Ground Penetrating Radar Survey at the Horton Plantation, Jekyll Island, Georgia

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By Daniel T. Elliott

[Note: This report is a slight revision of an earlier document by Daniel T. Elliott. It served as an appendix to a broader archaeological report on the Horton Plantation site by Rita Folse Elliott (2002) of Southern Research Historic Preservation Consultants, Ellerslie, Georgia, which was submitted to the National Park Service, Georgia Department of Natural Resource and the Jekyll Island Authority. Electronic Version Produced in 2009]

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Introduction

Ground Penetrating Radar (GPR) consulting services for the Horton House archaeological site on Jekyll Island were provided by Rocquemore Radar Research, Box Springs, Georgia, under subcontract to Southern Research Historic Preservation Consultants. The GPR study was part of a broader archaeological investigation of the Horton plantation (Figure 1), which was requested by the State of Georgia, Historic Preservation Division, Georgia Department of Natural Resources and the Jekyll Island Authority. Funding for this work was provided by a research grant from the National Park Service.

Fieldwork for this project was conducted in mid-March 2002. This project was exploratory in nature and represents the first attempt to apply the GPR technique to archaeological sites on Jekyll Island. GPR also has been used on other archaeological sites on Georgia’s Barrier Islands, but none of this work is presently available in published form.

The results of the present project demonstrate the utility of this remote sensing geophysical survey technique for examining subsurface deposits with archaeological content. Three areas of the Horton House site were subjected to GPR survey, which include: the Horton House Yard, the DuBignon Cemetery and its surroundings, and “the Brewery”.

Subsurface radar signatures, which are indicative of archaeological deposits such as features or concentrations of artifacts, were located in each of these areas. Initial fears that saltwater intrusion in the underlying water table would cancel out the radar signals were not realized. Although salt water may affect the radar signals at greater depths, the soils containing most of the archaeological strata are relatively well drained and produced adequate radar signals. These results are detailed in the following report. The primary radar data is provided in an accompanying CD-Rom disc.

Background

Ground Penetrating Radar (GPR) was developed by the U.S. Department of Defense during the Vietnam War as an aid in remotely locating Viet Cong tunnels. Since then the technique has been extensively miniaturized and the technological capability enhanced to a point where today a single individual with a minimum of instruction can conduct a GPR survey with ease.

The GPR device uses high frequency electromagnetic waves 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 (Figure 2). The receiving antenna records the reflected waves for a specified length of time (in nanoseconds). The approximate depth of an object can be estimated with GPR, by adjusting for electromagnetic propagation conditions.
The GPR sample blocks at the Horton House site were composed of a series of parallel transects, or traverses, which yielded a two-dimensional cross-section or profile of the radar data. This two-dimensional image is constructed from a sequence of thousands of individual radar “pings” or 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.

Figure 2. The Elliptical Cone of GPR Penetration into the Ground (Conyers and Goodman 1997: Figure 4, cited in Hodge et al. 2002).

The GPR signals that are captured by the receiving antenna are recorded in 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 the laptop computer monitor, which is mounted to the GPR cart. An example of a radargram (and an individual radar trace, shown on the right-hand side) from the Horton House site survey is illustrated in Figure 3.

Ground penetrating radar signals cannot penetrate 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 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 off the objects and produce a confusing signal. Rebar-reinforced concrete, as another example, generates an unmistakable radar pattern of rippled lines on the radargram.

Conyers notes: “Ground-penetrating radar works best in sandy and silty soils and sediments that are not saturated with water. The method does not work at all in areas where soils are saturated with salt water because this media is electrically conductive and ‘conducts away’ the radar energy before it can be reflected in the ground” (Conyers 2002).

Figure 3. Example of a Radargram, Horton House.

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 soils have moderately good properties for its application.

Both metal and salt water were expected to be present in the Horton House vicinity. It was anticipated that metal and salt water would have some effect
on the data that was gathered. The soils at the Horton House were well drained, however, and salt water was not a significant problem at shallower depths. Salt water may affect the radar information at greater depths on Jekyll Island. One possible example of this is discussed later for GPR Block 4.

GPR has been successfully used 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 best 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 (measured in nanoseconds), the deeper the search.

GPR has been used to a limited extent on archaeological sites in Georgia yielding mixed results. A study of a Creek habitation site in Muscogee County, which was part of the Upatoi village, circa 1790 to 1825, included GPR as part of a battery of geophysical techniques that were employed to delineate these sites (Elliott et al. 1999; Briuer et al. 1997). These archaeological sites were located in the Red Sand Hills of Georgia’s Fall Line Zone. The sandy soils on these sites were not too dissimilar from the soils at Ebenezer and the approximate ages of the two sites also were fairly similar. Preliminary testing at the site by Elliott and his colleagues had established the existence of Creek burials that were clearly associated with Upatoi. Briuer and his colleagues identified nine EM anomalies that were interpreted as possible human burials. After Briuer’s study was completed, additional test excavations were conducted by Elliott and his colleagues to “ground truth” a number of the anomalies that had been identified by the GPR survey. Most of these anomalies proved to be modern military disturbances, which was understandable given the location of this site on the Fort Benning Military Reservation. Nevertheless, the GPR technique was able to identify disturbed areas of soil, at least some of which were Creek-related phenomena. In the brief time that has elapsed since Briuer and his colleagues conducted this study, the GPR technology and equipment has significantly improved.

Elsewhere in Georgia, Ervan Garrison and his students have conducted numerous GPR surveys, including investigations at a number of aboriginal earthworks, including Little River mounds in Morgan County and Kolomoki mounds in Early County (Wynn 2002, Friends of Scull Shoals 2002). GPR also has been used to map portions of the Old Athens Cemetery in Clarke County (National Center for Preservation Technology and Training and USDA Forest Service, Southeast Region 2002).

GPR has been used with success in adjacent areas of the South Carolina interior coastal plain to map the stratigraphy of Carolina Bays. Carolina Bays, which are natural wetland features of undetermined origin, typically have deep sand deposits on their rims and these areas often contain deeply buried archaeological deposits (Brooks et al. 2002).
GPR was successfully employed at investigations of the Nathan and Polly Johnson House, New Bedford, Massachusetts (Hodge et al. 2002). Their website provides additional background information on GPR and its archaeological applications.

GPR is particularly well suited for the delineation of historic cemeteries, for example, the Bozeman site in Clark County, Arkansas (Kvamme 2002). Historic graves are often easy to recognize in radargrams, as evidenced by a pronounced hyperbola. When 3-D slices intersect these hyperbolas the graves are usually clearly evident in plan view. When a series of graves are closely spaced, however, the grave radar “signature” is less clear-cut. By slicing the radar data at various depths along the hyperbola, the aerial perspective can be refined for optimal viewing and recognition. Since not all graves were dug to the same depth, 3-D slices at different depths can often yield very different views of graves in plan by varying the slice only a few centimeters.

The equipment used for this study consisted of a RAMAC/X3M Integrated Radar Control Unit, mounted on a wheeled-cart and linked to a Dell 8100 laptop computer. An 800 megahertz (MHz) shielded antenna was used for the entire data gathering. MALÅ GeoScience’s Windows-based acquisition software program Ground Vision (Version 1.3) was used to acquire and record the radar data (MALÅ GeoScience USA 2002). The radar information was displayed as a series of radargrams, or radar profiles of each transect. Their Easy 3D software (Version 1.0) was used in post-processing the radar data and 3-D imaging. This entailed merging the data from the series of radargrams for each block. Once this was accomplished, horizontal slices of the data were examined by Mr. Elliott, in consultation with MALÅ GeoScience specialist Jim Cook, 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. Time-depth can be roughly equated to depth below ground. This equivalency relationship can be calculated using a mathematical formula.

Various adjustments to the GPR equipment were made in the field during the data collection phase. These included establishing:

- time zero (n=48318, initially),
- sampling frequency (n=22814),
- number of samples (n=1024),
- number of stacks (n=8),
- time window (45 ns, or nanoseconds),
- time resolution (high),
- trigger interval (0.02 m),
- antenna separation (0.14 m) and,
- calibration setting (500 cart).

Although the time zero was frequently reset, the other settings remained constant throughout the survey. This consistency allows for comparison between sample blocks. The number of stacks refers to trace stacking, which is a method of averaging traces to filter out noise. 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. Meta data for the radargrams are provided in the accompanying CD-Rom. 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.

This same battery of GPR equipment and radar imaging software was used previously at the colonial site of New Ebenezer in Effingham County, Georgia by the author with very satisfactory results (Elliott 2002). New Ebenezer is located on a high Pleistocene shoreline terrace immediately adjacent to the Savannah River, approximately 25 miles upstream from the town of Savannah. Soils at Ebenezer are derived from coastal sands and not too dissimilar to the soils at the Horton House, although the soils at Horton House are considerably younger and less consolidated. A distinctive difference between the two sites is the absence of oyster shell at New Ebenezer.
Horton House Ground Penetrating Radar Survey

The ground penetrating radar survey was conducted from March 12 to March 15, 2002 by Daniel Elliott with post-processing assistance provided by Jim Cook, MALÅ GeoScience USA, Charleston, South Carolina in May and June, 2002. These data were interpreted and described in the present report in July, 2002.

Upon arrival at the site, the RAMAC X3M Radar Unit was set up for the operation and calibrated. Eleven trial runs were made on parts of the site to test machine’s effectiveness in the site’s soils. The survey examined 12 areas of the Horton House site, covering an area of approximately 732.5 m² (Table 1). The greatest coverage was surrounding the main tabby house ruin. This area was sampled by Blocks 1 through 6, and Block 10. The next greatest GPR coverage was applied to the DuBignon Cemetery, which was sampled by Blocks 7 and 8 on the interior and Blocks 9 and 11 on the periphery. One small sample GPR block (Block 12) was placed in the vicinity of the Brewery. The details of each area sampled by GPR survey are provided in Table 2.

Table 1. Summary of Areas Sampled by GPR Survey.

<table>
<thead>
<tr>
<th>Sample Blocks No.</th>
<th>Area (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yard of Horton House</td>
<td>7 501</td>
</tr>
<tr>
<td>DuBignon Cemetery</td>
<td>4 207.5</td>
</tr>
<tr>
<td>Brewery</td>
<td>1 24</td>
</tr>
<tr>
<td>TOTAL</td>
<td>12 732.5</td>
</tr>
</tbody>
</table>

The Horton House Yard

GPR Blocks 1, 2 and 3 formed a contiguous polygon, which had a maximum extent of 19.25 m North-South and 30 m East-West. At the closest point (along the North edge of GPR Block 3) the GPR survey was 4.5 meters south of the South wall of the Horton House ruin. The 1966 and 1967 excavations at the Horton House extended 15 feet (4.57 m) south of the house ruin. Thus, a narrow strip along the northern edge of GPR Block 3 (approximately 7 cm) overlapped with the previous excavations. The GPR sample areas south of the Horton House Ruin was divided into three sections because of the tree and shrubbery obstacles that were present. These three blocks were located south of the Horton House tabby ruins in an area of grass and ornamental shrubs. The shrubs were bush hogged prior to this study, although their roots proved to be a minor obstacle for the survey.

This portion of the Horton House site has been subjected to archaeological excavation and landscaping. One test unit was placed within it during this study, which revealed a circa 1970s landscaping feature, which was an oyster shell paved walkway. This walkway was oriented East-West and extended across the entire test unit and continued beyond to an unknown extent. This feature was
relatively shallow and was not perceived in the GPR radar data. The upper strata of the site (generally the upper 40 cm) contained many artifacts and extensively disturbed soil, which created too much radar “noise” and did not lend itself to radar visualization or the discrimination of individual features or large objects.

Table 2. Horton House GPR Sample Areas.

<table>
<thead>
<tr>
<th>Block</th>
<th>Interval (cm)</th>
<th>Transsects</th>
<th>Area</th>
<th>North</th>
<th>East</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25</td>
<td>2 to 18</td>
<td>Rear of Horto House</td>
<td>715.75-720</td>
<td>424-454</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
<td>21 to 44, less 22</td>
<td>Rear of Horto House</td>
<td>720-725.5</td>
<td>424-449</td>
</tr>
<tr>
<td>3</td>
<td>25</td>
<td>45 to 92, less 55-56, 62, 85, 89</td>
<td>Rear of Horto House</td>
<td>725.5-735</td>
<td>438-449</td>
</tr>
<tr>
<td>4</td>
<td>25</td>
<td>94 to 126</td>
<td>Front of Horto House</td>
<td>764-772</td>
<td>452-460</td>
</tr>
<tr>
<td>5</td>
<td>25</td>
<td>127 to 143, less 139-142</td>
<td>Front of Horto House</td>
<td>764-785</td>
<td>460-463</td>
</tr>
<tr>
<td>6</td>
<td>25</td>
<td>144 to 145</td>
<td>East of Horto House</td>
<td>736.75-737</td>
<td>455-473</td>
</tr>
<tr>
<td>7</td>
<td>25</td>
<td>148 to 166</td>
<td>Inside Cemetery</td>
<td>*756.25-767.75</td>
<td>*347.75-359.4</td>
</tr>
<tr>
<td>8</td>
<td>25</td>
<td>167 to 172</td>
<td>Inside Cemetery</td>
<td>*757-767.75</td>
<td>*356-357.2 5</td>
</tr>
</tbody>
</table>

*Note: The GroundVision software did not allow transect numbers above 200, so the numbering system began again at the number one (1) but the two sets of transects were distinguished by different prefixes—Transect (for the first set) and Transects (for the second, which are identified in Table 2 by the letter “s” for the sake of brevity.)

GPR Block 1

GPR Block 1 was positioned with its northeastern corner at the common point of Excavation Test Units 1 and 2. This block measured 4.25 m North-South and 30 m East-West. Transects in Block 1 were run from East to West and lines progressed from North to South. The sampling interval used for Blocks 1 through 9 was 25 cm. Two aerial views of Block 1 were generated (Figures 4 and 5). The first was at a depth of 75 cm below surface (cmbs) and the second is the view at 1 meter below ground. Note that the final 5 meters of Block 1 is truncated in Figure 2. No significant anomalies were noted in that portion of the block.

The upper view (at about 75 cmbs) displays several large anomalies that are dispersed, which may represent pit features or concentrations of large artifacts (Figure 4). The most pronounced of these is centered at approximately 716.5 North 437 East.
The second view of Block 1, viewed at 1 meter depth, displays a series of parallel North-South anomalies that are visible in the lower view (Figure 5). Since it was known that a series of exploratory ditcher trenches was dug at the site by previous archaeologists, the interpretation of these anomalies as the exploratory trenches was suggested. The approximate centers of each anomaly were identified on the south edge of Block 1 (715.75 North) at: 440.5 East, 444.5 East, 446.5 East and, 452 East. The GPR survey identified these linear anomalies as running North-South. Previous site research, however, suggests that the 1966-1967 ditcher trenches ran East-West (Norma Harris personal communication, July 22, 2002).

GPR Block 2
GPR Block 2 was positioned immediately north of Block 1 and was flush with the West end of Block 1. Block 2 measured 5.5 m North-South x 25 m East-West.

Transects in Block 2 were run from East to West and lines progressed from South to North. Three aerial views of Block 2 were generated at 60 cm, 75 cm, and 1 meter below surface (Figure 6).

At 60 cm depth five prominent anomalies were noted and these were widely dispersed across the block (Figure 5a). These were clustered towards the western part of the block, possibly indicating a feature concentration or activity area (Figure 7). Four of the five anomalies were also evident at 75 cm below ground (Figure 4b). At 1 meter, however, none of these were clearly visible (Figure 5c). Oddly, Block 2 did not exhibit the North-South anomalies that were visible at 1 meter depth in Block 1. No significant anomalies were noted at 1 meter below ground in Block 2.
Figure 4. Aerial View of GPR Block 1 Revealing A) 0.75 meters and B) 1.00 meters Below the Surface, Horton House.

A)

B)

Figure 5. Aerial View of GPR Block 1 Revealing A) 0.75 meters and B) 1.00 meters Below the Surface, Horton House Noting Anomalies.

A)

Concentrated (above) and Scattered Anomalies.

B)

Note four anomalies, oriented North-South.
The anomalies in Block 2 that were visible at 60 cm depth, which may correspond to cultural features or activity areas, were located at approximately:

- a) 721 North, 435 East
- b) 721 North, 440.5 East
- c) 722 North, 451 East
- d) 723 North, 432.5 East
- e) 724 North, 436.5 East

This cluster of anomalies is in the approximate vicinity of West Georgia College’s Test Unit 4, which was excavated in 1991 (Crook n.d.). Crook’s plan of the site depicts Test Unit 4 as a 3 meter by 3 meter excavation. Details of this excavation were not published at the time of the present study.

Southern Research’s Test Unit 5, a 2 m by 2 m unit whose grid coordinates are 720-722 North, 445-447 East, was excavated within GPR Block 2 after the GPR survey was conducted. This test unit contained a shallow oyster shell-lined pathway, which was constructed in the 1970s. This feature, which was oriented East-West, did not extend deep enough to be of serious consequence for the GPR data interpretation.

GPR Block 3
GPR Block 3 was positioned immediately north of Block 2 and was flush with its East end. Block 3 measured 9.5 m North-South x 11 m East-West. Transects in Block 3 were run from East to West and lines progressed from South to North. Three aerial views of Block 3 were generated at 60 cm, 75 cm, and 1 meter below surface (Figure 8).

Block 3 did not contain obvious indications of the North-South trending anomalies that were viewed in Block 1. Block 3 did contain an interesting radar anomaly, however, which was a linear feature with an obtuse angle, which was clearly visible at 60 and 75 cm depth (Figures 7a and 7b). The corner of this anomaly is located at approximately 728.5 North, 440.5 East. The lines radiate out from it at bearings of 60 degrees (for approximately 3 meters) and 175 degrees (for approximately 9.5 meters) forming an angle of approximately 112 degrees (Figure 9). Oddly, this feature did not continue southward into Block 2.

This anomaly is inconsistent with a building foundation, since most buildings were built with 90 degree angles at the corners. One possibility is that it represents a palisade ditch or fence line that surrounded the main house. This radar anomaly should be “ground truthed” in future excavations to determine its character and function.

GPR Block 4
GPR Blocks 4 and 5 sampled the area north of the Horton House ruins. This part of the site has received no previous archaeological excavation. GPR Block 4 was located north of the main house and access road and east of the paved road. It measured 8 m x 8 m. Transects in Block 4 were run from South to North and lines progressed from East to West. Blocks 4 and 5 were located between the sloped road cut and the woods edge and were entirely vegetated in grass. The topography of Block 4 was slightly sloping toward the road but general level. Four aerial views of Block 4 were
generated at: 60 cm, 75 cm, 1 meter, and 1.3 meters below surface (Figure 10).

At 60 cm and 75 cm below ground several East-West oriented anomalies are present in the southwest quadrant of the sample block (Figures 9a and 9b). These are not visible at greater depths (Figures 9c and 9d). These anomalies covered the area from 765-767 North, 452-456 East. No interpretations of these anomalies are offered, although given the depth at which they were identified, they may result from cultural activity.

At 1 meter below ground the radar map is surprisingly quiet with no major anomalies visible. At 1.3 meters below ground, however, the northwestern one-third of the block contains a massive, pronounced anomaly, which may be geological, rather than archaeological, in character. One possible explanation for this radar signature is that it results from salt water in the soil. As noted previously, salt water attenuates the GPR signals. The depth of 1.3 meters may correspond to the level of the water table in this vicinity of Jekyll Island. The salt water marsh is located very near this sample block.

GPR Block 4 was surveyed on the morning of March 14, 2002, approximately from 9:30 AM to 11:00 AM. Fluctuations in the water table on this part of the island are likely affected by the tides and the sea level elevation. An interesting exercise would be to resurvey this area at a future date when the tides are different to see if this anomaly remains present.
Figure 7. Aerial View of GPR Block 2 at 0.60 meters, Highlighting Anomaly Cluster, Horton House.

Figure 8. Aerial View of GPR Block 3 Revealing A) 0.60 B) 0.75 meters and C) 1.00 meters Below the Surface, Horton House.
GPR Block 5
GPR Block 5 was positioned immediately north of Block 4 and was flush with its eastern edge. It measured 3 m North-South x 21 m East-West. Transects in Block 4 were run from South to North and lines progressed from East to West. The topography of Block 5 was nearly level on its eastern ¾ but rapidly sloped on its western end, which suggested that the area had been sculpted by heavy equipment in conjunction with the road construction. Three aerial views of the northern 8 meters of Block 5 were generated at: 60 cm, 75 cm, and 1 meter below surface (Figure 11). Prominent anomalies are present at all three depths and these may represent cultural features or artifact concentrations.

Several deep, faint anomalies were visible in the radargrams for Block 5 and one of these was examined with a 50 x 50 cm test excavation, which was located at 772-772.5 N and 459.5-460 E. The unit extended to 94 cm below ground surface. The results of this test were inconclusive. No deeply buried artifacts or features were detected. These anomalies may not relate to any cultural phenomena but may be of a geologic character.

Figure 9. Aerial View of GPR Block 5 at 0.60 meters Below the Surface highlighting Linear Anomaly, Horton House.

GPR Block 6
GPR Block 6 was originally planned as a larger block positioned to the East of the main house ruin. Only two East-West transects was completed in this area (see Figure 3). These transects extended for 18 m and were run from East to West
and progressed from North to South. Survey of this area was discontinued because of technical problems. The radargrams from these two transects display numerous anomalies (disturbances) in the upper 40 cm of soil, as well as several isolated anomalies at depths of 50 to 70 cm below ground.

GPR Block 10
GPR Block 10 was located to the West of the Horton House and the paved road and East of the Dubignon Cemetery in a grassy area (see Figure 3). It measured 4.5 m North-South by 30 m East-West. Transects in Block 10 were run from West to East and lines progressed from South to North. Two large live oak trees flanked the sample block on its western part. The topography of this area was nearly level. The sampling interval used for Blocks 10 through 12 was expanded from 25 cm to 50 cm, due to time constraints. Consequently, these three blocks were not submitted for 3D modeling. An examination of the radargrams from Block 10 indicated numerous deeply buried anomalies, which are likely to be archaeological features or artifact concentrations.
The DuBignon Cemetery

GPR Block 7
GPR Blocks 7 and 8 were placed within the brick cemetery enclosure, commonly known as the DuBignon Cemetery, which is located west of the Horton House ruin (see Figure 3). This cemetery wall measured approximately 11.65 m East-West by 11.5 m North-South and was oriented 20 degrees east of Magnetic North. Vegetation within this area was nearly absent and a thick humic mat was noted. Blocks 7 and 8 included most of the area within the enclosure where GPR survey was feasible. The remaining area was obstructed by two large Eastern Red Cedar trees and three brick crypts.

Block 7 was placed on the western side of the enclosure where two presumed graves were marked by tombstones (Figure 12). These markers contained epitaphs for two drowned seamen: George F. Harvey, Native of England, drowned on Jekyll Island, March 21, 1912, and Hector Deliyannis, Native of Smyrna, Drowned on Jekyll Island, March 21, 1912. Hector’s headstone had an accompanying foot stone but George’s did not. All three stones were contained within the sample block. Block 7 measured 10 m North-South by 4.5 m East-West. Transects in Block 7 were run from North to South and lines progressed from West to East.

One purpose of Block 7 was to test the GPR device in an area where subsurface features (human graves) were suggested. Surface evidence (gravestones) indicated the presence of two probable graves in this portion of the cemetery (Figure 13). These are located in the northern part of

Figure 11. Aerial View of North End of GPR Block 5 Revealing
A) 0.60 B) 0.75 meters and C) 1.00 meters Below Surface, Horton House.
the cemetery enclosure, rather than the southern part where the tombstones are located. These anomalies are best defined at 60 cm depth (Figure 11a), although they are also visible at 75 cm depth (Figure 11b), and slightly visible at 1 meter below ground (Figure 11c). The two anomalies are parallel and closely spaced and oriented East-West, which is consistent with Christian burials. The remainder of the block was vacant ground, although it was suspected of having a high likelihood for containing additional, unmarked graves.

GPR Block 8
GPR Block 8 was located on the eastern side adjacent to three brick crypts of the DuBignon family. From north to south the crypts contained the remains of: Mrs. Amelia Dubignon, died May 4, [illegible]; Joseph Dubignon, died April 27, 1850 and, Marie Felicite Riffalut, April 6, 1852. This block measured 10 m North-South by 1.25 m East-West (Figure 14). Transects in Block 8 were run from North to South and lines progressed from West to East. The first transect in Block 8 (Transect 172) began at a point approximately 9.25 m from the western interior corner of the cemetery wall. Like Block 7, Block 8 was considered to have a high possibility for containing unmarked graves. Three aerial views of Block 8 were generated at 60 cm (Figure 13a), 75 cm (Figure 13b), and 1 meter below ground (Figure 12c). Although numerous anomalies are visible in all three views, no obvious human burials are represented. Many of the anomalies that are visible at these depths are likely to be cultural in origin. The cemetery also contains two massive Eastern Red Cedar trees however, and some of the anomalies may result from the radar signal deflecting off of the large tree roots.

GPR Block 9
GPR Block 9 was located approximately 10 m east of the Dubignon Cemetery gate in an area marked by a gravel trail and patchy areas of grass (see Figure 3). Block 9 measured 20 m North-South x 4 m East-West. Transects were run from South to North and lines progressed from West to East. The central portion of Block 9 contained a gravel-paved trail or road with a slight depression within it. The northern end of Block 9 was located less than 2 m from the marsh edge. The transition was marked by a short bluff. The bluff edge exhibited erosional gullies. Two large cedar trees, which flanked both sides of the gravel trail, were located approximately 3 m east of Block 9.

Three aerial views of Block 9 were generated from the radar data, which are shown in Figure 15. At 60 cm depth, a very large anomaly, which appears to be rectangular in outline, is visible (Figure 14a). This anomaly continues through 75 cm depth and is fading out at about 1 meter below ground (Figures 14b and 14c). The suspected outline of this probable historic period feature is suggested in Figure 16. This anomaly corresponds to a large, shallow depression, which is visible on the surface in the gravel paved trail. The radar map shows a number of large anomalies within it, which may indicate concentrations of artifacts.

These data are interpreted as a possible historic cellar or large rectangular pit, which contains concentrations of artifacts in the fill. This possible cellar is oriented with its long axis approximately
East-Northeast. These suspicions should be “ground truthed” in future archaeological studies at the Horton House site.

GPR Block 11
GPR Block 11 was located immediately west of the DuBignon Cemetery wall (see Figure 3). It measured 5 m North-South by 12 m East-West. This sample block was aligned with the cemetery enclosure, which meant that the radargrams were actually oriented West-Northwest (bearing 20 degrees) and the lines progressed towards the South-Southwest (bearing 200 degrees). The northeastern corner of the sample block was approximately 2 m south of the cemetery wall corner and was offset from the wall toward the west by approximately 1 m.

The primary purpose of Block 11 was to determine the likelihood for additional human graves located outside of the brick enclosure. West Georgia College’s Test Unit 7, which was excavated in 1991, is located in the southwestern corner of Block 11 (Crook n.d.). Crook’s plan of the site depicts Test Unit 7 as a 3 meter by 3 meter excavation. Details of this excavation were not published at the time of the present study.

Figure 12. Aerial View of GPR Block 7 Revealing A) 0.60 B) 0.75 meters and C) 1.00 meters Below Surface, Horton House.
Figure 13. Aerial View of GPR Block 7, 60 cm Below Surface, Highlighting Anomalies.

Figure 14. Aerial View of Block 8 revealing A) 0.60 B) 0.75 meters and C) 1.00 meters Below Surface, Horton House.
Figure 15. Aerial View of Block 9 Revealing A) 0.60 B) 0.75 meters and C) 1.00 meters Below Surface, Horton House.

Figure 16. Aerial View of Block 9 at 0.60 meters Below Surface, Highlighting Large Anomaly, Horton House.
**The Brewery**

GPR Block 12 was located in the part of the site commonly known as the Brewery. The block was positioned immediately south of a tabby ruin, northeast of a large depression, and west of the paved road (see Figure 3). This area was wooded in maritime forest and the ground surface was slightly uneven. Block 12 measured 8 m North-South by 3 m East-West. Transects were run from South to North and lines progressed from East to West. Because of the dense understory, uneven ground surface, tabby obstacles, and limited area available for study, GPR survey was not very productive on this portion of the site.

**Summary**

Ground Penetrating Radar (GPR) survey of portions of the Horton House archaeological site on Jekyll Island, Georgia were completed in March, 2002 by Rocquemore Radar Research, Box Springs, Georgia, as a sub-contract with Southern Research Historic Preservation Consultants, Ellerslie, Georgia. This pilot study was the first application of GPR technology on an archaeological setting on Jekyll Island and one of the few that have been conducted on Georgia’s Barrier Islands. The results of this work were successful and indicate that this technique has useful application for archaeological sites in this environment.

The three days that were spent conducting GPR fieldwork at the Horton House site allowed only a small fraction of the entire site to be examined. The survey examined 12 sample blocks within a portion of the Horton House site that extended from grid point 511-785 North and 310-473 East, or a distance on the North-South axis of 274 meters and 163 meters on the East-West axis. These sample blocks covered an area of approximately 732.5 m². The majority coverage was placed around the Horton House ruin with lesser coverage at the DuBignon Cemetery and “the Brewery”. The balance of the site is in heavily wooded conditions, which are not conducive for GPR coverage.

The GPR radargram profiles revealed numerous anomalies across the site, particularly in the upper 60 cm of soil. At greater depths very few anomalies were identified and some of these may not be archaeological in origin. Some of the deeper anomalies, such as the pronounced anomaly that was observed at 1.3 meters depth in the northwest quadrant of GPR Block 4, are likely the result of geological or other environmental factors (possibly salt water intrusion in the water table). The upper stratum of the Horton House site (50 cm and shallower) contains abundant artifacts, as revealed from the various excavations. Many cultural features also are present in this zone, so much so, that the GPR mapping of these shallower depths yielded too many reflected signals. The density of large artifacts, artifact clusters, and features in the 0-50 cm soil zone, was not well suited for the isolation of individual features using GPR.

The major discoveries of the Horton House GPR survey included:

- ditch or trench feature, possibly part of a defensive palisade that surrounded the Horton House, which was located South of the ruin;
• two burials within the DuBignon Cemetery, probably the two drowned sailors and,
• large rectangular cellar, which was located about 10 meters east of the DuBignon Cemetery gate.

These suspected features should be verified by future excavations. Other portions of the site, which are currently wooded, should be considered as potential areas for additional GPR survey should the ground surface on these areas become exposed.

The angled linear anomaly in GPR Block 3 forms an interior angle of approximately 112 degrees. Such an angle may have been designed to allow for enfilading fire by gunmen defending against an attack. Most forts from this era incorporated these “salient angles” in their design, following military fortification theory of Vaughan and others (Lewis 1970). The suggestion of a palisade surrounding the Horton House seems logical, given that Major Horton established his plantation house on the hostile Georgia frontier, which was threatened by Spanish attack in the early part of the Georgia Trustee period.

Fortified house sites were not uncommon in the colonial period. Recent excavations at the Galphin trading post at Silver Bluff in Aiken County, South Carolina, have revealed a substantial palisade surrounding Galphin’s house. That fortification dates to the 1740s and serves as a possible analog for the Horton House. Alternatively, this linear anomaly may represent a planting alignment in a formal garden, or possibly an undocumented utility trench.

The two probable burials that were identified in the DuBignon Cemetery may be the same people who are commemorated with headstones. These stones indicate that the two men drowned on Jekyll Island. The headstones are located on the southern part of the enclosure and the suspected graves located by GPR are on the northern part. If these are one in the same, this suggests that the tombstones were erected sometime after the men were buried and were possible placed in the wrong location. Alternatively, the tombstones may actually be cenotaphs (markers placed to commemorate a dead person whose remains are not present) placed to commemorate two men, who were lost at sea and their bodies never recovered. This possibility could possibly be corroborated by a review of newspaper accounts of the tragedy, or from other historical records. If these are cenotaphs, then the two probable graves may be unrelated to the drowning victims. The fact that one of the tombstones has an accompanying footstone, however, supports the argument that these are not cenotaphs.

The GPR survey did not identify any probable graves outside of the brick enclosure at the DuBignon Cemetery. The entire area around the enclosure was not examined, however, so the potential for additional graves cannot be completely eliminated. The initial conclusion, however, is that this cemetery was built exclusively for the DuBignon family, and was used sparingly in later years. The cemetery for the enslaved African-Americans, who were exploited by the DuBignons was likely located elsewhere.
The suspected rectangular cellar, which was approximately 10 m east of the cemetery gate, measured approximately 7 m Northeast-Southwest by 5 m Northwest-Southeast. The age of this feature is not known, although it is suspected to be associated with the historic occupation. The orientation of this suspected cellar does not follow any cardinal direction. The DuBignon Cemetery enclosure shares this trait. In contrast, the Horton House was oriented along cardinal directions (Magnetic North).

Generally, the Horton House site showed promise for the application of remote sensing geophysical techniques. These techniques are non-destructive and therefore may be a desired approach for long-term management of this State-owned archaeological site. Knowledge of what lies beneath the ground is useful information for managers who need to select areas for disturbance, such as utility lines, fences, parking lots, and posts. In the past few years GPR equipment has improved significantly and continued improvement is to be expected.

In the near future the results of the present study may be vastly outmoded by new technology. Improved techniques and equipment may allow for the recognition of cultural features at very shallow depths. This would be an important advance for archaeology in Georgia since many sites are relatively shallow and features often extend only a few centimeters below the A-horizon. Such subtle differences were not recognizable with the equipment that was used in this study.

The current configuration of the RAMAC 3XM radar unit and its cart did not allow for the attachment of a 1000 MHz antenna, which was unfortunate. A higher frequency antenna would provide more precision in mapping very shallow features. Other self-criticism of the present study concerns the machine settings that were used for the sampling frequency, number of samples, and number of stacks. The project would have probably benefited from greater experimentation with these variables, but time and budgetary constraints prevented this. A 500 MHz antenna was available for use in the survey but it was not employed since the 800 MHz antenna allowed for a better examination of the soil depths that were of most concern to the archaeologists. Hopefully, the present study will serve as a stepping stone in the continuing learning process and future projects can build upon it.
References Cited

Briuer, Frederick L., Janet E. Simms, and Lawson M. Smith

Brooks, Mark J., Barbara E. Taylor, and John A. Grant.

Conyers, Lawrence B.

Conyers, Lawrence B., and Dean Goodman

Crook, Ray

Elliott, Daniel T.
2002 Ebenezer Revolutionary War Headquarters: A Quest to Locate and Preserve. Lamar Institute, Watkinsville, Georgia.

Elliott, Daniel T., Rita F. Elliott, W. Dean Wood, Russell M. Weisman, and Debra J. Wells

Friends of Scull Shoals

Hodge, C. J., R. D. Dubois, and A. Holt
2002 What is Ground Penetrating Radar? http://www.medianstrip.net/~jayne/arc

Kvamme, K. L.

Lewis, Emanuel R.

MALÅ GeoScience USA

National Center for Preservation Technology and Training and USDA Forest Service, Southeast Region

Wynn, Jack T.