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IDENTIFYING GEOPHYSICAL PATTERNING ALONG THE LANDSCAPE OF THE SILVER GLEN SPRINGS ARCHAEOLOGICAL COMPLEX

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Abstract

The Silver Glen Springs Complex (SGSC) is a collection of archaeological sites that has been thus-far defined by the terraforming regime of shell mounding conducted by fisher-gatherer-hunters that created many monumental constructions. These mounds were destroyed the 1920s by shell mining companies. Modern archaeological investigations into shell-bearing sites in northeast Florida broadly, and the SGSC specifically, have focused almost exclusively on these mounded spaces, leaving the non-mounded areas adjacent to the shell architecture under-studied. A landscape perspective is taken therefore, in order to understand the articulations of the shell architecture and landscape, as well as the total variability of architecture at this site. Geophysical techniques including ground penetrating radar, magnetic gradiometry, and electrical resistance, in conjunction with small-bore coring and test unit excavation was undertaken during the joint University of Oklahoma and University of Florida field school in the summer of 2018. The geophysical survey was conducted on two open fields located between three previously identified shell-bearing loci. The survey tested two things: first, the efficacy of the geophysical equipment at identifying the total variation of sub-surface shell and second, the patterning of sub-surface anomalies that might be suggestive of architecture. The survey identified archaeologically significant anomalies such as deep basin pits as well as bioturbation and modern terraforming. Additionally, the magnetic gradiometer results in the western extent of the survey area are suggestive of large, non-shell, above ground architecture. This area of possible communal gathering outside of the mounds speaks to the importance of non-mounded spaces and highlights the complicated history of ancient and modern terraforming at the SGSC. This survey also identified modern disturbances that suggest the non-mounded spaces were altered during the early twentieth century shell mining. With this in mind, it is possible that the shell-bearing loci were meaningfully connected prior to shell mining. Ultimately, more work needs to be conducted at the non-mounded spaces at the SGSC in order to understand the complicated history of terraforming outside of shell mounds.

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Chapter 1

An Introduction to the Geophysical Investigation of Mound Adjacent Space At the Silver Glen Springs Archaeological Complex

The Silver Glen Springs archaeological complex, situated adjacent to the St. Johns River in northeast Florida, is comprised of many discrete and interconnected archaeological remains and sites: 8LA1, 8MR123, and 8LA4242. These locales are arranged around a first magnitude spring that runs into Lake George. This landscape has been modified and made important by pre-colonial-era fisher-gatherer-hunter Floridians through the creation of shell mounds of varying types, sizes, and orientations (figure 1.1). Terraforming the landscape through the mounding of shell at this complex has been going on for at least 7000 years, transgressing through several archaeologically recognized cultural periods. At least three shell mounds were constructed around the spring run, two linear ridges near the center of the run, and two u-shapes shell rings that bound in the water from spring boil to mouth. These same mounds were almost entirely destroyed through shell mining in the early twentieth century.

Fisher-gatherer-hunters molded their landscape through mound construction undertaken over 200 generations. These mounds are part of a long history of placemaking, and the practices that created these monumental spaces have been intensively studied by archaeologists lately (e.g. Gilmore 2016; Randall 2015; Sassaman et al. 2011). These scholars have emphasized the role that these shell mounded spaces played in both ritual and quotidian life of those who constructed and engaged with these mounds. The social memory that is tied to these mounded places made them gathering places for folks all around Florida and the greater

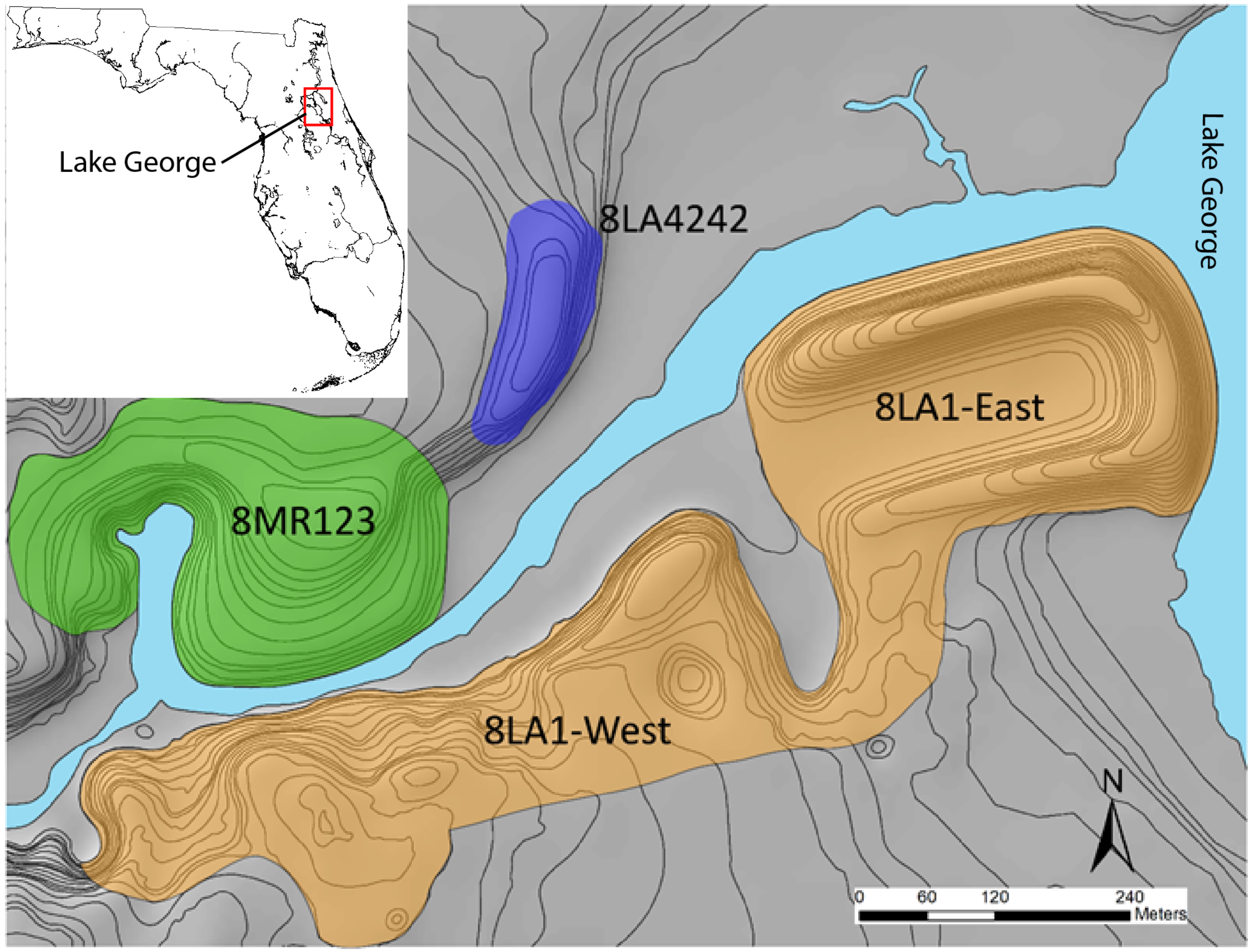


Figure 1.1: Map of the Silver Glen Springs Complex sites in Florida.

southeast (Gilmore 2016: 8-10). While providing needed clarity and correction on the significance of shell mounds, the large volume of research dedicated to understanding these mounds has left the non-mounded areas adjacent to them relatively understudied.

Mounds, in themselves, are single entities that are parts of complex and overlapping taskscapes that can speak to individual and community patterning. So too are non-mounded spaces. The act of digging pits for storage among other reasons should not be relegated to refuse piling but must be understood through complicated patterns of ritualized middening (Gilmore 2015; McNiven 2013; Randall and Sassaman 2017). The role of terraforming the landscape goes beyond mounding and should include digging as well. Appreciating the role pit construction has in placemaking can help explain the complexities of mound-adjacent places.

The terraformed landscape is both constructed and ideational; formed into physical mounds of social memory which are changed or reaffirmed in the ways they are interpreted. For this reason, mounded spaces should be considered just one part of the architecture of the site. In this thesis I treat non-mounded terraforming as part of the architecture of past Floridians. Architecture refers to any logical creations designed with pre-conceived notions of what it is and where it belongs, either functionally or ritually (Moore 2004). With this definition, the practices that gave rise to the mounds and subsequently created the non-mounded spaces can be fully appreciated. Creation of shell architecture, both mounded and dug, necessitates and engagement with the past that is used a reference to future events. As such, they are monuments that are engaged through social memory and give rise to future-oriented decision making (Sassaman 2010: 26). The shell monuments are only meaningful insofar as they articulate with the non-mounded spaces, as the practices that shape them are intertwined.

This thesis investigates the articulation of non-mounded and mounded spaces in northeast Florida. As such, a landscape perspective is adopted. Landscape archaeology attempts to translate the interaction between natural and ideational spaces evidenced through physical remains. In order to engage with this site with a landscape view, this investigation utilized geophysical equipment to understand the range of sub-surface variation of mound-adjacent places at the Silver Glen Springs Complex (SGSC). The capacity of large-scale data collection and interpretation allows for this thesis to approach a time-transgressive view of the taskscapes that formed the non-mounded spaces. The survey area included two cleared and maintained fields that rest between three shell-mounded shell loci that have previously been the target of archaeological investigations.

Four remote sensing techniques were utilized in this investigation: three geophysical and one coring device. Remote sensing at this site was two-fold; (1) the investigation planned to understand the efficacy of multiple devices at identifying sub-surface shell within a well-drained sandy soil, and (2) to capture the total range of variation of archaeological features in the non-mounded spaces. Geophysical testing at this site identified dozens of overlapping anomalies including gopher tortoise bioturbation, modern metal scatter, small shell accumulations, and deep shell-filled pits. Most surprisingly, it identified an oval-shaped cluster of anomalies about 17 meters long and 10 meters wide in the western most edge of the survey area. Based on multiple spatial statistical analysis, it appears that these anomalies might be representative of architectural remains. Such architectural remains are unprecedented in north central Florida.

Additionally, taking the entirely of the geophysical anomalies into consideration, a view of the taphonomic history of the site, with a consideration of modern shell mining, becomes clear. Based on the close association of the geophysical anomalies with archaeological correlates and the five-meter landscape contour interval, it appears that the northern portions of both survey areas were removed during modern intervention. In this way, the character of the Silver Glen Springs archaeological complex is defined by terraforming; the construction of shell mounds and formation of non-mounded spaces characterized the pre-contact landscape, while shell removal and creation of maintained open spaces characterized the post-contact landscape.

This thesis explicitly takes a landscape perspective which seeks to understand social organization through the articulation of physical and manufactured places and their associated ideas. Fisher-gatherer-hunters and other foraging peoples have long been excluded from complex ideas like monument construction (e.g. Lee and Devore's (1968) idea of mobile bands). Recent appreciations of the complexity of foraging groups has shed doubt on this previous certainty and held open the door for considerations of forager monument construction (Grier et al. 2006, 2017). In chapter 2 I investigate the intellectual history of forager monumentality and terraforming, in order to place the geophysical investigation of the Silver Glen Springs complex's non-mounded spaces in a greater context.

In chapter 3 I discuss the culture history of north-central Florida with an eye toward architectural traditions spanning initial colonization of the landscape by Paleoamerican communities to modern dredging regimes. Chapter 4 narrows the focus of the previous chapter by exploring the geologic and archaeological background of the SGSC. A typology of sub-surface pit features is borrowed from Gilmore (2011) and explained in this chapter. Chapter 5 delves into the research design and methodology of the geophysical investigation that forms the basis for this thesis. In this chapter the principles of the geophysical equipment's functionality and the data capture strategies are both made explicit.

Chapter 6 describes the results of the of the geophysical investigations in the survey areas. Anomalies are identified in plan-view for both the gradiometer and ground penetrating radar results, as well as in time-slice profiles for purposed GPR anomalies. Secondary analyses of these results are investigated in the succeeding Chapter 7. This chapter attempts to understand the archaeological correlates of the geophysical anomalies based on test unit excavations, test the efficacy of the geophysical techniques at correctly identifying sub-surface shell, Additionally, a variety of spatial statistical tests are applied to the magnetic anomalies to extrapolate the underlying patterning of the results. Such pattering suggests that a non-shell architectural feature was present in the western extent of the survey area.

Finally, Chapter 8 presents a discussion of the results and the conclusions of the thesis. In this chapter a predictive typology of characteristic anomalies is laid out with an eye towards directing future investigations at the non-mounded spaces. Ultimately what this investigation identified and what this thesis argues for are areas of intensive and less-intensive use of space over time. This landscape has been inhabited for thousands of years and the geophysical results do not have the resolution to date anomalies; therefore, I argue that these two non-mounded spaces are part of a larger complex of taskscapes, with places of more (or less) shell deposition that can be seen in the longue durée.

Chapter 2

Terraformed Traditions and Monumental Memories: The Articulation of Socially Significant Public and Private Spaces

Landscape archaeology provides a platform to understand how communities interact with and are informed by all spaces they inhabit and interact with. Historically, fisher-gatherer-hunter landscape studies have relied on reductive settlement models and an overemphasis on the centrality of mounded spaces, attempting to deconstruct behavioral strategies both ethnographically and archaeologically. A consideration of the underlying assumptions and theoretical paradigms that have made “landscape” of interest archaeologically might be able to illuminate how the shell mounded spaces in north-central Florida were reflective of the communities who constructed and lived with and in them.

Of immediate concern is understanding the interactions of monuments and spaces in-between them. This can be investigated by understanding the theoretical paradigms that shape what can be expected from any consideration of landscape. Ultimately, this articulation can be explained through terraforming (Grier 2014: 216; Grier and Schwadron 2017). Terraformed spaces create differences between areas that are changed and those that are not. The act of making a place meaningful ties it into structural role of social memory. Physical places are inscribed with narrative, made animate with their own intention by people, which then engages those same communities through social memory (Ingold 1999, 2000; Zedeño et al. 2009). A shared history persists through these inscribed places, which subsequently directs future decision making. A landscape approach presupposes that all the places that people use, as well as avoid, must be taken into account when understanding how historical processes and memory articulate with these places.

A landscape perspective leads to the broader question of how fisher-gatherer-hunters organized their spaces. Ethnographic investigations with a keen eye on indigenous ontology of space can provide a framework to understand the variability of foraging community patterning (Grøn 1991; Whitelaw 1994; Zedeño et al. 2009). Interactions between sacred landscapes and dwelling placements can provide reflections of social conventions that formed them. These conventions might have archaeological correlates that can be identified in an investigation of Florida shell mounded sites and their inter-related non-mounded spaces (Whitelaw 1991, 1994; Russo 1994; Jordan 2003). The sum of socially-significant mounded and non-mounded spaces and dwelling architecture explains the total enculturation of an area.

The St. Johns River valley has been occupied, changed, and made culturally meaningful by indigenous Floridian fisher-gatherer-hunters for over 9000 years. This landscape was repeatedly and extensively terraformed by its occupants. Shell and earth were both used to form mounded spaces, leaving a decipherable material record from which spatial organization can be inferred (Randall 2015). Investigations into the arrangements of these spaces have appreciated the occupational as well as symbolic nature of terraforming and monumentality.

The spatial organization of enculturated spaces vis-à-vis monumental mounds and non-mounded landscapes is the focus of this chapter. Monumental mounds are only significant when they are interpolated with other sorts of non-mounded spaces. Investigating the sub-surface variation at the non-mounded portions of site 8LA1 at the SGSC and identifying all occupational patterning can help situate shell mounds and non-mounded places in a larger conversation about monumentality. What patterning exists and how it fits into the larger literature about fisher-gatherer-hunter community patterning through time is the central investigative concern of this thesis.

Landscapes and Memory

Landscape, as an archaeological concept, has been a focus of archaeologists for more than 20 years (Anschuetz et al. 2001). Most broadly, landscape can be defined as the place which and through which memory, social conditions, identity, and transformation are constructed, interpreted, played out, re-interpreted and re-invented. Landscape can be understood through three interpretive descriptors: constructed, conceptualized, and ideational (Knap and Ashmore 1999: 10). These are not mutually exclusive; physical landmarks, such as gypsum buttes in South Dakota, are imbued with individual memory that are reflective of larger community mores and are therefore more-than-physical conceptions which represent and structure community ideas (Zedeño et al. 2009). Constructed spaces fundamentally alter the visual character of a landscape (Knapp and Ashmore 1999: 10-11). These visual changes can result in radical changes in the topography (e.g. shell mounds) or more subtle ones (e.g. shell fields). The visual interruption of constructed places within the greater non-constructed landscape provide significant places for socially structuring social memories to be attached.

These three interpretive frameworks tap into a broader consideration of commemorative places. Places are spaces that have been inscribed with significance, typically on the basis of a past event or attachment on the individual and community level (Van Dyke and Alcock 2003: 5).

Monuments and landscapes can hold individual memory and significance, but the memories that shape future decision-making are tied to social memory (Connerton 1989; Hutton 1993). Social memory, being the inscription of importance to past events, is a collective notion of the way things were in the past (Van Dyke and Alcock 2003: 2). Social memory is not immutable, rather it can be interpreted by gender, class, religion, ethnicity, and other factors. The significance of social memory is also variable. It evolves out of acts of remembering, forgetting, and intentional changing such as palimpsests where areas are continuously inhabited (Van Dyke and Alcock 2003: 1).

The significance of landscapes therefore is multi-foliate. Indeed, landscapes themselves are not easily definable. A landscape is a notion, rather than a physical thing. It consists of natural, physical things and ideational constructions, but it in and of itself is not "nature" (Ingold 1993: 161). What shapes landscapes then are the practices that the inhabitants engage in. These practices, termed "tasks" by Ingold (1993) are the constitutive acts of dwelling. Tasks are both individual and communal, forming "taskscapes" that are the entire ensemble of possible tasks involved with a physical area. These taskscapes shape the interaction between people and environment, contributing to cultural and symbolic interpretations of places. Just as landscapes are not inherently "natural," taskscapes are not inherently "cultural." Rather, these two concepts are interrelated and form the breadth of experiences tied to place and placemaking.

Landscapes and taskscapes are the product of "interanimation" (Basso 1996: 55). This term describes the constant mutual molding of places both natural and the product of human intervention and the people who dwell in them. This concept has been expressed as "sacred" landscapes in previous works (Alcock 1993; Thomas 1991, 1993). "Space" broadly defined, is a medium for and the product of human decision making with varying degrees of social significance (Tilly 1994: 10). Spaces are made meaningful by the actions that shape them, and necessary cannot exist apart from those actions.

Mounded spaces, therefore, are the result of a defined taskscape involving movement of raw material; they form the nexus for social memory for the community engaged with the construction of these spaces and those that re-occupy and re-interpreted these memories. These mounded spaces are inscribed with significance and the maintenance of these mounds reinforces the landscape as identity-making (Knapp and Ashmore 1999: 15). In this way, they are "sacred" in so far as they are a product of interanimation. The act of re-surfacing shell mounds over time, for example, reinforces the inscriptions between place and people through renewal (Randall 2015: 14). Mounds as ritual spaces can be defined through the framework of Rowlands (1993) practice perspective. Archaeologically significant distinctions are made between inscribed memory practices, which are characterized by repetition of practice and public access to place and event, and incorporated memory practices, defined by metaphoric symbolism and secrecy. Memory and its capacity to shape social identity and direct future decision making are created through both prescriptive, repetitive, and archaeologically evident actions (i.e. mound building) as well as mutable, performative, and symbolic actions (i.e. ritual and moral conventions) (Sahlins 1985; Bloch 1986).

In an attempt to understand fisher-hunter-gatherer realities more holistically, the non-mounded spaces that articulate with the intensively studied mounded area must be investigated with the same keen eye. Non-mounded spaces could have been used for residence of communities that engage with or are somehow are meaningfully connected with the social memory of mounded spaces. Ethnographic examples suggest that foraging community settlements may take on different shapes and involve different types of terraforming. Settlement shapes include the organization of individual dwellings in relation to each other as well as the overall distribution of dwellings over a certain scale of the landscape (Whitelaw 1994).

Monuments and Terraforming

How are mounded and non-mounded spaces articulated, and furthermore, how meaningful are these articulations? Previous archaeological investigations directed at this question have identified the historical importance of mounded spaces, particularly shell mounds in the middle St. Johns River valley. Shell mounds were places of occupation and ceremony, where communities gathered to deposit objects continuously (Randall et al. 2014). These mounded spaces were often revisited and re-constructed by subsequent groups than those that initially constructed them. For these reasons, shell mounds engage in social memory and enculturate the landscape as monuments or spaces of social poignancy. Landscape inculturation has been extensively invested by recent scholars that reject earlier functionalist arguments of shell mounding (Sassaman 2010; Randall 2015; Gilmore 2015, 2016; Randall and Sassaman 2017). The concept of enculturation is borrowed from Jordan (2003), who investigated the ways in which animated material culture perpetuated landscape-specific social memory. Essentially, enculturation refers to the practices that imbue a landscape with symbolic meaning that directs everything from social organization to settlement patterning.

Terraforming, monumental constructions, monuments, and monumentality definitions are borrowed from Grier's (2017) operational framework. Terraforming, a term borrowed from science-fiction, refers to the manipulation, alteration, and construction of architectural elements through moving physical building materials. In science-fiction this term is used to describe actions and practices that make planets inhabitable for humanity. This general concept of making an area more hospitable is re-interpreted and operationalized though archaeological investigations of the built environment. Terraforming is multi-scalar, being applied site wide or Locus specific. Monumental constructions are any large-scale physical feature produced through terraforming. The intention of this definition is not to simply classify shell mounds as merely large shell constructions but to identify the social practices that produces such massive additions to the built environment (Grier 2017: 5).

Monuments, in conjunction with terraforming and monumental construction, are features that engage with social history in a meaningful way. Monuments incorporate a physical element as well as a socio-historical process that perpetuates history and how that history is interpreted. Monuments are often monumental constructions; however, they are nor limited by scale. Any element that engages with communal history in a physical way is a monument. Similarly, monuments can exist in a multitude of time-scales. Monuments can be formed over hundreds of years or a few months, and their longevity is similarly complicated. Monuments are meaningful insofar as communities engage in sequential investments of labor and materials. Monuments are predicated on their involvement in and their capacity to draw upon past events in social memory in order to direct future social action by those interpreting them (Pauketat and Osborne 2014; Randall 2015). Monumentality defines the processes and practices involved in terraforming and the resulting monumental constructions, and how architectural elements produced through social action are interpreted and are utilized as monuments (Grier 2017: 6).

Terraforming, monumental construction, monuments, and monumentality are integral in archaeology from the landscape perspective. Landscape archaeology is focused on identifying how the various elements of a landscape (bodies of water, mountains, and including flora and fauna, etc.) articulate together to form something that is culturally meaningful. The landscape can be made similarly meaningful through human intervention. The process of enculturating a landscape is functionally predicated on how people live and manipulate the same landscape within set structural methods (Jordan 2003).

How do Fisher-Gatherer-Hunters enculturate spaces?

"Enculturated landscape" engages in the concept of placemaking, a theory central to understanding the shell monuments of Florida by many recent scholars (Sassaman 2010; Randall 2015; Gilmore 2016). Placemaking provides a theoretical framework to grapple with questions about why places persist over many hundreds or thousands of years (Brück 1999). Places are given intention and personified through substantive community and individual memories, reinforced over generations. For instance, Torres Straits Islanders remembered places carry spiritual or ceremonial positions associated with them which confer obligations on to community members to keep the memory alive McNiven (2004). While this ethnography engages with modern Australian aboriginal communities, the intellectual framework that addresses how the structure of encultured landscape persist can supply an operationalized understanding of the terraformed landscapes by ancient Floridians.

Placemaking is intimately connected to Bourdieu's practice theory. Bourdieu's concepts of *doxa* and *habitus* are involved in studying social reproduction of structure in everyday life.

Specifically, *habitus* is central in regulating individual practices that are directed towards available social structures (Bourdieu 1977). The practices of one's daily life exist within the framework created by those same practices. This self-referential system is mutable and can help explain long-term cultural shifts, as well as persistence of place and culture over a long period of time. For instance, the actions undertaken during the initial creation of shell mounds required a physical practice and can be seen as a representation of or the reconstructing of social conventions (Classen 1993).

Social memory, following this logic, informs all practices, including infrastructural creation. Social memory as a sociological concept is derived from de Certeau (1984). This type of memory is formed by linkages between different places and people in the enculturated landscape. Practices that involve the landscape in a meaningful way (i.e. terraforming, monument construction, domestic development) are called "inscriptive" practices. These inscriptions exist physically as a reminder of past landscape interactions and subsequently effect how people move across said landscape. Places formed from the landscape can become part of multiple biographies, such as: site, sacred, group, and individual (de Certeau 1984; Randall 2015: 80). Domestic spaces and other non-sacred spaces (and therefore non-mounded) are the mundane places were lives happen, where places are made living, rather than perceived as living.

The built environment encapsulates all intentional products of construction, which includes classically understood domestic structures with posts and walls as well as terraforming activities, such as pit digging and mounding of both earth and shell. "Middens" should not be understood by the same logic employed by Wyman in 1875 in his definitions of early Florida. Wyman borrowed a Danish term for his interpretations for all anthropogenic shell accumulations:

“kjokkenmoddinger,” which translates to roughly “kitchen trash heap” (Wyman 1875). Essentially, “midden” constrained pits to local resources and domestic contexts. Today, the word “midden” is often used to denote an accumulation or pit filled in will different soils, materials, or otherwise used contents (e.g. Marquardt 2010), but the word’s intellectual heritage ties it to an older perception of site function. It is the author’s suggestion that middens should not be locked into western perceptions of what is “garbage,” which implies its usefulness is null but instead understood within their own temporal context.

McNiven’s Australian ethnography brings us the concept “ritualized middening.” This concept was made after watching indigenous Australians sanctify places by depositing things in pits, following a sacred architectural grammar. The practice of carving out the earth and the depositing of shells and other so-called garbage in and of itself was ritually significant. The pits themselves became part of a spiritually “living architecture” which in turn carried social obligations for members of the community (McNiven 2013: 573). The same logic is applied to middens, even in domestic contexts, in ancient Florida.

McNiven’s larger theoretical contribution rests on his expansion of Halbwachs’ (1980) and de Certeau’s (1984) concept of place biographies. Places of utilized (e.g. mounded) shell are only significant insofar as they are related to those whose memories and social relationships were created during the capture, consumption, or disposal of the shells. The placement of material or object at a specific site carries with it “reciprocal care” as well as obligations that the depositor is expected to continue the same practices (McNiven 2013; Randall 2015).

“Ritualized middening” reinterprets ritual places (such as shell sites) that ascribe social obligation as “living architecture” (McNiven 2013: 573). McNiven introduces two key concepts that can be used to understand the formation and reuse evident in Florida shell mounds: “referencing” and “discrimination.” Referencing is the act of interring sacred or symbolically important things into living architecture. These interred objects include animal and human remains. The remains are used to permanently sanctify these spaces as well as continue the midden’s agency within its social and symbolic significance (McNiven 2013: 574). The practice of discrimination considers differentially significant objects to be included in the midden depending on the intention of the group involved in its construction. These two concepts have been fundamental in many recent studies of the St. Johns River valley, and Florida writ large.

McNiven’s concept of living architecture of ritualized middening provides the space to consider broadly how spaces are inhabited. All pits, mounded, and non-mounded spaces play into site biographies. The continuing use of practice theory concepts can further address the “how” of shell mound construction, and the incorporation of McNiven’s ideas of landscape and social memory can start to address the potential “why” questions.

What do Fisher-Gatherer-Hunter settlement spaces look like?

In the preceding section, I described various ways in which hunter-gatherers have been demonstrated to make landscapes sacred. In this section, I consider what the record of more mundane daily behavior might look like, and how that might intersect with the less than ordinary. The social and spatial consequences of sedentism is not clearly defined in ancient Florida, in fact, recent investigations into monumentality of shell mounds has identified how the landscape was enculturated appears to have more bearing on monumental construction and monumentality than mobility (Randall 2014, 2015; Sassaman 2010). The landscape of north-central Florida is encultured through meaningful changes in the form of monumental construction that are built by community practice and this monument acts to re-create that history. Such monuments can be manifested though terraforming practices. These are done for ritual, utilitarian, and cultural impetuses (Randall and Sassaman 2017). In order to understand the connection between monumentality and settlement patterning the whole landscape of ideas needs to be investigated.

There is ample writing on the connection between physical places with social memory and foraging community locations. Namely, how communities that are engaged in seasonal or annual mobility strategies engage with the mythic and historical past of places to orient their places of gathering and settlement (Jordan 2003; Zedeño et al. 2009). The Siouian-speaking Mandan and Hidatsa draw historical connections between place, travel, memory, and identity in relation to their settlements (Zedeño et al. 2009: 108). Writ-large, the connection between social memory and place is tied to gathering and events (Gilmore 2016). Community gathering events tie distant peoples together in time transgressive events that both re-confirm and re-interpret social connections. Shell mounds in north central Florida are one such place where this community gathering happens. The spatial organization specifics of dwelling arrangements of gathered people is not adequately researched.

Ethnologists and archaeologists studying the spatial organization of foraging communities in the ethnographic record have identified cross-cultural patterning that ties occupational strategies with social conventions. Settlement patterns are typically either linear, circular, or U-shaped. Commonly, linear and U-shaped community patterning is associated with nonegalitarian groups, while circular community gathering is considered more equal. This is not a rule of thumb however, as extraneous circumstances such as environmental and ritual conventions muddy this supposed “equal” vs. “less-than-equal” divide.

The preceding theoretical considerations have been operationalized in archaeology though a consideration of the reciprocal nature of settlement patterning and social systems (Grøn 1991). Human spatial behavior contains “metaphors” which according to Grøn are relatively consistent through time and in different cultures. Villages, being multiple dwellings organized with some kind of spatial logic, are based on the assumption that the spatial metaphors used to communicate social relationships between individuals at the household level are similar to community-level relationships between distinct houses. Archaeologically, the scalar-issue of block excavation will not be sufficient enough in scope to address these larger spatial arguments (Grøn 1991: 113). One possible solution to this issue is to employ remote sensing to get a larger view of sub-surface variation that might hint at spatial patterning.

The orientation of individual dwelling spaces within villages has been interpreted as either partially representative of social organization (Levi-Strauss 1963: 534), entirely representative (Chang 1958: 306), or only vague select social or economic aspects of the social group (Watanabe 1986: 490). Early investigations into spatial arrangements borrowed heavily from Levi-Strauss’s structural anthropology and social psychology. Early normative arguments claimed that linear settlement arrangements were representative of more hierarchical societies and circular or oval settlement were more representative of egalitarian foraging societies (Clastres 1972: 150; Fraser 1968). This coarse-grained analysis compared ethnographic communities cross-culturally, however, these comparisons quickly came under scrutiny.

Whitelaw (1991) argues that the orientation of hunter-gatherer settlements was not predicated on social hierarchy, but rather in relation to socially and ritually significant ideas. In fact, the spatial distribution of semi-circular or U-shaped settlement strategies might be suggestive of a hierarchical society, with a central house or leader and subordinate houses proceeding from either side of the center (Grøn 1991: 105-106). U-shaped shell rings of the coastal plain in the American southeast appear to sustain this suggestion. Often, shell rings are elevated near the center of the curve forming a literal hierarchy in space (Russo 2004). Additionally, a connection is made between foraging community orientation and characteristics of the physical environment such as bodies of water and mountains (Jordan 2003; Whitelaw 1991: 181). The Siberian Khanty forager group were orientated their arrangement with respect to the river. This formed a linear unit, even though their lacked a traditional hierarchical structure. Also, their movements across the landscape was entirely centered around seasonal movement up-stream, for sanitation and symbolic reasons.

Regarding the variation of hunter-gatherer settlement arrangements, Whitelaw (1991) discusses the linear arrangements of a hierarchical Pacific northwest coast foraging indigenous community. Rather than confirming earlier models, this example is an outlier. Most linear arrangements of foraging groups, notes Whitelaw, are due to co-habituating groups that are not closely kin related or are part of symbolic arrangements involving socially significant spaces. This connects with a larger body of research focused on the people-space relationship encountered by hunter-gatherer communities (Whitelaw 1983: 49). The primary factor in determining the settlement strategies for foraging groups is two-factor: the number of individuals, and the spacing of these individuals from each other. With this in mind, archaeological investigations might be able to ask questions beyond “how many” people were there, and towards questions about the inter-connectedness of communities at a site (Whitelaw 1983: 63). Following this logic, the spatial orientation of settlements around areas of social gathering, like shell mounds (Gilmore 2016), might shed light on how far-ranging these gathering places attracted people.

How then do non-mounded spaces, presumably where individual dwellings were located, articulate with ritual space? Identification of houses has proven to be exceedingly difficult in Florida, potentially due to high acid content in the surficial geology. Therefore, little is known about the size of family houses (the basic model for the functionalist arguments above), or even if archaeologically identifiable houses were constructed at all in ancient Florida. The division of space between gender, cultural, and ritual lines are often made manifest through physical building construction. Divisions of labor, supposedly identified archaeologically through middle-range theory and toss-drop zone dichotomy, might be more opaque than first thought (Binford 1983: 153). The necessity of buildings in patterning social organization, however, is not an *a priori* requirement (Whitelaw 1994: 225).

House-like dwellings are not required for settlement patterning; however, this makes it more difficult to identify archaeologically. As defined by Whitelaw (1983) the distance between domestic units is as integral to the spatial and social organization of an area as the number of people in a community gathering. This fundamentally comes down to control of space through private and public areas. Monumental spaces like shell mounds are part of the public infrastructure of a site and part of an inter-site network of interanimated places with distinct social memories tied to them (Thompson and Pluckhahn 2012). Traditionally, the areas outside of mounds are considered public spaces. The division between private and public spaces is both physical (raised elevation in mounds) and symbolic seen ethnographically in !Kung "notional" huts (Whitelaw 1994). Areas marked for private family space were divided simply placing sticks on the ground as a demarcation between public and private space. This example can supply an analogy within which the need for domestic architecture is not necessary to explain social patterning. This lack of built environment will not leave an archaeological record and might complicate investigations into non-mounded spaces. Therefore, the use of non-destructive, wide-ranging remote sensing equipment might hint at the kind of residential remains present in these spaces.

Concluding thoughts

Two theoretical concerns are addressed in this thesis; (1) the immediate problem of understanding monuments and the spaces in-between them, and (2) the broader question of how fisher-gatherer-hunters enculturate spaces. The former concern is addressed by considering the extensive terraforming regime that foraging communities engaged in, separating spaces into constructed, conceptualized, and ideational places. These places are referenced by the events that went into making them and act a nexus for future decision making. They are made meaningful through inscriptive processes which then shape the communities engaging with their memory. Places are made meaningful due to the practices that create them. Seemingly random assemblages of shell and consumption remains can be made ritualized though community intuition. The social memory ascribed to mounded spaces make the monumental in their reach, shaping group interaction and recollection of communal memory.

Made places are important for community structuring. Subsequently, they act as gathering places where groups actively engage with their histories. How these communities actively engaged in the occupying the landscape is less than clear in north central Florida archaeologically. As such, interpretative frameworks are borrowed from diverse ethnographic examples. The Khanty (Jordan 2003), !Kung (Whitelaw 1983, 1991, 1994), and Siouan-speaking communities (Zedeño et al. 2009), that have been investigated with an eye on indigenous ontologies. Additionally, the interaction of public/private shell rings from the coastal plain of the southeast (Russo 1994, 2004) provide a topical example.

Public shell architecture has directed most investigations into landscapes and taskscapes of ancient Florida, leaving the non-mounded spaces largely ignored. There are many “taskscapes” that are potentially present at non-mounded spaces, the issue is that focuses on monumentality can obscure all the potentially overlapping taskscapes of daily and non-daily life. How potentially private places were occupied and the social organizations that they might reflect need to be investigated with a holistic approach. In the next chapter, I review the culture-history of northeast Florida with an eye towards understanding the changing nature of architecture and space through time.

Chapter 3

Culture-History of Middle St. Johns River Valley

The St. John River Valley has been almost continuously occupied by people for over 12,000 years. The fisher-gatherer-hunters who lived along the edge of the roughly 500-kilometer river engaged in complex practices of terraforming, such as constructing monumental architecture out of the naturally abundant shellfish in the river (Randall 2015). These constructions were arguably a lasting narrative device that likely created a living history of the people who built them (McNiven 2013, Randall 2015).

The subject of this thesis is the middle St. Johns River basin, which is a roughly 125-kilometer run of the river encapsulating the highest density of shell bearing sites in the region (figure 3.1) (Randall 2015). In this chapter, I examine the time-transgressive architectural canon (or pattern of styles, formation practices, and utilization that acts as a model for each time period), created by regional communities that is characterized by shell accumulations. I argue that archaeologists can use this canon to understand ancient use of space and explore its potential implications through time. Broadly defined, the 9000 years of occupation in this area is separated into three archaeological time periods: Paleoindian, Archaic, and St. Johns (a regional Woodland/Mississippian culture group) (Table 3.1). Major changes in the architectural canon also fall along these lines.

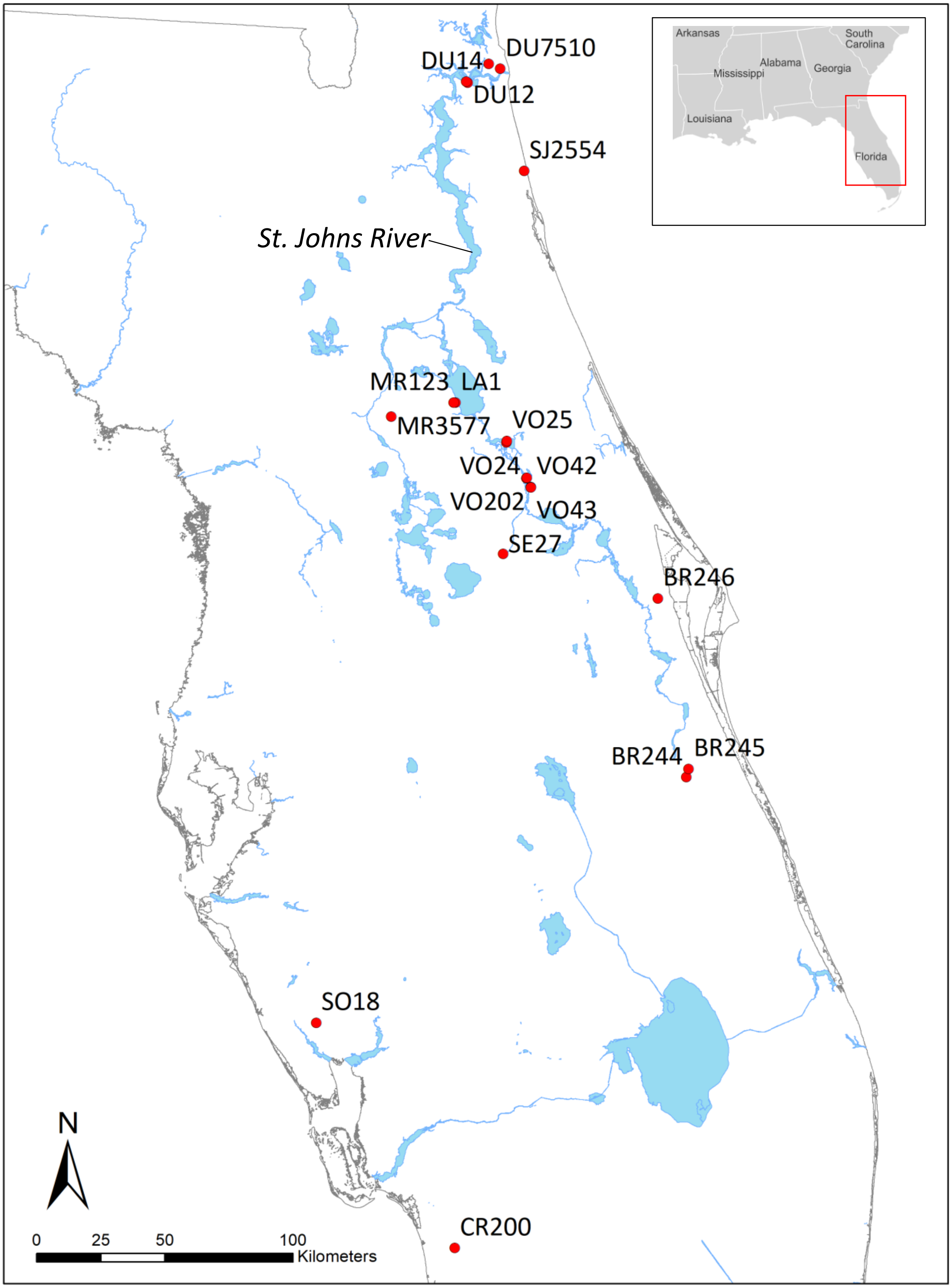


Figure 3.1: Map of all sites discussed in the thesis

Table 3.1. Cultural Sequence of Middle St. Johns River Valley
(after Anderson and Sassaman 2012: table 3.1)

Cultural Period	Date Range (Years cal BP)
St. Johns II	1250 - 500
St. Johns I	3600 - 1250
Orange	4600 - 3600
Mount Taylor	7400 - 4600
Thornhill Lake	5700 - 4600
Early Mount Taylor	7400 - 5700
Middle Archaic	9000 - 5700
Early Archaic	11,700 - 9000
Paleoindian	13,500 - 11,700

This chapter focuses on how the communities along the middle St. John River Valley modified their landscape, both above and below ground. Major focus is given to the constructed environment which takes the form of infrastructure (post-structures) and terraforming, which encompasses both intrusive (pit features) and built-up (sand and shell mounded spaces). A broad typology of each archaeological time period's architectural canon and settlement patterning is drawn out. These architectural features are categorized as an aid in contextualizing the geophysical investigations at the SGSC.

Culture-History and Characteristic Architectural Canons

Paleoindian and Early Archaic Periods (13,500 – 9000 cal BP)

The Paleoindian and Early Archaic period in northeast Florida is poorly understood, architecturally and archaeologically. Rising sea levels in both coastal and inland estuarine environments has similarly submerged Paleoindian and Early Archaic sites. This lack of visibility has as much to do with rising tides as it does with initial site formation. Both period's communities preferentially selected areas near sinkholes and well-watered places for a variety of uses (Milanich 1994: 106).

Any artifactual and any potential architectural evidence of the Paleoindian period in Florida is poorly preserved due to acidic soils and to Florida's low-lying topography which allowed for kilometers of shore-line transgression during the terminal Pleistocene (Randall 2015). Most of the Paleoindian material remains are preserved on karst outcroppings, away from the acidic fluvial soil formation at lower elevations (Milanich 1994: 43). The earliest Paleoindian groups did not appear to engage in shellfishing, or at least not even approaching the scale of later Archaic groups, therefore no shell architecture is recorded. Sassaman's (2003) survey of Crescent Lake identified a possible Paleoindian occupation preserved below the water, however no spacing data nor architectural remains were recovered.

Paleoindian occupational spaces in Florida are identified by the ephemeral remains they leave behind, such as lithic reduction flakes and butchered mega-fauna bones (Dunbar 2016). Traditionally, Paleoindian occupation is identified by their distinctive bifaces. Evidence for fluted hafted bifaces is present in Florida, as well as several local types without the classic flute but sharing other morphological similarities, identified as Simpson and Suwanee varieties (Bullen 1975). Paleoindian occupational spaces are identified in Florida by lithic reduction areas, which scattered nature makes spatial pattern of potential occupational spaces difficult to identify. Pit features strongly associated with Paleoindian occupation are exceedingly rare in Florida.

The community patterns of the Early Archaic period in Florida have been difficult to identify, similar to the earlier Paleoindian occupations. Their technology is characterized by introduction of the straight stemmed projectile point (Bullen 1975). The Early Archaic's architectural history is similarly obscured by increasing sea-levels at the end of the Pleistocene and the beginning of the early Holocene. The absence of post-molds and the few examples of prepared surface (most from Dust Cave in Alabama and similar cave sites north of Florida) makes it clear that few, if any architectural remains persist for these archaeological time periods.

Early Middle Archaic (9000 – 7400 cal BP)

The Middle Archaic period is concurrent with the beginning of the Altithermal period of the Middle Holocene. This climatological period changed Florida into a well-watered ecology, within which Archaic shell mounding commentates flourished (Saunders and Russo 2011). The communities of this time period are traditionally characterized by their use of stemmed hafted bifaces, exchange networks that span the greater southeast, and large scale aqua-centric landscape utilization (Anderson and Sassaman 2012: 74).

The early Middle Archaic period is not well defined. This archaeological period is the beginning of the fisher-gatherer-hunter subsistence economy (Randall 2019). Cerimele's (2017) analysis of sub-Mount Taylor mound pit features revealed the regime of shellfish, small fishes, and sparse ungulate faunal remains. The early Middle Archaic period is when the first architectural elements appear in Florida's archaeological record. The Windover site (8BR246) is the oldest mortuary complex in Florida, and indeed one of the oldest in the greater Southeast, dating to roughly 8900 calendrical years before present. The site is located along the St. Johns River, just south of the middle St. Johns River Valley. This site is a mortuary located within an anaerobic pond, exhibiting the first structures in Florida (Doran 2002). Individuals interred in the pond were staked down in textiles by specially made posts. These posts were uniformly manufactured based on a few examples preserved in the oxygen-deprived muck of the pond. This sub-aquatic burial practice is concurrent with the Locus A pit features excavated at the Silver Glen Springs site (Randall and Sassaman 2017).

The Windover-style posts are part of a greater mortuary architecture, with similar post manufacture and use at other pond burial sites in Florida: Little Salt Springs (8SO18) and the Bay West site (8CR200). These roughly contemporaneous sites utilize the same stake and pond architectural canon (Beriault et al. 1981; Clausen et al. 1979). Additionally, Little Salt Springs contains shell-filled shallow basins potentially excavated during the early Middle Archaic or the succeeding Mount Taylor Middle Archaic period. These pits characterize the so-called “habitation area” which might potentially indicate that the early Middle Archaic pond burial communities

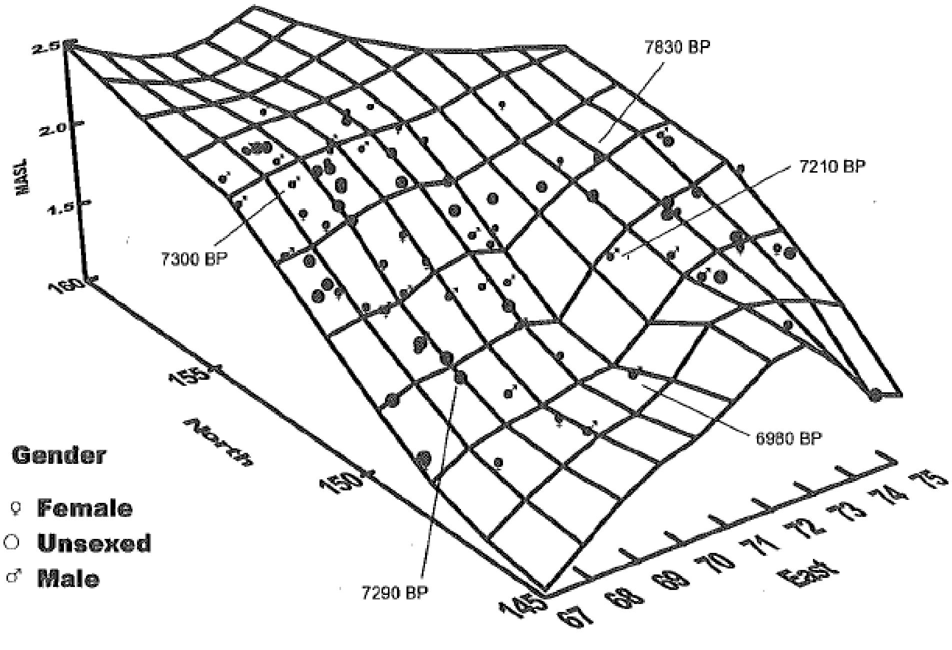


Figure 3.2: Southern pond burial distribution locations with associated Carbon 14 dates rendered in 3D. Notice the harsh slope and the clustered burials below it (Doran 2002: figure 3.2)

were engaging in shellfishing. Beyond these early pond mortuaries, the material remains of early Middle Archaic communities is equally elusive as the earlier Paleoindian groups, consisting of bone, antler, and lithic artifacts (Penders 2002). Unfortunately, the original spatial distribution of individuals interred in Windover pond burials is unknown due to colluvial soil formation below the surface of the wetland (figure 3.2) (Doran 2002).

Mount Taylor (7400 – 4600 cal BP)

The Mount Taylor period is separated into an early Mount Taylor phase (7400 – 5700 cal BP) and the Thornhill Lake phase (5700 – 4600 cal BP). The distinction between these phases is primarily based on material object production, mortuary practices, ritual landscape, social interaction, and as is explained here, architectural canon (Beasley 2008; Endonino 2008). Additionally, the Mount Taylor period communities utilized the landscape and deposits shell in a fundamentally different way from the preceding early Middle Archaic community. The vast quantity of shell was deposited in pit features and accumulated above ground, known as shell sites. Randall (2013) identified three shell depositional "episodes," dating to 7400 – 6350 cal BP, 6350 – 5700 cal BP, and 5700 – 4600 cal BP).

The known Mount Taylor period architectural canon is defined by the construction of shell mounds, shell fields, small post-structures, and complex mortuary practices. Subsistence economies consistently focused on the fisher-gatherer-hunter paradigm, with shellfishing, fish-capture, and ungulate food items. The lack of fish-hook artifacts suggests that the collection strategies of the Middle Archaic emphasized net-able fishes and other aquatic fauna (Blessing 2011). Seasonal mobility was bound in by the mortuary mounds that dotted the middle St. Johns

River basin. Settlement patterning consists of linear domestic habitation sites, mostly found along estuary and coastal lagoon ecotones (Randall 2019). Aggregation sites were the lynch-pins of Mount Taylor phase communities. Shell mound architecture was consistently re-surfaced throughout the Early Mount Taylor period, and Thornhill Lake period communities constructed sand mortuaries that bear evidence of extra-regional exchange networks (Endonino 2008; Randall 2015, 2017). Monumental shell architecture is the defining canon of this time period.

The Middle Archaic communities engaged in a seasonal mobility patterning, modeled off of the variable mortuary practices at the Harris Creek site (8VO24) and other Mount Taylor shell-ridge mortuaries. These mounds are part of the domestic and ritual landscape of the middle St. Johns River Basin, and repeated occupation and shell deposition is the practical manifestation of Mount Taylor traditions (Gilmore 2016). Abandonment and reoccupation of sites tie these communities into a complex web of interactions both regional and local. Rates of shell site creation are related to changes in population density and composition (Randall and Sassaman 2010). These fluid communities engaged in object-oriented exchange across the greater Southeastern United States, most evident thought the inclusion of bannerstones in mortuary tradition during the Thornhill Lake phase (Endonino 2008).

Both phases of the Mount Taylor period are characterized by extensive shellfishing and terraforming. Mounded shell and shell-filled pits form the basic architectural elements of Mount Taylor period communities (Randall 2015, Wheeler et al. 2000). The terms used to describe the architectural features are borrowed from Randall (2015) who ultimately derived them from Wyman (1875). Shell mounds were formed into ridges, with the average dimensions being 100 meters in length, and 5 meters in height, typically at a north-south orientation, otherwise parallel to bodies of water. These ridges are either formed into linear arrangements or "bean" shaped accumulations (Moore 1893). The ridges are comprised of fresh water mollusk shells. Two types of gastropods, banded mystery snails (*Viviparus georgianus*) and the Florida apple snail (*Pomacea paludosa*), and freshwater clams from the Unionidae family are the most common building material. These species are present in the mounds in either discrete layers separated by species or combined into one or several heterogenous layers (Randall 2015).

Within and below these ridges are many pits, thermal features, and faunal remains. Many of these Mount Taylor mounds are palimpsest as they were constructed on top of earlier pit features. The relatively shallow basins of many of these basal puts suggest domestic occupation of some kind below these mounds (Sassaman et al. 2011). These ridges might have capped off a domestic area after the community that occupied them vacated (Randall 2013). Additionally, shell "fields" are architectural elements defined as broad, low-elevation shell accumulations. These fields were utilized by later period occupations and articulated into their own architectural canons. These fields were often associated with shell ridges. This suggests that Mount Taylor period communities lived in linear villages (Randall 2015). This means that each architectural element drawn out in this paper is not discrete, but they are all interconnected into the larger terraformed landscape.

While the initial construction of shell ridges might have capped an occupational event, their functional histories are varied. Some mounds were constructed relatively rapidly, in fewer than 100 years, while others were consistently in the act of creation for millennia (Randall 2015). Several Mount Taylor mounds were also dedicated mortuaries. Indeed, one of the markers for the start of the Thornhill Lake phase is the construction of conical sand burial mounds (Endonino

2008; Randall and Tucker 2012). At the Thornhill Lake site, conical mounds were built on top of an existing Early Mount Taylor phase shell ridge suggesting the importance of placemaking via repeated re-use of spaces over thousands of years (Endonino 2010). Additionally, most shell ridges are placed parallel to the run of the river, often bounding it on both sides with two shell mounds. Perhaps this has to do with the placement of occupational spaces, as the St. Johns River hunter-gatherer-fishers often resided close to the water, where ridges accumulated after abandonment.

Taken thus far, the overall architectural grammar of the Mount Taylor period is defined by shell deposition and mounding. Shell ridges were spaces where communities engaged with their history in meaningful way, including mortuary ritual. The Harris Creek site (8VO24) site is comprised of five ridges that interconnect, with two prominent mortuary contexts (Bushnell 1960). This was a multi-component site, with most of the ridges constructed after the Mount Taylor period. Due to extensive shell mining over several decades in the twentieth century, most of the Harris Creek site was destroyed. Bullen performed salvage excavations in 1961, uncovering dozens of buried individuals eroding out from a shell mined cut bank (Aten 1999). This is one of the only Mount Taylor period mortuary mounds that has been excavated and published on, thus most of the architectural and mortuary traditions attributed to the Mount Taylor period are biased towards this site's construction. That being said, the detailed construction history was reconstructed by Aten (1999). The burial mound is composed of at least seven construction phases, indicating repeated occupation and construction. Two of the layers have unique architectural remains: layer 3 (Mortuary A) which is the earliest mortuary characterized by white sand in association with burials, layer 4 (Mortuary B) is a second mortuary, containing the so-called “black zone,” an amorphous pit that was filled with highly organic content (Aten 1999). These three layers are built above an earlier Archaic shell field. Additionally, layer 7 expanded the Mount Taylor ridge dimensions and has evidence of prepared floors, thermal features, and one additional burial into lower strata.

The Harris Creek site presents the most intact evidence for Mount Taylor period mortuary practices and architecture. Mortuary A consists of a mass grave pit of 11 individuals placed within a matrix of white sand, cut into the lower basal shell field of layer 2. This pit is approximately 1.1 meters in diameter and 90 centimeters deep. Other, smaller graves were also placed in similar white sand contexts containing no more than 2 individuals per burial. Mortuary B consists of individual burials placed into dark brown sand pits, sometimes intruding into the lower white sand of the first mortuary complex. Thermal features appear to be associated with mortuary B both at the bottom of pits and above them, perhaps as a part of the ritual apparatus of the site (Aten 1999).

The black zone’s use remains unknown. No burials are located within the dark matrix, rather they are located all around it. Initially, the post-molds found in layers 3 and 4 were considered part of a charnel house that would have sat on top of or nearby the pit of highly organic matrix (figure 3.3) (Bushnell 1960). Aten’s (1999) re-investigation suggests that due to the maximum depth of the posts below the black zone, that the multiple layers of posts are associated with the white sand mortuary. Indeed, this site has some of the only evidence of post-molds from the Mount Taylor period. Their placement within the white sand mortuary implies

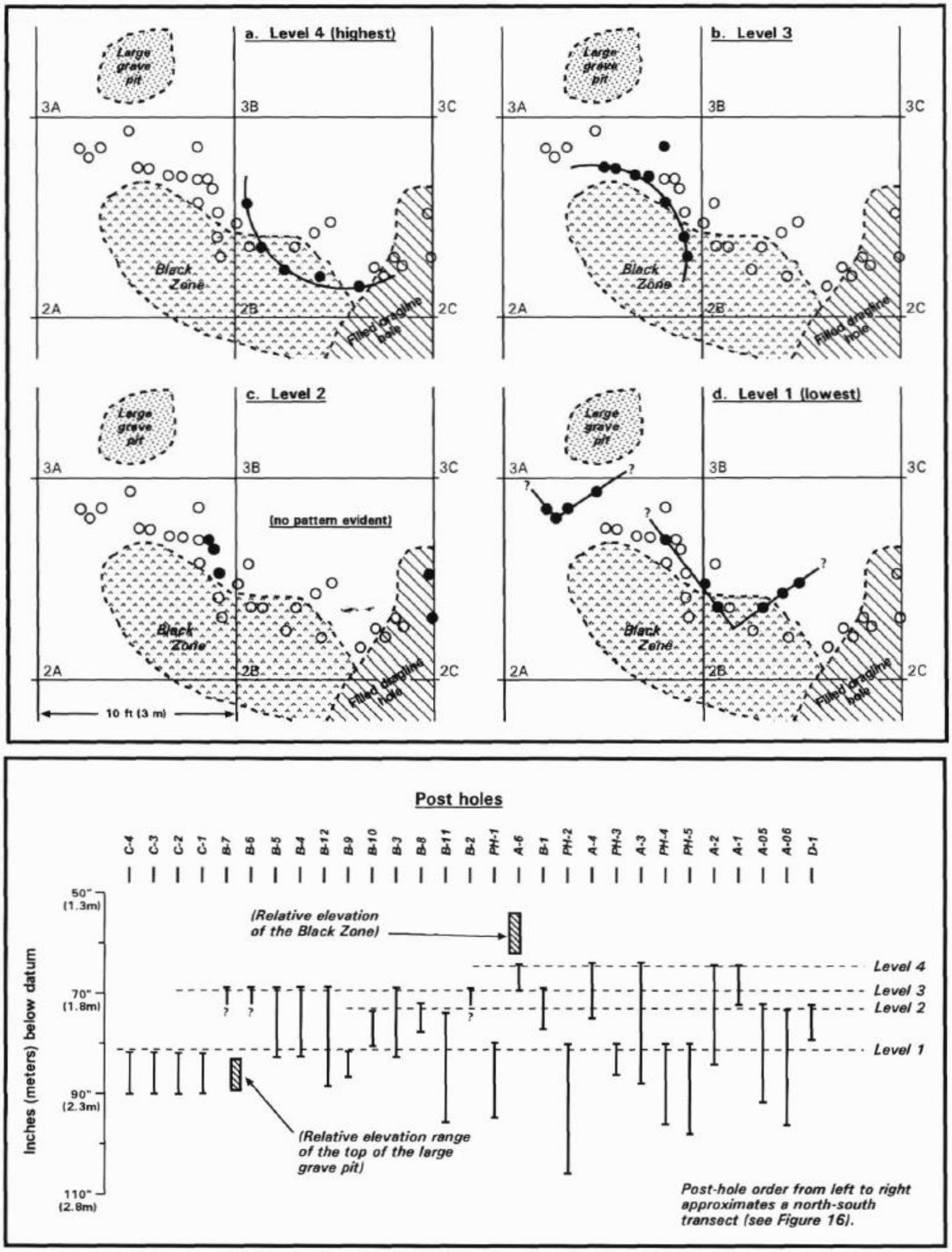


Figure 3.3: Harris Creek Mortuary post-mold configurations. (figures from Aten 1999: 39).

that they are part of a grammar of ritual architecture (Sassaman and Randall 2012). This mortuary grammar is not unique to Harris Creek, with similar white and dark sand mortuaries at Orange Mound and the Republic Grove site, another multi-ridge mortuary at the Tomoka Mounds, and similar artifactual components at the Gauthier site (Milanich 1994; Wharton et al. 1981).

Orange period (4600 – 3600 cal BP)

The Orange period is traditionally known for the introduction of the first pottery in Florida, but it also has several characteristic architectural nuances. The introduction of fiber-tempered pottery did not fundamentally change subsistence economies. Fish, shellfish, and terrestrial animals remains the dietary regime for Orange period communities (Gilmore 2015). Social gathering became a focus for Orange period life, as evidenced by increasing pit feature size, and re-vitalizations of earlier, social important architecture (Gilmore 2016). Site visibility of the Orange period is greater than the preceding Middle Archaic period. The Orange period covers the Late Archaic period in northern Florida.

Beyond the introduction of pottery, another defining Orange period tradition is the creation of shell rings. Shell rings are similar to Mount Taylor ridges as they are accretional deposits often constructed over earlier pit features (Russo 2006). Shell rings are characterized by either being entirely circular and connected, or open on one side forming a U-shape, with a center or plaza almost entirely devoid of shell. There are three shell rings in northeast Florida: Guana (8SJ554), Rollins (8DU7510), and Oxeye (8DU7478). Each shell ring is roughly 30 miles apart. These rings are on average 150-250 meters in diameter, and 3 to 5 meters in height. Along the coast, they are discrete constructions, although formed over sub-surface architecture, like pits, they are not attached to earlier architecture. The shell rings at the SGSC (8LA1-East, and 8MR123) are in fact constructed on top of Mount Taylor ridges. Interior north Florida shell rings are multi-component sites, while the coastal rings are independent of earlier built-up architecture. Both interior and coastal rings are U-shaped.

Mount Taylor shell sites experienced a revival and expansion under Orange period communities. The linear and “bean” shaped ridges were added on to, forming multi-ridged U-shaped mounds. The “amphitheater of shell” described by Wyman that is the Silver Glen site, is one such Orange period mound. Orange period mounds are characteristically built-up from earlier Mount Taylor ridges. The increased size of the sites, as well as the wide-scale use of fiber-tempered pottery suggests increasing community aggregation around these large shell architectures (Gilmore 2016). The differential distribution of incised fiber-tempered pottery on and around the apex of the U-shaped shell ring at 8LA1-East suggest a differential use of the rings as compared to the areas immediately adjacent, with primarily plain varieties of fiber-tempered Orange ware deposited in non-mounded areas (Gilmore 2016). Additionally, Gilmore’s (2016) provenance study of these incised sherds suggest that perhaps half have a non-local (most-likely from southern Florida), further progressing the aggregation model of social patterning.

Initially, shell rings were considered domestic rubbish from a circular village. Russo (1994) however, challenged this assumption. He argues that this architecture is an example of some of the earliest explicitly public architecture in the Southeast. Shell rings in north eastern Florida do not appear to have domestic contexts directly associated with them. Settlements are located adjacent to the rings, rather than on top of them (Saunders 2004). Horr’s island shell ring on the southern Gulf Coast of Florida had a plethora of post-molds and domestic architecture evidence, which is consistent with greater Southeastern shell rings on the Atlantic coast. The rings of northern Florida near the mouth of the St. Johns River are anything but traditional. Their morphology is more consistent with U-shaped shell mounds further up the river. The open ring shape suggests a distinct social segmentation, possibly involved in ritual life (Russo 2008: 19). The Rollins ring has 9 'ringlets' attached, theorized to be for separate ritual events or multiple groups utilizing the space (Saunders 2010)

In contrast to the preceding Mount Taylor period, burials and mortuary architectural canon is almost non-existent in the Orange period. Due to poor bone preservation in the acidic soils of Florida, it is possible that the cleared centers of the rings were used as mortuaries, but there is little to no evidence for this (Bense 1994). It is possible that Orange communities cremated their diseased or used scaffolding (Sanger 2017: 17). Any interments at shell rings are only placed at the site after abandonment of initial occupying communities, continuing the tradition of re-utilizing earlier places of significance (Russo 1991, 2004).

Communities during the Orange period appear to be living in circular villages, similar to other early fiber-tempered pottery producing communities on the greater interior and coastal Southeast (Gilmore 2016; Sassaman et al. 2006). This "life in the round" is different from Mount Taylor period linear community patterning. Orange villages are located at relatively high elevations, overlooking bodies of water. The Blue Springs Midden B (8VO43) site overlooks a spring, Sweetwater Orange site (8MR3557) overlooks Sweetwater springs, and 8MR123 overlooks the boil of Silver Glen Springs (O'Donoughue et al. 2011; Sassaman et al. 2003, 2011; Shanks 2009). Circular village patterning is an important view into the social organization and

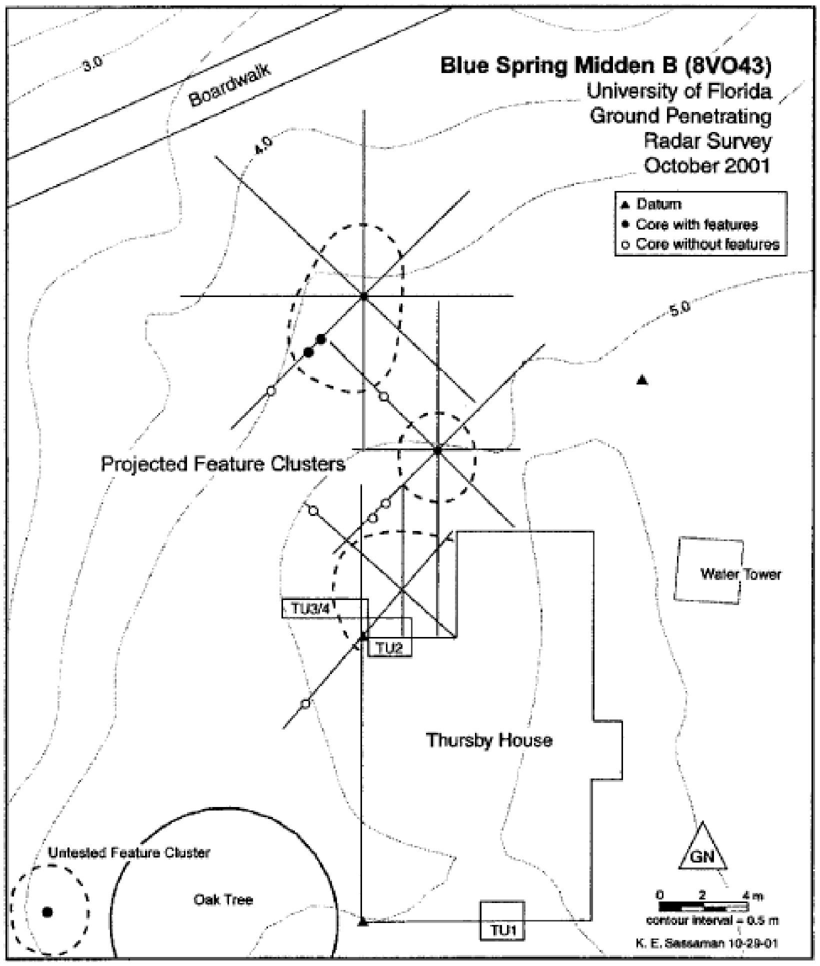


Figure 3.4a: GPR transects and features dimensions at the Blue Springs site. Note the circular or elliptical cluster arrangements of the domestic spaces (from Sassaman et al. 2003: Figure 3.21).

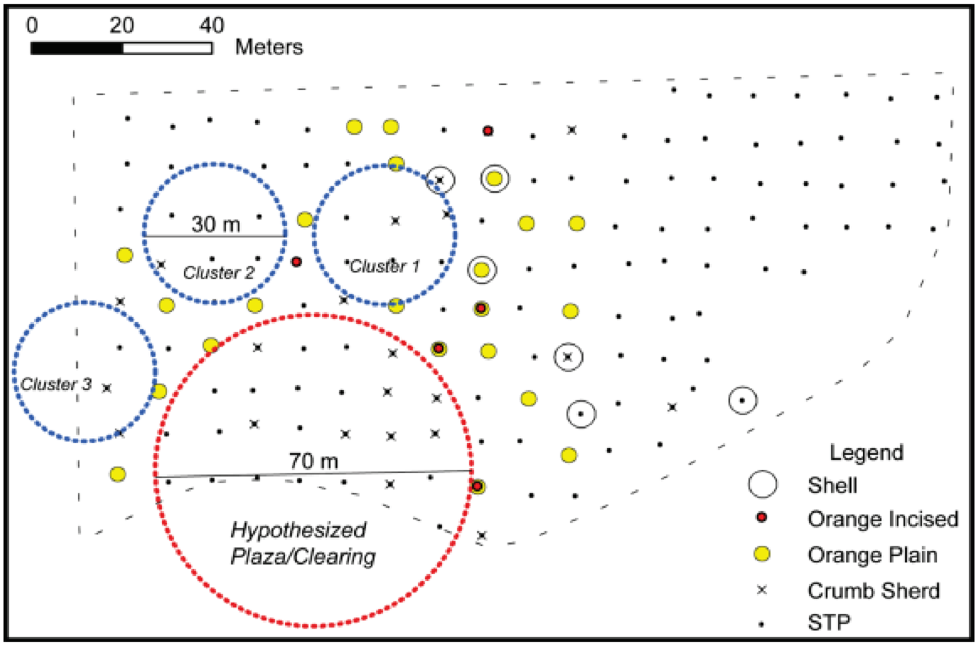


Figure 3.4b: Hypothesized 8MR123 circular village spatial patterning (from Randall et al. 2011: Figure 3.11)

greater settlement patterning, but the discrete occupational spaces are inferred from pit and post features.

The Blue Springs site contains evidence for several domestic architectural spaces, recorded as circular anomalies in a ground penetrating radar survey and the presence of crushed shell lenses discovered during excavation. The semi-circular arc of GPR anomalies suggest a midden-free center, suggesting, like similar shell bearing domestic sites along the coast, that this is an Orange period circular village (Sassaman et al. 2003). Similarly, site 8MR123 in the SGSC, is buried under a modern parking lot. This site contains a round plaza and three house clusters approximately 30 meters in diameter (figure 3.4). There is distinct lack of middening associated with these circular house spaces.

Orange period pit features are characteristically large compared to the pit architecture from earlier periods. They consist of deep basins, cylindrical pits, and craters often filled with shell. Massive shell pits, colloquially known as “party pits” are a defining sub-surface feature of the Orange period. The prevailing theory is that they were formed through larger gatherings at the Orange period U-shaped shell rings at the mouth of the Spring (Gilmore 2015: 171; Randall 2014). The increased number of gatherings and their associated large shell sites correspond to an increase of population density estimates (Sassaman et al. 2000). Regional settlement patterns during this archaeological time period emphasize elevation above, and proximity to, water. Orange period sites in general are clustered downriver, south of the Lake George Basin. While Orange sites are present outside the middle St. Johns River Basin, the majority of multiple period, multi-component Orange architecture is found within the basin (Sassaman et al. 2000: 106-107).

St. Johns I & II Traditions (3600 – 500 cal BP)

The St. Johns tradition is a regional manifestation of the Woodland and Mississippi periods in the Southeast. The St. Johns tradition is separated into St. Johns I (3600-1200 cal BP) and II (1250-500 cal BP). Traditionally, the Woodland period is identified by the wide-spread adoption of pottery, diverse foodways, and cyclical social gathering emphasizing the interconnected mortuary ritual (Anderson and Mainfort 2002). It is important to note that the body of knowledge about Woodland period architecture in northeast Florida is significantly out of date. Over the last twenty years, investigations into the construction histories of shell mounds has revealed that the bulk of shellfishing and shell-mounding was conducted by Archaic communities (Randall 2019). Diet remained consistent with earlier Archaic traditions, emphasizing the same species of fishes and terrestrial reptiles and ungulates present in the Orange period (Russo 2010).

The consistent diet regime lends support to Milanich's (1994) argument for a cultural continuity between the Archaic and Woodland period along the middle St. Johns River basin. St. Johns period pottery has been observed on many shell mounds throughout the region, initially lending credence to processual arguments that the mounds were Woodland in construction. Recent re-investigations into Wyman's initial observation of these sherds show they were only located on the top half meter of 90% of all sites surveyed (Randall 2019). Peacock (2002) argues that Woodland period communities, including St. Johns I groups, were producing domestic sheet middens and midden-mounds as basic elements of their architectural canon. Ovoid midden-mounds like those found at the Twin Island Site (8OR457) on the Wekiva river lend support to this argument (Weisman 1993). St. Johns period artifacts form a veneer along the surface of most

Archaic mounds, suggesting re-occupation, but not re-construction. What this means from a community building stand-point has yet to be investigated thoroughly (Randall 2019).

Coastal connections with interior sites are evidenced through whelk shell tools located in inland occupational sites. Larger exchange networks that connect to Weeden Island cultures and beyond are certainly present, but under-investigated. Regardless, aggregations along the St. Johns River valley were likely present. Suspected aggregations sites remain important to the social landscape of the St. Johns period. Gatherings emphasized earthen mounds, almost all of which have a mortuary component (Milanich 1994: 260-262). These mounds were used to bury individuals after prolonged charnel house post-life treatments. The social significance of burials was tied into these earthen mounds. Located in conjunction with earlier mounded spaces, these mortuaries were either physically connected with earthen ramps, or located in or around occupational spaces (Moore 1893, Wallis 2008).

Both St. Johns I and II periods shared similar architectural practices, comprised of conical burial mounds, and extensive reuse of earlier spaces. St. Johns people constructed ridges, ramps, and multi-mound complexes to physically connect their occupational and ritual spaces to earlier architectural canons. Their defining infrastructure is the conical burial mound (Moore 1892). These mounds were mostly constructed out of sand, rather than shell, or a combination of both. These mounds resemble the sand mounds from the Middle Archaic Thornhill Lake phase of the Mount Taylor period, but they differ in their depositional strategies and number of individuals. Thornhill Lake phase sand mounds form a burial tableau, with between 5 and 50 individuals placed within. St. Johns I conical sand burial mounds retain a consistent architectural patterning, with different, discrete layers of mortuary deposition, constantly being revisited (Endonino 2008;

2010). St. Johns communities expounded on the Orange period construction by adding shell ridges and mortuary mounds. The Hontoon Island North's (8VO202) community constructed a shell ridge attached to the Mount Taylor bean-shaped mound, parallel to the original Archaic ridge to the north. Additionally, they constructed two burial mounds on the east side of the ridges (Randall 2015). A ramp of shell and sand was constructed connecting a burial mound to the original shell ridge (figure 3.5).

The conical burial mounds have internal architectural patterning. Typically, they measured 30 meters in diameter, and 1 to 5 meters in height (Randall 2019). In at least one case, internal architecture consisted of alternating layer of different building material. The Thursby

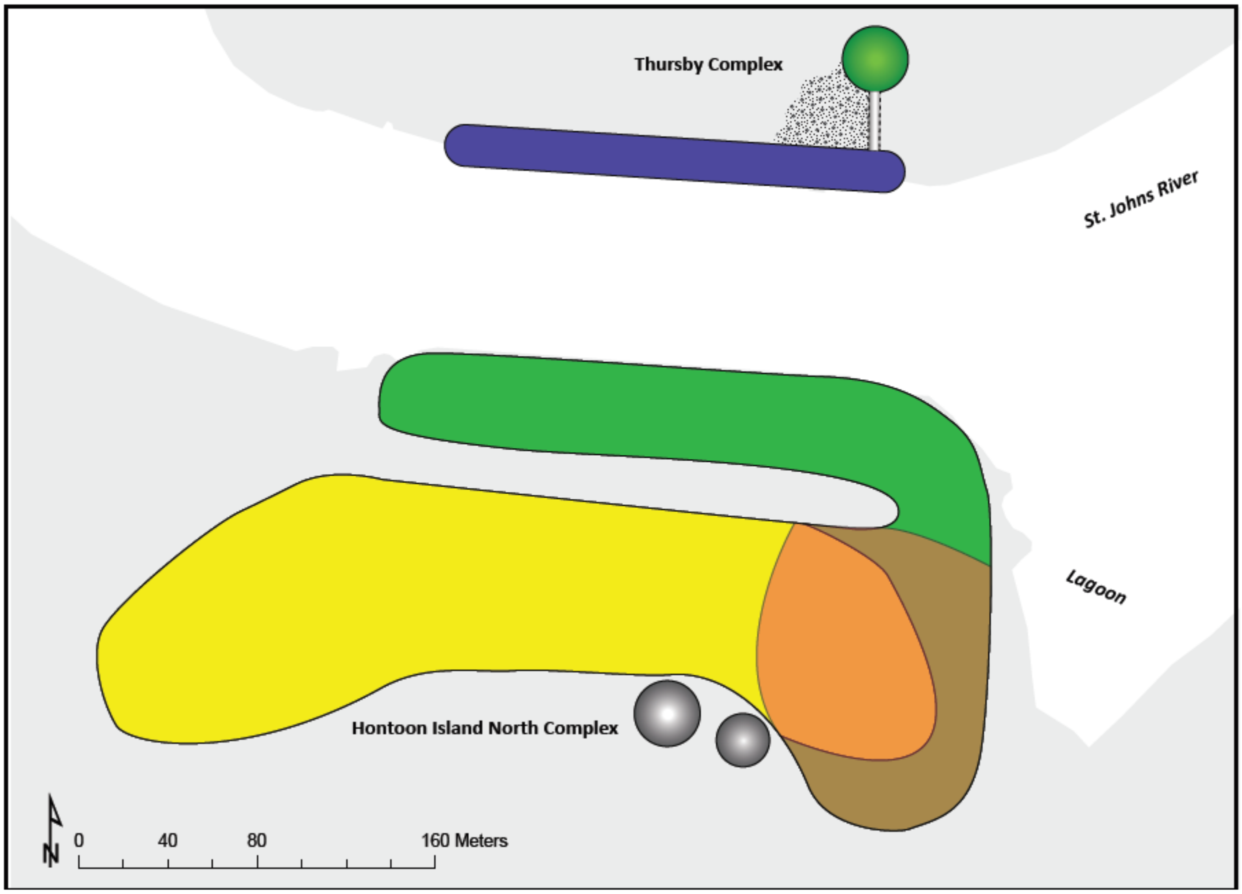


Figure 3.5: Hontoon Island North complex. Yellow is Mount Taylor, Orange is Orange period, Green is St. Johns, Blue is unknown multi-component. (Rainville and Randall 2017).

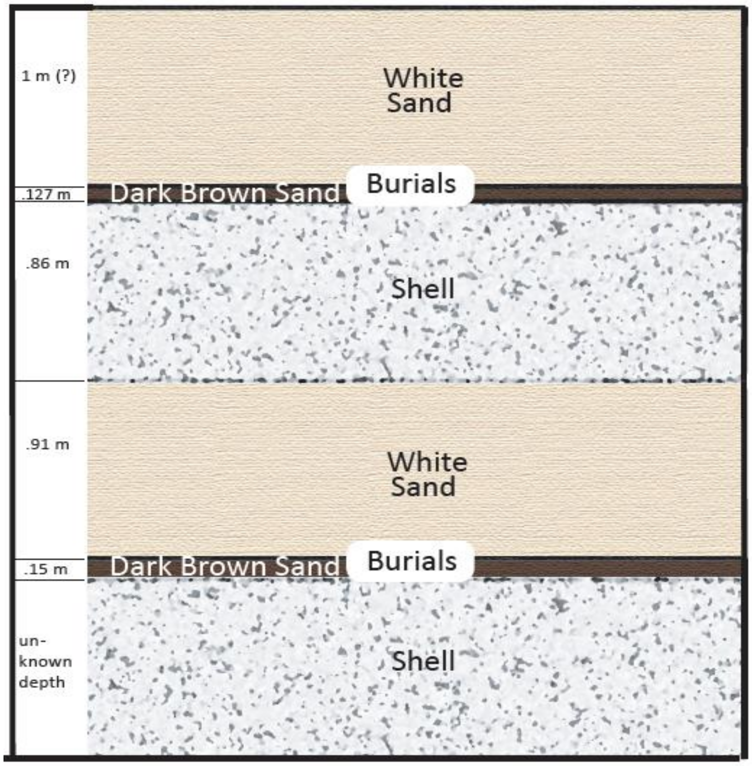


Figure 3.6: Thursby mound reconstructed profile

complex (8VO2600, across from 8VO202) for instance is built of alternating layers of dark brown sand, light brown or white sand, and a shell cap for each distinct deposit of individuals (figure 3.6) (Moore 1894). These mortuary mounds were constructed near previous terraformed landscapes and often connected by ramps of both sand and shell. They connected earlier period architecture and St. Johns architecture physically. Moore (1892) discussed a ramp built from sand with a base of shell at the Tick island site.

In addition to the mortuary component of the Thursby Mound is a votive offering pit dug into southeast side by St Johns II people (Moore 1894). This pit contained dozens of depictions of flora and fauna from across Florida, and perhaps some mythic creations. Additionally, burials that were placed in Thursby mound after the St. Johns I period did not follow the previous three-layer architectural norm of deposition, rather were placed with late or contact period artifacts such as gold and silver, and an iron axe. This mound remained in the consciousness of those who buried their dead there for over a thousand years.

The Green mound (Bullen and Sleight 1960) and Ross Hammock (Bullen 1967) sites are St. Johns I ovoid mounds that both contain structural remains, including one actual in-situ post and post mold. These mounds are located along the intercoastal waterway along the eastern coast of Florida, roughly southeast of Lake George. Green Mound had several stacked post molds and crushed shell floors that Bullen argued are consistent with domestic architecture. Ross Hammock was initially recorded as having a “building” on the top of the ovoid mound, although the time-period was not recorded (Bullen 1967: 45). This compelling evidence turned out to be a historic house built in the 1860s, which prevented the mound from being destroyed until the 1960s, when Bullen could conduct salvage archaeology. Regardless, Bullen identified several post molds, although his lack of time and funding cut the excavation short, without identifying patterning or chronology beyond their associations with St. Johns plain pottery sherds.

Another St. Johns architectural canon is the creation of ovoid mounds (Weisman 1993). Ovoid mound construction techniques and associated structural elements are evident in the Platt, Elder, and Wekiva mounds (8BR244, 8BR245, and 8SE24 respectively). The Platt mound is a highly stratified mound with evidence of one if not multiple occupational surfaces, including a “house” floor (Raymer 2005: 22). Two types of structural remains are present here: prepared floors and post holes. Post-molds from both Late Archaic and early Woodland occupations are present at the Platt Mound site. Prepared floors are indicated by differential compaction of the matrix and hearth features. Additionally, sherds and other perceived domestic waste pushed into a circular pattern (figure 3.7). Post holes at the Platt mound are preserved remarkably well

(Raymer 2005: 34). A series of 7 post-molds in tight grouping at similar depth are of unknown use, either multiple placements of the same or similar structure, or some other unidentified architectural function (figure 3.8). The Elder mound has 15 postholes, including one in-situ mineralized post end. The complexity of post-hole placement and their associated ashy lenses and compact floors on the apex of the mound signifies that a structure of some intermediate size was placed directly on top of the mound

Sometime between the end of the St. Johns I and the start of the St. Johns II culture period, there was a movement of some portion of basin communities north away from the central St. Johns River valley, into the mouth of the river. This new occupational area includes the Shields Mound (8DU12) and Grant Mound (8DU14) sites of the Mill Cove Complex (Ashley 2004). St. Johns II period communities continued to persist in the middle St. Johns River basin, including at Silver Glen Springs, Locus C, although the analysis is ongoing. At the mouth of the River, the Grant Mound consists of a truncated conical mound of familiar St. Johns I design, roughly 8 meters tall. This conical mound was also used as a mortuary, accumulating height through ritualized cemetery deposits.

This burial mound was built on top of an earlier shell midden of known age and this has evidence of contact with the concurrent Mississippian World, with an artifact assemblage including copper plates and long nose god masks. The Shields mound is a conical platform mound first described by Moore (1894). This so-called platform mound was connected by a long and

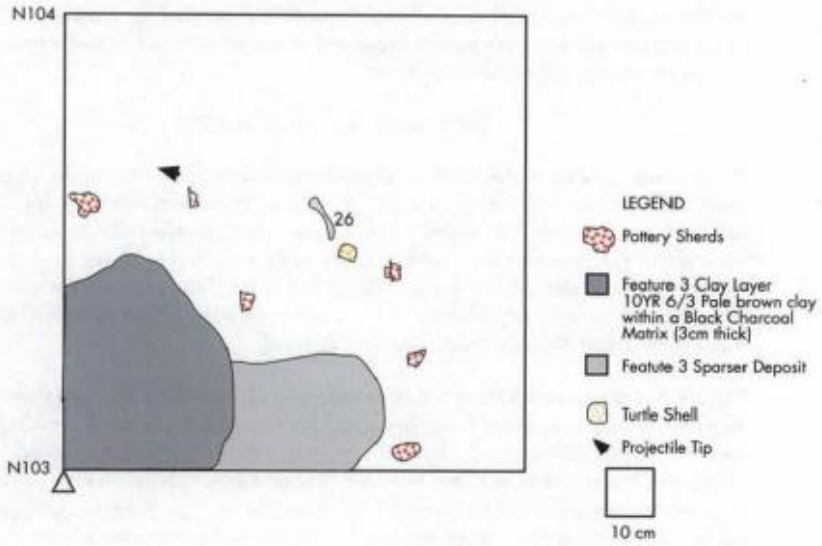
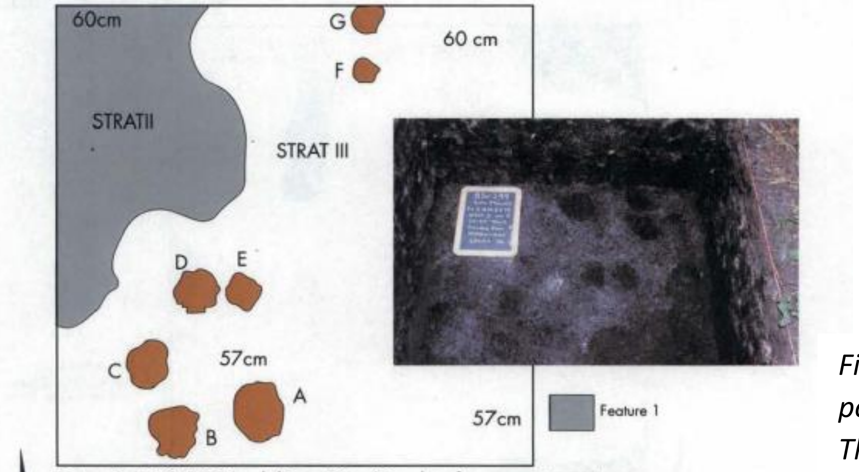
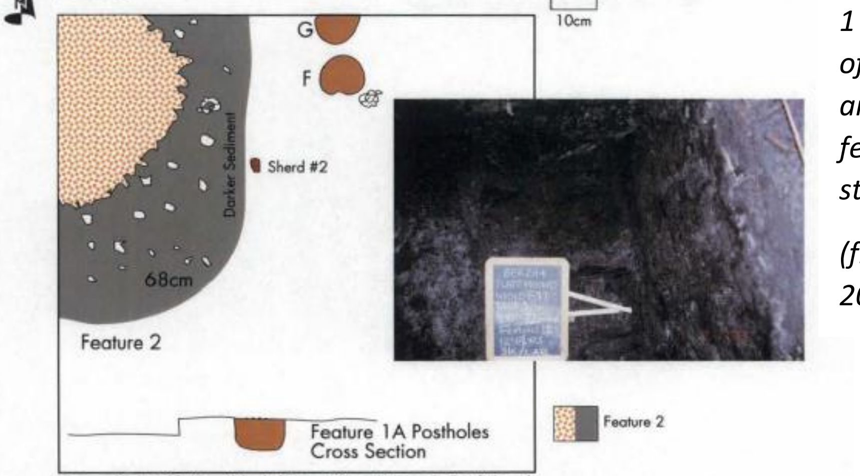


Figure 3.7: Platt mound structure surface. Pottery and faunal remainsM brushed to the side of a hearth feature, presumably the wall of the structure.



Feature 1, Unit 3, 57- 78 cmbd 1cm=10cm (Complex of seven postholes)



Feature 2, Unit 3, 66 - 77cmbd 1cm=10cm. (Concreted ash/sand lenses with possible hearth)

Figure 3.8: Platt mound post hole articulation. The narrow circular arrangement of feature 1 as well as the position of feature 2's post holed around a thermal feature attest to their structural properties.

(figure from Raymer 2005: 22)

narrow ramp similar in style to St. Johns I constructions further up the river (Ashley and Roland 2014) (figure 3.9). Arguments have been made that this ramp and truncated conical mound are facsimiles of Mississippian platform mounds however, their design is more consistent with earlier St. Johns I ramp structural grammar present at VO202.

Kinsey's knoll located to the southwest of the mound at 8DU12 included a deposit like the Thursby bestiary. This shell midden included exotic items (bone pins, pipes, pendants), diverse fauna including bear, human remains with evidence of ritualized use, and copper and red pigment (Ashley and Roland 2014). This deposit is consistent with the St. Johns tradition of ritualized deposits near mounds. Perhaps the most interesting addition to the architectural grammar of the St. Johns period is the creation of the Grand Shell Ring (Ashley and Roland 2014). This terraformed space is consistent with Orange period shell rings which have not been constructed for roughly three millennia. A St. Johns period conical burial mound was placed on top of the shell ring. The creation of this shell mound is consistent with the earlier traditions of connecting architecture with earlier canons, tapping into a shared social memory of this construction, but also the St. Johns tradition of grafting their constructions onto earlier socially-important places (Ashley and Rolland 2014). It is important to note that the presence of distinctly St. Johns II period occupational sites in the middle St. Johns River basin is limited due to twentieth century shell mining, so the above consideration of the Mill Cove complex is offered as a potential case study for interior occupational strategies.

In summary, the St. Johns period architectural canon is comprised of re-occupation of earlier spaces, construction of earthen mortuary mounds, and the physical connection between

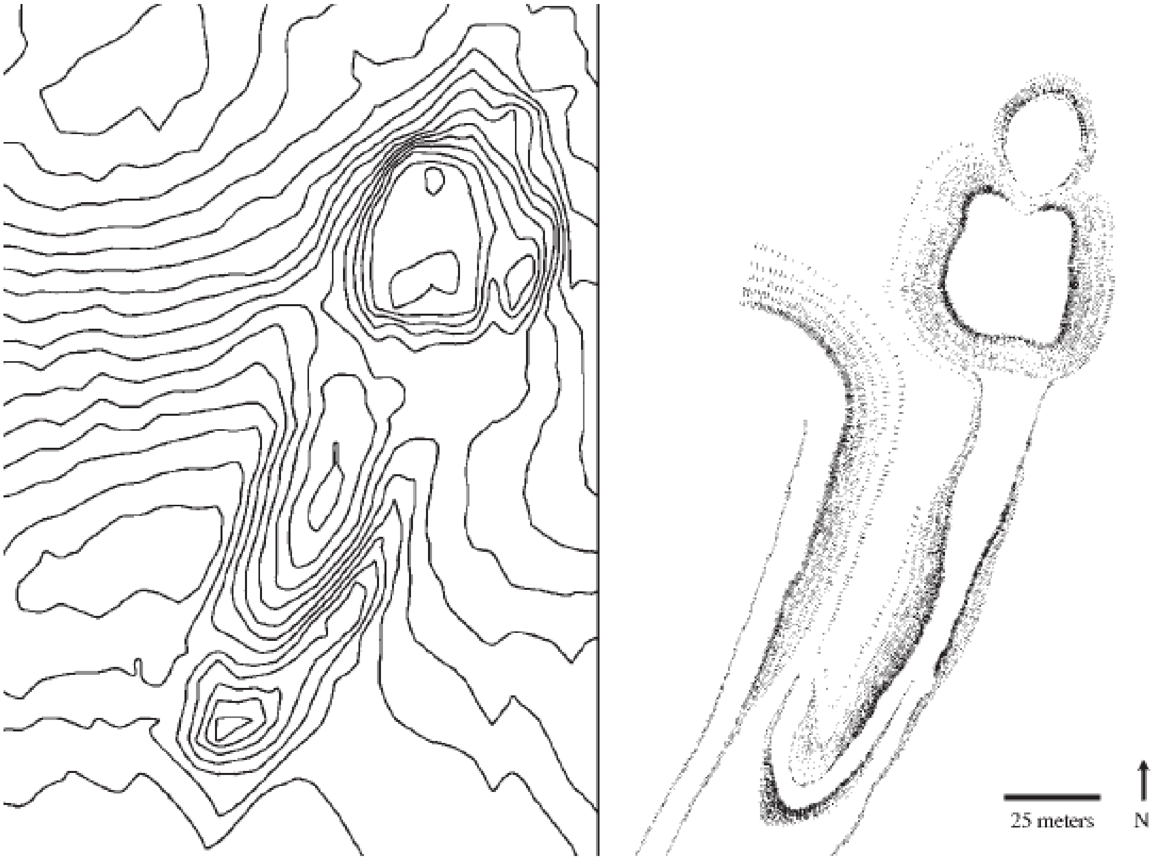


Figure 3.9: Shields Mound plan map. The left is an ArcGIS rendering, and the right image is from Moore 1895. Both show the articulation of the ramp and the truncated conical shape of the mound. (Ashley and Roland 2014).

together. The thin veneer of Woodland period ceramics along the top of most Archaic period mounds suggest a large-scale re-occupation of earlier sites. Social gathering is tempered by earthen mound mortuary traditions potentially mirrored by large-scale ceramic exchange between St. Johns II period peoples (Wallis 2011). The later St. Johns II period, however, is poorly understood in the freshwater St. Johns area due to extensive shell mining the architectural patterning of the Mill Cove complex might offer insights into the community planning and associated public architecture that might have existed further south along the river.

St. Johns River Architectural Canon

The architectural canon of the St. Johns River can be divided by cultural period (table 3.2). Architecture in ancient Florida began in earnest during the Early Mount Taylor period. Shallow pits were constructed by fisher-gatherer-hunters, often with shell fill. The most characteristic element of Early Mount Taylor period architecture are pond and stake burials. The individuals interred below anaerobic ponds were wrapped in textiles and emplaced using similarly manufactured stakes. Additionally, there is evidence for linear occupational arrangement at the Blue Spring site, whose community formed shell-fields and shallow pits.

The Mound Taylor period is split into the Early Mount Taylor and Thornhill Lake phases whose distinctiveness is based on a mortuary architecture canon. Mount Taylor phase communities constructed linear occupational spaces with many shallow shell-filled pits. These occupational spaces were transformed into linear shell-accumulated ridges. Some of these ridges contained the remains of interred individuals (like at the Harris Creek site). Post-mold structures

Table 3.2.
Architectural canon by Cultural Sequence
of Middle St. Johns River Valley

Cultural Period	Architectural Canon
Woodland: St. Johns II	Platform Mounds, Votive pits into St. Johns I Mounds, Isolated shell-ring construction
St. Johns I	Ramps, Causeways, Conical Sand Mortuary Mounds, construction on top of earlier shell-sites
Late Archaic: Orange	Circular Habitational spaces, U-Shaped Shell Rings, Massive Shell-filled Basins, Mortuary tradition not well understood
Thornhill Lake phase	Linear Habitational Spaces, Shell and Sand Mortuaries, shell-filled pits
Middle Archaic: Early Mount Taylor Phase	Linear Habitational spaces, Post-structures, Shell Mortuary Mounds
Early Mount Taylor	Linear Habitational spaces, shallow pits, Shell Field formation, Pond and Stake Mortuaries

appear in the archaeological record here, preserved in these shell ridges. At the Harris Creek site these posts are postulated to form a series of screens associated with a mass grave. There is little evidence for post structures outside of mortuary contexts during the Mount Taylor phase.

Thornhill Lake phase communities constructed sand and shell mortuary mounds, which differentiates them from the earlier Mount Taylor phase. These mounds were conical in shape and contained between 5 and 50 individuals deposited in a kind of burial tableau (Endonino 2010; Randall 2015). Screens or charnel houses potentially present in the preceding Early Mount Taylor period are not present (Endonino 2010: 130). The phase and its architectural canon were short lived.

The Late Archaic Orange period architectural canon is a departure from the preceding Mount Taylor period. Shell mounding took on a different morphology. They constructed multi-ridge sites on top of earlier Mount Taylor period ridges, forming them into shell rings. Shell rings were not linear, have evidence of specified ritual use, and an absence of inhumation within the shell matrix. Shell rings in the St. Johns River basin were not connected, but rather U-shaped. This perhaps related to ritual use of seasonally or annually gathering communities (Gilmore 2016). Similarly, shell-filled pits became significantly deeper and larger, owing to gathering communities. Finally, habitation consisted of "life-in-the-round," circular house arrangements, usually overlooking a body of water or karst spring.

Shell rings did not persist throughout the entire Woodland Period in the St. Johns River basin. Separated into St. Johns I and II, these time-periods architectural canon is defined by the conical sand burial mound. St. Johns I conical mounds are similar in shape to Thornhill Lake phase Mount Taylor mortuary mounds. These Woodland period mounds, however, were connected to earlier linear mounds via shell and soil causeways. These mounds also differ in their depositional histories; St. Johns I mounds have a consistent internal logic to their interments consisting of two different colored sands and shell layers that are not present in Thornhill Lake phase mounds. St. Johns I communities extensively re-used and meaningfully connected their architecture to earlier traditions.

St. Johns II period communities constructed platform mounds and continued the use of causeways. The extensive destruction of shell mounds throughout interior Florida made this time period difficult to quantify, however the Mill Cove Complex near the mouth of the St. Johns River offers a comparative contemporary example. The use of flat-topped earthen mounds with causeways is distinctive of this time period at the Mill Cove site. Shell-filled pits were also being deposited, shallower than Orange period pits. The creation of "bestiaries" into St. Johns I mounds is present at the Mill Cove complex and at the former Thursby Mound in the St. Johns River basin. The organization of occupational spaces is not well known.

The ancient architectural canon of the St. Johns River is fundamentally based around community gatherings. The Middle Archaic period's well-watered ecological regime gave rise to intensive shellfishing, which in turn provided the untold pounds of shellfish raw material needed in the terraforming of the river valley. The role of architecture in mortuary practice are intimately tied from the initial construction of pond and stake burials in the early Middle Archaic Period. The earliest shell mounds were formed on top of domestic pit features, emphasizing the important role that re-occupation of space plays throughout all archaeological time periods.

The introduction of ceramics increased the pace and size of community aggregation (Sassaman et al. 2000). St. Johns I sites throughout coastal and riverine ecotones in northern Florida experienced a population burst, evidenced in the number of Archaic sites re-occupied and transformed. They were transformed via the physical connection of St. Johns I mortuary complexes and Mount Taylor and Orange mounds through causeways. St. Johns II, although not strongly represented in the middle St. Johns River valley due to modern destruction, constructed plazas, platform mounds, and all the trappings of large aggregation sites of the Late Woodland and Mississippian periods of the greater Southeast.

The fisher-gatherer-hunters that colonized the St. Johns River engaged in complex practices of mobility, settlement, and monumental construction that created a cohesive, period-specific, architectural canon. The use of this canon can be assistive for archaeological investigations directed at understand site-specific nuances and region-wide community organization. Understanding the interconnected-ness of the architectural regimes at Silver Glen Springs can elucidate the underlying patterns of social engagement with monumental and mound-adjacent archaeology. In the next chapter I provide a geologic and archaeological history of investigations at the Silver Glen Complex with an eye towards identifying the underlying patterns of occupation and enculturation through architecture and social memory at the non-mounded spaces.

Chapter 4

Geologic and Archaeological background of the Silver Glen Springs Complex

In order to understand the cultural significance of the sub-surface variation at the Silver Glen Springs Complex (SGSC), a thorough consideration of the underlying soil formation and the archaeological history of the area is necessary. As a reminder to the reader, the SGSC is composed of several shell mounds and open spaces with archaeological deposits dating from 8900 and persisting to about 500 years ago. The landscape is now owned and managed by the US Forest Service on the north side of the spring run, and the Juniper Hunt Club, LLC on the south side. As is detailed in this chapter, there has been considerable terraforming in the modern era in the form of shell mining and clearcutting.

The St. Johns River dominates the landscape of northern Florida and its landscape has been meaningfully transformed by its ancient and modern inhabitants. Terraforming began thousands of years ago in the middle St. Johns Basin by shell accumulated architecture and persists in the modern era in the form of shell excavation (Randall 2019). Since the middle 20th century, archaeologists have focused on shell mound excavations and their potential social, ritual, and utilitarian uses. As such, the areas immediately adjacent to the shell mound have not been adequately studied, leaving potential occupational and social spaces ignored. Understanding the geology and soils of the region and all previous work at Silver Glen Springs is integral to better situating the geophysical investigation within a broader landscape history.

Geological nuances of the St. Johns River Basin

The waterways of Florida are part of the Atlantic Coastal Lowland physiographic region, established by geomorphologists for their surficial geography and hydrology, specifically Pleistocene marine terraces and Holocene relict beaches (Schmidt 1997; White 1970). Both coastal waterways and inland areas contain silicate-laden marine sediments, which make excellent beaches and barrier islands (Sassaman et al. 2011: 15). The 500 kilometers of the St. Johns river are generally situated between two low ridges and extensive marshland that allows the river to slowly meander through central Florida. The headwaters of the river extend inland from the Eastern Valley. The middle St. Johns area and the Lake George area are situated west of the eastern-most karst topographic area called Florida Crescent City-Deland ridge (Healey 1975).

This karst topography formed many vents, including Silver Glen spring (Randall 2015: 90; Sassaman et al. 2011). These vents are part of Florida's aquifer system. Florida has five main aquifers, two of which outload into the St. Johns river (Figure 4.1). All of Florida's freshwater comes from precipitation that is retained. This water acts to refresh Florida's aquifers (Miller 1997). The water level of both the St. Johns river and Lake George are directly controlled by the aquifer system (Randall 2015). The five aquifers are part of the greater "Surficial Aquifer System," which consists of all subterranean water retained within the permeable karst bedrock kept in containment though hydrostatic pressure. Within the greater Surficial system, the Floridian Aquifer (FAS) is the most expansive and involved in the formation and continuation of the St. Johns river. The subterranean water is expelled at first magnitude springs through areas of thin karst limestone and sinkholes.

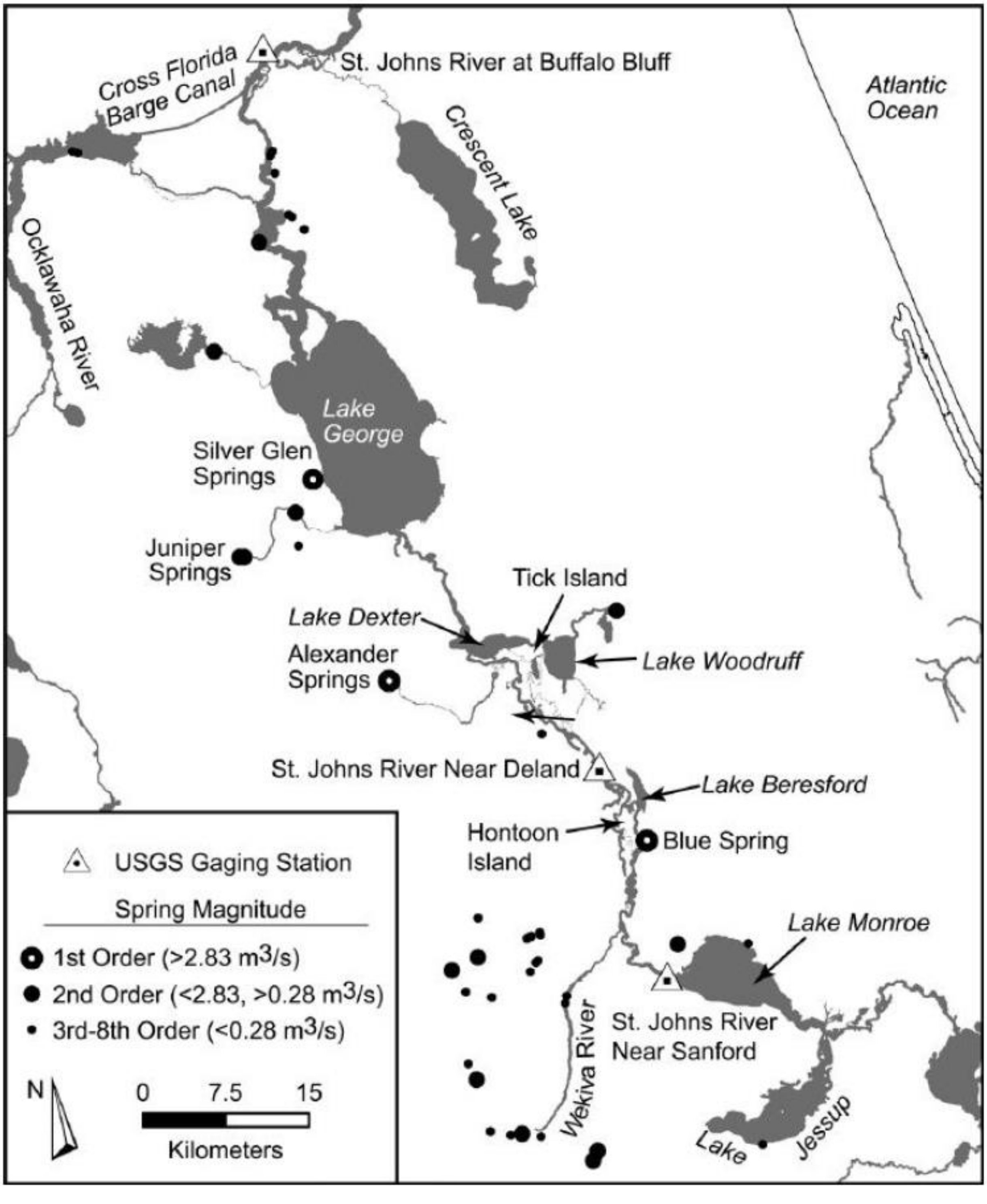


Figure 4.1: Map of several karst springs, including the two first magnitude springs in the Middle St. Johns River Valley (from Randall 2015: figure 1.3)

The St. Johns River drainage controls the region's landscape (Miller 1998: 27). The 500-kilometer length and average width of the river drainage area is the reason for its slow pace. The river discharges 8,300 cubic feet of water per second at its mouth near Jacksonville in northern Florida. This is a slow pace for such a large river. This primarily has to do with the minimal gradient of .02 meters per kilometer, flowing south to north (Miller 1992: 101). The gradual slope and slow discharge keep the river to an average of 5 feet above or below sea-level. This makes the river incredibly responsive to sea-level change, and tidal influence (Sassaman et al. 2011: 15). The river is considered a "blackwater" characterized by its high quantity of organic matter, clayey sediments, and an extremely low in-river sediment load (Randall 2015: 89). The slow-moving course of the river and its spring-fed nature have deposited feet of muck. The clay and organic material intermixed, combined with slow-flow, deposition is often in massive blocks with little to differentiate depositional events. Because of this, archaeology on the river bed is difficult, and little context can be recorded.

Draining sections of the lake to excavate, for example, further dies out the sediment, and any artifacts suspended in the muck are only in context as it relates to the most recent dying event performed by archeologists (Sassaman et al. 2011). The St. Johns river has three principal segments with distinct geomorphic characteristic (Schmidt 1997; White 1970). The modern rivers components were formalized during the early Pleistocene as part of a "beach-ridge" plain when the water was significantly lower (White 1970). The first segment, the headwaters, are characterized by extensive wetlands and braided stream mixing. The middle section, called the "St. Johns offset" consists of the greater Lake George area. The lower river and final segment empties into the Atlantic near Jacksonville and consist of a kilometer-wide estuary, brackish intermingling waters, and several relict channels when the once river jogged further east (Randall 2015; Sassaman et al. 2011). The river flows south to north.

The physiographic landscape form is the Pamlico terrace, which extends along both coasts of the state, and inland surrounding the St. Johns river valley (figure 4.2). This terrace is evidence of earlier Pleistocene shorelines, especially on the eastern coast of modern Florida, where the platform drops precipitancy (MacNeil 1950). The Pamlico terrace is characterized by its very low relief, extending just 8 feet above sea-level at its lowest near the coast to 25 feet above sea-level at its tallest inland (Healey 1975). This terrace is primarily compromised of quaternary sand. The St. Johns river valley is saved from constant inundation of sea water from the east by the Talbot terrace that borders and surrounds the extend of the St. Johns from Duval county to Volusia county. This was formed by the erosional force of the river in the beginning of the Pliocene when its course ran much faster (MacNeil 1950). The St. Johns river valley study area is bordered by both the Pamlico and Talbot terraces, which are characteristic of its physiographic profile.

Studies by the state of Florida's St. Johns River management district (Mace 2006; 2007) shed light on depositional trends in the river valley. Mace's research was designed to establish minimum flows and levels (MFLs) of the river valley water district. While this was designed for modern application, the geological investigation can help archaeologists to understand the complex history of this slow-moving river. Mace formed numerous ecological maps utilizing intensive surface water modeling and decades of river stage data to recommend several MFLs to minimize the environmental impact of development. This research developed a compressive list of soil descriptions across the river valley, which can prove invaluable for archaeological

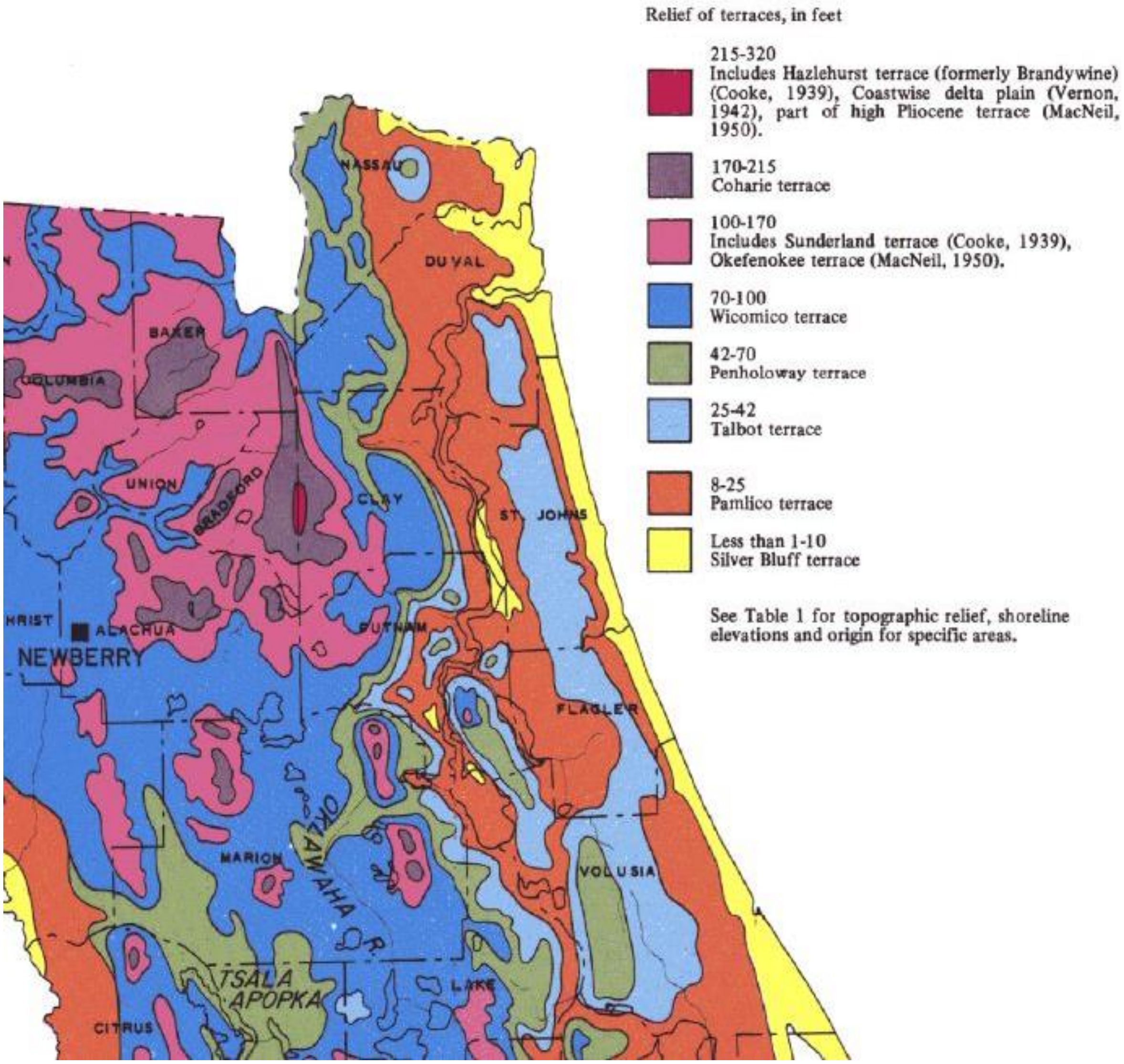


Figure 4.2: Relief map of terraces of north central Florida, focusing on the St. John river area. The river valley area is within the Pamlico terrace and bordered by the Talbot terrace (From Healey 1975: figure 1)

investigations (Mace 2006). For instance, the Paisley and Holopaw series sand identified at Tick Island can be used to place buried artifacts by riverine elevation history. Certain non-hydric soils and soils that drain-poorly can help frame a sites larger hydrologic history, and identify time when it might have been submerged, and presumably, uninhabited.

Silver Glen Spring Run Formation

The SGSC (sites 8LA1, 8LA4242, 8MR123) is located between a one-kilometer long watershed run bounded by the first magnitude spring to the west and Lake George to the north and east. Natural formation processes, such as fluctuating sea level from the early Pleistocene, local sinkhole events, and regressions of flood water, coupled with modern dredging have made the SGSC a constantly changing place. During the Pleistocene, sea levels were 40 meters lower than current height. When the sea-level rose in the beginning of the Holocene, (12000 to 10000 BP) it rose quickly, and many coastal sites were inundated with meters of water (Faught 2004). The St. Johns was equally affected by this deluge of sea-water. It was not until 6000BP that waters reached near modern level with intermittent Holocene fluctuations; modern levels were reached after initial Silver Glen Spring site formation (Faught 2004; Sassaman et al. 2011).

The arid Pleistocene was replaced by the wet modern Florida conditions after 9500BP. This caused the vegetation of the Carolina coastal plain and Georgia bight to fully inundate peninsular Florida by 5500BP creating a floral and faunal regime shift (Sassaman et al. 2011; Schulderein 1996; Watts et al. 1996). The SGSC had its beginning during this transition period. The middle St. Johns River was a dynamic place for early Floridians. Lake George, for all its size, is quite shallow. It was much lower in the early Holocene and many sites were covered with sea-level rise (Sassaman et al. 2011). The karst topography in this region is prone to form massive aquifer vents.

Specific investigations of soils at the Silver Glen spring site have identified numerous clay and silt deposits associated with the blackwater river and the karst vent (Sassaman et al. 2011). The underlying geological formation of the Silver Glen Complex, as well as the greater Ocala Forest area is quaternary Paola and Pomelo sand (Mace 2006). This is a well-rounded and well-drained primarily quartz sand. Shell deposits into this sand allow for poorly defined A horizon boundaries due to the rapid drainage. US department of Agriculture soil survey maps of the SGSC are not fine-grained enough to accurately record the minutia of soil variation however, it is broadly helpful. The overall soil profile for the surrounding landscape is composed of Tomoka-Terra Ceia-Samsula-Hontoon (s1548) series, characterized by deep O layers of muck, and Candler-Astatula (s1561) series sands, composed of Candler quartz sandy soils. Together the overall profile of the surficial geology of the silver Glen Springs is fine-grain, well-sorted sand.

Five sandy soils compose the nearly 1-kilometer buffer around the spring run: Paola fine sand, Immokalee fine sand, Polello Sand, Sellers-Pamilco soils, and so-called “made land” (Figure 4.3 and Table 4.1). Two of these dominate the landscape: Paola fine sand and Sellers-Pamilco soils. The USDA identified the cleared bait fields and Juniper Club lodging areas as made land, however closer investigation characterizes these soils as fine sand at the bait fields, and sandy-clay souls at the loci and site 8MR123 (Randall 2015: 236; Sassaman et al. 2011). Paola fine sands (unit names 15 and 16) are sandy aquatic deposits, with a typical profile including a hefty E horizon (approximately 60 centimeters) intermixed with an equally thick B horizon. Surficial A

Figure 4.3: USDA soils map of the Silver Glen Springs Complex.

Table 4.1: Map descriptions including soil names and relative percentages.

Soils at Site 8LA1

Map Unit Symbol	Map Unit Name	Acres	Percent of Total
15	Paola fine Sand, 0 to 5% slopes	44.6	13.6%
16	Paola fine Sand, 5 to 12% slopes	43.5	13.3%
28	Immokalee fine Sand, 0 to 2% slopes	29.8	9.1%
Ma	Made Land	30.2	9.2%
Po	Pomello Sand	61.1	18.6%
Sp	Sellers-Pamlico Soils	62.3	19.1%
Wa/99	Water	19.2	5.9%

horizons are often shallower than 10 centimeters. They are excessively drained Quartzipsamment unconsolidated dune sands. This soil is found throughout the landscape. Sellers-Pamilco soils are hydric poorly-drained Humaquepts sandy-clay soils. These soils have a strong A horizon, identified in some profiles as over 70 centimeters deep. B soil formation at site 8MR123 near the Thornhill Lake phase mortuary is consistent with this soil (Randall and Tucker 2012). These sandy-clay soils form the interface between the wetlands and the sandy uplands. Wetlands and water-logged clays are noted for the inclusion of shell, in addition to an unconsolidated muck layer.

History of Archaeological investigations at the Silver Glen Complex

The SGSC has been investigated archaeologically for over 140 years. The complex is comprised of four shell mounds and numerous shell and non-shell bearing deposits that are split into three archaeological sites, situated around the Silver Glen spring and its run into Lake George (figure 4.4). These sites are located around a first magnitude spring within the Ocala National Forest. Site 8LA1 comprises the U-shaped shell ring, and associated Loci A, B, and C along the southern extent of the spring run. Site 8MR123 is a shell mound surrounding the boil of the spring. Before the sites were damaged by shell mining in the 1920s, this whole landscape was comprised of many shell-filled and shell-free areas. Site 8LA4242 is a linear ridge to the north of 8LA1, bounding off the north extent and termination of the spring run (Randall et al. 2011). The underlying geology of the landscape are well-drained sandy Paola soils, persisting for over 2 meters below surface, and sandy-clay Sellers-Pamlico soil near the water’s edge. The landform on the north side of the run is a generally higher elevation than the southern side.

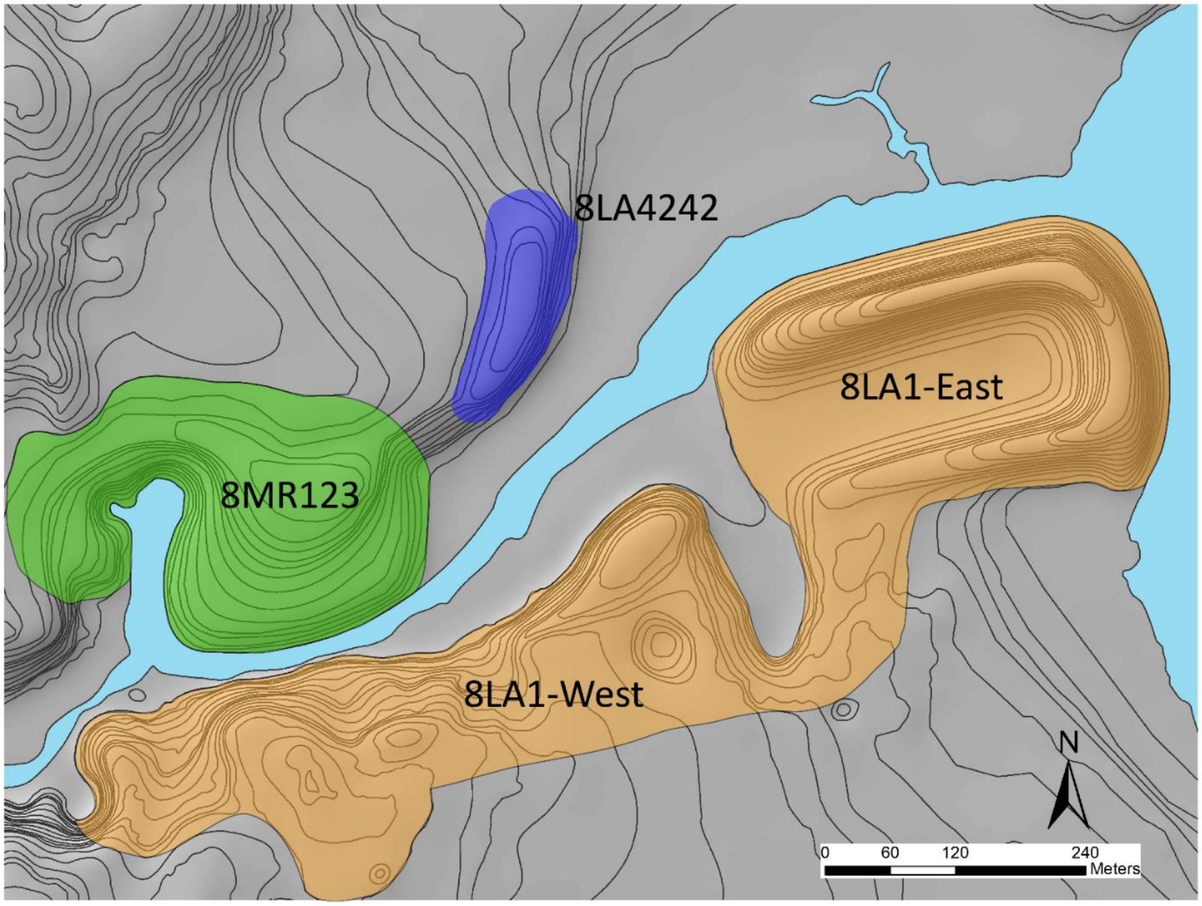


Figure 4.4: Sites 8LA1 (separated into east and west sections), 8MR123, and 8LA4242 that make up the Silver Glen Springs Complex. Reconstructed pre-1920 landscape.

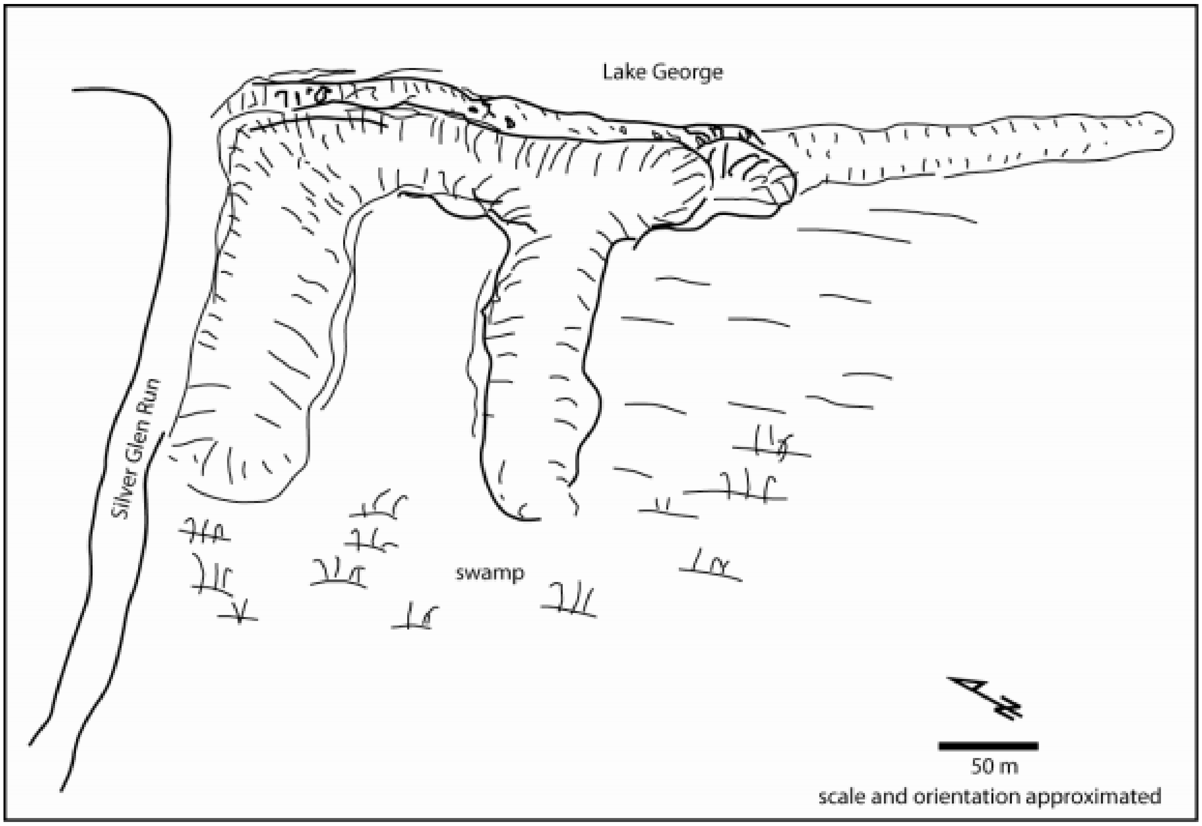


Figure 4.5: Wyman's unpublished sketch of the 8LA1-East mound redrawn by Randall (from Sassaman et al. 2011: figure 3.1).

Pre-1875

The St. Johns River proper had been Initially recorded by Spanish cartographers and explorers, who noted the large shell mounds, but thought nothing of their potential cultural value (Sassaman 2012). Since so little thought was involved with the shell mounds of the river, and colonization occurred for over 400 years, these shell sites were destroyed by negligence and mining. What few mounds remain today are poorly preserved. Indeed, most shell mounds were excavated during the end of the 19th century and start of the 20th century for road and foundation fill (Randall 2015a: 5). It wasn't until the naturalist Jefferies Wyman took a trip to Florida in an effort to cure an ailment in the humid south that these shell sites became noticed for their cultural value (Randall 2015b: 2).

The shell mounds which became the focus for most archaeological investigations was first recorded by the travel writer William Bartram in 1766, in his compendium of his travels in northeastern Florida (Bartram 2017). Over 100 years later it was re-recorded by Jefferies Wyman (1875). Of these accounts, only Wyman sketched the mound's general shape and size, which was never published (figure 4.5) (Sassaman et al. 2011). Wyman recorded the U-shaped mound as an "amphitheater of shell" which ran along the southern edge of the spring run. He wrote that the site had an "abundance" of pottery on the surface (Wyman 1875: 40). These sherds were taken to the Peabody Museum in Cambridge Massachusetts. Samples of this pottery were later returned to the Florida Museum of Natural History, who recorded its type as Orange Incised, dating the apex of the mound to the early Orange period (Sassaman 2003; Sassaman et al. 2011). Wyman notes both the U-shaped shell ring at the mound of the run (the "hollow square"), and what he identified as an "amphitheater" of shell, referring to the mortuary mound at 8MR123 (Wyman 1875: 39). He did not identify the linear ridge features (8LA1-West and 8LA4242) parallel to the spring run itself only the U-shaped shell mound. Wyman's notes connect the sites together, saying they comprised almost 20 acres, each shell rings being roughly 10 acres across. This is perhaps indicating a continuous shell field connecting sites 8LA1 and 8MR123.

1920s onward

After it this initial investigation by Wyman, the landscape was mined out by several companies throughout the early twentieth century, mostly concentrated after 1923. Since the mining did not go below grade (legally that is, although that was not always honored), there exists submerged and sub-surface features of this shell mound (Randall 2014: 171-173). The modern shoreline where the mound once bound it in was shaped by modern shell mining practices, including installing three islands out of the excess shell for the modern owners of the property where the site rests, the Juniper Hunting and Fishing Club.

Since 2007 the University of Florida and OU have thoroughly investigated the Silver Glen Complex (Randall et al. 2011; Sassaman et al. 2011). The aim of these investigations was to identify the construction history of the site, as well as understand the articulation of the monumental Orange period mound with the landform and other archaeological remains spread around the spring boil. The early field school investigations identified two “events” in site construction, associated with the intuition of monumental mounds during the Mount Taylor period, and the Orange period transformation of the space into a complex web of spatial separated monumental and adjacent spaces, mapped out by distribution of ceramic types through time. (Sassaman et al. 2011: 8). The several years of investigation was targeted at acquiring multi-scalar environmental and cultural data to understand these site construction events in context. Investigations are both intensive (targeted excavation and samples) and extensive (geophysical investigations, landscape-wide auger survey).

Site investigation started with the use of LiDAR data from 2006 in conjunction with a site-wide grid has allowed investigations to maintain a copasetic view of the archaeological remains at the site. An auger survey was conducted in 2007 to establish a basic landscape profile identifying any sub-surface variation and site location. A total of 84 augers and over 100 shovel tests were sunk in 2007. The shovel test results identified basal Mount Taylor deposits below the

U-shape mound proper, suggesting the Orange mound was placed on top of, or otherwise meaningfully connected to, an earlier deposit. The site is divided between 8LA1-East, which contains the archaeological remains of the U-shaped shell mound, and 8LA1-West which contains Locus A, B, and C, and two bait fields. The ceramics recovered from the shovel test data suggests a time transgressive trend from east to west, with the earlier occupational spaces further east, and later further west (figure 4.6).

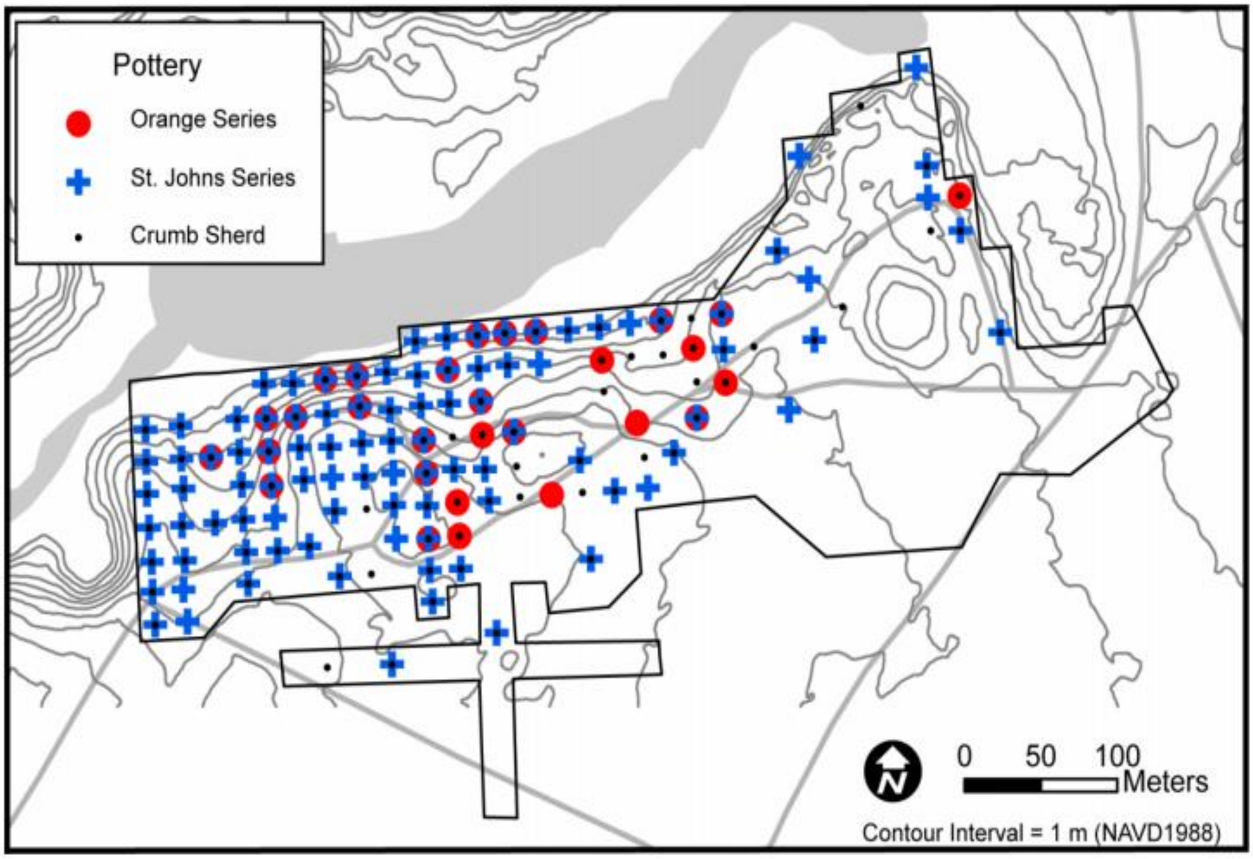


Figure 4.6: Ceramic distribution recovered during shovel testing, classified by chronological series. Note the presence of Orange period sherds near Locus B and the low relative amount of St. Johns sherds further east. (Randall 2011: 116: figure 4.6)

In 2007 and 2008 test units were placed in the islands off the edge of the spring run as it opened into Lake George proper, and other areas where sub-surface evidence for the U-shaped shell mound might have existed. These test units confirmed Wyman's drawing and description of a U-shaped shell site (Sassaman et al. 2011). Further test unit excavations identified several large pit features along the south ridge of the mound, as well as many Orange incised sherds. A GPR and close coring interval survey was conducted along the south ridge of the shell mound, identifying sub-surface variation in an arcuate formation (figure 4.7).

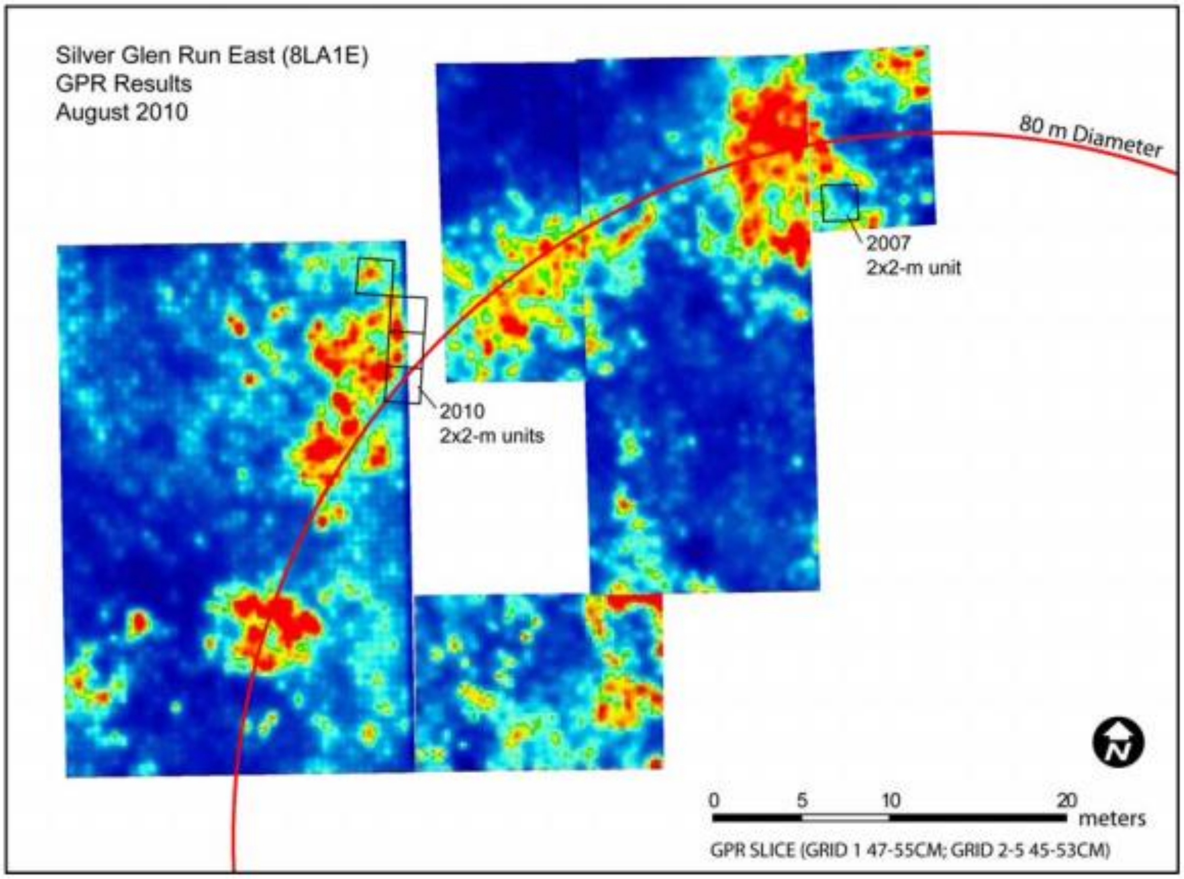


Figure 4.7: 2010 GPR results from the South ridge of 8LA1-East (Sassaman 2011)

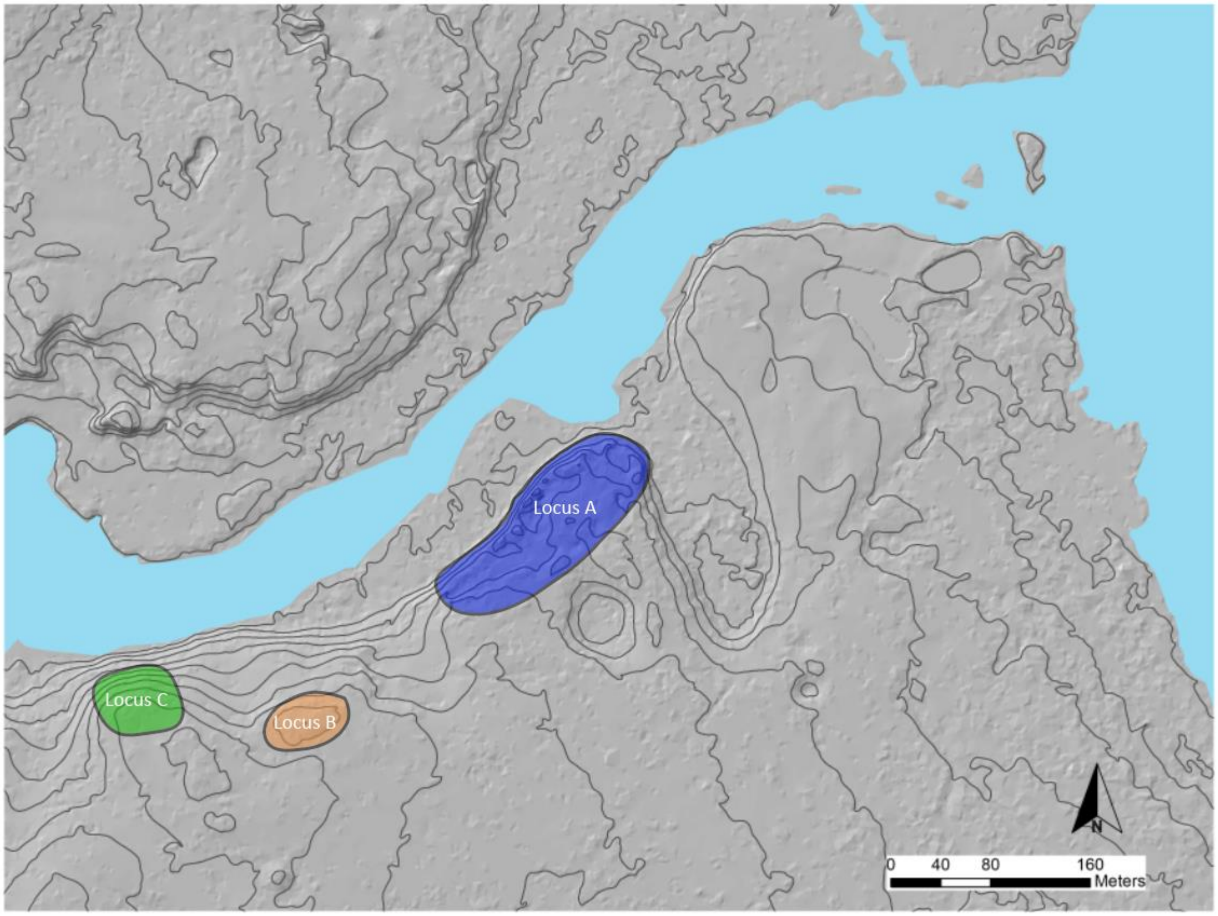


Figure 4.8: Loci A, B, and C at 8LA1-West. Modern landscape arrangement.

Most of the investigations have been conducted on the 8LA1, rather than 8MR123 in the Silver Glen Springs recreational area due to the presence of human remains in the Thornhill Lake phase Mount Taylor Sand mortuary (Randall et al. 2011). Three loci were identified by the 2007 auger and shovel test survey. Locus A was initially a 200-meter-long shell ridge, significantly reduced by the 1920s shell mining, although sub-surface Mount Taylor deposits remained intact. Locus B was “shell ridge nose” with several stacked shell surfaces as well as a significant amount of Orange period pits. Locus C is a similar ridge nose, and is the farthest west of the loci, nearest to the boil. This locus is a late-period St. Johns II occupational space (figure 4.8) (Sassaman et al.

2011). Locus C has been thoroughly investigated, uncovering several post-molds and shell filled pits, although the analysis of these results is still ongoing.

Since 2009, shell-bearing loci have been targeted for intensive investigation. Locus A was excavated in 2012, and 2015 with block excavations. Locus B had block excavations in 2009, 2010, and 2013. Locus C was investigated in 2012 and 2016. Each locus is broadly defined by an associated culture-group's architectural canon and, when evident, ceramic chronology. These inferences have been confirmed with radiocarbon assays, validating a period-specific architectural canon for this site (Gilmore 2016; Randall 2015). Locus A has a large Mount Taylor period presence, Locus B is broadly Thornhill Lake phase and Orange period, and Locus C is Orange through Woodland Period St. Johns I and II.

These Loci are situated around two modern cleared spaces, called bait fields. Bait fields have been used by the Juniper Club to encourage edge-browsers like deer and turkey, which are hunted by some club members. These broad, flat spaces were the focus of investigations in 2011 and during the 2018 field school geophysical and excavation investigations. These spaces were cleared of large vegetation during the shell mining operations of the early twentieth century. Originally, the modern bait fields were connected, rather than separated as they are now (figure 4.9). These bait fields are significant due to their relatively flat and low-lying topography in relation to the surrounding landscape. Their situation between both Locus B and Locus C allows questions about the size of feature variation specific to those loci to be addressed.

Figure 4.9: Aerial photos of the cleared spaces taken between 1941 and 2004. Figure courtesy of Sassaman et al. 2011:21, figure 2.4

Historical Photography was an initial impetus for the investigation into the bait fields. Aerial photography can provide an effective method for site identification and site boundaries (Bewley 2003: 274). Due the coarse-grain resolution and mono-chromatic nature of 1941 aerial photography, specific vegetation patterns were not considered, rather the clearings made by shell removal processes was taken into consideration (Randall 2014: 172). In the over half a century between the 1941 photos and modern aerial imagery, a significant portion of the deforested area grew back (figure 4.10). The secondary growth is readily identified in surface inspection by the new Juniper trees that leave a ghostly outline of the initial clearing.

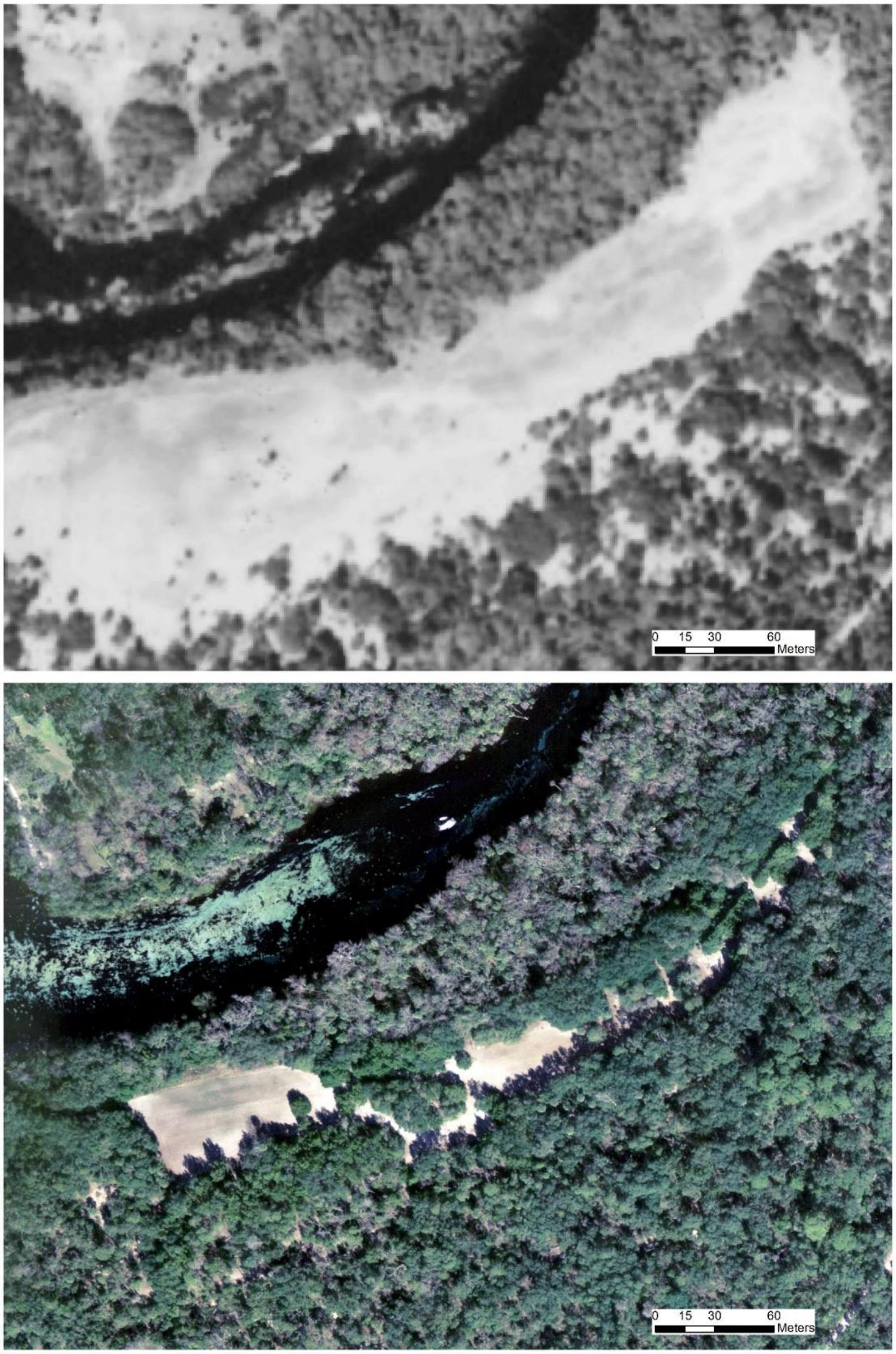


Figure 4.10: Historical Aerial photos from 1941 (top) and 2006 (bottom). Note the regrowth pattern and color difference, as well as the two bait fields left clear.

Investigations into the bait fields are primarily driven by a desire to understand the nature of the pre-1941 clearing and how this interruption of landform has archaeological repercussions.

Sub-surface variation at the Silver Glen Complex

Silver Glen Spring's extensive and consistent archaeological investigations have allowed for a cohesive picture of the sub-surface variation across various locations and time-period. The basic model of feature variation across 8LA1 and 8MR123 consists of shell filled pits, which make up the intrusive architectural canon for the site. As discussed previously, the above-ground architecture of the site is characterized by multi-component shell ridges and rings. These began their life-histories as Mount Taylor shell ridges and were expanded into Orange period shell rings. A fine-grained appreciation of the variations of sub-surface architectural features is considered here.

Gilmore created a thorough typology of the variations present in the pit features at Locus B, an area with both Thornhill Lake and Orange periods occupational spaces (Sassaman et al. 2011: chapter 6). These pit types are used as an example for the potential range of variation across the complex. Gilmore (2011) identified six types of pit features. Certain pit feature types are more closely associated with, but not exclusive to, certain archaeological time periods. At Locus B some pits are more often deposited, such as type 2 broad, deep basin of which there are eight examples, while some are scarce, such as type 3 cylindrical pits, where only one example is recorded. Preferential pit architecture might explain certain events around the deposition of the pit, such as gathering, and the spatial patterning of these pit features might indicate differential landscape use. Gilmore identified two depositional events, broadly relating to a Middle and Late

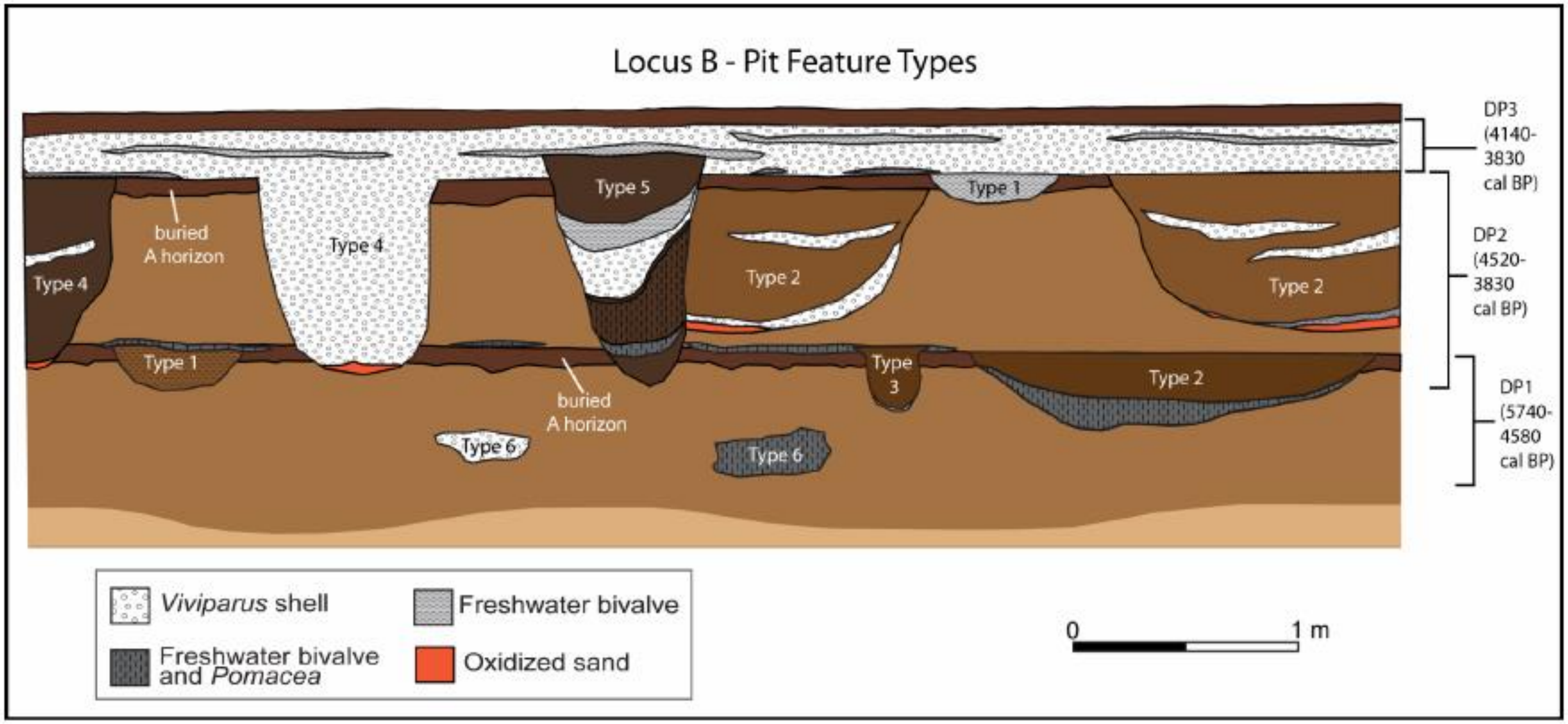


Figure 4.11: An example of pit types and their associated depth and time separation, identified through depositional events. Note the increase of Type 2 pits during depositional event 2, and the loss of type 6 pits after depositional event 1. (Gilmore 2011: 254, figure 6.36).

Archaic occupation. These depositional episodes match onto a break in loci occupation (figure 4.11) (Gilmore 2011: 283). The below typology outlines the basic sub-surface architectural canon of Silver Glen Springs.

Pit Typology

<u>Type 1</u>: Shallow basin-shaped pits with outward sloping margins. Typically, their maximum diameter ranges from 25 to 87 centimeters, and their average depth are between 8 and 20 centimeters below the top of the margins (figure 4.12).

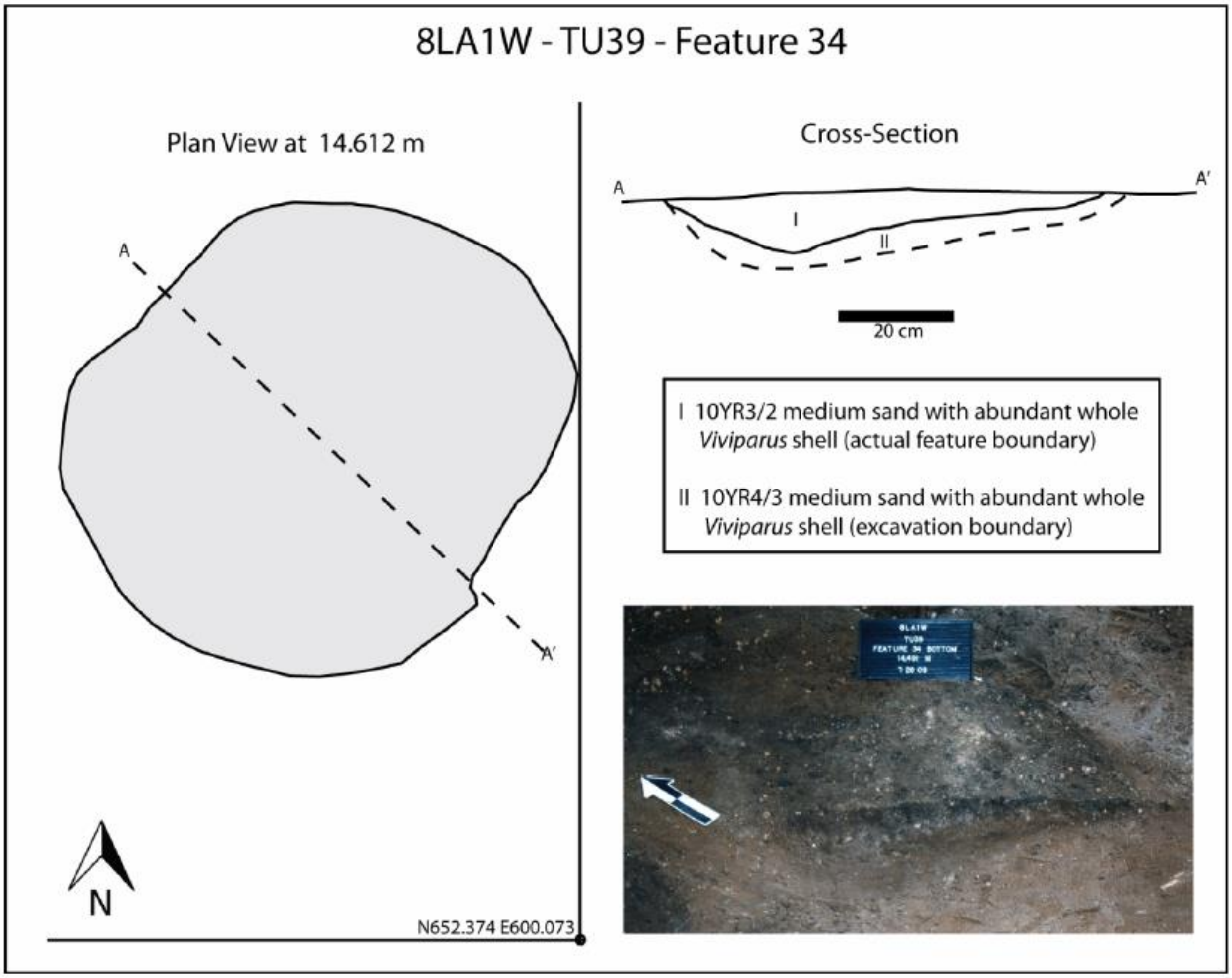


Figure 4.12: An example of a Type 1 pit from feature 34 in Test Unit 39 (Gilmore 2011: 259, figure 6.40).

<u>Type 2</u>: These pits include broad, deep basin-shaped pits with outward sloping margins. Their maximum diameter is between 67 and 230 centimeters and their depths persist from 42 to over 73 centimeters below the top of the feature (figure 4.13).

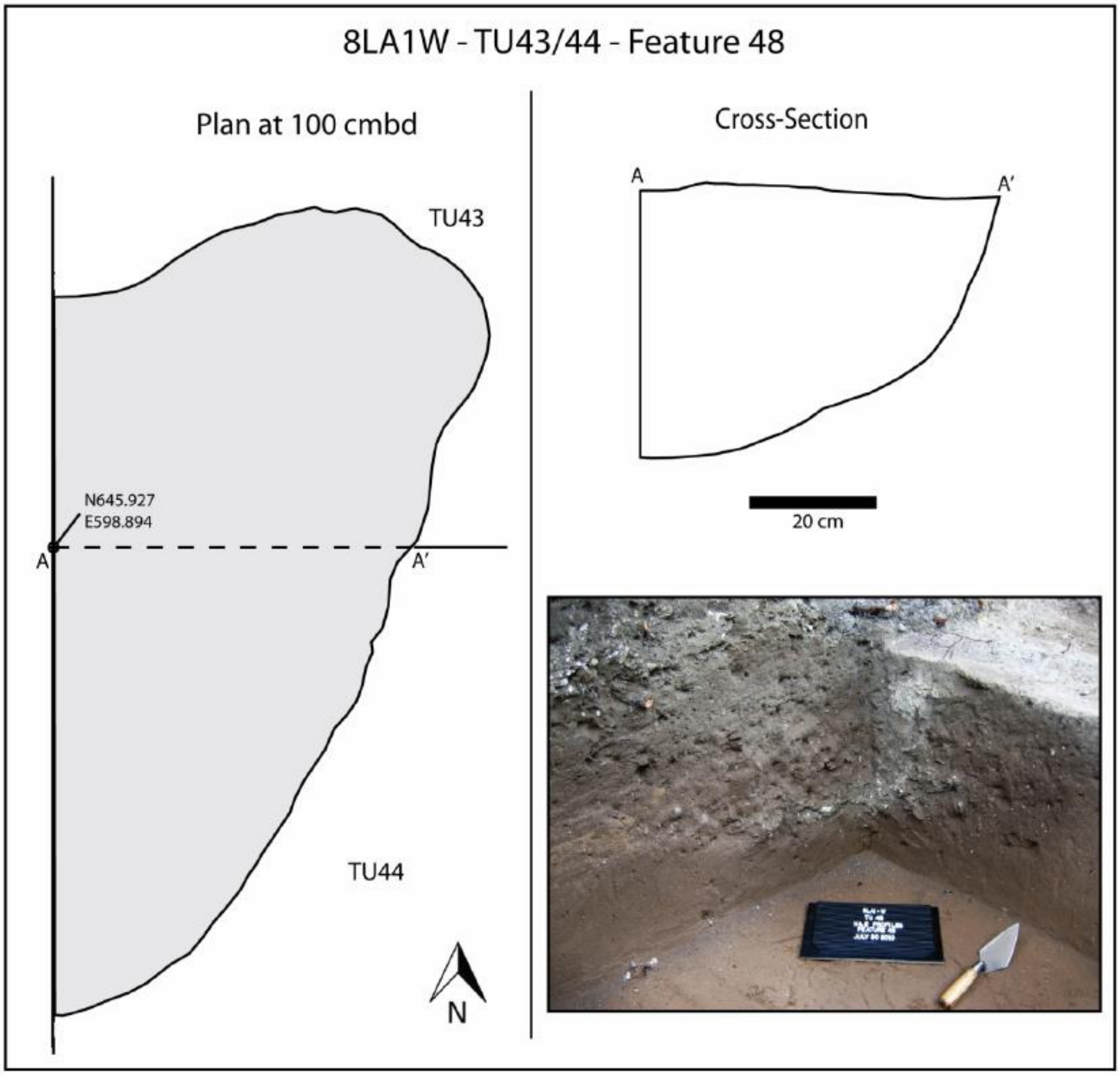


Figure 4.13: An example of a Type 2 pit from feature 48 in Test Units 43 and 44 (Gilmore 2011: 267, figure 6.48).

Type 3: Small cylindrical pits with vertical margins are included in this type. Maximum diameters are between 40 and 45 centimeters, and depths range from 31 to 51 centimeters (figure 4.14).

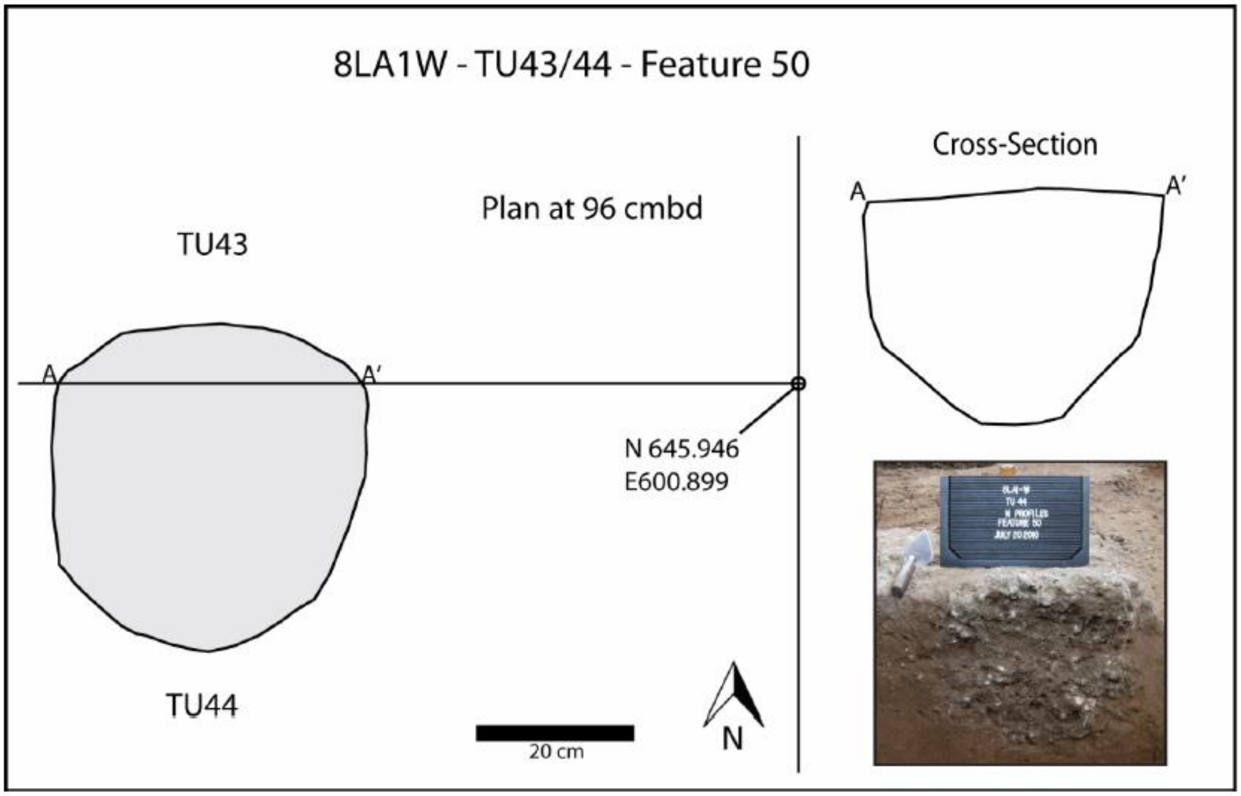


Figure 4.14: An example of a Type 3 pit from feature 50 in Test Units 43 and 44 (Gilmore 2011: 270, figure 6.50).

Type 4: This type is comprised of large cylindrical pits with vertical margins. Diameters range from 60 to over 140 centimeters, and maximum depths range from 50 to 102 centimeters below the top of the margin walls (figure 4.15).

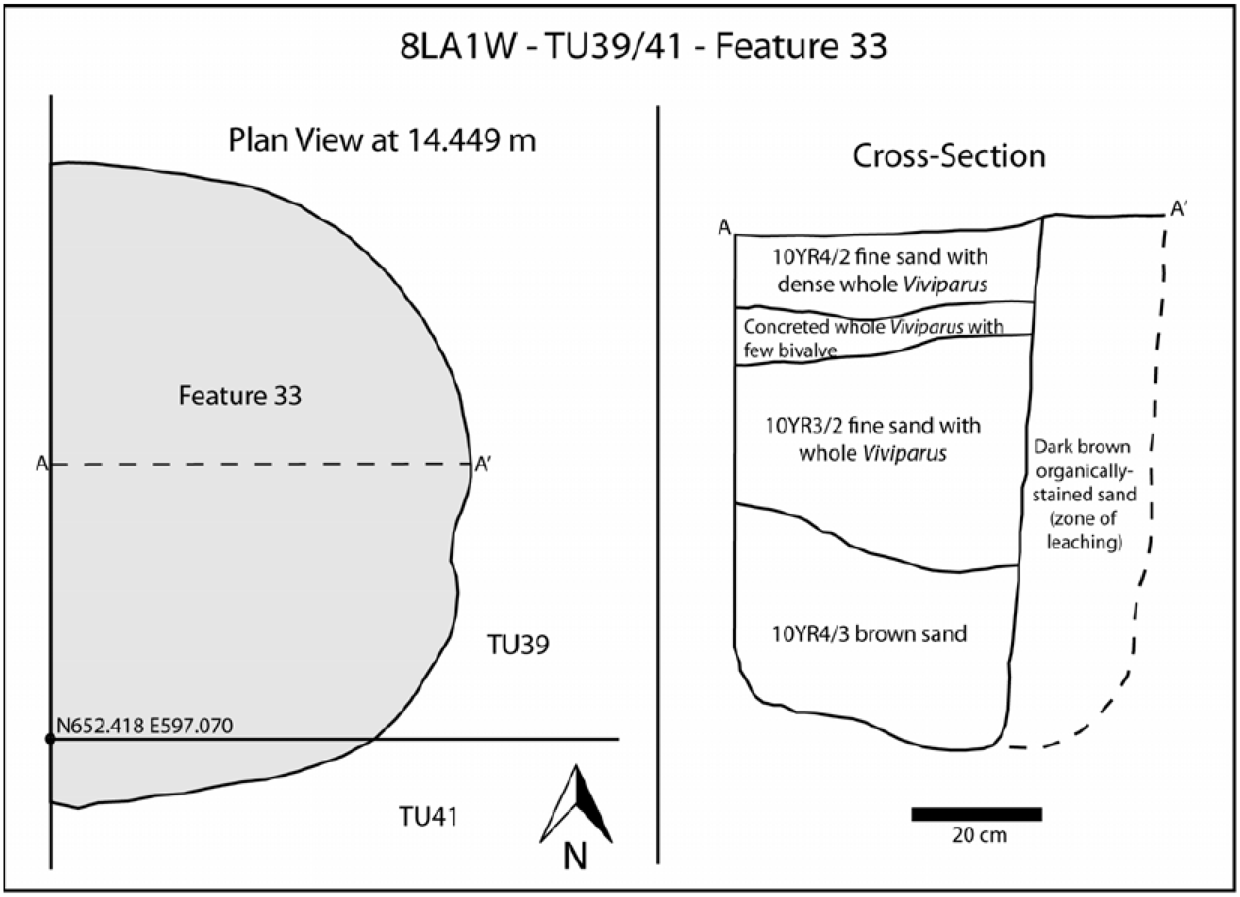


Figure 4.15: An example of a Type 4 pit from feature 33 in Test Units 39 and 41 (Gilmore 2011: 275, figure 6.54).

Type 5: These are conical pits with inward sloping margins. Maximum diameters are 120 centimeters with a maximum depth of 94 centimeters (figure 4.16).

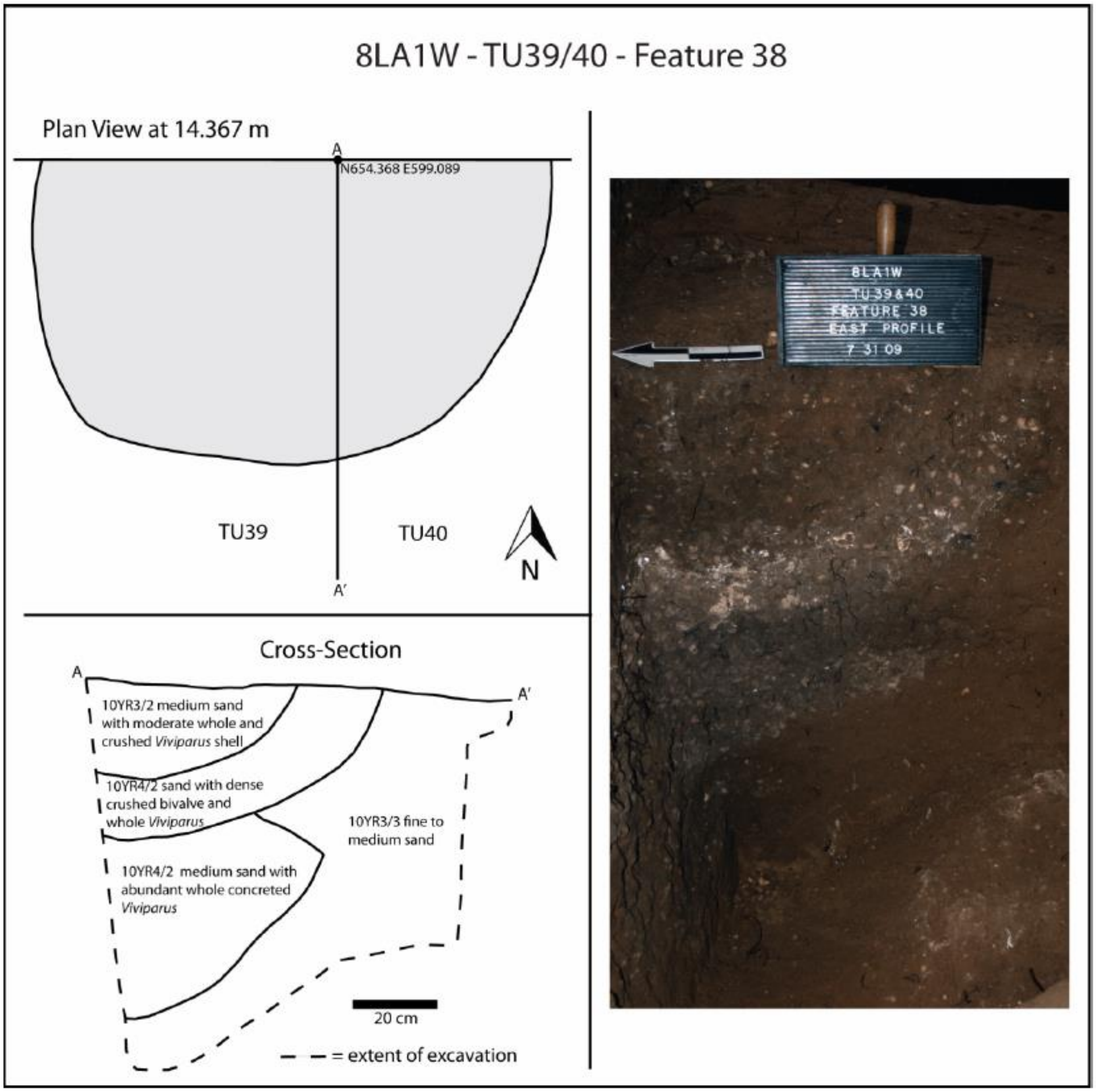


Figure 4.16: An example of a Type 5 pit from feature 38 in Test Units 39 and 40 (Gilmore 2011: 279, figure 6.57).

Type 6: Isolated shell pockets make up the last type. These pockets are from presumed cultural deposits based in depth below surface and spatial relation to other anthropogenic pits. Maximum diameters range from 38 to 47 centimeters with maximum depths from 20 to 28 centimeters (figure 4.17).

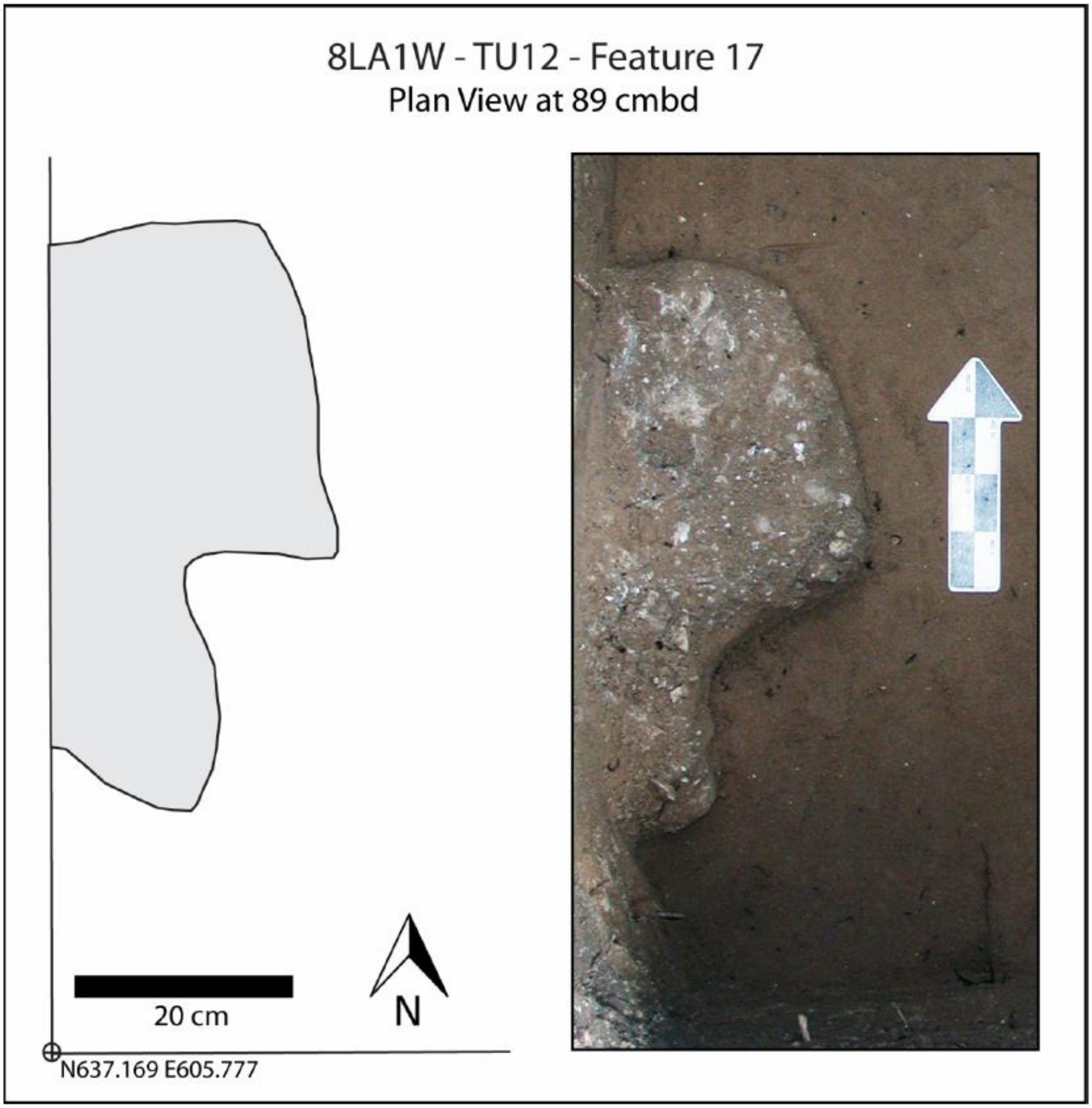


Figure 4.17: An example of a Type 6 pit from feature 17 in Test Unit 12 (Gilmore 2011: 281, figure 6.58).

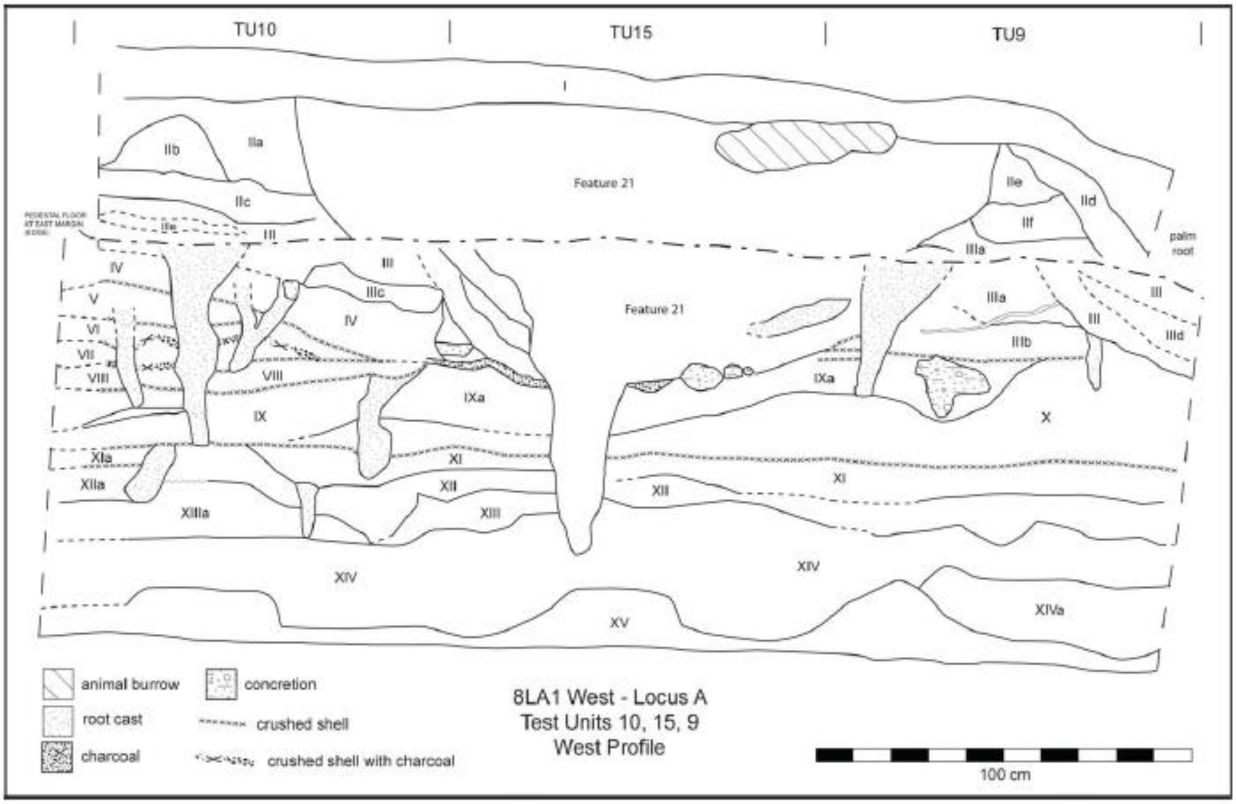


Figure 4.18: Composite profile of Test Units 9, 10, and 15 (Gilmore 2011: 151, figure 5.15).

Pit types are also related to time period. Mount Taylor period architectural canon consists of type 1 small basins, type 2 large basins, type 3 small cylinders, and type 6 isolate shell pockets. Early Middle Archaic type 1 and 2 pits are also present below Locus A. Test Units 9, 10, and 15 at Locus A exemplify the complicated stratigraphy of a pit filled, consistently re-occupied landscape (figure 4.18). Feature 21 from these test units is a large tree throw, not a type 2 pit. The basal features are consistent with domestic or quotidian activities, suggesting the basal Mount Taylor pits were part of an occupational space before further shell depositional events made the loci mounded (Sassaman et al. 2011).

Orange period sub-surface architectural canon is primarily comprised of type 1 small basins, type 2 large basins, and type 4 large cylinders. Besides the inclusion of type 4 pits and the end of type 6 pit deposition, the most dramatic change in Orange feature variation is scalar. The type 2 pits of the Orange period are massive in comparison to Mount Taylor period pits (Sassaman et al. 2011: 315). Large cylinder of over a meter in depth and diameter were emplaced during this period. Additionally, the pace of pit construction dramatically increased. Gilmore suggests that there is an estimated 310 Orange period type 1 and 2 pits buried in the areas within and adjacent to Locus B. Finally, the process of capping Orange period pits with shell is a new addition of the Orange period, starting around 4000 calendrical years before present (Gilmore 2014: 230). St. Johns I and II pit sub-surface pit variation is not well understood. Several woodland period pits were excavated at Locus C, but analysis is ongoing. Additionally, extensive shell mining at Locus A removed any potential data above the Orange pits. It does not appear that Woodland period pits were constructed at Locus B (Sassaman et al. 2011: 252).

Previously identified sub-surface variation

Pits are clustered in both space and time. The best evidence for pit feature clustering come from loci A and B, where the most intensive shell deposition occurred as well as the most extensive modern excavation has occurred. The spatial patterning of the non-mounded spaces is poorly understood but based on targeted excavations from the 2016 field school, the bait fields have a generally random patterning to pit development, at least based on test unit excavation (Sassaman et al. 2011).

In order to understand the sub-surface variation at the non-mounded spaces at Silver Glen Springs, the two bait fields were investigated in 2013. Zack Gilmore (2016) performed ground penetrating radar on two 30 by 30-meter grids (figure 4.19). He identified several ring-like anomalies with strong depth profiles. Based on the circular formation on the east grid at 42-51 centimeters below surface, a block excavation comprised of 5 test units was conducted. The GPR anomalies mapped on to shell-filled pits. These pits were mostly type 1 and 5, consisting of domestic remains, however there was also one large type 2 basin, identified as a roasting pit (Gilmore 2016: 123). None of these pits were "artifact rich," according to Gilmore. The presence of fiber tempered pottery in most of these features places these anomalous pit features in the Orange period. The shell deposits into the quaternary sand of the Silver Glen Complex are easily identifiable in the ground penetrating radar conducted by Gilmore. Additional geophysical work can provide the necessary resolution to identify these shell-filled patterns across the rest of the landscape.

The archaeological history of the SGSC has focused on the monumental shell mounds at the spring boil (8MR123) and at the mouth of the spring run (8LA1). Both extensive and intensive excavation has been completed since 2007. A systematic shovel test and auger survey was conducted, directed at identifying shell deposits that remain from the destroyed mounds, as well as other occupational spaces along the spring run. Based on the extensive survey, three loci were identified based on the presence of sub-surface shell and inferred shell mound emplacement pre-twentieth century steam-shovel shell removal. Locus A was a Mount Taylor period shell ridge, Locus B was an extensive series of Orange and Mount Taylor period pits that spread for an

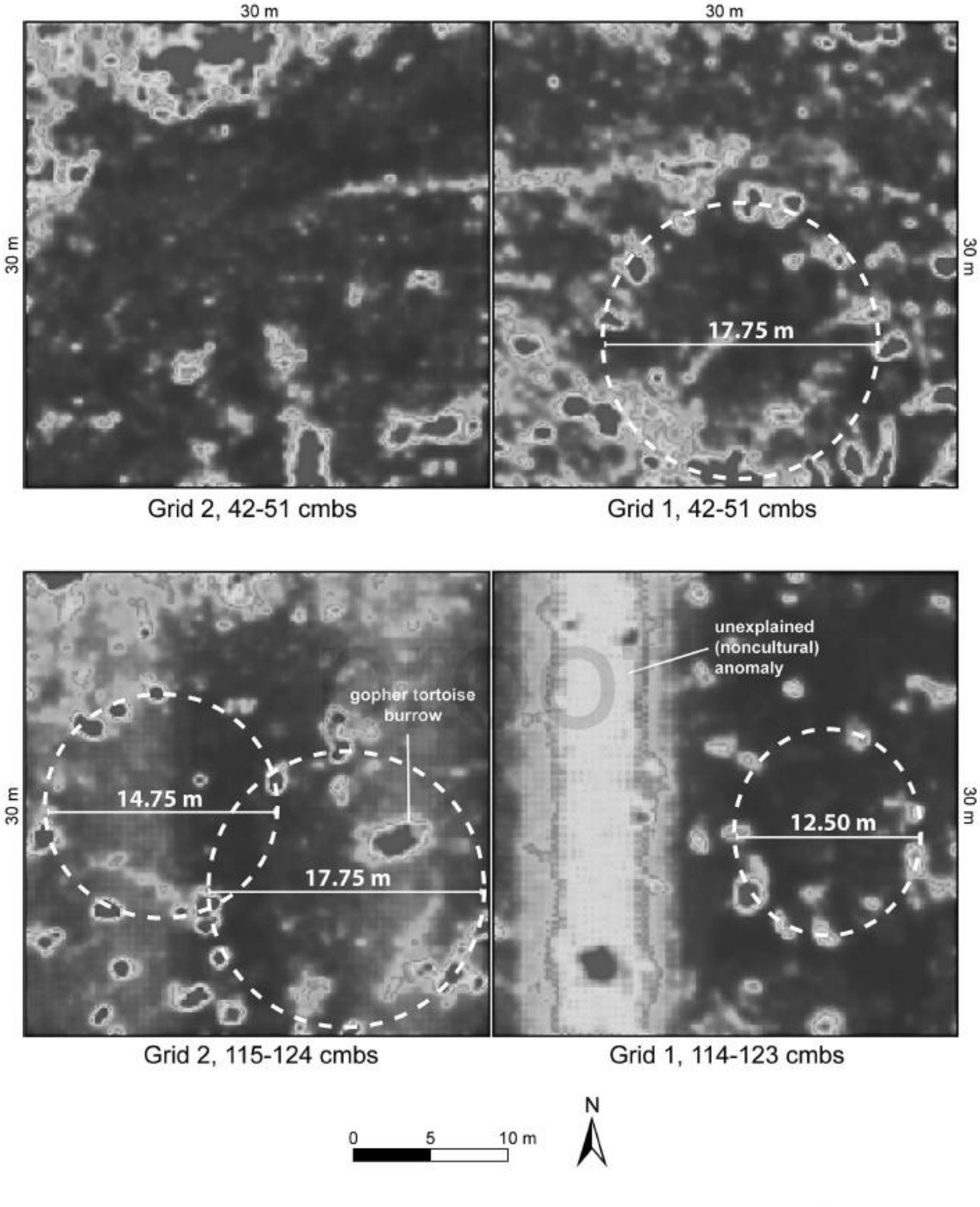


Figure 4.19: 2016 GPR grids on the West Bait Field. Gilmore identified several potential ring-like formations of sub-surface features (Gilmore 2016:122).

unknown distance around the top of the shell nub. Estimations suggest over three hundred Orange period pits are present around Locus B (Sassaman et al. 2011: 230). Locus C was a Woodland occupational space with sub-surface patterning, although the specifics remain to be analyzed.

The excavations of these mounded loci have identified the presence of clustered pit features. Clustering around mounded spaces appear to be characteristic for these architectures. The distribution of pit features in non-mounded has also been investigated. Geophysical investigations into the cleared spaces of the bait fields in 2016 suggest circular sub-surface patterning. Additional comprehensive geophysics work is necessary to identify the sub-surface variation and patterning at non-mounded spaces.

Conclusion

The archaeological investigations of site 8LA1 from Wyman to modern field schools have all been directed at understanding the role of shell mounding across the whole landscape. Prior to 1875, shell mounds at the mouth of the spring run and around the spring boil dominated the landscape, where communities persisted for thousands of years. Since the 1920s shell mining destroyed the mounds the landscape of the spring run has been reshaped through island creation and clear cutting. Archaeological remains persist and have been identified through extensive and intensive survey and excavation. Archaeology done thus far has been able to reconstruct the landscape before shell mining as well as direct future work towards areas outside the mounds that have been so-far under-researched

The use of geophysical equipment has allowed a greater appreciation for the sub-surface patterning and targeted test unit excavation was able to meaningfully connect the ground penetrating radar results with shell-filled pits, establishing its usefulness. The variation of subsurface features at Silver Glen Springs range from small shell accumulations to massive shell-filled pits, and further geophysical methods are necessary to appreciate this range. Archaeological research has identified that (1) there is variation among sub-surface features, (2) these features contain different types of matrix, such as shell and layered depositional events, and (3) some of these features have different uses, evidenced by burning at the base. These three observations in addition to the rapidly draining eolian sand that makes up the cleared areas of investigation, a geophysical survey with multiple methods can continue to reveal that nuances of spatial patterning at the SGSC. In the following chapter I discuss the geophysical methods used in collection of sub-surface data in the non-mounded areas, attempting to explore the ancient and modern taskscapes of the non-mounded bait fields.

Chapter 5

Geophysical Survey Research Design and Methodology

In order to determine the ancient land use of the non-mounded spaces at Silver Glen Springs, a multi-sensor survey was conducted on twenty-four 20-by-20-meter grids across two areas of interest. This survey was conducted during the 2018 St. Johns Archaeological Field School, a combined effort of the University of Oklahoma and University of Florida. All grids were aligned to the site wide grid, placing them in a broadly east-west orientation. In total, four remote sensing techniques were utilized in this investigation, three geophysical instruments, and one small-bore coring rig. The three geophysical instruments, (ground penetrating radar (GPR), electrical resistance, and magnetic gradiometry), are complimentary but fundamentally different in how they capture and display sub-surface data. Multiple instruments allow for a comprehensive view of sub-surface anomalies and patterning of the site more completely than just one instrument alone could produce. Anomalous features picked up by one instrument may or may not appear in results of another instrument. The absence or presence of anomalies across multiple technologies not only provides a non-destructive view of ancient landscape formation but also test the efficacy of each instrument in identifying sub-surface variation.

Field Methodology

Site 8LA1 was surveyed with these remote sensing techniques. The site has been separated into two areas of interest based on their proximity to archaeologically significant loci and their historical clearing of forest (figure 5.1). The westerns extent of site 8LA1 is separated into two bait fields: east and west. The east bait field (EBF) is situated between Locus A and Locus

B, and the west bait field (WBF) which is located between Locus B and Locus C. Remote sensing was conducted at these two areas to identify how extensive loci features were and if any archaeological remains persisted in the modern cleared space.

The EBF has a slight westward facing slope with higher elevation to the east, and a sudden rise to the west where intact archaeological deposits are present. The EBF is roughly 40 meters across at its widest and is dominated by Paola fine sand. The WBF is approximately twice the size of the east, running 100 meters east to west. It has similar soils, with more vegetation as the field approaches the water of the spring. The landform has a slight grade that increases as it proceeds west, with lower elevations to the north. There were two gopher tortoise burrows in this field, which turned up minimal shells or artifacts.

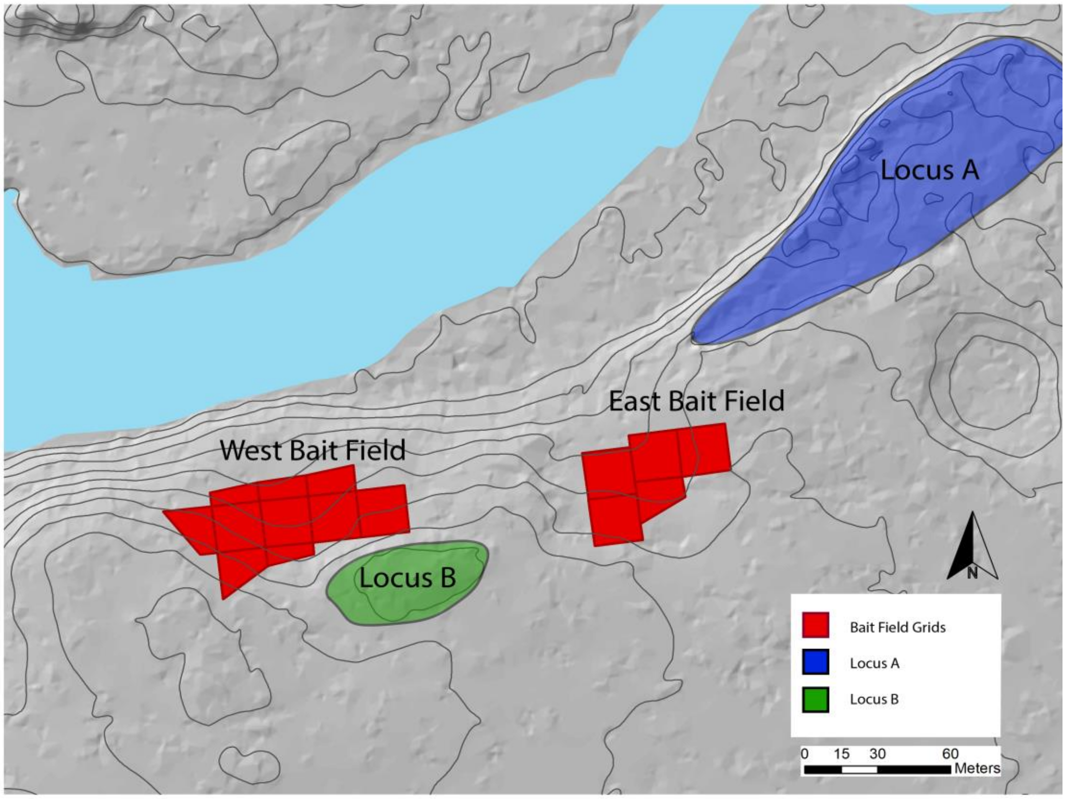


Figure 5.1: The two areas surveyed with remote sensing techniques.

Remote Sensing Methods

Remote sensing is a general term for a variety of non- or minimally invasive methods that can identify potential features below the surface of the ground. These techniques have been extensively used by archaeologists as an alternative to extensive, destructive block excavation as well as method for targeted excavation to answer specific questions (Kvamme 2008). Remote sensing geophysical tools have been adapted from geology and can detect changes in a variety of Earth's properties over multiple scales and over large areas.

As with all methods, analyzing raw data at face value is not acceptable, and a variety of inferences and data processing is necessary to comprehensively understand machine identified anomalies. Specifically, geophysical instruments cannot immediately differentiate between human construction and natural creation (barring the introduction and use of metal, although natural magnetic fields do occur). As such, data processing and test excavations can help with extrapolating data and identify in the patterns that are characteristically human-made.

Electrical Resistance Principles

An electrical resistance meter detects differences in moisture content in soils. This moisture determines the resistance of soils in completing a circuit with probes located outside of the survey area. This tests Ohm's law, which is resistance (R) of sub-surface soils tested by running a current (I) into the ground at a low-voltage (V), written out as R=I/V. While resistance is recorded, the actual measured soil property is resistivity. Resistivity is the conversion of resistance of different materials that are compared in a standardized way (Clark 2000: 27). This is represented by the omega (Ω) for Ohm.

Resistivity is captured by inserting two remote probes in the ground at a distance of 30 times the spacing away from the handheld resistance meters probe array. This is done to capture a baseline resistance of the soils below. Generally, the distance between the two remote proves was kept around 30 centimeters apart, in order to capture a reading approximately 50 centimeters below surface (Gaffney and Gater 2003). These ohm readings are turned into a two-dimension representation of the resistance across the whole area potentially revealing meaningful patterns. These patterns are more or less evident based on the underlying soil moisture and drainage-speed. Differential moisture can be a product of human actions, such as organic horizon formation, prepared floors, and filled pits. The decreased porosity of a hard-tamped floor might appear as an area of higher resistance. Lower resistance might represent pit formations due to an accumulation of water and a lower level of evaporation, given a consistent surrounding soil context (figure 5.2) (Kvamme 2001).

I used a Geoscan Research RM15 with MPX15 multiplexer in twin-probe array noted above. The well-drained sandy soils were not conductive enough to capture good raw data, often wildly over-range. This issue was common at both the EBF and the WBF.

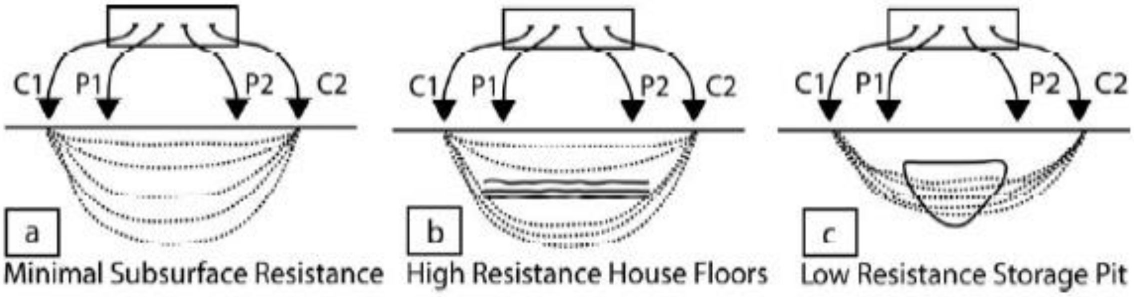


Figure 5.2: Electrical resistance schematic with differential sub-surface variation. (a) minimal resistance, (b) high resistance due to house floor, and (c) low resistance fur to pit formation. (Kvamme 2001: 355)

Electrical Resistance Data Capture Method

A survey of the EBF was conducted with the electrical resistance meter. These grids were 20-by-20 meters, with stakes driven every odd meter on the north and south sides. 20-meter lines were then stretched between stakes to aid in accurate spacing. Data was captured at a spacing of 50-centimeter intervals, giving 40 readings per one run down the grid. Each grid was recorded in a zig-zag pattern, starting at the southwest edge of the grid. A total of 3 grids were tested with this machine from the EBF. The WBF was not tested with the electrical resistance meter because of the over-range issue identified above.

Magnetic Gradiometry Principles

Magnetic gradiometry provides fast and accurate reading of sub-surface variation with resolution of just over a meter. Magnetometers detect small changes in the magnetic field below ground and report the results in nano-teslas (nT). Several types of magnetometer sensors have been designed, including: proton, alkaline vapor, and fluxgate magnetometers (Kvamme 2001). The most commonly used type of magnetometer in archaeology is fluxgate, and the fluxgate methods require calibration as they are prone to drift and heading issues. Most short comings have been addressed by further developments and software processing (Clark 2000). The speed in which large areas can be surveyed has led many archaeological geophysics practitioners to use magnetic gradiometry.

Anything that creates a magnetic field, including everything from small metal nails to the Earth itself, affects magnetometer data recovery (Clark 2000: 65). Gradiometers are composed of two sensors within a vertical plastic casing, attached to a handheld frame. The upper sensor detects the Earth's magnetic field and subtracts these nT readings from the bottom sensor which is more attenuated to anomalies closer to the surface of the ground. This allow for only the differential magnetic fields of nearby features to be captured. A pair of this type of sensor are often utilized for speed and consistency of data capture (figure 5.3). Soil magnetism is affected by thermoremanence and magnetic susceptibility, which rely on the relative amount of iron oxide in the ground. The higher the amount of iron oxide, the higher the chance that the soil will become magnetized. Additionally, anthropogenic activities can cause areas to become more or less magnetized.

Figure 5.3: Bartington 601 Magnetic gradiometer with dual sensor array (left), pin-flags set-up for data collection (right)

Thermoremanent has to do with heating and cooling of iron oxide that locks in the magnetic alignment when it was heated above 600° C (Kvamme 2006). Soils and materials burned at or near this temperature will have an altered magnetic signature that the surrounding matrix. This is present in burned areas, such as kilns and burned down buildings, and metal tools which have been repeatedly heated and hammered into shape. Magnetic susceptibility involves the capacity and ease in which iron oxide becomes magnetized when it comes into contact with a magnetic field. Materials more susceptible to magnetic fields are picked up by the gradiometer. Areas heated around 300° C can increase the magnetic susceptibility of the soil (Kvamme 2006: 222). Human activities that add a higher concentration of organic material, such as hearths and house floors can create positive magnetic features. As such, the topsoil moved for either mound construction or causeways creates areas of high magnetism. The removal of topsoil for the creation of channels, ditches, and pits create anomalies with low magnetic signatures. Even when magnetic features are present, they might not be picked up by the gradiometer due to their depth (below 1 or 2 meters) or due to uncalibrated data collection. Additionally, if the operator is wearing metal, or does not keep a consistent pace when using the machine in a grid, all of the data collection will be compromised.

Magnetic Gradiometer Data Collection

All 24 grids in this investigation were surveyed with a Bartington Grad 601 fluxgate magnetic gradiometer with two sensors mounted on one handheld frame. Similar to the electrical resistance survey, grid size was 20 meters by 20 meters, collected in a zig-zag pattern starting at the southwestern edge of the grid. Pin flags were used rather than stakes and ropes for spacing, speeding up the overall time of the survey (see figure 5.3 above). This allowed for multiple devices to run at the same time; the GPR survey was conducted with the stakes and lines while the gradiometer used the pin flags in a different grid. A total of 8 readings per meter were taken. The spacing between line lines was 50 centimeters. The three main east bait field grids were collected, followed by the four main grids in the west bait field, before partial grids were collected. Partial grids were taken the maximize the coverage of the survey extending from the previous grid to the vegetation. Partial grids were recorded with dummy data to maintain consistent size of grid spacing for later data processing.

Ground Penetrating Radar

Ground penetrating radar sends VHF radio pulses into the ground and reads the reflections, creating a three-dimensional view of sub-surface features. Two antennae are housed in an insulated module, the first one emits the propagated radar pulse and the second one records the wave reflections created by differences in density and other varying sub-surface properties and the surrounding soil matrix (Kvamme 2001). The wave differences are measured by the amount of time it takes for the radar to return to the second antennae. Depth is

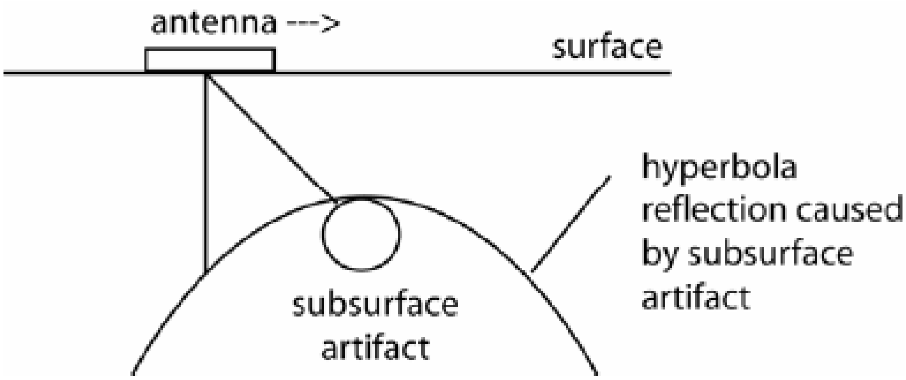


Figure 5.4: Basic model of GPR functionality (figure from Kvamme 2001).

extrapolated by the time differentials. This creates a vertical “time-slice” representing the sub-surface variations in two-dimensions as hyperbolas (figure 5.4). Time-slice data can be stacked to create a true three-dimensional representation. Stratigraphic soil changes can be represented based on breaks in the time-slice. Anomalies that are more localized are interpreted as features rather than landscape-wide sub-soil formations. Changes in soil densities, voids (like gopher tortoise burrows), large infilled pits, and other disturbances all create unique time-slice signatures.

Soil conditions affect the efficacy of ground penetrating radar. Radar pulses can be absorbed, conducted, or attenuated by a variety of soil types. Wet clay can attenuate the radar signal, which artificially limits the depth the pulse can reach and might cause anomalies to be missed. In contrast, well-drained and dry sand are fairly neutral, allowing for greater depth to attained. The increased speed that the signal travels in sandy soils can stretch the signal and might slightly increase depth reading artificially (Gaffney and Gater 2003). The type of antenna used determines the depth that data can be taken accurately. Frequencies between 200 and 500 MHz are commonly used. The GSSI Utility Scan used in this investigation has a 350 MHz antenna which has a maximum range of 10 meters below the surface (figure 5.5). Additionally, soil conductivity affects the results of GPR survey. Conductive soils will disperse the radar signal and create indecipherable noise. Thus, areas of higher electrical resistance are prone to be good candidates for GPR data collection.

Ground Penetrating Radar Data Collection

All 15 grids across both bait fields were targets of the GPR survey. Consistent with the other two geophysical methods, survey areas consisted of 20 meter by 20 meter grids, arranged along the east-west alignment of the site wide coordinate plain. Stakes were driven at odd numbers along the north and south 20-meter edge running north-south. Grids were captured in a zig-zag pattern, at 50 centimeters spacing, 100 readings per meter. Similar to the gradiometer survey, the initial survey consisted of three east bait field grids, followed by four grids in the west bait field, before the creation of partial grids was conducted. Partial grids were captured by running shorter than 20-meter lines.

Figure 5.5: GSSI UtilityScan GPR unit with Android tablet display (left), grid set up for GPR survey in the west bait field (right)

Small-bore Coring

Coring was conducted on areas relevant to the geophysical survey. A PN150 JMC Environmentalist's Sub-Soil Probe (henceforth ESP) was used to sample soil (figure 5.6). Coring with this machine has been used in recent work to identify deeply buried archaeological remains as well as to find the base of mounded spaces (Cannon 2000; Thompson et al. 2016). The samples were contained in 2-centimeter diameter copolyester tubes, allowing the soil to be observed without cutting into the tube wall. A selection of geophysical anomalies were cored in order to and potentially identify what they might represent without shovel testing or block excavation. The probe operated by slide hammer and drive shaft which, with extensions, could extend several meters below grade. Cores were extracted and capped, and their contents were recorded in-field. Their contents informed test unit placement.

Figure 5.6: ESP core device in use. A manual slide hammer drives the metal probe with copolyester tube into the soil, taking a slightly compacted version of real stratigraphy.

Data Processing

The data collected during the geophysical survey was used in directing archaeological investigations. As such, in-field data processing was necessary. Three types of software were used, more-or-less matching up to each machine type: Radan 7, developed by GSSI, was used for GPR data processing; TerraSurveyor 3, developed by DW Consulting, was used to process the magnetic gradiometer data, and to a limited degree the electrical resistance data; GeoPlot 4.0, developed by Geoscan Research, was used for the electrical resistance data processing. Due to the placement of grids and creation of partial grids, each software was used to stitch each grid into its real-space position.

Radan 7 post-processing involved several steps. Visually, parabolas were brought out by increasing image gain, and noise was reduced by time-zero corrections. Box-car triangle and range-gain correction were used to more clearly identify the significance of each parabola by removing noise. Time-slices were created to make a plan view of the data within which z-slices of depth could be investigated to see underlying patterning. Most GPR anomalies are characterized by consistent parabola patterning. Geoprocessing of the EBF and WBF GPR data underwent three steps: FIR background reduction, over 501 lines, with a low pass at 800 MHz and high pass at 200 MHz, data migration, and exponential range gain. This allowed for a more accurate representation of sub-surface variation, without fabricating data. The consistent method allowed for an accurate representation of sub-surface anomalies and does not overrepresent less-than-certain data.

Similar steps were taken with TerraSurveyor during the analysis of the gradiometer data. Destaggering and de-striping was used to reduce zagged edged between lines and clear up noise in the data. Areas with strong dipoles were considered metal and had to be masked out and replaced with dummy data so that the strong signatures of the dipoles would not wash out the actual anomalies. X and Y coordinates were interpolated, matched and a Gaussian filter was applied to clean-up the edges of anomalies. Finally, the masked and corrected data clipped to three standard deviations, revealing the underlying anomalies.

GeoPlot 4.0 was used to stitch together and analyze the electrical resistance data. Standard de-striping was applied; however, the data was not usable for the east bait field. These post-processing methods were (1) despike, (2) HPF using Gaussian with default settings, and (3) interpolation of the data. This created a plan-view map representation of the data.

The stitched and corrected full and partial grids were georeferenced into GIS ArcMap 10.6.1 to identify spatial patterning. In the following chapter, I discuss the results of this investigation targeted at identifying geophysical anomalies that might have archaeological correlates. The overall investigation provides more data to comprehend the orientation and quantity of potential architectural remains at the non-mounded spaces at the SGSC.

Chapter 6

Geophysical Bait Field Survey Results

Magnetic resistance, ground penetrating radar, and electrical resistance geophysical instruments were utilized to conduct a 15-grid survey in the east and west bait fields. Due to the well-drained, fine-grained Paola sands that make up the majority of the landscape to the south of the spring run, electrical resistance survey was unsuccessful in both fields at it was abandoned. The data was frequently over-range and presented little to no decipherable data. Magnetic gradiometry and GPR did present usable data which is discussed in this chapter. The gradiometry survey identified characteristic circular positive anomalies between 30 centimeters and 100 centimeters in diameter. The GPR survey results suggest linear anomalies are present below the plow zone, between 20 and 90 centimeters below surface (cmbs). Overall, the data gathered between gradiometer and GPR machines suggest pre-contact occupational spaces are preserved in both bait fields. Particularly, potential architectural remains are identified in the west bait field based on the presence of an oval-arrangement of circular positive magnetic anomalies.

Results Summary

The results of the geophysical investigation at the bait fields identified almost 100 sub-surface anomalous anomalies consistent with metal, bioturbation, and ancient occupation of non-mounded spaces. Magnetic gradiometry and GPR results of the west bait field were particularly revealing of occupational spaces. Similarly, the surveys identified disturbances. Most notably, a 20-meter-long linear ferrous anomaly in the west bait field obscured a large portion of the gradiometer grid data. Additionally, gopher tortoises frequently create sub-surface burrows in this landscape. These burrows were present in the surface of the west bait field, which are present in both the gradiometer and GPR data. Electrical resistance data was not usable for both bait fields. As such, magnetic gradiometer and GPR results from the east and west bait fields are the only data results reported below.

Fifteen grids were surveyed by gradiometry and GPR. A total of 1609 m^2 was surveyed in the east bait field (EBF) and 1999 m^2 was surveyed in the west bait field (WBF) (table 6.1). Three complete geophysical grids were captured in each field as well as nine partial grids: two in the EBF and seven in the WBF (figure 6.1). EBF grid 1 is offset by 5 meters in relation to grids 2 and 3 in order to maximize ground coverage. Grids 1, 2, and 3 for both bait fields are 20 by 20 meters. Partial grids are sized to match the overall non-wooded field size. Partial grids in the East Bait Field are 4 and 5, and in the West Bait Field are 4, 5, 6, 7, 8, 9, and 10. The EBF survey area is west of Locus A and east of Locus B. The WBF survey area is west of Locus B and east of Locus C.

These two bait fields cover a significant portion of the cleared land that separates the three loci. Originally, the whole half a kilometer from the eastern extent of Locus A to the edge of Locus C was clear-cut sometime in the 1920s (see figure 4.10). Since then, new-growth forest has covered most of the formerly cleared field. The modern bait field that are the target of this investigation compose a significant portion of the exposed ground surface as shown in figure 6.2. Since 2006, when this high-resolution aerial photograph was taken, thick vegetation has encroached into the field. Therefore, the edge of the survey grid represents the beginning of vegetation thick enough to prevent geophysical machine use.

The two bait fields are separated by a topographical rise as well as vegetation. This area of elevated topography was tested during the 2018 field school. Test Unit 105 was emplaced in a mining escarpment to determine if there are intact deposits here. Intact shell deposits, notably a type 1 shallow basin pit, are present beneath recent tree growth (figure 6.3). This pit is identified as Feature 236. This feature is roughly a meter above the bait field western edge of grid 1 in the EBF. A total of five test units were excavated in and around the bait fields.

Both bait fields are annually disc-plowed, and construction debris litters the surface around Locus A and south of the road near the EBF. These activities, in addition to the last century of modern occupation, left copious metal fragments and other modern metal parts in the field. These pieces of metal affected both the GPR and gradiometer in different ways. The ferrous metals complicate the magnetic readings and present as dipoles. Surficial metal presents in the GPR results as thin parabolas that often persist over half a meter in the time-slice (figure 6.4). Additionally, several occasionally used roadways cross both bait fields (figure 6.5).

East Bait Field

The east bait field survey area is comprised of 5 grids. Grids 1, 2, and 3 are sandy open spaces with little vegetation, and grids 4 and 5 comprise a road and denser vegetation areas with trees. The sandy grids do not have a surficial layer of organic-rich soil which did not allow for accurate electrical resistance data collection. The entire field is approximately 70 meters long and an average of 30 meters wide. It is situated between Locus A to the northeast and Locus B to the southwest.

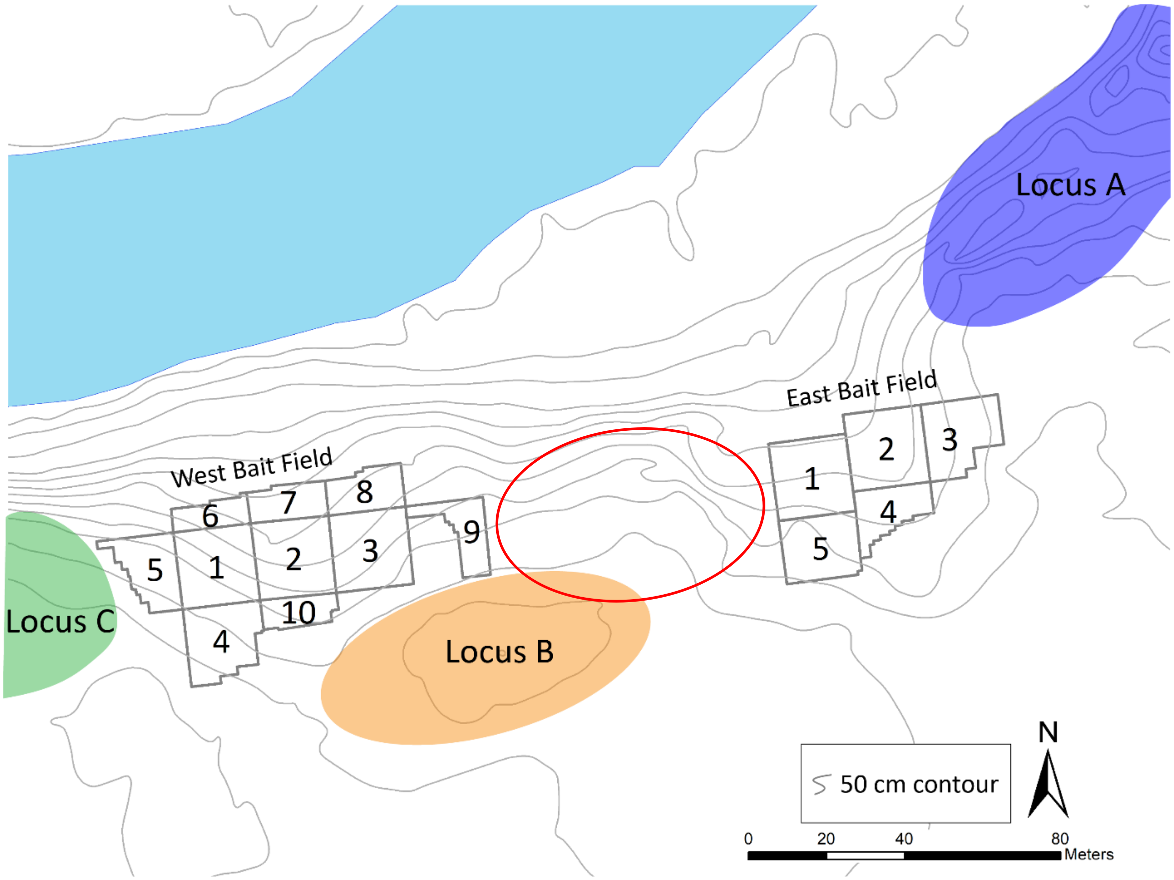


Figure 6.1: Survey grids in context with 50-centimeter contour. Note: the grids placement between the three loci. Additionally, the area of higher elevation between each bait field is highlighted by a red circle.

East Bait Field Grid	Area (m^2)	West Bait Field Grid	Area (m^2)
1	400	1	400
2	400	2	400
3	400	3	400
4	145	4	141
5	264	5	140
		6	32
		7	54
		8	72
		9	320
		10	40
Total (m^2)	**1609**		**1999**

Table 6.1: Aggregate total area for all surveyed bait field grids.

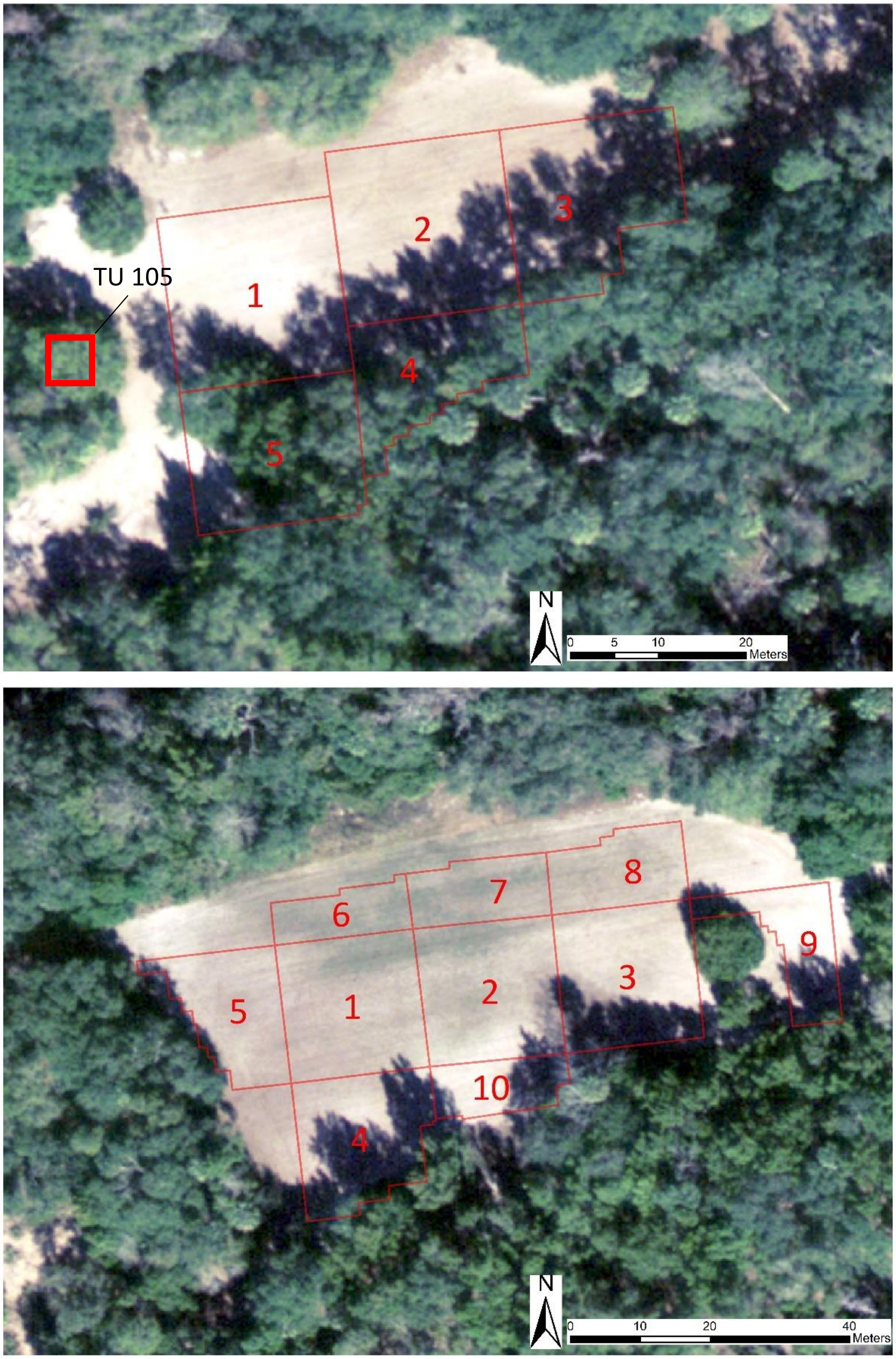


Figure 6.2: East bait field (top) and west bait field (bottom) geophysical grids overlaid on 2006 aerial photography. Recent vegetation growth has encroached, matching the northern edges of the grids in both the EBF and WBF. Note Test Unit 105 located to the west of grid 1 of the EBF

Figure 6.3: Test unit 105 north profile. Feature 236 is highlighted.

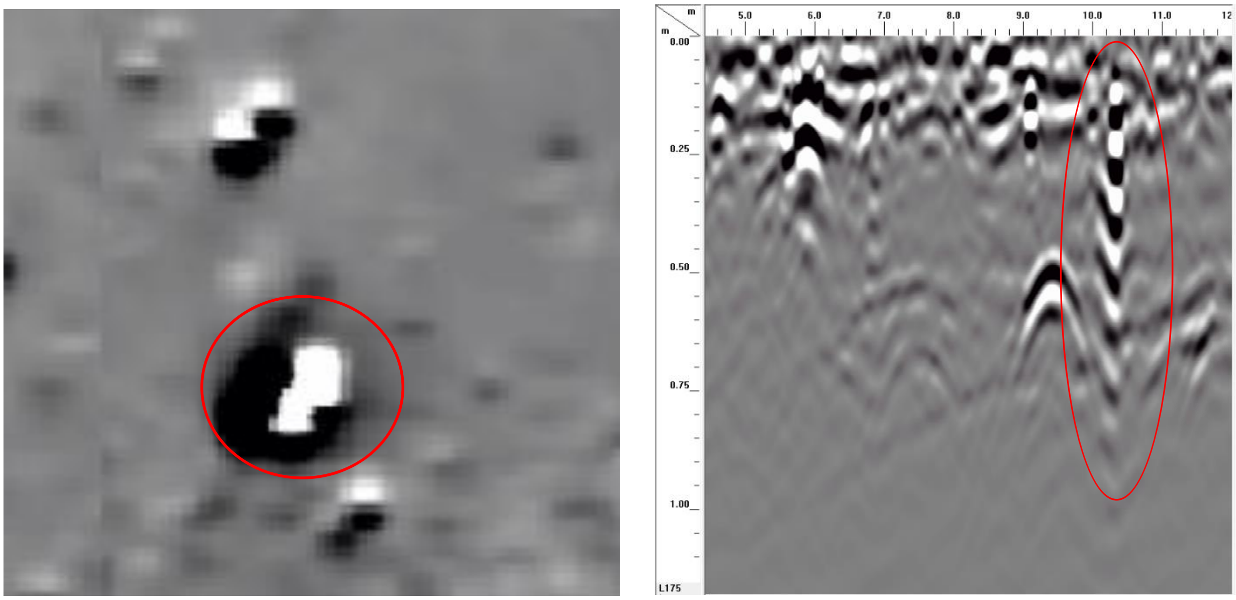


Figure 6.4: Gradiometer ferrous metal anomaly signature (left) and GPR metal anomaly signature (right).

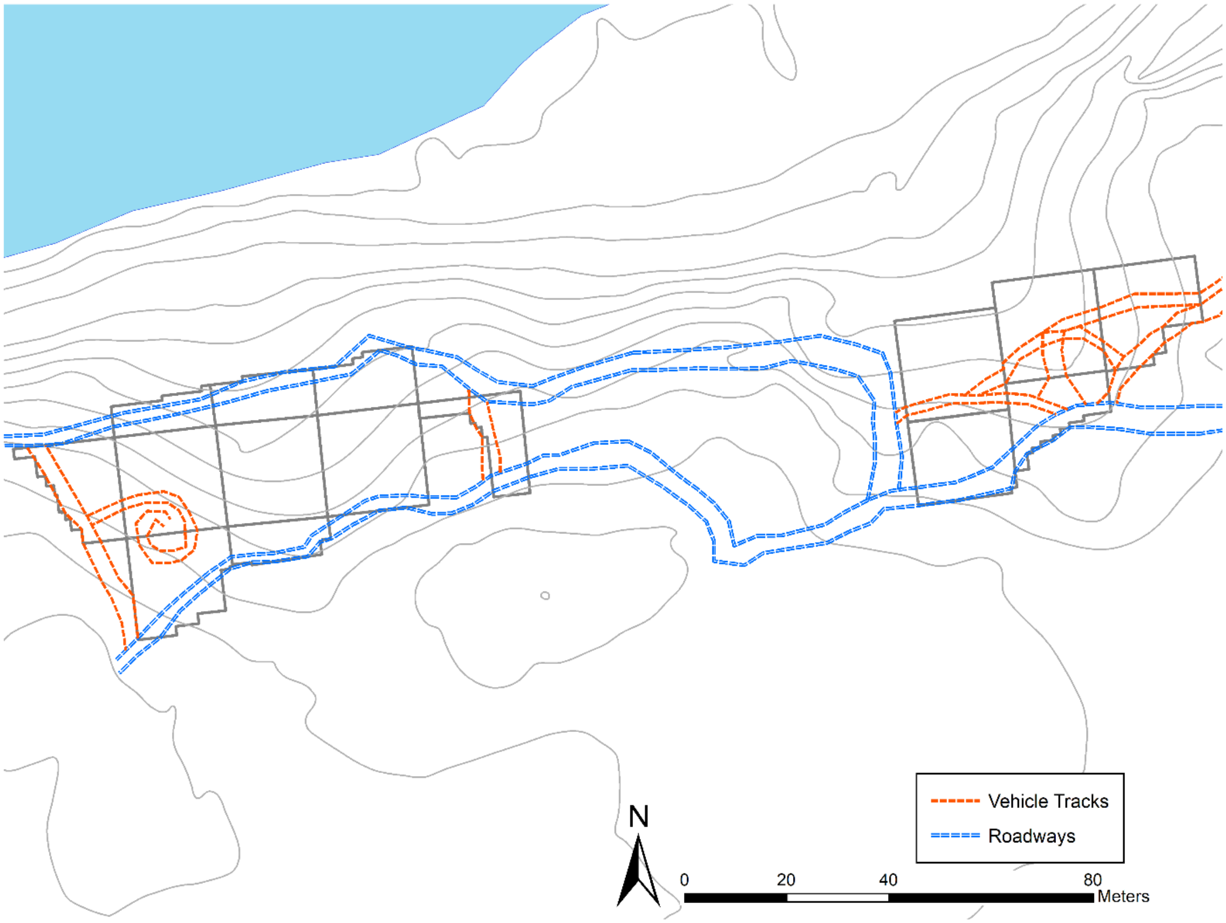


Figure 6.5: Map of roadways and vehicle tracks across both bait fields.

Magnetic Gradiometry

The gradiometer data gathered at the EBF lacks an easily identifiable pattern, with many small dipoles suggesting a large amount of modern metal, and several scattered positive non-dipolar nT anomalies suggestive of quantifiable sub-surface features. Additionally, the field has two truck roads that are occasionally used but are evident on the surface. Any strong dipoles were masked out from the raw data, in order for any possible subtle anomalies to become more visually evident when the data is clipped. When the data is masked and clipped, 39 positive magnetic anomalies, between 30 and 100 centimeters in diameter, are evident (figure 6.6).

Of most immediate interest was a concentration of inter-mixed positive and negative anomalies. The concentration of anomalies is located underneath a small island of vegetation and trees in the middle of several interconnecting roadways and trails (figure 6.7). This suggests that the anomalous concentration of positive and negative anomalies that make up this area is due to recent soil formation. Due to the tree in this area, vehicles often drive around this anomalous area. The tires displace soil around a central area, altering its relative magnetism to something different from the surrounding matrix. The altered magnetism presents as a dispersed "cloud" of magnetic anomalies. The concentration is not devoid of discernable non-dipolar, possibly cultural, anomalies. Eight potentially pre-contact cultural anomalies are present within the concentration of anomalies.

Equally important are the areas that lack non-dipolar anomalies. Grid 1 in the EBF is one such area. In contrast to the east grids 2 and 3, grid 1 is notable devoid of non-ferrous, potential cultural anomalies. When georeferencing the gradiometer results, the direction and general pattern of the results follow the 50-centimeter contour line. The edges of non-dipolar positive anomalies were traced using ArcGIS 10.6.1. Non-polar anomalies are considered potentially pre-contact culturally derived, as dipolar anomalies are constant with modern metal debris. The edges of these anomalies were determined by the constancy of nT readings, illustrated by change from dark grey to lighter gray more consistent with the background data. As such, 39 defined anomalies are outlined (figure 6.8).

All anomalies are circular, and between 30 centimeters and 1 meter. There are no linear arrangements that suggest architectural remains. Grid 1 has few non-dipole anomalies, while grids 2, 3, and 4 are anomalies rich. The anomalies in grids 2, 3, and 4 appear to be tied closely to the contour of the landscape. Anomalies are present in greatest number between 4.5 and 5 meters above spring level. Additionally, they trace the morphology of the contour line. The lack of anomalies in grid 1 matches up with an area of flatter elevation, and the anomalies in grids 2, 3, and 4 broadly match up with landform contour. Overall, the magnetic anomalies detected in the EBF appear to be discrete circles of potential pre-colonial human origin and are situated above the 4.5-meter contour interval.

Ground Penetrating Radar

In contrast with the gradiometry data, GPR results present discernable linear anomalies, rather than discrete circles as seen above. GPR data that are shallower than 24 cmbs is characteristic of modern disc-plowing and road formation (figure 6.9). Data resolution is slightly better at 24 cmbs. The linear anomaly in grids 2 and 4 is still consistent with road use, and

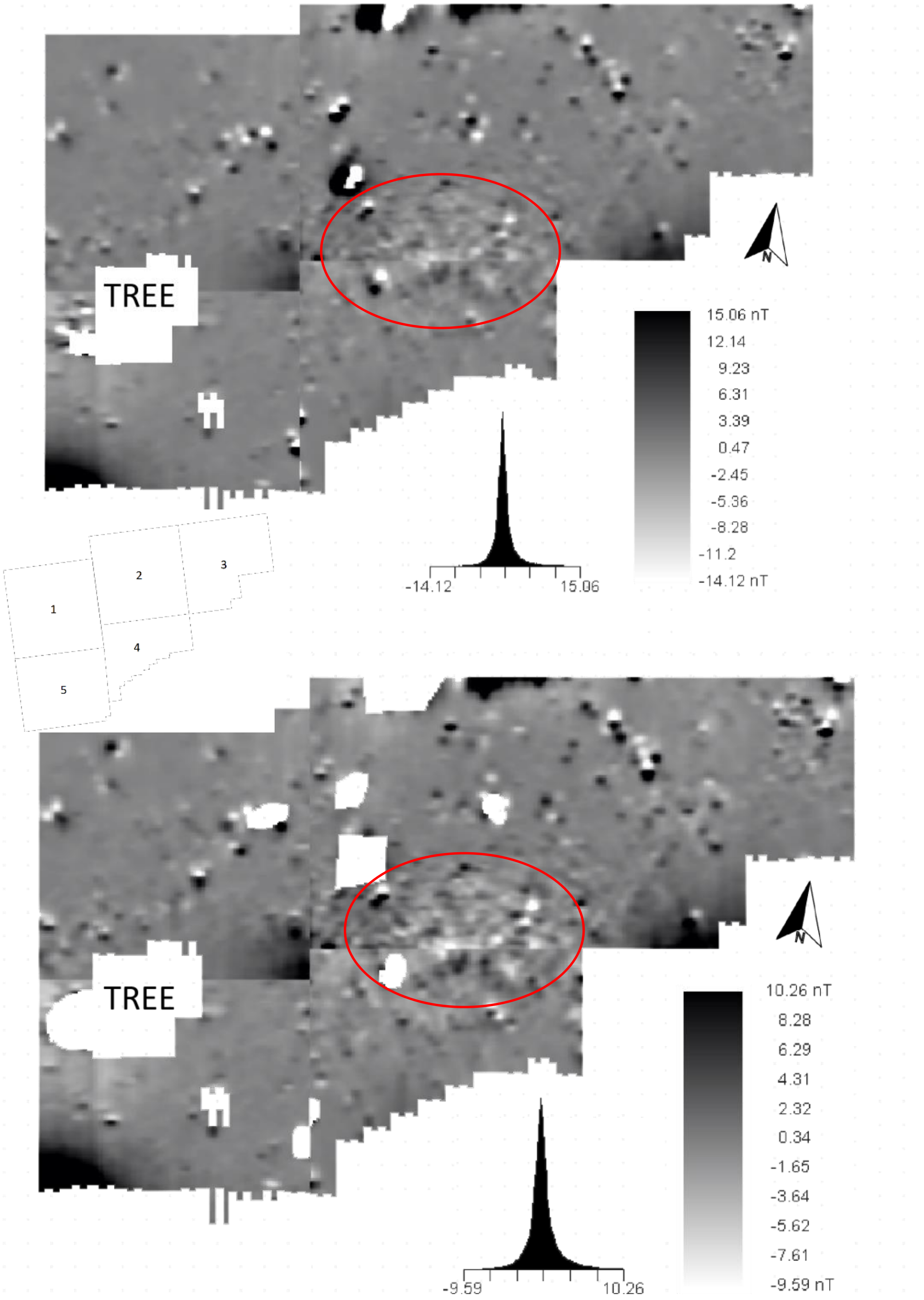
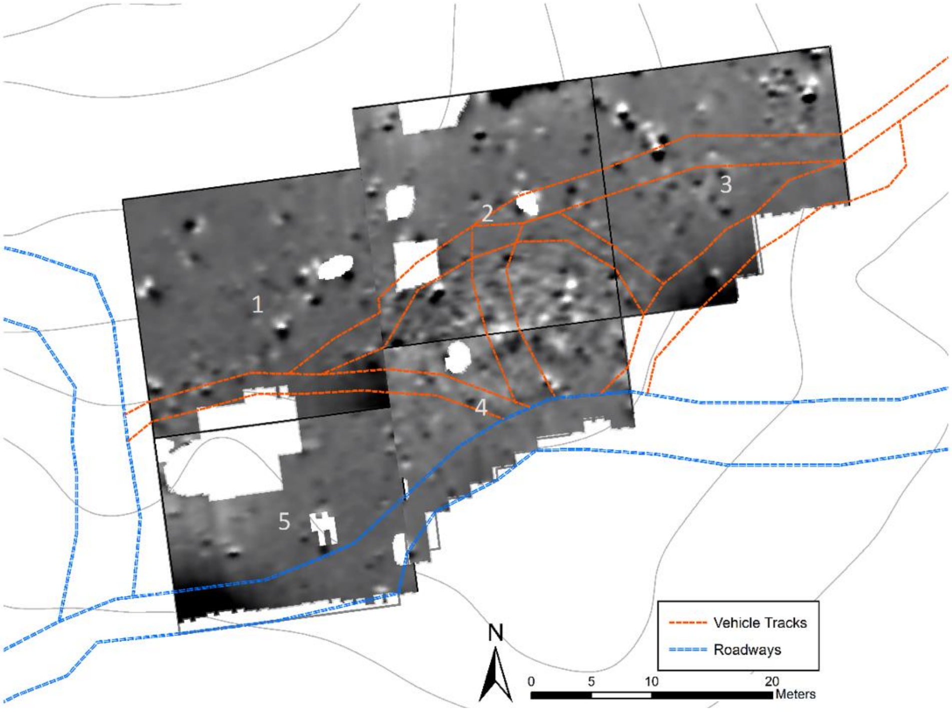


Figure 6.6: Raw Gradiometer data (top), masked and clipped data (bottom). Note the concentration of negative and positive noise between grids 2 and 4.



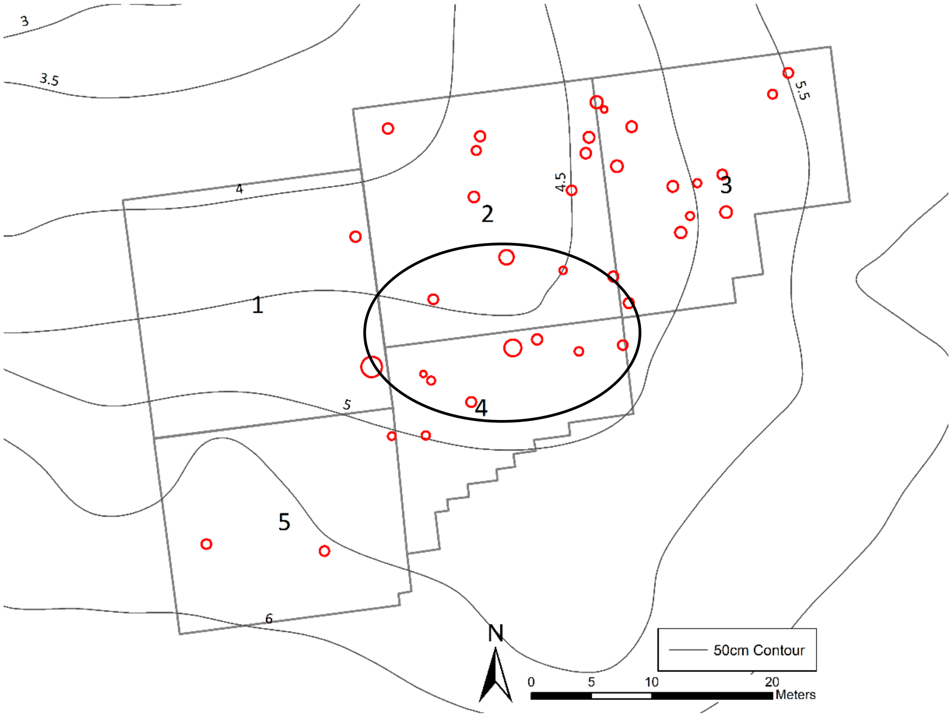


Figure 6.7 (above): Magnetic anomalous concentration as it relates to the vehicle trails in the EBF.

Figure 6.8 (below): traced non-dipolar anomalies. Note the anomalous concentration's extent outlined by black circle.

therefore, is most likely not a meaningful archaeological feature (figure 6.10). At 24 cmbs a cluster of anomalies is present in grid 3. At this depth it is unclear whether this is one large amorphous anomaly or several discrete anomalies cluster closely together.

Decipherable linear anomalies not related to soil or road formation begin to appear at 59 cmbs (figure 6.11). Grid 3 specifically is anomaly-rich, the cluster of anomalies initially suggested at the previous depth more clearly represented. In 2016 an area in the anomalous area in grid 3 was investigated through test unit excavation. Test Unit 103 was placed north of center of grid 3 within which Feature 215, a type 2 shell-filled pit, was recorded along the eastern profile. This feature is comprised of five layers. These layers are dominated by the presence of Florida Apple snail and Banded Mystery snails. Additionally, this pit feature has a burned base. The presence of a large archaeological feature in the EBF supplies precedent to suggest further archaeological deposits are present in the rest of grid 3, perhaps represented by the clustered GPR anomalies.

At depths around 95 cmbs linear anomalies become increasingly well defined (see figure 6.11). The linear anomalies are “zippered” which is a breakup of the anomalies that is due to difficulties with initial capture, such as moving too fast, or soils being more or less conductive for the VHF waves (Kvamme 2008). Taking the anomalies between 59 and 95 cmbs, it appears that the anomalous clustering in grid 1 are part of a larger linear formation. This larger linear pattern might be representative of intact archaeological features similar to feature 215 in Test Unit 103. At this depth there are even fewer anomalies in grid 1. Additionally, an approximately ten-meters-long by three-meters wide amorphous anomaly is evident. This anomaly ties into the

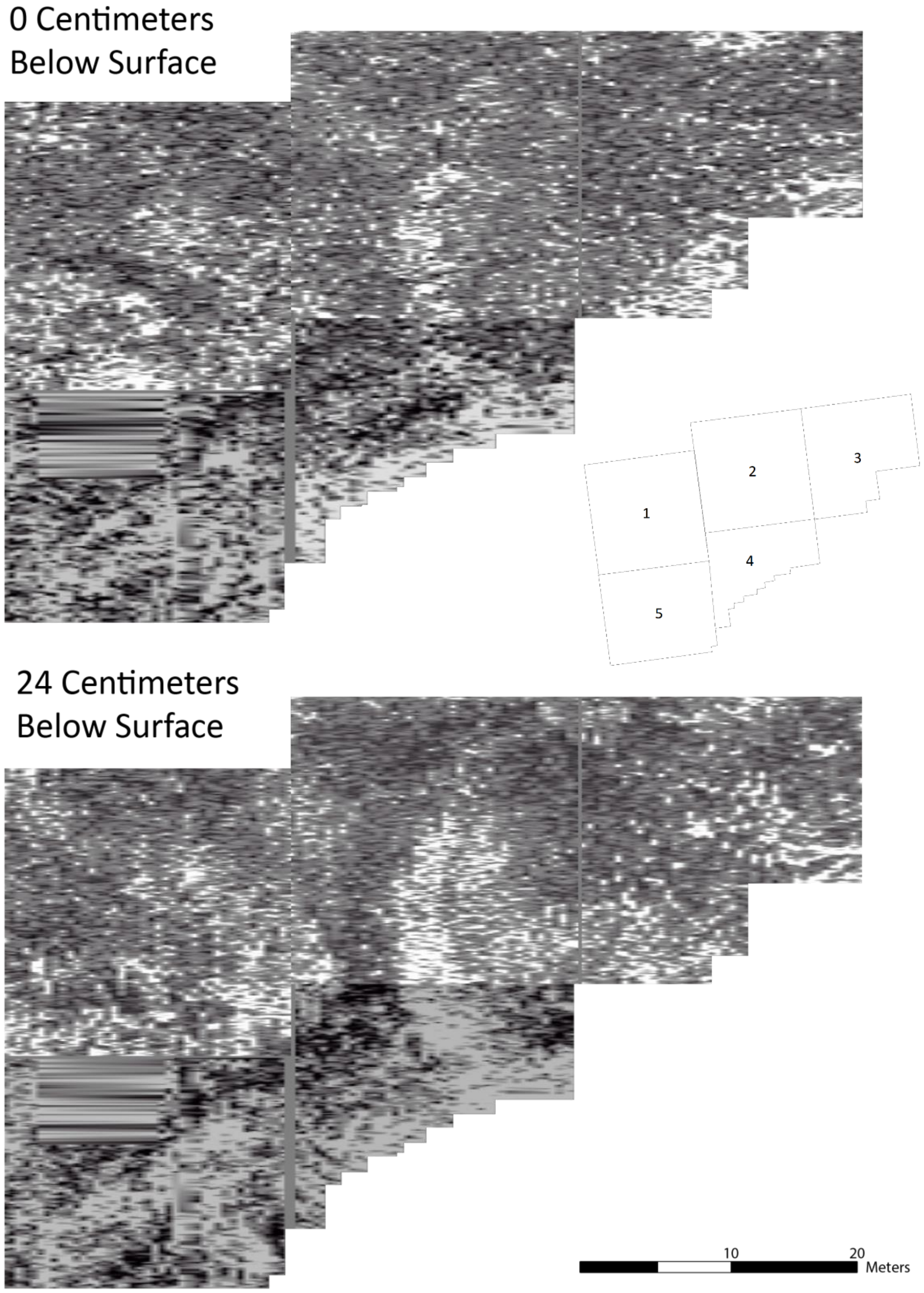


Figure 6.9: Ground Penetrating Radar plan-view map of surface (above) and 24 cmbs (bottom). The linear anomalies in grids 5 and 2 at both depths represent a road. Clustered anomalies appear at 24 cmbs in grid 3.

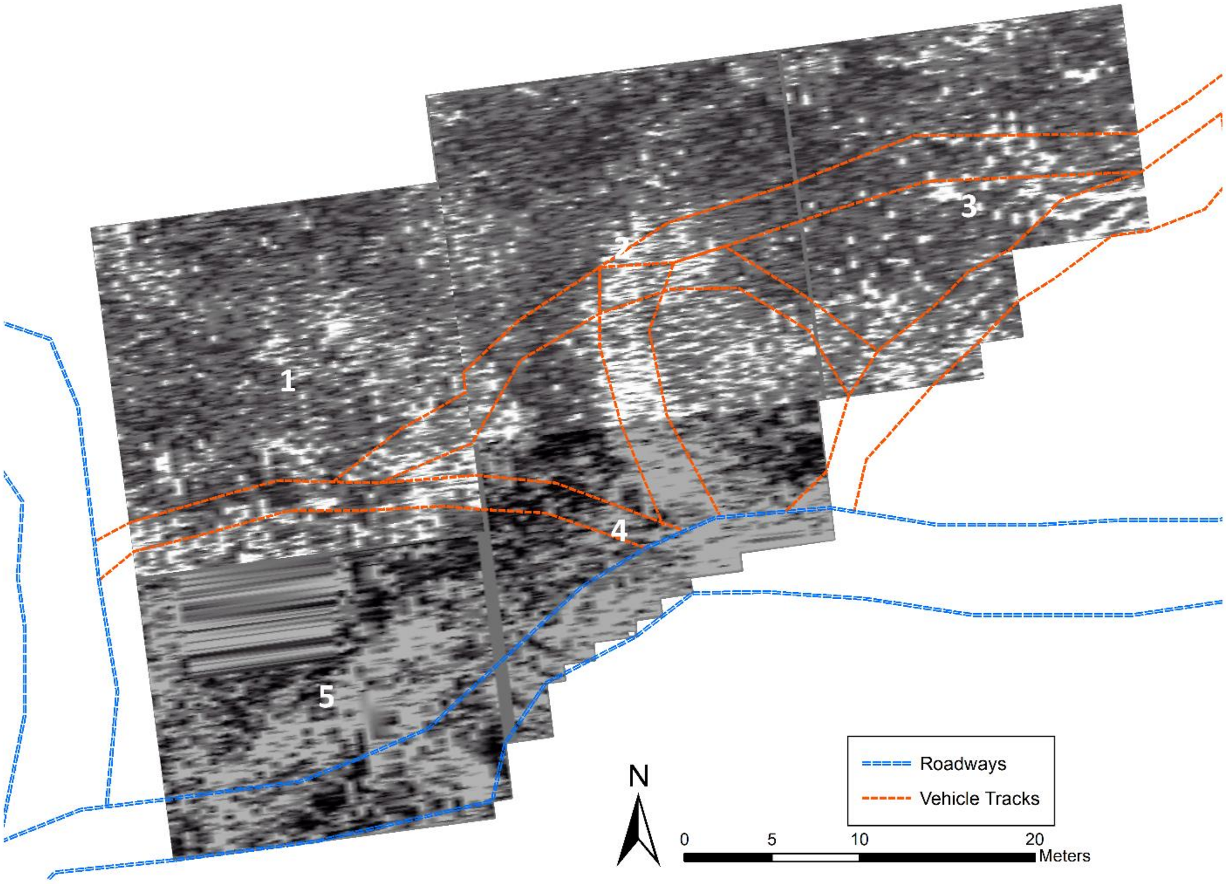


Figure 6.10: Ground Penetrating Radar plan-view map of 24 cmbs with roadways and vehicle tracks overlaid. Note the linear anomaly mirrors an occasionally used road.

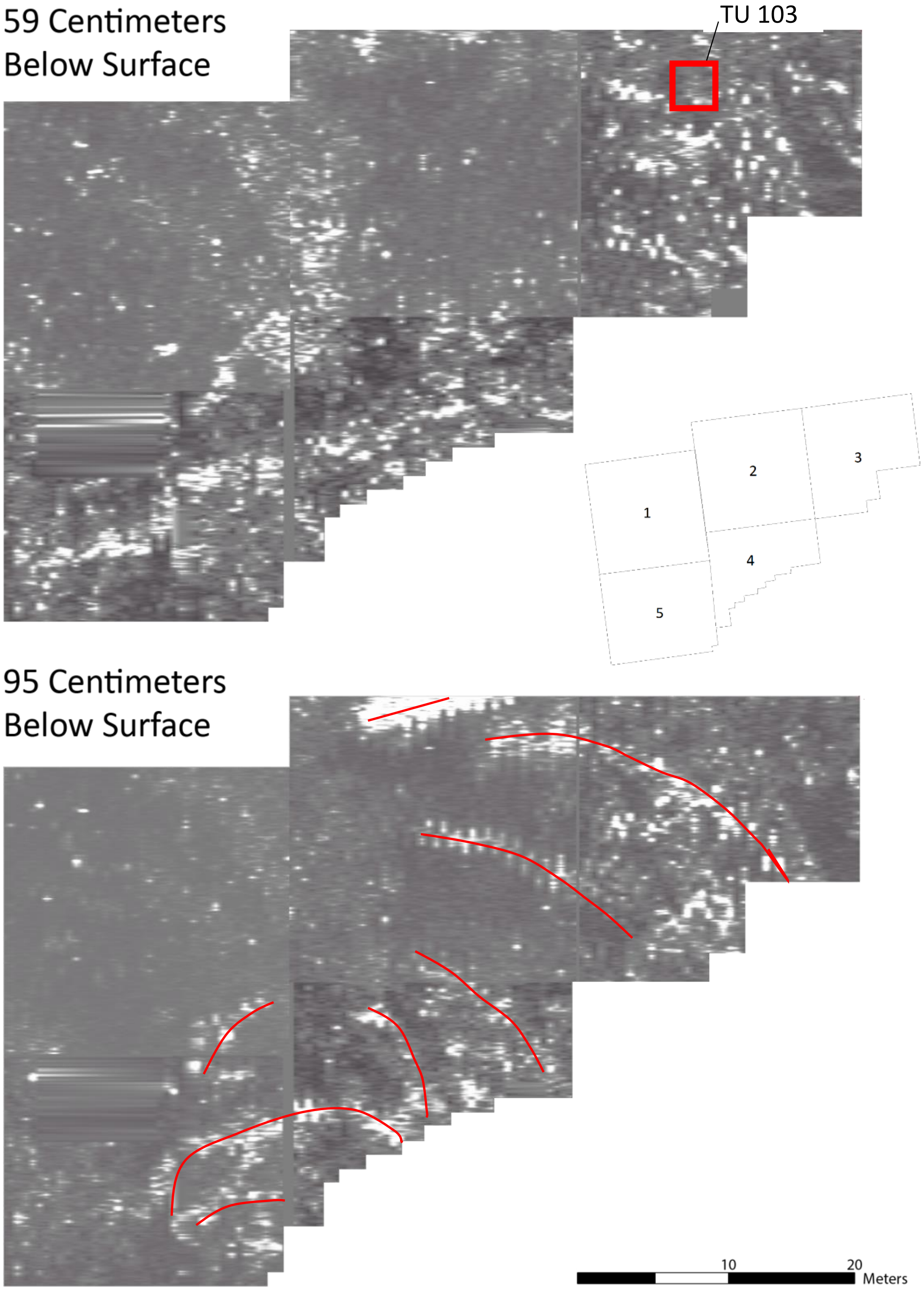


Figure 6.11: Ground Penetrating Radar plan-view map of 59 cmbs, and Test Unit 103 excavated in 2016 is represented by a vacancy in features near linear patterning. (above) and 95 cmbs (bottom). Note the linear anomalies that extend from southeast to northeast.

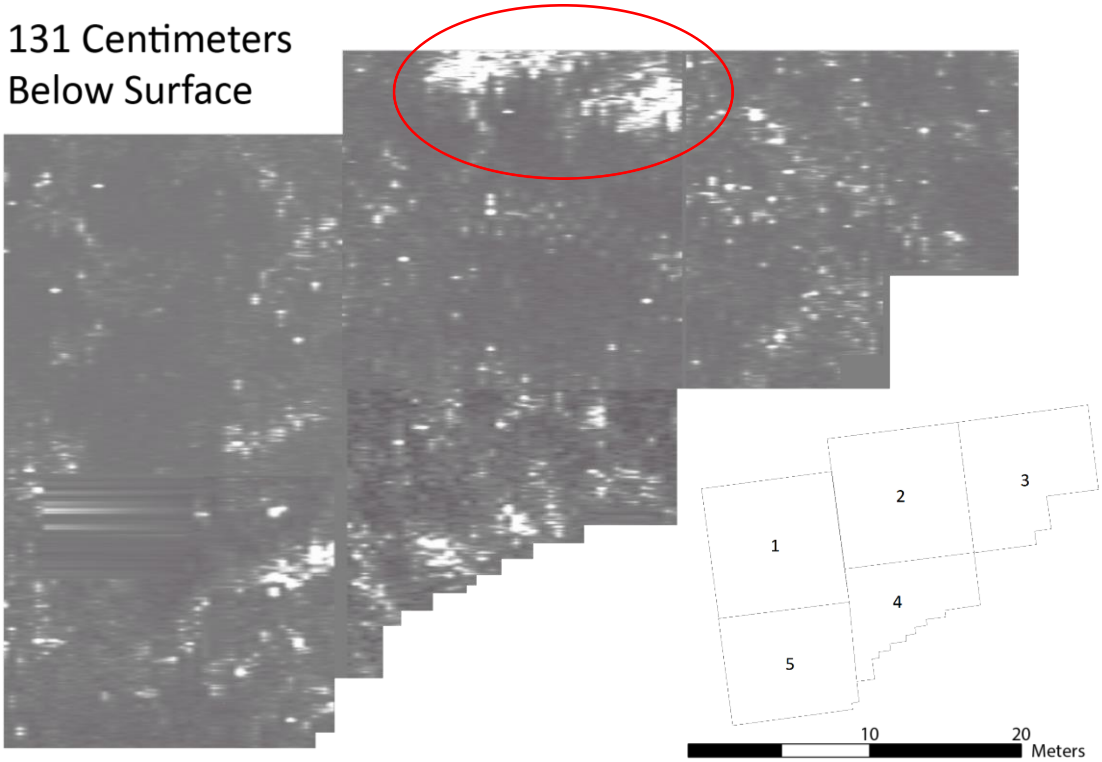


Figure 6.12: Ground Penetrating Radar plan-view map of 131 cmbs.

broader sub-surface variation in the EBF of linear anomalies tracing southwest to northeast in grids 2, 3, and 4.

The linear anomalies become less clear after 100 centimeters (figure 6.12). At 131 centimeters, linear anomalies are less strongly represented. Instead, The large amorphous feature in the north of grid 2 persists at this depth. This might be a product of bioturbation from gopher tortoises or modern disturbances. The edge effect between grids 2 and 3 creates a sharp contrast between these grids at this depth, as seen in the anomaly to the east of the amorphous anomaly. At 95 centimeters, this anomaly was connected to a longer linear anomaly. This suggests that perhaps the anomalies in grid 2 are over expressed. Additionally, the size and orientation of these large anomalies match up with two large diploes in the gradiometer data, therefore these might be deeply buried metal objects.

Ground Penetrating Radar Characteristic Anomaly Profiles

Several GPR anomalies identified in two-dimensions have characteristic parabolas in time time-slices. Anomalous areas start to become clear after 59 cmbs. The time-slice profiles of selected anomalous clusters and linear anomalies are investigated below. Grids 2, 3, 4, and 5 all have characteristic anomalous parabolas.

Grid 3 contains the characteristic parabola of surface metal. Metal presents as a thin, deep parabola that complicates plan-view mapping. The quantity of metal in the EBF might obscure buried anomalies when the data is only viewed in plan-map. The northeast quarter of grid 2 has a linear feature that appears at 59 cmbs. The time-slice profile for this anomaly consists of two layers: one surficial disturbance, and one deeper buried discrete deposit (figure 6.13).

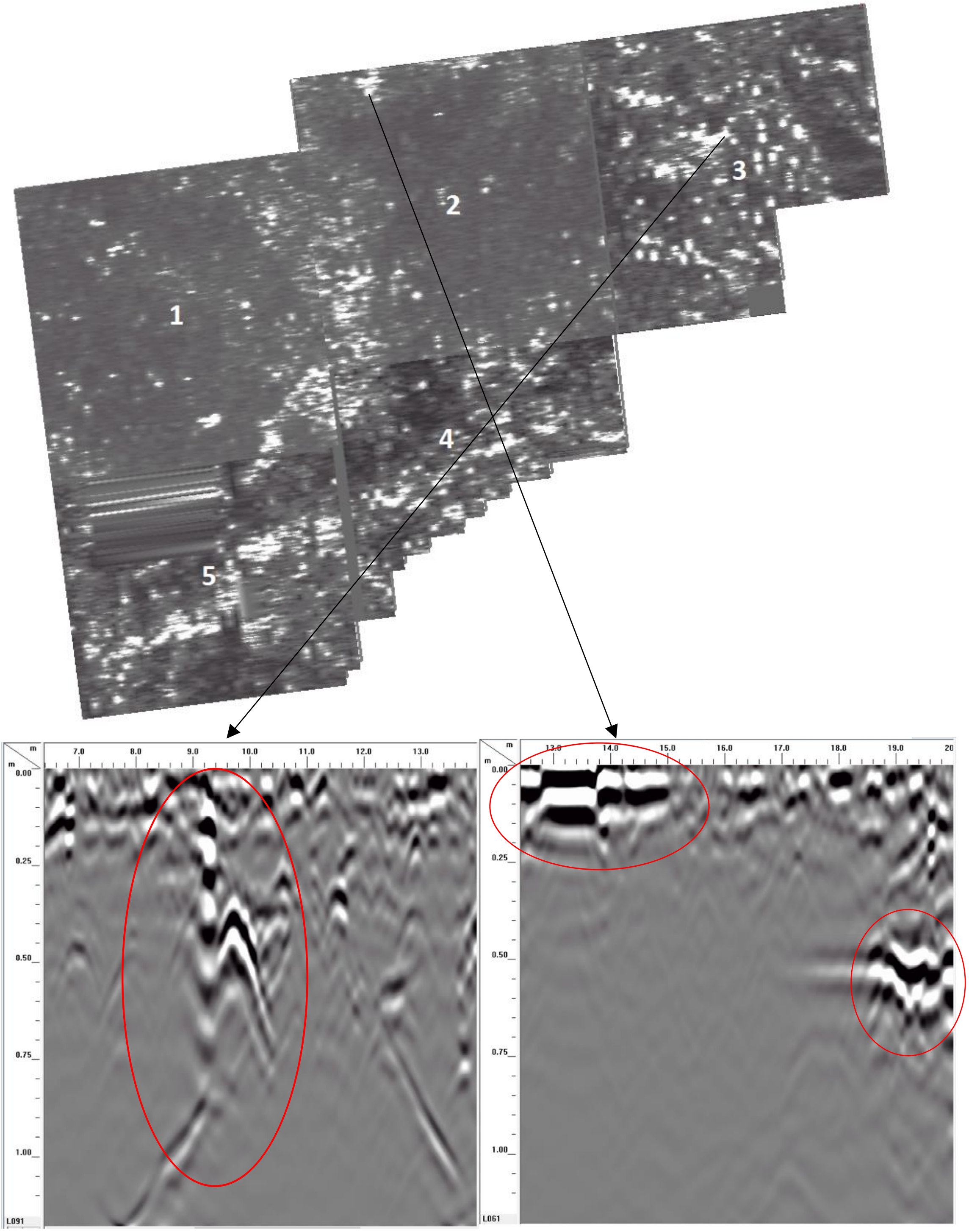


Figure 6.13: Time-slice profiles for two anomalies, surface metal (left) and unknown discrete parabolas not from metal (right).

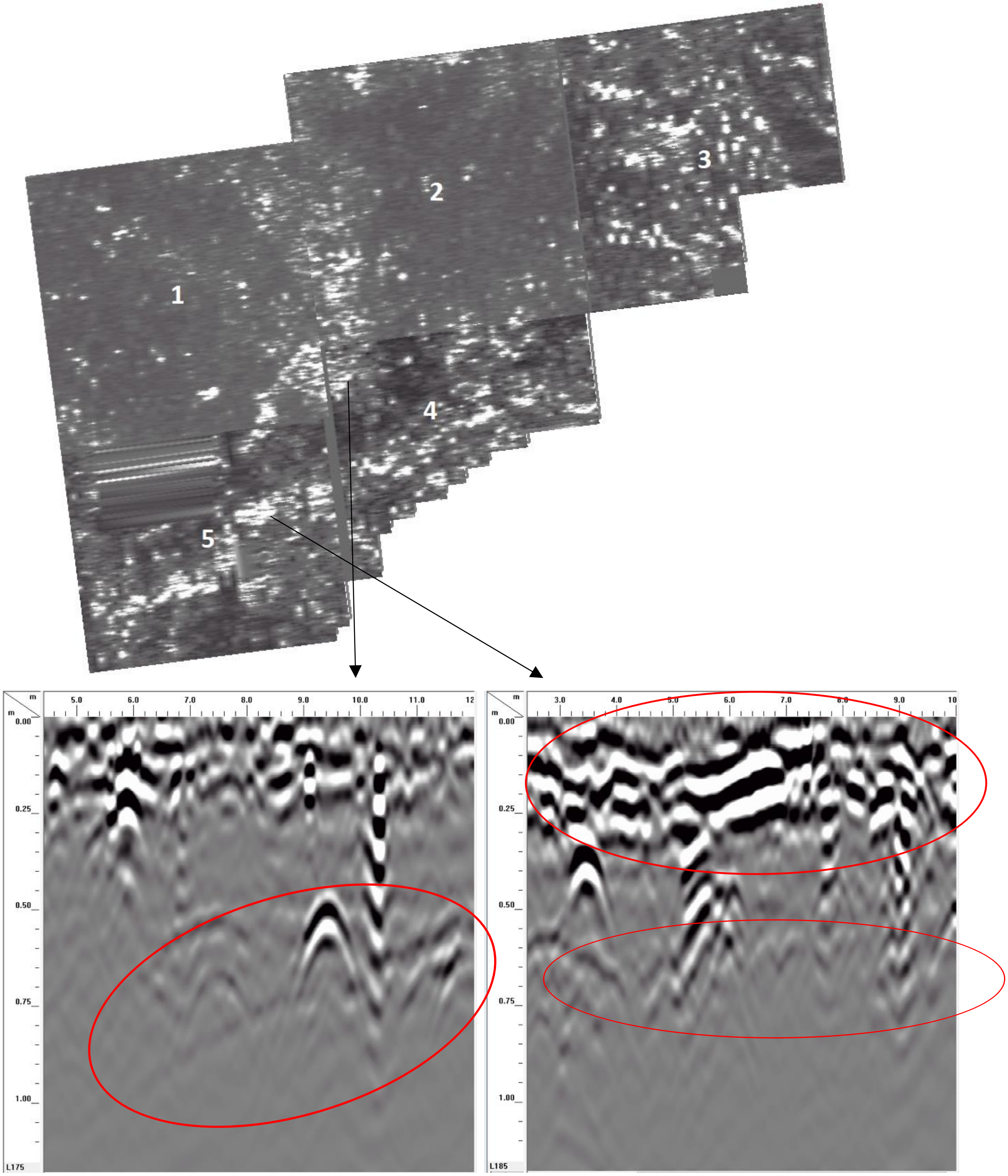


Figure 6.14: Time-slice profiles for two anomalies: soil change and buried anomaly (left), and road disturbance and possible soil change below it (right).

Neither parabola area is consistent with metal, suggesting some other depositional history. Grid 4 has a linear anomaly associated with road use, which obscures deeper parabolas. This profile has an isolated parabola at 48 cmbs, as well as weaker, horizontal anomalies suggestive of soil change. It is possible this is representative of a buried anomaly of cultural origin with a buried soil “A” horizon in association. Similarly, grid 5 has a profile characterized by deep ground disturbance due to road use which obviates some deeper anomalies (figure 6.14). The top 30 centimeters are related to the roadway and surficial metal, with a deeper horizontal anomaly suggestive of soil change as seen in grid 4.

West Bait Field

In contrast with the east bait field, the west bait field has clear spatial patterning present in the gradiometry that is suggesting of architectural elements. The WBF is over 100 meters long and 45 meters wide. A total of 10 grids were surveyed in the WBF. Like the EBF its surficial geology is composed primarily of Paola fine sand. Landform morphology is characterized by higher elevations on the east and west of the survey area with lowest elevation in the center of the grids. Vegetation is particularly strong in grid 9, preventing about half of grid to be captured.

Magnetic Gradiometry

Similar to the EBF, there is a heavy modern metal content on the surface based on annual disc plowing and occasional road use. A 25-meter-long ferrous linear anomaly is buried half a meter below the ground surface in the northern portion of grids 2 and 3. This ferrous anomaly complicated the magnetic gradiometer data by over-exposing a large portion of the survey area.

In order to properly analyze the gradiometer data this anomaly and other dipoles needed to be masked out prior to any other data processing.

Clipping the masked data identified a complicated scattering of similarly circular anomalies are spread across the landscape (figure 6.15). The magnetic anomalies' size and circularity are consistent across both bait fields, suggesting a similar type of anomalous feature are reflected in this form. The area with the linear ferrous anomaly is also the lowest and flattest portion of the landscape, which is also less-full of magnetic anomalies in comparison with the rest of the grids. This landscape relationship mirrors grid 1 in the EBF. It is important to note that the lack of magnetic anomalies in this area might also be due to the over-exposure of dipoles in the field. This might contribute to some of the patterning of the anomalies throughout the WBF.

One area of immediate interest was the western extent of the survey area, comprising grids 1, 4, and 5. A group of 31 circular anomalies between 30 and 50 centimeters in diameter appear to form two linear arrangements with a center devoid of magnetic anomalies barring one modern metal dipole. With this center clear of anomalies in mind, the arrangement of the two curvilinear anomalies are considered related, forming one larger "oval" of magnetic anomalies. The 31 anomalies have a consistent reading around 2 nT. Only 3 positive anomalies involved in the "oval" form are over 3 nT. This suggests that the anomalies between 1.8 and 2.2 nT are characteristic of this larger anomalous area.

The discrete magnetic anomalies were traced using ArcMap just as the EBF anomalies were. After tracing and georeferencing all positive, non-dipolar anomalies, the oval of magnetic

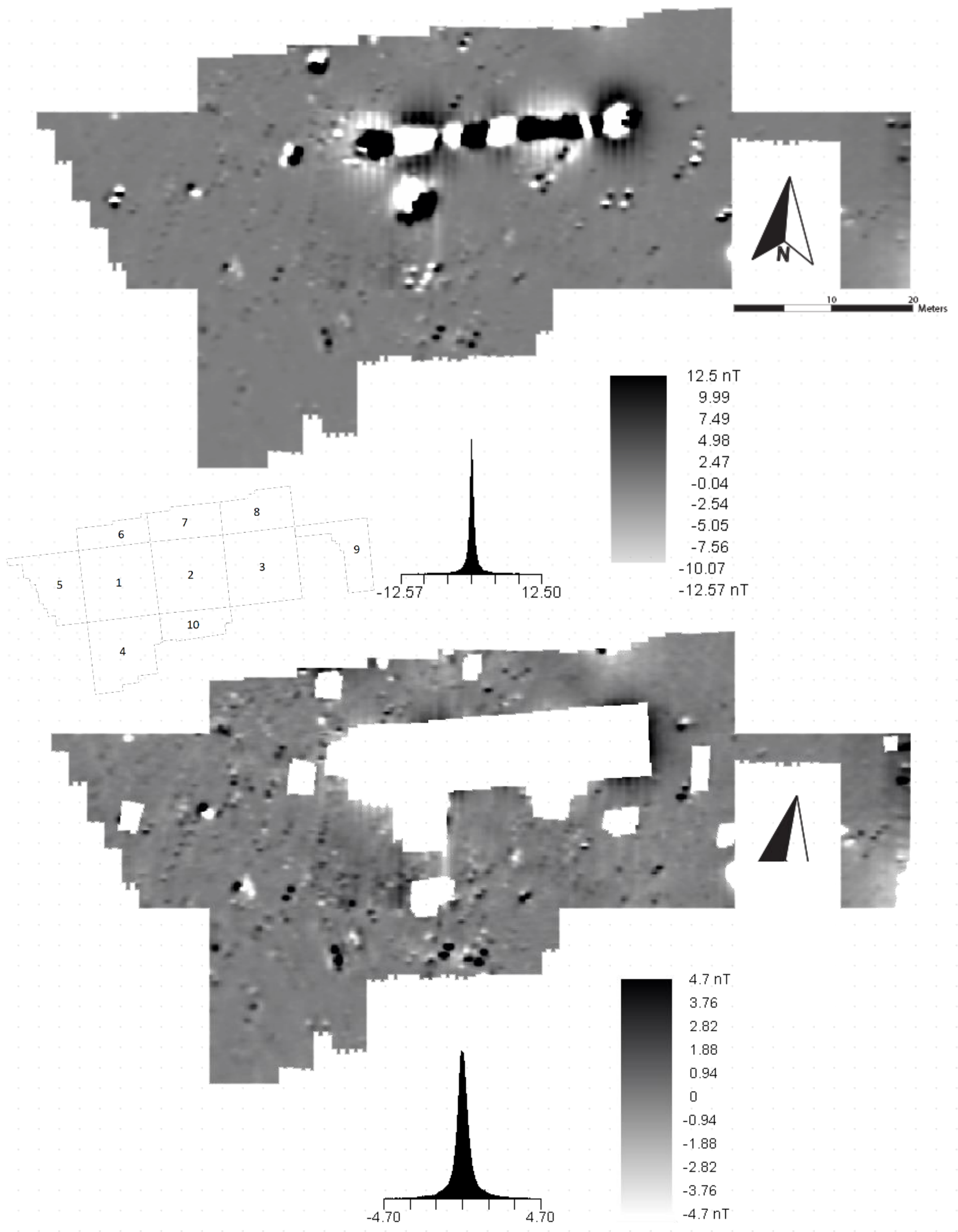


Figure 6.15: Unmasked Gradiometer data (top), masked and clipped data (bottom). A large area had to be masked from the data, perhaps relating influencing the overall anomaly patterning and clustering.

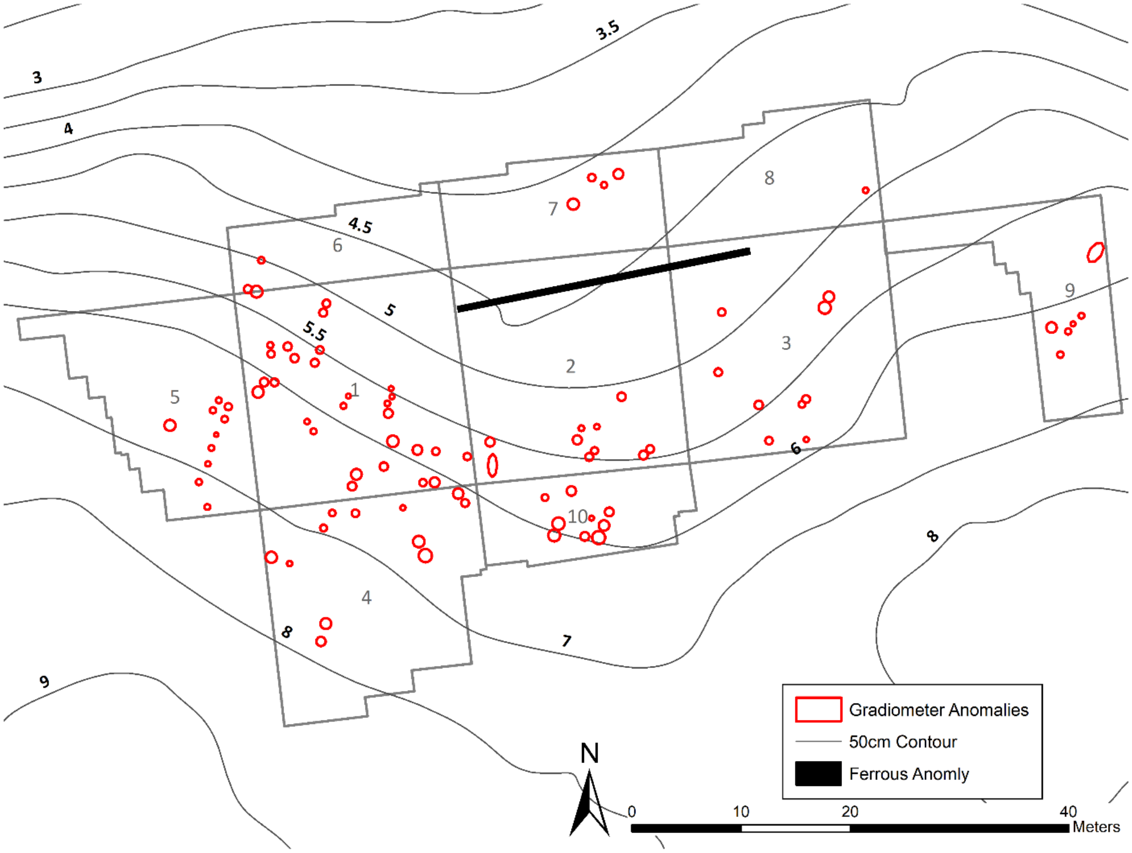


Figure 6.16: Non-dipolar positive anomalies traced for clarity in context with 50-centimeter landform contour. Note the linear ferrous anomaly in black.

anomalies (henceforth “OMA”) becomes more pronounced. Similar to the EBF, the areas with fewer magnetic anomalies is in the northern part of grids 2, 3, 7, and 8, relating to the area of lowest elevation. This might have to do with the presence of the long ferrous linear anomaly as well as masking of strong dipoles in this area. As such, this area might be unintentionally under-represented in the gradiometer data. The paucity of anomalies, however, also is related to the lowest elevations in this survey area (figure 6.16). The rest of the anomalies not involved in the OMA do not appear to have the same distinct kind of visual patterning. That being said, the majority of all magnetic anomalies are situated along the 5.5-meter contour interval, following the landform closely. This is a similar pattern as seen in the EBF. Secondary analyses can assist in defining if these patterns are significant and not simply visual pattern recognition.

Ground Penetrating Radar

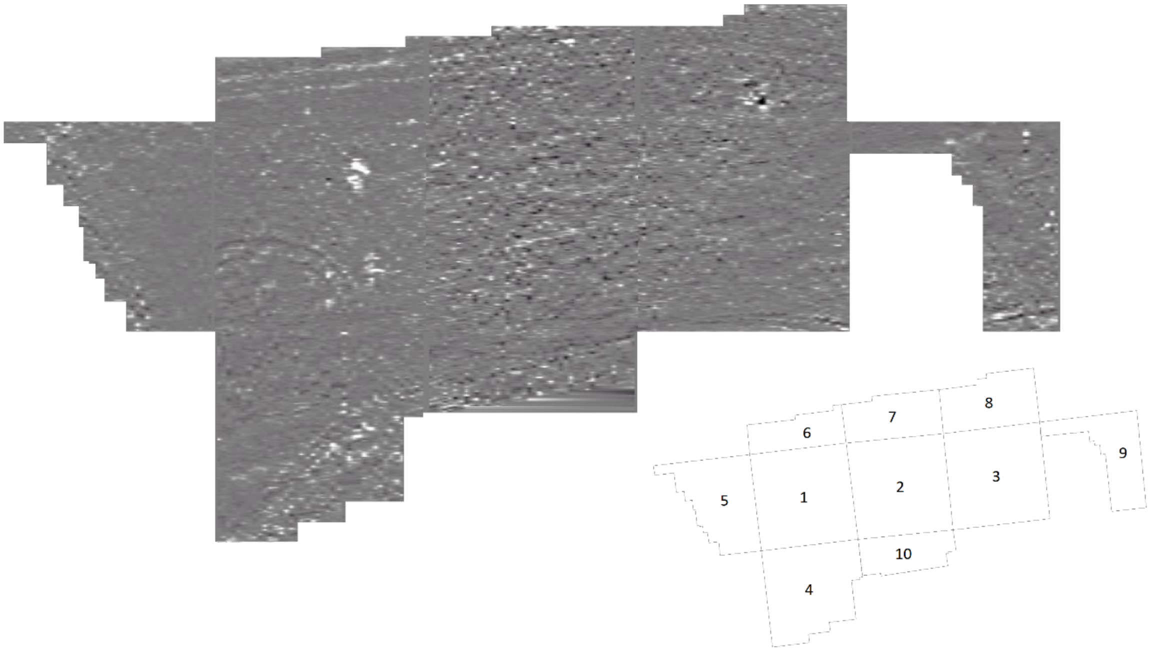
GPR readings at surface level are surprisingly fine grained. At depths between ground surface and 11 cmbs microtopographic rises are recorded (figure 6.17). These rises consist of vehicle tracks and occasionally used roads. Most notably is a tight curvilinear form in grid 1 which reflects tire marks from a small single-occupant vehicle, such as an all-terrain vehicle. Additionally, two gopher tortoise burrows are visible from the aerial photograph and in the GPR data (figure 6.18). Roadways are present as white linear anomalies. Resolution is similarly fine across all depths, significantly better than the EBF. The WBF had several instances of bioturbation and modern land change. Based on surface observation there are three active gopher tortoise burrows. These burrows are also represented in the GPR data between 0 cmbs and 11 cmbs.

Sub-surface variation starts to become apparent at depths of 44 cmbs and below. The linear ferrous anomaly first identified by the gradiometry is well represented in the GPR results The top of the linear feature has a strong signature, however in the GPR results it does not distort the data like it did in the magnetic gradiometry. At this depth, amorphous patterning appears in grids 1, 5, 6, and 10. Particularly interesting anomalies appear at this depth at the east and west extent of the survey area. These anomalies are thin, no more than 20-centimeters at thickest, and extend from vegetated areas. The basin of the active gopher tortoise burrows ends at about 40 centimeters, which is above this depth-view and are not represented in plan-view.

The ferrous linear anomaly's signature terminates at 66 cmbs. The anomalies at this depth continue to reproduce the patterning from the above 44 cmbs, with the notable increase in size of the thin linear anomalies. Additionally, a relict gopher tortoise burrow initially identified in the GPR data collection and analysis of Gilmore (2016) was recaptured at this depth. South of this relict burrow are two potentially clustered amorphous anomalies. If the gopher tortoise relict burrow is an accurate extrapolation of the data, then the anomalies south of the burrow might be additional burrows or a collapsed exit for the burrow. This inference is based on the active gopher tortoise burrow entrances and exits identified at surface level in grid 1. Beyond this observation, the amorphous features in grids 5, 6, and 10 are also more strongly represented and more defined at this depth. The anomalies in grid 10 specifically are of most interest at they extend directly from Locus B to the southeast (figure 6.19).

Finally, at 98 centimeters below the surface the patterning both becomes clearer and more complicated (figure 6.20). The amorphous anomalies in grids 4 and 5 appear to form

0 Centimeters Below Surface



11 Centimeters Below Surface

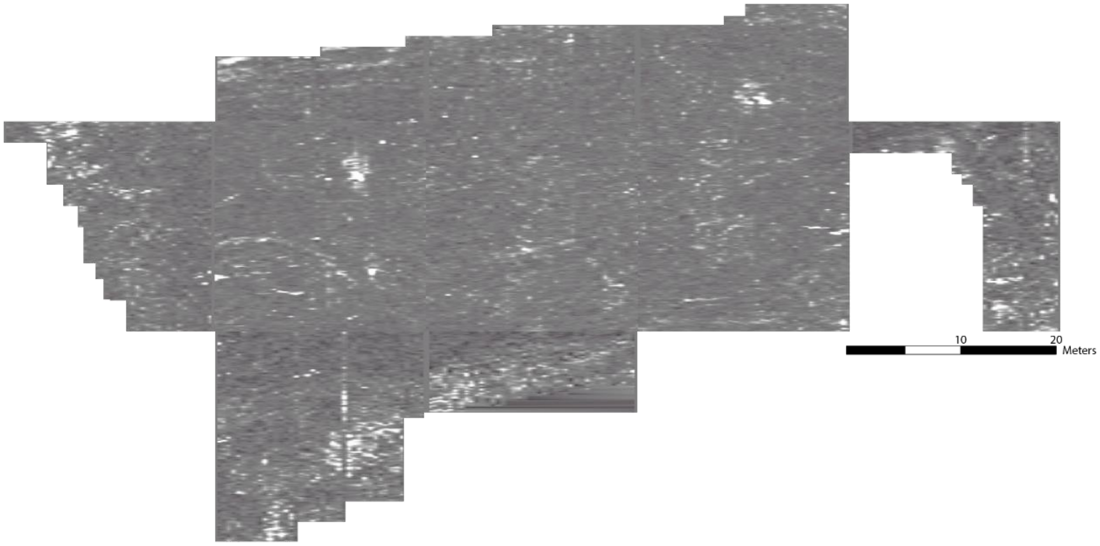


Figure 6.17: Ground Penetrating Radar plan-view map at ground surface (above) and 11 cmbs (bottom). Surface readings represent vehicle tracks and three gopher tortoise burrows.

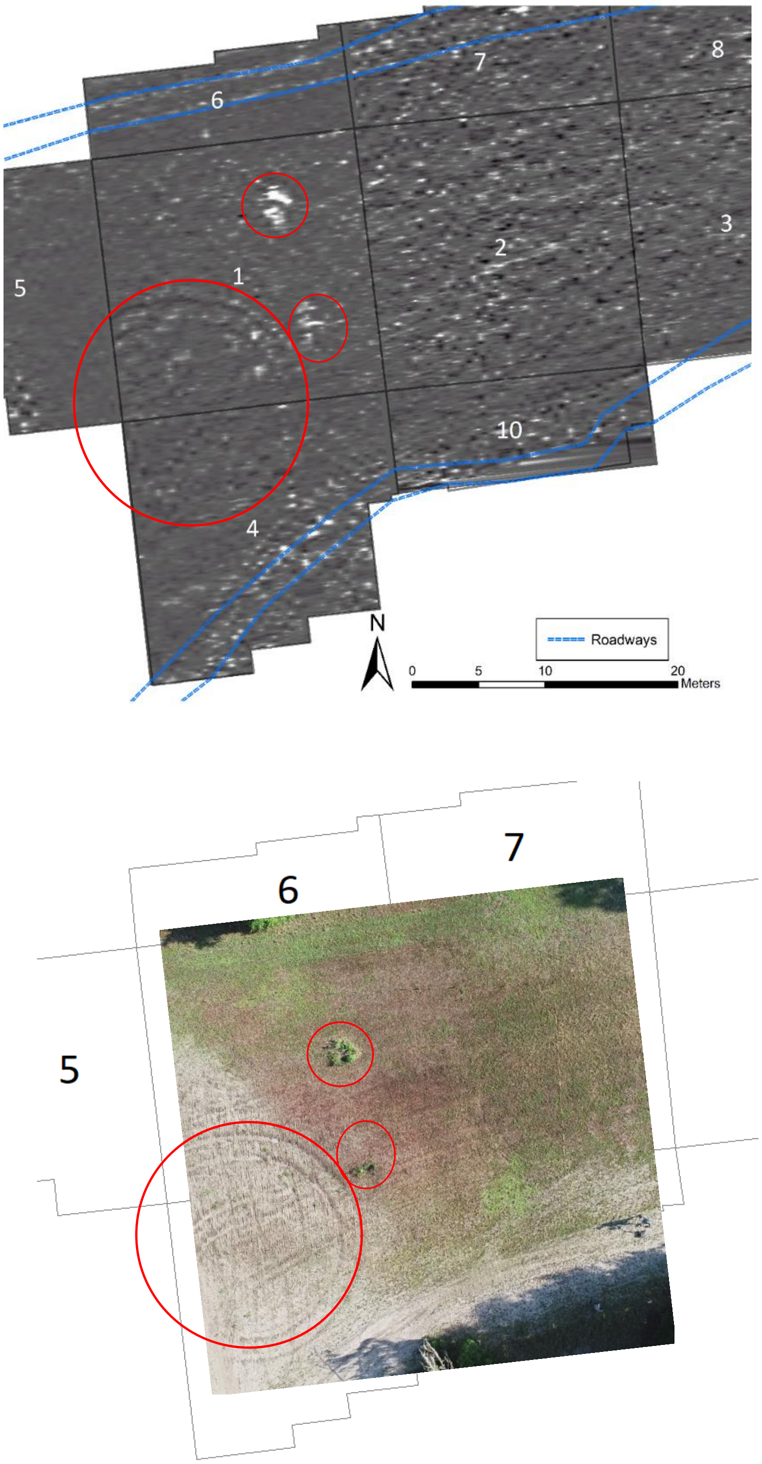
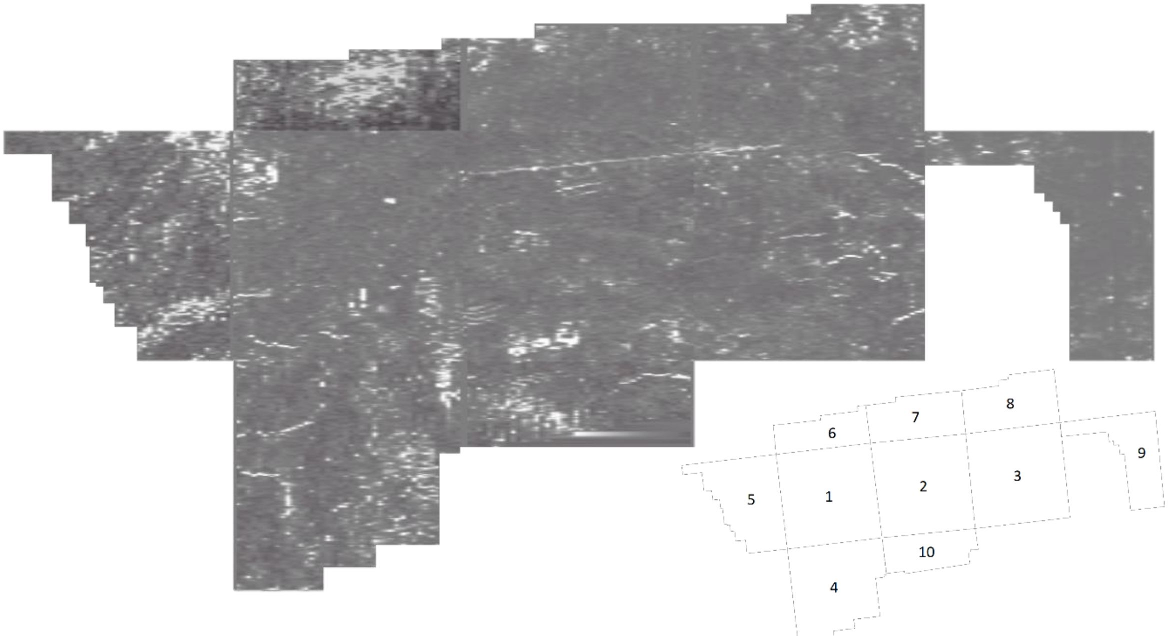


Figure 6.18: Comparison of GPR results at 0 cmbs (top) and aerial photograph of the same area (bottom). Note the direct mirror of microtopography in surface readings. Additionally, two anomalous areas are representative of gopher tortoise burrows

44 Centimeters Below Surface



66 Centimeters Below Surface

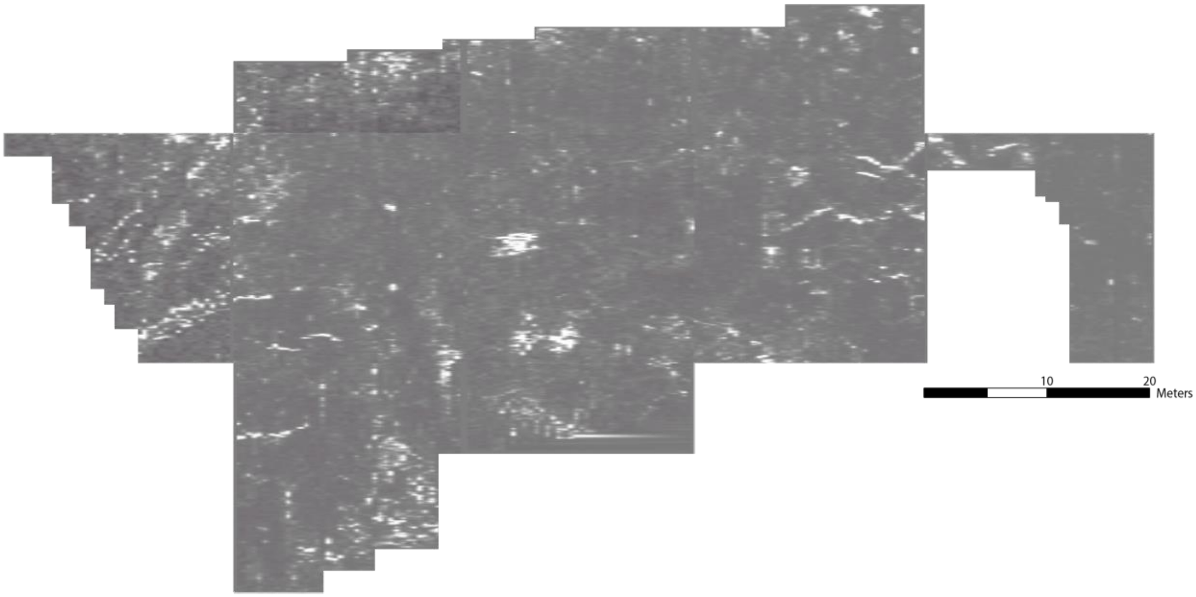


Figure 6.19: Ground Penetrating Radar plan-view map at 44 cmbs (above) and 66 cmbs (bottom). The bottom of the linear ferrous anomaly is present at 44 cmbs. The east and west of the survey area, thin linear anomalies are present at both depths. A previously identified relict gopher tortoise burrow (Gilmore 2016) is present in grid 2.

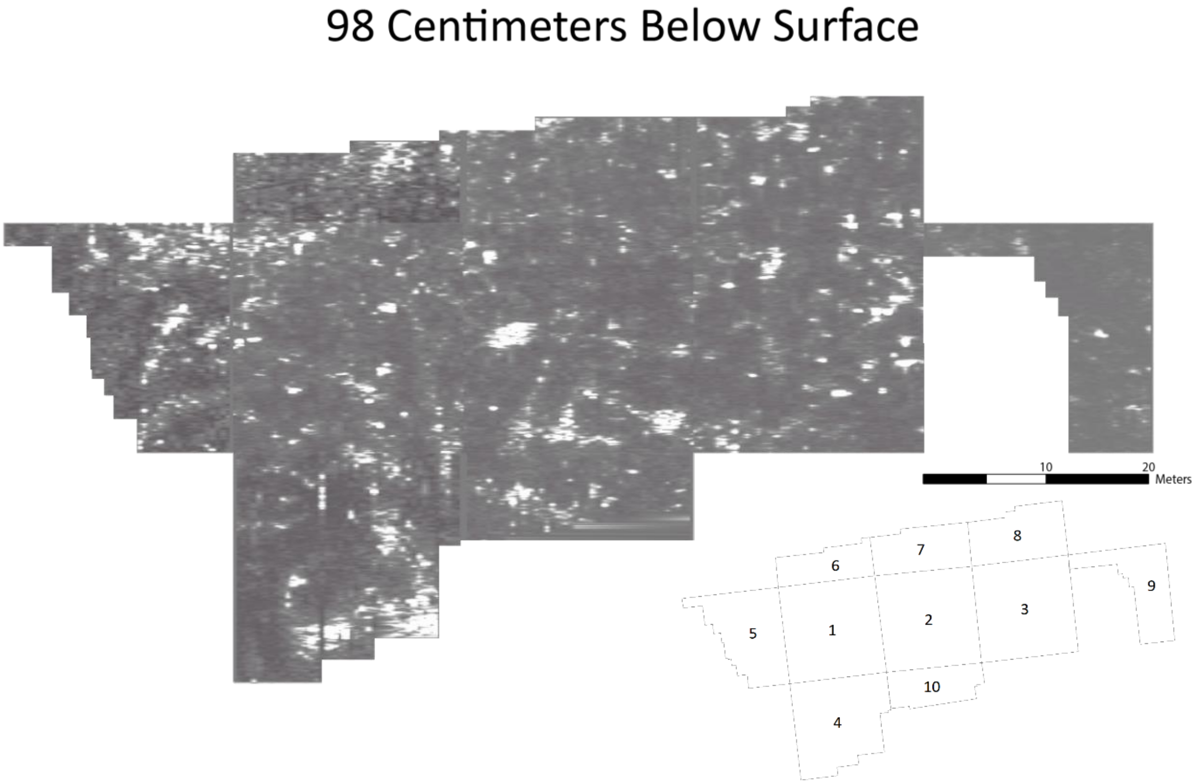


Figure 6.20: Ground Penetrating Radar plan-view map at 98 cmbs. The patterning of the above anomalies starts to break up, and more isolated, amorphous features become more apparent particularly in grids 4, 5, and 10.

clustered, discrete features, making larger linear formations. The hypothesized relict gopher tortoise burrow shows up strongly. The anomalies to the south are still present this depth but lose some of their definition. The depth of this plan-view restricts resolution on a general scale, but further identifies anomalies persisting from Locus B into the bait field. It is possible to infer the clustered and linear anomalies present in grid 5 might also be extend from the edge of the St. Johns village at Locus C. The edge of Locus C is to the west of the survey grid by only a few meters. The thin linear features at the eastern edge of grid 3 are no longer connected at this depth but rather are more discrete small anomalies.

Ground Penetrating Radar Anomalies

The GPR results have distinctive sub-surface anomalies that have characteristic parabolas that are both similar to the EBF anomalous profiles, as well as profiles unique to the WBF. Similar anomalies consist of metal interference and soil change. Unique anomalous profiles are thin linear formations, gopher tortoise burrows (both active and possibly relict) and what is suggestive of deep basin-like anomalies. Six profiles from three depths are explained below.

At 44 cmbs, the characteristic time-slice profiles of gopher tortoise burros and the ferrous linear anomaly are investigated (figure 6.21). The active gopher tortoise burrow from grid 1 is present at surface level as a discrete feature with a long tail of a parabola extending over a meter. This matches up with the slide that the tortoise uses to enter and exit the burrow. This anomaly is inferred due to its presence on the surface that could be easily observed. The ferrous linear anomaly identified by the gradiometer data carries a characteristic metal profile seen in the EBF.

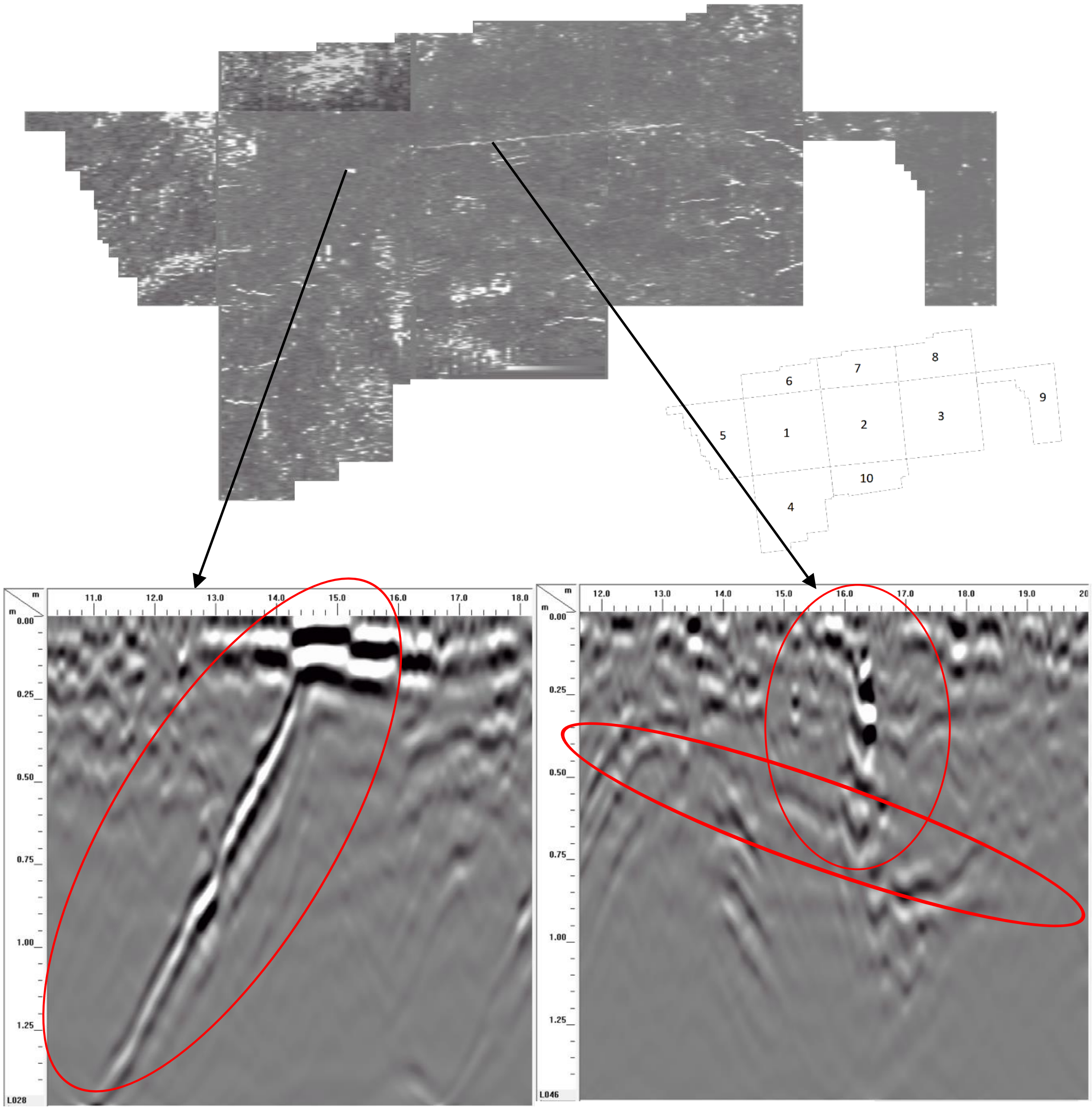


Figure 6.21: Active gopher tortoise burrow from grid 1 with apparent tortoise slide (left), and ferrous linear anomaly identified by the gradiometer data. Additionally, soil change is evident underneath the linear anomaly. The plan-view is 44 cmbs

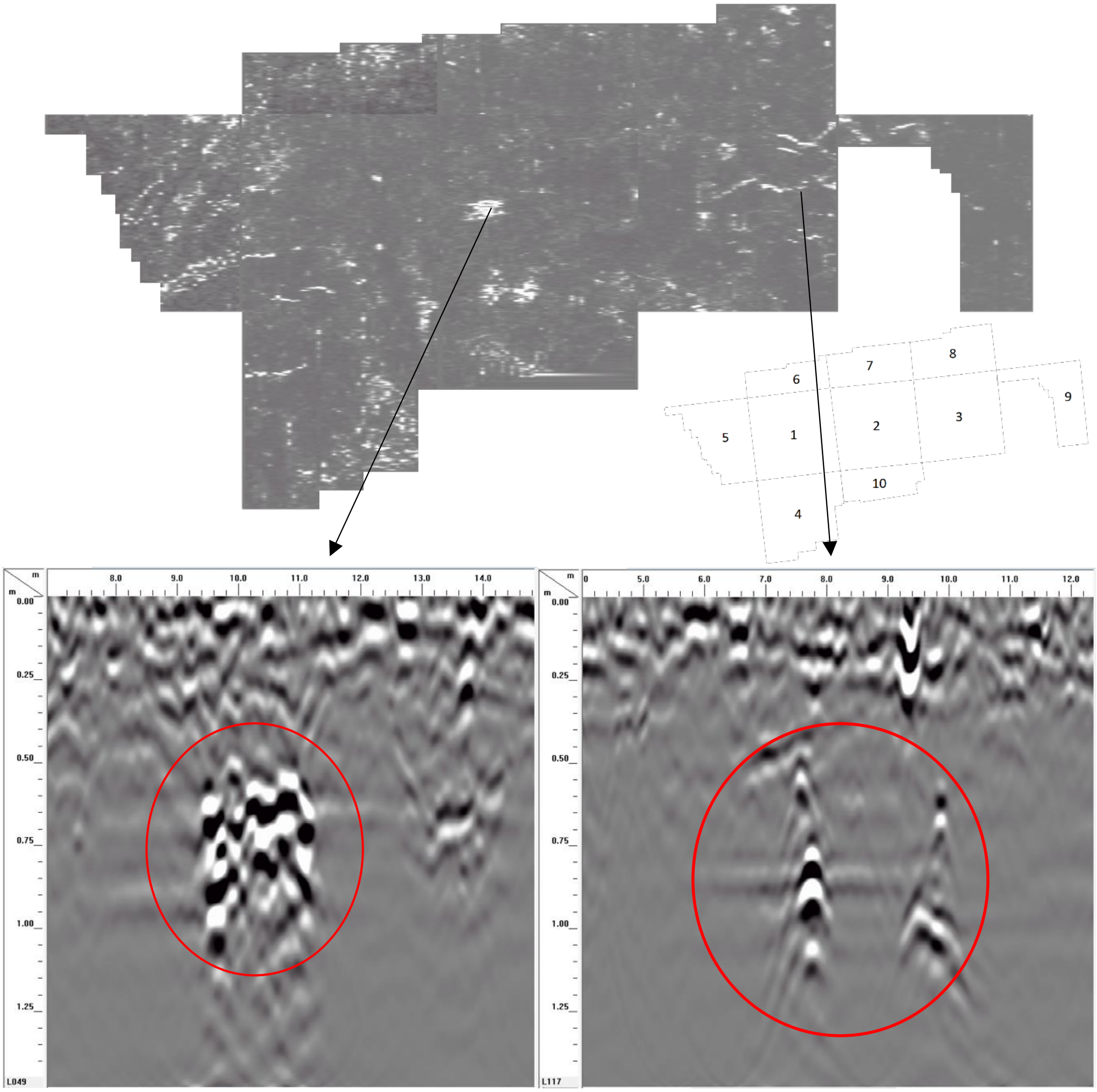


Figure 6.22: reported relict gopher tortoise burrow from Gilmore 2016 (left), profile for thin linear anomalies. Plan-view depth at 66 cmbs.

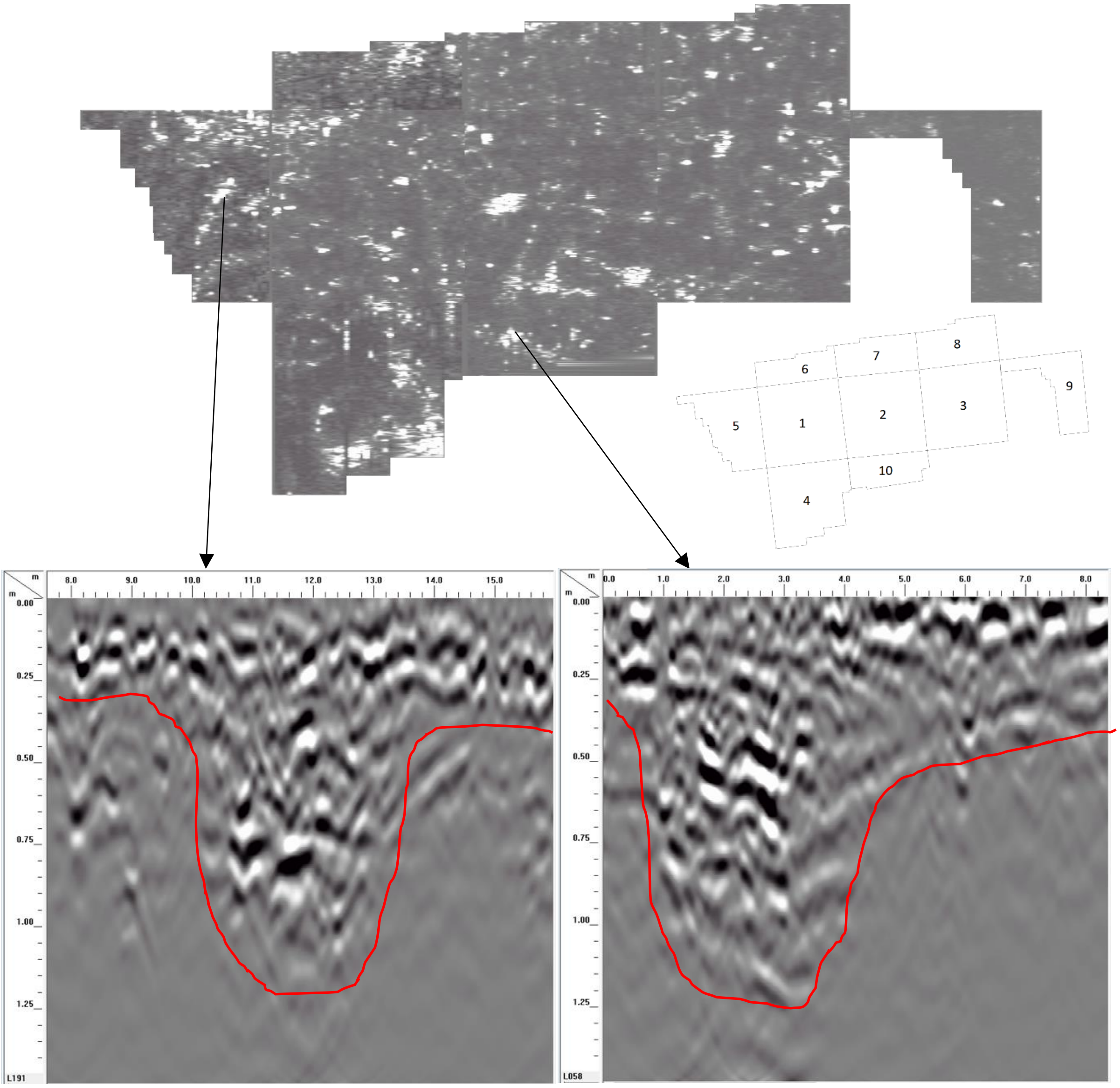


Figure 6.23: deep basin-like anomalies. Grid 5 anomaly (left), and grid 10 anomaly (right). These areas are near Locus C and Locus B respectively. The plan-view is 98 cmbs

Additionally, below the ferrous anomaly appears to be a soil change due to the horizontal banding.

The relict gopher tortoise burrow identified by Gilmore and the thin linear anomalies both appear at 66 cmbs (figure 6.22). The relict burrow is characterized by a discrete stack of strong vertical parabolas. Horizontal banding suggests differential soil formation around the burrow. This profile might represent the collapsed chamber of the burrow, as it does not match the profile of the surficial burrow entrance. The thin linear anomalies have a very distinctive profile. These anomalies are characterized by narrow parabolas that extend for about 50 centimeters. Their proximity to heavy vegetation and trees suggests that these anomalies might be tree roots. Ground penetrating radar is often used in the identification of root formations, being able to identify and quantify the depth and extensiveness of root formations (Guo et al. 2013). Deep testing is required to confirm this hypothesis.

Perhaps most compelling are the deep v-shaped anomalous parabolas present in profiles from 98cbms. These profiles are evocative of deep basins, that might suggest the presence of large archaeological deposits in grids with discrete amorphous anomalies at depths of almost a meter. Grid 5 near Locus C and grid 10 near Locus B have similar deep v-shaped anomalies in their time-slice profiles (figure 6.23). What differentiates these profiles from the proposed relict gopher tortoise burrows is the apparent soil formation present in weaker, horizontal pattering that traces the edge of the stronger parabolas. The relict gopher tortoise burrow has straight and short patterning, while the horizontal extent of the weak signals traces the exterior of the deep basins. This difference might suggest that human intervention in soil formation carries a specific signature, rather than the short horizontal signature of bioturbation.

Results in Context

Magnetic gradiometer and ground penetrating radar surveys in both the east and west bait fields were able to clearly identify potentially archaeologically significant sub-surface variation. Generally, in the GPR data, linear and amorphous features that extend up to 10-meters linearly begin to appear after 24 cmbs and become readily decipherable after 50 cmbs. These anomalies characterize the GPR results from depths of 50 centimeters to over 1 meter. Magnetic anomalies across both bait fields are discrete round readings with a diameter ranging from 50 centimeters to 1 meter. In the EBF, a concentration of magnetic anomalies is related to soil formation from a road that forks around an area of trees. In the WBF, magnetic anomalies form a possible "oval" that is suggestive of post-mold architecture due its formation and consistent diameter dimensions. One point of note is that the two geophysical instruments reveal different types of anomalies. The gradiometer identified circular discrete anomalies, and in grid 1, 4, and 5 in the WBF form a sensical pattern. The GPR results in this same area did not identify the same kind of anomalous results in plan-view. Rather, it identified more extensive anomalies that appear to be deep basins with unique soil formation events directly related to the edges of the anomaly. Both devices are necessary to capture the complexity of sub-surface variation at the bait fields, as they are able to identify different anomalies.

Sub-surface anomalies in both fields appear to be directly related to topographic contour. Areas of lower elevation and flatter land coverage also have significantly fewer geophysical anomalies. In the WBF this area is associated with a ferrous anomaly buried 40 cmbs. It is therefore possible that these areas of lower elevation were part of modern landscaping, including shell and soil removal. Intact archaeological deposits at test unit 105 persist in organic soils situated above the modern elevation of the sandy bait field. This suggest that a large portion of the landscape, argued here as the areas of lowest elevation and flattest contour were removed during shell mining operations in the early twentieth century.

Generally, the both magnetic and radar geophysical anomalies form linear patterns that are related to the spaces between mounded spaces and loci was occupied by ancient Floridians. How their occupational spaces and activities are manifested is investigated through targeted archaeology and geospatial secondary analysis.

Chapter 7

Secondary Analysis of the Results:

Archeological Correlates and Spatial Statistics of Anomalies

In this chapter, the data from both gradiometry and GPR are further analyzed with geographic information system (GIS), test unit (TU) excavation, and small-bore coring, in order to explore the sub-surface patterning, identify characteristic geophysical markers for archaeologically relevant features, and evaluate the efficacy of the both devices in identifying shell deposits in well-drained, sandy soils. This investigation identifies potentially anthropogenic sub-surface patterning in both horizontal distribution of geophysical anomalies across the landscape as well as anomalies in three-dimensional space though GPR time-slices of relevant areas of archaeological investigation.

Methods Review

In order to comprehend the articulation between anomalies in both bait fields the edges of the anomalous areas in plan-view maps are georeferenced and traced, creating polygons around non-polar magnetic anomalies, as well as around clusters of anomalous GPR parabolas. The test unit excavations that were directed at identifying the results of the geophysical survey are considered, and their archaeological results are compared to the geophysics to identify correlations between method and results.

All geophysical data was subject to post-processing, using TerraSurveyor 3.0 to reduce background noise and de-stagger all magnetic gradiometer data, and RADAN7 for GPR data to remove surface reflections and refine parabolas to reduce overlap and produce more accurate data. ArcMap 10.6.1 was used in georeferencing plan maps for both magnetic and GPR data. Additionally, spatial statistical tools are used within ArcMap such as kernel density and Moran's I to identify the spatial relationship between anomalies and across the landscape. In order to define the accuracy of the OMA in the west bait field, a linkage analysis, similar to Prezzano's (1988) method for identifying up-state New York longhouses based on post-mold distances, is utilized to determine if the oval patterning evident to the eyes is reflected in ArcMap.

Finally, the efficacy of multiple methods is investigated via selected ESP coring. Areas of high geophysical anomalies present in both machines were selected for small-diameter coring in order to determine what the anomalies represented below the surface. Six cores were selected to represent most of the range of sub-surface variability identified by geophysical methods.

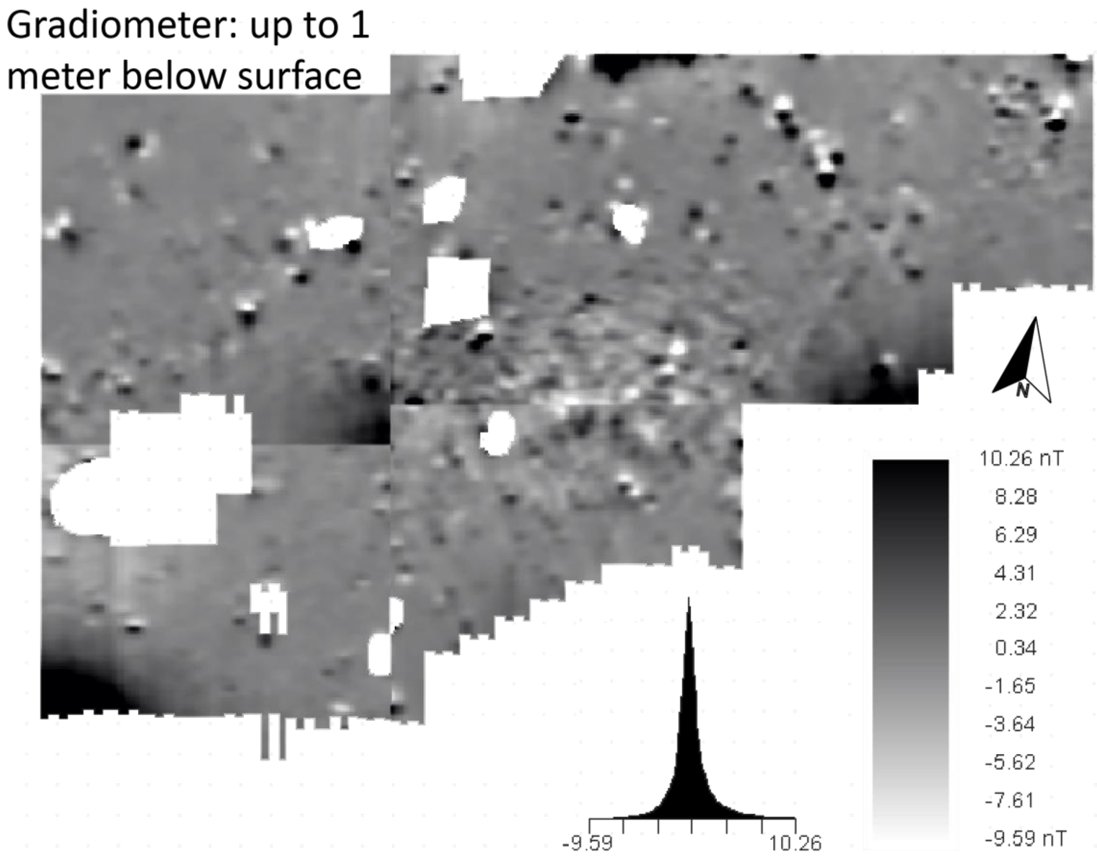
Archaeological Correlates

The sub-surface variations identified by geophysical instruments in the previous chapter require secondary analysis through mapping and spatial statistics. Potential architectural remains as well as traces of occupational spaces are extrapolated from the data anomalies. Specifically, within WBF, the OMA is investigated with several spatial statistical models to infer whether this orientation of this group of anomalies might be representative of an architectural space. First, archaeological correlates of anomalies need to be understood. In order to determine what the anomalies can represent in real space, four test units that were excavated during the 2018 field school are investigated below.

East Bait Field

In order to get a clearer perspective on not only how these features articulate with each other but also with the landscape in general, GPR anomalies from 59 and 95 cmbs were traced and overlaid with the magnetic gradiometry anomalies on contour map of the east bait field (figure 7.1). GPR depths are 59 cmbs and 95 cmbs, which are the areas with the most fine-grained data. Anomalous patterning matches up broadly with the contour lines (figure 7.2). Grid 1 is consistently devoid of anomalies from both devices, and the linear form of GPR anomalies trace the similarly shaped contour lines in the southeast of the survey area. Of particular note is the absence of features in Grid 1, and the similar linear form of anomalies in Grid 3 in both machines. The cluster of positive anomalies from the gradiometry is not present in the same way in the GPR, but anomalies are present in both general areas. Two devices were able to give a greater view of all possible sub-surface variation.

When comparing the two geophysics machine results directly several patterns emerge, principally regarding landform contour (figure 7.2). Magnetic and GPR anomalies are clustered in areas of higher elevation (typically over 4.5 meters above the NAVD 1988 vertical datum), whereas the flat portion of the landscape in grid 1 have almost no features. The geophysical results often overlap particularly in grids 3 and 4. One major disconnect between gradiometer and GPR results is the form of the average feature. Magnetic anomalies lack linear alignment, which is the most common shape of GPR features. This suggests that the machines are picking up different, but related sub-surface variations. The anomalies are clustered in areas of higher elevation (above 4.5m), and flat areas (north half of Grid 1) have almost no features. Often the gradiometry and GPR data overlap, particularly in Grids 3 and 4. The lack of linear magnetic



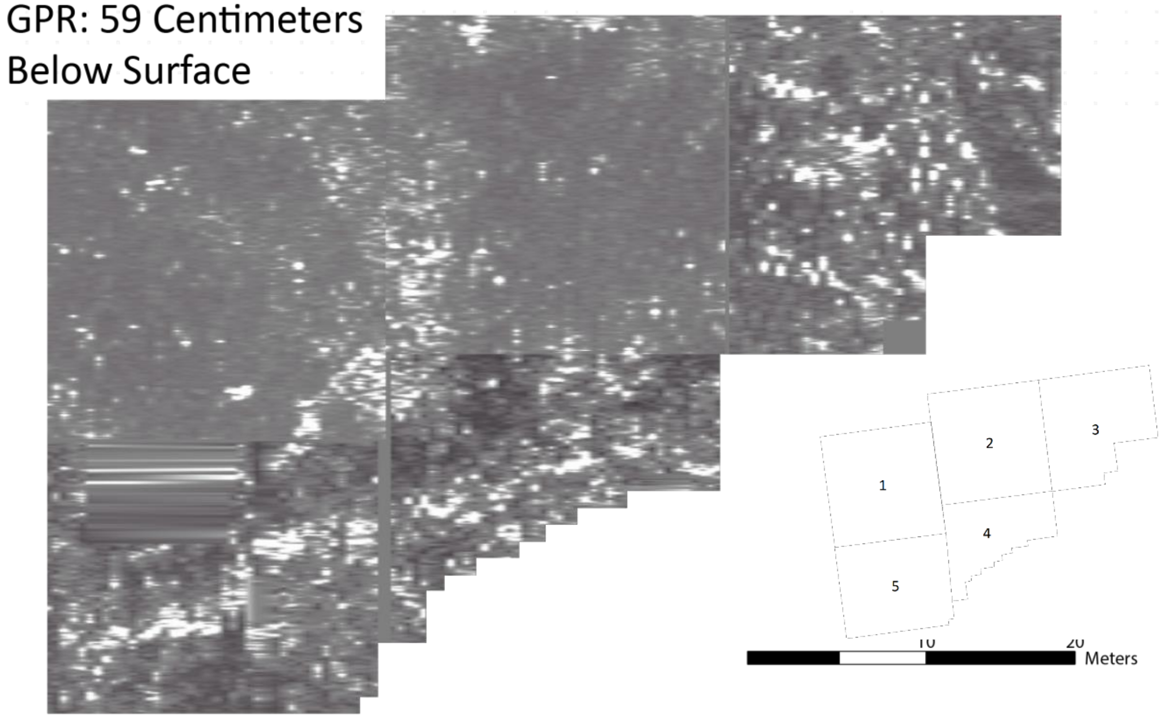


Figure 7.1: Masked and clipped magnetic gradiometer data (top) and GPR data at 59 cmbs (bottom).

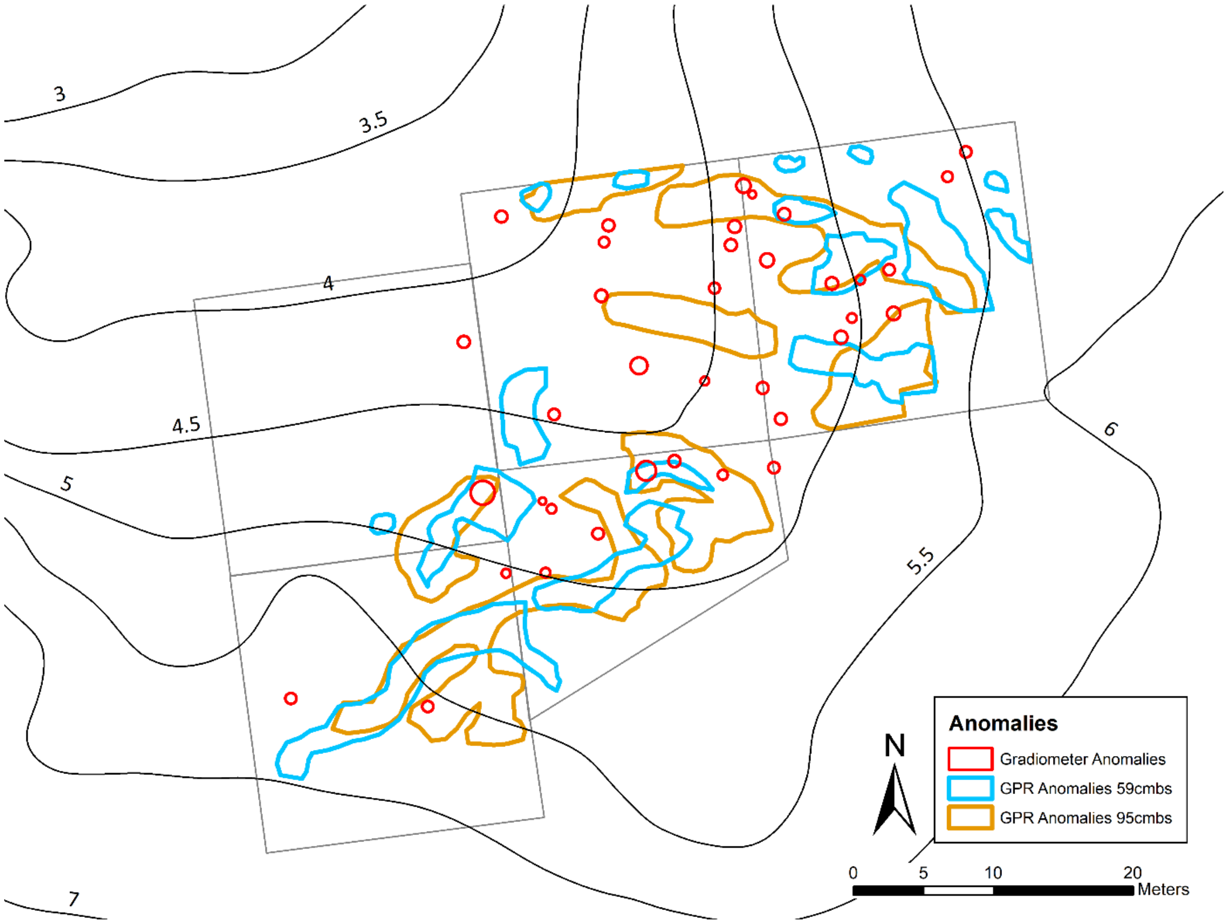


Figure 7.2: All features from both devices traced onto a contour map of the east bait

anomalies which make up the majority of GPR features suggest the machines are picking up different sub-surface variations. Comparing the data from both devices directly reveals that the instruments identified different anomalous properties. Spatial patterning overlap is especially illuminating for the total range of sub-surface variation.

Excavation Results

The significance of these anomalies, as well as the efficacy of the two geophysical machines at identifying shell-filled archaeological features in sandy soil, can be evaluated with reference to the excavation of two test units: TU107 and TU110. Previously, TU103 was excavated in the bait field within which a type 2 deep basin pit feature dating from the Mount Taylor period was identified. Test Unit 107 was placed in roughly the center of grid 3; we positioned TU107 in order to test the complicated overlapping pattern of GPR and magnetic data. It was situated on top of a positive magnetic anomaly, and in between two overlapping GPR features. During excavation, we encountered feature 221 at 50 cmbs. This feature is an example of a type 6 pit shell accumulation of perceived cultural origin, which appears to be represented in the gradiometer data (figure 7.3). The pit was associated with a darker buried “A” horizon. The cross section of the feature showed the shallow deposition. Feature 221 appears to be represented in the gradiometer data. The GPR data suggested more features should have been encountered, however, the isolated parabolas are spaced more than 2 meters away from each other, which might account for only one feature captured in the wall of TU 107 (figure 7.4).

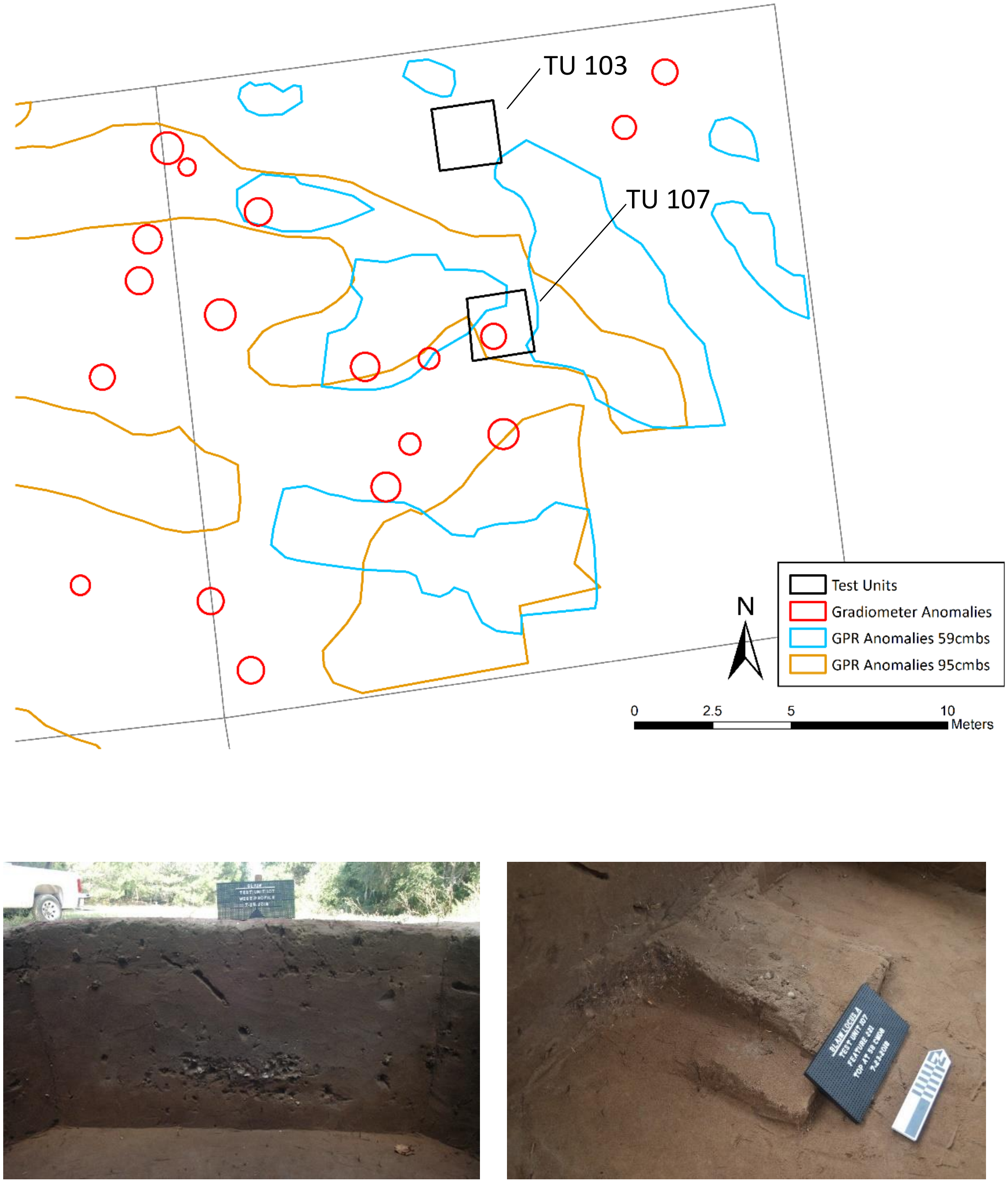


Figure 7.3: Test unit 107 placement within geophysical patterns (top). Profile of feature 221, a type 6 pit

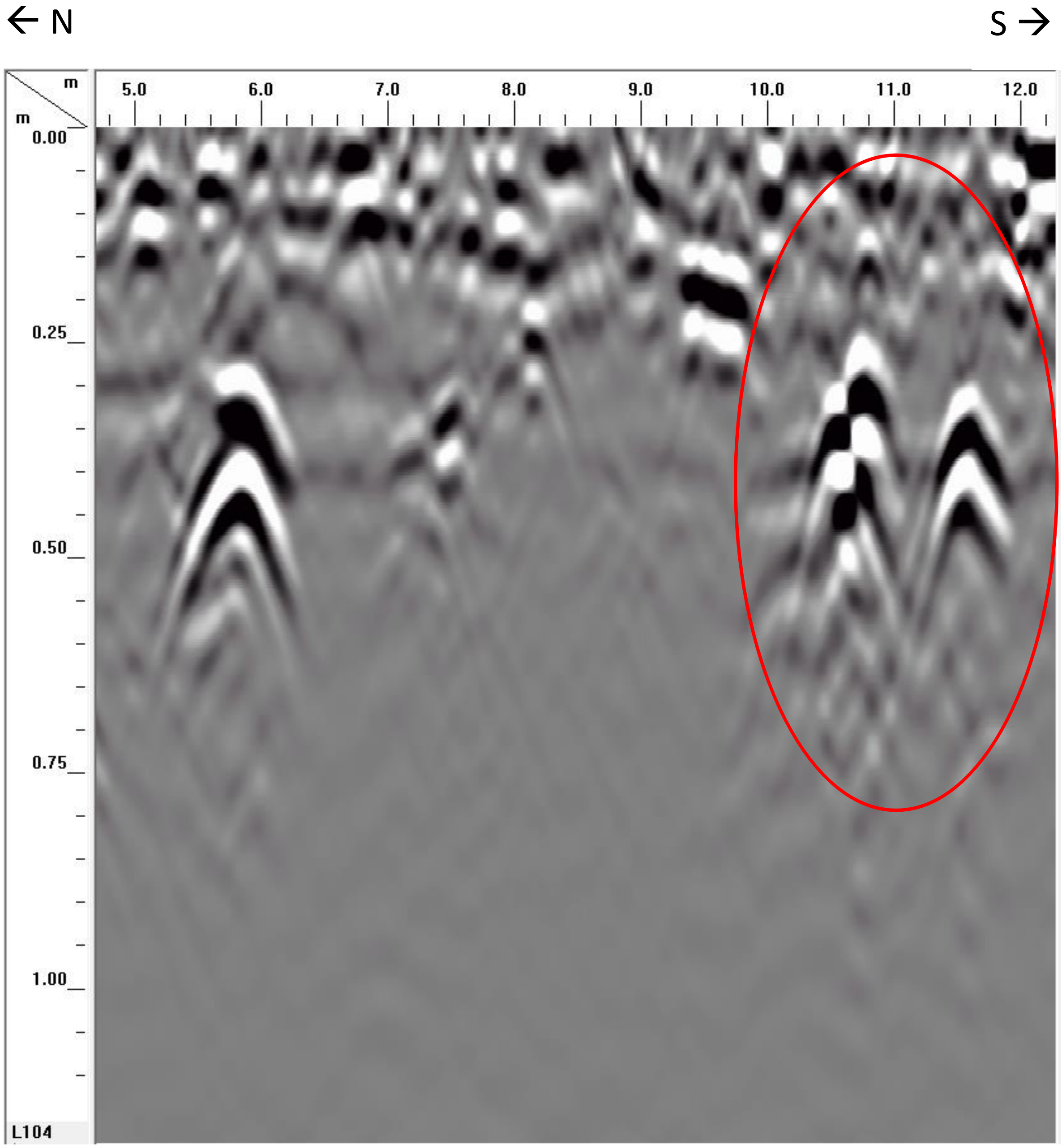


Figure 7.4: Time-slice from line 104 coinciding with western edge of test unit 107. The parabola registered at 11 meters south from the start of the line might represent feature 221. Other similar parabolas are suggestive of other buried type 6 shell deposits.

Test Unit 110 is located within the cluster of magnetic readings, and at the corner of several overlapping GPR results (figure 7.5). We documented three shell pit features (at depths from 40 cmbs to 90 cmbs. The location and depth of the features appear to correspond with the GPR data. In addition, we encountered one large spiculate-tempered St. Johns Plain sherd that spatially correlates with a magnetic anomaly. Feature 222 is a type 1 shell and sand filled, shallow basin pit that contained shell and fiber-tempered ceramics. This feature began at 55 cmbs in the center of the unit. Feature 223 is a large type 6 shell accumulation. It is primarily composed of clam shells, making it distinct from most other pit features, which are mostly filled with banded mystery snails. It located in the northwest corner of the test unit and persists for an unknown extent into the wall. Feature 226 is a type 3 small cylindrical pit composed of mystery snail shells. Feature 222 appears to intercept feature 226 on its northwestern edge. The top of feature 226 starts at 60 cmbs. The base of both feature 222 and 226 have burning. Both features 222 and 226 persist until about a depth of 96 cmbs.

These three features are associated with an organic buried “A” horizon that is evident in all four profile walls. Features 222 and 226 are also of interest, as they replicate the experimental parameters of a geophysical machine efficacy test by Kenedy et al. (2017). These authors tested the effectiveness of GPR and electrical resistance machines at identifying subsurface shell in sandy soil matrices. They suggest that more organic soil tended to obscure the differences in the overlapping shell layers in the GPR. Based on these experimental parameters, the GRP results might be picking up both the shell features and the lateral extent of the buried “A” horizon. Test Unit 110 confirms the efficacy of magnetic resistance in picking up archaeological remains, but

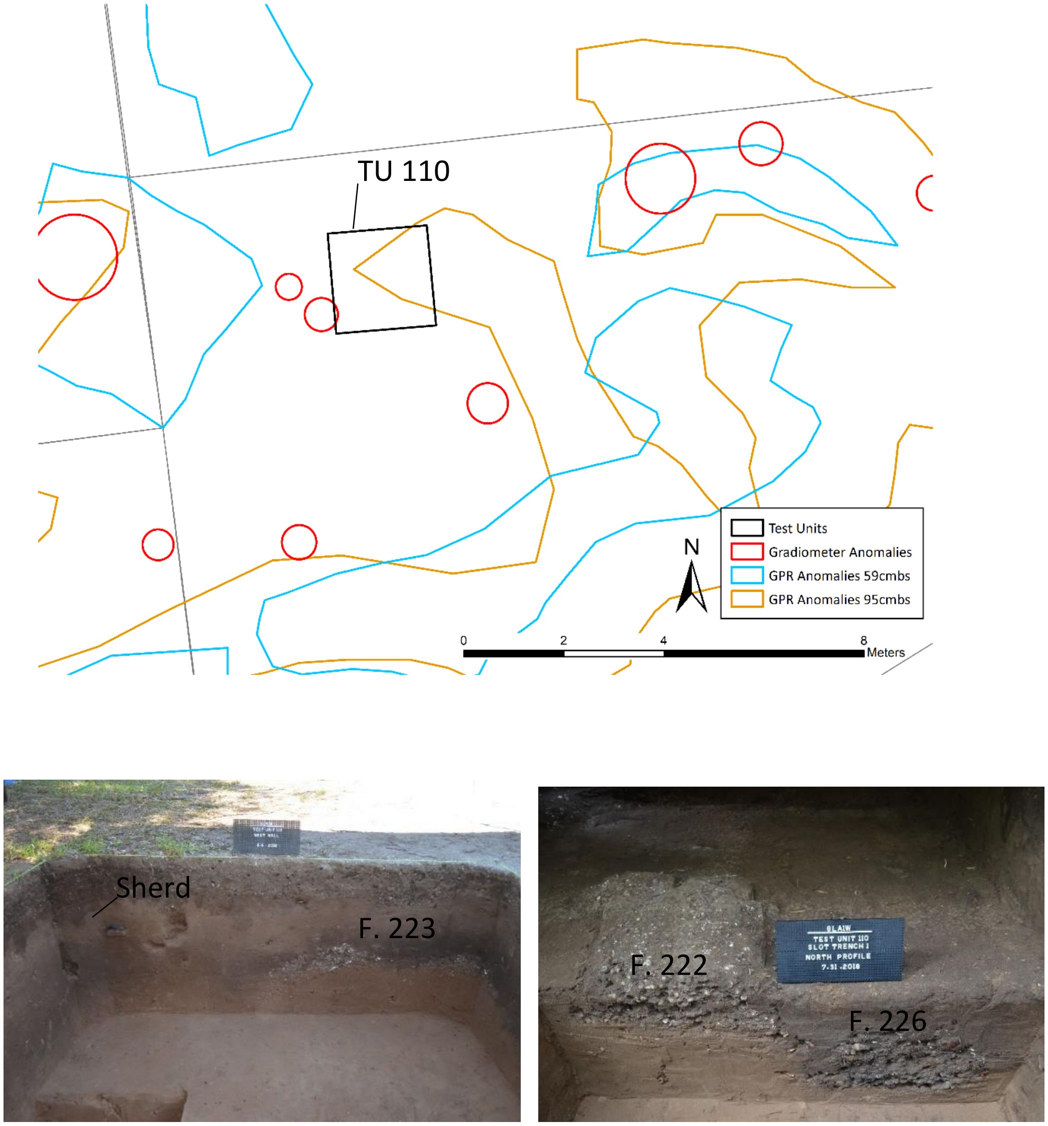


Figure 7.5: Test unit 110 placement within geophysical anomalies (top). Feature 223, a type 6 shell accumulation, and St. Johns Plain ceramic sherd near surface on the west profile (bottom left), and features 222 and 226, type 2 and 3 pit features respectively (bottom right). The buried "A" horizon matches with GPR results, although not at the correct depth. The sherd in the west profile is consistent with a magnetic anomaly.

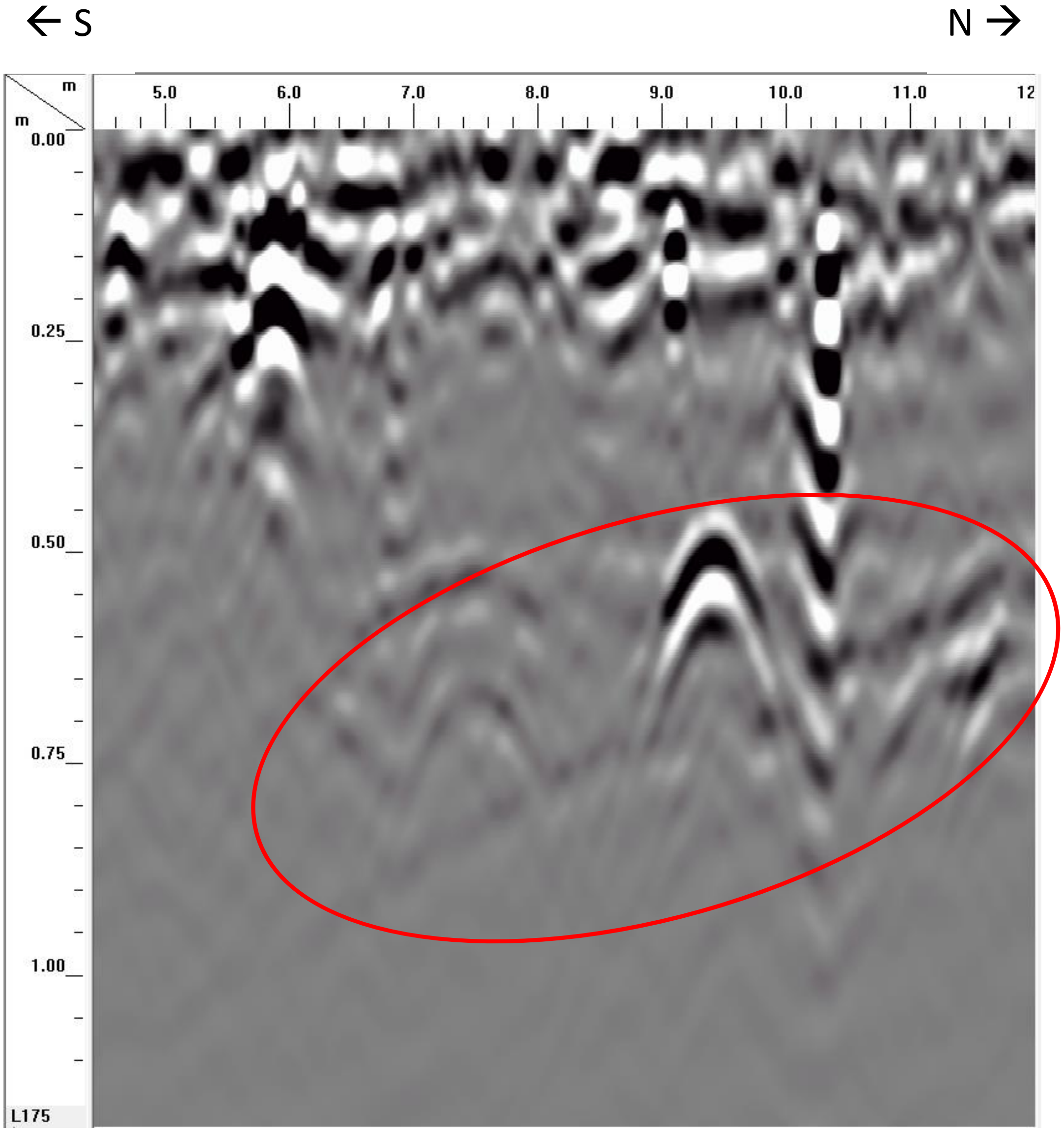


Figure 7.6: Time-slice from line 175 in grid 4. This lines up with feature 223 in the northwest corner of test unit 110.

the GPR data did not accurately reflect the way the pits are stacked. This can be in part due to the margins of error in georeferencing, as well as the organic “A” horizon. Additionally, these features are present in-between several pieces of modern metal. The parabolas that are suggestive of shell features might be representing either feature. Because the interface between features 222 and 226 are parallel, running north to south, it is possible that the time-slice representation might be flawed (figure 7.6). Regardless, the linear readings in context with the shell feature is suggestive of abrupt soil change. The depths of these readings match up with the buried “A” horizon starting at about 50 cmbs at the same depth as features 222 and 226.

West Bait Field

Comparing WBF magnetic gradiometry and GPR results of comparable depths illuminates what kind of feature patterning each machine identified. Figure 7.7 presents the overlapping gradiometer and GPR data from 44 cmbs within the WBF. The most striking difference between the machine readings is the absence of the OMA in the GPR data at all. One area of similarity is grid 10, where four distinct positive anomalies overlap with several GPR readings through over 50 centimeters of stacked parabolas. This suggests that there is archaeological material buried near Locus B. Similarly, the OMA and the deeply buried amorphous features in grids 1, 4, and 5 are near the Woodland period occupational space in Locus C and might be related. The OMA is suggestive of post-built architecture.

When both magnetic anomalies and GPR results are georeferenced and traced in context of landform contour lines, a consensus between machine results is evident (figure 7.8). Most notable anomalous comparisons are in south-central grid 10, marked by 4+ nT readings and amorphous GPR results being represented in the same space. The linear ferrous anomaly that distorted a large portion of the magnetic data is represented in the GPR data. The magnetic oval anomaly is not readily identifiable in the GPR results.

Similar to the EBF, the areas of lower elevation are devoid of features. The linear ferrous anomaly and gopher tortoise burrows are located within this area of flatter contour as well. From an overall landscape deposition perspective, the swath of features from both machines line up with the less-flat areas over 5-meters contour interval. One major constant between the two devices is the absence of anomalous readings in the center of the survey area, near the gopher tortoise burrows and presumed modern ferrous anomaly. Most of the magnetic anomalies, including the perceived oval in grids 1, 4, and 5, have related GPR results. The orientation of all the data broadly matches the 5.5 meter above spring level contour line, suggesting a meaningful connection between the amount of sub-surface variability and landform elevation.

Excavation Results

Two test units were excavated in grid 4 based on orientation of the OMA. Test Units 109 and 111 were sighted on top of four 2nT features. This arrangement also provides a way to test the accuracy of the gradiometer and GPR data intersections. These test pits uncovered four post features and several Type 2 deep basin pits, which are represented in the GPR data. These deep and complicated pits often had basal burning and ash. Test Unit 109 had the strongest indication of post-like features, although both units had post-mold evidence. Test Unit 111 has two pits, the north pit is filed mostly with banded mystery snails with a thin organic soil matrix. Orange period

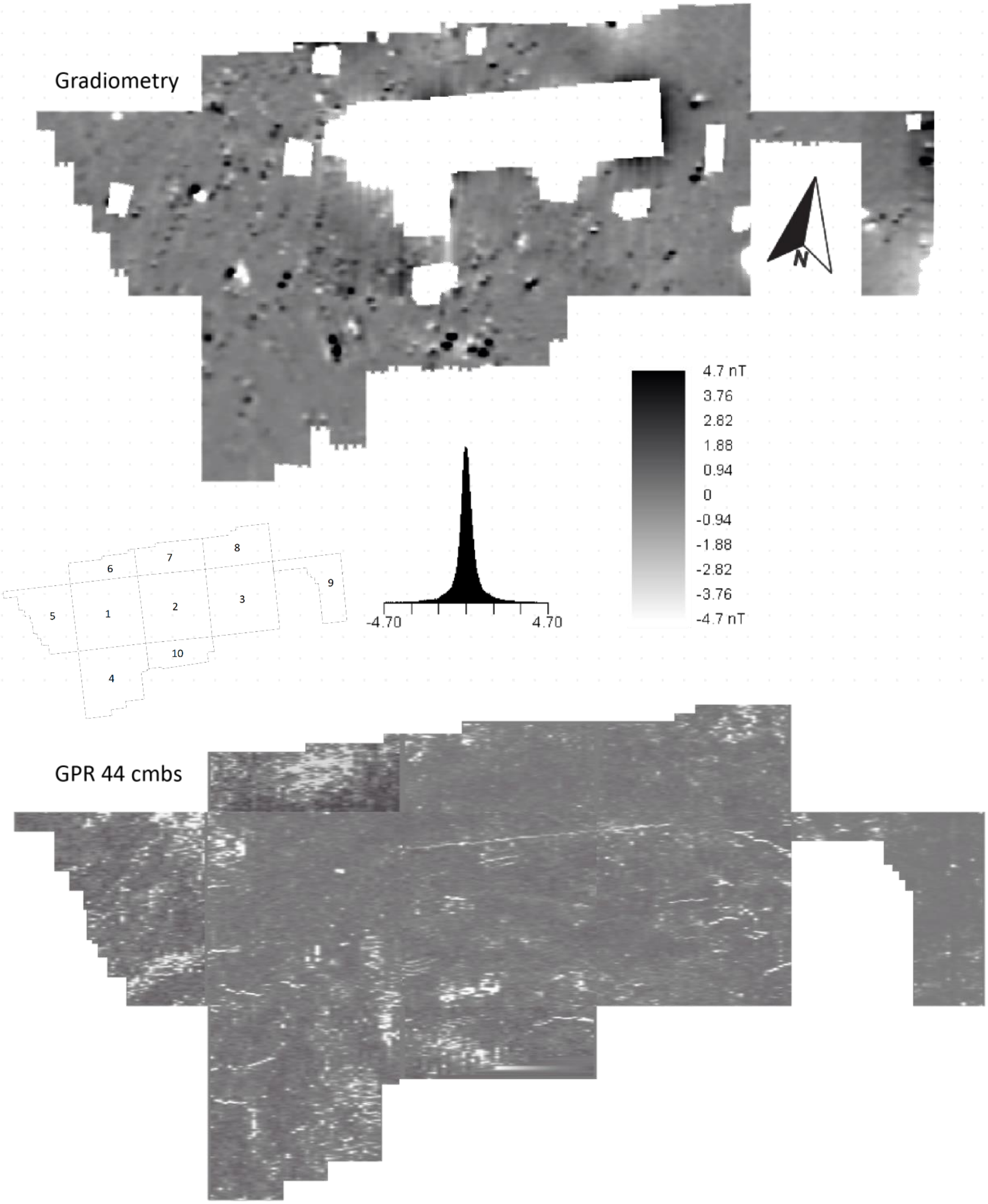


Figure 7.7: Magnetic gradiometer data compared with GPR data of comparable depths.

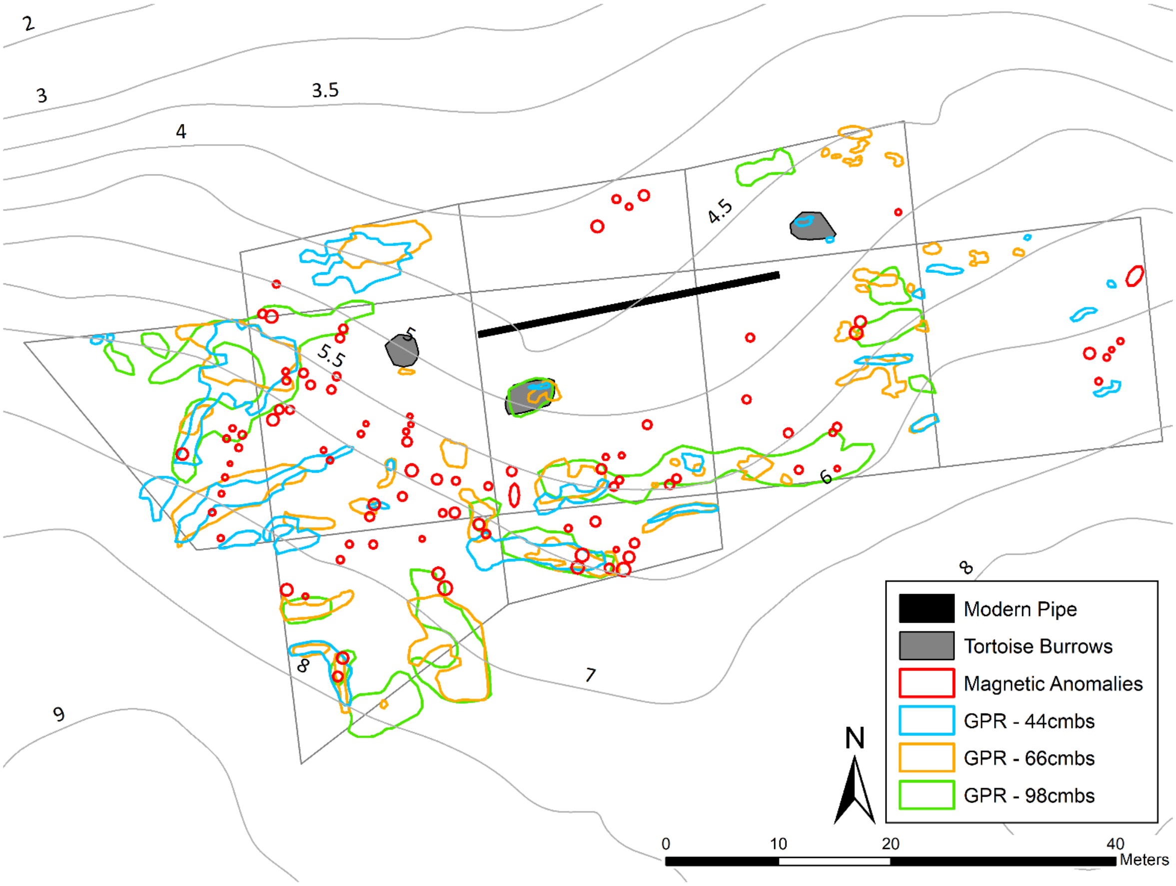
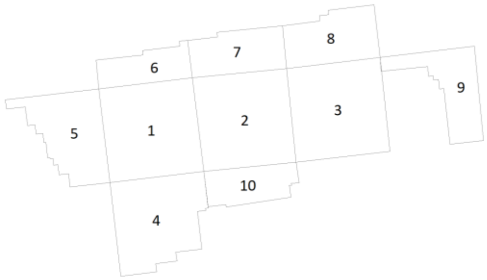


Figure 7.8: All west bait field geophysical anomalies traced and plotted over the 50-centimeter contour lines.



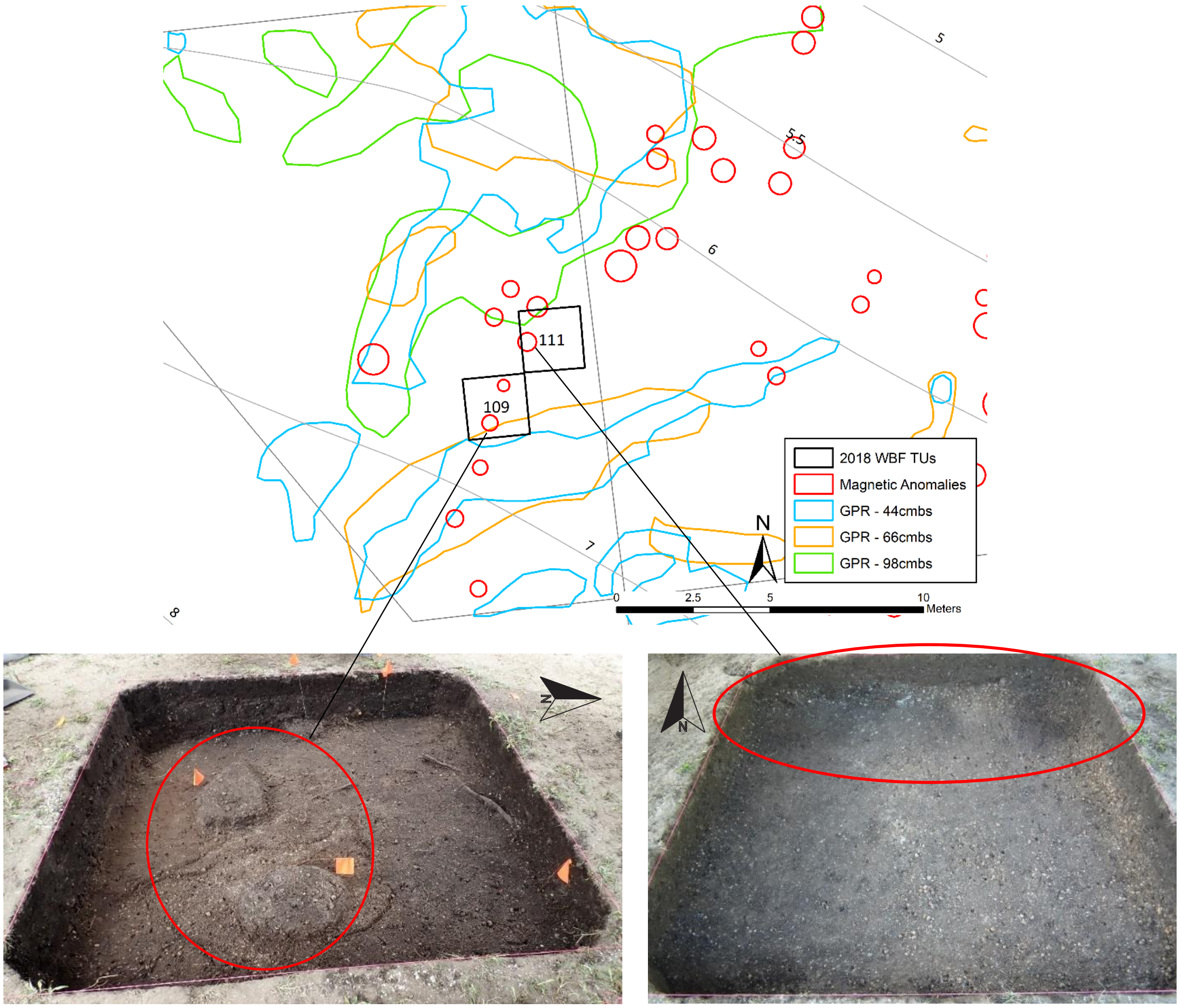


Figure 7.9: Test units in context with traced geophysical anomalies and contour lines. Magnetic anomalies are represented archaeologically in these test units.

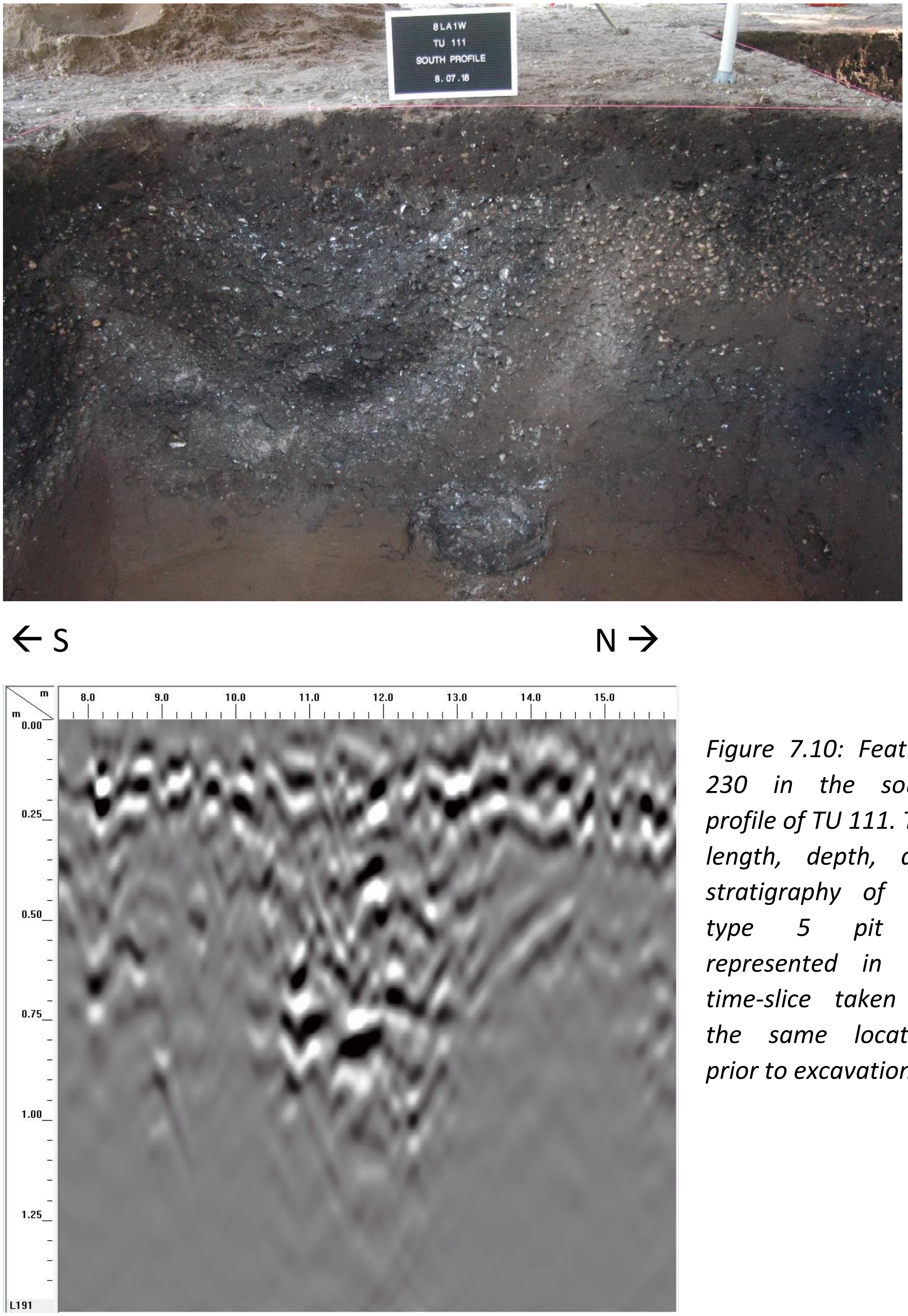


Figure 7.10: Feature 230 in the south profile of TU 111. The length, depth, and stratigraphy of the type 5 pit is represented in the time-slice taken at the same location prior to excavation.

sherds were recovered from this northern pit. The second pit is the south of the unit and contains feature 230. This feature's cross-section was identified by the GPR. Features suggestive of posts were identified by soil color and shell-rich soil change (figure 7.9). After the first layer of disc-plowed disturbed soil was removed, archaeological features immediately became evident. Two posts features were uncovered in TU 109, which closely matched the orientation and size of the positive magnetic anomaly. Similarly, areas of darker soil that mirrored magnetic anomalies were exposed in TU 111.

Excavation to depths close to 1 meter identified several pit features of different configurations. For example, Feature 230 is a Type 2 deep basin pit persisting to below 90 cmbs. This feature has several ashy, burned layers which might have been represented in the magnetic data, but was clearly defined by the GPR results. This feature is recreated in cross-section by the GPR. In figure 7.10, this one-to-one representation of sub-surface features lends confidence to the ability of this machine to identify sub-surface shell pits. The pit feature reflected in the GPR results allows for further inferenced to be made about the archaeological significance of GPR anomalies

ESP Selective Coring

The preceding analysis suggests that the gradiometry data reflect discrete circular features with archaeologically correlated circular features, while the GPR data profiles provide an accurate cross-section of archaeologically real pit features. Both machines are effective at identifying certain types of archaeological features. The efficacy of both devices in identifying the same feature, however, is tested with the ESP coring device. I used this slide-hammer assisted small-bore coring device to target areas of geophysical interest outside of test unit excavation. Each tube is 92 centimeters long, with an average compression from hammer impact of 20 centimeters. Typically, two tubes were taken for a total of 182 centimeters of data collected however, for this investigation only one length was analyzed, as most cores below 92 centimeters were light sandy subsoil. A total of six ESP cores are described below, two in the EBF, and four in the west (figure 7.11). These areas were selected because they had overlapping geophysical results.

In the EBF, ESP 22 was centered on a GPR anomaly and within close proximity to a gradiometer anomaly. This was the ESP that prompted excavation of TU 110. ESP 38 was centered on a pair of magnetic anomalies without GPR results, to test what kind of material was causing the anomaly. ESP 22 consisted of four layers, (1) 5 centimeters of shell-bearing top soil, (2) 33

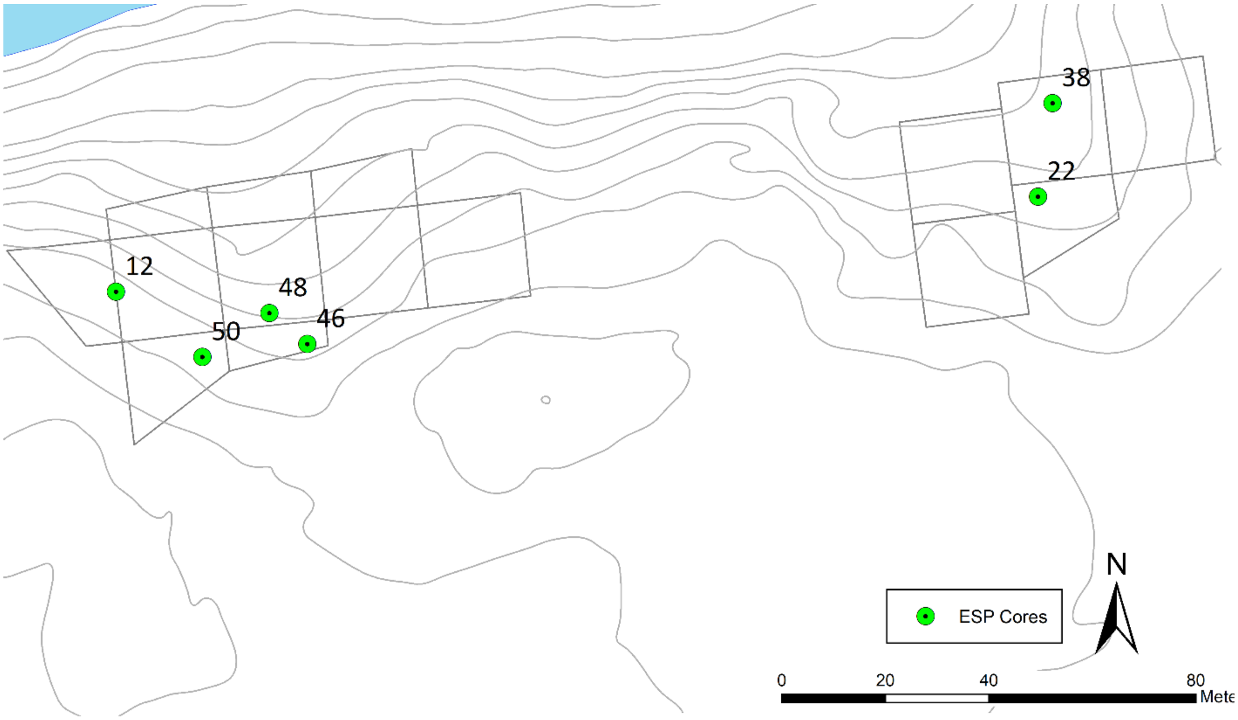


Figure 7.11: Map of the ESP core location across both bait fields.

centimeters of dark organic-rich sand, (3) 26 centimeters of heavy shell fill with organic matrix, and (4) 16 centimeters of light sandy subsoil (figure 7.12). The presence of a thick layer of dense shell is related to GPR anomalies at 95 cmbs, and is cored straight into feature 226, the base of which is at 96 cmbs. ESP 38 consists of three layers, (1) 11 centimeters of shell-bearing topsoil, (2) 3 centimeters of very fine shell with organic matrix, and (3) 57 centimeters of sandy subsoil (figure 7.13). The thin layer of shell relates to relates to the magnetic anomaly and can be associated with a type 6 thin shell deposit. Additionally, the core might have clipped a larger feature which might account for the high nT result, and the core just took a sample of an outward sloping pit feature.

In the WBF, four cores were taken: 12, 46, 48, and 50. ESP 12 consists of 4 layers, (1) 3 centimeters of top soil, (2) 15 centimeters of light shell with organic matrix, (3) 7 centimeters of heavy shell with organic matrix, and (4) 15 centimeters of sandy subsoil (figure 7.14). This core was heavily compressed, due to the significant quantity of shell. Presumably, the shell layers were thicker below the ground. Additionally, its location is between several “oval” anomalies, but outside the actual bounds of any geophysical anomalies. The presence of shell suggests a georeferencing or data processing issue, rather than a data capture issue, as other shell features are evidenced in both machines. ESP 46 has seven layers: (1) 4 centimeters of top soil, (2) 30 centimeters of shell with organic matrix, (3) 4 centimeters of dark sand, (4) 8 centimeters of shell with organic matrix, (5) 3 centimeters of dark sand, (6) 4 centimeters of shell with organic matrix, and (7) 18 centimeters of sandy subsoil (figure 7.15). This core is placed in grid 10, among many GPR and magnetic anomalies that overlap. This position is close to Locus B, and the layered shell is suggestive of several iterations of depositional events, on otherwise complicated stratigraphy.

ESP core 48 is composed of 4 layers of alternating shell. (1) instead of topsoil, this core has 19 centimeters of light shell with organic matrix, (2) heavy shell with organic matrix, (3) heavy shell with no matrix, and (4) heavy shell with organic matrix (figure 7.16). Similar to ESP 46, this core is located on overlapping geophysical readings, which are represented in the entirely shell-filled core. Finally, ESP 50 is made up of 3 layers. (1) 9 centimeters of top soil, (2) 14 centimeters of shell with organic matrix, and (3) 47 centimeters of sandy subsoil (figure 7.17). This core is located between two magnetic anomalies, directed at understanding the separation between them. The presence of a thin layer of shell suggests that is clips a larger feature, possibly related to the GPR readings to the west.

Selective ESP coring is helpful in being able to identify what the geophysical anomalies might represent archaeologically. Based on these cores, both methods can identify areas of shell (barring ESP 12), but gradiometry appears to be able to accurately depict the size of shell features better than GPR readings. The GPR however, picked up buried deposits when the gradiometer failed to do so (e.g. ESP 22). Ultimately, these methods are complimentary, and their efficacy is appropriately tested by selective ESP coring.

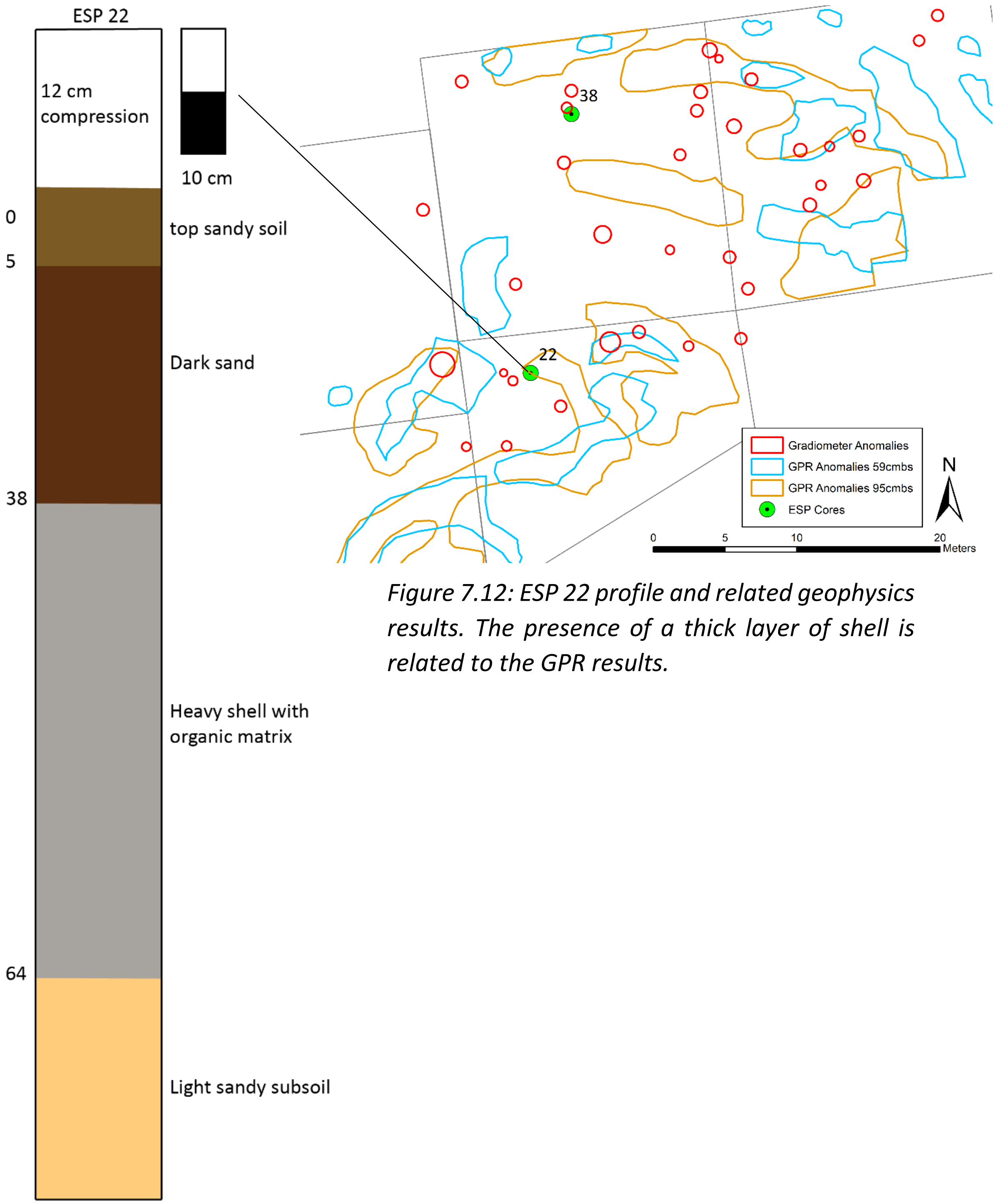


Figure 7.12: ESP 22 profile and related geophysics results. The presence of a thick layer of shell is related to the GPR results.

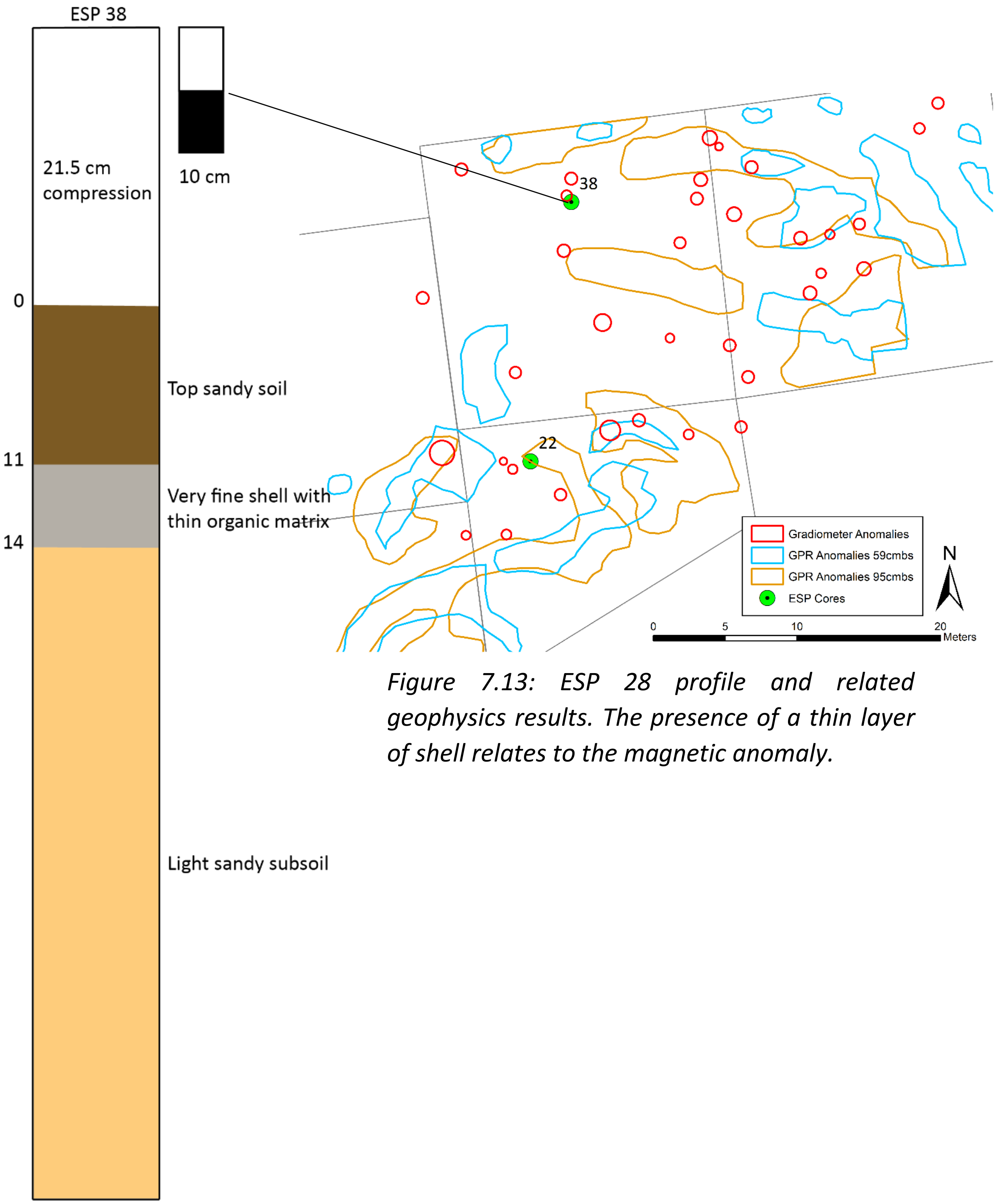
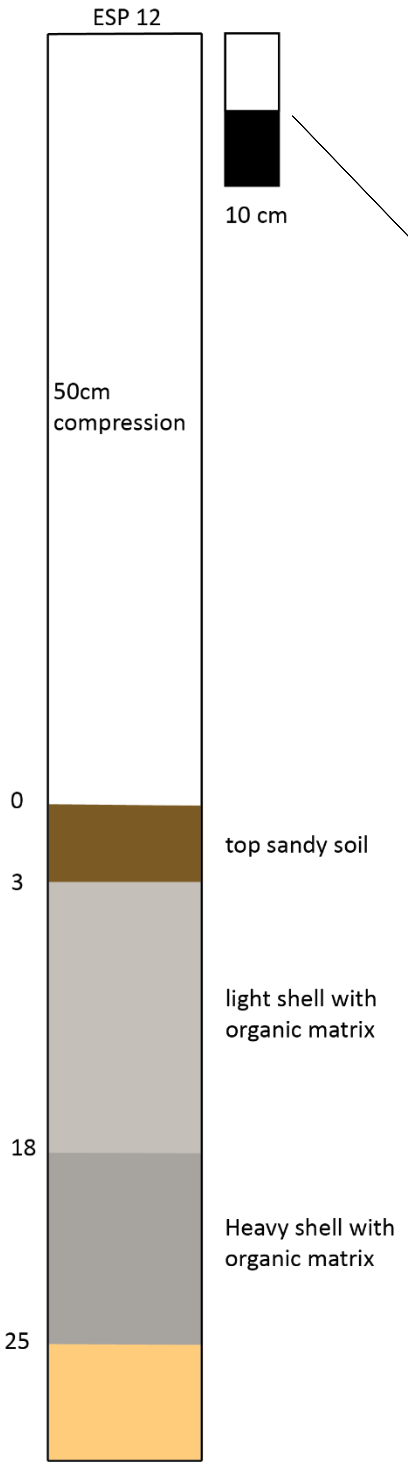


Figure 7.13: ESP 28 profile and related geophysics results. The presence of a thin layer of shell relates to the magnetic anomaly.



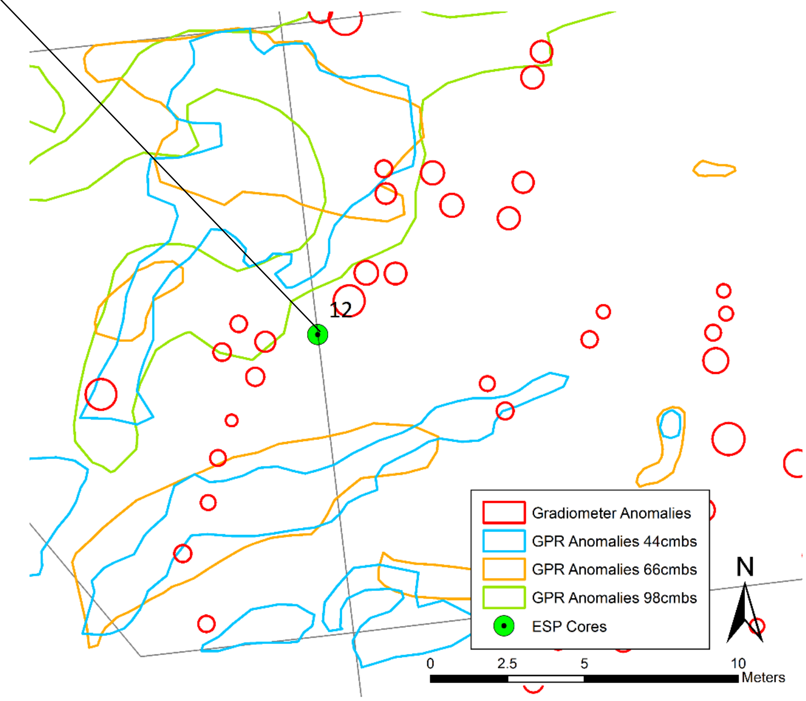


Figure 7.14: ESP 12 profile and related geophysics results. The presence of shell with not geophysical anomalies is suggestive of georeferencing or data processing issues.

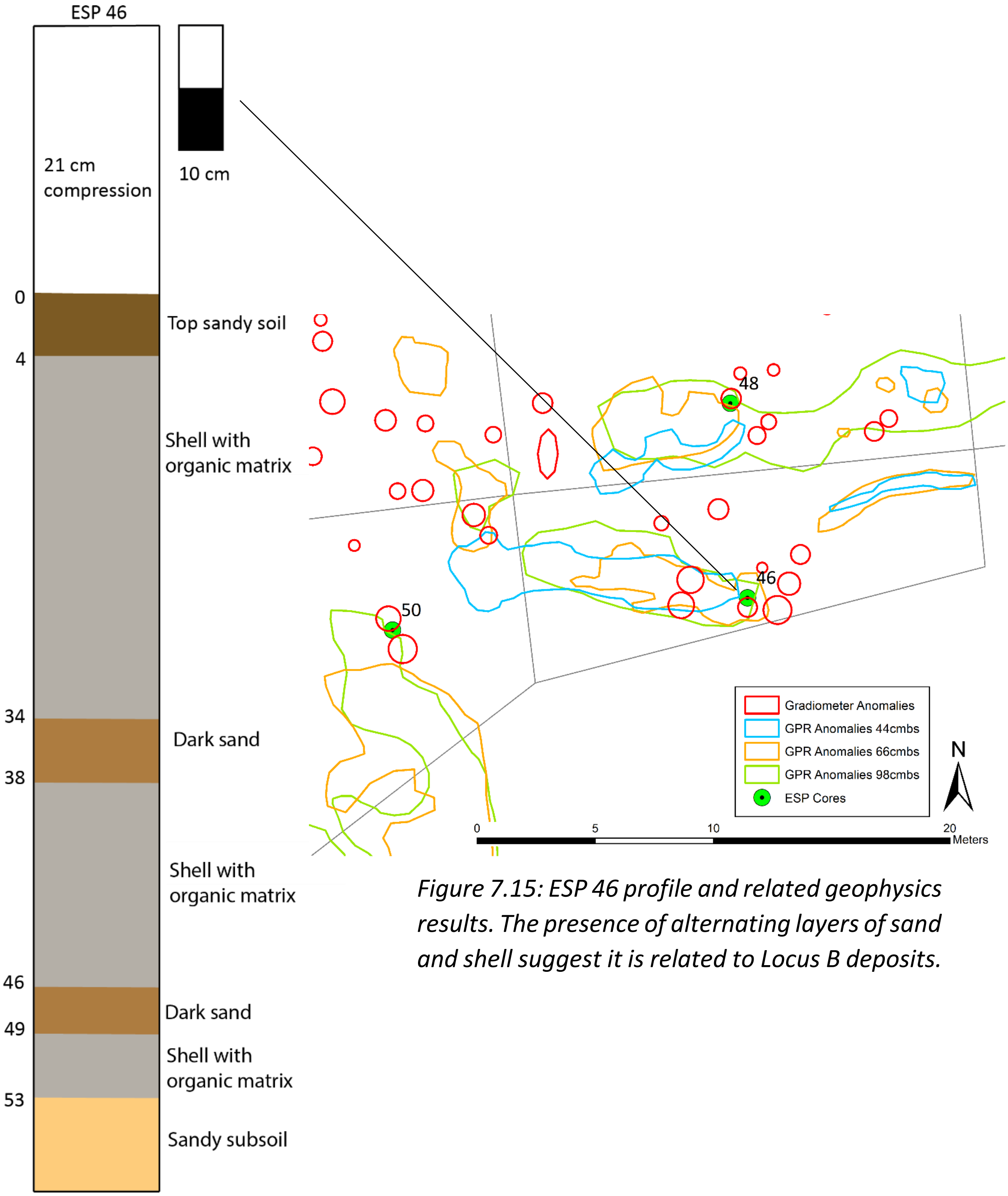


Figure 7.15: ESP 46 profile and related geophysics results. The presence of alternating layers of sand and shell suggest it is related to Locus B deposits.

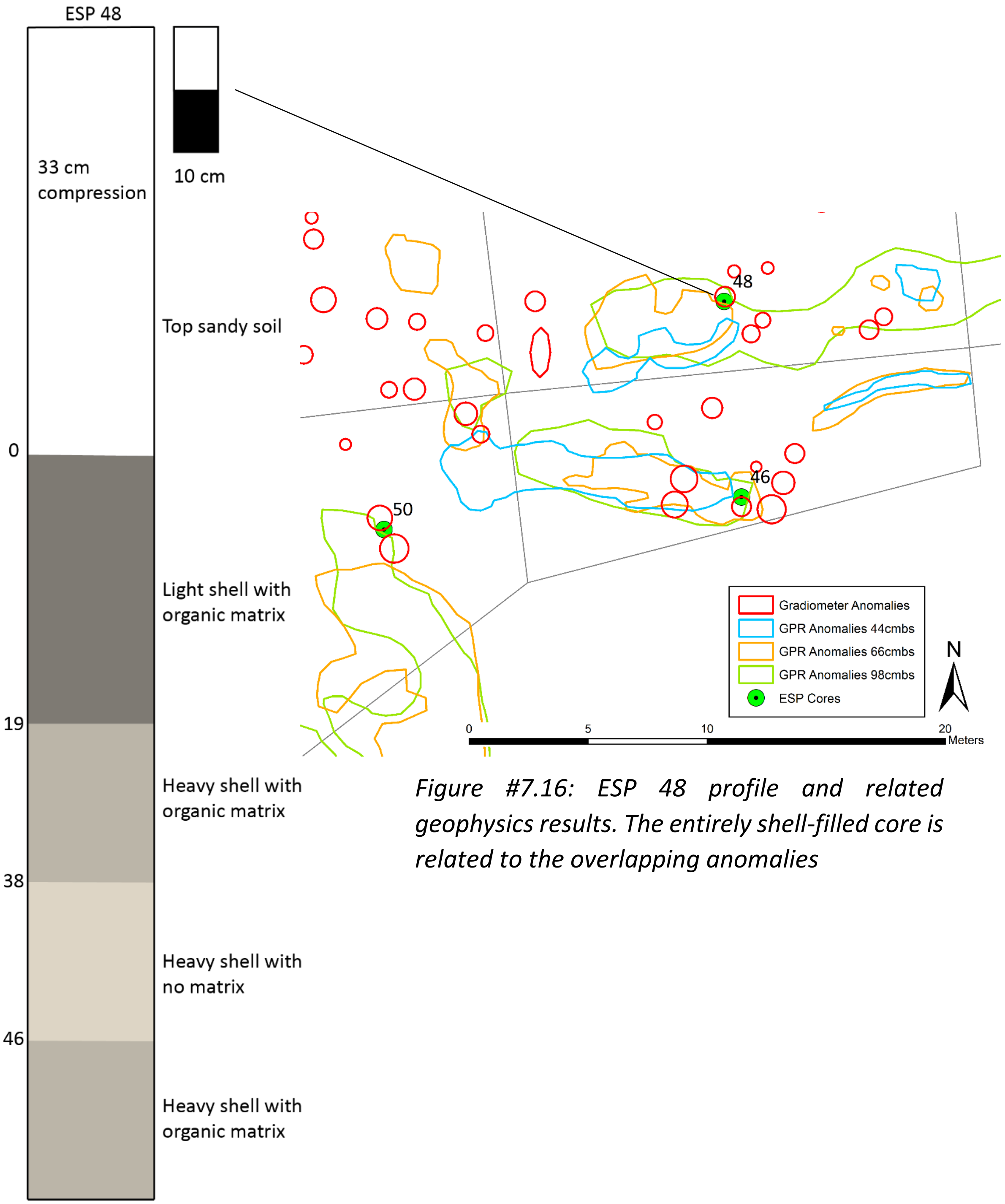


Figure #7.16: ESP 48 profile and related geophysics results. The entirely shell-filled core is related to the overlapping anomalies

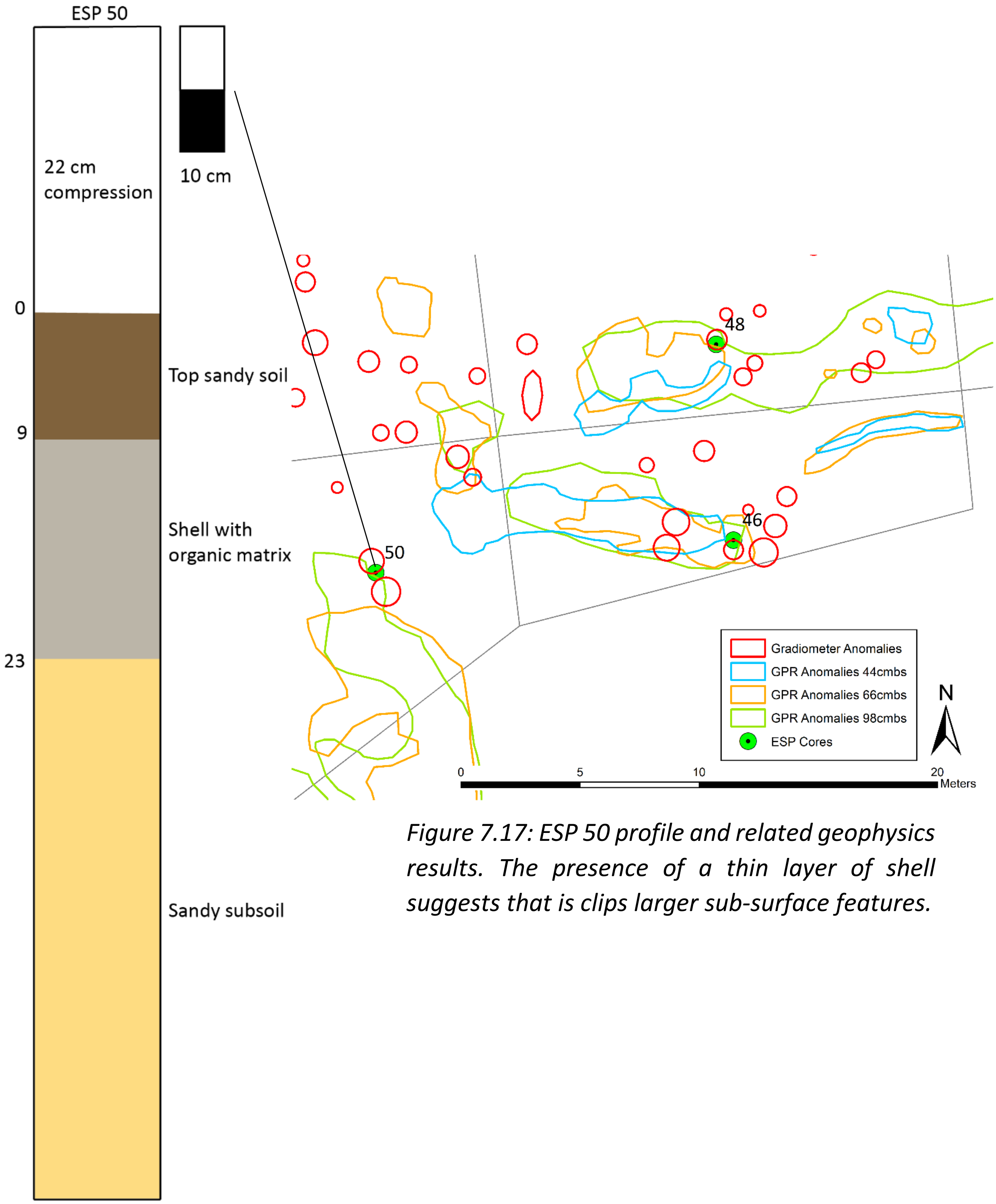


Figure 7.17: ESP 50 profile and related geophysics results. The presence of a thin layer of shell suggests that is clips larger sub-surface features.

Gradiometer Spatial Statistics

GPR and gradiometry anomalies do in fact reflect real archeological deposits. Since the gradiometer anomalies were consistently circular, in relation to the amorphous linear arrangements of the GPR data, spatial statistic methods can be utilized on gradiometer anomaly centroids in order to tell if there is statistically significant spatial patterning. Various statistical patterning tools were used in ArcGIS 10.6, including kernel density analysis to identify the closeness of each piece of data, spatial autocorrelation (Moran's I) to measure whether the point and polygon data are clustered, nearest neighbor to measure the average distance from each data point for clustering, and high-low clustering (Getis-Ord G*) to measure the degree of clustering between each point. The magnetic anomalies were analyzed through a centroid point for each circle traced over the original non-dipolar positive anomalies.

East Bait Field

A kernel of 50 centimeters was selected based on average distance of anomaly centroids. The kernel density for the magnetic anomalies in the EBF are clustered into 5 distinct lobes, with closer connection between clustered groups in the northeast grid (figure 7.18). Kernel density overlays a strength of connection heatmap that accounts for Euclidean spatial distance and relates their distances to each other to form clusters. This was done in order to visually identify if any of these anomalies might be clustered. Clustering was then tested with the above listed spatial statistics (table 7.1). The spatial statistics confirm the insights that the kernel density of the magnetic data indicated. The data is clustered, according to Moran's I spatial

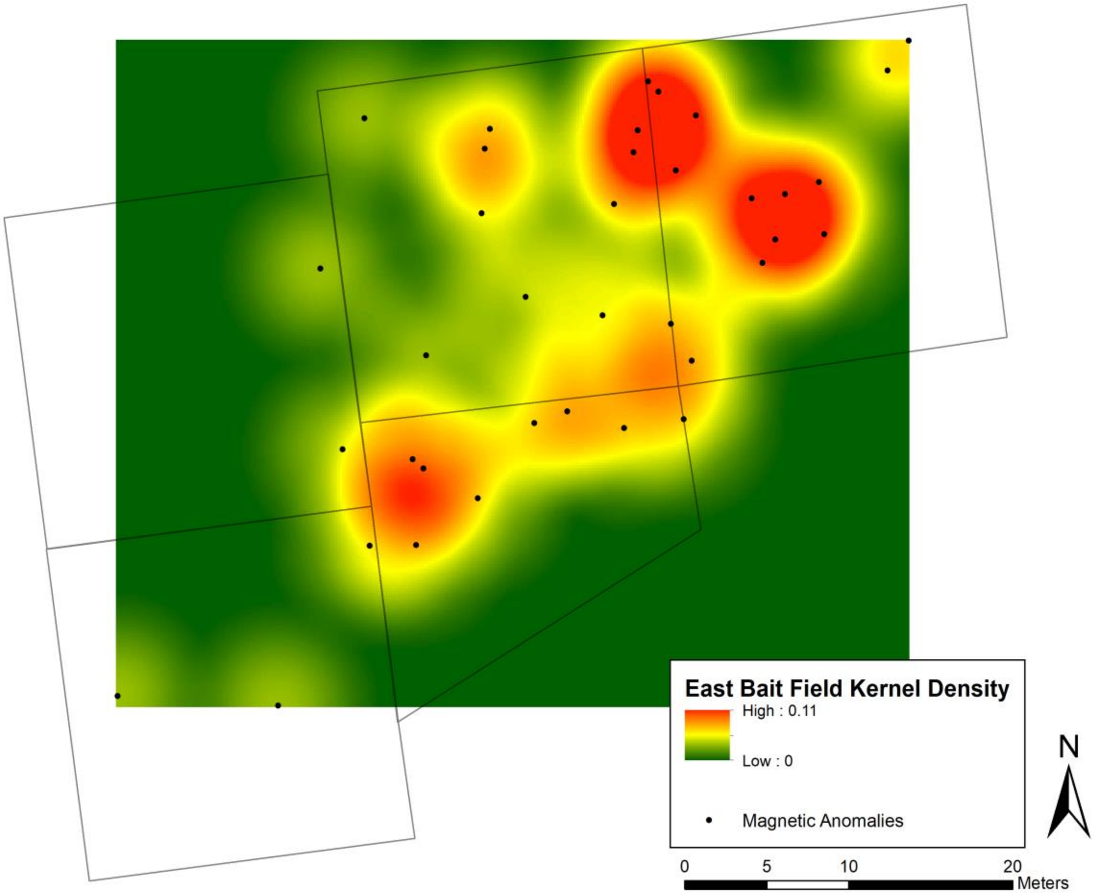


Figure 7.18: Kernel density analysis of the centroids of the magnetic anomalies in the EBF. There are 5 overall clusters, with 3 strongly spatially related groups, 2 in the northeast, and 1 in the northwest corner of the southeast grid.

Table 7.1: Range of spatial statistical methods ran on both GPR and magnetic gradiometry.

East Bait Field Magnetic Anomalies		Conclusion	P-value	Z-score	Index
	Moran's I	Clustered	<0.05	4.7	0.425
	Nearest Neighbor	Random	0.87	-0.15	0.986
	High-Low Clustering	Random	0.22	1.22	0.048

East Bait Field GPR Anomalies	59cmbs	Conclusion	P-value	Z-score	Index
	Moran's I	Random	0.66	0.43	0.011
	Nearest Neighbor	Dispersed	<0.05	2.69	1.351
	High-Low Clustering	Random	0.54	-0.61	0.021
	95cmbs	Conclusion	P-value	Z-score	Index
	Moran's I	Random	0.61	-0.51	-0.351
	Nearest Neighbor	Dispersed	<0.05	4.94	1.975
	High-Low Clustering	Random	0.78	-0.27	0.021

autocorrelation. This means that the points are not independent from each other and are therefore statistically significantly clustered in some way. This also means that the data was not evenly dispersed across the landscape. Nearest neighbor tests look to see how clustered each grouping is. Both the Magnetic anomalies and GPR results were tested to identify clustering. The magnetic results were spatially dependent with each other, but not evenly across the landscape. The GPR results were not clustered in any meaningful way but dispersed across the landscape evenly.

If these magnetic anomalies were distinct structures, it might be safe to assume that the anomalies would also be clustered in this analysis. Because both nearest neighbor and high-low clustering were random distributions, it might suggest that these clustered magnetic anomalies are only spatially related to each other in proximity, rather than in a way that might resemble structures.

West Bait Field

Following through on the idea that the OMA might be structural elements, spatial statistics were employed just as they were for the previous EBF. Firstly, a kernel density analysis of all the magnetic anomalies was completed (figure 7.19). A ~~50 centimeter~~50-centimeter kernel was selected based on average distance between magnetic anomaly centroids. The linear anomalies were strongly associated with each other, as well as the cluster of anomalies to the east. The “center” of the OMA was equally empty, which emphasized the arc shape of these features. There are four main clusters. One is the oval shape, another is a cluster in the south-center of the grids, and

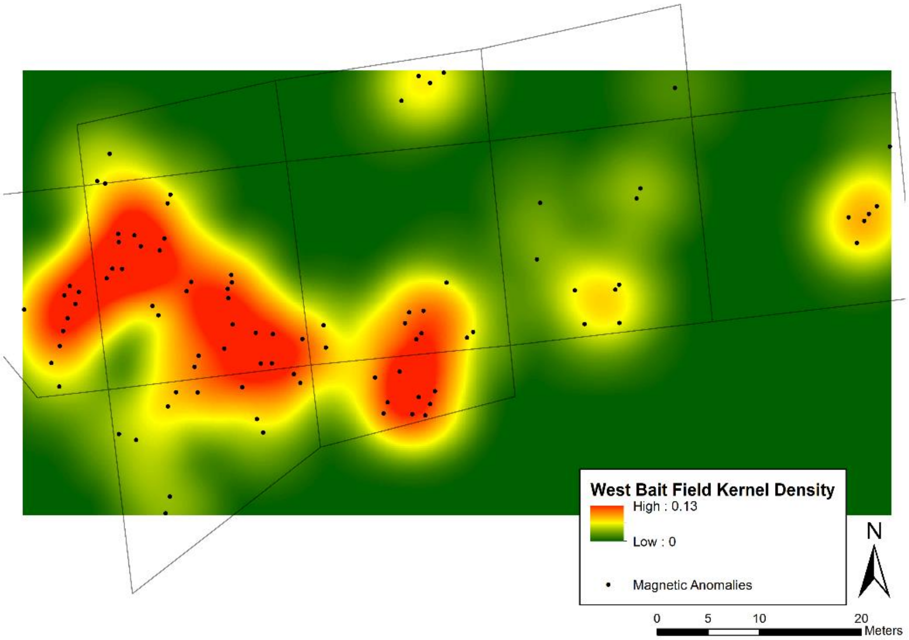


Figure 7.19: Kernel density map of all magnetic anomalies across the West Bait field.

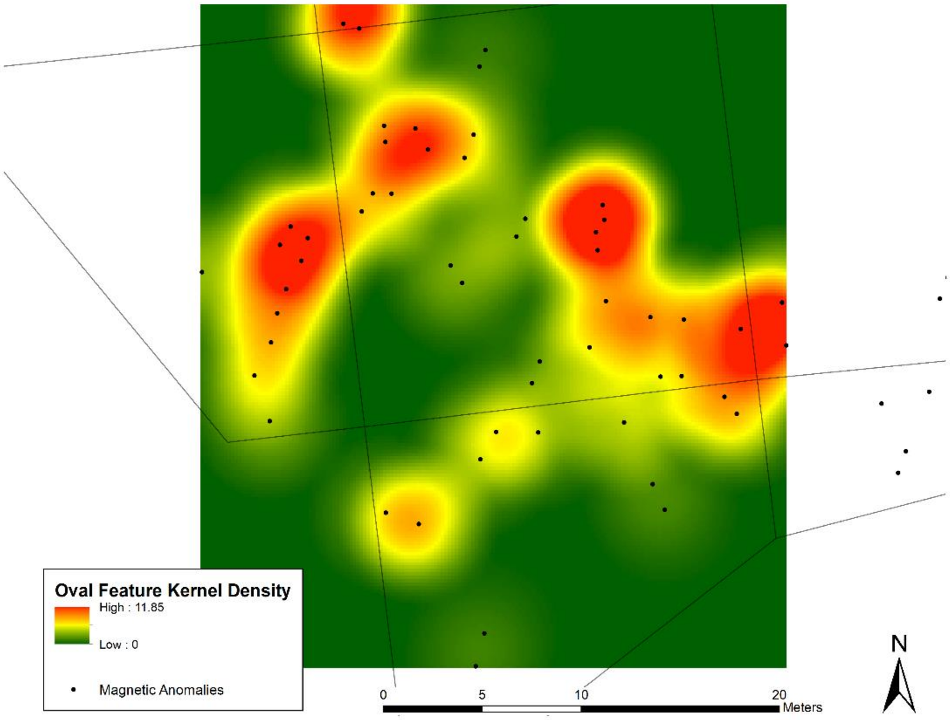


Figure 7.20: Kernel density map of the OMA. Interestingly, there appears to be two distinct linear areas, with a gap in the northeast. Additionally, the clustering strength of the east half of the arc is weaker moving south.

Table 7.2: Spatial statistics results for both the magnetic and GPR anomalies. Notice how strongly the clustering is for all the OMA anomalies. Also, all the GPR anomalies are randomly distributed.

West Bait Field Magnetic Anomalies		Conclusion	P-value	Z-score	Index
	Moran's I	Clustered	<0.05	4.04	0.172
	Nearest Neighbor	Clustered	<0.05	-7.24	0.605
	High-Low Clustering	Random	0.94	-0.06	0.083

West Bait Field Magnetic Oval		Conclusion	P-value	Z-score	Index
	Moran's I	Clustered	<0.05	3.45	0.335
	Nearest Neighbor	Clustered	<0.05	-2.75	0.804
	High-Low Clustering	Low-Clusters	0.04	-2.05	0.037

West Bait Field GPR Anomalies	44cmbs	Conclusion	P-value	Z-score	Index
	Moran's I	Random	0.11	1.62	0.205
	Nearest Neighbor	Random	0.6	0.51	1.052
	High-Low Clustering	Random	0.57	0.55	0.027

	66cmbs	Conclusion	P-value	Z-score	Index
	Moran's I	Random	0.13	1.49	0.129
	Nearest Neighbor	Random	0.4	0.83	1.06
	High-Low Clustering	Random	0.14	-1.46	0.008

	114cmbs	Conclusion	P-value	Z-score	Index
	Moran's I	Random	0.89	0.13	-0.042
	Nearest Neighbor	Random	0.24	1.16	1.157
	High-Low Clustering	Random	0.36	-0.91	0.013

two smaller groups to the east. In order to get a better view of just how the oval features are grouped, kernel density analysis was also done for just the features that make up the potential structure (figure 7.20).

The closer-cropped kernel density analysis makes the OMA even more clear. Interestingly, it appears that there are two lobes, or section of this shape, with an opening facing northeast. If this is to be believed to be a structure, perhaps that is the doorway. Additionally, the collection of the anomalies to the east makes the east arc of the oval less strongly related. Further spatial statistics were applied, all of them identifying a statistically significant clustering of the “oval” and the West Bait field in general. This clustering is only present in the magnetic data, not the GPR; none of the GPR results were clustered in any way (table 7.2). Some of the areas that are clustered in this analysis might be due to the masking and clipping of the data that significantly excised a large portion of the survey grid in the WBF.

Linkage Analysis

Kernel density analysis and spatial patterning is important to identify underlying trends in the data that reveal the meaningful distribution of clustered magnetic anomalies across the landscape. The WBF OMA is suggestive of architecture based on the kernel density and the center clear of magnetic anomalies. Taking the possibility of the OMA being a post structure, a linkage analysis was conducted. This linkage analysis was modeled after Prezzano's (1988) method of identifying the most likely connections between posts and drawing all possible connections. Prezzano's method was developed to make sense of the multitude of post-molds at a Haudenosaunee site in upstate New York. Her method took the proximity data for each of these posts and compared them together to find which posts were the most logically closest to each other. The closest neighbor was considered over several distances in order for the underlying logical patterning to become clear. These linkages essentially trace the most likely collection of posts that formed the walls of the long house. Based on length of possible connections, spatial patterning emerges that connects features in a meaningful way.

For this investigation the centroids of all magnetic anomalies were once again used. First, the centroids were assigned real XY coordinates based on the NAD 1983 UTM Zone 17N projection, then a near table was calculated for all possible combinations of points with 100 meters of each other (the linear length of the west bait field). The XY coordinates and line lengths were then converted to line vector data, and the resulting web of lines was sorted by length, ranging from 0 meters to 4 meters. Filtering by length of line, all lengths from 0 meter to 4 meters are written to identify the most meaningful linkages. Linkage analysis is measured by the length and strength of connection (e.g. the greater the number of lines connecting anomalies the greater the connection).

The smallest distance between magnetic anomalies in the WBF is .6 meters apart and the largest is over 4 meters. These distances, on average, are significantly larger than the mean distance between posts in Prezzano's data. Similarly, Steere's (2017) collection of post structures for eastern Woodland and Mississippian period houses has an average post separation of .78 meters apart. The largest spacing he identified was 3.1 meters, although post spacing above 2 meters is exceedingly rare. It appears that post architecture with a super structure almost never reaches the distance between posts that is consistent with my data. With this in mind, I am suggesting that the OMA represents an alignment of posts, suggestive of a fence or possibly a woodhenge, rather than a post structure.

In the WBF, line lengths from 1 to 2 meters, 2 to 3 meters, and 3 to 4 meters was tested. Next, all lines between 1 and 4 meters were tested. Finally, an inferred line was constructed from the most common linkages (figures 7.21 through 7.25). The lengths from 0 centimeters to 1 meter was not tested because it only connected three pairs of two anomalies which was not suggestive enough of any patterning. Linkages between 1 and 2 meters immediately begin to outline the western edge of the OMA. Additionally, the cluster of anomalies in the southern portion of grid

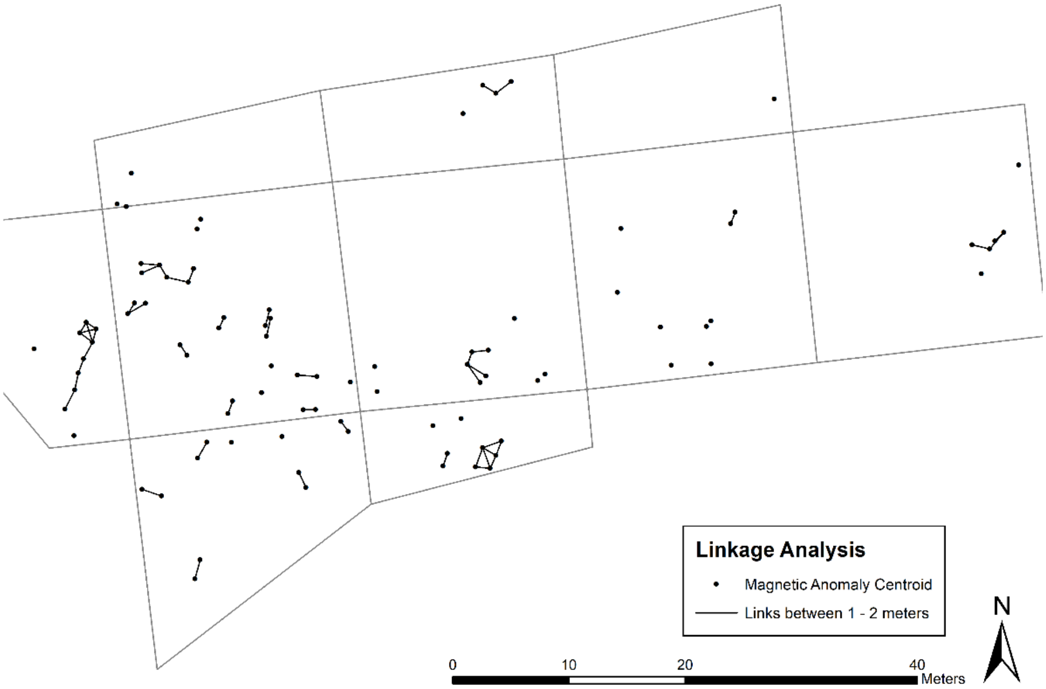


Figure 7.21: Linkage analysis of lengths between 1 and 2 meters.

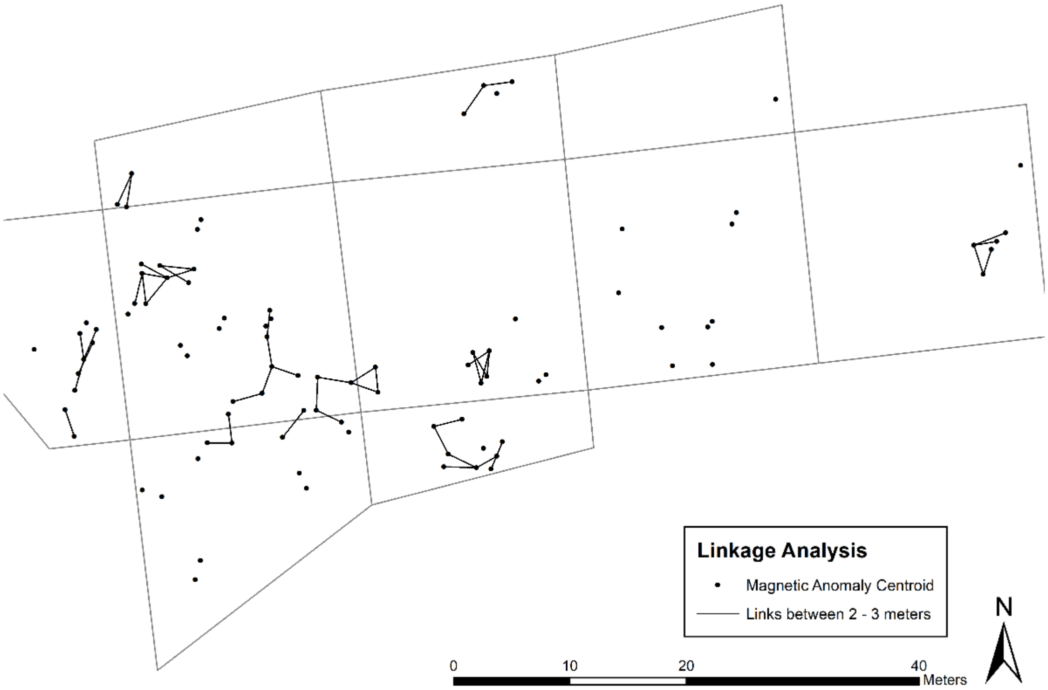


Figure 7.22: Linkage analysis of lengths between 2 and 3 meters.

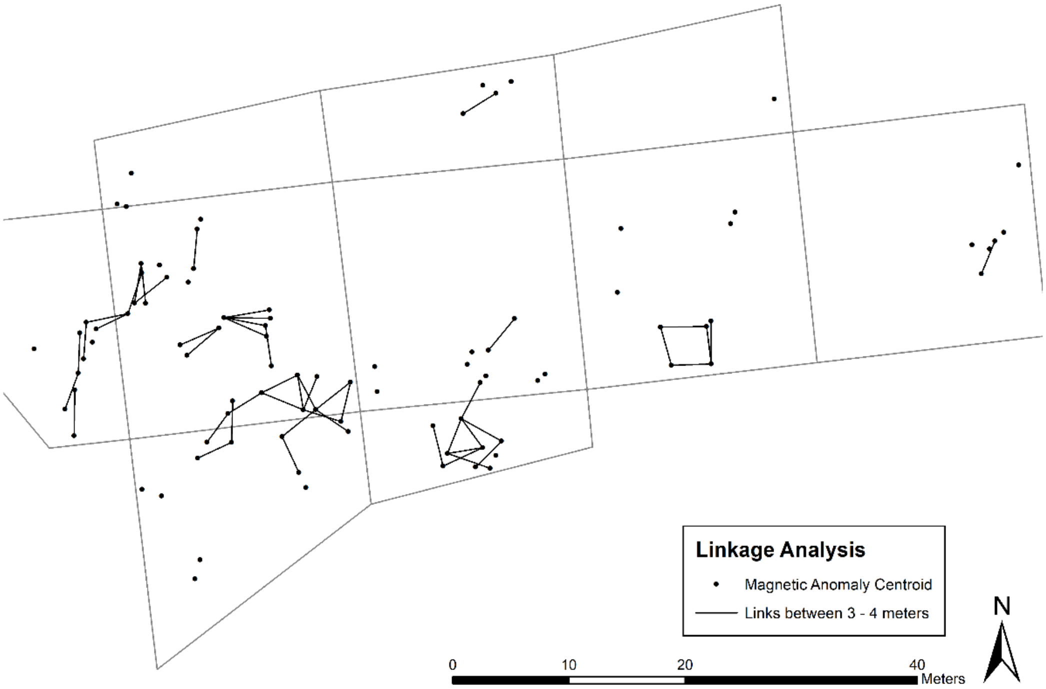


Figure 7.23: Linkage analysis of lengths between 3 and 4 meters.

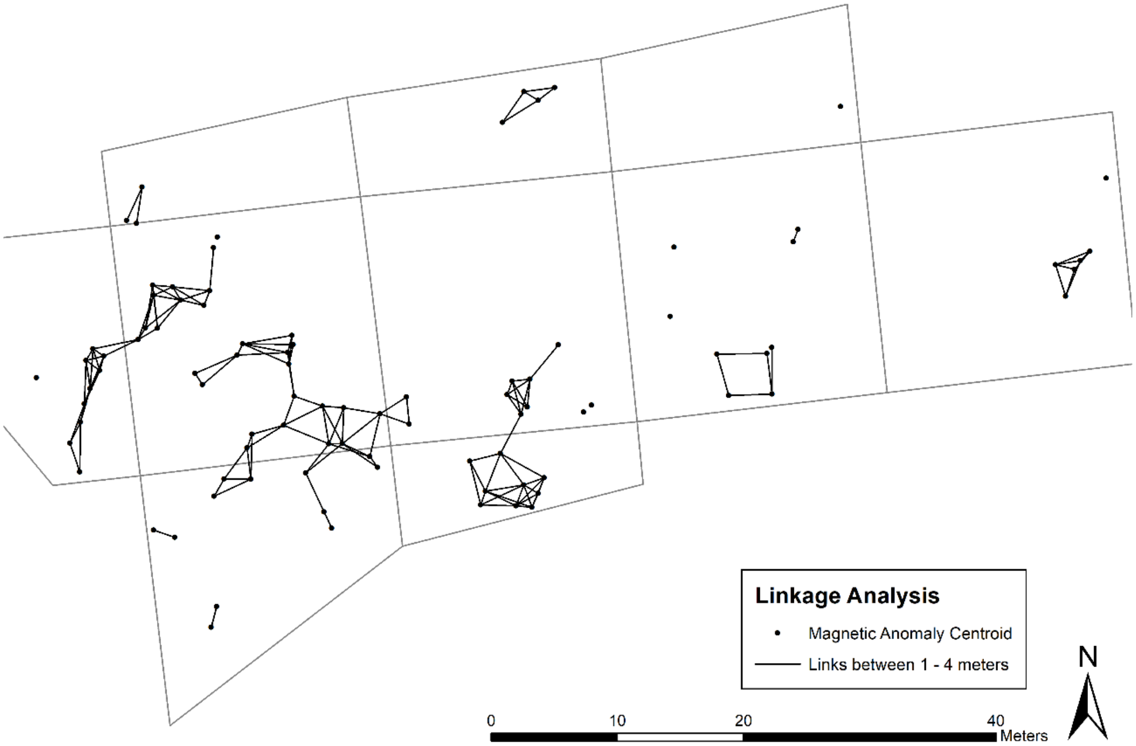


Figure 7.24: Linkage analysis of lengths between 1 and 4 meters.

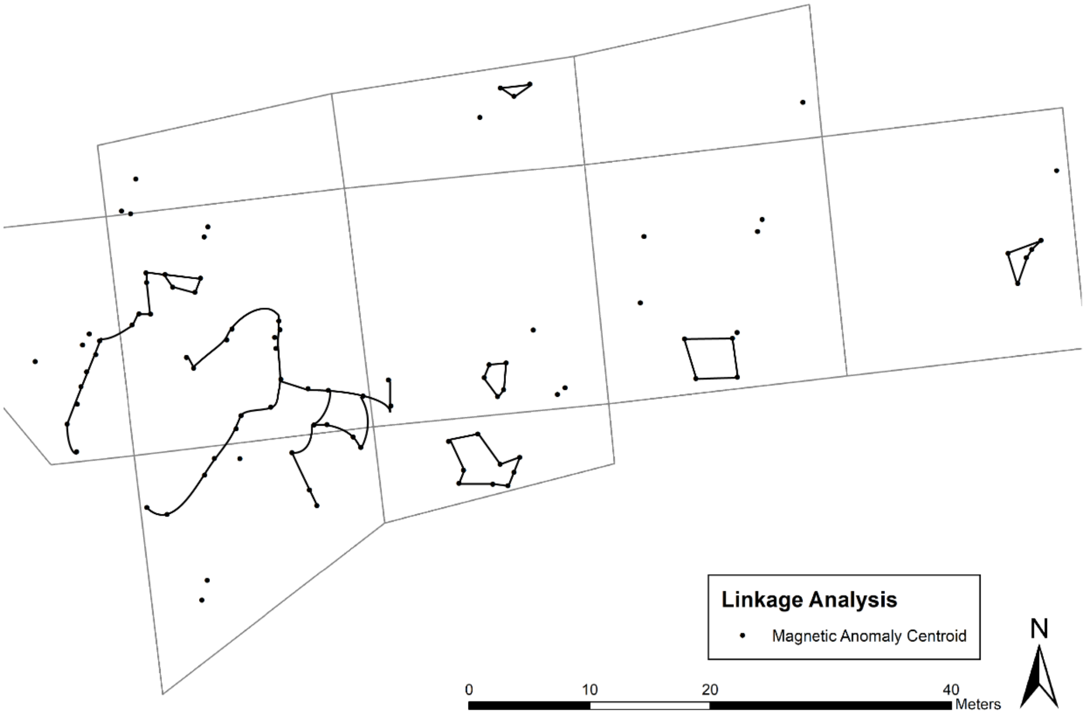


Figure 7.25: Inferred line linkages based on above lengths and strength of connection

2 and grid 10 are already linked. Between 2 and 3 meters the eastern extend of the hypothesized "oval" begins to be linked, as well as several suggested posts overlapping. At lengths between 3 and 4 the eastern cluster and the east extent become connected with overlapping lines. The clusters in grids 2 and 10 are connected by one link, and their relation to each other is clearer by the amount of links.

Finally, once lengths from 1 to 4 meters are placed at the same time, the above patterns are all reflected more strongly. The center of the "oval" has several overlapping links folding over from the eastern extent. At 4 meters the western extent becomes linked once with a more northern anomaly. Finally, an inferred line was drawn tracing out each cluster across the landscape of the west bait field. The linkage analysis of the west bait field meaningfully connects the magnetic anomalies and reinforces the notion that the "oval" has architectural logic in its patterning.

Based on the order of linkages and strength of connection (i.e. number of links), the distance between 1 and 2 meters are the most suggestive of a single architectural feature. The average distance of posts in Woodland or Mississippian structures is .78 meters, which suggests that this possible architectural anomaly is not a single structure (Steere 2017). It seems more likely that the OMA is an organized alignment of posts, possibly suggestive of a screen or henge of wooden posts with an architectural logic behind its construction. If this suggestion is to be accepted, then the SGSC would have the first evidence of this kind of architecture in Florida.

The EBF was also investigated with linkage analysis to test for anomaly patterning not identified by the naked eye nor kernel density. Based on the smaller number of anomalies and smaller overall land coverage, only two linkage lengths were investigated: 0 to 3 meters and 0 to 5 meters (figures 7.26 and 7.27). While 0 centimeters through 3 meters seems like a large variable range, the paucity of points and their distribution only started to reveal line connections in a meaningful way over 2 meters. At lengths between 0 and 3 meters, grids 2 and 3 had feature clustering, comprised of three interconnecting lines (weak). Between 0 and 5 meters, more connections are made, and the clusters above are more strongly connected. The several anomalies trace the outline of the "cloud." The more scattered and weaker connections is not suggestive of architectural use the same way the "oval" in the west bait field was. This reinforces the reality that the OMA that match up with circular magnetic anomalies in archaeological

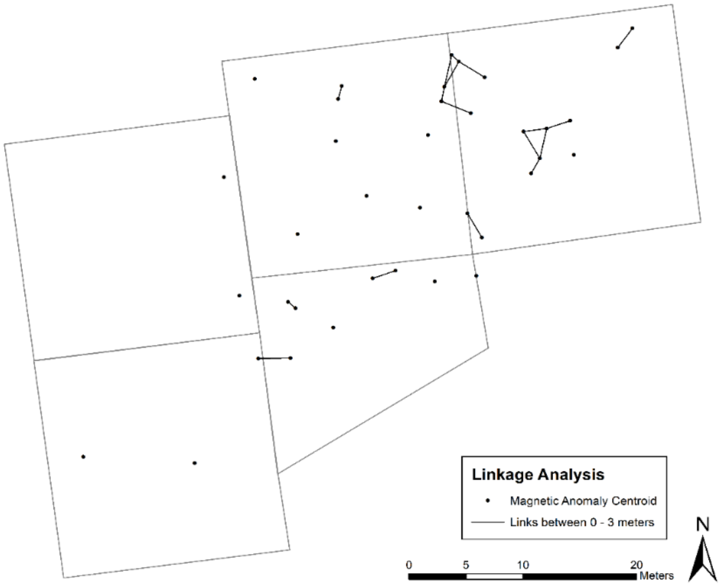


Figure 7.26: Linkage analysis of lengths between 0 and 3

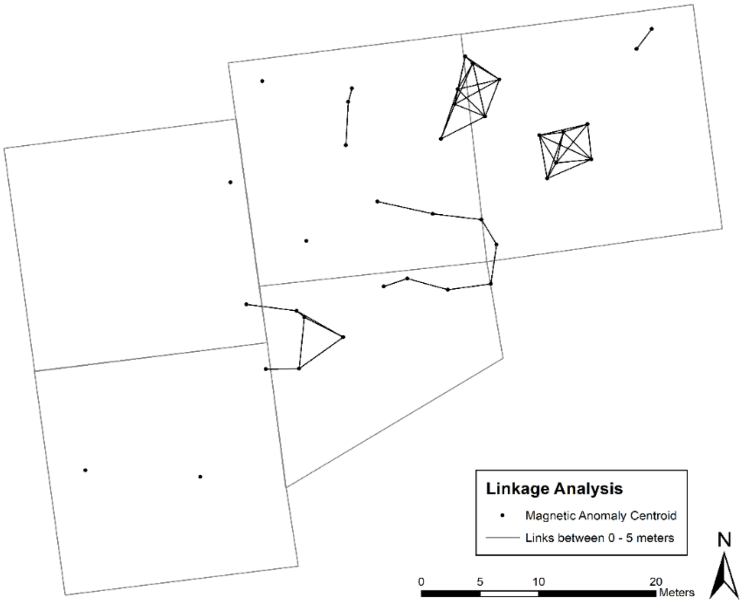


Figure 7.27: Linkage analysis of lengths between 0 and 5

investigations are part of an architectural feature in the west bait field.

Concluding Thoughts

Additional analysis of GPR and magnetic gradiometry using GIS, spatial statistics (including kernel density and linkage analysis), and selective ESP coring provides invaluable interpretative framework to identify meaningful variations in sub-surface features. For instance, the visual clustering of magnetic anomalies that make up the "oval" is made manifest through weighing of densities in relation to the whole survey area. Linkage analysis was invaluable in identifying the appropriate distances between possible post-features that suggest architectural logic. The OMA represents a potential non-shell above ground architecture, and its proximity to the Woodland Period occupational space in Locus C to the west of the survey area suggests they might be relatively contemporaneous. If this is to be accepted, the presence of this possible post built screen or woodhenge in Florida is association with mounded and village spaces is very exciting for further research into deeper architectural realities. This line of inquiry requires further archaeological investigation to corroborate it.

Additionally, the use of multiple geophysical methods is useful for extrapolating the most amount of variation in sub-surface anomalies. ESP coring of overlapping features revealed that while these machines record different inputs, their outputs are complimentary and capable of identifying sub-surface shell deposits in both sandy and organic soul matrices. Issues of landscape taphonomy might also be addressed with more ESP coring, to make meaningful connections between the contour elevation and the increasing absence of sub-surface anomalies.

The non-mounded spaces at the Silver Glen Complex are far from vacant. Indeed, the several thousands of years that this landscape has been occupied has allowed for the construction of many pit features and possible above ground architecture, all tied into this place of gathering between the mounds. The nature of geophysical equipment lacks a control over time, and the complex, often overlapping, archaeological features identified in GPR and gradiometry need to be investigated more fully to capture the whole range of varying practices that constructed the taskscape of the modern-day bait fields. In the concluding chapter to follow, I propose a typology of geophysical signatures with archaeological correlates and expand it across the bait fields. This predictive typology is designed to direct future research into how ancient Floridians created the space between monumental spaces, as well as identify modern taphonomic activities that produced these cleared spaces as we see them now.

Chapter 8

Discussion and Conclusion

The bait fields are part of the architectural canon of the SGSC. Their sub-surface architecture is defined by pit creation, broadly typed by period. I have identified areas of more intensive and less intensive terraforming based on the articulation of sub-surface anomalies with each other and the landscape more broadly. These patterns are defined by characteristic GPR profiles which have archaeological correlates, such as v-shaped stacked parabolas and Type 2 deep basin pits. These inferred pits are clustered near the Loci, suggesting an extension of the previously identified areas into the bait fields. Taking the characteristic profiles of these pits into consideration I have created a predictive typology to direct further research at this site.

Discussion

The distribution of anomalies at the east and west bait fields suggest that there are architectural remains present at the Silver Glen complex, and the orientation of geophysical results suggest that the regime of shell removal was not limited to mounded shell loci but was carved out a larger portion of the landscape, creating the modern bait fields. A kernel density and linkage analysis of the west bait field provides statistical significance to suggest the OMA represent architecture. In the WBF, TU 109 and TU 111 identified the presence of post-like features that corresponded with the magnetic anomalies. Additionally, the type 2 deep basin pits excavated in these test units have characteristic GPR profiles. In TU 107 and TU 110 in the EBF, Type 6 and Type 1 pits were identified in each unit respectively. These pit types also have characteristic GPR profiles.

Each instrument appears to have identified a type of archaeological feature: posts in the magnetic data, and pit features in the GPR data. Neither of the instruments were able to identify both types of feature at the same time, showing the necessity of multiple devices in a survey of all possible sub-surface variation. ESP cores and test units suggest that these devices have reliable accuracy at identifying sub-surface shell. The characteristic profiles with archaeological correlates can be extrapolated across the rest of the survey area. With this in mind, a simple typology of features based on anomalous profiles can be created as a predictive model of what might be expected across the landscape of the bait fields. Finally, looking at all anomalies from a landscape perspective, rather than dividing them between bait fields and depths, the taphonomic history of the site becomes clearer.

Predictive typology

GPR data has distinct time-slice depth readings that can be explicitly studied. Since magnetic gradiometer data lacks this necessary function, the predictive typology will lean more heavily on characteristic GPR anomalies. The magnetic anomaly in TU 107 in the EBF represented a Type 6 shell accumulation, but the results of TU 109 and TU 111 connected the magnetic anomalies with post features. This uncertainty is less helpful for the typology than the more consistent parabolas of the GPR data. Therefore, the predictive typology is based primarily on characteristic time-slice profiles of archaeological profiles. Each bait field is analyzed

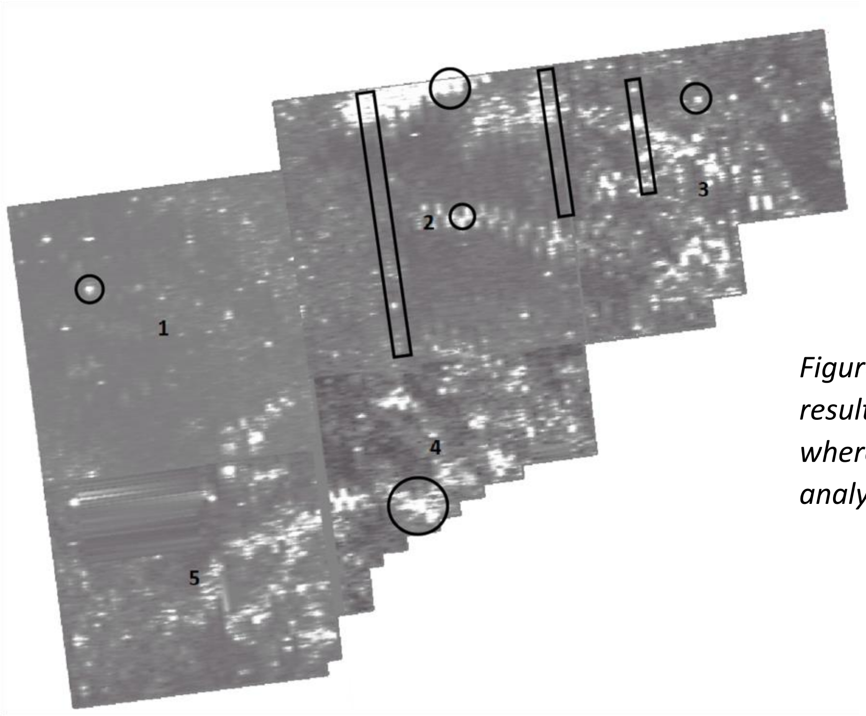


Figure 8.1: Areas of GPR results at 95 cmbs where profiles were analyzed

separately, although group patterns persist across both survey areas. GPR anomalies in plan-view are most well defined at 95 cmbs at the EBF and well represented at 66 cmbs in the WBF.

East Bait Field

In the EBF, eight anomalous areas were selected to view their profiles to identify known archaeological signatures (figure 8.1). These areas were selected because they well represent the variation of patterns at this survey area. One area was selected in grid 1, four in grid 2, two in grid 3, and 1 in grid 4. Five of these areas are discrete events, represented as circles, and three areas are parts of GPR lines. Profiles were conducted south to north in odd lines, and north to south in even lines. For this investigation, the start and end of the profiles are indicated in order

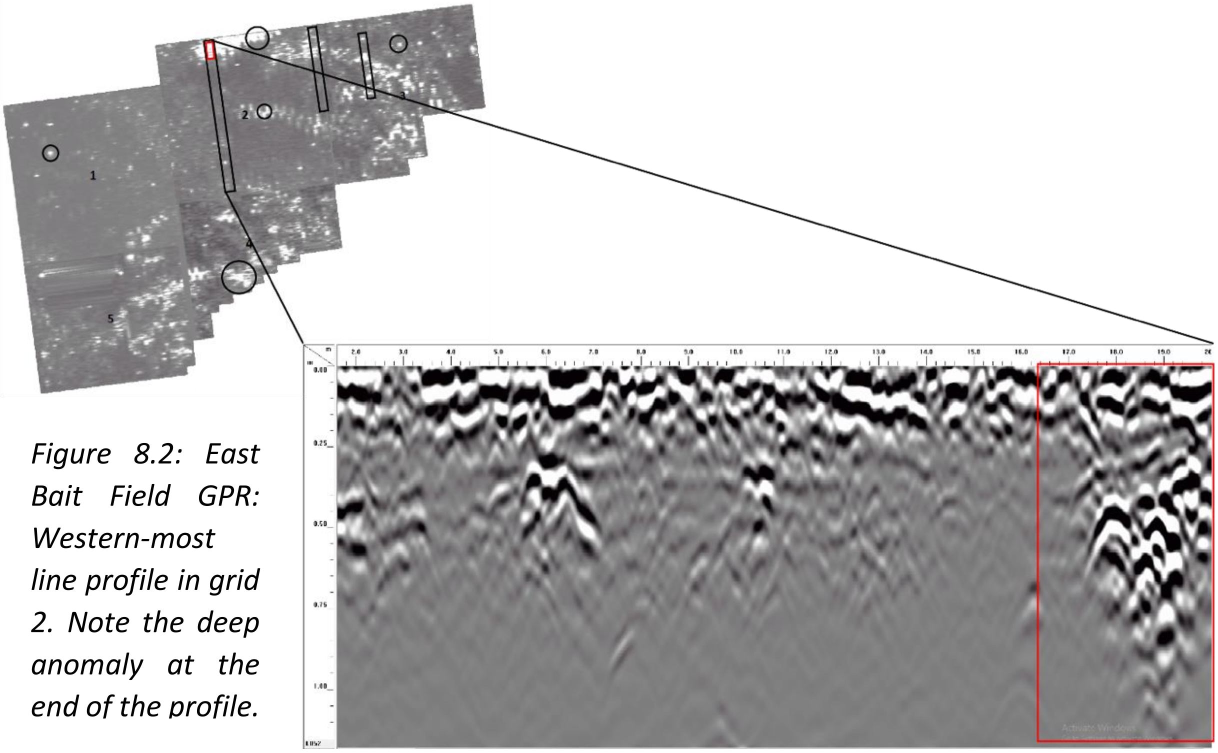


Figure 8.2: East Bait Field GPR: Western-most line profile in grid 2. Note the deep anomaly at the end of the profile.

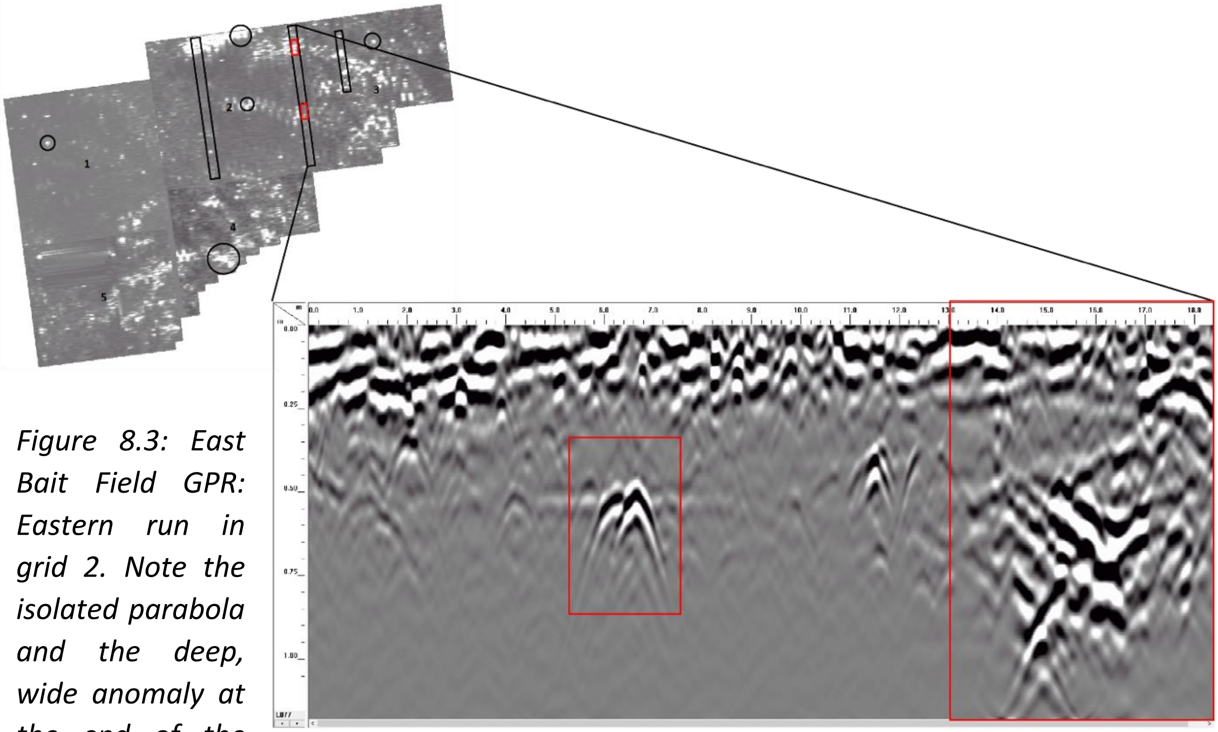


Figure 8.3: East Bait Field GPR: Eastern run in grid 2. Note the isolated parabola and the deep, wide anomaly at the end of the line.

to situate the results. These lines were selected because they represented more than one profiles of anomaly type, and the discrete circular areas were selected because they show the clearest characteristic anomaly in the whole length of the line. Longer profiles are analyzed first, followed by the characteristic feature profiles.

Moving west to east along the survey area, the first line in grid 2 has what appears to be a type 2 deep basin pit (figure 8.2). The first 25 centimeters of the profile represents the plow-zone. Just below this band of disturbance are small non-descript parabolas. They are not easily identifiable. At 16 meters into the 20-meter line, a large pit becomes apparent. It extends from about 30 cmbs to over a meter. It has a similar v-shaped profile as deep basin pit feature 230 in TU 111. The eastern line in grid 2 has two characteristic profiles (figure 8.3). Between 6 and 7 meters north there are two parabolas in close proximity. This appears to represent one anomaly, as the area is part of the “zipper” caused by issues with data collection. The end of the line appears to have a deep-basin pit profile. it is not the familiar v-shaped basin as seen previously, but it wider and deeper. Regardless of morphological differences, the stacked parabolas appear to represent a deep pit feature. Finally, the profile of the line in grid 3 is characterized by discrete, isolated parabolas (figure 8.4). Based on their similar morphology as the type 6 pit in TU 107, it can be extrapolated that these are representative of shallow shell accumulations. They are fairly shallow, only apparent around 50 cmbs, once again similar to the depth of feature 221 in TU 107. Based on the results of the profiles analyzed, it appears that the overall linear arrangement of anomalies represents archaeological features.

Other areas are targeted based on the strength of their representation in the plan-view. Two areas in grid 2 are targeted at identifying the end of the amorphous anomaly in the north of

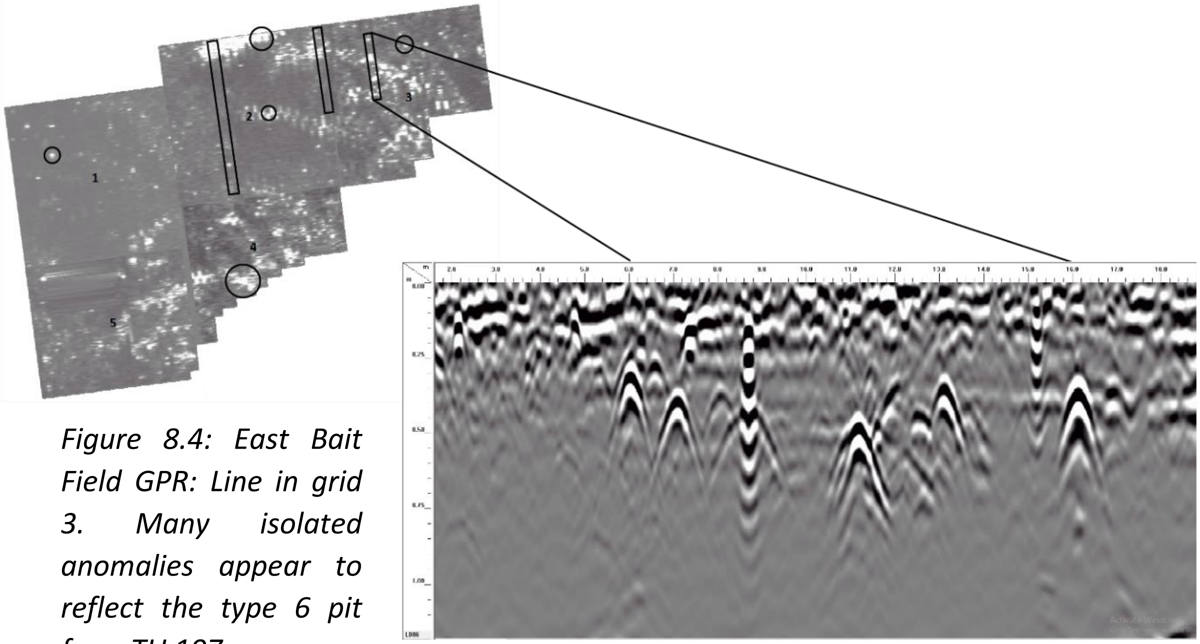


Figure 8.4: East Bait Field GPR: Line in grid 3. Many isolated anomalies appear to reflect the type 6 pit from TU 107.

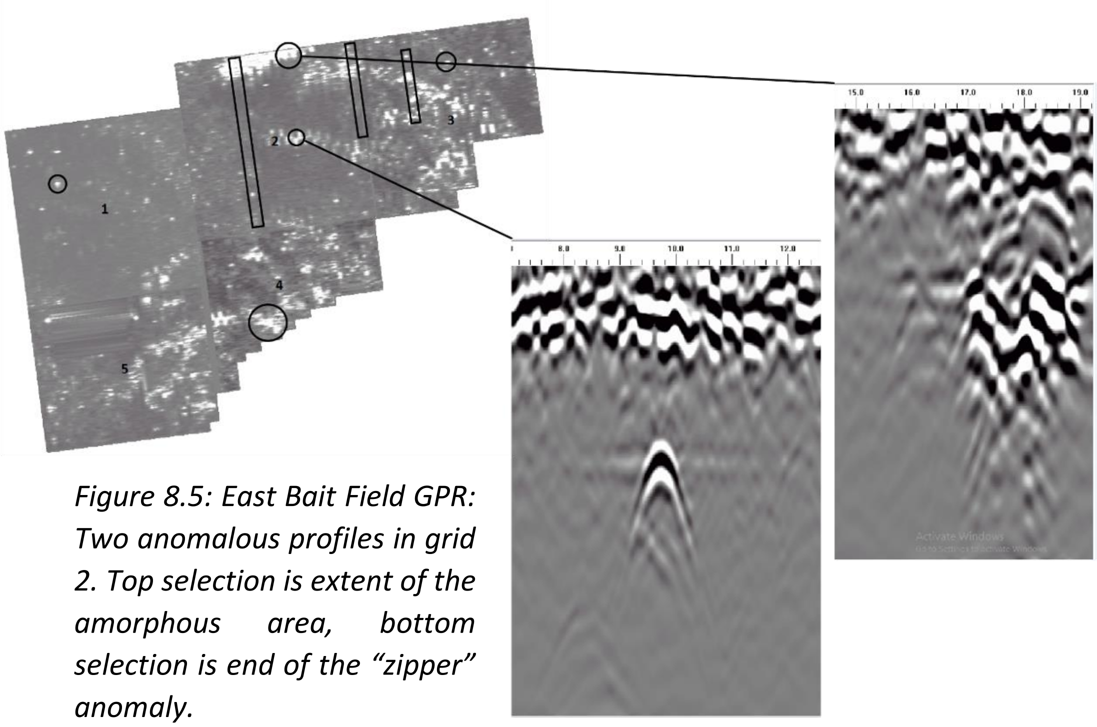


Figure 8.5: East Bait Field GPR: Two anomalous profiles in grid 2. Top selection is extent of the amorphous area, bottom selection is end of the "zipper" anomaly.

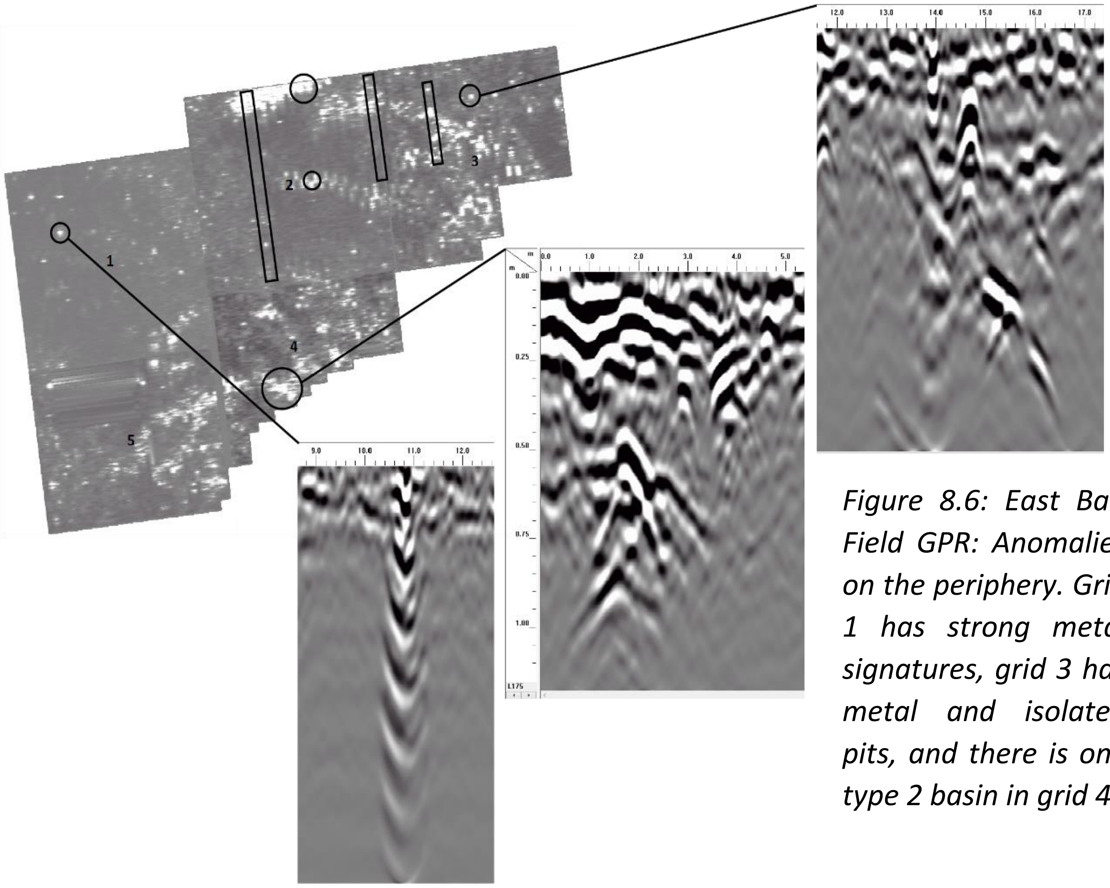


Figure 8.6: East Bait Field GPR: Anomalies on the periphery. Grid 1 has strong metal signatures, grid 3 has metal and isolated pits, and there is one type 2 basin in grid 4.

the grid, and further understanding the “zippered” linear anomaly (figure 8.5). These anomaly snap-shots are from two different lines, which is why they are not being studied as one continuous profile. The first profile is a portion of the end of the of the amorphous area in the north of grid 2, and the second profile is a representation of the end of the “zipper” anomaly. It appears that amorphous anomaly is in reality, one large basin pit feature based on this profile. The linear anomaly is one distinct feature that persists across both grids 2 and 3. The linear anomaly cannot be classified archaeologically so far. Other anomalies on the periphery of grids 2 and 3, include metal, small pits, and a large pit (figure 8.6). Grid 1 is characterized by a large number of metal and a paucity of other anomalies. The northeastern extent of grid 3 also

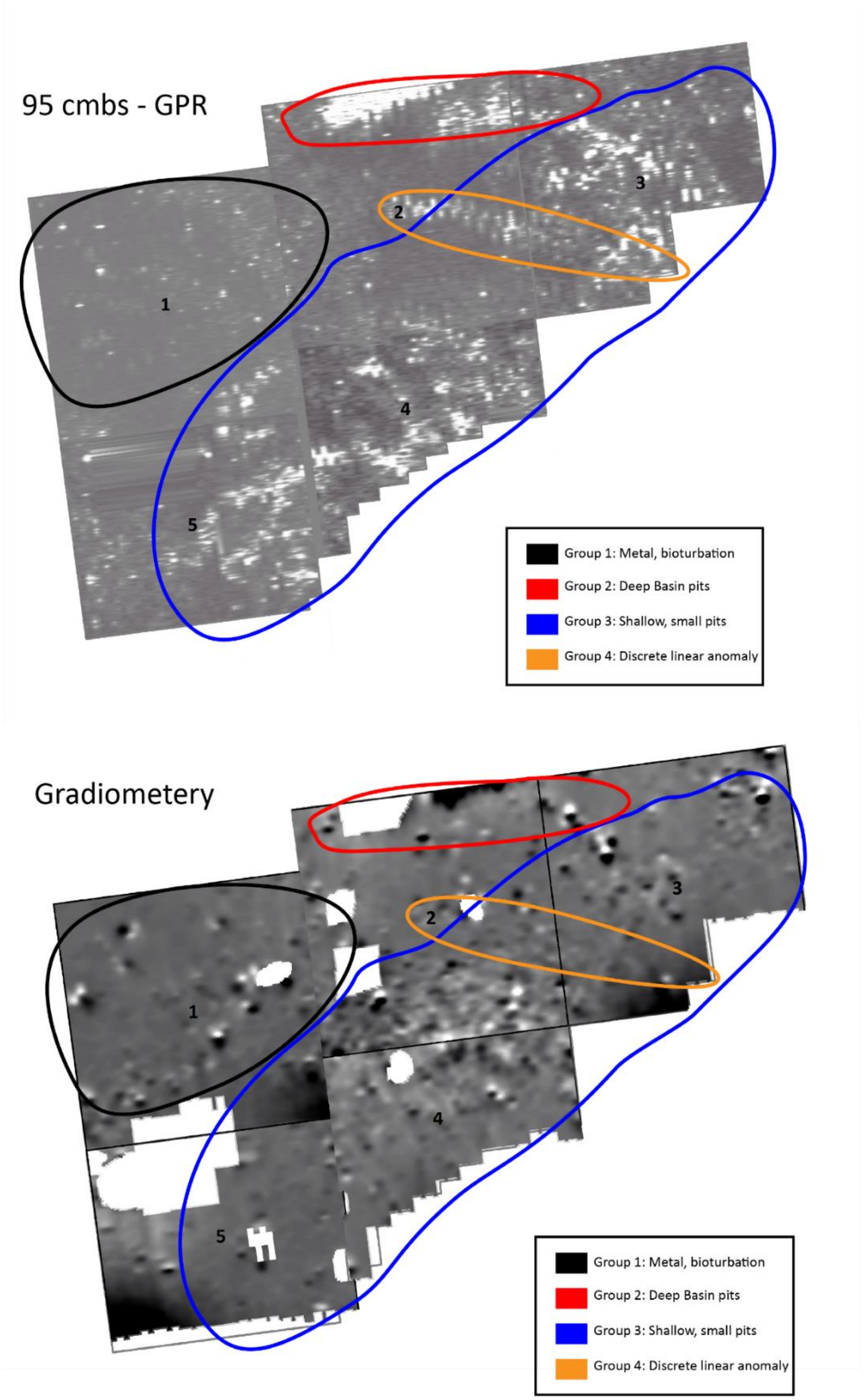


Figure 8.7: East Bait Field Groups as determined by characteristic anomalies (top). The four groups overlaid on the magnetic gradiometry data (bottom).

contains metal, as well as presumably more type 6 features. Finally, the area below the road in the southern extent of grid 4 appears to be a deeper pit, perhaps Type 2. This deep pit is an exception, not the rule, for grid 4.

Based on these extrapolations, the EBF has been divided into four groups of expected archaeological features (figure 8.7). Group 1 is modern debris and bioturbation, group 2 is comprised of deep basin pits, group 3 is shallow pits, and group 4 covers the anomalous "zippered" linear feature. Group 1 covers most of grid 1, group 2 covers the northern portion of grids 2 and 3. Group 3 encompasses the most amount of land in the EBF, coving grids 2, 3, 4, and 5. Group 4 is within group 3, bounding the linear "zippered" anomaly. The groups are based on the GPR results, and when overlaid on the gradiometer data only group 1 is consistent. The deep basin pits in the north of grid 2 are the closest to Locus A.

West Bait Field

Fourteen anomalous areas were selected in the WBF in order to determine where archaeological features are most likely to be encountered (figure 8.8). The depth selected for the plan-view is 66 cmbs because it has the best range of variation with best resolution between anomalies. Areas where features are known (i.e. active gopher tortoise burrows) are not considered for this analysis. Two lines are analyzed due to their overlap with the OMA. Long sinuous anomalies in the east and southwest of the survey areas were analyzed to understand what they might represent archaeologically. Special interest was paid to the areas in grids 4 and 10 near Locus B to better understand the potential connections between the bait field and the

Loci. Other amorphous anomalies were targeted to understand if their profiles might reflect a known archaeological signature.

The most significant observation of the profiles was the number of Type 2 deep basin pit-like profiles across the southern and western portion of the survey area. At least 10 characteristic Type 2 profiles have been identified in grids 1, 4, 5, 6, and 10 (figure 8.9). In grid 5, a 17-meter-long south to north line has at least three deep basin type 2 pits with clear v-shaped morphology. The area nearest to Locus B (grids 4 and 10) have at least four areas with characteristic deep basin pit profiles. Additionally, the northern edge of grid 6 appears to have a similar feature. This is the only area outside of the southern and western portion of the survey grids to have this kind of profile signature. The pit in grid 6 however, does not have the same kind of v-shaped base, perhaps suggestive of a Type 1 shallow basin pit. The most compelling evidence of a bait field

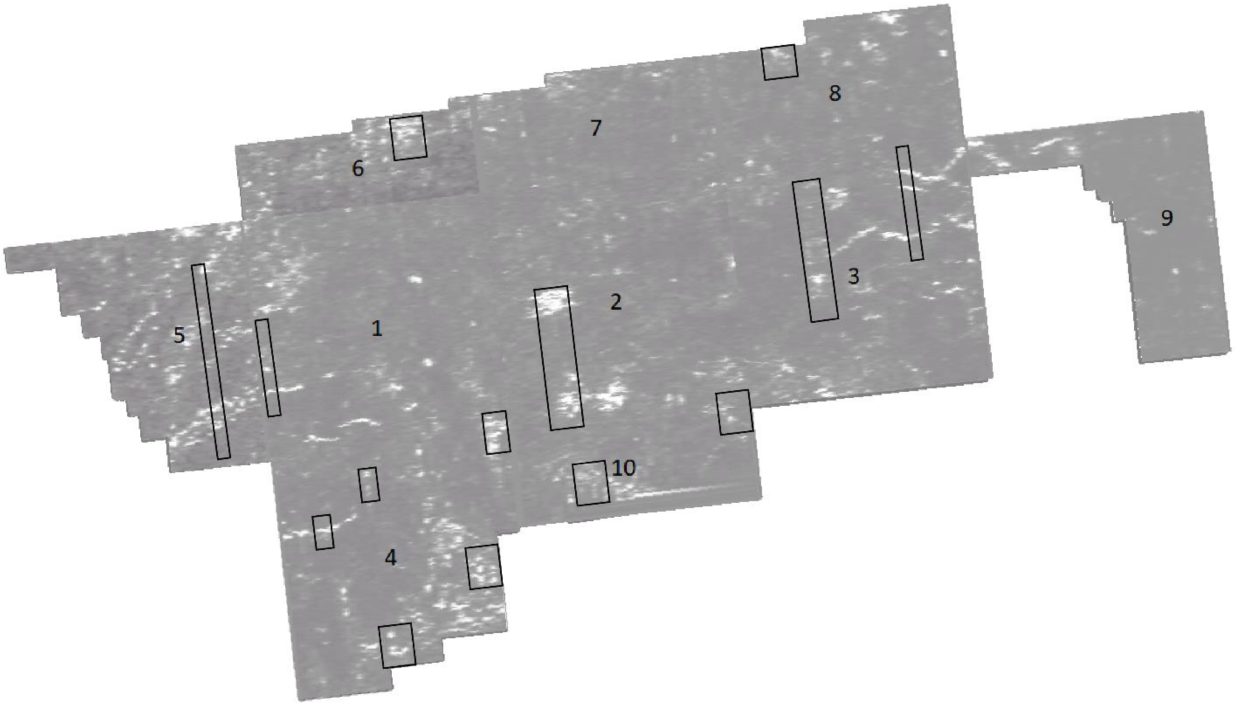


Figure 8.8 Areas targeted for this investigation in the WBF

connection with the previously identified loci is the quantity of apparent deep pit-like anomalies near Locus B and those anomalies in association with the magnetic “oval” in grid 5 also near Locus C.

The sinuous linear anomalies in this survey area were the cause of great confusion. Initially suggested to be part of a circular arrangement by Gilmore (2016), it appears that in this investigation they are most likely tree roots. This is due to their plan-view appearance, as well as their characteristic narrow and discrete parabolas as defined by Guo and colleagues (2013) (figure 8.10). In the eastern portion of grid 3 these anomalies are presented as individual parabolas, often with what appears to be differential soil formation, perhaps indicative of faster drying soils as the water is being absorbed by tree roots. In the western portion of grids 1 and 4, the parabolas are less clearly defined, perhaps owing to the grade of the hill or difference in surface cover altering the results. Regardless, there appear to be consistent isolated, thin parabolas. The breakup of grid 9 is also due to a large collection of trees that were so dense as to not let the devices pass unobstructed. The presence of such dense vegetation also supports the argument that these anomalies are roots

Previous work by Gilmore excavated a block of five test units in order to test the presence of sub-surface shell in one of the rings he identified through GPR data collection. These test units do not have a clear profile but are characterized by sharp breaks in the parabolas (figure 8.11). The clearest representation of these back filled test units in the GPR profiles is the 2-meter long soil layer disruption with clear edges. This results the difficulty in identifying discrete sub-surface features and lends support to the veracity of those profiles that have archaeological correlates.

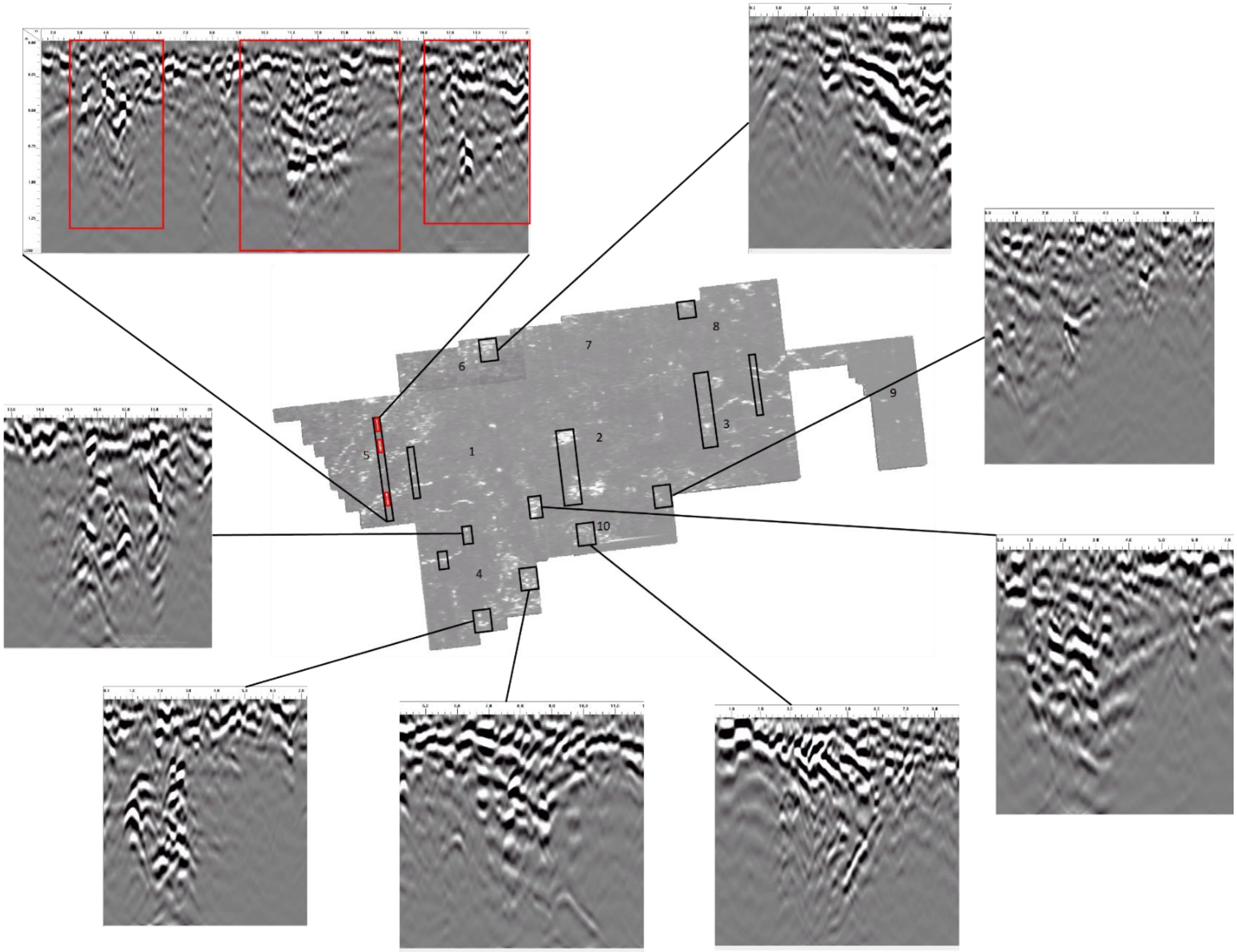


Figure 8.9: West Bait Field GPR: Type 1 shallow basin and 2 deep basin pit profiles from across the WBF

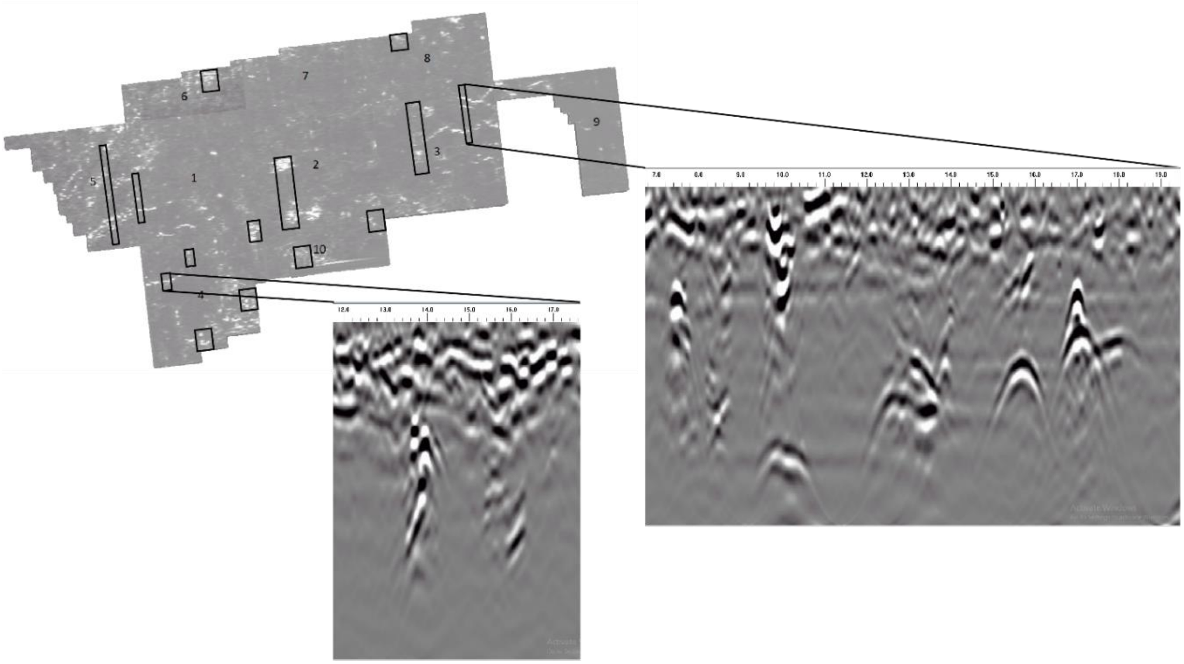


Figure 8.10: West Bait Field GPR: Sinuous linear anomalies. Their presence near vegetation further suggests that they are tree roots.

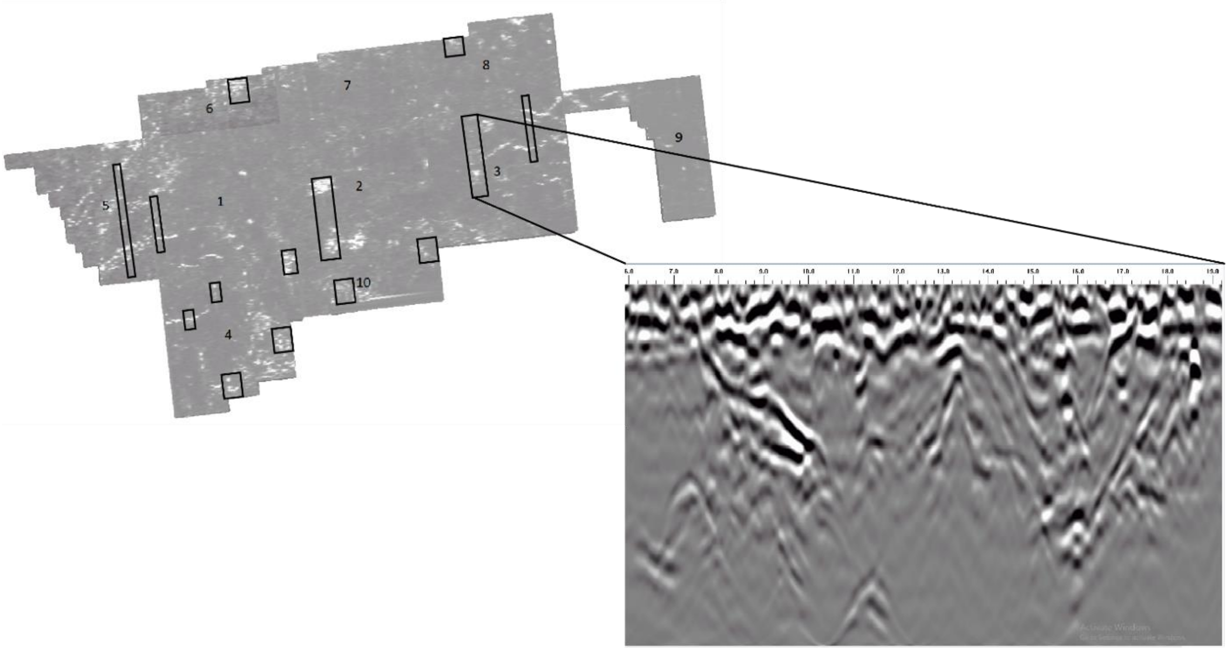


Figure 8.11: West Bait Field GPR: Back-filled test units in profile. Note the 2-meter long soil disruption.

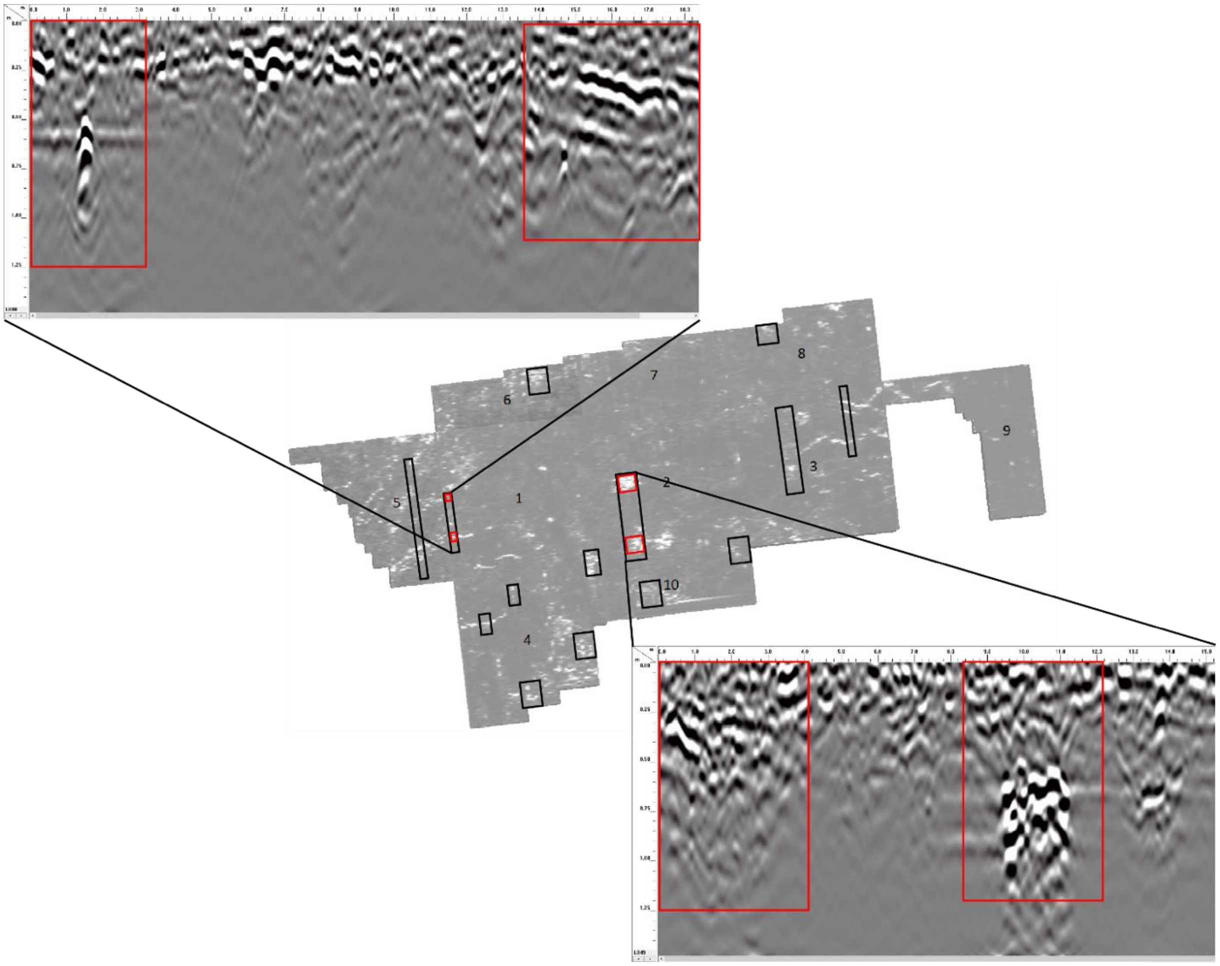


Figure 8.12: West Bait Field GPR: Other anomalous features including relic gopher tortoise burrow (bottom) and possible pits (top)

Finally, there are two areas with more than one anomalous profile in one line (figure 8.12). The first one is in grid 1, on the edge of a potential tree root anomaly and extending north intercepting with a larger amorphous anomaly. In the profile, the characteristic thin isolated parabola of the roots is evident, as well as what might be a pit feature based on its stacked parabolas. It does not have the clear v-shaped base that all other Type 2 basins express. Perhaps it's a different type of pit, but that is unknown. The second line covers what was identified by Gilmore (2016) and in the previous chapter as a relict gopher tortoise burrow. The tightly stacked parabolas might be suggestive of a collapsed burrow chamber. More definitive however, is the v-shaped morphology of a pit feature south of the relict burrow. This potential pit is close to other Type 2 deep basin pits in grid 4 as well as near Locus B.

Taking all of these anomalies into consideration, a similar type of grouping system from the EBF can be made for the WBF (figure 8.13). Like the EBF, four groups of proposed archaeological features are drawn. Group 1 is bioturbation (e.g. gopher tortoise burrows) and modern disturbances (ferrous linear anomaly), group 2 is deep basin Type 2 pits, group 3 is possible shallow basin pits, and group 4 is likely vegetation roots.

Finally, the OMA is drawn on top of these areas in order to situate all the range of variation in the survey grid. Unlike the EBF, this area has many Type 2 deep basin pits and a small number of shallow basin pits. Indeed, the purported shallow basin put in grid 6 might be a Type 2 deep basin pit, but since the grid is partial, this is hard to definitively say. The large amount of area taken up by group 1 accounts for the bioturbation and ferrous linear anomaly identified previously, as well as a paucity of other archaeologically correspondent profiles. Group 3 deep basin pits are separated by group 4 roots, more closely relating each area with a locus rather than with each other. Finally, overlaying these groups on the magnetic data highlights the division between the two areas of group 2, but the amount of data that had to be masked makes it hard to identify pit features from the GPR (figure 8.14).

Based on characteristic profiles for geophysical anomalies all potential archaeologically significant features across both bait fields have been separated into four groups. These groups

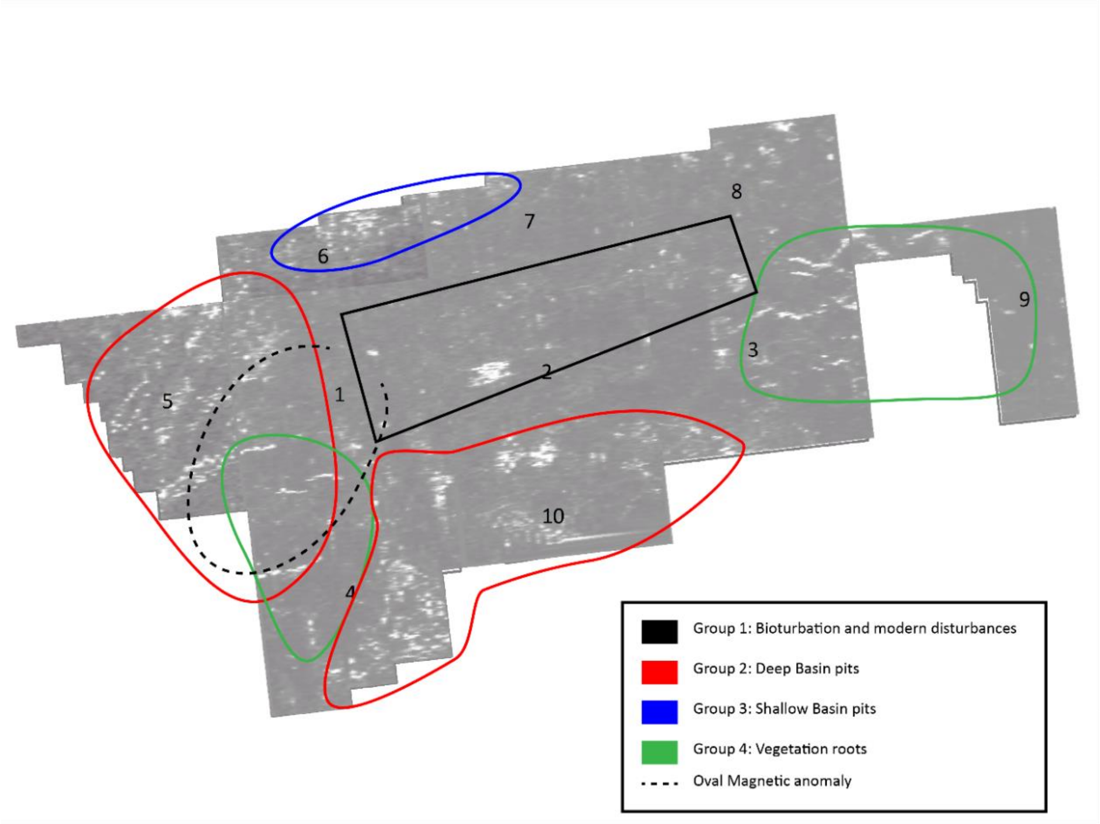


Figure 8.13: The four groups in the West Bait Field drawn up by the characteristic profiles with archaeological correlates.

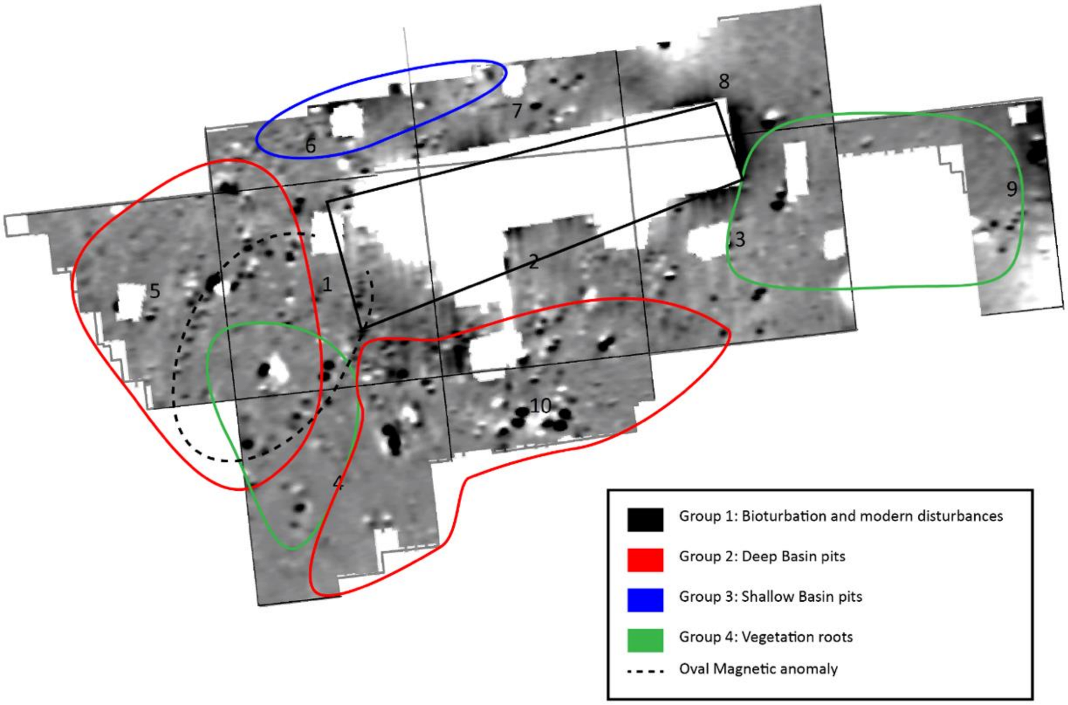


Figure 8.14: Groups in the West Bait Field overlaid on the magnetic gradiometry data.

are (1) modern development and bioturbation, (2) deep basined pits, (3) shallow basined pits, and (4) discrete linear anomalies. Group 1 is characterized not by the presence of metal on the surface, as there is metal in most of the survey grid, but by the absence of other anomalous signatures. Group 2 is characterized by v-shaped stacks of parabolas that extend below 50 cmbs. The characteristic profile for this group comes from Feature 230, the Type 2 pit in TU 111. Group 3 is characterized by isolated parabolas, similar to those seen to represent the type 6 pit in test unit 107. Group 4 is defined by the presence of discrete parabolas that present in the plan view as one (or more) linear anomalies. These four groups of characteristic anomalous profiles are present in both bait fields. As such, this predictive typology spans the entire variation of sub-surface GPR anomalies.

Landscape taphonomy

The total breadth of geophysical anomalies across both bait fields all comes to the broader landscape question about taphonomy. All the anomalous features appear to be situated along the 5-meter contour line. Areas of lower elevation have fewer (or in the case of the EBF, no) anomalies. The presence of the intact pit feature in TU 105 immediately to the west of the EBF survey grid (see figure 6.2 and 6.3) suggests that the landform elevation might have been higher in antiquity. This area was at one point more uniformly level, and modern shell mining and disc plowing further changed this landscape from its initial terraforming. The bait fields are bounded on the east by the Mount Taylor mound at Locus A, separated in the middle by the mound and Orange period Type 2 pits at Locus B, and ended in the west by the St. Johns village at Locus C. Due to the 5-meter contour interval proceeding from the edge of Locus A and tracing

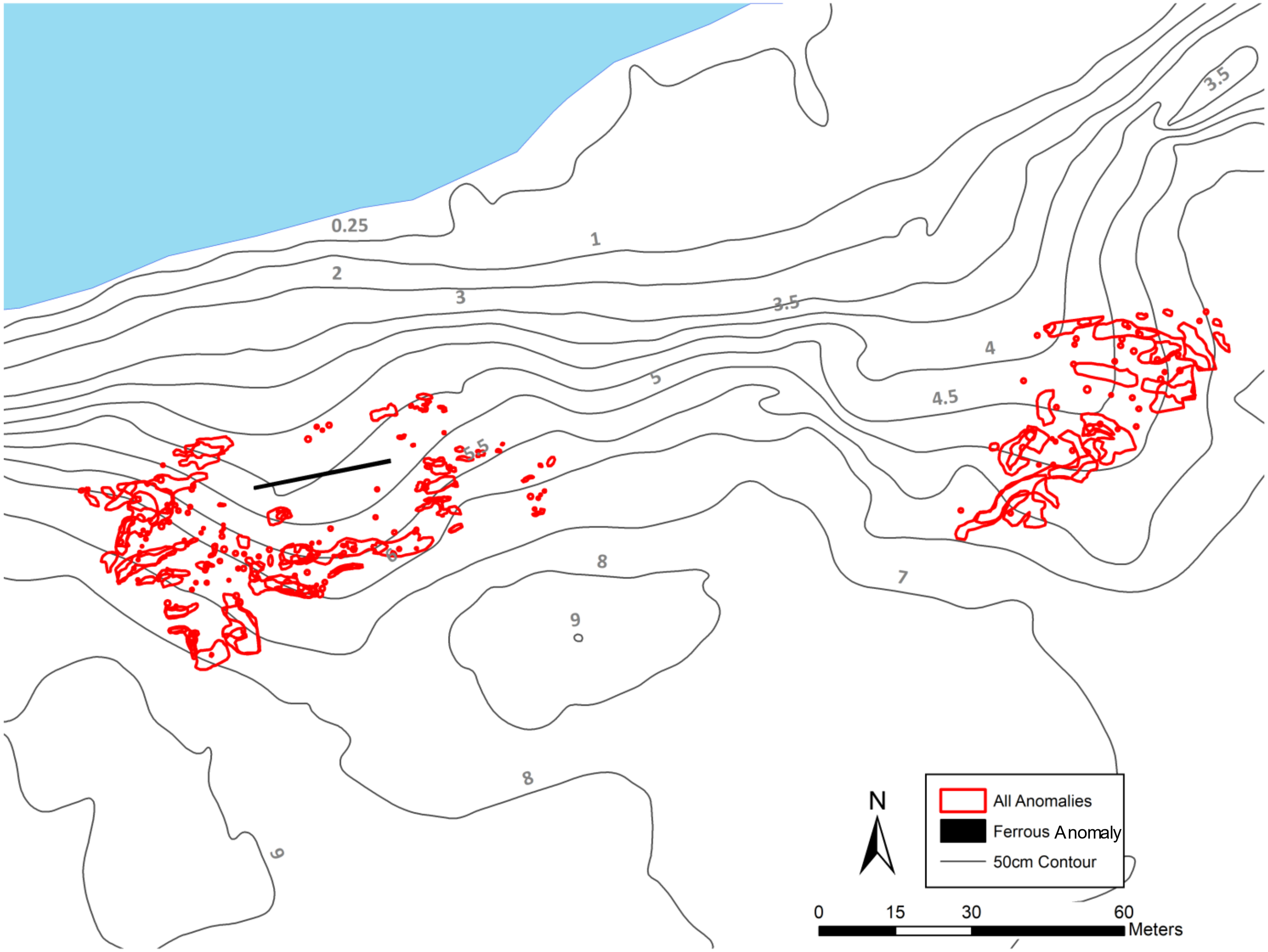


Figure 8.15: All anomalies taken holistically across both bait fields. The orientation of these anomalies with the 5-meter contour interval suggest theta portion of the landscape beyond the mounds was also mined.

the center of both bait fields, I suggest that these bait fields were meaningfully connected to all three loci, forming one continuous shell feature (figure 8.15).

When all the anomalous readings are taken together, the true articulation of sub-surface variation and modern terraforming becomes clear. The areas of lowest elevation are almost entirely devoid of anomalies. Additionally, the lowest portion of the WBF also has a linear ferrous anomaly, most likely suggestive of a metal drainage pipe or culvert. It appears that the arrangement of the anomalies was "carved" out around the 5-meter contour interval. Since the area was clear-cut in the 1920s for shell removal all the way from Locus A to Locus C, it is not a beyond reasoning to suggest that this area was also mined out for shell in the same way that the mounded spaces were. This potential destroyed much of the occupational history of the spaces between mounds.

Conclusion

Remote sensing at site 8LA1-West in the Silver Glen Complex identified architectural remains and insights into the taphonomic history of the site. An oval of magnetic anomalies is statistically significantly related to each other, possibly representing some division between public and private spaces, like the notional division of space by the !Kung. Such space division can be understood as communal meeting places that either existed at a structure (i.e. Calusa meeting house written about by Spanish colonizers), or an ideational construction separated via a screen representing a "notional" space physically (e.g. Whitelaw 1994: 225). Regardless of theoretical use, this area represents the best evidence for non-shell construction at the SGSC and beyond. Indeed, its proximity to Locus C and the presence of St. Johns plain sherds within post features suggests that it represents a Woodland period structure. The presence of this decipherable non-shell structure in a non-mounded space in Florida from this period, much less a large public structure, makes the Silver Glen Complex a significant archaeological resource. Further excavation targeted at the magnetic gradiometry results in the west bait field can help address issues of social organization and community representation in the ancient past.

Overall, I identified a number of overlapping traditions of landscape terraforming that are co-mingled in the non-mounded spaces of the SGSC. The OMA is an example of a possible communal structure not constructed of above ground shell. Additionally, the pit features encountered across the landscape highlight different kinds of spatial organization through time. These regimes of spatial organization still need to be thoroughly investigated in order to extract the nuance within. This being said, the clear circularity of anomalies at the bait fields argued by Gilmore (2016) is not represented in this survey. My suggestion that the landscape was more completely terraformed by modern shell removal might explain this discrepancy.

Ultimately, I identified areas of more intensive and less intensive landscape terraforming use through time. These areas are defined by geophysical anomalies with archaeological correlates such as shell-bearing pits. Sub-surface pit architecture is broadly defined by period-specific morphologies, such as Orange Period Type 2 deep basin pits. These pits have characteristic parabolas in the GPR results with which I identified areas where they are likely to be present. These areas are close to Locus B, a known Orange period occupational space (Sassaman et al. 2011). Indeed, pit types I identified through characteristic GPR profiles appear to extend from the previously identified loci. I argue that the architectural traditions associated with each Locus is more extensive than currently thought. They might, in fact, be connected in one massive shell-field before the shell mining of the 1920s.

The geophysical anomalies are associated with the 5-meter contour interval, tracing the contour lines closely around the area of lowest elevation at both bait fields. This suggests that shell-removal practices targeted this area as well as the previously identified mounded spaces. This is supported by the 1941 aerial photographs showing the entire span from Locus A to C clear cut. Clear cutting was done to facilitate shell removal in the 1920s. Based on the orientation of the geophysical anomalies "carved" out around the 5-meter contour interval, it is the suggestion of this author that this entire area contained shell. This is not to say that this area was mounded in the same way that the Mount Taylor period ridge at Locus A and the Orange period U-shaped shell ring at the mouth of the spring line were, but rather is representative of a larger shell field connecting the three loci together.

A multi-instrument geophysical investigation at the Silver Glen Complex bait field proved the efficacy of multiple devices at identifying sub-surface shell features within well-drained, fine sand matrices. While the data from the electrical resistance meter was rendered unusable due to the fast-draining surficial soils, the GPR and magnetic gradiometry proved invaluable. Both devices identified a different kind of anomaly; discrete circular anomalies that at least in the WBF were representative of post features, were characteristic of the gradiometry data, and long linear and amorphous anomalies with distinct profiles were characteristic of the GPR data. With these devices a predictive typology of characteristic profiles can be interpreted. This identified four distinct groups of anomalies that represent archaeological deposits. These are deep pits, shallow pits, modern and bioturbation disturbances, and unknown linear formations possibly representative of roots. This typology aims to be able to accurately direct future investigations in the bait fields of site 8LA1.

This landscape has imbued with social memory though extensive terraforming regimes which constructed monumental shell mounds for over 7000 years. From the Mount Taylor period shell ridges, to the Orange period shell ring, and finally the Woodland period public architecture, this gathering space held significance for ancient Floridians for over 200 generations. This is a landscape characterized by the practices that shaped it. The taskscape of monumental construction shaped its perception as a place of construction, and the community referencing power of memory tied to shell mound construction was retained in this landscape for thousands of years. The non-mounded areas hold just as much significance as the mounded spaces, as mounds can only be made meaningful insofar as they articulate with the rest of the landscape, they are situated in. In an attempt to understand the articulation of these spaces vis-à-vis the shell mounds, a complicated history of pit architecture digging, and public space construction is evident.

This landscape continues to hold importance to its modern inhabitants. Terraforming persisted at Silver Glen Springs in the form of shell removal, radically changing the visual landscape and subsequently reshaping its known history. Archaeological investigations since the early twenty-first century have been able to reconstruct the ancient past. From ritualized shell pit construction and sacred shell mound landscapes made through the practices of fisher-gatherer-hunters, to creation of public architecture, and finally as a gathering place for modern recreational hunters and fishers, the Silver Glen Springs Complex still has much more to share about the social organization and ritual landscape that once characterized it.

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