parenthesis (ie. 011904)

* If more than one TB is colleced in one day then name the Trip Blanks sequentially (ie. TB1(   ), TB2(   ), etc.)

**The time on the COC needs to be the same for MS/MSD as the parent sample.

SAMPLING LOCATION SURVEY SUMMARY

<table>
<tr><td colspan="3"><i>ARCADIS Project Number: GP08HAFS</i></td><td rowspan="5"><i>Ground Elevation (ft. AMSL)</i></td><td colspan="2"><i>Top of Casing Elevation</i></td><td rowspan="5"><i>Depth-to-Water Reference Elevation (ft. AMSL)</i></td><td rowspan="5"><i>Comment</i></td></tr>
<tr><td colspan="3"><i>Project Name: Fort Stewart / Hunter Army Airfield</i></td><td rowspan="4"><i>Inner (ft. AMSL)</i></td><td rowspan="4"><i>Protective/Outer (ft. AMSL)</i></td></tr>
<tr><td colspan="3"><i>Sampler:</i></td></tr>
<tr><td colspan="3"><i>Laboratory:</i></td></tr>
<tr><td><i>Location</i></td><td><i>Easting*</i></td><td><i>Northing*</i></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

* - Please provide reference for the coordinate system used.

ARCADIS

Soil/Sediment Sample Log

Project/Site Location Fort Stewart / Hunter Army Airfield Project No. GP08HAFS

Sample No. ____ Duplicate/QA/QC ____

Date ____ Weather ____

Site Description ____

Sampling Method and Material Geoprobe MacroCore with liner, stainless steel sampling spoon

Sample ID Boring ID-SO (depth)	Sample Time	Soil Class.	Soil Description (Color, description, moisute, odor, etc.)	PID/FID Reading	Offsite Lab Analysis?

Lab Analysis

Constituents Sampled	Container Description	Preservative

Remarks ____

Sample Personnel ____

SOIL SAMPLING SUMMARY

ARCADIS Project Number: GP08HAFS
Project Name: Fort Stewart / HAAF
Sampler:
Laboratory:

Sample ID	***Location ID***	***Collection Date (mm/dd/yy)***	***Collection Time (hr.min)***	***Estimated Ground Elevation (ft. AMSL)***	***Sample Start Depth (ft bgs)***	***Sample End Depth (ft bgs)***	***Comment***

Note: Sample ID = Location ID(Sample Start Depth-Sample End Depth)

ARCADIS

Groundwater Sampling Form

Site Location: Fort Stewart/HAAF
Project No. GP08HAFS
Well ID:
Date:
Sampled By:
Sampling Time:
Recorded By:
Weather:
Duplicate/QA/QC:

Instrument Identification

Instrument:	PID	Water Quality Meter(s)
Serial #:		

Purging Information

Casing Material:
Casing Diameter:
Total Depth:
Depth to Water:
Water Column:
Gallons/Foot:
Gallons in Well:

Purge Method:(circle one) Submersible Centrifugal Bladder Bailer Peristaltic
Screen Interval: From: To:
Pump Intake Setting:
Volumes to be Purged:
Total Volume Purged:
Pump On: Off:

Field Parameter Measurements During Purging

Time	Minutes Elapsed	Rate (gpm or ml)	Volume Purged	Depth to Water	Turbidity (NTUs)	pH (SI Units)	Conductivity (µmhos/cm)	Temp (ºC or ºF)	Diss. Oxygen	Comments

Observations During Sampling

Well Condition:
Color:
Odor:
Purge Water Disposal:
Turbidity(qualitative):
Other (OVA, HNU,etc.):

Constituents Sampled	Container Description From Lab ARCADIS	Preservative

Boring/Casing Volumes
2" = 0.16 4" = 0.65

ARCADIS

SURFACE WATER SAMPLE LOG

Sample ID ____________________ Project/No. ____________________

Date ____________________ Sampling Personnel ____________________

Time ____________________ ____________________

Weather ____________________

DESCRIPTION OF SAMPLE LOCATION:

Name of Water Body ____________________

Depth of Water ____________________ Velocity ____________________

Other Comments ____________________

Substrate Description ____________________

Location ____________________

____

Description of Nearby Vegetation ____________________

FIELD PARAMETERS:

Sample Method ____________________

Sample Description ____________________

____

Temperature (°C/°F) ____________________ pH ____________________

Dissolved Oxygen ____________________ SC ____________________

Salinity ____________________

CONTAINER DESCRIPTION: From ________ Lab ________

Bottle Type	Analysis	Preservative

f:\stds\forms\surfacewtr.xls

ARCADIS
CALIBRATION FORM
PHOTOIONIZATION DETECTOR

Project: **Fort Stewart / Hunter Army Airfield**

Location: ______________________________

PID Model: **Multi Rae**

Pre-Use Calibration

Date:____________ Time:_________am/pm

5 minute (minimum) warm up in ambient air: YES ☐ NO ☐

Battery indicator reading (e.g., 10 through +20): _____________

Instrument zeroed (ambient air): YES ☐ NO ☐

Span gas pressure (e.g., 30 psi minimum to 300 psi):

Calibration gas used is 100 ppm Isobutylene/air: YES ☐ NO ☐

Benzene Referenced: YES ☐ NO ☐

Calibration Value: _____________

Post-Use Calibration

Date:____________ Time:_________am/pm

Ambient air reading (e.g., 0 ppm): _____________ppm

Battery indicator reading (e.g., 10 through +20): _____________

Calibration Value: _____________

Comments and description of work activities performed during monitoring:

____

____

____

Calibrated by:__________________________________

ARCADIS

Field Instrument Calibration Log

Project Name/Number ______________________ Date ____________

Calibrating Personnel ______________________ Instrument ____________

Time of Initial Calibration ____________ Weather ______________________

Calibrant	Initial Reading	Adjusted Reading	Final Reading	Time	Temperature

instrcal.xls
7/23/2002

ARCADIS

Daily Log

Well(s) ____________ Project No. GP08HAFS Page ____________ of ____________

Site Location Fort Stewart / Hunter Army Airfield

Prepared by ____________

Date/Time	Description of Activities

ARCAD RAGHTY & MILLER Laboratory Task Order No./P.O. No. ________

CHAIN-OF-CUSTODY RECORD

Page ___ of ___

Project Number/Name ____________________

Project Location ____________________

Laboratory ____________________

Project Manager ____________________

Sampler(s)/Affiliation ____________________

Sample ID/Location	Matrix	Date/Time Sampled	Lab ID	ANALYSIS / METHOD / SIZE						Remarks	Total

Sample Matrix: L = Liquid; S = Solid; A = Air

Total No. of Bottles/ Containers ____

Relinquished by: ____________ Organization: ____________ Date __/__/__ Time ______ Seal Intact?
Received by: ____________ Organization: ____________ Date __/__/__ Time ______ Yes No N/A

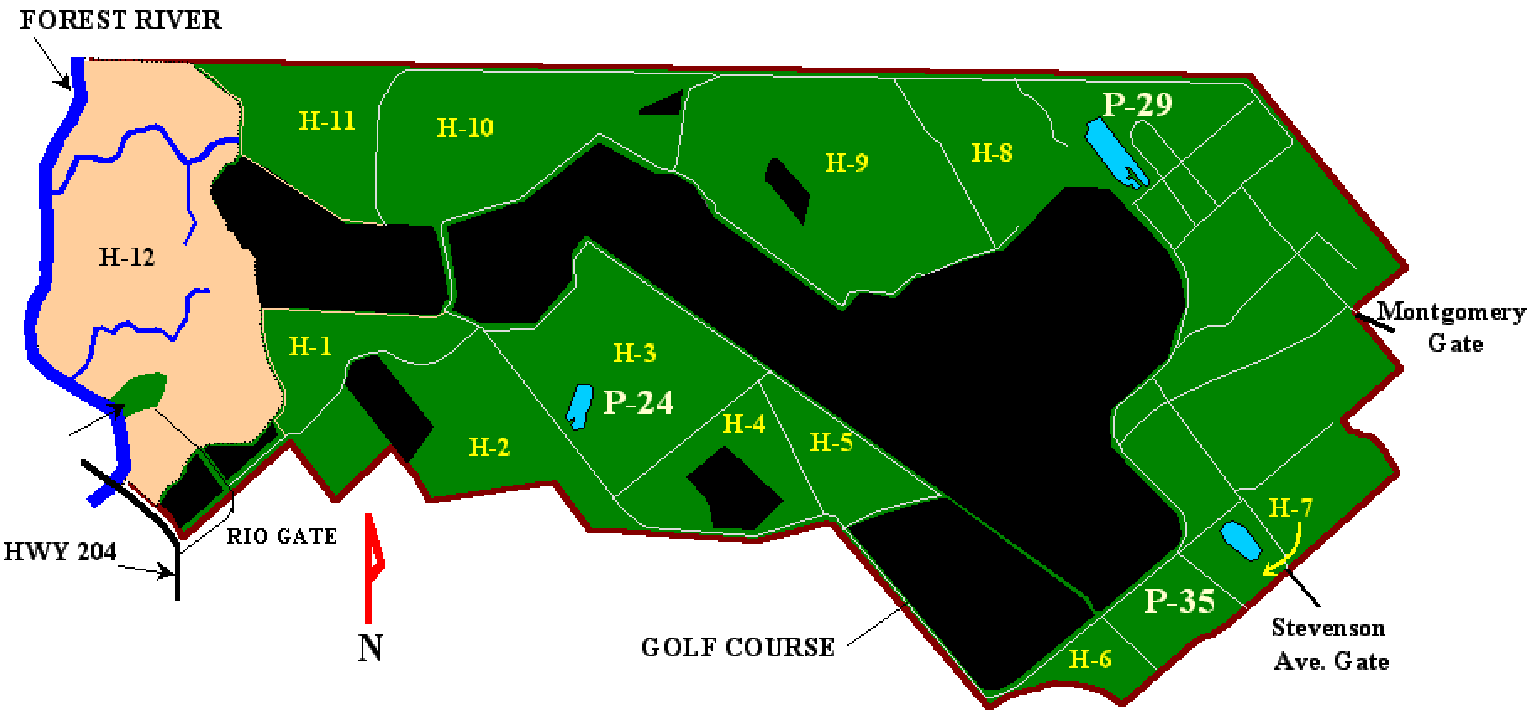
Relinquished by: ____________ Organization: ____________ Date __/__/__ Time ______ Seal Intact?
Received by: ____________ Organization: ____________ Date __/__/__ Time ______ Yes No N/A

Special Instructions/Remarks: ____________________

Delivery Method: ☐ In Person ☐ Common Carrier ____________ SPECIFY ☐ Lab Courier ☐ Other ____________ SPECIFY

AG 05-0597

HUNTER ARMY AIRFIELD RECREATIONAL FISHING MAP...



(Click on the pond below OR the pond on the map above to view a detail of the pond.)

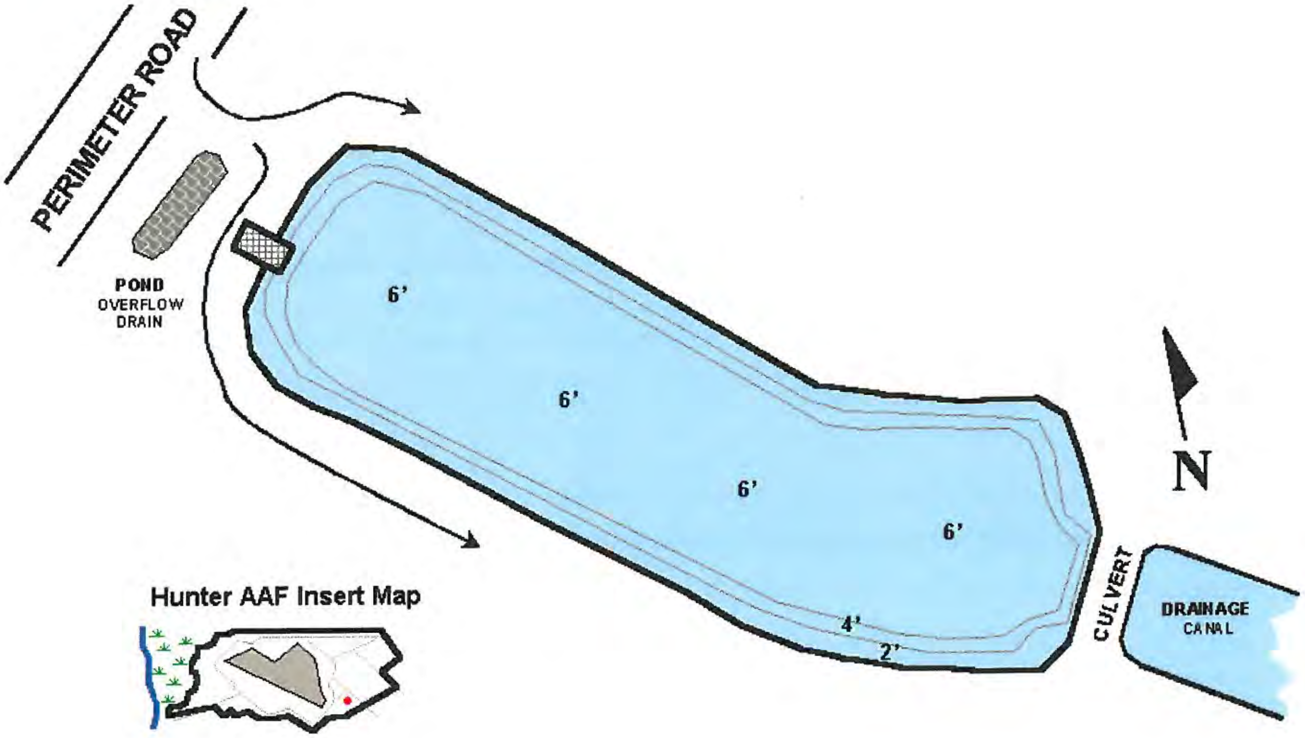
P-24 Hallstrom Pond (4.3 Acres)
P-29 Oglethorpe Lake (9.7 Acres)
P-35 Wilson Gate Pond (4.5 Acres)

INSTALLATION BOUNDARY
AREA BOUNDARY/ ROAD NETWORK
LAKES/PONDS/RIVERS
OFF LIMIT AREA
MARSH

Return to top

Date of last update: 11/23/2009

Wilson Gate Pond (Pond #35)



Lake Facts... (Contour Intervals: 2 feet)

Surface Acres: 4.0 Acres
Average Depth: 6 ft.
Constructed: 1998
Training Area: H-7 (HAAF)
Boat Ramps: No
Perimeter Road: Partial
Fish Attractors: No

Route to Pond...

Enter Hunter Army Airfield via Stevenson Avenue (Wilson Gate), proceed down Wilson Blvd., turn left on Perimeter Road and the pond will be on your immediate left.

Fish Species...

Stocked: **Largemouth Bass, Bluegill Sunfish, Redear Sunfish, Channel Catfish**

Available, But Not Stocked: **Black Crappie**

Management...

Liming, Fertilizing, Aquatic Weed Control, Fish Attractors, Water Quality Monitoring, Fish Population Sampling, Fish Stocking, Pond Maintenance and Repair

Return to top ▲

Date of last update: 06/09/2009

Appendix K
Photographic Log

Client Name:	**Site Location:**	**Project No.:**
U.S. Army Environmental Command	HAA-17 Hunter Army Airfield, GA	GP08HAFS.H17B

Photo No.	**Date**
1	04/11/09

Description
View looking south at drainage canal under S. Lightning Road

Photo No.	**Date**
2	04/11/09

Description
View looking northeast at drainage canal east of Motor Pool area

Appendix K
Photographic Log

Client Name:	Site Location:	Project No.:
U.S. Army Environmental Command	HAA-17 Hunter Army Airfield, GA	GP08HAFS.H17B

Photo No.	Date	
3	04/11/09	 04/11/2009
Description View looking south at drainage canal under S. Lightning Road		

Photo No.	Date	
4	04/11/09	 04/11/2009
Description View looking south at drainage canal on south side of S. Lightning Road		

Appendix K
Photographic Log

Client Name:	Site Location:	Project No.:
U.S. Army Environmental Command	HAA-17 Hunter Army Airfield, GA	GP08HAFS.H17B

Photo No.	Date
5	09/25/09

Description
View looking north along S. Perimeter Road

Photo No.	Date
6	04/11/09

Description
View looking north at drainage canal under S. Lightning Road and Motor Pool area

Appendix K
Photographic Log

Client Name:	Site Location:	Project No.:
U.S. Army Environmental Command	HAA-17 Hunter Army Airfield, GA	GP08HAFS.H17B

Photo No.	Date
7	04/11/09

Description
View looking northeast at drainage canal north of S. Lightning Road

Photo No.	Date
8	04/11/09

Description
View looking north at drainage canal north of S. Lightning Road

Appendix K
Photographic Log

Client Name:	Site Location:	Project No.:
U.S. Army Environmental Command	HAA-17 Hunter Army Airfield, GA	GP08HAFS.H17B

Photo No.	Date
9	9/25/08

Description
View looking south at Purge Facility

Photo No.	Date
10	9/25/09

Description
View looking north at Motor Pool north of S. Lightning Road

Appendix K
Photographic Log

Client Name:	Site Location:	Project No.:
U.S. Army Environmental Command	HAA-17 Hunter Army Airfield, GA	GP08HAFS.H17B

Photo No.	Date
11	9/25/09

Description
View looking west at Building 1290 west of S. Lightning Road

Photo No.	Date
12	9/25/09

Description
View looking east at Pond 35 east of S. Perimeter Road

Appendix K
Photographic Log

Client Name:	**Site Location:**	**Project No.:**
U.S. Army Environmental Command	HAA-17 Hunter Army Airfield, GA	GP08HAFS.H17B

Photo No.	**Date**
13	9/25/09

Description
View looking northwest at entrance to motor pool area from S. Lightning Road

Photo No.	**Date**
14	9/25/09

Description
View looking west into wooded area east of drainage canal

Appendix K
Photographic Log

Client Name:	Site Location:	Project No.:
U.S. Army Environmental Command	HAA-17 Hunter Army Airfield, GA	GP08HAFS.H17B

Photo No.	Date
15	9/25/09

Description
View of construction in area of former drycleaner and former weapon cleaning area

Photo No.	Date
16	9/25/09

Description
View looking southeast at vehicle maintenance area northeast of motor pool area

Compliance Status Report
Review Checklist

Site Name:	HAA-17			**HSI # :**	10903
City/County:	Savannah, Chatham County			**CSR Date:**	April 2011
PRP:	Fort Stewart/Hunter AAF	**Revision No. (if applicable):**		**Consultant**	ARCADIS

Release to Soil?	[✓ YES] NO			**Release to Groundwater:**	[✓ YES] NO	
Soil RRS Certification:	Type 1	Type 2	Type 3	Type 4	Type 5	[✓ Cannot certify]
GW RRS Certification:	Type 1	Type 2	Type 3	Type 4	Type 5	[✓ Cannot certify]

RULE SECTION	DESCRIPTION OF REQUIREMENT	Y or Ξ	Location in CSR (i.e. pg.)
391- 3-19-.06(3)(b)(1)	A description of each known source which has contributed to or is contributing to a release at the site including:		
391- 3-19-.06(3)(b)(1)(i)	Source name, number, or other descriptor;	Y	pgs 4-1,4-2
391- 3-19-.06(3)(b)(1)(ii)	Location of source on a map (minimum scale of 1" = 200');	Y	Fig 4-1
391- 3-19-.06(3)(b)(1)(iii)	Name of each regulated substance released from each source;	Y	Para. 4.2.1 & 5
391- 3-19-.06(3)(b)(1)(iv)	Chronology of each source of a release; and	Y	Para. 4.2.1 & 5
391- 3-19-.06(3)(b)(1)(v)	If source is an engineered structure or waste management unit, a description of the function, design, dimensions, capacity and operation of the source, including as-built construction diagrams	Y	pgs 4-1,4-2

RULE SECTION	DESCRIPTION OF REQUIREMENT	Y or Ξ	Location in CSR (i.e. pg.)
	where available.		
Releases to Soil			
391- 3-19-.06(3)(b)(2)	Complete definition of horizontal and vertical extent of soil contamination to background. Background shall be determined using samples representative of soil conditions not affected by a release of a regulated substance. In support of the definition of the extent of contamination, the CSR shall include, at a minimum:		
391- 3-19-.06(3)(2)(b)(i)	General approach used;	Y	pgs 6-1,6-2,6-3
391- 3-19-.06(3)(b)(2)(ii)	Analytical parameters selected and the rationale for selection;	Y	pg 6-2
391- 3-19-.06(3)(b)(2)(iii)	Map of minimum scale of 1" = 200' showing location of all sampling points by sample number, and vertical cross-sections where appropriate. Concentrations of constituents should be indicated by isoconcentration lines.	Y	Fig 5-1, 5-2, 6-1, 7-1
391- 3-19-.06(3)(b)(2)(iv)	Sampling and analysis procedures including:		
391- 3-19-.06(3)(b)(2)(iv)(I)	Sampling equipment and collection techniques;	Y	pg 6-4, App I, Sect. 3.2
391- 3-19-.06(3)(b)(2)(iv)(II)	Field analytical or measurement techniques including make and model of equipment and calibration schedule and type;	Y	App I, Section 3-2 and 3-3
391- 3-19-.06(3)(b)(2)(iv)(III)	Sample handling and preservation techniques;	Y	App I, Sect 4.3.3
391- 3-19-.06(3)(b)(2)(iv)(IV)	Equipment decontamination procedures;	Y	App I, Sect 3.12
391- 3-19-.06(3)(b)(2)(iv)(V)	Chain-of-custody procedures;	Y	App I, Sect 4.3
391- 3-19-.06(3)(b)(2)(iv)(VI)	Lab techniques including references to analytical methods, including QA/QC procedures;	Y	App C, pg 6-4
391- 3-19-.06(3)(b)(2)(v)	A description of any statistical procedures used to evaluate the data;	Y	Sect 8 and 9
391- 3-19-.06(3)(b)(2)(vi)	Procedures used to establish background soil concentrations; and	Y	pg 5-6, App H

RULE SECTION	DESCRIPTION OF REQUIREMENT	Υ or Ξ	Location in CSR (i.e. pg.)
391- 3-19-.06(3)(b)(2)(vii)	Narrative and tabular summary of all pertinent field data and the results of all final lab analyses that are supported by sufficient QA/QC control data to validate the results.	Y	pgs 5-5,5-6,6-3,6-4 Tables 5-3,5-5,7-3
Releases to Groundwater			
391- 3-19-.06(3)(b)(3)	Complete definition of horizontal and vertical extent of groundwater contamination to background. Background shall be determined using samples representative of groundwater conditions not affected by a release of a regulated substance. In support of the definition of the extent of contamination, the CSR shall include, at a minimum:		
391- 3-19-.06(3)(b)(3)(i)	Analytical parameters selected and the rationale for selection;	Y	pg 6-2, Sect 5
391- 3-19-.06(3)(b)(3)(ii)	A description of methods used to characterize sub-surface geology;	Y	App I, Sect 3.1
391- 3-19-.06(3)(b)(3)(iii)	A description of methods used to characterize vertical and horizontal groundwater flow gradients, flow rates, and flow directions;	Y	pg 7-2
391- 3-19-.06(3)(b)(3)(iv)	Methods used to determine hydraulic conductivities and other pertinent hydrogeological characteristics, including a description of any slug and/or aquifer tests;	Y	pg 6-2
391- 3-19-.06(3)(b)(3)(v)	A description of groundwater monitoring well locations, and their installation and construction methods, including:	Y	Sect 6.6, Fig 5-1 App I, Sect 3.5
391- 3-19-.06(3)(b)(3)(v)(I)	A map (minimum scale 1"= 200') depicting all existing well locations including a survey of each well=s surface reference point and the elevation of its top-of-casing;	Y	Fig 5-1
391- 3-19-.06(3)(b)(3)(v)(II)	Type of well casing material;	Y	Sect 6.6
391- 3-19-.06(3)(b)(3)(v)(III)	Description of well intake design including screen slot size and length, filter pack materials and length, and method of filter pack emplacement;	Y	Sect 6.6, App I Sect 3.5
391- 3-19-.06(3)(b)(3)(v)(IV)	Method used to seal the well from the surface and any other features designed to prevent or minimize downward migration of	Y	Sect 6.6, App I, Sect 3.5

RULE SECTION	DESCRIPTION OF REQUIREMENT	Y or Ξ	Location in CSR (i.e. pg.)
	contaminants along the well annulus; and		
391- 3-19-.06(3)(b)(3)(v)(V)	Description of methods and procedures used to develop the wells.	Y	App I, Section 3.6.2
391- 3-19-.06(3)(b)(3)(vi)	Description of all sampling and analysis procedures used including:		
391- 3-19-.06(3)(b)(3)(vi)(I)	Procedures and timing for measuring groundwater elevations for each sampling event;	Y	App I, Sect 3.6.1 Table 6-1
391- 3-19-.06(3)(b)(3)(vi)(II)	Well evacuation procedures including well volume evacuated prior to sampling;	Y	App I, Sect 3.6.2, App F
391- 3-19-.06(3)(b)(3)(vi)(III)	Sample withdrawal techniques, sampling equipment and materials;	Y	App I, Sect 3.6.2
391- 3-19-.06(3)(b)(3)(vi)(IV)	Sample handling and preservation techniques;	Y	App I, Sect 4.3
391- 3-19-.06(3)(b)(3)(vi)(V)	Equipment decontamination procedures;	Y	App I, Sect 3.12
391- 3-19-.06(3)(b)(3)(vi)(VI)	Chain-of-custody procedures;	Y	App I, Sect 4.3
391- 3-19-.06(3)(b)(3)(vi)(VII)	Lab techniques including references to analytical methods, including QA/QC procedures;	Y	pg 6-2, App C
391- 3-19-.06(3)(b)(3)(vii)	Description of procedures used to determine background groundwater concentrations;	Y	App H
391- 3-19-.06(3)(b)(3)(viii)	Map (minimum scale of 1" = 200') or less depicting the horizontal extent of contamination. Concentrations should be indicated by isoconcentration lines.	Y	Fig 7-7,7-8 and 7-9
391- 3-19-.06(3)(b)(3)(ix)	Map (minimum scale of 1" = 200') or less depicting the potentiometric surface of groundwater;	Y	Fig 7-2 and 7-3
391- 3-19-.06(3)(b)(3)(x)	Maps and vertical cross-sections of appropriate scale depicting concentrations for all contaminants superimposed upon site stratigraphic features and monitoring wells; and	Y	Figure 7-1
391- 3-19-.06(3)(b)(3)(xi)	Narrative and tabular summary of all pertinent field data and the results of all final lab analyses that are supported by sufficient	Y	Sect 7.2, Tables 7-4,7-5, 7-6

RULE SECTION	DESCRIPTION OF REQUIREMENT	Y or Ξ	Location in CSR (i.e. pg.)
	QA/QC control data to validate the results.		
ADDITIONAL REQUIREMENTS			
391- 3-19-.06(3)(b)(4)	A description of any human or environmental receptors who may have been or could potentially be exposed to a release at the site.	Y	Sect 8.1
391- 3-19-.06(3)(b)(5)	A description of all properties which are part of the site including the address and location of such property, its legal description, and the property owner=s name, address and telephone number.	Y	Sect 4.2
391- 3-19-.06(3)(b)(6)	The name, address, and telephone number of any other person who may be a responsible party for the site and a description of the type and amount of regulated substances such party may have contributed to a release.		Not Applicable
391- 3-19-.06(3)(b)(7)	A summary of previous actions taken to eliminate, control or minimize any potential risk at the site, including actions taken to comply with the risk reduction standards.	Y	Sect 5.8 & 8.4
391- 3-19-.06(3)(b)(10)	Attached to the front of the CSR, concise statement of the findings of the report presented in plain language, immediately followed by the certification required by 391-3-19-.06(4)(a).	Y	pgs 1 through 8
391-3-19-.06(4)(a)	The CSR shall include a compliance certification regarding the responsible party=s own determination as to the status of a site or any individual property at a site with regard to the applicable risk reduction standards for all regulated substances evaluated by the CSR.	Y	pg 2-1
391-3-19-.06(4)(b)	The CSR certification shall be signed by the applicable person described in Items 1 - 4 of .03(6)(c). Where the CSR is submitted for two or more cooperating responsible parties, the certification may be signed by a duly authorized representative of said responsible parties.	Y	pg 2-1
391-3-19-.06(4)(c)	Any person signing the certification of compliance shall make the certification specified in the Rules.	Y	pg 2-1

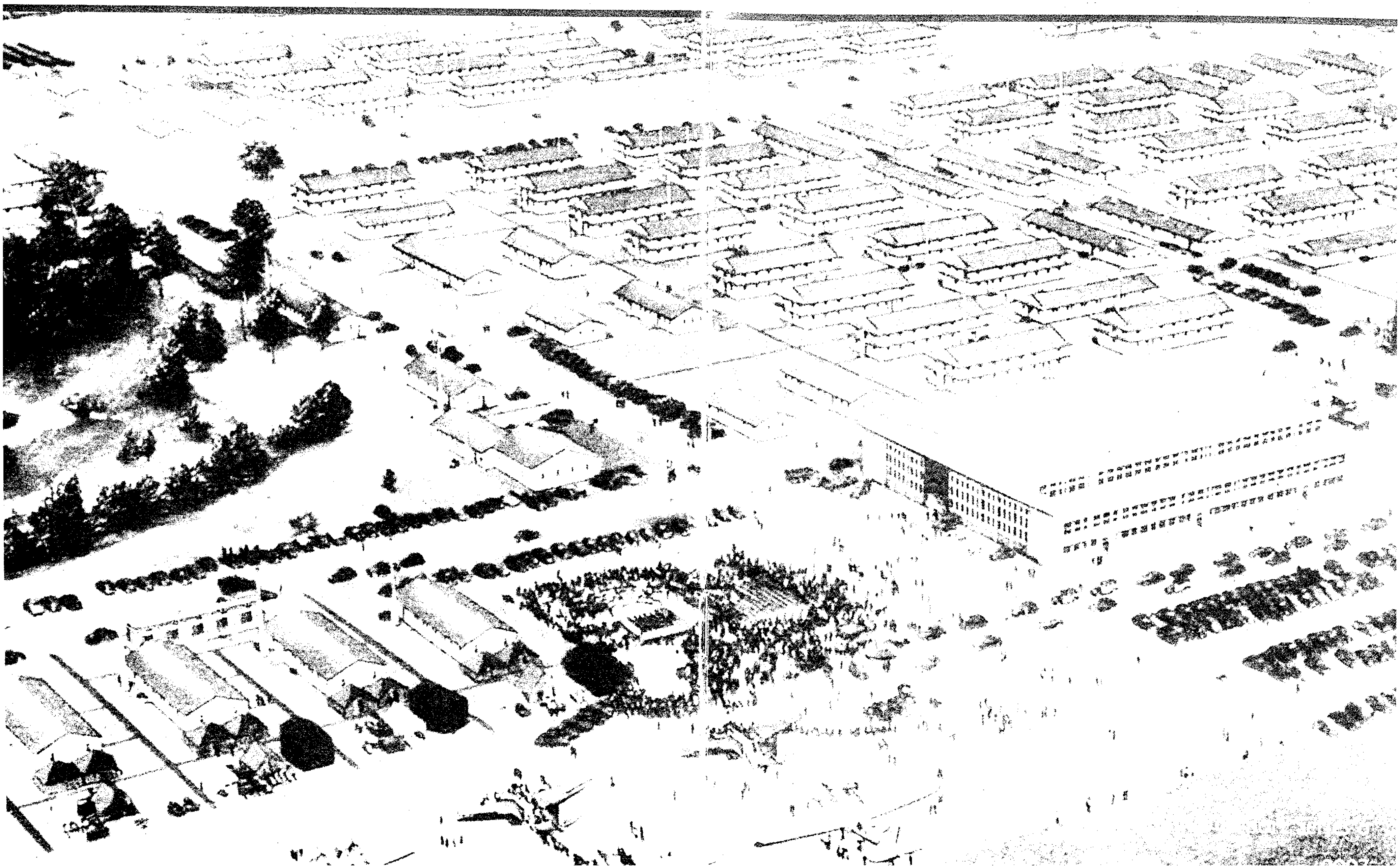
RULE SECTION	DESCRIPTION OF REQUIREMENT	Y or Ξ	Location in CSR (i.e. pg.)
391- 3-19-.06(5)(a)	Within 7 days of submitting the CSR, RP shall publish a notice in both a major local newspaper of general circulation and the legal organ of the local governments in whose jurisdiction the site is located, announcing that such a report is available for inspection by the general public, including:	Y	Section 10
391- 3-19-.06(5)(a)(1)	The name, address, and location of the site as it appears on the HSI, and, if the plan applies to less that the full site, the street address and owner=s name of the applicable properties;	Y	Title Page & Section 3
391- 3-19-.06(5)(a)(2)	The statement provided in this section;		
391- 3-19-.06(5)(a)(3)	Announcement of a 30-day comment period and the name, address, and phone number of the EPD contact person to whom written or oral comments can be made;	Y	Section 10
391- 3-19-.06(5)(a)(4)	Name, address, and phone number of the RP or its designated contact person; and		
391- 3-19-.06(5)(a)(5)	Location where the report may be viewed or copied.	Y	Section 10
391- 3-19-.06(5)(e)	Within 7 days of submitting the CSR to EPD, the RP shall provide to the count government in the county in which the site is located and to the government of any city in whose jurisdiction the site is located the same information required above.	Y	Section 10
391-3-19-.07(4)	For corrective action to be in compliance with these standards, the following common elements are required:		
391-3-19-.07(4)(a)	Removal of all free product to the extent practicable.	Y	Section 3
391-3-19-.07(4)(b)	No soil remaining in place shall exhibit the hazardous waste characteristics of ignitability, corrosivity, or reactivity.	Y	Section 3
391-3-19-.07(4)(c)	Shall not allow exposure to concentrations which would cause food chain contamination, damage to soils or to biota which could impair the use of the soils for agricultural or silvicultural purposed, adverse effects on vegetation or wildlife, or the accumulation of vapors in	Y	Section 3

RULE SECTION	DESCRIPTION OF REQUIREMENT	Y or Ξ	Location in CSR (i.e. pg.)
	buildings or other structures which pose a threat to human health and the environment.	Y	Section 3
391-3-19-.07(4)(d)	Shall protect the waters of the State from releases that would cause surface water to exceed the Georgia in-stream water quality standards.	Y	Pg. 7-9 and Section 3
391-3-19-.07(4)(e)	If the detection limit and/or the background concentration for a regulated substance is greater than the concentration specified in any risk reduction standard, the greater of the detection limit or background shall be used for determining compliance with the risk reduction standards.	Y	Section 3

______X______ Groundwater work certified by a geologist, etc.

____________ Corrective Action Plan included.

Additional Notes:



Hunter Army Airfield

A History

Joseph P. Maggioni

Funded by

United States Department of Defense
Department of the Army, Fort Stewart
Directorate of Public Works
Environmental Division, Prevention and Compliance Branch

Fort Stewart Popular Report Series 6
2007

Contents

Beginnings 3
Savannah Airport 3
World War II 4
Hunter Field Goes to War 5
A Municipal Airport Again 9
The Cold War and Strategic Air Command (SAC) 9
Early Sac Operations at Hunter AFB 12
The New Look 13
From Wing Rotation to Reflex 15
Changing Strategies 18
Materiel Air Transport Service 20
Vietnam and the Army's Arrival 20
Hunter Army Airfield: 1974 to 2001 21
Confronting Global Jihad: 2001 to the Present 22
Sources 24
Illustration Credits 24

Hunter Field, 1933

Beginnings

The 1920s marked the true beginning of civilian aviation in the United States. By 1930, nearly 1,700 civilian airports had been established in the nation. As part of this trend, in 1927, the city of Savannah bought 900 acres of woods, pasture, and swamp 3 miles south of the city limits for the first Savannah Airport—later known as Hunter Field.

Savannah Airport

In three years, using mostly chain-gang labor, Chatham County dug ditches in the area, graded the field with 400,000 cubic yards of sand, and planted it with Bermuda grass. The landing area was 4,500 feet long and 3,500 feet wide, with no runways. Aircraft could take off and land in any direction. The original airfield lay roughly on what is now Hunter Army Airfield's parking apron.

On September 20, 1929, a six-seater Bellanca CH-300 Pacemaker named "The City of Savannah" became the first aircraft to land at the Savannah Airport, inaugurating the Eastern Air Express, New York to Miami air service. One month later, the stock market crashed, plunging the U.S. into the Great Depression. By November of that ill-fated year, Eastern Air Express folded. This left Savannah without regular air service until 1931, when Eastern Airlines began offering intrastate travel from Savannah to Augusta and Atlanta.

Airfield Lighting at the Savannah Airport in the Early 1930s

"Robbie Richard and myself used to ride with Mr. Tillman... on the running board of his Ford and put out lanterns...so that the airplanes can land at night.... So when we come from school, just every afternoon...Mr. Tillman would have the lanterns filled with kerosene [in] the Model A.... We'd get on the running board and we'd put the lanterns down.... He'd go another, say, fifty feet and put another lantern down...."

—Joseph Butler Harris

In spite of the Depression, the city undertook a number of improvements to the airfield throughout the decade, including the 1932 construction of Wilson Boulevard, named after Judge Emmett Wilson, chairman of the city's airport commission. In 1936, the city and one of President Roosevelt's public works programs, the Works Progress Administration (WPA), cooperated in making significant improvements to the airport. The WPA spent $130,000, and the city $36,000 to rebuild the drainage system, construct a new metal hangar, and replace the grass airfield with three new asphalt runways.

Inside the WPA hangar (Building 1206), 1937

Henry G. "Sandy" Strachan ▶

The current Building 1206 is the WPA hangar, little changed since the 1930s. The first Savannah-based flying service, Strachan Skyways, moved into this hangar after it was built. The most prominent local aviator of the 1930s, Henry G. "Sandy" Strachan (pronounced "strawn") owned the company and was also the airport manager. According to the *Savannah Morning News* (Jan. 1941), Strachan was "recognized as one of the leading fliers of Georgia…[and] credited as much as anyone else with bringing the magical world of flight to Savannah's attention." Air activity grew apace with the airfield. By decade's end, the airfield hosted regular flights from both Delta and Eastern airlines.

World War II

When Hitler invaded Poland in September 1939, the U.S. Army, with 175,000 men, ranked seventeenth in the world—weaker than even the Dutch and Romanian armies. Meanwhile the Japanese, locked in combat with the Chinese since 1937, were looking to expand their empire in Asia. The Air Corps, part of the Army at the time, had only 2,200 obsolete aircraft stationed at twenty-four airfields around the country. Europe and China were engulfed in war, and, although the U.S. was not yet involved, in the corridors of Washington preparations began for a military build-up.

Still, the war seemed far away from Savannah during that late summer. In September, the Air Corps commissioned Sandy Strachan a lieutenant, but business continued as usual at the airport. In 1939 –1940, the city built a permanent municipal airport building to house the growing administrative activities of the airport. (The building's terrazzo floor still remained intact on the installation flightline as of July 2007.) On May 19, 1940, the city officially dedicated the airport as Hunter Field.

Hunter Field Goes to War

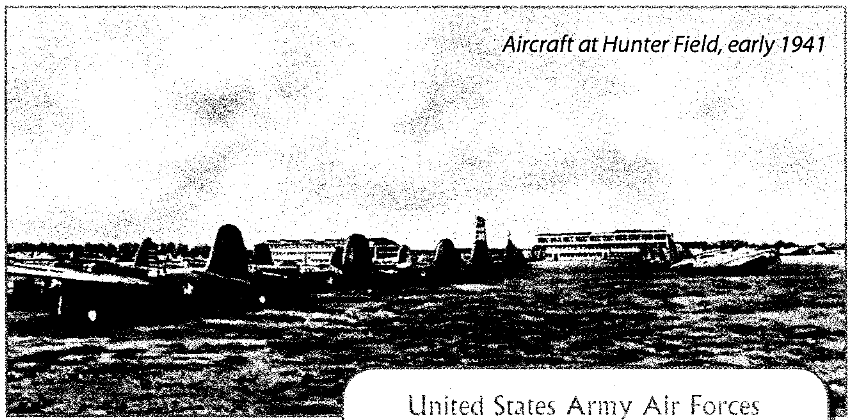
In 1940, the U.S. began to rearm in preparation for war. The government increased funding for new equipment and bases and instituted a peace-time draft. A primary beneficiary of this new largesse was the Air Corps, which by 1941 had grown to over 25,000 personnel and 4,000 aircraft. The Air Corps needed new airbases to accommodate its growth and, in August 1940, selected Hunter Field as a light-bomber training base.

Within two months, the Air Corps transferred 3,000 personnel of the 3rd and 27th Bomb Groups and 100 A-18 trainers, A-20 light bombers, and B-18 medium bombers to the new base, which shared the airfield with the civilian airport. Within nine months, the military had constructed an entire cantonment north of the runways consisting of over 220 facilities, including barracks, warehouses, a hospital, hangars, and operations buildings. The threat of war had transformed the sleepy southern airfield into a bustling military installation.

In January 1941, Savannah received the tragic news that Sandy Strachan had died in a training accident at Barksdale Field, Louisiana. In his honor the Air Corps named the

Frank O'Driscoll Hunter

Usually public facilities are named for deceased persons. However, Hunter Army Airfield's namesake, Frank O'Driscoll Hunter (1894–1982), Lieutenant Colonel, U.S. Army Air Corps, was very much alive when the city of Savannah christened the installation Hunter Field in 1940. A native of Savannah, Georgia's only World War I flying ace, and a lifelong bachelor, Hunter would be promoted to Major General and briefly lead the Eighth Air Force Fighter Command in World War II.



Aircraft at Hunter Field, early 1941

road running adjacent to the runways and parking aprons Strachan Road. (In the 1990s, the installation renamed this street Lightning Road.)

The 3rd and 27th Bomb Groups trained at Hunter Field throughout 1940 and 1941, participating in large-scale Army maneuvers in the Carolinas. On December 7, 1941, the Japanese bombed Pearl Harbor. All passes from Hunter Field were immediately canceled, and airmen were required to wear uniforms at all times. The U.S. now faced war with Japan and Germany.

From 1941 to 1943, the base grew to a population of 10,000, expanded its boundaries from 900 to nearly 3,000 acres, built six additional cantonments and tent camps at the installation, expanded runway capacity, built aircraft parking aprons, and trained ground support squadrons, bomber groups, and fighter groups. Units that trained at Hunter Field later saw active combat in all major theaters of war, including the China-Burma-India, the Pacific, and the European theaters.

United States Army Air Forces

The Air Corps was formed in 1926 as a subordinate branch of the Army. Initially the various ground force corps commands held operational control over Air Corps aircraft, but, in 1935, the Army formed General Headquarters Air Force (GHQAF), which placed all aircraft under the command of a single aviator general. This fractured the chain of command, as GHQAF only controlled flying aircraft, while the Air Corps, a separate organization, controlled logistics, training, and doctrinal development. To fix this problem, in June 1941, the War Department created the United States Army Air Forces (USAAF), a new organization that both the Air Corps and GHQAF (later renamed Combat Command) were subordinate to. Technically still a sub-service of the Army, the USAAF was assigned its own Undersecretary of War, with a seat on the General Staff. This was a major step towards the creation of the Air Force as a separate branch of service.

In March 1943, the USAAF designated Hunter Field as the Third Air Force Staging Wing Base, changing its mission to staging air crews and aircraft for transfer to combat operations in Europe. Over the next two years, Hunter Field processed 9,000 aircraft and 70,000 crewmen.

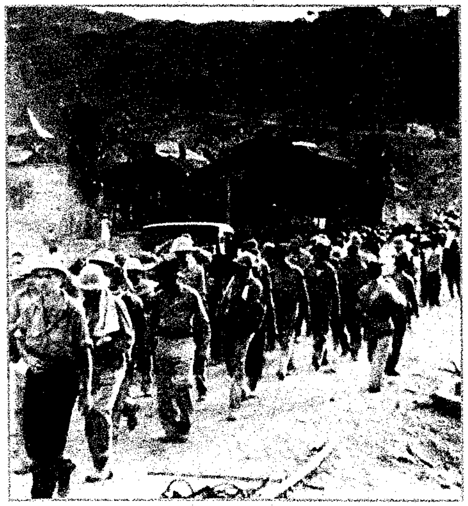
The military built approximately 450 buildings at Hunter Field from 1940 to 1945. Over the past sixty years, the installation has demolished most of its World War II buildings. As of 2007, the remaining on-post World War II structures include a water tower (Facility 721), an abandoned ammunition storage area (Buildings 1305–1308), a heat plant (Building 812), two bomb-sight

Birth of the Mighty Eighth Air Force

On January 28, 1942, the USAAF formed the Eighth Air Force at Hunter Field. For three months in early 1942, Hunter Field's personnel prepared the embryonic command for overseas service until its transfer to England, where the Eighth Air Force gained fame conducting daylight strategic bombing missions over western Europe.

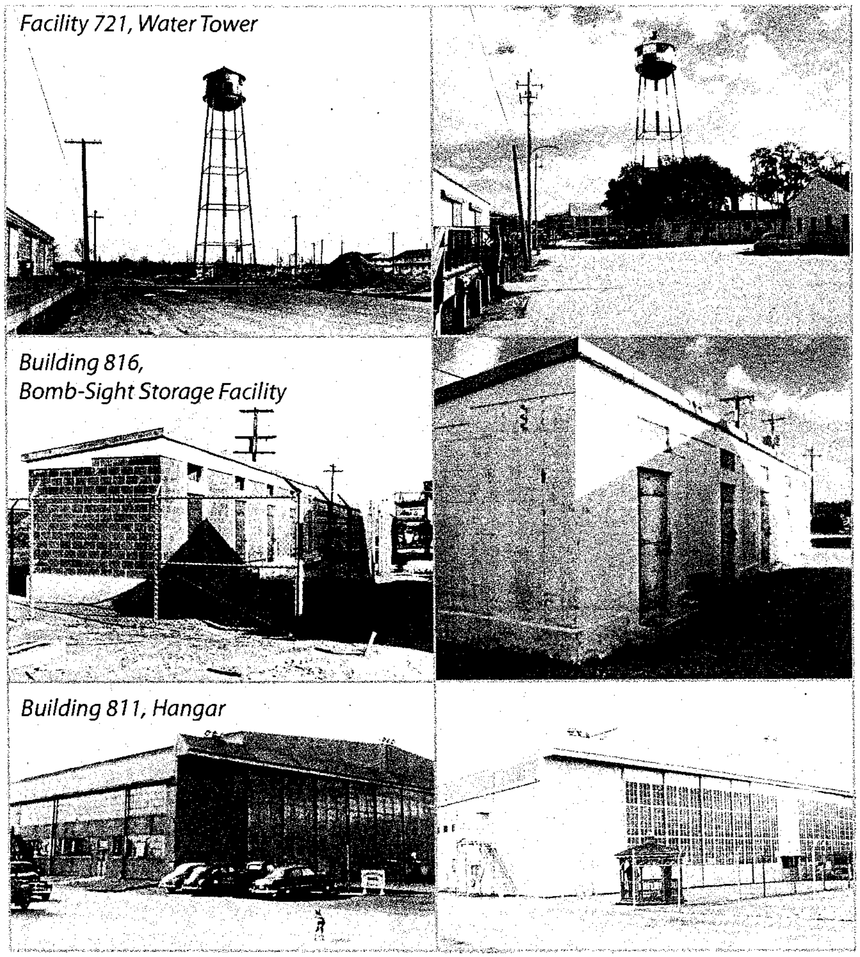
The Ill-Fated 27th Bomb Group

In November 1941, the Air Corps transferred the 27th Bomb Group from Hunter Field to the Philippines. The 27th arrived just before the Pearl Harbor attack on December 7, 1941. The Japanese invaded the Philippines days later. In a letter dated February 18, 1942, Lieutenant Colonel John Sewell described the 27th's ordeal to his family: "We never did get any airplanes and...as infantry we have functioned.... We are living in the jungle; no tents.... We eat twice a day...mostly canned salmon and rice. Morale is high.... I have lost several men and one officer, mostly killed by bombs.... But we have killed hundreds of [Japanese] too.... How or when this letter will reach you I have no idea. I am putting it in the hand of God." The Japanese killed or captured the entire unit when the Philippines fell in April 1942. The photo depicts U.S. prisoners of war on Bataan being led into a brutal captivity.



Hunter Army Airfield Then and Now

1940–1950 ▼ 2006 ▼



storage facilities (Buildings 803 and 816), the sewage treatment plant, the small arms range (used during World War II to test fire and sight in aircraft-mounted machine guns and cannon), three hangars (Buildings 811, 813, and 1290), and various administration buildings and warehouses.

After Germany's surrender in May 1945, Hunter Field processed aircraft and crew who were returning from the Mediterranean and slated for duty in the Pacific. This operation was cut short on August 6, 1945, when the B-29 *Enola Gay*, piloted by Colonel Paul Tibbetts, dropped a terrible new weapon—an atom bomb—on the Japanese city of Hiroshima, killing 100,000 Japanese. A second bomb dropped on Nagasaki prompted the Japanese government to surrender unconditionally. The mushroom clouds over Hiroshima and Nagasaki marked the final act of World War II and ushered in an era of global uncertainty. Would the destructive power of the bomb force an end to war? Or would the bomb lead to an end to humanity?

A Municipal Airport Again

After 1945, Hunter Field reverted to the Savannah Municipal Airport. The airport only used a small fraction of Hunter Field's cantonment; the balance, administered by the Federal Public Housing Administration, was leased to various public and private enterprises. Businessmen converted buildings to industrial plants, commercial businesses, and even apartments. The University of Georgia, overwhelmed with returning veterans, even opened a satellite campus on the old airbase.

The Cold War and Strategic Air Command (SAC)

As the 1940s ended, the Soviet Union, formerly a World War II ally, showed itself under the dictator Josef Stalin to be an implacable foe of western capitalism and democracy. The Soviets took control of Eastern European nations, attempted a blockade of Berlin in 1948, and exploded their own atomic weapon in 1949. The U.S. grew increasingly concerned with Communist aggression and expansion. In 1947, President Truman signed the National Security Act (NSA), reorganizing the U.S. defense and intelligence

Colonel Paul Tibbetts

Tibbetts, born in 1915, trained at Hunter Field in 1940 and 1941 as a lieutenant in the 3rd Bomb Group. He recalled that "the…months [training at Hunter Field] were the most important of my career from the standpoint of learning to become a precision pilot." Tibbetts distinguished himself in World War II as a squadron commander in Europe. In the Pacific, he commanded the 509th Composite Group, which dropped the A-bombs on Hiroshima and Nagasaki. Tibbetts returned to Hunter as commander of the 308th Bomb Wing from 1956 to 1958. He married his second wife in the Hunter Chapel, Building 145, in 1956. At left is Tibbetts just after completion of the Hiroshima mission.

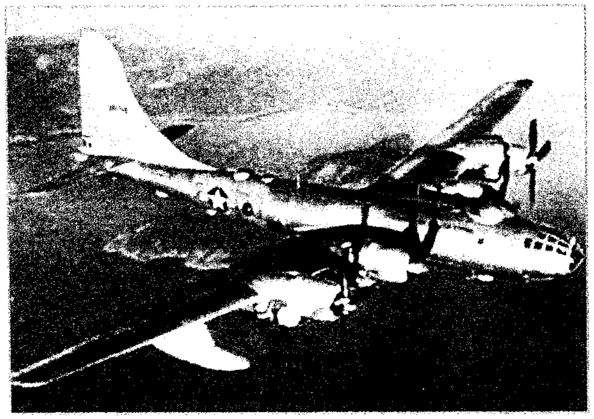
establishments and making the Air Force a completely independent branch of service. Because of its role in atomic bomb deployment, the Air Force became the most important branch of the military. Consequently, the Air Force's Strategic Air Command (SAC), responsible for delivery of the atomic bomb, became the most important Air Force command.

And what of SAC's principal weapons? In 1948, less than sixty atomic bombs were in the U.S. nuclear arsenal. Controlled by the civilian Atomic Energy Commission, the bombs were stored in four "Q Areas" adjacent to Air Force bases in the southern parts of the country: one in New Mexico, one in Tennessee, and two in Texas. By 1950, SAC consisted of fourteen bomb wings, flying mostly B-29 and B-50 propeller medium bombers or huge B-36 piston-pull heavy bombers. Like the Q Areas, SAC based its bombers primarily in the southeast and southwest parts of the country.

In 1949, as part of its southern strategy, SAC stationed the 2nd Bomb Wing and its B-50 bombers at Chatham Field, a World War II airbase built a few miles west of Savannah. However, with inadequate barracks and operations facilities, Chatham Field proved unsatisfactory for SAC. In order to keep SAC in the Savannah area, the city offered to exchange Hunter Field for Chatham Field.

SAC Bombers at Hunter AFB: 1950–1953

SAC stationed B-29 and B-50 bombers at Hunter AFB from 1950 to 1953. The B-29, with a maximum speed of 357 mph and a range of 3,250 miles, entered service during World War II. The B-29 spawned many variants, including the B-50 (left), which entered service in 1948. Similar to the B-29, the B-50 had greater speed (385 mph), range (4,650 miles), and mid-air refueling capability.



General Curtis LeMay

The controversial General Curtis LeMay (1906–1990) commanded SAC from 1948 to 1957. LeMay made frequent surprise visits to his bases, including Hunter AFB. Under LeMay, SAC continually improved its training, technology, doctrine, and morale. The general, however, was notorious for making disturbing public comments favoring preemptive nuclear war. LeMay retired as the Air Force Chief of Staff in 1965 and, in 1968, ran unsuccessfully for vice president on George Wallace's ticket.

SAC accepted, and, in September 1950, the switch occurred. Hunter Field became Hunter Air Force Base (Hunter AFB), while Chatham Field became the Savannah Municipal Airport, now known as the Savannah/Hilton Head International Airport.

On arrival at Hunter AFB in 1950, SAC found a neglected World War II–era airport. Buildings creaked with rotten siding and broken windows, while asphalt roads showed ruts and holes, and grass grew through the pavement of aircraft parking aprons. A land conflict in Asia soon accelerated the pace of base construction and development.

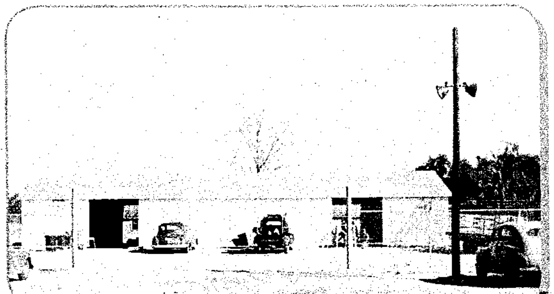
In June 1950, Communist North Korea invaded South Korea, starting the Korean War (1950–1953). Concerned that this attack was orchestrated by Moscow as the first round of World War III, the Truman administration began an immense military build-up, with SAC a major beneficiary. During the conflict, the U.S. nuclear arsenal increased from 300 atomic bombs to over 800. SAC grew from 59,000 to 153,000 personnel, developed and issued new jet aircraft, and built new bases, including Hunter.

By January 1951, SAC had slated a second bomb wing for Hunter AFB and, in 1950–1951, spent over $5.6 million on the base, mostly repairing World War II buildings, roads, and runways, and expanding the base to its current boundaries west to the Little Ogeechee (Forest) River and east to White Bluff Road. In the summer of 1951, Congress spent nearly $6 billion on the largest military construction program since World War II. Hunter AFB received $24.5 million and promptly spent $2.5 million building the installation's current runway.

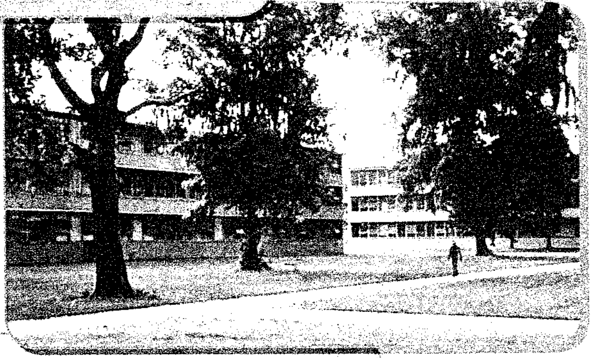
Early SAC Operations At Hunter AFB

In the midst of this new construction, the 2nd Bomb Wing conducted ground training, aircraft maintenance, unit-simulated combat missions (USCMs) involving practice bomb runs over American cities, and practiced the loading and deployment of nuclear weapons. SAC constructed a new ammunition storage area, which is still the post's ammunition storage point today. Hardstand 13, an unassuming facility located within the present-day Building 1336 motor pool area, served as a classroom for nuclear weapons operations and as a central control point for nuclear weapon loading exercises. Hardstand 13 has since been demolished.

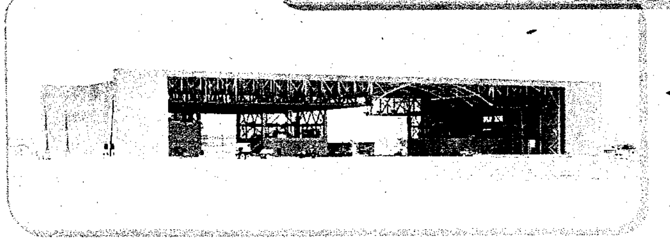
In April 1952, the 308th Bomb Wing, armed with B-29s, arrived at Hunter AFB. The 2nd and 308th Bomb Wings together formed the 38th Air Division. On paper, each wing had forty-five bombers divided into three combat squadrons and over 2,500 men, including combat crews, maintenance personnel, and security teams. In reality, the more recently-formed 308th did not have a full complement of bombers and was not yet rated combat ready.



◄ *Hardstand 13, December 1950*

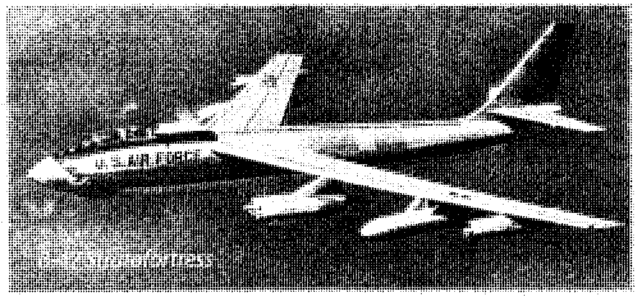


Pinwheel barracks, circa 1954 ►



◄ *Building 850 under construction, 1954*

The New Look



In 1952, Dwight D. Eisenhower was elected President. After the election, a series of military and political events, including the development of thermonuclear weapons thousands of times more powerful then atomic bombs, spurred the arms race between the U.S. and the Soviet Union. Under the Eisenhower administration, the concept of deterrence through the threat of massive nuclear retaliation became central to U.S. strategic planning and was formalized in a reform of the military establishment named the New Look after a ladies' fashion style promoted by *Vogue* magazine. Under the New Look, the Eisenhower administration stressed the deterrent potential of nuclear weapons by making SAC the centerpiece of the military establishment. From 1953 to 1961, SAC received nearly 50 percent of the entire U.S. military budget.

With this massive increase in funding, it is no surprise that many buildings at Hunter Field in 2007 date from this time period. From 1953 to 1956, the installation, in conjunction with the Savannah District Corps of Engineers, constructed double cantilever

U.S. Special Weapons Deployment 1948–1956

From the late 1940s through the 1950s, the government stored its nuclear arsenal in secure Q Areas, which grew in number from four in 1948 to twenty in 1960, matching the increase in the U.S. nuclear and thermonuclear arsenal. Some SAC airfields were located next to Q Areas, but for the other installations not adjacent to Q Areas (like Hunter AFB) the Air Force, prior to 1956, deployed the nuclear weapons in two ways: bombers would fly to the Q Areas, pick up bombs, and then conduct exercises; or transport aircraft would fly the bombs from the Q Areas to the bases, and the bombs would be temporarily stored on the base.

SAC Aircraft Maintenance at Hunter AFB

Crew chiefs would inspect their aircraft and inform Wing Maintenance Control of any maintenance problems. Using a large Plexiglas board to track the status of the sixty aircraft it was responsible for, Maintenance Control would then issue the wing maintenance shop work orders. Each shop, in turn, assigned mechanics to the aircraft, giving them specific work deadlines. Because B-47 bombers had limited space for maintenance, the work had to be carefully coordinated. If a mechanic, working on a tight schedule, ran out of time and did not inform Maintenance Control by radio, he would have to leave, allowing the next mechanic space to work.

hangars, three massive pinwheel barracks, new administration and shop buildings, air traffic control buildings, on-post family housing, and new community and recreation facilities.

The advent of The New Look coincided with a long-planned SAC-wide aircraft upgrade. In 1953, SAC began issuing the new B-47 jet bomber to its units, with Hunter AFB receiving its first jets in January 1954. Throughout the previous year, in addition to their regular duties, SAC personnel at Hunter AFB had been training to fly and maintain this new aircraft, vastly different from their vintage World War II propeller-driven bombers. With its swept-wing design and bubble cockpit, the B-47 looked and maneuvered more like a fighter than a bomber.

The B-47 flew at a top speed of 600 mph, 200 mph more than its predecessors. It had a range of only 4,000 miles, but its in-flight refueling capability gave this bomber a global reach. The B-47's speed and maneuverability revolutionized bomber tactics and doctrine. Instead of flying in mass formations, the B-47 would fly individually into enemy airspace at various points, relying on surprise and speed as its main defense. This required more intensive flight training than World War II bomber crews had received, and Hunter AFB, like other SAC bases, emphasized a high degree of training and readiness. Combat crews continually practiced bomb runs, outdoor survival, resolving navigational problems, and other skills necessary to fight and possibly survive nuclear war.

In support of the combat crews, SAC maintenance personnel worked on aircraft along the massive concrete aircraft parking apron, capable of parking over 130 bombers and refueling tankers. The 2nd Bomb Wing operated from the north edge of the apron, the 308th from the east edge. The space between the two double cantilever hangars, Buildings 850 and 860, marked the operational boundary between the two wings. New buildings were arranged and old buildings adapted to suit a maintenance system centrally controlled by single bomb wings. Basic maintenance and inspections of aircraft by combat squadrons and organizational/periodic maintenance squadrons occurred in nosedocks, such as Buildings 843, 844, and 845, or on the flightline.

More specialized maintenance occurred in the large hangars under field maintenance squadrons in Buildings 850 and 860. Smaller aircraft components were often removed for maintenance in the armament and electronics squadron shops, which mostly operated out of old World War II buildings and hangars, such as Buildings 811, 813, 1206, and 1290. Wing maintenance control directed all of these maintenance activities.

From Wing Rotation to Reflex

In 1954, SAC headquarters rated the entire 38th Air Division combat ready and nuclear capable. The 38th took part in wing rotation—a SAC program that brought bombers within easy range of the Soviet Union through ninety-day tours at SAC bases in the United Kingdom and North Africa. Hunter AFB's flightline was the staging area for the deployments. The 2nd Bomb Wing undertook two wing rotations to the United Kingdom in 1951 and 1952. Both the 2nd and 308th Bomb Wings conducted multiple wing rotations to North Africa, particularly to Sidi Slimane, Morocco, after 1952. However, the presence of large U.S. bomber forces often caused political problems for the host countries. Wing rotation deployments ceased by the late 1950s.

A Second Bomb Wing combat crew, 1957

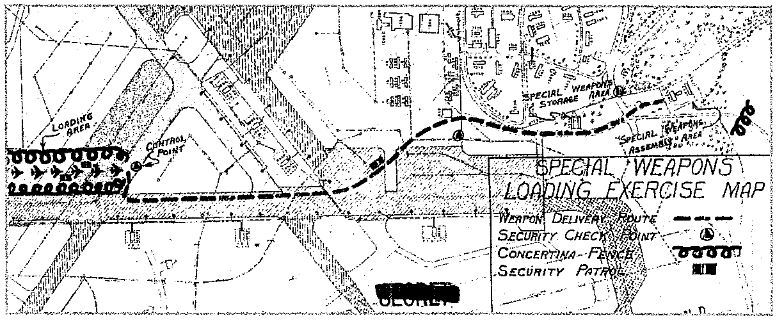
H-Bomb Accidents and Hunter AFB

Hunter AFB was involved in two hydrogen bomb accidents, occurring within a month of each other. In February 1958, a bomber from Homestead AFB collided with a fighter plane, forcing the bomber to jettison the bomb off the coast of Tybee Island and land at Hunter AFB. Then in March 1958, a B-47 of the 308th Bomb Wing inadvertently dropped a hydrogen bomb near Florence, South Carolina, injuring six people and destroying a farmhouse owned by the Gregg family (shown here at their house after the incident). Because of standard SAC safety precautions, neither bomb was armed for a thermonuclear detonation.

The 1950s was a decade of continual evolution of nuclear weapons and delivery technology. By 1953, both the Soviet Union and the United States had developed thermonuclear, or hydrogen bombs, hundreds of times more destructive than atomic bombs. More ominously still, the development of missiles meant that the warning time for an attack would soon be measured not in hours, but in minutes. This dawning realization led to SAC developing both a rapid response for its bomber force (the Alert program) and on-site nuclear and thermonuclear weapon storage on all SAC bomber installations. The latter program was called Bombs on Base (BOB). Fifteen facilities in the current ammunition area were constructed in 1957 as part of BOB.

By 1956, SAC had developed a one-third ground alert concept, which envisioned a third of SAC aircraft on alert and armed, ready to take off within fifteen minutes' warning for retaliatory nuclear strikes. In 1956, SAC headquarters designated Hunter AFB as the first test site for this concept. Under Operation TRY OUT (November 1956–April 1957), Hunter AFB locked the installation down, placed a third of its aircraft in full alert configuration, and continued normal training and maintenance schedules. The next six months were a grueling ordeal for the officers and men at Hunter AFB. One airman of the 2nd Field Maintenance Squadron recalled, "[W]e come on the base, we didn't go off the flightline for...months. I slept on mattresses brought in from the barracks on the hangar deck [of Building 850]. The mess hall brought bag lunches; that's what we ate, and we lived and worked right out of the hangar."

Hunter AFB proved the one-third alert concept feasible, and SAC quickly moved to implement the program after TRY OUT. In the late 1950s and early 1960s, when the U.S. faced the threat of missile attack with only a bomber force, one-third ground alert remained critical to U.S. nuclear deterrence. SAC bombers used variations of this alert concept through the end of the Cold War. In July 1957, SAC also began Reflex operations, which stationed bombers on ground alert in overseas bases, primarily in North Africa and England. Reflex soon replaced wing rotation. By 1958, Hunter AFB began both home station alert and Reflex operations.



Special Weapons Operations at Hunter AFB

"[W]e always towed the Bomb behind a truck and...the trailer was covered with canvas. When we got to the B-47, the crew chief on the B-47 would open up the bomb bay, back the bomb in, in between the engine and the bomb bay, then we would hang the curtains from the bomb bay to the trailer and we'd push the Bomb in.... Now when you loaded your Bomb...then we would set in what was called the Capsule. In those days, the Capsule was the uranium-235 or whatever they put in the atomic weapon, and it set separately in the bomb bay.... [I]t's against the law to fly over the continental United States with a loaded atomic bomb, so [when the aircraft got beyond the three-mile limit] the bombardier...would [crawl] back into the bomb bay, take the Capsule out, go around behind it (there was a little walkway where you'd go around behind the Bomb), [attach] the Capsule, then the Bomb was loaded...."

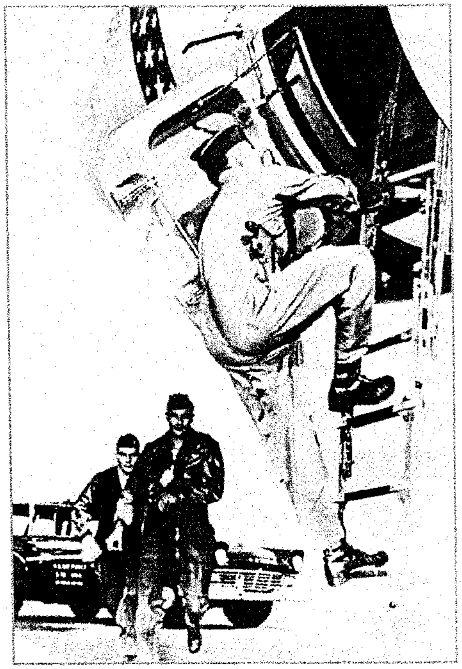
— Joe Kerr, 804th Supply Squadron, Hunter AFB, 1955–1957

In October 1957, the Soviet Union launched Sputnik I—the first man-made orbital satellite—leaping ahead of the U.S. in what came to be known as the "space race." Sputnik proved Soviet intercontinental ballistic missile (ICBM) capability. With the U.S. rockets and missiles still under development, SAC's bomber alert and Reflex program became more important than ever to the country's defense against a Soviet missile attack.

Changing Strategies

In the mid-1950s, SAC began basing bomb wings in the northern tier of the country, closer to the Soviet Union when flying over the Arctic Circle and away from heavily populated areas. By 1955, the first B-52 heavy bombers came online with greater range and payload capacity than the B-47s. The U.S. deployed ICBMs by 1959. The development of ICBMs and the B-52 precluded the need for B-47 bases in the Southeast. Hunter AFB became obsolete.

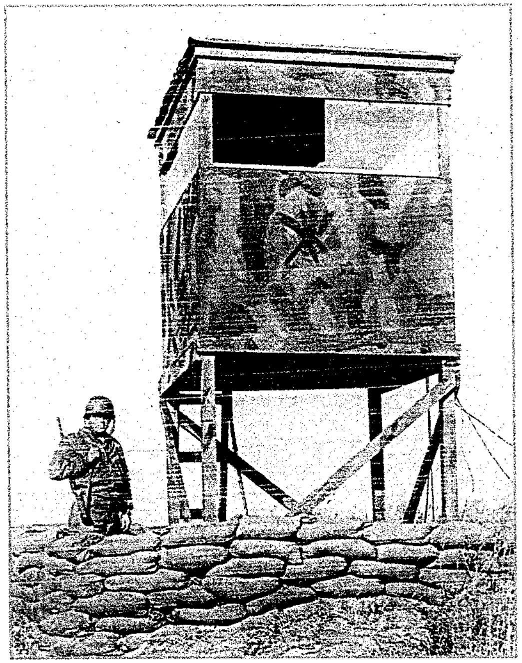
By 1960, SAC had transferred the 308th from Hunter AFB and announced the base's imminent reassignment to Military Air Transport Service (MATS), another Air Force command. Because of the changes in technology and American nuclear strategy, Hunter AFB's days as a SAC installation were definitely numbered.



The SAC Alert Area at Hunter AFB

The area known as Saber Hall was originally a SAC alert area built in 1960 for home station alert operations. Building 8661, known as the "molehole," housed combat crews on alert, ready to run up the ramps to waiting aircraft parked on the Christmas Tree apron. Fully fueled and loaded with nuclear weapons, aircraft parked at the alert area stood ready to take off within fifteen minutes of the alert siren. The photograph at left depicts an alert crew running to a B-47 at an unspecified alert area.

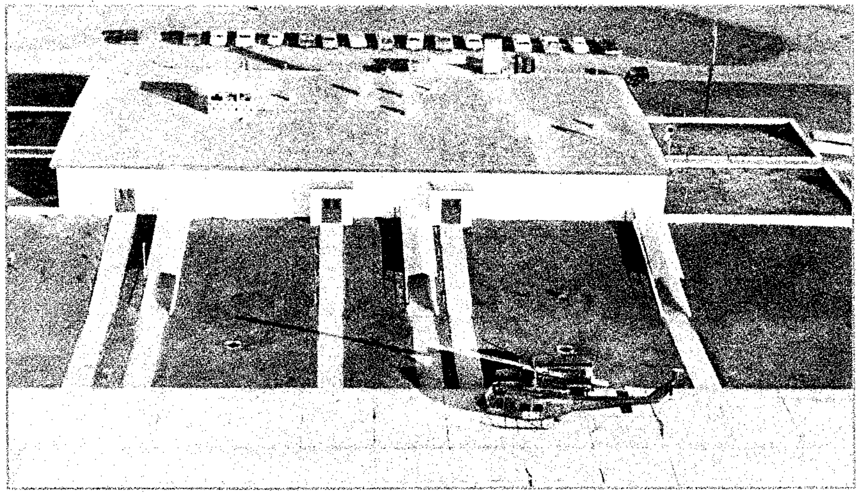
The country elected John F. Kennedy president in 1960. The Soviets tested the youthful Kennedy repeatedly. Two years into his presidency, in October 1962 (just six months before SAC was scheduled to leave Hunter AFB), the Soviets began installing medium-range nuclear missiles in Cuba. The U.S. imposed a naval blockade on missile shipments and demanded the missiles' removal. The world waited nervously and wondered what would happen if the Soviets tried to run the blockade; would a naval incident between the two superpowers start World War III?



Temporary guard tower during the Cuban Missile Crisis, Hunter AFB, October 1962

Hunter AFB's 2nd Bomb Wing, which already had seventeen B-47s on Reflex alert overseas, dispersed thirteen more bombers to Shaw AFB and Charleston AFB in South Carolina. All were in full Emergency War Order configuration, loaded with nuclear weapons and Jet-Assisted Take Off rockets for lift-off. Beginning on October 20, 1962, the installation hosted the B-47s of the entire 306th Bomb Wing based out of MacDill AFB, Florida. On October 22, SAC placed its fleet at DEFCON 3, increasing readiness and alert levels above normal. By October 24, all aircraft at Hunter AFB—sixty B-47 bombers with full nuclear payloads—sat silent on the aircraft parking apron and the Christmas Tree apron at the alert area, waiting for the balloon to drop.

Other SAC bases in the U.S. and overseas were on full alert. Overhead, B-52s flew on airborne alert. Fortunately, the Soviets stepped back from the abyss on October 29, 1962, pulling the missiles from Cuba while Kennedy secretly agreed to withdraw U.S. missiles from Turkey. In this most dramatic Cold War incident of nuclear brinkmanship, the Soviets had blinked.



Saber Hall (the old SAC Alert building) in 1970, then in use as an AH-1 Cobra training facility

Materiel Air Transport Service

Within six months of the end of the Cuban Missile Crisis, all SAC aircraft had left Hunter AFB. In April 1963, SAC transferred Hunter AFB to the 63rd Troop Carrier Wing of MATS (Military Air Transport Service), which stationed sixty C-124 cargo planes and 4,300 men to the installation. By 1964, tenant units had also moved to the base, including the Coast Guard. The 63rd's missions were truly global, supporting humanitarian efforts, the Gemini NASA missions, and such military operations as the 1965 U.S. intervention in the Dominican Republic. Significantly, missions to Vietnam gradually increased as the decade wore on and the U.S. became more deeply involved in that country's affairs. In 1964, a year after MATS arrived, the Department of Defense announced the closing of Hunter AFB. Built as a SAC base, Hunter AFB did not have the facilities to support transport missions.

Vietnam and the Army's Arrival

In the late 1950s and early 1960s, the Army developed troop-carrying transport helicopters, helicopter gunships designed for close air support, and tactical doctrine for airmobile warfare. These innovations paid off when the U.S. became involved in the Vietnam War.

In 1965, U.S. combat troops were sent to bolster a shaky authoritarian regime in South Vietnam fighting against an insurgency sponsored by Communist North Vietnam. The helicopter became the crux of the Army's tactical efforts, essential in jungle terrain for air transport, fire support, medical evacuation, and supply.

The AH-1 Cobra

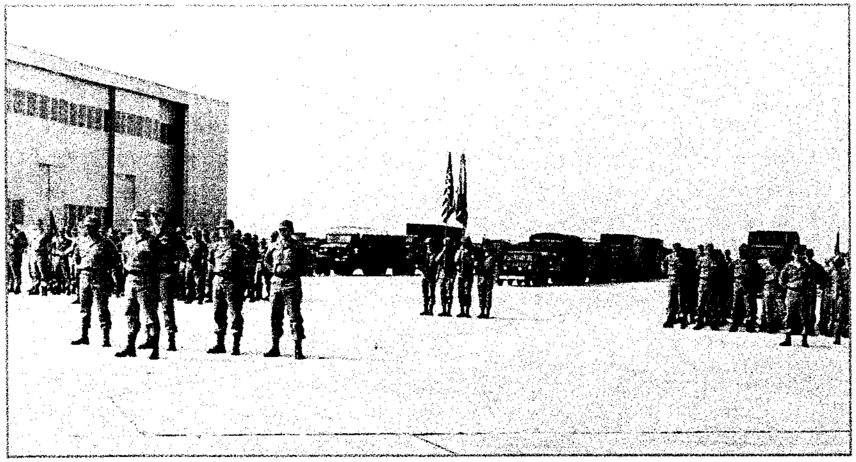
An AH-1 Cobra lands in the Oglethorpe Mall parking lot in 1972. The aircraft entered service in 1967 and saw extensive use in Vietnam. Hunter Army Airfield was the only location in the United States during the Vietnam War where aviators could train on the Cobra. The Army has since phased out the Cobra, but it is still used by the Marine Corps.

The need for more helicopter pilots drove the expansion of the Army's aviation program, which saved Hunter AFB as a military base. In December 1966, the Department of Defense announced that the official new home of the Army's Advanced Flight Training Center (AFTC) would be Hunter Army Airfield (HAAF) and Fort Stewart. The airfield's massive parking apron, built by SAC for jet bombers, offered more than enough space for helicopter training operations.

HAAF became one of the Army's key helicopter training sites during the Vietnam War. Between 1967 and 1972, HAAF and Fort Stewart trained 11,000 rotary wing pilots and 4,328 fixed wing pilots, including 1,400 South Vietnamese aviators. The U.S. withdrew all combat troops from Vietnam in the early 1970s, and, in 1972, the Army closed HAAF. In 1975, North Vietnam conquered South Vietnam, closing an ignominious chapter in American history.

Hunter Army Airfield: 1974 to 2001

The Army reopened HAAF in 1974 and designated it a sub-post of Fort Stewart and a base for the 24th Division's helicopter and support elements. In 1978, the 1st Battalion, 75th Ranger Regiment, moved to HAAF as a tenant unit.



Hunter Army Airfield is reactivated, 1974.

By the late 1970s, HAAF had become the U.S. Army's premier rapid deployment node on the eastern seaboard, thanks in no small part to facilities left behind by the Air Force, including the runway, parking apron, and the old SAC alert area, now known as Saber Hall. Special Forces troops or elements of the 24th Division could deploy as rapidly as possible to nearly anywhere in the world, making it a potent offensive resource during the Cold War. The installation's effectiveness was demonstrated by its use as a rapid deployment center during the 1983 Grenada invasion, when the U.S. squelched a Cuban-sponsored Marxist island state in the Caribbean.

In 1990, the Soviet Union collapsed, relegating Communism to the dustbin of history. For forty years the installation's purpose had been largely geared to the ongoing Cold War. What would the future hold for Hunter Field, and indeed the U.S. military?

In 1990–1991, the 24th Infantry Division participated in Operations Desert Shield and Desert Storm, taking part in the liberation of Kuwait and the destruction of much of Saddam Hussein's Iraqi Army. However, few missions in the 1990s had the clarity of Desert Storm, and the Army conducted multiple open-ended peace-keeping and humanitarian missions in countries as diverse as Haiti, Somalia, and the former Yugoslavia, with mixed results. In the middle of this uncertain decade, in 1996, the 24th Infantry Division was re-flagged the Third Infantry Division, "The Rock of the Marne."

Confronting Global Jihad: 2001 to the Present

After a close and controversial election, George W. Bush was sworn into office as president in January 2001. On September 11 of that year, al-Qaeda terrorists flew three passenger aircraft into the Pentagon and World Trade Center towers, killing 3,000 people. Once again America was at war, although not with a traditional enemy, but an extremist religious movement.

The current protracted guerrilla conflicts in Afghanistan and Iraq—part of the larger War on Terror—have accelerated changes in organization and doctrine and increased the construction tempo on Army bases. Within this context, HAAF continues to be an important Army deployment and support base thanks to existing airfield facilities and its location adjacent to Fort Stewart and the east coast ports of Savannah and Charleston. HAAF's status shows no sign of changing soon, particularly since Army reorganization and withdrawal from Europe means more troops will be stationed on the installation.

Some sixty years ago, the Air Corps developed an airfield that over the years has adapted to the military's changing needs, serving first as a bomber and air transport base for the Air Force, then as an Army helicopter training base, and finally as a rapid deployment node and home for an infantry division's aviation units and various Special Operations, Marine Corps, Coast Guard, and Air Force tenants. Hunter Army Airfield continues to adapt, driven by changing strategic and operational realities of the Global War on Terror. While the war will eventually pass into history, it will not mark the final chapter in this installation's history.

Third Division troops, returning from OIF III deployment in December 2005, walk through the massive doors of Building 850, a historic Strategic Air Command hangar.

Sources

Burr, Jack
  Personal interview, October 11, 2002.

Dick, Ron
  Reach and Power. U.S. Air Force, Washington, DC: 1997.

Hall, R. Cargill
  Case Studies in Strategic Bombardment. U.S. Air Force, Washington, DC: 1998.

Harris, Joseph Butler
  Personal interview, April 17, 2002.

Kerr, Joseph
  Personal interview, April 10, 2002.

Maggioni, Joseph P.
  Hunter Army Airfield: A Developmental History. Fort Stewart: 2005.

  Hunter Army Airfield Flightline Mitigation Report, vol. 1. Fort Stewart: 2005.

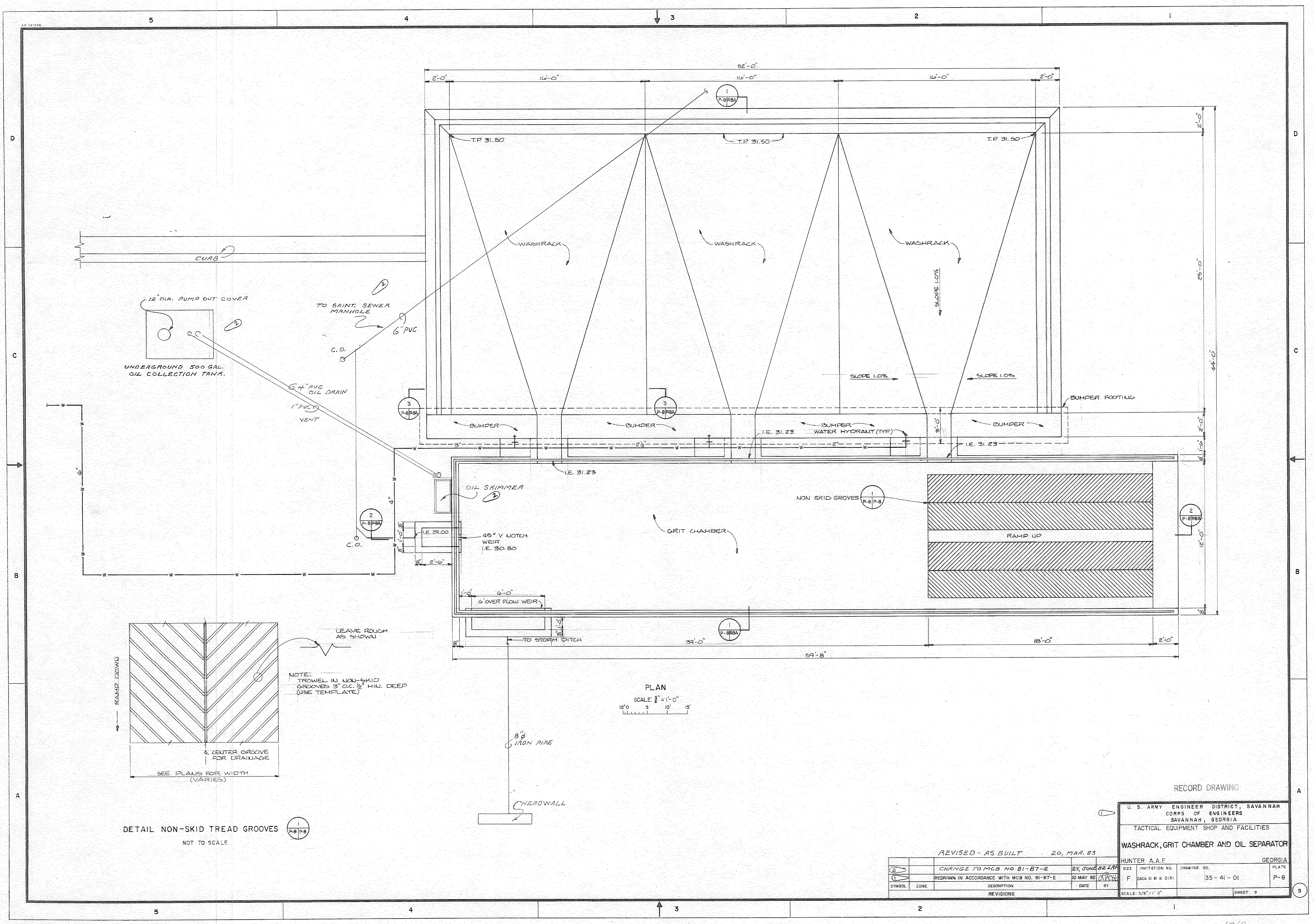
Tapert, Annette (editor)
  Lines of Battle: Letters from American Servicemen, 1941–1945. Pocket Books, New York: 1989.

Weitze, Karen J.
  Cold War Infrastructure for SAC. Corps of Engineers, Fort Worth: 1999.

Illustration Credits

Air Force Historical Research Agency	9, 17, 19
Associated Press/World Wide Photo	7
Bull Street Library (Municipal Airport Vertical File) [Strachan]	2, 4
Dick, Ron (1997)	11, 13
Esquire Magazine, May 2005	16
Georgia Historical Society (Cordray-Foltz Collection) [WPA Hangar]	4
Grashof, Beth	Cover, 6
Hall, R. Cargill (1998)	10
Mighty Eighth Air Force Museum (John Baker Collection) [HAAF Then]	8
Mighty Eighth Air Force Museum (John Baker Collection) [Hardstand 13]	12
Mighty Eighth Air Force Museum (Holly Lantz Collection)	15
National Archives and Records Administration [Bldg. 850 & Pinwheel Barracks]	12
U.S. Army	5, 20–23
U.S. Army (Ft. Stewart/HAAF DPW, Environmental Div.) [HAAF Now]	8
Weitze, Karen J. (Courtesy Geomarine, Inc.)	18

1310 Motor Pool



PLAN

SCALE: 3/8" = 1'-0"

NOTE:
TROWEL IN NON-SKID GROOVES 3" O.C. ½" MIN. DEEP (USE TEMPLATE)

DETAIL NON-SKID TREAD GROOVES

NOT TO SCALE

RECORD DRAWING

REVISED - AS BUILT 20, MAR. 83

SYMBOL	ZONE	DESCRIPTION	DATE	BY
2		CHANGE TO MCB NO. 81-87-E	25, JUNE 82	LAH
1		REDRAWN IN ACCORDANCE WITH MCB NO. 81-87-E	10 MAY 82	RH

REVISIONS

U. S. ARMY ENGINEER DISTRICT, SAVANNAH
CORPS OF ENGINEERS
SAVANNAH, GEORGIA

TACTICAL EQUIPMENT SHOP AND FACILITIES

WASHRACK, GRIT CHAMBER AND OIL SEPARATOR

HUNTER A.A.F. GEORGIA

SIZE	INVITATION NO.	DRAWING NO.	PLATE
F	DACA 21 81 B 0151	35 - 41 - 01	P-8

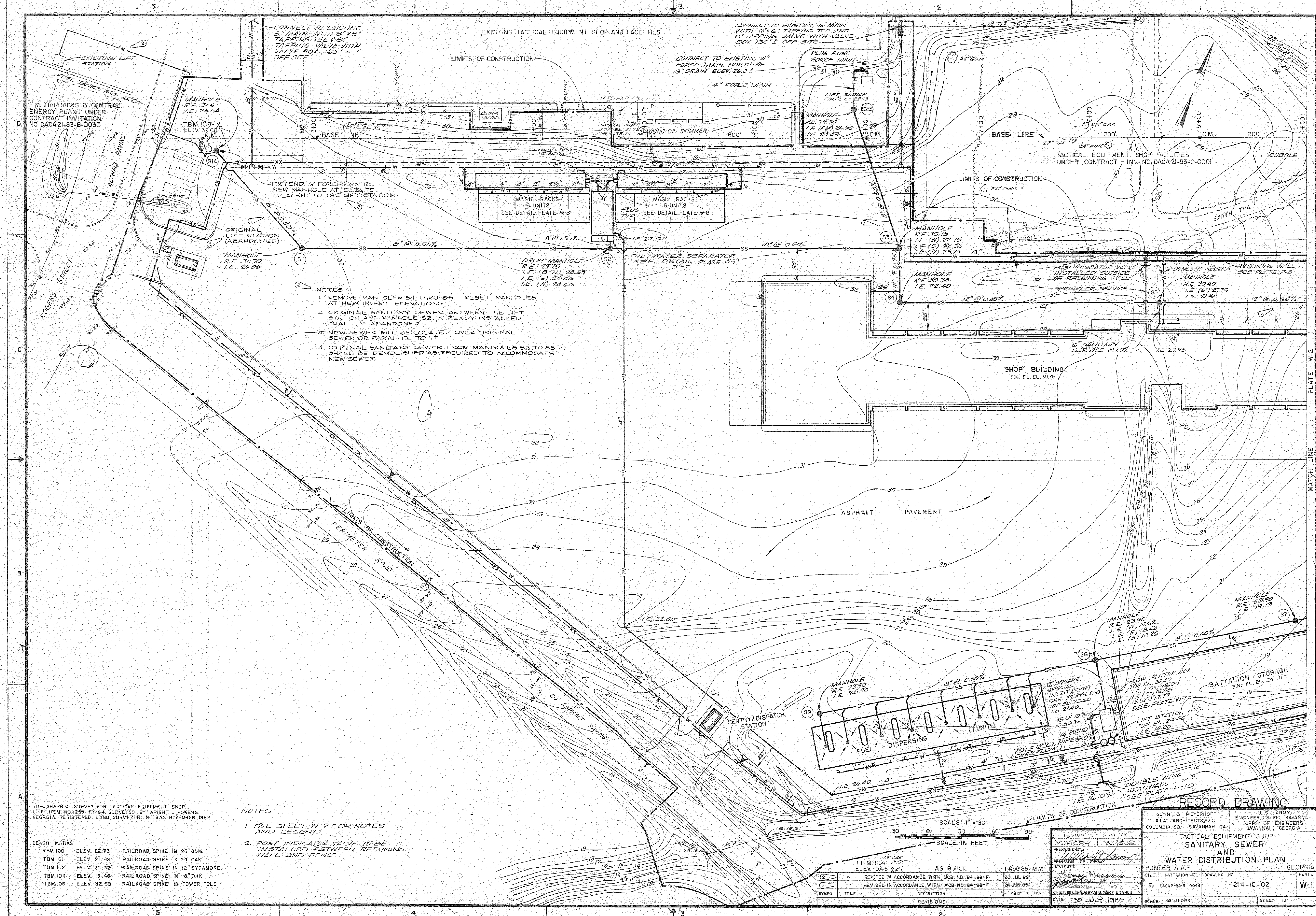
SCALE: 3/8" = 1' 0"
SHEET: 9

9

HARGREAVES 105

1310

Bldg 1336



NOTES

1. REMOVE MANHOLES S-1 THRU S-5. RESET MANHOLES AT NEW INVERT ELEVATIONS
2. ORIGINAL SANITARY SEWER BETWEEN THE LIFT STATION AND MANHOLE S2, ALREADY INSTALLED, SHALL BE ABANDONED.
3. NEW SEWER WILL BE LOCATED OVER ORIGINAL SEWER OR PARALLEL TO IT.
4. ORIGINAL SANITARY SEWER FROM MANHOLES S2 TO S5 SHALL BE DEMOLISHED AS REQUIRED TO ACCOMMODATE NEW SEWER

TOPOGRAPHIC SURVEY FOR TACTICAL EQUIPMENT SHOP
LINE ITEM NO. 255 FY 84. SURVEYED BY WRIGHT C. POWERS
GEORGIA REGISTERED LAND SURVEYOR. NO. 933, NOVEMBER 1982.

BENCH MARKS

TBM 100	ELEV. 22.73	RAILROAD SPIKE IN 26" GUM
TBM 101	ELEV. 21.42	RAILROAD SPIKE IN 24" OAK
TBM 102	ELEV. 20.32	RAILROAD SPIKE IN 12" SYCAMORE
TBM 104	ELEV. 19.46	RAILROAD SPIKE IN 18" OAK
TBM 106	ELEV. 32.68	RAILROAD SPIKE IN POWER POLE

NOTES:

1. SEE SHEET W-2 FOR NOTES AND LEGEND.
2. POST INDICATOR VALVE TO BE INSTALLED BETWEEN RETAINING WALL AND FENCE.

AS BUILT 1 AUG 86 MM

SYMBOL	ZONE	DESCRIPTION	DATE	BY
2	—	REVISED IN ACCORDANCE WITH MCB NO. 84-98-F	23 JUL 85	
1	—	REVISED IN ACCORDANCE WITH MCB NO. 84-98-F	24 JUN 85	

REVISIONS

RECORD DRAWING

DESIGN: MINCEY
CHECK: WHBJR
PREPARED BY:
PRINCIPAL OF FIRM
REVIEWED
Thomas Magomeni
PROJECT MANAGER
RCMD
CHIEF, MIL. PROGRAM & MGMT. BRANCH
DATE: 30 JULY 1984

GUNN & MEYERHOFF
A.I.A. ARCHITECTS P.C.
COLUMBIA SQ. SAVANNAH, GA.

U. S. ARMY
ENGINEER DISTRICT, SAVANNAH
CORPS OF ENGINEERS
SAVANNAH, GEORGIA

TACTICAL EQUIPMENT SHOP
SANITARY SEWER
AND
WATER DISTRIBUTION PLAN
HUNTER A.A.F. GEORGIA

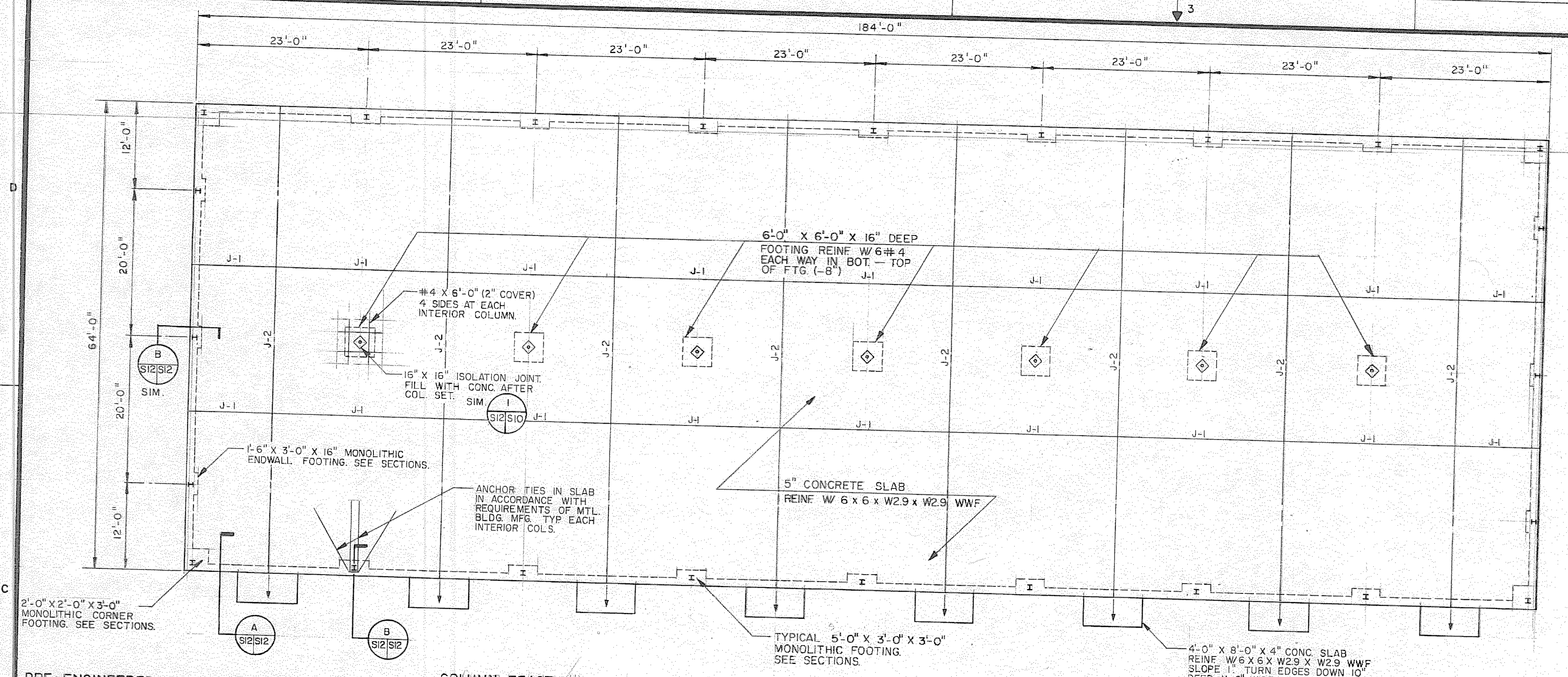
SIZE: F
INVITATION NO.: DACA21-84-B-0044
DRAWING NO.: 214-10-02
PLATE: W-1
SCALE: AS SHOWN
SHEET 13

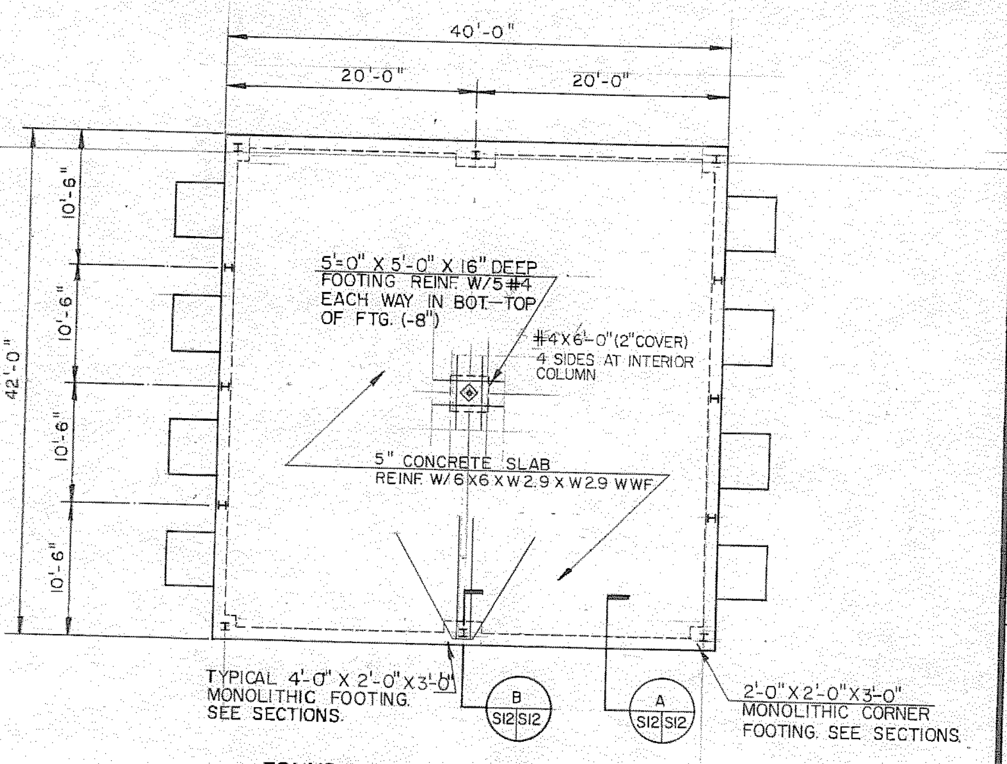
⑬

FORMAT 6

Fuel Dispensing was remved

POL Storage Yard Bldg 1345 + 1346





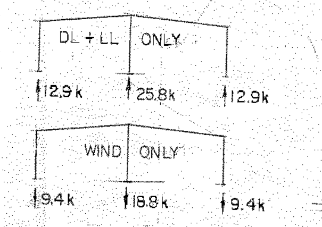
FOUNDATION PLAN-OIL HOUSE

SCALE: 1/8"=1'-0"

PRE-ENGINEERED METAL BUILDING

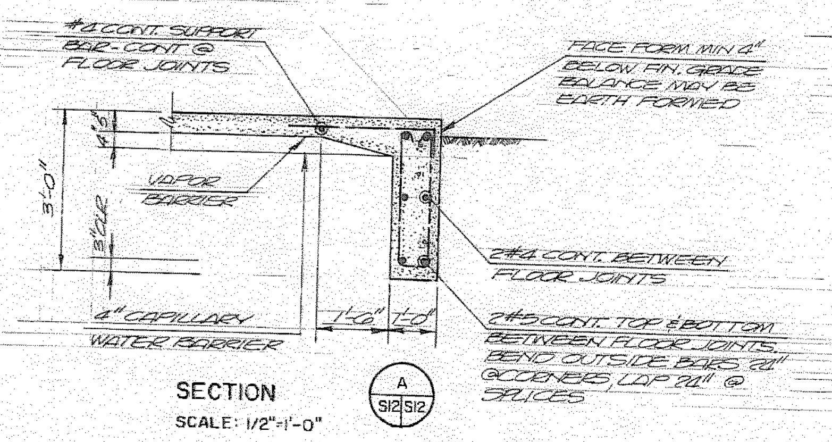
1. LOADING REQUIREMENTS AS PER ANSI A 58.1-1982
   - (a) LOADS:
     - (1) LIVE LOAD: ROOF: 20 PSF
     - (2) DEAD LOAD: BLDG. COMPONENTS + 5 PSF
     - (3) WIND LOAD: 110 MPH
   - (b) WIND BRACING: FRAME BRACING & ANCHORAGE SHALL BE CAPABLE OF RESISTING WIND LOADS DEVELOPED BY 110 MPH WIND VELOCITY IN ACCORDANCE WITH PROVISIONS OF ANSI A 58.1-1982.
2. GENERAL:
   - (a) BATTALION STORAGE BUILDINGS AND OIL STORAGE SHALL BE PRE-ENGINEERED STRUCTURES AS SPECIFIED IN SECTION "METAL BUILDING." EACH BUILDING SHALL BE A MANUFACTURER'S STANDARD PREFABRICATED METAL STRUCTURE OF THE APPROXIMATE INSIDE AREA SHOWN, EXCEPT AS NOTED. RIGID FRAMES SHALL BE SPACED AS SHOWN, BUT OVERALL DIMENSIONS AND CONSTRUCTION DETAILS MAY VARY TO SUIT MANUFACTURER'S STANDARD DESIGN.
   - (b) BUILDINGS SHALL BE DESIGNED AND FABRICATED ACCORDING TO AISC AND AISI LATEST SPECIFICATIONS. THE DIMENSIONAL TOLERANCES OUTLINED IN THE AWS CODE UNDER WORKMANSHIP AND THE TOLERANCES APPLICABLE TO ROLL FORM STELL UNDER THE AISC "STANDARD MILL PRACTICE" SECTION SHALL BE REQUIRED IN THE FABRICATION OF THE STEEL BUILDING FRAMES.
   - (c) A COMPLETE DESIGN ANALYSIS SHOWING ALL CALCULATIONS FOR THE RIGID FRAMES, GIRTS, & PURLINS AND A LAYOUT OF ANCHOR BOLTS AND OTHER EMBEDDED ITEMS SHALL BE SHALL BE SUBMITTED FOR APPROVAL WITH THE SHOP DRAWINGS. SHOP DRAWINGS SHALL INCLUDE DETAILS OF ALL MAIN MEMBERS, TYPICAL CONNECTIONS (SHOWING BOLT HOLES AND WELDS), AND ERECTION DRAWINGS.
   - (d) THE BUILDING SHALL BE DESIGNED TO SUPPORT ALL MECHANICAL EQUIPMENT INCLUDING HEATERS, SPRINKLERS, EXHAUST SYSTEMS AND ALL OTHER SUCH DEVICES. ADDITIONAL GIRTS OR PURLINS SHALL BE PLACED IN CONVENIENT LOCATIONS FOR ATTACHMENT OF ALL MECHANICAL EQUIPMENT.
   - (e) LOADING AND LOAD COMBINATIONS SHALL BE IN ACCORDANCE WITH THE MBMA "METAL BUILDINGS SYSTEMS MANUAL", LATEST EDITION.
   - (f) CROSS BRACING SHALL BE USED TO TAKE LATERAL LOADS.
   - (g) THE FOUNDATIONS SHOWN ARE ESTIMATES FOR THE BUILDING TYPE SHOWN ON THE DRAWINGS AND ARE TO BE USED AS A GUIDE FOR THE BUILDING SUPPLIED. THE CONTRACTOR SHALL DESIGN THE FOUNDATIONS FOR THE LOADS SHOWN AND THE BUILDING SUPPLIED.
   - (h) THE CONTRACTOR SHALL USE IN HIS DESIGN THE BASIC CRITERIA SHOWN BY THIS DRAWING, SUCH AS SLAB THICKNESS, CONTROLL JOINTS, CAPILLARY WATER BARRIER, VAPOR BARRIER, DESIGN LOADS AND MINIMUM DEPTH OF FOOTING.
   - (i) FOOTINGS SHALL BE SIZED FOR AN ALLOWABLE SOIL BEARING VALUE 2000 PSF. THIS VALUE IS BASED ON A MINIMUM FOOTING WIDTH OF 2 FEET AND A MINIMUM DEPTH OF 3 FEET TO THE BASE OF THE FOOTING MEASURED FROM FINISH FLOOR OR FINISH GRADE ELEVATION WHICHEVER IS LOWER.
   - (j) FOUNDATION DESIGN SHALL BE PERFORMED BY A REGISTERED PROFESSIONAL ENGINEER AND SHALL BE SUBMITTED FOR APPROVAL AS PART OF THE SHOP DRAWINGS.

COLUMN REACTIONS



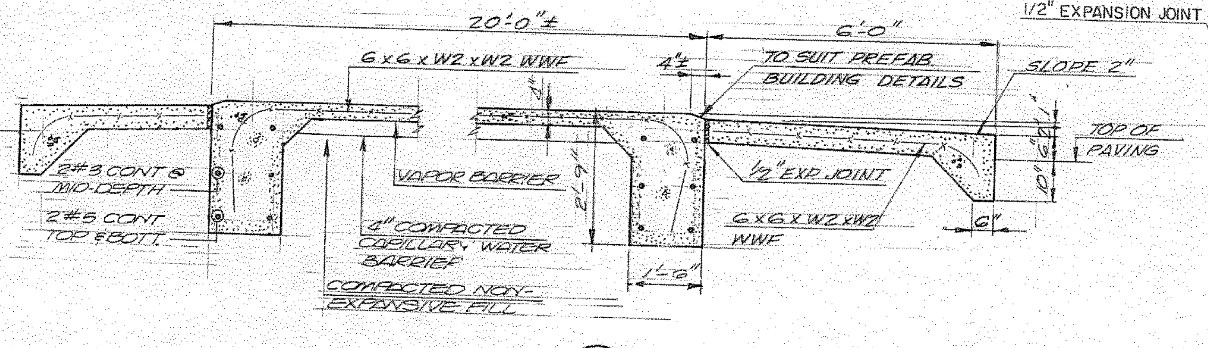
FLOOR PLAN- BATTALION STORAGE

SCALE: 1/8"=1'-0"



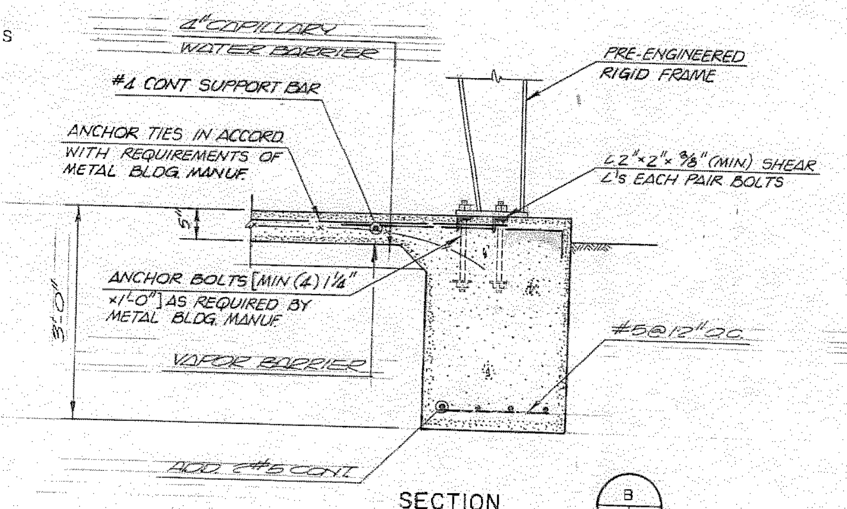
SECTION A S12 S12

SCALE: 1/2"=1'-0"



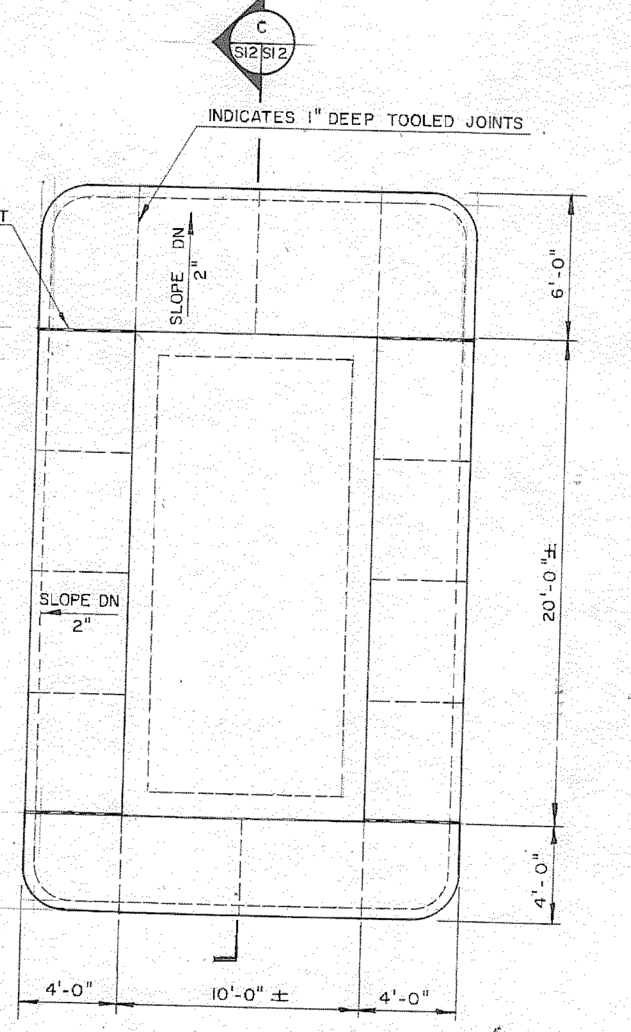
SECTION C S12 S12

SCALE: 1/2"=1'-0"



SECTION B S12 S12

SCALE: 3/4"=1'-0"



NOTE: ACTUAL BUILDING SLAB DIMENSIONS TO SUIT MANUFACTURER

CONTROL HOUSE/SENTRY STATION FOOTING/SLAB PLAN

SCALE: 1/4"=1'-0"

SCALE: 1/2"=1'-0"
12" 0 1' 2' 3' 4'

SCALE: 1/4"=1'-0"
12" 0 5' 10'

SCALE: 1/8"=1'-0"
12" 0 5' 10' 15'

RECORD DRAWING

SYMBOL	ZONE	DESCRIPTION	DATE	BY
		AS BUILT	1 AUG 86	M M

REVISIONS

GUNN & MEYERHOFF
A.I.A. ARCHITECTS P.C.
COLUMBIA SQ. SAVANNAH, GA.

U. S. ARMY
ENGINEER DISTRICT, SAVANNAH
CORPS OF ENGINEERS
SAVANNAH, GEORGIA

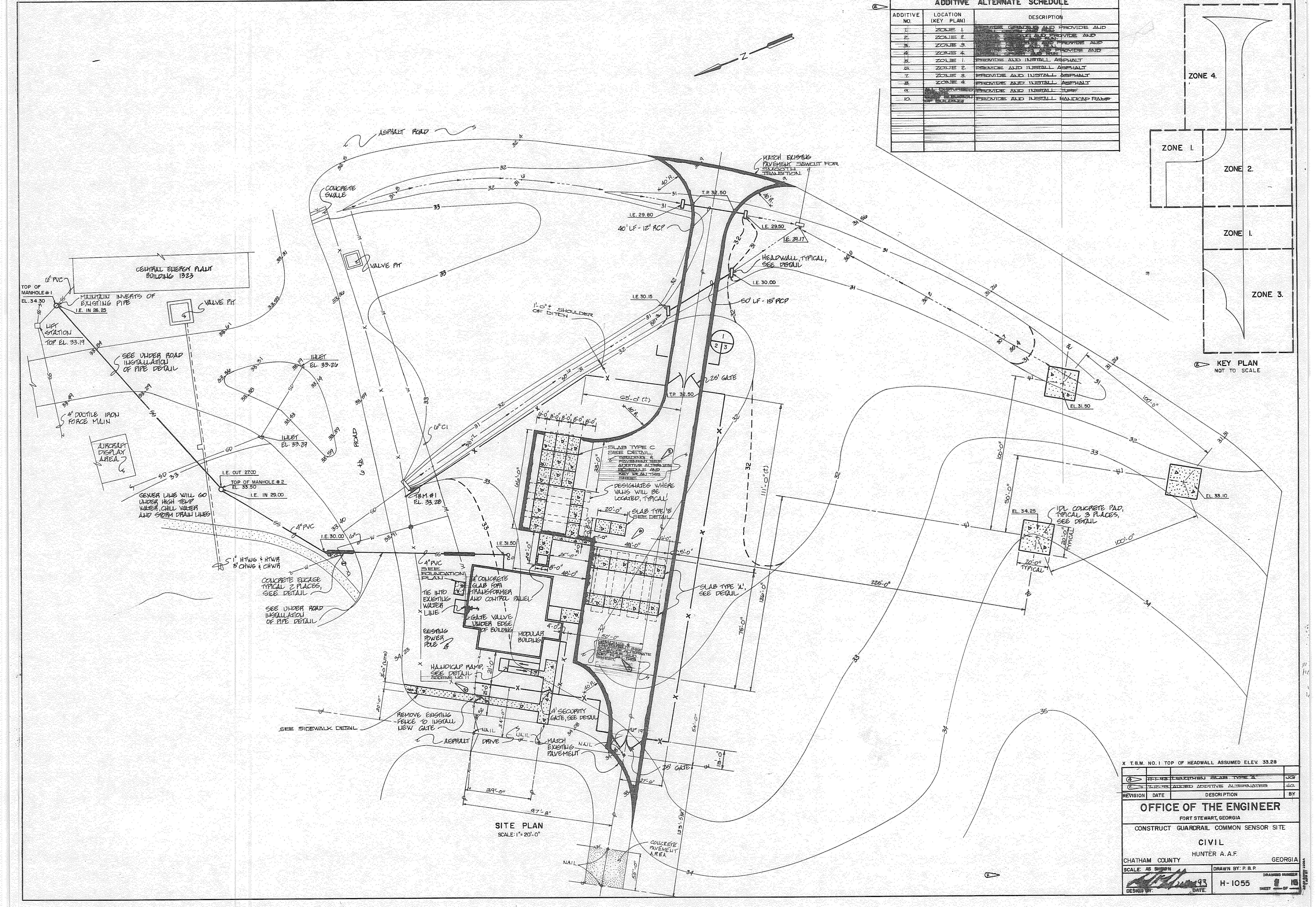
TACTICAL EQUIPMENT SHOP
BATTALION STORAGE AND OIL HOUSE
FOUNDATION PLAN

HUNTER A.A.F. GEORGIA

SIZE	INVITATION NO.	FILE NO.	PLATE
F	DACA21-84-B-0044	214-10-02	S-12

SCALE: AS SHOWN
SHEET 52

Bldg 1354 High Security



ADDITIVE ALTERNATE SCHEDULE

ADDITIVE NO.	LOCATION (KEY PLAN)	DESCRIPTION
1.	ZONE 1.	PROVIDE GRADING AND PROVIDE AND INSTALL CRUSH AND RUN.
2.	ZONE 2.	PROVIDE GRADING AND PROVIDE AND INSTALL CRUSH AND RUN.
3.	ZONE 3.	PROVIDE GRADING AND PROVIDE AND INSTALL CRUSH AND RUN.
4.	ZONE 4.	PROVIDE GRADING AND PROVIDE AND INSTALL CRUSH AND RUN.
5.	ZONE 1.	PROVIDE AND INSTALL ASPHALT
6.	ZONE 2.	PROVIDE AND INSTALL ASPHALT
7.	ZONE 3.	PROVIDE AND INSTALL ASPHALT
8.	ZONE 4	PROVIDE AND INSTALL ASPHALT
9.	ALL DISTURBED GRADE	PROVIDE AND INSTALL TURF
10.	WEST ELEVATION OF BUILDING	PROVIDE AND INSTALL HANDICAP RAMP

X T.B.M. NO. 1 TOP OF HEADWALL ASSUMED ELEV. 33.28

REVISION	DATE	DESCRIPTION	BY
4	11-1-93	LENGTHEN SLAB TYPE A	JG
2	7-12-93	ADDED ADDITIVE ALTERNATES	J.G.

OFFICE OF THE ENGINEER

FORT STEWART, GEORGIA

CONSTRUCT GUARDRAIL COMMON SENSOR SITE

CIVIL

HUNTER A.A.F.

CHATHAM COUNTY GEORGIA

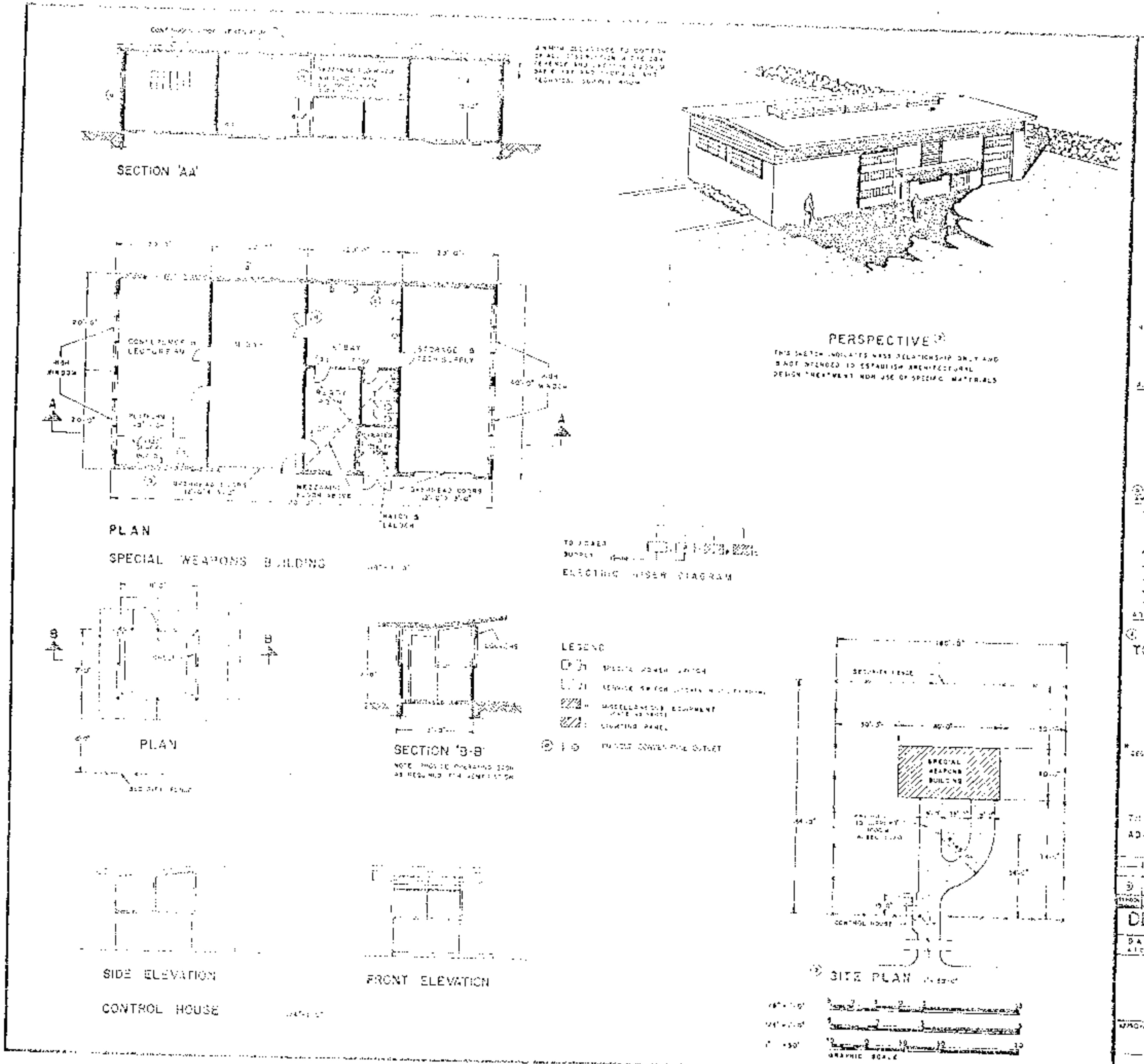
SCALE: AS SHOWN

DRAWN BY: P.B.P.

DESIGN BY: DATE: 93

DRAWING NUMBER H-1055

SHEET 8 OF 16



PROGRAMMING AND MASTER PLANNING GUIDES

UTILITY REQUIREMENTS

HEATING REQUIREMENTS

AIR CONDITIONING REQUIREMENTS

AREA ANALYSIS - SQ. FT.

④

TOTAL GROSS AREA **3,770 S.F.** *

GROSS AREA INCLUDES

SPECIAL WEAPONS BLDG. 3,714 S.F.*

CONTROL HOUSE 56 S.F.

HAA-124

THIS DRAWING SUPERSEDES DEFINITIVE DRAWING NO. AD-28-16-18, DATED 10 MAY 1954

DEPARTMENT OF THE AIR FORCE

DANIEL, MANN, JOHNSON & MENDENHALL

SPECIAL WEAPONS TRAINING FACILITY
(TECHNICAL)

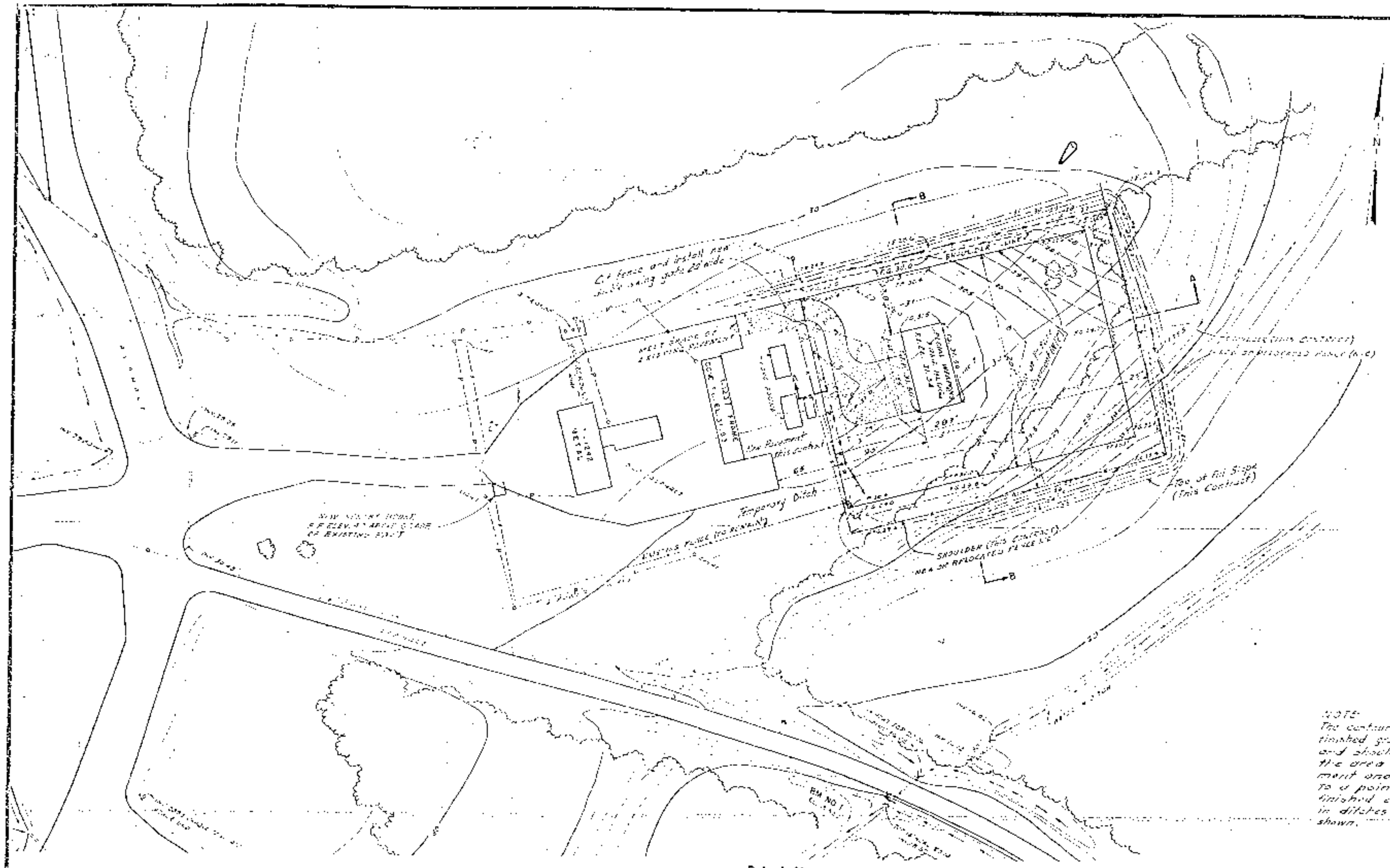
PLANS, ELEVATIONS AND SECTIONS

AD 28-16-18 R1

SHEET 1 OF 2

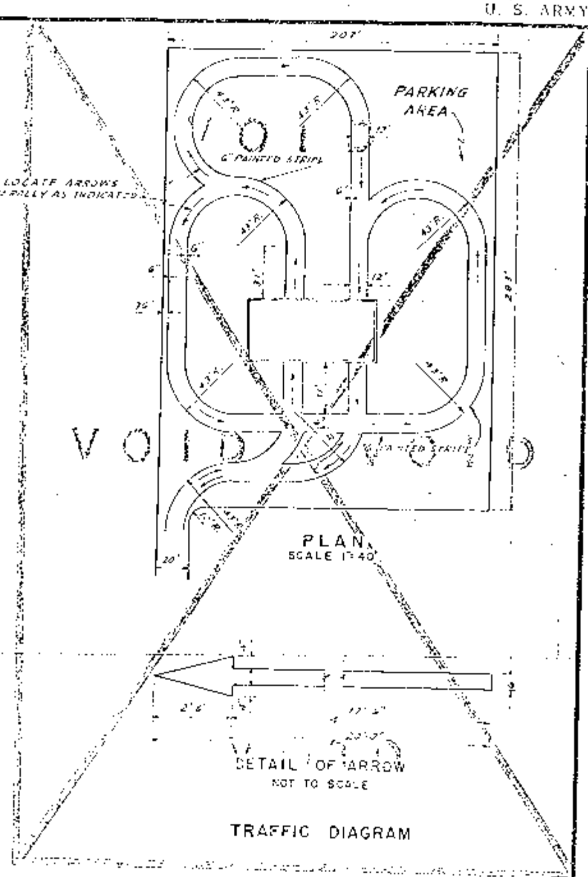
CORPS OF ENGINEERS

U. S. ARMY

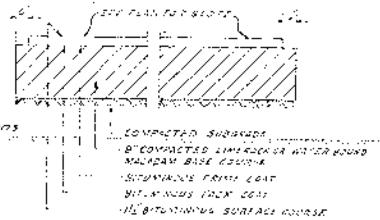


PLAN
SCALE: 1" = 50'

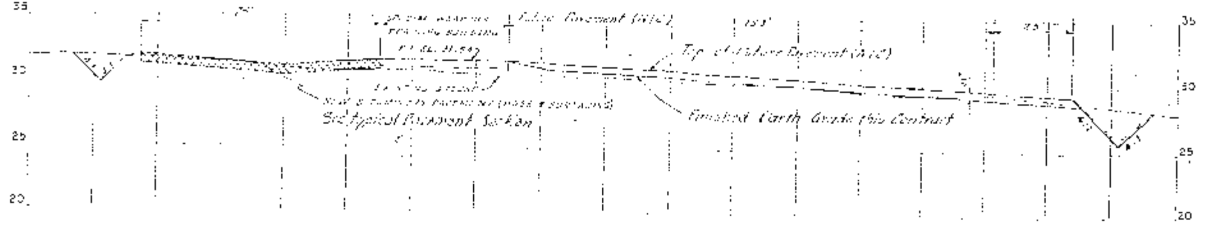
NOTE:
The contours shown on plan above are finished grade elevations for future pavement and shoulders. Under this contract, the area comprising the future pavement and shoulders shall be graded to a point 8" below the indicated finished contours. The invert elevations in ditches shall conform to the elevations shown.



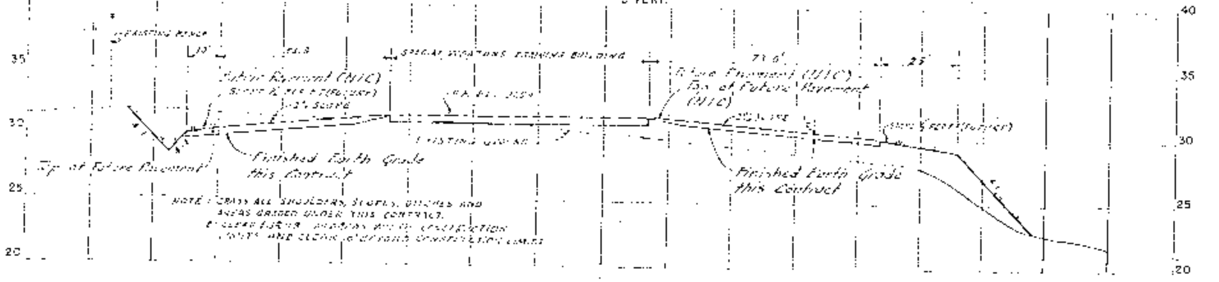
TRAFFIC DIAGRAM



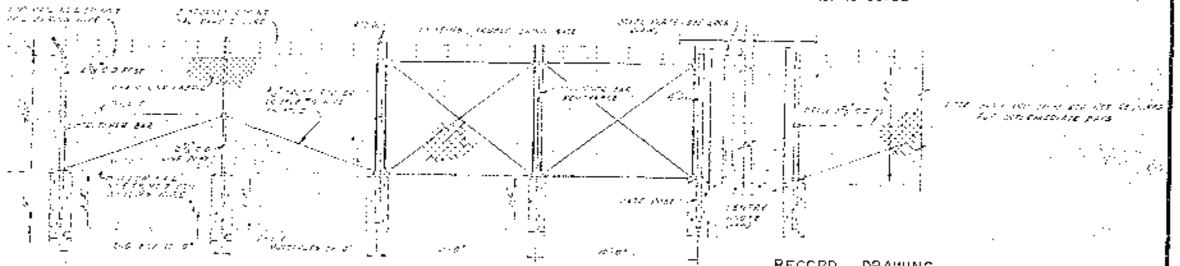
TYPICAL PAVEMENT SECTION
NOT TO SCALE



SECTION A-A
SCALE: 1" = 20' HOR, 5' VERT.



SECTION B-B
SCALE: 1" = 20' HOR, 5' VERT.



CHAIN LINK FENCE DETAILS
SCALE: ¼" = 1'-0"

NOTE:
New double gate shall conform to the details shown for the existing gate and shall also conform to the applicable specifications.

RECORD DRAWING

HAN-125

1-9-57 REVISED "AS BUILT" CUW

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER
SAVANNAH, GEORGIA

H. A. R.
E. C. K.

SPECIAL WEAPONS TRAINING BUILDING
GRADING, PAVING, DRAINAGE, &
FENCE DETAIL
HUNTER A. F. B.
SAVANNAH GEORGIA

AS SHOWN
28-13-01
2 14
G-2
24 AUGUST 1955

BROWN-143

RD 1239

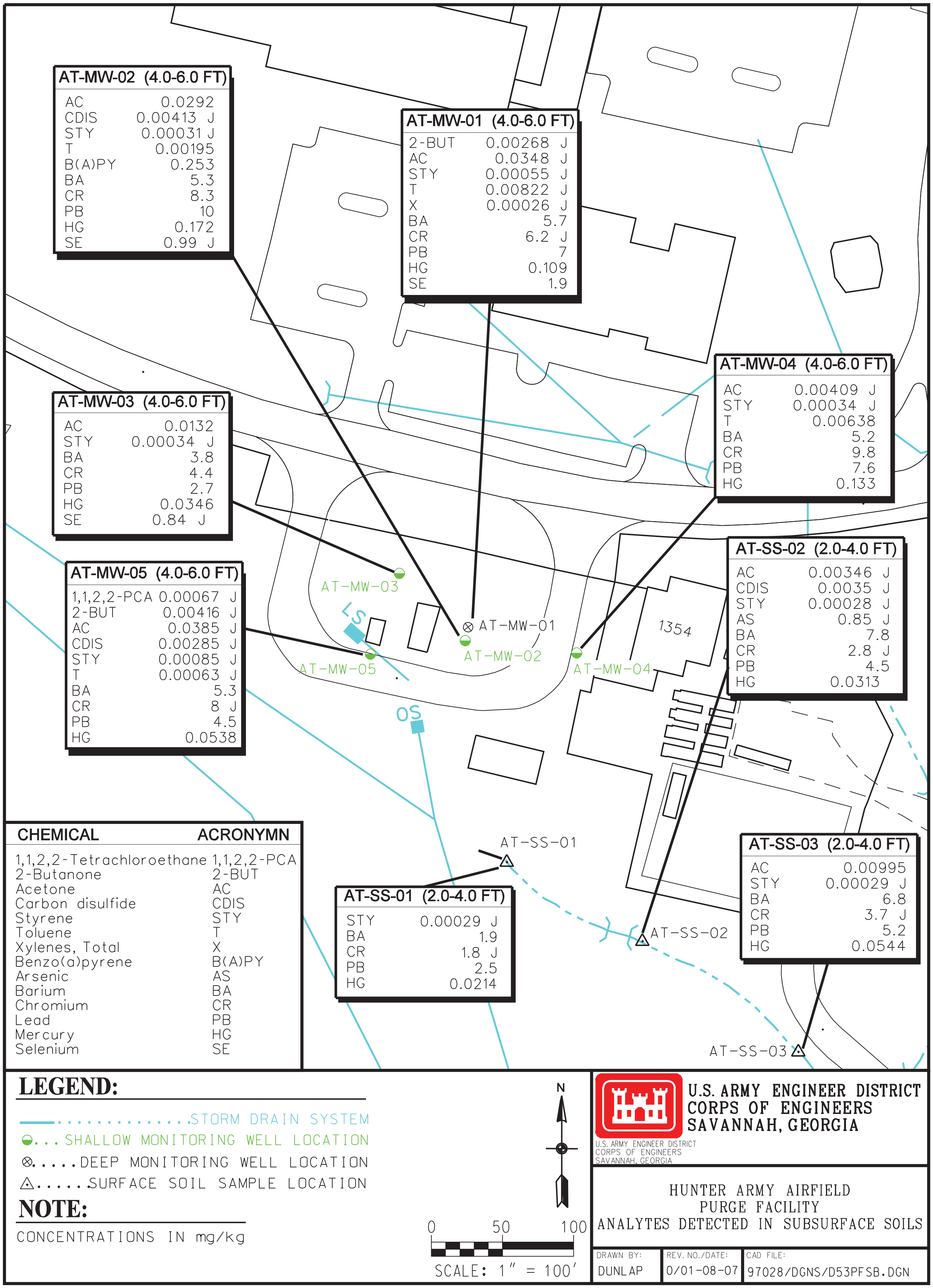


Figure 3-2. Analytes Detected in Subsurface Soil at the Hunter Army Airfield Purge Facility

AF-01
AF0111 (4.1-6.1 FT)

B	0.00083J
TPHG	0.219

AF-02
AF0211 (4.0-8.0 FT)

B	0.0129
T	0.0007J
TPHD	8.3
TPHG	1.32

AF-03
AF0311 (6.0-7.0 FT)

B	0.0022
TPHG	0.735

AF-04
AF0411 (5.5-7.0 FT)

B	0.0038J
T	0.001J
TPHD	2.9
TPHG	0.938

AF-05
AF0511 (2.0-4.0 FT)

B	0.0012J
T	0.0074J
X	0.933J
B(B)F	0.082J
FL	0.118J
N	0.408
PH	0.045J
TPHD	1050
TPHG	1130

AF-06
AF0611 (2.0-4.0 FT)

B	0.0013J
TPHD	1.6
TPHG	1.1

AF-07
AF0711 (2.0-4.0 FT)

B	0.069
T	0.0008J
E	0.0539
X	0.0526
N	0.489J
TPHD	1610J
TPHG	4030

AF-08
AF0811 (2.0-4.0 FT)

B	0.00072J
TPHG	0.223

AF-09
AF0911 (2.0-4.0 FT)

B	0.0859J
E	2.13
AN	1.1J
B(B)F	0.0833J
B(K)F	0.0761J
C	0.312J
N	17.1
PY	2.29
TPHD	13100J
TPHG	1270

AF-10
AF1011 (2.0-4.0 FT)

B(A)A	0.278J
B(A)P	0.242J
B(B)F	0.264J
B(G,H,I)P	0.157J
B(K)F	0.274J
C	0.292J
F	0.467J
I(1,2,3-CD)P	0.138J
PY	0.438J
TPHD	1.8J
TPHG	0.281

AF-11
AF1111 (4.0-5.5 FT)

T	0.002J
FL	0.135J
N	0.449
PH	0.052J
TPHG	0.637

AF-12
AF1211 (2.0-4.0 FT)

B	0.0012J
E	0.0274
X	0.0018J
AN	17.6J
B(A)A	0.164J
B(A)P	0.113J
B(B)F	0.0729J
C	0.257J
F	0.385J
N	9.6
PY	1.82
TPHD	6420J
TPHG	1320

AF-13
AF1311 (2.0-4.0 FT)

T	0.0013J
E	0.0025
X	0.0014J
B(A)P	0.0382J
TPHD	17.8J
TPHG	1.05

AF-14
AF1411 (4.0-4.8 FT)

T	0.0007J
E	0.0049
TPHD	14.4

AF-15
AF1511 (4.0-5.1 FT)

TPHD	2.8

AF-16
AF1611 (4.0-5.4 FT)

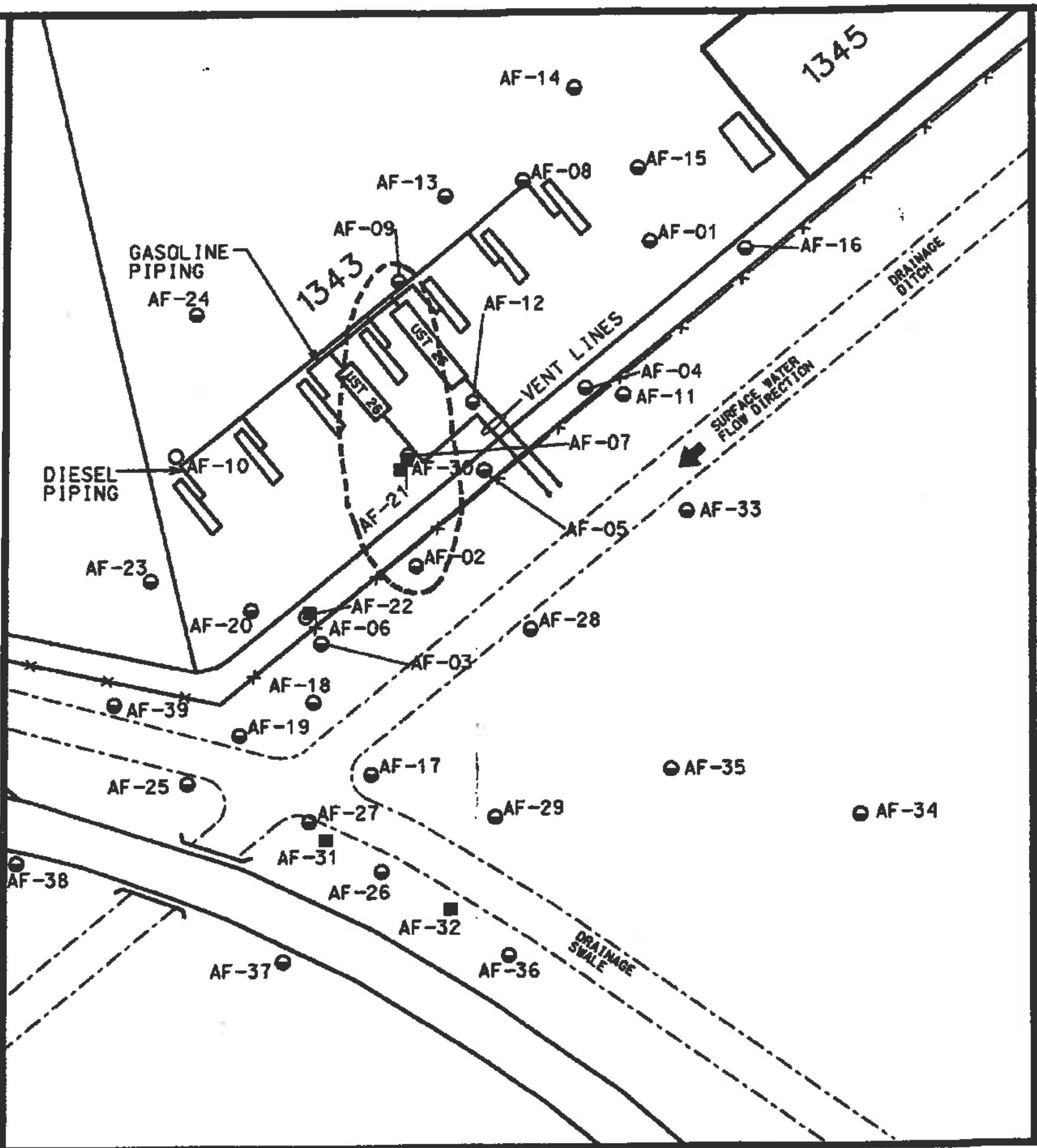
NO DETECTS

AF-17
AF1711 (4.0-6.0 FT)

B	0.0036

AF-18
AF1811 (2.0-4.0 FT)

TPHD	0.84
TPHG	5.14



AF-19
AF1911 (2.0-4.0 FT)

B(A)A	0.112J
B(A)P	0.0842J
B(B)F	0.0891J
B(G,H,I)P	0.0414J
B(K)F	0.0526J
C	0.118J
F	0.19J
I(1,2,3-CD)P	0.153J
TPHG	0.274

AF-20
AF2011 (6.0-7.0 FT)

B	0.0065
T	0.0033
E	0.021
TPHD	2
TPHG	0.188

AF-23
AF2311 (4.0-5.0 FT)

TPHD	5.6
TPHG	0.132

AF-24
AF2411 (2.0-3.0 FT)

T	0.00068J
B(A)A	0.156J
B(A)P	0.159J
B(B)F	0.137J
B(G,H,I)P	0.129J
B(K)F	0.15J
C	0.184J
F	0.115J
I(1,2,3-CD)P	0.496J
TPHD	21.5

AF-25
AF2511 (0.0-0.8FT)

T	0.0015J
TPHD	3.4

AF-26
AF2611 (6.0-7.4 FT)

B	0.0078

AF-27
AF2711 (2.0-4.0 FT)

NO DETECTS

AF-28
AF2811 (4.0-4.9 FT)

TPHD	2

AF-29
AF2911 (0.0-2.4 FT)

TPHD	2.5
TPHG	0.218J

LEGEND

⊖	CAP PART B MONITORING WELL
■	CAP PART B VERTICAL PROFILE
○	CAP PART B SOIL BORING
◌	ESTIMATED AREA OF SOIL CONTAMINATION ABOVE STLs

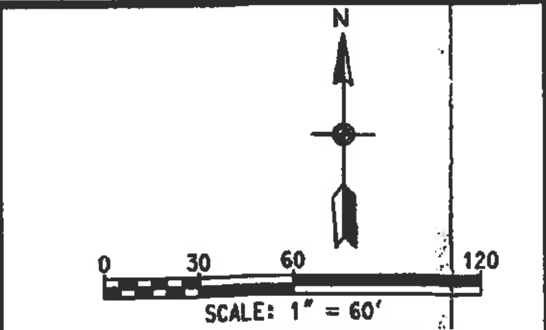
B	BENZENE
T	TOLUENE
E	ETHYLBENZENE
X	XYLENES, TOTAL
AN	ANTHRACENE
B(A)A	BENZO(A) ANTHRACENE
B(A)P	BENZO(A) PYRENE
B(B)F	BENZO(B) FLUORANTHENE
B(G,H,I)P	BENZO(G, H, I) PERYLENE
B(K)F	BENZO(K) FLUORANTHENE
C	CHRYSENE
F	FLUORANTHENE
FL	FLUORENE
I(1,2,3-CD)P	INDENO(1,2,3-CD) PYRENE
N	NAPHTHALENE
PH	PHENANTHRENE
PY	PYRENE
TPHD	TPH-DIESEL RANGE ORGANICS
TPHG	TPH-GASOLINE RANGE ORGANICS

NOTE:
SEE SITE LOCATION PLAN FOR LOCATION OF UTILITIES

CONCENTRATIONS IN mg/kg

THRESHOLD LEVELS

B - 0.008 mg/kg
T - 6.0 mg/kg
E - 10.0 mg/kg
X - 700 mg/kg



U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
SAVANNAH, GEORGIA

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
SAVANNAH, GEORGIA

USTs 25 & 26, BUILDING 1343
FACILITY ID: 9-025008
CAP-PART B
SOIL ANALYTICAL RESULTS

DRAWN BY:	REV. NO./DATE:	CAD FILE:
J. LAMB	0/01/14/00	97028/DGNS/F785008BB.DGN

Figure 4a. CAP-Part B Soil Sampling Analytical Results at the USTs 25 & 26 Site, Facility ID #9-025008

Table O-1.
Vapor Intrusion Evaluation
HAA-17 Site Building Construction
Hunter Army Airfield, Savannah, Georgia

Building	Foundation Type	**Notes**	
1336	Slab	vapor barrier with 4" capillary barrier (S-9 Sheet 49).	Pipe Sleeve Installations -seal between pipe sleeve and conduit with waterproof caulking material (M17 Sheet 70). Joint Sealant - hot applied jet fuel resistant type. Grout fill all C.M.U. cells below Bond beam (S-9 Sheet 49).
1345	Slab	vapor barrier with 4" compacted capillary barrier (S-12 Sheet 52).	
1354	Slab		
1355	Trailer with footing, elevated floor, and ground anchors	Floor is elevated on piers	

CITY:(KNOXVILLE) DIV/GROUP:(ENV) DB:(B.ALTOM) PIC:(T.TALELE) PM:(C.BERTZ) APM:(S.BOSTIAN)
PROJECT: GP08HAFS.H17C.DPCSR PATH: G:\GIS\HAAF\MapDocs\H17\2012\CSR R1\FO-1 H17_CSR1 BLDGS UST25_26.mxd - 1/24/2012 @ 2:02:32 PM

PROJECTION: NAD83 State Plane Georgia East
REFERENCE: SAGIS (2008).

LEGEND

- Storm Water Drainage Canal
- 1345 Building Number

0 120 240
SCALE IN FEET

HUNTER ARMY AIRFIELD, GEORGIA

HAA-17 COMPLIANCE STATUS REPORT, REVISION 1

Building Location Map
UST 25 and 26 Area

ARCADIS

FIGURE
O-1

PROJECTION: NAD83 State Plane Georgia East
REFERENCE: SAGIS (2008).

LEGEND

▬ ···	Storm Water Drainage Canal
1354	Building Number

0 120 240
SCALE IN FEET

HUNTER ARMY AIRFIELD, GEORGIA
HAA-17 COMPLIANCE STATUS REPORT, REVISION 1

Building Location Map
Purge Facility

ARCADIS

FIGURE
O-2