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Archaeological, Geophysical, and Geospatial Analysis at David Crockett Birthplace State Park, in Upper East Tennessee

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by

Reagan L. Cornett

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ABSTRACT

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A geophysical survey was conducted at David Crockett Birthplace State Park (40GN205, 40GN12) using ground-penetrating radar (GPR) and magnetometry. The data indicated multiple levels of occupation that were investigated by Phase II and Phase III archaeological excavations. New cultural components were discovered, including the remnants of a Protohistoric Native American structure containing European glass trade beads and Middle Woodland artifacts that suggest trade with Hopewell groups from Ohio. A circular Archaic hearth was uncovered at one meter below surface and similar deep anomalies were seen in the GPR data at this level. A semi-automated object-based image analysis (OBIA) was implemented to extract Archaic circular hearths from GPR depth slices using user-defined spatial parameters (depth, area, perimeter, length to width ratio, and circularity index) followed by manual interpretation. This approach successfully identified sixteen probable hearths distributed across the site in a semi-clustered pattern.

DEDICATION

I would like to dedicate this thesis to three people who have guided me down this long and winding road. First and foremost, my mother, Elaine Cornett who has always been there whenever I needed anything, from sifting dirt to making her famous potato soup in times of need. Second, I dedicate this thesis to S.D. Dean who is both mentor and friend, and whose excavation skills are with machine-like precision. Last, I dedicate this to the memory of Dr. Dorothy Humpf who was there at the beginning of my archaeological journey and continues to be an inspiration.

ACKNOWLEDGEMENTS

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Thank you to my classmates for all that you did – Lauren Franklin, Cayla Cannon, Nate Shreve, Claiborne Sea, Kingsley Fasesin, Raja Das, Jeff Banks, David Ferrell, Taylor Hodge, Montana Kruske, Karen Biggert, Willow Huddleston, Shelby Stahlhood, and Asheton Lorielle. I would like to acknowledge the students from the 2018/2019 ETSU Winter field school, along with other student volunteers (Kris Kaufman, Kevin Stell, Mathew Bushell, Jessica Barbee, Noah McGill, Caroline Drury, Mary Catherine Rush, Kayleigh Kent, Elizabeth Zeigler, Stephanie Peirce, John Boyd, Christopher Baxter, Marley Boies, Talis Cooper, Sam Ellison, and Joseph Scott). I would also like to acknowledge all the numerous local informants and volunteers including Bob Davis, Rikki Stonecypher, Ruth Stonecypher, James Tyree, Steve Ricker, Dalton Wade, Doug Ledbetter, and Kevin McMinn, to name a few.

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Thank you to Ryan Miller, Shelley Huber, and the rest of my family and friends for their moral support. To my parents: thank you to my father, Larry Cornett, for buying us that Commodore 64 and sparking my passion for technology, and to my mother, Elaine Cornett, for everything, along with your help on this project. I would also like to acknowledge the influence of my grandparents Jesse and Gordon Humphreys, and Aurine and J.I. Cornett, along with my step parents, Maureen Cornett and Gary Barrigar.

To my committee members, Dr. Eileen Ernenwein, Dr. Jay Franklin and Dr. Chris Widga: I am humbly and incredibly grateful for the opportunity you have given me to fulfill a lifelong dream of scientifically investigating the archaeology of Upper East Tennessee. Your mentorship and guidance has been invaluable to my success. I can only truly thank you by continuing to use the techniques and knowledge I have learned to add to the archaeological record and also by sharing this information with the public and future geophysicists and archaeologists. My educational journey has come full circle and I thank everyone from the bottom of my heart.

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CHAPTER 1. INTRODUCTION

Statement of Hypotheses

The archaeological record indicates that indigenous groups have inhabited Upper East Tennessee since at least the Paleoindian Period (before 8000 BC) (McIlhaney 1978). However, archaeological investigations of the area have been sparse due to lack of funding, resources, and overall interest in the area (Franklin and Dean 2006; Franklin et al. 2008; Franklin et al. 2017). More recent work performed by East Tennessee State University (ETSU) has revealed new information from several multi-component sites along the Holston, Watauga, and Nolichucky rivers (e.g. Ernenwein and Cannon 2017; Ernenwein and Franklin 2017; Franklin et al. 2017; Shreve et al. 2020). Two burned Native American villages have been discovered through geophysical surveys led by Dr. Eileen Ernenwein and archaeological excavations led by Dr. Jay Franklin at two sites (40WG20, 40WG143) along the Nolichucky River in Washington County (Franklin et al. 2010; Ernenwein and Franklin 2017; Franklin et al. 2017; Franklin 2018; Shreve et al. 2020). European glass trade beads were recovered, along with Accelerator Mass Spectrometry (AMS) radiocarbon and optically stimulated luminescence (OSL) dates from both sites, all of which indicate a Protohistoric occupancy (AD 1540-1700) (Franklin et al. 2010; Ernenwein and Franklin 2017; Franklin et al. 2017; Franklin 2018; Shreve et al. 2020). Many questions were raised that are still being investigated about the identity of the indigenous occupants of the Nolichucky and with what groups they were interacting.

In 2018, another opportunity arose to investigate an archaeological site along the Nolichucky River at David Crockett Birthplace State Park in Greene County, TN. The park was in the planning stages of the construction of a historic eighteenth-century homestead that would represent early European settler life around the time of David Crockett's birth in 1786. As part of this thesis project, a near-surface geophysical survey was conducted in an area encompassing approximately two hectares that now contains the homestead. The survey was then ground-truthed with Phase II and Phase III archaeological excavations. Previous archaeological work had been conducted during construction of the state park by Samuel Smith and Joseph Benthall in the 1970s through the 1990s (Benthall 1997; Smith 1980). Evidence of an indigenous occupation was discovered in an area of the park (recorded as state site 40GN12) that spanned the Archaic (8000-1000 BC), Woodland (1000 BC-AD 1000), and Mississippian (AD 1000-1548) periods (Smith 1980; Benthall 1997). The entire park area is designated as a state historic site (40GN205) and was the home of numerous families from the 1780s to the 1970s, including the Crockett family (Crockett 1834; Smith 1980). It was also the site of a popular wellness hotel that was in operation from 1885-1912, and the area is also the reported location of Fort Lee, which was partially constructed, abandoned, and burned during an attack by the Cherokee and the Creek in 1776 (Smith 1980).

Several research questions were formed before, during, and after the multi-staged geophysical, archaeological, and geospatial investigations: 1) Will there be evidence of Historic structures in the geophysical data, specifically the Crockett home or Fort Lee? 2) Will there be indications of a Native American village? 3) Can new cultural components be discovered by using geophysical techniques combined with archaeological excavations? 4) Will spatial and temporal patterns of occupancy emerge? 5) Can a semi-automated GIS model be constructed to identify archaeological features at varying depth levels from the geophysical data?

Method Approach

A multi-step approach was implemented to answer these questions. The geophysical survey was conducted by both ground-penetrating radar (GPR) and magnetometry using a GSSI SIR4000 GPR control unit with a 400 MHz antenna and a Bartington Grad 601-2 dual fluxgate magnetic gradiometer, respectively. The geophysical data were processed and examined using software that included *GPR-Slice*, *Surfer*, *Archaeofusion,* and *ESRI ArcMap*. An unmanned aerial vehicle (UAV) was used to create an orthophotograph of the survey area and a 3-D image of the excavation site within *Agisoft PhotoScan* Structure-from-Motion (SfM) photogrammetry software. Grids, test units, features, and diagnostic artifact locations were recorded with a Real-Time Kinematic Global Navigation Satellite System (RTK GNSS) -- a Spectra Precision SP80 survey kit with a positional accuracy level of +/- 5 cm. *ArcMap* was also used to create spatially accurate maps and images of the geophysical imagery and archaeological features. The archaeological investigation included metal detecting, auger testing, shovel and trowel excavations, and dry and wet screening of artifacts. A preliminary analysis was conducted on artifacts found in situ, including diagnostic prehistoric ceramics and lithics. AMS radiocarbon dates were obtained from burned organic materials recovered from all levels of investigation.

GPR is one of several geophysical techniques used in archaeology without destruction or disturbance to the site. It is often employed in preparation for archaeological excavations to pinpoint exact locations of features, saving valuable time and labor. Large areas can be surveyed in a shorter time than excavations, reaching depths of several meters. In some cases, GPR can discover subtle features and overall patterns that might be missed or overlooked in archaeological investigations. GPR is an active geophysical technique that uses high frequency electromagnetic radio waves to send out pulses that will reflect off subsurface objects and layers

(Conyers 2006). The magnitude and velocity of this reflection can then be measured in decibels (db) and nanoseconds per meter (ns/m), respectively (Vaughn 1986). GPR has been used to identify objects such as bedrock and utility lines, however, it is utilized by archaeologists to detect features such as structures, hearths, and burials (Conyers 2006). Changes in soil type and soil disturbance can also be detected, which allow the identification of more subtle features such as pits or compaction from human occupancy (Conyers 2006). Depth range is directly related to frequency and radar energy; antennas with lower frequency radio waves potentially have a greater depth penetration and vice versa, ranging from 16 MHz to 2600 MHz (Conyers 2006).

GPR was first used to penetrate ground surfaces under ice sheets and glaciers in the 1960s (Annan 2002). It was then used to locate geological materials such as coal and for lunar exploration by NASA in the 1970's, which lead to rapid advancements in the field. It was also during this decade that GPR was first explored for use in archaeology by L.T. Dolphin and colleagues to identify underground caves in New Mexico in 1977 (Vickers and Dolphin 1976) In 1982, C. J. Vaughn successfully employed GPR to identify features at a sixteenth century Basque whaling site in Canada (Vaughn 1986). The 1990's saw the advent of software techniques that allowed for horizontal depth slicing of GPR data, while software advances in the 2000s led to the development of 3-D imagery (Ernenwein and Kvamme 2008). One drawback of GPR is that data processing is time consuming and requires in-depth interpretation by an experienced geophysicist (Ernenwein and Kvamme 2008). However, technological advancements in equipment and computer software continue to improve geophysical techniques making them affordable and accessible for use at archaeological sites.

Magnetometry is a passive geophysical technique that uses sensors to detect both magnetic fields and changes between fields (Schmidt 2007; Aspinall et al. 2008). In archaeology, it is used to identify buried features or anomalies that have magnetic properties, such as metal objects and/or by detecting magnetic contrasts between soil layers and features (Witten 2006; Schmidt 2007). Magnetometers can also detect thermoremanent magnetization of burned features such as kilns, furnaces, bricks, and clay that have been heated past their Curie temperature, the point at which materials lose any magnetic properties (Schmidt 2007; Aspinall et al. 2008). These materials retain the magnetic field of the earth at the time they have cooled (Schmidt 2007; Aspinall et al. 2008). The strength of the magnetic susceptibility of objects and features varies from site to site based on material types and soil content, for example, soils with a high iron content will have a higher magnetic susceptibility (Schmidt 2007). These techniques are extremely valuable at (virtually metal-free) prehistoric sites in the Southeast, to detect subtle features such as remnants of trash pits, hearths, and decomposed wooden structures. However, magnetometry data can be masked by modern disturbances such as metallic debris, underground utility lines, high-powered electrical lines, construction, and agricultural plowing and tilling (Aspinall et al. 2008). All of these conditions were present at David Crockett Birthplace State Park, making magnetometry data only marginally useful. GPR data were not impacted by these conditions, resulting in the heavy reliance on it to investigate archaeological features in the park.

The first magnetometry survey designed specifically for archaeology was conducted in 1958 by J.C. Belshe in England, using both a torsion-fibre type and a transistorized proton magnetometer to investigate the remnant magnetic properties of Roman kilns (Aitken et al. 1958). Glenn Black was the first American to use magnetometry at the Angel site in Indiana in 1960, using a proton magnetometer to identify a prehistoric village stockade and associated trenches, reinforcing the future of magnetometry for archaeological use across the world (Black and Johnston 1962). Today magnetometry is an essential non-invasive tool that is often performed in tandem with other geophysical techniques such as GPR.

Multiple deep anomalies were seen in the GPR data that were not present in the magnetometry data. One of these was pinpointed for ground truthing during the Phase III excavation, where a large circular hearth was discovered at approximately 1 meter below surface (BS). As it was not practical or possible to excavate every deep anomaly, a semi-automated object-based image analysis (OBIA) was conducted on GPR depth slices with the intention of identifying features that had a high probability of being hearths, buried 80-120 cm BS. Probable hearths were identified in GIS based on reflection magnitude, size, and shape. The number of probable hearths was then reduced by manual interpretation of radargrams to eliminate obvious false positives such as utility lines and possible prehistoric burials. Selected features were then ground-truthed with a four-inch diameter bucket auger. This approach is discussed at length in Chapter 3.

Organization of Thesis

This thesis is presented in an alternate format consisting of two articles, preceded by an introduction in Chapter 1 and followed by a discussion and conclusion in Chapter 4 with a comprehensive bibliography. The thesis follows the style guidelines of the Council of Science Editors (CSE) with the exception of the two articles presented in Chapter 2 and Chapter 3. Chapter 2 presents a Historic Preservation and Survey and Planning Grant report that was submitted in October of 2019 as required by the Tennessee Historical Commission. An amended version will be submitted as a state archaeological report on David Crockett Birthplace State Park to the Tennessee Division of Archaeology (TDOA). The report presents the findings of a geophysical survey and archaeological investigation at the park performed in 2018-2019. Chapter 2 contains a detailed background on the Native American and early settler occupancy of the local area and previous archaeological work performed at the park. The results of the artifact analysis and AMS radiocarbon dates are given, along with geospatial imagery, photos, and maps of the survey. Newly discovered cultural components of the park are also discussed. Chapter 3 is a journal-style article that explores the use of semi-automated OBIA to extract sub-surface features from geophysical data. A brief overview of semi-automated image analysis is given. The results of the OBIA of ground-penetrating radar are presented and an argument is made for the future use of this time-saving method to reduce noise from geophysical data while successfully identifying archaeological features. Chapter 4 contains a discussion of local prehistoric ceramic types and thesis conclusion.

CHAPTER 2. GEOPHYSICAL SURVEY AND ARCHAEOLOGICAL INVESTIGATIONS AT DAVID CROCKETT BIRTHPLACE STATE PARK (40GN205, 40GN12)

Reagan L. Cornett and Eileen G. Ernenwein

Management Summary

In 2018 and 2019, geophysical surveys and Phase II/Phase III archaeological investigations were conducted by East Tennessee State University (ETSU) in anticipation of park renovations that included the construction of a new, historically accurate eighteenth-century farmstead and Visitors Center expansion. The park has plans to create a new museum exhibit that will highlight both the Native American occupancy of the land along with the history of early settlers such as David Crockett. Previous archaeological work was conducted by archaeologists Samuel Smith and Joseph Benthall during the initial construction of the campground, public buildings, and parking lots. The data and artifacts recovered from previous and recent archaeological excavations will be shared with the public through interpretive displays.

The 105-acre park is located at the confluence of Big Limestone Creek and the Nolichucky River in Greene County, TN. The entire park has been designated as a historical site (40GN205), while a smaller portion contains prehistoric cultural components (40GN12). The ETSU geophysical survey and excavations were confined to the location of the replica farmstead and adjacent lower floodplain. An unmanned aerial vehicle (UAV) was flown over the area to create a digital orthophotograph that was used as a high resolution base map for the survey. Spatial reference for geophysical survey grids and controlled archaeological research was provided by a Spectra Precision SP-80 Real-Time Kinematic (RTK) Global Navigation Satellite System (GNSS). Ground-penetrating radar (GPR) and magnetometry surveys began in 2018.

Phase II shovel test pits/auger testing and Phase III excavations began in 2018 and ended in 2019. Two main test areas were selected based on the geophysical data, auger testing, and location feasibility. Prehistoric features and artifacts were recovered spanning the Archaic, Woodland, and Mississippian Periods. No historic features or structures were located, but the remnants of a partially burned Protohistoric Native American structure was discovered and partially excavated, along with features and artifacts dating to the Archaic and Woodland Periods. This report is presented to the Tennessee Historical Commission (THC) to fulfill requirements as stated in the 2018 THC/ETSU grant contract. An amended version of this report will be submitted to the Tennessee Division of Archaeology to meet all obligations as required by the 2018/2019 archaeological permit.

Acknowledgements

We would like to thank the Tennessee Historical Commission for funding this project, along with the help and advice of the Tennessee Division of Archaeology. We would like to acknowledge the continued work of the Tennessee State Parks system in their efforts to preserve archaeological sites and share this knowledge with the public. The staff of David Crockett Birthplace State Park have been invaluable to the success of the project, especially state park manager Jackie Fischer and park rangers Sean McKay and Nate Dodson. We would also like to thank the entire staff of the ETSU Geosciences and Sociology & Anthropology departments for administrative support, specifically Dr. Jay Franklin for his collaboration in the excavations. Special thanks goes to S.D. Dean for his continued and tireless work on this and many other ETSU archaeological endeavors. Last, we would like to acknowledge the numerous professionals, students, and volunteers for their efforts in both the field and the lab. Permit number 000958R was granted by the State of Tennessee Department of Environment and Conservation through the Division of Archaeology.

Introduction

David Crockett Birthplace State Park consists of 105 acres within Greene County, TN (Figure 2.1) and is located at the confluence of the Nolichucky River and Big Limestone Creek (Tennessee State Parks 2016). The park was surveyed in 1977 by state archaeologists Samuel D. Smith and Joseph B. Benthall and was assigned state site 40GN12 (Figure 2.2), which was identified as having prehistoric components (Benthall 1997; Smith 1980). State records show the park was given state site number 40GN205 in 1994 to designate numerous historic sites throughout the park. In 2017, the park began construction of a historically accurate eighteenth-century farmstead to represent a living history of early settler life in the late 1700s, including a cabin, gardens, and animal enclosures that house donkeys, pigs, sheep, guineas, and chickens. The park has plans to renovate the Visitors Center, which will house a new museum that will showcase a timeline of the park's occupants, including both Native Americans and early setters. In anticipation of these renovations, we began a geophysical survey in 2018 using ground-penetrating radar (GPR) and magnetometry within the area of the historic farmstead and the adjacent lower floodplain. The goal of the project was to record and locate cultural features with a focus on possible historic and/or prehistoric structures. Several anomalies were tested by augering and excavations in 2018 and 2019.

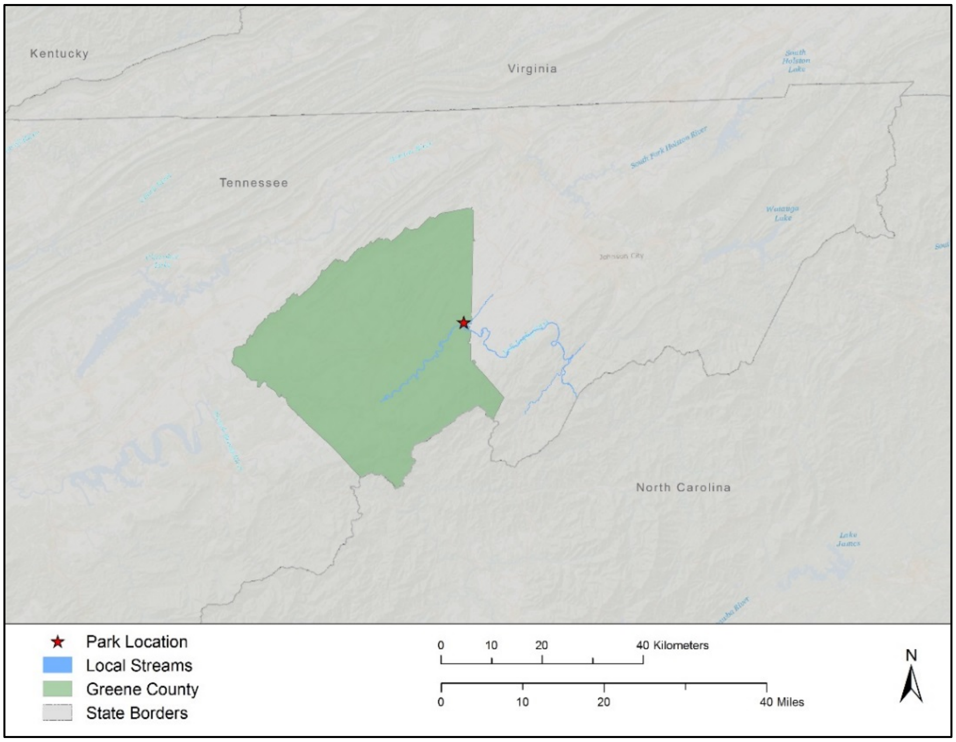

Figure 2.1. Location of David Crockett Birthplace State Park within Greene County, TN.

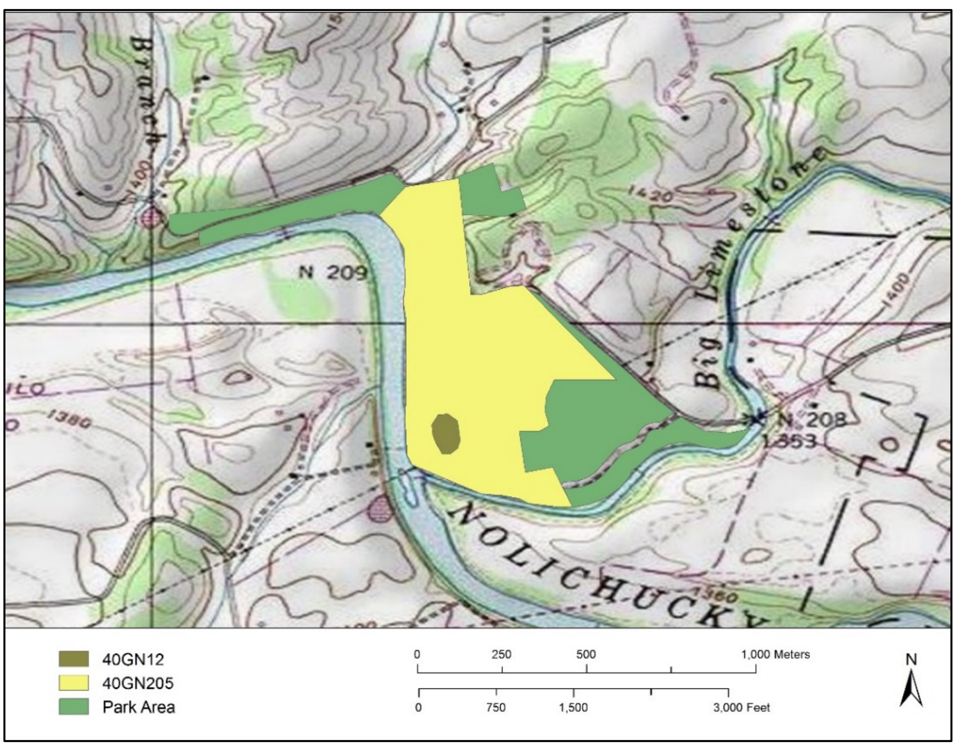

Figure 2.2. Boundaries of the park, including historic site 40GN205 and prehistoric site 40GN12. Source: Tennessee Division of Archaeology.

Background

Environment

Geology and Physiography. David Crockett Birthplace State Park is nestled within the Valley and Ridge physiographic province of the Eastern United States that runs northeast to southwest and parallel to the western side of the Blue Ridge Mountains (Rogers 1953). The Valley and Ridge region is bordered by the Cumberland Plateau to the east (Rogers 1953). The park is located along the Nolichucky River whose headwaters are formed in the Black Mountains of North Carolina, which contain the highest peak in the Eastern United States, Mount Mitchell. The 110-mile river begins at the confluence of the North Toe and Cane rivers at an elevation of over 2000 feet AMSL in North Carolina, ending at an elevation of around 1000 feet AMSL, where it joins the French Broad River to form Douglas Lake in Tennessee (National Park Service 1980; Tonn and Cottrill 2004). The river flows through portions of the Blue Ridge Mountains past the Unaka and Bald Mountains, which were formed during the Pre-Cambrian and Cambrian geologic periods (Rodgers 1953). These mountains are composed of rocks such as quartzite, sandstone, basalt, arkose, greywacke, and micaceous shale (Benthall 1997; McIlhany 1978). The Nolichucky transports these sediments from higher elevations into the Valley and Ridge province. The local geology consists of Knox limestone, Knox dolomite, sandstone, and shale formed during the Cambrian and Early Ordovician periods and Honaker dolomite formed during the later Ordovician (Benthall 1997; McIlhany 1978; National Park Service 1980). Regionally, limestone and dolomite formations are easily eroded, creating valleys and fertile floodplains, and are also an abundance source of chert nodules (Benthall 1997; McIlhany 1978). Figure 2.3 shows the geological formations of the park area, which consist mainly of cherty Knox limestone and dolostone overlain by a layer of Sevier shale (Hardeman et al. 1966; Rodgers 1953).

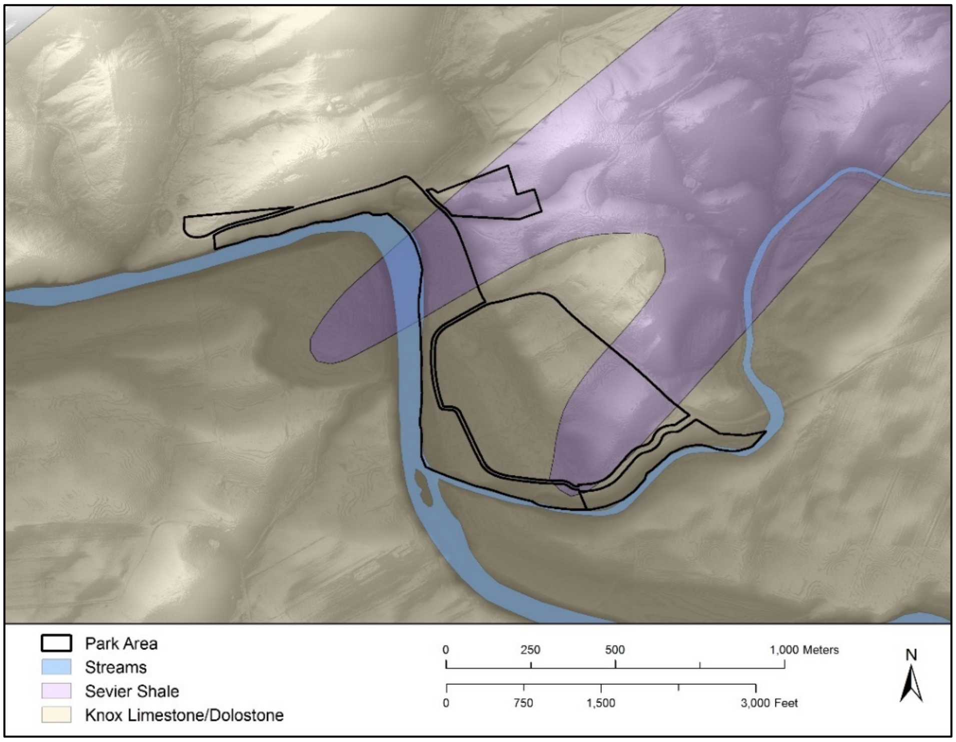

Figure 2.3. United States Geological Survey Map over a shaded relief created from Tennessee LIDAR data (resolution is 2.5 feet). Source: LIDAR from TN-GIS; USGS Geological Map was adapted from John Rodgers 1953 Geological Map of Tennessee.

The state park is located within the Middle Nolichucky River Valley, resting on a two-tiered alluvial terrace with a lower, narrow floodplain. The southern end of the park is bound by Big Limestone Creek with the Nolichucky River flowing north along the western portion of the park. There is a natural sand bank and a small island at the mouth of the creek. Large amounts of mica and feldspar have been released into the Nolichucky River by past mining in North Carolina and are now found along the riverbanks in abundance, adding to the natural deposit of these minerals (Muncy 1985). At the northern boundary of the park is a set of shoals where the river makes a sharp right angle, heading southwest. The lowest elevation of the park is approximately 1335 feet AMSL on the lower floodplain, and the first terrace is approximately 1350 feet AMSL. The second terrace contains the highest elevation in the park which is located along the road that forms the eastern boundary of the park, at approximately 1400 feet AMSL. The sediment found along the lower floodplain is comprised mainly of Congaree fine sandy loam. The raised terraces consist of sediments such as State loam (statler), Altavista loam, Congaree loam, Emory silt loam, Cumberland silty clay loam, and Waynesboro cobbly loam (USDA 2019). Figure 2.4 shows the soil map created with GIS (Geographical Information Systems) data retrieved from the United States Department of Agriculture (USDA) Web Soil Survey using the state park boundary polygon to define the Area of Interest. The soil type legend and summary are displayed in Table 2.1.

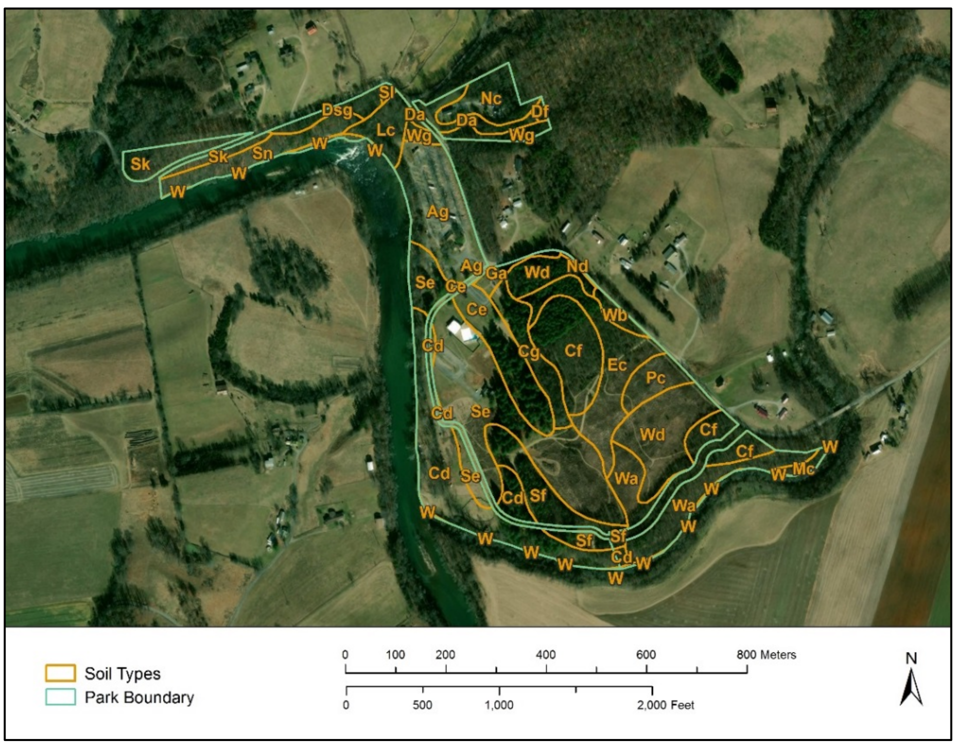

Figure 2.4. Map of soil types found within the park. Source: USDA Web Soil Survey.

Table 2.1. USGS Soil Map Legend

Symbol	Map Unit Name	Acres	Percent
Ag	Altavista loam, undulating phase	7.4	7.5%
Cd	Congaree fine sandy loam	10.7	11.0%
Ce	Congaree loam	4.7	4.8%
Cf	Cumberland silt loam, undulating phase (dewey)	7.8	7.9%
Cg	Cumberland silty clay loam, eroded hilly phase (dewey)	2.9	3.0%
Da	Dandridge shaly silt loam, eroded hilly phase	1.8	1.8%
Df	Dandridge silt loam, steep phase	0.2	0.2%
Dsg	Dunmore silty clay loam, 12 to 25 percent slopes, eroded	1.4	1.4%
Ec	Emory silt loam, 0 to 4 percent slopes, rarely flooded	6.6	6.7%
Ga	Greendale silt loam, 0 to 6 percent slopes, rarely flooded	0.8	0.8%
Lc	Lindside silt loam, 0 to 2 percent slopes, occasionally flooded, warm	2.2	2.2%
Mc	Melvin silt loam, 0 to 2 percent slopes, occasionally flooded, warm	0.5	0.5%
Nc	Needmore silty clay loam, eroded rolling phase	3.1	3.2%
Nd	Nolichucky cobbly fine sandy loam, eroded hilly phase	0.1	0.1%
Pc	Pace silt loam, eroded rolling phase (tasso)	2.1	2.2%
Se	State loam (statler)	16.7	17.1%
Sf	State loam, eroded rolling phase (statler)	4.6	4.7%
Sk	Stony hilly land, dunmore soil material (barfield-roc)	2.9	3.0%
Sl	Stony rolling land, dunmore soil material (barfield-roc)	0.2	0.2%
Sn	Stony steep land, dunmore soil material (barfield-roc)	3.6	3.6%
W	Water	0.6	0.6%
Wa	Waynesboro cobbly loam, eroded hilly phase (nolichucky)	6.3	6.4%
Wb	Waynesboro cobbly loam, eroded rolling phase (nolichucky)	0.8	0.8%
Wd	Waynesboro loam, 6 to 15 percent slopes, eroded	8.2	8.3%
Wg	Whitesburg silt loam	1.6	1.7%

Climate. Based on the Koppen Climate Classification system (Figure 2.5), the region is categorized as Cfa, which is a humid sub-tropical-warm summer climate type, with cold, but mild winters (TN Climate Office 2019). In higher elevations greater than 3000 feet, the summer temperature averages are cooler and these areas are classified as Cfb (Oceanic or Humid Highlands) (TN Climate Office 2019). Temperature records taken in Greene County from 1989-2010 report an average summer high as 87° F and an average summer low as 62° F, with the average winter high as 50° F and the average winter low as 26° F (U.S. Climate Data 2019). The annual precipitation is 43 inches and the average snow accumulation is 9 inches (U.S. Climate Data 2019).

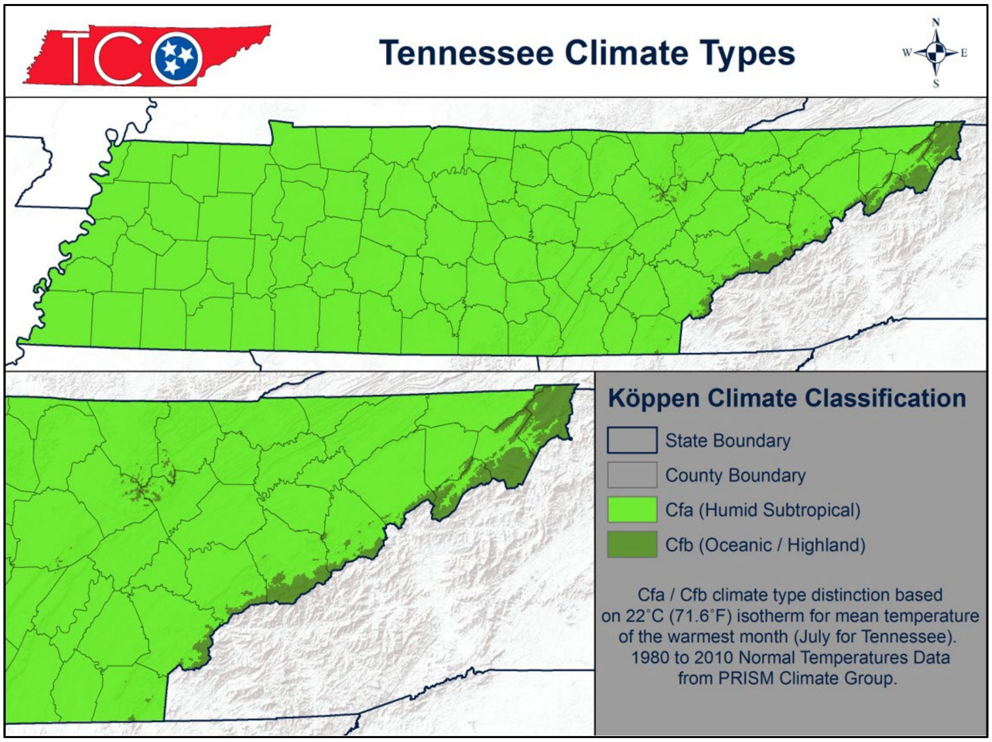

Figure 2.5. Tennessee Climate map. Map provided by the Tennessee Climate Office and used with permission.

Flora/Fauna. The Cherokee National Forest boasts "over 20,000 species of plants and animals" and many of these are found within the Middle Nolichucky River Valley (National Forest Foundation 2019). Area forests are classified as temperate deciduous, which have been altered by human impacts on the landscape. Along the Middle Nolichucky Valley the lands have been cleared for timber and agriculture, and farms and pasture lands are now abundant. Sparse patches of forests remain in the valley, while the nearby Cherokee and Pisgah National Forests protect natural resources found in the higher elevations of the Blue Ridge Mountains. Trees such as oak, maple, black locust, pine, birch, and hickory now dominate mountainous regions, while oak, pine, yellow poplar, red cedar, and hickory are found in the lower elevations (McIlhaney 1978). The Chestnut blight in the 1930s destroyed a major proportion of the American chestnut that once dotted the landscape, and invasive species such as the Bradford Pear have become abundant in the area (Shelford 1963; TN IPC 2019). Human-induced environmental change has further affected the forest environment through timber harvesting, land clearing, and wildfires.

According to the Tennessee Encyclopedia, the region sustains 47 species of mammals, at least 120 birds, 55 reptiles and amphibians, and 154 different species of fish (TN Encyclopedia 2017). Indigenous fauna include white-tailed deer, black bears, raccoons, opossum, eastern gray squirrels, beavers, and otters. Avian species include waterfowl, wild turkey, ruffed grouse, bald eagles, hawks, owls, and songbirds. Numerous amphibians such as box, painted and snapping turtles can be found, along with a variety of reptiles, including two species of venomous snakes: timber rattlesnakes and copperheads. Local wildlife has been impacted by modern anthropogenic events such as deforestation, mining, dams, construction, pollution, and climate change (Savitz et al. 1996). Riverine species such as freshwater mussels and fish in the Nolichucky have been heavily impacted by human activities, but this has been slightly offset by environmental regulations and federal efforts to restock rivers with fish such as rainbow trout by the U.S. Fish and Wildlife Service (TWRA 2017).

Site History

Prehistoric. The Prehistory of the Southeastern United States refers to the Native American occupancy documented through archaeological investigations, radiocarbon and other dating techniques, along with early historical records of European explorers and settlers. An established and general cultural chronology is presented that delineates five major time periods throughout environmental and societal changes. It is important to note that these dates can vary regionally and will continue to be revised as new sites are discovered. These periods include the Paleoindian, the Archaic, the Woodland, and the Mississippian, with each of these further condensed into Early, Middle, and Late. The Protohistoric Period is an extension of the

Mississippian, designating indigenous occupancy that is contemporaneous with the arrival of Europeans onto the continent, but does not necessarily indicate definitive contact between the two groups. All of these prehistoric periods are represented and have been recovered from state recorded archaeological sites in the Middle Nolichucky Valley (McIlhany 1978).

Paleoindian (> 10,000 BC – 8000 BC). The Paleoindian Period marks the earliest evidence of human occupancy in North and South America, including the Southeast. The archaeological signature of these sites suggest most Paleoindian groups were made up of small bands of mobile hunter/gatherers whose seasonal movements across the landscape were motivated by resource procurement (Anderson et al 1996; Ward and Davis 1999). The exact beginning of the Paleoindian Period has been debated as more sites are discovered (Davis et al. 2019). Current consensus postulates that people moved into the New World from Asia across the Bering Land Bridge that was exposed during the late Pleistocene. Sea level was 100 to 120 meters lower due to the presence of large glaciers in the northern hemisphere, and the land bridge, or Beringia, was inundated approximately 13,000 years ago (Dixon 2013; Fairbanks 1989). Controversial archaeological evidence indicates that humans were already in the New World by this time. The proposed oldest known site in North America was found at the Bluefish Caves in Canada where radiocarbon dating was performed on mammal bones with possible stone tool cut marks, placing human occupancy to "~ 24,000 cal yr BP" (Burgeon et al. 2017). Other migration theorists have suggested that there could have been several waves of migration, including routes along the northwestern coast of North America (Erlandson 2013). The multiple-wave migration theory has been supported by DNA evidence comparing ancient and modern Native American populations with their Asian counterparts, indicating splits in the gene flow at around 23,000 BP and again at 13,000 BP (Goebel et al. 2008; Raghavan et al. 2015; Reich et al. 2012).

The Paleoindian Period of the Southeast has been further refined as the Early, Middle, and Late Paleoindian Periods. Each period is associated with both climate and cultural changes during the "Ice Age" of the Pleistocene epoch, and lasted through the cooling of the Younger Dryas event that preceded the beginning of the warmer Holocene epoch (Anderson et al 1996). The archeological record suggests that Paleoindians were subsisting in small bands, seasonally moving across the landscape to procure resources and to hunt Pleistocene megafauna (Anderson et al 1996; Ward and Davis 1999). The Early Paleoindian Period dates from > 10,000 to 8850 BC and is marked by the widespread distribution of large fluted Clovis points (Anderson et al. 1996; Ward and Davis 1999). Waters and Stafford (2007) have revised the Clovis time range to 9100 to 8850 BC based on site data and radiocarbon dates. The Middle Paleoindian Period date range is 8850 to 8500 BC, while the Late Paleoindian Period dates from 8500 to 8000 BC (Anderson et al. 1996; Hudson 1994; Ward and Davis 1999). Projectile Points/Knives (PPKs) found at Paleoindian sites in the Southeast also include examples of other fluted and non-fluted types such as Redstone, Cumberland, Gainey, and Dalton points (Anderson et al 1996; Daniel and Goodyear 2006).

Archaic (8000 BC – 1000 BC). The Archaic Period in the Southeast is seen by regional adaptations to a warming climate in the Holocene epoch, which had direct effects on the environment (Anderson et al. 1996; Hudson 1994; Ward and Davis 1999). The expansions of deciduous forests created an ecosystem that provided Archaic peoples with a more diversified diet, as seen in an increased use of resources such as nuts, seed-bearing plants, fish, and smaller game (Anderson et al. 1996; Hudson 1994; Ward and Davis 1999). Territories decreased as populations increased and the archaeological record shows that technology also changes with the use of smaller, more expedient stone tools (Ward and Davis 1999). Early Archaic sites date from 8000 to 6000 BC, with stone tools of this time consisting of Palmer, St. Albans, LeCroy, Kanawha, and Kirk types (Anderson and Sassaman 2004, Ward and Davis 1999). The Middle Archaic lasts from 6000 to 3000 BC, in which Stanley, Morrow Mountain and Guilford type points have been recovered (Ward and Davis 1999). The archaeological record from sites of the Late Archaic suggests evidence for the beginnings of domestic plant cultivation and the use of soapstone carved vessels (Hudson 1994; Ward and Davis 1999). The Late Archaic lasted from 3000 BC to 1000 BC, and projectile points such as Appalachian Stemmed and Otarre types are found at these sites (Anderson and Sassaman 2004; Ward and Davis 1999). Localized cultural traits emerge in the Southeast during this time that include mortuary sites, mound building, and shell middens (Anderson and Hanson 1988; Gibson 2006; Russo 1994). The first pottery types in the United States also emerge along the East Coast in the Savannah River region (Sassaman and Rudolphi 2001).

Woodland (1000 BC – AD 1000). The Woodland Period in the Southeast is distinguished by widespread cultural changes, some of which continued from the Middle to Late Archaic Periods, such as sedentary villages and horticulture (Anderson et al. 2002). The archaeological record indicates that a vast trade network was accessed through trails and streams, utilized across the United States, creating widespread social connections and cultural diffusion (Anderson et al. 2002). Native Americans begin utilizing large-scale horticulture of plants such as maygrass, sumpweed, goosefoot, and sunflowers (Messner 2011, Ward and Davis 1999). These plants were cultivated for their nutritional value and use as medicines, textiles, tools, and architecture (Hudson 1994). Non-native plants such as maize, squash, and gourds appear, while pottery making becomes widespread throughout the Southeast (Anderson et al. 2002; Hudson 1994). The bow and arrow is introduced to the region, and as a result lithic technology changes and projectile points become smaller (Anderson et al. 2002, Hudson 1994).

Pottery traditions appear in East Tennessee during the Early Woodland at around 1000 BC (Sassaman and Rudolph 2001). Pottery recovered from Woodland sites show evidence of experimental and transitional pottery styles, with the introduction of surface decorations that were stamped by wooden paddles wound with cord and fabric or carved with designs (Hudson 1994). These types of surface treatments are unique to the Southeast (Hudson 1994). Effigies and important symbols, such as bird and serpent motifs, are also incorporated into vessel design (Hudson 1994). Pottery recorded from Woodland sites in Upper East Tennessee have included temper types such as sand, grit, quartz, chalcedony, and limestone (Franklin et al. 2008). Changes in pottery making and lithic technology have defined the Early (1000 BC – AD 0), Middle (AD 0 – 500), and Late Woodland (AD 500 – 1000) (Anderson et al. 2002; Bense 1994; Wright and Henry 2013). These pottery traditions continue into the Mississippian and Protohistoric Periods.

Mississippian (AD 1000 – AD 1570). The Mississippian Period in the Southeast is is defined by expansive agricultural societies ruled by chiefdoms and councils and by a ceremonial complex that had religious focus on seasons and maize cultivation (Hudson 1994). Throughout the eastern United States, large flat-topped mounds were constructed that supported religious structures and the homes of chiefs and the elite (Hudson 1994). Although mounds have been documented in Upper East Tennessee, they are not as large and extensive as the mound sites found in larger river valleys further south (Franklin et al. 2010). One hypothesis for this is that the Native Americans of this region may have been ruled by councils rather than chiefdoms recorded from other archaeological sites in the Southeast (Franklin et al. 2010).

The Pisgah Phase marks the beginning of the Mississippian culture in Upper East Tennessee and dates to roughly from AD 1000-1450 (Dickens 1976; Ward and Davis 1999). Pisgah pottery was tempered with sand, mica, and quartz and had distinctive ladder stamping and chevron incised decorations (Dickens 1976; Ward and Davis 1999). Around AD 1400, Southeastern pottery became branches of the Lamar style, which is identified by distinct surface treatments such as incised patterns and complicated stamping (Dickens 1976). Regional temper and surface treatments vary during this time period and in Upper East Tennessee temper types include sand, grit, quartz, steatite, and shell (Boyd 1986; Dickens 1976; Shreve et al. 2020). The ceramics types recovered from sites in Upper East Tennessee are similar to regionally defined typologies such as Dallas (Lewis and Kneberg 1946), Qualla (Egloff 1967), Overhill (Lewis and Kneberg 1946), Burke (Keeler 1971), and Nolichucky (Earnest n.d.), which are primarily based on temper, surface treatment, vessel form, cultural affiliation, and site location in the Southeast.

Protohistoric (AD 1570 – 1700). Dalton-Carriger (2016) has revised the Protohistoric range (AD 1570-1700) for East Tennessee as the transitional period between early contact and the Historic Period, based on an analysis of European glass trade beads found at regional sites. Other European trade items such as metal and firearms are found at these archaeological sites in the Southeast (Dalton-Carriger 2016; Shreve et al. 2020; Smith 2004). Dalton-Carriger (2016) also presents a date range for early European contact in the Late Mississippian as 1492-1568, representing early Spanish exploration from Columbus to Juan Pardo. Native American societies were dramatically altered by new diseases, technological changes, warfare, and displacement by direct and indirect contact with Europeans (Perdue and Green 1995; Smith 2004). This large scale cultural upheaval continued as indigenous peoples began adapting to European lifestyles until the removal of the majority of Southeastern Native Americans during the Trail of Tears in 1838 (Perdue and Green 1995).

Historic (post AD 1700). Early European settlers began moving into the area of what is now known as Upper East Tennessee during the 1760s and 1770s to escape British rule in the Colonies (Cox and Cox 2001; Dixon 1989; Kennedy 1995). This went against the Royal Proclamation of 1763, in which King George III forbid the settlement of lands west of the Appalachians Mountains, recognizing them as lands belonging to the Native Americans (Cox and Cox 2001; Kennedy 1995). More and more settlers began moving into areas along the Holston, Watauga, and Nolichucky rivers, and the three settlements soon joined forces to form the Watauga Association (Dixon 1989; Kennedy 1995). One of these immigrants was Jacob Brown, an Englishman from South Carolina who had set up a trading post and smithy on the Nolichucky River, winning favor by trading with Native American groups such as the Cherokee (Cox and Cox 2001; Dixon 1989). In 1772, representatives of the Watauga Association met with Cherokee leaders, including Chief Atacullaculla, in order to lease lands for a period of ten years (Dixon 1989). Among them was Jacob Brown, who negotiated separately to purchase land along the Nolichucky River including the property that is now David Crockett Birthplace State Park (Cox and Cox 2001; Dixon 1989).

The Revolutionary War began in 1775, and by then the British had joined forces with the Cherokee, many of whom were unhappy with the agreement to sell and lease lands, as they saw the numbers of European immigrants multiply (Cox and Cox 2001; Dixon 1989). Dragging Canoe, the son of Chief Atacullaculla, gathered a force of warriors that were soon joined by members of the Creek Nation (Cox and Cox 2001; Dixon 1989). As word spread of the imminent threat, the European settlements began constructing forts to protect them from both British and Native American attacks (Cox and Cox 2001; Dixon 1989). There are references in historical documents that famous Tennessean John Sevier may have had established one of his homesteads at the mouth of Little Limestone Creek on the Nolichucky River, which is a few miles upstream from the park (Schumate and Schumate-Evans 2002). The historical record shows that Fort Lee was constructed at the mouth of Big Limestone and the Nolichucky River by John Sevier and his men to protect the inhabitants of the Nolichucky settlements (Cox and Cox 2001). In July of 1776, the settlers were sent a message from Nancy Ward, a female Cherokee leader, of an oncoming attack from Cherokee forces led by Dragging Canoe, Chief Raven, and Chief Abraham (Dixon 1989; Cox and Cox 2001). The message was delivered by four white traders who had narrowly escaped with her help from the Cherokee settlements (Dixon 1989; Cox and Cox 2001). Fort Lee was abandoned before completion and the Nolichucky settlers fled north to Fort Caswell in the Watauga settlement (Dixon 1989; Cox and Cox 2001). A war party led by Chief Abraham was sent to the Nolichucky settlement, who then set fire to Fort Lee after finding it empty and uncompleted (Dixon 1989; Cox and Cox 2001). Many settlers were killed or captured by the Cherokee forces during the ensuing weeks of battles, which eventually ended with the retreat of the Cherokee and Creek warriors (Dixon 1989; Cox and Cox 2001).

Dragging Canoe and his warriors continued raiding the settlements for the several years, while the settlers led by John Sevier raided and burned Cherokee villages to the south (Dixon 1989; Cox and Cox 2001). Many died on both sides including David Crockett’s grandparents who were killed while tending their farm along the Holston River (Crockett 1834; Kennedy 1995). One of his uncles was severely wounded, while another uncle, who was reportedly deaf and mute, was held captive for 17 years (Crockett 1834). David Crockett’s father, John, was a soldier in the Revolutionary War and upon his return leased lands on the Nolichucky River from George Gillespie, who had by that time bought the land from Jacob Brown (Smith 1980). David Crockett states in his 1834 autobiography that at the time he was born in 1786, his family was living at the mouth of Big Limestone Creek and the Nolichucky River (Crockett 1834). The Crockett family moved from the area when he was around the age of four, but the Crockett name has remained tied to the lands and immortalized by the creation of a state park at this location (Smith 1980).

Many families moved into the area after the end of the Revolutionary War. The next recorded family to claim ties to the park was the Stonecypher family, who constructed a cabin on the land in 1824, allegedly using logs and beams from the remnants of the original Crockett Cabin (Smith 1980). The Stonecyphers maintained a farmstead on the property until 1968 (Smith 1980). Another family by the name of Falls built a nearby domestic structure sometime around 1860, which later became referred to as the Bailey house and was destroyed by fire in 1944 (Smith 1980). In the 1880s, William N. Collet purchased land from the Stonecyphers and built a mill along Big Limestone Creek near a local spring (Smith 1980). Collet was a Union soldier in the Civil War and his grave and marker remain in the park along a hiking path. B. R. Strong purchased land from Collet in 1885, building an inn above a spring that was in operation until 1912 (Smith 1980). The advertisements of Strong's Spring Hotel boasted the healing properties of the waters, along with the birthplace of David Crockett, who by that time had become a local and national hero (Smith 1980). The David Crockett Historical Society was formed in 1889, with annual celebrations to commemorate the birth of the famous Tennessean (Smith 1980). Plays and books about David Crockett continued to sell across the nation, but it wasn't until 1954 that he became world famous by a Walt Disney TV series and film based on his life adventures (Roberts and Olson 2001). The series and consequent movie were so popular that Disney reportedly made over 2 billion dollars by today's standards, selling David Crockett merchandise in the United States alone (Roberts and Olson 2001).

Park History. In 1955, the David Crockett Historical Society was formed in Greene County and purchased land from the Stonecyphers, building a replica Crockett cabin and gift shop (Smith 1980). Local oral history has it that the 1824 Stonecypher cabin was still standing and was dismantled to build the replica Crockett Cabin, boasting that logs from the original Crockett family cabin were recycled into the structure (Smith 1980). Kampgrounds of America (KOA) bought adjacent land, constructing a campground and pool house in the 1960s (Smith 1980). In 1973, the state of Tennessee assumed ownership of the land, designating it as a state historic site (Smith 1980). The state demolished all remaining domestic structures within the park boundaries, including the remnants of Strong's Inn (Smith 1980). The KOA pool was filled in and the state began remodeling the campground, building a new swimming pool and bathhouse in 1981, and the Visitor's Center and public bathrooms in 1984 (Benthall 1997). Figure 2.6 shows the current state park map, including the recently-constructed historic homestead. Tennessee State Parks has future plans to expand the Visitors Center with a new museum exhibit, adding interpretive displays along hiking trails within the park.

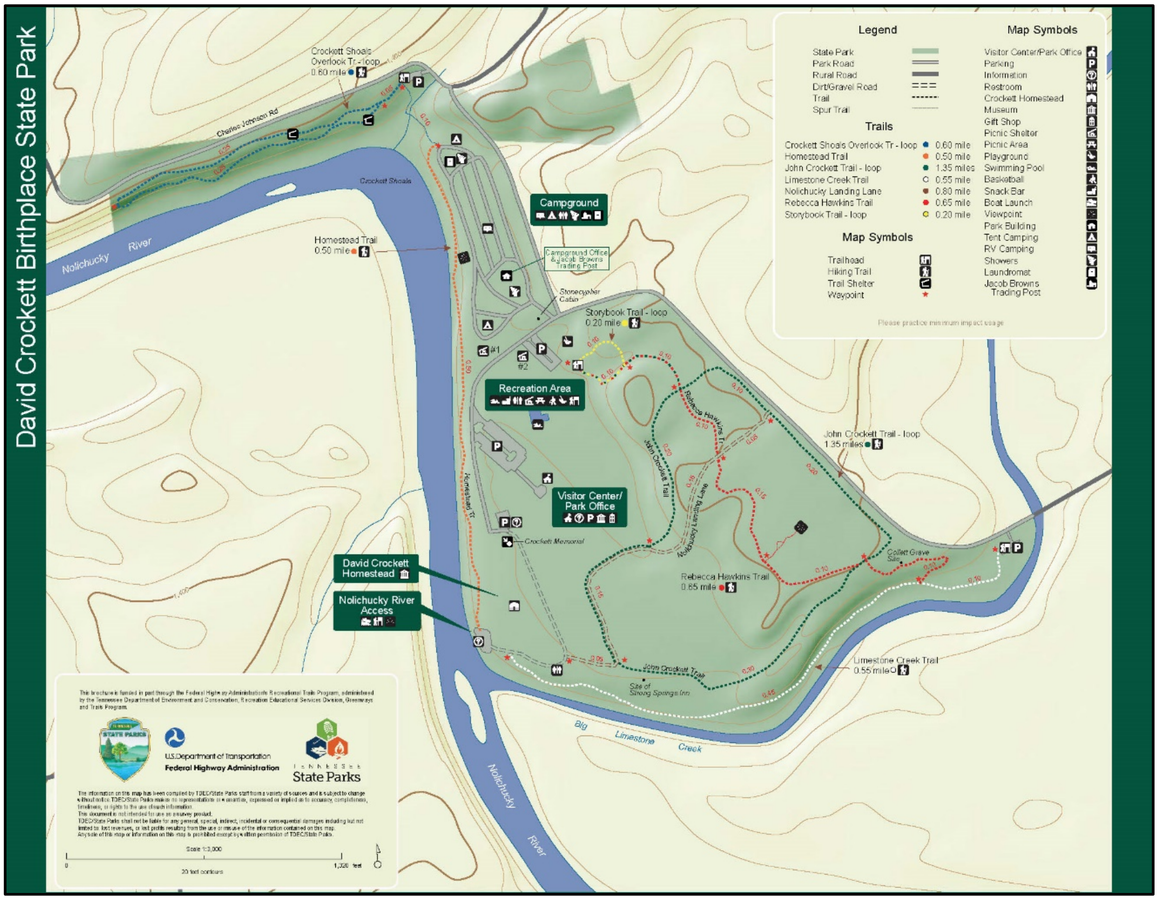

Figure 2.6. Map from David Crockett Birthplace State Park brochure. Source: Tennessee State Parks 2019 and used with permission.

Previous Archaeological Work. In 1978, an archaeological survey of selected portions of the Middle Nolichucky River Valley was conducted by Calvert W. McIlhaney in Greene and Washington counties for the Tennessee Division of Archaeology (McIlhaney 1978). While the survey was limited by time, land access, and field conditions, prehistoric artifacts were recovered from 38 sites (McIlhaney 1978). These sites were delineated based on biogeographic zones that included the following: floodplain, terrace, upland, and bluff (McIlhaney 1978). Seven of these sites are within a one-mile radius of the park and are listed in Table 2.2, along with their associated cultural component as reported by McIlhaney.

Table 2.2. Summary of 1978 McIlhaney Survey Sites (within a one-mile radius)

Cultural Component	40GN13	40GN14	40GN16	40GN17	40GN18	40WG35	40WG36
Paleoindian							
Transitional Paleoindian			✓				
Early Archaic	✓	✓	✓	✓			✓
Middle Archaic	✓	✓	✓				
Late & Terminal Archaic	✓	✓	✓			✓	
Early Woodland			✓			✓	
Middle Woodland	✓					✓	✓
Late Woodland	✓	✓		✓			✓
Mississippian		✓					✓
Cherokee				✓	✓		

In 1977, a state-funded archaeological assessment of the park was conducted under the supervision of state archaeologist Samuel D. Smith, along with the help of state archaeologist Joseph B. Benthall (Smith 1980). The park was in the planning stages for numerous renovations and by that time some historic structures had been demolished, with the exception of the 1955 replica Crockett cabin, gift shop, a barn, and the remnants of Strong's Inn. Smith was tasked with recording and excavating the parks historic areas and divided them into four locations: Areas A, B, C and D (Smith 1980). Smith denotes Area A as the location of the prehistoric site 40GN12 along the first terrace, which included the replica cabin and the location of the second Stonecypher house and barn (Smith 1980). The location of the original 1824 Stonecypher cabin was included in Area B (Smith 1980). Area C consisted of the Bailey farmstead located across from the campground, while the Strong's Inn site was designated as Area D near the spring above Big Limestone Creek (Smith 1980). In all of these areas, historic artifacts such as glass, metal, and ceramics were recovered through excavations and metal detection. Total counts of historic artifacts were as follows: Area A: 103, Area B: 3,678, Area C: 3,214 and Area D: 1,250 (Smith 1980). In addition to his archaeological work, Smith conducted extensive historical research with the help of local informants and historians (Smith 1980). A summary of the results of the research and archaeological investigations are presented in his 1980 report, noting that the location of Fort Lee and the original Crockett cabin could not be determined (Smith 1980).

Prehistoric artifacts were found in all four areas spanning the Archaic, Woodland, and Mississippian Periods (Benthall 1997; Smith 1980). Benthall concentrated his efforts within Area A, placing test units near the replica Crockett cabin. He had conducted a pedestrian survey early in 1977, reporting the location of prehistoric components to the state, which then assigned the area as 40GN12 (Benthall 1997). The earlier general surface collection yielded historic stoneware, along with prehistoric limestone, sand, and quartz-tempered ceramics and Archaic and Woodland projectile points (Benthall 1997). During the 1977 excavations, Area A lithics included debris, utilized flakes, chipped stone tools, and broken projectile points. Prehistoric ceramics included limestone, sand, and grit tempered sherds with surface treatments that included plain, cord-marked, fabric-impressed, brushed, simple-stamped, and check-stamped (Smith 1980). Area A yielded 1647 prehistoric artifacts that indicated a Woodland and possible Mississippian occupation (Smith 1980). Areas B and C yielded a few prehistoric artifacts, however Woodland artifacts were recovered in Area D, along with shell-tempered pottery indicating a Late Mississippian occupation (Smith 1980).

In 1981, Smith and Benthall returned to the park to assess the property that would be utilized for the new pool house and adjacent parking lots (Benthall 1997). A 100-foot trench was excavated using heavy machinery that yielded prehistoric artifacts (Benthall 1997). Benthall continued archaeological monitoring during construction phases, as several features were uncovered during the removal of topsoil (Benthall 1997). Two test trenches were placed in the pool house construction zone and adjacent parking lot, which revealed 23 Archaic and Woodland features consisting of fire-cracked rock (FCR) and two Morrow Mountain II Archaic points

(Benthall 1997). Ten post molds were also uncovered, indicating evidence of a prehistoric structure (Benthall 1997). The construction of the Visitors Center began in 1984 where several prehistoric features were uncovered and Benthall continued archaeological monitoring during additional park renovations in 1988, 1994, and 1995 (Benthall 1984).

Benthall and Smith made important discoveries about both the indigenous populations and the early settlers that occupied the land. They also confirmed that much of the archaeological record had been destroyed or disturbed by agricultural plowing and modern construction (Smith 1980). Benthall delineated several stratigraphic zones, identifying layers of cultural components. Zone A consisted of the plowzone, ending at a depth of 28-32 cm BS (Benthall 1980). Zone B contained the prehistoric habitation floor and a Late Archaic Savannah River point (locally referred to as an Appalachian Stemmed point) (Benthall 1980). Early and Middle Woodland components were found within Zones A and B, while Archaic features and artifacts were found in Zone C at around 61-65 cm BS. Both archaeologists report that faunal preservation was very poor and found no evidence of burials during excavations (Benthall 1997; Smith 1980).

In 1985, an archaeological assessment of the local area was performed by the Tennessee Department of Transportation (TDOT) due to the construction of a bridge that crossed Big Limestone Creek and was adjacent to the park border (Shea 1985). The survey included an examination of the Collet Mill site (40GN34) and the nearby mid-nineteenth century Bayless house located across the creek, which was recommended as being potentially eligible for the National Historic Register (Shea 1985). TDOT personnel also located prehistoric site 40GN43, recording lithic debris found on a rise to the northwest of the bridge and east of the park (Shea 1985).

Methods

Field Methods

Geophysical Survey and Mapping. The geophysical survey was conducted using ground-penetrating radar (GPR) and magnetometry (Figure 2.7). The survey area included the open field of the historic homestead and the lower and adjacent narrow floodplain. The GPR survey was conducted using a GSSI SIR-4000 unit with a 400 MHz antenna, with the parameters set to the following: meters per mark = 1, ns time window = 50, sample/scan = 512, and scans/m = 100. GPR was collected using a cart in open areas and a survey wheel in grids containing obstructions such as trees and objects from the construction of the interpretive farmstead. The magnetometry survey was conducted with a Bartington Grad 601-2 Magnetic Gradiometer System containing two Grad -01-1000L sensors and a DL601 data logger (Bartington Instruments 2018). Due to time constraints and instrument malfunction, electromagnetic induction (EMI) was not performed, though it was included in the plans of the original grant proposal.

Figure 2.7. Geophysical Instruments used for this project included: (left) a GSSI SIR4000 GPR control unit with a 400 MHz antenna and survey wheel and (right) a Bartington Grad 601-2 dual fluxgate magnetic gradiometer.

Figure 2.8 shows the layout of the geophysical survey grids and datum in reference to park features such as the Visitors Center, pool house, adjacent parking lots, hiking trails and the Nolichucky River. A Real-Time Kinematic Global Navigation Satellite System (RTK GNSS) was employed to create 30 x 30 meter grids when possible, using a Spectra Precision SP80 survey kit with a positional accuracy level of +/- 5 cm. The handheld data collector used *SurveyPro* software to record and store locations of survey grids and archaeological units, features, and artifacts. The local datum was located near the southern boundary of the park and was designated with a northing and easting of 1000 x 1000 meters. The grid system consisted of 28 grids beginning at Big Limestone Creek and ending at the Visitors Center parking lot. Each grid was surveyed in a zig-zag pattern in a north-south direction, starting in the southwest corner. Grid rows A and B were located on the lower floodplain, while grid rows C, D, E, F, and G were on the first raised terrace. An unmanned aerial vehicle, or UAV, was flown over the survey area of interest within the park to create a high resolution digital orthophotograph, which was used as an additional high-resolution base map for our survey grid, geophysical data, and archaeological excavations.

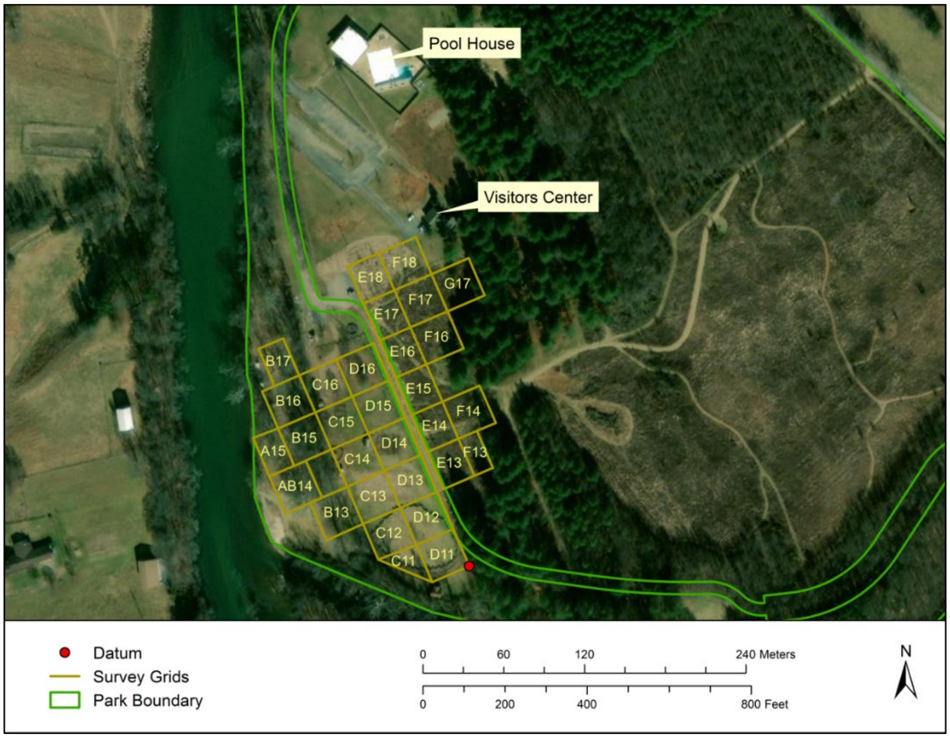

Figure 2.8. Survey area showing geophysical survey grids and datum, using ESRI satellite imagery as the base map.

Archaeological Testing. Test excavations were conducted in two areas: Area A.1 and Area A.2 (Figure 2.9), along with shovel test pits and auger tests (Figure 2.10) that were placed in locations within the boundary of 40GN12 as described by the 1980 archaeological report submitted by Samuel Smith. Areas names were kept in congruence with Areas A, B, C, and D as denoted by Smith during 1977 excavations. Locations within "Area A" were selected based on anomalies found within the geophysical data that had a high probability of containing prehistoric and/or historic features, while potential prehistoric burials were avoided. Excavation locations were also placed in low traffic zones to avoid disturbing both guest enjoyment of the park and the ongoing construction of the eighteenth-century farmstead. All units were excavated by shovel or trowel and placed at least two feet away from marked underground utility lines.

Figure 2.9. Excavation Areas A.1 and A.2 within the survey grids.

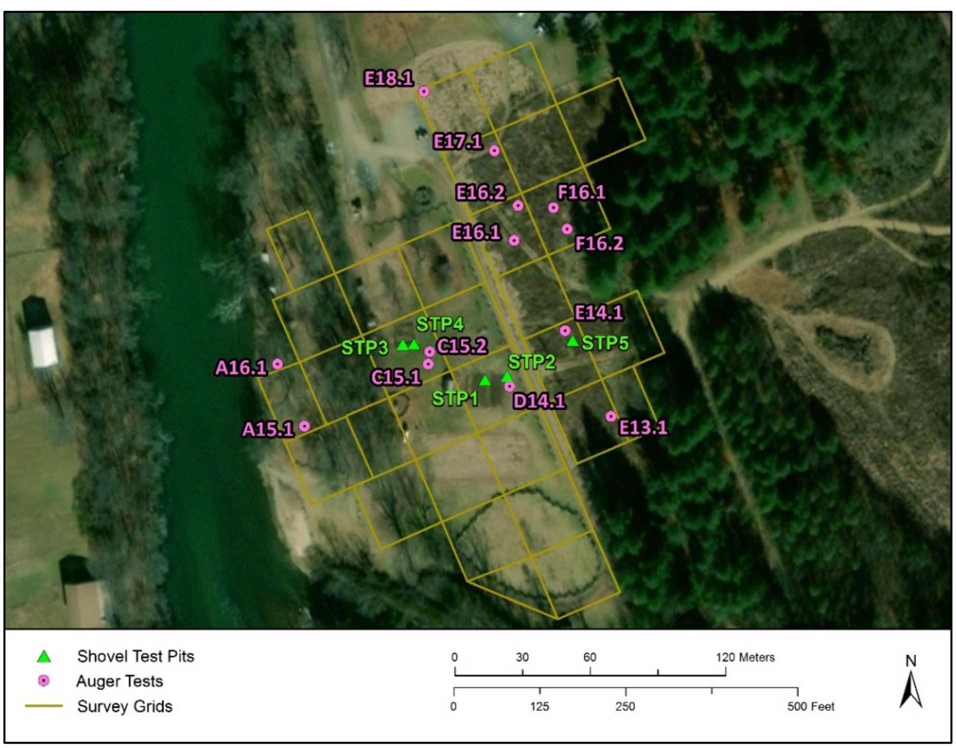

Figure 2.10. Locations of shovel test pits and auger tests.

Area A.1 (Figure 2.11) was located to the north and to the south of the corn field in grids C13 and C14. Five test units were opened here, with units 1 and 2 consisting of 2 x2 meter units and 3, 4, and 5 being 1 x 1 meter extensions of TU 2. Levels were excavated by shovel until the end of the plowzone was reached at an approximately 30 cm BS. All sediments from the plowzone were dry screened using 1/4 inch wire screens. Levels below the plowzone were troweled in natural stratigraphic levels until features were encountered. Non-feature sediments were dry screened, while sediments from within features were wet screened on site using 1/16 inch mesh. Artifacts were placed in bags, recorded by unit and level and separated by historic and then prehistoric subgroups: fauna, lithics, ceramics, and organic material. Diagnostic artifacts and organic material found in context were plotted by their northing, easting, and depth within units, measuring from the southwest corner. All features were mapped to scale using hand drawn planar view and/or profile view maps on graph paper. Photographs were taken continuously at the base of all excavated levels, along with photographs of all features and diagnostic artifacts found in situ. Other parts of Area A.1 were explored by five shovel test pits (STPs) in the newly added herb, vegetable, and pumpkin gardens.

Figure 2.11. Area A.1 test units. Test Unit 1 is located within Grid C14, while Test Units 2 through 5 are within Grid C13. The map is displayed using a digital orthophotograph created from UAV imagery. High voltage power lines that cross the park can be seen in the image.

Auger testing was performed on 13 anomalies of interest found within the GPR data along the floodplain and first terrace. Based on the auger results, new test units were plotted within Area A.2 (Figure 2.12) and were located in an open field directly north of the newly constructed eighteenth-century replica barn and corral. Test unit 6 was a 1 x 1 m unit and was excavated to 45 cm BS. Test units 8, 9, and 10 were not excavated due to time constraints. The remainder of the archaeological excavation was focused on Test Unit 7, expanding to the north and east for a total of 43 1 x 1 m units. Expansion to the south was blocked by the fence of an animal enclosure. The maximum extent of the western side was restricted by an electrical line that was seen in the geophysical data and that had been marked and flagged by the utility contract locator. Units here were also excavated by shovel until the end of the plowzone was reached at approximately 30 cm BS, after which units were excavated by trowel. Features were encountered directly below the plow zone and excavation levels were then based on individual assessments of each unit. Ending depth was ~ 40 cm BS in units, while pit features were excavated to end depths that ranged from 36 to 73 cm BS.

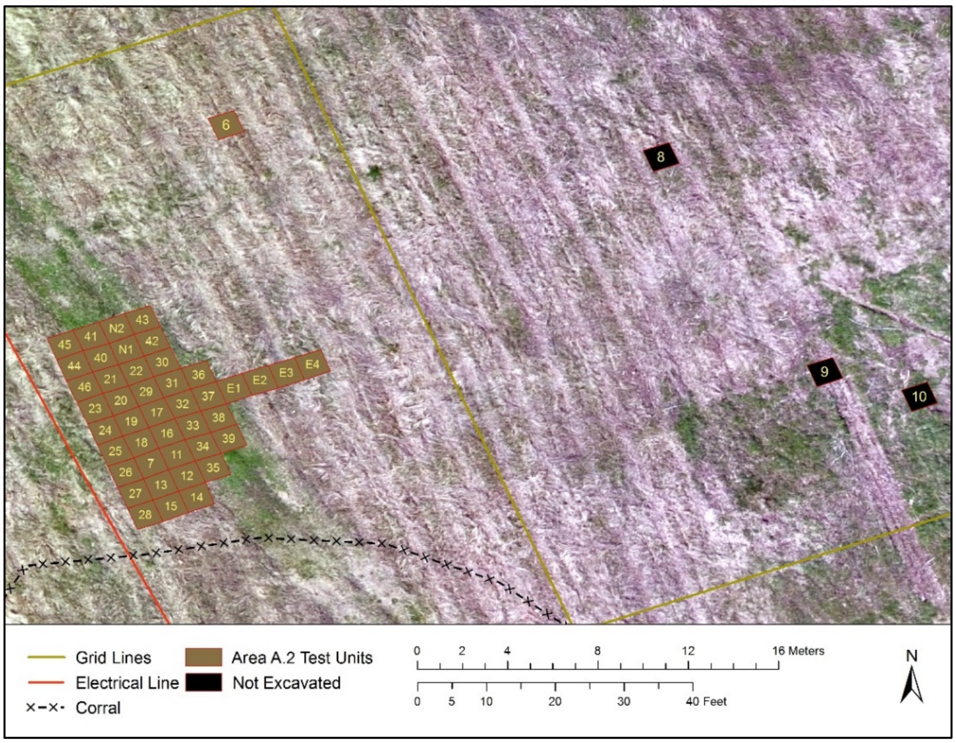

Figure 2.12. Area A.2 test units. All excavated units are shown in brown and were located in Grid E16. Due to time constraints TU 8, 9, and 10 not excavated. The map is displayed using the UAV digital orthophotograph basemap.

In Area A.2, all sediments recovered from below the plowzone were wet screened on site. As in Area A.1, artifacts were recorded by provenience and bagged and separated by type and cultural components. Diagnostic artifacts and organic material found in situ were plotted within the unit by depth and location from the southwest corner and then photographed. Features were photographed and recorded with hand drawn profile and/or planar view maps. All test units were photographed at all end levels and UAV photos were taken of the 43 expanded units.

Excavations were conducted under the supervision of Dr. Jay Franklin. A total of 52 units were excavated, along with 5 shovel test pits and 13 auger tests during the archaeological testing of the project. Archeological field equipment was supplied by the ETSU Archaeology program and was stored on site in a locked storage facility provided by David Crockett Birthplace State Park. The park also provided two wet screening stations at cold weather pumps that were installed for the purpose of maintaining the historic homestead. Additional fieldwork support was provided by volunteers and state park staff, under the supervision of park manager Jackie Fischer. Test Units 1 and 6 were backfilled with shovels, while the rest were filled in by park rangers using heavy machinery. A plastic barrier was placed in all excavated test units following Test Unit 7.

Laboratory Methods

Geophysical Data Processing. The RTK data were digitally mapped using *ESRI ArcMap* 10.6.1. The GPR data were processed using *GPR Slice* 7.0 by performing a background removal and a high and low-pass frequency filter for each radargram, using the first break for time zero. The GPR data were sliced in depth intervals based on average velocities of each grid for a total of 22 depth slices. Slices were examined in conjunction with radargrams for anomalies that had the best potential of being archaeological features. The slices were reprocessed using an overall average velocity of 0.78 m/ns and gridded within *Surfer* software. Final processing of both GPR slices and magnetometry data was performed within *ArchaeoFusion* software, which included the removal of striping and spikes, interpolation, and smoothing. The grids from each GPR slice were combined into seamless mosaics and spatially referenced using the local datum coordinates and directional azimuth, allowing for accurate mapping in *ArcMap*. UAV images were processed using *Agisoft PhotoScan Professional* software to create a digital orthophotograph basemap of the survey area, along with a 3D model of the final excavation area.

Artifact Analysis. Prehistoric artifact analysis was conducted with the aid of local expert S.D. Dean for lithic analysis. Historic analysis was assisted by archaeologist Alan Longmire, Tennessee Department of Transportation. All artifacts were washed and seriated into historic or prehistoric categories based on regional typologies. Historic artifacts were then separated by subcategories that included glass, metal, and other. The majority of the artifacts were prehistoric and were separated by ceramics, lithics, fauna, organic, raw materials, and other. Materials found in situ (below the plowzone and within test units) were catalogued by depth and/or location within the unit. Artifacts found within the plowzone and by General Surface Collections (GSC) were catalogued separately by unit.

A 1/2 inch screen was used to delineate prehistoric ceramics, with the analysis performed only on sherds that were greater than 1/2 inches. Prehistoric ceramics were seriated by rim sherds, body sherds, and other, then paste/temper and surface treatment. Temper types were determined by particle size and material as follows: fine sand (< 0.5 mm), coarse sand (0.5-1.0 mm), grit (1.0-3.0 mm), quartz (> 3.0 mm), limestone, mica, and shell. Cultural components and prehistoric ceramic typologies were determined by paste/temper, surface treatment and context with other diagnostic artifacts, features, and radiocarbon dates.

Artifact analysis for this project is ongoing. This report includes the results of a preliminary analysis of artifacts found in situ. The preliminary analysis of diagnostic artifacts found outside of context, only includes projectile point knives (PPK), raw materials and historic artifacts that could be identified within a specific time frame. Additional material will be analyzed at a later date. Eight Accelerator Mass Spectrometry (AMS) radiocarbon dates were obtained from wood, rivercane, and hickory nut charcoal found within features from both Area A.1 and Area A.2. All materials from previous state excavations by Samuel Smith and Joseph Benthall and recent ETSU archaeological investigations are currently being stored at the ETSU Valleybrook Archaeological Education and Curation Center.

Results

Geophysics

Magnetometry. Magnetometry is a passive method that is used in archaeology to identify buried features or objects having magnetic properties such as metal artifacts (Schmidt 2007; Witten 2006). Modern utility lines, historic debris, and possible prehistoric features can be seen within the magnetometry mosaic shown in Figure 2.13. The magnetometry readings were highly impacted by modern pipes, metal objects, electrical lines, and an electrical tower located in Grid E14 (Figure 2.14). This masked some of the more subtle prehistoric features in those areas. However, objects that needed to be avoided during excavations, such as utility lines, could clearly be seen, and this information was shared with the park staff. One area of interest was identified in Grid C14 where a number of dipolar anomalies were clustered in a rectangular shape, suggesting a historic structure. The area was investigated by excavation and metal detecting, uncovering a scattering of modern historic debris, including 14 machine cut nails. No evidence of a historic structure was seen in this area.

Figure 2.13. Mosaic of magnetometry data, showing high values in black and low values in white.

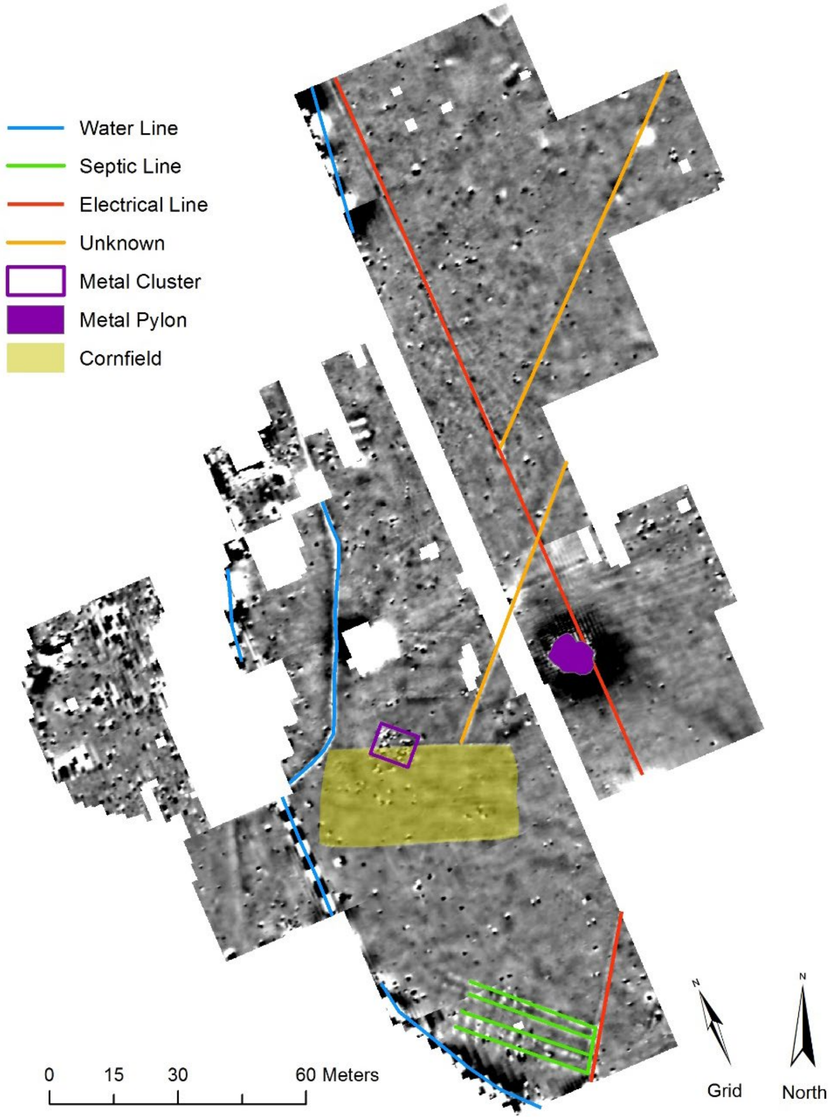

Figure 2.14. Mosaic of magnetometry data showing high values in black and low values in white. Modern, non-archaeological features are highlighted.

Ground Penetrating Radar. Ground-penetrating radar (GPR) is an active technique that emits electromagnetic pulses in the form of radio waves and records reflections of any objects or discontinuities, while also detecting voids and disturbance (Witten 2006). GPR data can help determine an anomaly's size and depth by examining the strength of the reflection and the time it takes the unit to receive a reflection (Witten 2006). The results of the GPR survey showed many anomalies of varying sizes and depth that had a high potential to be prehistoric and possibly historic features. The GPR data are very rich and best viewed in 3D and on a computer screen. Figure 2.15 shows an example of one anomaly selected for testing, but there are many more throughout the dataset. The interpretation of the GPR data was the basis of selecting auger test locations and all test excavations, with the exception of Test Unit 1. The GPR data were reexamined after archaeological testing due to new information that led to additional understanding of anomalies and depth calculations. This allowed more features to be identified in the data. Possible remnants of an old road are seen on the bottom-right GPR grids (E13 and F13) and visible in Figure 2.16, which shows the location of the Area A.2 test units.

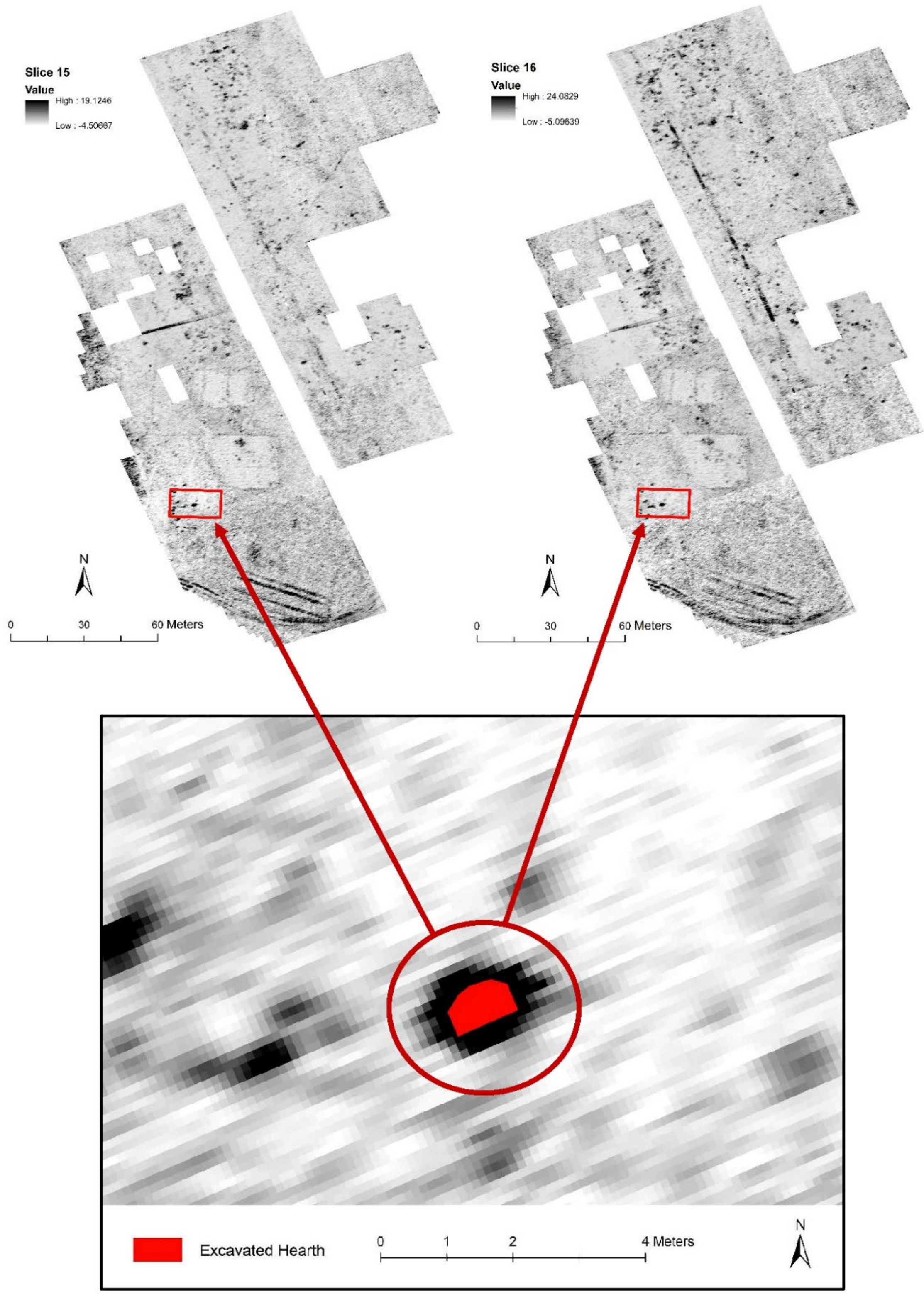

Figure 2.15. GPR Mosaic of Depth Slices with focus on Area A.1. Left: 125-130 cm BS. Right: 115-120 cm BS. Bottom image shows an excavated Archaic Hearth.

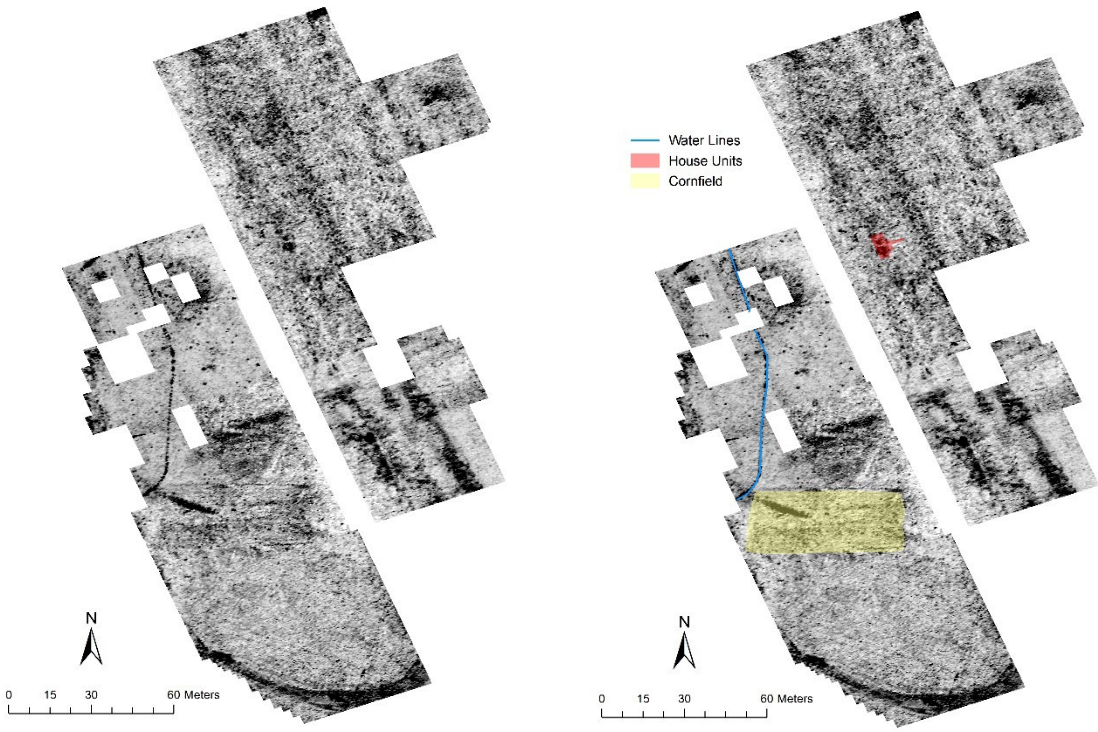

Figure 2.16. Ground Penetrating Radar depth slice, 35-40 cm BS. House units indicate excavation units that uncovered a prehistoric Late Mississippian/Protohistoric structure.

A detailed example of the GPR data is given in Figure 2.17. The anomalies in the GPR slice on the left were excavated in Test Units 2, 3, and 4, where two remnant hearths were found at 50 and 55 cm BS, along with compact sediment and charcoal mottling, all of which indicate human disturbance at this level. The large and deeper anomaly in the GPR slice was revealed to be a large Archaic hearth with a diameter > 1 m and a depth of 102 cm BS in Test Unit 5. Another detailed example of GPR data is shown in Figure 2.18. A hyperbolic reflection in the upper-right corner of this depth slice turned out to be a large, unworked stone and scattered FCR at 32 cm BS in Test Unit 6. The anomaly in the center of the slice is visible in the lower radargram as a strong planar reflection. This was excavated extensively and was found to be the remnants of a Protohistoric Native American structure. The reflection of a utility line is also visible, as are multiple deep hyperbolic reflections that could possibly be Native American burials.

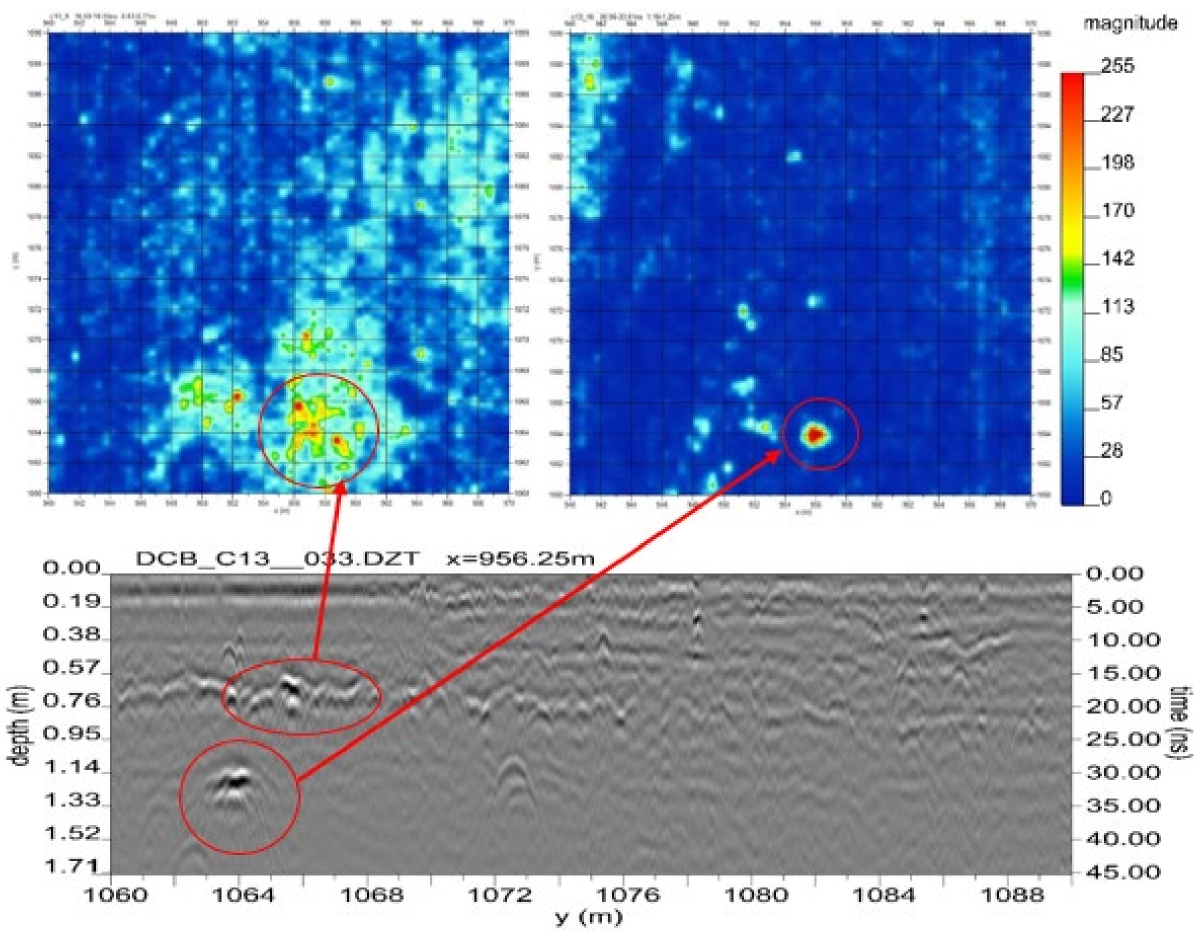

Figure 2.17. GPR slices and one radargram from Grid C13. Two remnant hearths along with compact sediment and charcoal mottling were found where the upper (shallow) reflections are highlighted. The deeper strong reflection was found to be a large Archaic hearth.

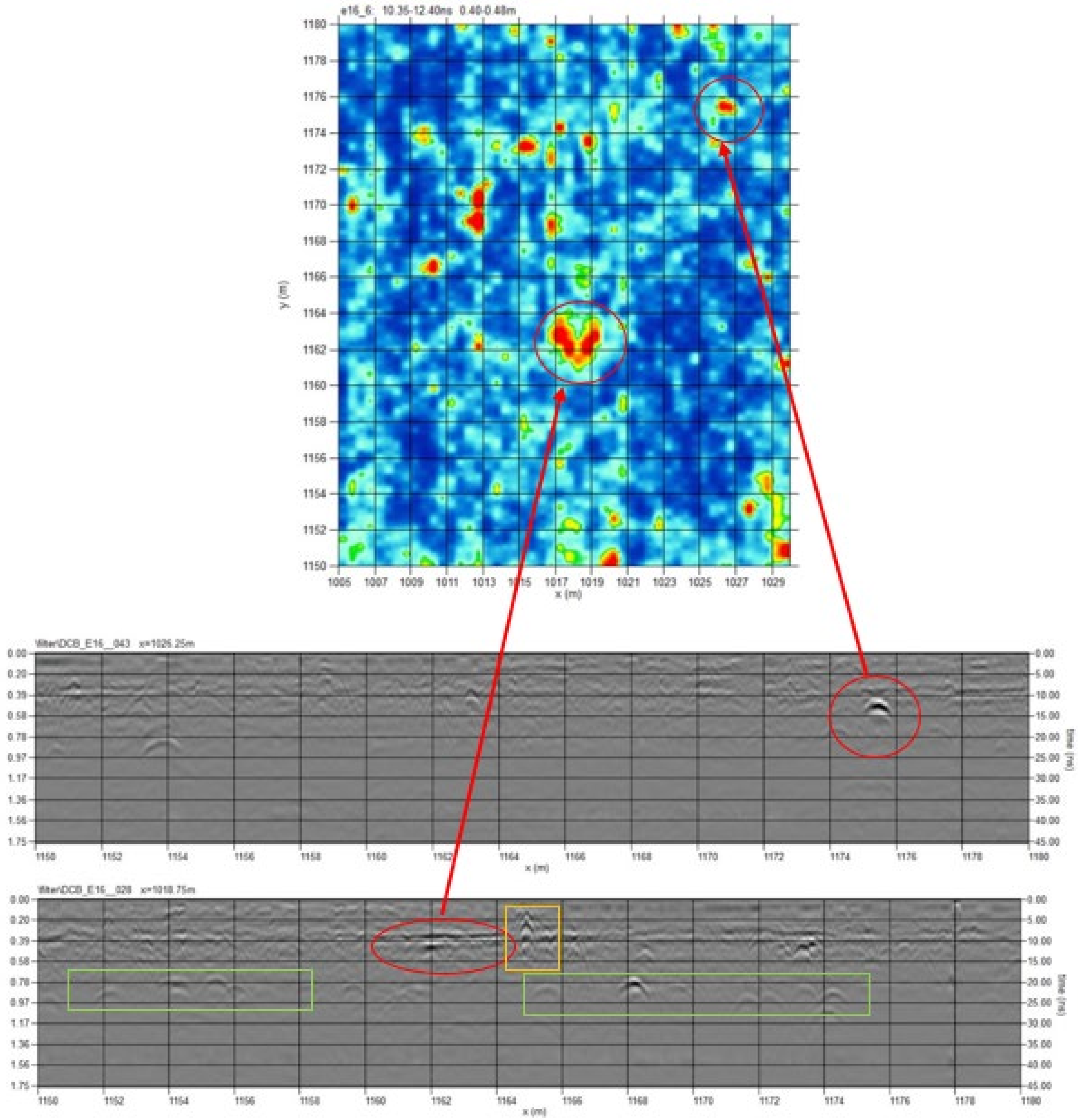

Figure 2.18. GPR slice and two radargrams from Grid E13. The hyperbolic reflection seen in the top radargram was a large unworked stone found along with scattered FCR at 32 cm BS in Test Unit 6. The anomaly circled in red in the bottom radargram shows a planar reflection that was revealed to be the remnants of a Protohistoric Native American structure. A utility line is highlighted in orange, and potential prehistoric burials are indicated in green.

Archaeological Investigations

A brief discussion of the preliminary results of the archaeological excavations will be presented in this section. Artifact analysis for the project is ongoing, however, diagnostic artifacts and AMS radiocarbon dates have revealed several periods of indigenous occupation. During the investigation of Area A.1, five 30 x 30 meter shovel test pits were performed in the vegetable garden (STP 1 and 2), herb garden (STP 3 and 4), and pumpkin garden (STP 5). Very few artifacts were recovered, however all STPs contained lithic debris. Prehistoric pottery sherds were found in STPs 1, 2, 3, and 4, along with a small side scraper from STP 3. A nail was found in STP 1 and a green soda bottle sherd was recovered from STP 5. The most important artifact in the shovel test pits was the only diagnostic Pisgah sherd found during the project, which was a grit-tempered sherd with a chevron-incised, collared rim, recovered from STP 2. The results of the auger testing that was conducted after the completion of Area A.1 excavations are presented in Table 2.3. Figure 2.19 shows excavation units in Area A.1, highlighting features found in Test Units 2, 3, 4, and 5 and metal artifacts found in Test Unit 1 by excavation and metal detection.

Table 2.3. Summary of Auger Tests

Test	Depth BS	Sediment Description (Munsell 10 YR)	Cultural Material	Notes
A15.1	0-30 cm	dark yellowish brown sandy loam		
	30-50 cm	brown sand		
	50-90 cm	dark yellowish brown sandy loam		
	90-140	brown sand	charcoal, ash	(110-120 cm BS)
C15.1	0-80 cm	dark brown/dark yellowish brown sandy loam		large rock obstruction
C15.2	0-20 cm	dark brown sandy loam	pottery	
	0-40 cm	dark brown sandy loam	FCR	
D14.1	38-40 cm	dark brown sandy loam	FCR	
E13.1	0-70 cm	dark brown sandy loam		
	70-110 cm	dark yellowish brown sandy loam		
E14.1	0-80 cm	very dark grayish brown sandy loam		
	80-105 cm	dark yellowish brown sandy loam	possible FCR	possible hearth
E16.1	0-25 cm	dark brown sandy loam		
	25-30 cm	dark brown sandy loam		
	30-40 cm	black mottling and charcoal	charcoal	excavated (TU7)
	40-50 cm	dark brown sandy loam		
E16.2	0-17 cm	dark brown sandy loam		
	17-37 cm	dark brown sandy loam	pottery, flake, FCR	excavated (TU6)
	42 cm	dark brown sandy loam		large rock obstruction
E17.1	0-30 cm	dark brown sandy loam		
	30-40 cm	dark brown sandy loam	pottery, FCR	
	40-60 cm	dark brown sandy loam		
	60-68 cm	dark yellowish brown sandy loam		
	60-142 cm	dark yellowish brown sandy loam		very soft sediment
E18.1	0-30 cm	dark brown sandy loam	FCR at 30 cm	possible hearth
F16.1	0-36 cm	dark brown sandy loam	FCR at 36 cm	
F16.2	0-60 cm	dark brown sandy loam	pottery at 60 cm	
	60-90 cm	dark yellowish brown sandy loam		

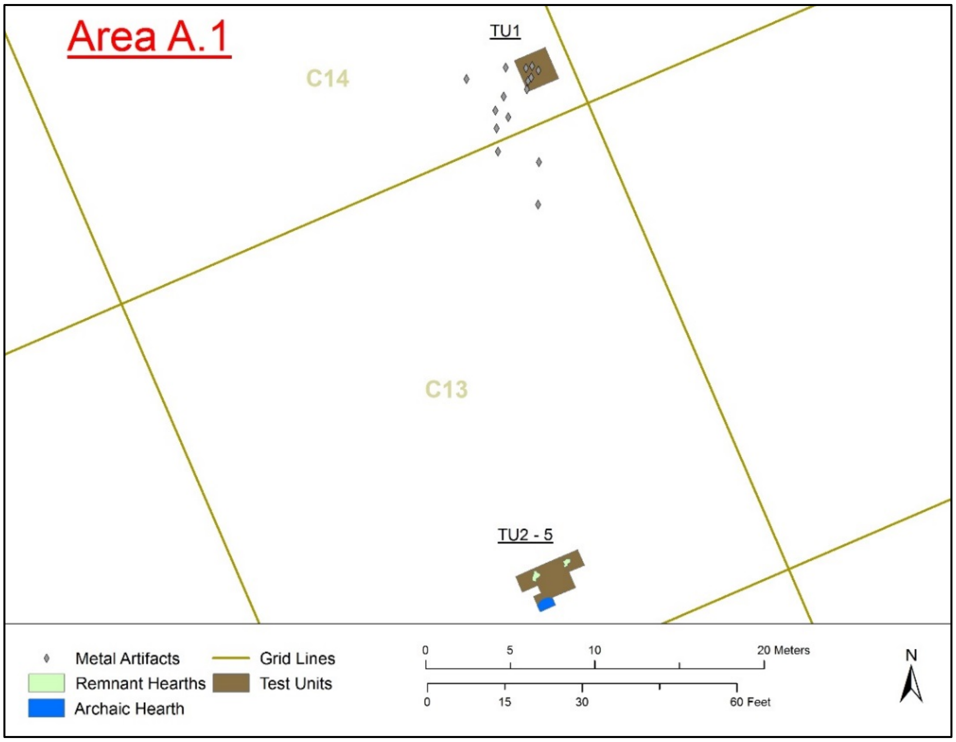

Figure 2.19. Excavation Area A.1, showing features found in Test Units 2, 3, 4, and 5, along with metal artifacts found in Test Unit 1 excavations and by metal detecting.

Archaeological Features

Metal Clustering. Figure 2.20 shows the cluster of dipolar anomalies in the magnetometry data in Area A.1 that were excavated and tested with a metal detector survey. No evidence of a structure was found, however, fourteen twentieth century machine-cut nails were recovered at a depth of 8-15 cm BS. The survey area contained a large amount of modern metallic debris including aluminum cans and bottle tops that were found in the plowzone of all test areas.

Figure 2.20. Dipolar anomaly cluster test. The magnetometry image (left) shows a cluster of magnetic anomalies found in the magnetometry data whose shape resembled the outline of a historic structure. The red square represents the location of Test Unit 1 seen in the photo on the right.

Remnant Hearths. Several hearths were found in the GPR data and tested with excavations. Test Units 2, 3, and 4 revealed remnant hearths found at 50 -55 cm BS (Figure 2.21). A dark band of sediment and charcoal mottling was seen at this layer throughout the units. No diagnostic artifacts were discovered at this level. Test Unit 5 was extended from the southwest corner of Test Unit 2 to investigate the large circular anomaly found in the GPR data. Photographs of this feature are shown in Figure 2.22. The Archaic hearth consisted of FCR, and the diameter was estimated to be greater than one meter based on the GPR data. The rocks extend to the edges of the 1 x 1 m unit, but are denser toward the center. Beneath this hearth was a sterile sediment that was excavated down to 120 cm BS and augered to 2 m BS. The cultural layers in the photo (Figure 2.22) show dark bands of sediment centered around 50 cm BS and 100 cm BS.

Figure 2.21. Test Unit 2 is shown with Test Unit 3 (right) and Test Unit 4 (left), containing remnant hearths found at 50 -55 cm BS. A dark band of sediment and charcoal mottling is visible throughout the units.

Figure 2.22. Archaic hearth encountered at 102 cm BS. FCR was densely distributed across the test unit and into the walls. The photo of the profile view (right) shows Test Unit 5 at 120 cm BS where a layer of sterile sandy sediment was reached.

Figure 2.23 shows the location of units excavated within Area A.2. Test Unit 6 was excavated to 45 cm BS and was found to contain a large unworked stone and FCR (Figure 2.24, left). Test Unit 7 was placed to explore the large planar reflection shown in Figure 2.18. Prehistoric pottery, lithics, and burnt daube, wood, and rivercane were encountered at 20 cm BS

(Figure 2.24, right). These deposits were richer and denser than found in other units. This unit was expanded and became the focus of the excavations, eventually leading to the discovery of a partially burned Late Mississippian/Protohistoric structure and features found at approximately 30 cm BS. Woodland features and artifacts were found directly below and outside of the floor of the structure at a depth range of 31-73 cm BS.

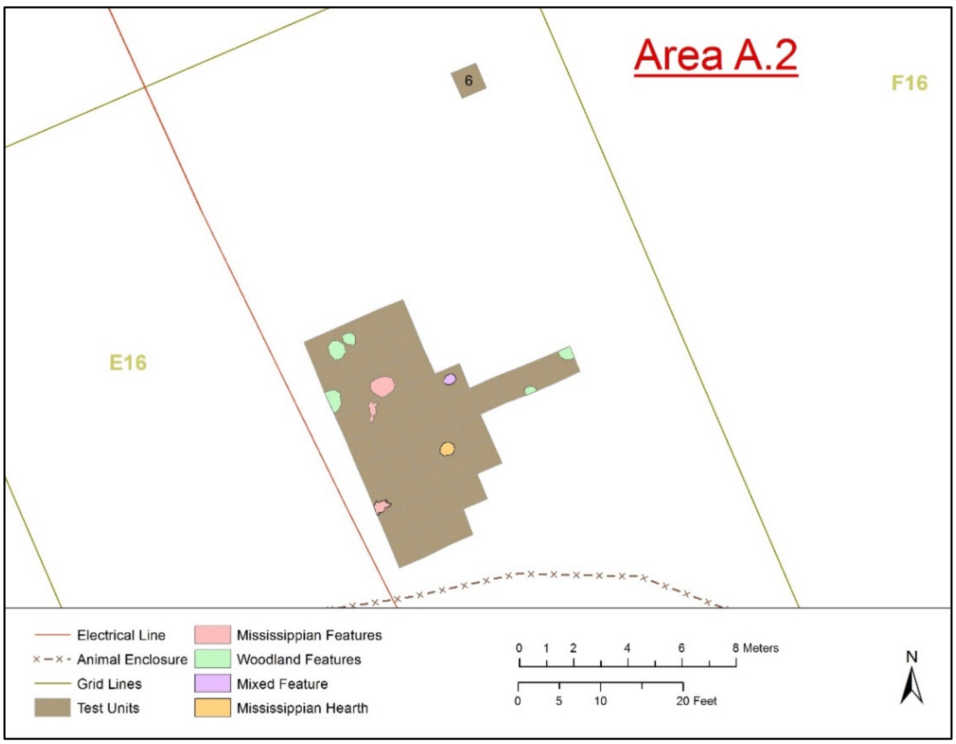

Figure 2.23. Excavation Area A.2 Test Units, showing the location of the remnant Mississippian/Protohistoric structure and features found at about 30 cm BS, along with Woodland pits that were directly below and outside of the house floor.

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Figure 2.24. Photographs of Test Units 6 and 7. Test Unit 6 (left) contained a large unworked stone and FCR. Test Unit 7 (right) contained rich cultural fill at 30 cm BS, leading to expanded excavations and the discovery of a partially burned Late Mississippian/Protohistoric Native American structure.

Mississippian Features and Structure. Several Mississippian vessel fragments were found on the house floor directly below the plowzone at a depth of 31 cm BS (Figure 2.25). The Mississippian house floor contained burnt roof fall and daub and had a central hearth (Figure 2.26). The hearth was a subterranean, clay-lined basin that had a depth of 30-48 cm BS. The image on the right in Figure 2.26 shows a plow scar that cut through part of the hearth. Artifacts, features, and the structure itself were heavily disturbed by over 200 years of farming and modern construction. No definitive evidence of walls or post holes were identified, making the exact dimensions of the house difficult to define.

Figure 2.25. Mississippian vessel fragments found on the house floor directly below the plowzone at a depth of ~ 31 cm BS.

Figure 2.26. A UAV photo (left) of the Mississippian house floor shows burnt roof fall and daub and the location of the Mississippian hearth (right). The subterranean, clay-basin hearth was located at 30 cm BS, with an ending depth level of 48 cm BS. A plow scar is clearly seen on the left side of the hearth. No definitive evidence of walls or post holes was identified.

Woodland Features. As units were expanded north and east of the structure's central hearth, several Woodland pits were discovered. These pits may define the outside edges of the domestic structure. Feature 13 (Figure 2.27, left) may have been a reused pit and contained Middle Woodland pottery and one Middle Woodland PPK. Similar artifacts were found in Feature 8, which was another Woodland pit seen in the image on right in Figure 2.27.

Figure 2.27. Photographs of Features 7 and 13. Feature 13 (left) contained a Middle Woodland PPK and Middle Woodland pottery. Middle Woodland artifacts were also found in Feature 8 (right).

Artifact Analysis

Prehistoric Ceramics. A mixture of Woodland and Mississippian pottery sherds was found within the plowzone. Farming and construction in the study area seems to have heavily disturbed these components. Intact layers directly beneath the plowzone also contain a mixture of Woodland and Mississippian pottery and features. A brief summary of the ceramic analysis (Tables 2.4-2.12) is presented here for the broken vessels found on the Mississippian house floor and ceramics found within features. Regional typologies are not discussed, however, general cultural components are listed, when possible. Exemplary crossmended pot breaks from features are shown in Figure 2.28. These include vessels from Middle Woodland and Late Mississippian.

Figure 2.28. Photographs of crossmended pot breaks. Left: Middle Woodland limestone/quartz tempered, Rectangular Check Stamped conical vessel. Center: Late Mississippian sand/grit tempered, burnished cazuela bowl with Lamar Incising. Right: Late Mississippian sand tempered Lamar Incised jar with a notched rim.

Table 2.4. Summary of the Ceramic Analysis of Crossmended Pot Breaks

Pot Break	Body Sherds	Rim Sherds	Provenience	Depth BS	Temper	Surface Treatments	Decoration	Cultural Component
PB1	1	2	TU19 Floor	31 cm	Shell	Plain	Filleted Notched Applique	Mississippian
PB2	9	0	TU20 Feature 6	31 cm	Shell	Plain		Mississippian
PB3	21	2	TU24 Floor	31 cm	Shell	Plain/Burnished		Mississippian
PB4	5	1	TU24 Floor	31 cm	Sand	Plain/Burnished Incised	Notched Rim	Mississippian
PB5	5	3	TU24 Floor	31 cm	Grit	Plain/Burnished Incised		Mississippian
PB6a	52	3	TU30 Floor	31 cm	Limestone/ Quartz	Check Stamped		Woodland
PB6b	5	2	TU30 Floor	31 cm	Grit/ Quartz	Check Stamped		Woodland
PB7	9	4	TU17 Floor	33 cm	Grit	Plain/Burnished Incised		Mississippian
PB8	0	3	TU12 Floor	35 cm	Sand/ Grit	Plain/Burnished		Mississippian

Table 2.5. Feature 5: Prehistoric Ceramics from Pit (32-49 cm BS)

Temper	Surface Treatment	Decoration	Body	Rim	Cultural Component
Limestone	Indeterminate		3		Woodland
Coarse Sand	Plain/Burnished		3		Mississippian
Grit	Plain	Rivercane Notched		1	Mississippian
Grit	Plain/Burnished	Strap Handle	1		Mississippian
Grit	Incised		3	1	Mississippian
Grit	Incised	Finger Pinched		1	Mississippian
Crushed Quartz	Plain/Burnished		2		Mississippian
Shell	Plain/Burnished		28	1	Mississippian
Shell	Plain/Burnished	Finger Pinched/Folded		3	Mississippian
Shell	Plain/Burnished	Rivercane Notched		2	Mississippian
Shell/Coarse Sand	Cord Marked		1		Mississippian
Shell/Coarse Sand	Plain/Burnished		12		Mississippian
Shell/Grit	Plain/Burnished		9		Mississippian

Table 2.6. Feature 6: Prehistoric Ceramics from House Floor Scatter (32-33 cm BS)

Temper	Surface Treatment	Decoration	Body	Rim	Cultural Component
Limestone	Cord Marked		1		Woodland
Shell	Plain/Burnished		9		Mississippian

Table 2.7. Feature 8: Prehistoric Ceramics from Pit (34-45 cm BS)

Temper	Surface Treatment	Decoration	Body	Rim	Cultural Component
Crushed Quartz/Sand	Fabric Marked		7		Woodland

Table 2.8. Feature 9: Prehistoric Ceramics from Pit (34-46 cm BS)

Temper	Surface Treatment	Decoration	Body	Rim	Cultural Component
Limestone	Indeterminate		3		Woodland
Limestone	Cord Marked		1		Woodland
Limestone	Check Stamped		6		Woodland

Table 2.9. Feature 10: Prehistoric Ceramics from Pit (31-37 cm BS)

Temper	Surface Treatment	Decoration	Body	Rim	Cultural Component
Sand	Indeterminate		1		Indeterminate
Grit	Plain		1		Woodland
Crushed Quartz	Simple Stamped		2		Woodland
Shell/Sand	Cord Marked		13	2	Mississippian

Table 2.10. Feature 11: Prehistoric Ceramics from Pit (32-63 cm BS)

Temper	Surface Treatment	Decoration	Body	Rim	Cultural Component
Crushed Quartz	Indeterminate		2		Indeterminate
Shell/Sand	Cord Marked		1		Mississippian

Table 2.11. Feature 12: Prehistoric Ceramics from Pit (33-48 cm BS)

Temper	Surface Treatment	Decoration	Body	Rim	Cultural Component
Limestone/Grit	Indeterminate		1		Woodland
Limestone/Grit	Simple Stamped		1		Woodland
Coarse Sand	Check Stamped		2		Woodland

Table 2.12. Feature 13: Prehistoric Ceramics from Pit (35-73 cm BS)

Temper	Surface Treatment	Decoration	Body	Rim	Cultural Component
Limestone	Check Stamped		1		Woodland
Limestone/Sand	Indeterminate		5		Woodland
Limestone/Sand	Cord Marked		5	1	Woodland
Limestone/Sand	Check Stamped		6		Woodland
Sand	Simple Stamped		1		Woodland
Grit	Plain		2		Woodland
Grit	Check Stamped		3		Woodland
Crushed Quartz	Cord Marked		2		Woodland

Lithics. Lithic material was found at all levels of investigation. The Archaic hearth found at 102 cm BS in Test Unit 5 contained quartzite and chert lithic flakes. Lithic debris was found in the sediment surrounding the remnant hearths in Test Units 2, 3, and 4. Raw materials for various lithic materials included quartzite, quartz, rhyolite, Knox chert, Flint Ridge chert, slate, and chlorite schist. One Madison point was found in context in Area A.1, and 30 PPKs were found in Area A.2. Only five of these were definitively located from below the plowzone due the disturbed nature of artifacts at this depth. Table 2.13 shows the complete list of PPKs, with examples shown in Figure 2.29. Numerous chipped stone tools were found including side scrapers and end scrapers, along with large worked stone such as pitted cobbles. One interesting cylindrical object found in the plowzone was made from chlorite schist and was possibly used as a steatite bowl plug during the Archaic Period (size: 20 x 14 mm) (DeJarnette et al. 1973).

Table 2.13. Projectile Point/Knives

PPK Type	Count	Provenience	Feature	Depth Cm BS	Raw Material	Cultural Component
Bradley Spike	1	plowzone			Knox Chert	Late Archaic - Early Woodland
Snapp Bridge	1	TU 11		35	Knox Chert	Early Woodland
Camp Creek	1	TU 19		32	Knox Chert	Early - Middle Woodland
Bakers Creek	1	plowzone			Knox Chert	Middle Woodland
Lowe Expanding Stem	1	TU 41/45	12	33-48	Flint Ridge Flint	Middle Woodland
Stemmed (unfinished)	1	TU 21		33	Knox Chert	Indeterminate
Swan Lake	5	plowzone			Knox Chert	Middle Woodland
Swan Lake	1	TU46	13	35-73	Knox Chert	Middle Woodland
Jack's Reef Pentagonal	1	plowzone			Knox Chert	Middle-Late Woodland
Nolichucky	1	plowzone			Knox Chalcedony	Late Woodland
Madison	17	plowzone			Knox Chert	Late Woodland - Mississippian
Madison	1	TU 3		33	Knox Chalcedony	Late Woodland - Mississippian
Total	31					

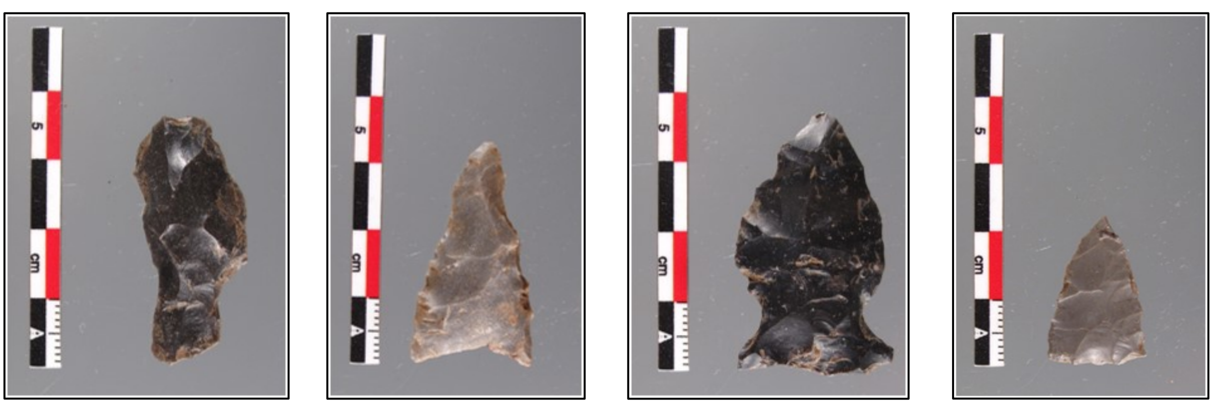

Figure 2.29. PPKs listed left to right: Bradley Spike, Camp Creek, Swan Lake, and Madison.

Other Cultural Material. As described in previous archaeological reports, the faunal preservation at the site was poor. However, diagnostic faunal remains recovered in features and by wet screening included white-tailed deer, opossum, turtle, snake, fish, and fresh-water mussel shell. Feature 5 was a Mississippian pit found in the house floor that contained fish vertebrae, an opossum jaw and teeth, and a projectile point made from a deer antler. A deer antler awl was found within Feature 10. Organic material was recovered from the Mississippian house floor that included burnt wood, rivercane, walnut, hickory nut, and maize (Figure 2.30).

Figure 2.30. Organic Material: Rivercane (left), Hickory Nut (center), and Maize (right).

Trade Items. Artifacts were recovered that indicate the prehistoric occupants of the park were part of a vast trade network that spanned the Eastern United States. Feature 12 contained mica sheets, a possible bladelet, and a Flint Ridge Flint point (Figure 2.31, left) and flake. Flint Ridge Flint (chert) is only found in Ohio and was quarried and traded by the Hopewell Native Americans during the Middle Woodland Period. Bladelets are small micro tools that were crafted and traded by the Hopewell people and were also recovered by testing conducted by Joseph Benthall (Benthall 1997). Mica is a local raw material that was valued by the Hopewell (Kimball et al. 2010). These items have also been recovered at three similar Middle Woodland sites in the region: Big Creek, Ice House Bottom, and the Garden Creek site (Chapman 1973; Franklin, Yon, Dennison et al. 2017; Kimball et al. 2010). A further lithic analysis of potential micro tools is still needed at this time.

Three European oyster-white glass trade beads (Figure 2.31, right) were recovered during the wet screening of Test Unit 24 sediment from the Mississippian structure. There is evidence that early Spanish explorers may have traveled through the Middle Nolichucky Valley (Sampeck et al. 2015). However, these beads could have been indirectly obtained from other Native American groups that had direct contact with the English colonies of Jamestown and Charleston in the seventeenth and eighteenth centuries. This is corroborated by the Mississippian ceramic styles and the AMS radiocarbon dates (refer to Table 2.14) retrieved from the house context that place the Mississippian occupancy to this time range.

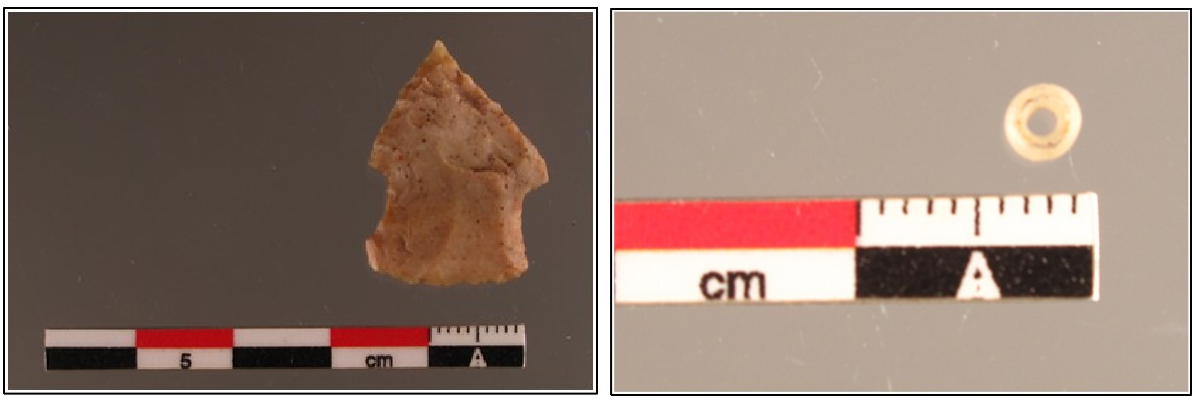

Figure 2.31. Trade items: (left) A Middle Woodland Expanding Stem point made from non-local Flint Ridge Flint that is found in Ohio and was traded by the Hopewell Native Americans; (right): An oyster-white European glass trade bead that was found in context of the Mississippian house floor.

Historic. Very little historic material of note was recovered and all came from the plowzone. Metal debris was seen throughout the park in the magnetometry data. Metal detecting was conducted in a 10 x 10 meter grid over the adjacent metal clustering to the southwest of Test Unit 1, which yielded six additional machine cut nails (Figure 2.32, left), two aluminum pop tops, and horse-drawn machine parts (Figure 2.32, right) that were found together at a depth of 30 cm and date to AD 1870-1920 (Alan Longmire, personal communication). Glass included modern soda bottles, window glass, and solarized glass (1890 to 1917) (Lockhart 2006). Other artifacts included a golf ball, a glass “amethyst” ring, and a button containing a railroad emblem that dates from the late 1800s to early 1900s. No historic ceramics were recovered during the project.

Figure 2.32. Metal artifacts: photo on left shows a machine cut nail, while the photo on the right shows two parts of a horse-drawn machine made of iron.

Radiocarbon Dates. Eight samples from hickory nut, rivercane, and wood charcoal were selected for AMS radiocarbon dating (Table 2.14). All samples were found in situ from features ranging from a depth of 30 cm BS to 120 cm BS. The radiocarbon dates indicate that the area of the park was inhabited by indigenous peoples for thousands of years, spanning back to at least the Early Archaic Period, as the AMS radiocarbon date from the Feature 3 remnant hearth suggests. The Woodland AMS dates fall within the range Middle to Late Woodland periods, matching the ceramic and lithic artifacts from feature 8, 10, and 13. Radiocarbon dates from the Mississippian component, along with diagnostic Mississippian ceramics, lithics, and European glass beads indicate that the partially burned structure was occupied at some time between the late 1500s and the early 1700s. All radiocarbon samples were processed by Direct AMS laboratories and calibrated at 2σ with *OxCal* 4.3 online software (Ramsey 2009), using the IntCal 13 curve for the Northern Hemisphere (Reimer et al. 2013).

Table 2.14. Summary of Calibrated AMS Radiocarbon Dates (σ = 2, p = 95.4 %)

Sample ID	Charcoal	Test Unit	Feature	Depth cm BS	Uncalibrated (σ = 1)	Calibrated Range (σ = 2)
D-AMS 033192	Wood	5	3	102-120	8083 BP +/- 40	7019-6832 cal BC
D-AMS 033776	Wood	36	10	30-36	1646 BP +/- 31	cal AD 272-534
D-AMS 033773	Wood	46	13	35-73	1568 BP +/- 26	cal AD 420-550
D-AMS 033775	Wood	ET4	8	34-45	1534 BP +/- 27	cal AD 460-594
D-AMS 033772	River Cane	7	floor	32	282 BP +/- 27	cal AD 1502-1792
D-AMS 033190	Hickory Nut	20	6	32	280 BP +/- 27	cal AD 1599-1794
D-AMS 033774	Hickory Nut	20	6	32	260 BP +/- 24	cal AD 1572-1799
D-AMS 033191	Wood	4	2	55	242 BP +/- 27	cal AD 1555-1800

Discussions and Conclusion

The ETSU geophysical survey and archaeological investigation of David Crockett Birthplace State Park revealed new information about the indigenous occupants of the land, while confirming cultural components that were recorded in previous archaeological work. An Early Archaic hearth was discovered in the GPR data and was easily located with GPR technology. Although no diagnostic artifacts were recovered, an AMS radiocarbon date gave a time stamp to this cultural layer that was found at a depth of 1 m BS. Two remnant hearths were also found at depths of 50 cm BS and 55 cm BS. An AMS radiocarbon date was retrieved from the former, however, the time range fell within the Late Mississippian/Protohistoric. As this depth was lower than Middle Woodland features, it is possible that the wood charcoal had been contaminated by human or animal disturbance. The three hearths found in this area match the descriptions of similar Archaic and Woodland hearths recorded by archaeologist Joseph Benthall.

Evidence of a Late Mississippian/Protohistoric structure confirmed a Native American occupancy that was only presumed previously. European glass trade beads found in the house floor context date the house to at least 1540 when Spanish explorers entered the Southeast, but could also be materials traded from later English coastal colonies. Multiple vessel pot breaks and organic materials may indicate that this structure was part of a larger community or village. It is possible that more remnant Mississippian structures have survived over 200 years of plowing and construction, which would confirm the evidence of a village, but the condition of the excavated structure suggests that this component is heavily disturbed. It is plausible that 40GN12 is related to the sites 40GN17 and 40GN18 which are located across the creek and south of the park.

The only structural elements that could be seen in the Protohistoric house were a small portion of roof fall and the central hearth. The floor appeared at 30 cm BS and disappeared completely by 36 cm BS. Woodland features were found directly below and outside of the house area to the east and north. Woodland lithics and ceramics were found throughout the plowzone and in some cases mixed with Mississippian features. The analysis of the ceramic assemblage has shown that both the Mississippian and Woodland sherds are similar to other ceramics found at contemporaneous sites found on the Nolichucky. The AMS radiocarbon dates from the Woodland pits have placed this occupancy into the Middle to Late Woodland Periods, and this is also corroborated by the Middle Woodland ceramics and lithics found in the pits. The Flint Ridge Flint point and flake indicates a Hopewellian interaction, adding another new cultural component to the park's history.

No historic structures were identified within the geophysical data or excavations. The absence of this evidence does not exclude the possibility that they exist in the areas explored, however. Geophysical surveys and archaeological excavations cannot always find features of low contrast and poor preservation. Given the fact that the Mississippian/Protohistoric components at the site are heavily disturbed suggests that anything later (e.g. the Crockett Family cabin and/or Fort Lee) would not remain intact. It is also possible that the original Crockett cabin and/or Fort Lee were located in other areas in the park that were not investigated, or were located outside of the park area. No historic burials were identified, but numerous anomalies were located within the GPR data that could indicate prehistoric burials.

Recommendations

Much of the archaeological evidence of a late Native American and early settler occupancy has been destroyed or heavily disturbed by plowing and modern construction. However, many areas of the park are yet to be explored with geophysical surveys and archaeological investigations. It is possible that the location of Fort Lee could be located near the spring in the vicinity of the Strong's Inn site, or it may lie across the creek on an adjacent farm. Since the Fort was reportedly burned, it could be discovered by a magnetometry survey. Evidence of the Crockett family cabin may also still exist, as well as the existence of a Mississippian and/or Woodland village on the second tier of the park. Excavations may reveal further evidence of Hopewell interaction in the Middle Woodland and additional trade items from Europeans during the Protohistoric Period. The ETSU survey recorded numerous anomalies in the geophysical data that have a high potential to contain prehistoric features. The archaeological testing of anomalies discovered in the GPR data at various depths can be used as a guideline for future investigations.

Public Outreach

Public archaeology has been and continues to be a vital process throughout this project. The geophysical survey and archaeological excavations were conducted in high traffic areas of the park, partly due to the addition of the historic homestead that attracted many new visitors. The addition of livestock, including pigs, sheep, and free range chickens and guineas, was a popular attraction for all ages. This presented a unique opportunity to interact with and educate the public on many topics such as geophysical and archaeological techniques and to compliment the park's interpretive history of both the Native American and early settlers that had occupied the land. Many locals shared both historical insight on the region and personal collections of local artifacts obtained from the many years of agriculture in the area.

At the park's 2018 Fall Festival, we provided an artifact identification booth led by local archaeologists Bob and Merry Noel. We also hosted an interactive children's booth where participants sifted for replica prehistoric and historic artifacts. We conducted an archaeological program for local groups of girl scouts at both the park and at ETSU in 2018 and 2019. In the summer of 2019, we again hosted an archaeological identification booth led by local archaeologist S.D. Dean and presented information on our discoveries from our ETSU investigations. We have future plans to continue our public outreach at park events. All artifacts and data recovered will be made available for the new interpretive museum that will showcase both Native American and early settler histories.

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CHAPTER 3. OBJECT-BASED IMAGE ANALYSIS OF GROUND PENETRATING RADAR DATA FOR ARCHAIC FEATURES

Reagan L. Cornett

Abstract

Object-based image analysis (OBIA) has been implemented in the field of remote sensing to identify landscape features of archaeological sites and more recently to extract sub-surface archaeological features using geophysical data. This approach was used to identify Archaic (8000-1000 BC) features from Ground Penetrating Radar data collected during a geophysical survey conducted at David Crockett Birthplace State Park (40GN12, 40GN205) in Greene County, Tennessee, United States. The data were pre-processed using *GPR-slice*, *Surfer* and *Archeofusion* software and depth slices were selected that contained anomalies ranging from 80 to 120 cm below surface (BS). The data were then segmented using a global threshold and, after vectorization, classified using attributes that included area, perimeter, length-to-width ratio and circularity index within *ESRI ArcMap* GIS software. The user-defined parameters were based on the attributes of an excavated Archaic circular hearth found at a depth of ~ 1 meter, which consisted of fire-cracked rock and had a diameter > 1 meter. Features that had a high probability of being Archaic hearths were further delineated by human interpretation from radargrams and then ground-truthed by auger testing. The semi-automated OBIA successfully predicted fourteen probable Archaic hearths at depths ranging from 85-120 cm BS. Observable spatial clustering of hearths may indicate possible periods of seasonal occupation by small mobile groups during the Archaic Period.

Keywords: archaeological geophysics; obia; gpr; gis; archaic

Introduction

Geophysical techniques are a non-invasive way to help archaeologists map and identify features from large areas, however, data processing is time consuming and can be enhanced with computer-aided object detection using GIS software (Ernenwein and Kvamme 2008; Verdonck et al. 2019). Object-based image analysis (OBIA) is a semi-automated method that uses a two-step system in which data is segmented by pixel values and then classified into objects based on user-defined parameters (Verdonck et al. 2019). For this case study, an OBIA of Ground Penetrating Radar (GPR) data was conducted to detect homogeneous features using the known attributes of an excavated circular Archaic hearth. Archaeological investigations and geophysical surveys are costly in both time and labor, and Archaic features may be overlooked or ignored due to scarcity, depth levels or simply lack of interest (Eastaugh 2013; Franklin and Dean 2006). GPR can detect size and depth of features by recording the reflectance strength and velocity of an electromagnetic radar wave that is emitted by the GPR instrument (Conyers 2006). Both GPR and magnetometry were conducted during a geophysical survey of David Crockett Birthplace State Park (40GN12, 40GN205) in Greene County, Tennessee. However, during pre-processing, the GPR data showed several deep anomalies that were not detectable in the magnetometry data. One deep anomaly was selected for testing during a Phase III archaeological excavation where an Archaic hearth was discovered at 102 cm BS that consisted of fire-cracked rock (FCR) and had a diameter greater than 1 meter. This feature was similar to other Archaic hearths found during previous archaeological work performed at the park during the construction of parking lots and public buildings (Benthall 1997). The OBIA of the GPR data was designed to target and extract features from this depth level that had the potential of being Archaic features, specifically hearths. The model drastically reduced the number of false positives created by utility lines, roads, gardens and tree roots and was further refined by manual elimination. The remaining features were examined within GPR radargrams using expert judgment and ground-truthed with auger testing.

Study Area

David Crockett Birthplace State Park (Figure 3.33) is named for the famous Tennessee statesman and frontiersman and has been recorded as a multicomponent archaeological site whose Native American occupancy dates back to at least the Archaic Period (Benthall 1997; Smith 1980). The property rests on an alluvial terrace and narrow floodplain containing natural springs and is located at the confluence of the Nolichucky River and Big Limestone Creek in Greene County, TN. The park is located in the Middle Nolichucky River Valley of the Valley and Ridge physiographic province that was formed by the regional erosion of the dolomite, limestone and shale bedrock formed during the Cambrian and Ordovician Periods (Rodgers 1953; Hardeman et al. 1966). The headwaters of the Nolichucky River are found at higher elevations in the adjacent Blue Ridge physiographic region of North Carolina. The river carries sediments eroding from rocks such as quartzite, sandstone, basalt, arkose, greywacke and micaceous shale, which make up the Appalachian Mountains of this region that were formed during the Cambrian and Pre-Cambrian Periods (Rodgers 1953; Hardeman et al. 1966). The elevation of the park ranges from 1335-1400 ft. AMSL (407-426 m AMSL), and the soil type within the survey area consists of a micaceous Congaree fine sandy loam (USDA 2019).

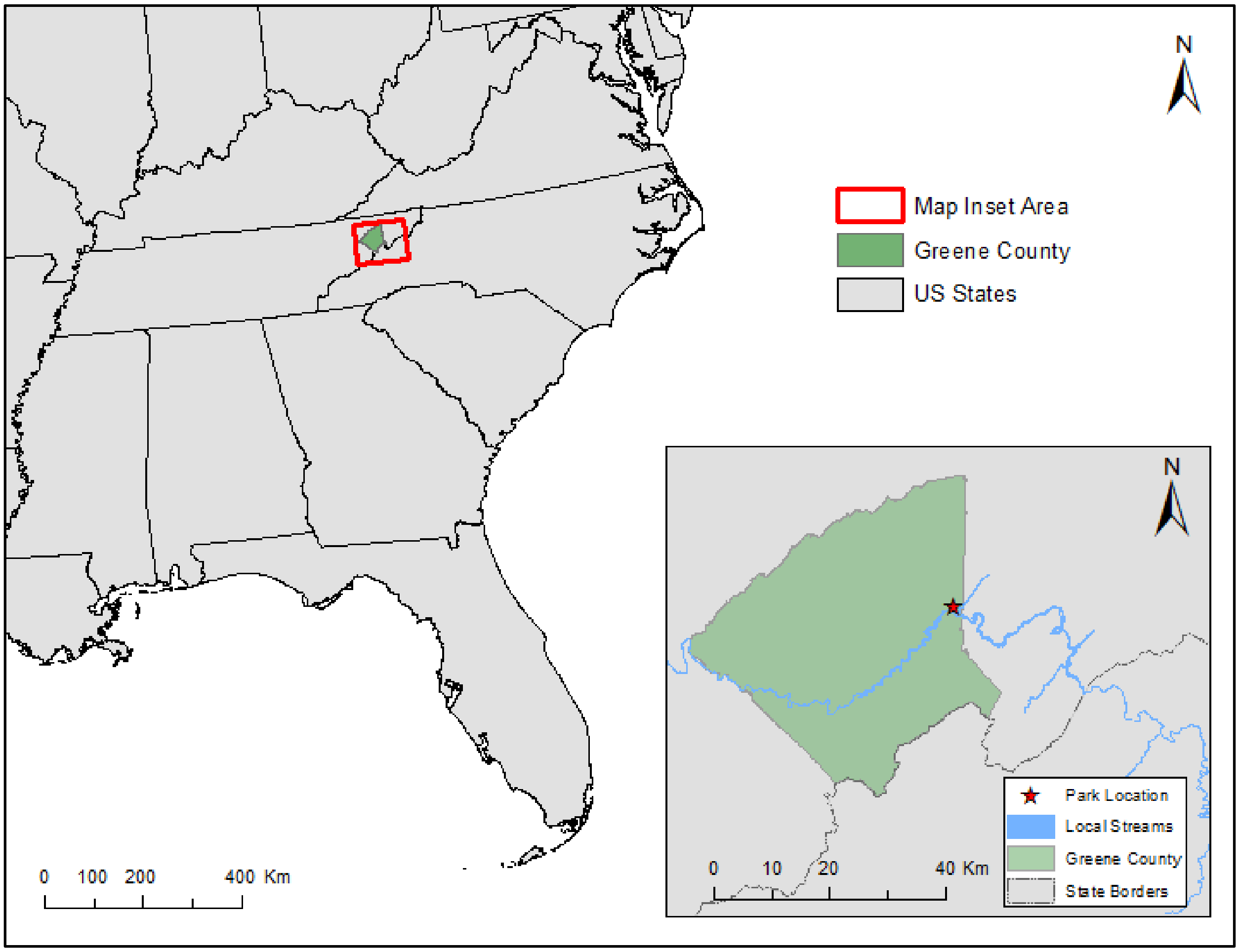


Figure 3.33. Location of study area, showing David Crockett Birthplace State Park in Greene County, TN, US.

Background

Archaic Period in the Southeastern United States

Indigenous populations have been in the southeastern US for at least 15,000 years, and archaeologists have divided this time into specific periods based on technological advances and cultural changes as follows: Paleoindian (before 8000 BC), Archaic (8000 BC-1000 BC), Woodland (1000 BC-AD 1000), Mississippian (AD 1000-AD 1570) and Protohistoric (AD 1570-1700) (Dalton-Carriger 2016; Hudson 1994; Ward and Davis 1999). The Archaic Period in the southeastern US is characterized by cultural adaptations to climate changes and landscape changes during the early and middle Holocene epoch. It is further delineated into Early (8000 BC-6000 BC), Middle (6000 BC-3000 BC) and Late (3000 BC-1000 BC) Archaic Periods (Hudson 1994; Ward and Davis 1999). Expanding deciduous forests created an ecosystem rich with nut-bearing trees, seed-bearing plants and small game, while riverine and marine environments provided an abundance of fish and shellfish (Hudson 1994; Ward and Davis 1999). The archaeological record has shown that populations increased and that groups were highly mobile across the landscape with a focus on seasonal resource procurement (Ward and Davis 1999). Major technological changes included smaller projectile points, more expedient stone tools, steatite carved vessels and domestic plant cultivation (Hudson 1994; Ward and Davis 1999). Some cultural traits of the southeastern Archaic Period seem to be regionally localized such as coastal shell middens, fiber tempered pottery and mortuary sites (Anderson and Hanson 1988; Gibson 2006; Russo 1994; Sassaman and Rudolphi 2001). Seven additional Archaic sites have been recorded within a one-mile radius of the study area (McIlhany 1978, TDOA 2020).

Ground Penetrating Radar

Ground-penetrating radar (GPR) is an active geophysical technique that propagates electromagnetic waves into the subsurface and records reflections from buried interfaces and objects (Conyers 2006). The GPR unit measures the reflection of returning waves from buried features and anomalies that can be metallic or non-metallic. GPR can also detect changes in material such as soil types and will detect areas that have been disturbed by human occupation, which makes it a suitable technique for archaeology (Conyers 2006; Dojack 2012). Depth range is greater with lower antenna frequency, which can range from 12.5 MHz to 2600 MHz (Neal 2004; Smith and Jol 1995). Site conditions such as soil saturation and soil type also affect signal penetration. Dryer sediments and low conductivity sediment types such as sand allow the signal to penetrate up to 30 m BS, while wetter sediments and materials with a higher conductivity can decrease signal depth to less than 1 meter (Neal 2004; Smith and Jol 1995; Witten 2006). The quality of results can vary as conditions such as weather change seasonally and daily, while sediment characteristics are based on regional and local geological morphology that may drastically change across a small area (Conyers 2006).

Object-based Image Analysis for Archaeology

The evolution of geophysical techniques has paralleled and been enhanced by the evolution of GIS applications, GPS and computer technology, in general (Barceló 2009). In 1999, Joseph Puyol-Gruart wrote that 'Artificial intelligence is especially useful for experience-based knowledge', successfully predicting the future importance of digitizing multimedia information in the field of archaeology. Puyol-Gruart (1999) further discussed extracting information from databases containing preprocessed data and computer models to identify patterns, while emphasizing the need for validation from the human expert. Semi-automated image analysis has become a multidisciplinary technique that began with aerial photography in the 1960s and satellite imagery in the 1970s. It has been employed in such fields as environmental science, microbiology and medical imagery using either a pixel-based or object-based classification system (Blaschke 2010, Blaschke et al. 2015; Verdonck et al. 2019). Pixel-based classification (PBIA) groups pixels together based on spectral data values and was first implemented in the 1970s, predating object-based image analysis (OBIA) (Blaschke 2010; Blaschke et al. 2015; Verdonck et al. 2019). The OBIA approach utilizes both spectral and spatial data, using a two-step process to segment data based on the spectral values of pixels and then to classify objects based on user-defined spatial attributes (Verdonck et al. 2019). This can be accomplished within GIS software using computer-implemented algorithms (Verdonck et al.

2019). Case studies comparing the two imagery analysis methods have shown significant advantages of using OBIA over PBIA, as OBIA allows for the addition of multi-parameter classifications, while additionally performing better with higher resolution data (Blaschke 2010; Kamagata et al. 2005; Liu and Xia 2010; Sevara et al. 2016, Sibaruddin 2018; Verhagen and Drăguţ 2012; Xiaoxia et al. 2005).

Archaeologists have been using aerial photography to identify archaeological sites and features for over a century and now have access to high-resolution data derived from satellites, unmanned aerial vehicles (UAV) and light detection and ranging (LiDAR), along with airborne and spaceborne synthetic aperture radar (SAR) (Kvamme 2013; Luo et al. 2019; Verhagen and Drăguţ 2012). Many recent studies have implemented semi-automated shape factor analysis (object-based) to identify natural landscape features such as sinkholes from LiDAR derived Digital Elevation Models (DEM) by using 'form defining properties' (Minar and Evans 2008) such as perimeter, area, circularity index and length-to-width (L2W) ratios (e.g., Doctor and Young 2013; Kobal et al. 2015; Parise 2020; Šegina et al. 2018; Shannon et al. 2019; Verbovšek and Gabor 2019). This technique has been applied in the field of archaeology to detect subtle surface features such as earthen mounds, using semi-automated OBIA with similar parameters such as area and circularity index within GIS software (e.g., Davis, Sanger and Lipo 2019; Freeland 2016; Kvamme 2013; Verhagen and Drăguţ 2012; Vogelaar 2017). OBIA has also been used to map and delineate archaeological surface features using multi-spectral satellite imagery (Dawson et al. 2019). Davis (2018) presents a detailed history of the use of OBIA (coined as 'GEOBIA' by Hay and Castilla (2008) when applied to remote sensing in the field of geosciences), noting that this method has only been employed in archaeology relatively recently and very rarely in North America. By employing semi-automated OBIA/GIS models to examine remote sensing of surface data, unknown archaeological sites and features can be identified from large areas, saving time, resources and possibly the sites themselves from destructive anthropogenic and natural events (Davis et al. 2018; Kvamme 2013). It is important to note that these studies have also recognized the importance of human interpretation alongside OBIA to both create model parameters from known feature attributes and to distinguish archaeological features from natural or modern features (Middleton et al. 2015; Seijmonsbergen 2011; Verhagen and Drăguţ 2012). Successful outcomes from semi-automated OBIA also depend on data quality, the scale and homogeneity of features and the nature of the site itself (Verhagen and Drăguţ 2012).

Several studies have implemented an automated exploration of sub-surface features using geophysical data to delineate homogenous objects, including archaeological features. Many techniques have been explored using methods such as neural network classification, normalized cross correlation, clustering, edge-detection segmentation and supervised and unsupervised classification (e.g. Al-Nuaimy et al. 2000; Bescoby 2004; Ernenwein 2009; Florio and Lo Re 2018; Sheen and Aspinall 1995; Verdonck et al. 2019; Ward et al. 2014). However, there are only a few examples in the current literature that specifically use a semi-automated OBIA approach using geophysical data in the field of archaeology. Case studies have successfully implemented OBIA using magnetometry data to identify archaeological features (e.g. Hegyi et al. 2019; Pregesbauer et al. 2014; Salguero et al. 2011; Verdonck et al. 2019), while others have applied this to GPR data (e.g. Linford et al. 2018; Schmidt and Tsetskhladze 2013; Verdonck et al. 2019). GPR data is highly suited for OBIA due to the ability to record anomalies at high spatial resolution and multiple depth levels and to display the data with 2D horizontal depth slices that can be further processed and converted from raster to vector data within GIS software.

As with OBIA performed on LiDAR datasets, the GPR data can be segmented and then classified by user-selected parameters (unsupervised classification). The spectral properties of each pixel in a GPR depth slice represent the reflection magnitude in decibels (db). Pixels values can be reclassified in GIS using a set threshold value, or values, and then grouped together to create objects or shapes, a technique known as global threshold segmentation (Blaschke et al. 2015, Verdonck et al. 2019). These objects can be further processed by vectorization, which will allow spatial attributes to be assigned to each shape, or polygon. GPR depth slices are already spatially segregated by depth during pre-processing, however, computer generated algorithms can further segregate vectorized data based on attributes such as perimeter, area, circularity index and L2W ratio using GIS tools.

Methods

Geophysical Survey

A geophysical survey of the park was completed in an area encompassing 2 hectares, which was being constructed into a late eighteenth-century historic homestead. This was performed using a GSSI SIR-4000 unit with a 400 MHz antenna. The parameters were as follows: meters per mark = 1, ns time window = 50, sample/scan = 512 and scans/m = 100. The magnetometry survey was conducted with a Bartington Grad 601-2 Magnetic Gradiometer System containing two Grad -01-1000L sensors and a DL601 data logger. A grid network was created using a Real-Time Kinematic Global Navigation Satellite System (RTK GNSS), a Spectra Precision SP80 survey kit with a positional accuracy level of +/- 5 cm. Grids measured 30 x 30 m, when possible and were surveyed north to south in a zig-zag pattern, starting in the southwest corner. Survey grid coordinates were recorded with a handheld data collector using *SurveyPro* software. A high-resolution digital orthophotograph was created within *Agisoft*

PhotoScan using photos taken with an unmanned aerial vehicle (UAV), which was used as an additional basemap. A workflow of the GPR data processing and OBIA steps is presented in Figure 3.34.

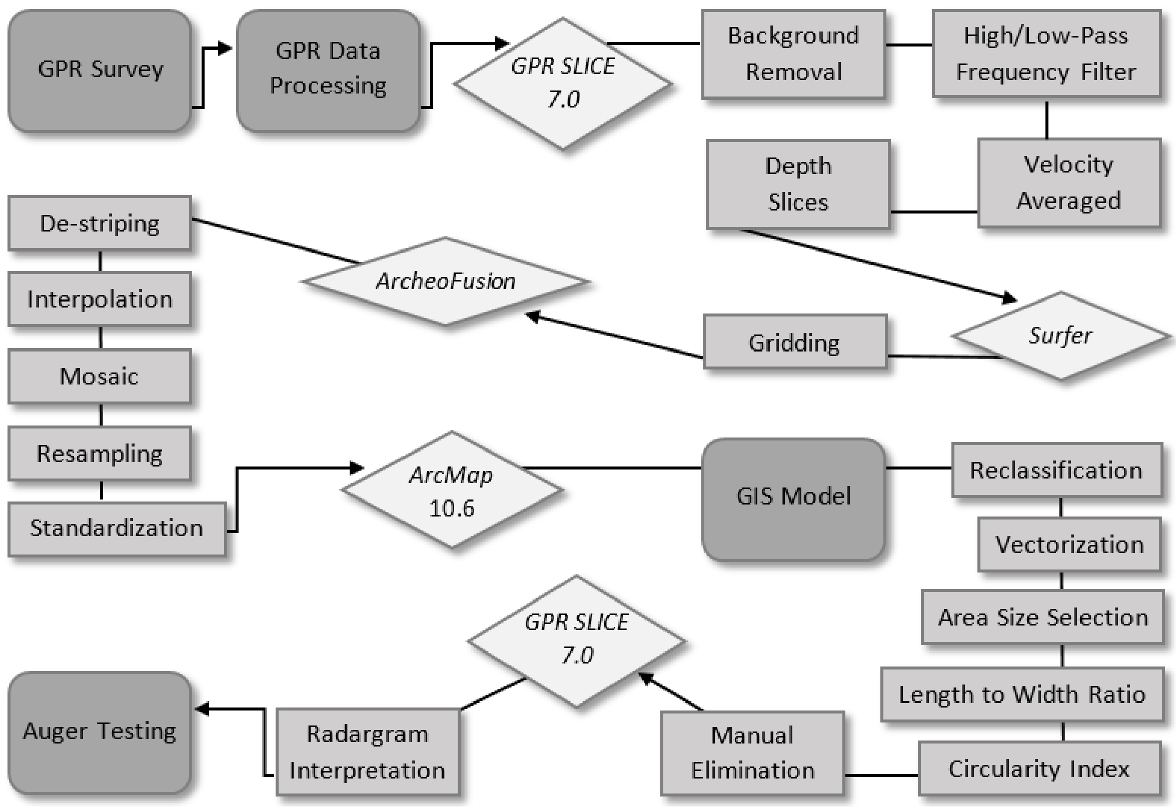


Figure 3.34. Workflow chart showing steps of the GPR data pre-processing and OBIA GIS model.

Ground Penetrating Radar Data Processing

GPR Slice 7.0 was used to process and display the GPR raw data into 22 horizontal depth slices with a thickness of 2.05 ns for each grid. Transects were displayed as radargrams showing profiles of depth levels starting at ground surface and ending at less than 2 meters. A background removal filter and a high and low-pass frequency filter were applied to all radargrams using the first break for time zero. During pre-processing, the slices and radargrams were examined at varying depth levels for reflections (see Figure 3.35) that had the potential to be archaeological features. A few of these (see Figure 3.36) were selected for ground truthing through both auger testing and test units, during a Phase II and Phase III investigation, respectively. After gaining accurate feature depth levels during excavation, the GPR data were reprocessed using an average velocity of 0.78 m/ns. GPR slices were further gridded using *Surfer* software, after which *Archeofusion* software was used to create a seamless mosaic of the surfer ASCII grid slices by depth. The data were also spatially defined within *Archeofusion* using the latitude and longitude coordinates of the local site datum and the azimuth degree calculator tool. Final processing in *Archeofusion* included the removal of spikes and striping, interpolation and smoothing. The GPR slice mosaics were resampled to a pixel size of 0.125 m x 0.125 m and then standardized with a mean of zero and a standard deviation of one.

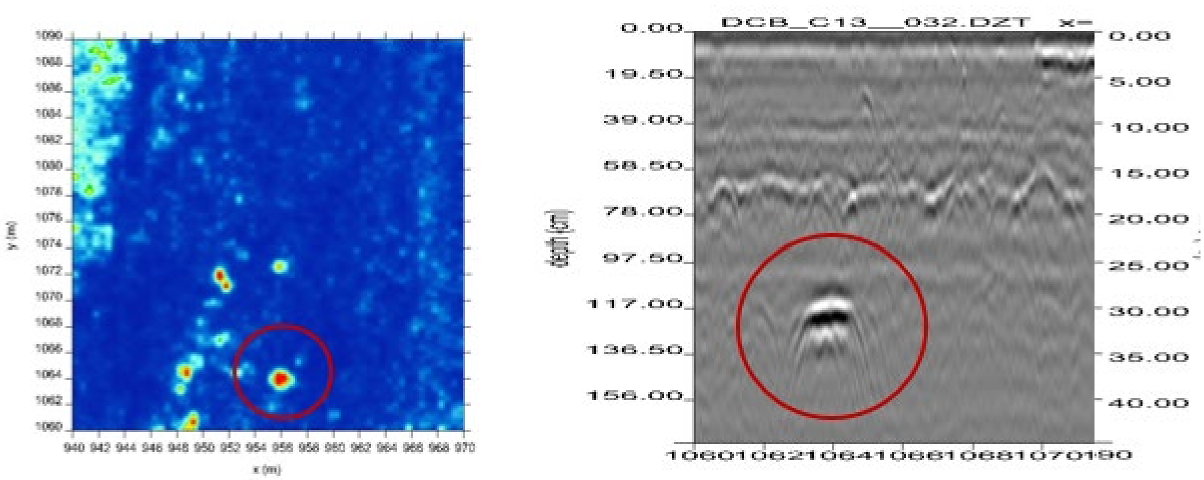


Figure 3.35. Left: Horizontal GPR Slice 15 of grid C13 (~ 111-119 cm BS) showing an excavated Archaic hearth at 1 m BS. Right: A portion of radargram 33 showing vertical depth of the transect containing the deep anomaly. Smaller hyperbolas representing multiple stacks of fire-cracked rock can be seen below the large flat hyperbola that represents the circular hearth as a whole.

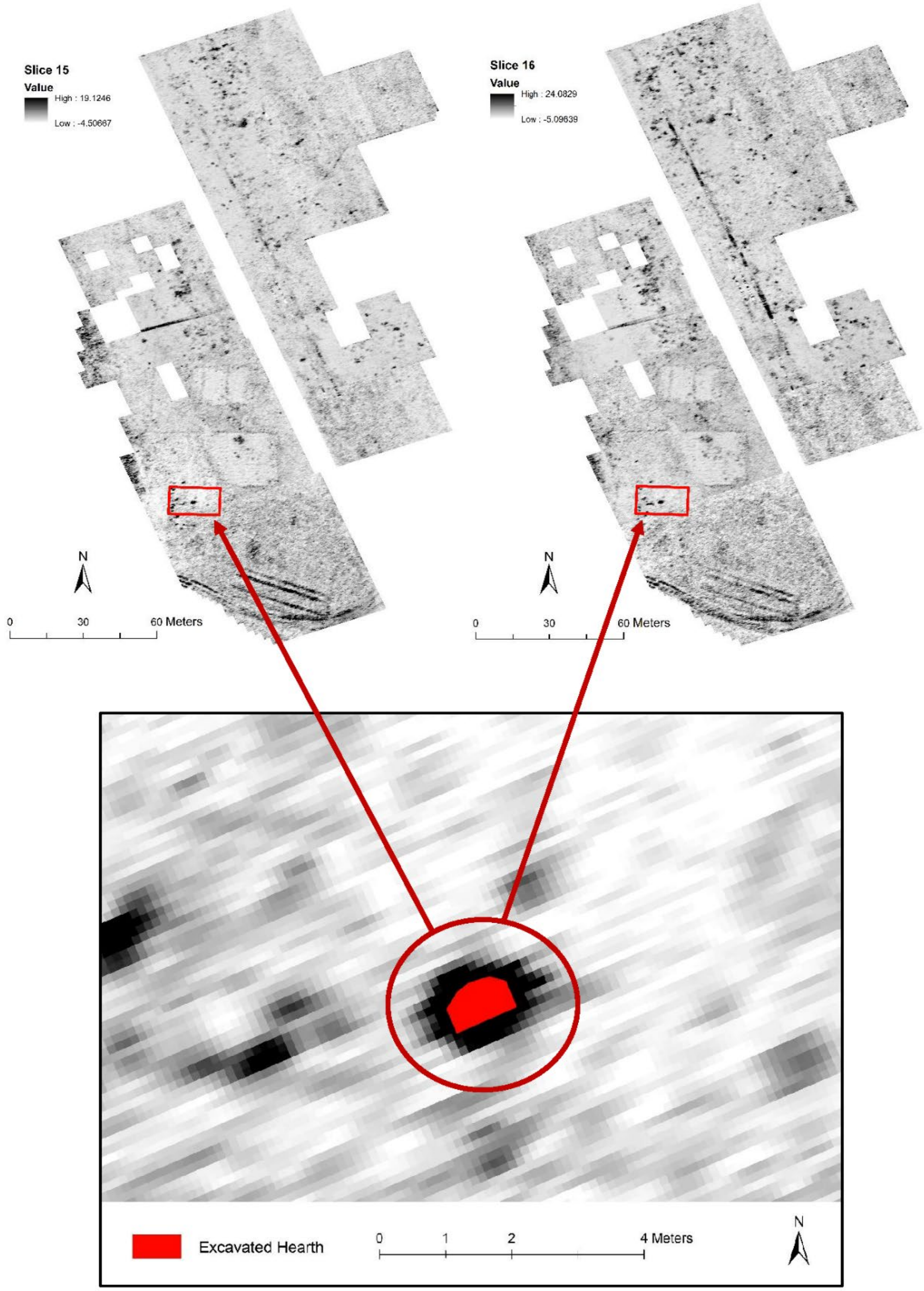


Figure 3.36. The mosaic of GPR depth Slices 15 and 16, showing the location of the ground-truthed anomaly. Top left: Slice 15 at 115-120 cm BS. Top right: Slice 16 at 125-130 cm BS. Bottom: Close up of anomaly in Slice 15 with the red polygon representing the excavated hearth location recorded by the RTK GNSS. The resolution of the GPR data is 0.125 x 0.125 m.

Archaeological Excavation

The deep anomaly discovered in radargram 33 of grid C13 was pinpointed for archaeological testing and a 1 x 1 meter unit was placed above the feature. At 102 cm BS a large circular hearth (Figure 3.37) consisting of FCR was uncovered with a diameter greater than one meter. Chert and quartzite lithic debris were recovered through wet screening of sediment located within the hearth area using a 1/16th inch mesh screen. Ash and wood charcoal were also recovered, and one wood charcoal sample from this level was analyzed by Direct AMS laboratories. The results of the Accelerator Mass Spectrometry (AMS) radiocarbon dating gives an uncalibrated mean of > 8083 +/- 40 BP (D-AMS 033192) with a 2-sigma calibrated age range of 7019-6832 cal BC. The calibration range was generated using *OxCal* 4.3 online software (Ramsey 2009) with the IntCal 13 curve for the Northern Hemisphere (Reimers et al. 2013). Several cultural levels were examined within the geophysical data and identified during the archaeological investigations, including Woodland features and artifacts encountered at depth levels ranging from 36-55 cm BS. The remnants of a burnt Mississippian/Protohistoric structure were uncovered at 30 cm BS at the base of the plowzone. Diagnostic artifacts from the house floor included broken vessel fragments and three European glass trade beads. AMS radiocarbon dates (Table 3.15) were obtained from organic material at all cultural levels.

Figure 3.37. Left: Planar view of Test Unit 5, showing the top of the Archaic hearth. Right: Profile view of the unit below the hearth showing FCR in the walls. A sterile layer was reached at 120 cm BS. Dark organic bands can be seen at the hearth level and at 55 cm BS, which contained probable Woodland remnant hearths.

Table 3.15. Summary of AMS Radiocarbon Dates

Sample ID	Charcoal	Test Unit	Feature	Depth cm BS	Uncalibrated (σ = 1)	Calibrated Range (σ = 2)
D-AMS 033192	Wood	5	3	102-120	8083 BP +/- 40	7019-6832 cal BC
D-AMS 033776	Wood	36	10	30-36	1646 BP +/- 31	cal AD 272-534
D-AMS 033773	Wood	46	13	35-73	1568 BP +/- 26	cal AD 420-550
D-AMS 033775	Wood	ET4	8	34-45	1534 BP +/- 27	cal AD 460-594
D-AMS 033772	River Cane	7	floor	32	282 BP +/- 27	cal AD 1502-1792
D-AMS 033190	Hickory Nut	20	6	32	280 BP +/- 27	cal AD 1599-1794
D-AMS 033774	Hickory Nut	20	6	32	260 BP +/- 24	cal AD 1572-1799
D-AMS 033191	Wood	4	2	55	242 BP +/- 27	cal AD 1555-1800

Object-based Image Analysis

ESRI ArcMap software (version 10.6.1) was used to conduct the object-based image analysis on the final processed GPR depth slice mosaics. Three GPR slice mosaics (Slice 14, 15 and 16) were chosen with a depth range of approximately 20 cm above and below the level of the excavated hearth that was discovered at 102 cm BS. Non-spatially referenced raster datasets were imported in order to retain exact pixel values that can be slightly altered due to automatic resampling. The raster datasets from each slice mosaic were first reclassified into a binary image, using a global threshold of two standard deviations. A raster to vector conversion was then performed to create polygons of the anomalies that had a reflectance value of 2σ or greater. The attributes of the excavated Archaic hearth and hearths excavated by Benthall (1977) were used to create formulas that extracted similar polygons from the vectorized data. The model used the following variables: area, perimeter, L2W ratio and circularity index. Perimeter and area values of polygons were automatically generated through the vector conversion tool. The known circular hearth had a diameter of greater than 1 meter, which would have an area of greater than 0.79 m^2. Anomalies were eliminated that had an area of less than 0.8 m^2 and greater than 3.5 m^2 (the area of a circle with a diameter of ~ 2.0 m) (see Eq. 1).

Area Selection Formula:

$$(Area >= 0.8) \text{ AND } (Area <= 3.5) \qquad (1)$$

The L2W ratio was created using the major and minor axis of the polygons with a minimum of 1 representing a perfect circle. Polygons were selected with a L2W ratio of less than 2.5 (Eq. 2) to allow room for potential hearths that may be more elliptical in shape, as was seen in Woodland layers during the ETSU excavation and Archaic hearths that were previously recorded by Joseph Benthall (1997).

Length to Width Ratio:

$$(L/W) <= 2.5 \qquad (2)$$

There are several Circularity Index formulas available that will calculate a mathematical value of a shape to represent deviation from a perfect circle (Kobal et al. 2015). The circularity formula used in this study was obtained from a GEOBIA sinkhole study conducted by Daniel H. Doctor and John A. Young (2013). The Po in the Circularity Index formula represents the observed or known perimeter of the shape, while Pe represents the expected perimeter value if the shape was a perfect circle (Doctor and Young 2013). The Circularity Index of a perfect circle would be 1, with all other shapes having a ratio of greater than 1. A final classification of the polygons was selected using a Circularity Index of less than 2.0 (Eq. 3) to extract polygons by eliminating non-circular shapes.

Circularity Index:

$$Circ\ i = < = 2.0 \qquad (3)$$

$$Circ\ i = ((Po - Pe)/Pe) + 1 \qquad (4)$$

$$Pe = 2\pi\ (\sqrt{A/\pi}) \qquad (5)$$

The polygons were then evaluated by human interpretation to eliminate anomalies that were known to be clutter from modern features such as utility lines, roads, gardens and tree roots. The anomalies were then matched to their location in the radargrams and probable Archaic hearths were identified using expert judgment. Features were eliminated that had the potential of being non-hearths, specifically avoiding disturbance of prehistoric burials and modern utility lines.

Results

GIS Model

The results of the model steps are presented in Table 3.16 after OBIA metrics, manual elimination and human interpretation of the radargrams. A combined total of 8,344 objects were created from slices 14, 15 and 16 after segmentation by the global threshold. The OBIA steps radically reduced clutter from modern features. The model parameters defined by area, reduced the number by ~ 95 %, eliminating many unwanted features such as small reflections created from the recently tilled gardens. The L2W ratio eliminated linear polygons, many of which were reflections from utility lines, ditch lines and roads. The circularity index extracted features that were closer to the shape of a circle, eliminating irregular features such as tree roots. The user-defined parameters of the OBIA reduced the total number of polygons by ~ 98 %. Further manual elimination of 31 objects was necessary to remove the remaining clutter from known modern features that were included in the OBIA model due to the nature of the GPR reflections. The remaining 106 objects were identified within the corresponding radargrams and expert judgement was used to identify 18 polygons as having a high potential to be probable Archaic hearths containing FCR. Two of the polygons in Slice 15 and Slice 16 were identified as the previously excavated hearth, while two more anomalies had overlapping polygons in Slice 14 and 15. Therefore, there was a total of 14 anomalies from the OBIA model that were selected for auger testing. During examination of the radargrams four additional anomalies were identified for testing that were not included in the OBIA model. Two had an area of less than 0.8 m^2, one had an area greater than 3.5 m^2, while the fourth anomaly was found in Slice 18 and was at a depth of ~ 140 cm BS. Figures 3.38, 3.39 and 3.40 show examples of anomalies at varying depth levels of Slice 14, 15, 16 within (A) GPR radargrams and (B) depth slices along with (C) images of polygons after segmentation and vectorization and (D) OBIA metrics and manual elimination.

Table 3.16. Anomaly Reduction Steps by Order

GPR Slice Mosaic	1. Polygons by Reclassification Threshold of 2σ	2. Polygons by Area (> = 0.8 m^2) & (< = 3.5 m^2)	3. Polygons by L2W Ratio (< = 2.5)	4. Polygons by Circularity Index (< = 2)	5. Modern Feature Elimination	6. Radargram Interpretation for Auger Tests
14	2270	91	68	40	31	7
15	2862	107	71	44	36	5
16	3212	199	91	53	39	6
Total	8344	397	230	137	106	16 (2 overlapping)

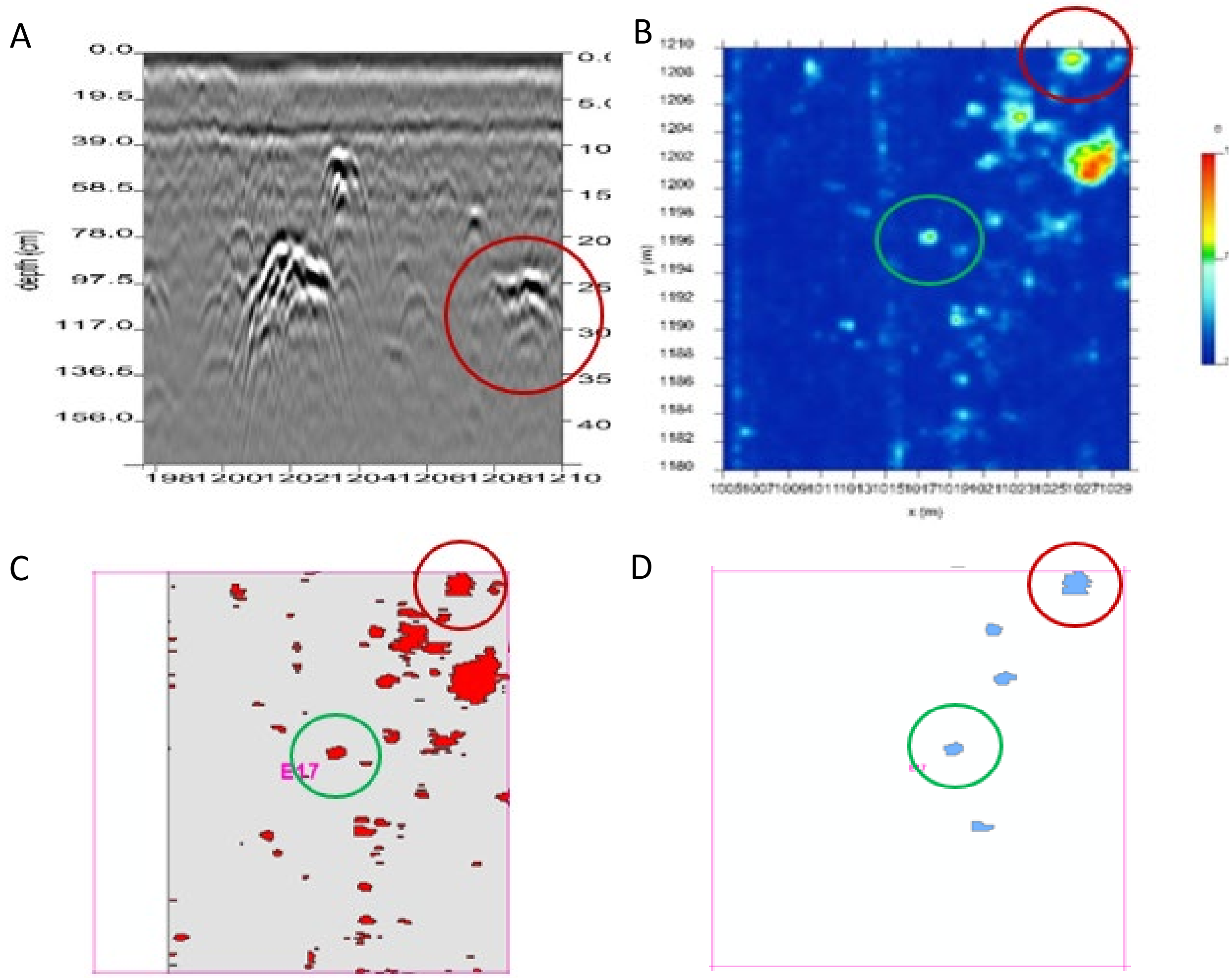


Figure 3.38. The four images represent images of a probable Archaic hearth (circled in red) that were extracted by the OBIA model. Fire-cracked rock was reached at ~ 85 cm during an auger test at this location. A) The anomaly as seen in a portion of radargram 44 representing depth levels. B) GPR Slice 14 of Grid E17 showing the reflections from all anomalies. C) GPR data after reclassification and vectorization. D) Features selected from Slice 14 of Grid E17 after OBIA and manual elimination of noise. Another probable hearth (circled in green) was identified by the OBIA model and was reached at a depth of ~ 102 cm BS during the auger testing.

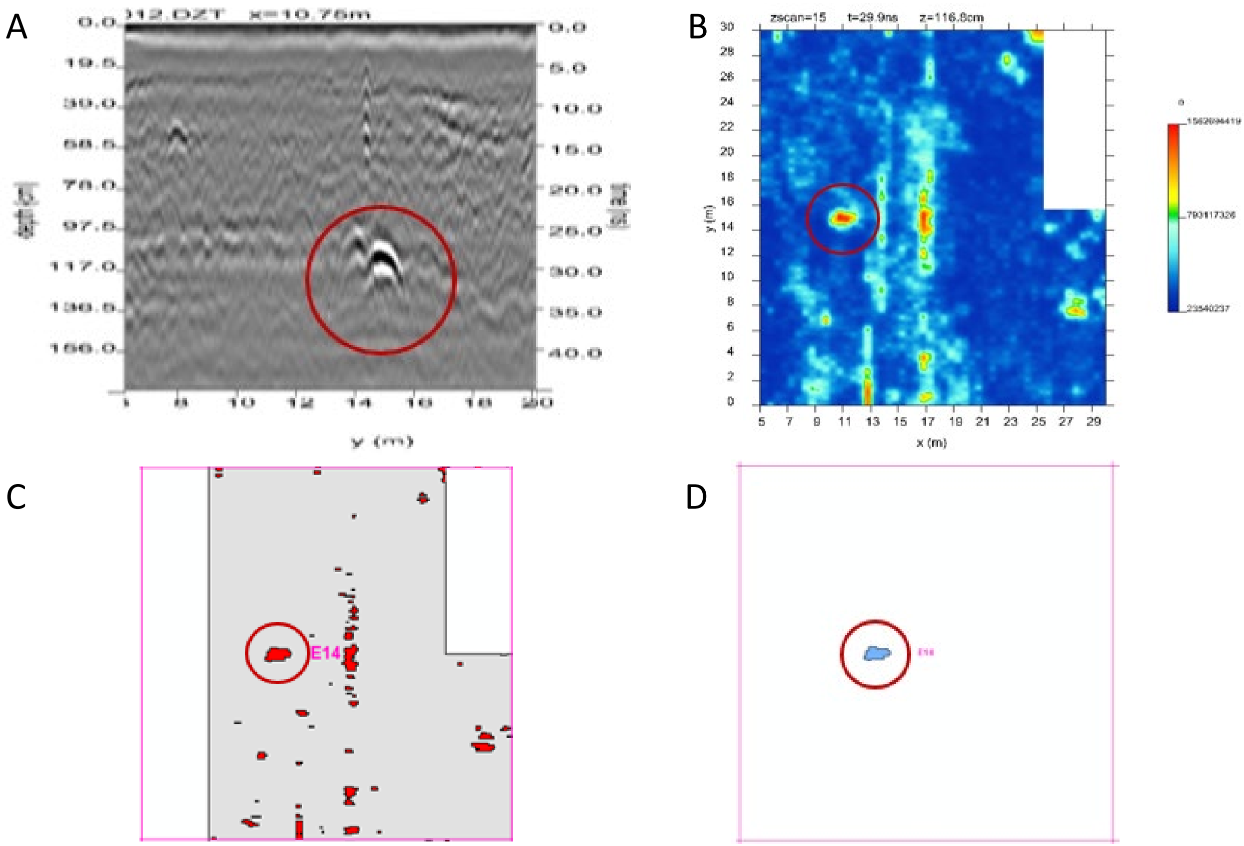


Figure 3.39. Images from Slice 15 where a probable hearth (circled in red) was reached at ~ 105 cm BS. A) Anomaly seen as a strong reflection in a portion of radargram 12 showing depth levels. B) Anomalies in Grid E14 of GPR Slice 15. Linear features can be seen from an electrical line and ditch. C) GPR data after reclassification and vectorization. D) Features selected from Grid E14 of Slice 15 after OBIA and manual elimination.

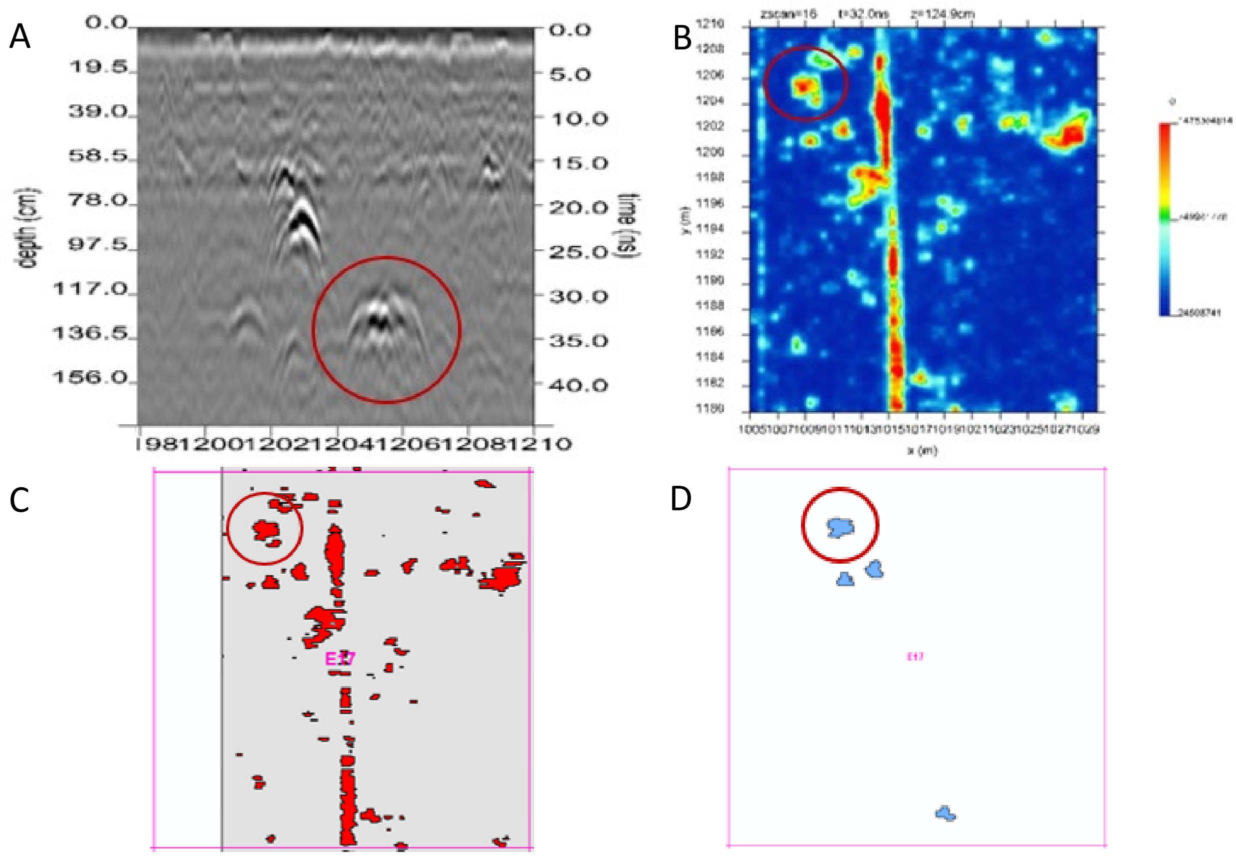
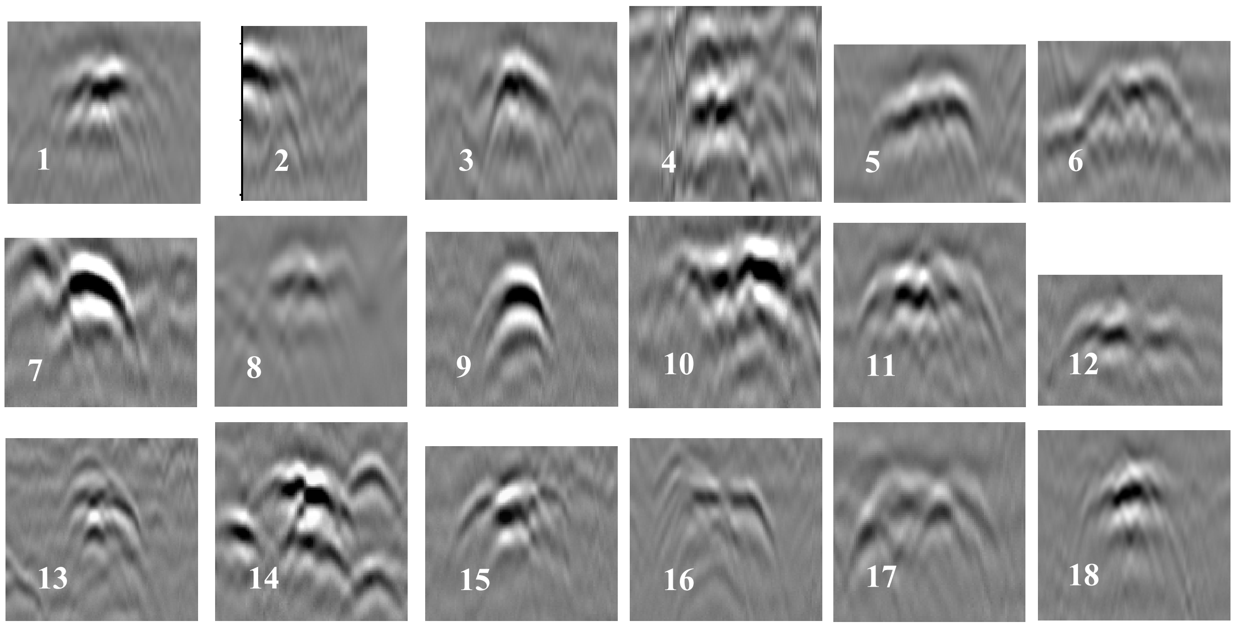


Figure 3.40. Images from Slice 16 showing the location of a probable hearth (circled in red) that was reached at ~ 118 cm BS. A) Anomaly seen as a strong reflection in a portion of radargram 8 in Grid E17 showing depth levels. B) Anomalies in GPR Slice 16 of Grid E17. Linear features can be seen showing the electrical line with high reflectance values. C) GPR data after reclassification and vectorization. (D) Features selected after the semi-automated OBIA steps.

Auger Testing

Fourteen anomalies were selected from the OBIA model for auger testing, based on visual inspection and expert judgement of the radargrams. Four more potential hearths were identified during this process. However, one of these was located at a depth level not included in the model and could not be reached by the four-inch diameter bucket auger, which had a depth range of 140 cm. A total of 17 features were selected based on a comparison with the characteristics of the excavated hearth. FCR was reached at the approximate predicted depths in 16 of the tests. One feature did not contain FCR, but was a probable prehistoric pit that had a depth range of 90-130 cm BS and contained ash, charcoal and a lithic flake. The pit feature had been excluded from the model based on area values greater than the metrics allowed. Obstructions were reached in three of the auger tests and the tests were then moved 30 cm grid north. Control tests were performed to depths of 140 cm, at a range of 0.5 to 4 meters outside of five of the test feature locations. There was no evidence of FCR in four of the control tests. FCR was reached at ~ 99 cm in one control test that was conducted at 0.5 m outside a probable hearth found at ~ 92 cm BS and is more than likely a continuation of the same hearth. The results of the auger tests (Table 3.17) show that the OBIA model successfully predicted 15 out of 17 probable hearths based on the user-defined parameters. Two probable hearths that tested positive for FCR and were not included in the OBIA had areas that were less than 0.8 m^2. Figure 3.41 shows the OBIA steps for Slice 14, while Figure 3.42 is a large-scale view of GPR slice 14, highlighting tested probable hearths. The map in Figure 3.43 shows the locations of the tested probable hearths in the area of the case study.

Table 3.17. Auger Test Results



Radargram Image	Test Number	Predicted cm BS	Actual cm BS	Predicted In Model	Tested Positive for FCR
1	Excavated Hearth	110	102	Yes	Yes
2	C13.S14.2/S15.1	95	92	Yes	Yes
3	C13.S14.3/S15.2	102	92	Yes	Yes
4	C14.S14.1NM1	102	91	No	Yes
5	D15.S16.1	120	110	Yes	Yes
6	D15.S16.5	115	120	Yes	Yes
7	E14.S15.1	100	105	Yes	Yes
8	E15.S14.NM2	95	90-130	No	No
9	E17.S14.2	90	102	Yes	Yes
10	E17.S14.6	90	85	Yes	Yes
11	E17.S16.1	112	118	Yes	Yes
12	E17.S16.NM3	125	108	No	Yes
13	E18.S14.2	95	102	Yes	Yes
14	E18.S14.4	85	92	Yes	Yes
15	E18.S15.5	90	94	Yes	Yes
16	F14.S14.4	98	110	Yes	Yes
17	F14.S16.3	120	120	Yes	Yes
18	F18.S16.1	95	87	Yes	Yes

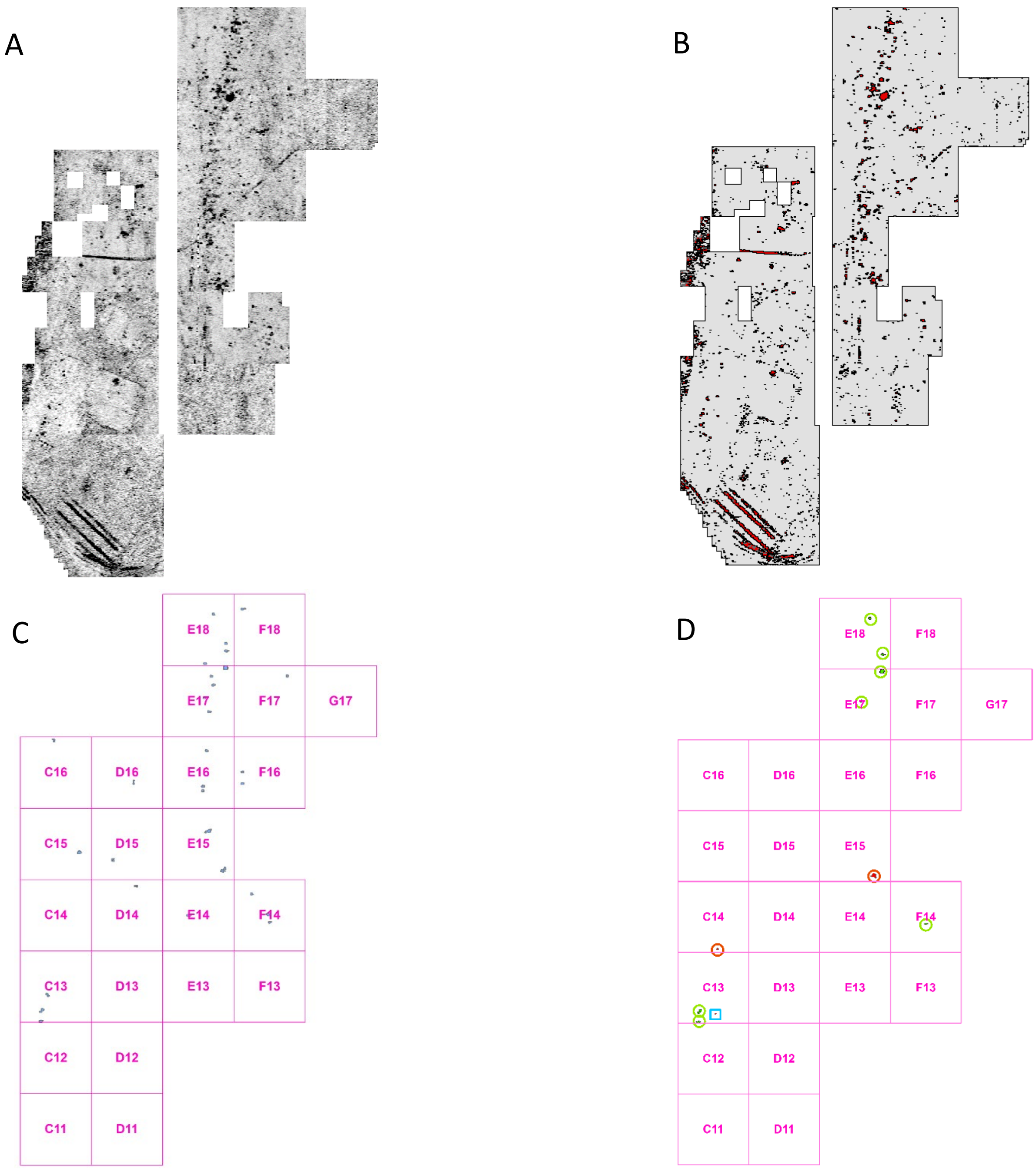


Figure 3.41. A) Mosaic of the raw data from Slice 14 after pre-processing within *Archeofusion* software. B) Slice 14 data after reclassification and vectorization within *ESRI ArcMap*. C) Anomalies selected from Slice 14 with OBIA metrics and manual elimination. D) Anomalies from Slice 14 that were auger tested after human interpretation of radargrams. Seven (green circles) were selected by OBIA and tested positive for FCR. Two (red circles) were not selected by the model with one containing FCR but had an area less than 0.8 m^2, while the other had an area greater than 3.5 m^2 and is a probable pit. The blue square represents the top of the excavated archaic hearth and was selected by OBIA in Slice 15 and Slice 16.

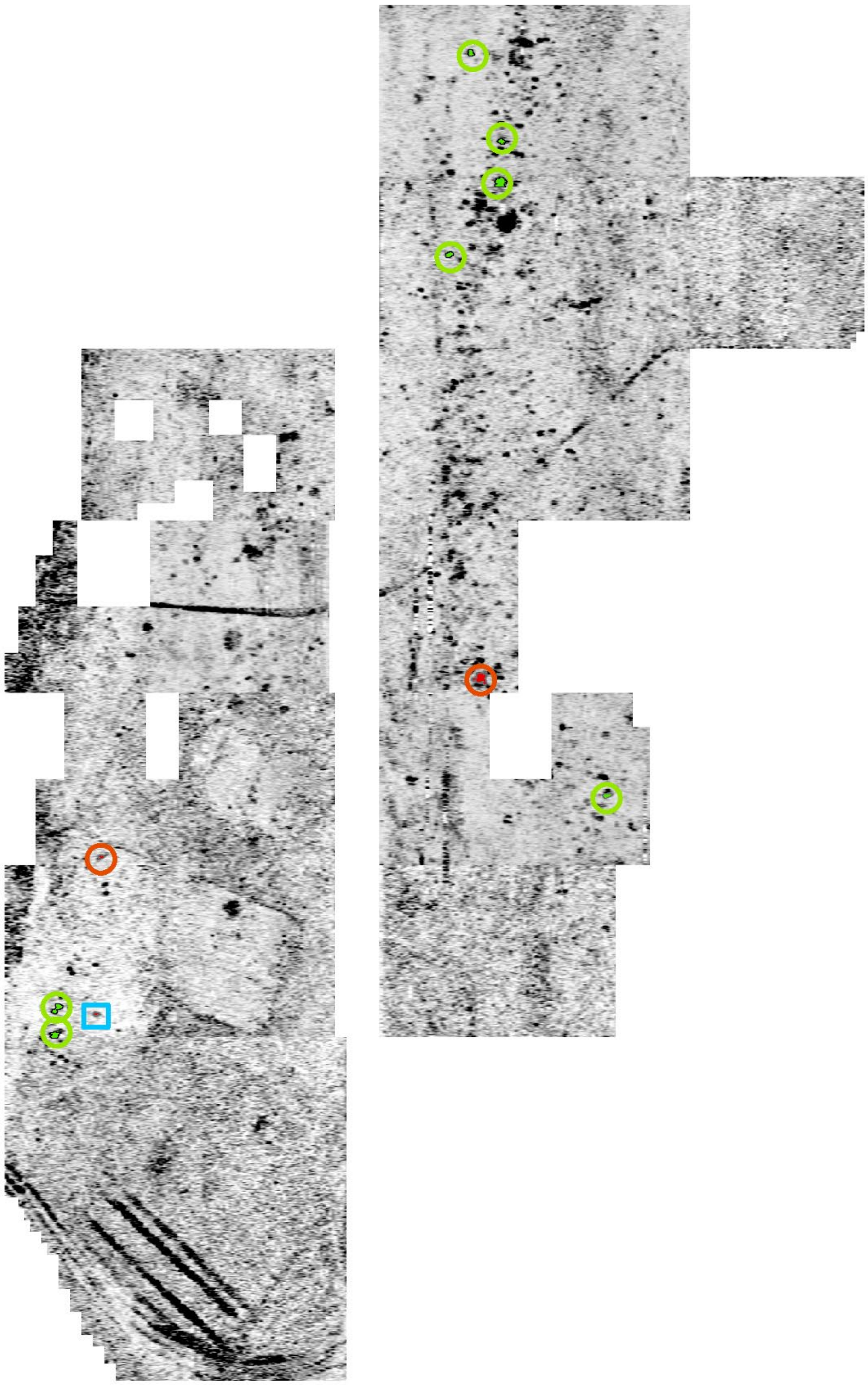


Figure 3.42. Large-scale view of GPR Slice 14 showing probable hearths selected by OBIA (circled green), non-model probable hearths (circled red) and top of excavated hearth (circled in blue). All anomalies tested positive for FCR, except the largest polygon on the right and circled in red, which was a probable prehistoric pit.

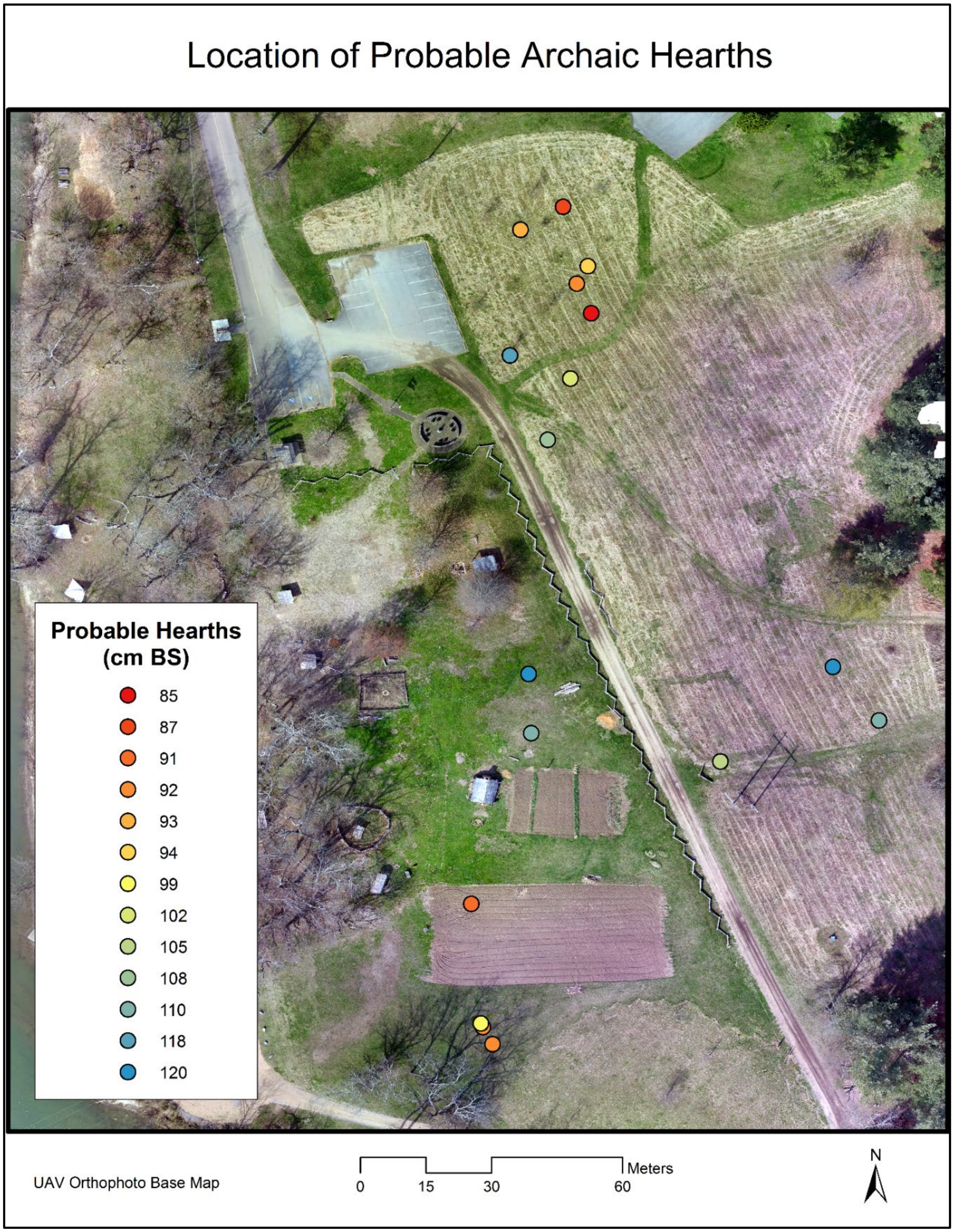


Figure 3.43. Probable Archaic hearths consisting of FCR and located with auger testing. The map is displayed using a digital orthophotograph created from UAV imagery. Noticeable patterns of clustering are visible.

Discussion

The results of geophysical techniques vary due to site conditions and feature characteristics. In this case study, deep features were identified within the GPR data that were not found with the magnetometer. This was more than likely due to soil conditions and interference from modern noise within the survey area. A micaceous sandy loam was found at all levels of auger testing that reached a depth of 140 cm. The low conductivity of sandy sediments will allow for greater depth penetration of GPR signals and this seems to have played a role in the ability of the GPR survey to receive strong reflections from features found at levels below one meter. Modern noise affected both the magnetometry and GPR data, especially at levels closer to ground surface. The survey area was filled with metallic debris and contained objects such as a large metal pylon supporting high powered electrical lines, all of which masked the values of the magnetometry data. Still, in limited regions with little to no modern magnetic interference, hearths identified by GPR were not detected. This suggests that the hearths do not have magnetic fields strong enough to be detected at these depths. The OBIA model radically reduced clutter in the GPR data and successfully extracted probable archaeological features.

Human interpretation and expert judgement was imperative to delineate all possible Archaic hearths from the GPR data, while excluding features such as utility lines and possible prehistoric burials. Manual examination of radargrams and auger testing also proved that the OBIA excluded some probable hearths, however, this could be corrected by expanding the metrics of the model. Further examination of the radargrams and slices also showed that one probable hearth not included by the OBIA had been separated into smaller polygons due to gaps in the reflectance of the anomalies, reinforcing the need for human interpretation. This problem could also be solved by adding a buffer or proximity analysis to the OBIA steps. All features that were selected by the OBIA and expert judgement tested positive for evidence of human occupation with many containing charcoal and ash. The success of the OBIA was in part due to the size, shape and depth of the Archaic features, along with previous knowledge of the attributes of the excavated hearth. It is important to note that this type of analysis may not suitable for all data. As stated by Verdonck et al. (2019) 'Where the archaeological features belong to one class with a simple shape (e.g., circular structures), relatively simple algorithms can be used'.

The map of the auger-tested probable hearths shows noticeable patterns of clustering, which may indicate the seasonal occupation of small groups. Resources such as nearby springs were more than likely utilized, along with a local abundance of small and large game and freshwater species from the adjacent creek and river. The quartzite and chert debris found during the excavation of the Archaic hearth suggests stone tool production and possible local raw material procurement, which was also proposed by Benthall (1997). AMS radiocarbon dating of charcoal samples may help determine a more robust occupation range. However, it is impossible to know the true nature of the occupation without a Phase III archaeological investigation. The FCR of the excavated Archaic hearth was stacked at a height of greater than 10 cm and was higher in the center of the hearth. The tested features were reached at depth levels ranging from 85-120 cm and exact occupation levels cannot be determined from auger testing alone. The survey area of the park is relatively flat due to decades of plowing and grading from modern construction. The slope and elevation of the prehistoric landscape of the river terrace may have been dramatically different during the Archaic Period. Landscape changes and feature disturbance are also likely, due to both alluvial and colluvial flooding events and erosion.

Conclusion

OBIA is a semi-automated method that can be utilized to quickly delineate homogenous sub-surface archaeological features from pre-processed geophysical data. This method was successfully applied to extract Archaic features from a large GPR dataset using the parameters of a known Archaic hearth. A logical sequence was constructed using computer-generated algorithms within GIS software to eliminate clutter. The result was a time-saving approach that reduced the number of anomalies by over 98 percent and eliminated some of the subjectivity and inconsistency associated with manual interpretation. Expert judgment and auger tests were used to validate the model, resulting in the identification of 16 probable Archaic hearths, of which 14 were successfully predicted by OBIA. This method could be beneficial in processing large datasets where large homogeneous features are expected to be found within geophysical data. OBIA could also be enhanced by future software development that would allow the technique to be implemented on anomalies found within GPR radargrams and 3D geophysical data. OBIA was implemented to target deep Archaic features that are sometimes overlooked, ignored or not identified with certain geophysical techniques, such as magnetometry in this case study. The OBIA of the pre-processed data was completed for one mosaic dataset in under 20 minutes, and while additional time was needed for human interpretation, the selected anomalies were quickly pinpointed within GPR radargrams. Auger testing was a fast and suitable method, as FCR could be felt and heard (and sometimes retrieved) without the need for a full excavation, while still collecting sediment samples and cultural material. Possible occupation patterns were seen through GIS mapping of the probable Archaic hearth locations, adding to the archaeological record of the park and region. By combining GPR, GIS, OBIA, expert judgment and auger testing, a cost effective and labor efficient method was developed that could be utilized to discover similar cultural components at local and regional prehistoric sites.

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CHAPTER 4. DISCUSSION AND CONCLUSION

Discussion of Ceramic Types

Prehistoric ceramics recovered during the ETSU excavation at David Crockett Birthplace State Park match the description of similar pottery styles found at other Woodland and Mississippian sites on the Nolichucky River. The Nelson site (40WG7) is a multi-component prehistoric site located at the confluence of Little Limestone Creek and the Nolichucky River, which is approximately five miles upstream from the park. Franklin et al. (2008) present a discussion on the Middle Woodland ceramics from the Nelson site, along with a brief overview of Middle Woodland ceramic typologies in Southern Appalachia. Middle Woodland ceramics from 40WG7 are described as having a mix of limestone, mica, and sand/grit/quartz tempers with surface treatments consisting of plain, fabric-marked, cord-marked, simple-stamped, and check-stamped (Franklin et al. 2008). These are consistent with pottery types recovered from Middle Woodland pits during the ETSU excavation at 40GN12. Due to the mix of temper types, these ceramics represent a range of regional Middle Woodland phases that are both congruent with and defy previously defined typologies (e.g. Wright-Checked Stamped, Connestee, Pigeon) (Franklin et al. 2008). Benthall (1997) noted that the Middle Woodland ceramics from 40GN12 resembled Connestee series ceramics found in Western North Carolina. Franklin et al. (2008) propose that cultural changes as seen in the ceramic assemblages of Nolichucky sites are influenced by 'contact with groups both inside and outside of Southern Appalachia' (Franklin et al. 2008). This hypothesis is supported by the recovery of probable Hopewell artifacts found at 40GN12.

Mississippian pottery types from the recent ETSU excavation at 40GN12 are also consistent with contemporaneous Native American sites along the Nolichucky. Only one Pisgah sherd was recovered from the plowzone at 40GN12 from the ETSU excavation, and none were recorded by Smith (1980) or Benthall (1997). However, Pisgah phase ceramics have been found at major Mississippian and/or Protohistoric sites on the Nolichucky including Lick Creek (40GN2), the Nelson site (40WG7), Plum Grove (40WG17), and Cane Notch (40WG143) (McIlhaney 1977; Boyd and Radford 1987; Franklin et al. 2008; Ernenwein et al. 2016; Franklin et al. 2017; Shreve et al. 2020). Pisgah ceramics are important in the chronology of Southern Appalachian archaeology, as the Pisgah phase in the Appalachian Summit region (AD 1000-1450) marks the beginning of the Mississippian Period (Dickens 1976). A current study of previous and recent ETSU excavations of local sites, place the Pisgah phase in Upper East Tennessee at AD 1000-1550 based on both AMS and OSL dating techniques (Franklin et al. 2017).

Lamar Incised sherds recovered from the 40GN12 excavation represent a Late Mississippian/Protohistoric occupation and are similar to types also found at Middle Nolichucky Valley sites, such as 40WG7, 40WG17, 40WG20, and 40WG143 (McIlhaney 1977; Boyd and Radford 1987; Franklin et al. 2008; Ernenwein et al. 2016; Ernenwein and Franklin 2017; Franklin et al. 2017; Shreve et al. 2020). Again, these ceramics represent a mixture of previously defined typologies and do not fit the mold of regionally defined Mississippian ceramic types. Several sherds, including a crossmended pot break were recovered from the house floor that match the description of Qualla phase ceramics as described by Brian Egloff (1967), as all were grit tempered sherds with externally burnished plain or Lamar Incised surface treatments. A notched Lamar Incised and micaceous, sand tempered pot break is congruent with the

Nolichucky series as described by Howard Earnest Jr. (n.d.). Shell tempered sherds were also recovered, however, none had Lamar incising. Surface treatments of shell-tempered wares did include check stamping and finger pinched and folded rims with notching, which may be more closely related to styles defined as Overhill by Thomas Lewis and Madeline Kneberg (1946). It is beyond the scope of this thesis to delve into the complexities of the cultural identities of the Mississippian occupation of the Middle Nolichucky River and local region in general. Therefore, it is imprudent at this time to tie a specific group of peoples to the Protohistoric structure that was discovered by the recent ETSU geophysical and archaeological investigations at the park. Refer to Shreve et al. (2020) for a more thorough examination and discussion of Late Mississippian and Protohistoric Middle Nolichucky River Valley ceramics and sites.

Conclusion

The recent geophysical and archaeological investigations at David Crockett Birthplace State Park have revealed new cultural components that have added to the local and regional archaeological record of Upper East Tennessee and the overall Southern Appalachian region. Many cultural components are congruent with previously recorded archaeological investigations of the park and Middle Nolichucky River Valley sites. Newly obtained information has uncovered possible evidence of a Native American village during the Protohistoric Period. The artifacts recovered from the remnants of a partially burnt structure indicate a long-term occupation of peoples who had direct or indirect contact with Europeans. The Middle Woodland pits contained artifacts that suggest interaction with Hopewell groups in Ohio. Based on this evidence, it is plausible that the site was located near or on a major trade route. Previous archaeological work had uncovered Archaic hearths, features, and artifacts, as did the recent ETSU excavation. A semi-automated object-based image analysis of the GPR data was able to successfully identify similar Archaic features, containing cultural material that were ground-truthed by auger testing.

Recent advances in technology have substantially enhanced the ability for archaeologists to remotely obtain data from sites without even breaking ground. Remote sensing techniques have allowed for the exploration of archaeological sites through imagery obtained from satellites, LiDAR, UAVs, GPS, GIS, photogrammetry, and geophysics that were unavailable to archaeologists in the past. The data obtained from these approaches is invaluable due to the lack of funding and resources currently available to adequately recover and record sites. The archaeological, geophysical, and geospatial exploration at David Crockett Birthplace State Park integrated all of these methods to discover new information about the indigenous peoples who occupied the area for thousands of years. However, human knowledge, intuition, and expertise will always be a necessary component in the interpretation of the lifeways of previous cultures.

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