Adirondack Regional Business Incubator Site
36 Elm Street
City of Glens Falls, New York

Environmental Restoration Project

Appendix A - O

Site Investigation Report

New York State Assistance Contract No. C303163
ERP Project No. E557019

May 2008

Prepared For:

Greater Glens Falls Local Development Corporation
42 Ridge Street
Glens Falls, New York 12801

Attn: Mr. Thomas Donohue
Tel: (518) 761-3883

Barton & Loguidice, P.C.
Engineers · Environmental Scientists · Planners · Landscape Architects

2 Corporate Plaza
264 Washington Avenue Extension
Albany, New York 12203

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Engineers, Environmental Scientists, Planners, Landscape Architects
2 Corporate Plaza
264 Washington Avenue Extension
Albany, New York 12203

Attn: Mr. Stephen Le Fevre, P.G.
Tel: (518) 218-1801

Appendix B

Geophysical Report
(Radar Solutions International)

RSI Geophysics for the 21st Century
Radar Solutions International™

September 13, 2006

Mr. Stephen LeFevre, P.G., C.P.G.
Managing Geologist
Barton and Loguidice, P.C.
2 Corporate Plaza
264 Washington Avenue Extention
Albany, New York 12203

Re: GPR and EM-61 Surveys for USTs
36 Elm Street, Glens Falls, NY
Project No. 1032.001

Dear Stephen:

In accordance with your authorization, Radar Solutions International (RSI) conducted ground penetrating radar (GPR) surveys at the above-referenced site on August 10, 2006. The purpose of the geophysical surveys was to locate abandoned underground storage tanks (USTs) in two areas adjacent to and between two buildings . The surveys were by RSI's Sr. Geophysicist, Mr. Mark Kick, and was assisted by Barton and Loguidice personnel. RSI's survey results and interpretations are summarized below.

LOCATION AND SURVEY CONTROL

The project is located at 36 Elm Street, in the Town of Glens Falls, New York. RSI and Barton and Loguidice personnel established a geophysical grid within each area. The approximately 90 by 20 foot area of investigation, located north of the buildings and inclusive of the reinforced concrete sidewalk, is referred to as Area 1. Area 2 is an approximately 150 by 15 foot area situated in between the two buildings. In Area 1, grid coordinate 0E and 139N corresponds to the northwest corner of the eastern most building. In Area 2, RSI's geophysical grid was referenced to the southwest corner of the OTB Building, where 0N and 0E represents the building's corner. Both survey areas share the same easting and northing coordinates, although all coordinates referenced west of the west edge of the site and OTB buildings are referenced to the west instead of the east.

METHODOLOGY

In this particular region of New York, GPR signal penetration and resolution is limited by conductive soil and by road salt. To better refine our GPR data interpretation, RSI used a GEONICS Model EM-61 induction meter, which is essentially a highly-sensitive metal detector.

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The EM-61 is used to detect any type of metal while minimizing the effects of overhead power lines and above-ground metal objects.

The EM method works by inducing an EM current into the ground and measuring the induced EM field, measured in millivolts (mV) at a specific time after the transmitted signal is switched off. The greater the amount of buried metal, the larger the measured induced response. Data were collected at 0.5 second intervals and field markers applied every 5 feet along survey lines spaced 2.5 to 5 feet apart. EM data were recorded on a portable field computer then transferred to desktop computer and contoured (i.e. data with similar values were shaded similarly to bring out patterns of high voltages indicative of buried or near-surface metal). EM-61 results are presented on Figures 1 and 3. For this survey, orange to red and pink-filled contours indicate a large mass of buried metal. The greater the metal mass, the higher (and the closer to magenta and pink) the recorded induced voltages. "Background" inductive values are shown in green or cyan-filled contours. Dark blue to blue-filled contours typically indicate surface metal, such as a sign or light post, or at-grade metal, such as scrap metal or a gate box. Appendix A describes the EM induction method in more detail.

The GPR method of investigation operates on the principal that materials of differing dielectric (i.e. electrical and conductive) properties cause high-frequency EM energy to be reflected. The amplitude of reflection and the characteristic shape of the reflector indicates the approximate location and size of the buried target. Buried metal objects typically produce the highest-amplitude reflection, while those targets with similar electrical characteristics as the surrounding soil, such as from a boulder, would produce weaker reflections.

RSI personnel used a GSSI SIR-2000 digital radar system and a 400 MHz antenna to collect GPR data along lines spaced 2.5 to 5 feet apart. GPR lines were oriented parallel and perpendicular to existing buildings. Data were recorded on the SIR-2000 and simultaneously displayed on the computer's monitor for immediate field inspection. Data were extensively filtered to remove noise caused by the conductive soil and fill and then transferred to desktop computer and processed using GSSI's proprietary radar processing package, RADAN NT. Each GPR record was inspected for reflections characteristic of a UST or other large object. Figures 2 and 3 present GPR results.

GPR data were manually inspected to observe the characteristic shape and amplitude of reflection from the target, which can be diagnostic in identifying a target. Several different types of reflections have been characterized on the GPR figures from each site. Large, high-amplitude GPR reflectors are shown as color-filled rectangles on the accompanying GPR figures. Each color corresponds to the depth (in meters) of the observed target. Those large GPR reflectors that appear hyperbolic on the GPR record may indicate a UST, large diameter utility, boulder, or multiple closely-spaced utilities. The hyperbolic shape is produced when the radar antenna is moved across a target at a 90-degree (or near 90-degree) angle. The same target, if it represents a UST, would have flattish reflectors when the antenna is moved parallel to the long axis.

Rectangles filled with a blue cross-hatched pattern represent an area that has previously been excavated. Small hyperbolic reflectors of high to moderate reflection amplitude are denoted on GPR figures by a single color-filled circle. Again, the color corresponds to the observed depth (in meters) of the target. These types of reflectors are typically caused by a buried utility, but can also be attributed to a metal scrap or cobble. Appendix B describes the GPR method of investigation in more detail.

RESULTS

GPR signal penetrated to a maximum depth of 5 feet below grade due to conductive soil conditions. In some areas, even less signal penetration was observed. Figures 1 through 3 summarize geophysical results for this project. Interpreted results are presented at a scale of 1 inch = 20 feet, and have been superimposed a sketch map based on RSI's field notes. Key results are summarized below.

- Figure 1 shows contoured EM-61 results. Large concentrations of buried metal are evident north of the site building, between 145N and 150N, from 10E to 30E. The size of the anomaly suggests that the buried metal could represent a UST. GPR data, shown on Figure 2, revealed several large hyperbolic-shaped reflections consistent with that of a UST. These large GPR reflectors were observed along Lines 20E to 32E, and from 142.5N to 148N at an approximate 1.5 to 2 foot depth, and likely represent a UST with an approximate 1,000 gallon capacity.

- On the contoured EM-61 map, a smaller EM anomaly indicating buried metal was observed in the alley between the site building and the Labor-Ready Building near 30N and 0E to 2.5E. A fill-like pipe was observed near 31N and 2W, coincident with the anomaly. However, no GPR target was observed coincident with it. The size of the anomaly would suggest that the target is more likely to represent a small waste-oil tank, on the order of 55 gallons to possibly 275 gallons.

- Figure 2 shows other large GPR targets, especially within the alley. However, we attribute these to multiple closely spaced utilities, and not to a UST. Smaller GPR reflectors are also likely to represent buried utilities and/or cobbles or metal scrap within the fill.

SUMMARY AND RECOMMENDATIONS

One UST may be present near 144N and 25E at an approximate 1.5 to 2 foot depth. The size of the GPR anomaly indicates that the possible UST may have a 1,000 gallon capacity. A second EM anomaly coincident with what appeared to be a possible fill pipe indicates that there could be buried metal within the alley, near 31N from 0W to 3W. No GPR reflector was observed coincident with the anomaly. The size of the EM anomaly suggests that if the buried metal represents a UST, it likely represents a small (55 to 275 gallon) capacity UST.

****

We appreciate this opportunity to work with Barton and Loguidice, P.C. again. Please call should you have any inquiries regarding this or future assignments.

Sincerely,
RADAR SOLUTIONS INTERNATIONAL

Doria L. Kutrubes

Doria Kutrubes
President and Senior Geophysicist

APPENDIX A

EM-61 METHOD OF INVESTIGATION

Manufactured by Geonics, Inc., the EM-61 is a time-domain electromagnetic instrument developed to find unexploded ordinances (UXOs) and other buried metal targets in environments where there may be a lot of interference from surface metal and overhead power lines. According to tests conducted by the manufacturer and reports from other geophysical service providers, the EM-61 is has a sensitivity sufficient to detect metal objects as small as a few centimeters.

The EM-61 operates on the principle that the time-decay rate (i.e. transient pulse) of a signal induced in metal decays proportionally to the mass of the metal object. The EM-61 works by generating an EM signal of known frequency and voltage at the transmitter, located in the backpack configuration. In the presence of metal objects, an EM signal is induced when the transmitted signal is applied. When the transmitter is switched off, the induced field decays at a rate specific to the metal mass in which it is induced. The EM-61 top and bottom receiver coils measure the decay voltage at a specific time (i.e. "time gate") after the transmit pulse has been shut off. The amplitude of the voltage after the transmit pulse has been shut off is proportional to the size of the metal object: the larger the voltage (as measured in millivolts) at the time of the measurement, the larger the metal object. High voltages indicate metal objects. Negative voltages can also indicate both above-ground and buried metal.

The EM-61 operates by pulling or pushing the instrumentation along survey lines that were spaced 1 meter apart for this survey. Data can be collected using an encoder or "DMI" - distance measurement instrument, which is built into the EM-61's left wheel, or manually. The station spacing varies, depending upon the application. For this survey, data were collected using the DMI with a station spacing of 10 feet.

Four different data sets are generated from the two measurements made at top and bottom receiver coils: bottom, top, differential, and noise. Data obtained from the bottom receiver coil is considered to be most representative of buried and above-ground metal. Information from the top receiver coil is used with bottom coil measurements to calculate the differential data, which result from subtracting top coil measurements from bottom. Differential measurements help determine whether the source is from the above or below ground sources. Differential data are used to can also minimize the response from at or very near surface (i.e. 1 cm deep or less) metal. Positive voltages in the differential contour map shown in red, magenta, and pink, indicate buried metal. Blue or black filled contours indicate above-ground sources of metal. The "noise" calculations represent the bottom coil data that has been filtered to reduce the noise from spurious EM interference from overhead power lines, etc.

SURVEY LIMITATIONS

While differential and noise measurements help reduce EM noise from adjacent power lines, cell phone and radio towers, etc., the may not eliminate them completely. Therefore, in urban environments, data may appear noisy and not have a lot of continuity.

For maximum sensitivity, the EM-61 meter should be calibrated in an area free of buried metal and overhead power lines. Because the survey area had significant sources of cultural noise, the EM-61 instrument was not calibrated on site.

APPENDIX B
GROUND PENETRATING RADAR METHOD OF INVESTIGATION

GPR data were acquired using a GSSI SIR-3000 digital radar system and a 400 MHz antenna. GPR lines were originally spaced 5 feet apart, however additional lines were added to increase coverage. Data were recorded on the SIR-2000 and simultaneously displayed on the computer's monitor for immediate field inspection. Data were then transferred to desktop computer and processed using GSSI's proprietary radar processing package, RADAN NT. The horizontal scale on each GPR record is determined by the antenna speed. Survey stations are recorded on GPR records by pressing a marker button as the antenna's centerline passes each grid node (at 10 foot intervals for this survey). The vertical scale of these radar "cross-sections" is determined by the recording interval, which was 60 nanoseconds (ns) using the 400 MHZ antenna. The recording interval represents the maximum two-way travel time in which data is recorded. This recording interval was selected to be greater than the anticipated maximum two-way travel time during which real GPR reflections might be observed. GPR travel times were converted to depths using an approximate dielectric constant determined from "typical" soil propagation velocities from similar sites.

The GPR method operates by transmitting low-powered microwave energy into the ground. The GPR signal is reflected back to the antenna by materials with contrasting electrical (dielectric and conductive) and physical properties. Metal objects, such as USTs and pipes, typically produce high-amplitude hyperbolic reflections on the GPR records. Sometimes concrete blocks, bricks, and cobbles cause similar signatures on the radar record.

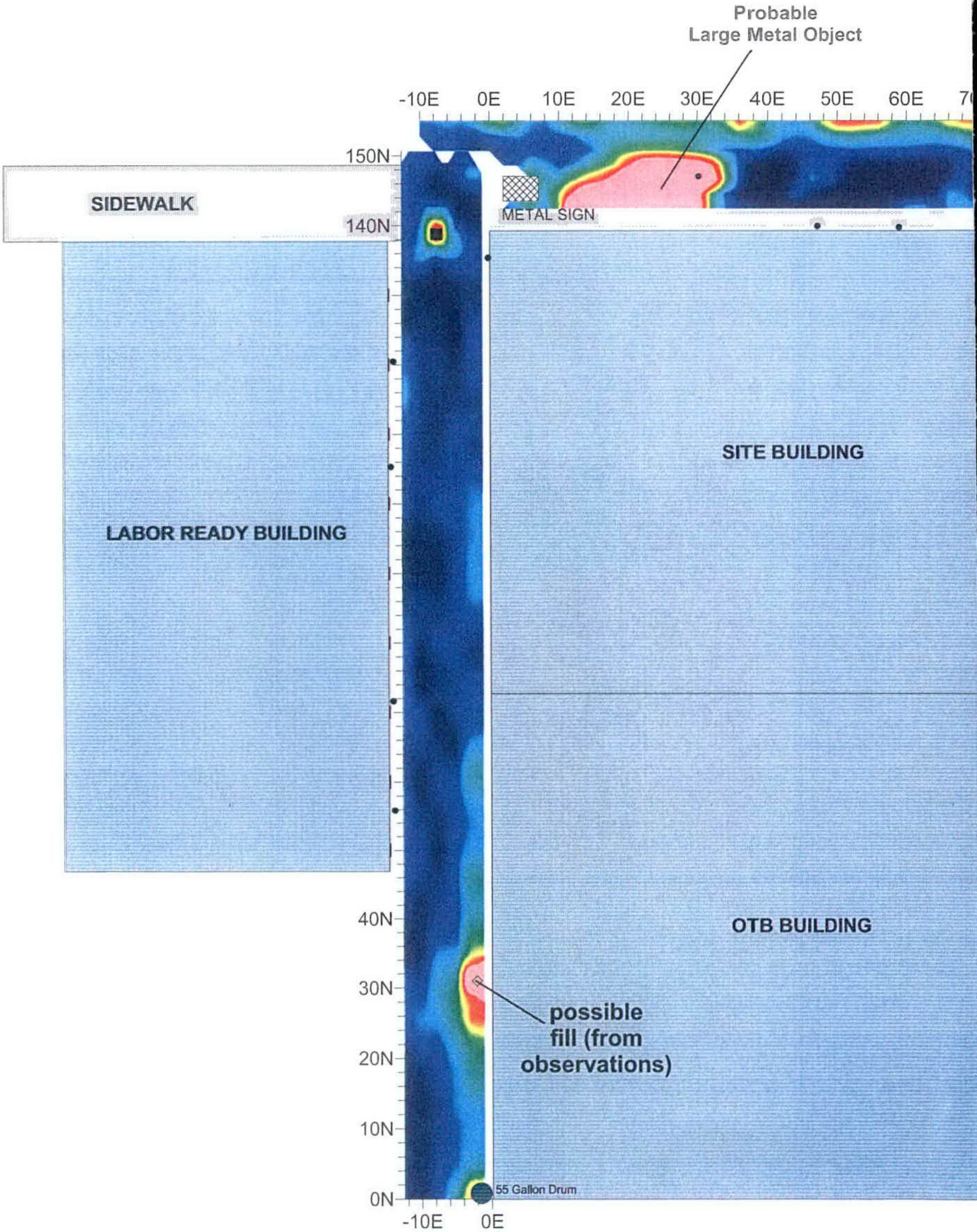
SURVEY LIMITATIONS

GPR signals propagate well in sand and gravel. Conditions such as clay, ash, road salt, and fill saturated with brackish or otherwise conductive groundwater, cause GPR signal attenuation and loss of target resolution (i.e. limited detection of small objects). Typically, when background conductivity measurements exceed 30 millimhos per meter (mmhos/m), GPR signal penetration is limited to 1.0 to 1.5 meters. Reinforced concrete also causes limited GPR penetration and resolution. Signal penetration under these conditions is quite variable, ranging from about 3 to 4 feet, depending upon the type and spacing of metal reinforcing.

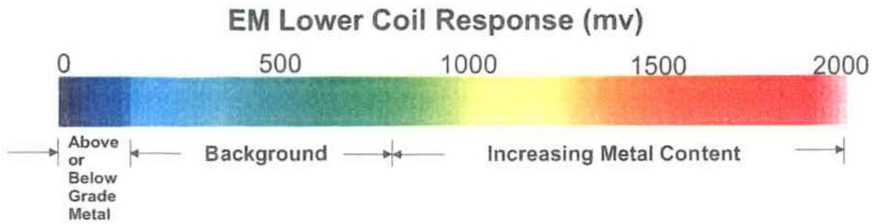
GPR is an interpretive method, based on the subjective identification of reflection patterns that may not uniquely identify a subsurface target or stratigraphic horizon. For instance, the hyperbolic reflector corresponding to a utility is similar to that produced by a metal scrap or cobble. Utilities are inferred from where hyperbolic reflectors of similar depth and reflection characteristics align along adjacent lines. Reflections from USTs are asymmetric: reflectors appear flat and of finite dimensions when the antenna moves parallel to the UST's long axis, but appear as large hyperbolic reflectors when the antenna crosses obliquely or perpendicular to the short axis of the UST. In both instances, UST reflectors are of finite length. Obtaining data along multiple survey traverses helps to determine the size, shape, and continuity of buried objects. For instance, buried utilities are interpreted from hyperbolic reflectors of similar depth and appearance, which are aligned along adjacent lines. GPR data interpretation is more subjective than it is for most other geophysical methods, and confirmation using boreholes or test pits is strongly recommended.

Changes in the speed at which the antenna is moved between stations causes slight errors in horizontal distance interpolations, and hence interpreted object positions. Such interpolation errors were minimized by using 2 meter distance marks during this survey and subsequently "rubber sheeting" the data.

The antenna radiation pattern is cone-shaped, emanating GPR signals approximately 15 degrees from horizontal fore and aft, and about 45 degrees from horizontal along the sides of the antenna, depending upon the dielectric properties of the soil. Therefore, buried objects may be detected before the antenna is located directly over them. GPR anomalies often appear larger than actual target dimensions.



Probable
Large Metal Object
-10E
0E
10E
20E
30E
40E
50E
60E
150N
140N
SIDEWALK
METAL SIGN
SITE BUILDING
LABOR READY BUILDING
OTB BUILDING
40N
30N
20N
10N
0N
possible
fill (from
observations)
55 Gallon Drum
-10E
0E



SCALE: 1 Inch = 20 Feet

20 0 20 Feet

FIGURE 1
EM-61 RESULTS
36 ELM STREET
GLENS FALLS , NEW YORK
Prepared for
BARTON AND LOGUIDICE, INC.
SEPTEMBER 2006

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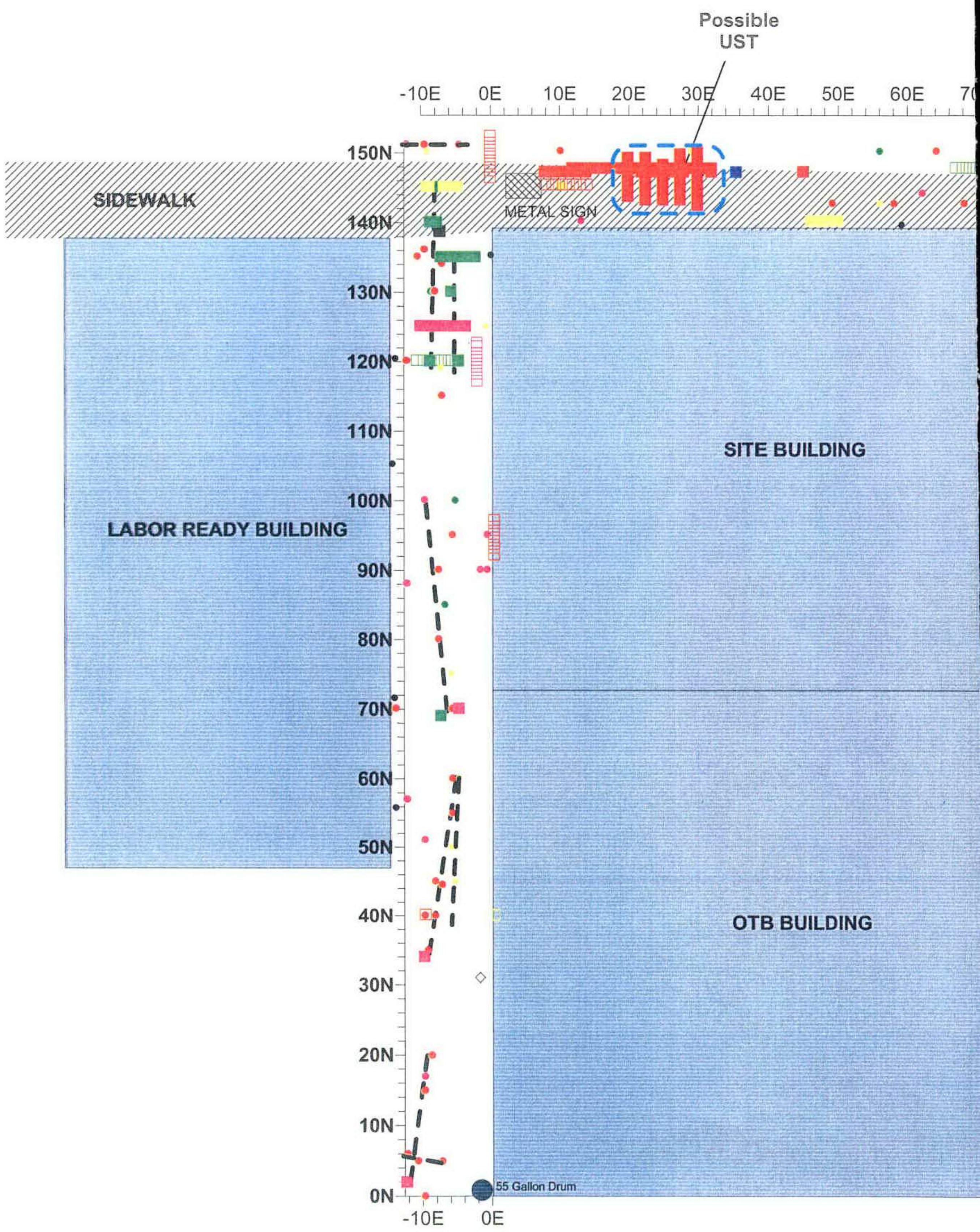
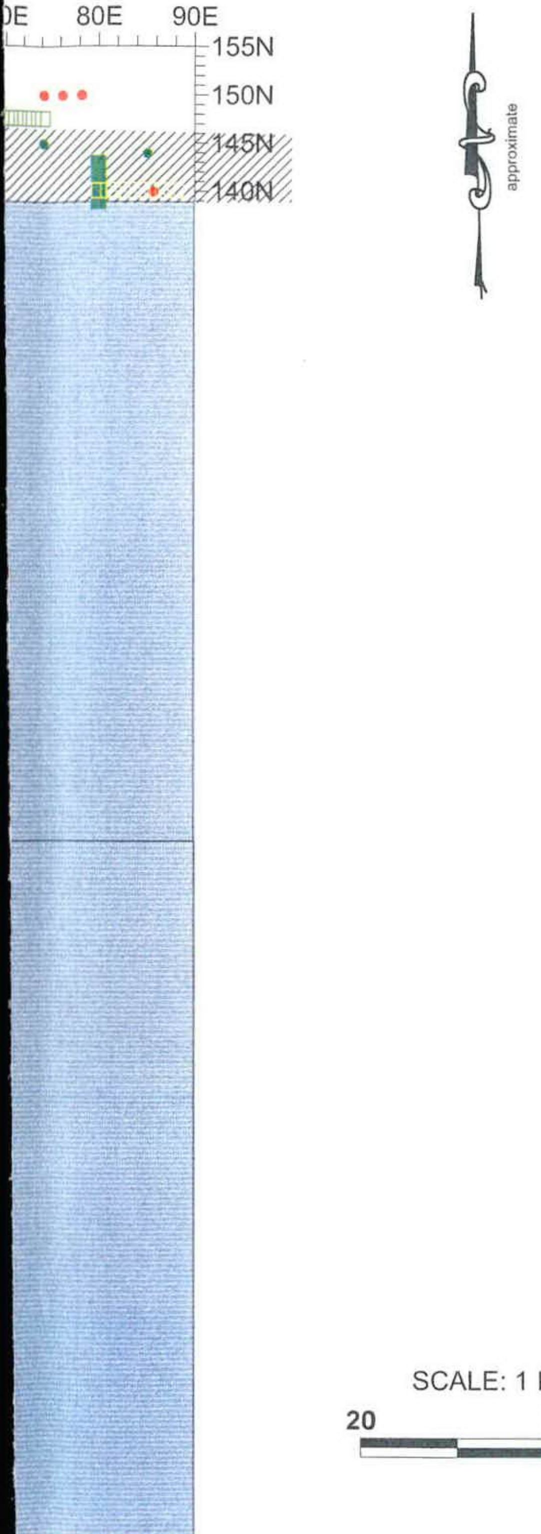


Possible
UST
-10E
0E
10E
20E
30E
40E
50E
60E
150N
140N
130N
120N
110N
100N
90N
80N
70N
60N
50N
40N
30N
20N
10N
0N
SIDEWALK
METAL SIGN
LABOR READY BUILDING
SITE BUILDING
OTB BUILDING
55 Gallon Drum



LEGEND

Interpreted Utility Position (EM Induction and EM-61)

- Communications / Electric
- Water
- Storm Drain
- Unknown (from GPR only)

- Small High-Amplitude Hyperbolic Reflector (possible utility, metal scrap, rebar, cobble); depth (ft.) as indicated below
- Weak-Amplitude, Small Reflector (probable cobble, concrete rubble, possible utility); depth (ft.) as indicated below
- Large GPR Target (possible large-diameter utility or boulder; reflection possibly from UST); Depth (ft) as indicated below:
  - 0 ft. to 1 ft.
  - 1 ft. to 2 ft.
  - 2 ft. to 3 ft.
  - 3 ft. to 4 ft.
  - 4 ft. to 5 ft.
  - 5 ft. to 6 ft.
  - 6 ft. to 7 ft.
  - 7 ft. to 8 ft.
- Large, Weak-Amplitude Reflection (possible boulder, large diameter utility, reflection possibly from rusted UST); depth (ft.) as indicated above
- Irregularly-shaped Target (multiple closely spaced utilities); depth (ft.) as indicated above
- Interpreted Boundary of Possible UST

SCALE: 1 Inch = 20 Feet

20 0 20 Feet

FIGURE 2
INTERPRETED GPR RESULTS
36 ELM STREET
GLENS FALLS , NEW YORK

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BARTON AND LOGUIDICE, INC.
SEPTEMBER 2006

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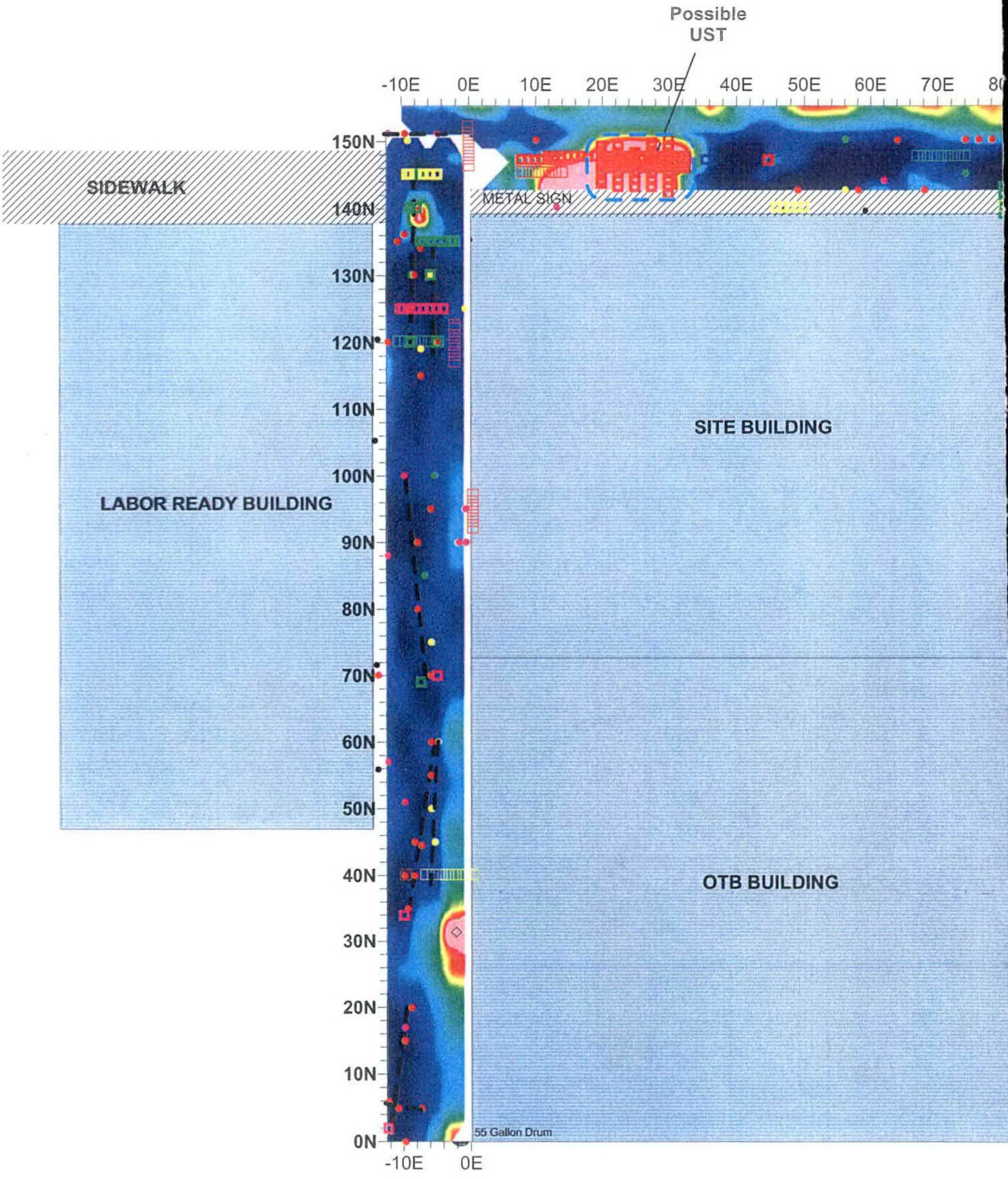

Possible
UST
-10E
0E
10E
20E
30E
40E
50E
60E
70E
150N
140N
130N
120N
110N
100N
90N
80N
70N
60N
50N
40N
30N
20N
10N
0N
SIDEWALK
METAL SIGN
SITE BUILDING
LABOR READY BUILDING
OTB BUILDING
55 Gallon Drum
-10E
0E

LEGEND

Interpreted Utility Position (EM Induction and EM-61)

- - - - Communications / Electric

- - - - Water

- - - - Storm Drain

.... Unknown (from GPR only)

● Small High-Amplitude Hyperbolic Reflector (possible utility, metal scrap, rebar, cobble); depth (ft.) as indicated below

○ Weak-Amplitude, Small Reflector (probable cobble, concrete rubble, possible utility); depth (ft.) as indicated below

□ Large GPR Target (possible large-diameter utility or boulder; reflection possibly from UST); Depth (ft) as indicated below:

- □ 0 ft. to 1 ft.
- □ 1 ft. to 2 ft.
- □ 2 ft. to 3 ft.
- □ 3 ft. to 4 ft.
- □ 4 ft. to 5 ft.
- □ 5 ft. to 6 ft.
- □ 6 ft. to 7 ft.
- □ 7 ft. to 8 ft.

□ Large, Weak-Amplitude Reflection (possible boulder, large diameter utility, reflection possibly from rusted UST); depth (ft.) as indicated above

+ Irregularly-shaped Target (multiple closely spaced utilities); depth (ft.) as indicated above

Interpreted Boundary of Possible UST

SCALE: 1 Inch = 20 Feet

20 0 20 Feet

EM Lower Coil Response (mv)

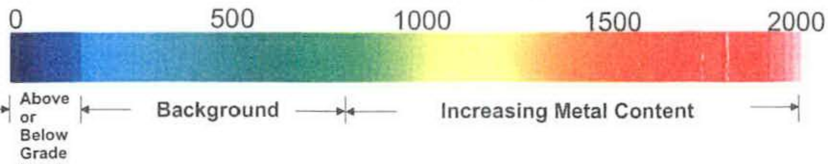

FIGURE 3
COMBINED GEOPHYSICAL RESULTS
36 ELM STREET
GLENS FALLS , NEW YORK

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