URS

9 April 2011

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NCDOT – Century Center, Bldg B
1020 Birch Ridge Drive
Raleigh, NC 27610

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

Subject: Geophysical Survey Report
Charlotte Pipe and Foundry - Parcel #31
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

According to information provided by NCDOT, Parcel #31 is referenced as Facility I.D. #'s: 0-003806 and 0-013550 and includes the properties at 520, 606, 624, 632 West Summit Avenue and 1336 South Graham Street, Charlotte, North Carolina. These properties are currently owned by Charlotte Pipe and Foundry Company.

The geophysical survey area consisted of approximately 11 acres. Historical information provided by NCDOT indicates that a total of seven USTs were removed from the properties comprising Parcel #31. 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 #31 operated as a tractor trailer drop lot and maintenance and storage area for equipment, raw materials and staged inventory (e.g. pipes, couplings, etc.). Several buildings were also present on-site. Site plans provided by NCDOT indicate that a rail spur formally bisected the current drop lot and that some of the buildings and road layouts throughout the site have changed prior to the geophysical survey. In addition, homes were formerly located along the eastern side of West Summit Avenue, as evidenced by remnants

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of concrete steps and abandoned utility structures (e.g. water meter boxes) along the street. The exact location and number of former homes is not known.

Ground surface conditions across Parcel #31 at the time of the survey included concrete, asphalt, and mowed grass. Metallic surface debris (e.g. metal bindings, nails, etc.) was observed across much of the parcel. The concrete surface within the drop lot does not appear to be reinforced. Numerous obstructions were present at the time of the survey and primarily included trailers parked at the drop lot, raw material storage areas, and staged foundry inventory and equipment.

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. Work performed within the drop lot was conducted during weekend hours due to heavy truck traffic observed between Monday and Friday.

The EM-61 data were collected along parallel profiles spaced approximately 3 feet apart and extending across the accessible portions of Parcel #31. 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 existing buildings and within areas exhibiting uneven terrain. 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 #31.

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 relative wide range of the interpreted background response is warranted due to an apparent elevated background metallic signature related to the following observed conditions:

- metallic surface debris,
- historical documents indicating former rail spur,
- historical documents indicating former layout of structures and roadways,
- observed underground utility structures (e.g. manholes, drop inlets, water meters), and
- observed remnants of structures associated with former houses along West Summit Avenue.

This interpreted elevated metallic signature is evident in the Channel 1 data presented as **Figure 1**. The widespread dark yellow color contours indicate that surface conditions across the majority of the site are characterized by elevated negative EM responses.

The differential response results presented as **Figure 2** further indicate that the elevated negative responses in the Channel 1 data are most likely a result of surface conditions across Parcel #31. 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 30 anomalies indicative of potential USTs or drums were interpreted from the Channel 1 and differential response data and are annotated accordingly on **Figure 2**. One anomaly (#27) was identified during the sweep search with the GEMINI-3. These combined 31 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 #17 is most likely associated with an underground utility and is therefore designated as a "No Confidence" anomaly in accordance with the NCDOT guidelines for identifying and ranking potential USTs. The remaining 30 anomalies are designated as "Possible UST/Drum" in accordance with these guidelines. Representative GPR cross-sections recorded across each of these 30 anomalies are presented as **Figures 3** through **5**.

The relative large number of anomalies considered "Possible Drum/UST" at Parcel #31 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 **Figures 3** through **5** 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 suspected remnant building foundations, the former rail spur, the former houses along West Summit Avenue, and existing surface features. However, it is important to note that the remaining anomalies designated "Possible UST/Drum" in **Figures 3** through **5** 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.

The center lines of suspected subsurface utilities identified in the EM-61 results are depicted with dashed lines on **Figures 1 and 2**. The results of this geophysical survey do not constitute a comprehensive underground utility avoidance survey

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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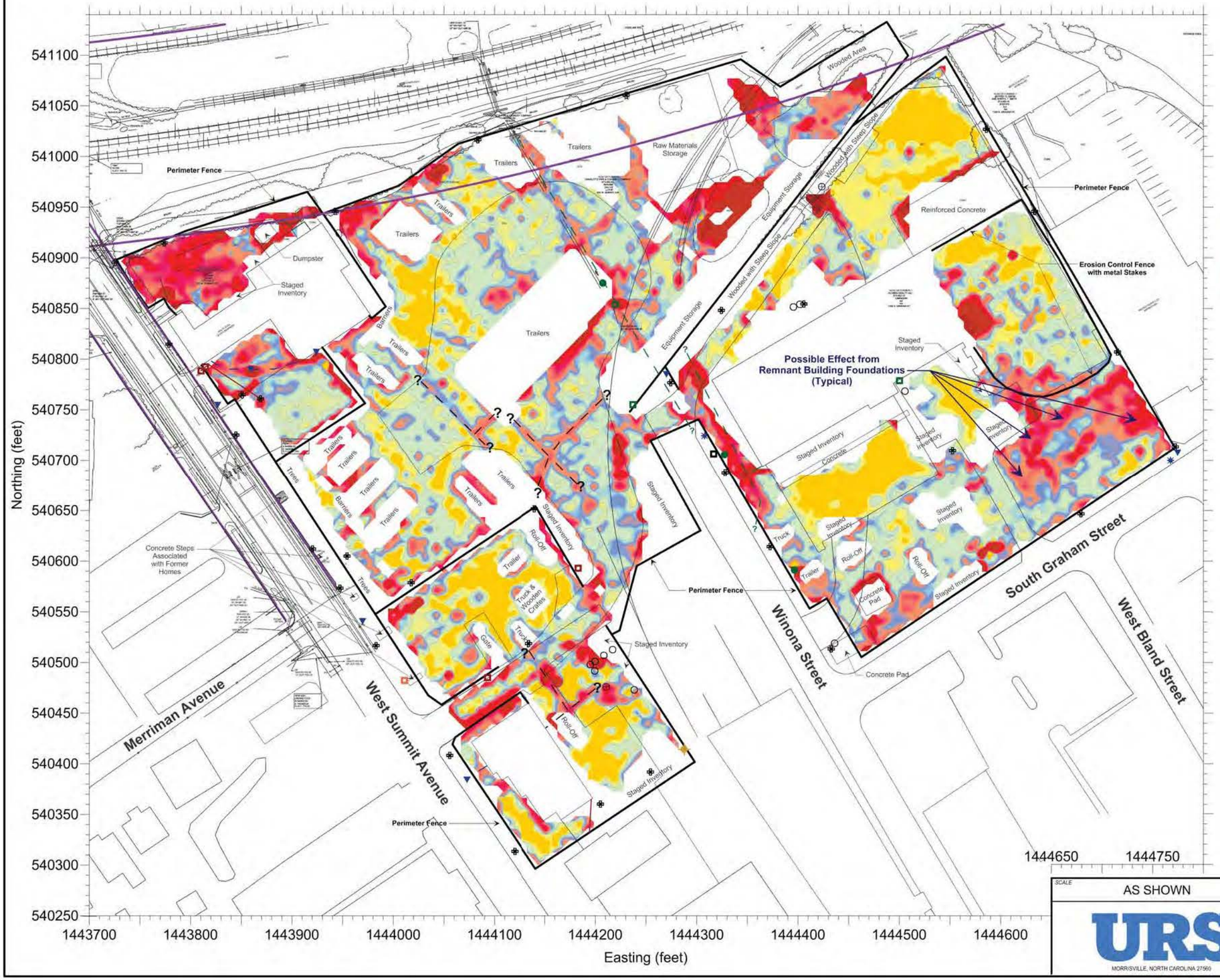
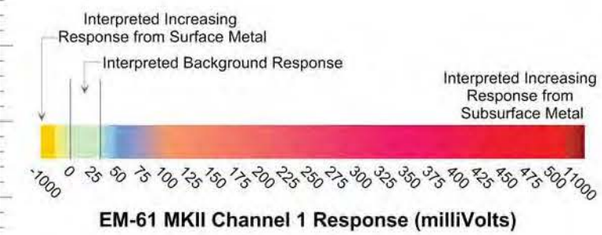
FEET





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.

LEGEND

- ROW
- Unknown Utility
- Light/Power/ Telephone Pole
- Gas Meter
- Gate Control
- Water Meter
- Fire Hydrant
- Monitoring Well
- Sewer Manhole
- Metal Vault
- TeleComm Pull Box
- Drop Inlet/Catch Basin
- Interpreted Water Line
- Interpreted Sewer Line
- Electric Line (Visible Cut)
- ? Utility Termination Not Known
- Metal Pipe (Flush with Ground Surface)

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

PROJECT REFERENCE NO.	SHEET
P-3800	2

GeoEnvironmental

0 50 100 150 200 FEET

Interpreted Increasing Response from Surface Metal

Interpreted Background Response

Interpreted Increasing Response from Subsurface Metal

-400 5 35 65 95 125 155 185 215 245 275 305 335 365 395 425 455 485 3500

EM-61 MKII Differential Response (milliVolts)

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. Anomaly #27 identified during initial sweep search with GEMINI-3 hand-held metal detector.

LEGEND

- ROW
- Unknown Utility (from Figure 1)
- Light/Power/ Telephone Pole
- Gas Meter
- Gate Control
- Water Meter
- Fire Hydrant
- Monitoring Well
- Sewer Manhole
- Metal Vault
- TeleComm Pull Box
- Drop Inlet/Catch Basin
- Interpreted Water Line
- Interpreted Sewer Line
- Electric Line (Visible Cut)
- Utility Termination Not Known
- Metal Pipe (Flush with Ground Surface)
- EM Anomaly Identified for GPR Follow-Up

SCALE	DESIGNED BY	DATE	DRAWING TITLE
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	DRAWN BY: MAB	DATE: 30MAR11	
	CHECKED BY: CSZ	DATE: 31MAR11	CONTRACT NO.: 31826405
	APPROVED BY: TJK	DATE: 06APR11	DRAWING NO.: FIGURE-2 / REV.: 0

URS
MORRISVILLE, NORTH CAROLINA 27560

PROJECT REFERENCE NO.	SHEET
P-3800	3

GeoEnvironmental

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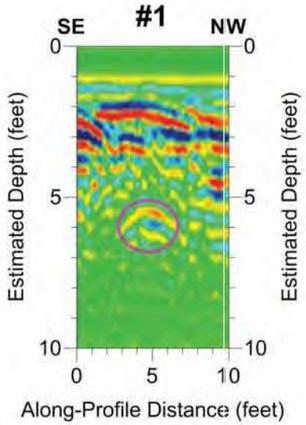
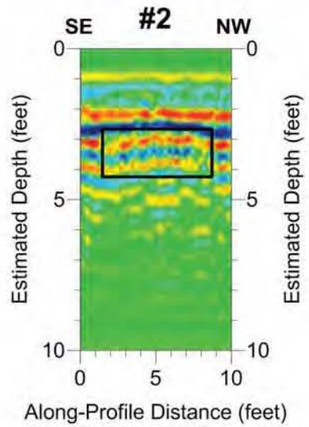
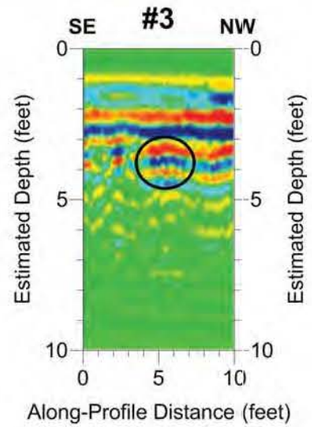
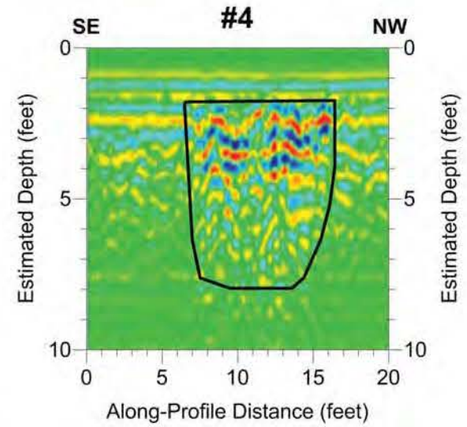




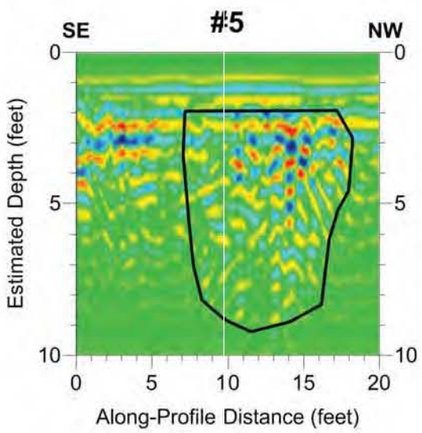


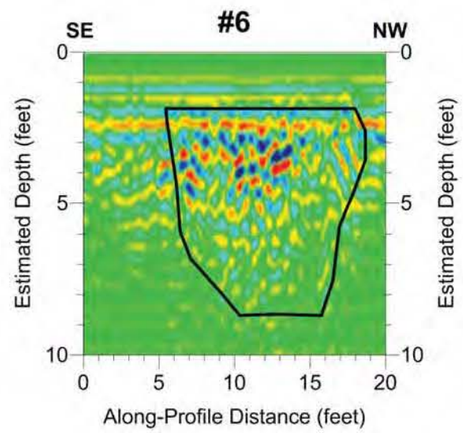


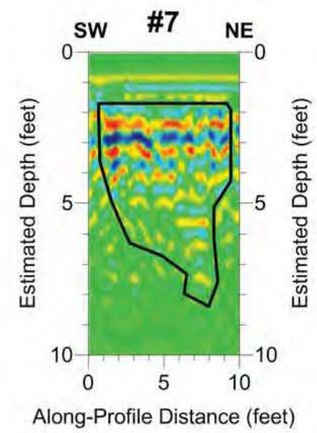
LEGEND

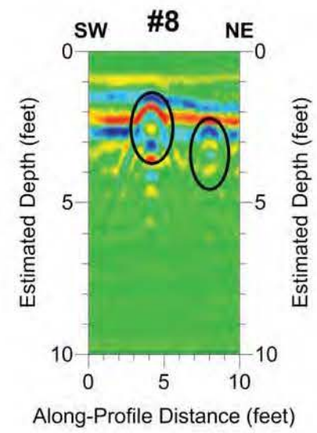
Possible UST/Drum

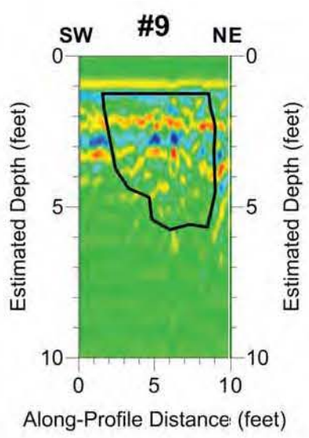
Possible UST/Drum;
Anomaly Likely Associated with Buried Debris,
Remnant Foundation or Underground Utility

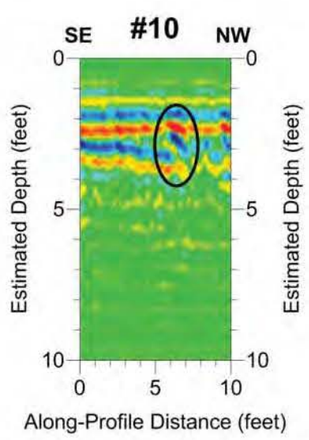


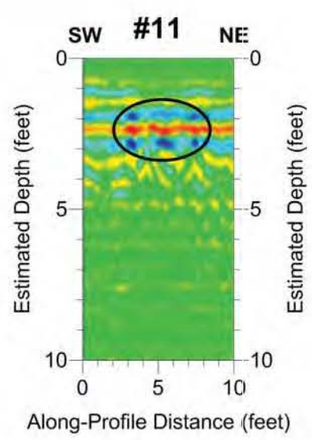












Notes:

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. Anomaly designations in accordance with NCDOT guidelines, dated May 19, 2009.
5. 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 31 Charlotte, North Carolina
URS MORRISVILLE, NORTH CAROLINA 27560	DRAWN BY: MAB	DATE: 31MAR11	
	CHECKED BY: CSZ	DATE: 31MAR11	CONTRACT NO.: 31826405
	APPROVED BY: TJK	DATE: 06APR11	DRAWING NO.: FIGURE-3 / REV.: 0

PROJECT REFERENCE NO.	SHEET
P-3800	4

GeoEnvironmental

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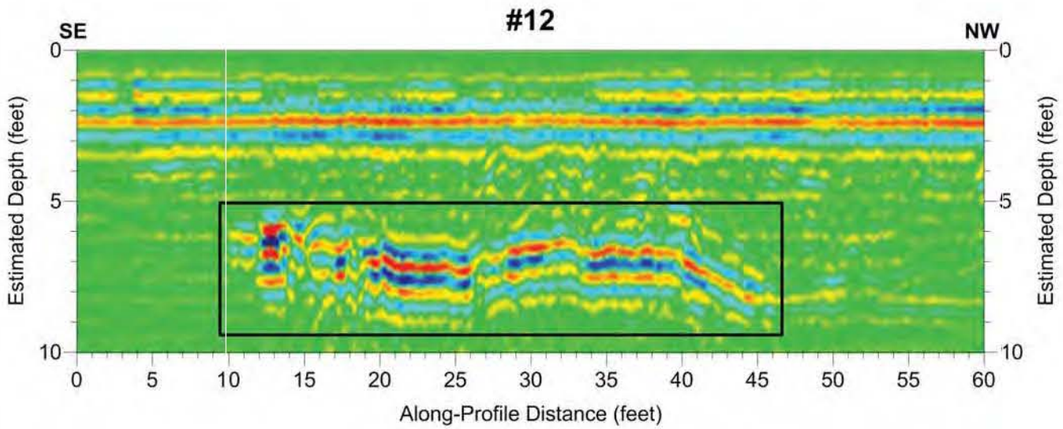
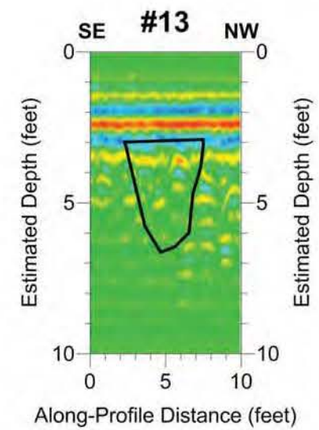
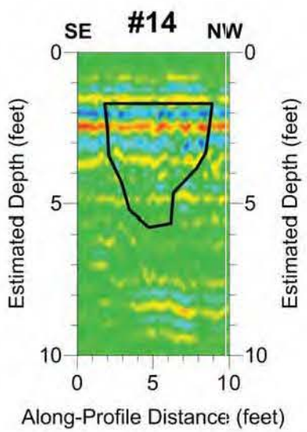
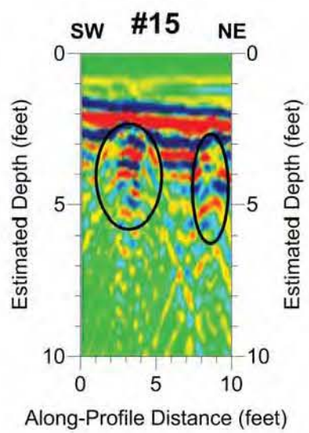


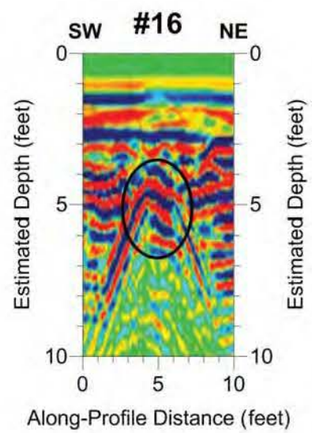


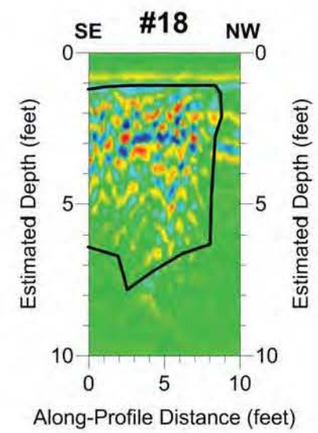
LEGEND

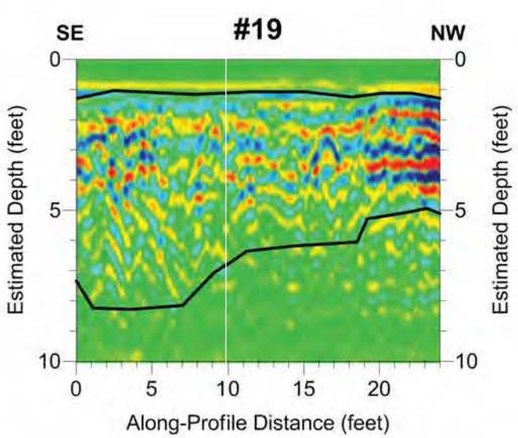
Possible UST/Drum;
Anomaly Likely Associated with Debris, Remnant Foundation or Underground Utility

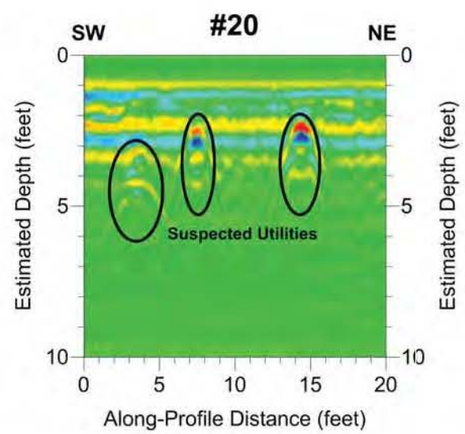


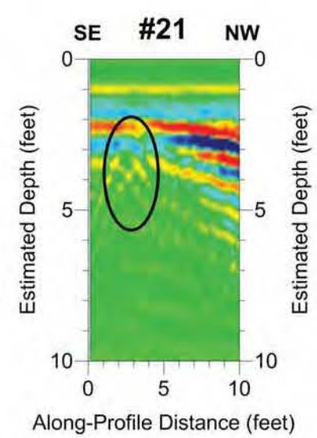












Notes:

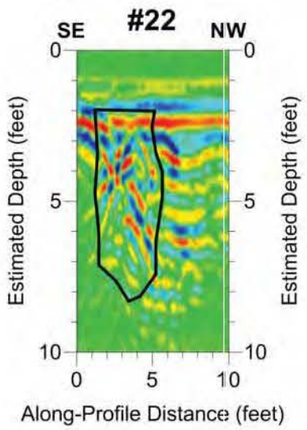
1. Refer to Figure 2 for anomaly locations.
2. Each GPR profile centered on "X" corresponding to anomaly location on Figure 2.
3. Data from Sensors & Software, Inc. Noggin PLUS System with 250 MHz antenna.
4. GPR profiles not presented for anomalies designated "No Confidence Anomaly".
5. Anomaly designations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

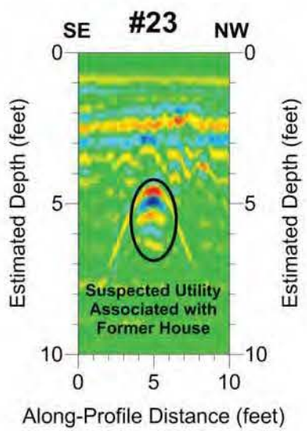
SCALE	DESIGNED BY	DATE	DRAWING TITLE		
AS SHOWN	MAB	30MAR11	Ground-Penetrating Radar Profiles Charlotte Pipe and Foundry NCDOT Parcel 31 Charlotte, North Carolina		
URS MORRISVILLE, NORTH CAROLINA 27560	DRAWN BY MAB	DATE 30MAR11			
	CHECKED BY CSZ	DATE 31MAR11	CONTRACT NO.	DRAWING NO.	REV.
	APPROVED BY TJK	DATE 06APR11	31826405	FIGURE-4	0

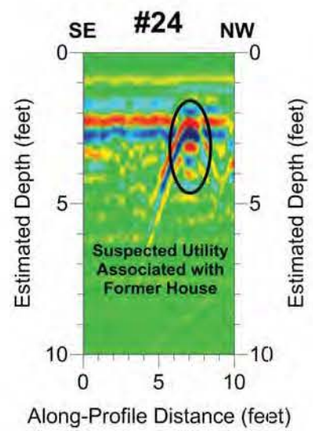
PROJECT REFERENCE NO.	SHEET
P-3800	5

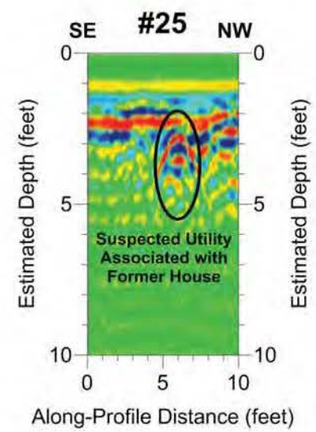
GeoEnvironmental

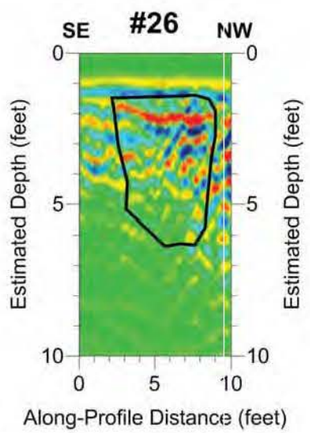
0 10 20
HORIZONTAL SCALE (FEET)

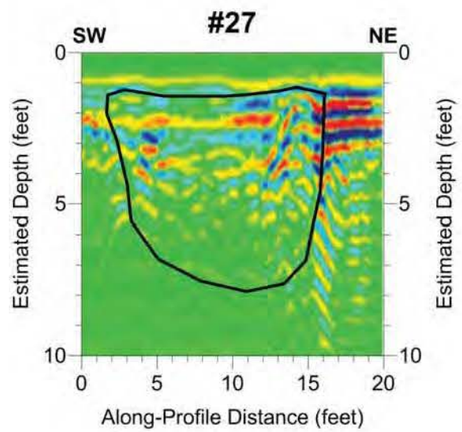


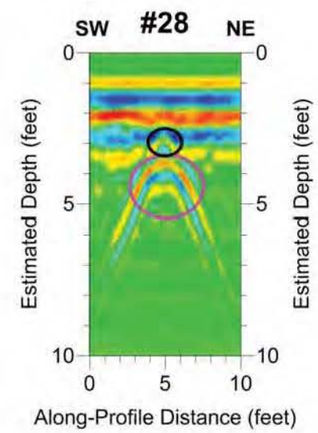


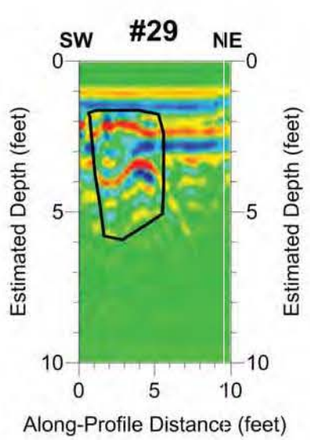


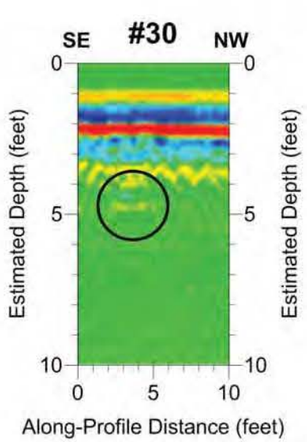


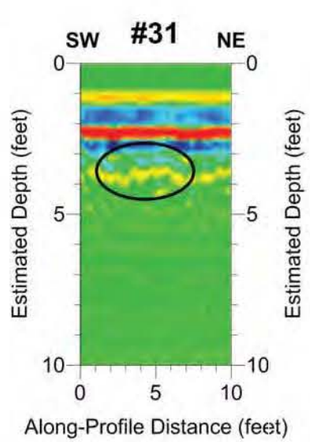












LEGEND

Possible UST/Drum

Possible UST/Drum;
Anomaly Likely Associated with 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. Anomaly designations in accordance with NCDOT guidelines, dated May 19, 2009.
5. 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 31 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-5 / REV.: 0