URS

8 April 2011

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State Project: **P-3800**
WBS Element: **49999.1.STR8**
County: **Mecklenburg**
Description: **Charlotte Service Facility**

Subject: Geophysical Survey Report
Charlotte Pipe and Foundry - Parcel #31A
URS Project No. 3182 6405

Dear Cyrus:

In accordance with the URS Corporation – North Carolina (URS) Revised Technical Cost Proposal (TCP) dated 13 January 2011, submitted to the North Carolina Department of Transportation (NCDOT), we are pleased to provide this report on the findings of the geophysical survey conducted in support of NCDOT Project P-3800, WBS Element 49999.1.STR8. The objective of the survey was to assess whether buried tanks or drums are located at the above-referenced parcel.

SITE DESCRIPTION

No Facility I.D. was listed for Parcel #31A in the information provided by NCDOT. The parcel includes the properties at 1116, 1120, and 1128 South Graham Street, Charlotte, North Carolina. These properties are currently owned by Charlotte Pipe and Foundry Company.

The geophysical survey area consisted of approximately 1 acre. Historical information provided by NCDOT indicates that two USTs were removed from the properties comprising Parcel #31A. The background information provided in the NCDOT request for TCP does not mention the historical presence of drums, although NCDOT indicates that available records and historical information are incomplete.

At the time of the geophysical survey, Parcel #31A consisted of a parking lot surrounded by a secure fence. Site plans provided by NCDOT indicate the presence of former buildings that have been demolished. Remnant brick foundations and water meter boxes in-line with these foundations were observed along South Graham Street. The exact location and number of former structures is not known.

Ground surface conditions across Parcel #31A at the time of the survey included gravel and mowed grass. A concrete pad was observed in the middle of the parcel. Obstructions present at

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the time of the survey included the concrete pad as well as several large trees. The parcel is reportedly used as a parking area for events at nearby Bank of America Stadium.

GEOPHYSICAL SURVEY METHODS

The geophysical survey was conducted using a combination of electromagnetics (EM) and ground penetrating radar (GPR).

Electromagnetic Surveying

The EM survey was completed using the EM-61 MKII (EM-61), manufactured by Geonics, Ltd. The EM-61 is a time domain EM instrument specifically designed to detect buried metal objects. The EM-61 generates rapid EM pulses through a transmitter coil. These pulses induce secondary EM fields in the near subsurface. The secondary EM fields induced from moderately conductive subsurface materials (i.e. soil and rock) are of relatively short duration. However, the secondary EM fields induced from metallic objects, such as reinforced concrete or steel drums, are of relatively long duration. The EM-61 measures this prolonged response from metallic objects after the EM response from conductive earth materials dissipates. This design provides high resolution of metallic targets. The depth of investigation of the instrument is relatively unaffected by site specific subsurface conditions.

The EM-61 measures the EM response in milliVolts (mV). The variations in EM response readings from some background level are more diagnostic than the absolute values. EM response values can be plotted and contoured to evaluate the variations across the site. Variations in the EM response resulting from buried metallic objects such as cast iron pipes are generally manifested by relatively large amplitude (greater than about 50 mV) anomalies.

The Fisher Laboratories GEMINI-3 hand-held instrument was utilized in areas where access with the EM-61 was limited. The GEMINI-3 is a deep-sensing metal detector that consists of a transmitter and receiver separated by a non-conductive pole. The transmitter emits an electromagnetic field at a constant frequency as the instrument is carried a few feet above the ground surface. When in the presence of metallic objects, the field becomes distorted and sounds an audible alarm. Differences in the pitch of the alarm typically allow the operator to differentiate between surface debris (e.g. nails, bolts, etc.) and larger objects such as drums, USTs, reinforced concrete, or underground utilities.

Under optimal conditions, the GEMINI-3 is capable of detecting an object in size comparable to a 55-gallon steel drum to a depth of approximately 10 feet. However, resolution and the ability to locate subsurface metallic objects are diminished in areas of metallic interference from surface debris.

Ground Penetrating Radar (GPR)

The GPR method involves transmitting electromagnetic pulses into the subsurface and recording the subsequent reflected signal. These electromagnetic pulses are primarily influenced by the dielectric properties of subsurface materials. Reflection of the transmitted energy back to the GPR

antenna occurs at the interfaces of dielectric contrasts while some of the transmitted energy is lost to attenuation and signal degradation. Contrasts in dielectric properties typically correspond to variations in soil type, rock type, ground water content, and the presence of buried cultural features (e.g. building foundations, debris, utilities, voids, etc.). These variations in subsurface conditions subsequently influence the amount of energy that is reflected back to the antenna and the amount of energy lost to attenuation and signal degradation. In addition, these variations in subsurface conditions result in changes in electromagnetic wave propagation velocity, which in turn influences the achievable depth of investigation using the GPR method.

The GPR survey was conducted using the Sensors & Software Noggin Smart Cart PLUS system with a 250 MHz scanning antenna.

SURVEY EXECUTION

The geophysical survey was conducted between March 14 and 19, 2011. Access to the site was coordinated with Mr. Bob Currie, Facilities Manager, of Charlotte Pipe and Foundry Company.

The EM-61 data were collected along parallel profiles spaced approximately 3 feet apart and extending across the accessible portions of Parcel #31A. The relatively dense profile spacing was utilized in an attempt to delineate potential small-capacity USTs (e.g. heating oil or waste oil tanks).

Simultaneous positional data were collected using a Novatel Smart-V1 global positioning system (GPS). Real-time differential corrections were provided via an Omnistar subscription service, where the resulting differential GPS (DGPS) have a horizontal accuracy of 3 feet or better. URS utilized a Trimble ProXH DGPS to record the locations of relevant site features within the survey area.

The GEMINI-3 was used to perform a sweep search around the perimeter of the concrete pad and remnant building foundations. In addition, the GEMINI-3 was used to perform a sweep search of the relatively narrow areas between the perimeter fence line and adjacent streets. The GEMINI-3 has a smaller survey footprint compared to the EM-61 and can generally be used to survey closer to above-ground metal structures than the EM-61.

The EM-61 data were evaluated in the field to identify anomalies potentially indicative of USTs and drums and to select target locations for the follow-up GPR survey to further characterize these anomalies.

DATA PROCESSING

The EM-61 data were pre-processed and formatted for contouring using the programs TrackMaker 61MK2, Version 1.65 (Geomar Software, Inc.), and DAT61 MK2, Version 2.30 (Geonics, Ltd). The data were contoured in Surfer, Version 9.0 (Golden Software, Inc.). Contoured data represent the EM-61 Channel 1 and differential responses. The Channel 1 response represents data recorded at the earliest time interval along the EM-61 response decay curve. These data are applicable to

detection of subsurface objects including USTs, drums, and other underground obstructions. The differential channel data typically provide enhanced discrimination between anomalies associated with surface or near-surface objects versus USTs and other deeper targets of interest.

No GPR data were processed as part of this geophysical survey.

RESULTS AND INTERPRETATION

The results of the geophysical survey are presented in accordance with the NCDOT guidelines, dated May 19, 2009, for identifying and ranking potential USTs on NCDOT projects. These same guidelines were utilized for evaluating the potential presence of buried drums at Parcel #31A.

The EM-61 Channel 1 and differential response results are provided as plan view, color-enhanced contour maps in **Figures 1 and 2**, respectively. The interpreted background response is represented by the light green contours and corresponds to the range of approximately 0 to 30 milliVolts (mV). The relatively wide range of the interpreted background response is warranted due to an apparent elevated background metallic signature associated with the site history and current site usage.

This interpreted elevated metallic signature is evident in the Channel 1 data presented as **Figure 1**. The widespread red and blue color contours indicate that surface and near-surface conditions across the majority of the site are characterized by elevated EM responses. The differential response results presented as **Figure 2** further indicate that the elevated responses in the Channel 1 data are most likely a result of surface and near-surface conditions across Parcel #31A. The effect of these surface conditions appears to be relatively muted in the differential response data, thus facilitating the identification of anomalies characteristic of USTs and drums.

A total of 8 anomalies indicative of potential USTs or drums were interpreted from the Channel 1 and differential response data and are annotated accordingly on **Figure 2**. Two anomalies (#4 and #10) were identified during the sweep search with the GEMINI-3. These combined 10 anomalies are characterized by dimensions and EM response amplitudes consistent with the characteristics of USTs or drums and were therefore targeted for follow-up GPR surveying.

GPR was used to further evaluate the EM anomalies identified in **Figure 2** interpreted as potentially indicative of USTs and drums. No surface features indicative of USTs (e.g. vent pipes, fill ports) were observed on-site. The results of the follow-up GPR survey indicated that Anomaly #2 is most likely associated with interference from an adjacent wall and that Anomaly #4 is most likely associated with near-surface debris because of its relatively small size. Therefore, these two anomalies are designated as “No Confidence” anomalies in accordance with the NCDOT guidelines for identifying and ranking potential USTs. The remaining eight anomalies are designated as “Possible UST/Drum” in accordance with these guidelines. Representative GPR cross-sections recorded across each of these eight anomalies are presented as **Figure 3**.

The relatively large number of anomalies within an approximate 1-acre survey area that are designated “Possible Drum/UST” is most likely the result of the dynamic site history. In an

attempt to provide additional guidance for planning potential future investigations, the anomalies in **Figure 3** are identified in either black or magenta on the individual cross-sections. The anomalies identified in magenta represent those that are interpreted to be the most likely candidates for potential USTs or drums. This distinction is based on the results of the geophysical survey, but also the location of the anomaly relative to remnant building foundations. However, it is important to note that the remaining anomalies designated "Possible UST/Drum" in **Figure 3** are designated as such because buried USTs or drums that may have been crushed or that may have degraded or corroded over time may not exhibit GPR reflections characteristic of their intact counterparts.

LIMITATIONS

This geophysical survey was conducted in accordance with reasonable and accepted engineering geophysics practices, and the interpretations and conclusions are rendered in a manner consistent with other consultants in our profession. All geophysical techniques have some level of uncertainty and limitations. No other representations of the reported information is expressed or implied, and no warranty or guarantee is included or intended.

We have greatly appreciated the opportunity to support you on this project. Please feel free to contact us at 919.461.1100 if you have any questions regarding this report.

Respectfully submitted,

URS Corporation – North Carolina

Vernon E. Keys
Program Manager

Matthew A. Barner, P.G.
Senior Geophysicist

1c: File 3182 6405

PROJECT REFERENCE NO.	SHEET
P-3800	1

GeoEnvironmental

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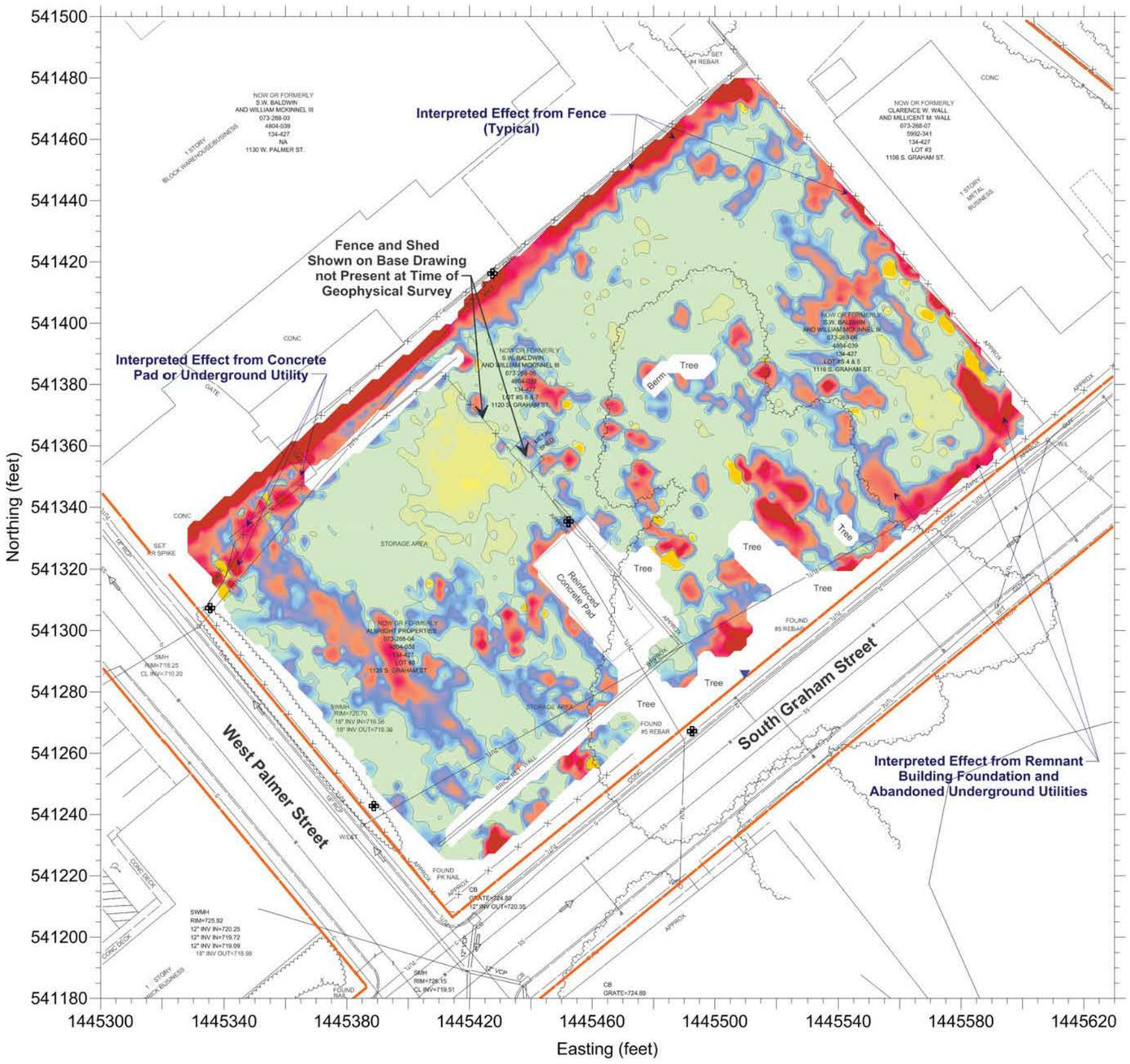
FEET



LEGEND

- ROW
- Light/Power/Telephone Pole
- Water Meter

EM-61 MKII Channel 1 Response (milliVolts)

Interpreted Increasing Response from Subsurface Metal

3500, 500, 485, 470, 455, 440, 425, 410, 395, 380, 365, 350, 335, 320, 305, 290, 275, 260, 245, 230, 215, 200, 185, 170, 155, 140, 125, 110, 95, 80, 65, 50, 35

Interpreted Background Response

20, 5

Interpreted Increasing Response from Surface Metal

-10, -500

Notes:

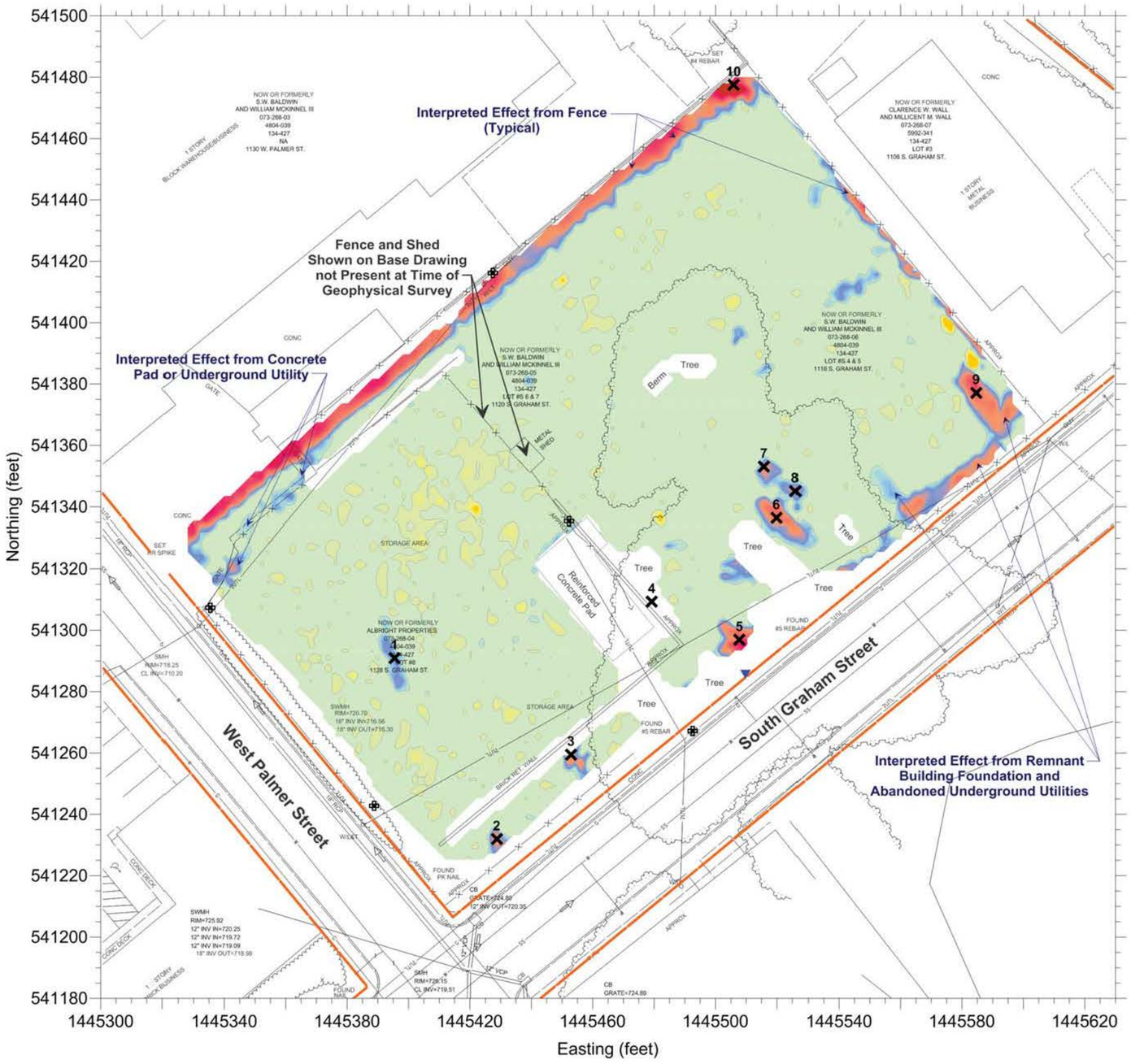
1. Coordinates in NC State Plane, NAD-83.
2. Base drawing after file "CRISP_Rail_srvcalt2c-rev1.dwg", provided by NCDOT.
3. Data from Geonics, Ltd. EM-61 MKII instrument.
4. Location control and site features from DGPS survey by URS Corporation.

SCALE	DESIGNED BY	DATE	DRAWING TITLE
AS SHOWN	MAB	30MAR11	EM-61 MKII Channel 1 Response Contours Charlotte Pipe and Foundry NCDOT Parcel 31A Charlotte, North Carolina
URS MORRISVILLE, NORTH CAROLINA 27560	DRAWN BY: MAB	DATE: 30MAR11	
	CHECKED BY: CSZ	DATE: 31MAR11	CONTRACT NO.: 31826405
	APPROVED BY: TJK	DATE: 06APR11	DRAWING NO.: FIGURE-1 / REV.: 0

PROJECT REFERENCE NO.	SHEET
P-3800	2

GeoEnvironmental

0 20 40 60 80
FEET



LEGEND

- ROW
- Light/Power/Telephone Pole
- Water Meter
- EM Anomaly Identified for GPR Follow-Up

EM-61 MKII Differential Response (milliVolts)

Interpreted Increasing Response from Subsurface Metal

875, 500, 485, 470, 455, 440, 425, 410, 395, 380, 365, 350, 335, 320, 305, 290, 275, 260, 245, 230, 215, 200, 185, 170, 155, 140, 125, 110, 95, 80, 65, 50, 35

Interpreted Background Response

20, 5

Interpreted Increasing Response from Surface Metal

-10, -70

Notes:

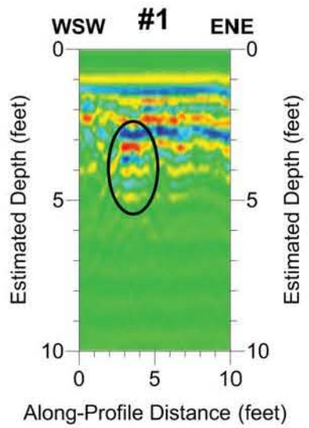
1. Coordinates in NC State Plane, NAD-83.
2. Base drawing after file "CRISP_Rail_srvcalt2c-rev1.dwg", provided by NCDOT.
3. Data from Geonics, Ltd. EM-61 MKII instrument.
4. Location control and site features from DGPS survey by URS Corporation.
5. Anomalies #4 and #10 identified during initial sweep search with GEMINI-3 hand-held metal detector.

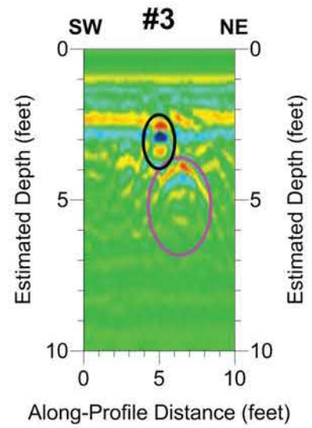
SCALE	DESIGNED BY	DATE	DRAWING TITLE
AS SHOWN	MAB	30MAR11	EM-61 MKII Differential Response Contours Charlotte Pipe and Foundry NCDOT Parcel 31A Charlotte, North Carolina
URS MORRISVILLE, NORTH CAROLINA 27560	DRAWN BY: MAB	DATE: 30MAR11	
	CHECKED BY: CSZ	DATE: 31MAR11	CONTRACT NO.: 31826405
	APPROVED BY: TJK	DATE: 06APR11	DRAWING NO.: FIGURE-2 / REV.: 0

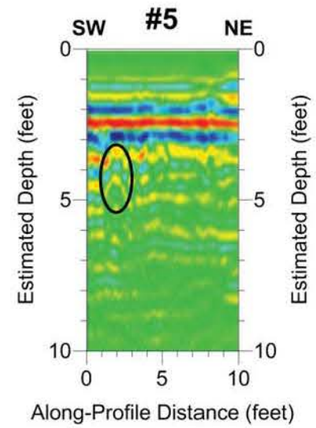
PROJECT REFERENCE NO.	SHEET
P-3800	3

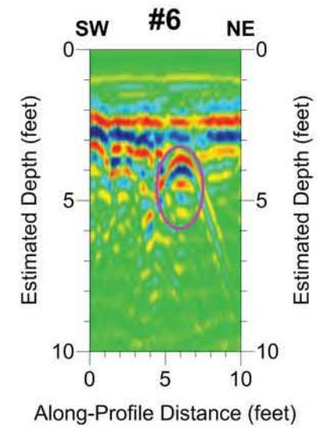
GeoEnvironmental

0 10 20
HORIZONTAL SCALE (FEET)





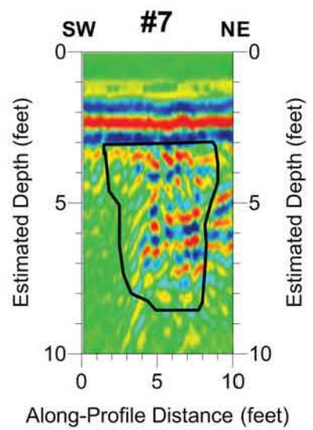


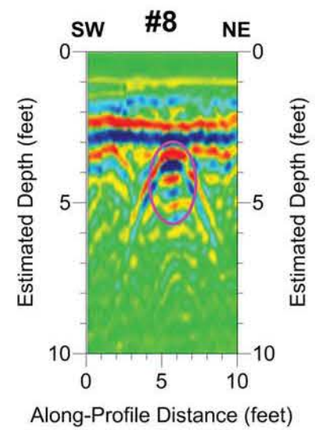


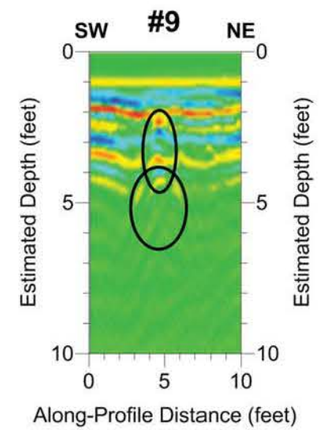
LEGEND

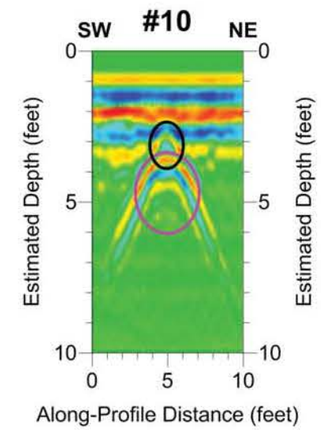
Possible UST/Drum

Possible UST/Drum;
Anomaly Likely Associated with Buried Debris,
Remnant Foundation or Underground Utility









Notes:

1. Refer to Figure 2 for anomaly locations.
2. Each GPR profile centered on "X" corresponding to anomaly location on Figure 2.
3. Data from Sensors & Software, Inc. Noggin PLUS System with 250 MHz antenna.
4. GPR profiles not presented for anomalies designated "No Confidence Anomaly".
5. Anomaly designations in accordance with NCDOT guidelines, dated May 19, 2009.
6. Vertical scale exaggeration for GPR profiles = 2x.

SCALE	DESIGNED BY	DATE	DRAWING TITLE
AS SHOWN	MAB	30MAR11	Ground-Penetrating Radar Profiles Charlotte Pipe and Foundry NCDOT Parcel 31A Charlotte, North Carolina
URS MORRISVILLE, NORTH CAROLINA 27560	DRAWN BY: MAB	DATE: 30MAR11	
	CHECKED BY: CSZ	DATE: 31MAR11	CONTRACT NO.: 31826405
	APPROVED BY: TJK	DATE: 06APR11	DRAWING NO.: FIGURE-3 / REV.: 0