Hager GeoScience Inc.

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July 21st, 2006
File 200633

Mr. Michael Healey
Charbert, A Division of NFA Corporation
299 Church Street
Alton, Rhode Island 02832

Re: Geophysical survey to confirm utility locations
Charbert Facility
299 Church Street
Alton, Rhode Island 02832

Dear Mr. Healey:

This letter details the results of a geophysical survey conducted by Hager GeoScience, Inc. (HGI) for Charbert, A Division of NFA Corporation (Charbert) at the Facility on 299 Church Street in Alton, Rhode Island. The survey was performed on the southwest side of the Charbert Mill Building. The purpose of the survey was to determine the locations and depths of subsurface utilities. The work was performed under the direction of GZA GeoEnvironmental, Inc. (GZA), Charbert's consultant for work at the site.

FIELDWORK

Survey Control

This survey was performed on May 22nd, 2006, using ground penetrating radar (GPR). The Charbert on-site representative determined the location and extent of the survey area. HGI personnel laid out the GPR traverses using fiberglass tapes and spray paint. Distances were taped from fixed surface cultural features, including buildings, curbs, etc., and were noted on the site plan map and survey notes.

Data Collection

GPR data were then collected in all accessible portions of the designated survey area along traverses in two perpendicular directions spaced 5 feet apart. The locations of the GPR traverses are shown on Plate 1, an AutoCAD map adapted from a base plan provided by GZA.

HGI collected GPR data using a GSSI SIR 2000 acquisition system with a 500-MHz antenna and survey wheel. Data were recorded with the acquisition time window set at 120 nanoseconds (ns), a time range that provided an average signal penetration of 10 to 15 feet. Data were collected and displayed in real time for quality control and initial data review purposes, as well as to confirm the results of the utility location survey.

All acquired data were stored on the system's internal hard drive and transferred to a PC at the HGI office for signal processing and analysis using GSSI's RADAN for Windows NT™ software.

RESULTS

Plate 1 shows the locations of interpreted utilities and their approximate depth in feet. The color-coding reflects the level of confidence in their identification, which is based on determining whether reflectors of similar size and depth show a consistent linear trend across the survey grid.

It should be noted that GPR cannot unambiguously determine the physical properties of the reflectors, or that all interpreted reflectors are related (see Limitations of the Method in Appendix A).

Please contact us at (781) 935-8111 if you have any questions or need additional information.

Respectfully yours,
HAGER GEOSCIENCE, INC.

Jutta Hager, Ph.D.
President

APPENDIX A: GROUND PENETRATING RADAR

DESCRIPTION OF THE METHOD

The principle of ground penetrating radar (GPR) is the same as that used by police radar, except that GPR transmits electromagnetic energy into the ground. The energy is reflected back to the surface from interfaces between materials with contrasting electrical (dielectric and conductivity) and physical properties. The greater the contrast between two materials in the subsurface, the stronger the reflection observed on the GPR record. The depth of GPR signal penetration depends on the properties of the subsurface materials and the frequency of the antenna used to collect radar data. The lower the antenna frequency, the greater the signal penetration, but the lower the signal resolution.

Data Collection. GPR data are collected using a Geophysical Survey Systems (GSSI) SIR 2000/3000 ground penetrating radar system. GPR data are digitally recorded on the internal hard drive, or flash-memory of the system. System controls allow the GPR operator to filter out noise, attributed to both coupling noise, caused by conductive soil conditions, spurious noise caused by local EMF fields and internal system noise. For shallow surveys, we use 400-, 200-, 100- or 1500-megahertz (MHz) antennas. For deeper penetration, we use lower frequency antennas ranging from 200 MHz to 15 MHz, depending on the anticipated depth of the target(s) and the degree of signal penetration. All of these antenna configurations can collect data in continuous mode or as discrete point measurements using signal-stacking techniques. Since there is a tradeoff between signal penetration and resolution, test lines are run using different antennas at several frequencies and then the highest frequency antenna that produces the highest quality data is used. In some cases, data are collected with several antenna frequencies.

The horizontal scale of the GPR record shows distance along the survey traverse. In the continuous data collection mode, the horizontal scale on each GPR record is determined by the antenna speed along the surface. When a survey wheel is used, the GPR system records data with a fixed number of traces per unit distance. The GPR record is automatically marked at specified distance intervals along the survey line. The velocity of the transmitted signal and the recording time window or range determines the vertical scale of the radar record. The recording time interval, or range, represents the maximum two-way travel time in which data are recorded. The conversion of two-way travel time to depth depends on the propagation velocity of the GPR signal, which is site specific. When little or no information is available about the makeup of subsurface materials, we estimate propagation velocities from handbook values and experience at similar sites or by CDP velocity surveys with a bi-static antenna.

Data Processing. After completion of data collection, the GPR data are transferred to a PC for review and processing using RADAN NT for Windows™ software. When appropriate, we prepare 3D models of GPR data, which can be sliced in the X, Y, and Z directions.

The size, shape, and amplitude of GPR reflections are used to interpret GPR data. Objects such as metallic UST's and utilities produce reflections with high amplitude and distinctive hyperbolic shapes. Clay, concrete pipes boulders and other in-situ features may produce radar signatures of similar shape but lower amplitude. The boundaries between saturated and unsaturated materials such as sand and clay, bedrock and overburden generally also produce strong reflections.

LIMITATIONS OF THE METHOD

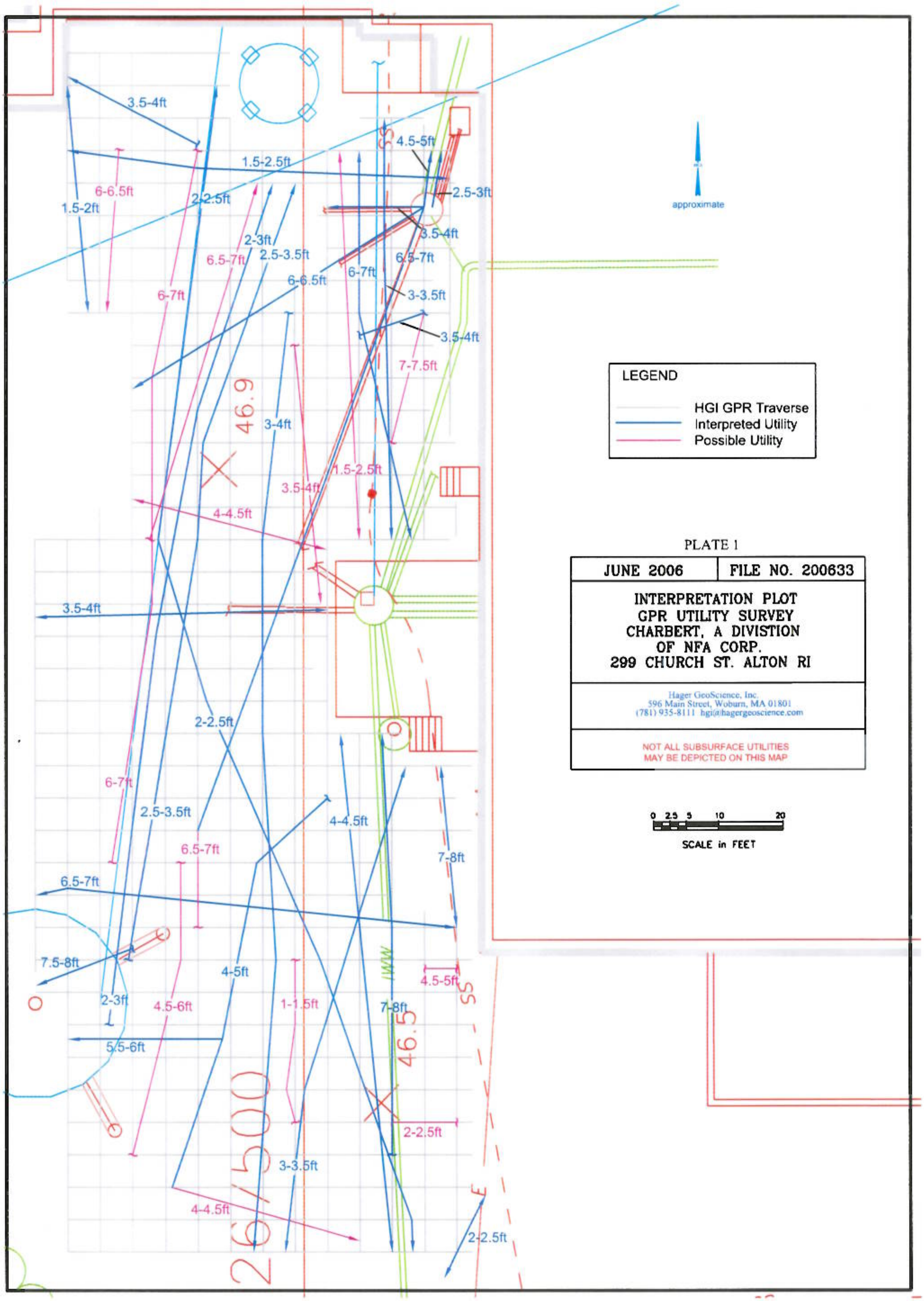
GPR signal penetration is site-specific. It is determined by the dielectric properties of local soil and fill materials. GPR signals propagate well in resistive materials such as sand and gravel; however, soils containing clay, ash- or cinder-laden fill or fill saturated with brackish or otherwise electrically conductive groundwater cause GPR signal attenuation and loss of target resolution. Concrete containing rebar or wire mesh also inhibits signal penetration.

The interpreted depths of objects detected using GPR are based on on-site calibration, handbook values, and/or estimated GPR signal propagation velocities from similar sites. GPR velocities and depth estimates may vary if the medium under investigation or soil water content is not uniform throughout the site.

Utilities are interpreted on the basis of reflections of similar size and depth that exhibit a linear trend; however GPR cannot unambiguously determine that all such reflectors are related. Fiberglass UST's, or utilities composed of plastic or clay may be difficult to detect if situated in soils with similar electromagnetic properties, or if situated in fill with other reflecting targets which generate "clutter" or signal scattering and thus obscure other deeper reflectors. Objects buried beneath reinforced concrete pads or slabs may also be difficult, but possible, to detect.

Changes in the speed at which the GPR antenna is moved along the surface causes slight variations in the horizontal scale of the recorded traverse. Distance interpolation may be performed to minimize the error in interpreted object positions. The variation in the horizontal scale of the GPR record may be controlled, to a certain extent, with a distance encoder or Survey Wheel. The GPR antenna produces a cone-shaped signal pattern that emanates approximately 45 degrees from horizontal front and back of the antenna. Therefore, buried objects may be detected before the antenna is located directly over them. GPR anomalies may appear larger than actual target dimensions.

GPR interpretation is more subjective than other geophysical methods. The interpretive method is based on the identification of reflection patterns that do not uniquely identify a subsurface target. Borings, test pits, site utility plans and other ground-truth are recommended to verify the interpreted GPR results.


approximate
LEGEND
HGI GPR Traverse
Interpreted Utility
Possible Utility
PLATE 1
JUNE 2006
FILE NO. 200633
INTERPRETATION PLOT
GPR UTILITY SURVEY
CHARBERT, A DIVISTION
OF NFA CORP.
299 CHURCH ST. ALTON RI
Hager GeoScience, Inc.
596 Main Street, Woburn, MA 01801
(781) 935-8111 hgi@hagergeoscience.com
NOT ALL SUBSURFACE UTILITIES
MAY BE DEPICTED ON THIS MAP
0 2.5 5 10 20
SCALE in FEET
3.5-4ft
1.5-2.5ft
6-6.5ft
1.5-2ft
2-2.5ft
2-3ft
2.5-3.5ft
6.5-7ft
6-6.5ft
6-7ft
4.5-5ft
2.5-3ft
3.5-4ft
6-7ft
6.5-7ft
3-3.5ft
3.5-4ft
7-7.5ft
46.9
3-4ft
1.5-2.5ft
3.5-4ft
4-4.5ft
3.5-4ft
2-2.5ft
6-7ft
2.5-3.5ft
6.5-7ft
4-4.5ft
7-8ft
6.5-7ft
7.5-8ft
2-3ft
4.5-6ft
4-5ft
1-1.5ft
7-8ft
4.5-5ft
SS
5.5-6ft
46.5
2-2.5ft
3-3.5ft
4-4.5ft
2-2.5ft
26500