TOWN OF HILLSBOROUGH

Old Town Cemetery Master Plan

Developed by

Hillsborough Cemetery Committee

Adopted February 2018

Background

The Hillsborough Old Town Cemetery is one of the oldest public burial grounds in North Carolina and contains 184 marked graves, including many of the town's notable early residents. It is located on the corner of North Churton and West Tryon streets, at the former site of St. Matthew's Church. Records date to 1757 when this 1-acre property was sold to the Vestry of St. Matthew's Parish Church. But local lore says the field had been used as an informal graveyard since before 1754, when the town was established.

The cemetery consists of two parts. The eastern half, now dotted with a few scattered tombstones, was the original burial ground. In August 2016, the Hillsborough Cemetery Committee undertook a ground-penetrating radar survey that located more than 100 possible unmarked graves in the east portion of the cemetery. The western portion consists of 11 private cemeteries as well as individual tombs. Walls of fieldstone, brick or hedgerows were added to delineate and protect the plots. Today, the cemetery is nearly encircled by stone walls dating from the 19th and early 20th centuries.

Among the cemetery's earliest known graves is that of William Hooper, a lawyer who lived in Hillsborough during the late 18th century and was one of three N.C. signers of the Declaration of Independence (Hooper's remains have since been moved to the Guilford Courthouse National Military Park in Greensboro). Other important figures buried in the cemetery include early settlers, such as Scotland-born merchant James Hogg; William Graham, who served as a U.S. senator, secretary of the Navy, N.C. governor, and Confederate senator; John Berry, a Hillsborough-based brick mason who built some of the region's finest buildings of the antebellum, including the Orange County Courthouse; and at least eight of the women who attended the Burwell School for young women between 1837 and 1857, including Sara Jane Kollock, co-founder of the Nash-Kollock School.

Maintenance

The Old Town Cemetery is owned and maintained by the Town of Hillsborough. The Hillsborough Cemetery Committee, a volunteer advisory board which was formed in 2014, works to maintain and preserve the town's three cemeteries. The committee has hosted a series of volunteer workdays to maintain the Old Town Cemetery grounds, clean gravestones and record the inscriptions. More than 100 volunteers have attended the workdays. During the workdays, gravestones were cleaned and restored using appropriate methods and under the guidance of Cemetery Committee members who received training from Dean Ruedrich, a historic preservation consultant and cemetery specialist. Dean Ruedrich was also contracted by the town to repair damaged gravestones in the Old Town Cemetery.

Suggested sources for further reading:

Dunaway, S.(2012) *Hillsborough, N.C. – History of Town Lots*, (ISBN 978-1-300-34110-9), LULU.com

Dunaway, S.(2015) *Hillsborough, N.C. – History of Town Lots – An Addendum*, (ISBN 978-1-329-39031-7), LULU.com

Little, R. (1998) *Sticks and Stones*. Chapel Hill, North Carolina: University of North Carolina Press.

Mary Claire Engstrom Papers, 1963-1984 (Collection: 04684). The Southern Historical Collection, Louis Round Wilson Special Collections Library, University of North Carolina at Chapel Hill, Chapel Hill, NC.

Powell, W. (2000) Dictionary of North Carolina Biography. Chapel Hill, North Carolina: University of North Carolina Press.

Preservation Fund of Hillsborough (2017) *Hidden Hillsborough.* Hillsborough, North Carolina: Eno Publishers.

Master Plan Priorities

In 2018, the Hillsborough Cemetery Committee, in coordination with the Public Space Division, developed a list of recommended improvements for Old Town Cemetery. The recommendations are detailed below and are intended to guide future spending decisions.

Recommendations

- Add and interpretive sign explaining the history of the cemetery near the entrance from West Tryon Street
- Add a plaque like the one located at the West Tryon Street entrance to the North Churton Street entrance
- Add several benches in the approved style-Urbanscape 'Butler' bench
- Conduct a property survey to determine the boundaries of the town-owned parcel
- Consider marking newly discovered probable gravesites with steel pins
- Protect and retain existing trees and consider adding trees in areas that do not compromise gravesites
- Repair stone walls and steps that area deteriorating
- Repair brick walls repair
- Repair gravestones that are damaged and continue to maintain existing gravestones through appropriate methods
- Repair the latch for the gate at the North Churton Street entrance
- Consider planting enclosed family plots with groundcover, such as Vinca
- Develop a maintenance policy for grounds keeping
- Develop a policy for use of the cemetery property
- Maintain the town website and Old Town Cemetery brochure with updated information and maps

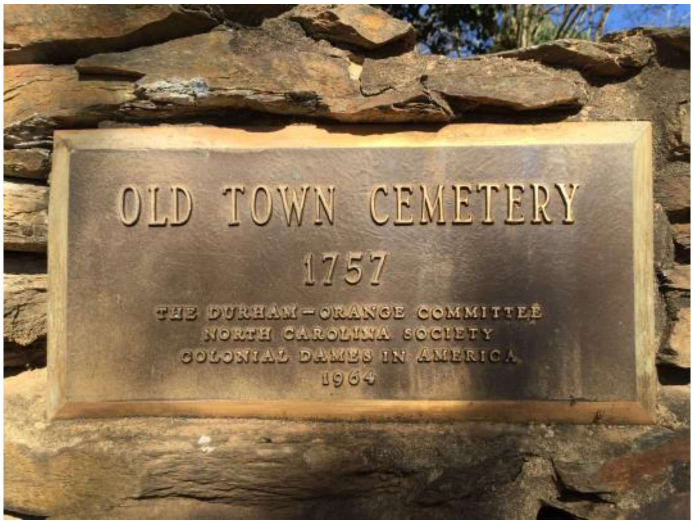
Implementation Priorities

The implementation priorities are as follows:

1. Repair and preserve gravestones
2. Repair cemetery infrastructure (stone walls, steps, gate latch)
3. Conduct property survey
4. Add recommended signage
5. Add recommended landscaping and amenities

The following pages include photographs of the existing conditions in the Old Town Cemetery and a map rendering noting the recommended location for improvements.

Photographs of Old Town Cemetery

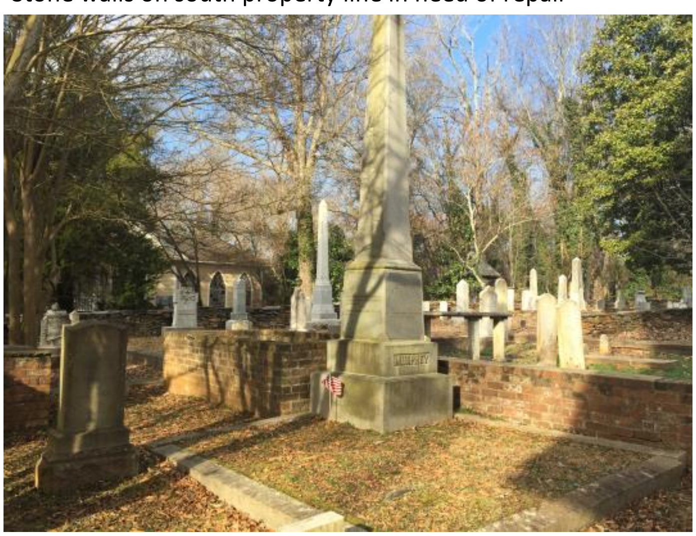


West Tryon Street entrance plaque

West Tryon Street wayfinding sign and stone walls

Stone walls on south property line in need of repair

Stone walls on east property line in need of repair



View of west portion of Old Town Cemetery plots

View of west portion of Old Town Cemetery plots

Photographs of Old Town Cemetery


Boxwood hedges and pathways


View of east portion of Old Town Cemetery plots

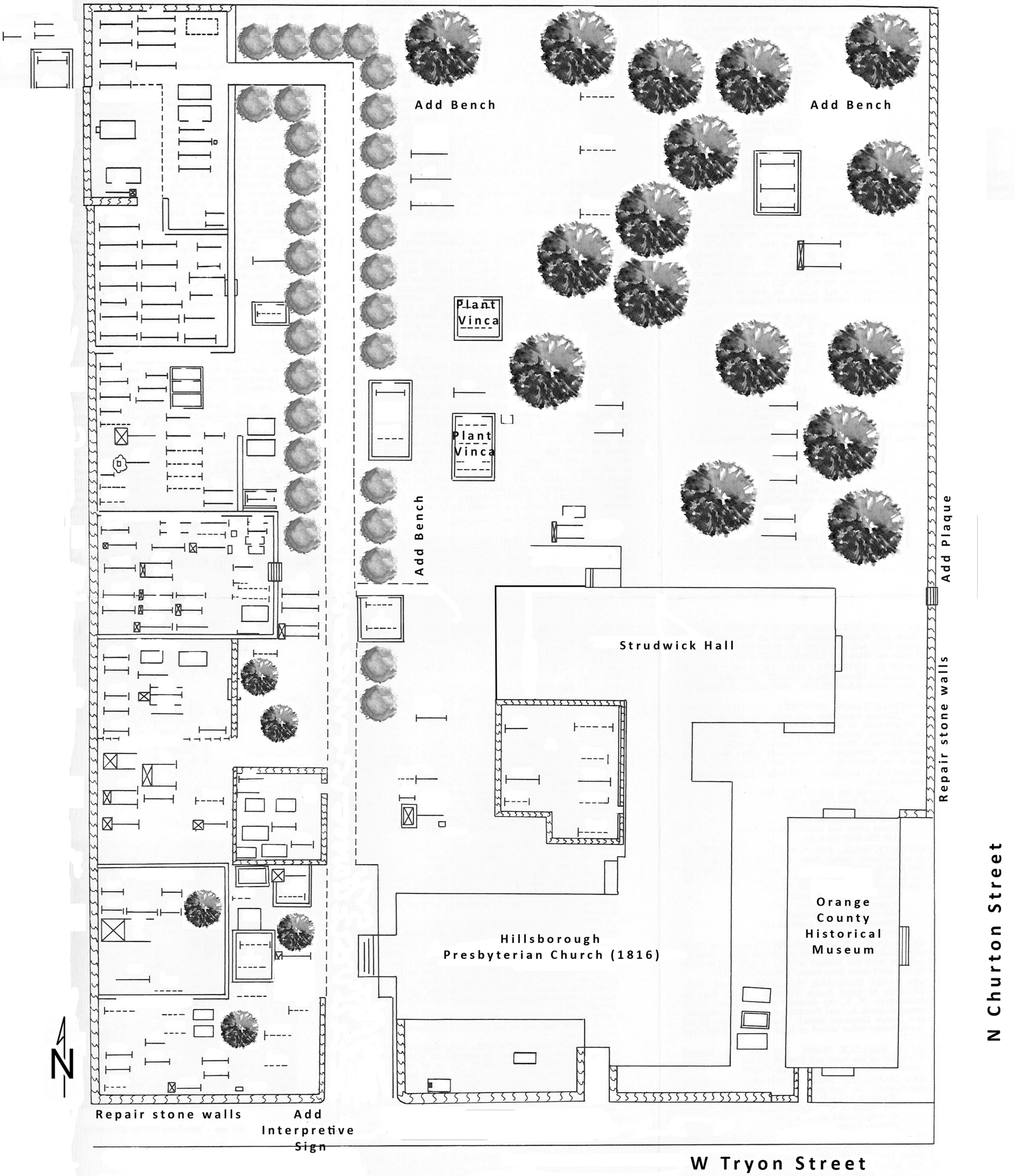

Stone walls surrounding plots


Brick walls surrounding plots


View of east portion of Old Town Cemetery

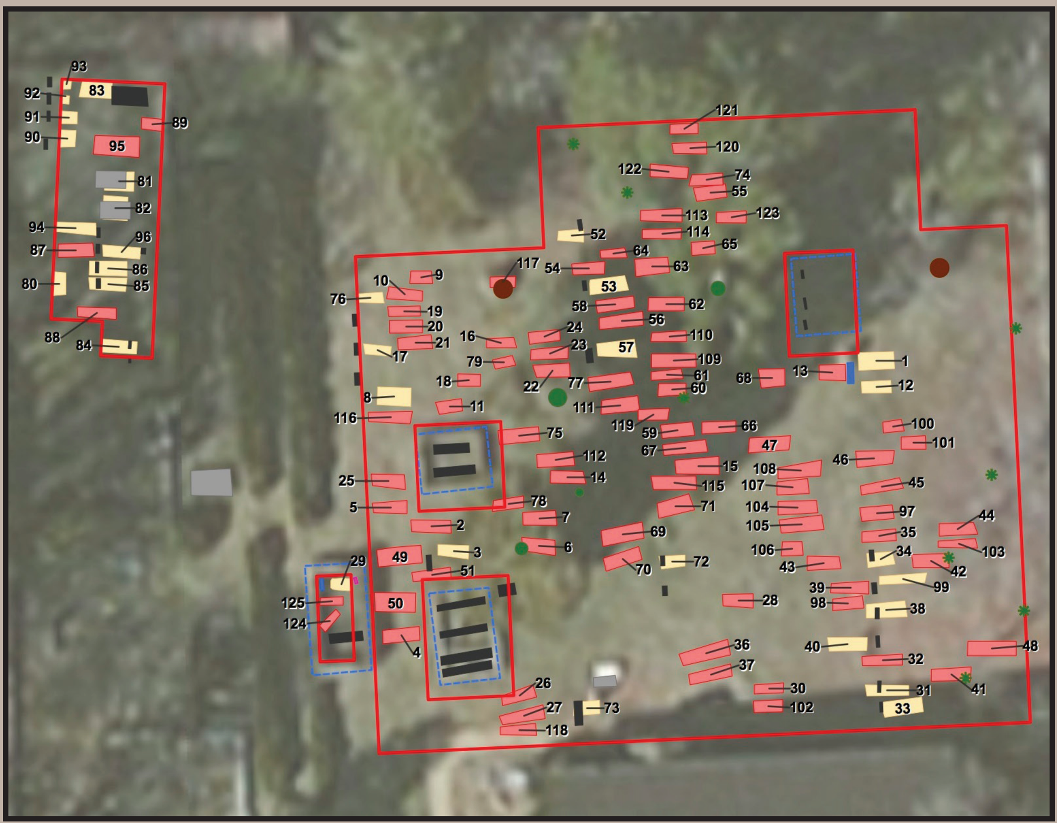

North Churton Street stone walls

The Old Town Cemetery (1757)
Hillsborough, North Carolina



Ground Penetrating Radar Survey for Historic Graves in Selected Portions of the Old Town Cemetery in the Town of Hillsborough

Orange County, North Carolina



NEW SOUTH ASSOCIATES, INC.

Ground Penetrating Radar Survey for Historic Graves in Selected Portions of the Old Town Cemetery in the Town of Hillsborough

Orange County, North Carolina

Report submitted to:

Town of Hillsborough • 101 E. Orange Street • Hillsborough, NC 27278

Report prepared by:

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October 11, 2016 • Draft Report
New South Associates Technical Report 2626

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ABSTRACT

New South Associates, Inc., conducted a ground-penetrating radar (GPR) survey in selected sections of the Old Town Cemetery in Hillsborough, Orange County, North Carolina. The purpose of the project was to identify unmarked burials in three areas: Lot 98, the Heartt Plot, and the east side of the Hooper Compound. Fieldwork was conducted on August 18-19, 2016, by Sarah Lowry with assistance from Ashley Krauss. An existing map from 1966 shows approximately 35 individual marked and unmarked graves in the survey areas. The GPR survey identified a total of 125 possible graves, 94 of which were not marked with a grave marker or shown on the map. The combined geophysical data and 1966 map reveal an estimated total of 129 individuals in the survey areas.

New South recommends that the 129 markers and anomalies identified as probable graves should be treated as such. These should be avoided if future ground disturbance is planned. Because burials could have been missed due to lack of preservation and ground conditions, caution should be taken if any ground is to be disturbed within the cemetery. If avoidance is not possible, provisions should be made for disinterment and reburial in compliance with North Carolina General Statutes Chapter 65, Article 12, Sections 85-113, Abandoned and Neglected Cemeteries.

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I. INTRODUCTION

New South Associates, Inc., conducted a ground-penetrating radar (GPR) survey in selected sections of the Old Town Cemetery in the Town of Hillsborough, Orange County, North Carolina (Figure 1). The purpose of the project was to identify unmarked burials in three areas: Lot 98, the Heartt Plot, and the east side of the Hooper Compound. Although part of a large, historic cemetery with many headstones, the surveyed areas themselves contain relatively few headstones.

The Old Town Cemetery is estimated to have been first used by early settlers prior to the town's official establishment in 1754 (Historic Hillsborough Commission 1966). Lot 98 is the oldest section of the cemetery. A map of Hillsborough from 1768 shows the lot to have been heavily wooded and filled with crosses. Many of the tombstones from this period have likely been damaged or removed since the eighteenth century. There are reports of wandering cows and pigs into the 1870s, which is likely the reason the four high brick enclosures were constructed in Lot 98. To the north and west of Lot 98, the Hooper compound was a private family cemetery first used in the 1790s. William Hooper, a signer of the Declaration of Independence, is buried here (Historic Hillsborough Commission 1966). This cemetery was later expanded and merged with Lot 98.

The survey area is a grassy, mowed lawn with mature trees. The cemetery is located to the north and the west of the Hillsboro Presbyterian Church and the Orange County Historical Museum, at the corner of West Tyron Street and North Churton Street. Survey area soils are Georgeville-Urban land complex (GhC) with 2-10 percent slopes (Soil Survey Staff 2015). These are moderately well-drained silt and clay loam soils with a depth to the water table of over 80 inches (2 m). Fieldwork was conducted August 18-19, 2016 under the supervision of Sarah Lowry, with assistance from Ashley Krauss.

The report is divided into three chapters. After this chapter introducing the investigation and description of the project setting, Chapter II discusses methods employed during the field investigations. Chapter III discusses the field investigation results and recommendations. After the References Cited, Appendix A contains a table of the possible graves identified.

Figure 1.
Project Location Map

Imagery Source: USDA NAIP 2014

II. METHODS

New South's geophysical survey of the selected portions of the Old Town Cemetery focused on determining the number and position of unmarked and marked graves. Field efforts included the use of ground-penetrating radar (GPR) and total station mapping of relevant markers to match the existing cemetery map (Historic Hillsborough Commission 1966).

GPR SURVEY GRIDS AND MARKER MAPPING

A total of three GPR grids (0.314-ac.) were established using metric measuring tapes. Grids were placed to cover Lot 98, the Heartt Plot, and the eastern half of the Hooper Compound (Figure 2). Transects were collected in the north-south direction, perpendicular to the suspected burial orientation. Survey flags and temporary marking paint were used to mark each grid corner. Grid corners were also mapped using a Nikon total station and TDS Recon data collector. In addition to mapping grid corners, a series of control points were collected on markers within the cemetery with the overall goal of georeferencing the 1966 cemetery marker map (Historic Hillsborough Commission 1966).

All data were downloaded from the total station and then imported into ArcMap 10, ESRI's geographic information system (GIS) program. Separate shapefiles were then created for the surface grave features, GPR interpretations, and grids. A scanned copy of the 1966 cemetery map was imported to ArcMap to be georeferenced. The control points collected in the cemetery were associated with the drawn markers on the cemetery map. Unfortunately, the 1966 cemetery map appeared to be not drawn to scale even though there was a scale mark noted on the map. It was impossible to georeference the data without skewing the map. A rough georeferenced map was made for report purposes, but marker locations may be slightly inaccurate. A new map of the cemetery would be necessary to accurately map marker locations.

GROUND PENETRATING RADAR (GPR)

GPR is a remote sensing technique frequently used by archaeologists to investigate a wide range of research questions. In archaeological applications, GPR is used to prospect for potential subsurface features. Because GPR is a remote sensing technique, it is non-invasive, non-destructive, relatively quick, efficient, and highly accurate when used in appropriate situations. In cemeteries, GPR is commonly used to identify anomalies consistent with the expectations for human graves (Jones 2008; King et al. 1993).

Figure 2.
GPR Grid

Imagery Source: USDA NAIP 2014

The use of GPR for identifying potential historic graves is based on the concept of contrast, which may include differences in physical, electrical, or chemical properties between an object or feature and its surrounding matrix (Conyers 2004a). For graves, the body itself is generally not detected; it is typically the coffin or casket, burial shaft, or bottom of the grave that causes the reflection (Jones 2008; King et al. 1993). Not surprisingly, greater contrast generally equates to better detection and resolution. For example, a metal casket in a concrete vault is much easier to see with GPR than a body buried in a wooden coffin only.

GPR data are acquired by transmitting pulses of radar energy into the ground from a surface antenna, reflecting the energy off buried objects, features, or bedding contacts, and then detecting the reflected waves back at the ground surface with a receiving antenna (Conyers 2004a). When collecting radar reflection data, surface radar antennas are moved along the ground in transects, typically within a survey grid, and a large number of subsurface reflections are collected along each line. As radar energy moves through various materials, the velocity of the waves will change depending on the physical and chemical properties of the material through which they are traveling (Conyers and Lucius 1996). The greater the contrast in electrical and magnetic properties between two materials at an interface, the stronger the reflected signal, and, therefore, the greater the amplitude of reflected waves (Conyers 2004b).

When travel times of energy pulses are measured, and their velocity through the ground is known, distance (or depth in the ground) can be accurately measured (Conyers and Lucius 1996). Each time a radar pulse traverses a material with a different composition or water saturation, the velocity will change and a portion of the radar energy will reflect back to the surface and be recorded. The remaining energy will continue to pass into the ground to be further reflected, until it finally dissipates with depth.

The depths to which radar energy can penetrate, and the amount of resolution that can be expected in the subsurface, are partially controlled by the frequency (and therefore the wavelength) of the radar energy transmitted (Conyers 2004b). Standard GPR antennas propagate radar energy that varies in frequency from about 10 megahertz (MHz) to 1,000 MHz. Low frequency antennas (10-120 MHz) generate long wavelength radar energy that can penetrate up to 50 meters in certain conditions but are capable of resolving only very large buried features. In contrast, the maximum depth of penetration of a 900 MHz antenna is about one meter or less in typical materials, but its generated reflections can resolve features with a maximum dimension of a few centimeters. A trade-off therefore exists between depth of penetration and subsurface resolution.

The success of GPR surveys in archaeology is largely dependent on soil and sediment mineralogy, ground moisture, subsurface material moisture retention, the depth of buried features, feature preservation, and surface topography and vegetation. Electrically conductive or highly magnetic materials will quickly attenuate radar energy and prevent its transmission to depth. Depth penetration varies considerably depending on local conditions. Subsurface materials that absorb and retain large amounts of water can effect GPR depth penetration because of their low relative dielectric permittivity (RDP). In practical applications, this generally results in shallower than normal depth penetration because the radar signal is absorbed (attenuated) by the materials regardless of antenna frequency (Conyers 2004a; 2012; Conyers and Lucius 1996). Differential water retention can also positively affect data when a material of interest, such as a burial, retains more water than the surrounding soils and, therefore, presents a greater contrast.

The basic configuration for a GPR survey consists of an antenna (with both a transmitter and receiver), a harness or cart, and a wheel for calibrating distance. The operator then pulls or pushes the antenna across the ground surface systematically (a grid) collecting data along transects. These data are then stored by the receiver and available for later processing.

The "time window" within which data were gathered was 45 nanoseconds (ns). This is the time during which the system is "listening" for returning reflections from within the ground. The greater the time window, the deeper the system can potentially record reflections. To convert time in nanoseconds to depth, it is necessary to determine the elapsed time it takes the radar energy to be transmitted, reflected, and recorded back at the surface by doing a velocity test. Hyperbolas were found on reflection profiles and measured to yield a relative dielectric permittivity (RDP), which is a way to calculate velocity. The shape of hyperbolas generated in programs is a function of the speed at which electromagnetic energy moves in the ground, and can therefore be used to calculate velocity (Conyers and Lucius 1996). The RDP for soils in the cemetery area was approximately 13.39, which, when converted to one-way travel time, (the time it takes the energy to reach a reflection source), is approximately 8.2 centimeters/nanosecond. All profiles and processed maps were converted from time in nanoseconds to depth in centimeters using this average velocity.

GPR FIELD METHODS

The first step was to calibrate the antenna to local conditions by walking the survey area and adjusting the instrument's gain settings. This method allows the user to get an average set of readings based on subtle changes in the RDP (Conyers 2004b). Field calibration was repeated as necessary to account for changes in soil and/or moisture conditions (Conyers 2004a). Effective depth penetration was approximately 1.65 meters (5.4 ft.). This is an adequate depth penetration for a 400 MHz antenna, with only slight signal attenuation at the bottom of the profile.

The field survey was conducted using a GSSI SIR-3000 using a 400 MHz antenna over the selected areas. Total survey area was approximately 0.314 acres (1,271 sq. m). It is generally standard practice to orient transects perpendicular to the long axis of suspected features. In this case, data were collected roughly north-south as Christian burials are generally oriented east-west. Transect spacing was 50 centimeters, an interval that has been demonstrated to generate the best resolution possible while still maintaining field efficiency (Pomfret 2005). Transects were collected in a zig-zag pattern, alternating starting direction, and started in the southwest grid corners.

GPR DATA PROCESSING

All data were downloaded from the control unit to a laptop computer for post-processing. Radar signals are initially recorded by their strength and the elapsed time between their transmission and reception by the antenna. Therefore, the first task in the data processing was to set "time zero", which tells the software where in the profile the true ground surface was. This is critical to getting accurate results when elapsed time is converted to target depth. A background filter was applied to the data, which removes the horizontal banding that can result from antenna energy "ringing" and outside frequencies such as cell phones and radio towers. Background noise can make it difficult to visually interpret reflections. Hyperbolic reflections are generated from the way the radar energy reflects off point targets. In cemeteries, graves are often visible as hyperbolic reflections.

The next data processing step involved the generation of amplitude slice-maps (Conyers 2004b). Amplitude slice-maps are a three-dimensional tool for viewing differences in reflected amplitudes across a given surface at various depths. Reflected radar amplitudes are of interest because they measure the degree of physical and chemical differences in the buried materials. Strong, or high amplitude reflections often indicate denser (or different) buried materials. Such reflections can be generated at pockets of air, such as within collapsed graves, or from slumping sediments. Amplitude slice-maps are generated through comparison of reflected amplitudes between the reflections recorded in vertical profiles. Amplitude variations, recorded as digital values, are analyzed at each location in a grid of many profiles where there is a reflection recorded. The amplitudes of all reflection traces are compared to the amplitudes of all nearby traces along each profile. This database can then be "sliced" horizontally and displayed to show the variation in reflection amplitudes at a sequence of depths in the ground. The result is a map that shows amplitudes in plan view, but also with depth.

Slicing of the data was done using the mapping program Surfer 8. Slice maps are a series of x,y,z values, with x (east) and y (north) representing the horizontal location on the surface within each grid and z representing the amplitude of the reflected waves. All data were interpolated using the Inverse Distance Weighted method and then image maps were generated from the resulting files.

From the original .dzt files (raw reflection data), a series of image files was created for cross-referencing to the amplitude slice maps that were produced. Two-dimensional reflection profiles were also analyzed to determine the nature of the features identified on the amplitude slice maps. The reflection profiles show the geometry of the reflections, which can lend insight into whether the radar energy is reflecting from a flat layer (seen as a distinct band on profile) or a single object (seen as a hyperbola in profile). Individual profile analysis was used in conjunction with amplitude slice maps to provide stronger interpretations about possible graves.

The final step in the data processing was to integrate the depth slices with other spatial data. This was done using ArcGIS 10, which can display and manipulate all forms of spatial data created for this project, including GPR results, cemetery features, grid data, and base graphics such as aerial photography and topographic maps. The resulting anomalies were digitized as individual features and referenced to the coordinate system.

GEOPHYSICS IN CEMETERIES

Several factors influence the overall effectiveness of geophysics for detecting anomalies consistent with individual graves. Contrast between the remains, grave shaft, coffin, or casket and the surrounding soils is the most important variable. Remains that have a chemical or physical contrast from the subsurface materials surrounding them will cause GPR reflections of electromagnetic energy. Age of the graves is critical to this contrast. Older graves typically have less contrast and are more difficult to detect because they have had more time to decompose and are less likely to have intact coffins or caskets (if these were present to begin with).

The burial “container” that the remains may have been placed in is also important and includes simple linen or cloth shrouds, pine boxes or wooden coffins, lead or other metal caskets, and burial vaults. In certain cases, hardware such as nails, hinges, and handles may be present, but not necessarily all the time. Although there is a high degree of variation in specific container types among different geographical regions, each of these tends to have been used at certain times throughout history and correlates with the presumed age of the grave. For example, burial shrouds were common throughout the seventeenth and early eighteenth centuries before being replaced by wooden coffins. It must also be noted that cultural trends and patterns tended to persist much longer in rural and/or economically depressed areas than in urban centers.

III. RESULTS AND RECOMMENDATIONS

The primary purpose of this survey was to identify geophysical anomalies consistent with the expected signature for burials. To accomplish this, control points were collected on a selection of standing markers to georeference the 1966 cemetery marker map. Then GPR survey and the georeferenced map results were combined to establish an estimated number of individuals buried in the cemetery and produce a map of marked and unmarked burials.

CEMETERY MAPPING RESULTS

The 1966 map of cemetery markers was an imperfect spatial reference, probably because it was inaccurately scaled or mapped originally. However, the number of markers and their relative positions were correct. For the present survey, rough positions of markers shown on the 1966 map were georeferenced and labeled with the same numbers used on the earlier map. These were superimposed on a plan of the sections of the Hillsborough cemetery covered by the present investigations (Figure 3). There were 31 single headstones, two double-person headstones, and four brick family plot boundaries (of which only the Heartt plot was surveyed) within the study area. The number of individuals buried in the surveyed areas was estimated at 35.

GPR RESULTS

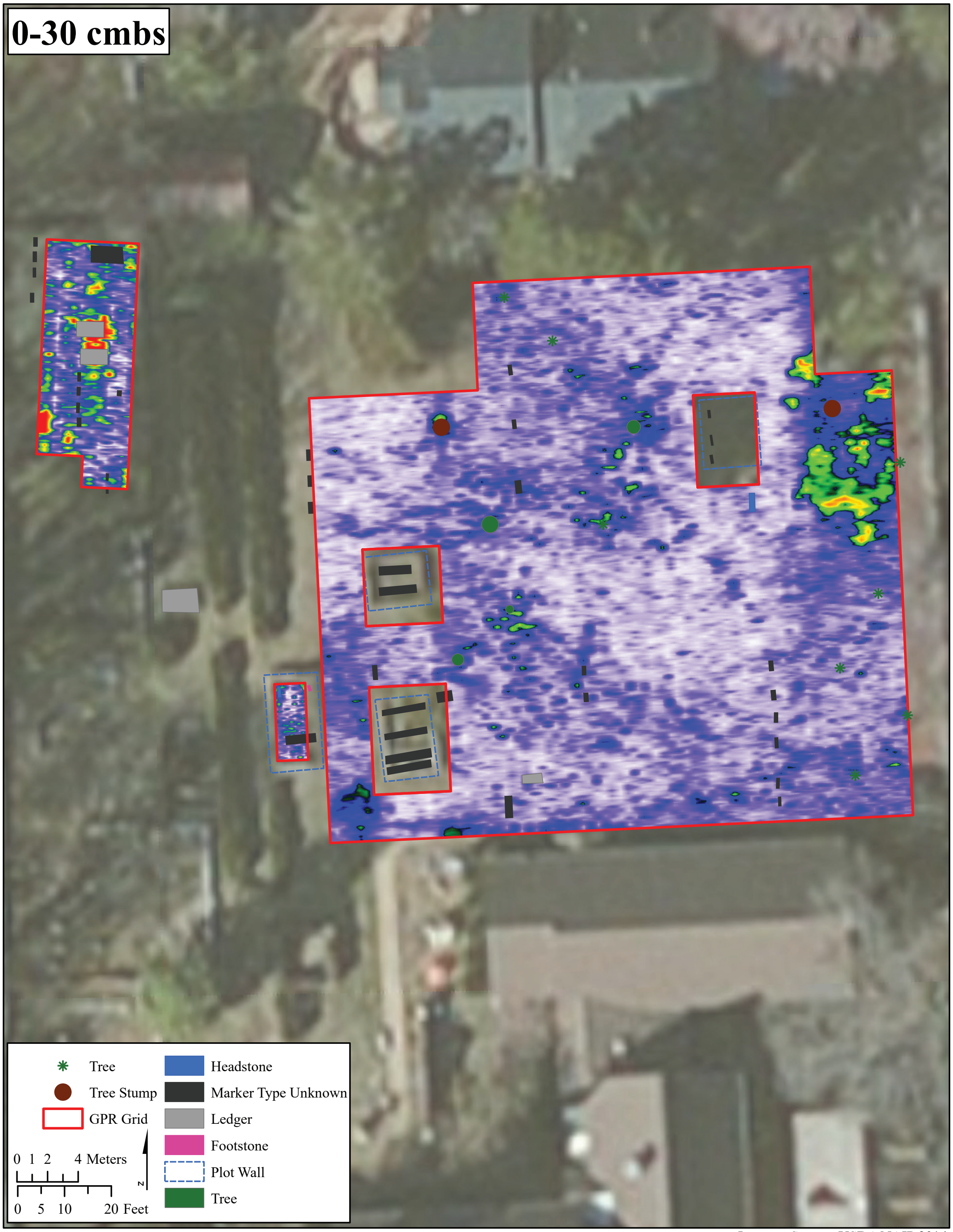
GPR results were based on analysis of the 400MHz data, including individual reflection profiles and amplitude slice maps (Figures 4-9). Burials appear in the GPR results as a contrast with their surrounding soils. The GPR survey identified 125 probable graves (Appendix A). Of these, 31 were associated with some form of grave marker and 94 were not indicated by any surface evidence. Of the single or double markers on the 1966 cemetery map, all but three had associated GPR anomalies. As noted, many of the monuments were probably plotted incorrectly on the 1966 map, making georeferencing inaccurate. Therefore, a great deal of latitude was given in matching anomalies with grave markers. With respect to the three markers lacking associated GPR anomalies, these could reflect instances where markers were moved away from the burial, monuments being placed for someone buried elsewhere, or the grave lacking sufficient contrast for detection with GPR.

New South approaches the identification of graves based on geophysical data conservatively. The probable graves in the survey area were identified based on their size, shape, depth, orientation, and overall characteristics in both plan and profile (Figure 10). Many factors

Figure 3.
Markers Shown on the 1966 Cemetery Map Superimposed on the Project Plan

Imagery Source: USDA NAIP 2014

Figure 4.
GPR Amplitude Slice Map, 0-30 Centimeters Below Surface (cmbs)



Imagery Source: USDA NAIP 2014

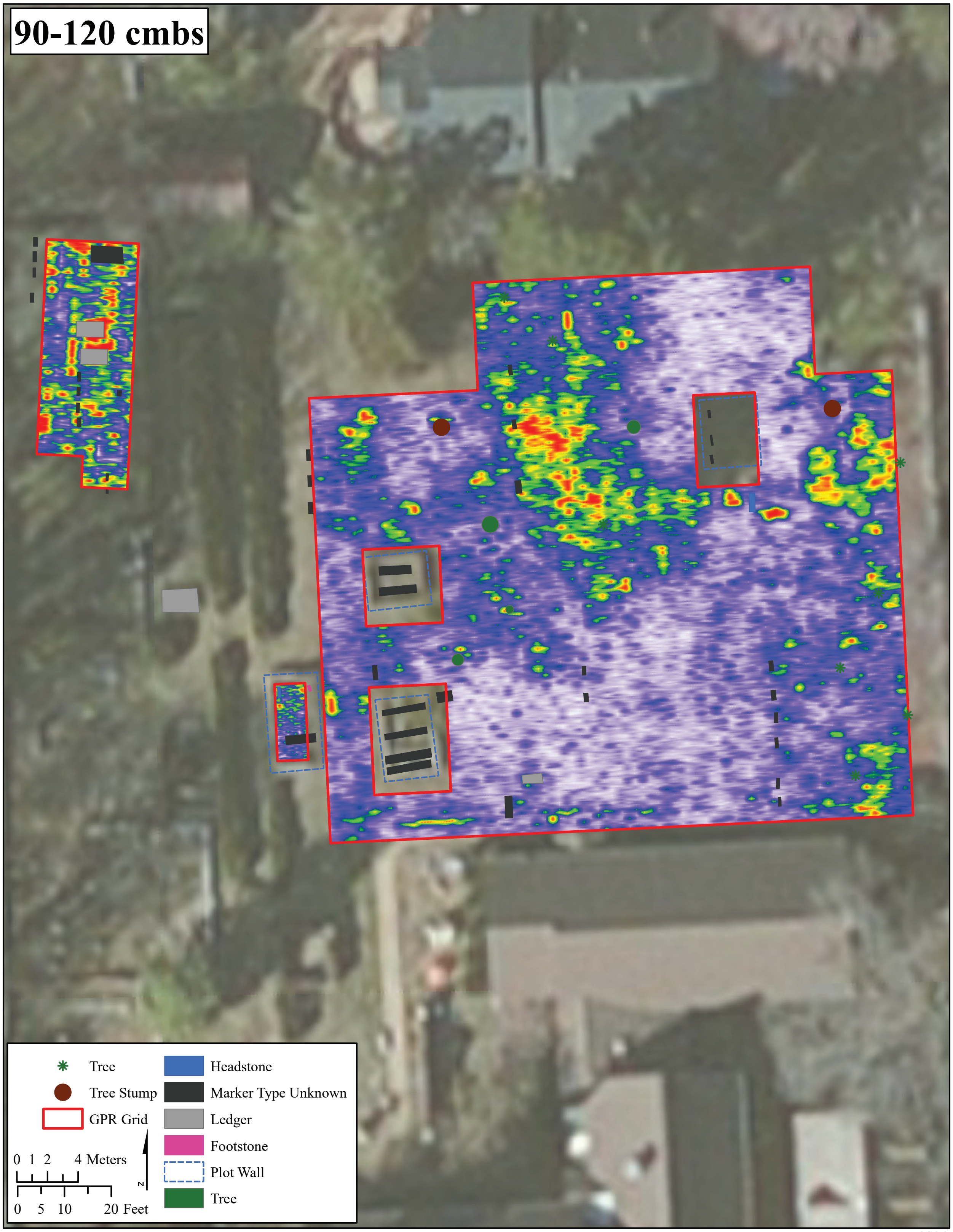
Figure 5.
GPR Amplitude Slice Map, 30-60 cmbs

Imagery Source: USDA NAIP 2014

Figure 6.
GPR Amplitude Slice Map, 60-90 cmbs

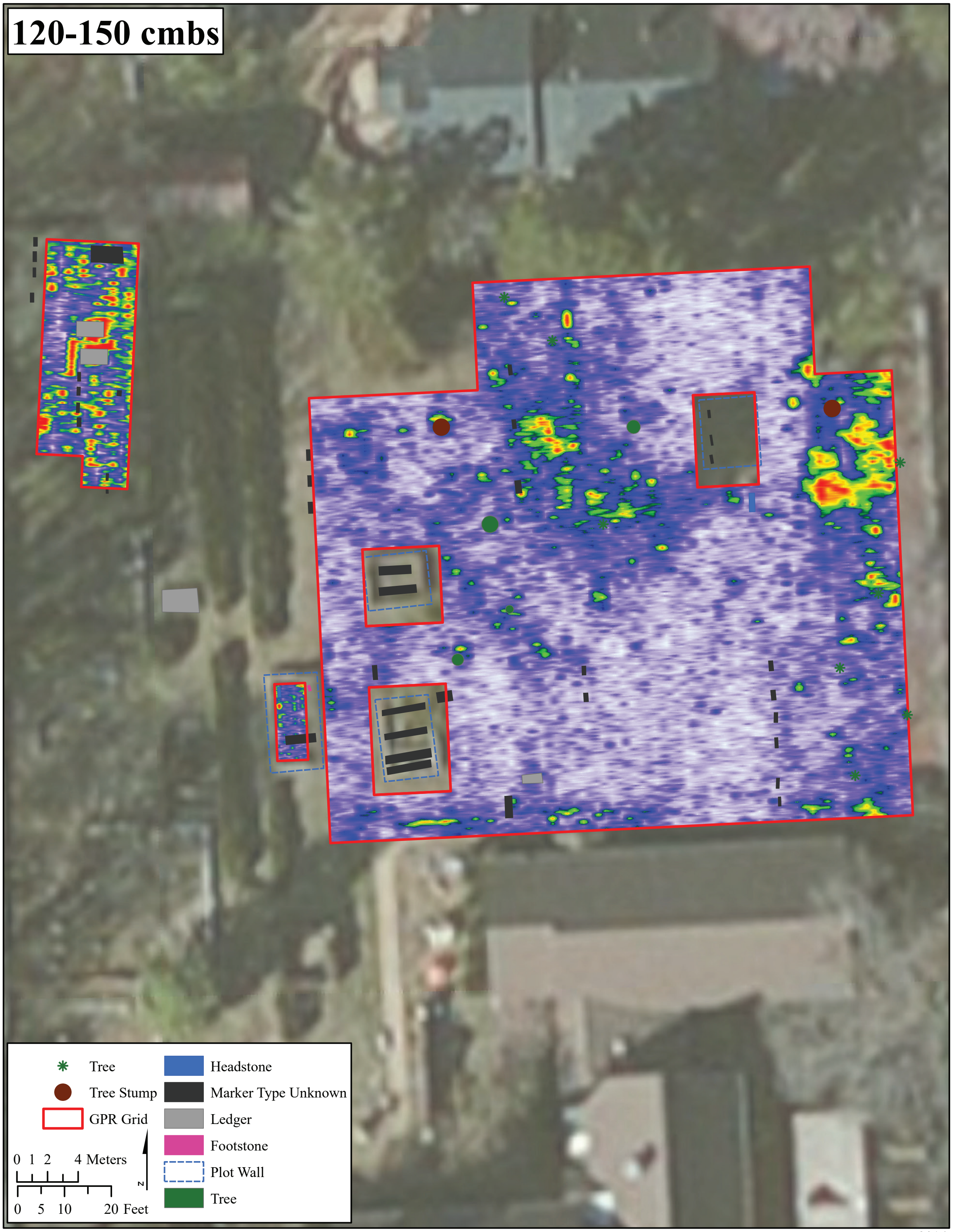
Imagery Source: USDA NAIP 2014

Figure 7.
GPR Amplitude Slice Map, 90-120 cmbs



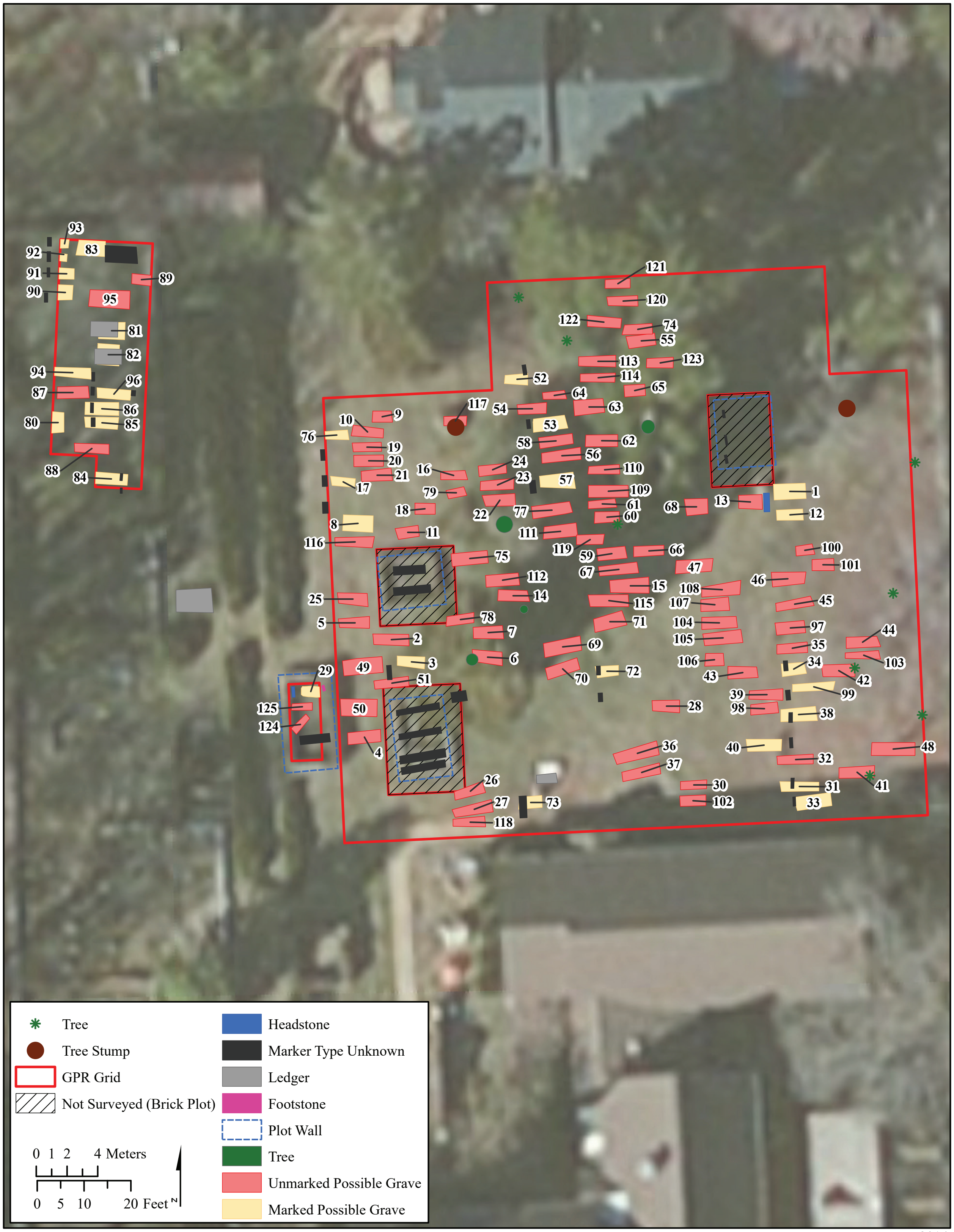
Imagery Source: USDA NAIP 2014

Figure 8.
GPR Amplitude Slice Map, 120-150 cmbs



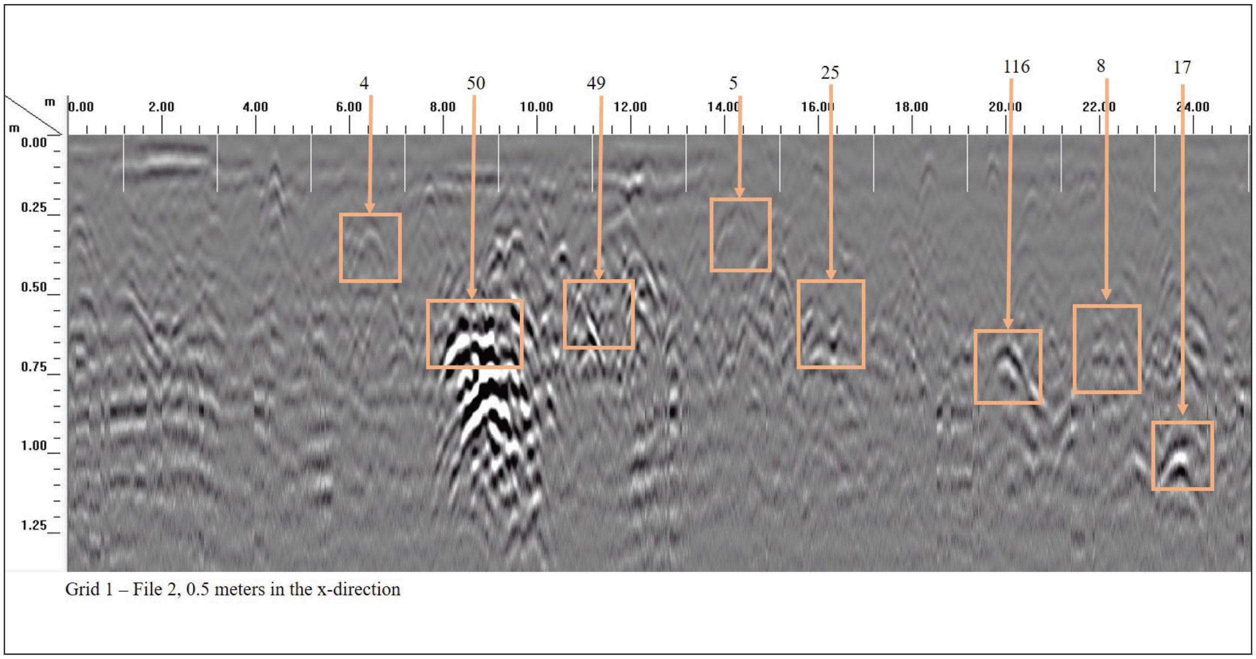
Imagery Source: USDA NAIP 2014

Figure 9.
GPR Results on Cemetery Map

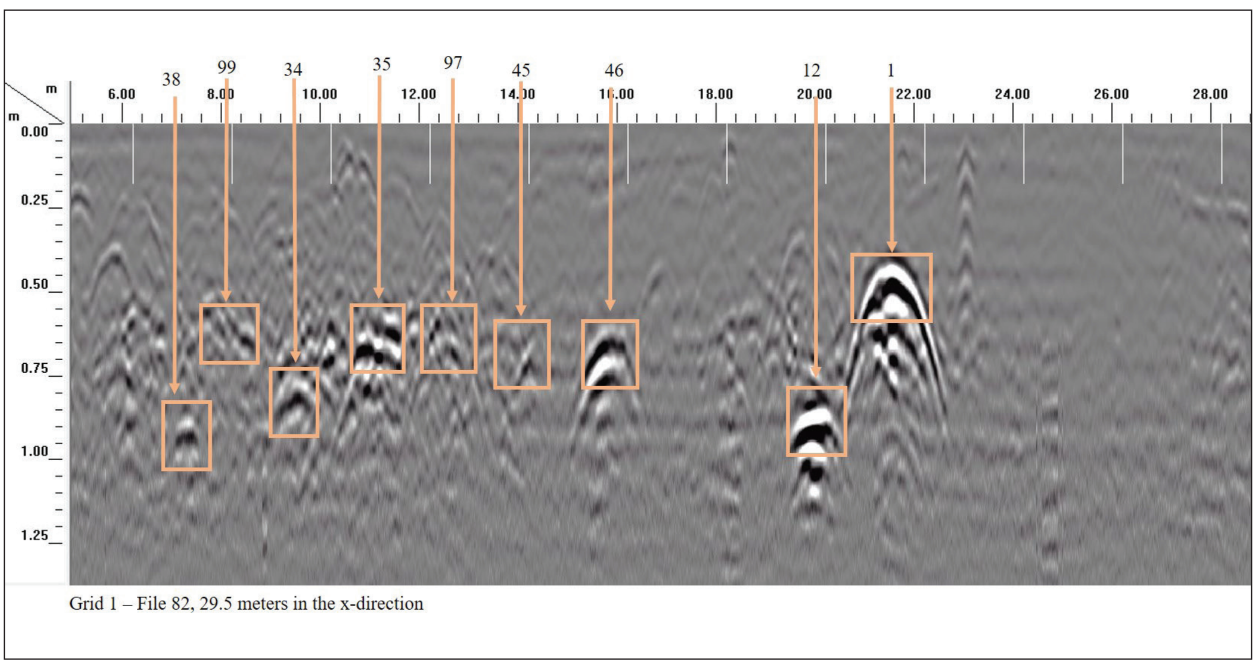


Imagery Source: USDA NAIP 2014

Figure 10.
Example of Graves in Profile



A. Grid 1, File 2



B. Grid 1, File 82

influence the overall effectiveness of geophysics for detecting anomalies consistent with graves including soil type and acidity, moisture and precipitation, soils magnetic properties, age of probable graves, likely burial depth, and burial container (e.g., shroud, wood coffin, metal casket, and concrete vault). In general, if the anomaly has any of the characteristics of a burial it is marked as a potential burial. Because of this, it is likely that some of the possible burials identified are false positives and were identified as burials incorrectly. It is impossible to conclusively identify burials without excavation, and caution is used in all interpretations made with GPR.

SUMMARY

The surveyed sections of the Old Town Cemetery have 31 possible graves either marked with a headstone or ledger, or are plotted on the 1966 map. Additionally, the GPR survey identified 94 possible graves having no surface indications. The estimated number of individuals within the surveyed area, including markers and GPR anomalies is 129.

The 94 unmarked burials within the survey is high compared to the number of markers, but not unusual for a cemetery used consistently for a long time period. Grave markers are often, but not always, a reasonable estimate of internment numbers. In a cemetery dating to the eighteenth century, markers may have been displaced, destroyed, or constructed of impermanent materials, and some graves were never marked. The anomaly patterns show that the unmarked burials fall within rows and clusters as would be expected in an organized community cemetery. Rows of marked graves often continue with several unmarked graves. Burial placement seems to be orderly throughout the cemetery.

RECOMMENDATIONS

The geophysical survey results identified a total of 125 possible graves, of which 31 had an associated marker. New South Associates recommends that the markers and geophysical anomalies identified as probable graves should be treated as such. The GPR results indicate this cemetery has a dense number of marked and unmarked burials. Because burials could have been missed due to lack of preservation and ground conditions, caution should be taken if any ground is to be disturbed within the vicinity of the cemetery. Great care should be taken if future internments are planned in the cemetery, both to avoid the graves identified in this survey and to consider any unmarked graves that might have been missed. If avoidance of known graves is not possible, then additional steps should be taken in compliance with North Carolina Statute Chapter 65 on Cemeteries.

REFERENCES CITED

Conyers, Lawrence

2004a Moisture and Soil Differences as Related to the Spatial Accuracy of GPR Amplitude Maps at Two Archaeological Test Sites. Paper presented at the Tenth International Conference on Ground Penetrating Radar, The Netherlands.

2004b *Ground-Penetrating Radar for Archaeology*. AltaMira Press, Walnut Creek, California.

2012 *Interpreting Ground-Penetrating Radar for Archaeology*. Left Coast Press, Walnut Creek, California.

Conyers, Lawrence and Jeffery Lucius

1996 Velocity Analysis in Archaeological Ground Penetrating Radar Studies. *Archaeological Prospection* 3(1):25–38.

Historic Hillsborough Commission

1966 The Old Town Cemetery 1757, Hillsborough, North Carolina. The Historic Hillsborough Commission.

Jones, Geoffrey

2008 Geophysical Mapping of Historic Cemeteries presented at the Conference on Historical and Underwater Archaeology, Albuquerque, New Mexico.

King, Julia A., Bruce W. Bevan, and Robert J. Hurry

1993 The Reliability of Geophysical Surveys in Historic-Period Cemeteries: An Example from the Plains Cemetery, Mechanicsville, Maryland. *Historical Archaeology* 27(3):4–16.

Pomfret, James E.

2005 *Ground Penetrating Radar Survey at Andersonville National Historic Site*. Report available from the Georgia Department of Transportation. Atlanta, Georgia.

Soil Survey Staff

2015 Web Soil Survey. *Natural Resources Conservation Service, United States Department of Agriculture*. Electronic document, http://websoilsurvey.nrcs.usda.gov/app/homepage.htm, accessed September 10, 2015.

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APPENDIX A: POSSIBLE GRAVES

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Anomaly ID	Label	GPR Grid	Marked (Y/N?)	UTM Easting	UTM Northing
1	Possible Grave	Grid 1	Y	671107.59282	3994237.50886
2	Possible Grave	Grid 1	N	671081.66467	3994227.85878
3	Possible Grave	Grid 1	Y	671082.97599	3994226.41362
4	Possible Grave	Grid 1	N	671079.91494	3994221.51249
5	Possible Grave	Grid 1	N	671079.30516	3994228.96177
6	Possible Grave	Grid 1	N	671087.94932	3994226.72049
7	Possible Grave	Grid 1	N	671087.99712	3994228.32212
8	Possible Grave	Grid 1	Y	671079.50782	3994235.43081
9	Possible Grave	Grid 1	N	671081.06717	3994242.37583
10	Possible Grave	Grid 1	N	671080.09858	3994241.38419
11	Possible Grave	Grid 1	N	671082.73168	3994234.85112
12	Possible Grave	Grid 1	Y	671107.61880	3994235.98806
13	Possible Grave	Grid 1	N	671105.05667	3994236.82968
14	Possible Grave	Grid 1	N	671089.59186	3994230.72122
15	Possible Grave	Grid 1	N	671097.22535	3994231.36747
16	Possible Grave	Grid 1	N	671085.74013	3994238.55304
17	Possible Grave	Grid 1	Y	671078.52504	3994238.14091
18	Possible Grave	Grid 1	N	671083.85687	3994236.38257
19	Possible Grave	Grid 1	N	671080.08478	3994240.40183
20	Possible Grave	Grid 1	N	671080.18840	3994239.50649
21	Possible Grave	Grid 1	N	671080.73669	3994238.56466
22	Possible Grave	Grid 1	N	671088.73163	3994236.94589
23	Possible Grave	Grid 1	N	671088.57824	3994237.93517
24	Possible Grave	Grid 1	N	671088.23857	3994238.91931
25	Possible Grave	Grid 1	N	671079.20511	3994230.50619
26	Possible Grave	Grid 1	N	671086.79088	3994217.99070
27	Possible Grave	Grid 1	N	671087.06291	3994216.81108
28	Possible Grave	Grid 1	N	671099.57166	3994223.53755
29	Possible Grave	GPR 2	Y	671076.42205	3994224.47708
30	Possible Grave	Grid 1	N	671101.35192	3994218.39955
31	Possible Grave	Grid 1	Y	671108.22245	3994218.29807
32	Possible Grave	Grid 1	N	671107.98550	3994220.04587
33	Possible Grave	Grid 1	Y	671109.12720	3994217.32080
34	Possible Grave	Grid 1	Y	671107.82850	3994225.93946
35	Possible Grave	Grid 1	N	671107.77280	3994227.29718
36	Possible Grave	Grid 1	N	671097.67403	3994220.46349
37	Possible Grave	Grid 1	N	671097.96866	3994219.21040
38	Possible Grave	Grid 1	Y	671108.20854	3994222.98414
39	Possible Grave	Grid 1	N	671106.11582	3994224.27387

Anomaly ID	Label	GPR Grid	Marked (Y/N?)	UTM Easting	UTM Northing
40	Possible Grave	Grid 1	Y	671105.92908	3994220.99565
41	Possible Grave	Grid 1	N	671111.98493	3994219.22289
42	Possible Grave	Grid 1	N	671110.79206	3994225.85162
43	Possible Grave	Grid 1	N	671104.50454	3994225.71830
44	Possible Grave	Grid 1	N	671112.32760	3994227.69193
45	Possible Grave	Grid 1	N	671107.92522	3994230.17926
46	Possible Grave	Grid 1	N	671107.47755	3994231.83401
47	Possible Grave	Grid 1	N	671101.36037	3994232.65348
48	Possible Grave	Grid 1	N	671114.33803	3994220.73692
49	Possible Grave	Grid 1	N	671079.82109	3994226.12823
50	Possible Grave	Grid 1	N	671079.56128	3994223.43286
51	Possible Grave	Grid 1	N	671081.70843	3994225.03443
52	Possible Grave	Grid 1	Y	671089.84311	3994244.81170
53	Possible Grave	Grid 1	Y	671091.97471	3994241.92200
54	Possible Grave	Grid 1	N	671090.84740	3994242.89754
55	Possible Grave	Grid 1	N	671097.93790	3994247.32436
56	Possible Grave	Grid 1	N	671092.77002	3994239.84164
57	Possible Grave	Grid 1	Y	671092.53404	3994238.19309
58	Possible Grave	Grid 1	N	671092.37347	3994240.79917
59	Possible Grave	Grid 1	N	671096.01379	3994233.46627
60	Possible Grave	Grid 1	N	671095.68337	3994235.83856
61	Possible Grave	Grid 1	N	671095.41104	3994236.69761
62	Possible Grave	Grid 1	N	671095.35653	3994240.81229
63	Possible Grave	Grid 1	N	671094.51150	3994243.01780
64	Possible Grave	Grid 1	N	671092.29965	3994243.76710
65	Possible Grave	Grid 1	N	671097.50678	3994244.08587
66	Possible Grave	Grid 1	N	671098.41665	3994233.64016
67	Possible Grave	Grid 1	N	671096.48006	3994232.43314
68	Possible Grave	Grid 1	N	671101.52703	3994236.52404
69	Possible Grave	Grid 1	N	671092.81358	3994227.39560
70	Possible Grave	Grid 1	N	671092.81252	3994225.96271
71	Possible Grave	Grid 1	N	671095.88216	3994229.02955
72	Possible Grave	Grid 1	Y	671095.70654	3994225.80833
73	Possible Grave	Grid 1	Y	671090.72454	3994217.26023
74	Possible Grave	Grid 1	N	671097.72256	3994248.06429
75	Possible Grave	Grid 1	N	671086.76285	3994233.14601
76	Possible Grave	Grid 1	Y	671078.14631	3994241.18066
77	Possible Grave	Grid 1	N	671092.08106	3994236.30055
78	Possible Grave	Grid 1	N	671086.16314	3994229.16714

Anomaly ID	Label	GPR Grid	Marked (Y/N?)	UTM Easting	UTM Northing
79	Possible Grave	Grid 1	N	671085.90409	3994237.42016
80	Possible Grave	Grid 3	Y	671059.96619	3994241.99964
81	Possible Grave	Grid 3	Y	671063.45363	3994247.98267
82	Possible Grave	Grid 3	Y	671063.24360	3994246.41950
83	Possible Grave	Grid 3	Y	671062.13993	3994253.34195
84	Possible Grave	Grid 3	Y	671063.44810	3994238.33250
85	Possible Grave	Grid 3	Y	671062.83414	3994241.98983
86	Possible Grave	Grid 3	Y	671062.83447	3994242.89990
87	Possible Grave	Grid 3	N	671060.94111	3994243.95701
88	Possible Grave	Grid 3	N	671062.19881	3994240.31126
89	Possible Grave	Grid 3	N	671065.40966	3994251.30197
90	Possible Grave	Grid 3	Y	671060.44763	3994250.47123
91	Possible Grave	Grid 3	Y	671060.52654	3994251.68953
92	Possible Grave	Grid 3	Y	671060.32148	3994252.74661
93	Possible Grave	Grid 3	Y	671060.39678	3994253.64551
94	Possible Grave	Grid 3	Y	671060.98701	3994245.24948
95	Possible Grave	Grid 3	N	671063.34703	3994250.03586
96	Possible Grave	Grid 3	Y	671063.60968	3994243.85780
97	Possible Grave	Grid 1	N	671107.64293	3994228.63008
98	Possible Grave	Grid 1	N	671105.95636	3994223.37053
99	Possible Grave	Grid 1	Y	671109.16459	3994224.78630
100	Possible Grave	Grid 1	N	671108.57990	3994233.68490
101	Possible Grave	Grid 1	N	671109.77676	3994232.73269
102	Possible Grave	Grid 1	N	671101.30733	3994217.37568
103	Possible Grave	Grid 1	N	671112.41083	3994226.84511
104	Possible Grave	Grid 1	N	671102.99651	3994228.95728
105	Possible Grave	Grid 1	N	671103.26110	3994227.97285
106	Possible Grave	Grid 1	N	671102.69184	3994226.55070
107	Possible Grave	Grid 1	N	671102.74698	3994230.13374
108	Possible Grave	Grid 1	N	671103.20642	3994231.11762
109	Possible Grave	Grid 1	N	671095.77828	3994237.52169
110	Possible Grave	Grid 1	N	671095.54711	3994238.91887
111	Possible Grave	Grid 1	N	671092.68038	3994234.91484
112	Possible Grave	Grid 1	N	671088.90875	3994231.73352
113	Possible Grave	Grid 1	N	671095.11714	3994245.98961
114	Possible Grave	Grid 1	N	671095.12714	3994244.91525
115	Possible Grave	Grid 1	N	671095.83242	3994230.39801
116	Possible Grave	Grid 1	N	671079.31092	3994234.22582
117	Possible Grave	Grid 1	N	671085.83241	3994242.10439

Anomaly ID	Label	GPR Grid	Marked (Y/N?)	UTM Easting	UTM Northing
118	Possible Grave	Grid 1	N	671086.79722	3994215.97710
119	Possible Grave	Grid 1	N	671094.60725	3994234.38379
120	Possible Grave	Grid 1	N	671096.75467	3994249.91240
121	Possible Grave	Grid 1	N	671096.40826	3994251.04366
122	Possible Grave	Grid 1	N	671095.50007	3994248.54436
123	Possible Grave	Grid 1	N	671099.16839	3994245.88288
124	Possible Grave	GPR 2	N	671075.74862	3994222.35781
125	Possible Grave	GPR 2	N	671075.87096	3994223.49020