Florida Department of Health
Onsite Nitrogen Reduction Strategies Study

Contract CORCL

TASK C.23
INSTRUMENTATION OF WAKULLA COUNTY HOME SITE C-HS1

June 2011

Background

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 Task C QAPP documents the objectives, monitoring framework, sample frequency and duration, and analytical methods to be used at home sites. This report documents the progress for instrumentation of home site C-HS1 in Wakulla County, Florida.

Site Description

Site C-HS1 is located in Wakulla County, Florida in a neighborhood close to the Wakulla River. The site has a single residence, 2 bedroom, 2 bathroom house and is home to 2 adults and 2 small children. The conventional septic system consists of a baffled tank and plastic tubing industries (PTI) multi-pipe bed drainfield in a large mound. The drainfield mound also contains a PTI bed drainfield for the residence across the street, which is located on the Wakulla River. This house is a 2 bedroom, 2 bathroom house with two adults and has a baffled tank and a separate pump tank. Except for the drainfield mound, the site is mostly wooded except for a garden next to the driveway.

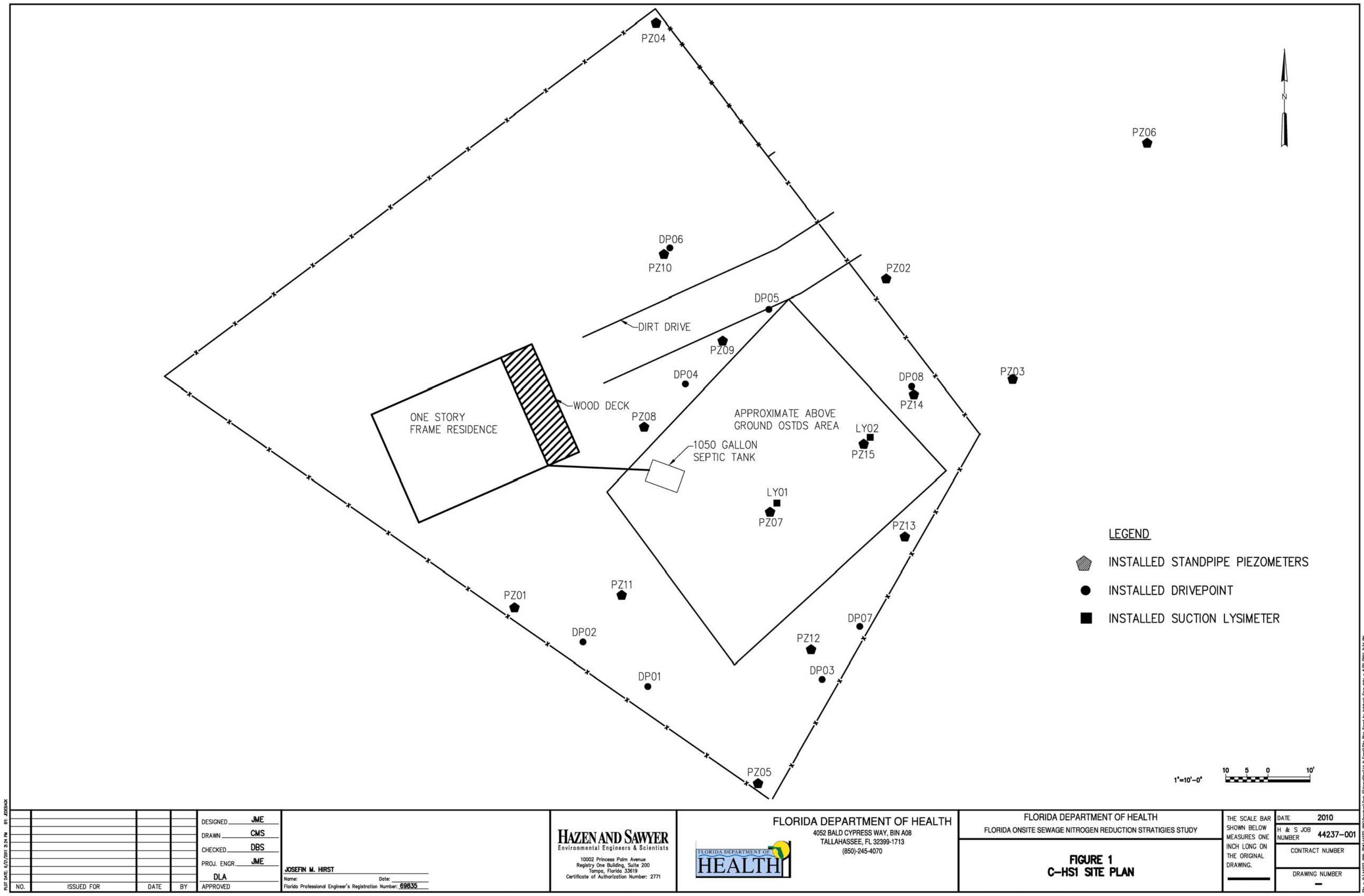
Installation of Monitoring Points and Preliminary Data

Three types of monitoring points were installed: drive point samplers, standpipe piezometers and suction lysimeters. Drive point samplers consist of a stainless steel drive tip with a 1" long protective screen and attached flexible ¼ inch tubing that extends to the ground surface. The drive points are installed by inserting the drive point into a hollow core barrel (push-pull sampler) and driving the barrel to the desired depth with a hammer drill. The hollow core barrel is then removed with a hand jack, leaving the drive point in place. Standpipe piezometers consist of a ¾" diameter, 5' long PVC screen with a PVC riser extending to the ground surface. A hand auger was used to install the piezometers and soil descriptions were noted and samples taken during augering. Once a piezometer was in place, sifted coarse sand was poured around the piezometer to a height above the piezometer screen. Six to twelve inches of bentonite was placed above the sand pack. Native soil was used to fill the remainder of the borehole around the piezometer. A 7 inch irrigation cover was installed over each drive point sampler and standpipe piezometer to protect the monitoring point and decrease disturbance to the homeowner. Two soil suction lysimeters were installed within the drainfield mound. The lysimeters consist of a 9 inch porous ceramic cup attached to a 2 inch PVC pipe with a bushing. The top of the pipe has another bushing with two valves. Inside the lysimeters a tube goes to one of the valves to the bottom of the ceramic cup. The lysimeters are sampled by placing a vacuum on the lysimeter (using a peristaltic pump) and returning the following day to collect the sample.

Four site visits have occurred (September 2010, November 2010, April 2011, and May 2011) for the purpose of instrumentation of site C-HS1. A total of 25 monitoring points have been installed: 15 standpipe piezometers, 8 drive point samplers and 2 lysimeters as outlined in Table 1. Figure 1 illustrates the location of the equipment installed.

Table 1
Site C-HS1 Installed Monitoring Points

	Identification	Type of Monitoring Point	Surface Elevation (ft)	Bottom Elevation (ft)	Depth Below Ground Surface (ft)
1	DP-01	1” SST Drive Point	96.30	87.05	9.25
2	DP-02	1” SST Drive Point	95.61	86.71	8.90
3	DP-03	1” SST Drive Point	96.33	86.49	9.84
4	DP-04	1” SST Drive Point	96.32	85.71	10.61
5	DP-05	1” SST Drive Point	96.25	86.70	9.55
6	DP-06	1” SST Drive Point	96.05	87.35	8.70
7	DP-07	1” SST Drive Point	96.24	90.14	6.10
8	DP-08	1” SST Drive Point	97.41	89.89	7.52
9	PZ-01	3/4" Standpipe Piezometer, 5’ screen	95.73	85.11	10.62
10	PZ-02	3/4" Standpipe Piezometer, 5’ screen	96.17	86.99	9.18
11	PZ-03	3/4" Standpipe Piezometer, 5’ screen	96.54	88.66	7.88
12	PZ-04	3/4" Standpipe Piezometer, 5’ screen	95.77	85.76	10.01
13	PZ-05	3/4" Standpipe Piezometer, 5’ screen	96.06	87.99	8.07
14	PZ-06	3/4" Standpipe Piezometer, 5’ screen	95.57	90.26	5.31
15	PZ-07	3/4" Standpipe Piezometer, 5’ screen	99.84	87.22	12.62
16	PZ-08	3/4" Standpipe Piezometer, 5’ screen	95.91	89.69	6.22
17	PZ-09	3/4" Standpipe Piezometer, 5’ screen	96.33	86.73	9.6
18	PZ-10	3/4" Standpipe Piezometer, 5’ screen	95.97	88.80	7.17
19	PZ-11	3/4" Standpipe Piezometer, 5’ screen	97.17	85.27	11.9
20	PZ-12	3/4" Standpipe Piezometer, 5’ screen	96.36	87.93	8.43
21	PZ-13	3/4" Standpipe Piezometer, 5’ screen	97.15	89.44	7.71
22	PZ-14	3/4" Standpipe Piezometer, 5’ screen	97.31	89.84	7.47
23	PZ-15	3/4" Standpipe Piezometer, 5’ screen	99.79	86.73	13.06
24	LY-01	Soil Lysimeter	99.84	≈93.84	~6
25	LY-02	Soil Lysimeter	99.79	≈93.79	~6



PZ04
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DP06
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DP05
DIRT DRIVE
PZ09
DP04
PZ03
DP08
PZ14
ONE STORY
FRAME RESIDENCE
WOOD DECK
PZ08
APPROXIMATE ABOVE
GROUND OSTDS AREA
LY02
PZ15
1050 GALLON
SEPTIC TANK
LY01
PZ07
PZ13
LEGEND
INSTALLED STANDPIPE PIEZOMETERS
INSTALLED DRIVEPOINT
INSTALLED SUCTION LYSIMETER
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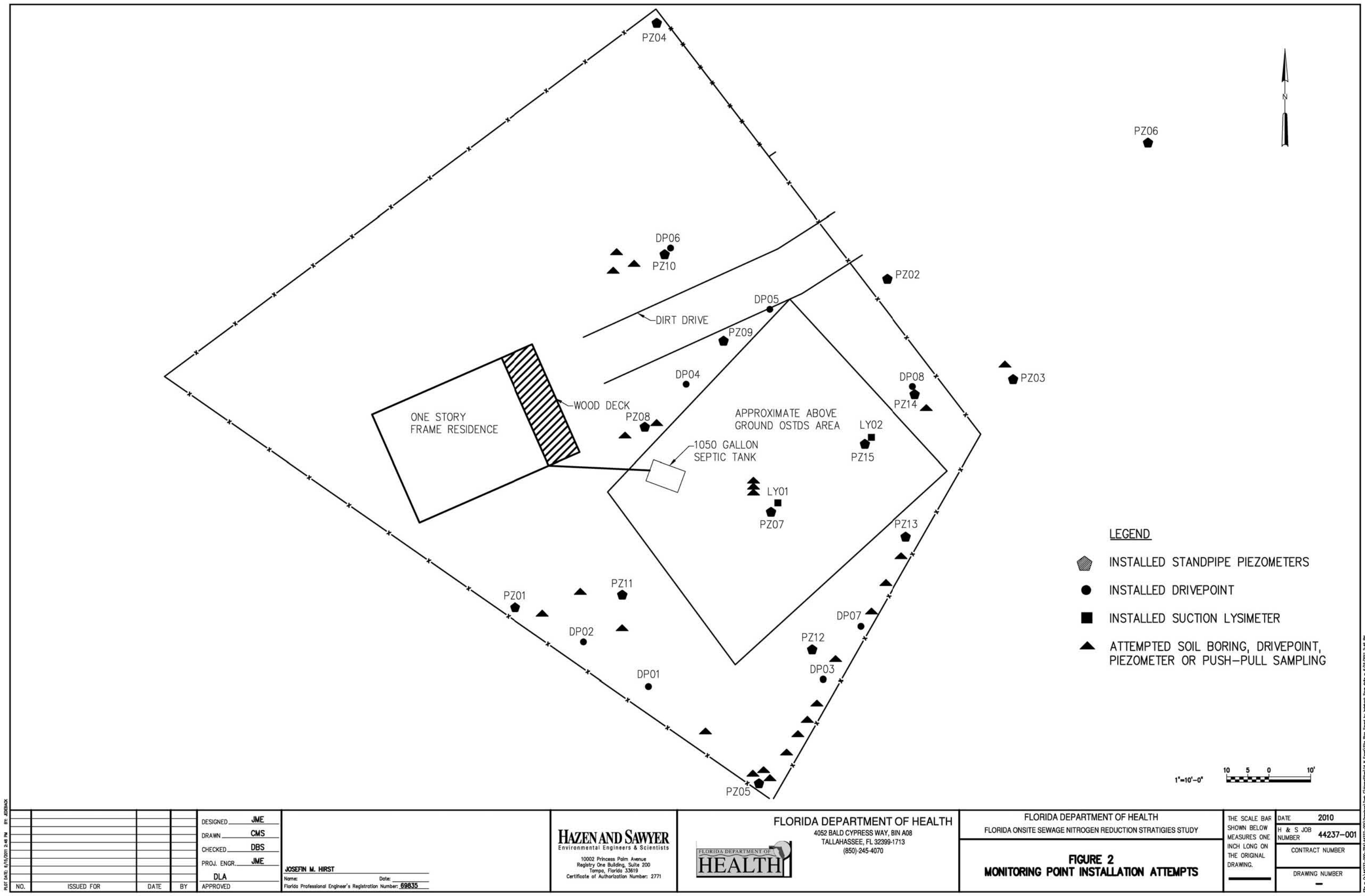
FLORIDA ONSITE SEWAGE NITROGEN REDUCTION STRATIGIES STUDY
FIGURE 1
C-HS1 SITE PLAN
THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.
DATE 2010
H & S JOB NUMBER 44237-001
CONTRACT NUMBER
DRAWING NUMBER

Installation of monitoring points and obtaining samples with the push-pull sampler was problematic due to the variability of the underlying limestone rock and clay layers. Five bore holes for piezometers were abandoned because rock was encountered before the groundwater or very close to the groundwater table. This does not include augering that encountered rock within the first couple of feet of a bore hole which occurred frequently. Likewise, the variability of the depth of the clay layer made installing the drive points difficult. If installed into the clay, the drive points will not yield water. Out of the 12 drive points installed during the April 2011 site visit, 7 drive points were dry and abandoned and only 5 yielded water. The depth of all the drive points installed was well below the water line. During the May installation and sampling trip, another drive point that had been functional failed to yield water.

The push-pull sampler using the retract-a-tip mostly failed to yield results. Several attempts were made during each of the first three site visits to use the push-pull sampler, where only three of these attempts yielded results. Apparently the sampler became clogged as it was pulled through the clay layer. Figure 2 shows the approximate locations of attempts to install piezometers, drive points, and use the push-pull sampler retract-a-tip.

Two lysimeters were installed during the April 2011 site visit but were not measured until the May 2011 site visit. The lysimeters were installed in the drainfield mound next to the drainfield beds at a 45 degree angle. This was done in order to place the lysimeter ceramic cup underneath the drainfield without going through the drainfield. As discussed within the site description, the drainfield mound has two separate drainfields: one from the residence on the property and the other from the residence directly across the street. The first lysimeter (LY-01) was installed at the end of the drainfield bed serving the residence on the property and is located near the center of the mound. The second lysimeter (LY-02) is located under the influent end of the neighbor's drainfield, which is near the edge of the mound closer to the street. Both lysimeters are 9 feet in length; therefore the ceramic cup is approximately 6 to 6.5 feet below the mound surface, placing the lysimeter cups at least 2 feet below the drainfield.



PZ04
PZ06
DP06
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DIRT DRIVE
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PZ01
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1"=10'-0"
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FIGURE 2
MONITORING POINT INSTALLATION ATTEMPTS
THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.
DATE 2010
H & S JOB NUMBER 44237-001
CONTRACT NUMBER
DRAWING NUMBER
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The fourth site visit was made May 17–20, 2011 which focused on installing piezometers as neither the drive points nor push-pull sampler were effective in previous site visits. An additional 8 piezometers were installed during this visit. However during sampling on May 19th and May 20th, two of the piezometers (PZ08 and PZ14) failed to provide enough water flow to allow for purging and sampling, taking approximately an hour to recharge. Other wells with similar water column heights yielded samples and had much higher recharge rates.

Table 2 summarizes the groundwater levels as measured in the standpipe piezometers during the November 2010, April 2011, and May 2011 site visits. Groundwater levels were measured using a flat tape water level meter graduated in feet (measurement accuracy is 0.01 ft). Elevations are relative to a benchmark onsite and not mean sea level.

Table 2
Installed Piezometer and Groundwater Elevations

ID	Bottom Elevation (ft)	GW Elevation Nov 4, 2010 (ft)	GW Elevation April 27, 2011 (ft)	GW Elevation April 29, 2011 (ft)	GW Elevation May 19, 2011 (ft)
PZ-01	85.11	90.77	91.92	92.59	91.26
PZ-02	86.99	91.10	91.97	92.41	91.46
PZ-03	88.66	91.00	92.01	92.46	91.39
PZ-04	85.76	91.23	92.14	92.75	91.64
PZ-05	87.99	90.46	91.82	92.31	91.09
PZ-06	90.26	90.86	91.69	92.26	91.08
PZ-07	87.22	Not installed	91.97	92.34	91.42
PZ-08	89.69	Not installed	Not installed	Not installed	91.43
PZ-09	86.73	Not installed	Not installed	Not installed	91.47
PZ-10	88.80	Not installed	Not installed	Not installed	91.41
PZ-11	85.27	Not installed	Not installed	Not installed	91.33
PZ-12	87.93	Not installed	Not installed	Not installed	91.18
PZ-13	89.44	Not installed	Not installed	Not installed	91.30
PZ-14	89.84	Not installed	Not installed	Not installed	91.76
PZ-15	86.73	Not installed	Not installed	Not installed	91.43

The groundwater elevations have been found to fluctuate due to periods of dry weather and/or heavy precipitation; however, the general flow direction trend to the southeast appears to not change. The data indicates that the direction of the groundwater is somewhat influenced by a change in height of the water table or the Wakulla River. In November 2010, PZ-01 was 0.33 ft lower in elevation than PZ-02, indicating that the groundwater is flowing towards PZ-01. On April 27, 2011, the groundwater was higher and the gradient between PZ-01 and PZ-02 was flat, with the difference in groundwater elevation of the two piezometers being 0.05 ft. On April 28th, a heavy rain fell, significantly raising the groundwater when measured April 29th. On April 29th, the elevation in PZ-01 was 0.18 feet higher than PZ-02 indicating that the groundwater was flowing east towards the river. In May, a relatively dry period, the elevation in PZ-01 was again 0.2 ft lower in elevation than PZ-02. The groundwater contours on these different dates are illustrated in Figures 3 through 6.

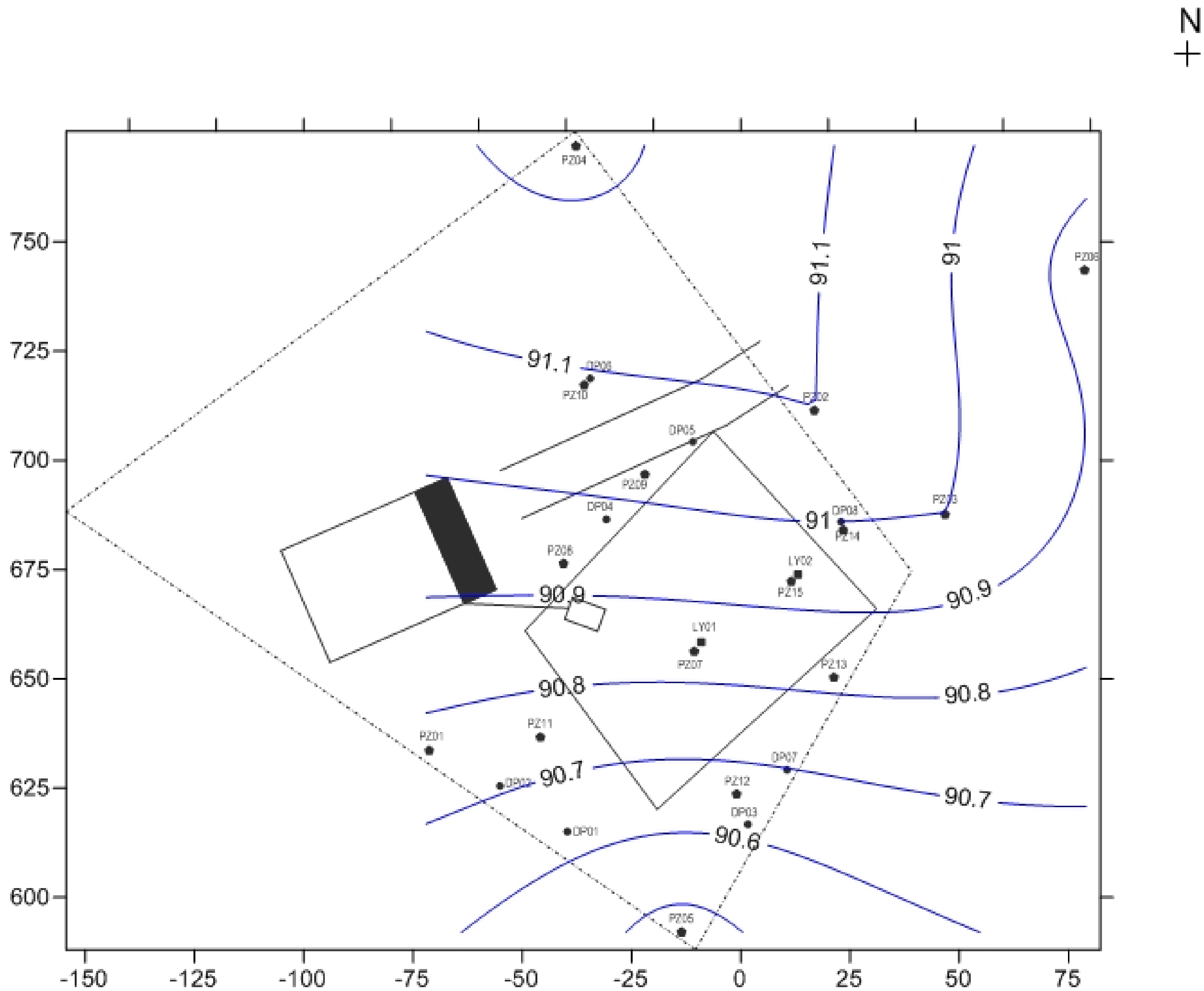

Figure 3
Surficial Groundwater Contours November 4, 2010

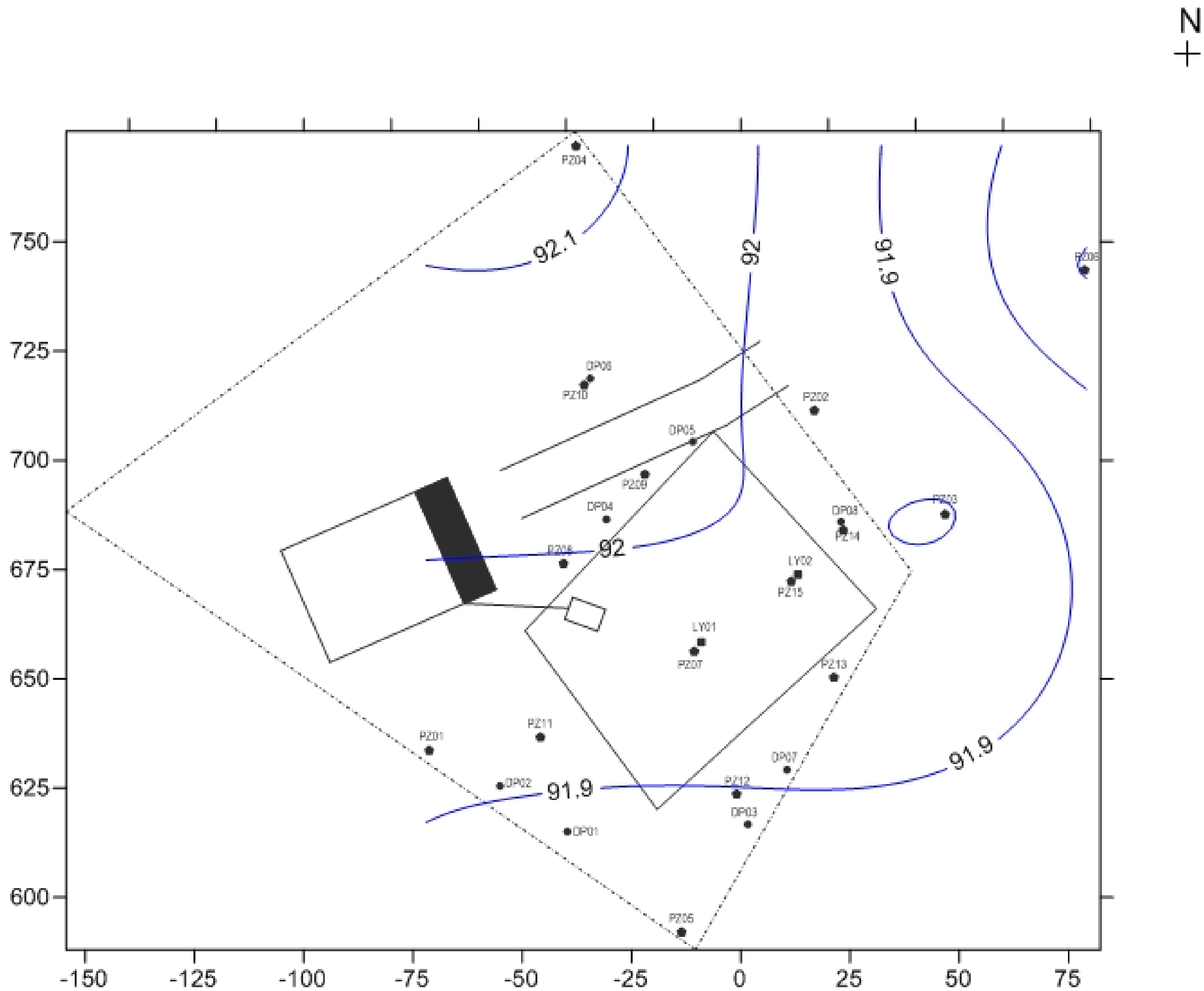

Figure 4
Surficial Groundwater Contours April 27, 2011

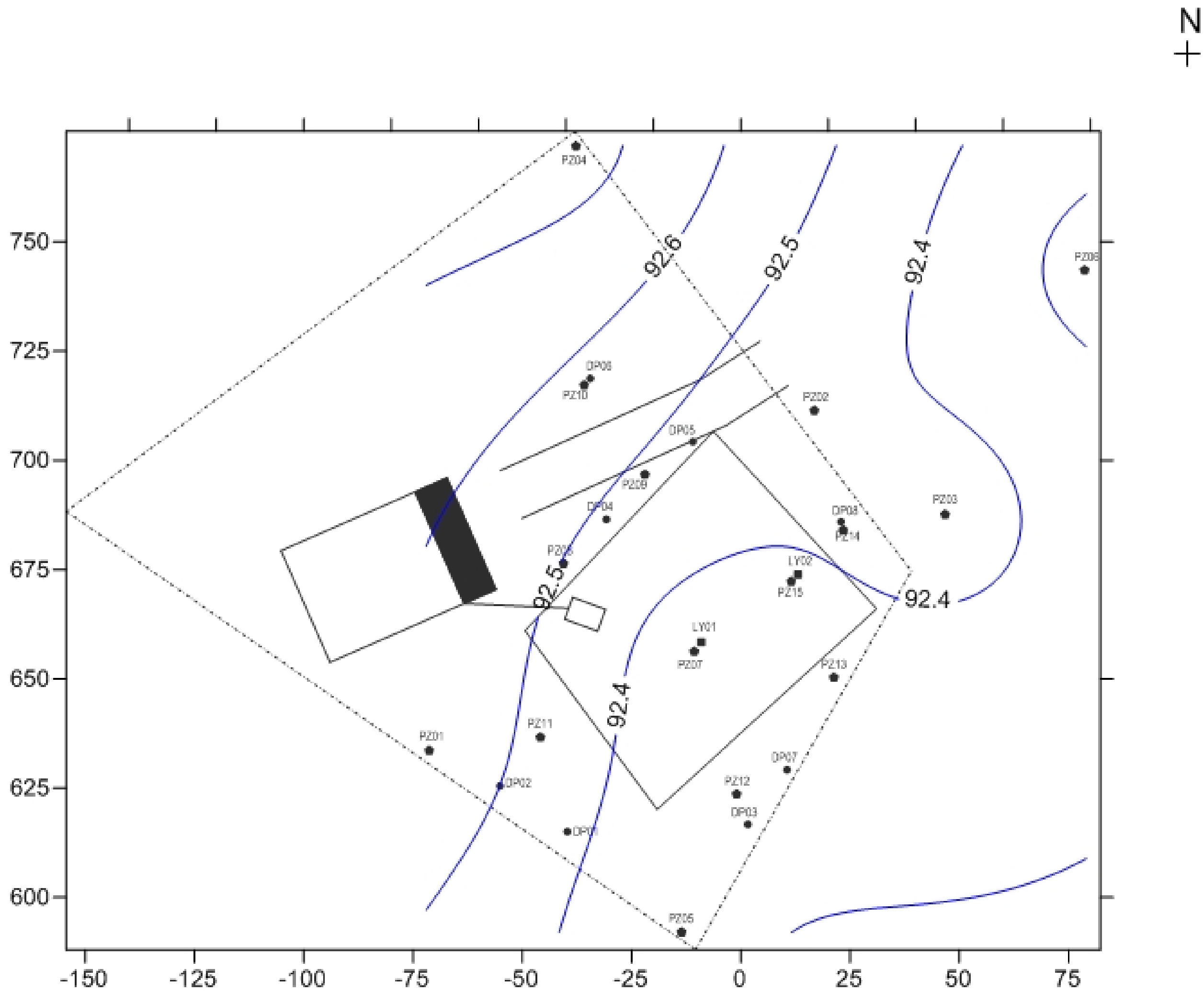

Figure 5
Surficial Groundwater Contours April 29, 2011

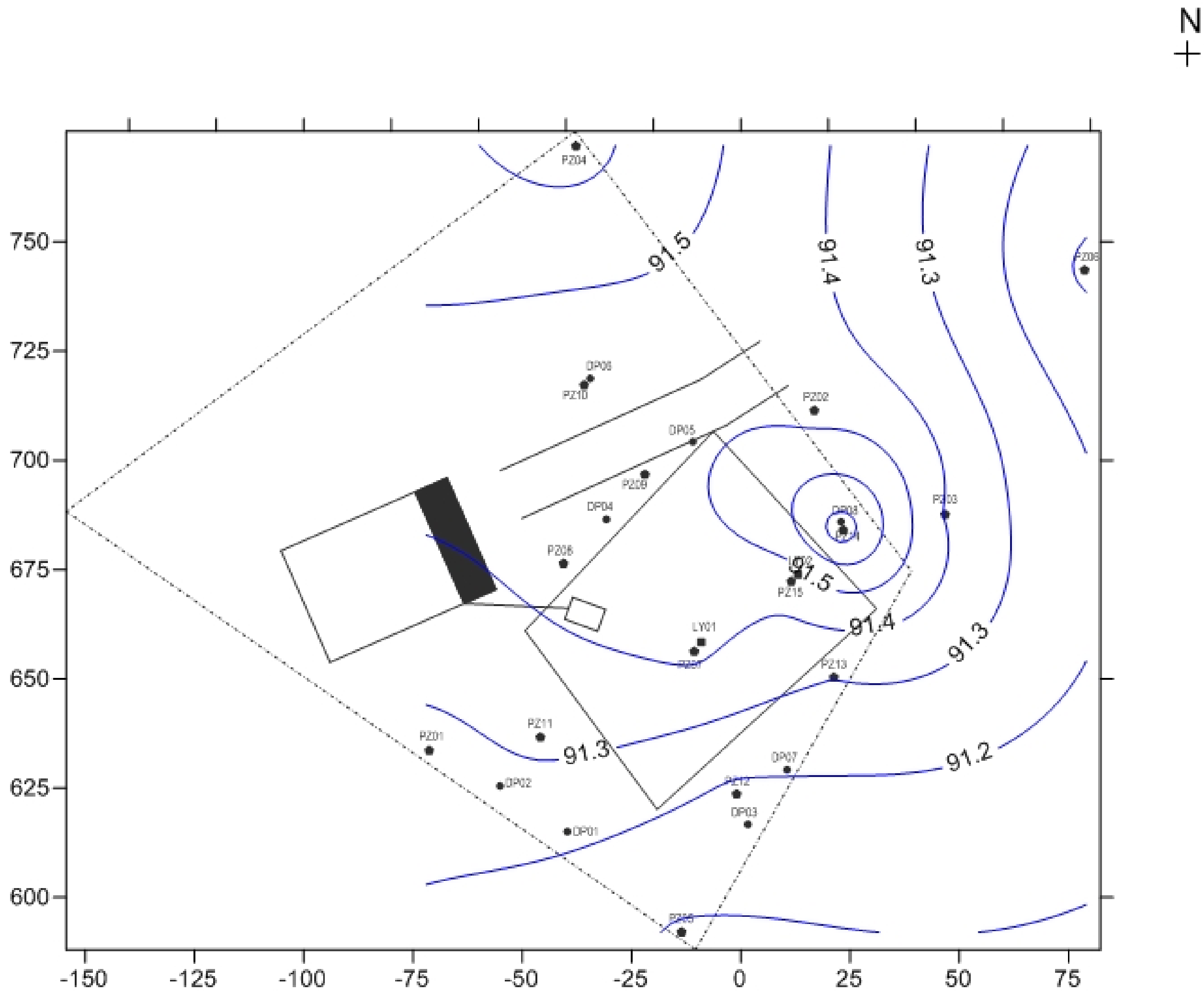

Figure 6
Surficial Groundwater Contours May 19, 2011

The specific conductance, pH, and temperature of the groundwater at the standpipe piezometer and drive point locations were measured and recorded on April 29, 2011 and May 19-20, 2011. In April, nitrogen measurements were taken using nitrate and nitrite HACH test strips and recorded. Tables 3 and 4 outline the STE and groundwater field parameter measurements recorded for the STE, standpipe piezometer and drive point locations in April and May, respectively.

Table 3
Field Parameter Measurements April 29, 2011

Sample ID	Temp (C)	pH	Conductivity (µS)	Est. NO_2 test strip mg/L	Est. NO_3 test strip mg/L
STE	21.6	7.03	1,542	NR	NR
DP-01	20	6.54	946	0	0
DP-02	19.8	6.41	876	0	0
DP-03	19.9	6.62	1,040	0	0
DP-04	19.2	6.83	678	0	0
DP-05	19.3	6.59	907	0	0
DP-06	19.2	6.62	1,061	0	0
DP-07	18.8	6.52	911	0	0
DP-08	20.1	7.01	794	0	0
PZ-01	20.2	5.87	118	0	0
PZ-02	19.4	6.68	595	0	0
PZ-03	19.4	6.6	457	0	0
PZ-04	24.3	6.67	558	0	0
PZ-05	19.6	6.57	673	0	0
PZ-06	20.1	6.79	757	0	0
PZ-07	19.3	6.64	1,173	0.3	40

NR=no reading

Table 4
Field Parameter Measurements
May 19-20, 2011

	Sample ID	Temp (°C)	pH	Dissolved Oxygen (mg/L)	Conductivity (µS)
1	STE	22.3	7.20	1.36	1,367
2	DP-01	18.6	6.60	0.84	845
3	DP-02	18.7	6.60	0.56	770
4	DP-03	18.6	6.60	0.44	868
5	DP-04	18.8	7.10	0.38	570
6	DP-05	20.6	7.10	1.50	830
7	DP-06	19.2	7.00	0.49	926
8	DP-07	18.9	6.60	0.46	813
9	DP-08	Dry			
10	PZ-01	18.9	5.83	0.71	75
11	PZ-02	19.2	7.10	3.02	516
12	PZ-03	19.0	7.10	1.95	500
13	PZ-04	19.2	7.20	1.45	484
14	PZ-05	18.8	6.60	2.58	752
15	PZ-06	21.3	7.29	6.86*	580
16	PZ-07	19.6	6.50	1.04	999
17	PZ-08	Not fast enough recharge for sample			
18	PZ-09	19.1	7.10	0.56	665
19	PZ-10	19.5	7.10	0.58	674
20	PZ-11	18.8	6.69	0.43	913
21	PZ-12	19.0	6.60	0.78	933
22	PZ-13	18.9	6.12	1.49	692
23	PZ-14	Not fast enough recharge for sample			
24	PZ-15	22.6	6.51	1.48	842
25	LY-01	21.6	6.42	4.57	788
26	LY-02	24.2	6.34	1.95	1433

*Note: Bubbles were present in the sampling tube in PZ-6 due to low volume in the well, most likely elevating the dissolved oxygen reading.

In the April sampling, PZ-07, which is installed in the mound near the downgradient end of the C-HS1 residence drainfield, is the only drive point or piezometer that indicated NOx presence using the test strips. In both April and May, PZ-01 measured significantly lower conductivity (118 and 75 µS, respectively) than all the other drive points and piezometers. Figures 7 and 8 show the specific conductance contours of the concentrations as estimated using the Kriging method in Surfer. The specific conductance concentrations show some movement similar to the groundwater contours. Based on these preliminary groundwater specific conductivity and pH measurements, the general plume appears to extend to the southeast with the highest conductivity and pH measurements in the mound. Sampling and analysis using standard analytical methods is required to confirm the plume extent and is planned in May 2011.

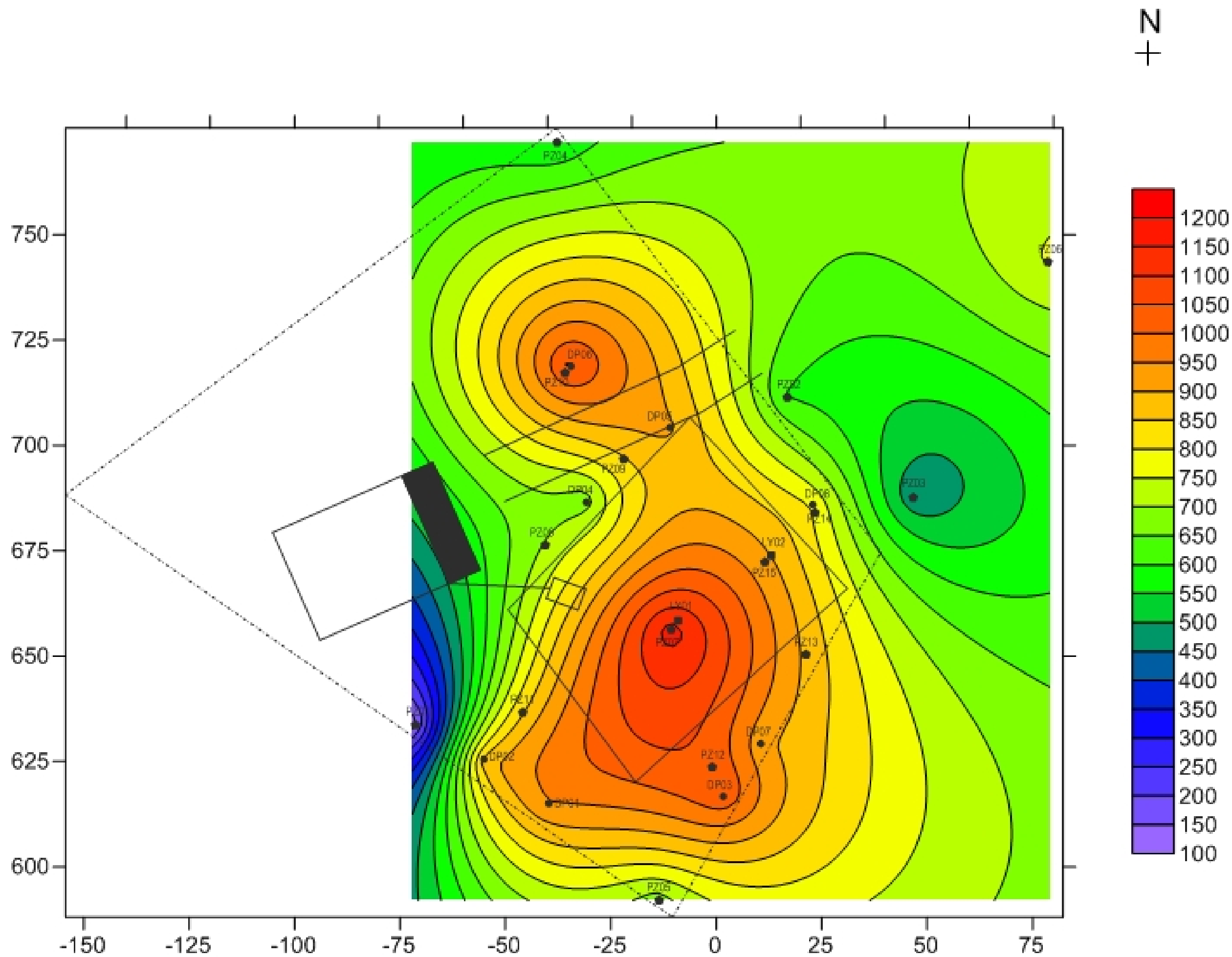

Figure 7
Specific Conductance Contours April 29, 2011

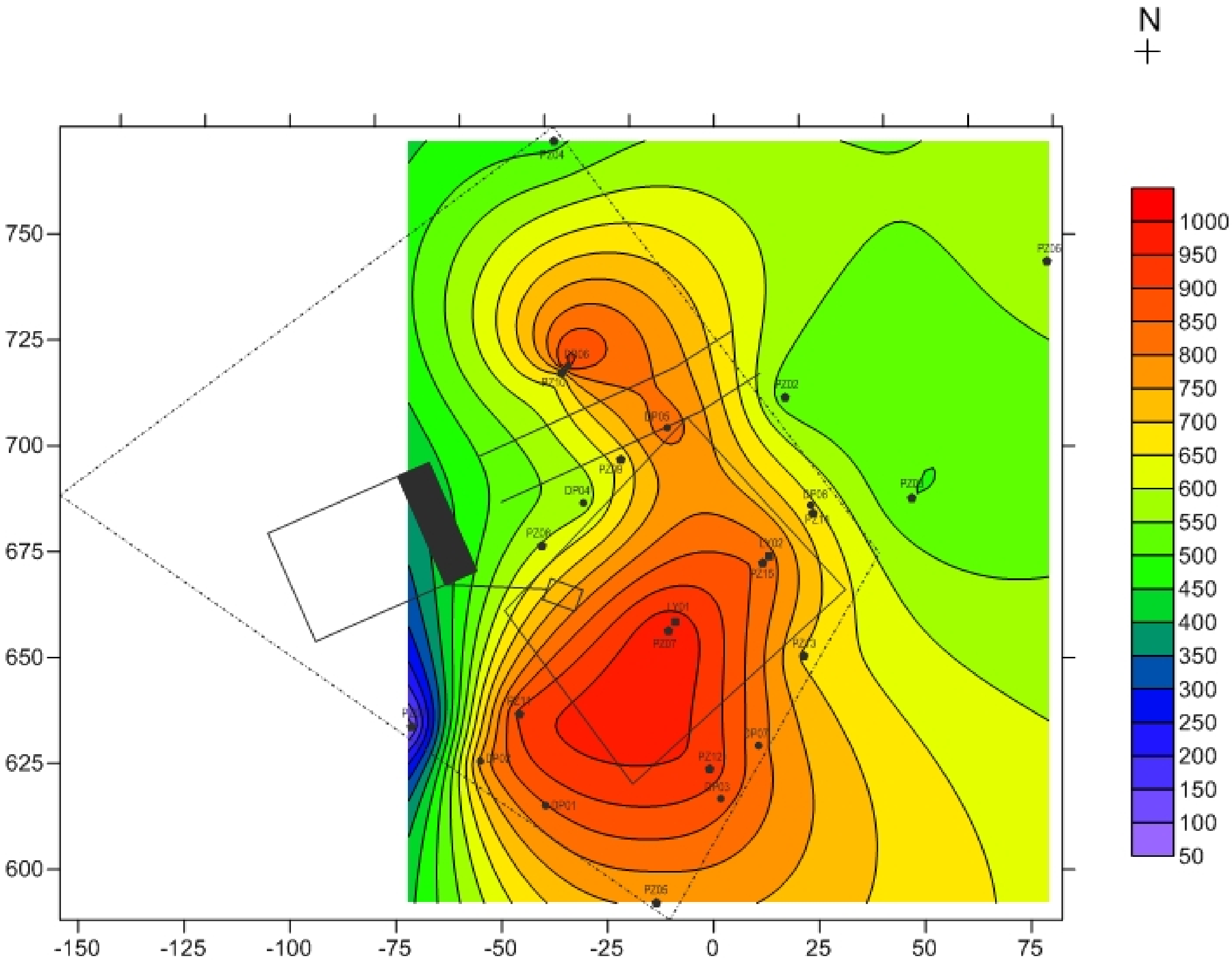

Figure 8
Specific Conductance Contours May 19 - 20, 2011