Florida Department of Health
Onsite Nitrogen Reduction Strategies Study

Contract CORCL

TASK C.20
INSTRUMENTATION OF GCREC MOUND MONITORING SYSTEM & PLUME IDENTIFICATION

PROGRESS REPORT #2

November 30, 2010

Task C of the Florida Onsite Nitrogen Reduction Strategies Study includes monitoring at field sites in Florida to evaluate nitrogen reduction in soil and groundwater, to assess groundwater impacts due to conventional and nitrogen removal systems, and to provide data for parameter estimation, verification, and validation of models developed in Task D. The existing mound system at the Gulf Coast Research and Education Center (GCREC) is being monitored to serve as a bridge between the controlled GCREC pilot-scale testing conducted within the same type of soils and the uncontrolled monitoring at home sites in different soils throughout the state. The Task C QAPP documents the objectives, monitoring framework, sample frequency and duration, and analytical methods to be used at the GCREC existing mound system site. This report documents the completion of the GCREC mound plume installation of the instrumentation and monitoring framework.

A sampling grid for groundwater screening was developed downgradient of the soil treatment unit. A 25-ft by 25-ft grid was staked then locations surveyed (x, y, and z). Transect lines AA through R are parallel to the southern edge of the mound and increase (higher letter identification) moving southward from the mound. Transect lines 1 through 15 (from east to west) are perpendicular to the southern edge of the mound. Groundwater monitoring points were installed in May, June, and November 2010. Two types of monitoring points were installed using either hand or drilling methods: drive point samplers and standpipe piezometers. Drive point samplers consist of a stainless steel drive tip and attached 1-in. long screen with a protective “umbrella” (to prevent soil entering and clogging the screen), and flexible tubing that extends to the ground surface. Standpipe piezometers consist of either ¾-in., 1¼-in., or 2-in. diameter PVC with 1-ft, 4-ft, 5-ft, or 10-ft long 0.010 slot PVC screens and PVC riser extending to the ground surface (refer to the Task C QAPP and C.20 Progress Report #1 for additional detail).

Initially (May 2010) handheld methods (electric powered hammer drill or auger) were used to place fourteen drive point samplers and six standpipe piezometers within the monitoring area. The auger was advanced to the maximum depth feasible retrieving a soil sample during augering. The drive point sampler or standpipe piezometer was then installed into the open hole. After installation, native sand was backfilled into the borehole and a water sample was collected to track preliminary plume extent. Five additional standpipe piezometers have been installed using hand methods to provide water table elevations.

The hard spodic horizon located at approximately 6 ft below ground surface (bgs) made it difficult to use handheld methods and a small direct push rig (6620 Geoprobe™) was brought to the site (June

2010) to more efficiently obtain boreholes for instrumentation. Drive point samplers were installed by advancing a disposable drive tip attached to a hollow core barrel to the desired depth. The drive point sampler was then inserted into the hollow core barrel, approximately 1 ft of filter sand was added around the stainless steel drive point and screen, and the core barrels were retrieved to the surface. Standpipe piezometers (¾-in. diameter PVC with 5-ft screen) were then installed similar to the drive point samplers (see C.20 Progress Report #1 for more detail). A total of forty-seven drive point samplers and four standpipe piezometers were installed in June 2010.

At five locations (south end of the mound, E9, G10, F4, and west side of the mound), continuous soil cores were collected to determine general soil properties (lithology, soil features, organic matter content, grain size, etc). Soil samples were also collected southeast of the mound from 0-50 in. bgs to evaluate vadose zone soil properties. The results are summarized in Tables 1 and 2.

Table 1
Soil Grain Size Distribution in Percent (%)

	Depth Below Ground Surface (inches)			
Grain Size (mm)	0 – 5	12 – 18	24 – 30	44 – 50
<0.004	1.69	0.92	0.16	0.57
0.004 – 0.062	2.46	1.35	1.63	2.26
0.062 – 0.125	16.26	15.48	4.39	10.94
0.125 – 0.25	40.50	41.90	17.65	35.83
0.25 – 0.5	31.19	31.79	15.26	35.27
0.15 – 1.0	6.21	6.47	58.53	11.71
1.0 – 2.0	1.55	1.82	2.09	3.01
> 2.0	0.15	0.27	0.30	0.42

Table 2
GCREC Soil Properties

		Depth Below Ground Surface (inches)			
Parameter	Units	0 – 5	12 – 18	24 – 30	44 – 50
Soil Moisture	%	32.08	38.25	37.26	35.89
Total Organic Carbon	mg/kg	2.32	0.52	0.06	1.02
CEC	meq EC/100 grams	12.3	1.9	11.2	13.4
Total Phosphorus	mg-P/kg	2.09	0.40	0.15	4.29
Total Kjeldahl Nitrogen	mg-N/kg	1100	0.07	0.05	0.07
Ammonia	mg-N/kg	140	37	34	84
Nitrate	mg-N/kg	0.33	0.16	0.16	0.20
Calcium	mg-Ca/kg	117	1.6	3.5	1.3
Sodium	mg-Na/kg	2.4	2.3	2.0	2.3
Magnesium	mg-Mg/kg	7.0	0.31	0.61	0.55
Potassium	mg-K/kg	8.1	1.1	0.62	0.44

Again, the hard spodic horizon proved to be difficult to penetrate and in situ groundwater samples were collected at two locations where penetration was achieved. At the first location (M12) four depths were tested: 9-10 ft, 12-13 ft, 15-16 ft and 29-30 ft. At the second location (I5) one depth, 26-28 ft, was tested. These screening water samples were useful in determining if the nitrogen groundwater plume was expected below the spodic horizon (see C.20 Progress Report #1 for specific results). Indeed, this was the case and the need to return to the site for additional instrumentation was apparent.

To overcome the thickness and compressive strength of the spodic horizon a standard auger rig (Dietrich 120) was brought to the site (November 2010) (Figure 1 through 3). This standard drilling rig was required to enable installation of monitoring points between the spodic horizon and confining Hawthorne clay. Drive point samplers were installed by augering to approximately 28 ft bgs, dislodging a disposable plug, and pulling the auger flights up 1 ft (Figure 2). The drive point sampler was then inserted into the hollow stem auger and held in place as the auger flights were again pulled up allowing for the borehole to collapse. This process was repeated to install drive point samplers at three target depths in each location of approximately 14, 20, and 26 ft bgs. At four locations (F11, G7, G12, and N12) drive point samplers were installed at five target depth intervals; 14, 17, 20, 23, and 26 ft bgs. Standpipe piezometers (¾-in. diameter PVC with 1-ft screen) were installed similar to the drive point samplers. However a 20/30 silica sand filter pack was placed around the screen to 2 ft above the top of the screen with a bentonite seal placed on top of the sand filter pack. Finally, four 2-in. diameter standpipe piezometers (PVC with 5-ft screens) were installed following the same procedure (Figure 3). A total of sixty drive point samplers and nine standpipe piezometers were installed in November 2010.

Figure 1
Dietrich 120 Standard Auger Rig

Figure 2
Installation of Drive Point Sampler

Figure 3
Installation of 2" Diameter Standpipe Piezometer

Prior to instrumentation in November 2010, several test borings were drilled to refine installation methods and identify the general site lithology. Specifically, the depth to the bottom of the spodic horizon and the top of the confining Hawthorne was not clear. The test borings indicated that the bottom of the spodic was at approximately 10 to 13 ft bgs and the top of the Hawthorne was at 26 to 28 ft bgs. In addition, during these test locations, flowing sands were encountered, below the spodic horizon, which create additional challenges for instrumentation. Most notable was the difficulty in installing monitoring points at precise depths due to collapsing of the borehole when the hollow stem augers were retrieved. Thus, attempts were made to install monitoring points consistently at the target depths, but some variation was unavoidable. However, the flowing sands also served as a native filter pack without requiring a bentonite seal between depth intervals because preferential flow within the borehole is avoided (e.g., no subsurface structure remained after the augers were removed) in combination with the small flow field generated during drive point sample collection.

Although the equipment used was different during each installation event (May, June and November), the drive point samplers and standpipe piezometers were installed in a consistent fashion following standard well installation methods (Driscoll, 1986; EPA, 1991). Each borehole was grouted to the surface or a bentonite seal was placed to prevent migration of water from above the spodic horizon to below the spodic horizon within the borehole. A total of 121 drive point sampler locations and 24 standpipe piezometers have been installed to monitor the plume. Figure 4 illustrates the spatial distribution of monitoring locations. Table 3 summarizes the monitoring equipment installed for the GCREC mound. Each monitoring location has been assigned a unique identification indicating the type of monitoring point (DP = drive point, PZ = standpipe piezometer), grid location (self explanatory), and depth below ground surface (bottom of the drive point or well screen in feet). For example, DP-C11-8 is a drive point sampler located on the grid at C11 (see Figure 4) at 8 ft below ground surface.

It should also be noted that each type of monitoring point is intended to provide a different type of information required for a comprehensive understanding of the plume as well as data for modeling in Task D. Drive point samplers provide plume concentration information. Multiple locations (horizontal and vertical) can be monitored with minimal disruption to the subsurface and plume. However, the limitation of the drive point samplers is that they do not provide information specific to aquifer properties. A ¾-in. and 1 ¼-in. diameter standpipe piezometer enables measurement of water levels to determine groundwater flow direction and gradient and can also be used for slug tests to estimate hydraulic conductivity. The same data can be obtained from a 2-in diameter standpipe piezometer with the added capability of enabling aquifer tests (i.e., pumping tests). The length of the screen is also designed to provide different information. A 1-ft screen provides discrete depth information to assess vertical gradients while a 10-ft screen is intended to encompass a large depth interval at the water table to observe fluctuations during pumping tests. A 4-ft or 5-ft screen provides sufficient contact with the formation to screen the bottom third of the aquifer while balancing the specific capacity (rate of yield per unit of drawdown) during aquifer testing (e.g., pumping tests). All standpipe piezometers can also be used for general plume concentration information although the samples represent an averaged depth interval of either 1, 4, 5, or 10ft. Because of the different intent of the monitoring points, combination of results from different types of points is strongly cautioned as the samples do not represent the same conditions. While the plume is not 100% delineated (e.g., no background location southwest of the plume), the existing locations are sufficient to enable modeling in Task D within the project budget constraints.

Specific conductance, pH, and nitrogen measurements (using nitrate and nitrite HACH test strips) were taken at all standpipe piezometer and drive point sampler locations. During field screening in November 2010 immediately following installation it was observed that ammonia was not detected at any location. It was later confirmed with HACH, that a low pH interferes with the ammonia test strip.

Results from this November 2010 sampling round are presented in Tables 4 and 5. Table 4 outlines the initial groundwater specific conductance, pH, nitrate and temperature measurements for the drive point locations. Table 5 outlines the initial groundwater depth, specific conductance, pH, nitrate and temperature measurements for the standpipe piezometer locations. Figures 5 through 9 illustrate the results by approximate depth bgs. Figure 10 illustrates the groundwater elevation measured within the standpipe piezometers November 12, 2010. Based on these preliminary groundwater specific conductivity and pH measurements, the general plume appears to extend to the southwest with the highest conductivity and pH measurements just below the spodic horizon. Note that based on six rounds of screening data, the average background conductivity is 118.4 µS and pH is 5.1 while the septic tank effluent conductivity is 823.2 µS and pH is 6.8. Sampling and analysis using standard analytical methods is required to confirm the plume extent and is planned in December 2010.

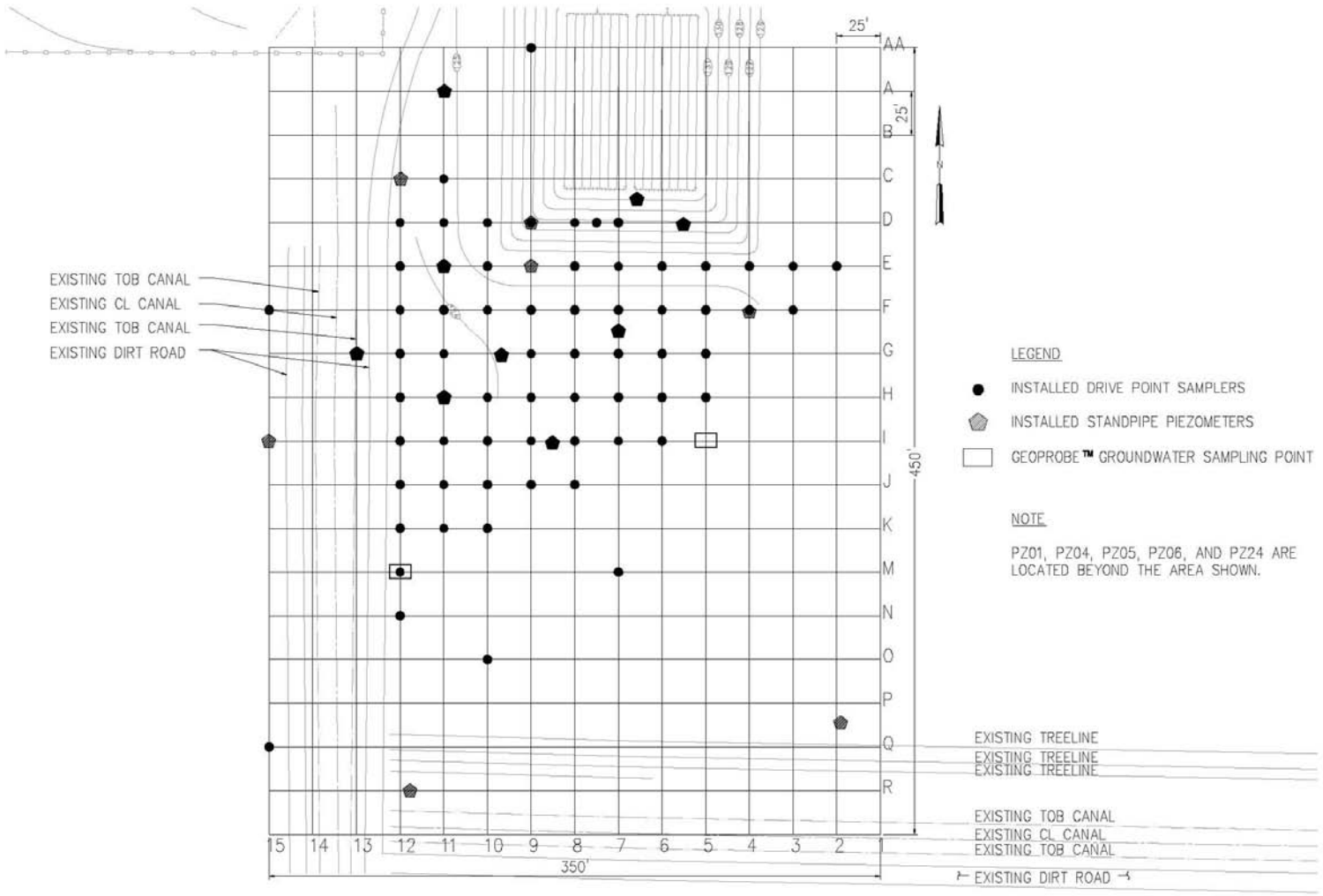

Figure 4
Monitoring Plan

Table 3
Monitoring Equipment Installed

	Grid Location	Identification	Notes	Bottom Elevation (ft)	Depth Below Ground Surface (ft)
1	Bkgd, North	PZ01-BKG-9	1 1/4” Standpipe Piezometer, 4’ screen	120.33	9.04
2	Bkgd, North	PZ04-BKG-9	1 1/4” Standpipe Piezometer, 4’ screen	118.66	8.88
3	Bkgd, North	PZ24-BKG-26	2" Standpipe Piezometer, 5' screen	101.41	25.98
4	Bkgd, East	PZ05-BKG-9	1 1/4" Standpipe Piezometer, 4' screen	117.39	8.95
5	Bkgd, NW	PZ06-BKG-12	1 1/4" Standpipe Piezometer, 4' screen	118.10	11.90
6	AA9	DP-AA9-14	SST Drive Point	110.68	14.4
7	AA9	DP-AA9-22	SST Drive Point	103.08	22.00
8	AA9	DP-AA9-27	SST Drive Point	98.28	26.8
9	A11	PZ15-A11-6	3/4" Standpipe Piezometer, 5' screen	118.84	5.75
10	CD6.5	PZ10-CD6-13	3/4" Standpipe Piezometer, 5' screen	116.03	13.48
11	C11	DP-C11-8	SST Drive Point	116.18	7.67
12	C12	PZ16-C12-28	3/4" Standpipe Piezometer, 1' screen	94.75	27.93
13	D5.5	PZ07-D05-7	1 1/4" Standpipe Piezometer, 4' screen	118.89	7.13
14	D7	DP-D07-5	SST Drive Point	120.82	4.91
15	D7	DP-D07-7	SST Drive Point	118.86	6.87
16	D7	DP-D07-9	SST Drive Point	116.79	8.94
17	D7.5	DP-D7.5-14	SST Drive Point	111.24	14.20
18	D7.5	DP-D7.5-20	SST Drive Point	105.31	20.13
19	D7.5	DP-D7.5-26	SST Drive Point	99.24	26.20
20	D8	DP-D08-9	SST Drive Point	116.31	8.86
21	D9	DP-D09-6	SST Drive Point	118.35	5.90
22	D9	DP-D09-8	SST Drive Point	116.45	7.80
23	D9	DP-D09-15	SST Drive Point	109.18	14.80
24	D9	DP-D09-21	SST Drive Point	103.18	20.80
25	D9	DP-D09-27	SST Drive Point	97.18	26.80
26	D9	PZ23-D09-27	2" Standpipe Piezometer, 5' screen	97.41	26.59
27	D10	DP-D10-8	SST Drive Point	116.31	7.78
28	D11	DP-D11-11	SST Drive Point	113.29	10.65
29	D12	DP-D12-11	SST Drive Point	112.46	11.10
30	E2	DP-E02-6	SST Drive Point	119.55	5.65
31	E2	DP-E02-8	SST Drive Point	117.55	7.65
32	E3	DP-E03-10	SST Drive Point	115.26	9.83
33	E4	DP-E04-6	SST Drive Point	119.71	6.20
34	E4	DP-E04-8	SST Drive Point	117.71	8.20
35	E5	DP-E05-6	SST Drive Point	118.58	5.80
36	E6	DP-E06-6	SST Drive Point	118.86	5.95

Table 3
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	Grid Location	Identification	Notes	Bottom Elevation (ft)	Depth Below Ground Surface (ft)
37	E6	DP-E06-8	SST Drive Point	116.86	7.95
38	E7	DP-E07-10	SST Drive Point	114.77	9.80
39	E8	DP-E08-6	SST Drive Point	118.41	6.00
40	E8	DP-E08-8	SST Drive Point	116.41	8.00
41	E9	PZ11-E09-10	3/4" Standpipe Piezometer, 5' screen	114.56	9.50
42	E10	DP-E10-6	SST Drive Point	118.21	5.80
43	E11	DP-E11-12	SST Drive Point	111.98	11.85
44	E11	PZ21-E11-26	2" Standpipe Piezometer, 5' screen	98.25	25.72
45	E11	PZ22-E11-15	3/4" Standpipe Piezometer, 10' screen	108.36	15.44
46	E12	DP-E12-10	SST Drive Point	113.22	10.25
47	E12	DP-E12-15	SST Drive Point	108.66	14.72
48	E12	DP-E12-22	SST Drive Point	101.56	21.82
49	E12	DP-E12-28	SST Drive Point	95.71	27.67
50	F3	DP-F03-8	SST Drive Point	116.44	8.35
51	F4	PZ13-F04-8	3/4" Standpipe Piezometer, 5' screen	116.31	8.20
52	F4	DP-F04-17	SST Drive Point	107.76	16.84
53	F4	DP-F04-22	SST Drive Point	102.95	21.65
54	F4	DP-F04-32	SST Drive Point	92.85	31.75
55	F5	DP-F05-5	SST Drive Point	119.94	4.80
56	F5	DP-F05-31	SST Drive Point	93.91	30.85
57	F6	DP-F06-10	SST Drive Point	115.03	9.50
58	F7	DP-F07-6	SST Drive Point	118.25	6.25
59	FG7	PZ08-FG7-6	1 1/4" Standpipe Piezometer, 4' screen	118.25	5.76
60	F8	DP-F08-14	SST Drive Point	110.43	13.80
61	F8	DP-F08-20	SST Drive Point	103.96	20.27
62	F8	DP-F08-28	SST Drive Point	96.18	28.05
63	F9	DP-F09-5	SST Drive Point	118.98	5.45
64	F10	DP-F10-11	SST Drive Point	112.93	10.85
65	F11	DP-F11-11	SST Drive Point	112.68	10.95
66	F11	DP-F11-15	SST Drive Point	108.88	14.75
67	F11	DP-F11-18	SST Drive Point	105.73	17.90
68	F11	DP-F11-21	SST Drive Point	102.93	20.70
69	F11	DP-F11-24	SST Drive Point	99.88	23.75
70	F11	DP-F11-27	SST Drive Point	96.73	26.90
71	F12	DP-F12-10	SST Drive Point	112.82	10.45
72	F15	DP-F15-14	SST Drive Point	108.82	14.45

Table 3
Monitoring Equipment Installed

	Grid Location	Identification	Notes	Bottom Elevation (ft)	Depth Below Ground Surface (ft)
73	F15	DP-F15-20	SST Drive Point	102.87	20.40
74	F15	DP-F15-26	SST Drive Point	96.97	26.30
75	G5	DP-G05-6	SST Drive Point	118.51	5.96
76	G6	DP-G06-7	SST Drive Point	116.95	7.37
77	G7	DP-G07-13	SST Drive Point	111.63	12.58
78	G7	DP-G07-15	SST Drive Point	109.56	14.65
79	G7	DP-G07-17	SST Drive Point	106.76	17.45
80	G7	DP-G07-21	SST Drive Point	103.31	20.90
81	G7	DP-G07-24	SST Drive Point	100.51	23.70
82	G7	DP-G07-27	SST Drive Point	97.61	26.60
83	G8	DP-G08-5	SST Drive Point	119.54	4.71
84	G9	DP-G09-11	SST Drive Point	112.99	11.00
85	G9.75	PZ19-G10-26	2" Standpipe Piezometer, 5' screen	97.55	26.06
86	G9.75	PZ20-G10-15	3/4" Standpipe Piezometer, 10' screen	108.5	15.08
87	G10	PZ12-G10	Abandoned, replaced by PZ19 and PZ20	-	-
88	G11	DP-G11-8	SST Drive Point	117.93	7.88
89	G12	DP-G12-9	SST Drive Point	114.44	8.83
90	G12	DP-G12-15	SST Drive Point	108.37	14.90
91	G12	DP-G12-18	SST Drive Point	105.27	18.00
92	G12	DP-G12-21	SST Drive Point	102.32	20.95
93	G12	DP-G12-24	SST Drive Point	99.72	23.55
94	G12	DP-G12-27	SST Drive Point	96.37	26.90
95	G13	PZ14-G13-7	1 1/4" Standpipe Piezometer, 4' screen	115.11	6.52
96	H5	DP-H05-7	SST Drive Point	117.13	7.42
97	H6	DP-H06-7	SST Drive Point	117.33	6.90
98	H7	DP-H07-8	SST Drive Point	116.32	7.67
99	H8	DP-H08-10	SST Drive Point	113.84	10.25
100	H9	DP-H09-12	SST Drive Point	111.74	12.17
101	H10	DP-H10-11	SST Drive Point	112.68	11.02
102	H11	PZ03-H11-6	1 1/4" Standpipe Piezometer, 4' screen	121.47	5.68
103	H12	DP-H12-5	SST Drive Point	117.96	5.29
104	I6	DP-I06-14	SST Drive Point	110.24	13.90
105	I6	DP-I06-20	SST Drive Point	103.99	20.15
106	I6	DP-I06-26	SST Drive Point	97.94	26.20
107	I7	DP-I07-8	SST Drive Point	115.67	8.34
108	I8	DP-I08-5	SST Drive Point	118.56	5.27

Table 3
Monitoring Equipment Installed

	Grid Location	Identification	Notes	Bottom Elevation (ft)	Depth Below Ground Surface (ft)
109	I8.5	PZ09-I08-5	1 1/4" Standpipe Piezometer, 4' screen	118.93	4.67
110	I9	DP-I09-11	SST Drive Point	112.96	10.71
111	I10	DP-I10-6	SST Drive Point	117.72	6.46
112	I11	DP-I11-10	SST Drive Point	113.5	10.05
113	I12	DP-I12-6	SST Drive Point	117.54	5.71
114	I15	PZ17-I15-26	3/4" Standpipe Piezometer,1' screen	97.09	25.66
115	J8	DP-J08-6	SST Drive Point	118.02	5.79
116	J9	DP-J09-12	SST Drive Point	112.05	11.56
117	J9	DP-J09-14	SST Drive Point	109.61	14.00
118	J9	DP-J09-20	SST Drive Point	103.36	20.25
119	J9	DP-J09-26	SST Drive Point	97.11	26.50
120	J10	DP-J10-6	SST Drive Point	117.32	6.19
121	J11	DP-J11-12	SST Drive Point	111.99	11.50
122	J12	DP-J12-13	SST Drive Point	110.44	12.67
123	J12	DP-J12-15	SST Drive Point	108.26	14.85
124	J12	DP-J12-20	SST Drive Point	102.61	20.50
125	J12	DP-J12-27	SST Drive Point	96.36	26.75
126	K10	DP-K10-7	SST Drive Point	116.41	6.84
127	K11	DP-K11-13	SST Drive Point	110.43	12.80
128	K12	DP-K12-5	SST Drive Point	117.68	5.33
129	M7	DP-M07-15	SST Drive Point	108.975	14.63
130	M7	DP-M07-21	SST Drive Point	102.65	20.95
131	M7	DP-M07-27	SST Drive Point	96.95	26.65
132	M12	DP-M12-10	SST Drive Point	112.79	10.06
133	N12	DP-N12-14	SST Drive Point	108.4	14.30
134	N12	DP-N12-18	SST Drive Point	104.75	17.95
135	N12	DP-N12-21	SST Drive Point	101.725	20.98
136	N12	DP-N12-24	SST Drive Point	98.75	23.95
137	N12	DP-N12-27	SST Drive Point	95.63	27.07
138	O10	DP-O10-12	SST Drive Point	110.71	12.20
139	O10	DP-O10-18	SST Drive Point	104.56	18.35
140	O10	DP-O10-24	SST Drive Point	98.56	24.35
141	PQ1.75	PZ02-P02-9	1 1/4" Standpipe Piezometer, 4' screen	115.24	8.72
142	Q15	DP-Q15-15	SST Drive Point	108.2	14.62
143	Q15	DP-Q15-21	SST Drive Point	102.29	20.53
144	Q15	DP-Q15-26	SST Drive Point	96.4	26.42

Table 3
Monitoring Equipment Installed

	Grid Location	Identification	Notes	Bottom Elevation (ft)	Depth Below Ground Surface (ft)
145	R12	PZ18-R12-26	3/4" Standpipe Piezometer, 1' screen	96.56	25.54

Table 4
Drive Point Sampler Field Parameters Measured November 18-19, 2010

	Location	Identification	Specific Conductance (µS)	pH	Estimated NO_X (Test Strip)[1] (ppm)	Temperature (°C)
1	AA9	DP-AA9-14	302	5.03	8	25.6
2	AA9	DP-AA9-22	246	5.08	4	25.3
3	AA9	DP-AA9-27	253	5.04	4	25.4
4	C11	DP-C11-8	232	6.25	0	25.1
5	D7	DP-D07-5	Dry			
6	D7	DP-D07-7	307	4.42	11	23.5
7	D7	DP-D07-9	334	4.37	10	23.2
8	D7.5	DP-D7.5-14	355	4.94	20	23.5
9	D7.5	DP-D7.5-20	223	5.14	9	22.8
10	D7.5	DP-D7.5-26	243	5.2	10	23.6
11	D8	DP-D08-9	369	5.06	4	23.1
12	D9	DP-D09-6	283	4.49	6	23.2
13	D9	DP-D09-8	294	4.48	11	23.3
14	D9	DP-D09-15	314	5.5	5	24.2
15	D9	DP-D09-21	247	6.41	2	24.0
16	D9	DP-D09-27	217	6.09	0	23.6
17	D10	DP-D10-8	248	5.98	3	23.8
18	D11	DP-D11-11	351	5.43	9	24.5
19	D12	DP-D12-11	247	5.02	12	24.4
20	E2	DP-E02-6	62[2]	5.29[2]	nm	28.2[2]
21	E2	DP-E02-8	186[2]	4.75[2]	nm	27.5[2]
22	E3	DP-E03-10	220[2]	5.39[2]	nm	27.3[2]
23	E4	DP-E04-6	76[2]	4.57[2]	nm	28.1[2]
24	E4	DP-E04-8	140[2]	4.99[2]	nm	27.5[2]
25	E5	DP-E05-6	160	6.11	0	26.3
26	E6	DP-E06-6	145	4.5	2	24.3
27	E6	DP-E06-8	159	4.52	2	24.6
28	E7	DP-E07-10	333	5.04	12	24.9
29	E8	DP-E08-6	263	4.72	7	24.4

Table 4
Drive Point Sampler Field Parameters Measured November 18-19, 2010

	Location	Identification	Specific Conductance (µS)	pH	Estimated NO_X (Test Strip)[1] (ppm)	Temperature (°C)
30	E8	DP-E08-8	274	4.66	11	24.8
31	E10	DP-E10-6	297	4.51	11	25.2
32	E11	DP-E11-12	442	5.07	40	25.1
33	E12	DP-E12-10	368	5.18	19	25.3
34	E12	DP-E12-15	355	5.19	18	25.0
35	E12	DP-E12-22	365	6.64	20	26.2
36	E12	DP-E12-28	324	5.11	12	24.4
37	F3	DP-F03-8	113	6.07	0	25.8
38	F4	DP-F04-17	982	6.91	0	24.9
39	F4	DP-F04-22	448	5.74	3	25.0
40	F4	DP-F04-32	197	6.35	0	24.8
41	F5	DP-F05-5	144	7.24	0	27.9
42	F5	DP-F05-31	131	7.25	0	28.6
43	F6	DP-F06-10	147	5.54	0.5	25.8
44	F7	DP-F07-6	206	7.1	0	29.4
45	F8	DP-F08-14	2367	6.79	3	27.0
46	F8	DP-F08-20	427	6.13	4	26.0
47	F8	DP-F08-28	267	6.01	2	25.7
48	F9	DP-F09-5	183	6.1	0	26.1
49	F10	DP-F10-11	376	4.85	15	25.2
50	F11	DP-F11-11	301	4.85	11	25.3
51	F11	DP-F11-15	377	5.3	18	26.3
52	F11	DP-F11-18	390	5.02	18	26.3
53	F11	DP-F11-21	379	6.02	19	26.6
54	F11	DP-F11-24	281	5.21	11	25.8
55	F11	DP-F11-27	234	5.51	2	26.1
56	F12	DP-F12-10	344	4.47	11	25.8
57	F15	DP-F15-14	423	5.14	10	24.4
58	F15	DP-F15-20	633	5.13	20	24.1
59	F15	DP-F15-26	272	5.22	5	23.7
60	G5	DP-G05-6	203[2]	5.89[2]	nm	29.3[2]
61	G6	DP-G06-7	216	5.91	0	26.1
62	G7	DP-G07-13	218	5.87	0	26.2
63	G7	DP-G07-15	263	5.11	2	25.4
64	G7	DP-G07-17	297	5.19	3	25.1
65	G7	DP-G07-21	327	5.16	5	25.2

Table 4
Drive Point Sampler Field Parameters Measured November 18-19, 2010

	Location	Identification	Specific Conductance (µS)	pH	Estimated NO_X (Test Strip)[1] (ppm)	Temperature (°C)
66	G7	DP-G07-24	287	5.21	4	24.8
67	G7	DP-G07-27	277	5.28	4	25.2
68	G8	DP-G08-5	230	5.99	0	24.8
69	G9	DP-G09-11	267	5.58	3	24.6
70	G11	DP-G11-8	276	4.55	4	23.2
71	G12	DP-G12-9	344	4.54	5	22.6
72	G12	DP-G12-15	440	4.81	11	24.1
73	G12	DP-G12-18	486	4.86	17	23.3
74	G12	DP-G12-21	391	5.08	10	23.5
75	G12	DP-G12-24	331	5.09	6	23.6
76	G12	DP-G12-27	284	5.59	3	23.0
77	H5	DP-H05-7	187	5.48	0	25.0
78	H6	DP-H06-7	140	6.14	0	24.8
79	H7	DP-H07-8	140	5.51	0	26.0
80	H8	DP-H08-10	204	6.27	0	25.7
81	H9	DP-H09-12	245	5.21	2	25.1
82	H10	DP-H10-11	159	5.92	0	25.5
83	H12	DP-H12-5	176	6.04	0	25.8
84	I6	DP-I06-14	186	5.44	3	25.9
85	I6	DP-I06-20	225	5.36	5	26.0
86	I6	DP-I06-26	237	5.52	10	24.9
87	I7	DP-I07-8	152	6.31	0	24.7
88	I8	DP-I08-5	220	6.15	nm	24.3
89	I9	DP-I09-11	182	5.21	0.5	25.1
90	I10	DP-I10-6	170	6.18	0	26.3
91	I11	DP-I11-10	174	5.92	0	25.6
92	I12	DP-I12-6	132	5.23	0	24.6
93	J8	DP-J08-6	181	6.28	nm	24.5
94	J9	DP-J09-12	139	4.98	1	26.5
95	J9	DP-J09-14	166	4.85	2	27.6
96	J9	DP-J09-20	234	5.29	4	25.8
97	J9	DP-J09-26	233	5.62	5	25.5
98	J10	DP-J10-6	201	6.37	nm	25.1
99	J11	DP-J11-12	159	4.35	0.5	25.5
100	J12	DP-J12-13	177	5.06	1.5	25.7
101	J12	DP-J12-15	225	5.19	3	26.2

Table 4
Drive Point Sampler Field Parameters Measured November 18-19, 2010

	Location	Identification	Specific Conductance (µS)	pH	Estimated NO_X (Test Strip)[1] (ppm)	Temperature (°C)
102	J12	DP-J12-20	255	5.53	5	26.1
103	J12	DP-J12-27	237	4.99	10	26.0
104	K10	DP-K10-7	173	5.73	nm	25.1
105	K11	DP-K11-13	200	5.67	0.5	24.9
106	K12	DP-K12-5	78	5.35	nm	25.1
107	M7	DP-M07-15	224	5.09	4	25.6
108	M7	DP-M07-21	252	5.38	5	25.4
109	M7	DP-M07-27	230	5.03	5	25.3
110	M12	DP-M12-10	182	6.05	0	25.0
111	N12	DP-N12-14	137	4.86	0	24.8
112	N12	DP-N12-18	196	5.12	2	22.2
113	N12	DP-N12-21	275	5.13	2	24.6
114	N12	DP-N12-24	320	5.17	5	24.5
115	N12	DP-N12-27	312	5.11	5	24.4
116	O10	DP-O10-12	113	4.92	0.5	25.2
117	O10	DP-O10-18	203	5.17	2	25.1
118	O10	DP-O10-24	268	5.11	4	25.2
119	Q15	DP-Q15-15	270	4.91	2	23.0
120	Q15	DP-Q15-21	324	5.19	3	23.0
121	Q15	DP-Q15-26	300	5.76	3	22.2

[1]Test strip concentration values have not been confirmed with laboratory results, nm = not measured, and 0 = non detect.
[2]Field parameters measured on 8/26/10.

Table 5
Standpipe Piezometer Field Parameters Measured November 18-19, 2010

	Location	Identification	Depth to Water Table (ft)	Specific Conductance (µS)	pH	Estimated NO_X (Test Strip)[1] (ppm)	Temperature (°C)
1	Bkgd, North	PZ01-BKG-9	nm	nm	nm	nm	nm
2	Bkgd, North	PZ04-BKG-9	5.28	nm	nm	nm	nm
3	Bkgd, North	PZ24-BKG-26	5.43	285	5.59	7	23.3
4	Bkgd, East	PZ05-BKG-9	nm	nm	nm	nm	nm
5	Bkgd, NW	PZ06-BKG-12	nm	nm	nm	nm	nm
6	A11	PZ15-A11-6	4.50	114	5.08	0.5	24.9
7	C12	PZ16-C12-28	2.97	248	5.74	0	24.8
8	CD6.5	PZ10-CD6-13	nm	416[2]	6.23[2]	nm	26.6[2]

Table 5
Standpipe Piezometer Field Parameters Measured November 18-19, 2010

	Location	Identification	Depth to Water Table (ft)	Specific Conductance (µS)	pH	Estimated NO_X (Test Strip)[1] (ppm)	Temperature (°C)
9	D5.5	PZ07-D05-7	5.46	201	4.43	4	23.3
10	D9	PZ23-D09-27	4.09	247	6.55	0	24.3
11	E9	PZ11-E09-10	4.10	351	5.26	19	25.0
12	E11	PZ21-E11-26	4.44	407	5.88	18	24.9
13	E11	PZ22-E11-15	4.29	438	5.78	20	25.3
14	F4	PZ13-F04-8	3.97	84	5.08	0	25.9
15	FG7	PZ08-FG7-6	4.08	124	4.43	0	25.0
16	G9.75	PZ19-G10-26	4.16	331	5.38	10	24.4
17	G9.75	PZ20-G10-15	4.13	411	6.05	4	24.7
18	G13	PZ14-G13-7	2.66	Dry			
19	H11	PZ03-H11-6	4.42	155	4.35	0	24.3
20	I8.5	PZ09-I08-5	4.22	60	5.15	nm	24.1
21	I15	PZ17-I15-26	4.26	279	5.21	5	24.2
22	PQ1.75	PZ02-P02-9	nm	nm	nm	nm	nm
23	R12	PZ18-R12-26	3.76	320	5.36	4	24.2

[1]Test strip concentration values have not been confirmed with laboratory results, nm = not measured, and 0 = non detect.
[2]Field parameters measured on 8/26/10.

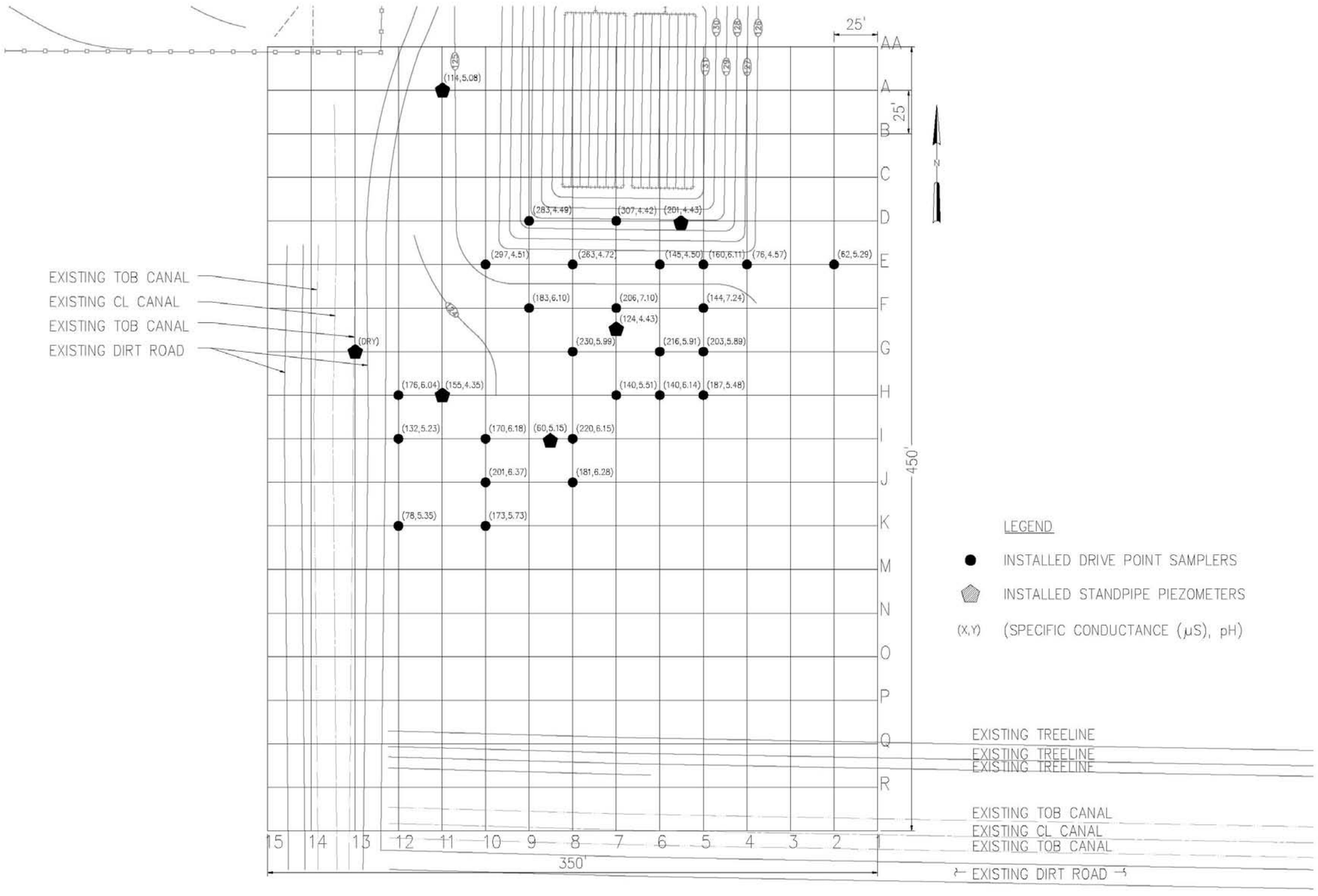

Figure 5
Initial Groundwater Sampling Results
Monitoring Points Approximately 5 ft BGS

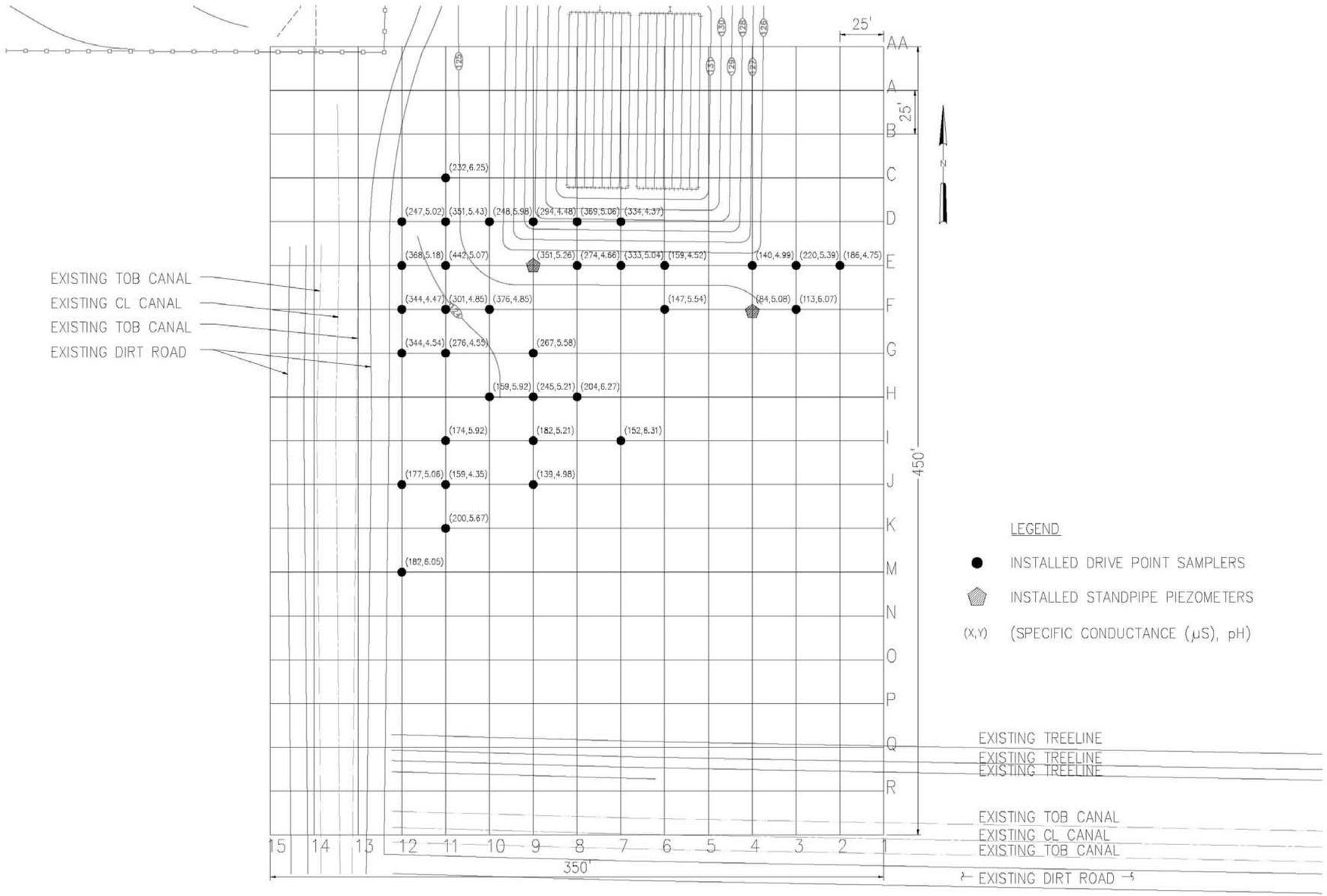

Figure 6
Initial Groundwater Sampling Results
Monitoring Points Approximately 10 ft BGS

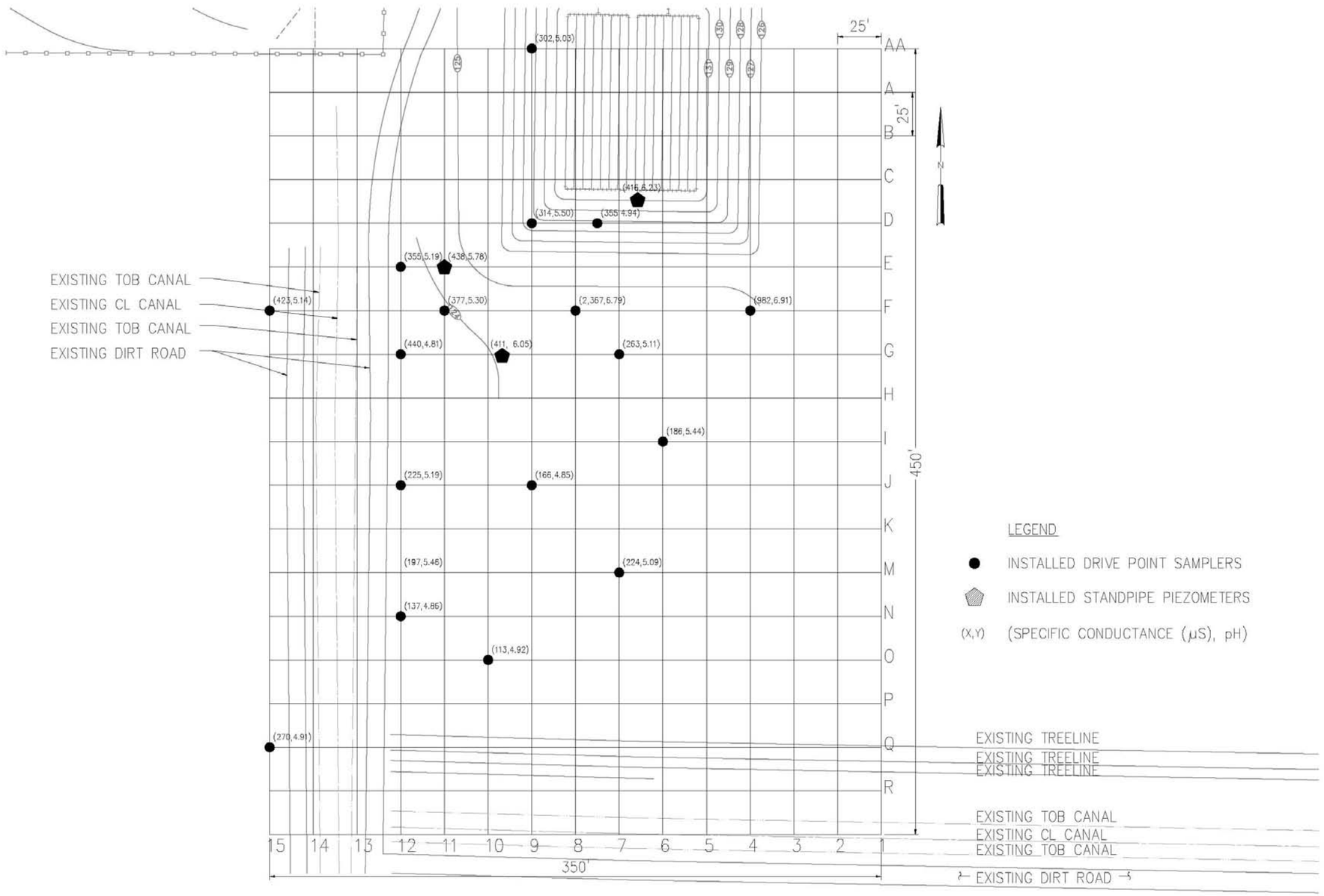

Figure 7
Initial Groundwater Sampling Results
Monitoring Points Approximately 15 ft BGS

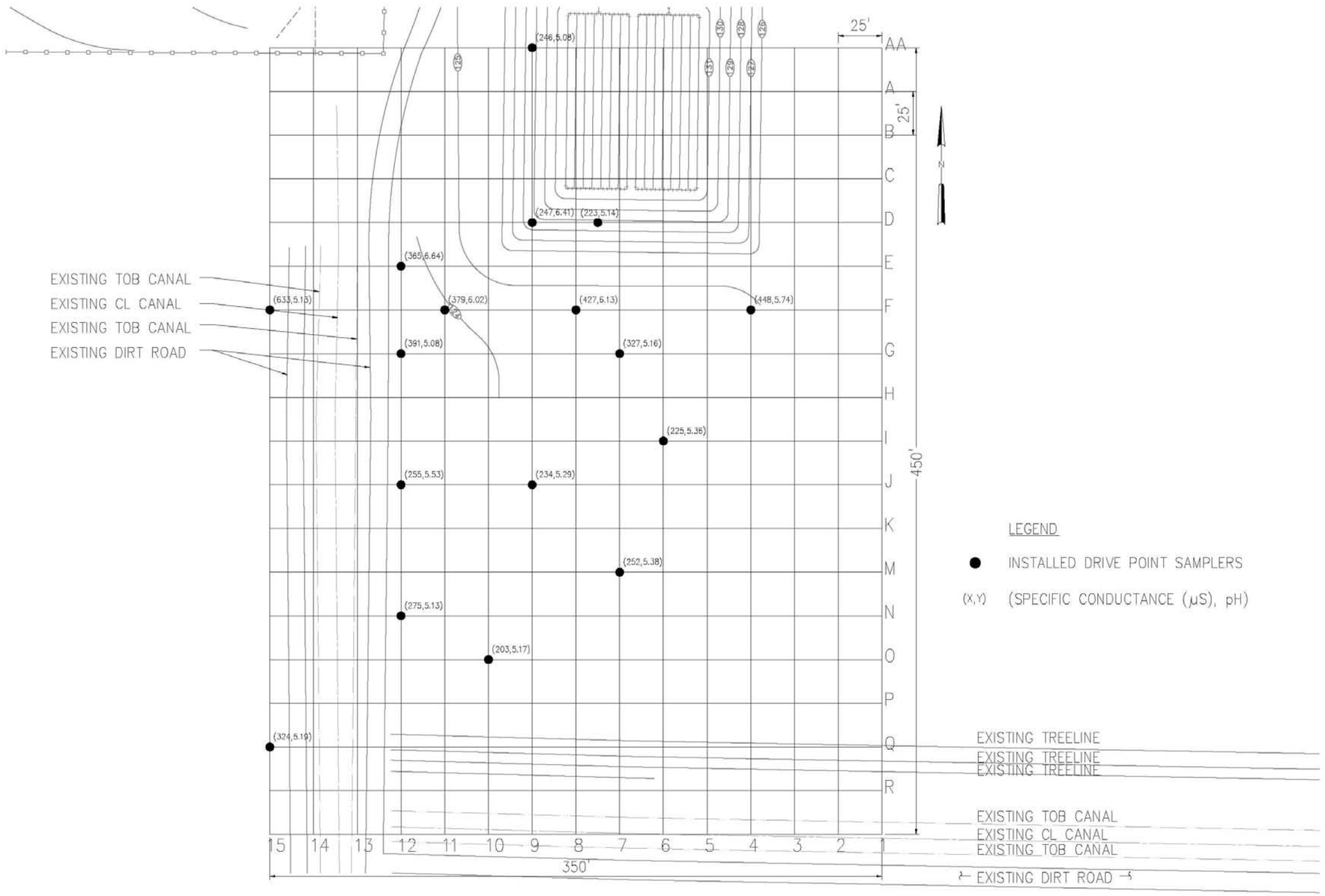

Figure 8
Initial Groundwater Sampling Results
Monitoring Points Approximately 20 ft BGS

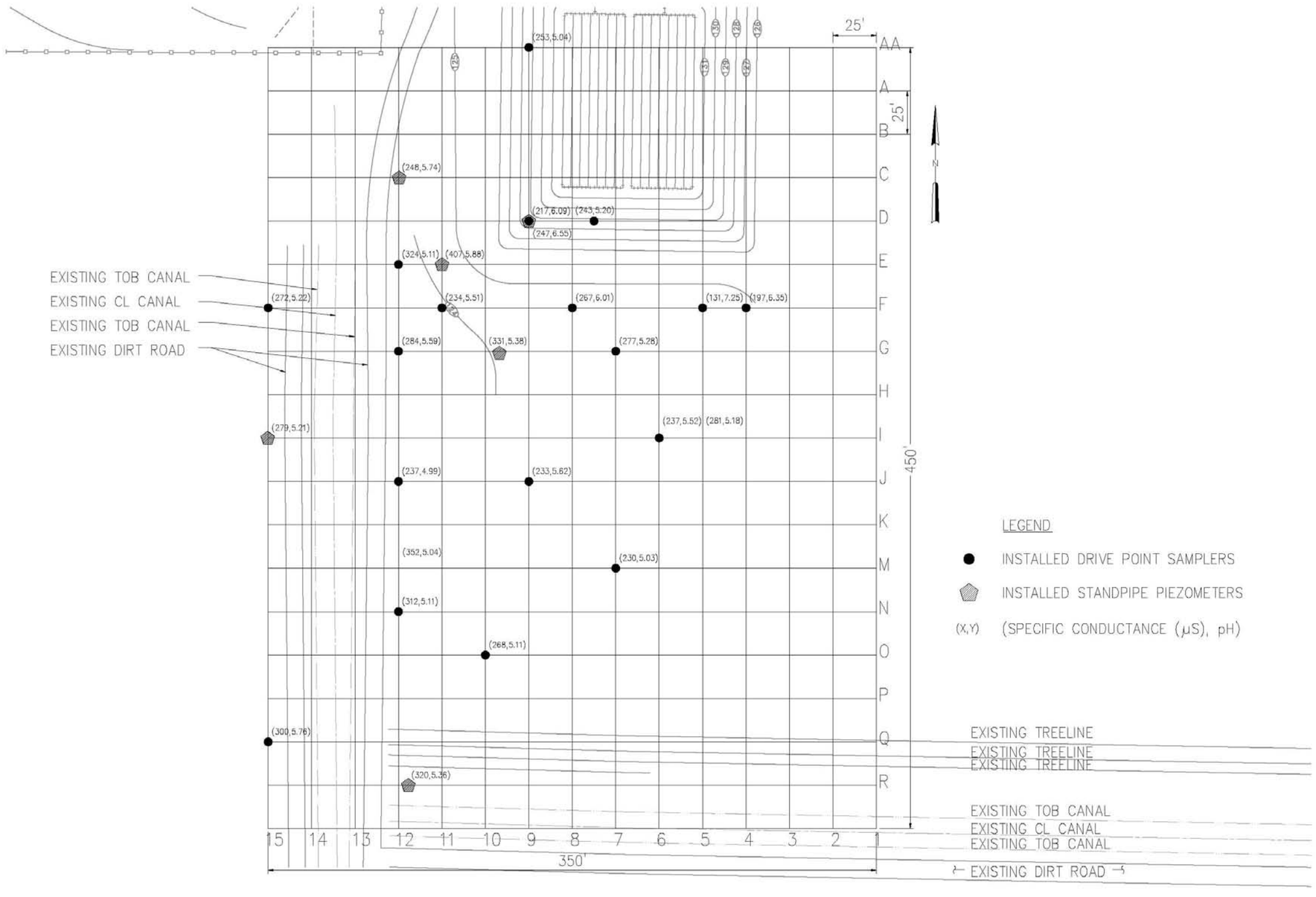

Figure 9
Initial Groundwater Sampling Results
Monitoring Points Approximately 26 ft BGS

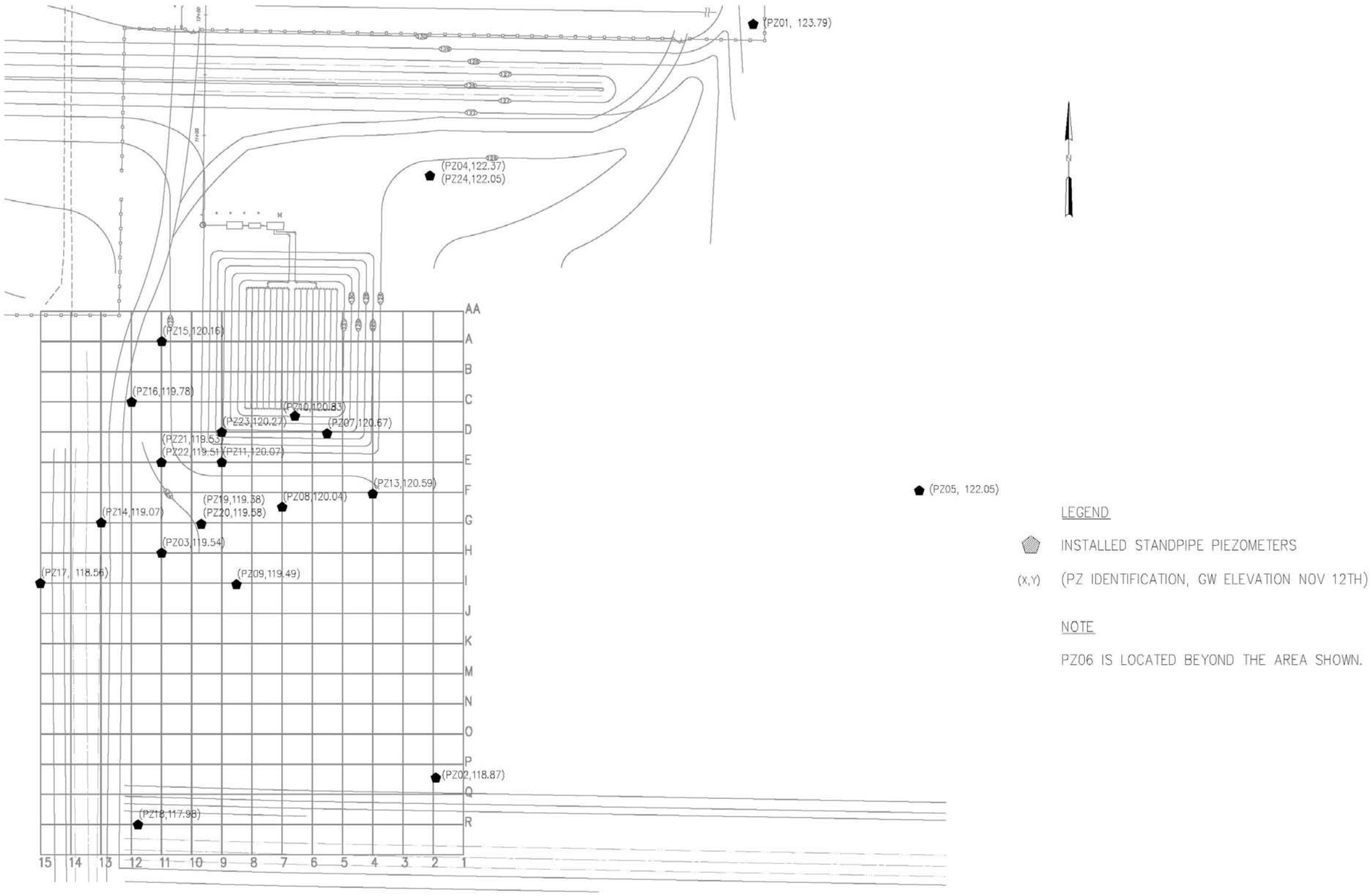

Figure 10
Initial Groundwater Sampling Results
Groundwater Elevations Measured November 12, 2010

References:

Driscoll, F.G. 1986. Groundwater and Wells, Second Edition. U.S. Filter/Johnson Screens, St Paul, MN. 1089 pgs.

U.S. EPA. 1991. Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells. EPA160014-891034. Office of Research and Development. Las Vegas, NV. 221 pgs.