UST Investigation Report
TIP: U-4020
WBS: 35015.1.1
Betty Elliott Property, Parcel #31
Boone, North Carolina

H&H Job No. ROW-151

August 22, 2008

Hart & Hickman

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August 22, 2008

North Carolina Department of Transportation
Geotechnical Unit
Geoenvironmental Section
1589 Mail Service Center
Raleigh, NC 27699-1589

Attention: Mr. Cyrus Parker, LG and PE

Re: UST Investigation Report
TIP: U-4020
WBS: 35015.1.1
Betty Elliott Property, Parcel #31
Boone, North Carolina
H&H Job No. ROW-151

Dear Cyrus:

1.0 Introduction and Background Information

Hart and Hickman, PC (H&H) has completed underground storage tank (UST) investigation activities at the Betty Elliott property (NC DOT Parcel #31) located at 358 East King Street (US Highway 421) between Hillside Drive and Horn in the West Drive in Boone, Watauga County, North Carolina. This investigation was conducted on behalf of the North Carolina Department of Transportation (NC DOT) in accordance with the scope of work outlined in our June 19, 2008 proposal. A site location map is provided as Figure 1.

H&H previously conducted a Preliminary Site Assessment (PSA) dated May 29, 2008 on Parcel 31. Ground penetrating radar (GPR) work conducted by URS Corporation (URS) during the PSA indicated the presence of a small UST of unspecified size in the proposed DOT right-of-way on the northwestern portion of the property. URS's report including a site map depicting the results of the GPR is included in Appendix A. There was no surface evidence of a UST, and

no soil impacts were detected in samples collected by H&H on each end of the suspected UST. H&H recommended removal of the UST and its contents along with any related impacted soils.

2.0 Potential UST Removal Activities

On July 9, 2008, H&H mobilized to the site to conduct potential UST removal activities. H&H subcontracted with Soil Solutions, Inc. (SSI) of Winston-Salem, North Carolina to conduct the UST removal. The asphalt surface above the suspected UST was carefully broken using a backhoe. Excavated soil was stockpiled adjacent to the excavation pit. The excavation area had approximate dimensions of 19 ft by 7 ft and 9 ft deep. During excavation activities, no UST was encountered, however; several pieces of cast iron were found buried approximately 3 feet below ground surface throughout the area. In addition, an inactive municipal water meter was encountered approximately 1 ft below ground surface in the excavation area. Based on subsequent conversations with URS, the cast iron and water meter found in the excavation likely caused the GPR data to be misinterpreted as a potential UST. The excavation area is shown on Figure 2.

During excavation activities, soils from the sidewalls and base of the excavation were field screened for potential impacts using a photoionization detector (PID). Based on field screening, no impacted soils were encountered during the excavation. In addition, H&H did not observe any visual staining or petroleum odors. Because there was no evidence of a UST and no suspected soil impacts, post-excavation soil samples were not collected for laboratory analysis.

Since no impacted soil was encountered, the area was backfilled with the soil that was removed from the excavation. The backfill was covered with approximately 12 inches of compacted gravel. Due to heavy rains during backfilling, the soil and gravel could not be properly compacted on July 9, 2008. SSI returned to the site on July 14, 2008 and removed rain soaked soils to a depth of five feet. These clean soils were removed from the site. The area was

backfilled with crushed stone and compacted at several intervals to existing grade using the backhoe. Asphalt was hauled offsite for proper disposal.

3.0 Conclusions

No UST was encountered during excavation activities conducted at the Betty Elliott property (NC DOT Parcel #31). Pieces of cast iron and an inactive municipal water meter found buried in the upper portion of the excavation likely caused GPR data to be misinterpreted as a potential UST. Upon completion of excavation activities, the excavation area was backfilled with the removed soil and capped with crushed stone. Based on the results of excavation activities, no UST or impacted soil will be encountered in this area of the Betty Elliott property during proposed NC DOT road work.

Please contact me if you have any questions or comments.

Very truly yours,

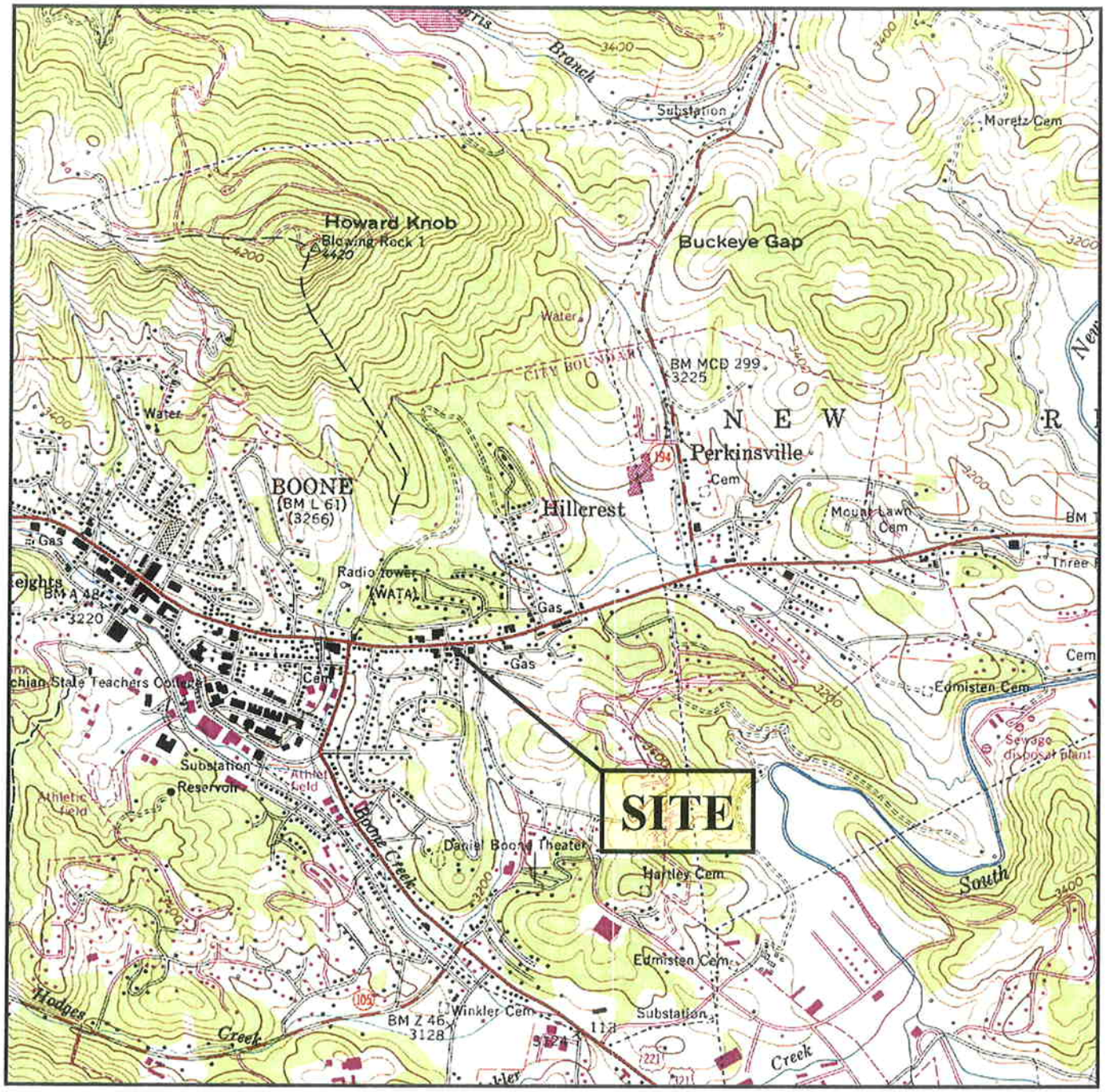
Hart & Hickman, PC

David Graham
Project Geologist

Matt Bramblett, PE
Principal and Project Manager

DBG/MVB

Attachments



N

APPROXIMATE

0 2000 4000

SCALE IN FEET

U.S.G.S. QUADRANGLE MAP

BOONE, NC 1959
PHOTOREVISED 1978

QUADRANGLE
7.5 MINUTE SERIES (TOPOGRAPHIC)

TITLE	SITE LOCATION MAP
PROJECT	BETTY ELLIOTT PROPERTY PARCEL #31 BOONE, NORTH CAROLINA

Hart & Hickman
A PROFESSIONAL CORPORATION
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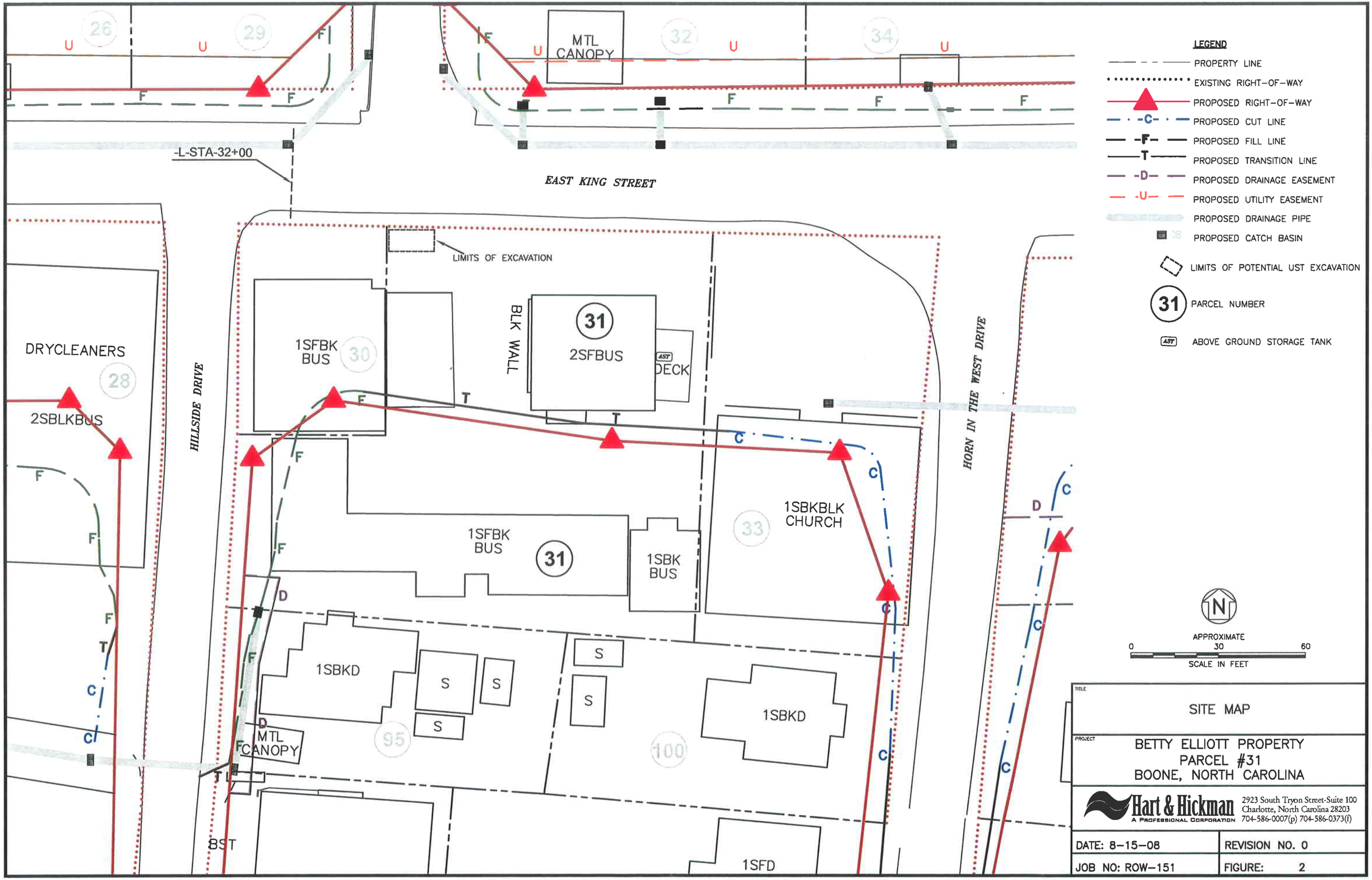
DATE:	4-28-08	REVISION NO:	0
JOB NO:	ROW-148	FIGURE NO:	1



TITLE: SITE MAP

PROJECT: BETTY ELLIOTT PROPERTY
PARCEL #31
BOONE, NORTH CAROLINA

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DATE: 8-15-08	REVISION NO. 0
JOB NO: ROW-151	FIGURE: 2

Appendix A

URS Geophysical Investigation Report

URS

March 31, 2008

Mr. Matt Bramblett, P.E.
Hart & Hickman
2923 South Tryon Street
Suite 100
Charlotte, North Carolina 28203

Subject: **Geophysical Investigation Report and UST Delineation**
NCDOT State Project U-4020, Watauga County
Parcels #30, 31, 33, 35, 37, 38
Boone, North Carolina
URS Project No. 31825704

Dear Mr. Bramblett:

In accordance with our technical and cost proposal (TCP) submitted to North Carolina Department of Transportation (NCDOT) on March 7, 2008, URS Corporation (URS) is pleased to present the findings of the geophysical investigation conducted as part of NCDOT State Project U-4020, Watagua County, WBS Element 35015.1.1. The objective of the investigation was to locate underground storage tanks (USTs) within the NCDOT right-of-way and construction easements along US 421/King Street in Boone, North Carolina. The geophysical investigation was conducted in advance of proposed widening of US 421/King Street and will be used to assist with the Preliminary Site Assessment (PSA) of individual parcels within the right-of-way and easement.

Site Description

The geophysical investigation was conducted for Hart & Hickman at Parcels #30, 31, 33, 35, 37, and 38. According to the Request for Proposal (RFP) issued by NCDOT, dated February 20, 2008, Parcels #30, 33, and 35 are expected to be total takes. Therefore, all accessible portions of these parcels were surveyed for this investigation. For Parcels #31, 37, and 38, the right-of-way and construction easements were surveyed for this investigation. These limits had been physically marked in the field by others prior to conducting the geophysical investigation. None of these parcels were abandoned at the time of the geophysical investigation. The majority of the survey areas consisted of asphalt driveways or parking lots.

Survey Methods

The geophysical investigation was conducted using primarily the electromagnetic (EM) method. The Geonics, Ltd. EM-61 MKII (EM-61) instrument was used to perform the investigation. Ground-penetrating radar (GPR) was used as a follow-up technique to the

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EM-61 survey. The GPR survey was completed using a Sensors & Software, Inc. Noggin PLUS Smart Cart System with a 250 MHz scanning antenna.

Electromagnetic Surveying with the EM-61 MKII (EM-61)

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 response amplitude for a given buried metallic object is primarily a function of burial depth and size of the object. It is thus useful to have some means of interpreting the depth of a given object. The EM-61 uses a two receiver coil system consisting of a top coil and a bottom coil. This design facilitates the recognition of near-surface objects from deeper targets. The EM-61 record includes the response from the top coil, the bottom coil and the differential response between the two coils. Near surface objects, such as small pieces of scrap metal, can mask the response from larger objects, such as utility lines, drums or underground storage tanks, at deeper depths. The two-coil design of the EM-61, and differential processing, allows for this masking effect to be significantly reduced. Although the EM-61 is designed to mitigate interference from surface features, large metallic objects at the surface, such as cars, buildings, and fences can effectively saturate the EM response and mask potential buried metal objects below.

Ground Penetrating Radar (GPR)

The GPR method involves transmitting relatively high-frequency electromagnetic pulses into the subsurface using a transducer antenna, and recording the subsequent signal from reflected and refracted electromagnetic energy using a receiving antenna. The electromagnetic pulses, or radar waves are influenced by many factors in the subsurface, the most important being the dielectric constant of the soil. The dielectric constant is the ratio of the speed of light in a vacuum (0.3m/ns) to the velocity of the GPR wave, quantity squared. Therefore, changes in dielectric constant correspond to changes in electromagnetic wave propagation velocity. When the wavelength is short compared to the thickness of soil layers, which is generally

true, electromagnetic waves are reflected at the interfaces of dielectric contrast in accordance with the principles of optics.

GPR is useful in mapping and locating subsurface features and stratigraphy under a variety of conditions. The method is useful in many types of geologic, environmental, and engineering applications including: locating and mapping buried waste materials; locating and delineating metallic and nonmetallic utilities, pipes, underground storage tanks and drums; mapping geological strata, fractures, and voids; and delineating and mapping previously excavated and backfilled areas.

The effectiveness of GPR surveying at a given site is directly related to the dielectric properties of the subsurface materials. The effective depth of exploration provided by the method can be limited by subsurface materials characterized with high conductivity and dielectric constants, including clay, metal and metallic minerals, or reinforced pavement, all of which absorb radar energy instead of reflecting waves back to the surface receiver. In general, the depth of investigation at a given site is inversely proportional to frequency and the degree of feature resolution is proportional to frequency. Irregular and/or rough terrain can negatively impact the quality of GPR data.

Field Investigation

The field investigation was conducted between March 18 and 22, 2008. EM-61 data were collected along parallel profiles spaced approximately 3 feet apart across the portions of the survey areas that were accessible with the EM-61. Inaccessible areas included portions of the parcels containing parked cars, dumpsters, and landscaping features. EM-61 data were recorded at a rate of 5 readings per second, which equates to an along-profile data point spacing of less than 1 foot.

A Trimble ProXRS global positioning system (GPS) was used to record simultaneous positional data coincident with the EM-61 data. The ProXRS system provides real-time differential corrections via an Omnistar subscription service. The acquired differential GPS (DGPS) have a horizontal accuracy of approximately 3 feet. URS also used the GPS system to record the locations of relevant site features.

Prior to conducting the GPR investigation, URS performed preliminary in-field analysis of the EM-61 data to identify anomalies potentially indicative of USTs. GPR follow-up was conducted at individual point target locations identified in the EM-61 data or within the sections of the parcels that could not be accessed using the EM-61. Because GPR was used as a follow-up technique, no data sets were post-processed for purposes of this investigation.

Data Processing

The EM-61 data were pre-processed using the program DAT61 MK2, issued by Geonics Ltd. The program was used primarily to prepare the data for contouring in Surfer, issued by Golden Software. Contoured data represent EM-61 Channel 3 response data. Channel 3 data include milliVolt readings recorded at a relatively later time interval during the measured response from the secondary EM field. Thus, this channel generally records secondary field responses from depths consistent with USTs. Interference from surface or near-surface features (e.g. reinforced concrete, buried catch basin, etc.) will also be recorded by this channel, which is why the GPR follow-up survey was conducted over EM-61 anomalies that could not be readily attributed to existing site features.

Investigation Results

The results of the geophysical investigation for Parcels #30, 31, and 33 are presented as **Figure 1**. The results for Parcel #35 are presented as **Figures 2 and 3**. The results for Parcels #37 and 38 are presented as **Figures 4 and 5,** respectively.

Responses from metallic objects are represented by color-shaded contours outside the interpreted background response range. Relatively strong responses (i.e. yellow to dark red contours) generally indicate buried objects of significant metal mass or surface or near-surface features (e.g. reinforced concrete pad). Relatively muted responses (i.e. dark blue contours) generally indicate decreased metal mass or metallic objects potentially buried to greater depths. Sources of known or suspected metallic interference are identified accordingly in **Figures 1 through 5**. Anomalies consistent with EM-61 response patterns for USTs are identified in **Figures 1 through 5** with either green or magenta ellipses. These anomalies were subsequently targeted for GPR follow-up surveying.

The EM-61 anomaly annotated with the green ellipse in **Figure 1** indicates a potential UST as indicated by both the EM-61 and GPR surveys. GPR surveying across this anomaly revealed parabolic-shaped reflection patterns that are consistent with USTs. The EM-61 anomalies annotated with magenta ellipses in **Figures 1, 4, and 5** indicate that the GPR follow-up survey did not reveal the characteristic parabolic-shaped reflection patterns typically associated with USTs. However, it should be noted that USTs that may no longer be intact may not exhibit characteristic GPR reflection patterns. Therefore, intrusive investigations of the EM-61 anomalies annotated with magenta ellipses in **Figures 1, 4, and 5** may be warranted if it is necessary for completion of the PSA to have confirmation of the identity of these anomalies.

A single UST appears to be buried along the southern edge of the building situated at Parcel #35. The EM-61 results in **Figure 2** indicate high-amplitude responses consistent with the presence of a UST. Follow-up GPR surveying also revealed the presence of parabolic-shaped reflection patterns associated with USTs. A fill port is situated within the center of the geophysical anomaly. The GPR antenna was used to identify the perimeter of the UST.

Figure 3 presents a photo of the field markings that indicate the interpreted UST perimeter at Parcel #35.

In general, sections of the parcels that are represented by the interpreted background range of colors in the EM-61 results appear to be free of buried metal to depths within the survey capabilities of the instrument. The results presented in **Figures 1 through 5** do not constitute an underground utility avoidance survey and therefore should be used in conjunction with proper utility marking protocol prior to beginning any intrusive work at these parcels.

Limitations

This geophysical investigation 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 greatly appreciate the opportunity to work with you on this project. We will transmit AutoCAD files (.DXF type) of the geophysical results in a separate submittal. Please contact Matt Barner at (704) 716-0737 if you have any questions regarding this report.

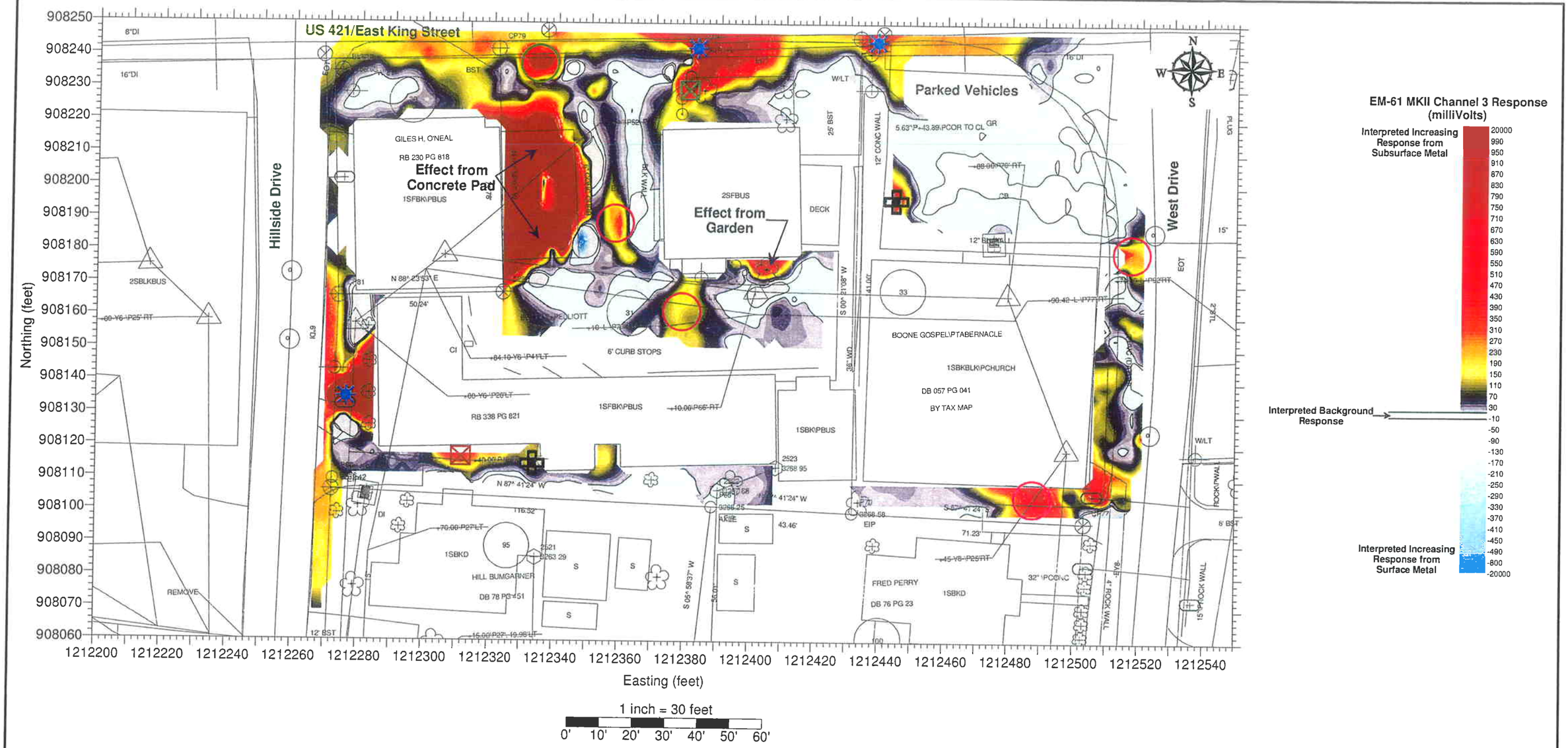
Very truly yours,

URS Corporation – North Carolina

Matthew A. Barner	Timothy J. King	Walt Plekan, L.G.
Senior Geophysicist	Principal Geophysicist	Project Manager

Enc.: Figure 1 – Geophysical Investigation Results, Parcels #30, 31, 33
Figure 2 – Geophysical Investigation Results, Parcel #35
Figure 3 – Site Photograph, Parcel #35
Figure 4 – Geophysical Investigation Results, Parcel #37
Figure 5 – Geophysical Investigation Results, Parcel #38

1c: Vernon Keys, URS, Raleigh
File 3182 5704 – 4.2



1 inch = 30 feet

0' 10' 20' 30' 40' 50' 60'

EM-61 MKII Channel 3 Response (milliVolts)

Interpreted Increasing Response from Subsurface Metal

20000 990 950 910 870 830 790 750 710 670 630 590 550 510 470 430 390 350 310 270 230 190 150 110 70 30

Interpreted Background Response

-10 -50 -90 -130 -170 -210 -250 -290 -330 -370 -410 -450 -490 -800 -20000

Interpreted Increasing Response from Surface Metal

Legend

- EM-61 Anomaly Surveyed with GPR Follow-Up (Both Surveys Indicate Potential UST)
- EM-61 Anomaly Surveyed with GPR Follow-Up (GPR Does not Indicate Potential UST)
- AST
- Utility Feature
- Flower Bed
- Electrical Box

Notes:

1. Coordinates in NC State Plane, NAD-83 datum.
2. Data from Geonics, Ltd. EM-61 MKII instrument.
3. Base drawing from U-4020 contract drawings provided by NCDOT.
4. EM-61 location control and additional site features from DGPS survey by URS Corporation.

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Geophysical Investigation Results
Parcels #30, 31, 33

NCDOT State Project U-4020, Watauga County

Boone, North Carolina

DESIGNED BY		DRAWN BY		CHECKED BY		JOB NUMBER	Figure
MAB	03/27/08	MAB	03/27/08	SJH	03/28/08	31825704	1