

Appendix G
Well Logs



Purge Well PW-5R - Installation Report

Purge well PW-5R was installed to replace purge well PW-5. A work plan for the installation was submitted to the Michigan Department of Environmental Quality (MDEQ) by Engineering & Environmental Solutions on August 30, 2012. The purge well was installed on September 4, 2012.

The purge that was replaced (PW-5) was one of three groundwater purge wells (PW-5, PW-6, and PW-7) installed in April 1997. The purge wells were located immediately downgradient from the landfill and were installed to replace older purge wells located at the perimeter of the site. In August 2003, purge well PW-5 was turned on and began pumping groundwater at approximately 15 to 25 gallons per minute (gpm). Results of a purge system performance sampling program conducted in 2003 showed decreasing VOC trends at purge well PW-5. The decreasing trends were based on an evaluation of chlorinated VOCs. With MDEQ approval, purge well PW-5 was “turned-off” in June 2004. The remediation system remained running using purge wells PW-6 and PW-7. Additional VOCs were added to the site's monitoring program in 2007 and these additional VOCs were later confirmed in the vicinity of purge well PW-5.

Central Sanitary Landfill proactively implement upgrades to the remediation system as proposed under a October 2011 draft RAP. The updated groundwater model in the RAP showed that the new purge well (PW-5R) will improve groundwater capture for the site's remedial action. Purge well PW-5R is designed to remove a higher volume of groundwater from the capture zone.

Replacement purge well PW-5R was installed adjacent to purge well PW-5 using 10.25-inch outside diameter hollow stem augers. Split spoon soil samples were collected from approximately 53 to 76 feet below ground surface (BGS) to log the soil at the screened interval. The well was constructed with a PVC casing, a 20-foot-long stainless steel wire wrapped 4-inch diameter screen, and a 3-foot-long sump at the bottom of the screen. The piping and pump were transferred from purge well PW-5 to well PW-5R after the pump and piping were cleaned.

Purge well PW-5 was abandoned by pumping the well full of grout and cutting off the well casing below the ground surface.

A well log is provided in Attachment G and the location of the purge well PW-5R is shown on Figure 2. Groundwater pumping at purge well PW-5R began in December 2012 when the new air-stripper began operation.

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Project Name: <u>Central Sanitary Landfill</u>	Log of Borehole: <u>PW-5R</u>
Project Number: <u>001.02-09-003</u>	Start Date: <u>9-4-2012</u>
Site Location: <u>Pierson, MI</u>	End Date: <u>9-4-2012</u>
Drilling Method: <u>10 1/4" O.D. HSA</u>	Driller: <u>EDAC</u>
Sampling Method: <u>2' Split Spoon</u>	Crew Chief: <u>Sean</u>
Ground Elevation (feet): <u>925.58</u>	Depth to Water (ft BGS during drilling): <u>33.7</u>
Top of Casing Elevation (feet): <u>927.95</u>	Easting: <u>8780.586</u>
Logged By: <u>Kurt Van Appledorn</u>	Northing: <u>8563.917</u>
Comments: <u>Screened interval elevation at 872.58 - 852.58'</u>	

SUBSURFACE PROFILE				SAMPLE			Well Completion Details	
Depth (feet BGS)	Symbol	Description	Depth/Elev.	Sample Length (feet)	Recovery (feet)	Blow Counts		ASTM Symbol
0		Ground Surface	936.1					
0.0		0-54.1' Brown fine SAND. Medium sand to fine gravel occasionally observed in drill cuttings while drilling between 20 and 40'.	0.0					
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
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Project Name: Central Sanitary Landfill

Project Number: 001.02-09-003

Site Location: Pierson, MI

Drilling Method: 10 1/4" O.D. HSA

Sampling Method: 2' Split Spoon

Ground Elevation (feet): 925.58

Top of Casing Elevation (feet): 927.95

Logged By: Kurt Van Appledorn

Comments: Screened interval elevation at 872.58 - 852.58'

Log of Borehole: PW-5R

Start Date: 9-4-2012

End Date: 9-4-2012

Driller: EDAC

Crew Chief: Sean

Depth to Water (ft BGS during drilling): 33.7

Easting: 8780.586

Northing: 8563.917

SUBSURFACE PROFILE				SAMPLE				Well Completion Details
Depth (feet BGS)	Symbol	Description	Depth/Elev.	Sample Length (feet)	Recovery (feet)	Blow Counts	ASTM Symbol	
45	[Symbol: Fine Sand]	Brown fine SAND, wet	882.0	SS	1.0	0 2 2 2		
46								
47								
48								
49								
50								
51								
52								
53								
54			54.1-55.2' Brown silty CLAY					882.0 54.1
55								
56								
57								
58	[Symbol: Silty Sand]	Brown very fine silty SAND, wet.	867.9 68.3	SS	1.8	6 2 18 18		
59								
60								
61								
62								
63								
64								
65								
66								
67								
68	[Symbol: Fine Sand]	69.0-76.0' Brown fine SAND, wet.	860.1 76.0	SS	2.0	6 12 28 40		
69								
70								
71	[Symbol: Fine Sand]	4" fine sand with little medium and coarse sand at 71'.	860.1 76.0	SS	1.8	10 9 16 18		
72								
73								
74								
75								
76								
77								
78								
79								
80								
81								
82								
83								
84								
85								
86								
87								
88								
89								
90								
91								

4" Dia. 20 Slot Stainless Steel Wire Wrapped Screen

K&E #1 Filter Sand

4" Dia. Stainless Steel Sump



WATER WELL AND PUMP RECORD

Completion is required under authority of Part 127 Act 368 PA 1978.

Failure to comply is a misdemeanor.

Well ID: 59000003955

Tax No:	Permit No: W5904249	County: Montcalm	Township: Pierson
<h1 style="margin: 0;">Well ID: 59000003955</h1> <p>Elevation: Latitude: 43.33249278 Longitude: -85.50155701</p>	Fraction: NW¼ SW¼ NW¼	Section: 22	Town/Range: 11N 10W
	French Claim: WSSN:		
	Distance and Direction from Road Intersection: 3/10 MILE SOUTH OF CANNONSVILLE; 150 YDS EAST OF AMY SCHOOL		
	Well Name:		
Well Owner: Signature Home Bldrs		Well Address: 20959 SCHOOLFIELD DR MI	
		Owner Address: 600 CLARKSON ST SPARTA MI 49345	

Drilling Method: Rotary	Pump Installed: Yes	Pump Installation only: No
Well Depth: 110.00 ft. Well Use: Household	Pump Installation date:	HP: 0.75
Well Type: New Date Completed: 6/17/2004	Manufacturer: Goulds	Pump Type: Submersible
Casing Type: PVC plastic	Model Number: 10	Pump Capacity: 12.00 GPM
Casing Joint: Unknown	Length of Drop Pipe: 100.00 ft.	Id of Well:
Diameter: 5.00 in. to 110.00 ft. depth	Diameter of Drop Pipe:	
Bore Diameter 1: 8.50 in. to 110.00 ft. depth	Draw Down Seal Used: No	
Bore Diameter 2:	Pressure Tank Installed: Yes	
Bore Diameter 3:	Pressure Tank Type: Unknown	
Height: 1.00 ft. above grade	Manufacturer: Well-Rite-Flexcon	
Casing Fitting: None	Model Number: WR-120	
Static Water Level: 30.00 ft. Below Grade(Not Flowing)	Formation Description	Thickness
Yield Test Method: Air	Depth to Bottom	
Measurement Taken During Pump Test: 100.00 ft. after 2.00 hrs. pumping at 40.00 GPM	Brown-Clay	10.00
	Sand	59.00
	Gray-Clay	21.00
	Sand-Water Bearing	20.00
Abandoned Well Plugged: No		
Reason for not plugging Well:		
Abandoned well ID:		
Screen Installed: Yes Well Intake:		
Filter Packed: Yes		
Screen Diameter: 5.00 in. Length: 10.00 ft.		
Screen Material Type: PVC -slotted		
Slot: 15.00 in. Set Between 100.00 ft. and 110.00 ft.		
Blank:		
Fittings:		
Unknown		
Well Grouted: Yes Grouting Method: Unknown	Geology Remarks:	
No. of Bags: 12 Additives: None		
Grouting Materials: Bentonite slurry From 0.00 ft. to 100.00 ft.		
Well Head Completion: 12 inches above grade, Pitless adapter	Contractor Type: Water well drilling contractor	
	Registration Number: 1561	
	Business Name: TRI NORTHERN WELL DRLG	
	Business Address:	
Nearest source of possible contamination:	WATER WELL CONTRACTOR'S CERTIFICATION:	
Type: Septic tank Distance: 75.00 ft. Direction: Southwest	This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.	
Drilling Machine Operator Name: JOHN SCHMID	Signature of Registered Representative	Date
Employment: Employee		
General Remarks: GROUT WEIGHT 9.5		
OTHER REMARKS		

EQP 2017C (2/2000)

ATTENTION WELL OWNER: FILE WITH DEED

7/28/2004 07:46

Engineering & Environmental Solutions, LLC

200 North Franklin Street
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 Phone: (616) 931-3960
 Fax: (616) 931-3970

Project Name: Central Sanitary Landfill

Project Number: 001.02-09-003

Site Location: Pierson, MI

Drilling Method: 10 1/4" O.D. HSA

Sampling Method: 2' Split Spoon

Ground Elevation (feet): 936.15

Top of Casing Elevation (feet): 938.05

Logged By: Kurt Van Appledorn

Comments: Screened interval elevation at 883.05 - 863.05'

Log of Borehole: PW-7R

Start Date: 4-19-2010

End Date: 4-20-2010

Driller: EDAC

Crew Chief: Sean

Depth to Water (ft BGS during drilling): 42.7

Easting: 8890.76

Northing: 7598.85

SUBSURFACE PROFILE				SAMPLE				Well Completion Details
Depth (feet BGS)	Symbol	Description	Depth/Elev.	Sample Length (feet)	Recovery (feet)	Blow Counts	ASTM Symbol	
-3								<p>4" Dia. PVC Riser</p> <p>Bentonite Grout</p> <p>Native Soil</p> <p>Natural Sand Pack</p>
-2								
-1								
0		Ground Surface	936.2					
1		0-13' Brown sandy CLAY, moist.	0.0					
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13		13-60.8' Brown (10YR/5/3) fine SAND.	923.2					
14			13.0					
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								
41								
42			893.4					
43		Wet at 42.7'	42.7					
44								
45								
46								
47								

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Top of Casing Elevation (feet): 938.05

Logged By: Kurt Van Appledorn

Comments: Screened interval elevation at 883.05 - 863.05'

Log of Borehole: PW-7R

Start Date: 4-19-2010

End Date: 4-20-2010

Driller: EDAC

Crew Chief: Sean

Depth to Water (ft BGS during drilling): 42.7

Easting: 8890.76

Northing: 7598.85

SUBSURFACE PROFILE				SAMPLE				Well Completion Details			
Depth (feet BGS)	Symbol	Description	Depth/Elev.	Sample Length (feet)	Recovery (feet)	Blow Counts	ASTM Symbol				
48	[Symbol: Fine Sand]	60.8-62.8' Brown SILT with occasional 1" clay seams, wet. 62.8-76.0' Brown fine SAND, wet. 3" silt seam at 64.7'.	875.4 60.8 873.4 62.8								
49											
50											
51											
52											
53											
54							SS		1.0	0 2 2 2	
55											
56							SS		1.7	7 7 7 7	
57											
58							SS		1.9	6 2 18 18	
59											
60							SS		1.8	0 3 5 7	
61											
62				SS	1.8	9 10 19 +35					
63											
64				SS	1.8	6 6 9 13					
65											
66				SS	1.5	2 6 6 13					
67											
68				SS	1.8	3 6 12 26					
69											
70				SS	2.0	6 12 28 40					
71											
72				SS	1.8	10 9 16 18					
73											
74											
75											
76			860.2 76.0								
77		End of Boring									
78											
79											
80											
81											
82											
83											
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Project Name: <u>Central Sanitary Landfill</u>	Log of Borehole: <u>PW-4</u>
Project Number: <u>001.02-09-003</u>	Start Date: <u>4-21-2010</u>
Site Location: <u>Pierson, MI</u>	End Date: <u>4-22-2010</u>
Drilling Method: <u>-</u>	Driller: <u>EDAC</u>
Sampling Method: <u>-</u>	Crew Chief: <u>Sean</u>
Ground Elevation (feet): <u>901.2</u>	Depth to Water (ft BGS during drilling): <u>20</u>
Top of Casing Elevation (feet): <u>902.36</u>	Easting: <u>9587.41</u>
Logged By: <u>Kurt Van Appledorn</u>	Northing: <u>9065.84</u>
Comments: <u>Monitoring Well - Installed 2" dia. well inside 8" dia well</u>	

SUBSURFACE PROFILE				SAMPLE				Well Completion Details
Depth (feet BGS)	Symbol	Description	Depth/Elev.	Sample Length (feet)	Recovery (feet)	Blow Counts	ASTM Symbol	
-3 -2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48		<p style="text-align: right; color: blue;">Ground Surface</p> <p>See original well log for purge well PW-4 for soil and 8" dia. well construction details</p> <p>The 2" dia. well screen was placed in the lower screen interval of the original 8" dia. well</p>	<p>901.2</p> <p>0.0</p>					<p style="color: blue;">Well Stabilizer</p> <p style="color: blue;">2" Dia. PVC Riser</p> <p style="color: blue;">8" dia purge well</p> <p style="color: blue;">No backfill above bentonite seal in annular space between 2" and 8" casings</p>

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Project Name: <u>Central Sanitary Landfill</u>	Log of Borehole: <u>PW-4</u>
Project Number: <u>001.02-09-003</u>	Start Date: <u>4-21-2010</u>
Site Location: <u>Pierson, MI</u>	End Date: <u>4-22-2010</u>
Drilling Method: <u>-</u>	Driller: <u>EDAC</u>
Sampling Method: <u>-</u>	Crew Chief: <u>Sean</u>
Ground Elevation (feet): <u>901.2</u>	Depth to Water (ft BGS during drilling): <u>20</u>
Top of Casing Elevation (feet): <u>902.36</u>	Easting: <u>9587.41</u>
Logged By: <u>Kurt Van Appledorn</u>	Northing: <u>9065.84</u>
Comments: <u>Monitoring Well - Installed 2" dia. well inside 8" dia well</u>	

SUBSURFACE PROFILE				SAMPLE				Well Completion Details
Depth (feet BGS)	Symbol	Description	Depth/Elev.	Sample Length (feet)	Recovery (feet)	Blow Counts	ASTM Symbol	
49								<p>No backfill above bentonite seal in annular space between 2" and 8" casings</p> <p>2" Dia. 10 Slot PVC Screen set at 79'</p> <p>Filter Sand</p> <p>Global #7 Filter Sand</p> <p>Bentonite Holeplug</p> <p>8" dia purge well</p>
50								
51								
52								
53								
54								
55								
56								
57								
58								
59								
60								
61								
62								
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69								
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71								
72								
73								
74								
75								
76								
77								
78								
79								
80			821.2					
81		End of Boring	80.0					
82								
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Project Name: Central Sanitary Landfill
 Project Number: 001.02-09-003
 Site Location: Pierson, MI
 Drilling Method: 8 1/4" O.D. HSA
 Sampling Method: 2' Split Spoon
 Ground Elevation (feet): 911.69
 Top of Casing Elevation (feet): 914.27
 Logged By: Kurt Van Appledorn
 Comments: _____

Log of Borehole: MW-39

Start Date: 4-21-2010
 End Date: 4-22-2010
 Driller: EDAC
 Crew Chief: Sean
 Depth to Water (ft BGS during drilling): 20
 Easting: 9900.10
 Northing: 8790.37

SUBSURFACE PROFILE				SAMPLE				Well Completion Details
Depth (feet BGS)	Symbol	Description	Depth/Elev.	Sample Length (feet)	Recovery (feet)	Blow Counts	ASTM Symbol	
-3								<p>Concrete Pad</p> <p>Bentonite Grout</p> <p>2" Dia. PVC Riser</p>
-2								
-1								
0		Ground Surface	911.7					
1		0-25' Dark yellowish brown (10YR/4/4) fine SAND, trace medium and coarse sand, slightly moist.	0.0					
2								
3								
4								
5								
6				SS	0.4	3 6 3 2		
7								
8								
9								
10			901.7					
11		0.3' lense at 10' with some medium sand to fine gravel. All brown (10YR/5/3) fine sand below 10.3' to ~20', then occasional lenses with some medium to coarse sand.	10.0	SS	1.1	8 7 5 5		
12								
13								
14								
15								
16				SS	1.0	7 7 7 8		
17								
18								
19								
20		Wet at 20'	891.7					
21			20.0	SS	1.3	3 7 8 9		
22								
23								
24								
25			886.7					
26		25.0-36.0' yellowish brown (10YR/5/4) fine SAND, little medium to coarse sand, trace fine and coarse gravel, wet.	25.0	SS	0.9	1 2 5 5		
27								
28								
29								
30								
31				SS	1.5	6 6 9 13		
32								
33								
34								
35								
36			875.7	SS	1.5	5 11 13 21		
37			36.0					

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Project Name: Central Sanitary Landfill

Project Number: 001.02-09-003

Site Location: Pierson, MI

Drilling Method: 8 1/4" O.D. HSA

Sampling Method: 2' Split Spoon

Ground Elevation (feet): 911.69

Top of Casing Elevation (feet): 914.27

Logged By: Kurt Van Appledorn

Comments:

Log of Borehole: MW-39

Start Date: 4-21-2010

End Date: 4-22-2010

Driller: EDAC

Crew Chief: Sean

Depth to Water (ft BGS during drilling): 20

Easting: 9900.10

Northing: 8790.37

SUBSURFACE PROFILE				SAMPLE				Well Completion Details	
Depth (feet BGS)	Symbol	Description	Depth/Elev.	Sample Length (feet)	Recovery (feet)	Blow Counts	ASTM Symbol		
38	[Dotted pattern]	36.0-80' Grayish brown (10YR/5/2) fine SAND with occasional 0.2 to 0.5' lenses of fine sand with some medium sand to fine gravel, wet.						[Hatched pattern]	
39									
40									
41				SS	1.5	0 5	9 18		
42									
43									
44									
45									
46				SS	1.6	2 5	5 12		
47									
48									
49									
50									
51				SS	1.1	2 3	3 8		
52									
53									
54									
55		Less to no lenses at 55 to 76'. Lenses typically 0.2' or less.	856.7						
56	SS		1.8	1 2	7 18				
57									
58									
59									
60									
61	SS		1.5	5 11	30 40				
62									
63									
64									
65									
66	SS	0.8	20 30	48 53					
67									
68									
69									
70									
71	SS	1.8	0 3	10 45					
72									
73	SS	1.7	3 5	15 24					
74									
75									
76	SS	2.0	4 10	23 15					
77		76.0-80.0' Occasional 0.2 to 0.5' lenses of	835.7						
	SS		1.8	8 13	23 26				

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Project Name: Central Sanitary Landfill

Project Number: 001.02-09-003

Site Location: Pierson, MI

Drilling Method: 8 1/4" O.D. HSA

Sampling Method: 2' Split Spoon

Ground Elevation (feet): 911.69

Top of Casing Elevation (feet): 914.27

Logged By: Kurt Van Appledorn

Comments:

Log of Borehole: MW-39

Start Date: 4-21-2010

End Date: 4-22-2010

Driller: EDAC

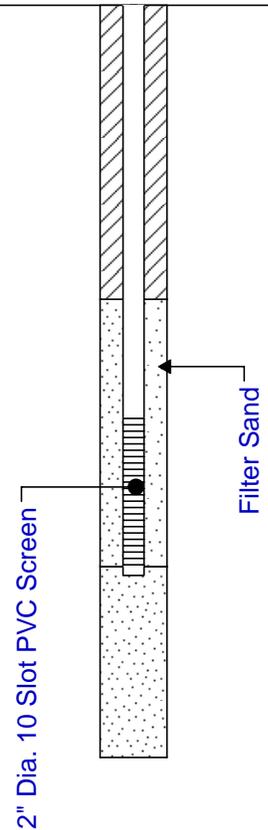
Crew Chief: Sean

Depth to Water (ft BGS during drilling): 20

Easting: 9900.10

Northing: 8790.37

SUBSURFACE PROFILE				SAMPLE				Well Completion Details
Depth (feet BGS)	Symbol	Description	Depth/Elev.	Sample Length (feet)	Recovery (feet)	Blow Counts	ASTM Symbol	
78	[Symbol: Dotted pattern]	36.0-80' Grayish brown (10YR/5/2) fine SAND with occasional 0.2 to 0.5' lenses of fine sand with some medium sand to fine gravel, wet.	831.7	SS	2.0	23 26		
79						29 28		
80	[Symbol: Dotted pattern]	80.0-83.1' Grayish brown (2.5Y/5/2) medium SAND, some coarse sand, little fine gravel, lenses of coarse sand and fine gravel, wet.	80.0	SS	2.0	27 18		
81						28 19		
82	[Symbol: Vertical lines]	83.1' to 86.0' Light olive brown (2.5Y/5/4) silty medium and coarse sand and little fine to coarse gravel, very moist to wet.	828.6	SS	1.6	35 15		
83						15 20		
84	[Symbol: Vertical lines]	86.0-96.0' Light brownish gray (2.5Y/6/2) fine SAND, wet. 0.2' lense with some coarse sand at 86.5'. No lenses below 86.5'.	83.1	SS	1.0	24 36		
85						49 56		
86	[Symbol: Dotted pattern]		825.7	SS	1.8	24 42		
87						45 62		
88	[Symbol: Dotted pattern]		86.0	SS	1.0	3 7		
89						15 37		
90	[Symbol: Dotted pattern]			SS	1.5	4 8		
91						28 60		
92	[Symbol: Dotted pattern]			SS	1.3	6 10		
93						28 45		
94	[Symbol: Dotted pattern]		815.7	SS	2.0	23 58		
95						110 79		
96	[Symbol: Diagonal lines]	96.0-97.1' Grayish brown (10YR/5/2) silty CLAY, trace coarse sand and fine gravel.	96.0	SS	1.6	3 15		
97						43 55		
98	[Symbol: Diagonal lines]	97.1-98.0' Grayish brown silty fine SAND, little medium sand, wet.	97.8	SS	1.8	14 21		
99						29 62		
100	[Symbol: Diagonal lines]	98.0-102.0' Grayish brown silty CLAY, trace coarse sand and fine gravel, slightly moist.	809.7	SS	1.5	0 4		
101						18 91		
102		End of Boring	102.0					
103								
104								
105								
106								
107								
108								
109								
110								
111								
112								
113								
114								
115								
116								
117								



Engineering & Environmental Solutions, LLC

200 North Franklin Street
 Suite 202
 Zeeland, Michigan 49464
 Phone: (616) 931-3960
 Fax: (616) 931-3970

Project Name: Central Sanitary Landfill
 Project Number: 001.02-09-003
 Site Location: Pierson, MI
 Drilling Method: 8 1/4" O.D. HSA
 Sampling Method: 2' Split Spoon
 Ground Elevation (feet): 904.50
 Top of Casing Elevation (feet): 906.84
 Logged By: Kurt Van Appledorn
 Comments: _____

Log of Borehole: MW-38

Start Date: 7-23-2009
 End Date: 7-24-2009
 Driller: EDAC
 Crew Chief: Rick/Sean
 Depth to Water (ft BGS during drilling): 14
 Easting: 11303
 Northing: 7695

SUBSURFACE PROFILE				SAMPLE				Well Completion Details
Depth (feet BGS)	Symbol	Description	Depth/Elev.	Sample Length (feet)	Recovery (feet)	Blow Counts	ASTM Symbol	
-3								<p>Concrete Pad</p> <p>Bentonite Grout</p> <p>2" Dia. PVC Riser</p>
0		Ground Surface	904.5					
1		0-14' Brown (10YR/4/3) sandy CLAY, slightly moist.	0.0					
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14		14-20' Brown (10YR/5/3) silty fine SAND, wet	890.5					
15			14.0					
16								
17								
18								
19								
20		20-32.0' Brown (10YR/5/3) fine SAND, occasional fine gravel seam (<0.1'), wet.	884.5					
21			20.0					
22								
23								
24								
25				SS	0.5	7 5 6 4		
26								
27								
28		no gravel seams in 29-31' sample						
29								
30				SS	1.5	1 3 9 20		
31								
32			872.5					
33			32.0					
34								
35				SS	1.3	5 14 13 16		
36								
37								

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Logged By: Kurt Van Appledorn

Comments: _____

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Driller: EDAC

Crew Chief: Rick/Sean

Depth to Water (ft BGS during drilling): 14

Easting: 11303

Northing: 7695

SUBSURFACE PROFILE				SAMPLE				Well Completion Details			
Depth (feet BGS)	Symbol	Description	Depth/Elev.	Sample Length (feet)	Recovery (feet)	Blow Counts	ASTM Symbol				
38	[Symbol: Brown (10YR/5/3) medium SAND, little fine and coarse gravel, trace fine sand and silt, wet]	32.0-49.2' Brown (10YR/5/3) medium SAND, little fine and coarse gravel, trace fine sand and silt, wet						[Diagram: Well completion details showing casing and screen]			
39											
40				SS	1.2	3 3	9 3				
41											
42											
43					0.5' fine sand seams in 39-41' sample						
44											
45				SS	1.5	6 5	3 5				
46											
47											
48			855.3								
49	[Symbol: Yellowish brown (10YR/5/4) sandy SILT, wet]	49.2-52' Yellowish brown (10YR/5/4) sandy SILT, wet.	49.2								
50				SS	1.4	11 11	16 16				
51											
52			852.5								
53	[Symbol: Brown (10YR/5/3) fine SAND, wet]	52-81.0' Brown (10YR/5/3) fine SAND, wet.	52.0								
54											
55				SS	1.8	1 0	0 0				
56											
57											
58											
59											
60				SS	0.1	4 20	46 54				
61											
62											
63											
64											
65	SS	2.0	2 11	18 22							
66											
67											
68											
69											
70	SS	2.0	1 2	7 9							
71											
72											
73											
74											
75	SS	1.1	2 12	15 33							
76											
77											

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Comments: _____

Log of Borehole: MW-38

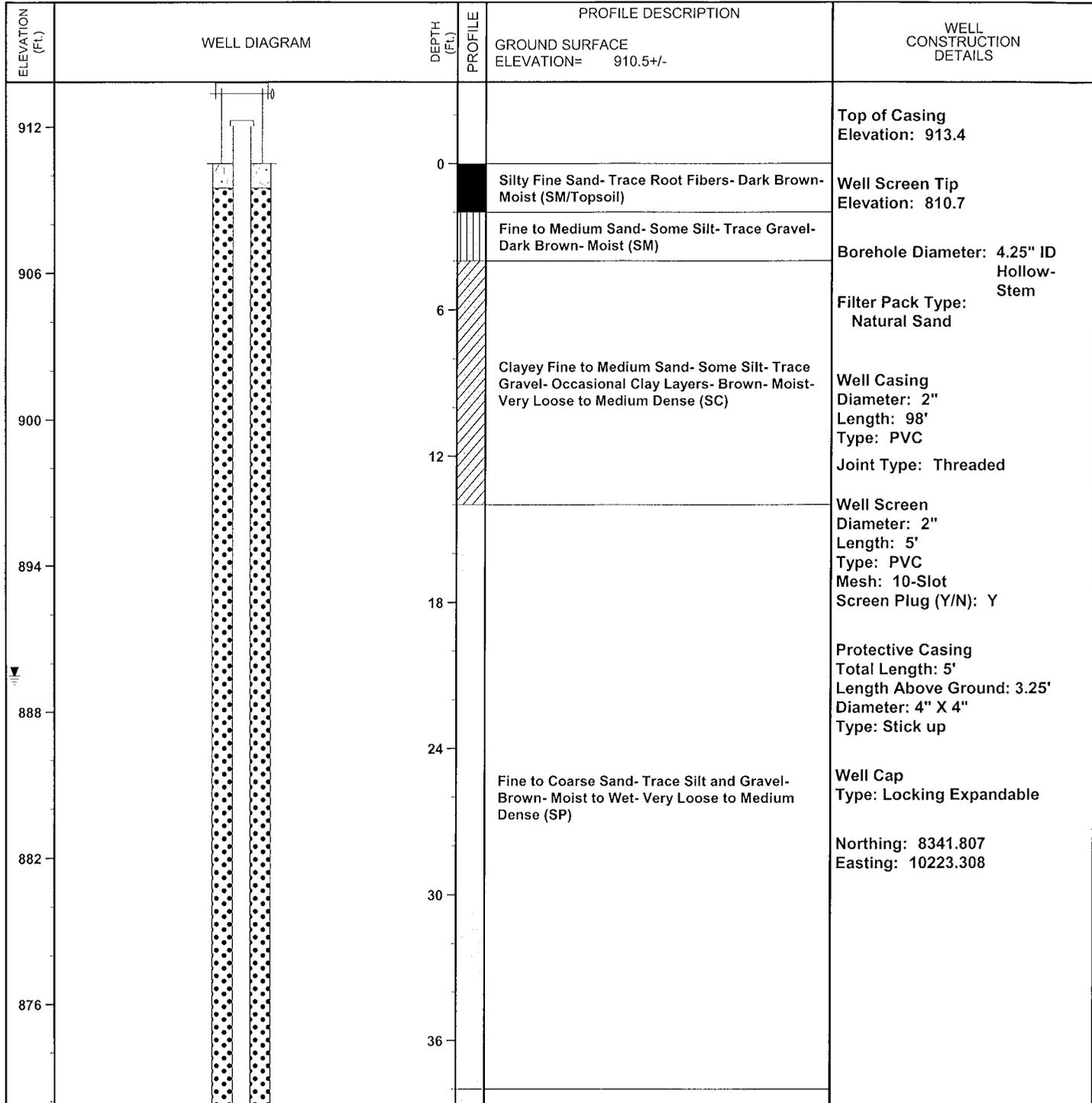
Start Date: 7-23-2009
End Date: 7-24-2009
Driller: EDAC
Crew Chief: Rick/Sean
Depth to Water (ft BGS during drilling): 14
Easting: 11303
Northing: 7695

SUBSURFACE PROFILE				SAMPLE				Well Completion Details
Depth (feet BGS)	Symbol	Description	Depth/Elev.	Sample Length (feet)	Recovery (feet)	Blow Counts	ASTM Symbol	
78								<p>2" Dia. 10 Slot PVC Screen</p> <p>Filter Sand</p> <p>Natural Backfill</p>
79								
80								
81			823.5	SS	0.5	4 13 35 51+		
82		81.0-84.7' Grayish brown (10YR/5/2) SILT, wet.	81.0	SS	1.3	0 1 3 5		
83								
84								
85			819.8	SS	0.7	3 5 8 11		
86		84.7-89.0' Grayish brown (10YR/5/2) silty CLAY, moist with wet silty fine sand seams at 86.5'. Clay and clayey fine sand seams (0.2'), trace fine gravel between 87' and 89'.	84.7	SS	1.0	1 9 14 15		
87								
88								
89			815.5	SS	1.7	1 3 14 15		
90		89.0-91.0' Grayish brown (10YR/5/2) silty fine SAND, <0.1' seam with little coarse sand at 89.5', wet.	89.0	SS	0.6	0 1 1 5		
91			813.5	SS	0.9	0 5 30 50+		
92		91.0-97.0' Grayish brown (10YR/5/2) fine SAND, very moist to wet, with 0.3' grayish brown clay seams.	91.0	SS	0.8	14 45 50+		
93								
94								
95								
96								
97			807.5	SS	1.0	43 50+		
98		97.0-108.0' Brown (10YR/5/3) fine SAND, trace medium and coarse sand between 97' and 99', wet.	97.0	SS	1.3	9 14 40 50+		
99								
100								
101								
102								
103								
104								
105								
106								
107								
108			796.5	SS	0.5	-- 25 50+		
109		End of Boring	108.0	SS	0.3	10 50+		
110								
111								
112								
113								
114								
115								
116								
117								



MONITORING WELL
SME PROJECT No. KE41176F

PROJECT NAME: CENTRAL SANITARY LANDFILL
 PROJECT LOCATION: PIERSON, MICHIGAN BY: NBB/MLB DATE: 3/12/07
 CLIENT: CENTRAL SANITARY LANDFILL



WELL TYPE: Monitoring Well DRILLING METHODS: Hollow-Stem Augers
 DRILLER: JV/RK
 RIG NUMBER OR
 CONTRACTOR: ATV

Notes:

1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. MONITORING WELL MW-37 WAS INSTALLED ADJACENT TO THE BOREHOLE ON 3/19/07.
3. BOREHOLE WAS TREMMIE BACKFILLED WITH A THICK BENTONITE SLURRY CONTAINING 5 PERCENT CEMENT.
4. MONITORING WELL WAS DEVELOPED BY PURGING APPROXIMATELY 150 GALLONS OF GROUNDWATER FROM WELL AND SURGING WITH AIR.

WATER LEVEL DATA		
DATE	DEPTH (Feet)	COMMENTS
3/12/07	21.0	During Drilling
3/12/07	21.0	Upon Completion of Drilling
3/12/07	21.0	5 Hours After Completion of Drilling
3/20/07	18.0	



MONITORING WELL
SME PROJECT No. KE41176F

PROJECT NAME: CENTRAL SANITARY LANDFILL
PROJECT LOCATION: PIERSON, MICHIGAN **BY:** NBB/MLB **DATE:** 3/12/07
CLIENT: CENTRAL SANITARY LANDFILL

ELEVATION (Ft.)	WELL DIAGRAM	DEPTH (Ft.)	PROFILE	PROFILE DESCRIPTION	WELL CONSTRUCTION DETAILS
				GROUND SURFACE ELEVATION= 910.5+/-	
870		42		Fine to Coarse Sand- Trace to Some Gravel- Trace Silt- Occasional Clay Layers- Brown- Wet- Medium Dense (SP)	Top of Casing Elevation: 913.4
864		48		Fine to Coarse Sand- Trace to Some Gravel- Trace Silt- Occasional Clay Layers- Brown- Wet- Medium Dense (SP)	Well Screen Tip Elevation: 810.7 Borehole Diameter: 4.25" ID Hollow-Stem Filter Pack Type: Natural Sand
858		54			Well Casing Diameter: 2" Length: 98' Type: PVC Joint Type: Threaded
852		60			Well Screen Diameter: 2" Length: 5' Type: PVC Mesh: 10-Slot Screen Plug (Y/N): Y
846		66			Protective Casing Total Length: 5' Length Above Ground: 3.25' Diameter: 4" X 4" Type: Stick up
840		72		Fine to Coarse Sand- Trace to Some Silt- Trace Gravel- Occasional Cobbles- Brown- Wet- Medium Dense to Extremely Dense (SP-SM)	Well Cap Type: Locking Expandable
834		78		Silty Fine Sand- Brown- Wet- Dense (SM)	Northing: 8341.807 Easting: 10223.308

WELL TYPE: Monitoring Well **DRILLING METHODS:** Hollow-Stem Augers
DRILLER: JV/RK
RIG NUMBER OR CONTRACTOR: ATV

Notes:

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2. MONITORING WELL MW-37 WAS INSTALLED ADJACENT TO THE BOREHOLE ON 3/19/07.
3. BOREHOLE WAS TREMMIE BACKFILLED WITH A THICK BENTONITE SLURRY CONTAINING 5 PERCENT CEMENT.
4. MONITORING WELL WAS DEVELOPED BY PURGING APPROXIMATELY 150 GALLONS OF GROUNDWATER FROM WELL AND SURGING WITH AIR.

WATER LEVEL DATA

DATE	DEPTH (Feet)	COMMENTS
3/12/07	21.0	During Drilling
3/12/07	21.0	Upon Completion of Drilling
3/12/07	21.0	5 Hours After Completion of Drilling
3/20/07	18.0	



MONITORING WELL
SME PROJECT No. KE41176F

PROJECT NAME: CENTRAL SANITARY LANDFILL
 PROJECT LOCATION: PIERSON, MICHIGAN BY: NBB/MLB DATE: 3/12/07
 CLIENT: CENTRAL SANITARY LANDFILL

ELEVATION (ft.)	WELL DIAGRAM	DEPTH (ft.)	PROFILE	PROFILE DESCRIPTION	WELL CONSTRUCTION DETAILS
				GROUND SURFACE ELEVATION= 910.5+/-	
828		84		Fine to Coarse Sand- Trace to Some Gravel- Trace Silt- Occasional Cobbles- Brown- Wet- Extremely Dense (SP)	Top of Casing Elevation: 913.4
				Silty Fine Sand- Trace to Some Clay- Occasional Sandy Silt Layers- Gray- Wet- Dense (SM)	Well Screen Tip Elevation: 810.7
822		90			Borehole Diameter: 4.25" ID Hollow-Stem
					Filter Pack Type: Natural Sand
816		96		Fine to Coarse Sand- Trace to Some Gravel- Trace Silt- Brown- Wet- Medium Dense (SP)	Well Casing Diameter: 2" Length: 98' Type: PVC Joint Type: Threaded
810		102		Silty Clay- Some Sand- Trace Gravel- Gray- Hard (CL)	Well Screen Diameter: 2" Length: 5' Type: PVC Mesh: 10-Slot Screen Plug (Y/N): Y
804				END OF BORING AT 105 FEET.	Protective Casing Total Length: 5' Length Above Ground: 3.25' Diameter: 4" X 4" Type: Stick up
798		108			Well Cap Type: Locking Expandable
792		114			Northing: 8341.807 Easting: 10223.308
		120			

WELL TYPE: Monitoring Well DRILLING METHODS: Hollow-Stem Augers
 DRILLER: JV/RK
 RIG NUMBER OR CONTRACTOR: ATV

Notes:

1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. MONITORING WELL MW-37 WAS INSTALLED ADJACENT TO THE BOREHOLE ON 3/19/07.
3. BOREHOLE WAS TREMMIE BACKFILLED WITH A THICK BENTONITE SLURRY CONTAINING 5 PERCENT CEMENT.
4. MONITORING WELL WAS DEVELOPED BY PURGING APPROXIMATELY 150 GALLONS OF GROUNDWATER FROM WELL AND SURGING WITH AIR.

WATER LEVEL DATA

DATE	DEPTH (Feet)	COMMENTS
3/12/07	21.0	During Drilling
3/12/07	21.0	Upon Completion of Drilling
3/12/07	21.0	5 Hours After Completion of Drilling
3/20/07	18.0	



Project Name: Central Sanitary Landfill Sentinel Wells Start Date: 4-19-05
 Project Number: 001-05-014 End Date: 4-19-05
 Site Location: Central Sanitary Landfill, Pierson, MI Logged By: Kurt Van Appledorn
 Drilling Method: 8.25" O.D. HSA Driller: EDAC
 Sampling Method: 2' Split Spoon Crew Chief: Emerick
 Ground Elevation (ft): 896.81 Depth to Water (ft BGS): 3
 Top of Casing Elevation (ft): 900.05 Easting: 9929.3539
 Comments: Lithology based on MW-36d log Northing: 8461.6507

Blow Counts	Sample Length (ft)	Recovery (ft)	Profile	Depth BGS (ft)	Lithology Description	Well Construction
				-4		<p>Bentonite Grout at 0 to 11'</p> <p>2" dia. PVC Riser at -3.3' to 15.4'</p> <p>Filter Sand at 21' to 11'</p> <p>2" dia. 10-Slot PVC Screen at 20.4' to 15.4' + 0.3' point</p> <p>Steel above ground protective casing set in concrete</p>
				-2		
				0	0 - 5.9' Dark brown, silty, fine SAND, wet at 3'	
				2	Static 5/16/05 ▼ First Encountered ▽	
				4		
				6	5.9' - 10.5' Brown fine SAND, trace medium and coarse sand, wet	
				8		
				10	10.5' - 14' Grayish brown, silty, fine SAND, trace coarse sand and fine gravel, wet	
				12		
				14		
				16	14' - 18' Brown medium SAND, some fine coarse sand and fine gravel, little silt, wet	
				18		
				20	18' - 21' Brown, silty, fine SAND, some medium to fine gravel, wet	
				22	End of boring at 21'	
				24		
				26		
				28		
				30		
				32		
				34		
				36		
				38		
				40		
				42		
				44		
				46		



Project Name: Central Sanitary Landfill Sentinel Wells Start Date: 4-18-05
 Project Number: 001-05-014 End Date: 4-19-05
 Site Location: Central Sanitary Landfill, Pierson, MI Logged By: Kurt Van Appledorn
 Drilling Method: 8.25" O.D. HAS Driller: EDAC
 Sampling Method: 2' Split Spoon Crew Chief: Emerick
 Ground Elevation (ft): 895.76 Depth to Water (ft BGS): 3
 Top of Casing Elevation (ft): 898.63 Easting: 9922.3135
 Comments: Northing: 8476.6828

Blow Counts	Sample Length (ft)	Recovery (ft)	Profile	Depth BGS (ft)	Lithology Description	Well Construction
				-4		<p>Steel above ground protective casing set in concrete</p> <p>Bentonite Grout at 0 to 70'</p> <p>2" dia. PVC Riser at -3.0' to 73'</p>
				-2		
				0	0 - 5.9' Dark brown, silty, fine SAND, wet at 3'	
				2	Static 5/16/05 ▼ First Encountered ▽	
				4		
10 5	2	1.8		6	5.9' - 10.5' Brown fine SAND, trace medium and coarse sand, wet	
2 5				8		
				10	10.5' - 14' Grayish brown, silty, fine SAND, trace coarse sand and fine gravel, wet	
3 1	2	1.1		12		
1 2				14		
				16	14' - 18' Brown medium SAND, some fine coarse sand and fine gravel, little silt, wet	
27 5	2	2		18	18' - 21' Brown, silty, fine SAND, some medium to fine gravel, wet	
6 7				20		
				22	21' - 24' Brown fine SAND, wet	
3 2	2	1.8		24		
2 3				26	24' - 30.5' Brown fine SAND, grades into fine sand with medium and coarse sand, wet	
				28		
4 6	2	1		30		
9 9				32	30.5' - 35' Brown fine SILT and very fine SAND, wet	
				34		
4 6	2	0.9		36	35' - 38' Brown CLAY with 1" seams of wet fine sand and silt seams	
14 16				38		
				40	38' - 54' Brown fine SAND, little medium sand, wet	
5 7	2	1		42		
9 7				44		
	2	2		46		



Project Name: <u>Central Sanitary Landfill</u>	Start Date: <u>10-14-04</u>
Project Number: <u>001-04-024</u>	End Date: <u>10-17-04</u>
Site Location: <u>Pierson, Michigan</u>	Logged By: <u>Kurt Van Appledorn</u>
Drilling Method: <u>4.25 ID HSA</u>	Driller: <u>EDAC</u>
Sampling Method: <u>2' split spoon, QED Hydropunch</u>	Crew Chief: <u>Emmerick</u>
Ground Elevation (ft): <u>936.85</u>	Depth to Water (ft BGS): <u>47</u>
Top of Casing Elevation (ft): <u>939.66</u>	Easting: <u>9421.8613</u>
Comments: <u>Clay-hard drilling at 126', confirmed in 128-130' sample</u>	Northing: <u>8298.3859</u>

Blow Counts	Sample Length (ft)	Recovery (ft)	Water Sample Depth (ft)	Depth BGS (ft)	Lithology Description	Well Construction
7,9,9,14	2	1.2		5	0-10.7' Brown fine SAND, little medium and coarse sand, slightly moist	<p>Bentonite Grout at 0 to 117'</p> <p>2" dia. PVC Riser at -3' to 120.7'</p> <p>Filter Sand at 117' to 130'</p> <p>2" dia. 10-Slot PVC Screen at 120.7' to 125.7'</p> <p>Steel above ground protective casing set in concrete</p>
				10	Silty seam at 10.5'-10.7'	
11,11,21,23	2	1.2		15	10.7'-60.0' Light brown fine SAND, slightly moist	
				20		
				25		
8,12,14,24	2	1.2		30		
				35		
9,12,17,19	2	1.4		40		
				45	Wet at 47'	
4,3,5,8	2	1.3		50	Brown at 50'-60'	
				55		
0,6,6,8	2	1.9	61	60	60.0'-70.0' Brown fine SAND, trace medium sand, wet	
27,46,57,47	2	1.4	71	70	70.0'-100.0' Brown fine SAND, little medium to coarse sand, trace fine gravel, wet	
				75		
12,13,15,24	2	1.9	81	80		
				85		
8,10,10,14	2	0	91	90	Coarse sand and gravel seam at 90.8'-90.9'	
				95		
0,6,8,6	2	2	101	100	100.0'-105.0' Brown fine SAND, little medium to coarse sand, trace fine gravel, wet	
7,8,16	1.5	1.5		105	105.0'-115.0' Brown fine SAND, some medium sand, little coarse sand, trace fine gravel, wet	
10,13,24,40	2	2	111	110		
7,7,19,51	2	1.5		115	115.0'-128.0' Brown fine SAND, little medium to coarse sand, trace fine gravel, wet	
7,9,9,12	2	2		120	Seam of fine gravel, some medium to coarse sand and coarse gravel at 121.6'-122'.	
7,8,20,55	2	0		125		
NA	2	0.7		130	126'-130.0' Very stiff, brownish gray silty CLAY, little fine gravel and medium to coarse sand, slightly moist. End of boring at 130'	



Project Name: Central Sanitary Landfill	Start Date: 11-22-04
Project Number: 001-04-024	End Date: 11-22-04
Site Location: Pierson, Michigan	Logged By: Kurt Van Appledorn
Drilling Method: 4.25 ID HSA	Driller: EDAC
Sampling Method: N/A	Crew Chief: Emmerick
Ground Elevation (ft): 937.66	Depth to Water (ft BGS): 47
Top of Casing Elevation (ft): 940.24	Easting: 9421.8613
Comments: Lithology based on soil observed from MW-35d	Northing: 8298.3859

Blow Counts	Sample Length (ft)	Recovery (ft)	Water Sample Depth (ft)	Depth BGS (ft)	Lithology Description	Well Construction
				5	0-10.7' Brown fine SAND, little medium and coarse sand, slightly moist	
				10	Silty seam at 10.5'-10.7'	
				10.7'-60.0'	Light brown fine SAND, slightly moist	
				15		
				20		
				25		
				30		
				35		
				40		
				45	Wet at 47'	
				50	Brown at 50'-60'	
				55		
				60	60.0'-70.0' Brown fine SAND, trace medium sand, wet	
				65		
				70	70.0'-73.0' Brown fine SAND, little medium to coarse sand, trace fine gravel, wet	
				75	End of boring at 73'	
				80		
				85		
				90		
				95		
				100		
				105		
				110		
				115		
				120		
				125		
				130		

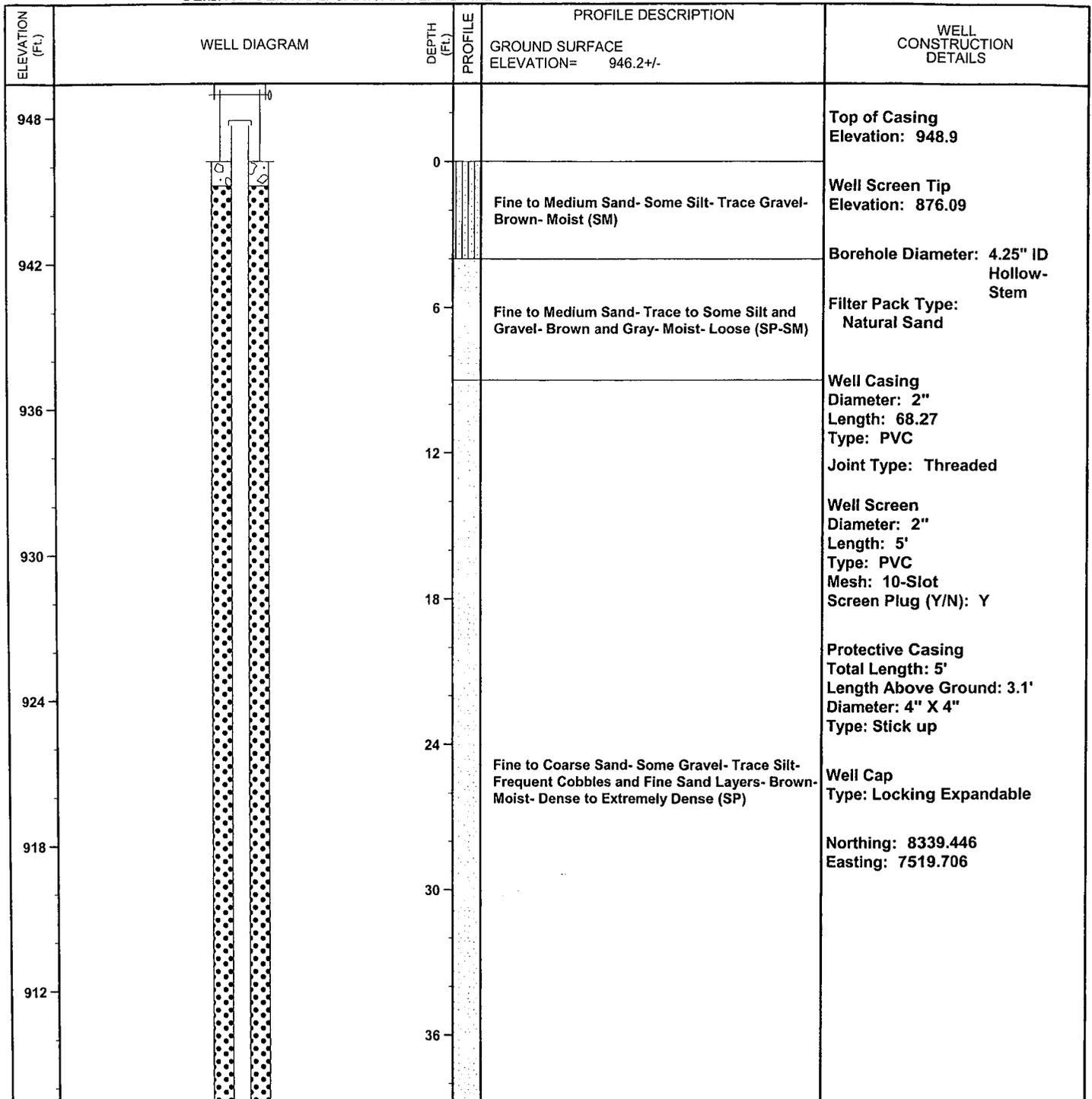


Blow Counts	Sample Length (ft)	Recovery (ft)	Lab Sample Depth (ft)	Depth BGS (ft)	Lithology Description	Well Construction
				48		
13 8 9 11	2	2		50		
				52		
12 9 12 15	2	2		54	54' - 64' Brown fine SAND, wet	
10 10 10 12	2	1.5		56		
4 10 9 10	2	2		58		
3 3 4 6	2	1.5		60		
7 10 12 20	2	2		62	- Trace medium sand and gravel seam at 61.8'	
5 8 12 15	2	2		64	64' - 66' Brown fine SAND, trace medium sand, wet	
4 4 3 3	2	2		66	66' - 68' Brown fine SAND, some medium to coarse sand, wet	
4 2 3 4	2	2		68	68' - 70' Brown fine SAND, trace medium to coarse sand, wet	
7 13 9 14	2	2		70	70' - 72' Brown fine SAND, some medium to coarse sand, wet, trace coarse sand and fine gravel at 71.5' - 72'	
9 5 7 7	2	2		72	72' - 74' Brown fine SAND, little medium sand, trace coarse sand and fine gravel, wet	
4 4 4 6	2	2		74	74' - 75' Brown fine SAND, trace med sand & fine gravel, wet	
25 6 6 16	2	1.8		76	75' - 76' Brown fine SAND, some medium sand to fine gravel, wet 76' - 77.5' Brown fine SAND with 2" fine to coarse sand seam, wet	
5 3 4 12	2	0.6		78	77.5' - 78' Brown clayey SILT, little fine sand, wet	
15 18 20 22	2	0.5		80	78' - 82' Grayish brown silty CLAY	
				82	End of boring at 82'	
				84		
				86		
				88		
				90		
				92		
				94		
				96		
				98		
				100		
				102		
				104		
				106		



MONITORING WELL
SME PROJECT No. KE41176F

PROJECT NAME: CENTRAL SANITARY LANDFILL
PROJECT LOCATION: PIERSON, MICHIGAN **BY:** NBB/MLB **DATE:** 3/20/07
CLIENT: CENTRAL SANITARY LANDFILL



WELL TYPE: Monitoring Well **DRILLING METHODS:** Hollow-Stem Augers
DRILLER: JV/RK
RIG NUMBER OR CONTRACTOR: ATV

Notes:

1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. PIEZOMETER P-34 WAS INSTALLED IN THE BOREHOLE.
3. MONITORING WELL WAS DEVELOPED BY PURGING APPROXIMATELY 25 GALLONS OF GROUNDWATER FROM WELL AND SURGING WITH AIR.

WATER LEVEL DATA

DATE	DEPTH (Feet)	COMMENTS
3/20/07	54.0	During Drilling
3/20/07	52.0	Upon Completion of Drilling
3/21/07	52.0	15 Hours After Completion of Drilling
3/20/07	51.9	



MONITORING WELL
SME PROJECT No. KE41176F

PROJECT NAME: CENTRAL SANITARY LANDFILL
PROJECT LOCATION: PIERSON, MICHIGAN **BY:** NBB/MLB **DATE:** 3/20/07
CLIENT: CENTRAL SANITARY LANDFILL

ELEVATION (FL)	WELL DIAGRAM	DEPTH (FL) PROFILE	PROFILE DESCRIPTION	WELL CONSTRUCTION DETAILS
906		42	GROUND SURFACE ELEVATION= 946.2+/-	Top of Casing Elevation: 948.9
900		48		Well Screen Tip Elevation: 876.09
894		54		Borehole Diameter: 4.25" ID Hollow-Stem
888		60	Fine to Coarse Sand- Trace to Some Silt- Trace Gravel- Frequent Cobbles and Fine Sand Layers- Brown- Moist to Wet- Dense to Loose (SP-SM)	Filter Pack Type: Natural Sand
882		66		Well Casing Diameter: 2" Length: 68.27 Type: PVC Joint Type: Threaded
876		72	Fine Sand- Trace Silt and Gravel- Brown- Wet- Medium Dense (SP)	Well Screen Diameter: 2" Length: 5" Type: PVC Mesh: 10-Slot Screen Plug (Y/N): Y
870		78	END OF BORING AT 71 FEET.	Protective Casing Total Length: 5' Length Above Ground: 3.1' Diameter: 4" X 4" Type: Stick up
				Well Cap Type: Locking Expandable
				Well Cap Type: Locking Expandable
				Well Cap Type: Locking Expandable

WELL TYPE: Monitoring Well **DRILLING METHODS:** Hollow-Stem Augers
DRILLER: JW/RK
RIG NUMBER OR CONTRACTOR: ATV

Notes:
1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. PIEZOMETER P-34 WAS INSTALLED IN THE BOREHOLE.
3. MONITORING WELL WAS DEVELOPED BY PURGING APPROXIMATELY 25 GALLONS OF GROUNDWATER FROM WELL AND SURGING WITH AIR.

WATER LEVEL DATA

DATE	DEPTH (Feet)	COMMENTS
3/20/07	54.0	During Drilling
3/20/07	52.0	Upon Completion of Drilling
3/21/07	52.0	15 Hours After Completion of Drilling
3/20/07	51.9	



MONITORING WELL
SME PROJECT No. KE41176F

PROJECT NAME: CENTRAL SANITARY LANDFILL
PROJECT LOCATION: PIERSON, MICHIGAN **BY:** NBB/MLB **DATE:** 3/15/07
CLIENT: CENTRAL SANITARY LANDFILL

ELEVATION (Ft.)	WELL DIAGRAM	DEPTH (Ft.)	PROFILE	PROFILE DESCRIPTION	WELL CONSTRUCTION DETAILS
954				GROUND SURFACE ELEVATION= 951.9+/-	
		0		Fine to Coarse Sand- Trace Silt and Gravel- Dark Brown- Moist (SP)	Top of Casing Elevation: 954.5
948		6		Silty Clay- Trace to Some Sand- Trace Root Fibers- Brown and Dark Brown- Stiff (CL)	Well Screen Tip Elevation: 872.22
942		12			Borehole Diameter: 4.25" ID Filter Pack Type: Natural Sand Well Casing Diameter: 2" Length: 5' Type: PVC Joint Type: Threaded
936		18		Fine to Medium Sand- Trace Silt and Gravel- Brown- Moist- Loose to Dense (SP)	Well Screen Diameter: 2" Length: 5' Type: PVC Mesh: 10-Slot Screen Plug (Y/N): Y
930		24			Protective Casing Total Length: 5' Length Above Ground: 3.0' Diameter: 4" X 4" Type: Stick up
924				Fine to Coarse Sand- Trace to Some Gravel- Trace Silt- Brown- Moist- Dense (SP)	Well Cap Type: Locking Expandable
918				Fine to Coarse Sand- Trace Silt, Gravel, and Cobbles- Brown- Moist- Dense to Medium Dense (SP)	Northing: 7173.883 Easting: 7312.524

WELL TYPE: Monitoring Well **DRILLING METHODS:** Hollow-Stem Augers
DRILLER: JV/RK
RIG NUMBER OR CONTRACTOR: ATV

Notes:

1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. PIEZOMETER P-35 WAS INSTALLED IN THE BOREHOLE.
3. MONITORING WELL WAS DEVELOPED BY PURGING APPROXIMATELY 60 GALLONS OF GROUNDWATER FROM WELL AND SURGING WITH AIR.
4. END OF BORING AT 81 FEET.

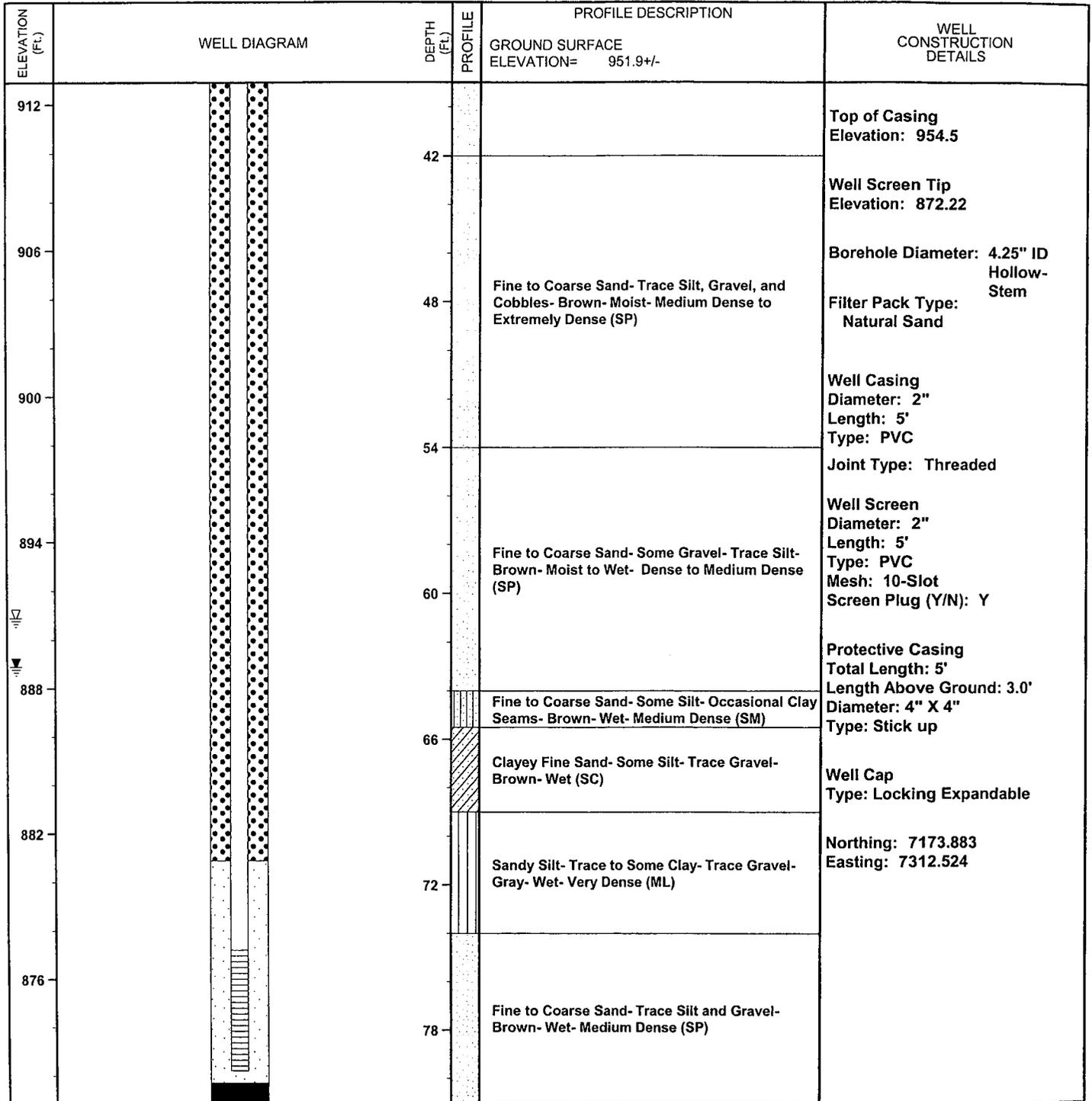
WATER LEVEL DATA

DATE	DEPTH (Feet)	COMMENTS
3/15/07	63.0	During Drilling
3/15/07	61.0	Upon Completion of Drilling
3/16/07	61.0	18 Hours After completion of Drilling
3/20/07	57.9	



MONITORING WELL
SME PROJECT No. KE41176F

PROJECT NAME: CENTRAL SANITARY LANDFILL
 PROJECT LOCATION: PIERSON, MICHIGAN BY: NBB/MLB DATE: 3/15/07
 CLIENT: CENTRAL SANITARY LANDFILL



WELL TYPE: Monitoring Well DRILLING METHODS: Hollow-Stem Augers
 DRILLER: JV/RK
 RIG NUMBER OR CONTRACTOR: ATV

Notes:

1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. PIEZOMETER P-35 WAS INSTALLED IN THE BOREHOLE.
3. MONITORING WELL WAS DEVELOPED BY PURGING APPROXIMATELY 60 GALLONS OF GROUNDWATER FROM WELL AND SURGING WITH AIR.
4. END OF BORING AT 81 FEET.

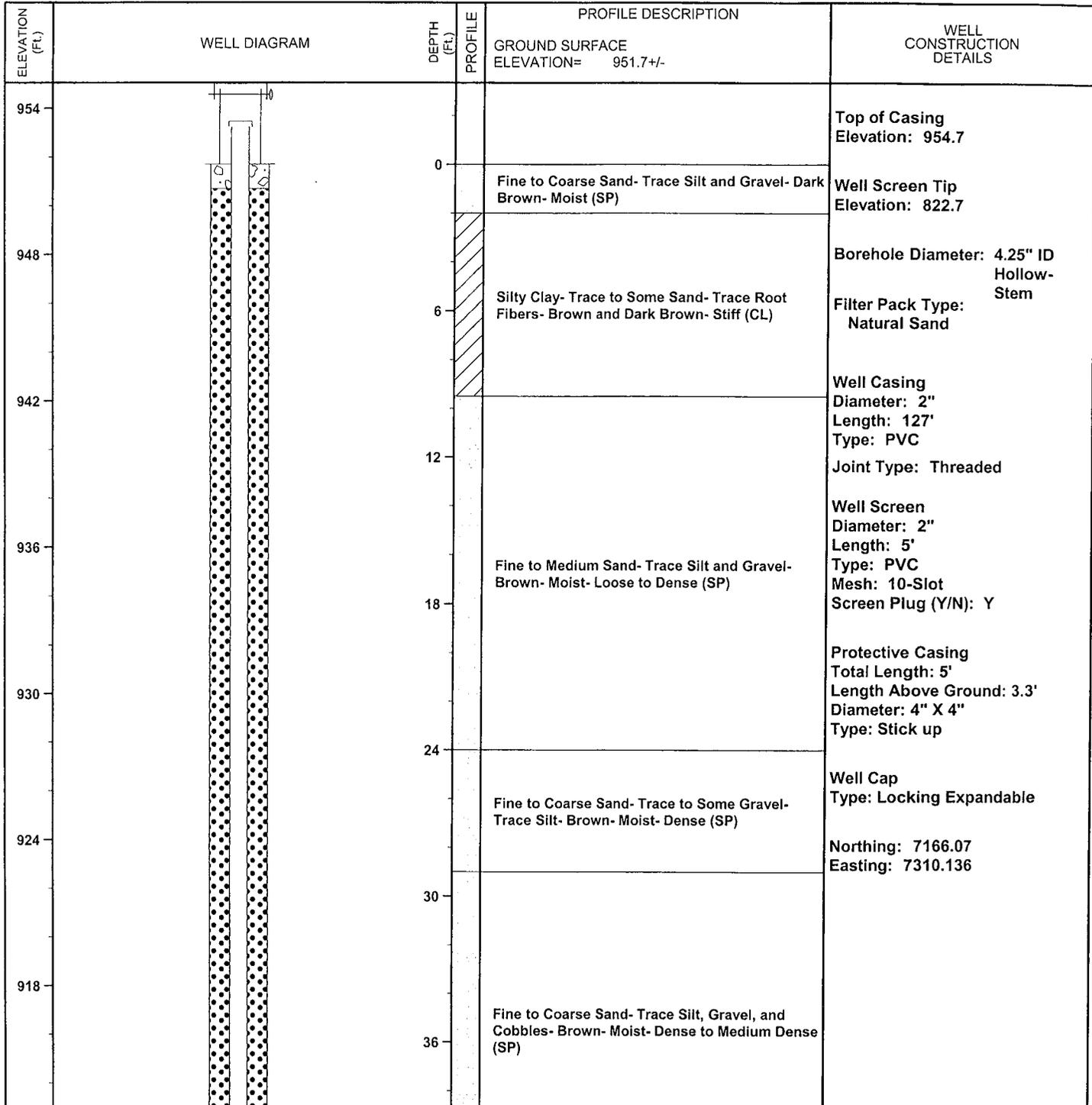
WATER LEVEL DATA

DATE	DEPTH (Feet)	COMMENTS
3/15/07	63.0	During Drilling
3/15/07	61.0	Upon Completion of Drilling
3/16/07	61.0	18 Hours After completion of Drilling
3/20/07	57.9	



MONITORING WELL
SME PROJECT No. KE41176F

PROJECT NAME: CENTRAL SANITARY LANDFILL
 PROJECT LOCATION: PIERSON, MICHIGAN BY: NBB/MLB DATE: 3/16/07
 CLIENT: CENTRAL SANITARY LANDFILL



WELL TYPE: Monitoring Well DRILLING METHODS: Hollow-Stem Augers
 DRILLER: JV/RK
 RIG NUMBER OR CONTRACTOR: ATV

Notes:

1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. SOIL STRATIGRAPHY FROM 0 TO 81 FEET BELOW THE EXISTING GROUND SURFACE WAS TAKEN FROM ADJACENT BORING P-35.
3. PIEZOMETER P-36 WAS INSTALLED IN THE BOREHOLE on 3/16/07.
4. MONITORING WELL WAS DEVELOPED BY PURGING APPROXIMATELY 80 GALLONS OF GROUNDWATER FROM WELL AND SURGING WITH AIR.

WATER LEVEL DATA		
DATE	DEPTH (Feet)	COMMENTS
3/16/07	63.0	During Drilling
3/16/07	61.0	Upon Completion of Drilling
3/17/07	61.0	18 Hours After Completion of Drilling
3/20/07	57.2	



MONITORING WELL
SME PROJECT No. KE41176F

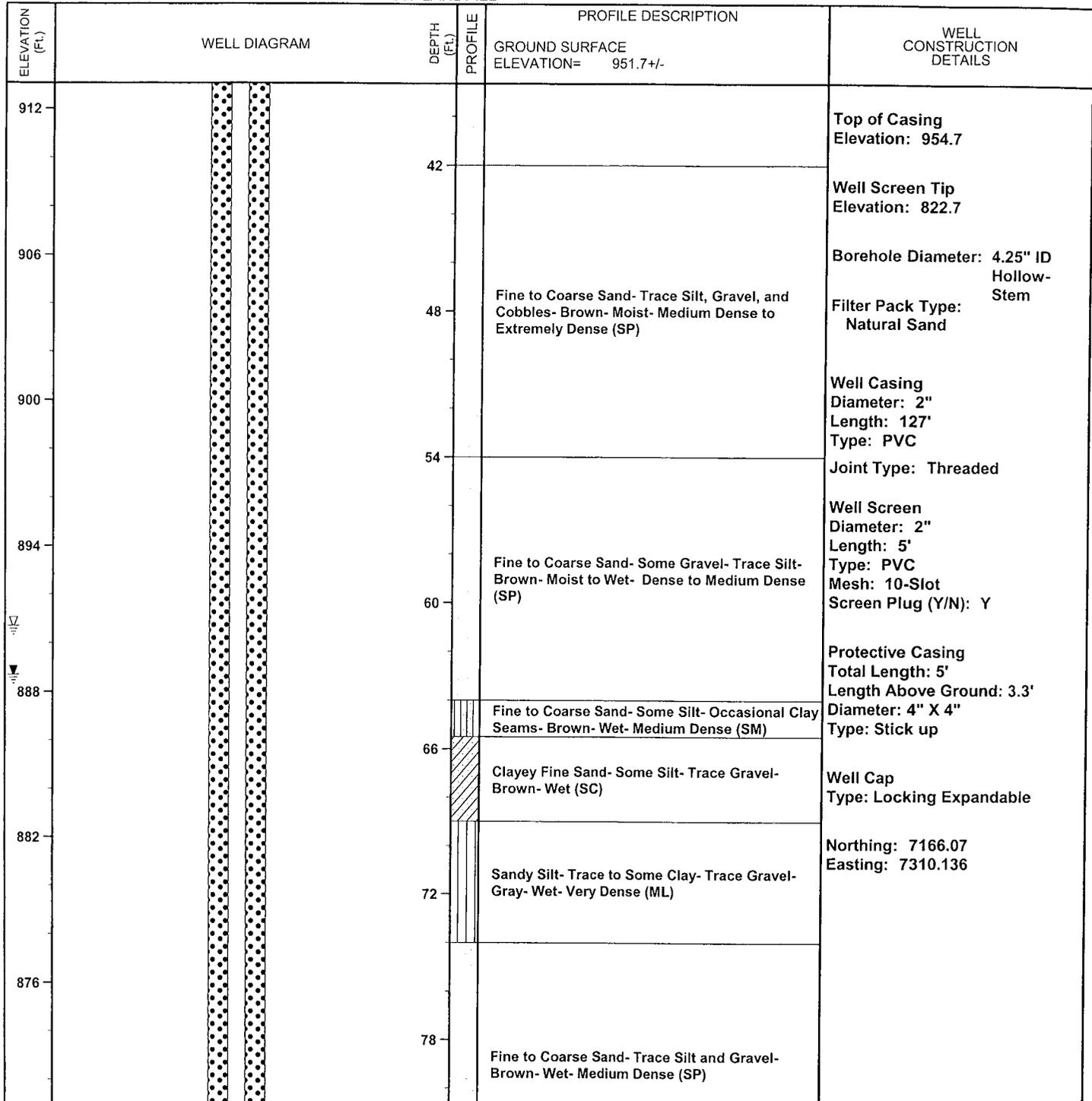
PROJECT NAME: CENTRAL SANITARY LANDFILL

PROJECT LOCATION: PIERSON, MICHIGAN

BY: NBB/MLB

DATE: 3/16/07

CLIENT: CENTRAL SANITARY LANDFILL



WELL TYPE: Monitoring Well DRILLING METHODS: Hollow-Stem Augers
 DRILLER: JV/RK
 RIG NUMBER OR CONTRACTOR: ATV

Notes:
 1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
 2. SOIL STRATIGRAPHY FROM 0 TO 81 FEET BELOW THE EXISTING GROUND SURFACE WAS TAKEN FROM ADJACENT BORING P-35.
 3. PIEZOMETER P-36 WAS INSTALLED IN THE BOREHOLE on 3/16/07.
 4. MONITORING WELL WAS DEVELOPED BY PURGING APPROXIMATELY 80 GALLONS OF GROUNDWATER FROM WELL AND SURGING WITH AIR.

WATER LEVEL DATA		
DATE	DEPTH (Feet)	COMMENTS
3/16/07	63.0	During Drilling
3/16/07	61.0	Upon Completion of Drilling
3/17/07	61.0	18 Hours After Completion of Drilling
3/20/07	57.2	



MONITORING WELL

SME PROJECT No. KE41176F

PROJECT NAME: CENTRAL SANITARY LANDFILL
 PROJECT LOCATION: PIERSON, MICHIGAN BY: NBB/MLB DATE: 3/16/07
 CLIENT: CENTRAL SANITARY LANDFILL

ELEVATION (FT.)	WELL DIAGRAM	DEPTH (FT.)	PROFILE	PROFILE DESCRIPTION	WELL CONSTRUCTION DETAILS
				GROUND SURFACE ELEVATION= 951.7+/-	
870					Top of Casing Elevation: 954.7
		84		Fine to Coarse Sand- Trace Silt and Gravel- Brown- Wet- Very Loose (SP)	Well Screen Tip Elevation: 822.7
864			90		Borehole Diameter: 4.25" ID Hollow-Stem
					Filter Pack Type: Natural Sand
858			96	Fine to Medium Sand- Trace Silt and Gravel- Brown- Wet- Medium Dense to Dense (SP)	Well Casing Diameter: 2" Length: 127' Type: PVC
					Joint Type: Threaded
852			102	Fine Sand- Trace to Some Silt- Trace Gravel- Occasional Sandy Silty Seams- Gray- Wet- Medium Dense to Loose (SP-SM)	Well Screen Diameter: 2" Length: 5' Type: PVC Mesh: 10-Slot Screen Plug (Y/N): Y
846			108		Protective Casing Total Length: 5' Length Above Ground: 3.3' Diameter: 4" X 4" Type: Stick up
840			114	Fine Sand- Trace to Some Silt- Trace Gravel- Occasional Sandy Silty Seams- Gray- Wet- Medium Dense to Loose (SP-SM)	Well Cap Type: Locking Expandable
834			120		Northing: 7166.07 Easting: 7310.136
				See Next Page for Description	

WELL TYPE: Monitoring Well DRILLING METHODS: Hollow-Stem Augers
 DRILLER: JV/RK
 RIG NUMBER OR CONTRACTOR: ATV

Notes:

1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. SOIL STRATIGRAPHY FROM 0 TO 81 FEET BELOW THE EXISTING GROUND SURFACE WAS TAKEN FROM ADJACENT BORING P-35.
3. PIEZOMETER P-36 WAS INSTALLED IN THE BOREHOLE on 3/16/07.
4. MONITORING WELL WAS DEVELOPED BY PURGING APPROXIMATELY 80 GALLONS OF GROUNDWATER FROM WELL AND SURGING WITH AIR.

WATER LEVEL DATA		
DATE	DEPTH (Feet)	COMMENTS
3/16/07	63.0	During Drilling
3/16/07	61.0	Upon Completion of Drilling
3/17/07	61.0	18 Hours After Completion of Drilling
3/20/07	57.2	



MONITORING WELL
SME PROJECT No. KE41176F

PROJECT NAME: CENTRAL SANITARY LANDFILL
PROJECT LOCATION: PIERSON, MICHIGAN **BY:** NBB/MLB **DATE:** 3/14/07
CLIENT: CENTRAL SANITARY LANDFILL

ELEVATION (Ft.)	WELL DIAGRAM	DEPTH (Ft.)	PROFILE	PROFILE DESCRIPTION	WELL CONSTRUCTION DETAILS
				GROUND SURFACE ELEVATION= 932.1+/-	
930		0			Top of Casing Elevation: 934.8
		6		Clayey Fine to Medium Sand- Some Silt- Trace Gravel- Gray and Brown- Moist (SC)	Well Screen Tip Elevation: 870.3
924		12		Fine to Medium Sand- Trace to Some Silt- Trace Gravel- Brown- Moist- Medium Dense to Loose (SP-SM)	Borehole Diameter: 4.25" ID Hollow-Stem Filter Pack Type: Natural Sand
918		18		Clayey Fine to Medium Sand- Some Silt- Trace Gravel- Brown- Moist- Loose (SC)	Well Casing Diameter: 2" Length: 60 Type: PVC Joint Type: Threaded
912		24		Fine to Medium Sand- Trace Silt and Gravel- Brown- Moist- Medium Dense (SP)	Well Screen Diameter: 2" Length: 5' Type: PVC Mesh: 10-Slot Screen Plug (Y/N): Y
906		30		Fine Sand- Trace Silt- Brown- Moist- Medium Dense to Dense (SP)	Protective Casing Total Length: 5' Length Above Ground: 3.1' Diameter: 4" X 4" Type: Stick up
900		36		Fine to Medium Sand- Trace Silt- Brown- Moist to Wet- Dense (SP)	Well Cap Type: Locking Expandable
894					Well Cap Type: Locking Expandable Northing: 7150.263 Easting: 8619.501

WELL TYPE: Monitoring Well **DRILLING METHODS:** Hollow-Stem Augers
DRILLER: JV/RK
RIG NUMBER OR CONTRACTOR: ATV

Notes:
 1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
 2. PIEZOMETER P-37 WAS INSTALLED IN THE BOREHOLE ON 3/19/07.
 3. MONITORING WELL WAS DEVELOPED BY PURGING APPROXIMATELY 75 GALLONS OF GROUNDWATER FROM WELL AND SURGING WITH AIR.

WATER LEVEL DATA		
DATE	DEPTH (Feet)	COMMENTS
3/14/07	43.0	During Drilling
3/14/07	41.0	Upon Completion of Drilling
3/15/07	41.0	17 Hours After Completion of Drilling
3/20/07	38.2	



MONITORING WELL
SME PROJECT No. KE41176F

PROJECT NAME: CENTRAL SANITARY LANDFILL

PROJECT LOCATION: PIERSON, MICHIGAN

BY: NBB/MLB

DATE: 3/14/07

CLIENT: CENTRAL SANITARY LANDFILL

ELEVATION (FL)	WELL DIAGRAM	DEPTH (FL)	PROFILE	PROFILE DESCRIPTION	WELL CONSTRUCTION DETAILS	
				GROUND SURFACE ELEVATION= 932.1+/-		
888		42		Fine to Medium Sand- Trace Silt- Brown- Moist to Wet- Dense (SP)	Top of Casing Elevation: 934.8 Well Screen Tip Elevation: 870.3	
882		48		Sandy Silt- Trace Clay- Brown- Wet- Medium Dense (ML)	Borehole Diameter: 4.25" ID Hollow-Stem Filter Pack Type: Natural Sand	
876		54		Fine to Medium Sand- Trace Silt- Occasional Clay Layers- Brown- Wet- Medium Dense to Loose (SP)	Well Casing Diameter: 2" Length: 60 Type: PVC Joint Type: Threaded	
870		60		Fine to Medium Sand- Trace Silt and Gravel- Brown- Wet- Loose (SP)	Well Screen Diameter: 2" Length: 5' Type: PVC Mesh: 10-Slot Screen Plug (Y/N): Y	
					END OF BORING AT 61 FEET.	Protective Casing Total Length: 5' Length Above Ground: 3.1' Diameter: 4" X 4" Type: Stick up
864			66			Well Cap Type: Locking Expandable
858		72			Northing: 7150.263 Easting: 8619.501	
852		78				

WELL TYPE: Monitoring Well DRILLING METHODS: Hollow-Stem Augers
 DRILLER: JV/RK
 RIG NUMBER OR CONTRACTOR: ATV

Notes:

1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. PIEZOMETER P-37 WAS INSTALLED IN THE BOREHOLE ON 3/19/07.
3. MONITORING WELL WAS DEVELOPED BY PURGING APPROXIMATELY 75 GALLONS OF GROUNDWATER FROM WELL AND SURGING WITH AIR.

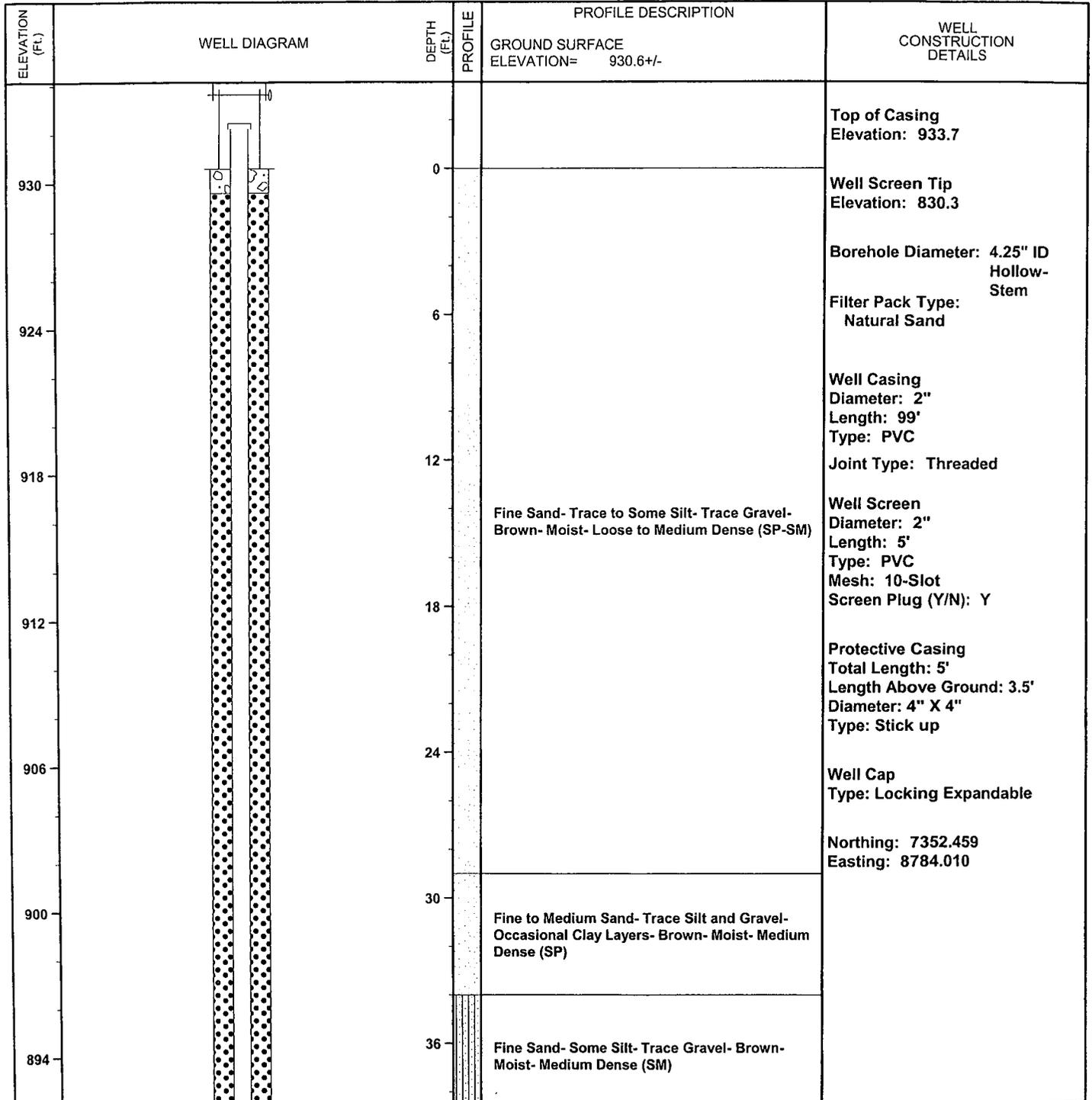
WATER LEVEL DATA

DATE	DEPTH (Feet)	COMMENTS
3/14/07	43.0	During Drilling
3/14/07	41.0	Upon Completion of Drilling
3/15/07	41.0	17 Hours After Completion of Drilling
3/20/07	38.2	



MONITORING WELL
SME PROJECT No. KE41176F

PROJECT NAME: CENTRAL SANITARY LANDFILL
PROJECT LOCATION: PIERSON, MICHIGAN **BY:** NBB/MLB **DATE:** 3/13/07
CLIENT: CENTRAL SANITARY LANDFILL



WELL TYPE: Monitoring Well **DRILLING METHODS:** Hollow-Stem Augers
DRILLER: JV/RK
RIG NUMBER OR CONTRACTOR: ATV

Notes:

1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. PIEZOMETER P-38 WAS INSTALLED IN THE BOREHOLE.
3. MONITORING WELL WAS DEVELOPED BY PURGING APPROXIMATELY 75 GALLONS OF GROUNDWATER FROM WELL AND SURGING WITH AIR.

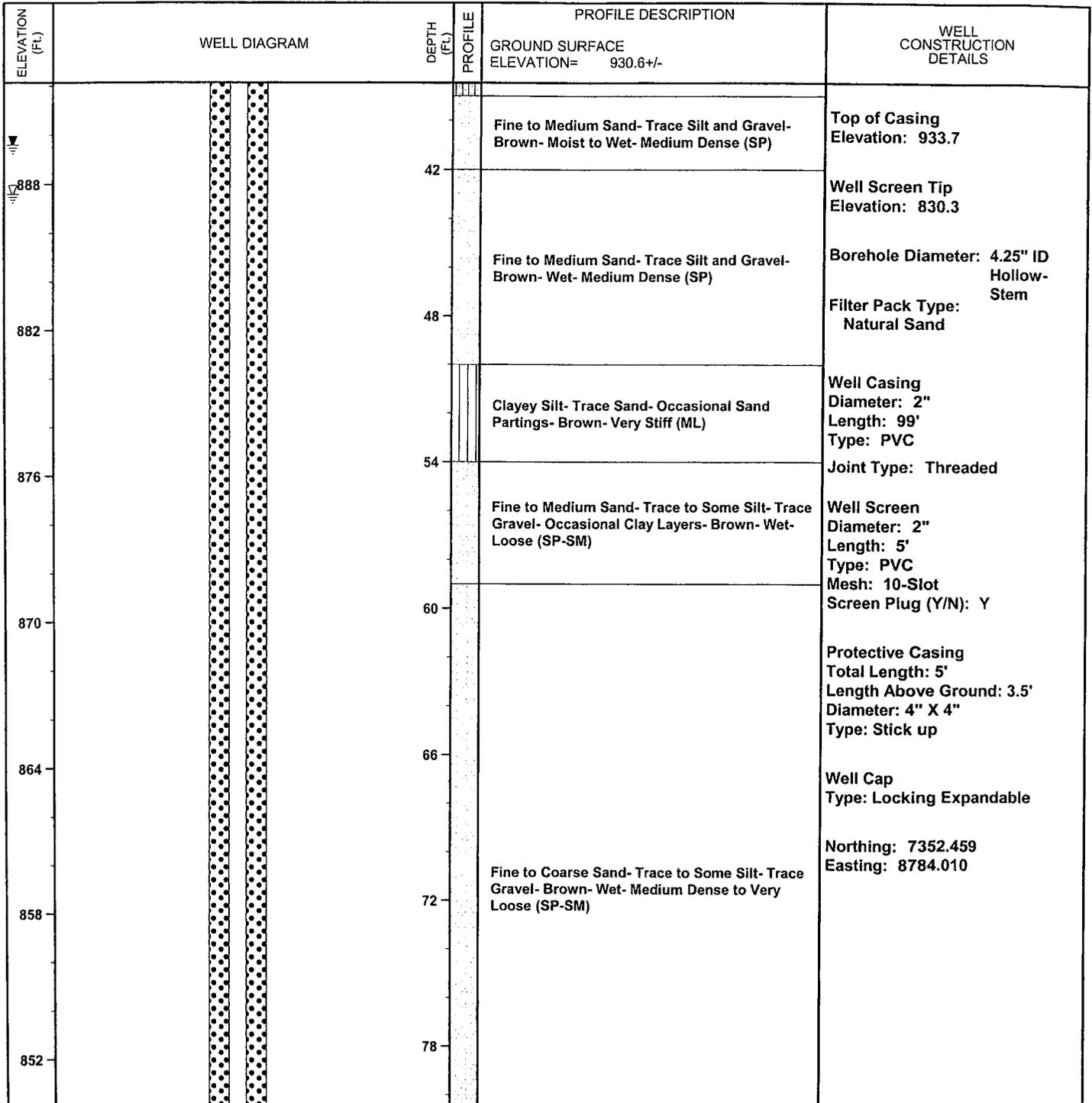
WATER LEVEL DATA

DATE	DEPTH (Feet)	COMMENTS
3/13/07	41.0	During Drilling
3/13/07	43.0	Upon Completion of Drilling
3/14/07	40.0	16 Hours After Completion of Drilling
3/20/07	36.6	



MONITORING WELL
SME PROJECT No. KE41176F

PROJECT NAME: CENTRAL SANITARY LANDFILL
 PROJECT LOCATION: PIERSON, MICHIGAN BY: NBB/MLB DATE: 3/13/07
 CLIENT: CENTRAL SANITARY LANDFILL



WELL TYPE: Monitoring Well DRILLING METHODS: Hollow-Stem Augers
 DRILLER: JV/RK
 RIG NUMBER OR
 CONTRACTOR: ATV

Notes:

1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. PIEZOMETER P-38 WAS INSTALLED IN THE BOREHOLE.
3. MONITORING WELL WAS DEVELOPED BY PURGING APPROXIMATELY 75 GALLONS OF GROUNDWATER FROM WELL AND SURGING WITH AIR.

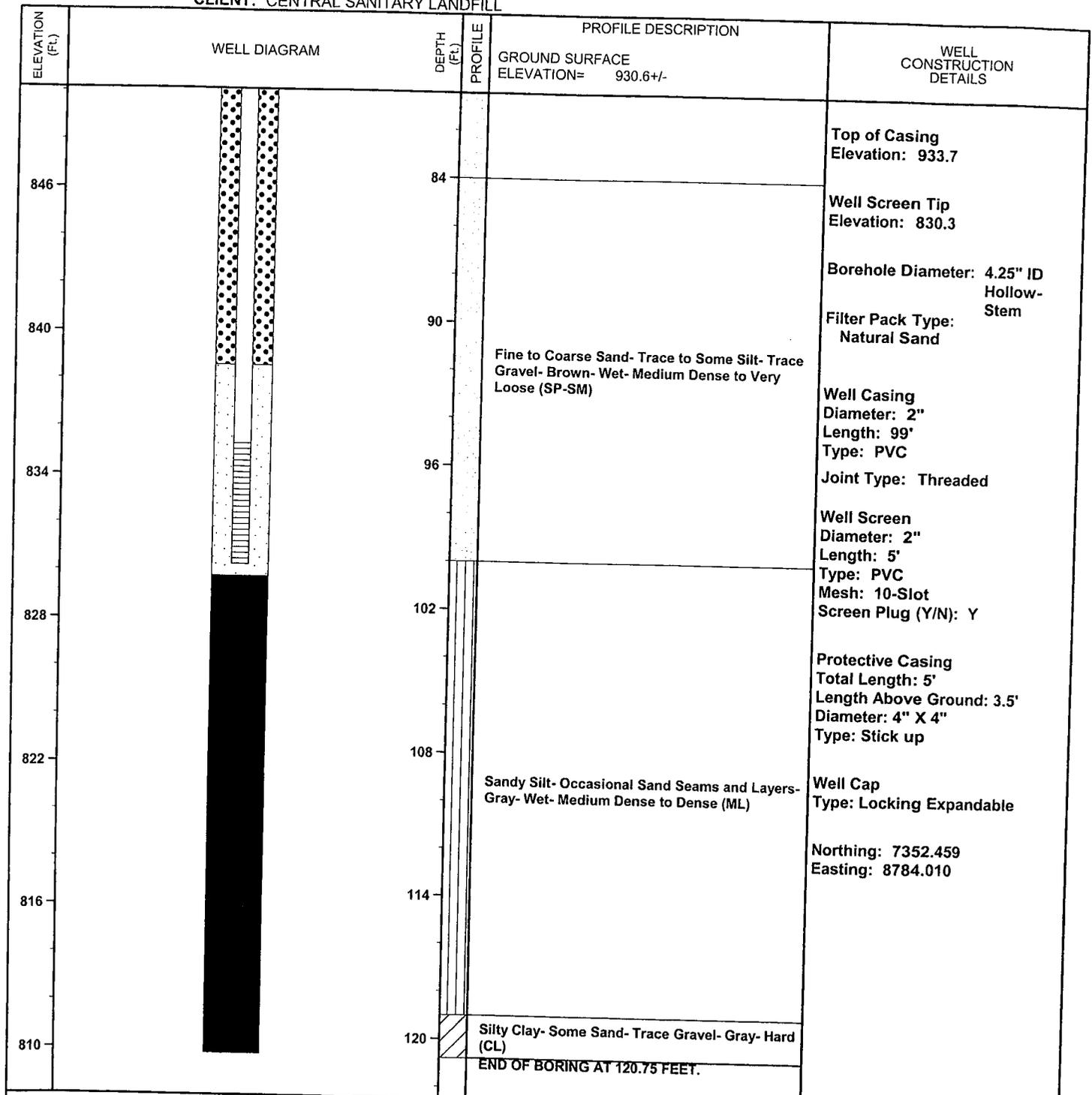
WATER LEVEL DATA

DATE	DEPTH (Feet)	COMMENTS
3/13/07	41.0	During Drilling
3/13/07	43.0	Upon Completion of Drilling
3/14/07	40.0	16 Hours After Completion of Drilling
3/20/07	36.6	



MONITORING WELL
SME PROJECT No. KE41176F

PROJECT NAME: CENTRAL SANITARY LANDFILL
PROJECT LOCATION: PIERSON, MICHIGAN **BY:** NBB/MLB **DATE:** 3/13/07
CLIENT: CENTRAL SANITARY LANDFILL



WELL TYPE: Monitoring Well **DRILLING METHODS:** Hollow-Stem Augers
DRILLER: JV/RK
RIG NUMBER OR CONTRACTOR: ATV

Notes:

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WATER LEVEL DATA

DATE	DEPTH (Feet)	COMMENTS
3/13/07	41.0	During Drilling
3/13/07	43.0	Upon Completion of Drilling
3/14/07	40.0	16 Hours After Completion of Drilling
3/20/07	36.6	

Appendix H
*Operation and Maintenance Plan for the
Groundwater Remediation System*

Operation and Maintenance Plan
for the
Groundwater Remediation System
Central Sanitary Landfill

Prepared for:

Central Sanitary Landfill
21545 Cannonsville Road
Pierson, Michigan

Prepared by:

Engineering & Environmental Solutions, LLC
400 136th Avenue, Building 100, Suite B
Holland, Michigan 49424

February 2013

1.0 INTRODUCTION

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2.2 Process Instrumentation

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2.2.2 Motor Controllers for Purge Wells

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2. Site Map
3. VOC Plume Map

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- A Groundwater Treatment System Record Drawings/Purge Well Information
- B Renewable Operating Permit
- C Manufacturers Information Regarding Electric Well Pumps
- D Manufacturers Information Regarding Air Stripper
- E Manufacturers Information Regarding Flow Meters, Flow Sensors and Flow Totalizers
- F Manufacturers Information Regarding Motor Controllers
- G Manufacturers Information Regarding Electric Panels and Controls

1.0 INTRODUCTION

The Operation and Maintenance Plan (O&M Plan) was prepared by Engineering & Environmental Solutions, LLC on behalf of the Central Sanitary Landfill. A site location map is presented as Figure 1. The purpose of the O&M Plan is to provide a description of the performance standards and operation and maintenance procedures for the groundwater pump and treat system at the Central Sanitary Landfill, Pierson, Michigan. Troubleshooting guidelines and monitoring procedures for the system are also provided.

The groundwater pump and treat system will be operated in partial fulfillment of Central Sanitary Landfill's remedial obligations. The following information is provided in the O&M Plan:

- A description of the performance objectives/standards for the groundwater pump and treat system, as well as, the monitoring, record keeping, and reporting required to document compliance.
- A description of the groundwater pump and treat system, including engineering design plans, specifications, and a sequence of system operations.
- A description of normal operation and maintenance of the system, including a summary of the specific tasks that will be required to be performed to maintain normal system operation and the schedule upon which the tasks are to be performed.
- A description of the potential operating problems and their possible causes, as well as troubleshooting guidelines.
- A description of the corrective actions to be taken in the event that treatment system performance standards are not met.
- A description of potential exposures, precautions to be taken by operation personnel, emergency response measures, and emergency contacts.
- The names, telephone numbers, and addresses of the persons responsible for operation and maintenance activities.

2.0 SYSTEM DESCRIPTION

The groundwater pump and treat system is intended to provide capture and treatment of groundwater impacted with volatile organic compounds (VOCs). Groundwater is the only potential exposure route identified for the site. Current monitoring results indicate that impacted groundwater associated with the VOC plume has not migrated off-site. A groundwater flow model prepared as part of this Remedial Action Plan (Appendix D of the RAP) shows impacted groundwater captured by three existing purge wells. This scenario includes the use of three purge wells (PW-5R, PW-6, and PW-7R; Figure 2) along with a treatment water infiltration basin. The infiltration basin was located to serve as an additional hydraulic barrier to eastward migration of VOCs while remaining above the VOC plume. The lateral extent of the VOC plume is shown on Figure 3. The proposed pumping scenario maximizes capture of the existing VOC plume while minimizing the potential for drawing contamination further from the known source. Details of the performance objectives and groundwater protection standards are provided in the site's Remedial Action Plan.

The groundwater pump and treat system includes purge wells PW-5R, PW-6 and PW-7R; a bag filter used to filter iron and particulates from purged groundwater; an air-stripper to treat purged groundwater; and an effluent infiltration pond located above the VOC plume. An isoconcentration map for total VOCs (Figure 3) shows the extent of the VOC plume at the site. Purge well construction logs and the remediation system layout are provided in Attachment A. The purge wells are recommended to operate between 20 and 30 gallons per minute (gpm) for a total groundwater extraction rate of approximately 60 to 90 gpm. Extracted groundwater will be routed to the air stripping system for treatment and discharged to the water infiltration basin (Figure 2). Air emissions from the air stripper are discharged to the atmosphere. The site's Renewable Operating Permit is provided in Attachment B.

2.1 Process Equipment

2.1.1 Electric Well Pumps

Grundfos(model #25S15-9) 4-inch diameter submersible pumps with Franklin Electric (model #234524) 4-inch diameter submersible motors (three-phase, 460 volt) have been installed in the groundwater purge wells. Manufacturer's information regarding the well pumps, including recommended operation and maintenance procedures, is provided in Attachment C.

2.1.2 Air Stripper

The groundwater that is treated is pumped into a EZ-Tray air stripper (model # EZ-12.6ss) manufactured by QED Environmental Systems. The normal operating range of the air stripper is 01 to 120 gpm. Manufacturers' information regarding the air stripper, including recommended O&M procedures, is provided in the System Operation and Maintenance Manual (Attachment D).

The air stripper package is equipped with a control panel for blower and discharge pump controls, and a main disconnect switch with alarm interlocks, blower low pressure alarm switch and sump high-high level alarm switch.

The low-profile air stripper package is designed for ease of maintenance. If oxidized iron or hardness buildup begins to foul the trays, the trays will be removed and cleaned with a pressure washer. Proper cleaning instructions are provided in the QED "System Operation and Maintenance Manual" (Attachment B) starting on page 14. The trays can also be removed for thorough inspection and cleaning.

2.2 Process Instrumentation

The groundwater pump and treat system consists of three groundwater purge wells (PW-5R, PW-6, and PW-7R) equipped with submersible electric pumps. The groundwater electric pumps have an individual control system to turn the pumps on and off. The air stripper is a package system and has its own control system. This panel is interlocked into the main control panel so that when the air stripper shuts down the electric well pumps will automatically shut-down. The air stripper and electric well pumps will shut down if either of the following occurs:

1. Air Stripper Blower Low Pressure - Deactivates groundwater purge system at critically low pressure indicating blower malfunction. A STAT blower low pressure alarm will light on the process control panel.
2. Air Stripper Sump High-High Level - Deactivates groundwater purge system at critically high level indicating discharge line obstructed. A STAT sump high-high level alarm will light on the process control panel.

Instrumentation used in the system is described in detail below.

2.2.1 Turbine Meters and Flow Totalizers

A Blancett Turbine Flow Meter (Model 1100) and battery powered Blancett flow totalizers (Model 2800) are provided for measurement of the flow rate and GPM total for each groundwater purge well. A secondary Blancett Turbine Flow Meter (Model 1100) and battery powered Blancett flow totalizers (Model 2800) is provided for measurement of the combined flow from all purge wells prior to entering the air stripping unit. Manufacturer's information regarding the flow meter, flow sensors and totalizers is provided in Attachment E.

2.2.2 Motor Controllers for Purge Wells

The starters for the purge wells are Square D series (model #8536). The Relays for the purge wells are Square D Motor Logic series (model #9065). Electronic motor protection relays are installed for each groundwater purge well. The motor protectors (Model #5250) are manufactured by Greenlee, a subsidiary of Textron Inc. Manufacturer's information regarding the motor controllers is provided in Attachment F.

2.2.3 Electronic Purge Well Pump Controls

The Purge Well Pumps are controlled through the use of the main breaker system in the Siemens 250 p1 panel. The purge wells controls can be overridden if the QED air stripper Air Stripper Blower Low Pressure alarm activates, or the Air Stripper Sump High-High Level activates.

Manufactures' information regarding startup and shutdown of the purge well pump controls is provided in Attachment G, and Attachment D of the QED Manual regarding the electronic pump High level control system and Blower Low Pressure.

2.3 Ancillary Equipment

Supporting systems installed as part of the groundwater pump and treat system includes transmission piping cleanouts, electrical utility services, and electrical equipment. Additional detail regarding this equipment is provided in this section.

2.3.1 Control Panels/Utility Service

The treatment system is equipped with 2 main electrical panels. One panel is a 200 amp 3 Phase 480 volt panel. The 3 Phase 480 volt power is supplied to the pump and treat building directly from the local electric company. The second panel is a 200 amp single

phase 120/240 volt panel. The single phase 120/240 volt panel gets its power supply through a step down transformer (model #15S1H) located inside the pump and treat building. Power is supplied to the purge well pumps and air stripper by these electrical panels.

Manufactures' for all 3 electrical panels are provided in Attachment G.

2.3.2 Transmission Piping and Cleanouts

The treatment system is equipped with 4" HDPE pipe from each purge well to the pump and treat building. Transmission piping is shown on the Remediation System Site Map (Attachment A). A cleanout access point is located directly at each purge well on the transmission piping header to allow for periodic maintenance. The cleanouts consist of a four-inch diameter HDPE pipe extending approximately one foot above grade that connects to the header at a 45 degree angle.

3.0 OPERATIONAL PROCEDURES

The sequence of operations for the groundwater pump and treat system is as follows:

3.1 Start-Up Procedures

Operations personnel should use the following procedure for routine startup of the system:

1. Verify that all piping is connected and valves are in their proper open/close position.
2. Verify that all well pump control switches are in the "OFF" position.
3. Energize the groundwater pump and treat system by manually setting the primary electrical disconnect to the "ON" position.
4. Switch the blower control switch to the "AUTO" position.
5. Switch the air stripper pump to the "AUTO" position.
6. Switch the purge well pump control switches to the "ON" position.
7. Verify the flow meters are working and that water is flowing from the purge wells.
8. Verify the air stripper pump turns on and off automatically.

3.2 Automatic "Emergency" Shutdown Conditions

The system will operate continuously until the system is manually shut down or one of the following events occurs:

- In the event of a low pressure alarm in the air stripper, the system will shut down. If this condition occurs the following light will be illuminated on the air stripper control panel **STAT BLOWER LOW PRESSURE ALARM**.
- In the event of a high water level in the air stripper sump, the system will shut down to prevent overflow in the air stripper. If this condition occurs the following light will be illuminated on the air stripper control panel **STAT SUMP HIGH-HIGH LEVEL ALARM**.

3.3 Emergency Shutdown Procedure

Switching the primary electrical disconnect to the "OFF" position will shut down the entire treatment system.

3.4 Routine Shutdown Procedure

If the system needs to be shut down for any routine procedure, the following procedure should be followed:

1. Switch the purge well pump controls to the "OFF" position.
2. Switch the air stripper pump controls to the "OFF" position.
3. Switch the blower control switch to the "OFF" position.
4. The system is now shut down and the routine inspection / procedure may be performed.

3.5 Extended Shutdown Procedure

If the system is going to be shut down for an extended period of time (i.e., one week or more), the following procedure should be followed:

1. Switch the purge well pump controls to the "OFF" position.
2. Switch the air stripper pump controls to the "OFF" position.
3. Switch the blower control switch to the "OFF" position.
4. The system is now shut down and the primary electrical disconnect may be switched to the "OFF" position to assure safety while the necessary maintenance is performed on the system.

4.0 *SYSTEM TROUBLESHOOTING GUIDELINES*

Potential problems may be encountered during operation of the groundwater pump and treat system. For solutions and further details refer to the operation and maintenance information in the manufacturers' instructions included in the Attachments to this O&M Plan.

5.0 *ROUTINE SYSTEM MAINTENANCE*

Routine maintenance of the groundwater pump and treat system is required to ensure efficient, reliable operation of the system. A brief description of routine maintenance requirements for major pieces of equipment is included in this section. Detailed maintenance procedures are included with manufacturer literature provided in the attachments.

5.1 **Groundwater Purge Wells**

The groundwater purge wells (PW-5R, PW-6, and PW-7R) will be inspected on a quarterly basis to verify that they are in proper operating condition. The covers will be inspected for cracks, damage from site operations. On a biweekly basis (i.e., twice per week), operations personnel will verify that each groundwater extraction pump is operating. Operations personnel will also note the flow rate and totalizer reading for each groundwater purge pump on a weekly basis. The following is the procedure that will be followed to address malfunction of a purge well.

1. If a purge well fails to produce the required volume of groundwater CSL will conduct the following activities.
 - The flow meter will be removed, inspected and cleaned or replaced.
 - If, after flow meter removal, inspection, and cleaning or replacement, the groundwater extraction rate still does not meet the required rate, the well pump and riser piping will be removed, inspected and cleaned or replaced.
 - Notify the MDEQ describing additional steps (including timeframe) to be completed to resolve problem, if necessary.
2. If the flow rate from a purge well still does not meet the required rate, the following activities will be completed.
 - The well will be redeveloped by a well drilling firm. Groundwater purge wells will be redeveloped with an oxidizer solution, acid, or other appropriate methods.
3. If, after well redevelopment the flow rate remains inadequate, a well drilling contractor will be scheduled to install a replacement purge well.

5.2 Process Equipment

5.2.1 Submersible Groundwater Extraction Pumps

In order to inspect a submersible groundwater extraction pump, the pump needs to be removed from the well. Maintenance requirements of the pumps may include acid washing to remove precipitates, replacement of seals, cleaning of inlet strainers, and removal of blockage from the integral check valves. Inspection and maintenance of the groundwater extraction pumps will be performed on an as-needed basis.

5.2.2 Purge Well Redevelopment

Iron fouling and iron bacteria buildup on the purge wells and flow meters can reduce the efficiency of the recovery system and reduce extraction rates. For purge wells, introduction of an oxidizer or acidifier will be performed on an as needed basis to control iron fouling and bacterial growth.

5.2.3 Air Stripper

The air stripper requires cleaning of the stripper trays to remove oxidized iron and particulates. These trays will be inspected for buildup and cleaned as necessary utilizing a pressure washer or other appropriate methods. The procedure for cleaning these trays is included on page 14 in Attachment D which also includes a recommended schedule for other maintenance activities (i.e., gasket inspection, demister inspection, etc.). The blower will also require periodic maintenance. The blower bearings will be lubricated as needed in accordance with manufacturer's recommendations.

5.3 Transmission Piping

Iron fouling and iron bacteria buildup on transmission piping can reduce the efficiency of the pump and treat system and reduce groundwater extraction rates. As previously mentioned, the transmission piping is equipped with cleanout access points. The transmission piping will be cleaned, as needed, utilizing a high pressure water jet or other appropriate method.

5.4 Maintenance Summary

In the event that the groundwater extraction rates do not meet the required flow, corrective actions described above will be taken as soon as practicable to address the system malfunction.

6.0 ROUTINE SYSTEM MONITORING

Groundwater monitoring associated with the groundwater pump and treat system and routine monitoring of the system influent and effluent is a component of the site wide Hydrogeological Monitoring Plan (HMP). Remedial system performance monitoring will be performed in accordance with the HMP. Influent and effluent results will be submit to the MDEQ within 30 days after the calendar.

6.1 Routine System Record Keeping (Treatment System)

The groundwater extraction, treatment and discharge system will be checked periodically by maintenance personnel. An operating logbook will be kept to record the activities of each visit. Maintenance activities performed during each system check will be recorded in the logbook. In addition to routing performance checks, maintenance personnel shall document any shutdown, malfunction or system compromise. Documentation shall include causes, dates, and times of occurrences and restart or return to full operation. This documentation will also include information for shutdowns associated with routine maintenance.

7.0 OPERATION AND MAINTENANCE RESPONSIBILITY

Operation and maintenance of the groundwater pump and treat system is the responsibility of the CSL. Several individuals will be involved in the operation and maintenance. The following identifies the individuals, their titles, and contact telephone numbers:

Roger Rockburn	Landfill Manager	616-292-8114
Debbie Nurmi	Environmental Manager	616-437-8408

8.0 SAFETY

An environmental health and safety plan (EHSP) related to operation and maintenance of the groundwater pump and treat system provides health and safety guidelines and procedures relevant to the operation and maintenance of the system. All personnel responsible for operation and maintenance of the system will be familiar with the information presented in this plan prior to working with the system.

When conducting maintenance of the groundwater pump and treat system, Level D protection shall be used. Level D protection will consist of long-sleeved shirt, full-length pants, rubber gloves and safety glasses with side shields. Activity-specific augmentations (e.g., splash-resistant goggles or a full face shield when working with liquids) shall be used as appropriate.

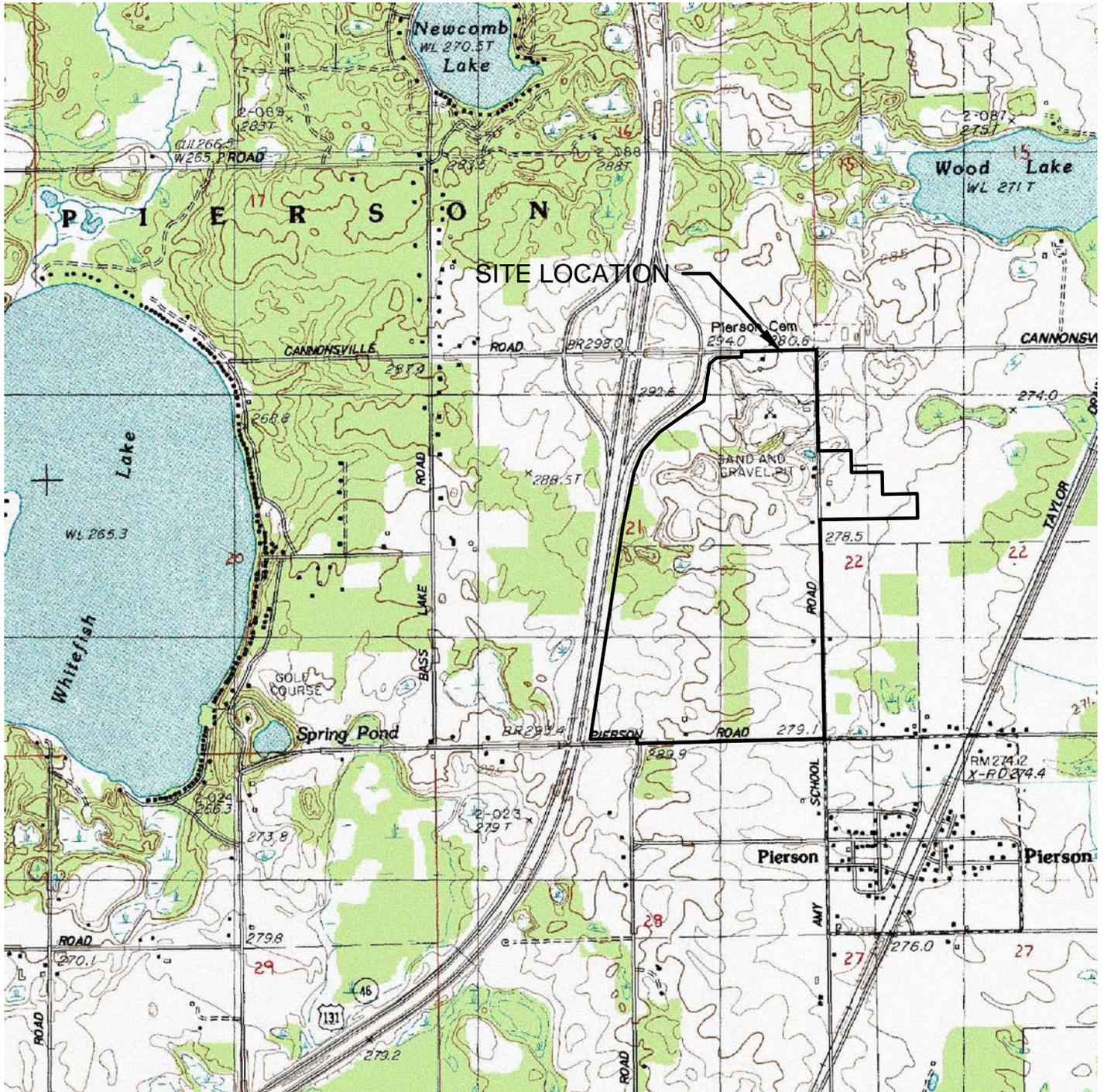
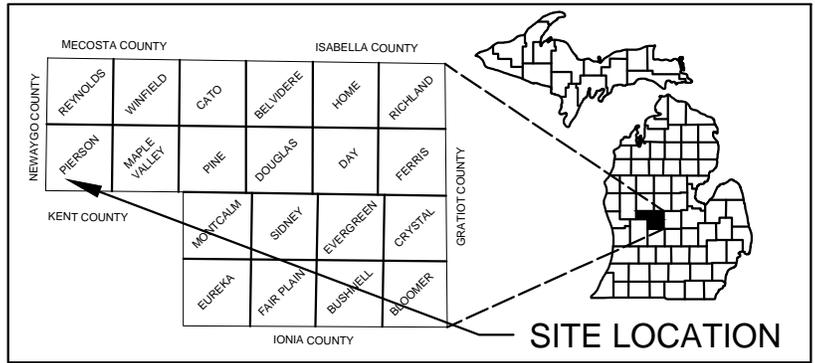
9.0 EMERGENCY CONTACTS

The following contacts are provided for use in the event of an emergency related to the groundwater pump and treat system, such as fire, medical emergency, or excessive chemical exposure.

Emergency Response Will be Carried Out By the Responding Emergency Service Only. Employees trained in first aid and CPR may render the same as Good Samaritans.

Emergency Response		911
Roger Rockburn	Landfill Manager	616-292-8114
Debbie Nurmi	Environmental Manager	616-437-8408

SECTION 21
 T.11N. - R.10W.
 PIERSON TOWNSHIP
 MONTCALM COUNTY
 MICHIGAN



Engineering & Environmental Solutions, LLC

400 136th Avenue, Building 100
 Suite B
 Holland, Michigan 49424
 Phone/Fax: (616) 994-6541

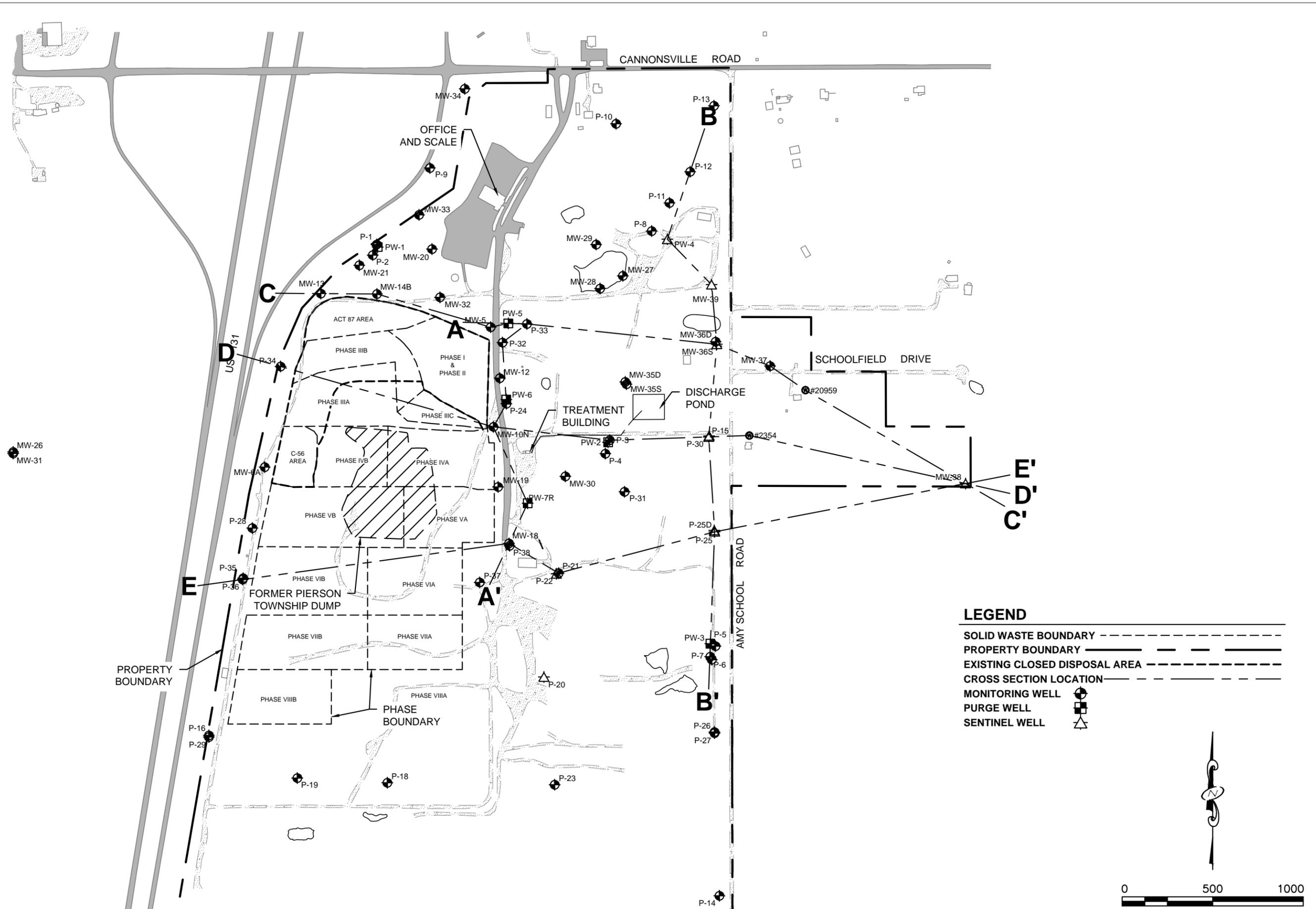
CENTRAL SANITARY LANDFILL

21545 CANNONVILLE ROAD
 PIERSON, MICHIGAN

DRAWN BY DJS	PROJECT NUMBER 001.02-09-003
CHECKED BY KJV	SHEET
DATE 01-18-2013	FIGURE 1

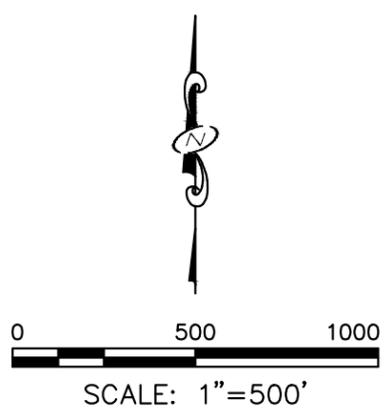
SITE LOCATION MAP

S:\Projects\001 - Republic Waste Systems\001.02 Central Sanitary Landfill\2009\001.02-09-003 GW Remediation System\CA\January 2013 Submittal\001-02-09-003 GEOLOGIC CROSS SECTIONS.dwg 10/10/2011 7:59 AM



LEGEND

- SOLID WASTE BOUNDARY - - - - -
- PROPERTY BOUNDARY ———
- EXISTING CLOSED DISPOSAL AREA - - - - -
- CROSS SECTION LOCATION ———
- MONITORING WELL ●
- PURGE WELL ■
- SENTINEL WELL ▲



Engineering & Environmental Solutions, LLC
 400 136th Avenue, Building 100, Suite B, Holland, Michigan 49424
 Phone/Fax: (616) 994-6541
 www.gEESolutions.com

CENTRAL SANITARY LANDFILL
 GEOLOGIC CROSS SECTIONS
 SECTION 21, T. 11 N., R. 10 W., PIERSON TOWNSHIP, MONTCALM COUNTY
REPUBLIC SERVICES, INC.
 21545 CANNONSVILLE ROAD, PIERSON, MI 49339

MARK	DATE	DESCRIPTION
	11-08-2010	GEOLOGIC CROSS SECTIONS

DESIGNED BY: KJV
 DRAWN BY: JLO
 CHECKED BY: KJV
 PROJECT NO: 001.02-09-003
 SHEET TITLE

SITE MAP

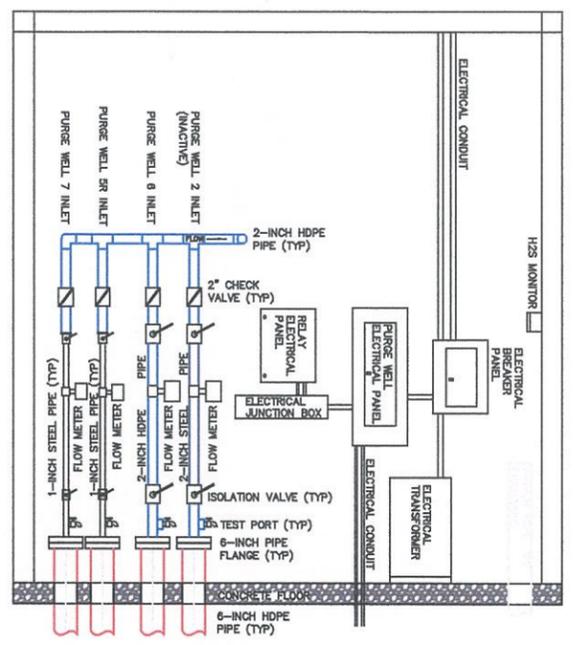
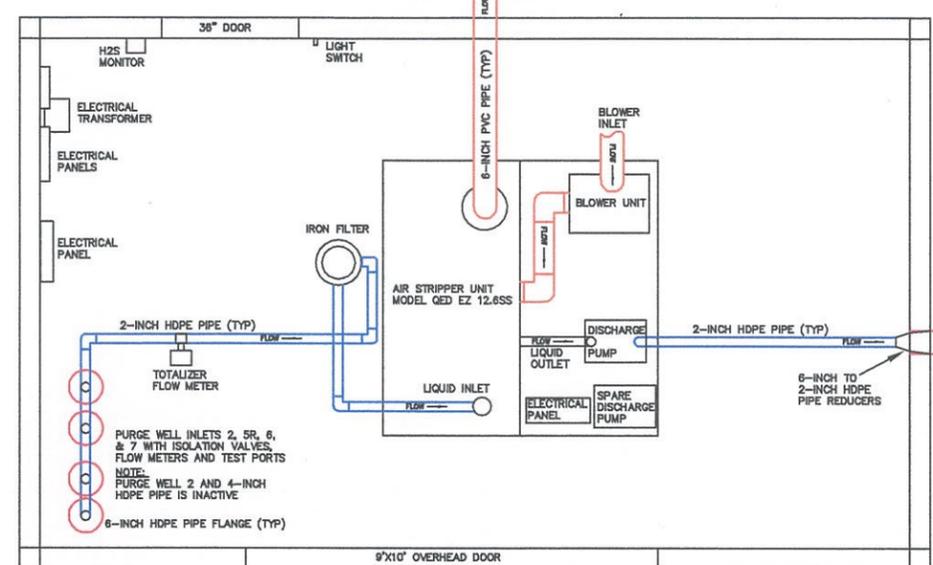
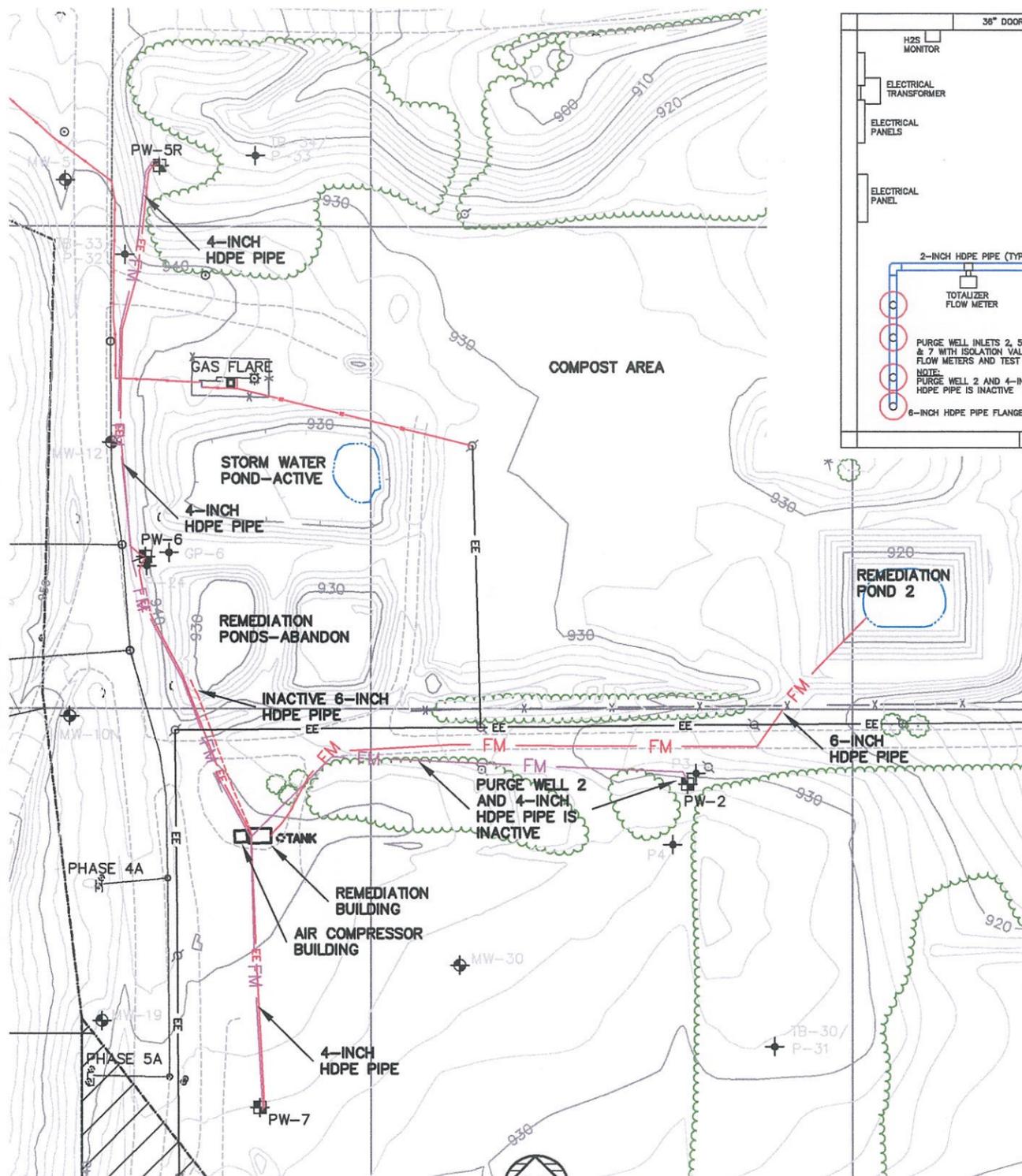
FIGURE 2

Attachment A

Groundwater Treatment System Record Drawings

Purge Well Information

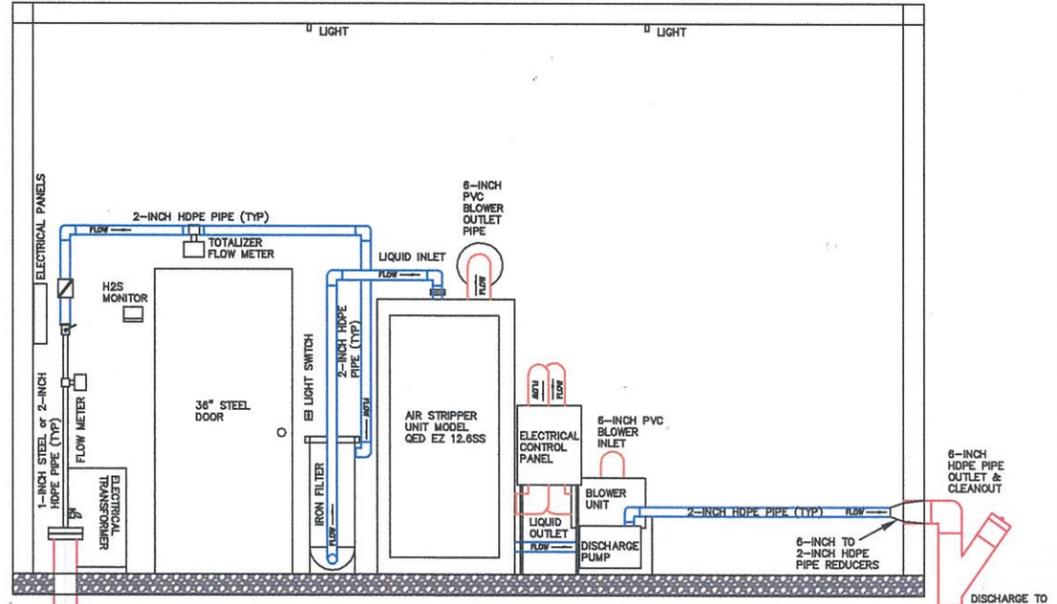
REMEDIATION SYSTEM SITE MAP



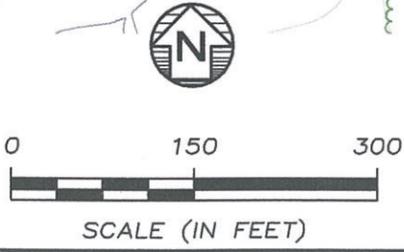
101 REMEDIATION BUILDING LAYOUT
1 NOT TO SCALE

102 WEST BUILDING WALL LAYOUT
1 NOT TO SCALE

- LEGEND**
- LIMITS OF CURRENT PERMITTED AREA
 - - - EXISTING PHASES LEACHATE
 - - - UNDERGROUND ELECTRIC LINE
 - OVERHEAD ELECTRIC LINE
 - UTILITY POLE
 - EXISTING CONTOUR
 - 980 EXISTING INDEX CONTOUR
 - UNPAVED ROAD
 - FENCE
 - FM 4" PURGE WELL FORCEMAIN
 - FM 6" PURGE WELL FORCEMAIN
 - FM 6" PURGE WELL FORCEMAIN
 - 1.5" STEEL PIPE
 - 2" STEEL PIPE
 - 2" HDPE PIPE
 - 6" HDPE PIPE
 - 6" PVC PIPE
 - ⊕ PIEZOMETER LOCATION
 - ⊕ MONITORING WELL LOCATION
 - ⊕ PURGE WELL LOCATION



103 NORTH BUILDING VIEW LAYOUT
1 NOT TO SCALE



Drawn By
PEW

CADD Review

Date Drawn/Rev'd
1/15/13



CENTRAL SANITARY LANDFILL
21545 CANNONSVILLE ROAD
MONTCALM COUNTY, MICHIGAN

Field Technology Services

CHK'D

CSL-13-004

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E:\field\tech_services\CLIENT PROJECTS\CENTRAL SANITARY LANDFILL\2013 Projects\Remediation Pond\CSL - Rem'd Pond_Site_Map_2013_revised.dwg, 1/22/2013 5:08:29 PM, WF-7500\Server\Network\temp\p01.p3
 This is not in the business of providing licensed professional surveying or engineering services. This document has been prepared at the request of and for the exclusive benefit of Central Sanitary Landfill (Republic), and is intended to be used for "internal purposes" only. FTS makes no representations or warranties as to the accuracy or validity of the contents hereof. Use of or reliance upon the information contained herein by any third party shall be at such third party's own risk.

Engineering & Environmental Solutions, LLC

400 136th Avenue
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 www.goEESolutions.com

Project Name: <u>Central Sanitary Landfill</u>	Log of Borehole: <u>PW-5R</u>
Project Number: <u>001.02-09-003</u>	Start Date: <u>9-4-2012</u>
Site Location: <u>Pierson, MI</u>	End Date: <u>9-4-2012</u>
Drilling Method: <u>10 1/4" O.D. HSA</u>	Driller: <u>EDAC</u>
Sampling Method: <u>2' Split Spoon</u>	Crew Chief: <u>Sean</u>
Ground Elevation (feet): <u>925.58</u>	Depth to Water (ft BGS during drilling): <u>33.7</u>
Top of Casing Elevation (feet): <u>927.95</u>	Easting: <u>8780.586</u>
Logged By: <u>Kurt Van Appledorn</u>	Northing: <u>8563.917</u>
Comments: <u>Screened interval elevation at 872.58 - 852.58'</u>	

SUBSURFACE PROFILE				SAMPLE			Well Completion Details	
Depth (feet BGS)	Symbol	Description	Depth/Elev.	Sample Length (feet)	Recovery (feet)	Blow Counts		ASTM Symbol
0		Ground Surface	936.1					
0.0		0-54.1' Brown fine SAND. Medium sand to fine gravel occasionally observed in drill cuttings while drilling between 20 and 40'.	0.0					
1								
2								
3								
4								
5								
6								
7								
8								
9								
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11								
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14								
15								
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Engineering & Environmental Solutions, LLC

400 136th Avenue
 Building 100, Suite B
 Holland, Michigan 49424
 Phone/Fax: (616) 994-6541
 www.goEESolutions.com

Project Name: Central Sanitary Landfill

Project Number: 001.02-09-003

Site Location: Pierson, MI

Drilling Method: 10 1/4" O.D. HSA

Sampling Method: 2' Split Spoon

Ground Elevation (feet): 925.58

Top of Casing Elevation (feet): 927.95

Logged By: Kurt Van Appledorn

Comments: Screened interval elevation at 872.58 - 852.58'

Log of Borehole: PW-5R

Start Date: 9-4-2012

End Date: 9-4-2012

Driller: EDAC

Crew Chief: Sean

Depth to Water (ft BGS during drilling): 33.7

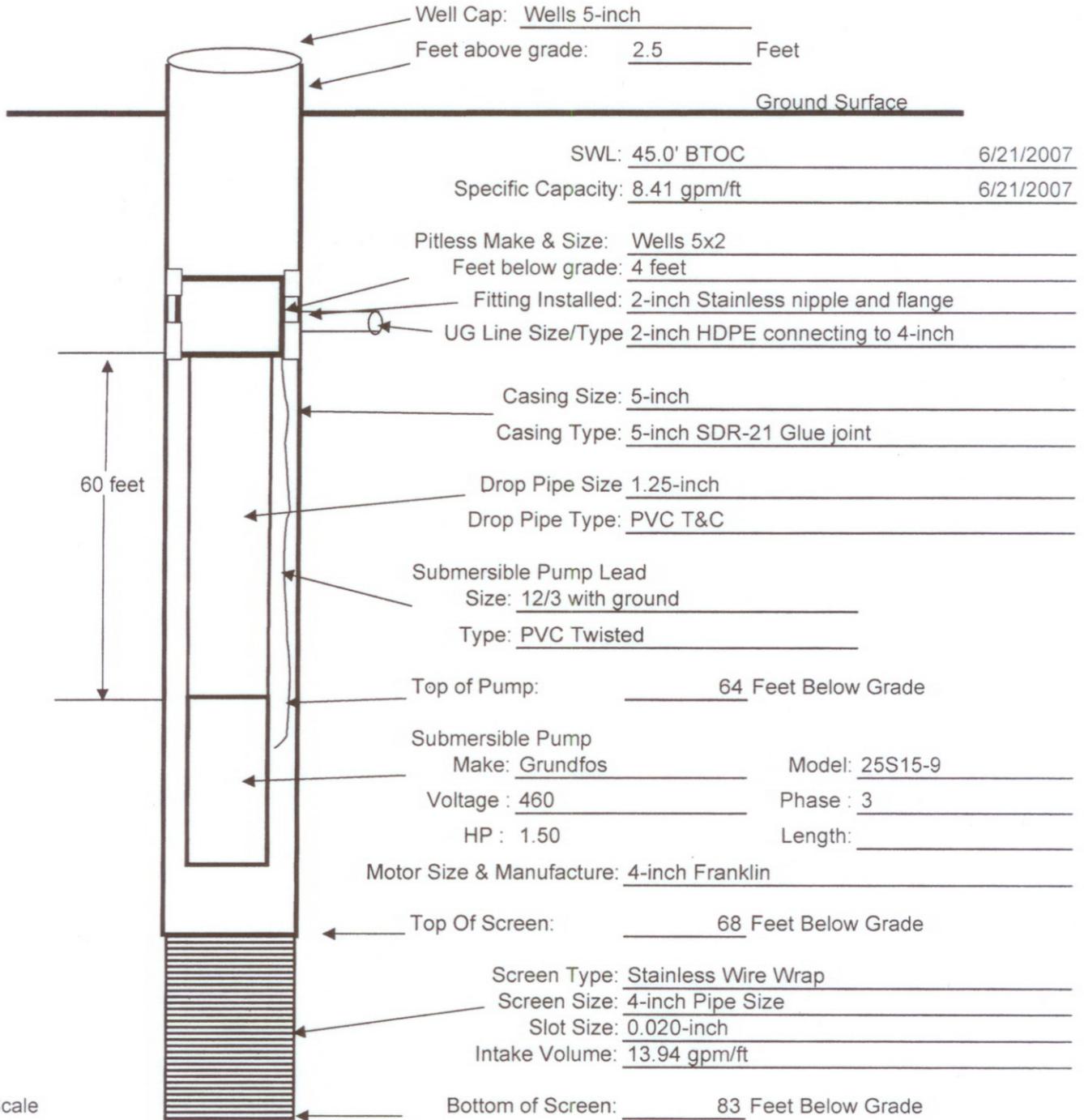
Easting: 8780.586

Northing: 8563.917

SUBSURFACE PROFILE				SAMPLE				Well Completion Details	
Depth (feet BGS)	Symbol	Description	Depth/Elev.	Sample Length (feet)	Recovery (feet)	Blow Counts	ASTM Symbol		
45	[Symbol: Fine Sand]								
46									
47									
48									
49									
50									
51									
52									
53									
54				882.0					
54		[Symbol: Clay]	54.1-55.2' Brown silty CLAY	54.1	SS	1.0	0 2 2 2		
55									
56			Brown fine SAND, wet		SS	1.7	7 7 7 7		
57									
58				SS	1.9	6 2 18 18			
59									
60				SS	1.8	0 3 5 7			
61									
62				SS	1.8	9 10 19 +35			
63									
64				SS	1.8	6 6 9 13			
65									
66				SS	1.5	2 6 6 13			
67									
68			867.9						
68			68.3	SS	1.8	3 6 12 26			
69		68.3-69.0' Brown very fine silty SAND, wet.							
70		69.0-76.0' Brown fine SAND, wet.		SS	2.0	6 12 28 40			
71									
72		4" fine sand with little medium and coarse sand at 71'.		SS	1.8	10 9 16 18			
73									
74									
75									
76			860.1						
76			76.0						
77		End of Boring							
78									
79									
80									
81									
82									
83									
84									
85									
86									
87									
88									
89									
90									
91									

Stearns Drilling Well Information Log

Project Name: Central Sanitary Landfill **Well Number:** Well 6A
Client Name: Allied Waste Industries, Inc. **Client Contact:** Debbie Nurmi./Roger Rockburn
Well Install By: Verrett **Date of Service:** 6/19/2007 **Project #** 07-11667-7
Serviced By: Meredith **Date of Service:** 6/21/2007 **Project #** 07-11667-7
Serviced By: _____ **Date of Service:** _____ **Project #** _____



No Scale

Screen attached to well casing
 4" x 2' PVC sump, TD of well is 85 feet with sump
 Replacement Well for Well #6. New well is 20 feet due east of old well.
 Old well was a 4-inch steel well set at the same depth as this well.

Engineering & Environmental Solutions, LLC

200 North Franklin Street
 Suite 202
 Zeeland, Michigan 49464
 Phone: (616) 931-3960
 Fax: (616) 931-3970

Project Name: Central Sanitary Landfill

Project Number: 001.02-09-003

Site Location: Pierson, MI

Drilling Method: 10 1/4" O.D. HSA

Sampling Method: 2' Split Spoon

Ground Elevation (feet): 936.15

Top of Casing Elevation (feet): 938.05

Logged By: Kurt Van Appledorn

Comments: Screened interval elevation at 883.05 - 863.05'

Log of Borehole: PW-7R

Start Date: 4-19-2010

End Date: 4-20-2010

Driller: EDAC

Crew Chief: Sean

Depth to Water (ft BGS during drilling): 42.7

Easting: 8890.76

Northing: 7598.85

SUBSURFACE PROFILE				SAMPLE				Well Completion Details
Depth (feet BGS)	Symbol	Description	Depth/Elev.	Sample Length (feet)	Recovery (feet)	Blow Counts	ASTM Symbol	
-3								<p>4" Dia. PVC Riser</p> <p>Bentonite Grout</p> <p>Native Soil</p> <p>Natural Sand Pack</p>
-2								
-1								
0		Ground Surface	936.2					
1		0-13' Brown sandy CLAY, moist.	0.0					
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13		13-60.8' Brown (10YR/5/3) fine SAND.	923.2					
14			13.0					
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								
41								
42			893.4					
43		Wet at 42.7'	42.7					
44								
45								
46								
47								

Engineering & Environmental Solutions, LLC

200 North Franklin Street
Suite 202
Zeeland, Michigan 49464
Phone: (616) 931-3960
Fax: (616) 931-3970

Project Name: Central Sanitary Landfill

Project Number: 001.02-09-003

Site Location: Pierson, MI

Drilling Method: 10 1/4" O.D. HSA

Sampling Method: 2' Split Spoon

Ground Elevation (feet): 936.15

Top of Casing Elevation (feet): 938.05

Logged By: Kurt Van Appledorn

Comments: Screened interval elevation at 883.05 - 863.05'

Log of Borehole: PW-7R

Start Date: 4-19-2010

End Date: 4-20-2010

Driller: EDAC

Crew Chief: Sean

Depth to Water (ft BGS during drilling): 42.7

Easting: 8890.76

Northing: 7598.85

SUBSURFACE PROFILE				SAMPLE				Well Completion Details			
Depth (feet BGS)	Symbol	Description	Depth/Elev.	Sample Length (feet)	Recovery (feet)	Blow Counts	ASTM Symbol				
48	[Symbol: Fine Sand]							<p>4" Dia. 20 Slot Stainless Steel Wire Wrapped Screen</p> <p>4" Dia. Stainless Steel Sump</p> <p>K&E #1 Filter Sand</p>			
49											
50											
51											
52											
53											
54							SS		1.0	0 2 2 2	
55											
56							SS		1.7	7 7 7 7	
57											
58				SS	1.9	6 2 18 18					
59											
60			875.4	SS	1.8	0 3 5 7					
61		60.8-62.8' Brown SILT with occasional 1" clay seams, wet.	60.8								
62			873.4	SS	1.8	9 10 19 +35					
63		62.8-76.0' Brown fine SAND, wet. 3" silt seam at 64.7'.	62.8								
64				SS	1.8	6 6 9 13					
65											
66				SS	1.5	2 6 6 13					
67											
68				SS	1.8	3 6 12 26					
69											
70				SS	2.0	6 12 28 40					
71											
72				SS	1.8	10 9 16 18					
73											
74											
75											
76			860.2								
77		End of Boring	76.0								
78											
79											
80											
81											
82											
83											
84											
85											
86											
87											
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