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FOCUSED FEASIBILITY STUDY ADDENDUM – RESPONSE TO SCDHEC COMMENTS
Duke Energy Pine Street MGP Site
Spartanburg, South Carolina
S&ME Project No. 1264-02-146

Prepared for:

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February 28, 2011

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February 28, 2011

South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, South Carolina 29201

Attention: Mr. Lucas Berresford
State Remediation Section
Bureau of Land and Waste Management

Reference: Focused Feasibility Study Addendum – Response to SCDHEC Comments
Duke Energy Pine Street MGP Site
Spartanburg, South Carolina
S&ME Project No. 1264-02-146

Dear Mr. Berresford:

In May 2008, ENSR/AECOM, on behalf of Duke Energy, submitted to SCDHEC a Remedial Alternatives Focused Feasibility Study (FFS) for the Spartanburg, South Carolina Pine Street MGP Site. SCDHEC provided comments to the FFS in a letter dated September 2, 2010 (Berresford to McGary).

On behalf of Duke Energy, S&ME, Inc. (S&ME) respectfully submits this letter report and its attachments as response to SCDHEC's comments and as an addendum to the FFS. This document is not intended to serve as a stand-alone resubmission of the original FFS nor as a comprehensive review/revision of the original FFS. We assume those portions of the FFS not commented on by SCDHEC or addressed in this addendum are valid as provided by ENSR/AECOM.

We appreciate your receipt of this information; we trust it will be responsive to your needs. Please contact us if you have comments, questions, or need additional information.

Sincerely,

S&ME, Inc.

SOUTH CAROLINA CERTIFICATE OF AUTHORIZATION S & ME, INC. No. C00473

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FIGURES

SCDHEC Comment 1

Chinquapin Creek should be sampled at several locations on a periodic basis coinciding with the groundwater monitoring events to determine if contamination is entering the creek from groundwater discharge. This should be added to the groundwater monitoring plan. If contamination is discharging to the creek above allowable levels, natural attenuation would not be viable.

Response to Comment 1

As documented in correspondence of November 19, 2010 (Lummus/Armstrong to Bednarcik), December 2, 2010 (Berresford/Canova to McGary), and December 21, 2010 (Lummus/Armstrong to Berresford), future site monitoring will incorporate collection of groundwater samples from Chinquapin Creek. During the scheduled March 2010 site monitoring, S&ME will perform a reconnaissance of Chinquapin Creek that will include an ORP profile along the creek banks and observations for bedrock outcroppings, iron staining, and naphthalene odors. If suspect area(s) of contaminated groundwater discharge to the creek are noted during the reconnaissance observations, surface water samples will be collected at these locations. In the absence of conclusive observations during the reconnaissance, surface water samples from Chinquapin Creek will be collected at the locations indicated on attached Figure 1, Initial Surface Water Sample Locations from Chinquapin Creek. Surface water samples will be analyzed for VOCs and SVOCs.

A stand-alone report of the Chinquapin Creek reconnaissance and sampling will be compiled and submitted by May 31, 2011 along with the scheduled groundwater monitoring report. If sampling results indicated elevated concentrations, the surface water report will establish surface water monitoring locations to be incorporated into the ongoing semi-annual site monitoring program.

SCDHEC Comment 2

The site should be broken into two sections for the purposes of selecting a remedy for groundwater. The first section is anywhere where NAPL may remain or areas of significantly elevated contamination in groundwater. The second area is where regulatory standards are exceeded but it is not considered a source area. Different remedies are appropriate for these different areas.

Response to Comment 2

NAPL has not been detected in groundwater monitoring wells installed at the site. We evaluated location(s) of significantly elevated groundwater contamination versus areas where regulatory limits are exceeded using Figure 2, Benzene & Naphthalene Concentration in Shallow (Saprolite) Groundwater (2010) and Figure 3, Benzene & Naphthalene Concentration in Upper Fractured Bedrock Groundwater (2010). Within the extents of Risk-Based Screening Levels (RBSLs) exceedance north of Chinquapin Creek, there is no remarkable difference in groundwater concentrations. Benzene detections range from 5.3 to 994 ug/L in shallow (saprolite) groundwater and 5.55 to 105 ug/L in the upper fractured bedrock groundwater. Naphthalene detections range from 18.8 to 3,430 ug/L in shallow (saprolite) groundwater and 24 to 3,640 ug/L in the upper fractured bedrock groundwater.

In absence of other clear demarcations, we propose to consider remedial feasibility at the site relative to the following criteria:

- Historic source soils/infrastructure;
- Shallow (saprolite) groundwater; and,
- Upper fractured/weathered bedrock groundwater.

- **Source Soils/Infrastructure:** The historical source of site contaminants is MGP byproducts disposed or stored in shallow soil/infrastructure (e.g., gasholders, tar wells, etc). Accessible source soil/infrastructure was excavated in 2003-'04[1]. Some excavation confirmation soil samples exhibited TPAH concentrations >250 mg/kg[1,2]. Additional excavation, however, was precluded by groundwater and other site restrictions (e.g. Duke Energy substation, railroad right-of-way, etc.)[1].

  The May 2008 FFS evaluated additional soil excavation, disposal, and replacement as means to "remove the impacted saturated zone soil and partially weathered rock in the area of the former MGP operations", as well as in-situ solidification. While actual location(s) and extent(s) of excavation or solidification would be refined, the alternatives remain valid for consideration.

  We offer here, however, two inherent cost risks that may not be captured within the May 2008 FFS. First, the baseline dewatering costs ($172,900, 3% of total cost) seem possibly low considering potential permitting considerations/costs, the extent of excavation (1.6± acres), duration of the project (7± months), and difficulty estimating the amount of groundwater and surface water (precipitation) that might enter the excavation(s). Second, Figure 4, Cross-Sections, documents that the excavation would extend through 5±- to 10±-feet of partially weathered rock (PWR). (PWR was defined in these sections as material exhibiting a standard penetration resistance (N-value) greater than 100 blows per foot.) Our geotechnical experience in the Piedmont indicates that excavation of PWR generally requires very hard ripping, a heavy front-end loader, and/or use of a heavy tracked excavator, with difficulty. Excavation difficulty will be compounded in confined area excavations. The possibility of light blasting or hand excavation using pneumatic tools exists where boulders or rock lenses are present. That said the saturated soil excavation baseline unit rate and corresponding extended rate may be very low.

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[1] Final Soil Excavation Summary Report, Spartanburg – Pine Street MGP Site, Duke Energy, June 6, 2006.
[2] TPAH >250 mg/kg was one of the criteria for excavation boundaries.

Table 6-2 of the FFS incorporates a 50% contingency on the overall Saturated Zone Excavation alternative, which may or may not cover the cost implications of the above factors.

To some extent, the same issues apply to In-Situ Solidification, as it will be very difficult to solidify within the PWR. In order for solidification to be viable, all subsurface obstruction would need to be removed through excavation. As with the excavation option, the unit rate and extended rates for solidification may be very low, and it is unknown if the 50% contingency will cover the potential risks.

A number of the unit rates for excavation and solidification have been updated based on a current Duke Energy project in another state. These updated prices do not take into account working in PWR, as they are based on excavation/solidification in clay and silt. Updated costs and summary tables have been included as Table A4, Revised Construction Cost Estimate for Excavation and Disposal and Table A3, Revised Construction Cost Estimate for In-Situ Solidification in this letter report. We point out that only unit costs associated with excavation, solidification, and backfill/fill placement have been updated; other unit costs and the treatment area(s) for excavation and disposal and solidification remain those presented in the FFS.

Given the updated costs noted above for excavation and disposal and in-situ solidification, Table 6-2 (Revised), Cost Comparison for Remedial Alternatives has been revised for both of these scenarios and included in this letter report.

- **Shallow (Saprolite) Groundwater:** Impact to the shallow (saprolite) aquifer is delineated on Figure 2. Benzene is more prevalent in wells MW-13S and 13iSOC and less prevalent in wells MW-12S, MW-14S, and MW-15S. Naphthalene is more prevalent in wells MW-13S, MW-13iSOC, MW-14S, MW-15S, moderately present in MW-18S, and less present in MW-12S.

- **Upper Fractured/Weathered Bedrock Groundwater:** Groundwater is also impacted in the upper fractured/weathered bedrock as shown on Figure 3. Benzene exceeds its RBSL in only well MW-13D. Naphthalene is most prevalent in well MW-15D and less prevalent in MW-13D and MW-14D (north of Chinquapin Creek) and MW-11D (southwest of Chinquapin Creek).

While the area of impacted saprolite groundwater and fractured/weathered bedrock groundwater north of Chinquapin Creek overlap, the areas aren't entirely coincident. Similarly, the fractured/weathered groundwater southwest of Chinquapin Creek is impacted while the saprolite groundwater is not. Therefore, while the active remediation technology may be the same for groundwater impacted areas, the spatial layout and target treatment levels may vary.

We propose that the In Situ Enhanced Biodegradation (iSOC®) and In Situ Chemical Oxidation (ISCO) alternatives of the FFS be revised in line with the proposed remediation areas and levels shown in Figure 5, Groundwater Remediation Areas and

Levels. The corresponding revised cost estimates are provided in attached Table A1, Revised Construction Cost Estimate for In-Situ Enhanced Bioremediation (iSOC) and Table A2, Revised Construction Cost Estimate for In-Situ Chemical Oxidation (ISCO).

SCDHEC Comment 3

The Department has concerns regarding the costs of the In Situ Chemical Oxidation and the In Situ Enhanced Biodegradation. The Design costs for In Situ Chemical Oxidation seam extremely high when compared to the In Situ Biodegradation. Please provide a justification for the drastic difference in the design costs.

Response to Comment 3

The note on Table 6-2 of the May 2008 FFS defines that "design costs (are) estimated at 5% of construction costs". The In-Situ Chemical Oxidation (ISCO) exhibits a higher construction cost, thus the associated design cost is correspondingly higher. Based on our experience, bioremediation, chemical oxidation, solidification, and excavation should carry more similar design costs, and are shown as so in Table 6-2.

SCDHEC Comment 4

It is noted that the Feasibility Study assumed different radii of influence (and thus a different number of injection points) for enhanced attenuation and in-situ chemical oxidation. The differences in cost between these two technologies would change significantly if the same number or a similar number of injection points was proposed for each technology. Please provide a justification for using different radii of influence, or assume the same radii and number of injection points for each alternative.

Response to Comment 4

The radius of influence (ROI) of the *in-situ* submerged oxygen curtain (iSOC®) technology has been estimated at ten feet. Additional information on this ROI is included below, in the response to Comment 8.

The ROI of the In-Situ Chemical Oxidation (ISCO) option is estimated to be 25±-feet, based on experience in similar geology. Differences in radii are attributable to the delivery mechanism: iSOC® relies on diffusion to increase the dissolved oxygen content of the aquifer where ISCO chemicals are injected under positive pressure.

SCDHEC Comment 5

O&M durations should be based on 30 years for MNA for all remedial alternatives.

Response to Comment 5

To account for the 30 years of operation & maintenance (O&M) requested by DHEC, as well as O&M requirements for the In-Situ Enhanced Biodegradation (iSOC) and In-Situ Chemical Oxidation scenarios (ISCO), Table 6-2 (Revised) has been updated to include O&M required for the baseline scenario and Monitoring & Reporting required for 30 years of groundwater monitoring after the remedial option is implemented.

SCDHEC Comment 6

The Feasibility Study should include a detailed discussion of the time frame to meet remedial goals for each remedial alternative.

Response to Comment 6

iSOC®: MW-13S is 10±-feet down-gradient of the iSOC® pilot injection and an iSOC® diffuser has been installed directly in MW-13D since September 2006. Temporal concentrations of benzene and naphthalene in wells MW-13ISOC, MW-13S, and MW-13D are provided in Chart 1, Temporal Benzene in Groundwater – iSOC Pilot Study and Chart 2, Temporal Naphthalene in Groundwater – iSOC Pilot Study, respectively. Groundwater from MW-13S has exhibited decreasing benzene and naphthalene concentrations over the period of record since 2004. Trend line analysis of benzene and naphthalene in MW-13D suggest slightly decreasing to slightly increasing concentrations, respectively, over the same period of record. Considering the decreasing concentration trends are observed in MW-13 prior to iSOC® installation, it is questionable whether the decreasing concentrations can be attributed to the iSOC® treatment. Similarly, concentration trends in MW-13D do not support influence from iSOC® treatment. Based on these observations from the iSOC® pilot study, it appears that remedial goals for naphthalene, at least under the pilot study configuration(s), will not be met with iSOC® treatment.

ISCO: Based on past experience with ISCO technologies, the reaction is relatively rapid. Substantial remediation will be achieved upon contact of the oxidant with the contaminant. In order to reduce the probability of day-lighting chemical to the surface or into the creek, injection events will proceed intermittently, delivering the requisite chemical over a three year period. RBSLs are anticipated to be achieved in approximately two years. Rebound is expected, and five years of additional active monitoring is included in the attached revised costs. A pilot test will be performed prior to remediation initiation to determine applicable injection rates and to refine these estimates.

SCDHEC Comment 7

Table 6-1, Monitored Natural Attenuation should be changed from fair to poor on State and Community Acceptance and Compliance with Applicable federal and State requirements.

Response to Comment 7

This response to Comment 7 reflects SCHDHEC's request to change the status of the Monitored Natural Attenuation (MNA) option from fair to poor relative to State and Community Acceptance and Compliance with Applicable Federal and State requirements (in Table 6-1 of the FFS). Table 6-1 (Revised), Summary of Alternatives Analysis is included with this letter report and changes the status of MNA from fair to poor.

In so much as the Addendum identifies and updates various implementation, cost, operational, and risk considerations with the various remedial alternatives, we have taken the opportunity to revise and update Table 6-1 (Revised) appropriately.

SCDHEC Comment 8

The pilot study that was completed using ISOC should have included an evaluation of the radius of influence.

Response to Comment 8

The original objective of the iSOC® pilot study was to establish whether the radius of influence of the technology was at least that suggested by the manufacturer - ten feet. As such, the iSOC® infusion points (MW-13-ISOC and MW-13D) were installed approximately ten feet upgradient of the observation well, MW-13S. As discussed in our response to Comment 6, historical naphthalene concentration trends in MW-13S do not give a clear indication of the long term efficacy of the iSOC® technology at this site.

Dissolved oxygen (DO) concentrations in MW-13S tend to support this conclusion (reference Chart 3, Temporal DO in Groundwater - iSOC Pilot Study). The baseline DO in MW-13S prior to pilot implementation was approximately 0.2 mg/L, an indication of a strongly anaerobic environment. After pilot initiation (September 2006), DO levels increased within the wells containing the iSOC® diffusers themselves – MW-13ISCO and MW-13D. Over the period of operation of the iSOC® diffuser in well MW-13ISOC (September 2006 through December 2008), however, DO levels in down-gradient well MW-13S only averaged 1.2 mg/L, ranging from a low of 0.15 mg/L to a high of 2.31 mg/L. DO concentrations in this range indicate a marginally aerobic environment (marginally capable of supporting aerobic microbial populations), and is significantly lower than the DO concentrations (40-100 mg/L) that the iSOC® is expected to generate as indicated in the manufacture's supplied literature.

As a result of the pilot, we conclude that the radius of influence associated with iSOC® oxygen diffusion at this site is at best no more than ten feet.

SCDHEC Comment 9

The presence of dissolved iron is a critical factor in the success or failure of ISOC and may also affect chemical oxidation success. Therefore, dissolved iron should be determined in the field using a Hach test kit. Groundwater samples from selected locations should be collected using low flow methods and analyzed in the field for dissolved iron. Natural oxidant demand should also be determined using a groundwater/aquifer matrix sample in the source area which will allow a more accurate determination of the amount of oxidant required to address the contaminant and will improve the cost estimates for the FS.

Response to Comment 9

Empirical evidence from the pilot indicates that significant dissolved iron concentrations exist at the site. The unit installed in MW-13ISOC experienced operational difficulties due to iron fouling, resulting in complete malfunction of the unit after two years of operation. Similar issues are anticipated in a full-scale system, and are reflected in the revised cost analyses.

Our experience in Piedmont geology, with confirmation from chemical suppliers, indicates that the natural oxidant demand (NOD) is consistent across the region. A conservative value has been assumed for purposes of evaluating technology feasibility.

As noted in response to Comment 6, the design phase of an ISCO treatment program would include a pilot study. The pilot would be designed to evaluate chemical requirements, impact(s) of potential interference from iron and other inorganics, and radius of influence.

SCDHEC Comment 10

The lognormal scale of the time versus concentration graphs reduces the appearance of groundwater quality trends and leads to a false conclusion of water quality stability. Future graphs of time versus concentration should use an arithmetic scale.

Response to Comment 10

As indicated in our November 19, 2010 letter, the most recent semiannual report included graphs of time vs. compound concentrations plotted on an arithmetic scale, as requested. Future monitoring report graphs will utilize the same arithmetic scale.

TABLES

TABLE 6-1 (REVISED)
SUMMARY OF ALTERNATIVES ANALYSIS
DUKE ENERGY PINE STREET MGP
SPARTANBURG, SOUTH CAROLINA
S&ME Project 1264-02-146

	Remedial Alternatives					
Criterion	**No Action**	**MNA**	***In-Situ* Enhanced Biodegradation**	***In-Situ* Chemical Oxidation**	***In-Situ* Solidification**	**Saturated Zone Excavation**
Overall protection of human health and the environment	Fair	Fair	Fair	Good	Fair	Fair
Compliance with applicable federal, state, and local regulations	Unacceptable	Poor	Good	Good	Good	Good
Long-term effectiveness and permanence	Fair	Fair	Fair	Good	Good	Good
Reduction of toxicity, mobility, and volumes	Fair	Fair	Fair	Good	Fair to Good (depending upon Implementability)	Fair to Good (depending upon Implementability)
Short-term effectiveness	Poor	Poor	Poor	Fair	Fair	Fair
Implementability	Good	Good	Fair	Fair	Difficult	Difficult
Cost	Low	Low	High	Moderately High	Moderatly High with Cost Risks	High with Cost Risks
State and community acceptance	Poor	Fair	Good	Good	Fair	Fair
Time Frame (without O&M)	Unknown	Unknown	8+ Years	3+ Years	2-3 Years	2-3 Years

TABLE 6-2 (REVISED)
COST COMPARISON FOR REMEDIAL ALTERNATIVES
DUKE ENERGY PINE STREET MGP
SPARTANBURG, SOUTH CAROLINA
S&ME Project 1264-02-146

Option	Description	Pilot	Design	Construction	O&M	O&M Duration	O&M Present Value
1	No Action	$ -	$ -	$ -	$ -	0	$ -
2	MNA	$ -	$ -	$ -	$ -	0	$ -
3	*In-Situ* Enhanced Biodegradation	$ -	$ 100,000	$ 8,195,883	$ 611,720	8	$ 4,294,086
4	*In-Situ* Chemical Oxidation	$ 100,000	$ 100,000	$ 2,217,094	$ 150,000	3	$ 424,292
5	*In-Situ* Solidification	$ 100,000	$ 100,000	$ 3,512,451	$ -	0	$ -
6	Saturated Zone Excavation	$ 100,000	$ 100,000	$ 6,278,893	$ -	0	$ -

Option	Description	M&R	M&R Duration	M&R Present Value	Total	-30%	+50%
1	No Action	$ -	0	$ -	$ -	$ -	0
2	MNA	$ 25,000	30	$ 490,011	$ 490,011	$ 343,008	$ 735,017
3	*In-Situ* Enhanced Biodegradation	$ 25,000	30	$ 490,011	$ 13,079,980	$ 9,155,986	$ 19,619,970
4	*In-Situ* Chemical Oxidation	$ 25,000	30	$ 490,011	$ 3,331,396	$ 2,331,977	$ 4,997,094
5	*In-Situ* Solidification	$ 25,000	30	$ 490,011	$ 4,202,462	$ 2,941,723	$ 6,303,692
6	Saturated Zone Excavation	$ 25,000	30	$ 490,011	$ 6,968,904	$ 4,878,233	$ 10,453,357

NOTES:
% = percent
O&M = Operation and Maintenance
M&R = Monitoring and Reporting
Pilot for In-Situ Solidification and Saturated Zone Excavation comprises a Geotechnical Exploration
Design Costs estimated at 5% of construction costs for In-situ Solidification and Saturated Zone Excavation
Present Value Calculations assume an estimated time period and a discount rate of 3%

TABLE A1
REVISED CONSTRUCTION COST ESTIMATE FOR IN-SITU ENHANCED BIOREMEDIATION (iSOC)
DUKE ENERGY PINE STREET MGP
SPARTANBURG, SOUTH CAROLINA
S&ME Project 1264-02-146

Item	Description	Unit	Quantity	Unit Cost	Cost	10% Markup	20% Contingency	Total Costs
1	Well Installation							
1a	Mobilization & Demobilization	LS	2	$ 2,000	$ 4,000		$ 800	$ 4,800
1b	Shallow	LS	175	$ 3,000	$ 525,478		$ 105,096	$ 630,573
1c	Deep	LS	188	$ 9,000	$ 1,691,083		$ 338,217	$ 2,029,299
2	ISOC equipment	LS	363	$ 4,000	$ 1,452,229	$ 145,223	$ 290,446	$ 1,887,898
3	ISOC Equipment Replacement (every other year in shallow wells)	LS	701	$ 4,000	$ 2,802,548	$ 280,255	$ 560,510	$ 3,643,312
							TOTAL IN-SITU ENHANCE BIOREMEDIATION (iSOC) =	**$ 8,195,883**

NOTES:

1. Number of Wells = Area to be Treated / Coverage Area of One Well: Area = pi r^2 = 314 sq ft, assuming a ROI of 10 feet.

Shallow Wells:	55,000	ft2 =	175	Shallow
Transition Zone Wells:	59,000	ft2 =	188	Transition Zone
			363	Total

2. O&M assumption based on trendline evaluation of benzene concentrations at wells MW-13S and MW-13ISOC = 8 years

TABLE A2
REVISED CONSTRUCTION COST ESTIMATE FOR IN-SITU CHEMICAL OXIDATION (ISCO)
DUKE ENERGY PINE STREET MGP
SPARTANBURG, SOUTH CAROLINA
S&ME Project 1264-02-146

Item	Description	Unit	Quantity	Unit Cost	Cost	10% Markup	20% Contingency	Total Costs
1	Well Installation							
1a	Mob/Demob	LS	2	$ 2,000	$ 4,000		$ 800	$ 4,800
1b	Shallow	LS	28	$ 3,000	$ 84,098		$ 16,820	$ 100,917
1c	Deep	LS	30	$ 9,000	$ 270,642		$ 54,128	$ 324,771
2	Centralized Line Installation	LS	58	$ 3,000	$ 174,312	$ 17,431	$ 34,862	$ 226,606
3	Injection Equipment - Building, Tanks, Pumps	LS	1	$ 200,000	$ 200,000	$ 20,000	$ 40,000	$ 260,000
4	Chemical Cost	LS	1	$ 1,000,000	$ 1,000,000	$ 100,000	$ 200,000	$ 1,300,000
							TOTAL IN-SITU CHEMCIAL OXIDATION (ISCO) =	**$ 2,217,094**

NOTES:

1. Number of Wells = Area to be Treated / Coverage Area of One Well: Area = pi r^2 = 1962 sq ft, assuming a ROI of 25 feet.

Shallow Wells:	55,000	ft2 =	28	Shallow
Transition Zone Wells:	59,000	ft2 =	30	Transition Zone
			58	Total

2. O&M assumtion based on experience with ISCO = 3 years

TABLE A3
REVISED CONSTRUCTION COST ESTIMATE FOR IN-SITU SOLIDIFICATION
DUKE ENERGY PINE STREET MGP
SPARTANBURG, SOUTH CAROLINA
S&ME Project 1264-02-146

Item	Description	Unit	Quantity	Bare Cost	10% Markup	20% Contingency	Total Costs	Unit Cost
1	Mobilization & Demobilization	LS	1	$ 256,115	$ 25,612	$ 51,223	$ 332,950	$ 332,950
2	Temporary Facilities	MO	7	$ 355,780	$ 35,578	$ 71,156	$ 462,514	$ 66,073
3	Clearing	LS	1	$ 6,503	$ 650	$ 1,301	$ 8,454	$ 8,454
4	Fencing	LS	1	$ 11,288	$ 1,129	$ 2,258	$ 14,674	$ 14,674
5	Excavation of Overburden	CY	21,325	$ 170,600	$ 17,060	$ 34,120	$ 221,780	$ 10
6	In-Situ Solidification	CY	20,189	$ 686,426	$ 68,643	$ 137,285	$ 892,354	$ 44
7	Transportation and Disposal	Ton	6,056	$ 242,240	$ 24,224	$ 48,448	$ 314,912	$ 52
8	Odor Control Foam	LS	1	$ 62,500	$ 6,250	$ 12,500	$ 81,250	$ 81,250
9	Backfill	CY	21,325	$ 234,575	$ 23,458	$ 46,915	$ 304,948	$ 14
10	Site Restoration	SF	72,316	$ 41,158	$ 4,116	$ 8,232	$ 53,505	$ 1
11	Perimeter Air monitoring	Day	6	$ 150,000	$ 15,000	$ 30,000	$ 195,000	$ 32,500
12	Temporary Facilities	LS	1	$ 44,300	$ 4,430	$ 8,860	$ 57,590	$ 57,590
13	ISS QA Sampling	Ea	20	$ 8,000	$ 800	$ 1,600	$ 10,400	$ 520
14	Personnel	Man Hours	3,521	$ 370,400	$ 37,040	$ 74,080	$ 481,520	$ 137
15	Monitoring Well Replacements							
15a	Mobilization & Demobilization	LS	1	$ 2,000	$ 200	$ 400	$ 2,600	$ 2,600
15b	Shallow	Each	5	$ 15,000	$ 1,500	$ 3,000	$ 19,500	$ 3,900
15c	Deep	Each	5	$ 45,000	$ 4,500	$ 9,000	$ 58,500	$ 11,700
						TOTAL IN-SITU SOLIDIFICATION =	**$ 3,512,451**	

TABLE A4
REVISED CONSTRUCTION COST ESTIMATE FOR EXCAVATION AND DISPOSAL
DUKE ENERGY PINE STREET MGP
SPARTANBURG, SOUTH CAROLINA
S&ME Project 1264-02-146

Item	Description	Unit	Quantity	Bare Cost	10% Markup	20% Contingency	Total Costs	Unit Cost
1	Mobilization & Demobilization	LS	1	$ 20,000	$ 2,000	$ 4,000	$ 26,000	$ 26,000
2	Temporary Facilities and Controls	Mo	7	$ 323,935	$ 32,394	$ 64,787	$ 421,116	$ 60,159
3	Clearing	LS	1	$ 4,630	$ 463	$ 926	$ 6,019	$ 6,019
4	Fencing & E&S Control	LS	1	$ 2,800	$ 280	$ 560	$ 3,640	$ 3,640
5	Sheetpile Installation	LF	1,141	$ 1,369,200	$ 136,920	$ 273,840	$ 1,779,960	$ 1,560
6	Construction Dewatering - 200 gpm system	LS	1	$ 133,000	$ 13,300	$ 26,600	$ 172,900	$ 172,900
7	Excavate Overburden	CY	21,325	$ 170,600	$ 17,060	$ 34,120	$ 221,780	$ 10
8	Saturated Soil Excavation	Cy	20,189	$ 302,835	$ 30,284	$ 60,567	$ 393,686	$ 20
9	Soil Amendment	Tons	15,000	$ 58,500	$ 5,850	$ 11,700	$ 76,050	$ 5
10	Transportation and Disposal	Tons	30,283	$ 1,223,350	$ 122,335	$ 244,670	$ 1,590,355	$ 53
11	Fill Placement	CY	44,343	$ 487,773	$ 48,777	$ 97,555	$ 634,105	$ 14
12	Odor Control Foam Consumables	Day	60	$ 47,000	$ 4,700	$ 9,400	$ 61,100	$ 1,018
13	Site Restoration	LS	1	$ 21,695	$ 2,170	$ 4,339	$ 28,204	$ 28,204
14	Air Monitoring	Mo	6	$ 190,000	$ 19,000	$ 38,000	$ 247,000	$ 41,167
15	Oversight	Hrs	4,188	$ 412,600	$ 41,260	$ 82,520	$ 536,380	$ 128
16	Monitoring Well Replacements							
16a	Mobilization & Demobilization	LS	1	$ 2,000	$ 200	$ 400	$ 2,600	$ 2,600
16b	Shallow	Each	5	$ 15,000	$ 1,500	$ 3,000	$ 19,500	$ 3,900
16c	Deep	Each	5	$ 45,000	$ 4,500	$ 9,000	$ 58,500	$ 11,700
						TOTAL EXCAVATION & DISPOSAL =	$ 6,278,893	

CHARTS

CHART 1
Temporal Benzene in Groundwater - iSOC Pilot Study
Pine Street MGP Site

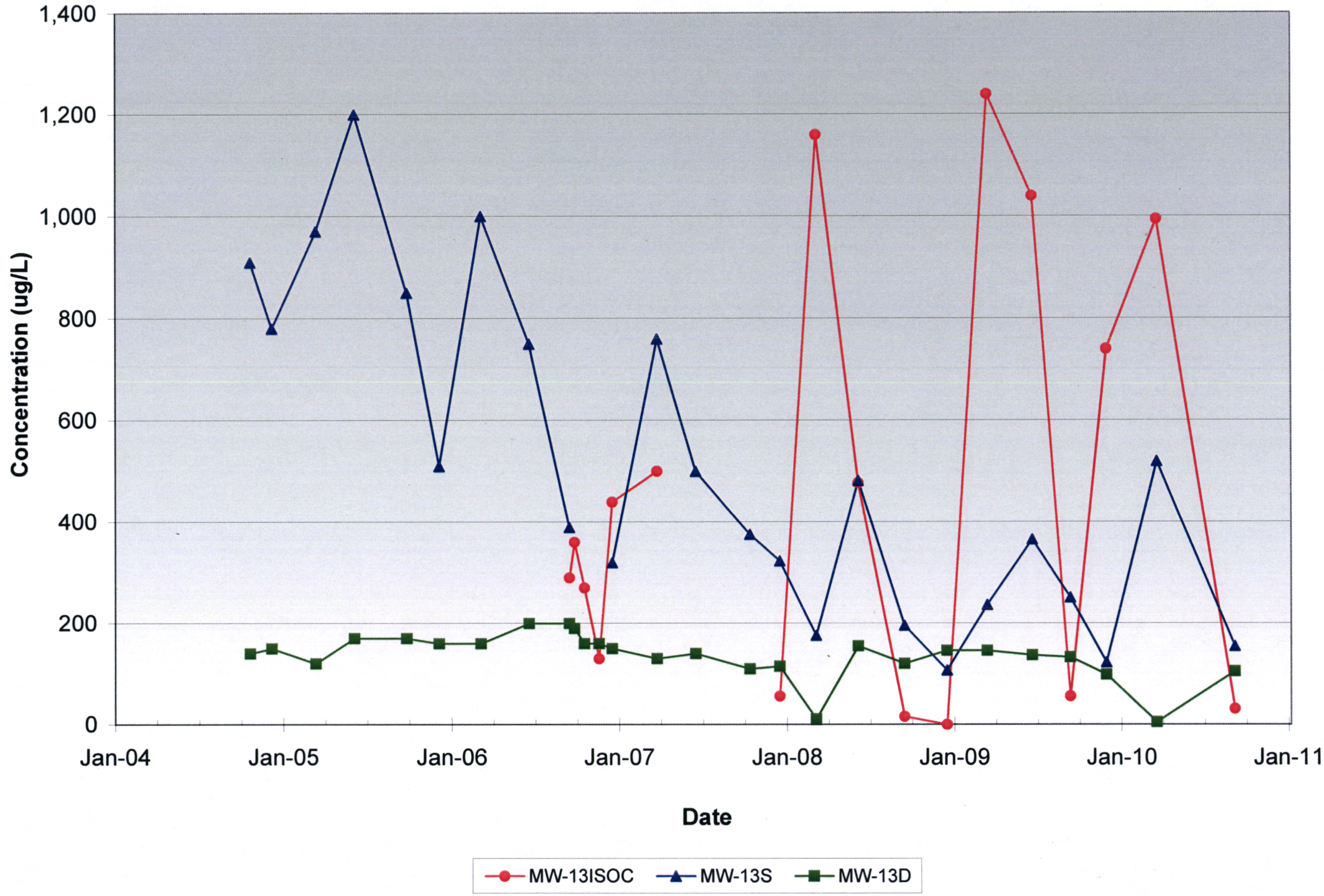


CHART 2
Temporal Benzene in Groundwater - iSOC Pilot Study
Pine Street MGP Site

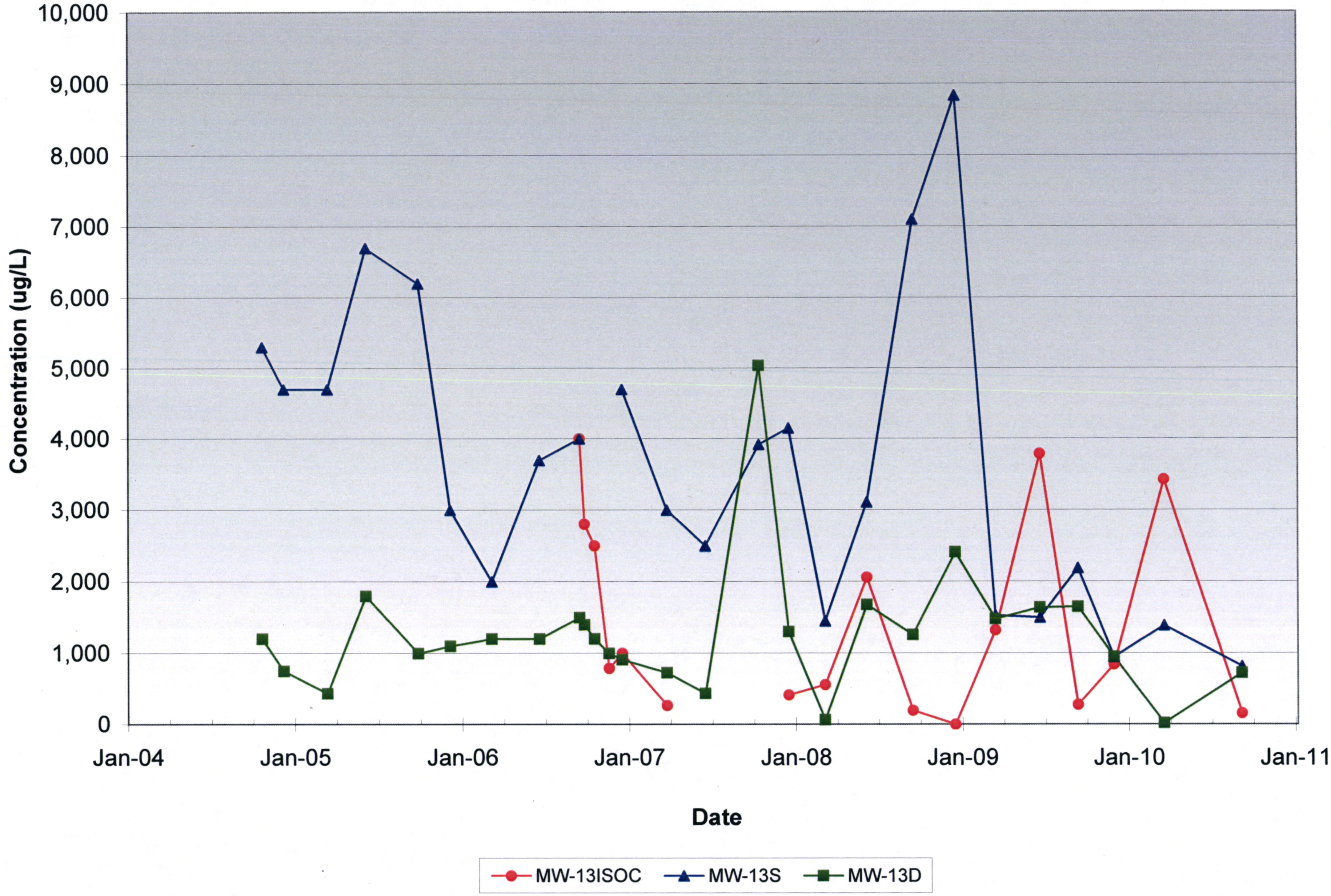
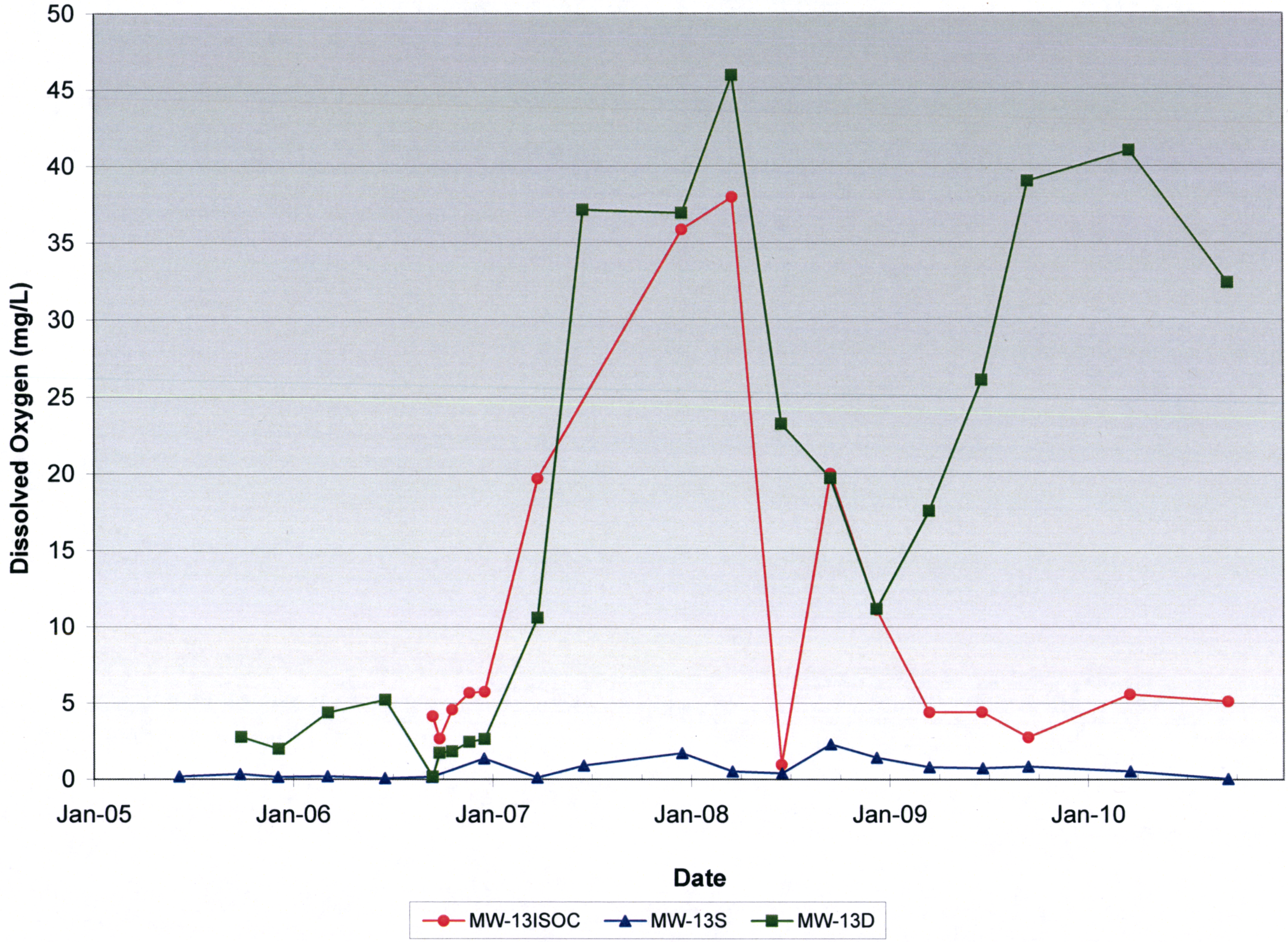
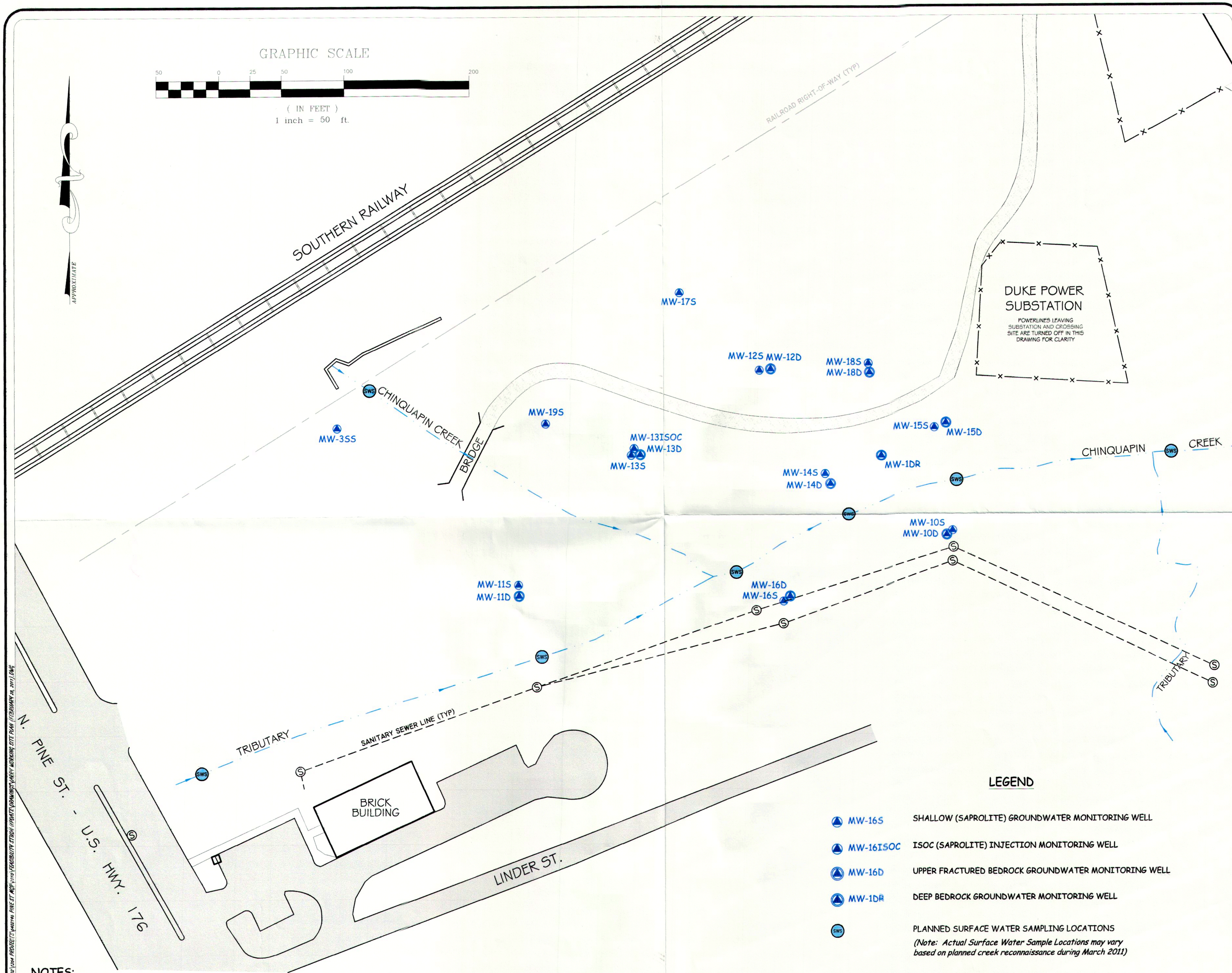


CHART 3
Temporal DO in Groundwater - iSOC Pilot
Duke Energy Pine Street MGP Site



FIGURES



NOTES:

1. SITE INFORMATION COMPILED FROM A VARIETY OF DRAWINGS/CADD FILES PROVIDED BY DUKE ENERGY, INCLUDING SITE SURVEY(S), SPRTBRGMESS.DWG, AND SPRTBRGPHASES.DWG.

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0	FEB 28, 2011	ISSUED WITH FFS ADDENDUM	LA

INITIAL SURFACE WATER SAMPLES FROM CHINQUAPIN CREEK

DUKE ENERGY
PINE STREET MGP SITE
SPARTANBURG, SOUTH CAROLINA

DRAWN BY: LA	CHECKED BY: SJL
DESIGNED BY: —	APPROVED BY: —
PROJECT NUMBER: 1264-02-146	
SCALE: AS SHOWN	DATE: FEB 2011
DRAWING: 1	OF: 5

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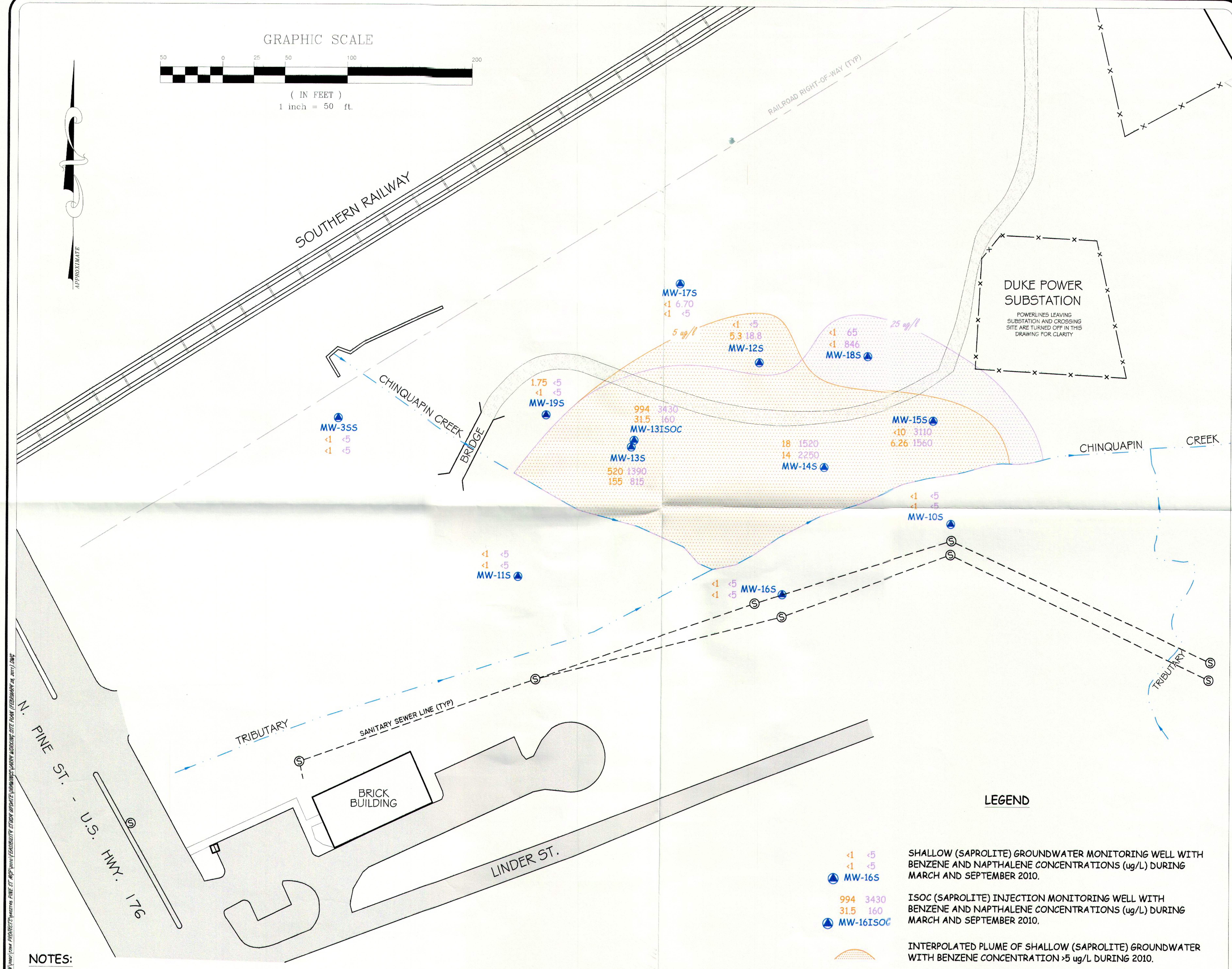
56553 (46)



LEGEND

<1 <5 <1 <5 MW-16S	SHALLOW (SAPROLITE) GROUNDWATER MONITORING WELL WITH BENZENE AND NAPTHALENE CONCENTRATIONS (ug/L) DURING MARCH AND SEPTEMBER 2010.
994 3430 31.5 160 MW-16ISOC	ISOC (SAPROLITE) INJECTION MONITORING WELL WITH BENZENE AND NAPTHALENE CONCENTRATIONS (ug/L) DURING MARCH AND SEPTEMBER 2010.
(orange plume)	INTERPOLATED PLUME OF SHALLOW (SAPROLITE) GROUNDWATER WITH BENZENE CONCENTRATION >5 ug/L DURING 2010.
(purple plume)	INTERPOLATED PLUME OF SHALLOW (SAPROLITE) GROUNDWATER WITH NAPHTHALENE CONCENTRATION >25 ug/L DURING 2010.

NOTES:

1. *SITE INFORMATION COMPILED FROM A VARIETY OF DRAWINGS/CADD FILES PROVIDED BY DUKE ENERGY, INCLUDING SITE SURVEY(S), SPRTBRGMESS.DWG, AND SPRTBRGPHASES.DWG.*

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BENZENE & NAPHTHALENE IN SHALLOW (SAPROLITE) GROUNDWATER (2010)

DUKE ENERGY PINE STREET MGP SITE SPARTANBURG, SOUTH CAROLINA

DRAWN BY: LA	CHECKED BY: SJL
DESIGNED BY: —	APPROVED BY: —
PROJECT NUMBER: 1264-02-146	
SCALE: AS SHOWN	DATE: FEB 2011
DRAWING: 2	OF: 5

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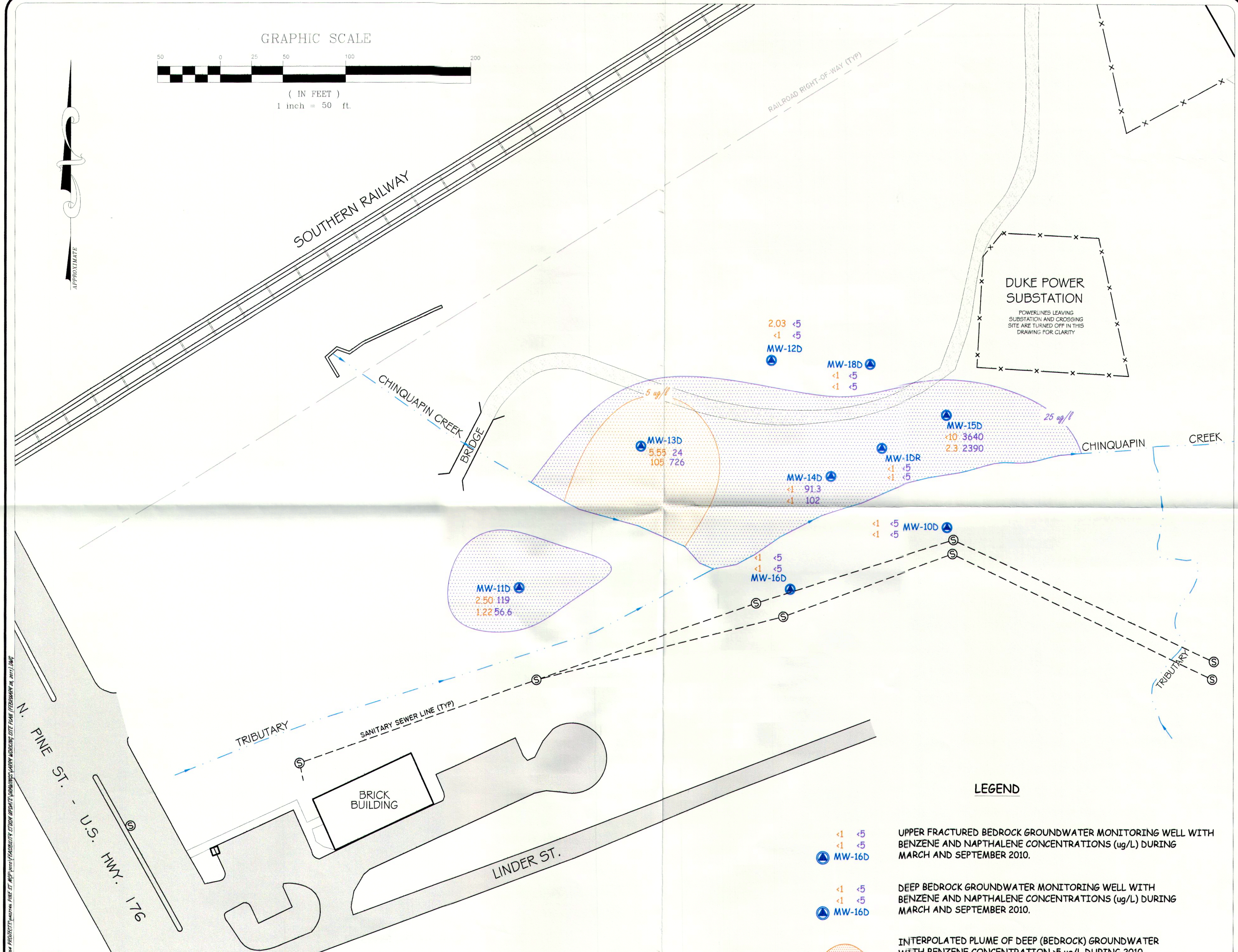

LEGEND

<1 <5
<1 <5
MW-16D — UPPER FRACTURED BEDROCK GROUNDWATER MONITORING WELL WITH BENZENE AND NAPTHALENE CONCENTRATIONS (ug/L) DURING MARCH AND SEPTEMBER 2010.

<1 <5
<1 <5
MW-16D — DEEP BEDROCK GROUNDWATER MONITORING WELL WITH BENZENE AND NAPTHALENE CONCENTRATIONS (ug/L) DURING MARCH AND SEPTEMBER 2010.

INTERPOLATED PLUME OF DEEP (BEDROCK) GROUNDWATER WITH BENZENE CONCENTRATION >5 ug/L DURING 2010.

INTERPOLATED PLUME OF DEEP (BEDROCK) GROUNDWATER WITH NAPHTHALENE CONCENTRATION >25 ug/L DURING 2010.

NOTES:

1. SITE INFORMATION COMPILED FROM A VARIETY OF DRAWINGS/CADD FILES PROVIDED BY DUKE ENERGY, INCLUDING SITE SURVEY(S), SPRTBRGMESS.DWG, AND SPRTBRGPHASES.DWG.
2. MW-1DR IS COMPLETED IN DEEPER LESS FRACTURED BEDROCK AND DOES NOT EXHIBIT CONTAMINATION. ALTHOUGH THE WELL IS SHOWN ABOVE, IT IS NOT CONSIDERED IN CONCENTRATION EXTENTS.

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NO.	DATE	DESCRIPTION	BY
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BENZENE & NAPHTHALENE IN UPPER FRACTURED BEDROCK GROUNDWATER (2010)

DUKE ENERGY
PINE STREET MGP SITE
SPARTANBURG, SOUTH CAROLINA

DRAWN BY: LA	CHECKED BY: SJL
DESIGNED BY: —	APPROVED BY: —
PROJECT NUMBER: 1264-02-146	
SCALE: AS SHOWN	DATE: FEB 2011
DRAWING: 3	OF: 5

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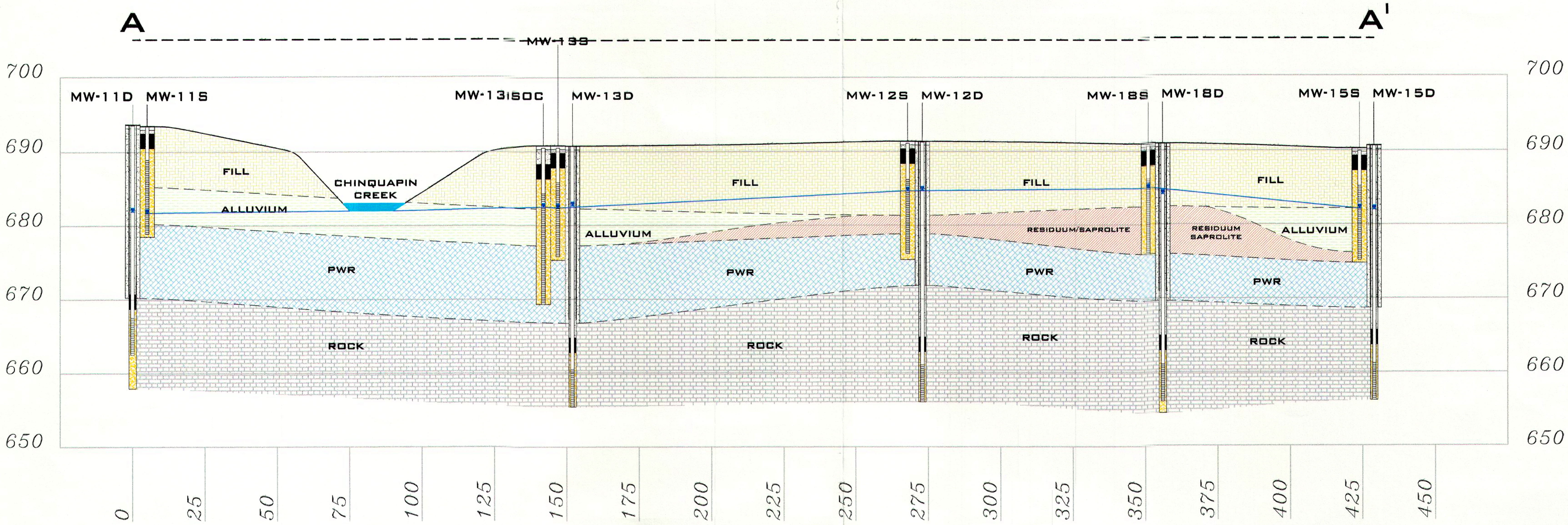

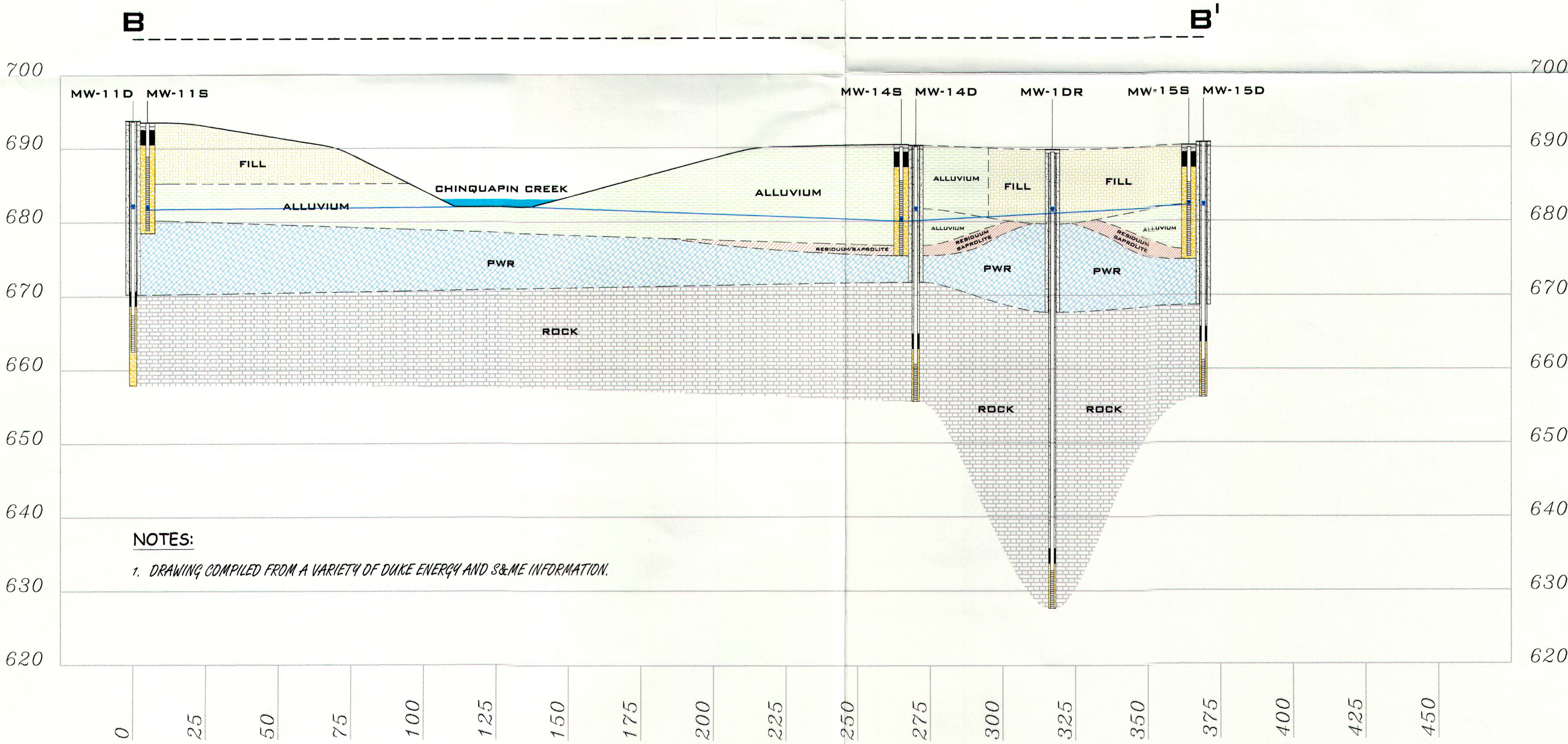

NOTES:

1. DRAWING COMPILED FROM A VARIETY OF DUKE ENERGY AND S&ME INFORMATION.

S:\ENVIRON\2002\1264 PROJECTS\6402146 PINE ST MGP\2010\FEASIBILITY STUDY UPDATE\DRAWINGS\CROSS SECTIONS WORKING (FEBRUARY 28, 2011).DWG

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CROSS-SECTIONS

DUKE ENERGY PINE STREET MGP SITE SPARTANBURG, SOUTH CAROLINA

DRAWN BY: LA	CHECKED BY: SJL
DESIGNED BY: —	APPROVED BY: —
PROJECT NUMBER: 1264-02-146	
SCALE: AS SHOWN	DATE: FEB 2011
DRAWING: 4	OF: 5

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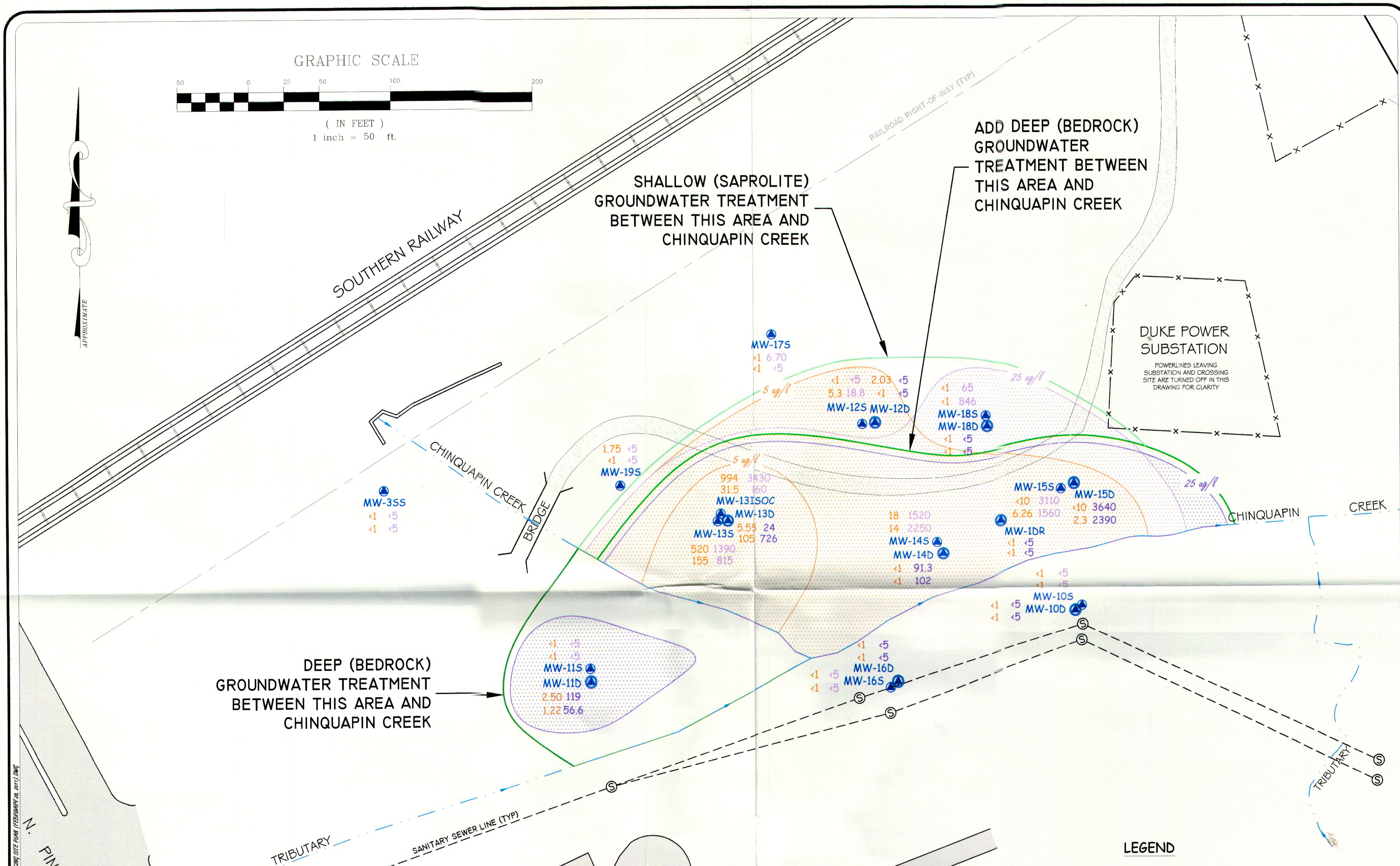

LEGEND

<1 <5 / <1 <5 / MW-16S	SHALLOW (SAPROLITE) GROUNDWATER MONITORING WELL WITH BENZENE AND NAPTHALENE CONCENTRATIONS (ug/L) DURING MARCH AND SEPTEMBER 2010.
994 3430 / 31.5 160 / MW-16ISOC	ISOC (SAPROLITE) INJECTION MONITORING WELL WITH BENZENE AND NAPTHALENE CONCENTRATIONS (ug/L) DURING MARCH AND SEPTEMBER 2010.
<1 <5 / <1 <5 / MW-16D	UPPER FRACTURED BEDROCK GROUNDWATER MONITORING WELL WITH BENZENE AND NAPTHALENE CONCENTRATIONS (ug/L) DURING MARCH AND SEPTEMBER 2010.
<1 <5 / <1 <5 / MW-1DR	DEEP BEDROCK GROUNDWATER MONITORING WELL WITH BENZENE AND NAPTHALENE CONCENTRATIONS (ug/L) DURING MARCH AND SEPTEMBER 2010.
	INTERPOLATED PLUME OF DEEP (BEDROCK) GROUNDWATER WITH BENZENE CONCENTRATION >5 ug/L DURING 2010.
	INTERPOLATED PLUME OF DEEP (BEDROCK) GROUNDWATER WITH NAPHTHALENE CONCENTRATION >25 ug/L DURING 2010.
	INTERPOLATED PLUME OF SHALLOW (SAPROLITE) GROUNDWATER WITH BENZENE CONCENTRATION >5 ug/L DURING 2010.
	INTERPOLATED PLUME OF SHALLOW (SAPROLITE) GROUNDWATER WITH NAPHTHALENE CONCENTRATION >25 ug/L DURING 2010.

NOTES:

1. SITE INFORMATION COMPILED FROM A VARIETY OF DRAWINGS/CADD FILES PROVIDED BY DUKE ENERGY, INCLUDING SITE SURVEY(S), SPRTBRGMESS.DWG, AND SPRTBRGPHASES.DWG.
2. MW-1DR IS COMPLETED IN DEEPER LESS FRACTURED BEDROCK AND DOES NOT EXHIBIT CONTAMINATION. ALTHOUGH THE WELL IS SHOWN ABOVE, IT IS NOT CONSIDERED IN CONCENTRATION EXTENTS.

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GROUNDWATER REMEDIATION AREAS & LEVELS

DUKE ENERGY
PINE STREET MGP SITE
SPARTANBURG, SOUTH CAROLINA

NO.	DATE	DESCRIPTION	BY
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DESIGNED BY: —	APPROVED BY: —
PROJECT NUMBER: 1264-02-146	
SCALE: AS SHOWN	DATE: FEB 2011
DRAWING: 5	OF: 5

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