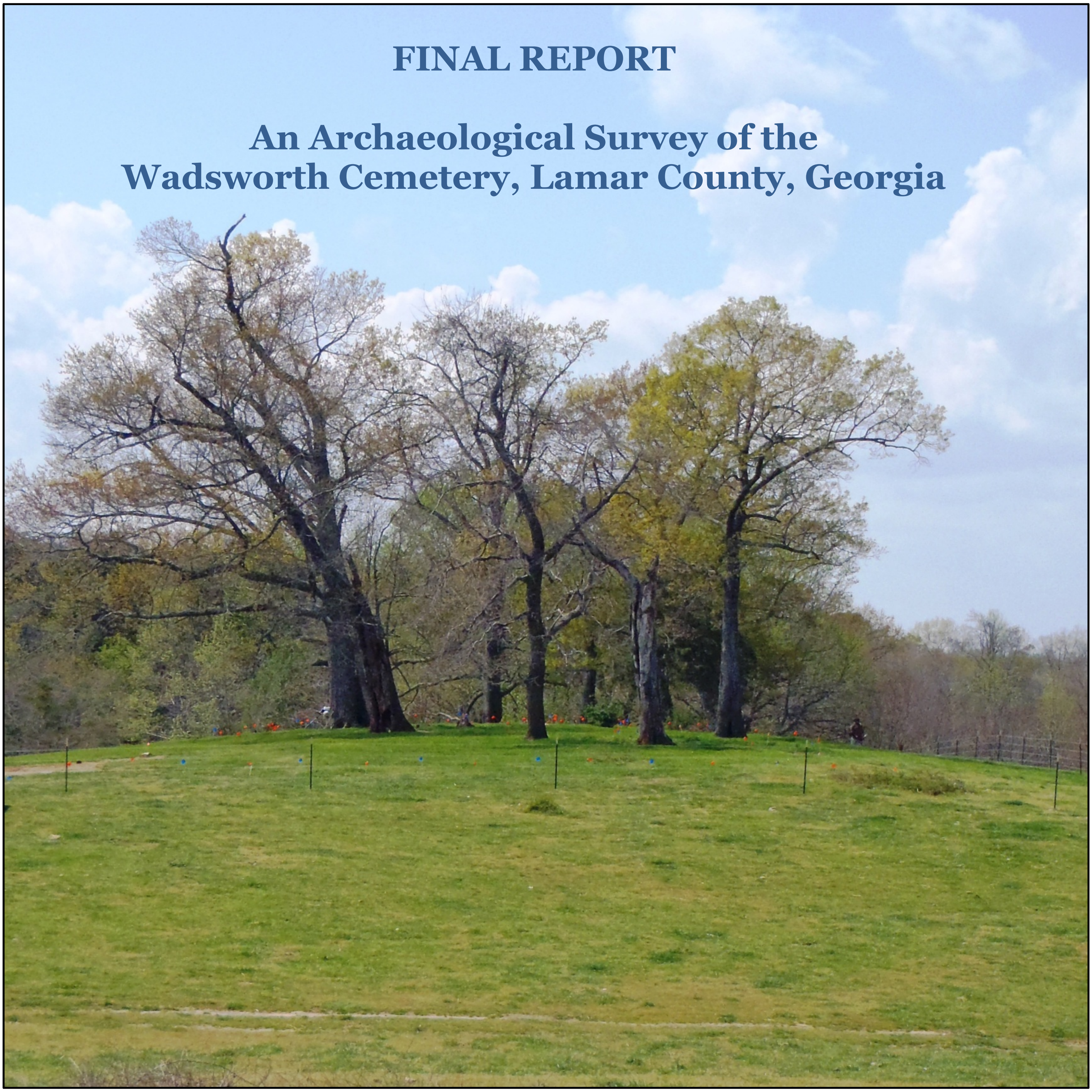
FINAL REPORT

An Archaeological Survey of the Wadsworth Cemetery, Lamar County, Georgia



SOUTHERN RESEARCH

Historic Preservation Consultants

FINAL REPORT

An Archaeological Survey of the Wadsworth Cemetery, Lamar County, Georgia

Submitted to:

City of Barnesville
109 Forsyth Street
Barnesville, Georgia 30204

Prepared by:

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SOUTHERN RESEARCH
Historic Preservation Consultants

24 April 2017

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INTRODUCTION

The Wadsworth Cemetery is located in Lamar County just northwest of Barnesville, Georgia near the intersection of Cannafax Road and Old Milner Road (Figure 1). It is a nineteenth century family cemetery that is owned by the City of Barnesville. Southern Research, Historic Preservation Consultants, Inc. was asked by the city to delineate the cemetery and provide an estimate of how many individuals might be buried there.

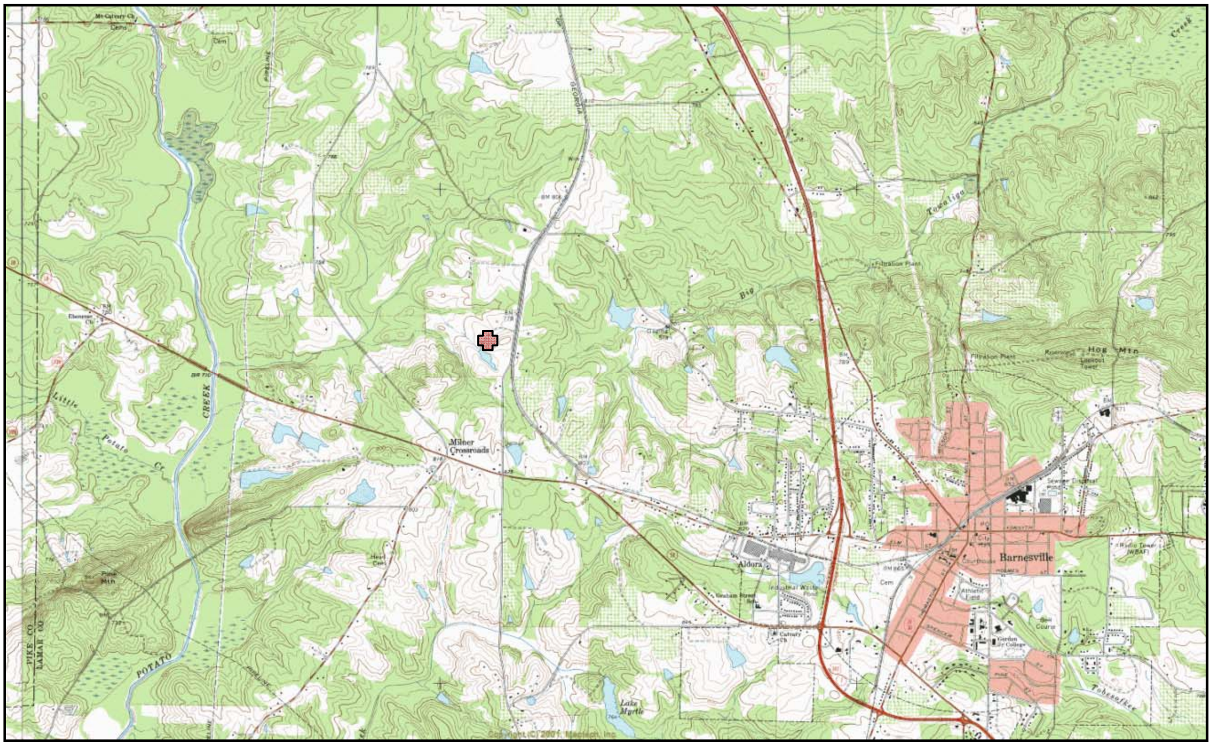


Figure 1. Location of the Wadsworth Cemetery in Lamar County, Georgia. Map Source, Barnesville 1:24,000 Topographic Map, USGS.

The family of Archibald Wadsworth began to be buried in the cemetery as early as the nineteenth century. Archibald Wadsworth was buried there in 1856. There are varying accounts of who may be buried there but as many as a dozen family members may be present. In addition to the Wadsworth family graves, there may be African-American slaves and freedmen as well as a mass grave with thirty or so victims of a civil war era train wreck.

Wadsworth Cemetery has been assigned site number 9LR67 by the Georgia Archaeological Site File. It is located on top of a prominent hill off the highway in a cattle pasture with ancient hardwood trees still standing (Figures 2 and 3). There are no monuments or marked graves across the hilltop although a few fieldstone markers are present (Figures 4 and 5). There are surface undulations all across the hilltop but no clearly aligned rows of depressions. On the west end are six angle iron fence posts lying on the ground presumably from a wire fence that has since collapsed.

Figure 2. Google Earth Imagery from March 2014.


Figure 3. View of Wadsworth Cemetery Looking West.

Figure 4. Example of a Grave Marked with a Quartzite Fieldstone at the Wadsworth Cemetery.

Figure 5. Example of a Grave Marked with a Quartzite Ledger at the Wadsworth Cemetery.

METHODS

The goal of the archaeological survey at the Wadsworth cemetery was to delineate the boundaries and provide an estimate of how many individuals might be buried there. The Wadsworth Cemetery is an example of an abandoned cemetery where no descendant group is maintaining it and no one has been buried there recently. Its past use as a cattle pasture has obscured the subtle surface indicators such as sunken rows of east-west oriented depressions, stone monuments or other mortuary furniture.

Surface Survey

The first step in delineating the cemetery was to conduct a surface survey. Archaeologists Matthew Wood and Matthew Newberry from Southern Research, HPC, Inc. spent two days carefully inspecting the hilltop for depressions, fieldstones and any other indicators of graves. Probing was useless for detecting graves due to the extremely gravely condition of the soils. All surface features were flagged and sketched onto a scaled map of the cemetery

Metal Detector Survey

A systematic metal detector survey was conducted on the hilltop to identify metal artifacts on the cemetery, especially evidence of fences or mortuary furniture. It was carried out by Matthew Wood and Matthew Newberry from Southern Research guided by Patrick Severts, Advanced Metal Detecting for Archaeologists (AMDA) Instructor (Figure 6).


Figure 6. Intensive Metal Detecting at the Wadsworth Cemetery

Two metal detector types where utilized on the metallic survey of the Wadsworth Cemetery; these include a CTX 3030 and a GPZ 7000 both produced by Minelab Corporation. The CTX 3030 is a FBS (Full Band Spectrum) detector that operates on 28 frequencies 1.5KHz-100KHz at the same time. The FBS technology allows the detector to operate in frequencies allowing for better discrimination, coverage, and depth than other traditional single frequency detectors. The detector as used in this survey had the standard 11" coil. The GPZ 7000 is the newest and most sensitive detector on the market with depth capabilities recorded to over 1 meter in optimal condition. The GPZ 7000 technology of Zero Voltage Transmission creates ultra-consistent high-power opposite polarity magnetic fields that greatly increase sensitivity to metallic objects at extreme depths.

The Wadsworth Cemetery metal detectors survey consisted of 100 percent coverage in a single direction with transects spaced every 1.5 meters. This 1.5-meter lane width is the standard average for a comfortable detector swing and is the most commonly used transect for full coverage detecting lanes as set by the AMDA. The CTX 3030 was used to conduct full coverage survey of the fenced in portion of the Wadsworth Cemetery. The GPZ 7000 later targeted the areas void of targets to identify deeply buried objects. Areas covered by the CTX 3030 were ground-truthed by the use of a handheld pin pointer to determine the depth of the objects. Objects that were found near the surface were excavated to determine relationship to the cemetery; all artifacts found were left in place while the modern trash such as pull-tabs and ring pulls were removed from the ground. In the areas where trash was removed, the GPZ 7000 was utilized to identify deeply buried objects. All deeply buried objects were double flagged while single blue flags were used to identify non-ferrous objects and orange flags identified ferrous materials. All targets that were not identified as modern trash were then mapped.

Transit Mapping

All surface features and metal detector hits were mapped with a Topcon Laser Transit. An arbitrary metric grid was established on the hilltop using magnetic North as Grid North. Temporary reference points were established along the 1000 east base line. The UTM point for our grid point 1000 East, 1000 North is Zone 16S, 761,087.13E 3,662,551.47N (WGS84).

Ground Penetrating Radar Survey

A Ground Penetrating Radar (GPR) Survey of the cemetery was conducted by Dan Elliott of the LAMAR Institute, Inc. assisted by Matthew Newberry from Southern Research (see Appendix 2). The GPR sample block in this study area was composed of a series of parallel transects, or traverses, which yielded a two-dimensional cross-section or profile of the radar data. These samples are termed radargrams. This two-dimensional image is constructed from a sequence of thousands of individual radar traces. A succession of radar traces bouncing off a large buried object will produce a hyperbola, when viewed graphically in profile. Multiple large objects that are in close proximity may produce multiple, overlapping hyperbolas, which are more difficult to interpret. For example, an isolated historic grave may produce a clear signal, represented by a well-defined hyperbola. A cluster of graves, however, may produce a more garbled signal that is less apparent.

The GPR signals that are captured by the receiving antenna are recorded as an array of numerals, which can be converted to gray scale (or color) pixel values. The radargrams are essentially a vertical map of the radar reflection off objects and other soil anomalies. It is not an actual map of the objects. The radargram is produced in real time and is viewable on a computer monitor, mounted on the GPR cart (Figure 7).

Figure 7. Ground Penetrating Radar Survey at the Wadsworth Cemetery.

The equipment used for this study consisted of a RAMAC/X3M Integrated Radar Control Unit, mounted on a wheeled-cart and linked to a RAMAC XV11 Monitor (Firmware, Version 3.2.36). A 500 megahertz (MHz) shielded antenna was used for the data gathering. MALÅ GeoScience's *Ground Vision* (Version 1.4.5) software was used to acquire and record the radar data (MALÅ GeoScience USA 2006). The radar information was displayed as a series of radargrams. Output from the survey was first viewed using *GroundVision*. This provided immediate feedback about the suitability of GPR survey in the area and the effective operation of the equipment. The time window that was selected allowed data gathering to focus on the upper 1.5 meters of soil, which was the zone most likely to yield archaeological deposits. Additional filters were used to refine the radar information during post-processing. These include adjustments to the gain. These alterations to the data are reversible, however, and do not affect the original data that was collected.

Upon arrival at the site, the RAMAC X3M Radar Unit was set up for the operation and calibrated. Several trial runs were made on parts of the site to test the machine's effectiveness in the site's soils. Machinery settings and other pertinent logistical attributes included the following:

Machine Settings, Block A
Time Window: 64.6 ns
Number of Stacks: 4
Number of Samples: 512
Sampling Frequency: 7,462 MHz
Antenna: 500 MHz shielded
Antenna Separation: 0.18 m
Trigger: 0.04 m
Radargram orientation: South to North (Magnetic North)
Radargram progress: West to East
Radargram Spacing: 50 cm
Total Radargrams: 184
Total Survey Length: 5,020.2 m
Dimensions: 44 m N-S (maximum) by 76 m E-W

The GPR data from the present study was processed with *GPR-Slice* (Version 7.0). Mapping in 3D entailed merging the data from the series of radargrams for each block. Once this was accomplished, horizontal slices of the data were examined for important anomalies and patterns of anomalies, which were likely of cultural relevance. These data were displayed as aerial plan maps of the sample areas at varying depths below ground surface. These horizontal views, or time-slices, display the radar information at a set time depth in nanoseconds (ns). Time-depth can be roughly equated to depth below ground. This equivalency relationship can be calculated using a mathematical formula.

Test Excavations

After the surface survey, systematic metal detecting and GPR survey, we opened a shallow hand dug excavation in grid square 990-995N, 995-1000E to ground truth the preliminary results (Figure 8). The location chosen had surface indicators, deep metal detector hits and several GPR targets to investigate. The shallow excavation measured about four by three meters and was approximately 25 cm deep. The soil was not screened but the excavation was backfilled.


Figure 8. Shallow hand dug excavations were used to ground truth the survey results.

RESULTS

The Wadsworth Cemetery in Lamar County, Georgia was surveyed by careful surface searching, systematic metal detecting, ground penetrating radar and shallow hand dug excavations. The results of these techniques, although not always in agreement, all point to the same conclusion: there may be as many as 100 individuals buried on the hilltop.

Preliminary Historical Background

The Wadsworth Cemetery, also referred to as the Wadsworth-Clayton Cemetery in some online sources, is named for the family patriarch Archibald Wadsworth. These online sources along with an examination of the population schedules for the US Census (Ancestry.com) provide the current historical narrative for the family and cemetery. The following brief history is based primarily on information compiled by Ruth Frances Aaron (http://www.oocities.org/claytonresearch/archibald_wadsworth.html) about the Wadsworth family and cemetery.

Archibald Wadsworth was born in the state of North Carolina around 1765. His name appears in the first US census of 1790 as dwelling in Moore County, North Carolina. Archibald Wadsworth married Clarissa Kenny (born in 1774) around 1792 in Moore County, North Carolina. Ten years later in the 1800 census, Archibald Wadsworth is again listed as living in Moore County, North Carolina. His household includes 3 children all under 10 years of age. In the 1810 census the Wadsworths are still living in Moore, North Carolina but with a household that has grown to include eight children. The 1820 census identifies the Wadsworth household in Moore, North Carolina and lists seven children in the household and one slave (US Census, Population Schedules, 1790 - 1860 Federal Censuses, Ancestry.com; Aaron n.d.).

By 1825 Archibald had moved to Pike County, Georgia where he resided for the rest of his life. In the 1830 census Archibald and Clarissa had three female children living at home and one male slave. The eldest daughter, while not named in the census, was Clarissa who was born around 1796 based on later census age information. There is a female household member shown as being in the age range of 30 to 40 years, which fits Clarissa's age, who would have been around 34 or 35 years of age at that date. In the 1840 census Archibald Wadsworth resides in Pike County with two white females, one is a female in the 60 to 69 age range (probably wife Clarissa) and one female in the age range 40 to 49, which is probably daughter Clarissa. There is also a free black female (age range 26-56) in the household. It should be noted that until the 1850 US census only the head of household's name is given for each census household and the rest of the family is identified by gender and age ranges only with no names (US Census, Population Schedules, 1790 - 1860, Ancestry.com).

By the 1850 census there is only one other person residing in the household with Archibald and that is his daughter, Clarissa Wadsworth, who is listed as being 53 years of age. Archibald's wife Clarissa, who would have been around 76 in 1850 isn't listed in the schedule, which suggests she had already passed away in the decade after the 1840 census. It is surmised that she was buried on the hill nearby, although there is no way to be certain. Six years after the 1850 census Archibald passed away and was buried in the nearby cemetery (US Census, Population Schedules, 1790 - 1860, Ancestry.com).

According to one online source (Ruth Frances Aaron n.d.), there are approximately 18 family members buried in the cemetery. Besides Archibald Wadsworth, the cemetery reportedly contains the remains of Archibald and Clarissa's oldest son, John and his wife (Nancy), as well as daughter Clarissa, and at least four other daughters (Amy, Nancy, Mary and Elizabeth and some of their spouses and children) are buried in the cemetery. Aaron's account also notes that there were "many slave graves ... on the outskirt of the cemetery". In Ms. Aaron's account of those buried in the cemetery is also the cryptic note that a Mr. and Mrs. J.D. Moore visited the cemetery sometime during World War II and counted upwards of 140 graves.

A visit to the Find A Grave website for the Wadsworth-Clayton Cemetery lists four graves: Archibald Wadsworth, Clarissa Wadsworth (the daughter), John Wadsworth (son) and a Mary Suzan Wadsworth, who according to the site was born in 1957 and died in 2016. However, there is no evidence of a recent grave at the site and it is likely that the dates for Mary Suzan Wadsworth listed on the website are erroneous.

Aaron notes that there were around twenty Confederate soldiers also buried in the cemetery. These are the remains of wounded soldiers that were being transported south from Atlanta by train on the Macon and Western Railroad to the Confederate Hospital at Milner. A second source (crghenry.org) notes that early on the morning of September 1, 1864 the train of wounded soldiers collided with a Confederate supply train traveling north. The accident occurred near an area on the rail line known as Lavender's Curve, which is near the Wadsworth family property and cemetery. The CRG source notes that there were 31 or more killed in the accident and that the dead were buried near the rail line on a nearby cemetery located on a hill, but does not specify how many dead were buried there.

Ruth Frances Aaron also notes that sometime in the early twentieth century the grave markers in the cemetery were removed and used to "prop up the last old house on the property".

Surface Survey

Surface features have been obscured in large part due to the many years of trampling by cattle. The removal of all formal monuments from the cemetery has confounded the ability to recognize individual graves. The surface indicators include depressions, fieldstone markers, stone ledgers and iron fence posts as shown in Figure 9. In all, 40 possible graves are indicated by surface indicators.

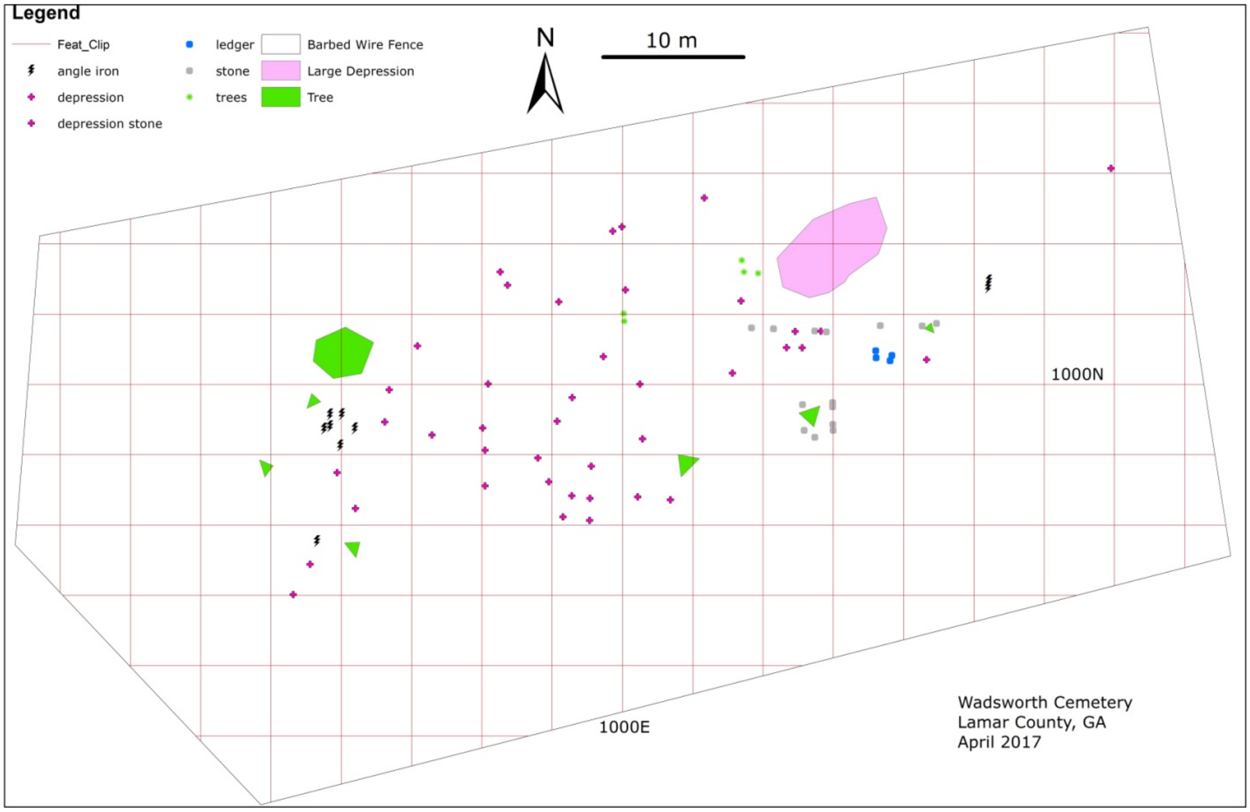


Figure 9. A map of the surface features on the Wadsworth Cemetery.

Metal Detecting

The systematic metal detecting on the cemetery recorded 77 individual deep metal hits (>30 cm deep). Some of these hits may indicate coffin hardware associated with shallow graves. The hits that were recovered included fence posts, railroad spikes, a rose head wrought nail and an iron ball measuring one inch in diameter and strongly resembling a ball from civil war canister artillery munitions. The map of metal detector hits is presented in Figure 10.

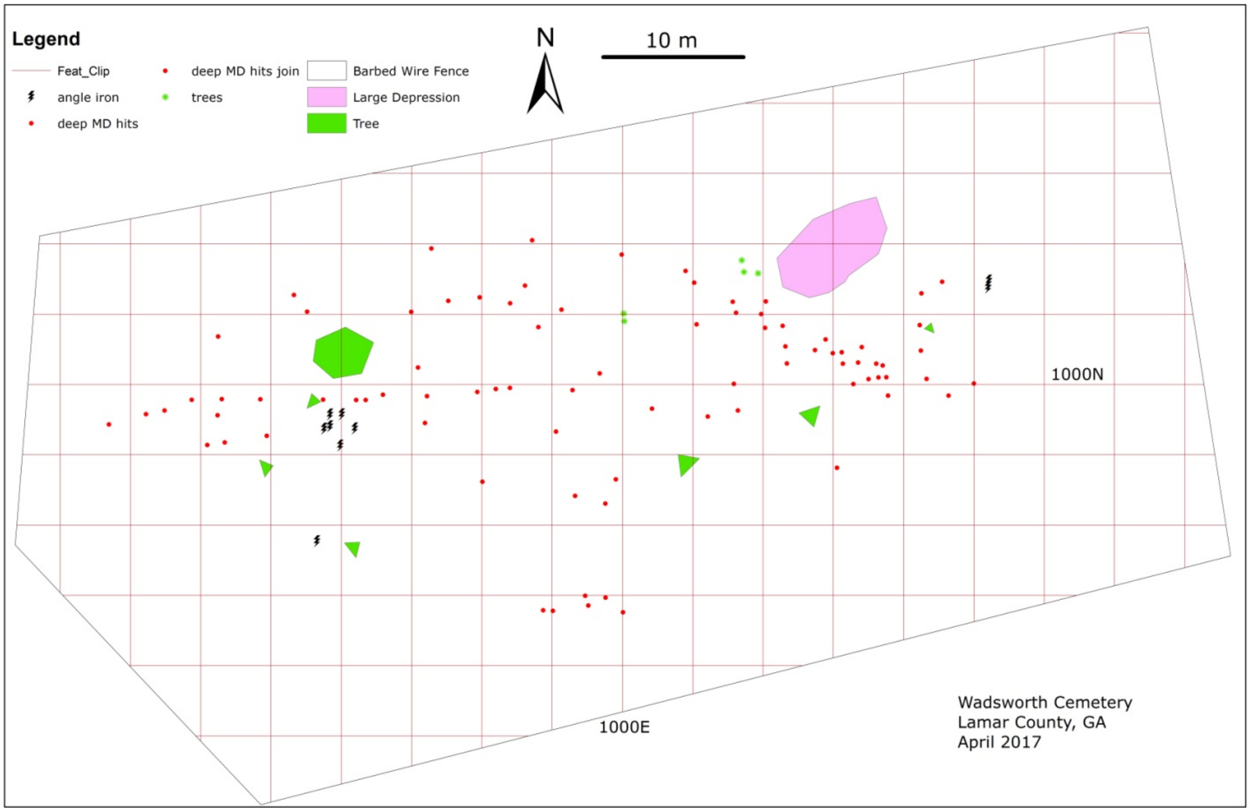


Figure 10. A map of the deep metal detector hits at the Wadsworth Cemetery.

Ground Penetrating Radar Survey

The ground penetrating radar survey of the cemetery provided the best data regarding the number and locations of graves. There are 103 GPR targets on the hilltop that are possible graves. Some will undoubtedly turn out to be old tree stumps and other natural disturbances but most are expected to be graves. Although there is a general agreement between the GPR data and the surface indicators and deep metal detector hits, there are some confusing discrepancies as well. For example, some of the graves that show up on the surface were not detected by the GPR. Also, in the northeast corner of the cemetery, the GPR picked up at least eleven possible graves when the surface searching found one possible grave and the metal detecting recorded no deep hits here. Figure 11 shows the GPR results superimposed upon the surface features.

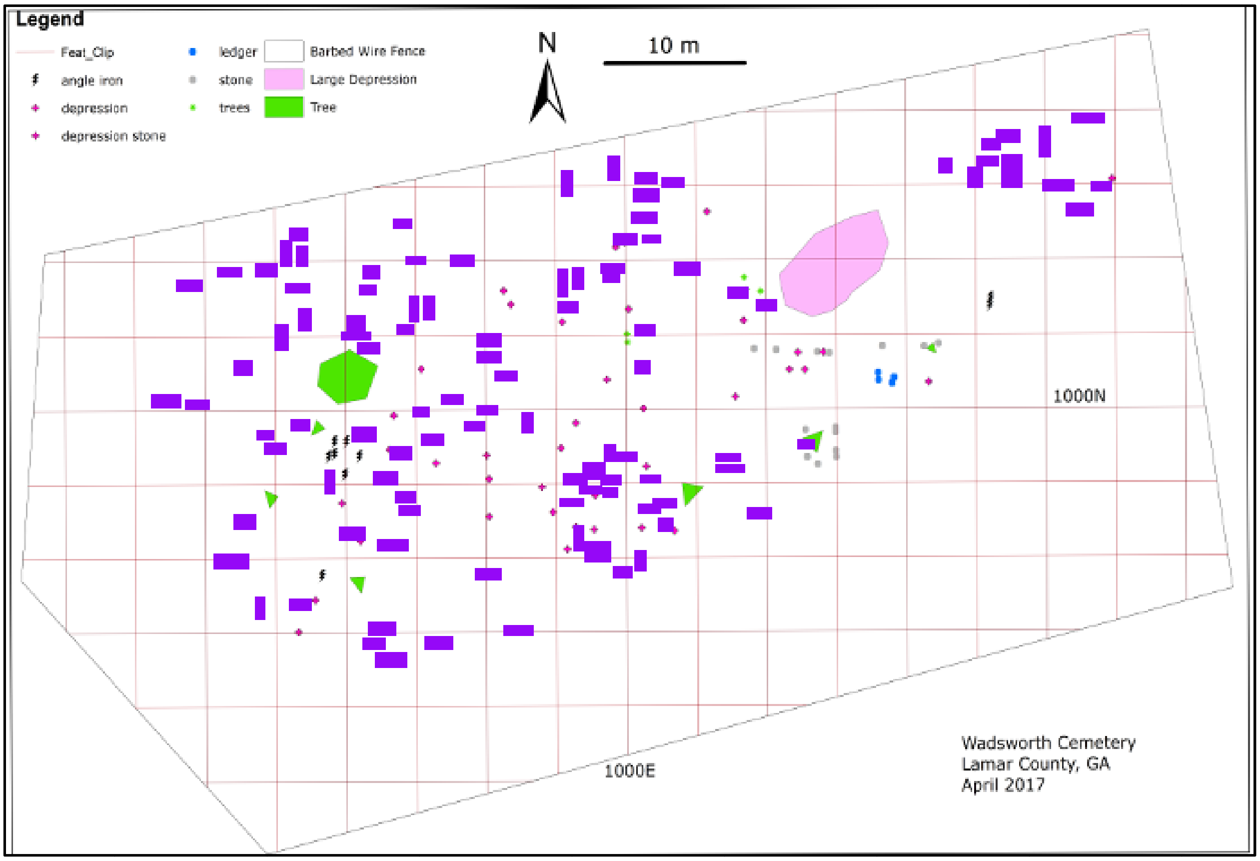


Figure 11. The results of the Ground Penetrating Radar Survey on the Wadsworth Cemetery

Test Excavation

To better assess the results of the three techniques used to delineate the cemetery we opened a shallow hand dug excavation. The area chosen is in grid square 995 – 1000 East and 990 – 995 North. The grid square contains possible graves identified by surface indicators, deep metal detector hits and GPR targets so it made a good test of what works best on this cemetery. Figure 12 shows the results of the excavations. There are three grave shafts that show up as dark rectangular stains in the light colored subsoil of the hilltop. All run east to west as is typical of nineteenth century Christian burials (Figures 13 - 15).

The northern grave shaft was detected by surface indicators and a GPR target. The middle grave shaft was detected by surface conditions only, as the GPR did not record an anomaly here. The southern grave shaft was detected by surface indications, a deep metal hit and a GPR target.

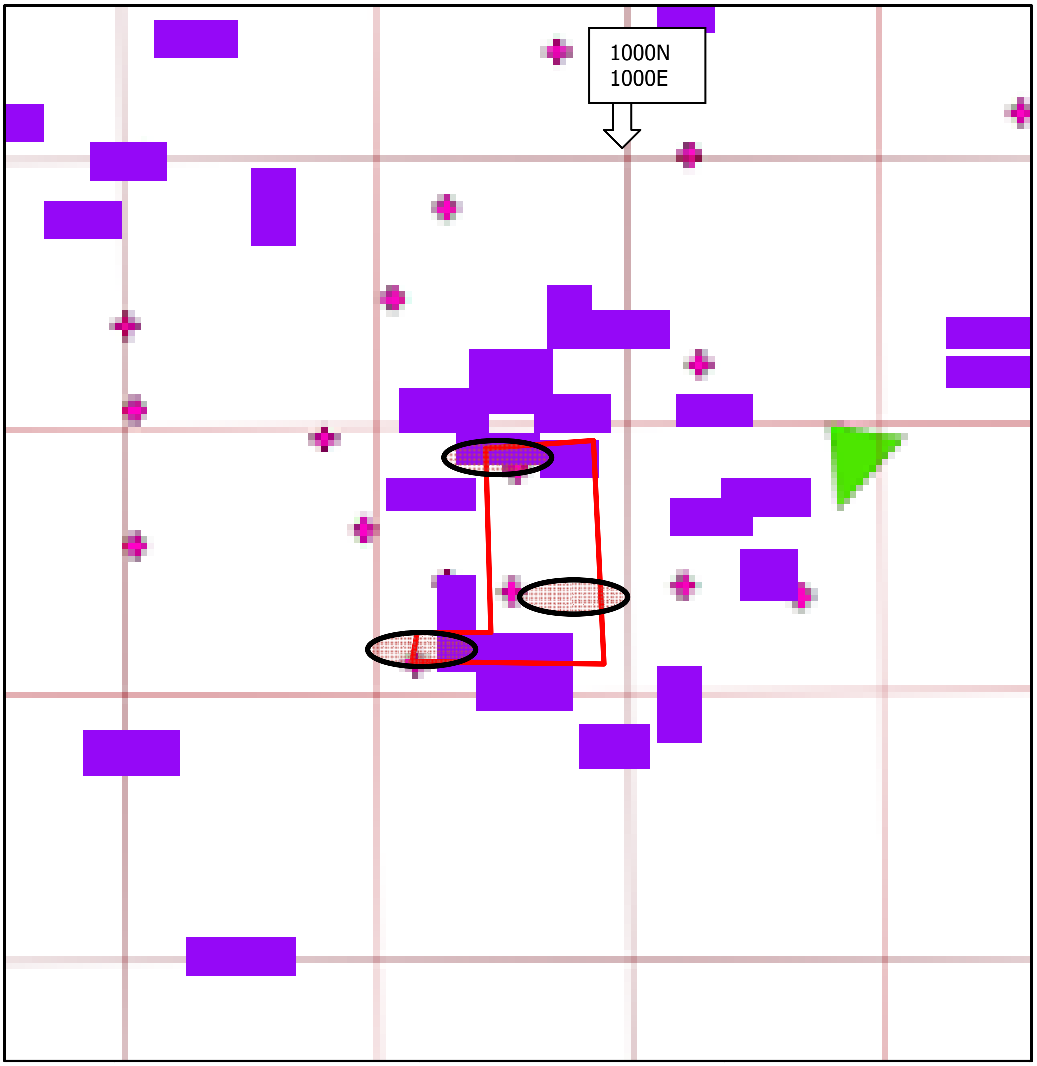


Figure 12. A detail map of the area chosen for test excavations at the Wadsworth Cemetery. The red rectangular polygon is the excavation trench and the east to west ovals are grave shafts.

The photographs in Figures 13, 14 and 15 show the soil stains that represent the tops of the grave shafts as they appeared just below the sod. They have been outlined in black so that the reader can better discern the features.

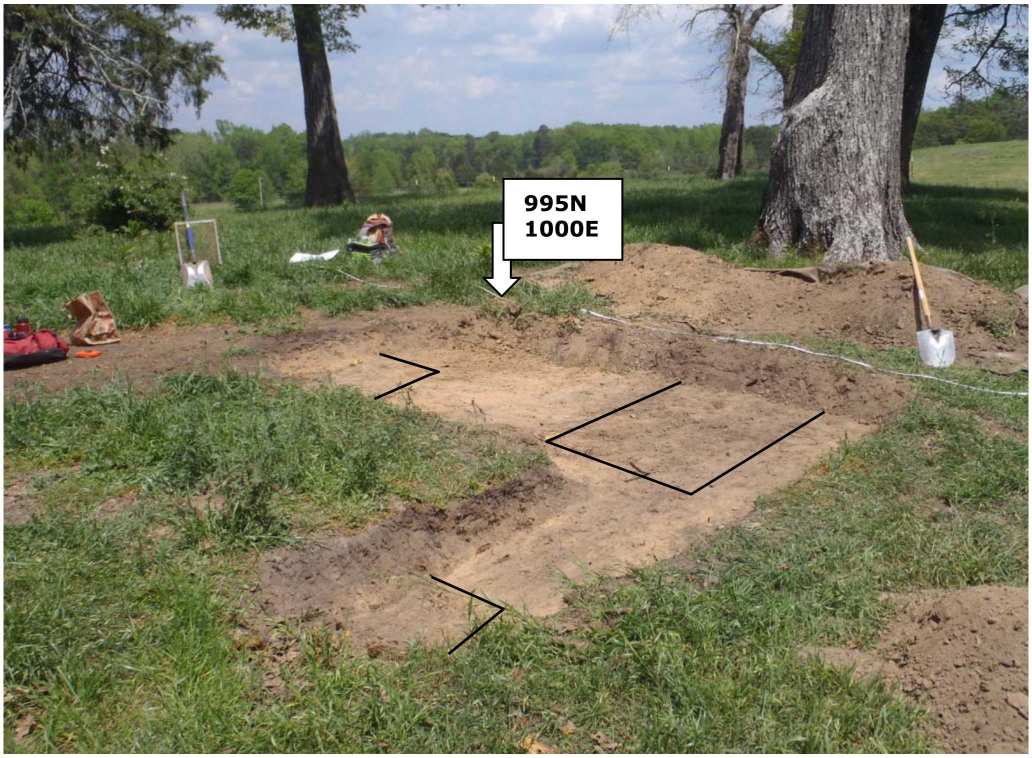


Figure 13. A view of the test excavations looking northeast in grid square 990-995N, 995-1000E.


Figure 14. A view of two grave shafts looking south in grid square 990-995N, 995-1000E.

Figure 15. A view of the two grave shafts looking north in grid square 990-995N, 995-1000E.

RECOMMENDATIONS

The archaeological survey of the Wadsworth Cemetery in Lamar County, Georgia was conducted using surface searching, systematic metal detecting, Ground Penetrating Radar and hand dug excavations. The results suggest that there may be 100 individuals buried on the hilltop. The exact location of each grave and location of the 1864 mass grave from the train wreck was not determined. The best guess has the mass grave in the northeast part of the cemetery with the Wadsworth family and African American slaves and freedmen covering the middle and western portions.

If the City of Barnesville wishes to relocate the individuals buried in the Wadsworth Cemetery, here are the next steps required to move forward:

Survey by Registered Surveyor *

Conduct Genealogical Research to identify descendants:
- Consult local historians, historical societies,
- Contact local African American Communities and the Sons of Confederate Veterans
- Research pertinent local, state, federal documents
- Research genealogical sources

Prepare Application for Permit:
- Introduction
- Evidence of Ownership (Deed) *
- Cemetery Delineation Report
- Legal Description and Surveyors Plat *
- Plan for Notifying Descendants
- Disinterment and Relocation Plan

Application approved by County

Notify descendants and consult about relocation plan:
- Include local African American Communities and the Sons of Confederate Veterans
- Newspaper Outreach
- World Wide Web requests
- Letters to historical and genealogical groups

Disinter Remains:
- Remove top soil with skilled backhoe operator
- Hand excavate individual graves
- Conduct limited analysis of the remains to identify sex and age
- Place remains in new containers

Arrange Reburial with Greenwood Cemetery:
- Transport remains daily to cemetery

Prepare a Final Report of Project

* Provided by the City of Barnesville

References Cited

Aaron, Ruth Frances
n.d. Archibald Wadsworth, circa 1765-1856. File accessed April 14, 2017 http://www.oocities.org/claytonresearch/archibald_wadsworth.html).

Ancestry.com
2017 Federal Census Population Schedules for 1790 to 1860. Files accessed April 14-18, 2017. Ancestry.com

Find A Grave
2017 Wadsworth Cemetery. File accessed April 14, 2017: http://www.oocities.org/claytonresearch/archibald_wadsworth.html.

Cemetery Research Group (CRG), Henry County, Georgia
2007 Milner Train Wreck. File accessed April 14,2017: http://www.crghenry.org/milner/milnertrainwreck.html

Appendix A: 9LR67 Site Form

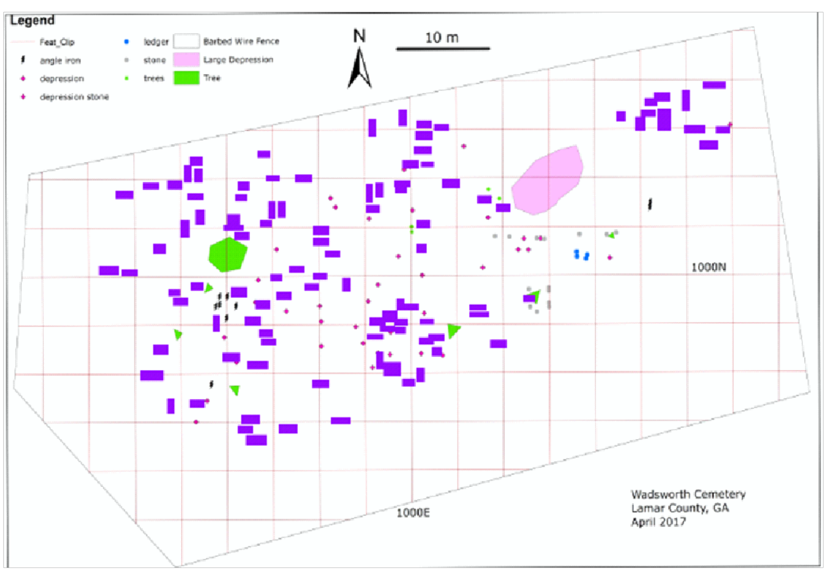
GEORGIA ARCHAEOLOGICAL SITE FORM
1990
Official Site Number: 9Lr67

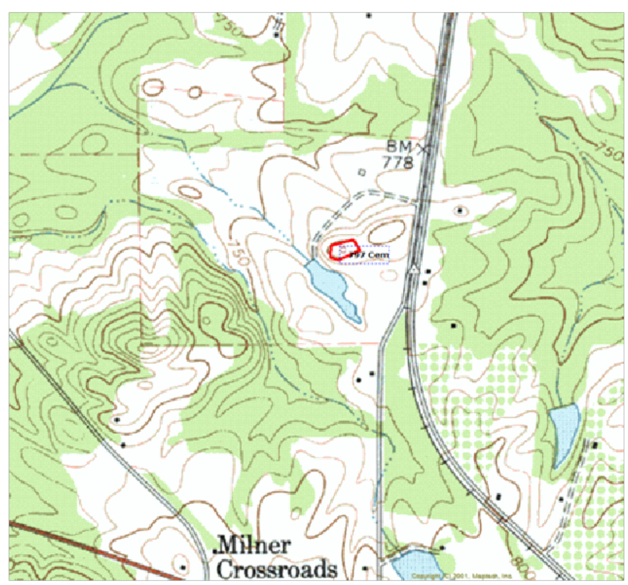
Institutional Site Number: 797 -1 **Site Name:** Wadsworth Cemetery
County: Lamar **Map Name:** Barnesville USGS or USNOAA
UTM Zone: 16 **UTM East:** 761 103 **UTM North:** 3 662 342
Owner: City of Barnesville, Ga **Address:** Barnesville, GA
Site Length: 75 **meters Width:** 45 **meters Elevation:** + - 244 **meters**
Orientation: 1. N-S 2. E-W 3. NE-SW 4. NW-SE 5. Round 6. Unknown
Kind of Investigation: 1. Survey 2. Testing 3. Excavation 4. Documentary 5. Hearsay 6. Unknown 7. Amateur
Standing Architecture: 1. Present 2. Absent
Site Nature: 1. Plowzone 2. Subsurface 3. Both 4. Only Surface Known 5. Unknown 6. Underwater
Midden: 1.Present 2.Absent 3.Unknown **Features:** 1.Present 2.Absent 3.Unknown
Percent Disturbance: 1. None 2. Greater than 50 3. Less than 50 4.Unknown
Type of Site (Mill, Mound, Quarry, Lithic Scatter, etc.) Historic cemetery

Topography (Ridge, Terrace, etc.): Hill Top

Current Vegetation (Woods, Pasture, etc.): Pasture with large hardwoods

Additional Information: Archibald Wadsworth family cemetery from ca. 1839. Possible mass gr
The survey included surface searching, systematic metal detecting, GPR and shallow hand du
The survey indicated that 100 +/- graves are present.





SKETCH MAP
(Include sites, roads, streams, landmarks)

OFFICIAL MAP
(Xerox of proper map)

State Site Number: 9Lr67 **Institutional Site Number:** 797-1

Public Status: 1. National Historic Landmark 2. National Natural Landmark 3. Georgia Register 4. Georgia Historic Trust 5. HABS 6. HAER

National Register Standing: 1. Determined Eligible 2. Recommended Ineligible 3. Recommended Eligible 4. Nominated 5. Listed 6. Unknown 7. Removed

National Register Level of Significance: 1. Local 2. State 3. National

Preservation State (Select up to Two): 1. Undisturbed 2. Cultivated 3. Eroded 4. Submerged 5. Lake Flooded 6. Vandalized 7. Destroyed 8. Redeposited 9. Graded 10. Razed

Preservation Prospects: 1. Safe 2. Endangered by: Industrial Development 3. Unknown

RECORD OF INVESTIGATIONS

Supervisor: W D Wood **Affiliation:** Southern Research, HF **Date:** April 2017

Report Title: Archaeological Survey of the Archibald Wadsworth Cemetery, Lamar Cour

Other Reports:

Artifacts Collected: One one inch diameter iron ball, possible canister shot from civil wa

Location of Collections: Southern Research Lab, Waverly Hall, GA

Location of Field Notes: Southern Research Lab, Waverly Hall, GA

Private Collections:

Name: **Address:**

CULTURAL AFFINITY

Cultural Periods: Historic

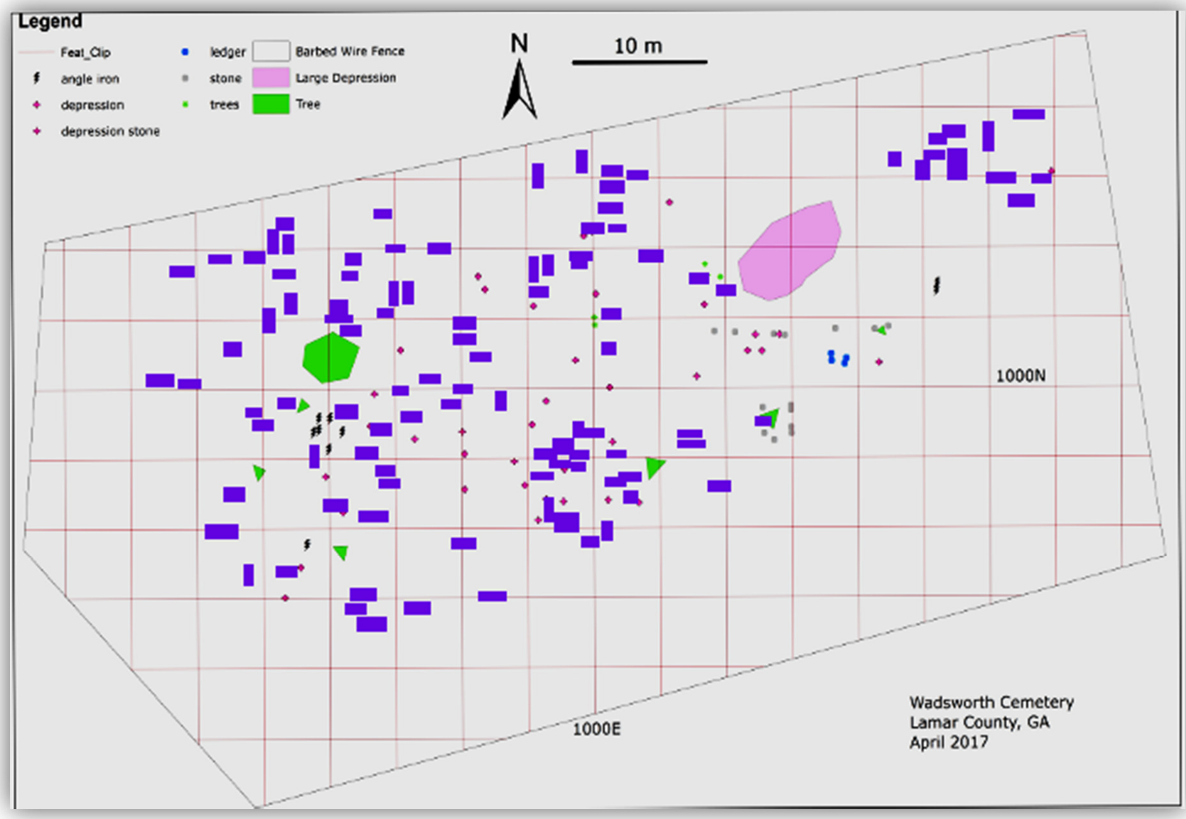
Phase: Nineteenth Century

FORM PREPARATION AND REVISION

Date	Name	Institutional Affiliation
14 April 2017	W D Wood	

Appendix B: Ground Penetrating Radar Survey Report

Ground Penetrating Radar Survey of the Wadsworth Cemetery, Lamar County, Georgia



By Daniel T. Elliott

The LAMAR Institute, Inc.
Savannah, Georgia
2017

Table of Contents

I. Introduction

This report presents the findings of a Ground Penetrating Radar (GPR) survey by the LAMAR Institute for the Wadsworth Cemetery in Lamar County, Georgia. This work was performed for Southern Research Historic Preservation Consultants, Inc. and the City of Barnesville, Georgia. The GPR survey provides a better understanding of the historic resources in the Wadsworth Cemetery. The present report addresses the methods, findings, and interpretations of the GPR portion of the project. The GPR survey resulted in the identification of at least 103 potential graves.

Historical Background

The Wadsworth Cemetery is located in Lamar County, Georgia (Figure 1). It contains the interments of the Wadsworth family from the nineteenth century and possibly many others. Several families of Wadsworths are recorded in the 1850 census for Pike County, Georgia. The patriarch was Archibald Wadsworth, who was listed in the 1830 census for Pike County and in the 1850 as an 85 year old farmer (Ancestry.com 2017). He died in 1856 and was buried in the family cemetery. Other family members thought to be buried in this cemetery include Clarissa Wadsworth (1800-Unknown) and John Wadsworth (1802-1864) (Whitehead 2003).

Figure 1. Wadsworth Cemetery Location Map (General Location Outlined in Red).

This cemetery may be the site of a mass grave of Confederate soldiers who were killed in a train wreck on September 1, 1864. One newspaper account of September 4 listed 26 men and one woman (Miss Saffen of Memphis) killed. Among the soldiers killed were Major Saunders of Savannah and Lieutenant Bond of Garrett's battery. The 22nd Georgia sent Captain Q. Born's Company on the train and Ben Smith and Joe Johnson, of that company, were killed (*Daily Constituionalist* 1864a:1). A newspaper story from September 7 noted that 31 dead bodies were taken from the wreck. That account noted, "the collision occurred in a cut and a curve two miles on the other side of that place [Barnesville]" (*Daily Constitutionalist* 1864b:3). Contemporary newspaper accounts place the location of the wreck between 2 and 2.5 miles north of Barnesville. The Wadsworth cemetery also may have been used by other families in the community.

Report Organization

This report is organized into four chapters. Chapter 2 contains the research methods used in this study. Chapter 3 contains the results and interpretation of the GPR survey. Chapter 4 provides a project summary. This is followed by a bibliography of references cited in the report.

II. Research Methods

GPR is an important remote sensing tool used by archaeologists (Conyers 2002, 2004; Conyers and Goodman 1997). The technology is particularly effective in mapping historic cemeteries. The technology uses high frequency electromagnetic waves (microwaves) to acquire subsurface data. The device uses a transmitter antenna and closely spaced receiver antenna to detect changes in electromagnetic properties beneath them. The antennas are suspended just above the ground surface and the antennas are shielded to eliminate interference from sources other than directly beneath the device. The transmitting antenna emits a series of electromagnetic waves, which are distorted by differences in soil conductivity, dielectric permitivity, and magnetic permeability. The receiving antenna records the reflected waves for a specified length of time (in nanoseconds, or ns). The approximate depth of an object can be estimated with GPR by adjusting for electromagnetic propagation conditions.

The GPR sample block in this study area was composed of a series of parallel transects, or traverses, which yielded a two-dimensional cross-section or profile of the radar data. These samples are termed radargrams. This two-dimensional image is constructed from a sequence of thousands of individual radar traces. A succession of radar traces bouncing off a large buried object will produce a hyperbola, when viewed graphically in profile. Multiple large objects that are in close proximity may produce multiple, overlapping hyperbolas, which are more difficult to interpret. For example, an isolated historic grave may produce a clear signal, represented by a well-defined hyperbola. A cluster of graves, however, may produce a more garbled signal that is less apparent.

The GPR signals that are captured by the receiving antenna are recorded as an array of numerals, which can be converted to gray scale (or color) pixel values. The radargrams are essentially a vertical map of the radar reflection off objects and other soil anomalies. It is not an actual map of the objects. The radargram is produced in real time and is viewable on a computer monitor, mounted on the GPR cart.

GPR has been successfully used in Georgia's coastal plain for archaeological and forensic anthropological applications to locate relatively shallow features, although the technique also can probe deeply into the ground. The machine is adjusted to probe to the depth of interest by the use of different frequency range antennas. Higher frequency antennas are more useful at shallow depths, which is most often the case in archaeology. Also, the longer the receiving antenna is set to receive GPR signals the deeper the search. The effectiveness of GPR in various environments on the North American continent is widely variable and depends on solid conductivity, metallic content, and other pedo-chemical factors. Generally, Georgia's coastal soils have moderately good properties for GPR application.

GPR signals cannot penetrate large metal objects and the signals are also significantly affected by the presence of salt water. Although radar does not penetrate metal objects, it does generate a distinctive signal that is usually recognizable, particularly for larger metal objects, such as a cast iron cannon or man-hole cover. The signal beneath these objects is often canceled out, which results in a pattern of horizontal lines on the radargram. For smaller objects, such as a scatter of nails, the signal may ricochet from the objects and produce a confusing signal. Rebar-reinforced concrete, as another example, generates an unmistakable radar pattern of rippled lines on the radargram.

Using the same RAMAC X3M GPR system as that used in the present study, Elliott has conducted several GPR studies of eighteenth and nineteenth century cemetery sites in Georgia. The first LAMAR Institute cemetery study to employ GPR was at the New Ebenezer town site in Effingham County, Georgia (Elliott 2003). The results of the GPR work at New Ebenezer were quite exciting and included the delineation of a large portion of a British redoubt palisade ditch and the discovery of several dozen previously unidentified human graves (both within and beyond the known limits of the Jerusalem Lutheran Church Cemetery). GPR survey was conducted by Elliott at Sunbury Cemetery (Liberty County), Woodbine Plantation cemetery (Camden County), the Gould-Bethel Cemetery (Chatham County), Bullhead Bluff Cemetery (Camden County), Behavior Cemetery (McIntosh County) and numerous other coastal cemetery sites with satisfactory results (Elliott 2003, 2004, 2005, 2006a-d, 2009, 2010a-d, 2014). This equipment and survey methodology also has proven successful on cemetery sites in the Georgia piedmont and South Carolina foothills.

The equipment used for this study consisted of a RAMAC/X3M Integrated Radar Control Unit, mounted on a wheeled-cart and linked to a RAMAC XV11 Monitor (Firmware, Version 3.2.36). A 500 megahertz (MHz) shielded antenna was used for the data gathering. MALÅ GeoScience's *Ground Vision* (Version 1.4.5) software was used to acquire and record the radar data (MALÅ GeoScience USA 2006). The radar information was displayed as a series of radargrams. Output from the survey was first viewed using *GroundVision*. This provided immediate feedback about the suitability of GPR survey in the area and the effective operation of the equipment. The time window that was selected allowed data gathering to focus on the upper 1.5 meters of soil, which was the zone most likely to yield archaeological deposits. Additional filters were used to refine the radar information during post-processing. These include adjustments to the gain. These alterations to the data are reversible, however, and do not affect the original data that was collected.

Upon arrival at the site, the RAMAC X3M Radar Unit was set up for the operation and calibrated. Several trial runs were made on parts of the site to test the machine's effectiveness in the site's soils. Machinery settings and other pertinent logistical attributes included the following:

Machine Settings, Block A
Time Window: 64.6 ns
Number of Stacks: 4
Number of Samples: 512
Sampling Frequency: 7,462 MHz
Antenna: 500 MHz shielded
Antenna Separation: 0.18 m
Trigger: 0.04 m
Radargram orientation: South to North (Magnetic North)
Radargram progress: West to East

Radargram Spacing: 50 cm
Total Radargrams: 184
Total Survey Length: 5,020.2 m
Dimensions: 44 m N-S (maximum) by 76 m E-W
UTM Location (WGS 84): Keyed to Figure 3, A- 200891.7E 3663624.1N; B- 200900.2E 3663614.5N; C- 200967.5E 3663631.8N

The GPR survey covered an area approximately 76 m East-West by 44 m North-South. The work required no excavation. The survey was accomplished by Daniel Elliott with the able assistance of archaeologist Matthew Newberry. GPR data collection began on April 3 and was completed on April 4, 2017. Surveyors collected 184 radargrams from the cemetery. Figure 3 shows the radargram plan for Block A. Figure 4 contains a key to the UTM locations for the GPR grid.

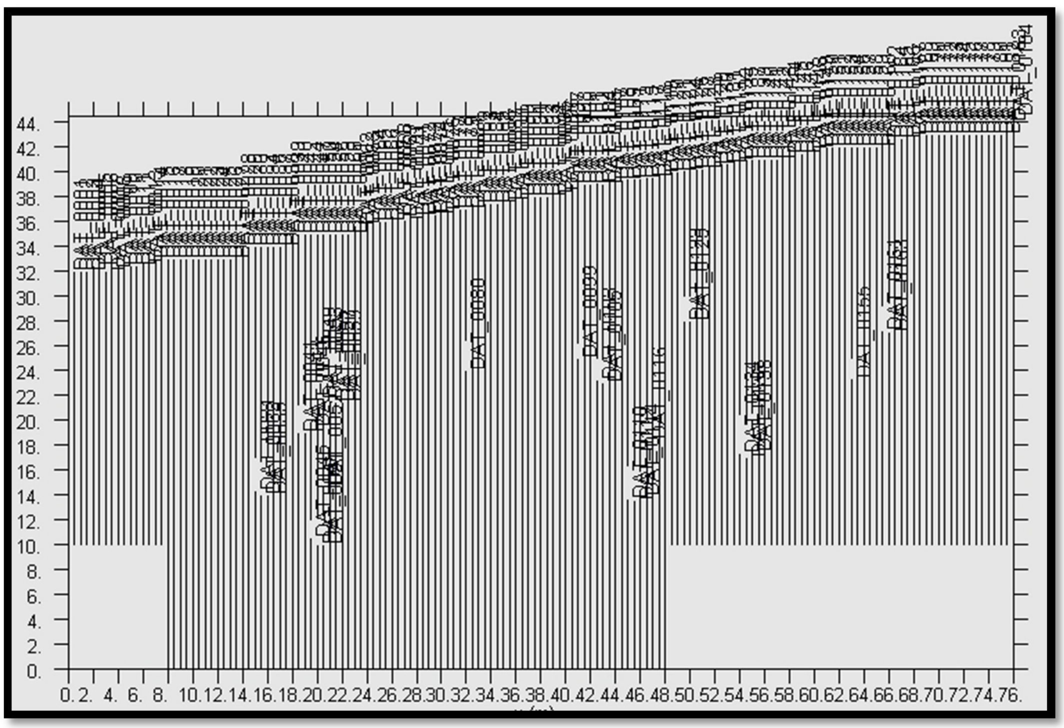


Figure 2. Radargram Plan of GPR Block A, Wadsworth Cemetery.

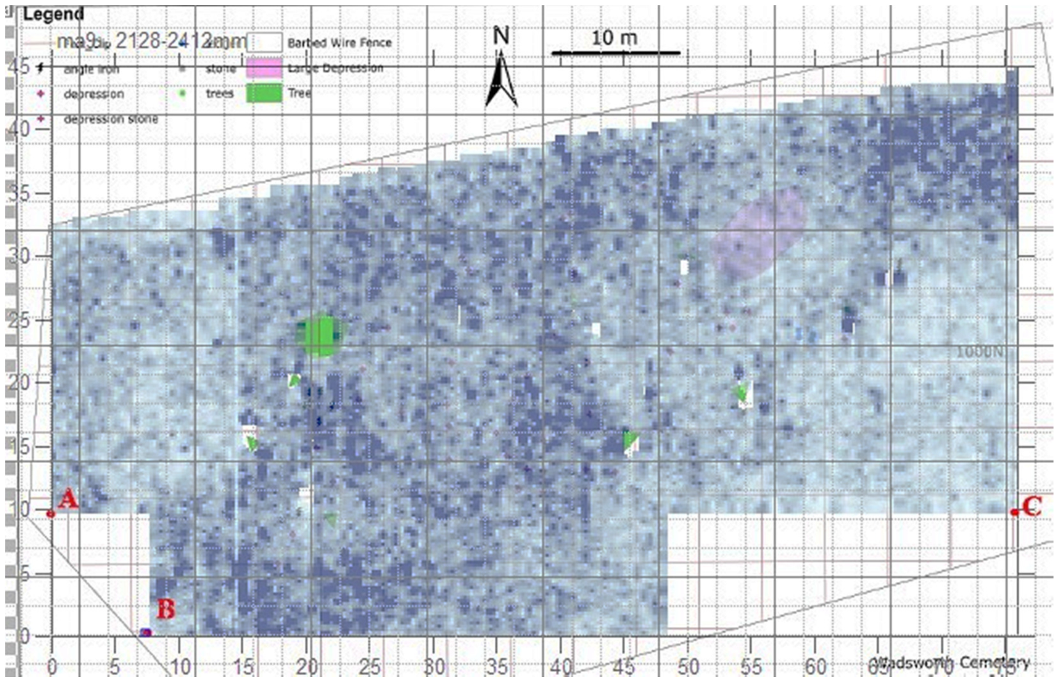


Figure 3. GPS Locations A, B and C, Wadsorth Cemetery.

The GPR data from the present study was processed with *GPR-Slice* (Version 7.0). Dean Goodman's *GPR-Slice* program is recognized as the world leader in GPR imaging and it has proven quite effective in mapping historic cemeteries (Goodman 2010). Mapping in 3D entailed merging the data from the series of radargrams for each block. Once this was accomplished, horizontal slices of the data were examined for important anomalies and patterns of anomalies, which were likely of cultural relevance. These data were displayed as aerial plan maps of the sample areas at varying depths below ground surface. These horizontal views, or time-slices, display the radar information at a set time depth in nanoseconds (ns). Time-depth can be roughly equated to depth below ground. This equivalency relationship can be calculated using a mathematical formula.

III. GPR Survey-Results and Interpretation

As expected, the GPR survey identified many marked graves and unmarked potential graves in the Wadsworth Cemetery. GPR mapping also generated images of known graves except in areas where the tombstones or other obstacles prevented data collection. Quantifying the potential graves in the cemetery from the GPR data is challenging. For many of the graves, their recognition on plan maps is straightforward. In other instances, clusters of graves that are closely spaced generated more amorphous "large blobs" and it is not readily apparent how many individual graves these radar reflections represent. Large trees also confuse the interpretation of the cemetery data by creating large radar reflections that often masked historic graves. In some cases the large reflections generated by tree stumps and tree roots are very difficult to distinguish from clusters of burials or shallow, infant burials. The GPR survey also was hampered by several fieldstone grave markers in the cemetery, which served as minor obstacles for the collection of data.

GPR Radargrams

Radargrams provide a profile view of the radar reflections. This class of information is useful when studying cemeteries because graves often create characteristic radar profiles. Depending on the spacing of the graves, a grave may be recognized by the hyperbola that is a reflection from the top of coffin, by the steep slope created by the grave shaft excavation, by the disturbed soil conditions within the grave pit relative to the less disturbed matrix soils, and sometimes by a reverse hyperbola created by the radar pulses reflecting off of the base of the grave excavation pit. Burials with high metal content, typically more massive coffin hardware and not simply coffin nails, may generate distinctive signatures. A grave with a metal vault cover or a metal coffin creates its own distinctive profile. When graves are clustered and closely spaced, however, it becomes more difficult to distinguish individual graves. In these cases, large areas of soil disturbance may be recognized.

Figures 4 through 6 are three examples of radargrams collected by the survey. Figure 4 shows Radargram 30 from the survey. This transect is located along the suspected western margin of the cemetery. Many of the hyperbolas that appear in this diagram likely represent large tree roots. Figure 5 shows Radargram 101, which is located near the suspected center of the cemetery. As compared with Figure 4, this radargram contains many strong radar anomalies, including several that likely represent human burials. This transect also passed over several large metal objects, which may represent grave furniture. Figure 6 shows Radargram 168, which is located near the suspected eastern end of the cemetery. At the eastern end of this transect (right-hand side) a large, deep radar anomaly is represented. It remains to be determined if the strong, massive radar anomalies that appear in the eastern end of the study area represent human burials or not. These may represent some other type of deep cultural feature, such as a buried agricultural terrace. For now, however, our interpretation is that these anomalies may represent human burials.

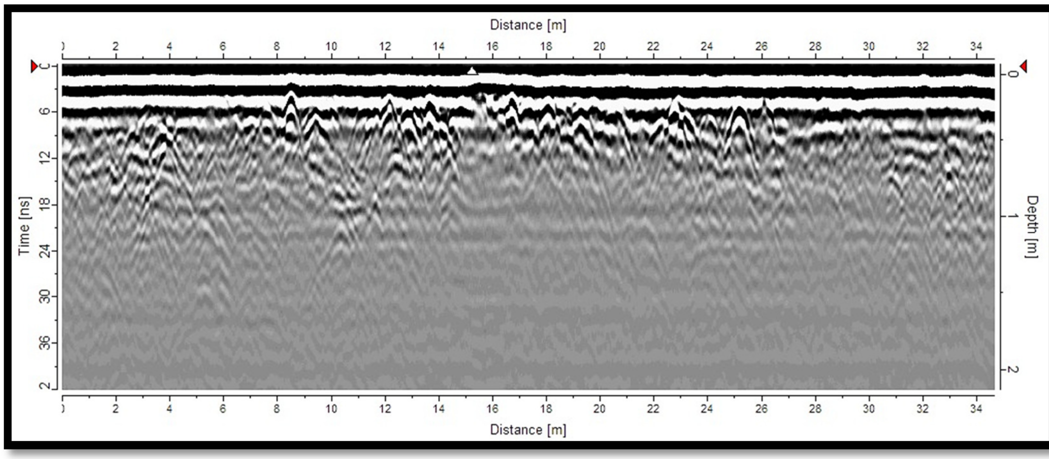


Figure 4. Radargram 30, West End, Wadsworth Cemetery.

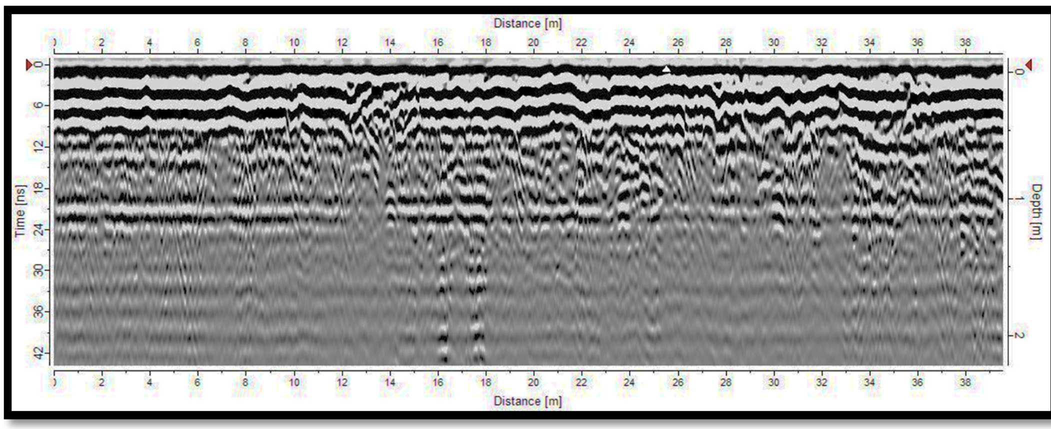


Figure 5. Radargram 101, Cemetery Center, Wadsworth Cemetery.

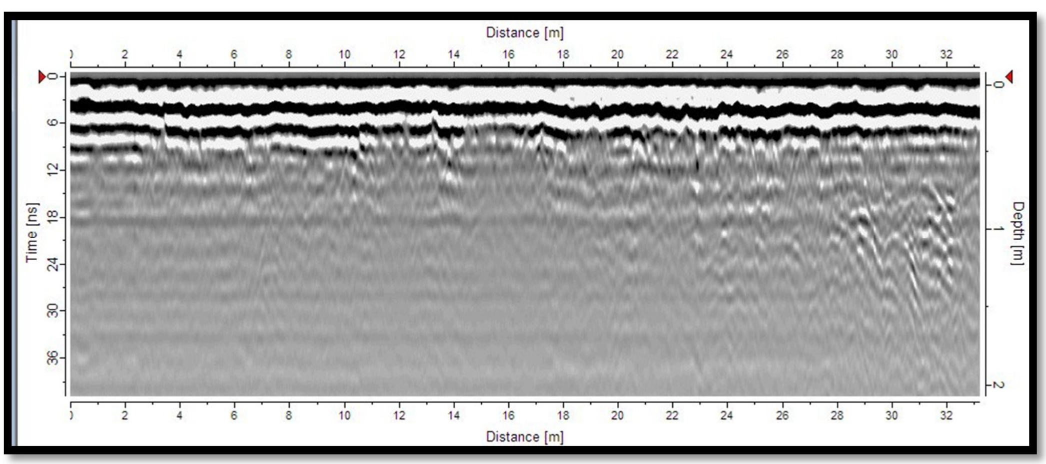


Figure 6. Radargram 168, East End, Wadsworth Cemetery.

GPR Time Slice Maps

The GPR survey of the Wadsworth Cemetery adds another dimension of information about the content and characteristics of the graveyard. We used the combined overlay map for the upper and lower zones to plot potential grave locations from the GPR data. Figures 7 through 12 show a series of time slice plan view maps at increasing depths.

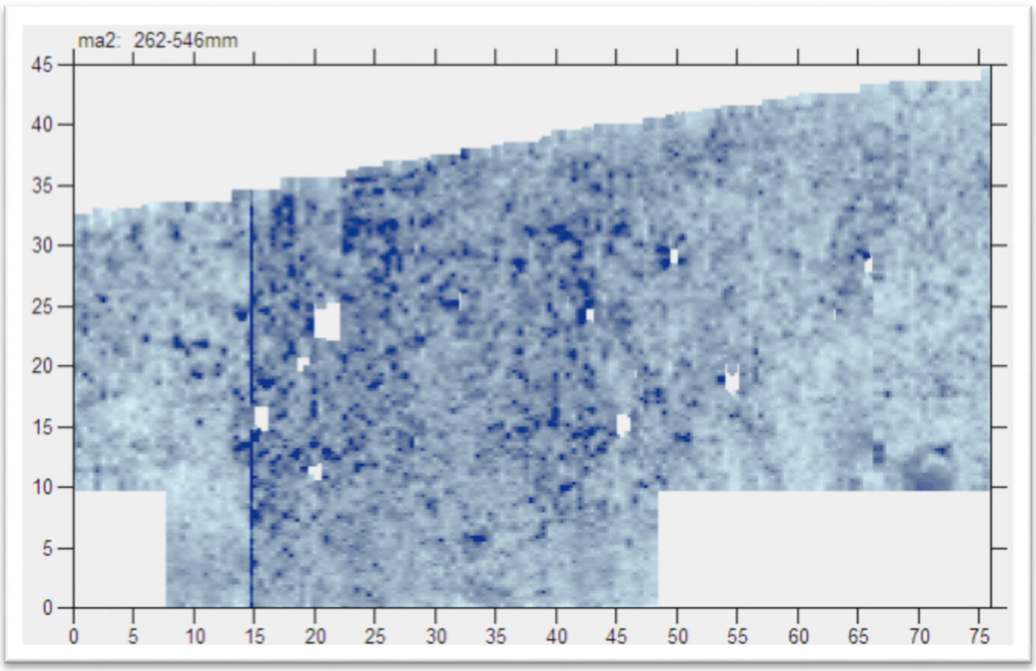


Figure 7. Composite GPR Plan Map, 262-546 mm Depth, Wadsworth Cemetery.

Many graves appear as rectangular dark blue shapes. Other isolated strong radar reflections indicate possible graves that are unmarked. Other strong radar reflections in these maps probably represent trails or vehicle ruts and large trees. Many smaller radar reflections are problematic, as it is possible that some represent children's graves, but these cannot be readily distinguished from other small cultural features or natural features.

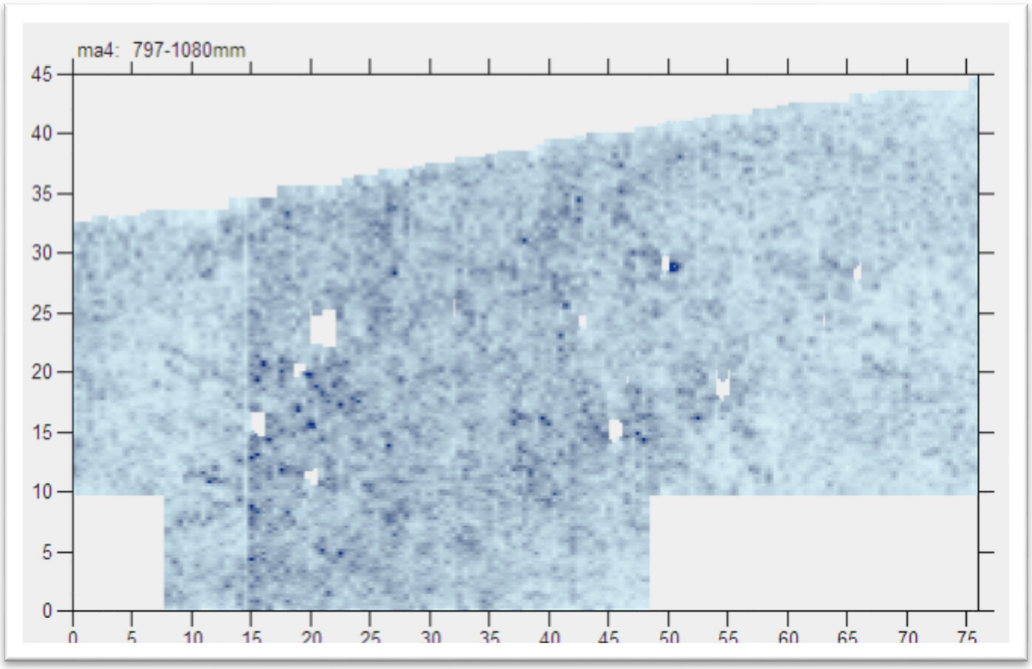


Figure 8. Composite GPR Plan Map, 797-1080 mm Depth, Wadsworth Cemetery.

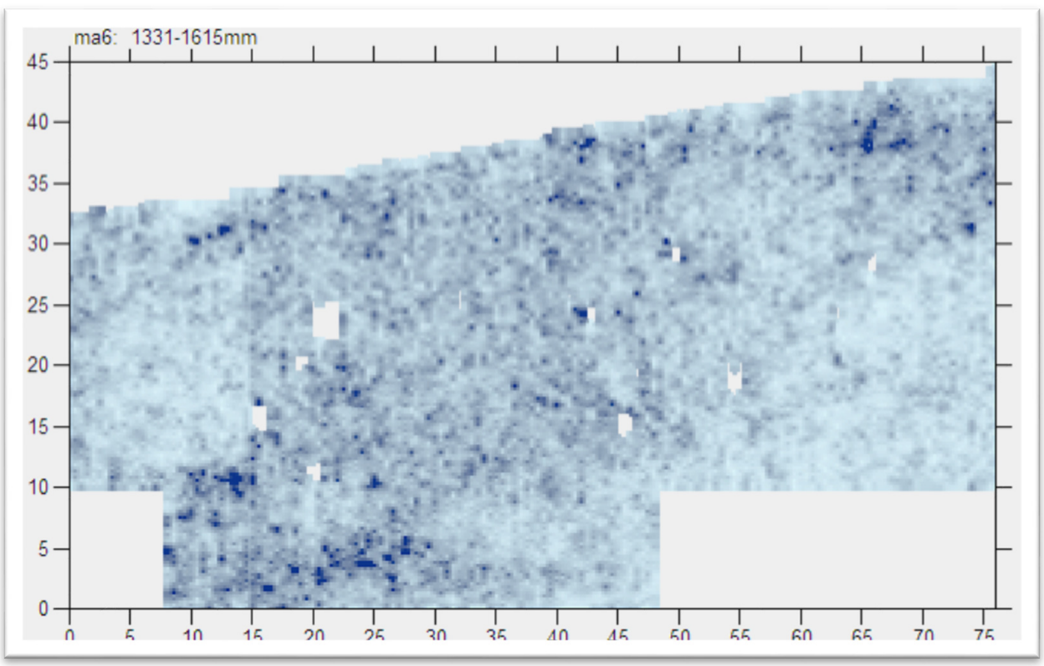


Figure 9. Composite GPR Plan Map, 1331-1615 mm Depth, Wadsworth Cemetery.

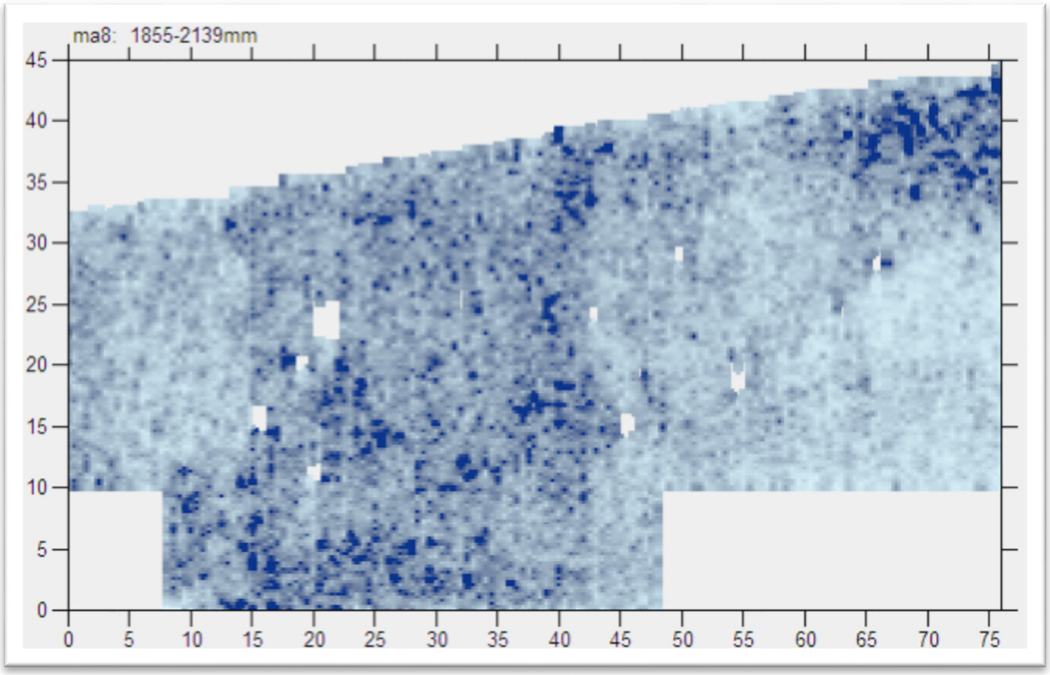


Figure 10. Composite GPR Plan Map, 1855-2139 mm Depth, Wadsworth Cemetery.

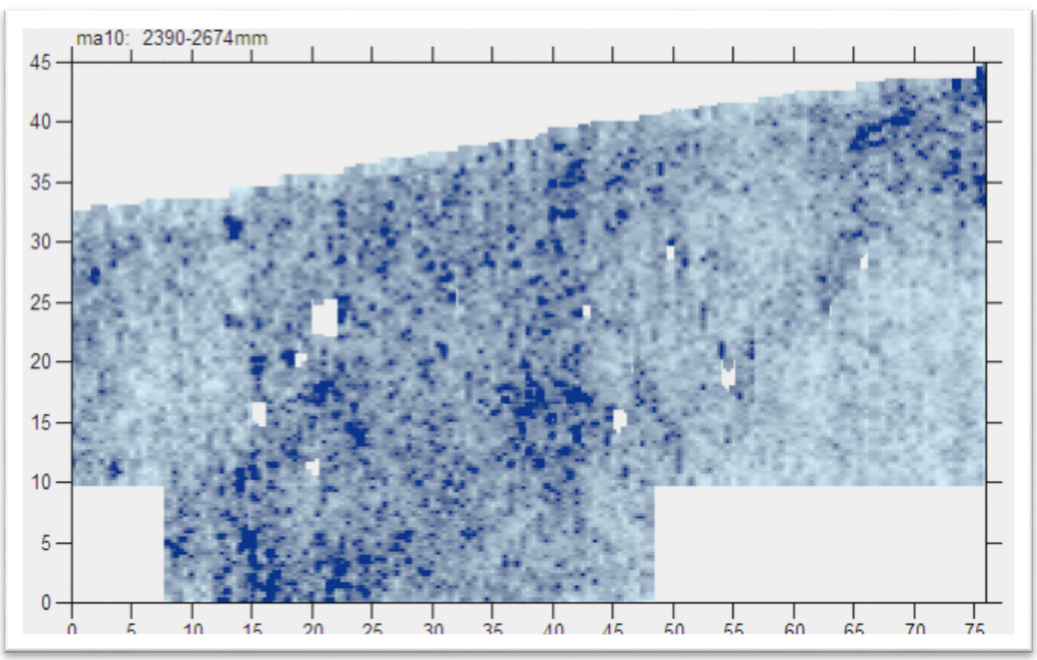


Figure 11. Composite GPR Plan Map, 2390-2674 mm Depth, Wadsworth Cemetery.

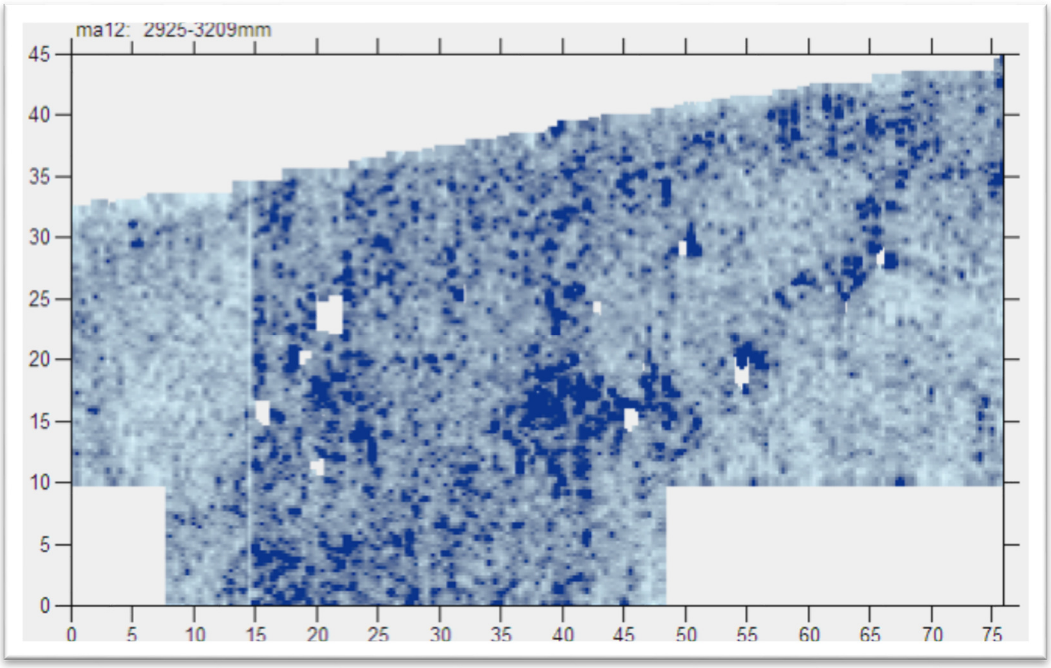


Figure 12. Composite GPR Plan Map, 2925-3209 mm Depth, Wadsworth Cemetery.

Figure 13 is a perspective, isomorphic view of the strongest GPR anomalies from the survey. This is simply another way to view the radar data.

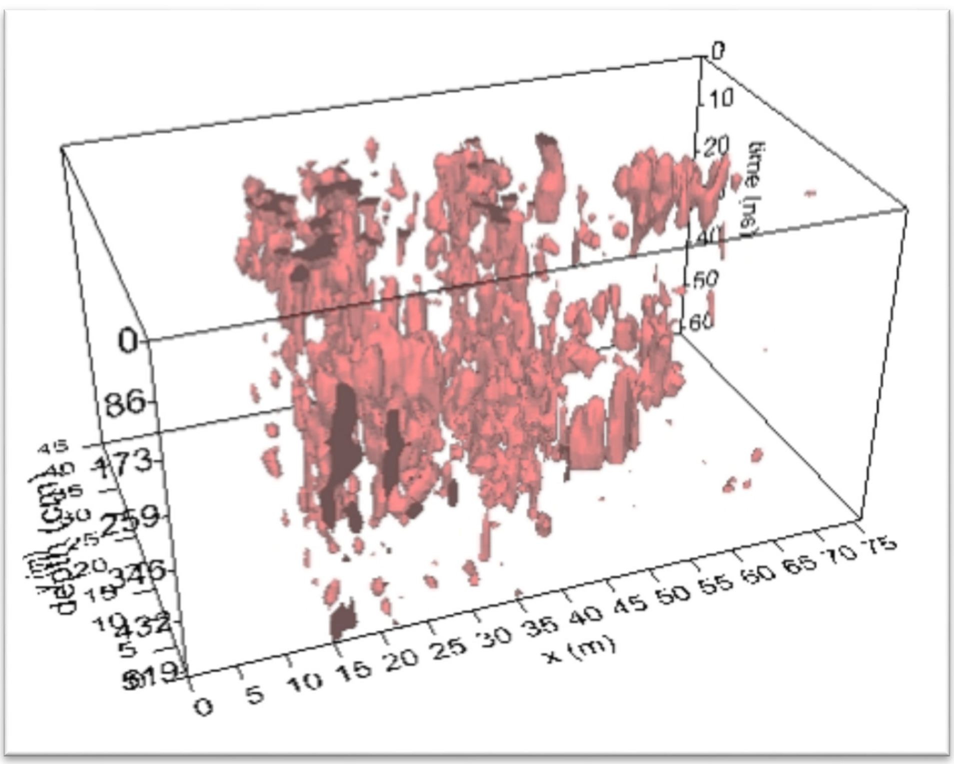


Figure 13. Isomorphic, Perspective View of GPR Anomalies, Wadsworth Cemetery.

The project geophysicist (Elliott) examined the radargrams, sequential time slices, composite time slices and isomorphic views in interpreting the GPR data. Figures 14 and 15 show the suspected human burials as interpreted. Suspected burials are shown as purple rectangles in these two figures. An estimated 103 potential graves were identified with the GPR information. It is also apparent from Figure 15 that several likely burials, which are indicated by surface depressions or fieldstone head or foot stones, were not detected in the GPR data. So, the actual number of interments may be more than 103 persons.

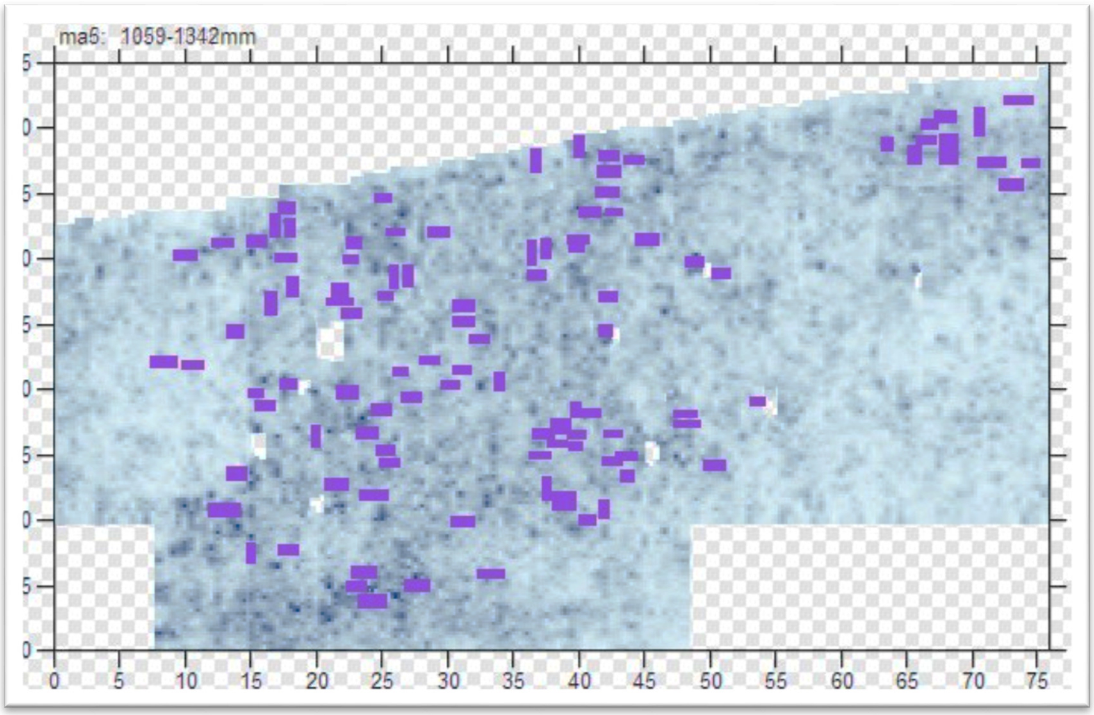


Figure 14. Potential Burials (Indicated by purple rectangles), Wadsworth Cemetery.

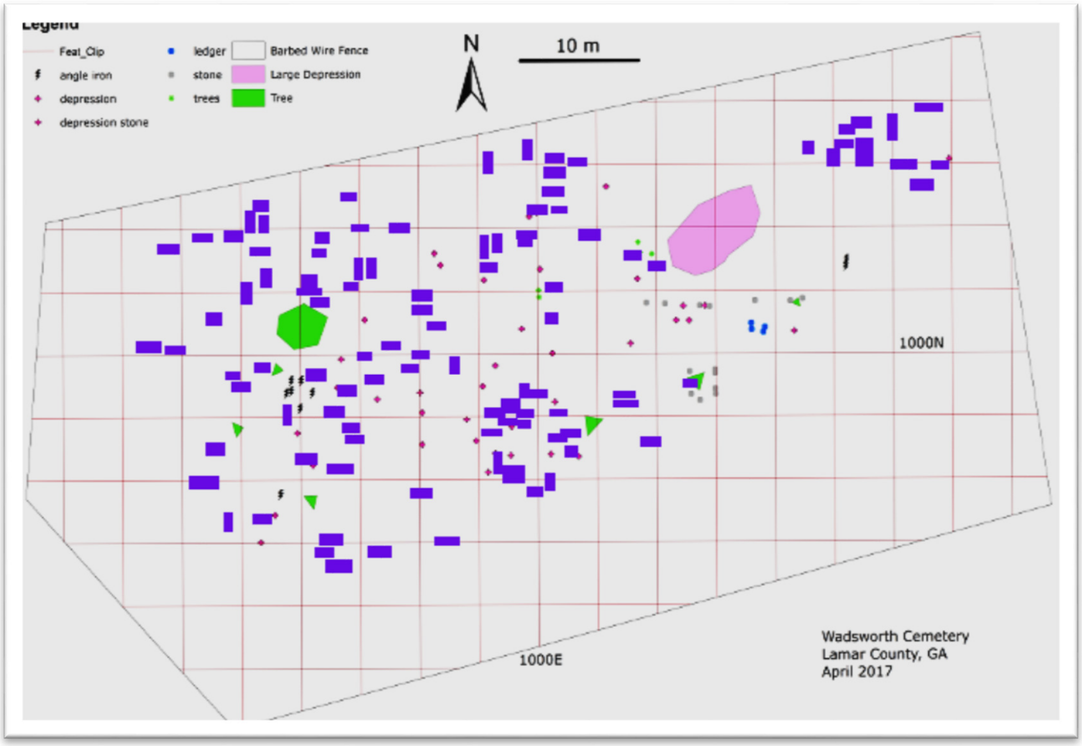


Figure 15. Wadsworth Cemetery Plan Map (Potential Graves from GPR Survey Shown as Purple Rectangles).

IV. Summary

The LAMAR Institute was pleased to be involved in the Wadsworth Cemetery project. The site is an extremely important part of the history of both Lamar County, Georgia and the region in general. The GPR survey project of the Wadsworth Cemetery undertaken by The LAMAR Institute for the City of Barnesville, Georgia created a body of information that will enable wise stewardship of this important historical, cultural, natural, and spiritual site and help with its long-term preservation. Superimposed maps of this data with modern maps to determine where unmarked, likely burials may be located across the cemetery. As with all GPR data, anomalies cannot be verified as being graves without their scientific, archaeological investigation. This is traditionally not an option chosen when the cemetery is not facing relocation. There is always the possibility that some anomalies marked as potential graves are not, and some not marked may be graves – particularly with infant burials. The GPR data and its analysis by a professionally trained, highly-experienced archaeologist, however, provides for the most comprehensive and educated determinations on where unmarked burials are without archaeological excavation. If the City of Barnesville opts to exhume these remains, then the GPR data will serve as an invaluable aid in that process.

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