

AECOM

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Ms. Addie Walker
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201

August 19, 2013

Dear Ms. Walker,

**Subject: Bruckner Road Results and Plan activities
Auriga, Spartanburg Facility
BoW Site ID# 00225, VCC 13-5841-RP
AECOM Project No. 60280417**

RECEIVED

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SITE ASSESSMENT,
REMEDICATION &
REVITALIZATION

Please find enclosed the above referenced report. As indicated in the Voluntary Cleanup Contract, three hard copies and one electronic copy on CD are included.

If you have questions, please contact me at 404.965.9657.

Sincerely,



Bryon Dahlgren, PE
Project Manager



Environment

Prepared for:
CNA Holdings LLC

Prepared by:
AECOM
Atlanta, GA
60280417


Auriga Spartanburg
Bruckner Road Direct Push Investigation
Chloroform Results and
Recommendations
Voluntary Cleanup Contract 13-5841-RP
August 2013



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Prepared By Bryon Dahlgren, P.E.
Project Manager




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Program Director

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1.0 Introduction and Summary of Work Completed

This report provides a summary of the Bruckner Road area investigation activities, the results of the work, and recommendations for additional activity. A similar plan has been proposed for the DMT area on site. Comments on the proposed DMT area were received from South Carolina Department of Health and Environmental Control (DHEC) on this plan on June 11, 2013. A supplement to the DMT area plan was submitted on July 29 and this plan includes consideration of those comments.

A work plan for investigation of the chloroform plume near Bruckner Road was submitted to the South Carolina Department of Health and Environmental Control (DHEC) on August 2, 2012. This plan was approved in a letter from DHEC dated August 21, 2012. The direct push activities described in the plan were completed between December 14 and December 21, 2012. The laboratory analytical data were provided to DHEC under a letter dated January 31, 2013. The locations of direct push temporary wells included in this investigation are presented on Figure 1.

As described in the work plan, groundwater samples were collected at two depths from each direct push location whenever possible. One sample was collected when groundwater was first encountered. When the direct push technology (DPT) could advance at least 10 feet beyond the first sample depth, a second sample was collected at refusal depth. The direct push groundwater samples were analyzed for volatile organic compounds (VOCs), including chloroform.

2.0 Results

Samples from direct push locations were identified as OSS122-XX-YY. The value of XX ranges from 01 to 09 and identifies the specific direct push location. The value of YY indicates the depth of sample collection below ground surface.

A summary of direct push analytical results is presented in Table 1. Only those parameters detected in at least one sample are included in Table 1. Four permanent groundwater monitoring wells were also analyzed between December 2012 and January 2013, including MW-109, RW-108, RW-110, and RW-111, as shown in Table 2. Wells RW-110 and RW-111 were installed along Bruckner Road during December 2012, and the construction details are presented in Appendix A. A summary of groundwater data associated with permanent wells is presented in Table 2. In addition, chloroform results are presented on Figure 2. The results for refusal depth samples collected during the 2011 investigation (locations OSS-GW-1 through OSS-GW-8) are also presented on Figure 2.

Analytical results presented on Figure 2 show the area for chloroform remediation. The chloroform plume exceeding the MCL extends from west of Bruckner Road to approximately the parking lot location to the east. Additional delineation is required for the western extent of the plume. Delineation was also incomplete to the southeast, with detections of 0.272 milligrams per liter (mg/L) and 0.180 mg/L noted at OSS12-08 and OSS12-09, respectively. The Maximum Contaminant Level (MCL) for chloroform is 0.080 mg/L (as total trihalomethanes).

Surface water data are also included on Figure 2 and are summarized in Table 3. Concentrations of chloroform in surface water were significantly below the MCL (0.080 mg/L) in all samples. Chloroform was detected at locations SW-12 (0.0187 mg/L), OSS-SW1 (0.00853 mg/L), and OSS-SW2 (0.0076 mg/L). Chloroform was non-detect (<0.005 mg/L) at each of the remaining surface water locations.

3.0 Plan Forward

Additional actions are planned to complete the delineation and address remediation of chloroform. The delineation, remediation, and the post-injection activities are discussed in the following sections.

3.1 Baseline Monitoring

The site monitoring plan will consist of three stages.

- Establish baseline monitoring
- Quarterly post injection monitoring and
- On-going monitoring

Quarterly and on-going monitoring events to occur subsequent to injection are discussed later in this document.

Prior to injection a pair of monitoring wells will be installed to establish a baseline of remediation effectiveness. The treatment area for this effort will consist of the plume to the east of Bruckner Road. The highest concentration noted in this area was in a sample from location OSS-GW-3. A well pair will be installed immediately downgradient of this location. The location for this well pair is presented on Figure 3. The well pair will consist of one saprolite well to be placed approximately halfway between the groundwater surface and the bedrock surface and a bedrock well to be placed approximately 15 feet below the top of bedrock.

This well pair will be installed prior to injection activities. The wells will be developed and sampled prior to injection activities. Monitoring of this well pair will also be included in June and December sampling events going forward.

3.2 Delineation

The data in Table 1 and shown on Figure 2 provide a definition for the area requiring remediation. The area is defined as the wooded region extending from Bruckner Road to the east approximately to the parking lot. However, two gaps in this delineation are identified. Samples collected from direct push locations OSS12-01 and OSS12-02 west of Bruckner Road indicated chloroform concentrations of 2.53 and 2.03 mg/L, respectively; therefore, additional delineation to the west of locations OSS12-01 and OSS12-2 is recommended. Likewise, the concentrations at locations OSS12-08 (0.272 mg/L) and OSS12-09 (0.180 mg/L) exceed the MCL of 0.080 mg/L; therefore additional delineation to the southeast of these locations is recommended.

Four wells have been sampled on the south side of the creek. The shallow private well located to the west of Bruckner Road and a deeper private well located to the east of Bruckner Road were each sampled in August 2010. The chloroform results for these samples were non-detect (<0.005 mg/L). The two new bedrock wells located along Bruckner Road were sampled in January 2013. The chloroform result for the sample from the well located closer to the creek was 0.00574 mg/L. The chloroform result for the sample collected from the well located further from the creek was non-detect (<0.005 mg/L). The data from samples collected across the creek indicate that chloroform is not present within an order of magnitude of the MCL (0.080 mg/L) and is frequently non-detect. The creek is interpreted to be a key drainage feature for this immediate area. Chloroform which may pass

under the creek is expected to quickly flow back to the creek as water from both sides drains into this feature. The significantly lower concentrations on the south side of the creek confirm this conclusion. The conclusion regarding this creek and the data from the four wells provide delineation to the south.

Five additional direct push locations are proposed to address the gaps in delineation of the plume. The proposed additional locations are shown on Figure 4. As the first step of the remediation, groundwater samples will be collected from each of these locations following the same protocol used in the December 2012 investigation. One sample will be collected at first groundwater and a second sample will be collected at refusal, if at least 10 feet deeper than first groundwater. The samples will be delivered to the laboratory for rush analysis.

Three of the five additional proposed direct push locations are intended to complete the delineation to the west. These locations have been placed along the Interstate 85 right-of-way in a similar manner to the locations of wells MW-109 and RW-108. Recent direct push work on the plant property across the interstate highway has demonstrated that chloroform concentrations exceeding the MCL are not present more than 500 feet west of a line extended from Bruckner Road to the plant. Groundwater flows in a southeasterly direction from the plant to the Bruckner Road area. Therefore, the westerly extent of the plume is expected to be limited. The first location will be installed approximately 75 to 100 feet west of the existing locations near Bruckner Road. The next two locations will be installed approximately 100 and 200 feet further to the west.

The remaining two proposed direct push locations are placed southeast of locations OSS12-08 and OSS12-09. The exact locations for the supplemental direct push wells will be established based on access and will be surveyed after completion.

3.3 Remediation

Remedial actions have been undertaken at the DMT area located on the plant site and at well RW-108. In the fall of 2012, investigation of the remaining plume in the DMT area included evaluations of the remediation effectiveness. The results of that investigation are presented in a report dated March 25, 2013. Additional assessment of the process is presented in our work plan supplement submitted July 29, 2013. The investigation demonstrated the potential for significant downgradient treatment (greater than 100 feet) and that persistent effectiveness can be achieved through lactate injection.

The injection plan proposed for the Bruckner Road area is consistent with the DMT area plan. Temporary direct push injection locations will be used to provide coverage of the target area. The proposed remediation plan is presented on Figure 5. The plan focuses on the area to the east of Bruckner Road.

As described in Section 3.2, additional delineation to the west will be completed prior to injection. Based on existing data, remediation activities will be required adjacent to neighboring properties and delineation will determine if injection further to the west is needed.

A total of 32 proposed injection locations are presented on Figure 5. Injection locations are distributed every 100 feet across the width and length of the plume. An effective radius of influence of 50 feet was used to establish this distribution. Prior data indicate that treatment is effective approximately 100 to 150 feet from injection locations, and this overlapping placement will provide additional coverage to address variations in the actual distribution of materials. The locations shown on Figure 5 are approximate and will be finalized based on utility clearance and access. Final injection locations will be surveyed and reported.

A total of 40 drums of sodium lactate material will be delivered to the site for injection. The lactate material will be equivalent to the substrate used in prior injection events and will also be prepared for injection in the same manner as prior events. The contents of one 55-gallon drum will be placed in a mixing tank and diluted to approximately 500 gallons. The injection procedure, however, will be modified from prior events. As described previously, temporary locations installed by direct push will be used for injection. Injection will also be completed using pumps in place of the gravity feed method previously implemented. One drum plus dilution water (approximately 500 gallons total) will be injected at each location. Approximately one-half of the total volume will be injected 5 to 10 feet below the groundwater surface. The remainder of the volume will be injected at refusal depth.

Analytical results of the additional monitoring locations are anticipated to be available prior to completion of the 32 proposed injection points. Since 8 additional drums of lactate material will be available after 32 injections are completed, supplemental injection locations will be selected based on the results of the analysis of the samples collected from the supplemental locations shown on Figure 4. The locations will be placed to address the plume to the west and southeast. If fewer than 8 drums are needed to address locations to the west and southeast, additional injection utilizing the remaining drums may be added at or near other injection points presented on Figure 5. Modifications to the injection plan using the additional drums will be documented and reported to DHEC.

3.4 Post-Injection Activities

After the injection is complete, continued monitoring is planned. Based on prior results, a minimum of one year of monitoring is needed to establish the effectiveness. To accomplish this, monitoring of existing and proposed wells in the area will continue in June and December. In addition, quarterly direct push monitoring will be implemented for four quarters. The proposed direct push monitoring locations are presented on Figure 6. Four quarterly direct push monitoring events will be completed starting one quarter after injection is complete. Samples will be collected at first groundwater and refusal when possible.

After four quarters of monitoring, the results will be reviewed and additional actions will be recommended. Additional actions will be proposed after the injection results have been assessed; therefore, the additional post-injection actions will be planned and recommended after the remediation monitoring is complete. The post-injection phase of activities will include:

- Addition of pairs of permanent monitoring wells for tracking of the remediation – Pairs of monitoring wells will be installed. The quarterly direct push data will be referenced to establish the placement of permanent monitoring wells. . Each pair will consist of a saprolite well and a bedrock well.
- Using monitoring well data to confirm treatment into bedrock – The wide distribution of pressure injection at refusal depth is expected to follow chloroform into bedrock; however, if chloroform detections persist in bedrock, additional injection plans will be developed.

The prior treatment work has shown that remediation effectiveness persists after the lactate has been consumed. The planned injection mass is expected to be adequate to change the geochemical conditions; however, if the quarterly direct push monitoring events demonstrate that an additional injection is needed, supplemental injections will be proposed, and the supplemental monitoring activities will be modified as appropriate.

Tables

Table 1
 Summary of Direct Push Analytical Results
 December 2012
 AECOM Project No. 60280417

Parameter	Unit	OSS12-01-21 12/14/2012	OSS12-01-52 12/14/2012	OSS12-02-15 12/14/2012	OSS12-02-32 12/13/2012	OSS12-03-20 12/17/2012	OSS12-04-28 12/18/2012
acetone	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	0.0121
chloroform	mg/L	0.238	2.53	0.0134	2.03	0.689	1.35
1,4-dioxane	mg/L	<0.002	<0.002	<0.002	<0.002	0.00301	<0.002
alkalinity	mg/L	15.4	49.2	7.69	43.1	14.4	78.9
ferrous Fe	mg/L	0.53	0.63	0.78	0.24	3.3	2.85
nitrate-nitrite nitrogen	mg/L	0.732	2.17	2.75	1.97	1.73	1.11
dissolved oxygen	mg/L	6.09	2.07	1.79	4.29	6.25	1.11
ORP	mV	71.4	-61.4	-74.1	81.4	123.5	-93.4
pH	su	5.45	6.45	5.23	6.04	5.35	5.84
specific conductance	umhos/cm	0.043	0.094	0.032	0.071	0.04	0.056
sulfate	mg/L	<1	1.03	<1	1.3	<1	<1
sulfide	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
temperature	degrees C	16.53	16.71	13.41	16.11	18.57	16.53
turbidity	NTU	>1000	>1000	>1000	>1000	>1000	>1100

NA - Not Analyzed

degrees C - degrees Celsius

mg/L - milligrams per liter

mV - millivolts

NTU - nephelometric turbidity units

su - standard units

umhos/cm - micromhos/cm

Table 1
 Summary of Direct Push Analytical Results
 December 2012
 AECOM Project No. 60280417

Parameter	Unit	OSS12-04-45 12/18/2012	OSS12-05-15 12/17/2012	OSS12-05-37 12/17/2012	OSS12-05-37 Dup 12/17/2012	OSS12-06-35 12/19/2012	OSS12-06-35 Dup 12/19/2012
acetone	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
chloroform	mg/L	1.44	0.479	1.26	1.32	1.18	1.12
1,4-dioxane	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
alkalinity	mg/L	77.9	<1	28.7	26.7	28.2	15.4
ferrous Fe	mg/L	2.77	0	2.6	2.6	1.37	1.37
nitrate-nitrite nitrogen	mg/L	0.632	0.237	1.28	1.29	1.07	1.04
dissolved oxygen	mg/L	5.35	5.04	3.75	3.75	6.21	6.21
ORP	mV	62.3	85.7	33.7	33.7	99.5	99.5
pH	su	6.38	5.1	5.94	5.94	6.03	6.03
specific conductance	umhos/cm	0.077	0.022	0.066	0.066	0.051	0.051
sulfate	mg/L	1.7	<1	1.77	13.5	<1	<1
sulfide	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
temperature	degrees C	15.53	16.16	16.64	16.64	12.43	12.43
turbidity	NTU	>1100	>1100	>1100	>1100	>1100	>1100

NA - Not Analyzed

degrees C - degrees Celsius

mg/L - milligrams per liter

mV - millivolts

NTU - nephelometric turbidity units

su - standard units

umhos/cm - micromhos/cm

Table 1
 Summary of Direct Push Analytical Results
 December 2012
 AECOM Project No. 60280417

Parameter	Unit	OSS12-07-44 12/19/2012	OSS12-07-57 12/19/2012	OSS12-08-28 12/20/2012	OSS12-08-44 12/20/2012	OSS12-09-14 12/21/2012	OSS12-09-25 12/21/2012
acetone	mg/L	<0.01	0.0115	<0.01	<0.01	<0.01	<0.01
chloroform	mg/L	<0.005	0.114	0.214	0.272	0.149	0.18
1,4-dioxane	mg/L	<0.002	<0.002	0.00318	0.00275	0.00266	0.0022
alkalinity	mg/L	26.7	43.6	35.9	55.9	32.8	36.9
ferrous Fe	mg/L	0.64	1.87	1.58	2.97	0	2.9
nitrate-nitrite nitrogen	mg/L	0.129	0.454	0.75	0.943	0.607	0.885
dissolved oxygen	mg/L	3.04	2.03	6.51	3.32	3.38	4.62
ORP	mV	31.2	-31.7	91.6	35.2	158.9	-5.5
pH	su	6.21	6.47	6.29	6.49	5.89	6.46
specific conductance	umhos/cm	0.048	0.068	0.048	0.078	0.046	0.066
sulfate	mg/L	<1	<1	<1	1.41	<1	<1
sulfide	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
temperature	degrees C	19.24	21.65	13.61	15.44	10.85	13.9
turbidity	NTU	>1100	>1100	NA	NA	NA	NA

NA - Not Analyzed

degrees C - degrees Celsius

mg/L - milligrams per liter

mV - millivolts

NTU - nephelometric turbidity units

su - standard units

umhos/cm - micromhos/cm

Table 2
 Summary of Permanent Well Analytical Results
 December 2012 - January 2013
 AECOM Project No. 60280417

Parameter	Unit	MW-109 12/5/2012	RW-108 12/5/2012	RW-110 1/8/2013	RW-110 1/28/2013	RW-111 1/8/2013	RW-111 1/28/2013
acetone	mg/L	<0.05	<0.01	0.118	<0.01	<0.01	<0.01
chloroform	mg/L	0.586	<0.005	0.00574	0.00649	<0.005	<0.005
1,4-dioxane	mg/L	NA	NA	0.0036	<0.002	<0.002	<0.002
alkalinity	mg/L	16.4	186	67.7	NA	69.7	NA
chloride	mg/L	3.62	4.94	NA	NA	NA	NA
ferrous Fe	mg/L	0.14	0.16	0.33	0.30	0.03	0.13
dissolved oxygen	mg/L	9.21	0.41	4.66	3.36	1.83	0.76
groundwater elevation	feet MSL	674	673.3	NA	NA	NA	NA
manganese	mg/L	<0.01	0.169	NA	NA	NA	NA
ORP	mV	184.1	-86.11	45.9	203.2	51.6	187.9
pH	su	5.82	7.81	7.21	7.05	8.39	8.3
specific conductance	umhos/cm	56	326	0.125	0.134	0.117	0.132
temperature	degrees C	17.91	17.79	18.25	16.38	14.46	15.59
turbidity	NTU	281.6	15	165	96	2.1	0.05

NA - Not Analyzed

feet MSL - feet above mean sea level

degrees C - degrees Celsius

mg/L - milligrams per liter

mV - millivolts

NTU - nephelometric turbidity units

su - standard units

umhos/cm - micromhos/cm

Table 3
 Summary of Surface Water Analytical Results
 December 2012
 AECOM Project No. 60280417

Parameter	Unit	OSS-SW-1 12/19/2012	OSS-SW-2 12/19/2012	OSS-SW-3 12/19/2012	OSS-SW-4 12/19/2012	OSS-SW-5 12/19/2012	OSS-SW-6 12/19/2012	OSS-SW-7 12/19/2012	OSS-SW-7 Dup 12/19/2012	SW-12 12/5/2012
chloroform	mg/L	0.00853	0.0076	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0187
1,4-dioxane	mg/L	0.00203	<0.002	0.00211	0.00223	0.00211	0.00204	0.00219	0.00202	NA
ferrous Fe	mg/L	0	0	0	0.03	0.12	0	0	0	NA
dissolved oxygen	mg/L	7.27	7.28	6.89	7.72	7.13	7.58	7.45	7.45	8.07
ORP	mV	101.2	123.3	128.3	172.6	169.5	206.9	222.1	222.1	157.6
pH	su	6.81	6.63	6.77	6.75	6.85	6.28	6.35	6.35	6.11
specific conductance	umhos/cm	0.076	0.076	0.07	0.07	0.069	0.07	0.07	0.07	0.103
temperature	degrees C	12.48	12.44	12.15	11.91	11.6	11.49	11.59	11.59	14.24
turbidity	NTU	NA	NA	NA	NA	NA	NA	NA	NA	10.91

NA - Not Analyzed

degrees C - degrees Celsius

mg/L - milligrams per liter

mV - millivolts

NTU - nephelometric turbidity units

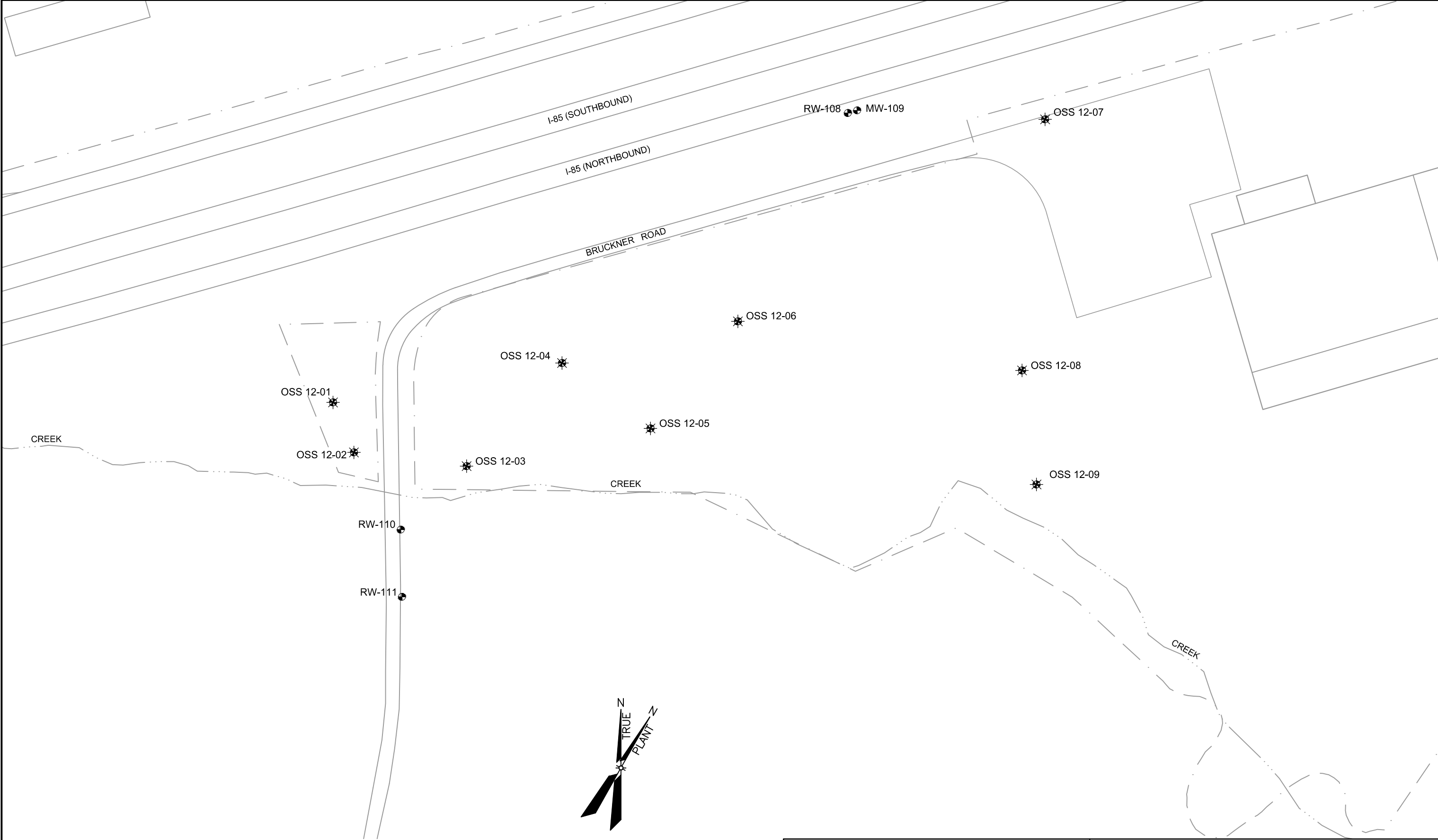
su - standard units

umhos/cm - micromhos/cm



Figures

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LEGEND

-  DPT LOCATION
-  MONITORING WELL LOCATION

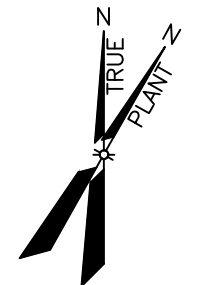
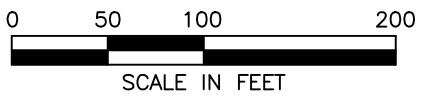


FIGURE 1
DIRECT PUSH LOCATIONS

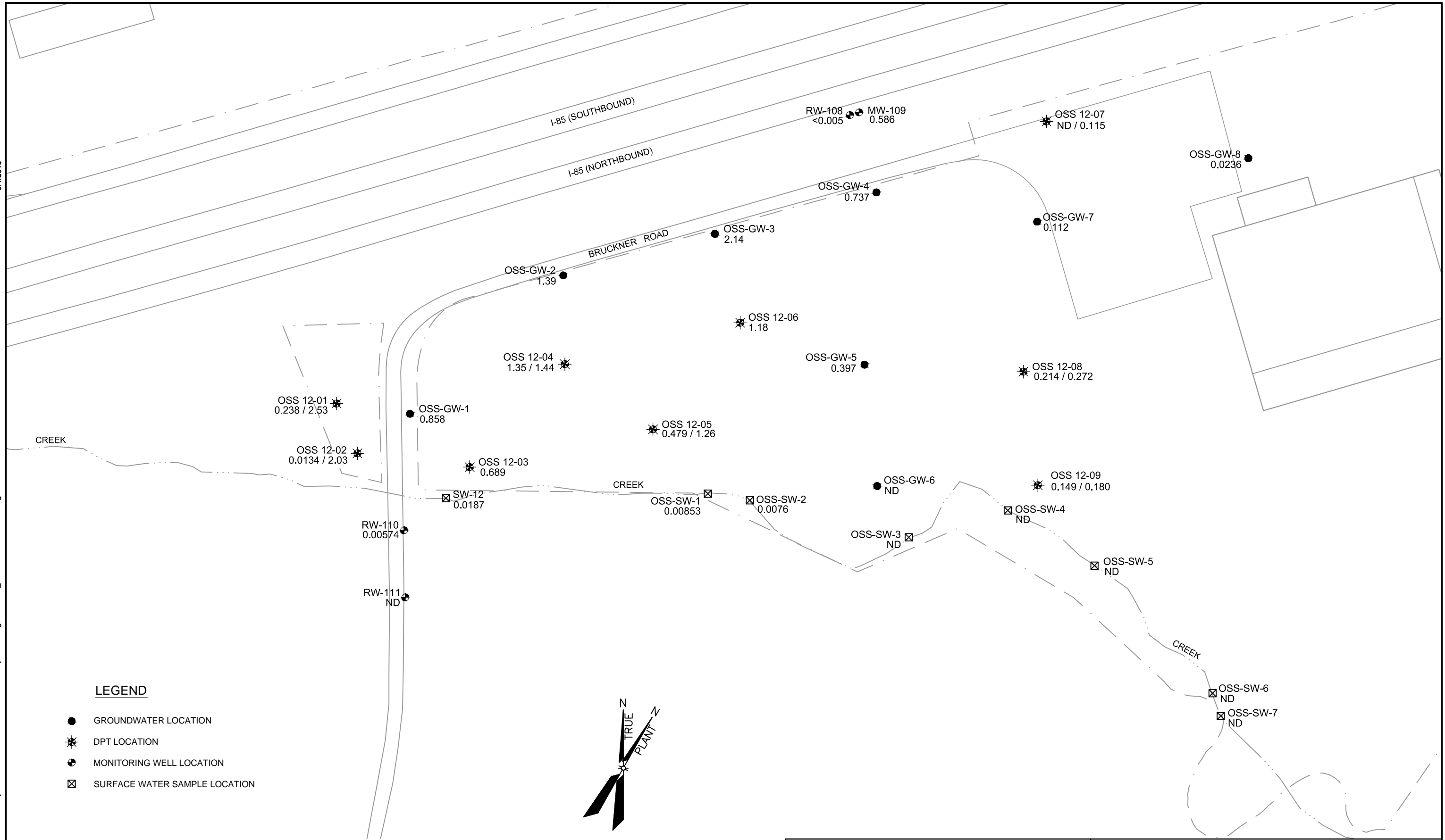
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SPARTANBURG, SOUTH CAROLINA

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LEGEND

- GROUNDWATER LOCATION
- ⊛ DPT LOCATION
- MONITORING WELL LOCATION
- ⊠ SURFACE WATER SAMPLE LOCATION

NOTES:

1. RESULTS IN mg/L.
2. ND = NOT DETECTED.

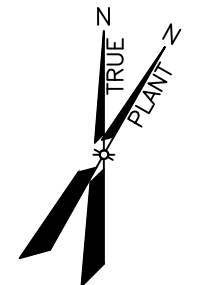
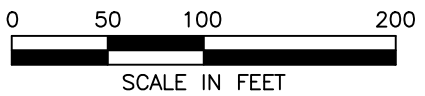


FIGURE 2
CHLOROFORM RESULTS

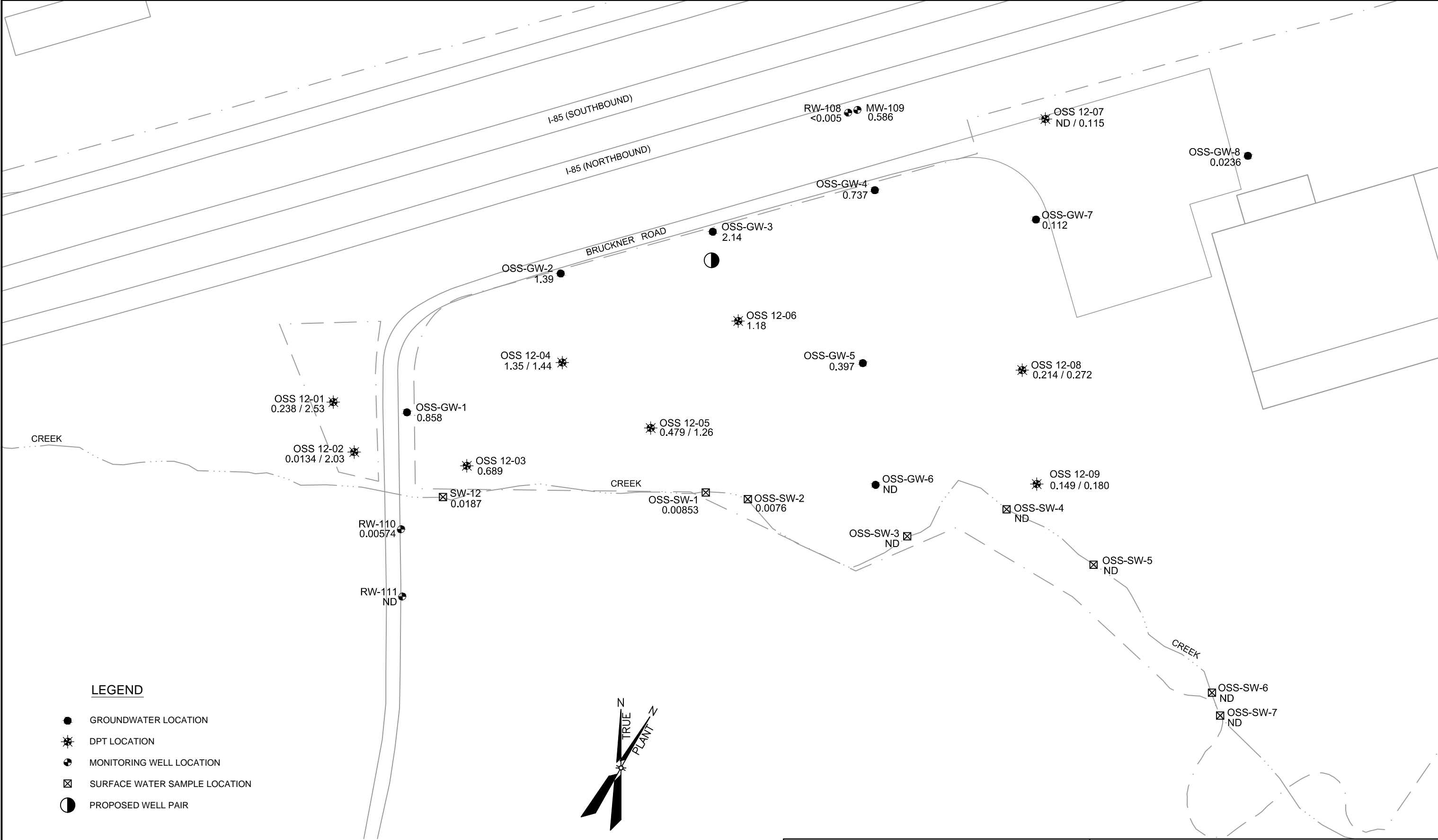
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AUGUST 2013

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LEGEND

- GROUNDWATER LOCATION
- ⊛ DPT LOCATION
- MONITORING WELL LOCATION
- ⊠ SURFACE WATER SAMPLE LOCATION
- PROPOSED WELL PAIR

NOTES:

1. RESULTS IN mg/L.
2. ND = NOT DETECTED.

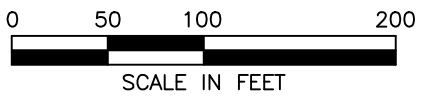
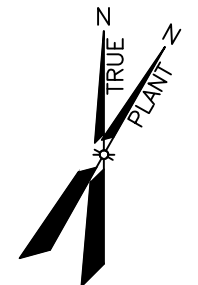


FIGURE 3
EFFECTIVENESS MONITORING LOCATION

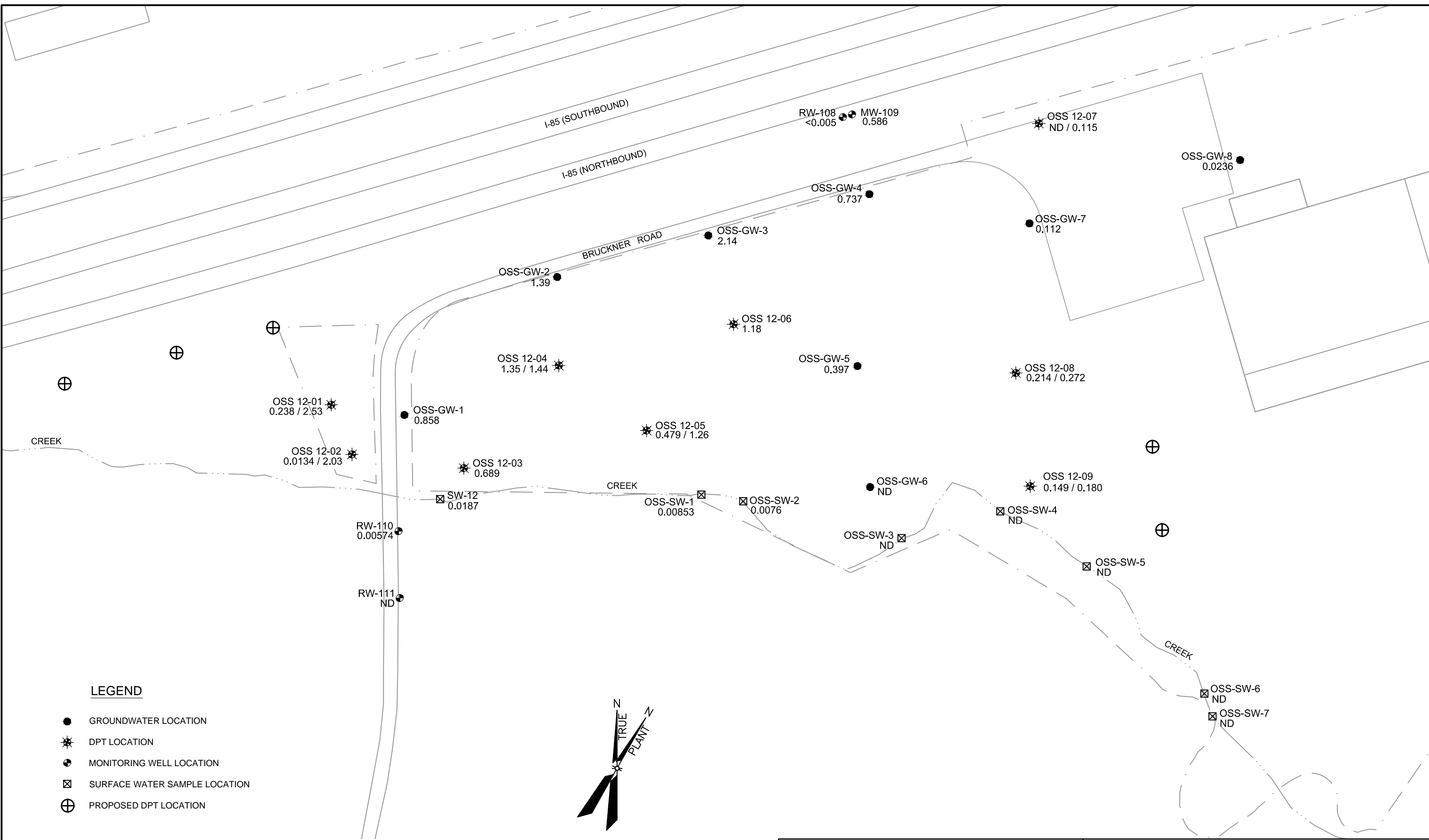
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LEGEND

- GROUNDWATER LOCATION
- ⊛ DPT LOCATION
- MONITORING WELL LOCATION
- ⊠ SURFACE WATER SAMPLE LOCATION
- ⊕ PROPOSED DPT LOCATION

NOTES:

1. RESULTS IN mg/L.
2. ND = NOT DETECTED.

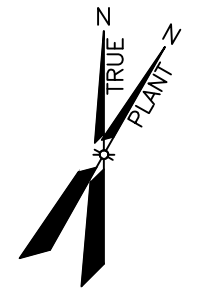
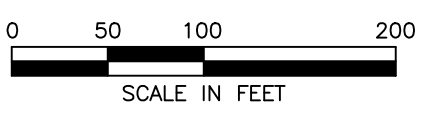


FIGURE 4
PROPOSED DELINEATION LOCATIONS

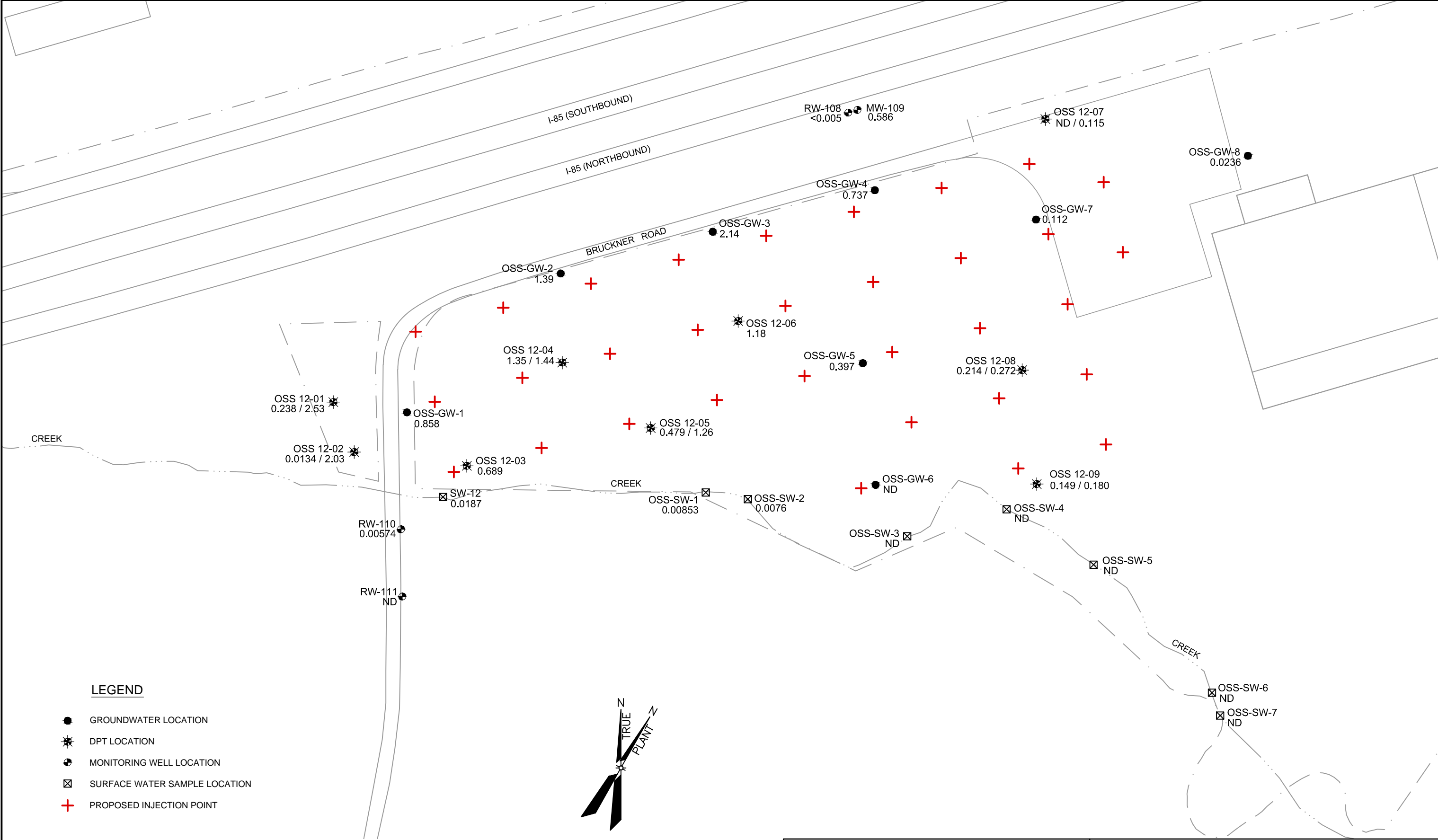
AURIGA SPARTANBURG FACILITY
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LEGEND

- GROUNDWATER LOCATION
- ⊛ DPT LOCATION
- MONITORING WELL LOCATION
- ⊠ SURFACE WATER SAMPLE LOCATION
- ⊕ PROPOSED INJECTION POINT

NOTES:

1. RESULTS IN mg/L.
2. ND = NOT DETECTED.

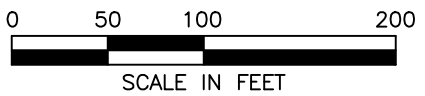
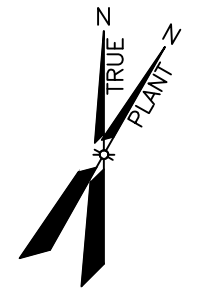


FIGURE 5
PROPOSED INJECTION PLAN

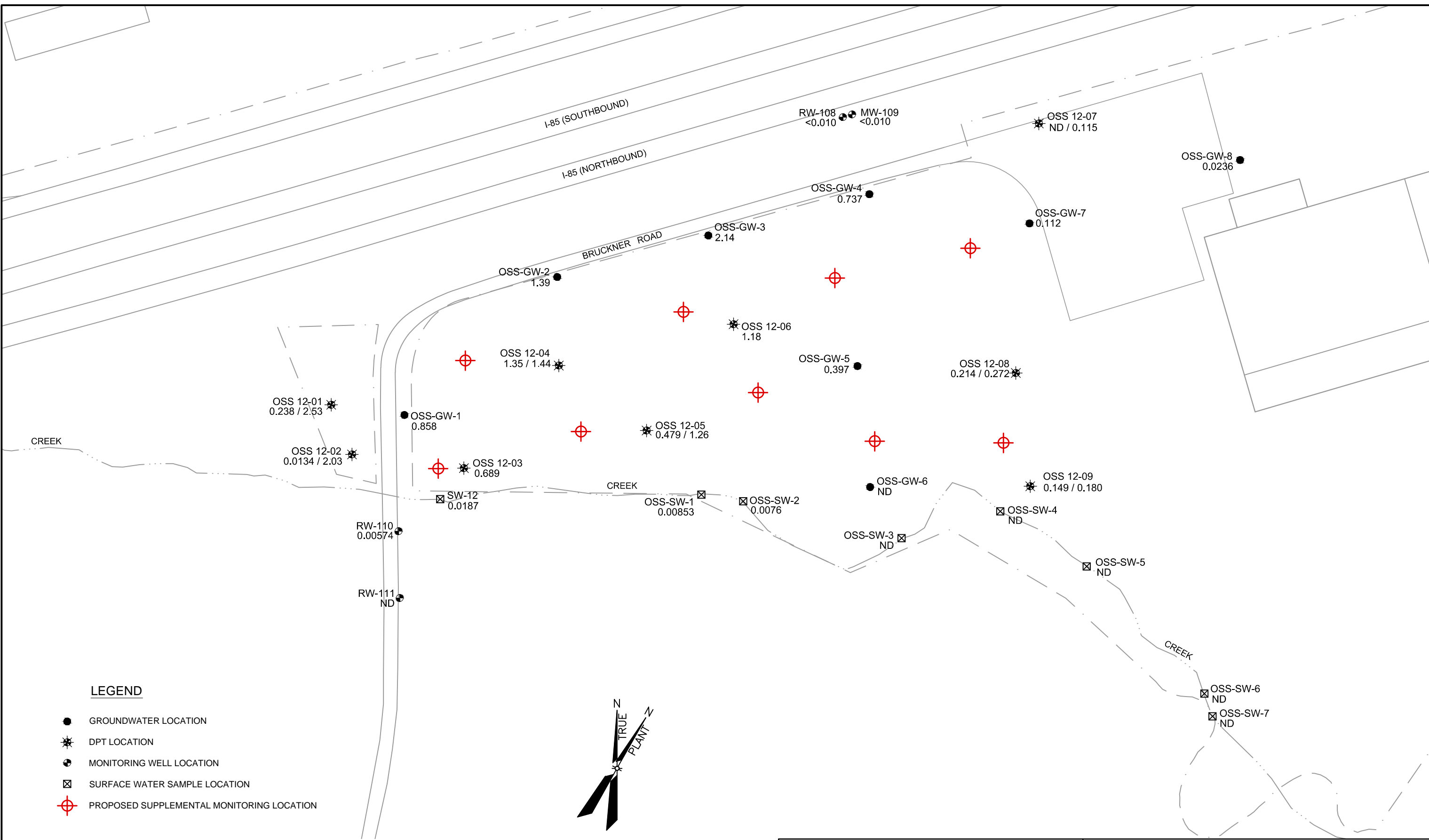
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AUGUST 2013

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LEGEND

- GROUNDWATER LOCATION
- ✱ DPT LOCATION
- MONITORING WELL LOCATION
- ☒ SURFACE WATER SAMPLE LOCATION
- ⊕ PROPOSED SUPPLEMENTAL MONITORING LOCATION

NOTES:

1. RESULTS IN mg/L.
2. ND = NOT DETECTED.

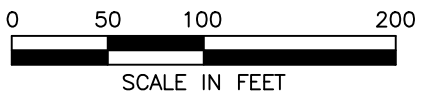
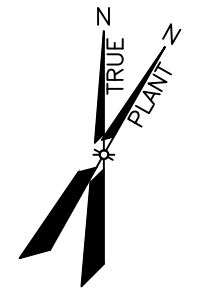


FIGURE 6
PROPOSED SUPPLEMENTAL MONITORING LOCATIONS

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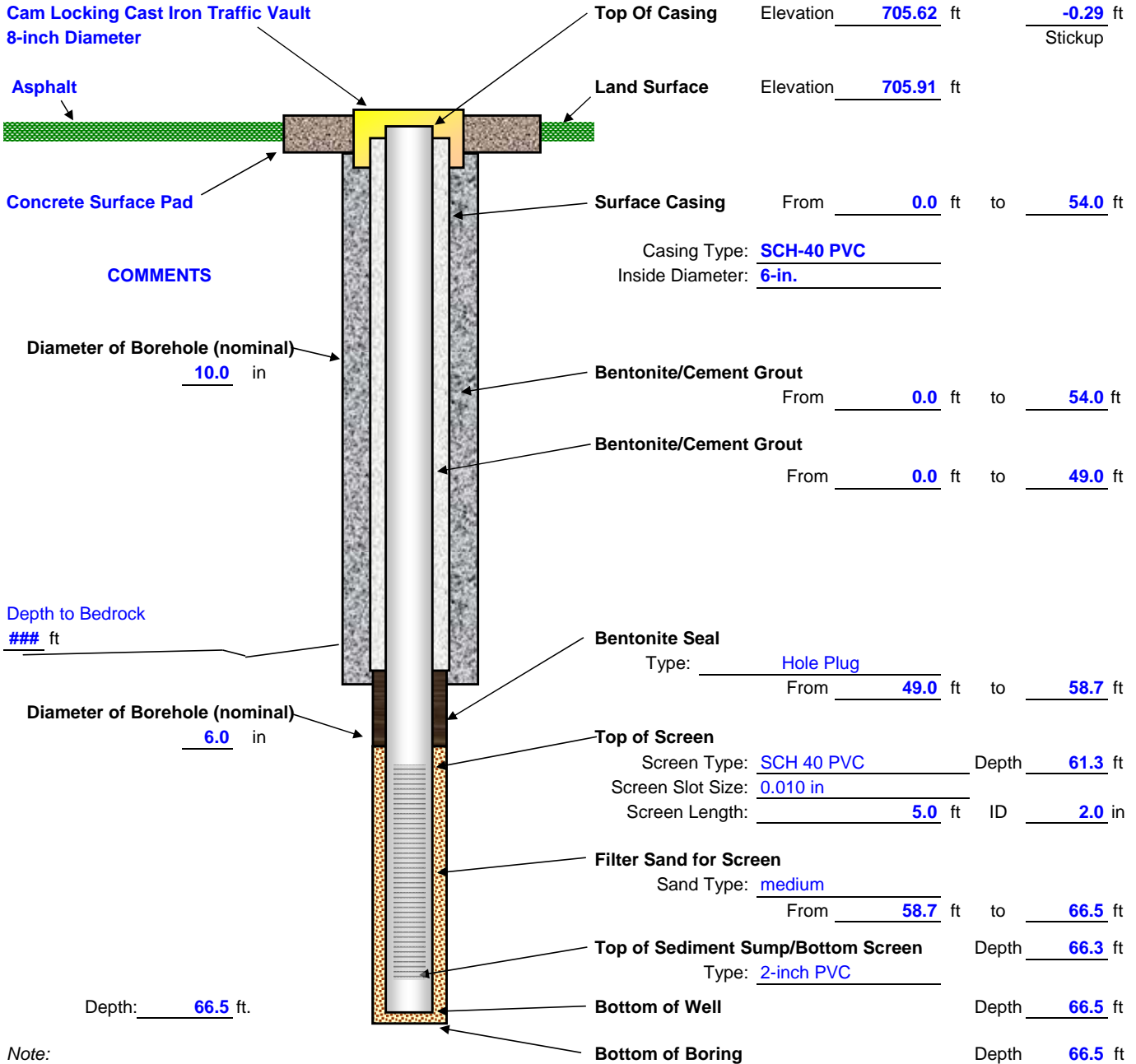
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Appendix A

Well Construction Details

GROUNDWATER MONITORING WELL INSTALLATION DETAIL

Project Name: Auriga Spartanburg **Drilling Co:** AE Drilling Services **Well Number:** RW-110
Location: Bruckner Road **Driller:** Tommy Burnette **Job Number:** 60280417
Client: Celanese **Drilling Method:** Mud/Air Rotary **Date Completed:** 12/19/2012
Geologist: Mark Hartford **Static Water Level** 22.00 **b.TOC** **Survey Datum:** NAVD '88



Note:
 Drawing Not to Scale
 All Depths are Referenced to Ground

GROUNDWATER MONITORING WELL INSTALLATION DETAIL

Project Name: <u>Auriga Spartanburg</u>	Drilling Co: <u>AE Drilling Services</u>	Well Number: <u>RW-111</u>
Location: <u>Bruckner Road</u>	Driller: <u>Tommy Burnette</u>	Job Number: <u>60280417</u>
Client: <u>Celanese</u>	Drilling Method: <u>Mud/Air Rotary</u>	Date Completed: <u>12/20/2012</u>
Geologist: <u>Mark Hartford</u>	Static Water Level: <u>10.73</u> b.TOC	Survey Datum: <u>NAVD '88</u>

