

GROUND PENETRATING RADAR SURVEY  
OF THE  
HISTORIC FRIENDSHIP CHAPEL BAPTIST  
CHURCH CEMETERY

Wake County, North Carolina  
New South Associates, Inc.



Intentionally Left Blank

# Ground Penetrating Radar Survey of the Historic Friendship Chapel Baptist Church Cemetery

Wake County, North Carolina

Report submitted to:

---

Wake Forest Historical Association • 414 N. Main Street • Wake Forest, NC 27587

Report prepared by:

---

New South Associates • 6150 East Ponce de Leon Avenue • Stone Mountain, Georgia 30083



---

Shawn Patch – Principal Investigator

Sarah Lowry – Geophysical Archaeologist and Author

April 14, 2017 • **Draft Report**  
New South Associates Technical Report 2695

Intentionally Left Blank

# ABSTRACT

New South Associates, Inc. conducted a ground-penetrating radar (GPR) survey of the historic Friendship Chapel Baptist Church Cemetery, Wake County, North Carolina. The purpose of the survey was to identify and map unmarked graves, grave markers, and collapsed grave depressions to establish a cemetery boundary. Approximately 400 individual marked and unmarked graves were identified on the basis of surface features. The GPR identified a total of 277 possible graves in the surveyed areas and the outline of one possible unmarked mass burial. Of the possible graves, 167 were not indicated with markers, fieldstones, or collapsed grave depressions. Between geophysical and surface survey an estimated total of 567 individuals were identified in the cemetery. This number likely underrepresents the actual total because the GPR survey was limited by vegetation and slope.

New South Associates recommends that the 567 markers and anomalies identified as possible graves should be treated as such. Ground disturbance within the cemetery boundary established during this survey should be avoided. Also, because burials could remain undetected due to lack of preservation, ground conditions, and the inability to perform a comprehensive GPR survey, caution should be taken if any ground is to be disturbed within the cemetery or near its boundary. If avoidance is not possible, then additional steps should be taken to relocate the burials in compliance with North Carolina Statutes, Chapter 65, Article 12, Abandoned and Neglected Cemeteries.

## ACKNOWLEDGEMENTS

New South Associates thanks the community of the Friendship Chapel Baptist Church for their continued support and enthusiasm for this project. Additionally, the Wake County Historical Society provided valuable information, in field support, and sponsored this project. Colin Bean and John Kimes provided assistance during the fieldwork.

# TABLE OF CONTENTS

ABSTRACT .....	i
ACKNOWLEDGEMENTS .....	ii
TABLE OF CONTENTS .....	iii
LIST OF FIGURES .....	iv
I. INTRODUCTION .....	1
II. METHODS .....	5
GPR FIELD METHODS .....	9
GPR DATA PROCESSING .....	9
GEOPHYSICS IN CEMETERIES .....	10
III. RESULTS AND RECOMMENDATIONS .....	13
CEMETERY MAPPING RESULTS .....	13
GPR RESULTS .....	13
SUMMARY .....	22
RECOMMENDATIONS .....	24
REFERENCES CITED .....	25
APPENDIX A: GPR ANOMALIES - POSSIBLE GRAVE LOCATIONS	
APPENDIX B: DETAILED CEMETERY MAPS	

# LIST OF FIGURES AND TABLES

Figure 1. Cemetery Location in Wake County, North Carolina .....	2
Figure 2. Photographs of Formal Headstones .....	3
Figure 3. Geophysical Grid Locations .....	6
Figure 4. Map of Surface Features Indicating Grave Locations .....	14
Figure 5. GPR Amplitude Slice Map, 0-30 Centimeters Below Surface .....	15
Figure 6. GPR Amplitude Slice Map, 30-60 Centimeters Below Surface .....	16
Figure 7. GPR Amplitude Slice Map, 60-90 Centimeters Below Surface .....	17
Figure 8. GPR Amplitude Slice Map, 90-120 Centimeters Below Surface .....	18
Figure 9. GPR Amplitude Slice Map, 120-150 Centimeters Below Surface .....	19
Figure 10. GPR Results on Cemetery Map .....	20
Figure 11. Examples of Graves in Profile .....	21
Figure 12. Cemetery Boundary .....	23
Table 1. GPR Grids .....	5
Table 2. Summary of Graves .....	24

# I. INTRODUCTION

New South Associates, Inc. conducted a ground-penetrating radar (GPR) survey of the historic Friendship Chapel Baptist Church Cemetery, Wake County, North Carolina (County PIN 1840546558) (Figure 1). The goal of the survey was to identify and map unmarked graves, grave markers, and collapsed grave depressions to establish the boundary of the cemetery. Fieldwork was conducted in February 2017.

The historic Friendship Chapel Baptist Church Cemetery (referred to as the Friendship Cemetery) is associated with the present day church, although it is no longer used for interment. Oral history suggests that prior to emancipation, the African American community used the area containing the cemetery for covert Christian worship services. Following emancipation, the community continued to meet at site and began using the area as a cemetery. The landowner eventually deeded the parcel to the church. The church's pastor, Dr. Enoch Holloway, believes that the cemetery was first used following emancipation and was formally closed around the 1950's when it was determined to be full.

The historic cemetery is located in a suburban residential neighborhood at the terminus of South Franklin Street and approximately 0.4 mile (0.64 km) southeast of the Friendship Chapel Baptist Church. It occupies a southeast-facing ridge flank in the uplands along Smith Creek. Vegetation at the time of the fieldwork consisted of forest with mature trees and sporadic understory. The steep terrain and vegetation prevented complete GPR coverage over the entire cemetery.

Two soil types were identified in the survey area Cecil sandy loam (CeB2 and CeC2) and Wilkes loam (WwF) (Soil Survey Staff 2015). Within the cemetery, Cecil sandy loam soils are classified as having 2-6 percent slopes (CeB2) and 6-10 percent slopes (CeC2). These soils are moderately eroded sandy loams that cover the majority of the cemetery. The Wilkes loam soils have 20-45 percent slopes.

There is no formal layout of burials in the Friendship Cemetery. Markers are clustered in small, unorganized groups. There are only 16 formal headstones. Some of these are manufactured using traditional tools and forms, while others exhibit vernacular designs with unique hand carvings (Figure 2). Most graves are marked with only fieldstones. Additionally, there is evidence of vandalism in the cemetery, with some markers broken or defaced with spray paint. Some markers may have been stolen or displaced.

Figure 1.  
Cemetery Location in Wake County, North Carolina



Imagery Source: USDA NAIP 2014

Figure 2.  
Photographs of Formal Headstones



A. Handmade Headstone: "Helen  
Dunn was born March 1884 Died Feb  
1898"



B. Handmade Headstone with  
Carving and Decorative Cut Shape

The report is divided into three chapters. This chapter (Chapter I) introduces the investigation and describes the project setting. Chapter II discusses methods employed during the field investigations and Chapter III discusses the field investigation results and recommendations. Appendix A has a table with possible grave anomaly locations and Appendix B has detailed maps of the cemetery markers and GPR results.

## II. METHODS

New South's archaeological investigations at the historic Friendship Cemetery focused on determining the cemetery size and extent. Field efforts included a GPR survey and mapping marked and possible unmarked graves. GPR grids were established where terrain permitted, with particular emphasis placed on the perimeter of the cemetery. It was not possible to conduct a comprehensive GPR survey of the cemetery due to the terrain and vegetation.

### MAPPING AND GPR SURVEY GRIDS

Prior to mapping, the entire survey area was walked systematically and all possible grave features were flagged. At the Friendship Cemetery these included formal headstones and footstones; fieldstones that were deliberately placed in the ground, presumably to signify burials; depressions that could indicate collapsed graves; and a single rock pile. Each of these identified features was mapped using a Nikon total station and TDS Recon data collector to collect several points establishing their size, shape, and location.

GPR grids were established using metric measuring tapes. Grid corners were placed to cover a total survey area of 0.87 acres (3,504 sq. m) (Figure 3, Table 1). Survey flags and temporary marking paint were used to indicate each grid corner. Grid corners were also mapped using a Nikon total station and TDS Recon data collector.

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. The advantage of this method is that each feature now has associated coordinates and can be relocated.

*Table 1. GPR Grids*

Label	Acres	Square Meters
GPR 1	0.33	1,320
GPR 2	0.27	1,092
GPR 3	0.11	450
GPR 4	0.09	384
GPR 5	0.06	258
Total	0.87	3,504

Figure 3.  
Geophysical Grid Locations



Imagery Source: USDA NAIP 2014

## 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).

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 emit

radar energy varying from about 10 to 1,000 megahertz (MHz) in frequency. Low frequency antennas (10-120 MHz) generate long wavelength radar energy that can penetrate up to 50 meters in certain conditions but resolve 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. Thus, a trade-off 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 13.5, which, when converted to one-way travel time, (the time it takes the energy to reach a reflection source), is approximately 8 centimeters/nanosecond. All profiles and processed maps were converted from time in nanoseconds (ns) 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 1.83 meters (6 ft.). This is an adequate depth penetration for a 400 MHz antenna, slight signal attenuation occurred at the bottom of the profile.

The field survey was conducted using a GSSI SIR-3000 using a 400 MHz antenna over all areas suitable for GPR grids within the cemetery. Total survey area was approximately 0.86 acres. It is generally standard practice to orient transects perpendicular to the long axis of suspected features. In this case data were collected roughly north to south as Christian burials are generally oriented east to 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 corner.

## 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 receipt 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 is 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 physical 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.

The Friendship Cemetery is an African American burial ground thought to date between the late nineteenth and mid-twentieth centuries. Both marked and unmarked graves are present, and many of the more formal monuments are hand-carved and probably do not reflect the work of professional stone carvers. In the period immediately following the Civil War through the early twentieth century, African American residents of Wake County likely faced significant economic disadvantages. It is probable that many people buried in this cemetery could not afford formal funerary materials such as caskets, coffins, or professionally made memorials. Burial containers made of less substantial material (e.g., wood or cloth shrouds), combined with the age of the burials makes the GPR data more difficult to interpret because grave remains will be more ephemeral.

Intentionally Left Blank

### III. RESULTS AND RECOMMENDATIONS

The primary purpose of this survey was to identify geophysical anomalies consistent with the expected signature for burials and surface indications of graves. The mapping and GPR survey results were together and used to establish an estimated number of individuals buried in the cemetery and draw a cemetery boundary.

#### CEMETERY MAPPING RESULTS

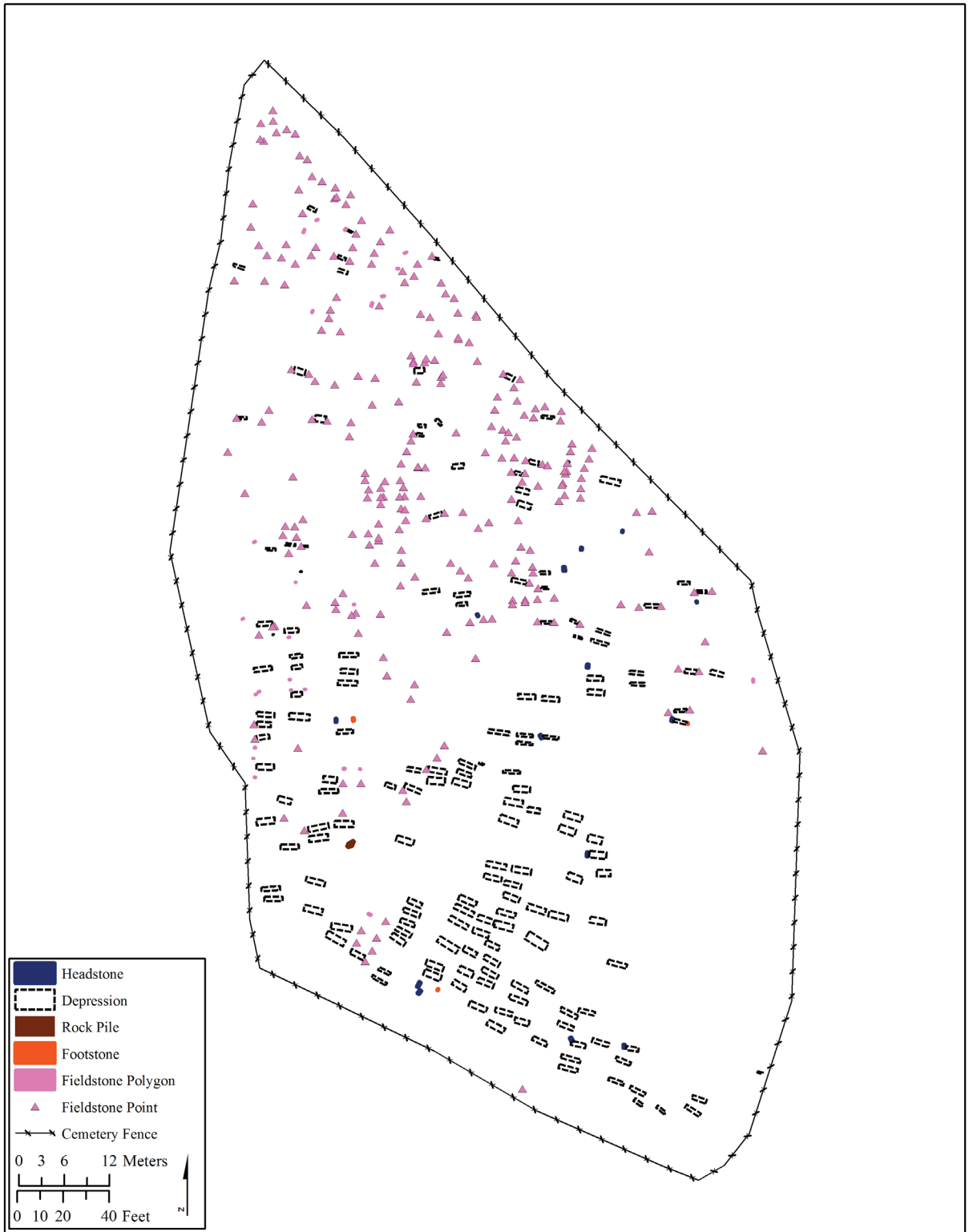
The pedestrian survey and mapping of the cemetery identified 16 formal headstones, three formal footstones, 286 markers consisting of fieldstones, and one pile of fieldstones, as well as 164 surface depressions that likely reflect collapsed coffins (Figure 4). When depressions and markers were associated and aligned with each other, they were considered single grave features. Some of the stone markers were lined up in a way that suggested they could comprise the head- and footstones of single graves. This type of pairing was unusual among non-formal stone markers, however, and because no names were inscribed on the markers, it was impossible to determine if the possible footstones were actually associated with the headstone or if they represent a separate headstone in the next row. In most cases, the possible footstones were designated as separate headstones markers. Based on the pedestrian survey, the funerary features suggested 400 individual burials.

#### GPR RESULTS

GPR results were based on analysis of the 400MHz data, including individual reflection profiles and amplitude slice maps (Figures 5-10, Appendices A and B). The GPR identified the burials as a contrast with their surrounding soils. In the GPR results, 277 possible individual graves were identified along with one possible mass burial. Of the possible graves, 167 were not indicated by surface features and 110 were associated with a previously identified marker or depression.

Church oral history reported that a mass burial was used to inter victims of the influenza epidemic in the early twentieth century. A possible location of this internment was identified in the GPR results, but there were no surface indications of it. This area had individual burials within it and there was evidence of a large excavated area. There may be additional individuals within this interment that could not be detected with the GPR. The possible mass burial is identified as anomaly 401.

Figure 4.  
Map of Surface Features Indicating Grave Locations



Imagery Source: USDA NAIP 2014

Figure 5.  
GPR Amplitude Slice Map, 0-30 Centimeters Below Surface

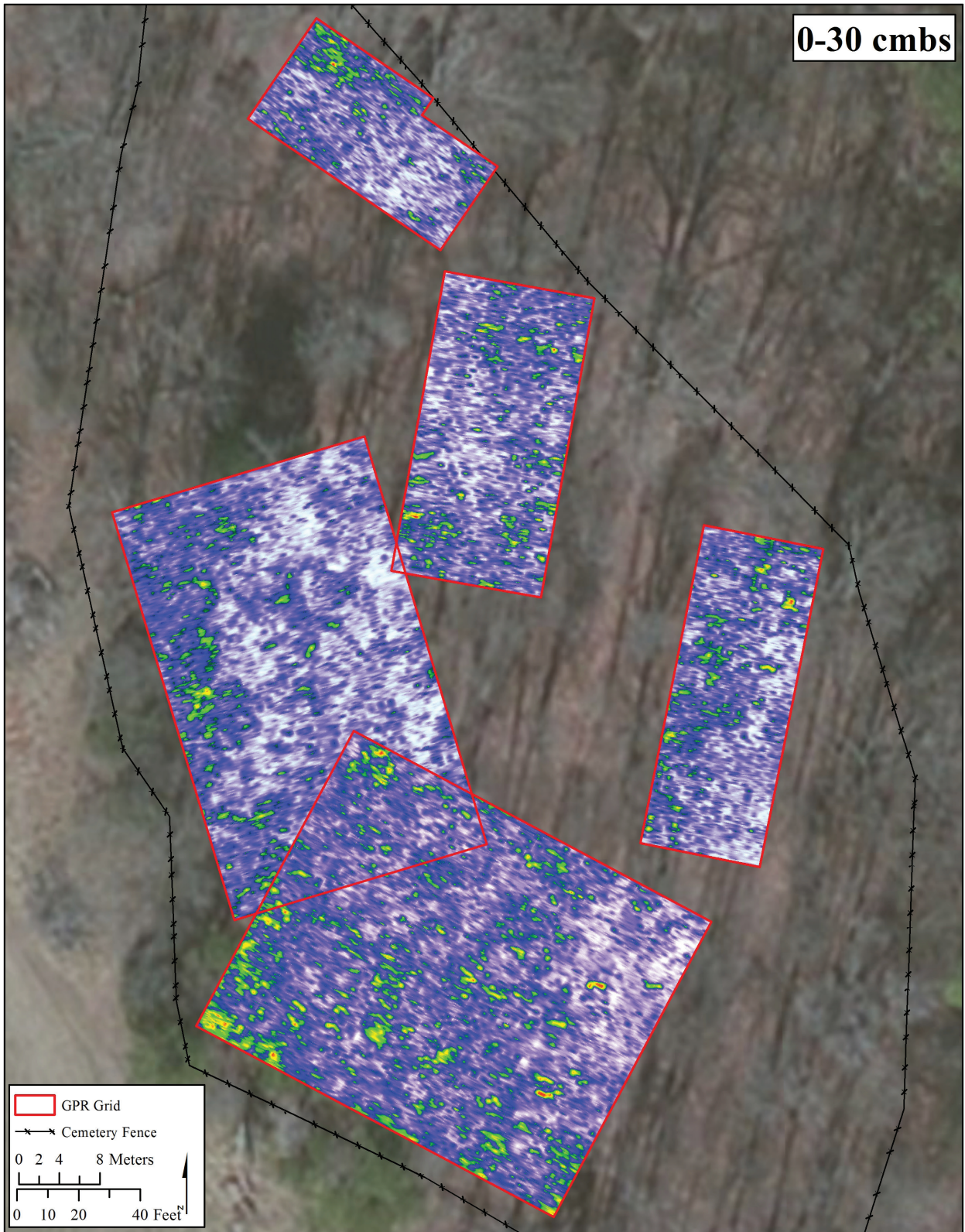


Figure 6.  
GPR Amplitude Slice Map, 30-60 Centimeters Below Surface

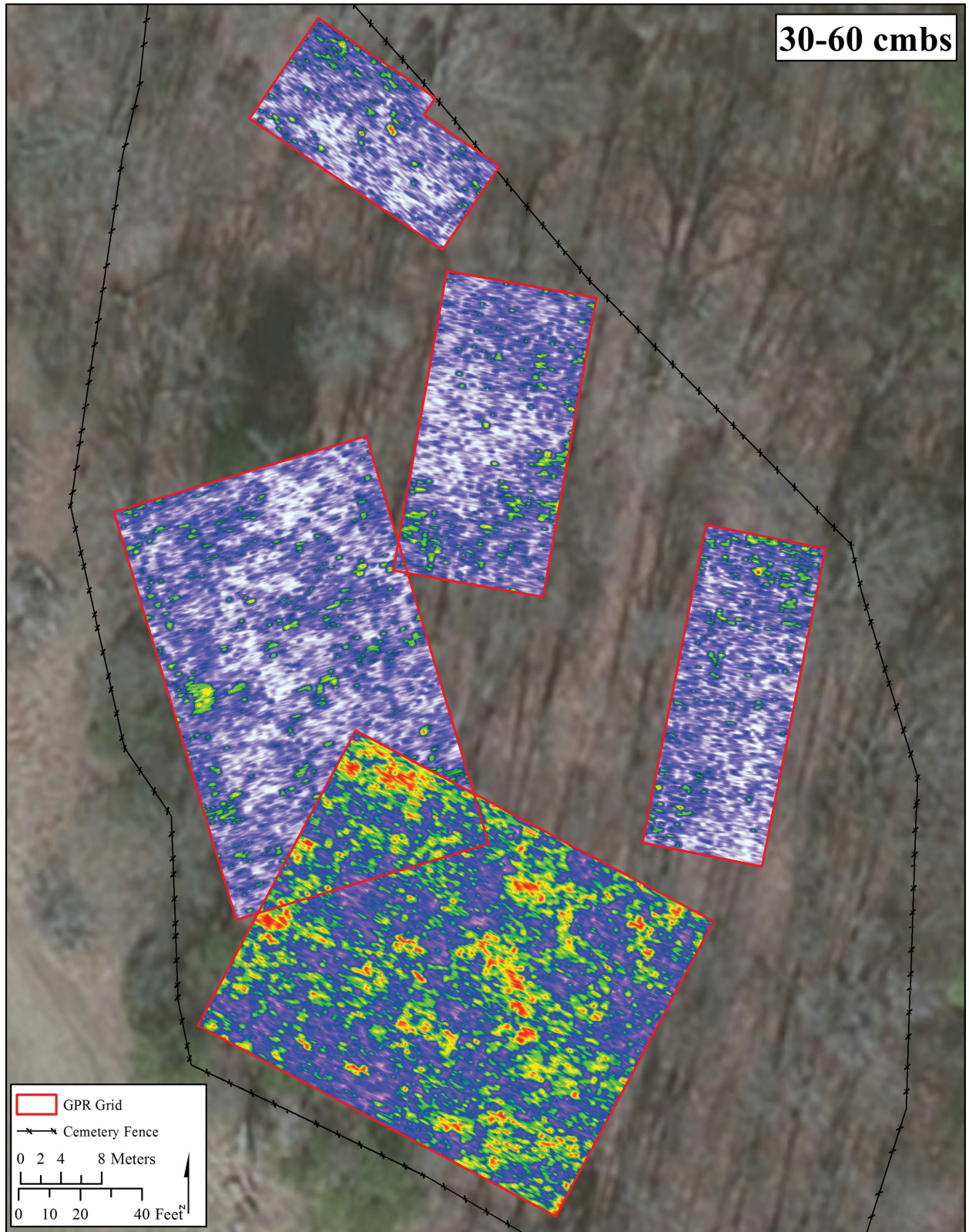


Figure 7.  
GPR Amplitude Slice Map, 60-90 Centimeters Below Surface

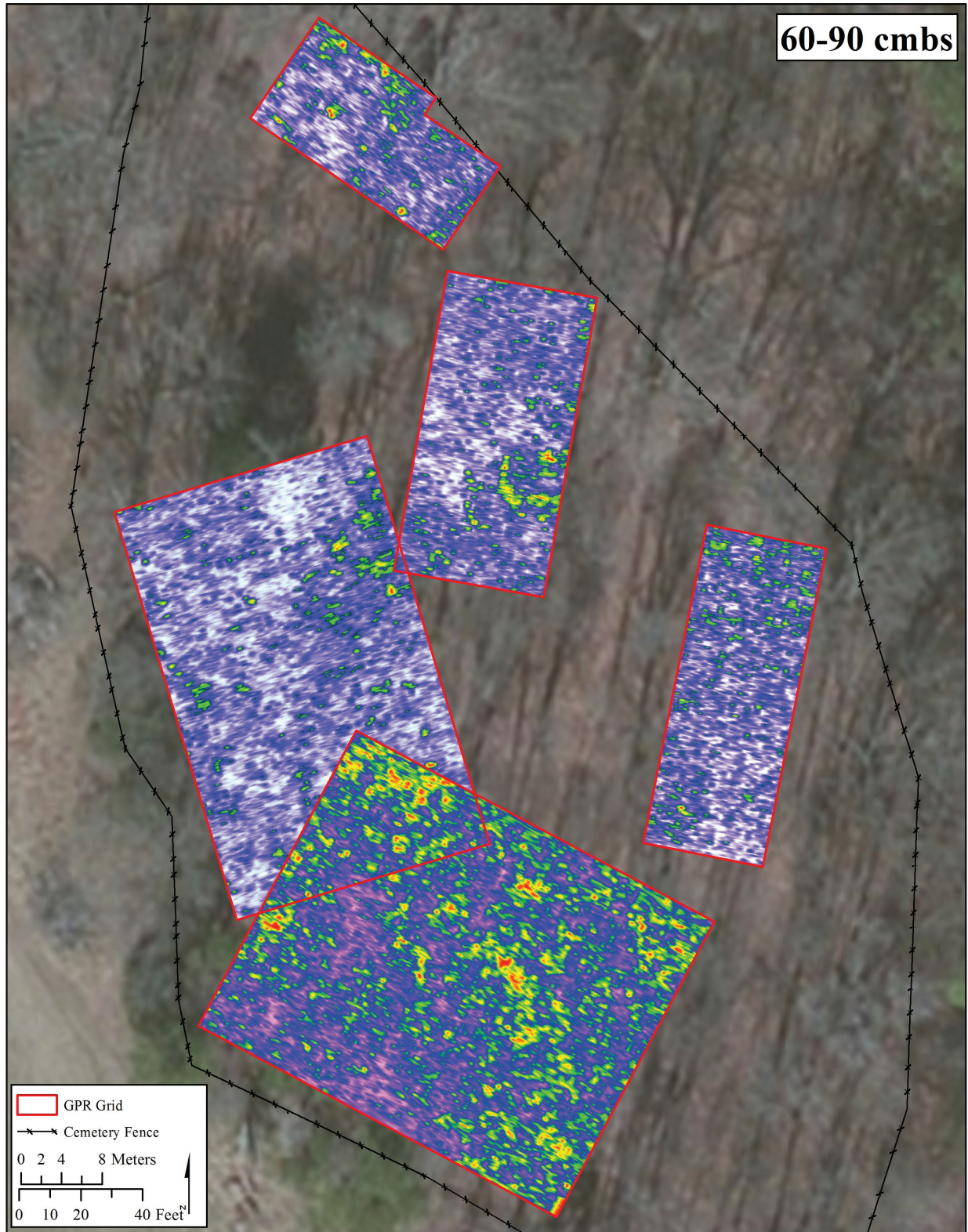


Figure 8.  
GPR Amplitude Slice Map, 90-120 Centimeters Below Surface

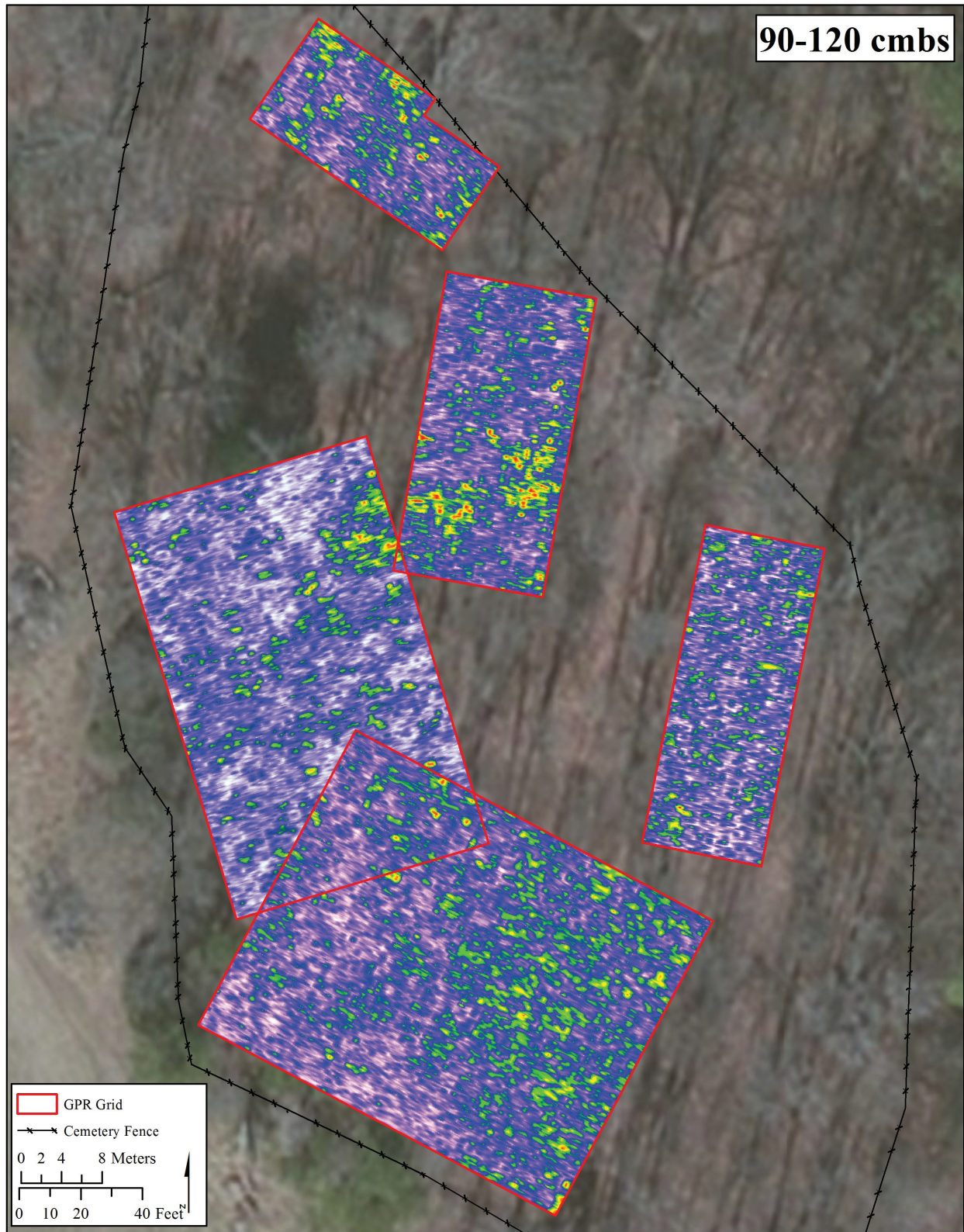


Figure 9.  
GPR Amplitude Slice Map, 120-150 Centimeters Below Surface

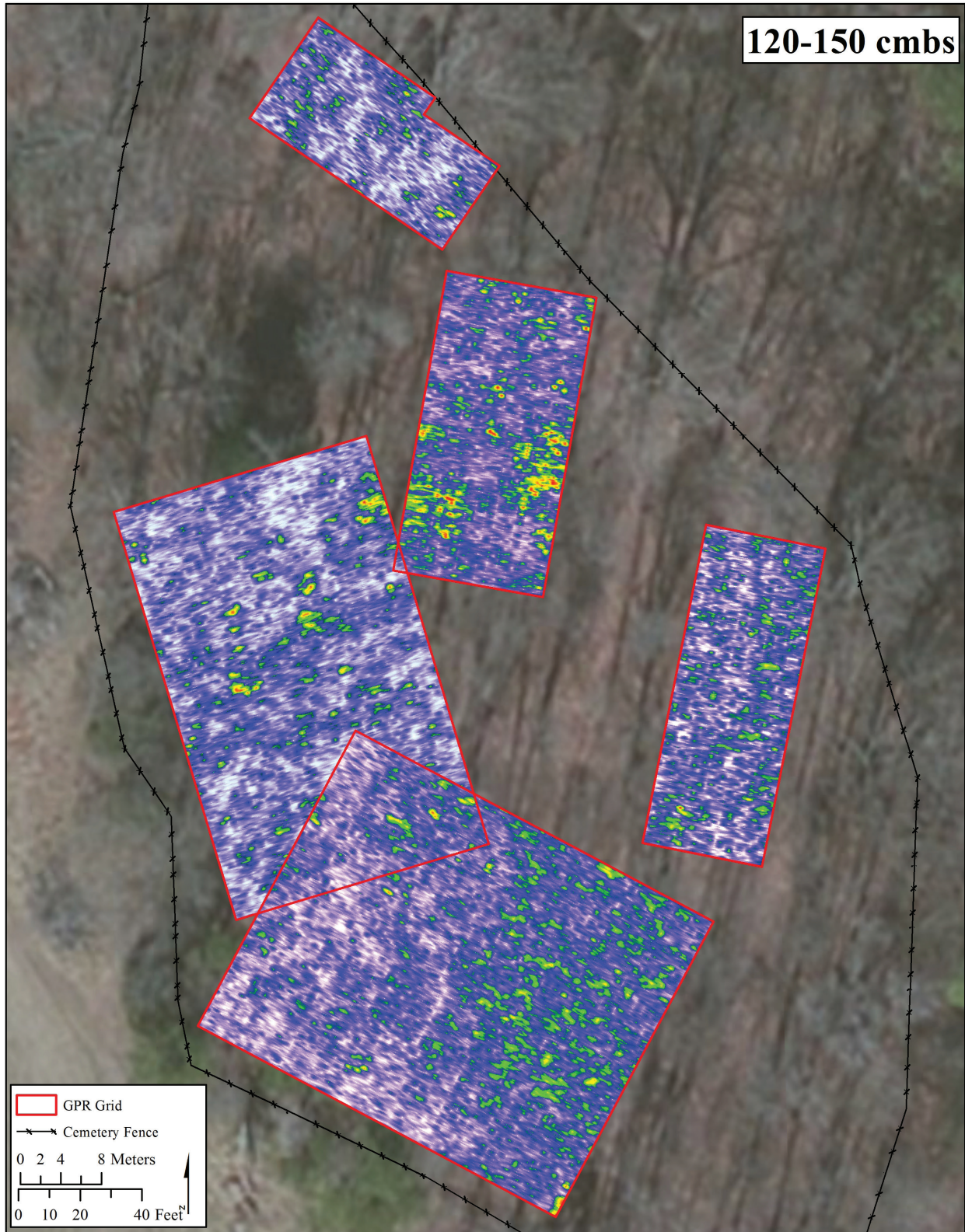
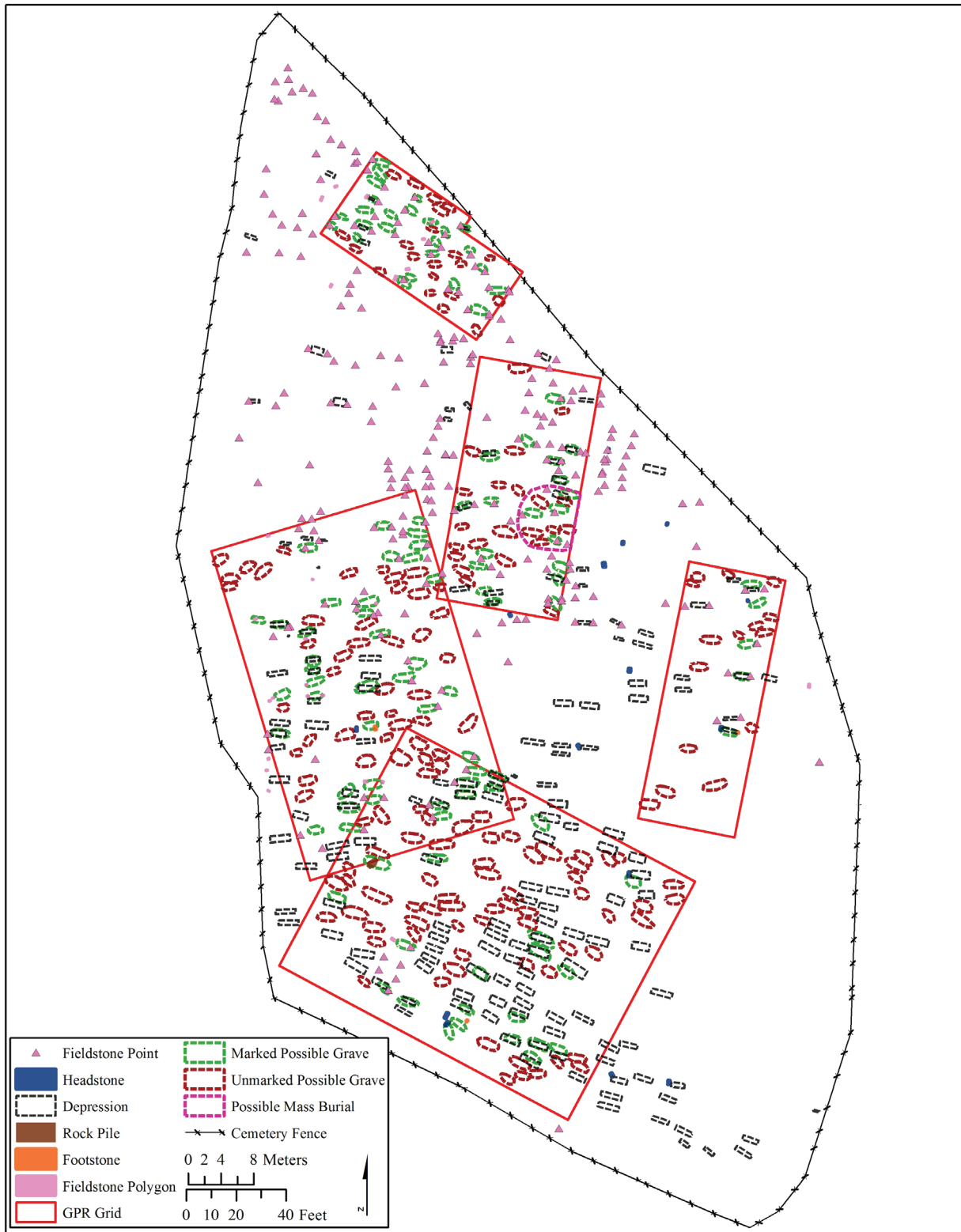


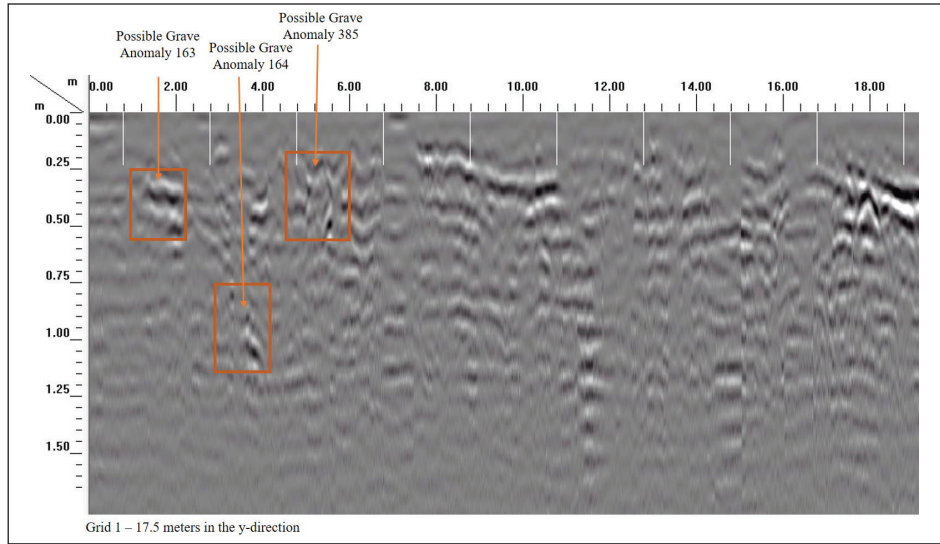
Figure 10.  
GPR Results



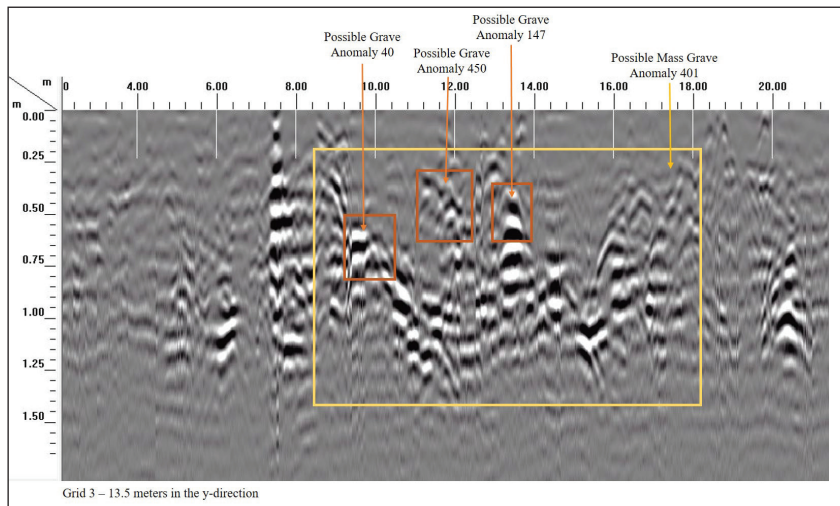
Imagery Source: USDA NAIP 2014

Figure 11.  
Examples of Graves in Profile

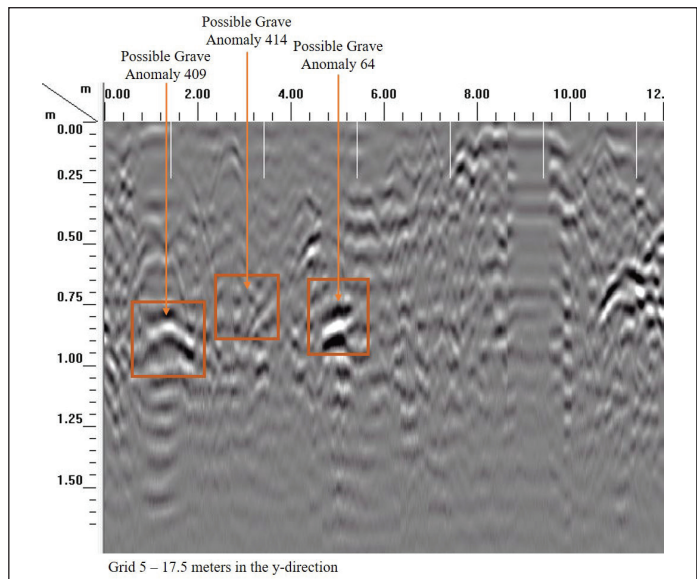
A. Grid 1



B. Grid 3



C. Grid 5



Many factors 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 possible graves, likely grave depth, and burial container (e.g., shroud, wood coffin, metal casket, concrete vault). The probable graves in the survey area were identified based on their size, shape, depth, orientation, and overall characteristics in plan and, where possible, GPR profile (Figure 11). New South takes a conservative approach to the identification of graves detected with geophysical data and, in general, if an anomaly has any of the attributes listed above, it is marked as a potential grave. Because of this, it is likely that some of the possible burials are false positives and were misidentified. It is impossible to conclusively ascertain the presence of burials without excavation, and caution is used in all interpretations made with GPR.

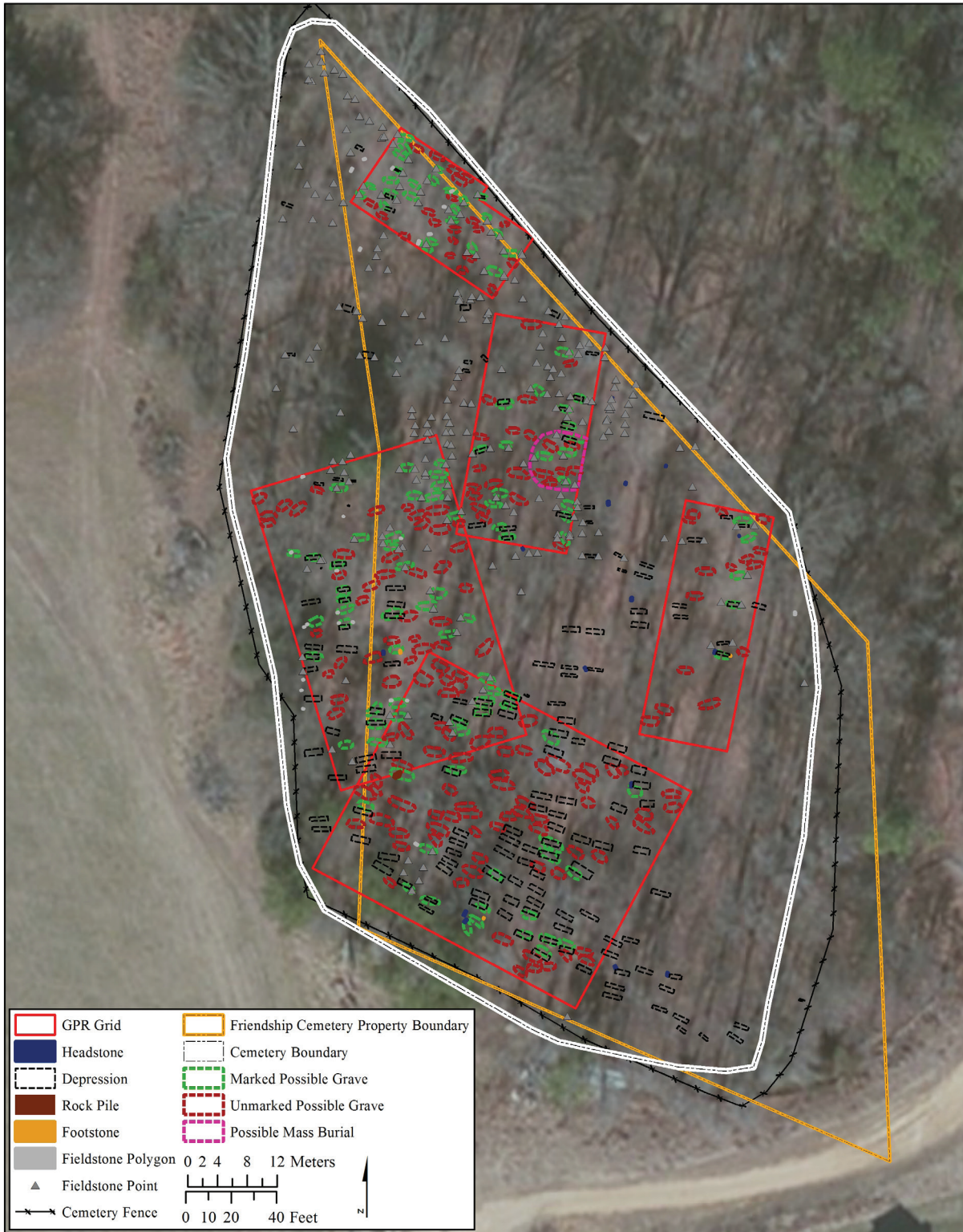
In the areas surveyed with GPR there were markers and depressions that did not have associated GPR anomalies. The grave stones may have been displaced from the associated burials. Alternatively, the burials may not have sufficient contrast with the surrounding soil to be visible in the GPR results. This condition can occur over time, as graves take on more of the characteristics of the adjacent matrix. As this happens, burials do not reflect GPR energy.

The cemetery has mature trees and some areas contained dense undergrowth. The trees' associated root systems were visible in the GPR results. Every effort was made to filter out the tree roots and interpret only possible graves in the GPR results, but it is probable that in some cases, anomalies identified as possible graves are actually tree roots, or that possible graves located very near the largest trees have been missed.

## SUMMARY

The historic Friendship Chapel Baptist Church Cemetery contains 469 surface features that indicate possible graves. These include formal markers, fieldstone markers, and depressions that reflect collapsed graves. In some instances, separate surface features denote a single grave (e.g., a headstone aligned with a depression). Accounting for these instances, 400 graves were mapped from surface indications. Additionally, GPR survey of accessible portions of the cemetery identified 167 anomalies consistent with burials that were not indicated by surface features of any kind, bringing the total number of individuals buried in the cemetery to 567. The GPR survey also detected 110 anomalies that were associated with surface features (a marker and/or depression) (Table 2). This calculation of individual burials probably underestimates the actual total because the GPR survey could not provide complete coverage due to vegetation and slope. Using the GPR results, surface features, and surface topography, a cemetery boundary was drawn (Figure 12).

Figure 12.  
Cemetery Boundary



Imagery Source: USDA NAIP 2014

*Table 2. Summary of Graves.*

Marker Type	Number
Formal Headstone	16
Formal Footstone	3
Fieldstone	286
Depression	164
Total Markers/Depressions	469
Total Number of Individual Burials	400
Marked GPR Anomalies	110
Unmarked GPR Anomalies	167
Possible Mass Grave	1
Total Number of GPR Anomalies	278
Estimated Number of Individuals	567

The large number of burials is not unusual for an African American cemetery of this age and type. The cemetery was in use by a growing community in post emancipation Wake Forest for nearly 100 years. Burials appear to be arranged in rough rows and clusters that may be family groups or may reflect informal community organization. Also, it is not uncommon for an African American cemetery dating to this time period to have missing markers and have a large number of unmarked graves. In cemeteries where economically and socially disadvantaged individuals were interred, markers are often displaced, destroyed, were constructed of expedient materials (such as stone or wood), or graves were never marked. Additionally, this cemetery has been impacted by vandalism and markers may have been stolen or moved.

## RECOMMENDATIONS

New South recommends that the 277 geophysical anomalies identified as probable graves should be treated as such. Additionally, care should be taken if any ground is to be disturbed within the entire cemetery to avoid damaging any burials that might be present but were not detected because of poor preservation and ground conditions. No evidence of burials was found outside of the identified cemetery boundary, but caution should always be used when disturbances are planned adjacent to the cemetery. If avoidance of graves is not possible, then additional steps should be taken to relocate the burials in compliance with North Carolina Statutes, Chapter 65, Article 12, Abandoned and Neglected 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.

Conyers, Lawrence B.

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.

Jones, Geoffrey

2008 Geophysical Mapping of Historic Cemeteries. Paper 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*. 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.

Intentionally Left Blank

# APPENDIX A: GPR ANOMALIES - POSSIBLE GRAVE LOCATIONS

Intentionally Left Blank

GPR SURVEY OF THE HISTORIC  
FRIENDSHIP CHAPEL BAPTIST CHURCH CEMETERY

APPENDIX A: GPR ANOMALIES-  
POSSIBLE GRAVE LOCATIONS

Grave ID	Label	Grid	Marked	UTM Northing	UTM Easting
1	Possible Grave	GPR 5	Y	3982412.4492	3982412.4492
5	Possible Grave	GPR 5	Y	3982415.1544	3982415.1544
6	Possible Grave	GPR 5	Y	3982417.3809	3982417.3809
7	Possible Grave	GPR 5	Y	3982420.0738	3982420.0738
8	Possible Grave	GPR 5	Y	3982419.5475	3982419.5475
10	Possible Grave	GPR 5	Y	3982420.8504	3982420.8504
13	Possible Grave	GPR 5	Y	3982416.9387	3982416.9387
14	Possible Grave	GPR 5	Y	3982420.1330	3982420.1330
15	Possible Grave	GPR 5	Y	3982421.7309	3982421.7309
16	Possible Grave	GPR 5	Y	3982422.2442	3982422.2442
17	Possible Grave	GPR 5	Y	3982423.7170	3982423.7170
18	Possible Grave	GPR 5	Y	3982423.5898	3982423.5898
19	Possible Grave	GPR 5	Y	3982428.0178	3982428.0178
21	Possible Grave	GPR 5	Y	3982426.7134	3982426.7134
40	Possible Grave	GPR 3	Y	3982381.9376	3982381.9376
41	Possible Grave	GPR 5	Y	3982421.4652	3982421.4652
42	Possible Grave	GPR 5	Y	3982413.4058	3982413.4058
42	Possible Grave	GPR 5	Y	3982420.3507	3982420.3507
43	Possible Grave	GPR 5	Y	3982420.5431	3982420.5431
45	Possible Grave	GPR 2	Y	3982359.2608	3982359.2608
47	Possible Grave	GPR 5	Y	3982414.0224	3982414.0224
63	Possible Grave	GPR 5	Y	3982410.0563	3982410.0563
64	Possible Grave	GPR 5	Y	3982413.2003	3982413.2003
66	Possible Grave	GPR 5	Y	3982422.2733	3982422.2733
89	Possible Grave	GPR 3	Y	3982378.6122	3982378.6122
123	Possible Grave	GPR 4	Y	3982374.2135	3982374.2135
128	Possible Grave	GPR 3	Y	3982394.0354	3982394.0354
129	Possible Grave	GPR 3	Y	3982386.1694	3982386.1694
131	Possible Grave	GPR 3	Y	3982386.7506	3982386.7506
133	Possible Grave	GPR 3	Y	3982385.2420	3982385.2420
136	Possible Grave	GPR 3	Y	3982391.6059	3982391.6059
137	Possible Grave	GPR 3	Y	3982392.9903	3982392.9903
145	Possible Grave	GPR 4	Y	3982369.2171	3982369.2171
147	Possible Grave	GPR 3	Y	3982385.7576	3982385.7576
163	Possible Grave	GPR 1	Y	3982321.9057	3982321.9057
164	Possible Grave	GPR 1	Y	3982322.7633	3982322.7633
170	Possible Grave	GPR 2	Y	3982383.6964	3982383.6964
172	Possible Grave	GPR 2	Y	3982381.2952	3982381.2952
173	Possible Grave	GPR 2	Y	3982384.3173	3982384.3173
176	Possible Grave	GPR 2	Y	3982380.9911	3982380.9911
179	Possible Grave	GPR 2	Y	3982379.9421	3982379.9421
180	Possible Grave	GPR 2	Y	3982379.7844	3982379.7844
181	Possible Grave	GPR 3	Y	3982380.2884	3982380.2884
182	Possible Grave	GPR 3	Y	3982378.7689	3982378.7689
186	Possible Grave	GPR 2	Y	3982377.2379	3982377.2379

GPR SURVEY OF THE HISTORIC  
FRIENDSHIP CHAPEL BAPTIST CHURCH CEMETERY

APPENDIX A: GPR ANOMALIES-  
POSSIBLE GRAVE LOCATIONS

Grave ID	Label	Grid	Marked	UTM Northing	UTM Easting
187	Possible Grave	GPR 2	Y	3982370.6971	3982370.6971
188	Possible Grave	GPR 2	Y	3982374.3349	3982374.3349
189	Possible Grave	GPR 2	Y	3982373.0242	3982373.0242
190	Possible Grave	GPR 2	Y	3982370.4947	3982370.4947
191	Possible Grave	GPR 2	Y	3982371.6200	3982371.6200
192	Possible Grave	GPR 2	Y	3982366.8228	3982366.8228
197	Possible Grave	GPR 2	Y	3982364.6161	3982364.6161
198	Possible Grave	GPR 2	Y	3982362.8666	3982362.8666
200	Possible Grave	GPR 2	Y	3982363.0248	3982363.0248
211	Possible Grave	GPR 2	Y	3982352.0497	3982352.0497
214	Possible Grave	GPR 2	Y	3982372.1588	3982372.1588
215	Possible Grave	GPR 2	Y	3982358.3186	3982358.3186
219	Possible Grave	GPR 2	Y	3982350.2302	3982350.2302
220	Possible Grave	GPR 2	Y	3982346.4727	3982346.4727
222	Possible Grave	GPR 2	Y	3982346.7848	3982346.7848
223	Possible Grave	GPR 1	Y	3982332.4180	3982332.4180
225	Possible Grave	GPR 1	Y	3982342.4773	3982342.4773
229	Possible Grave	GPR 2	Y	3982352.2888	3982352.2888
230	Possible Grave	GPR 2	Y	3982353.7050	3982353.7050
231	Possible Grave	GPR 2	Y	3982349.4464	3982349.4464
232	Possible Grave	GPR 2	Y	3982348.2144	3982348.2144
233	Possible Grave	GPR 2	Y	3982355.3649	3982355.3649
238	Possible Grave	GPR 4	Y	3982376.5392	3982376.5392
240	Possible Grave	GPR 4	Y	3982365.2815	3982365.2815
244	Possible Grave	GPR 2	Y	3982365.1465	3982365.1465
245	Possible Grave	GPR 2	Y	3982361.3297	3982361.3297
246	Possible Grave	GPR 2	Y	3982363.4515	3982363.4515
250	Possible Grave	GPR 2	Y	3982374.2990	3982374.2990
252	Possible Grave	GPR 2	Y	3982382.7603	3982382.7603
253	Possible Grave	GPR 1	Y	3982343.0729	3982343.0729
254	Possible Grave	GPR 5	Y	3982418.3923	3982418.3923
256	Possible Grave	GPR 5	Y	3982425.7149	3982425.7149
260	Possible Grave	GPR 3	Y	3982399.2018	3982399.2018
263	Possible Grave	GPR 2	Y	3982364.0390	3982364.0390
270	Possible Grave	GPR 2	Y	3982365.9882	3982365.9882
271	Possible Grave	GPR 2	Y	3982367.1696	3982367.1696
275	Possible Grave	GPR 2	Y	3982350.8518	3982350.8518
285	Possible Grave	GPR 3	Y	3982374.1370	3982374.1370
292	Possible Grave	GPR 5	Y	3982418.8460	3982418.8460
298	Possible Grave	GPR 2	Y	3982349.2327	3982349.2327
300	Possible Grave	GPR 3	Y	3982392.1498	3982392.1498
303	Possible Grave	GPR 3	Y	3982389.2663	3982389.2663
304	Possible Grave	GPR 3	Y	3982387.5365	3982387.5365
305	Possible Grave	GPR 3	Y	3982375.7345	3982375.7345
306	Possible Grave	GPR 3	Y	3982374.3934	3982374.3934

GPR SURVEY OF THE HISTORIC  
FRIENDSHIP CHAPEL BAPTIST CHURCH CEMETERY

APPENDIX A: GPR ANOMALIES-  
POSSIBLE GRAVE LOCATIONS

Grave ID	Label	Grid	Marked	UTM Northing	UTM Easting
308	Possible Grave	GPR 3	Y	3982377.0818	3982377.0818
309	Possible Grave	GPR 2	Y	3982351.1992	3982351.1992
317	Possible Grave	GPR 4	Y	3982358.4818	3982358.4818
322	Possible Grave	GPR 1	Y	3982328.9952	3982328.9952
334	Possible Grave	GPR 1	Y	3982333.1656	3982333.1656
335	Possible Grave	GPR 1	Y	3982331.6331	3982331.6331
340	Possible Grave	GPR 1	Y	3982340.2129	3982340.2129
345	Possible Grave	GPR 1	Y	3982347.4449	3982347.4449
350	Possible Grave	GPR 2	Y	3982351.6690	3982351.6690
351	Possible Grave	GPR 2	Y	3982353.0763	3982353.0763
355	Possible Grave	GPR 1	Y	3982323.5924	3982323.5924
359	Possible Grave	GPR 1	Y	3982320.9488	3982320.9488
360	Possible Grave	GPR 1	Y	3982318.7134	3982318.7134
361	Possible Grave	GPR 1	Y	3982320.2887	3982320.2887
364	Possible Grave	GPR 1	Y	3982329.2189	3982329.2189
367	Possible Grave	GPR 1	Y	3982319.7224	3982319.7224
385	Possible Grave	GPR 1	Y	3982324.5484	3982324.5484
388	Possible Grave	GPR 1	Y	3982327.1610	3982327.1610
394	Possible Grave	GPR 1	Y	3982325.5031	3982325.5031
396	Possible Grave	GPR 1	Y	3982338.2555	3982338.2555
401	Possible Mass Burial	GPR 3	NA	3982384.6358	3982384.6358
402	Possible Grave	GPR 5		3982419.2065	3982419.2065
403	Possible Grave	GPR 5		3982426.5624	3982426.5624
404	Possible Grave	GPR 5		3982419.9344	3982419.9344
405	Possible Grave	GPR 5		3982425.4856	3982425.4856
406	Possible Grave	GPR 5		3982422.2653	3982422.2653
407	Possible Grave	GPR 5		3982423.6503	3982423.6503
408	Possible Grave	GPR 5		3982422.5879	3982422.5879
409	Possible Grave	GPR 5		3982410.2245	3982410.2245
410	Possible Grave	GPR 5		3982412.1386	3982412.1386
411	Possible Grave	GPR 5		3982418.0100	3982418.0100
412	Possible Grave	GPR 5		3982414.7538	3982414.7538
413	Possible Grave	GPR 5		3982416.5917	3982416.5917
414	Possible Grave	GPR 5		3982411.8240	3982411.8240
415	Possible Grave	GPR 5		3982416.7991	3982416.7991
416	Possible Grave	GPR 5		3982415.6844	3982415.6844
417	Possible Grave	GPR 5		3982414.1879	3982414.1879
418	Possible Grave	GPR 5		3982407.5634	3982407.5634
419	Possible Grave	GPR 5		3982411.1814	3982411.1814
420	Possible Grave	GPR 5		3982416.3906	3982416.3906
421	Possible Grave	GPR 5		3982417.5337	3982417.5337
422	Possible Grave	GPR 5		3982415.6413	3982415.6413
423	Possible Grave	GPR 4		3982376.8127	3982376.8127
424	Possible Grave	GPR 4		3982377.4028	3982377.4028
425	Possible Grave	GPR 4		3982376.6357	3982376.6357

GPR SURVEY OF THE HISTORIC  
FRIENDSHIP CHAPEL BAPTIST CHURCH CEMETERY

APPENDIX A: GPR ANOMALIES-  
POSSIBLE GRAVE LOCATIONS

Grave ID	Label	Grid	Marked	UTM Northing	UTM Easting
426	Possible Grave	GPR 4		3982377.7335	3982377.7335
427	Possible Grave	GPR 4		3982372.4995	3982372.4995
428	Possible Grave	GPR 4		3982371.4156	3982371.4156
429	Possible Grave	GPR 4		3982370.6112	3982370.6112
430	Possible Grave	GPR 4		3982370.3058	3982370.3058
431	Possible Grave	GPR 4		3982369.7541	3982369.7541
432	Possible Grave	GPR 4		3982358.9573	3982358.9573
433	Possible Grave	GPR 4		3982356.4694	3982356.4694
434	Possible Grave	GPR 4		3982351.1948	3982351.1948
435	Possible Grave	GPR 4		3982349.6390	3982349.6390
436	Possible Grave	GPR 4		3982351.9407	3982351.9407
437	Possible Grave	GPR 4		3982366.4436	3982366.4436
438	Possible Grave	GPR 3		3982378.1483	3982378.1483
439	Possible Grave	GPR 3		3982376.8335	3982376.8335
440	Possible Grave	GPR 3		3982381.0924	3982381.0924
441	Possible Grave	GPR 3		3982373.2221	3982373.2221
442	Possible Grave	GPR 3		3982379.3957	3982379.3957
443	Possible Grave	GPR 3		3982383.5904	3982383.5904
444	Possible Grave	GPR 3		3982381.4858	3982381.4858
445	Possible Grave	GPR 3		3982382.9301	3982382.9301
446	Possible Grave	GPR 3		3982383.1572	3982383.1572
447	Possible Grave	GPR 3		3982386.5853	3982386.5853
448	Possible Grave	GPR 3		3982381.6754	3982381.6754
449	Possible Grave	GPR 3		3982386.6255	3982386.6255
450	Possible Grave	GPR 3		3982383.2634	3982383.2634
451	Possible Grave	GPR 3		3982382.8458	3982382.8458
452	Possible Grave	GPR 3		3982388.6677	3982388.6677
453	Possible Grave	GPR 3		3982387.8290	3982387.8290
454	Possible Grave	GPR 3		3982388.0195	3982388.0195
455	Possible Grave	GPR 3		3982392.8566	3982392.8566
456	Possible Grave	GPR 3		3982392.7573	3982392.7573
457	Possible Grave	GPR 3		3982397.6835	3982397.6835
458	Possible Grave	GPR 3		3982402.9291	3982402.9291
459	Possible Grave	GPR 3		3982379.9193	3982379.9193
460	Possible Grave	GPR 2		3982354.9014	3982354.9014
461	Possible Grave	GPR 2		3982354.3527	3982354.3527
462	Possible Grave	GPR 2		3982352.5569	3982352.5569
463	Possible Grave	GPR 2		3982350.6669	3982350.6669
464	Possible Grave	GPR 2		3982357.8171	3982357.8171
465	Possible Grave	GPR 2		3982357.4897	3982357.4897
466	Possible Grave	GPR 2		3982360.4896	3982360.4896
467	Possible Grave	GPR 2		3982355.9360	3982355.9360
468	Possible Grave	GPR 2		3982359.3699	3982359.3699
469	Possible Grave	GPR 2		3982359.8415	3982359.8415
470	Possible Grave	GPR 2		3982363.0167	3982363.0167

GPR SURVEY OF THE HISTORIC  
FRIENDSHIP CHAPEL BAPTIST CHURCH CEMETERY

APPENDIX A: GPR ANOMALIES-  
POSSIBLE GRAVE LOCATIONS

Grave ID	Label	Grid	Marked	UTM Northing	UTM Easting
471	Possible Grave	GPR 2		3982360.7161	3982360.7161
472	Possible Grave	GPR 2		3982359.4538	3982359.4538
473	Possible Grave	GPR 2		3982367.5223	3982367.5223
474	Possible Grave	GPR 2		3982361.4474	3982361.4474
475	Possible Grave	GPR 2		3982365.8846	3982365.8846
476	Possible Grave	GPR 2		3982367.8045	3982367.8045
477	Possible Grave	GPR 2		3982363.7243	3982363.7243
478	Possible Grave	GPR 2		3982369.6123	3982369.6123
479	Possible Grave	GPR 2		3982369.3609	3982369.3609
480	Possible Grave	GPR 2		3982369.2101	3982369.2101
481	Possible Grave	GPR 2		3982372.0854	3982372.0854
482	Possible Grave	GPR 2		3982372.9704	3982372.9704
483	Possible Grave	GPR 2		3982376.1671	3982376.1671
484	Possible Grave	GPR 2		3982375.3665	3982375.3665
485	Possible Grave	GPR 2		3982376.0916	3982376.0916
486	Possible Grave	GPR 2		3982378.3400	3982378.3400
487	Possible Grave	GPR 2		3982377.9650	3982377.9650
488	Possible Grave	GPR 2		3982377.3135	3982377.3135
489	Possible Grave	GPR 2		3982377.8860	3982377.8860
490	Possible Grave	GPR 2		3982378.6331	3982378.6331
491	Possible Grave	GPR 2		3982378.1244	3982378.1244
492	Possible Grave	GPR 2		3982379.5290	3982379.5290
493	Possible Grave	GPR 2		3982376.2285	3982376.2285
494	Possible Grave	GPR 2		3982377.2156	3982377.2156
495	Possible Grave	GPR 2		3982380.6717	3982380.6717
496	Possible Grave	GPR 2		3982370.3377	3982370.3377
497	Possible Grave	GPR 2		3982358.1293	3982358.1293
498	Possible Grave	GPR 2		3982371.7164	3982371.7164
499	Possible Grave	GPR 1		3982327.9771	3982327.9771
500	Possible Grave	GPR 1		3982317.9967	3982317.9967
501	Possible Grave	GPR 1		3982317.5672	3982317.5672
502	Possible Grave	GPR 1		3982318.1934	3982318.1934
503	Possible Grave	GPR 1		3982318.6133	3982318.6133
504	Possible Grave	GPR 1		3982316.0456	3982316.0456
505	Possible Grave	GPR 1		3982316.4645	3982316.4645
506	Possible Grave	GPR 1		3982320.3277	3982320.3277
507	Possible Grave	GPR 1		3982331.4694	3982331.4694
508	Possible Grave	GPR 1		3982332.0409	3982332.0409
509	Possible Grave	GPR 1		3982329.1619	3982329.1619
510	Possible Grave	GPR 1		3982330.1123	3982330.1123
511	Possible Grave	GPR 1		3982335.1328	3982335.1328
512	Possible Grave	GPR 1		3982340.0292	3982340.0292
513	Possible Grave	GPR 1		3982340.3318	3982340.3318
514	Possible Grave	GPR 1		3982335.8494	3982335.8494
515	Possible Grave	GPR 1		3982332.8394	3982332.8394

GPR SURVEY OF THE HISTORIC  
FRIENDSHIP CHAPEL BAPTIST CHURCH CEMETERY

APPENDIX A: GPR ANOMALIES-  
POSSIBLE GRAVE LOCATIONS

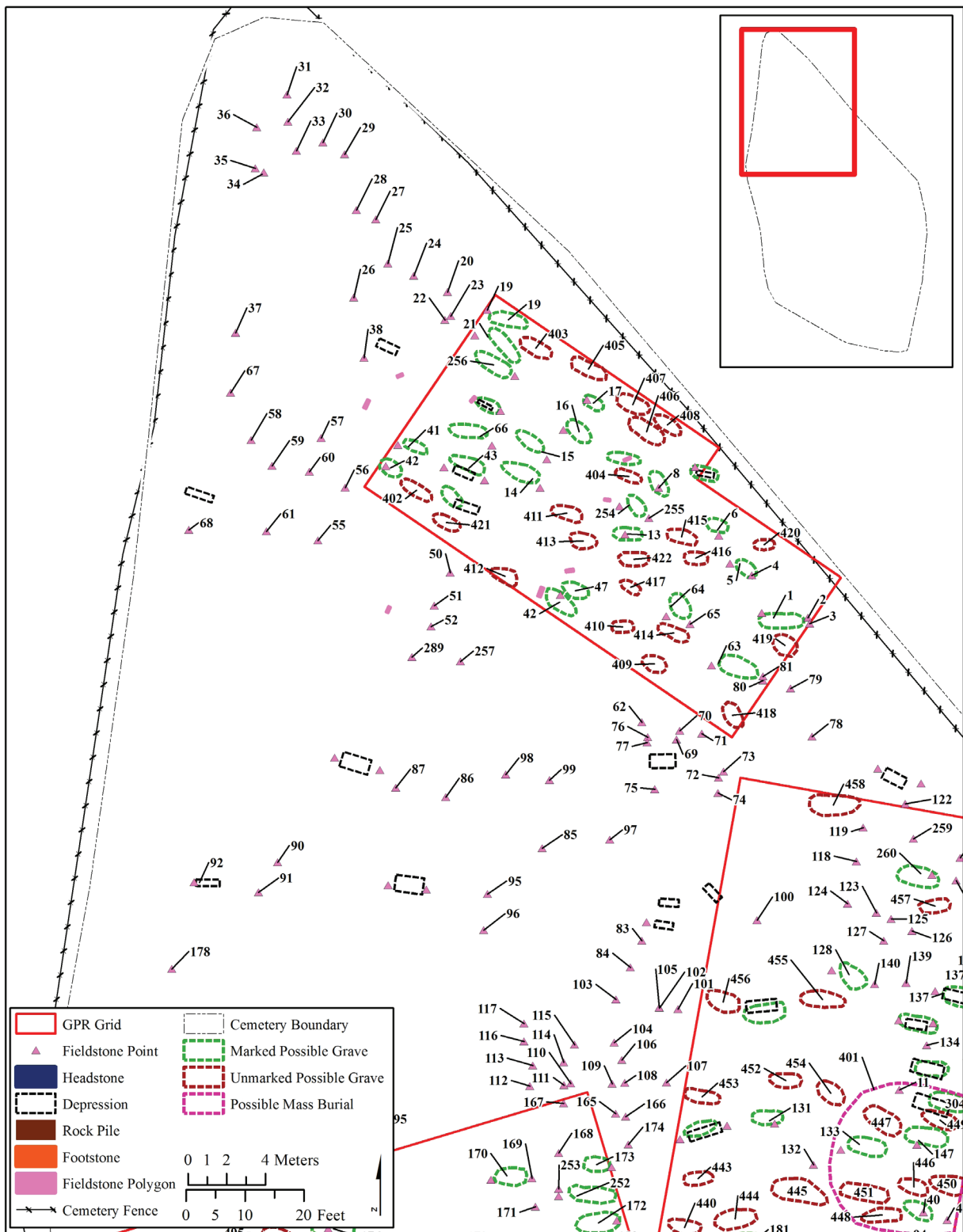
Grave ID	Label	Grid	Marked	UTM Northing	UTM Easting
516	Possible Grave	GPR 1		3982345.5187	3982345.5187
517	Possible Grave	GPR 1		3982340.4190	3982340.4190
518	Possible Grave	GPR 1		3982336.3621	3982336.3621
519	Possible Grave	GPR 1		3982334.6142	3982334.6142
520	Possible Grave	GPR 1		3982338.4574	3982338.4574
521	Possible Grave	GPR 1		3982335.1398	3982335.1398
522	Possible Grave	GPR 1		3982341.6768	3982341.6768
523	Possible Grave	GPR 1		3982343.7457	3982343.7457
524	Possible Grave	GPR 1		3982334.7630	3982334.7630
525	Possible Grave	GPR 1		3982336.8397	3982336.8397
526	Possible Grave	GPR 1		3982338.1982	3982338.1982
527	Possible Grave	GPR 1		3982337.2192	3982337.2192
528	Possible Grave	GPR 1		3982337.0904	3982337.0904
529	Possible Grave	GPR 1		3982344.7370	3982344.7370
530	Possible Grave	GPR 1		3982347.5140	3982347.5140
531	Possible Grave	GPR 1		3982348.2810	3982348.2810
532	Possible Grave	GPR 1		3982355.2889	3982355.2889
533	Possible Grave	GPR 1		3982353.4237	3982353.4237
534	Possible Grave	GPR 1		3982349.0443	3982349.0443
535	Possible Grave	GPR 1		3982347.8246	3982347.8246
536	Possible Grave	GPR 1		3982348.1110	3982348.1110
537	Possible Grave	GPR 1		3982357.0249	3982357.0249
538	Possible Grave	GPR 1		3982355.6982	3982355.6982
539	Possible Grave	GPR 1		3982349.6709	3982349.6709
540	Possible Grave	GPR 1		3982345.5571	3982345.5571
541	Possible Grave	GPR 1		3982342.4144	3982342.4144
542	Possible Grave	GPR 1		3982341.1461	3982341.1461
543	Possible Grave	GPR 1		3982345.7200	3982345.7200
544	Possible Grave	GPR 1		3982355.1974	3982355.1974
545	Possible Grave	GPR 1		3982343.9030	3982343.9030
546	Possible Grave	GPR 1		3982343.3986	3982343.3986
547	Possible Grave	GPR 1		3982336.8659	3982336.8659
548	Possible Grave	GPR 1		3982338.7188	3982338.7188
549	Possible Grave	GPR 1		3982331.2400	3982331.2400
550	Possible Grave	GPR 1		3982329.4426	3982329.4426
551	Possible Grave	GPR 1		3982327.9430	3982327.9430
552	Possible Grave	GPR 1		3982336.4901	3982336.4901
553	Possible Grave	GPR 1		3982337.1831	3982337.1831
554	Possible Grave	GPR 1		3982342.9660	3982342.9660
555	Possible Grave	GPR 1		3982343.0972	3982343.0972
556	Possible Grave	GPR 1		3982343.0897	3982343.0897
557	Possible Grave	GPR 1		3982342.2144	3982342.2144
558	Possible Grave	GPR 1		3982340.7554	3982340.7554
559	Possible Grave	GPR 1		3982336.0194	3982336.0194
560	Possible Grave	GPR 1		3982335.5013	3982335.5013

<b>Grave ID</b>	<b>Label</b>	<b>Grid</b>	<b>Marked</b>	<b>UTM Northing</b>	<b>UTM Easting</b>
561	Possible Grave	GPR 1		3982338.0308	3982338.0308
562	Possible Grave	GPR 1		3982339.8407	3982339.8407
563	Possible Grave	GPR 1		3982316.6924	3982316.6924
564	Possible Grave	GPR 1		3982335.4341	3982335.4341
565	Possible Grave	GPR 1		3982338.6597	3982338.6597
566	Possible Grave	GPR 1		3982337.4186	3982337.4186
567	Possible Grave	GPR 1		3982333.7210	3982333.7210
568	Possible Grave	GPR 1		3982346.8073	3982346.8073

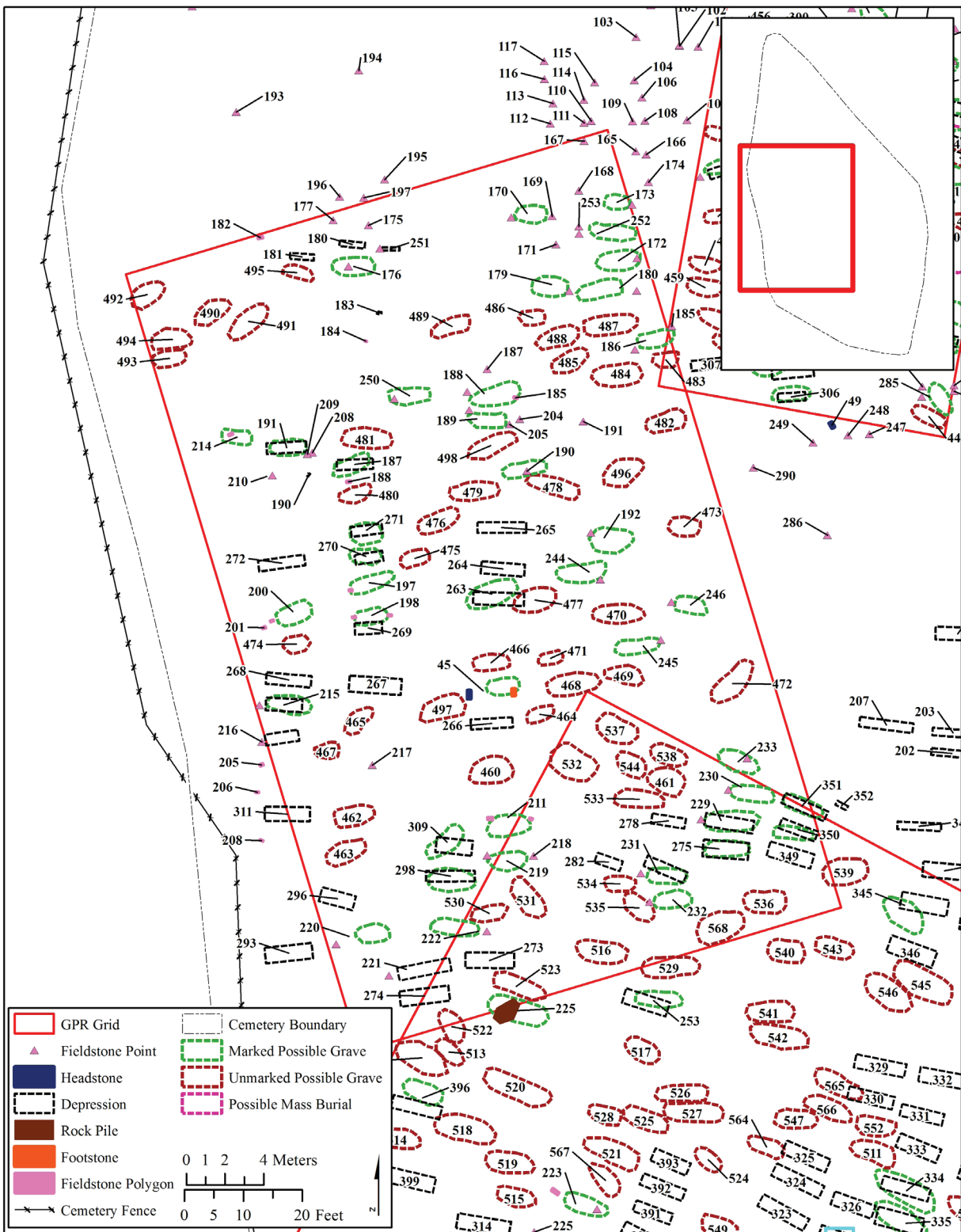
Intentionally Left Blank

# APPENDIX B: DETAILED CEMETERY MAPS

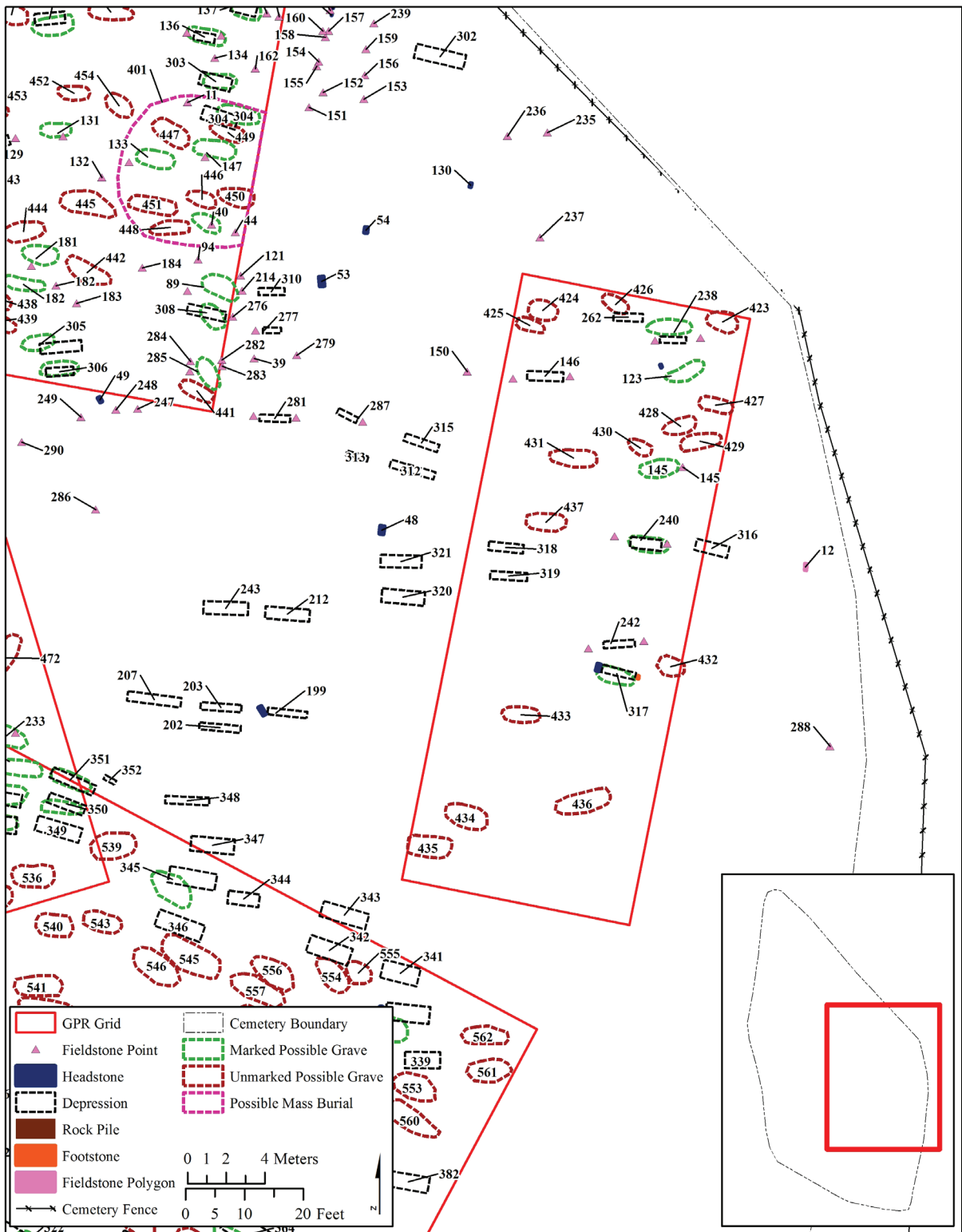
Intentionally Left Blank



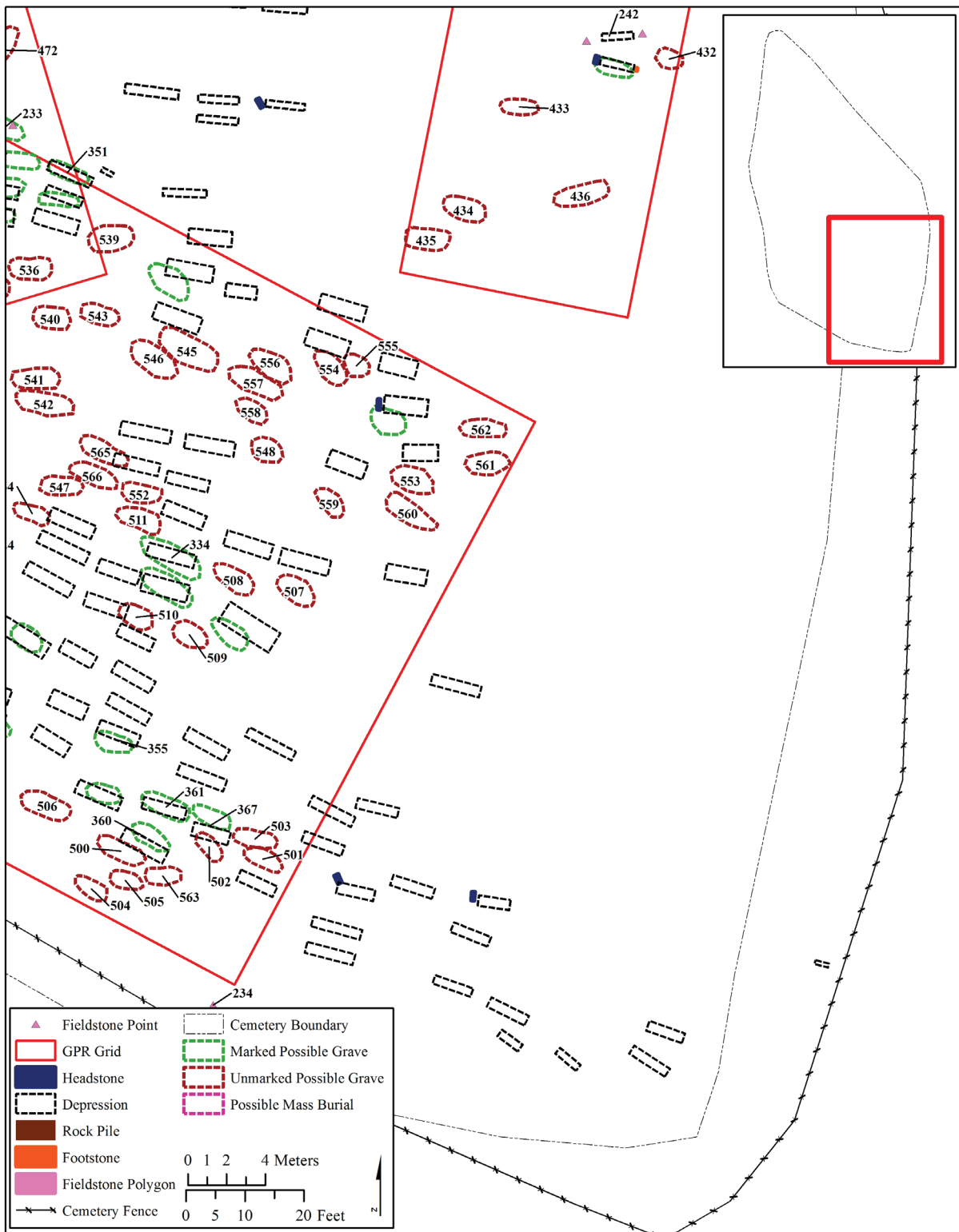
Imagery Source: USDA NAIP 2014



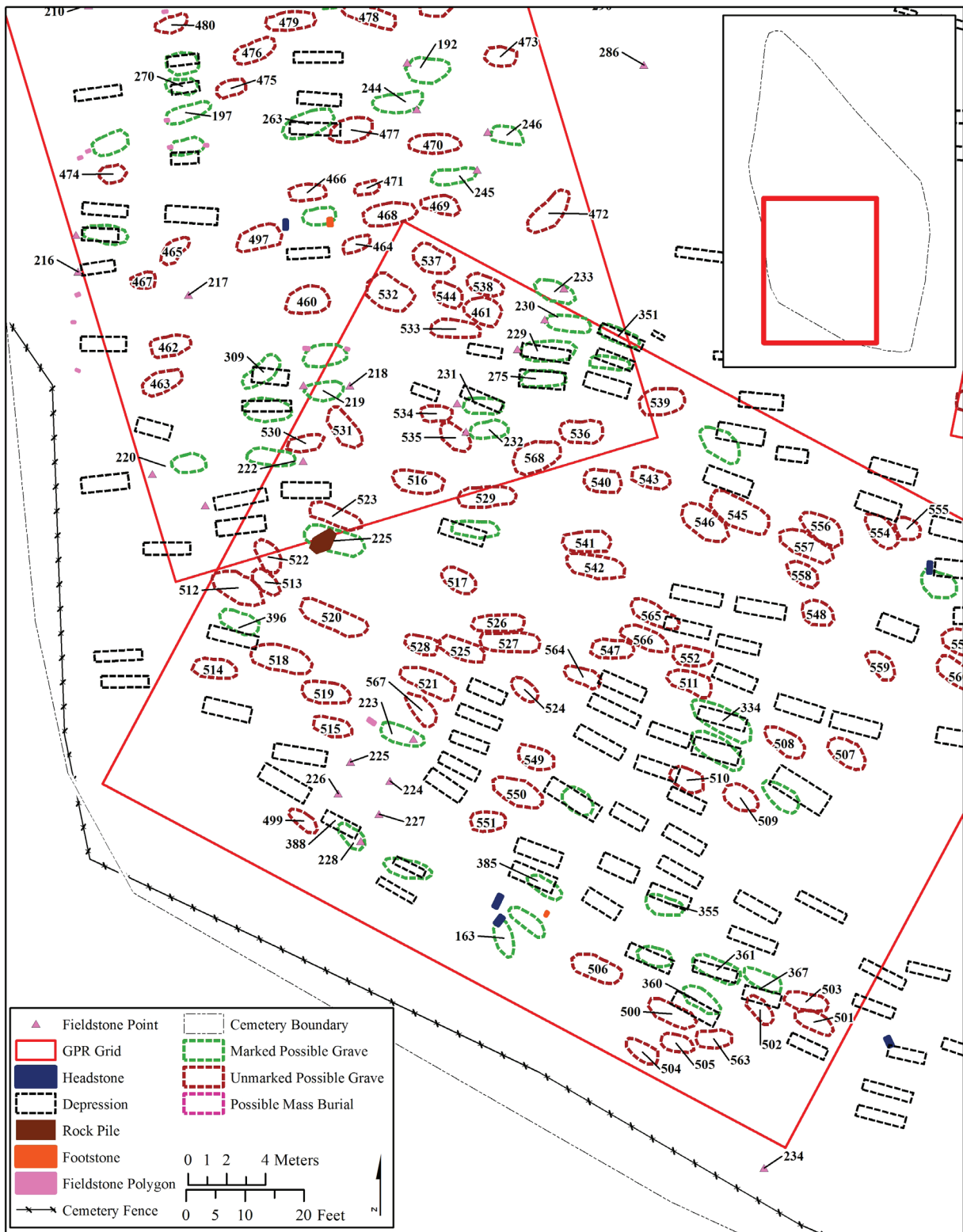
Imagery Source: USDA NAIP 2014



Imagery Source: USDA NAIP 2014



Imagery Source: USDA NAIP 2014



Imagery Source: USDA NAIP 2014

