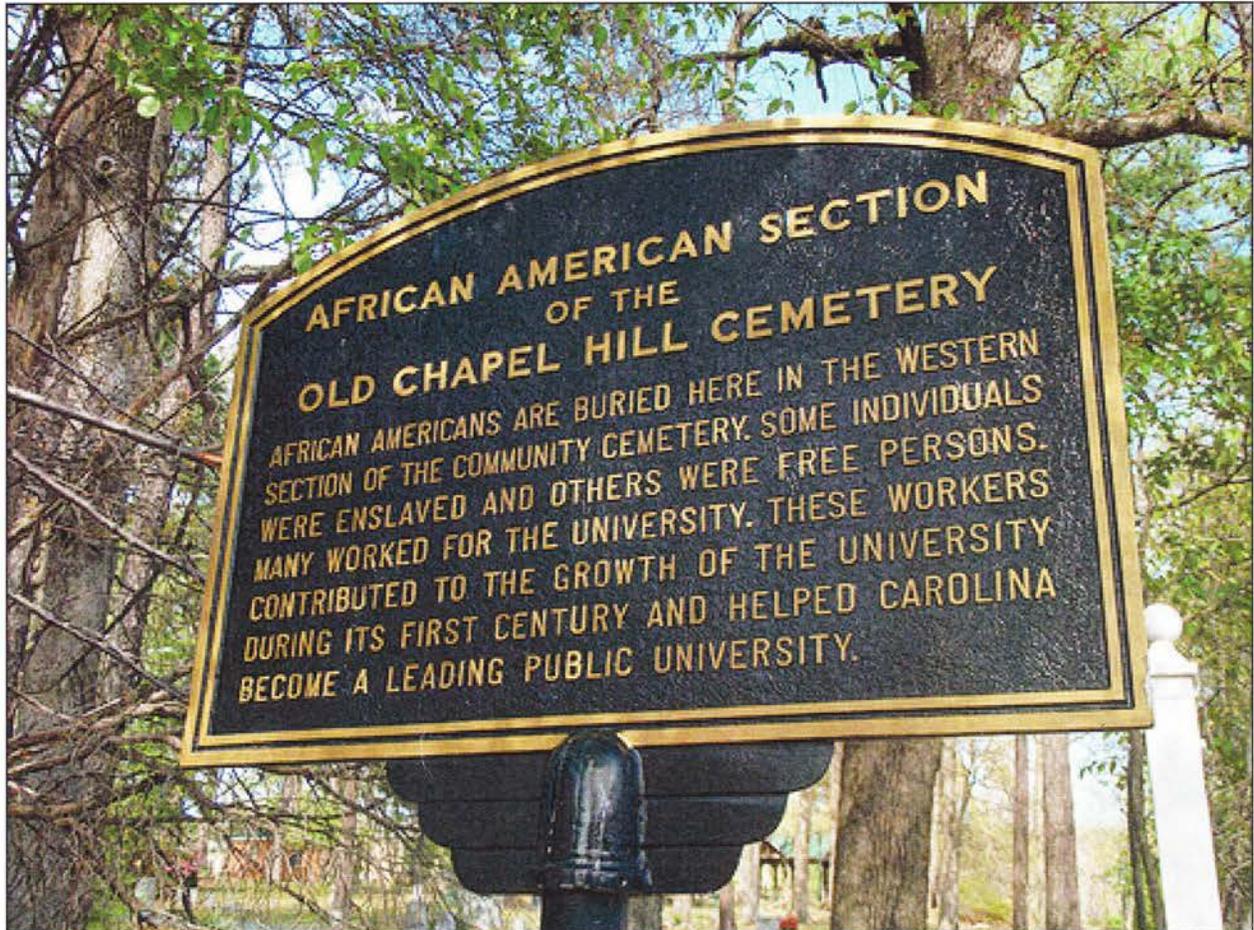


**INVESTIGATION OF A PORTION OF SECTION B
OF THE OLD CHAPEL HILL CEMETERY**

CHAPEL HILL, ORANGE COUNTY, NORTH CAROLINA



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For: Chapel Hill Preservation Society



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INTRODUCTION

Environmental Services, Inc. (ESI), along with its subcontractor, Thacker, Seramur and Associates (TSA), was contracted by the Preservation Society of Chapel Hill (PSCH) to conduct an investigation of a portion of the Old Chapel Hill Cemetery (**Figure 1**), which is located on the campus of the University of North Carolina at Chapel Hill (UNC-CH). The Town of Chapel Hill owns the Old Chapel Hill Cemetery and is responsible for its maintenance.

The purpose of the investigation was to identify, if possible, unmarked and undocumented burials within a portion of Section B, which is within the historically African-American part of the cemetery. The project area was roughly 0.33 acres in size and located in the northern third of Section B (**Figure 2**). It was chosen for this investigation as it appeared to have the highest potential to contain unmarked burials given the open areas that contained no markers and the presence of uninscribed fieldstone markers.

Involved in the investigation were Scott Seibel and Terri Russ of ESI and Jay Thacker, Keith Seramur, Beth Compton, Beth Williamson, Joe Cumbee of TSA. The investigation included the use of geophysical survey techniques (Ground Penetrating Radar and Electrical Resistivity) and soil density testing. The locations of potential grave shafts identified as a result of the soil density testing were recorded using a Sokia Total Station. The geophysical survey and probing occurred in November 2009, while the Total Station recording was conducted in December 2009.

GENERAL HISTORY OF THE CEMETERY

The Old Chapel Hill Cemetery is about 7 acres in size. The land was part of a 125-acre grant from the State of North Carolina to the newly established University of North Carolina. George Clark, a student from Burke County who died on 28 September 1798, is the first recorded burial in the cemetery. The original rock wall around the cemetery was built in 1835. The cemetery is divided into six sections (A-B and I-IV) and is estimated to contain over 1,600 interments (**Figure 2**).

The westernmost sections, Sections A and B, comprise the historically African-American part of the cemetery. During the late eighteenth and early nineteenth century, Section B was set aside for the purpose of burying slaves and freemen. Following the end of the Civil War, the racial segregation of the cemetery continued, extending into Section A beginning during the 1880s. The earliest known burial in this part of the cemetery belongs to Ellington Burnett, who died in 1853.

There have been numerous incidents that have led to damage in Sections A and B. In 1985, these parts of the cemetery were used by football fans for parking for a game versus Clemson. Also, it was conveyed by maintenance staff that numerous fieldstone markers were removed in the past to help rebuild stone walls. The stones were not recognized as grave markers as they were not cut or inscribed in the manner of formal markers.

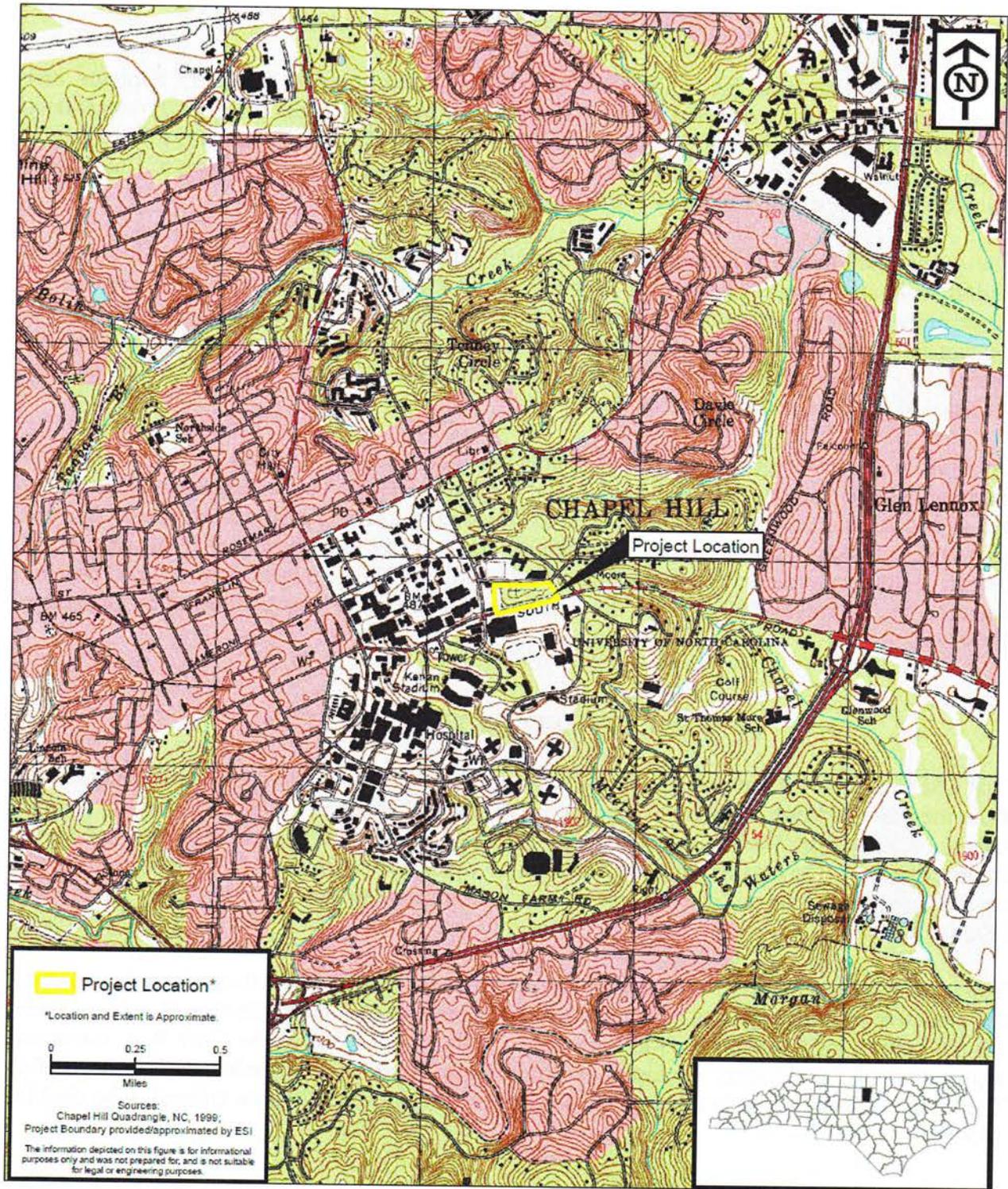


Figure 1: General Project Location

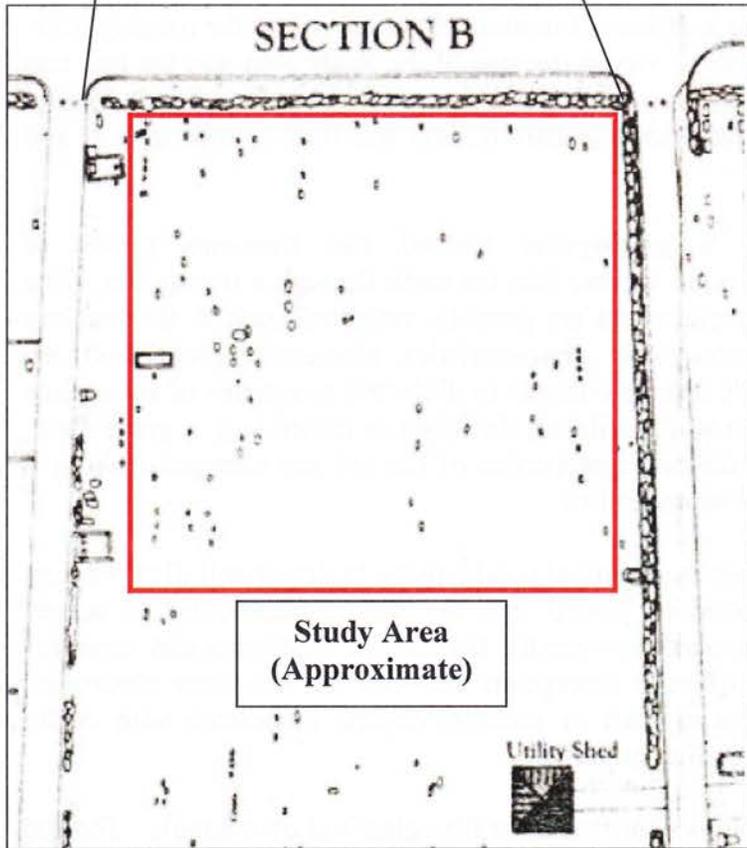


Figure 2: Study Area

The cemetery was listed in the *National Register of Historic Places* (National Register) under Criteria A and C in 1994 based on its association with events that have made significant contributions to the broad patterns of history and as it contains grave markers and other construction elements that embody the distinctive characteristics of a type, period, or method of construction, represent the work of a master, possesses high artistic values, or represents a significant and distinguishable entity (Baten and Little 1994). Its period of significance ranges from 1798 to 1944.

PROJECT METHODOLOGY

According to a plan of the cemetery produced in the 1990s, approximately 100 headstone, footstone, and other grave markers were once located within or immediately adjacent to the study area. At the time of the investigation, however, it was estimated that the number of visible markers was approximately 75, representing about 50 separate interments. The majority of the grave markers within the study area consist of uninscribed field stones, comprised of the local bedrock, but other formal, inscribed markers, both headstones and footstones made of granite, brownstone, marble, or concrete are also present. A number of graves lacking markers can also be seen, their locations indicated by linear depressions aligned east-west.

The goal of the project was to identify the locations of unmarked graves within the roughly 0.33-acre study area in Section B of the cemetery. Given the size of the study area and the fact that the cemetery is maintained and in use, it was determined that a combination of geophysical survey, Ground Penetrating Radar and Electrical Resistivity, and soil density testing (e.g. soil probing) would yield the best results.

Ground Penetrating Radar (GPR) is a geophysical method that transmits pulses of electromagnetic energy (high frequency radio waves) into the earth through a transmitter. The radar waves propagate through the subsurface and are partially reflected back to the receiver when materials with different electromagnetic characteristics (dielectric properties) are encountered below the surface. The GPR detects changes in dielectric properties of subsurface materials. When different layers within a soil profile are disturbed or mixed (e.g. a grave shaft, former tree root or rodent borrow), the dielectric properties of the soil are changed making it possible for the GPR to detect these areas as anomalies.

Electrical Resistivity (ER) utilizes changes in electrical conductivity to detect soil disturbances. The ER system uses four parallel electrodes placed into the soil perpendicular to survey transects. It transmits a current into the ground between the two outside electrodes and measures the resistivity of soil at depths of 3 to 5 feet in ohmmeters between the two inner electrodes. Disturbed soil, such as backfill in a grave shaft or metallic objects associated with coffin hardware, will produce a low resistivity reading or value.

Soil density testing, or soil probing, employs a thin metal or fiberglass rod on a handle. The rod is inserted into the ground to detect differences in the density of the soil. Typically, an area of disturbed soil is looser and less dense than surrounding undisturbed soil.

The study area was encompassed by a grid with an arbitrary datum point of 0 N, 0 E located in the southwest corner of the study area. To identify potential unmarked burials, GPR and ER surveys were run along north-south aligned transects spaced 2 feet apart within the study area (**Figure 3**). Subsurface anomalies detected by either the GPR or the ER surveys were marked in the field using survey pin flags (**Figure 4**). Soil probing using a 5/8-inch steel probe was then conducted around the pin flags. Linear areas of less dense soil aligned roughly east-west encountered by the probing were then marked at each end and numbered in the field as potential unmarked graves (Soil Probe Points).

In order to produce graphical plans of the in-field findings, the corners of the study area were recorded using a Trimble GeoXT Global Positioning System (GPS). Additionally, the Soil Probe Points were located using a Sokia Total Station. TSA produced three-dimensional (3-D) cuts of the GPR data and a georeferenced contour plan of the ER data. The ER data were integrated with the Total Station data and a plan of the Old Chapel Hill Cemetery showing the locations of grave markers produced in the 1990s in an ESRI ArcMap Geographic Information System (GIS) geodatabase.

FINDINGS

Ground Penetrating Radar

GPR transects were aligned north-south and spaced 2 feet apart over the study area. Individual GPR transects were interpreted in the field as data were collected, and both strong anomalies and subtle anomalies detected by the GPR were flagged in the field so that soil probing could determine if a grave shaft was potentially present. The individual GPR transect data were compiled at TSA's laboratory using GSSI Radan™ software to produce 3-D models of the anomalies. **Figures 5 and 6** show the survey area from the 22 E transect to the 116 E transect.

Strong anomalies are shown by darker shades of red on **Figure 5**, while subtle anomalies are shown as lighter shades of red. Blue and white colors on the model indicate areas of similar dielectric properties indicative of undisturbed soil. When subjected to probing, some of the anomalies detected by the GPR did not correspond with areas of less dense soil suggestive of grave shafts. These anomalies could represent former tree roots or animal burrows.

Figure 6 shows anomalies with the background data removed. Anomalies that extend in an east/west direction and are oriented in north/south rows are most likely graves. The GSSI Radan™ software gives these anomalies a rectangular appearance as a result of the data processing, which terminates an anomaly along a survey line when it is not detected on the adjacent transect. Anomalies suggestive of grave shafts were most common in the eastern half of the study area, while GPR anomalies were much rarer in the western half. The center of the study area yielded a paucity of returns. The results of the GPR survey correlated best with the ER data in the eastern half of the study area (see below).



Figure 3: Collecting of ER data



Figure 4: Pin flags indicating locations of GPR and ER anomalies

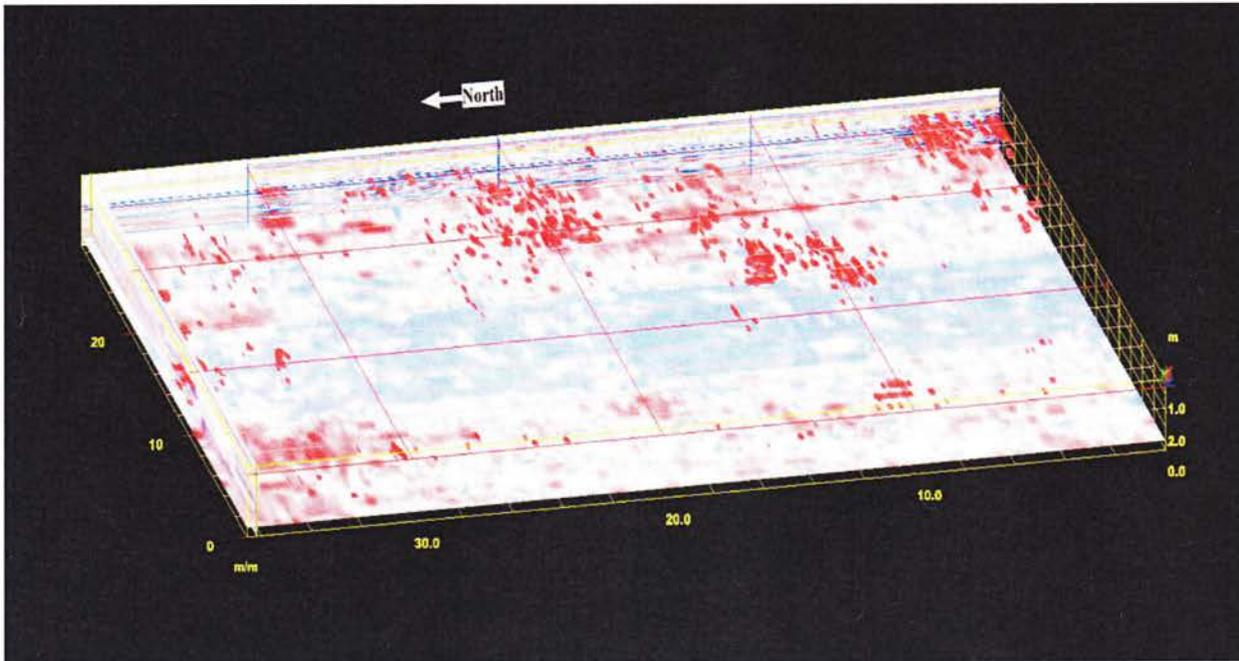


Figure 5: 3-D time-slice block of GPR anomalies

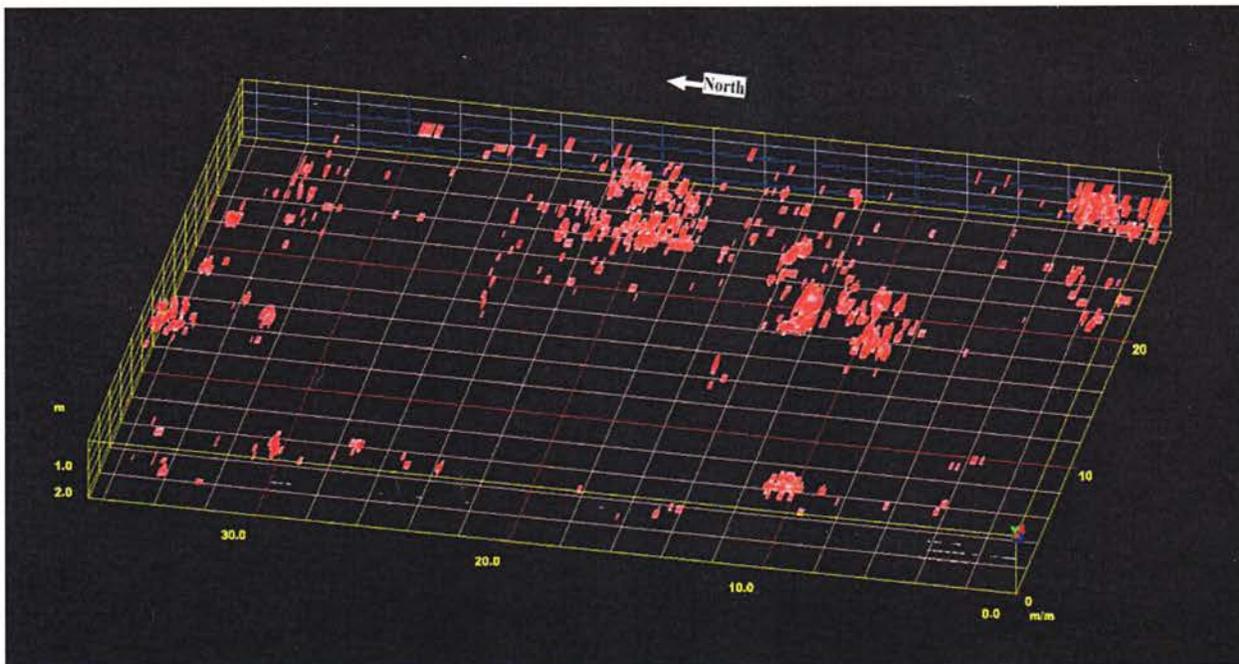


Figure 6: 3-D time-slice block of GPR anomalies with background data removed

Electrical Resistivity Geophysical Survey

The ER survey was conducted across the study area to detect areas where there was a change in the conductivity of the soil that could indicate disturbed soil related to the presence of unmarked graves. ER data was collected along the same 2-foot grid spacing along which the GPR survey was conducted using a R-40C Strata Scout Resistivity meter equipped with four electrodes in a Weiner Configuration. An electrode spacing of 2.5 feet was used to collect data from a depth of 3-5 feet below the ground surface. The ER data were used in the field to identify and mark areas of low resistivity (or targets) that could be indicative of unmarked graves with pin flags for probing.

The resistivity values were compiled in an MS Excel spreadsheet, and ESRI Arc GIS™ software was used to produce a computer-generated contour map of resistivity values, which was overlain on the plan of the cemetery (**Figure 7**). Areas on the contour map with a dark grey color or black are areas of higher resistivity and areas with a lighter shade of grey or white are areas with a lower resistivity. The locations of potential unmarked graves can be identified on the resistivity map by low resistivity anomalies that line up in a north-south direction. A north-south alignment of multiple low-resistivity anomalies is a strong indication that a row of unmarked graves is present.

Soil Density Testing (Probing)

Soil probing was conducted at and in the vicinity of the location of each of the flagged anomalies to determine if the location represented a potential grave shaft. Soil density varied considerably across the survey area. Some marked grave shafts had dense, compact soil not typical of disturbed soil, while other marked grave shafts had typical soft, low-density soil. Some anomalies identified by both GPR and Electrical Resistivity were determined not to be unmarked graves during the soil density testing based on their size and/or alignment.

A total of 104 different burials and potential burials were identified during the investigation based on the soil probing. Each burial or potential burial was identified as a Soil Probe Point and given a unique number. Some of the soil probe points are associated with marked burials, while others are associated or in close proximity to a grave marker.

The soil probe points were overlain on both the ER data (**Figure 8**) and the cemetery plan (**Figure 9**). The GPR and ER data correlated well with the locations of marked and unmarked graves as indicated by probing in the east-central portion of the study area around Soil Probe Point 98 (see **Figures 6, 8, and 9**). However, between Probe Points 15 and 28, ER data indicated the potential for unmarked graves, which was substantiated by the plan map of the cemetery showing the location of grave markers, but probing did not identify any areas suggestive of grave shafts (see **Figures 7 and 8**). Conversely, ER data did not indicate any areas suggestive of grave shafts in the southeastern corner of the study area (**Figure 8**), but this area was identified as potentially containing unmarked graves based on the GPR data (**Figure 6**), which was confirmed by the presence of numerous grave markers and many additional unmarked graves identified by soil probing (**Figure 9**).



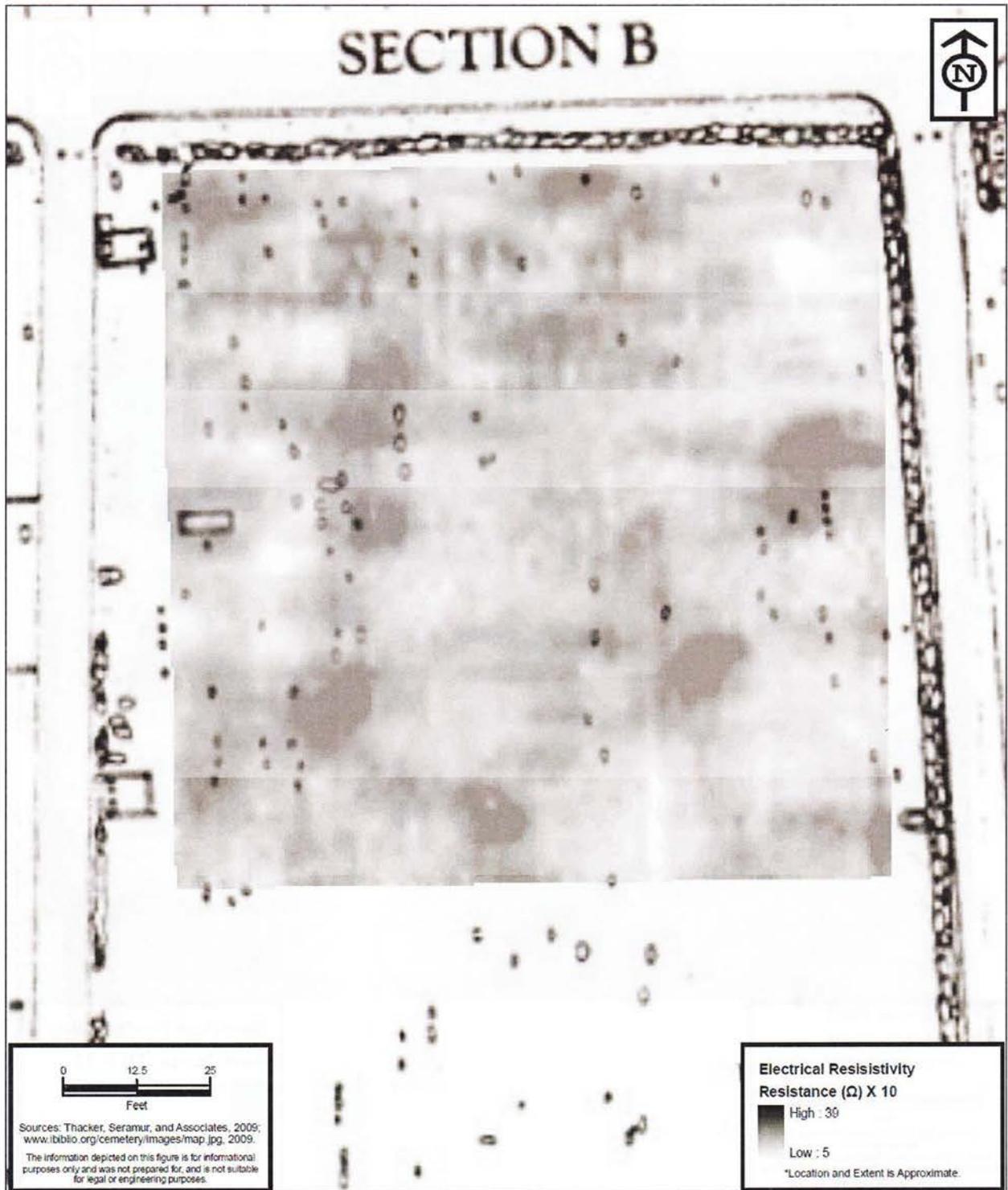


Figure 7: ER data overlain on cemetery plan

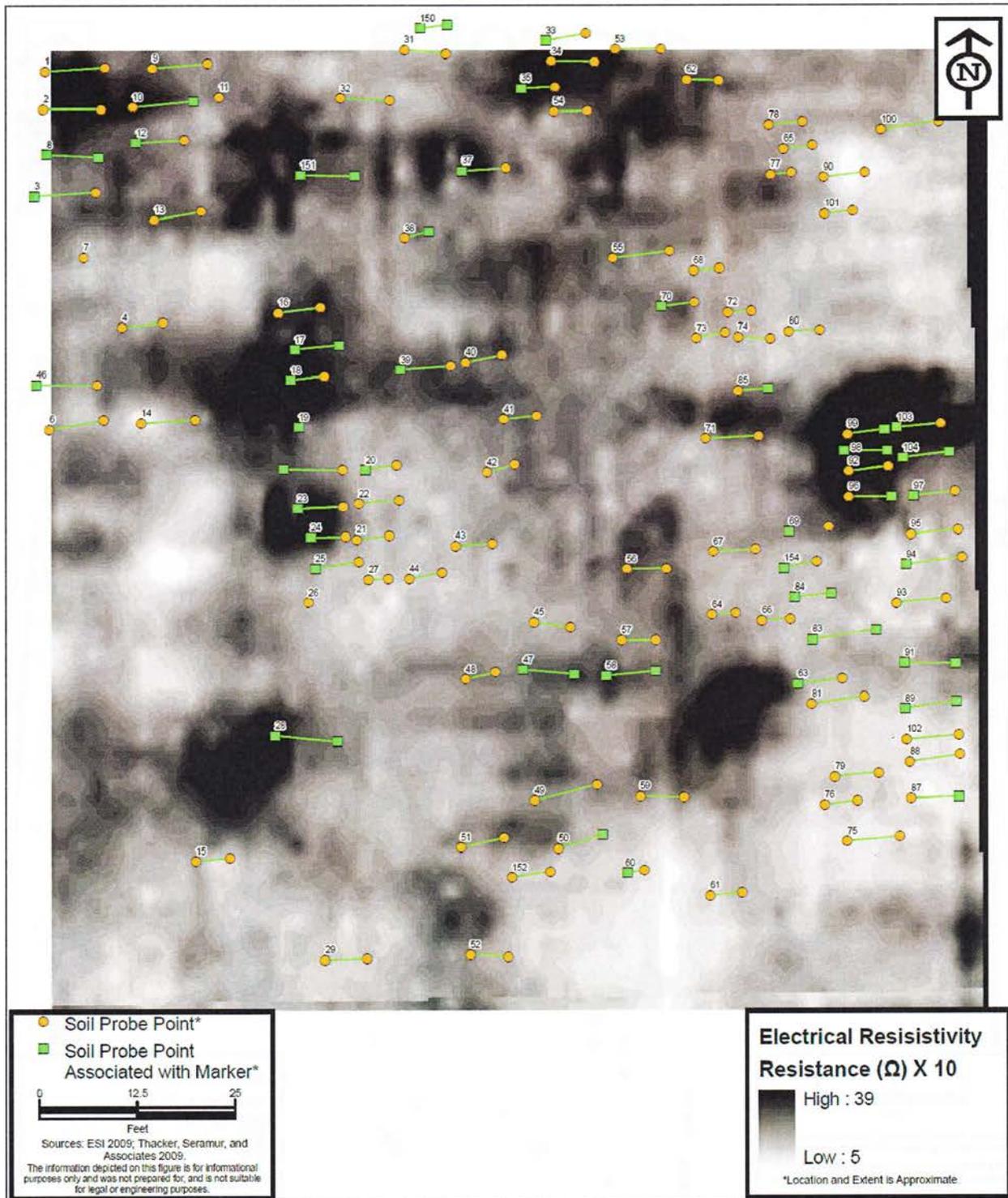


Figure 8: Soil probe points overlain on ER data

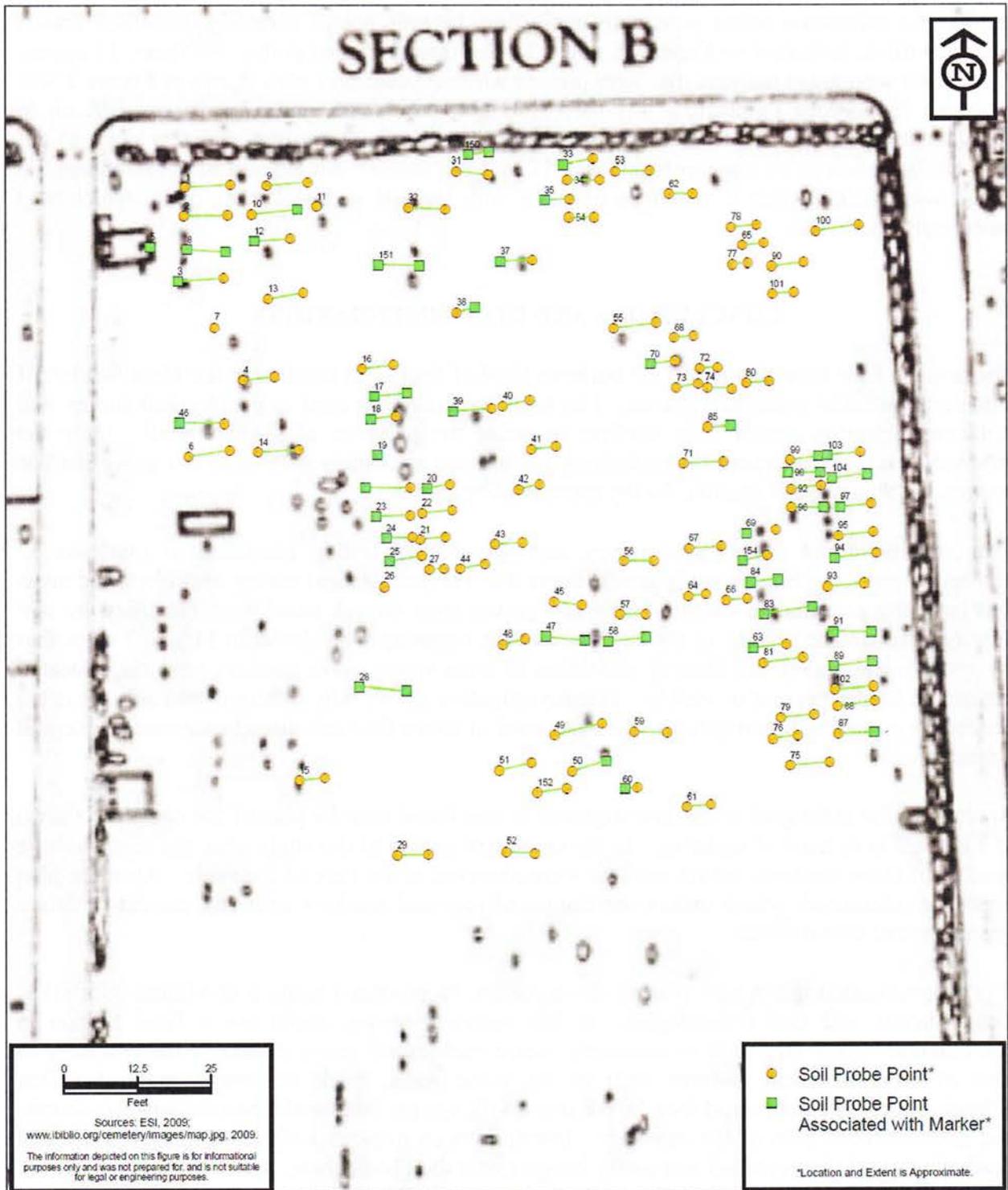


Figure 9: Soil probe points overlain on cemetery plan

In total, 62 soil probe points potentially indicating the presence of currently unmarked graves were identified, indicated on **Figures 8 and 9** by only round-shaped points. Of these, 11 appear to correlate with grave markers that were present when the cemetery plan shown as **Figure 2** was produced (Soil Probe Points 1, 2, 11, 14, 15, 31, 34, 45, 49, 55, and 57). It was difficult to correlate soil probe points with previously marked graves shown on the cemetery plan, as the plan was supplied as an ungeoreferenced JPEG format image. An attempt to georeference the image was made so that it could be overlain with the ER and soil probe data, which was moderately successful.

CONCLUSIONS AND RECOMMENDATIONS

The results of the investigation in the northern third of Section B resulted in the identification of numerous potential unmarked graves. The term "potential" is used as geophysical survey and soil density testing cannot fully confirm or refute the presence of a grave shaft. Only the removal of topsoil to expose the underlying subsoil can absolutely determine if a grave shaft is present, but this was not feasible for the present investigation.

The combination of geophysical survey and soil density testing identified as many as 62 unmarked graves within the study area (**Figure 9**). The geophysical survey also identified areas that have the potential to contain unmarked graves even though none were identified by soil density testing. The overlay of the ER data and the cemetery plan shown in **Figure 7** show that the geophysical survey did identify anomalies in areas where grave markers were once located but are no longer present or visible. This investigation shows why different data sets are often needed for cemetery investigations when the level of subsurface soil disturbance must be kept at a minimum.

Apart from the main goal of the investigation, it was found that the plan of the cemetery shown as **Figure 2** is in need of updating. In the southwest corner of the study area, the map shows a number of stone markers, but no markers were observed at the time of the study. Also, the plan is not georeferenced, which makes correlation of recorded markers with any current or future georeferenced data difficult.

It is recommended that a new plan of the cemetery be produced using a combination of GPS, Total Station, and GIS technologies. A full cemetery survey could use a Total Station in combination with a GPS unit to accurately locate each extant grave marker in the cemetery as well as other pertinent features such as the stone walls, brick walkways, and subsurface infrastructure. The data could then be put into a GIS system that would then contain an accurate and georeferenced plan of the cemetery. Inscriptions on markers such as names and birth and death dates could be recorded and easily integrated in the geodatabase, and data from surveys of the cemetery such as this one could easily be integrated with the existing data. The plan could also be easily updated when new burials were placed in the cemetery.

REFERENCES CITED

Baten, Betsy, and Ruth Little

1994 *Old Chapel Hill Cemetery National Register of Historic Places Registration Form*. Longleaf Historic Resources, Raleigh, NC.

