APPENDIX E

GEOPHYSICAL SURVEY - GRAVE DETECTION/DELINEATION BENEATH PAVED PARKING LOT

Final Report
Geophysical Survey
Grave Detection/Delineation Beneath Paved Parking Lot
~200’ x 400’ Area (estimated ½-city block)
Queen Lane Apartments Site
Philadelphia, PA
Enviroscan Reference Number 031236a

Prepared For: CHRS, Inc.
Prepared By: Enviroscan, Inc.
May 11, 2012

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May 11, 2012

Mr. Thomas Lewis
CHRS, Inc.
451 North Cannon Avenue
Suite 100B
Lansdale, PA 19446

RE: Geophysical Survey
Grave Detection/Delineation Beneath Paved Parking Lot
~200' x 400' Area (estimated ½-city block)
Queen Lane Apartments Site
Philadelphia, PA
Enviroscan Reference Number 031236a

Dear Mr. Lewis:

Pursuant to our proposal dated March 26, 2012, Enviroscan, Inc. completed a ground penetrating radar (GPR) survey of the above-referenced site on April 9 and 10, 2012. The purpose of the survey was to delineate the western extents of a historic potter's field cemetery (the eastern extents of which have been built over), identify any possible interments inside or outside the potter's field, and delineate any historic structures related to the former buildings within the half-block survey area. The following report and figures describe the methods and results of the survey.

Interviews with local neighborhood historians revealed information indicating that many of the interments would have been wooden caskets or no casket. Additionally, many interments were of children in the later years of the cemetery's use. Interments such as these (wood casket/no casket, small children) are very difficult to image with a sufficiently high resolution to accurately mark individual graves; however, a highly used and excavated area such as a cemetery plot will show signs of soil disturbance over a large aerial footprint. It is possible to image this type of anomaly with a higher degree of accuracy. The local history also indicated that the cemetery's suspected location was partially underneath the abandoned high-rise on the eastern side of the block. The western side of the cemetery may still have been within the influence of the high-rise construction, making it difficult to determine the difference between soil disrupted by cemetery excavations and soil disrupted by later construction activities. Anecdotal stories from neighborhood locals also indicated that bones were exhumed during the high-rise construction and reburied under the building and/or playground adjacent to the building.

The site background information altered the survey only slightly, with more weight put on the delineation of larger-scale features such as former buildings on the north, east, and south sides of the block or structures and areas of disturbance. Locating these features could help the client focus future archeological investigations.

Survey Methods

GPR

Ground penetrating radar (GPR) systems produce cross-sectional images of subsurface features and layers by continuously emitting pulses of radar-frequency energy from a scanning antenna as it is towed along a survey profile. The radar pulses are reflected by interfaces between materials with differing dielectric properties. The reflections return to the antenna and are displayed on a video monitor as a continuous cross-section in real time. Disturbed soils, stone, and wood targets, as well as subsurface voids produce subtle but recognizable reflections. Please note that the age of the cemetery indicates that the most prevalent type of interment would be a wooden casket; furthermore, any wood used at the time would be highly decomposed. Given the site conditions and history, GPR anomalies resulting from large areas of disturbed soils or soil structures resulting from digging are the most likely targets to be used for possible interment locations and/or cemetery boundaries.

Enviroscan performed GPR scanning of the survey area using a GSSI SIR-2000 GPR controller with an internal hard drive and color display, along with a 500 MHz scanning antenna with an optical survey wheel for accurate scanning distance control. The survey areas were scanned along an orthogonal grid of profiles spaced two feet apart north to south and 5 feet apart east to west (see magenta lines on Figure 1). Note that some lines are discontinuous due to the presence of trees, walls, fencing, playground equipment, and other obstructions. The location of numerous grid points and nearby site surface features were recorded with a Topcon Hyperlite RTK survey grade GPS system. Several observed storm pipes were imaged with GPR to calibrate the depth estimations.

The recorded GPR profiles were compiled into a 3-dimensional (3D) block of data using GPR-Slice by the Geophysical Archaeometry Laboratory. Since a 3D volume cannot be portrayed on 2D paper or a monitor screen, the final block was sliced at approximately one-half foot intervals to produce horizontal slices at increasing depths (see Appendix A Figures). To aid in interpretation, the GPR-Slice program allows one to compile a composite image of the high-amplitude features from several horizontal depth slices, essentially viewing the “highlights” of several depth slices as one image. Several horizontal slices were compiled for this survey including slices from 15 to 44 inches below ground surface. This composite is displayed in Figures 2-1 and 2-2 with different color shading to enhance the visibility of different features.

Results

Figures 2-1 and 2-2 show the compiled GPR slice images with permanent site features such as the basketball court, light poles, and manhole covers. The piping connecting the manhole covers was imaged in the survey and is highlighted with green lines. For viewing clarity, Figures 2-1 and 2-2 are not marked with interpretations of the GPR data. Figure 3 shows GPR anomalies of interest outlined in magenta polygons that may be associated with historic structures and the cemetery. Polygons with an "S" within indicate a suspected historic structure. Polygons with a "C" within indicate a feature that may be associated with the cemetery.

Figure 4 displays three representative raw GPR images from three selected grid lines. Please note that a raw GPR profile represents a vertical slice (cross section) through the ground, such that the top of the profile is the ground surface. The locations of these grid profiles are shown in light blue lines labeled A-A', B-B', and C-C' on Figure 3. GPR anomalies of interest on both Figures 3 and 4 are also numbered, i.e. S1, C1, for clarity in comparing the two types of data in different figures (raw GPR profile vs. processed GPR slices).

Several features on the cross section are noted for better understanding of the profile image. Features S1, S2, C1, and C2 appear as highly disturbed areas starting at a depth of 2.5 to 3 feet below ground surface. Feature C1 also displays historic settling of soil near the surface (see yellow line), as evidenced by the depression of the near surface reflectors. This is common for excavations when the fill material decomposes over time, such as a covered pit filled with tree stumps. Anomaly C2 is within the suspected boundaries of the cemetery; however, it is also within a reasonable range of the high rise to have been influenced by construction activities. The depth of Anomaly C2 is similar in depth to the other anomalies that are reasonably far away from the high-rise to be categorized as historic or non-construction-related. Anomaly C2 should be further investigated as an anomaly of interest for the cemetery. Anomaly C1 is not within the suspected boundaries of the cemetery; however, it is also not near the historic building locations on the south side of the block. Anomaly C1 should also be further investigated as a possible cemetery-related anomaly. The remaining "S" labeled anomalies are roughly coincident with historic house locations on this block.

GPR anomalies of the size of individual interments are numerous throughout the survey area. Discrete target designation as a possible interment should not be done until a qualified archeologist has reviewed the GPR data in context with the history of the housing layout and better knowledge of other possible small historic structures that are similar in size to graves (e.g. privies. After review by an archeologist, possible interments can be picked. To simplify this process, two polygons – one rectangle 4 feet by 7 feet and one 3-foot diameter circle – are depicted and labeled in the southwest portion of the survey area on Figure 3 to represent possible adult-sized (Feature A) and child-sized (Feature B) interments.

The GPR results for the elevated playground areas are not very useful, possibly due to the highly disturbed soils/fill material used to build up the ground surface under the playground.

Conclusions

The GPR survey was successful in delineating several possible historic features, including suspected former house foundations and possible features associated with the former potter's cemetery. These large-scale features are clearly delineated in the processed GPR data. The goal of individual gravesite delineation encountered some complications, largely due to the highly culturalized nature of the site. The GPR data clearly show numerous singular anomalies that are similar in size to both an adult interment and a child's interment; however, many of these anomalies are likely due to a variety of buried material that accumulates over time in areas occupied by humans. Enviroscan proposes that the client reviews the survey data in an archeological context and ground truths some of the GPR anomalies. Following that, a better understanding of the site will allow for a more critical selection of anomalies that might represent possible singular interment locations.

Limitations

The above-referenced geophysical survey was completed using standard and/or routinely accepted practices of the geophysical industry and equipment representing the best available technology. Enviroscan does not accept responsibility for survey limitations due to inherent technological limitations or unforeseen site-specific conditions. However, we make every effort to identify and notify the client of such limitations or conditions. Please note that the completion of this survey does not relieve any party of their legal obligation to notify the appropriate One-Call service prior to digging or drilling. In addition, please be aware that there are almost certainly underground sewer lines that could not be imaged or traced.

We have enjoyed and appreciated the opportunity to have worked with you. If you have any questions, please do not hesitate to contact the undersigned.

Sincerely,
Enviroscan, Inc.

William E. Steinhart III, M.Sc., P.G.
Principal Geophysicist

Technical Review By:
Enviroscan, Inc.

Felicia Kegel Bechtel, M.Sc., P.G.
President

enc.:
- Figure 1: GPR Survey Layout
- Figure 2-1: GPR Survey Results Composite Horizontal Slice Grey Scale Coloring
- Figure 2-2: GPR Survey Results Composite Horizontal Slice Green to Orange Scale Coloring
- Figure 3: GPR Survey Results Composite Horizontal Slice Anomalies of Interest
- Figure 4: Example GPR Profiles
- Appendix A: GPR Survey Results Horizontal Slices at 5-inch increments

N

- Fence
- Manhole
- Storm Pipe
- GPR Transect
- Light Pole

0 50′ 100′

The information depicted on this drawing represents survey results on the date surveyed and can only be considered to be indicative of the general conditions existing on that survey date.

Data collected with GSSI, Inc. SIR-2000 GPR using 500 MHz Antenna.

Data Processed with GPR Slice 7, from Geophysical Archaeometry Laboratory, Inc.

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GPR Survey Layout

Queen Lane Apartments Site
Germantown, PA

Figure 1

Project Number	Survey Date	Drawn by:
031236a	04/10/2012	WES
Original Scale	Revision/Issue	Approved by:
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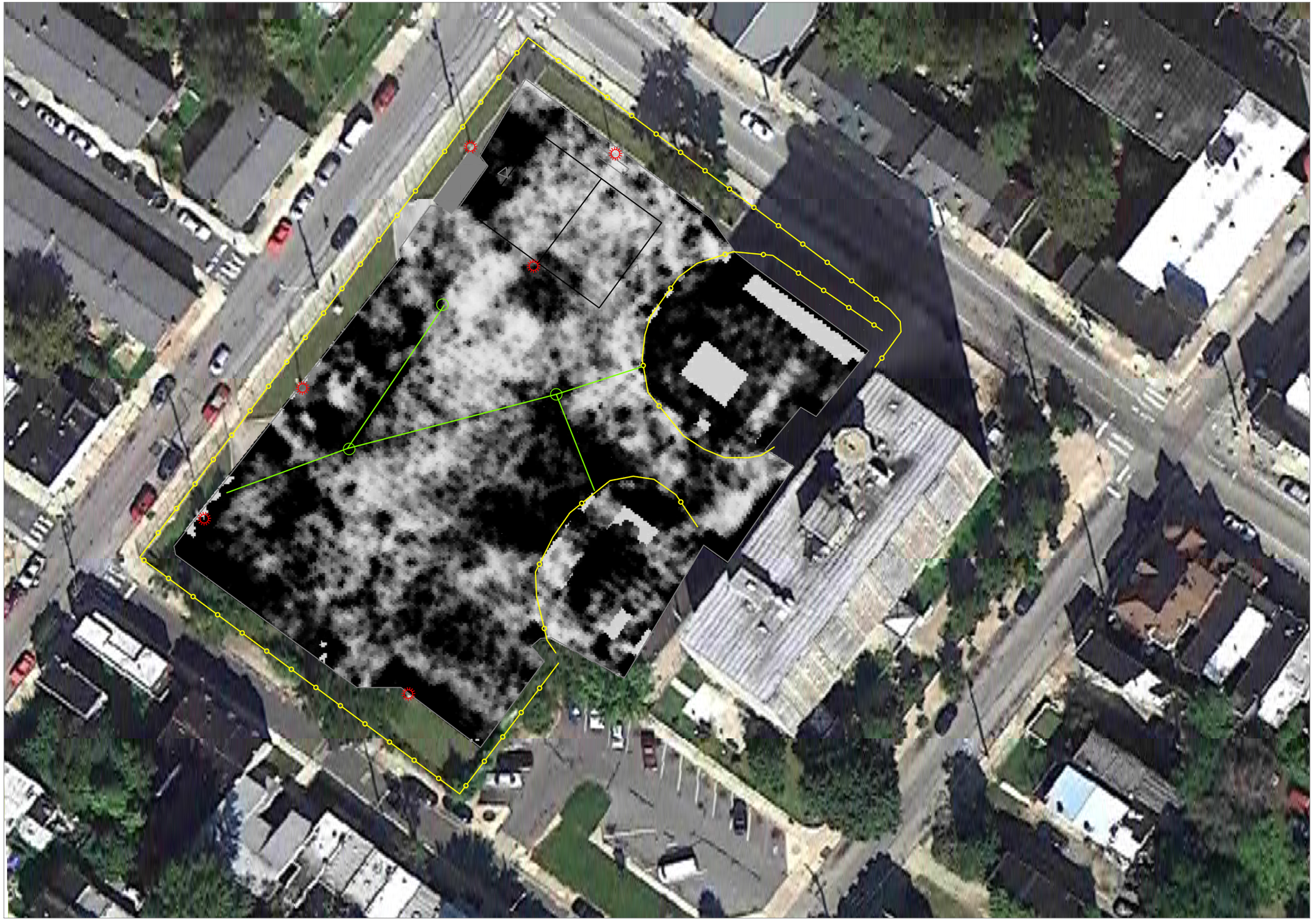

N

1
0.75
0.5
0.25
0
Relative Reflected GPR Signal Power

Fence
Manhole
Storm Pipe
Light Pole

0 50′ 100′

The information depicted on this drawing represents survey results on the date surveyed and can only be considered to be indicative of the general conditions existing on that survey date.

Data collected with GSSI, Inc. SIR-2000 GPR using 500 MHz Antenna.

Data Processed with GPR Slice 7, from Geophysical Archaeometry Laboratory, Inc.

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GPR Survey Results
Composite Horizontal Slice
Grey Scale Coloring

Queen Lane Apartments Site
Germantown, PA

Figure 2-1

Project Number	Survey Date	Drawn by:
031236a	04/10/2012	WES
Original Scale	Revision/Issue	Approved by:
1" = 50'	010911.DWG	FKB

N

1
0.75
0.5
0.25
0
Relative Reflected GPR Signal Power

Fence
Manhole
Storm Pipe
Light Pole

0 50′ 100′

The information depicted on this drawing represents survey results on the date surveyed and can only be considered to be indicative of the general conditions existing on that survey date.

Data collected with GSSI, Inc. SIR-2000 GPR using 500 MHz Antenna.

Data Processed with GPR Slice 7, from Geophysical Archaeometry Laboratory, Inc.

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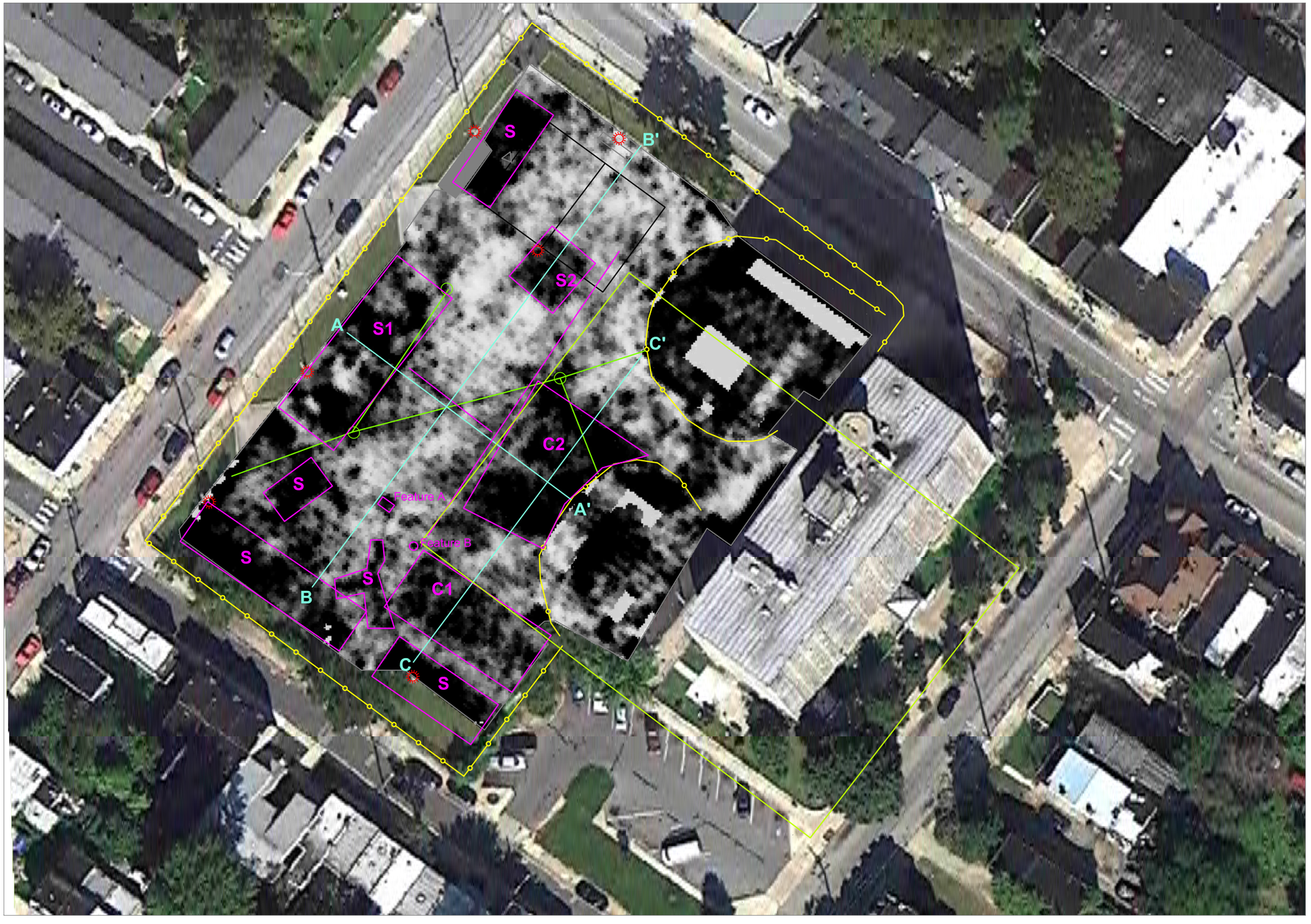
GPR Survey Results
Composite Horizontal Slice
Green to Orange Scale Coloring

Queen Lane Apartments Site
Germantown, PA

Figure 2-2

Project Number	Survey Date	Drawn by:
031236a	04/10/2012	WES
Original Scale	Revision/Issue	Approved by:
1" = 50'	010911.DWG	FKB



N

1
0.75
0.5
0.25
0

Relative Reflected GPR Signal Power

- Fence
- Manhole
- Storm Pipe
- GPR Transect
- Light Pole
- Example GPR Transect
- Potters Field Boundary
- GPR Anomaly of Interest

0 50′ 100′

The information depicted on this drawing represents survey results on the date surveyed and can only be considered to be indicative of the general conditions existing on that survey date.

Data collected with GSSI, Inc. SIR-2000 GPR using 500 MHz Antenna.

Data Processed with GPR Slice 7, from Geophysical Archaeometry Laboratory, Inc.

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GPR Survey Results
Composite Horizontal Slice
Anomalies of Interest

Queen Lane Apartments Site
Germantown, PA

Figure 3

Project Number	Survey Date	Drawn by:
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Original Scale	Revision/Issue	Approved by:
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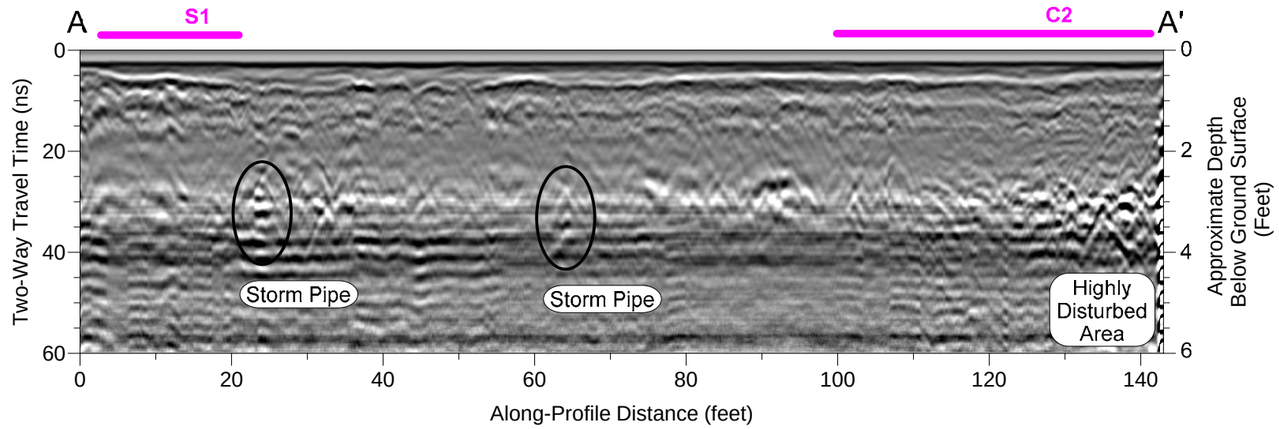

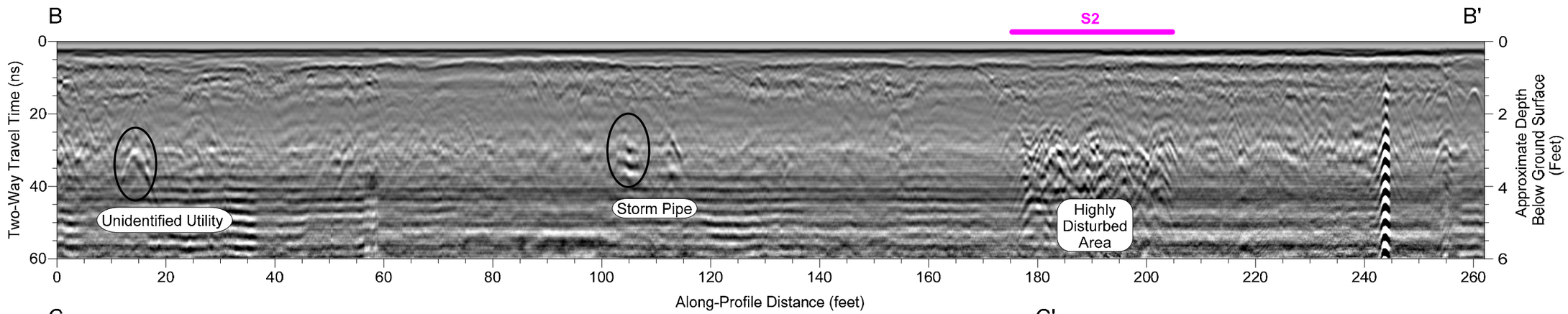

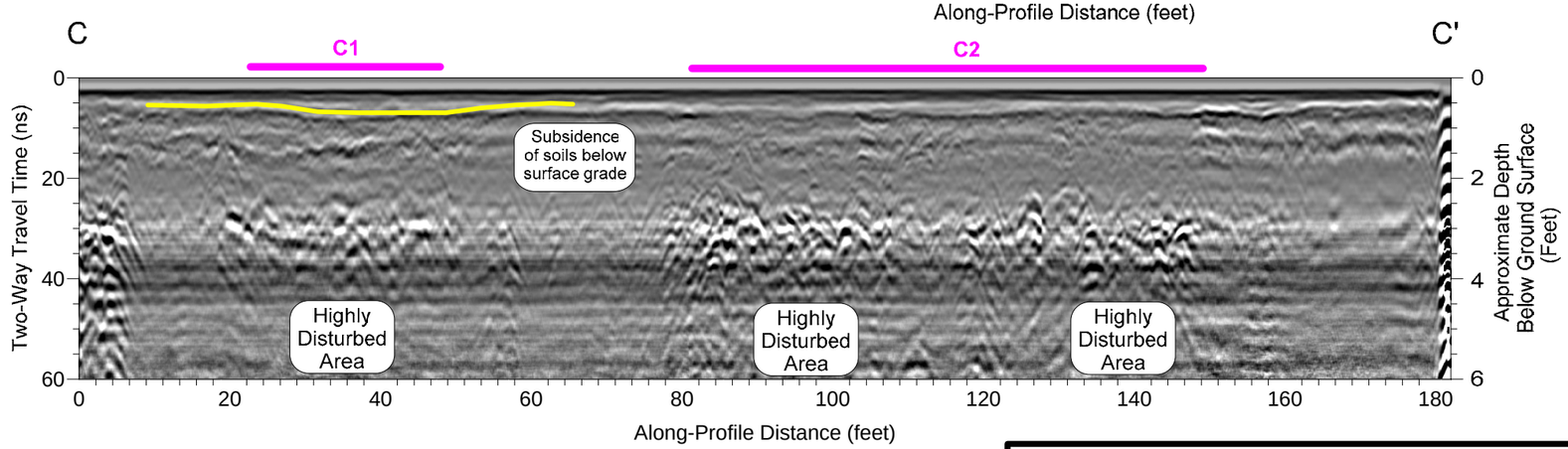

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Title:

Example GPR Profiles

Project Location:

Queen Lane Apartments Site Germantown, PA

Figure: 4

Project Number	Revision/Issue		
031236a	05/9/2012		
Original Scale	Survey Ending Date	Drawn by:	Approved by:
1" = 20' Horizontal	04/10/2012	WES	FKB