PROJECT MEMORANDUM
NORTH CAROLINA STATE UNIVERSITY – LOT 86 SITE

TO: **Karen Trimberger, NCSU**
Ken Kretchman, NCSU
Bruce Stewart, NCSU

FR: **Pete Dressel, Project Manager, Piedmont Geologic**

DATE: **February 18, 2016**

RE: **February 2016 Monitoring-Well Gauging and Updated Groundwater-Flow Modeling**

A round of monitoring-well gauging was completed on February 10, 2016 at the North Carolina State University (NCSU), Lot 86 Superfund site in Raleigh, North Carolina. The site location and layout are shown in Figures 1 and 2. The layout of the site groundwater extraction (GWE) system is shown in Figure 3. Site groundwater monitoring well construction details are listed in Table 1 and tabulated groundwater level data for the February 2016 well-gauging event are provided in Table 2.

The site monitoring wells were gauged for groundwater levels utilizing an electronic depth-to-water probe. Monitoring-wells MW-6, MW-9, MW-10, MW- 11, and MW-15 were dry during the February 2016 gauging event. All of these wells except MW-11 were dry during the previous gauging event completed in November 2015 and reflect effective operation of the site GWE system.

Updated groundwater-flow modeling based on February 2016 site groundwater levels was completed using Surfer 8® contouring software, produced by Golden Software, Inc. Groundwater potentiometric-surface and flow models for the shallow, intermediate, and deep aquifer zones were developed. Model output is attached. Two model depictions are provided for the shallow aquifer zone, one containing monitoring-well and data labels and the second not containing monitoring-well and data labels, with the latter enabling easier view of the potentiometric-surface contours with respect to recovery well locations.

The site GWE system was operating normally during the November 2016 well-gauging event. All of the shallow recovery wells were on-line during the event, with the exception of RW-8, RW-10, RW-11, and RW-13. The recovery pump for RW-13 was in a "dry running" condition (i.e., apparently due to the recovery well being dry). The recovery pumps for RW-8 and RW-11 were in a "overload" condition, indicating a possible seized pump motor. The recovery pump for RW-10 was in a normal operating condition, but no water appeared to be discharging from the well. As reported previously, deep recovery wells DRW-A, DRW-B, DRW-C, and DRW-D have been off-line since 2008. Efforts are in progress for replacement of groundwater recovery pumps for RW-8, RW-11, and RW-13.

February 2016 groundwater potentiometric-surface contours for the shallow and intermediate aquifer zones reflect drawdown influence and groundwater-capture zones from pumping of the shallow recovery wells, most notably in the western half of the site, including the areas of RW-1 through RW-4 and RW-9 through RW-11. Groundwater potentiometric-surface contours for the deep aquifer zone also appear to reflect drawdown influence in the area of RW-1.

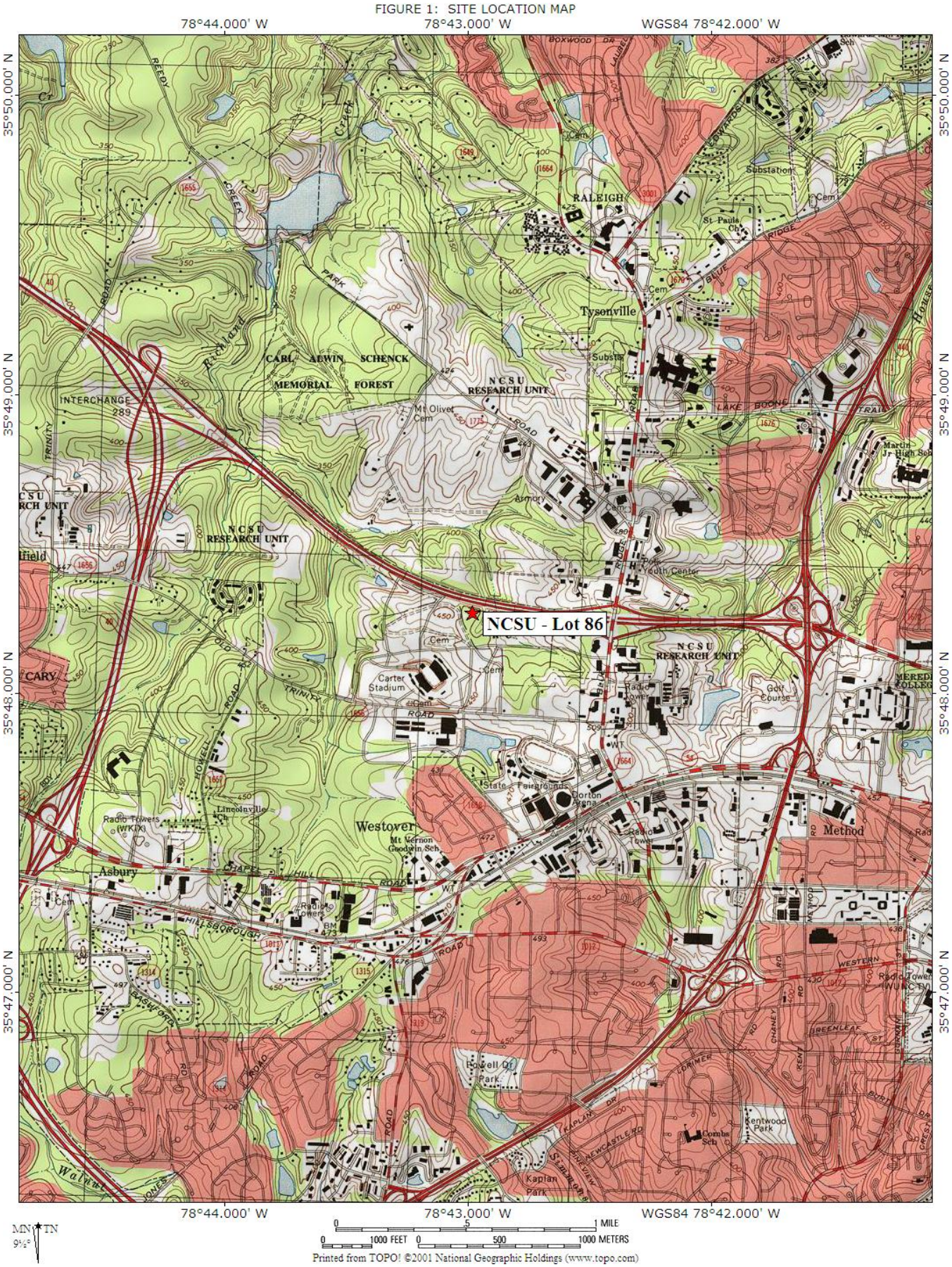
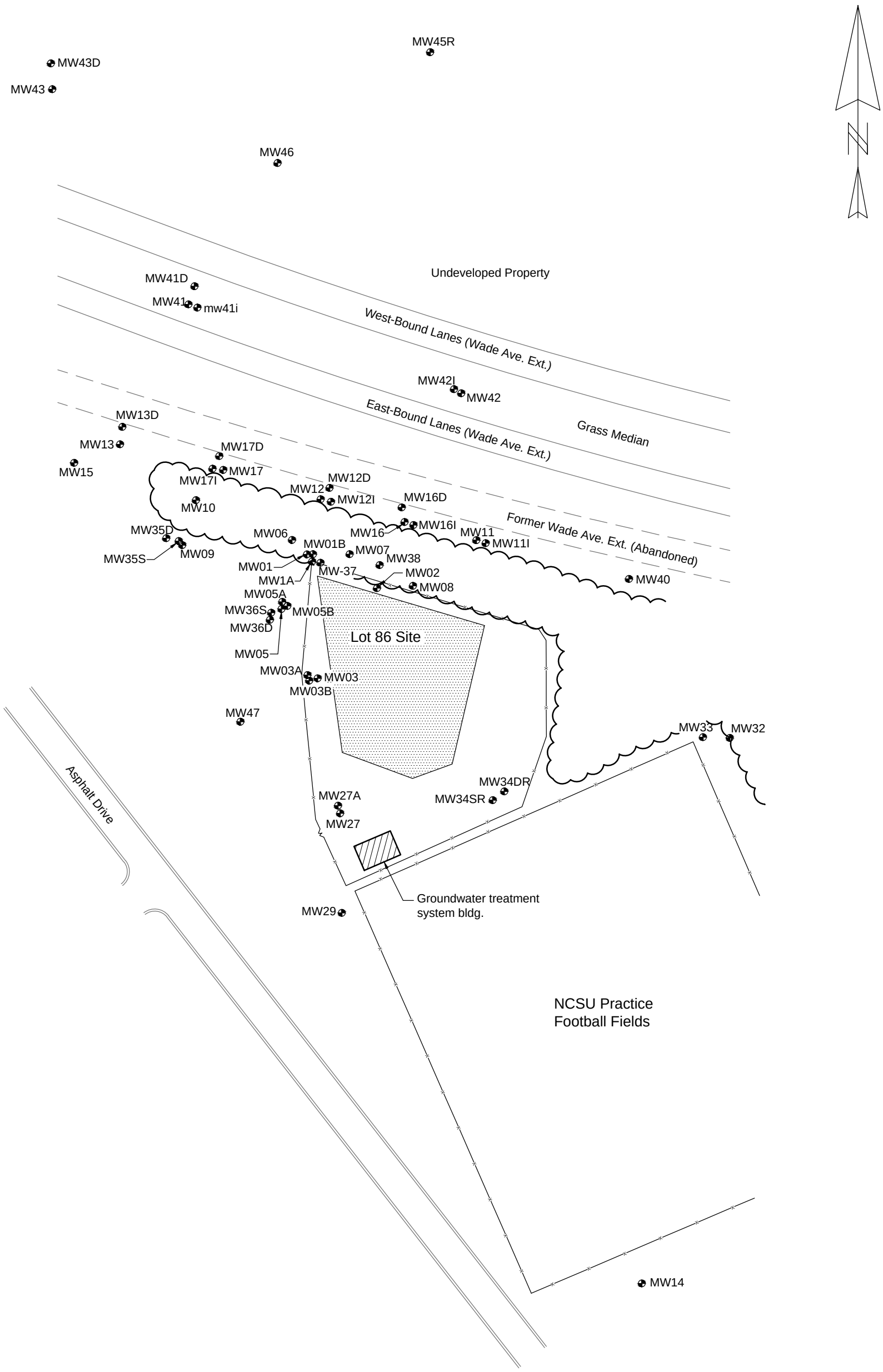


FIGURE 1
SITE LOCATION MAP
NCSU – Lot 86
Raleigh, North Carolina



LEGEND

MW33 Monitoring Well

Waste Burial Area (Source Area)

Fenced Area

Edge of Wooded Area

PIEDMONT GEOLOGIC
SMART EARTH SOLUTIONS

Gauging Date:		
Drawing Date: 8/13/14		
ACAD File: Fig 2.dwg		
Designed: PD	Site Map	
Detailed: PD	Client: North Carolina State University	Project No.: 1441
Checked: PD	Location: Lot 86 Raleigh, North Carolina	Figure: 2

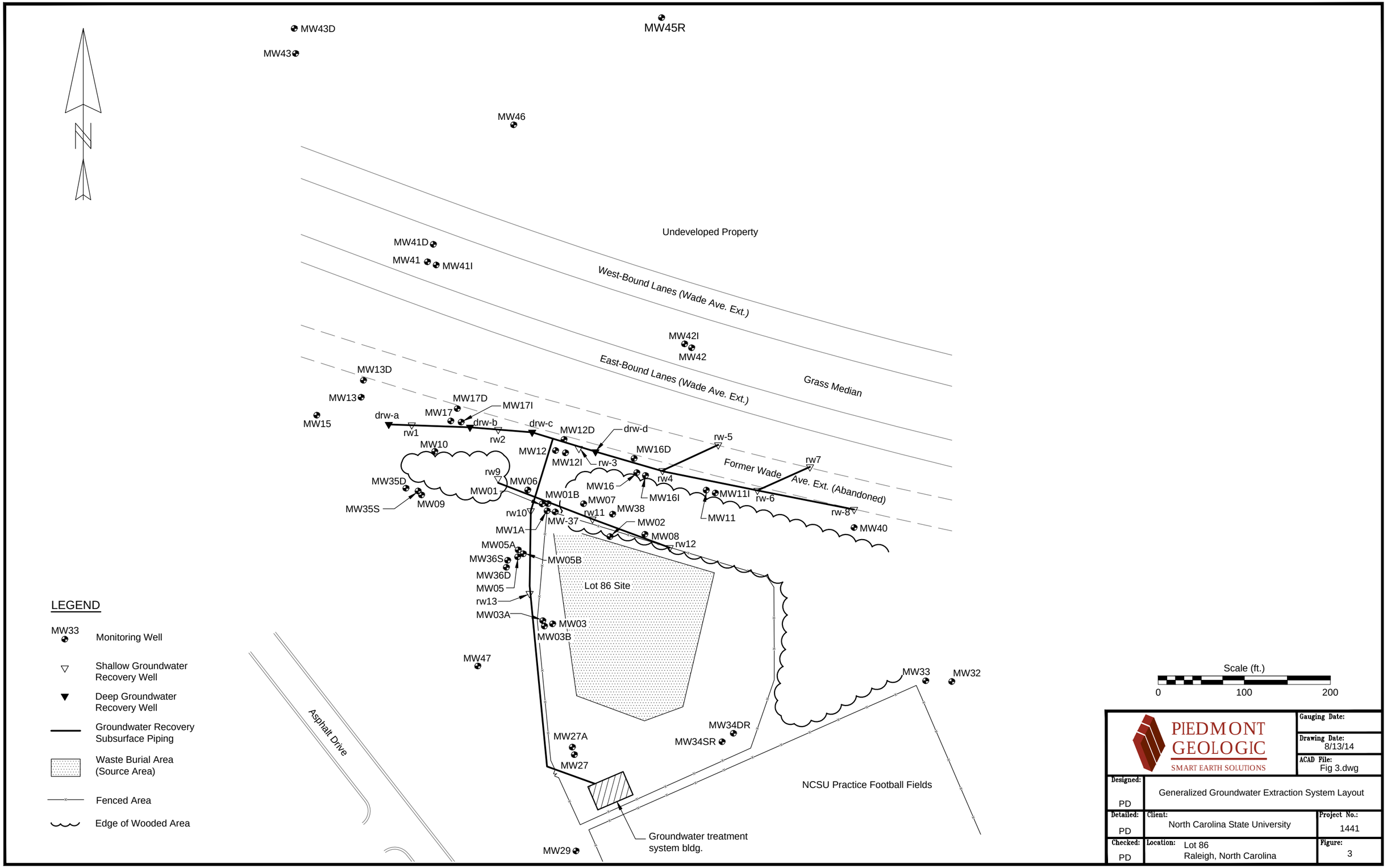

MW43D
MW45R
MW43
MW46
Undeveloped Property
MW41D
MW41
MW41I
West-Bound Lanes (Wade Ave. Ext.)
MW42I
MW42
East-Bound Lanes (Wade Ave. Ext.)
Grass Median
MW13D
MW13
MW17D
MW17I
MW17
MW15
drw-a
drw-b
drw-c
drw-d
rw1
rw2
MW12D
MW10
MW12
MW12I
rw-3
MW16D
rw-5
rw7
Former Wade Ave. Ext. (Abandoned)
rw9
MW06
MW16
rw4
MW35D
MW01
MW01B
MW07
MW16I
MW11I
rw-6
MW35S
MW09
rw10
rw11
MW38
MW11
rw-8
MW40
MW1A
MW-37
MW02
MW08
rw12
MW05A
MW36S
MW05B
MW36D
MW05
Lot 86 Site
rw13
MW03A
MW03
MW03B
MW47
MW33
MW32
Asphalt Drive
MW34DR
MW27A
MW34SR
MW27
NCSU Practice Football Fields
Groundwater treatment system bldg.
MW29
LEGEND
MW33
Monitoring Well
Shallow Groundwater Recovery Well
Deep Groundwater Recovery Well
Groundwater Recovery Subsurface Piping
Waste Burial Area (Source Area)
Fenced Area
Edge of Wooded Area
Scale (ft.)
0
100
200
PIEDMONT GEOLOGIC
SMART EARTH SOLUTIONS
Gauging Date:
Drawing Date: 8/13/14
ACAD File: Fig 3.dwg
Designed: PD
Generalized Groundwater Extraction System Layout
Detailed: PD
Client: North Carolina State University
Project No.: 1441
Checked: PD
Location: Lot 86 Raleigh, North Carolina
Figure: 3

TABLE 1
GROUNDWATER MONITORING WELL CONSTRUCTION DETAILS

North Carolina State University
Lot 86 Site
Raleigh, North Carolina

Well I.D.	Northing	Easting	Well Class (1)	Top of Casing Elevation (2)	Ground Elev. (2)	Screen Elevation (2)		Screen Depth (3)	
						Top	Bottom	Top	Bottom
MW-1	747,972.81	2,083,713.47	S	439.30	437.73	400.5	395.5	37.2	42.2
MW-1A	747,968.37	2,083,717.18	S	438.92	438.05	397.4	392.4	40.7	45.7
MW-1B	747,972.08	2,083,718.51	S	438.25	437.93	387.4	382.4	50.5	55.5
MW-2	747,934.50	2,083,791.44	S	448.74	446.00	401.2	396.2	44.8	49.8
MW-3	747,831.30	2,083,724.81	S	445.39	443.58	411.2	406.2	32.4	37.4
MW-3A	747,833.58	2,083,714.96	S-I	443.15	441.89	381.9	379.9	60.0	62.0
MW-3B	747,829.10	2,083,716.16	S-I	443.66	442.02	371.0	369.0	71.0	73.0
MW-4	747,738.38	2,083,847.26	S	454.32	452.54	405.5	400.5	47.0	52.0
MW-5	747,911.73	2,083,684.29	S	441.26	439.53	400.5	395.5	39.0	44.0
MW-5A	747,917.11	2,083,685.48	S	439.81	439.38	393.4	388.4	46.0	51.0
MW-5B	747,913.31	2,083,688.75	S-I	440.13	439.72	383.7	378.7	56.0	61.0
MW-6	747,987.81	2,083,695.81	S	438.61	436.36	402.9	397.9	33.5	38.5
MW-7	747,972.40	2,083,759.49	S	441.94	440.09	401.3	396.3	38.8	43.8
MW-8	747,936.68	2,083,831.30	S	447.85	445.91	397.9	392.9	48.0	53.0
MW-9	747,984.18	2,083,569.82	S	442.52	ND	ND	ND	ND	ND
MW-10	748,035.32	2,083,584.16	S	438.09	ND	ND	ND	ND	ND
MW-11	747,987.24	2,083,904.54	S	430.01	429.56	405.6	400.6	24.0	29.0
MW-11I	747,982.67	2,083,914.92	I	434.29	431.20	373.6	363.6	57.6	67.6
MW-12	748,035.37	2,083,726.83	S	427.24	426.18	397.2	392.2	29.0	34.0
MW-12I	748,031.08	2,083,738.92	I	430.70	427.45	359.8	354.8	67.7	72.7
MW-12D	748,048.21	2,083,735.45	D	427.45	427.95	331.0	321.0	97.0	107.0
MW-13	748,099.25	2,083,498.80	S	423.82	423.73	394.7	389.7	29.0	34.0
MW-13D	748,122.47	2,083,503.49	D	423.43	423.93	333.9	323.9	90.0	100.0
MW-14	747,148.54	2,084,091.12	S	451.87	450.38	413.4	408.4	37.0	42.0
MW-15	748,078.43	2,083,447.10	S	432.38	431.67	397.7	392.7	34.0	39.0
MW-16	748,009.06	2,083,822.21	S	427.94	427.61	399.6	394.6	28.0	33.0
MW-16I	748,004.62	2,083,832.41	I	432.14	429.23	374.7	364.7	54.5	64.5
MW-16D	748,024.15	2,083,819.82	D	428.98	429.48	349.5	339.5	80.0	90.0
MW-17	748,068.64	2,083,615.41	S	425.09	424.02	398.0	393.0	26.0	31.0
MW-17I	748,062.71	2,083,626.56	I	427.74	424.96	371.8	361.8	53.2	63.2
MW-17D	748,087.86	2,083,612.19	D	425.44	425.94	330.9	320.9	95.0	105.0
MW-27	747,678.44	2,083,751.29	S	448.26	447.22	407.2	402.2	40.0	45.0
MW-27A	747,687.36	2,083,749.28	S	448.55	447.40	392.9	388.9	54.5	58.5
MW-29	747,565.34	2,083,753.75	S	447.67	446.01	395.5	390.5	50.5	55.5
MW-30	747,579.80	2,084,072.68	S	440.86	438.17	399.2	389.2	39.0	49.0
MW-31	747,564.14	2,084,073.85	S	440.72	438.15	396.2	386.2	42.0	52.0
MW-32	747,760.44	2,084,186.72	S	438.15	436.21	411.4	401.4	24.8	34.8
MW-33	747,760.99	2,084,157.91	I	441.38	438.42	378.4	368.4	60.0	70.0
MW-34SR	747,694.98	2,083,926.43	S	454.82	452.32	424.3	404.3	28.0	48.0
MW-34DR	747,702.24	2,083,936.61	D	454.71	452.21	361.2	351.2	91.0	101.0
MW-35S	747,989.14	2,083,565.01	S	443.12	441.57	401.6	391.6	40.0	50.0
MW-35D	747,991.91	2,083,552.20	D	444.69	441.99	305.0	295.0	137.0	147.0

TABLE 1 (continued)
GROUNDWATER MONITORING WELL CONSTRUCTION DETAILS

North Carolina State University
Lot 86 Site
Raleigh, North Carolina

Well I.D.	Northing	Easting	Well Class (1)	Top of Casing Elevation (2)	Ground Elev. (2)	Screen Elevation (2)		Screen Depth (3)	
						Top	Bottom	Top	Bottom
MW-36S	747,905.86	2,083,672.19	S	442.71	439.64	399.6	389.6	40.0	50.0
MW-36D	747,898.07	2,083,671.54	D	442.87	439.75	335.5	325.5	104.3	114.3
MW-37	747,964.33	2,083,718.54	S	440.88	438.70	398.7	388.7	40.0	50.0
MW-38	747,959.35	2,083,794.05	D	445.38	442.47	345.4	335.4	97.1	107.1
MW-40	747,908.53	2,084,062.93	S	435.47	432.87	405.1	395.1	27.8	37.8
MW-41	748,239.12	2,083,608.18	S	421.17	421.30	396.9	386.9	24.4	34.4
MW-41I	748,235.91	2,083,619.56	I	421.57	421.47	371.0	361.0	50.5	60.5
MW-41D	748,278.60	2,083,583.47	D	420.67	421.17	341.2	331.2	80.0	90.0
MW-42	748,149.51	2,083,907.73	S	427.25	427.18	402.0	392.0	25.2	35.2
MW-42I	748,155.61	2,083,896.58	I	426.68	426.76	376.8	366.8	50.0	60.0
MW-43	748,526.66	2,083,396.75	S	437.03	438.74	385.4	375.4	53.3	63.3
MW-43D	748,532.52	2,083,416.56	D	438.01	435.50	339.5	329.5	96.0	106.0
MW-45R	748,539.15	2,083,844.73	S	426.15	426.45	396.5	381.5	30.0	45.0
MW-46	748,444.92	2,083,683.30	S	451.35	449.42	396.2	386.2	53.2	63.2
MW-47	747,787.80	2,083,636.72	D	441.11	441.61	336.6	321.6	105.0	120.0

(1) S = shallow wells with screen intervals in the elevation range from 382-413 ft;
I = intermediate-depth wells with screen intervals in the elevation range from 355-377 ft;
D = deep wells with screen intervals in the elevation range from 295-360 ft in bedrock.
(2) Measured in feet relative to National Vertical Datum (NGVD) of 1929.
(3) Measured in feet below ground surface.
ND = No data currently available.

TABLE 2
MONITORING-WELL GAUGING DATA SHEET: FEBRUARY 10, 2016

North Carolina State University
Lot 86 Site
Raleigh, North Carolina

Well I.D.	Northing	Easting	Well Class	Top of Casing Elevation (ft)(1)	Depth to Ground-water (ft)(2)	Groundwater Elevation (ft)(1)
MW-1	747,972.81	2,083,713.47	shallow	439.30	42.56	396.74
MW-1A	747,968.37	2,083,717.18	shallow	438.92	41.83	397.09
MW-1B	747,972.08	2,083,718.51	shallow	438.25	41.49	396.76
MW-2	747,934.50	2,083,791.44	shallow	448.74	49.65	399.09
MW-3	747,831.30	2,083,724.81	shallow	445.39	44.96	400.43
MW-3A	747,833.58	2,083,714.96	shallow	443.15	42.94	400.21
MW-3B	747,829.10	2,083,716.16	intermediate	443.66	41.99	401.67
MW-5	747,911.73	2,083,684.29	shallow	441.26	42.98	398.28
MW-5A	747,917.11	2,083,685.48	shallow	439.81	41.71	398.10
MW-5B	747,913.31	2,083,688.75	intermediate	440.13	42.09	398.04
MW-6	747,987.81	2,083,695.81	shallow	438.61	DRY	NA
MW-7	747,972.40	2,083,759.49	shallow	441.94	44.15	397.79
MW-8	747,936.68	2,083,831.30	shallow	447.85	48.84	399.01
MW-9	747,984.18	2,083,569.82	shallow	442.52	DRY	NA
MW-10	748,035.32	2,083,584.16	shallow	438.09	DRY	NA
MW-11	747,987.24	2,083,904.54	shallow	430.01	DRY	NA
MW-11I	747,982.67	2,083,914.92	intermediate	434.29	34.81	399.48
MW-12	748,035.37	2,083,726.83	shallow	427.24	31.61	395.63
MW-12I	748,031.08	2,083,738.92	intermediate	430.70	33.78	396.92
MW-12D	748,048.21	2,083,735.45	deep	427.45	28.92	398.53
MW-13	748,099.25	2,083,498.80	shallow	423.82	27.76	396.06
MW-13D	748,122.47	2,083,503.49	deep	423.43	28.61	394.82
MW-14	747,148.54	2,084,091.12	shallow	451.87	33.80	418.07
MW-15	748,078.43	2,083,447.10	shallow	432.38	DRY	NA
MW-16	748,009.06	2,083,822.21	shallow	427.94	30.00	397.94
MW-16I	748,004.62	2,083,832.41	intermediate	432.14	36.02	396.12
MW-16D	748,024.15	2,083,819.82	deep	428.98	30.52	398.46
MW-17	748,068.64	2,083,615.41	shallow	425.09	29.68	395.41
MW-17I	748,062.71	2,083,626.56	intermediate	427.74	32.64	395.10
MW-17D	748,087.86	2,083,612.19	deep	425.44	30.76	394.68
MW-27	747,678.44	2,083,751.29	shallow	448.26	42.11	406.15
MW-27A	747,687.36	2,083,749.28	shallow	448.55	42.53	406.02
MW-29	747,565.34	2,083,753.75	shallow	447.67	42.09	405.58
MW-32	747,760.44	2,084,186.72	shallow	438.15	30.80	407.35
MW-33	747,760.99	2,084,157.91	intermediate	441.38	33.61	407.77
MW-34SR	747,694.98	2,083,926.43	shallow	454.82	41.84	412.98
MW-34DR	747,702.24	2,083,936.61	deep	454.71	41.54	413.17
MW-35S	747,989.14	2,083,565.01	shallow	443.12	47.48	395.64
MW-35D	747,991.91	2,083,552.20	deep	444.69	48.92	395.77

(continued)

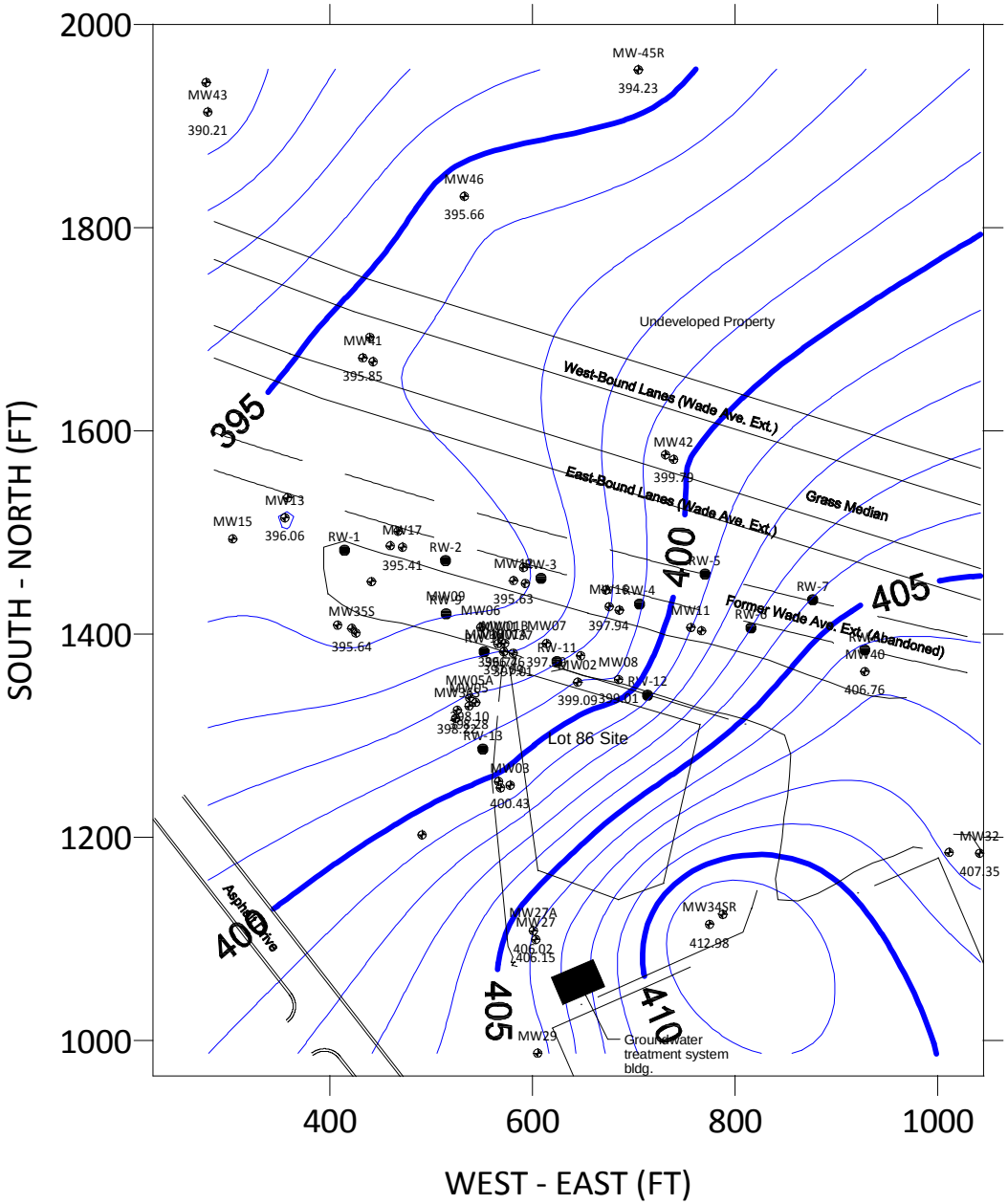
TABLE 2 (CONTINUED)
MONITORING-WELL GAUGING DATA SHEET: FEBRUARY 10, 2016

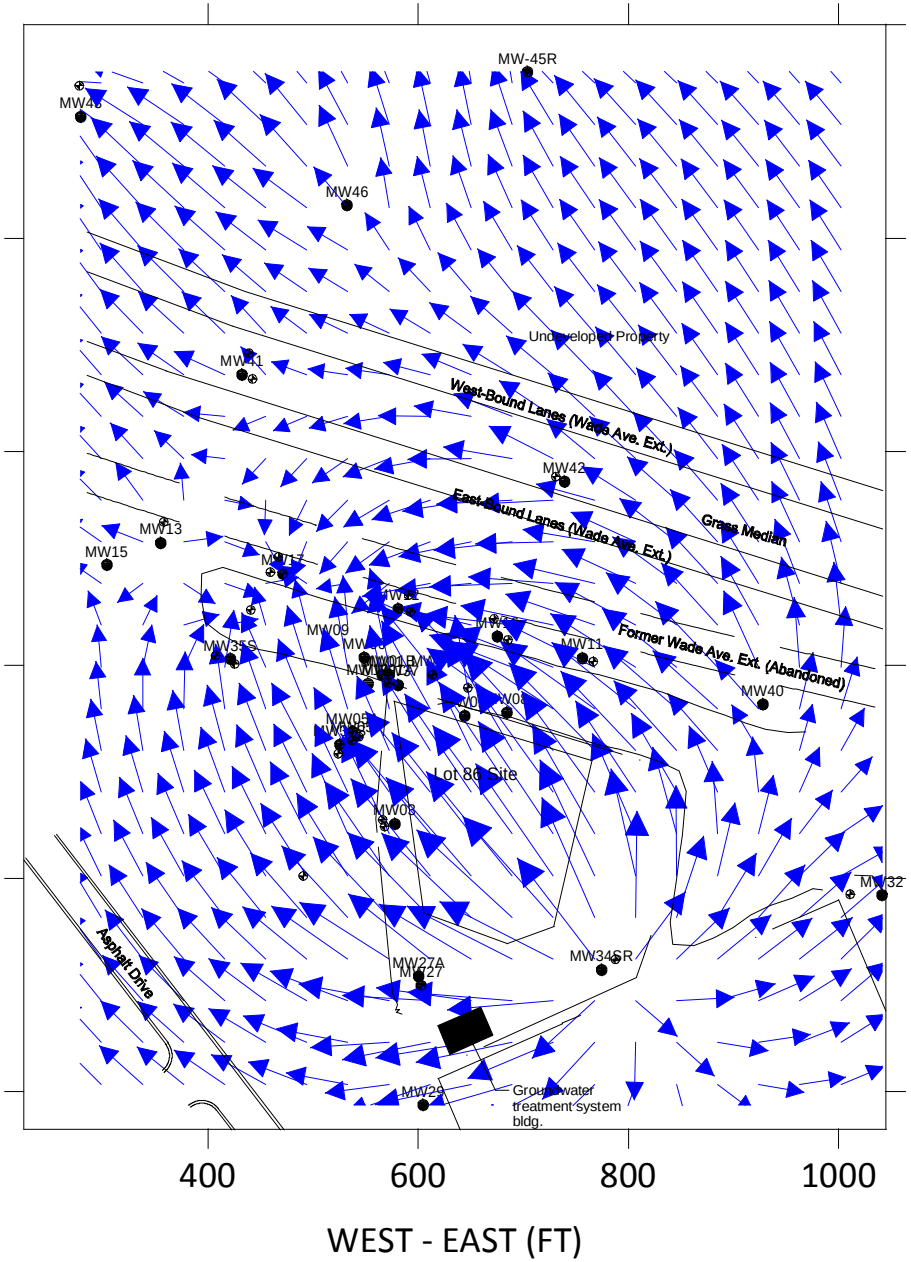
North Carolina State University
Lot 86 Site
Raleigh, North Carolina

Well I.D.	Northing	Easting	Well Class	Top of Casing Elevation (ft)(1)	Depth to Ground-water (ft)(2)	Groundwater Elevation (ft)(1)
MW-36S	747,905.86	2,083,672.19	shallow	442.71	44.49	398.22
MW-36D	747,898.07	2,083,671.54	deep	442.87	45.02	397.85
MW-37	747,964.33	2,083,718.54	shallow	440.88	43.87	397.01
MW-38	747,959.35	2,083,794.05	deep	445.38	46.48	398.90
MW-40	747,908.53	2,084,062.93	shallow	435.47	28.71	406.76
MW-41	748,239.12	2,083,608.18	shallow	421.17	25.32	395.85
MW-41I	748,235.91	2,083,619.56	intermediate	421.57	25.74	395.83
MW-41D	748,278.60	2,083,583.47	deep	420.67	25.28	395.39
MW-42	748,149.51	2,083,907.73	shallow	427.25	27.46	399.79
MW-42I	748,155.61	2,083,896.58	intermediate	426.68	26.97	399.71
MW-43	748,526.66	2,083,396.75	shallow	437.03	46.82	390.21
MW-43D	748,532.52	2,083,416.56	deep	438.01	48.36	389.65
MW-45R	748,539.15	2,083,844.73	shallow	426.15	31.92	394.23
MW-46	748,444.92	2,083,683.30	shallow	451.35	55.69	395.66
MW-47	747,787.80	2,083,636.72	deep	441.11	42.20	398.91

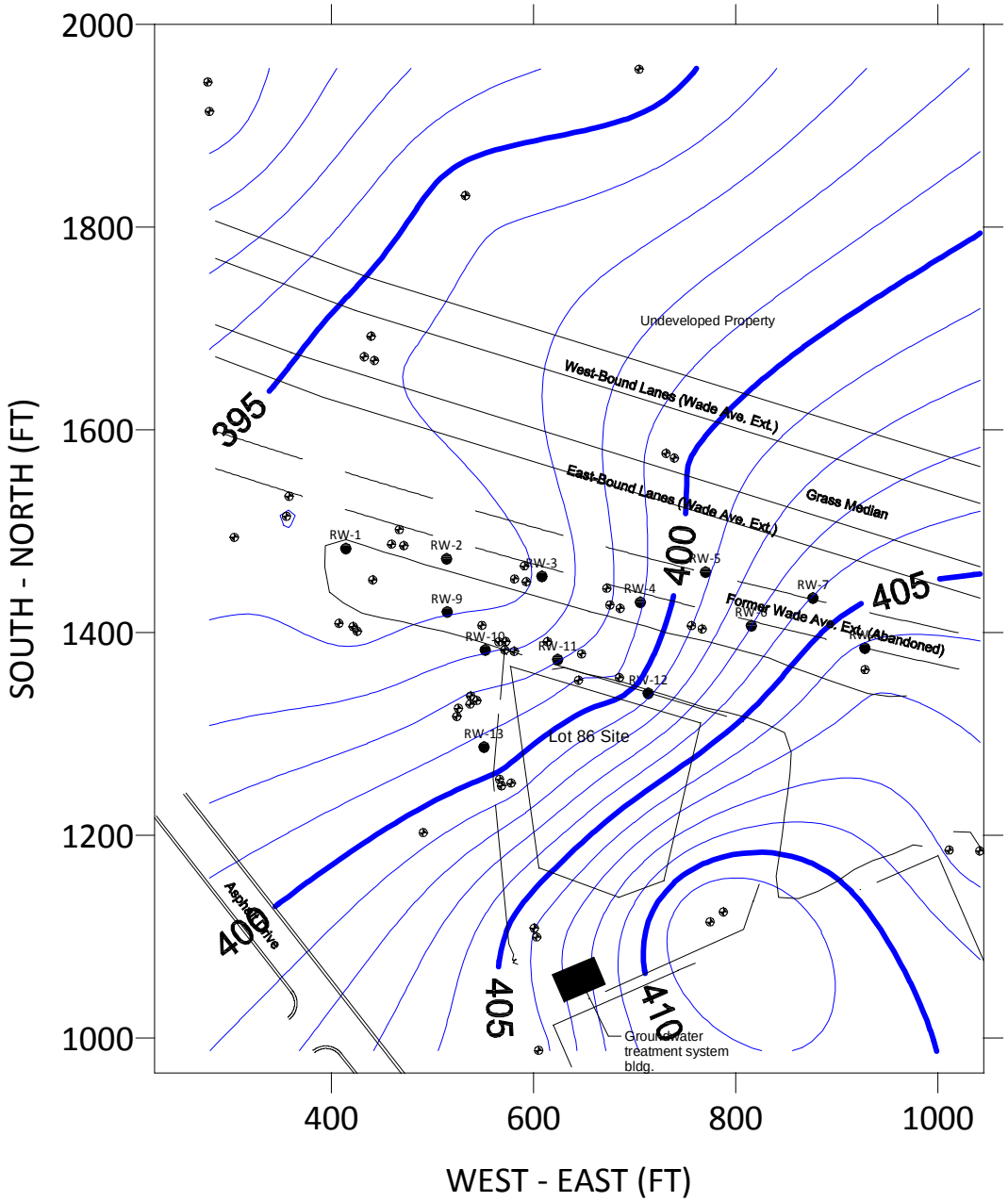
(1) Measured in feet relative to site datum.
(2) Measured relative to top-of-casing reference point.
NA = Not Applicable
NS = Not surveyed

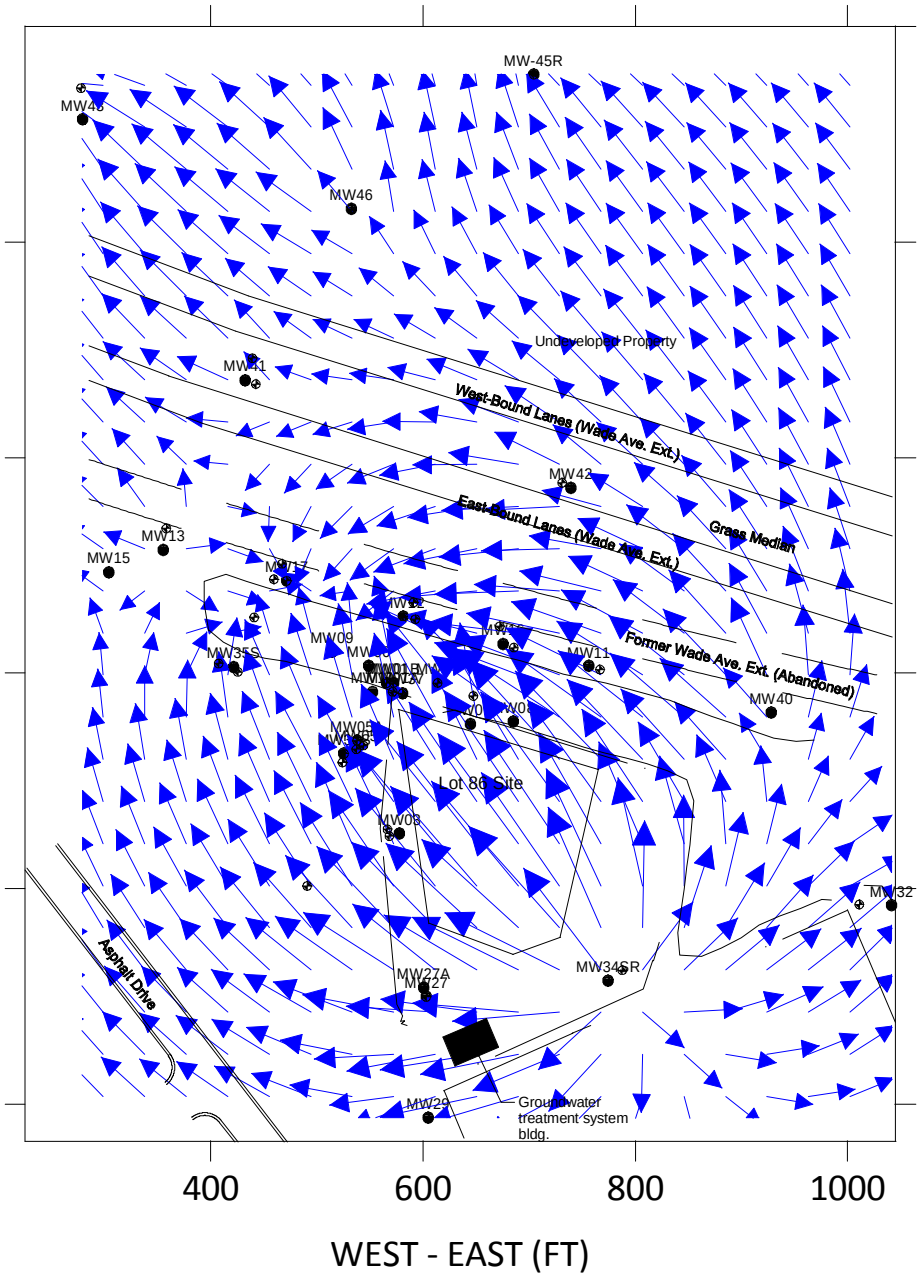
SHALLOW GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR:
AND FLOW VECTOR MAPS: FEBRUARY 10, 2016
NCSU - LOT 86 SITE



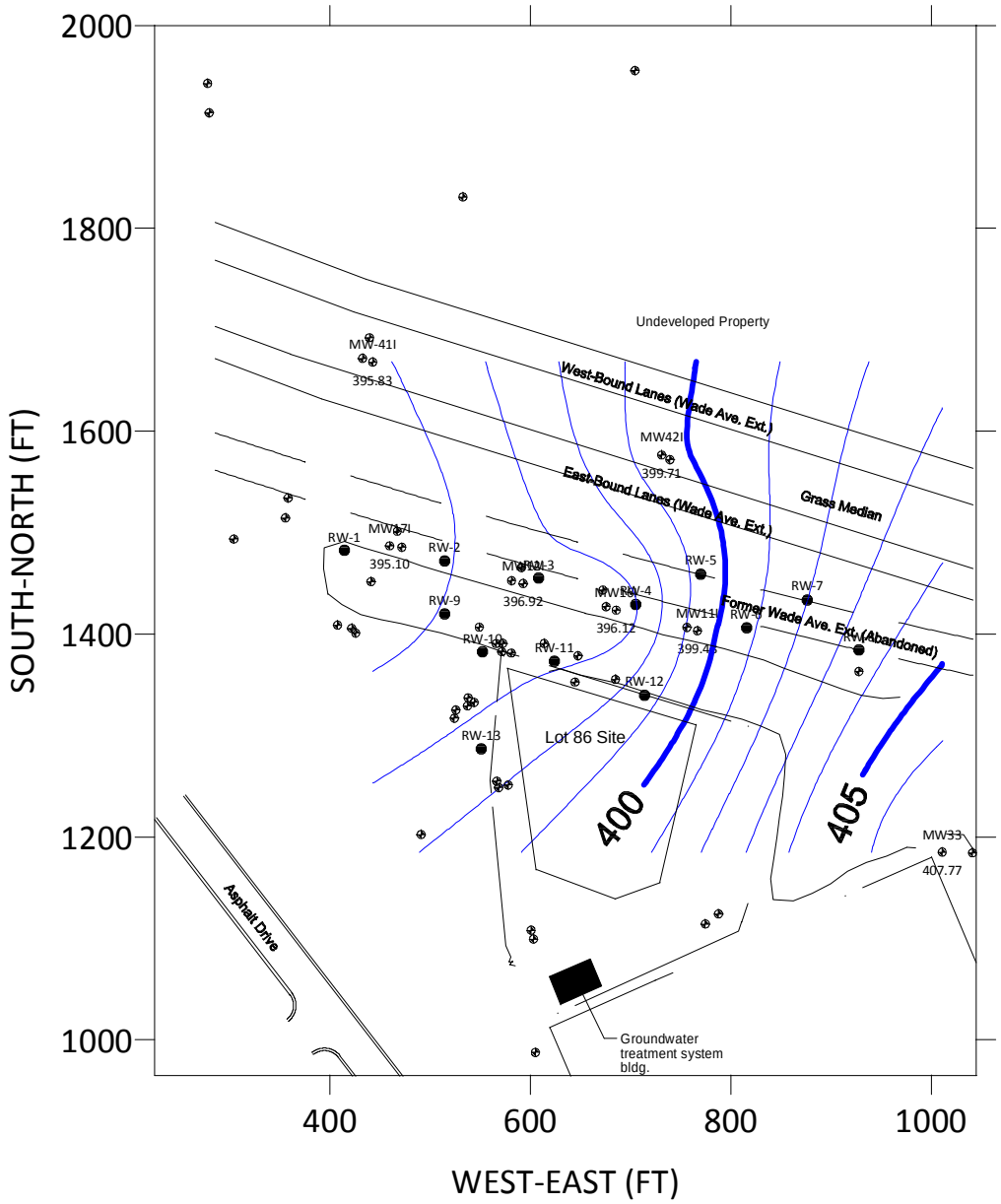


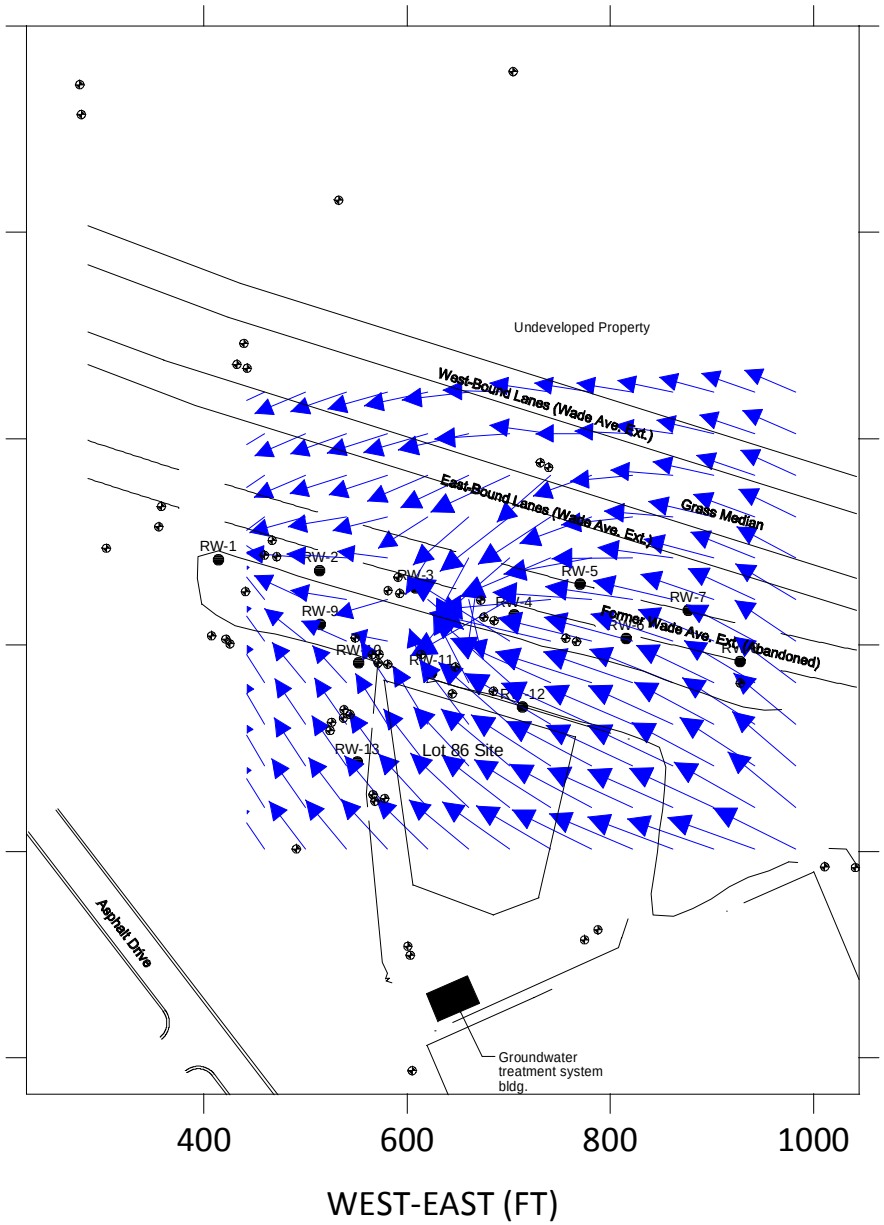
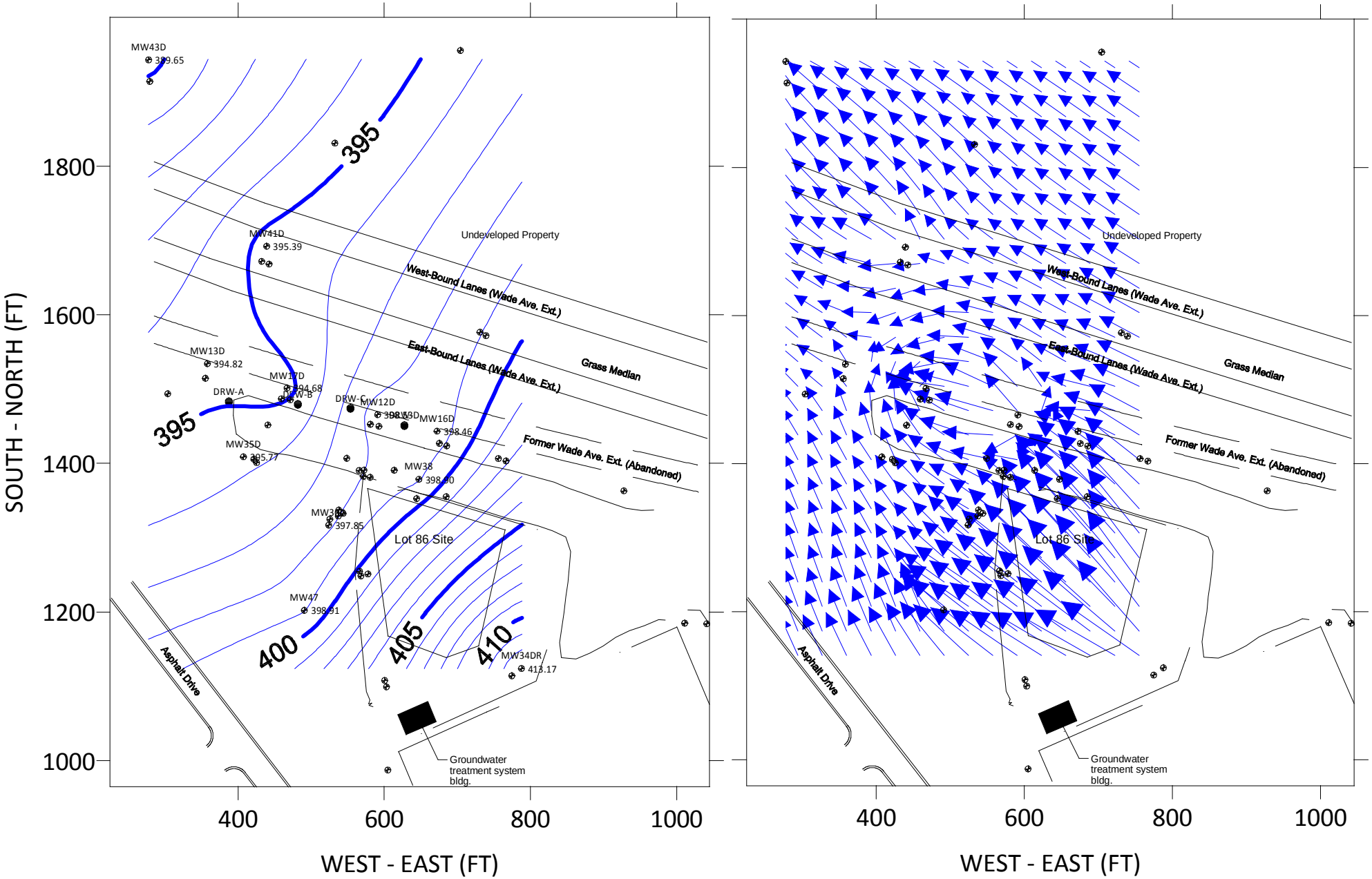
SHALLOW GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR:
AND FLOW VECTOR MAPS: FEBRUARY 10, 2016
NCSU - LOT 86 SITE





INTERMEDIATE GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR
AND FLOW VECTOR MAPS: FEBRUARY 10, 2016
NCSU - LOT 86 SITE





DEEP (BEDROCK) GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR
AND FLOW VECTOR MAPS: FEBRUARY 10, 2016
NCSU - LOT 86 SITE