Archeological Data Recovery On Three Sites Along The San Antonio River Bexar County, Texas- Volume II: Further Excavations At 41BX256

Antonio E. Padilla

W Nicholas Trierweiler

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AmaTerra Environmental, Inc.

Texas Antiquities Permit: 5023

June 2012

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by

Antonio E. Padilla and W. Nicholas Trierweiler

Contract W9126G-07-C-0033

Texas Antiquities Permit 5023

National Park Service Scientific Research and

Collecting Permit SAAN-2008-SCI-0003

Prepared for

United States Army Corps of Engineers

Fort Worth District

by

AmaTerra Environmental, Inc.

Austin, Texas

November 2012

4009 Banister Lane, Suite 300

Austin, Texas 78704

AmaTerra Project No. 011-041

Cover photograph: Feature 4, at 70 cmbs, facing southwest.

REPORT DOCUMENTATION PAGE	*Form Approved OMB No. 0704-0188*

1. AGENCY USE ONLY *(leave Blank)*	2. REPORT DATE **November 2012**	3. REPORT TYPE AND DATES COVERED **Final Report, 2012**

3. TITLE AND SUBTITLE
Archeological Data Recovery on Three Sites Along the San Antonio River, Bexar County, Texas.
Volume II: Further Excavations at 41BX256

5. FUNDING NUMBERS
W9126G-11-P-0193

4. AUTHOR(S)
Antonio E. Padilla and W. Nicholas Trierweiler

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

AmaTerra Environmental, Inc.
4009 Banister, Suite 300
Austin, TX 78704

8 PERFORMING ORGANIZATION REPORT NUMBER

011-041

9. SPONSRING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U.S. Army Corps of Engineers, Fort Worth District
819 Taylor Street, #3A12
Fort Worth, Texas 76102

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENARY NOTES

12a. DISTRIBUTION AVAILABILITY STATEMENT

Available for public release

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

This volume documents the archaeological excavation of a prehistoric, burned wattle and daub structure dating between 4830–5060 BP at site 41BX256, located along the San Antonio River in Bexar County, Texas. The feature is a large mass of fired clay measuring about 2 meters in diameter at a depth of 70 centimeters below ground level. First excavated in 2008, it was provisionally interpreted as a baked clay cooking feature. Later examination of chunks of baked clay revealed numerous stick impressions, leading to the speculation that the feature might instead be a habitation structure of wattle and daub. Archaeologists revisited the site in 2011 and re-excavated the feature and a similar, smaller clay mass located nearby. Both features were excavated deeper and surrounding areas were newly excavated. A trench through the main feature exhibits soil reddening below 70 centimeters. No post molds were found, but additional features were documented including three burned rock hearths. Additional samples of the baked clay were recovered and were subjected to analyses for possible lipids, starches, phytoliths, and for estimation of firing temperatures. Multiple radiocarbon samples confirmed the Middle Archaic date. The newly recovered data support the interpretation that the feature is a burned domestic structure.

14. SUBJECT TERMS

archeology, prehistory, Texas, San Antonio, Bexar, burned clay, wattle-and-daub, archaic

15. NUMBER OF PAGES **136+ appendices**

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF THIS PAGE	20. LIMITATION OF ABSTRACT
unclassified	**unclassified**	**unclassified**	**unclassified**

Abstract

This report documents the archaeological excavation of a prehistoric, burned wattle and daub domestic structure dating between 4830–5060 BP at site 41BX256, located along the San Antonio River in Bexar County, Texas. The feature is described as a large, U-shaped mass of fired clay measuring about 2 meters (m) in diameter at a depth of 70 centimeters below the modern ground surface (cmbs). It was discovered through remote sensing and was archaeologically tested in 2006 and it was later fully excavated in 2008. Following both of these investigations, the feature was provisionally interpreted as a baked clay cooking feature. Later examination of hundreds of chunks of the baked clay revealed numerous mold impressions of sticks and twigs, leading to the speculation that the feature, since backfilled, might actually be a domestic structure constructed of wattle and daub. To investigate this possibility, archaeologists revisited the site in 2011 and re-excavated the feature and a similar, smaller clay mass located nearby. Additional surrounding units were explored, the features were excavated deeper to 90–110 cmbs, and a trench through the main feature was carefully examined and profiled. The profile exhibits distinct reddening below 70 cmbs in a pattern consistent with the interpretation of the feature as a structure. No post molds were found, but additional features were documented including three burned rock hearths. Additional samples of the baked clay were recovered and were subjected to analyses for possible lipids, starches, phytoliths, and for reconstruction of estimated firing temperatures. Multiple radiocarbon samples confirmed the Middle Archaic date. The newly recovered data support the interpretation that the feature is a burned domestic structure.

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Acknowledgments

The success of this investigation has been the result of more than a dozen people including archaeologists, analysts, consultants, State and Federal agency personnel, and subcontractors. All of these persons played key roles and are gratefully acknowledged. To begin, we extend our appreciation to the United States Army Corps of Engineers, Fort Worth District (USACE) who funded the investigations and to USACE archaeologist Nancy Parrish who oversaw our efforts and who showed great patience with our requests. We are also indebted to Susan Snow, archaeologist of the San Antonio Missions National Historical Park, who was keenly interested in our research and helped with our logistical needs.

In addition, we thank Waukesha Pearce of San Antonio for providing the Gradall for removal of overburden around Block 1. Mr. Charles Burns from Grand Prairie, Texas skillfully served as the Gradall operator and we acknowledge his deft touch with the multi-ton machine. We also thank Mr. Calderon for backfilling the site.

We are indebted to the expert advice and opinions from numerous professionals, including Dr. Charles Frederick who offered his thoughts and experiences with similar features; Richard Weinstein from Coastal Environments Inc. and Dr. Robert Rickles from TRC Solutions who offered their assessment based on their field experiences with burned clay; Doug Boyd who inspected samples of the burned clay and shared his published reports about similar features; Dr. Steve Black and Mark Wolfe who offered their assessment based on their field experiences with burned clay and similar features; and Joe Rogers who offered his thoughts and opinions based on his experiences with burned clay and similar features. We greatly appreciate all of the contributions and criticism offered by these experts.

Field archaeologists Noel Steinle, Dan Rose, Bruce Darnell, Amanda Murphy, and Brittany McClain are chiefly credited for the careful fieldwork, directed by Crew Chief Jon Dowling and Project Archaeologist Antonio Padilla. Nick Trierweiler served as the Principal Investigator. The artifacts were meticulously cleaned, sorted, and cataloged by Brittany McClain, Emory Worrell, and Noel Steinle and lithic artifacts were classified by Antonio Padilla. Selected burned clay nodules were saw cut by David Day from Austex Drilling and Sawing, Inc. for submission for lipid, fatty acid, starch, and phytolith assays. Dr. Alston Thoms and Dr. Tim Riley from Texas A&M University conducted the microfossil analysis and Dr. Mary Malainey from Brandon University conducted the lipid and fatty acid analysis. Other burned clay samples were sent to Dr. Leslie Cecil from Stephen F. Austin State University for estimated thermal signatures. Primary authors of this report have been Antonio Padilla and Nick Trierweiler, but some portions have been adapted from our previous report on 41BX256, which was authored by Antonio Padilla and David Nickels. Our photographs and illustrations have been prepared by Dan Rose and Joel Butler, respectively. Brad Hamer proof read the draft report which was assembled, edited, and produced by Margo Gregory.

Chapter 1

Introduction

In 2008 Ecological Communications Corporation (EComm)[1], under contract to the United States Army Corps of Engineers (USACE), Fort Worth District, conducted data recovery excavations at archaeological sites 41BX254, 41BX256, and 41BX1628 along the San Antonio River in Bexar County, Texas. The excavations were designed to mitigate adverse effects to the sites resulting from a river restoration project proposed by the San Antonio River Authority (SARA) and the USACE. The undertaking will involve realigning the river channel, contouring its banks, and restoring vegetation. The contouring will remove most of the land area within the three sites.

Because the undertaking will involve federal funds, it falls under the requirements of Section 106 of the National Historic Preservation Act (NHPA). Moreover, because a portion of the undertaking is located on land controlled by the National Park Service (NPS), Section 110 of NHPA, the Native American Graves Protection and Repatriation Act (NAGPRA) of 1990, and the Archaeological Resources Protection Act (ARPA) also apply. In compliance with these statutes, an archaeological survey of the entire project area was conducted in 2005 (Peter et al. 2006 and follow-up testing concluded that three sites warranted data recovery excavations to mitigate the adverse effects of the undertaking (Osburn et al. 2006).

Excavations on the three sites required two permits. A Texas Antiquities Permit was required from the Texas Historic Commission (THC) since the project involved land controlled by SARA (a political subdivision of the State of Texas), and an NPS Scientific Research and Collecting Permit was required to conduct work on sites controlled by the NPS. Work was conducted under NPS National Park Service Scientific Research and Collecting Permit No. SAAN-2008-SCI-0003 and Texas Antiquities Permit No. 5023. The archaeological excavations began in August 2008 and were completed by late December, 2008. The final report of those excavations was completed in September 2010 (Padilla and Nickels 2010) and was accepted by the USACE, SARA, NPS and the THC as fulfilling the requirements of the several permits.

Subsequent to completion of the field work, additional laboratory data were obtained and reported (Padilla and Nickels 2010: 326-329) which strongly suggested that one of the features investigated on 41BX256 might actually be a habitation structure dating to the Middle Archaic Period (ca. 5030–4840 BP), an interpretation that was not recognized during the field work. Because of the rarity of these types of resources in Texas, the THC and the USACE agreed that additional field work at 41BX256 was warranted to further investigate this feature before it was destroyed by the bank contouring. The USACE thus directed EComm to return to the site and collect additional data. Accordingly EComm conducted supplementary archaeological excavations at site 41BX256 from August 1–19, 2011, under the existing Texas Antiquities permit 5023 and also under US Department of the Interior, NPS Scientific Collecting permit

1 In January 2012, EComm was acquired by AmaTerra Environmental, Inc.

number SAAN-2008-SCI-0003 (neither of which had been closed). Following completion of this supplementary investigation, a letter report was prepared (Trierweiler 2011) and submitted to the USACE for use in concluding the Section 106 consultation process with the Texas State Historic Preservation Officer (SHPO). The current document is the complete technical report of findings of the supplementary 2011 excavations. Results of the 2008 excavations are presented in Padilla and Nickels (2010).

For the current investigation as previously, Nick Trierweiler served as Principal Investigator and Antonio Padilla served as Project Archaeologist and directed field investigations and artifact analysis. In 2011, Jon Dowling served as Crew Chief and Crew Members included Noel Steinle, Amanda Murphy, Bruce Darnell, Dan Rose and Brittney McClain.

1.1 Project Location

Site 41BX256 is located within the boundary of the San Antonio Missions National Historic Park (Figure 1-1). Much of the site and the surrounding areas have undergone massive landscape alteration due to the recent channelization of the river and the construction of a hike and bike trail along its western bank. The site sits on a small terrace measuring 0.5–1 m above the hike and bike trail and it is apparent that some of the site was removed during the construction of the trail. Evidence is seen along the mechanically sloped edge where artifacts are eroding out. The trail consists of a 14-foot (ft) asphalt road with a 50-centimeter (cm) shoulder on either side. Directly to the east of the trail, another artificially created terrace slopes downward 7 meters (m) to the floodplain of the channelized river.

The river flows along the eastern edge of the Balcones Escarpment, which forms the southern and eastern edge of the Edward Plateau, a rugged, hilly region broken up by small streams and drainages. The project area falls within the juncture of three biotic provinces as described by Blair (1950): the Balconian, the Texan, and the Tamaulipan. The Balconian Biotic Province is associated with the Edwards Plateau, which is typically characterized by open savannah rangeland interspersed with live oak-ashe juniper woodlands and small brush. The Texan Biotic Province, associated with the Blackland Prairie physiographic region, is characterized by gently undulating topography generally defined as grasslands punctuated by riparian bands along creeks, rivers, and other drainages. The Tamaulipan Biotic Province, associated with the South Texas Plains, is characterized as a subtropical brushland consisting of shrubs, cactus, weeds, grasses, and small trees. The underlying geology of the project area consists of fluviatile terrace deposits of gravel, silt, and clay formed along the San Antonio River (Bureau of Economic Geology 1982). The soils encountered within the project area belong to the Venus-Frio association, deep calcareous soils occupying bottomlands and terraces (Taylor et al. 1962). The natural setting, however, has been heavily modified through centuries of farming and ranching, followed by urban development. The San Antonio River was first channelized in 1929 to divert water around the city and prevent flooding. Subsequent efforts, involving widening, straightening, bank stabilizing, and dam and culvert construction, took place in the 1960s and 1980s (Osburn et al. 2007).

This figure has been redacted due to site sensitive information.

Figure 1-1. Location of 41BX256 on USGS topographic quadrangle.

1.2 Project History

Site 41BX256 is currently listed on the NRHP and has been the subject of several investigations. It was initially recorded by Isham and Ray in 1974 (Isham and Ray 1974b) as part of the Mission Parkway project and was described as a probable Colonial period Native American site with a boundary of 75 x 50 m. In 2002, CAR documented all cultural materials encountered during Isham and Ray's 1974 surface inspection (Fox et al. 2002). The collection consisted of 134 chipped stone, one unidentifiable projectile point fragment, nine stone tools, mussel shells, bone fragments, 88 Native American ceramic sherds, five Mexican lead-glazed sherds, and four Mexican tin-glazed sherds of majolica. One of the majolica sherds found was a Puebla Polychrome that dates to the last part of the seventeenth century, which raised the possibility that the site may actually predate the establishment of the missions (ca. 1731) in the area, and may be related to an early Spanish expedition (Fox et al. 2002; Scurlock et al. 1976).

While visiting 41BX256 in early 2005, Mr. Clint McKenzie of the Southern Texas Archaeological Association (STAA) noted that artifacts were eroding from the eastern edge of the site where the river had been artificially channeled. Artifacts observed at that time consisted of fire-cracked rock, lithic debris, and historic glass (Osborne 2007).

In 2005, the site was resurveyed by GeoMarine, Inc (GMI) to evaluate the site boundaries and identify the vertical and horizontal extent of cultural material. GMI excavated six shovel tests and 15 auger tests, eight of which were positive for cultural material (Osburn et al. 2007). The cultural material recovered consisted of 13 pieces of lithic debitage, two stone tools, one core, one smoothed hematite piece, one Native American pottery sherd, two mussel shell fragments, six fire-cracked rocks, and one piece of animal bone. GMI also re-established a new boundary for the site, measuring 175 x 28 m (1.25 acres) (Peter et al. 2006). Following this survey, GMI conducted testing investigations in 2006 including geophysical investigations (Ground Penetrating Radar [GPR] and magnetometer surveys), plus three backhoe trenches and manual excavations of six test units. The upper 30 cm of the site yielded abundant Native American ceramics, lithic debitage, and a few stone tools, as well as Spanish Colonial period tin- and lead-glazed polychromes. Diagnostic artifacts and radiocarbon assays identified three distinct cultural components: the late Early/Middle Archaic, Late Archaic, and Spanish Colonial period.

Feature 4 was initially discovered during this 2006 magnetometer survey and was tested with two 1x1 m manually excavated units, revealing a large burned clay concentration. Given the density of burned clay and the semi-circular shape revealed, GMI's assessment was that the feature was a possible cooking pit utilizing burned clay as opposed to burned rock heating elements. A radiocarbon date placed the feature at 5040–4840 cal BP (2σ).

In 2008, Feature 4 was excavated by EComm and a block of 14 1 x 1-m units was established over the feature, which was encountered in eight of the 14 units, plus the two original GMI units. The feature was first encountered at a depth of 47 cm below surface (cmbs) and extended to a depth of 70 cmbs. The feature was described in the field as a large, sintered, burned clay feature measuring 3.0 x 2.5 m, consisting of numerous burned clay nodules ranging in size from 5 to 25 cm, with very few small pieces of fire-cracked rock. In plan view the feature appears to have a horseshoe shape. Two charcoal samples yielded dates of 5030–5010 and 4980–4840 cal BP (2σ), placing the use of the feature in the Middle Archaic; these dates corresponded to the GMI date. Prior to backfilling, a mechanically dug trench was used to expediently bisect Feature 4. Additionally, Feature 9, discovered at the margin of the excavation block, was stratigraphically associated with Feature 4 and also contained a quantity of burned clay. Upon completion of the 2008 field work, Features 4 and 9 were provisionally interpreted as cooking features.

Approximately 23 kg of burned clay was collected from Feature 4 for further examination. The clay nodules (N=383) ranged in size from about 5 cm to larger than 10 cm in diameter, and all exhibited varying degrees of burning. Upon detailed examination, about one in four pieces showed evidence of one or more stick impressions that ranged in width from less than 1 mm to 70 mm. The impressions on the burned clay suggest that it is actually daub. Although some wattle and daub structures have been found in Texas, they are not common in Central Texas, and especially not within a Middle Archaic context. The interpretation of Feature 4 as a habitation structure was not proposed until after the site was backfilled, and as a result the immediate occupation surface was not closely examined for possible post molds or other evidence of structures nor was the surrounding vicinity explored for evidence of other possible structures.

Because such features are exceedingly rare in the archaeological record of Central Texas, especially dating to the Middle Archaic, the USACE, in consultation with the Texas SHPO, authorized an additional phase of data recovery excavation. The primary research objectives of the additional work reported here were the recovery of data informing on the function of Features 4 and 9, and recovery of data informing on the possibility of additional similar features in the vicinity.

In August 2011, archaeologists mechanically removed approximately 50–60 cm of overburden above Features 4 and 9 and identified and verified the block that had been previously excavated in 2008. Backfill was manually removed from the block down to the 70 cmbs surface that had been left by the 2008 excavation (a few units had been dug deeper in 2008), as was the backfill from the bisecting trench. The block grid was reestablished and was expanded beyond the block.

Archaeologists excavated a total of twelve (12) new 1 x 1-m units and the bisecting trench through Feature 4 was cleaned, closely inspected, drawn and photographed. In general, all of the 12 newly established units as well as the other previously established units in Block 1 were excavated down to 90 cmbs. A few units immediately surrounding Feature 4 were taken down to 110 cmbs. The excavation tactic employed shallow scraping of the exposed surface in an attempt to identify possible post molds, while pedestaling the several burned clay masses. All new manual excavations below the terminal level of the grade-all scraping were dry screened through ¼-inch (in) mesh and all artifacts were recovered to be analyzed and curated. Additional opportunistic samples were collected from the feature contexts including samples for radiocarbon, lipid, clay, and other assays.

No post molds were discovered despite meticulous searching. Burned clay Features 4 and 9 were completely exposed, delineated in three dimensions, and 100 percent excavated; and additional samples of the burned clay were collected for assays. Feature 9 was revealed to be similar in composition to Feature 4, though smaller and with less expression beneath the 70 cmbs surface. In addition, three new features were identified. Designated as Features 14, 15, and 16, these were small concentrations of burned rocks in association with Feature 4. The bisected profile through Feature 4 exhibited significant reddening of the substrate beneath 70 cmbs which was most pronounced at both outside margins. Upon completion, the excavations were backfilled by backhoe and ground contours were restored.

1.3 Summary and Conclusions

Examination of the recovered baked clay pieces revealed a number of clear stick impressions on fired clay nodules. These impressions ranged in size from about 1.5 mm to about 5.4 cm in diameter. While fewer total impressions were observed than on pieces recovered in 2008, the average size of baked clay piece was much smaller (17g) compared to those that were previously collected. In total, 127 stick impressions have been recovered from both field seasons on 100 pieces of baked clay.

Recovery of artifacts was sparse. The assemblage consisted of merely 110 flaked stone items including 64 incomplete flakes, 37 complete flakes, five pieces of angular debris, two cores, one biface, and one untyped Middle Archaic projectile point. The vertical distribution of these artifacts is strongly unimodal at 70-90 cmbs. Horizontal distribution of artifacts for all levels shows a central zone of low density surrounded by several loci of higher artifact density.

Five samples of charcoal were submitted for Accelerator Mass Spectroscopy (AMS) radiocarbon dating. Combined with two samples that had been previously analyzed in 2006 and 2008, a total of seven radiocarbon dates are available for interpreting the several features. All dates associated with Feature 4 are highly clustered and provide a reliable Middle Archaic date for the burned clay mass between 5060 BP and 4830 BP. The date obtained from burned rock hearth Feature 15 also wholly overlaps the date range obtained for Feature 4. However, two dates obtained from the smaller burned clay Feature 9 are both younger and are stratigraphically inverted, suggesting rodent disturbance.

Analysis of baked clay samples for lipid and fatty acid residue indicates low to non-detectable amounts of fatty acids. Moreover, the lipid residues appear to match patterns suggested from combinations of plant materials; only one of four samples has a lipid signature suggesting both plant and animal materials. No evidence of starches or phytoliths was seen in matching baked clay samples.

Forty-four burned clay samples were analyzed for estimated firing temperature. The samples from Feature 4 show evidence of being heated/fired to temperatures between 400–500 ºC (752–932 ºF), with the majority of the samples fired to 450 ºC (842 ºF).

Based on the above evidence, we conclude that Feature 4 represents a burned wattle and daub domestic structure dating to the Middle Archaic Period. While the dating of Feature 9 is problematic, it stratigraphically matches Feature 4 and is morphologically similar, if somewhat smaller and is associated with quantities of burned rock as well. On this basis, we speculate that additional such domestic structures may well be present along intact portions of the San Antonio River, and in other comparable locations within south central Texas. The main feature was initially discovered as an anomaly in a remote sensing geotechnical survey; such surveys are recommended as a cost effective technique for identifying additional domestic structures in future investigations. Shovel testing tactics alone, even if densely plotted, may not be sufficient to discover these buried, intact, and highly significant features. Based on lessons learned while conducting this investigation, we recommend carefully bisecting the feature with abundant mosaic photography, and detailed plotting of soil textures and colors. While no post molds were discovered associated with the current features, we also recommend that at least half of the occupation surface surrounding such structures be incrementally scraped in search of post-molds. Finally, abundant samples for thermal signature analysis could help identify firing patterns.

Chapter 2
Environmental Context

2.1 Physiographic Setting of Bexar County

The physiographic makeup of Bexar County is a combination of four distinct physiographic regions of Texas: the Edwards Plateau, the Balcones Escarpment, the Blackland Prairie, and the Gulf Coastal Plain. Each of these regions provides unique geological elements in the development of the San Antonio area (Figure 2-1).

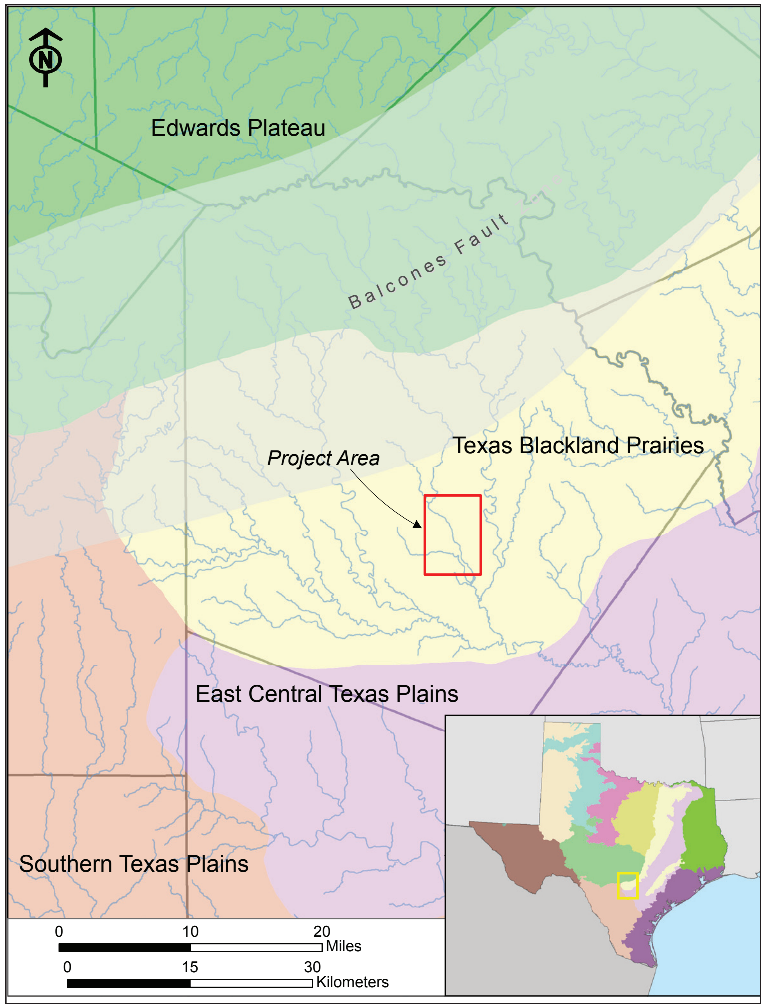

Figure 2-1. Physiographic regions located within Bexar County (adapted from United States Environmental Protection Agency 2004).

2.1.1 Edwards Plateau

The Edwards Plateau is a large physiographic province covering approximately 24 million acres of Central Texas, and is characterized as a karst landscape composed of strong, resistant, Cretaceous-aged limestones, shales, marine sandstones, and dolomites originating from various geological groups (e.g., Navarro, Taylor, Austin, Eagle Ford, Buda, Glen Rose, Hensell, Del Rio, Edwards, and Devil's River) (Barnes 1974; Spearing 1991). According to many geologists, creation of the Edwards Plateau occurred during the Miocene with massive tectonic activity along the Balcones fault, resulting in the uplifting of the Cretaceous rock to an elevation of 2,000 feet (ft) above sea level (Spearing 1991). Exposure to natural processes such as wind and water erosion over millions of years transformed the landscape dramatically. Signs of extensive wear and scarring are seen, especially along the softer rocks located along the eastern and southern section of the Balcones fault. Constant erosion by streams of the plateau's soft limestone created extensive subterranean cavities and sinkholes. These dissolved areas of limestone became filled with water and formed the plateau's vast subsurface aquifer hydrology (Spearing 1991), and were then affected by the formation of the Balcones Escarpment.

2.1.2 Balcones Escarpment

The Balcones Escarpment is a several-mile-wide fault zone that extends across Texas from the Red River to Del Rio, reaching elevations up to 1,000 ft above the coastal prairie in some areas (Spearing 1991). The geographical division created by the Balcones Escarpment marks a transition between upland Texas, west of the escarpment, and lowlands to the east. The escarpment forms the southern and eastern border of the Edwards Plateau and is characterized as "a zone of stair-stepping faults" (Spearing 1991:87). Due to the enormous strain brought on by the downwarping of land near the Gulf Coast, an uplifted landmass was created inland, forming the Edwards Plateau (Handbook of Texas Online 2008). During the creation of the Plateau, existing aquifers located in proximity to the Balcones fault zone were perforated, forcing water to the surface and thus forming numerous clear springs (Spearing 2001). These serve as the heads of rivers and creeks that drain towards the Blackland Prairie.

2.1.3 Blackland Prairie

The Blackland Prairie lies at the base of the Balcones Escarpment, within the broad Gulf Coastal region, and follows the fault zone from the Red River to the Rio Grande, varying in width from 15 to 70 miles along its course (Alvarez and Plocheck 2006). Although the Blackland Prairie is located within the Gulf Coastal Plains region, it is considered its own physiographic region. Distinction between the Blackland Prairie and the Gulf Coastal Plain is based on the types of soils underlying the areas. Creation of the soils occurred during the late Tertiary, with the erosion of soils on the Edwards Plateau (Black 1989). These soils were then deposited by a combination of eolian and colluvial processes across an already-existing eroding parent material (Midway Group) of the Gulf Coastal Plain. Thus the mixture of Tertiary and Quaternary calcareous clay soils accumulated to great depths (Black 1989). Geographically, the Blackland Prairie is characterized as an area of low topographic relief and poor drainage that is prone to frequent flooding (Collins 1995).

2.1.4 Gulf Coastal Plain

The Gulf Coastal Plain, also know as the Rio Grand Plain, is the western extension of the coastal plain that extends from the Gulf of Mexico (Alvarez and Plocheck 2006). Topographically the plain is relatively flat, consisting of undulating or nearly level prairie lands (Taylor et al. 1991). Much of the recent formation of the plain is attributed to millions of years of continual stream and river activity that deposited sediments in low areas between rivers and swamps (Spearing 1991). Deposition of these sediments above the underlying parent material (sandstone, shale, and mudstone) allowed for the formation of distinctive areas within the Gulf Coastal Plain, which are recognized as distinct physiographic zones and biotic provinces. These zones are called the Blackland Prairie, the Post Oak Belt, the Pine Belt, the Coastal Prairie, and the Rio Grande Plain (Perttula 2004).

2.2 Hydrology

In addition to the physiographic makeup of Bexar County, hydrology plays an important role in the environmental setting of the area. Much of the hydrology of the area is attributed to the many subsurface aquifers and surface drainages located on the Balcones Escarpment and the streams and seeps of the Edwards Plateau (Figure 2-2). During the formation of the Edwards Plateau, fault movement along the Balcones fault zone cut through the karst landscape of the plateau, raising the formation. As the fault pushed the plateau upward, many of the subterranean aquifers beneath the plateau were dissected, creating separate sources of water within the Balcones Escarpment. A major hydrologic unit underlying the Edwards Plateau and Balcones Escarpment is known as the Edwards Underground Reservoir, also called the Edwards Aquifer. This hydrologic unit spans over several counties (Kinney, Uvalde, Medina, Bexar, Comal, and Hays counties) along the Balcones Escarpment and serves as a major domestic water source for the cities within these counties, including San Antonio.

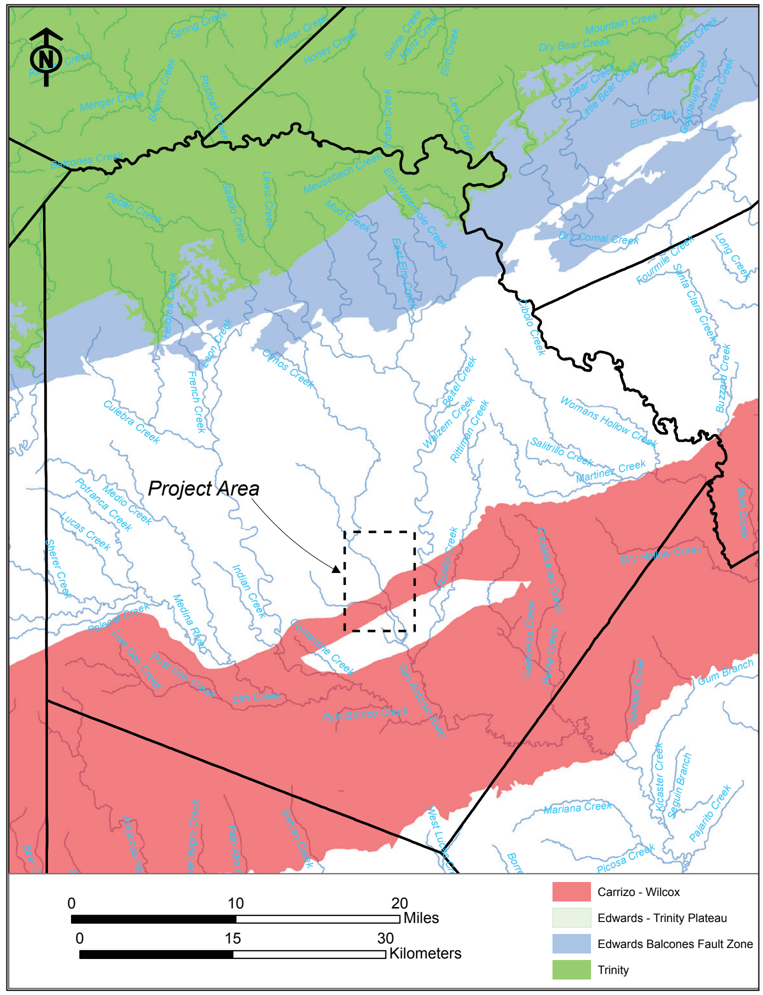

Figure 2-2. Waterways and the Edwards Aquifer in Bexar County.

Although the Balcones Escarpment houses a major source of water for the surrounding communities and is headwaters of many perennial streams (e.g., Medio Creek and the San Antonio River) in the area, the Edwards Plateau also contributes to the water sources in the region. Many seeps and springs occur in areas to the south where the plateau outcrops, and create some of the major creeks (e.g., Culebra, Leon, and Salado creeks) that drain the Edwards Plateau (Taylor et al. 1991) These streams and rivers drain towards the San Antonio River Basin, influencing settlement patterns in the region (Gerstle 1978). Not only did these waterways provide a valuable source of drinking water to inhabitants of the area, raw materials, specifically those used in the production of stone tools by prehistoric peoples, were transported from the uplands to the lowlands, where these materials are not readily available.

Of the many waterways meandering throughout Bexar County, the San Antonio River became a major cornerstone in the development of San Antonio both in historic and prehistoric times. The headwaters of the San Antonio River are located approximately four miles north of downtown. The river originates from a cluster of springs know as Blue Hole, which is located within the Balcones Escarpment physiographic region on the campus grounds of the University of the Incarnate Word (Donecker 2008). The river flows 240 miles through Wilson, Karnes, Goliad, Victoria, and Refugio counties, and ends with the convergence of the Guadalupe River in Refugio County. Although the river emanates from a spring, its major tributaries (San Pedro Creek, Leon Creek, the Medina River, Salado Creek, Marcelinas Creek, Cibolo Creek, Ecleto Creek, Escondido Creek, and Manahuilla Creek) contribute substantial amounts of water, providing a steadier flow than other Texas streams (Donecker 2008; San Antonio River Authority 2009).

2.3 Environmental Context Of The Project Location

The project is located in southern Bexar County along the San Antonio River. The river flows along the eastern edge of the Balcones Escarpment, which forms the southern and eastern edge of the Edward Plateau, a rugged, hilly region broken up by small streams and drainages. The site is located within the footprint of the proposed SARIP along the San Antonio River between Interstate Highway (IH) 10 and Loop 410 and lies within the boundary of the San Antonio Missions National Historic Park on the west bank of the river.

2.3.1 Environmental Setting

Given the dynamic geological makeup of Bexar County, the project area falls within the juncture of three biotic provinces as described by Blair (1950): the Balconian, the Texan, and the Tamaulipan (Figure 2-3). The Balconian Biotic Province is associated with the Edwards Plateau, which is typically characterized by open savannah rangeland interspersed with live oak-ashe juniper woodlands and small brush. The Texan Biotic Province, associated with the Blackland Prairie physiographic region, is characterized by gently undulating topography and generally defined as grasslands punctuated by riparian bands along creeks, rivers, and other drainages. The Tamaulipan Biotic Province, associated with the South Texas Plains, is characterized as a subtropical brushland consisting of shrubs, cactus, weeds, grasses, and small trees. Because the project area is situated at the ecotone of three biotic provinces, it attracts a number of wildlife generalists, including species of squirrels, deer, sparrows, javelina, feral pig, opossum, skunk, doves, ravens, mockingbirds, turtles, and armadillos, among others.

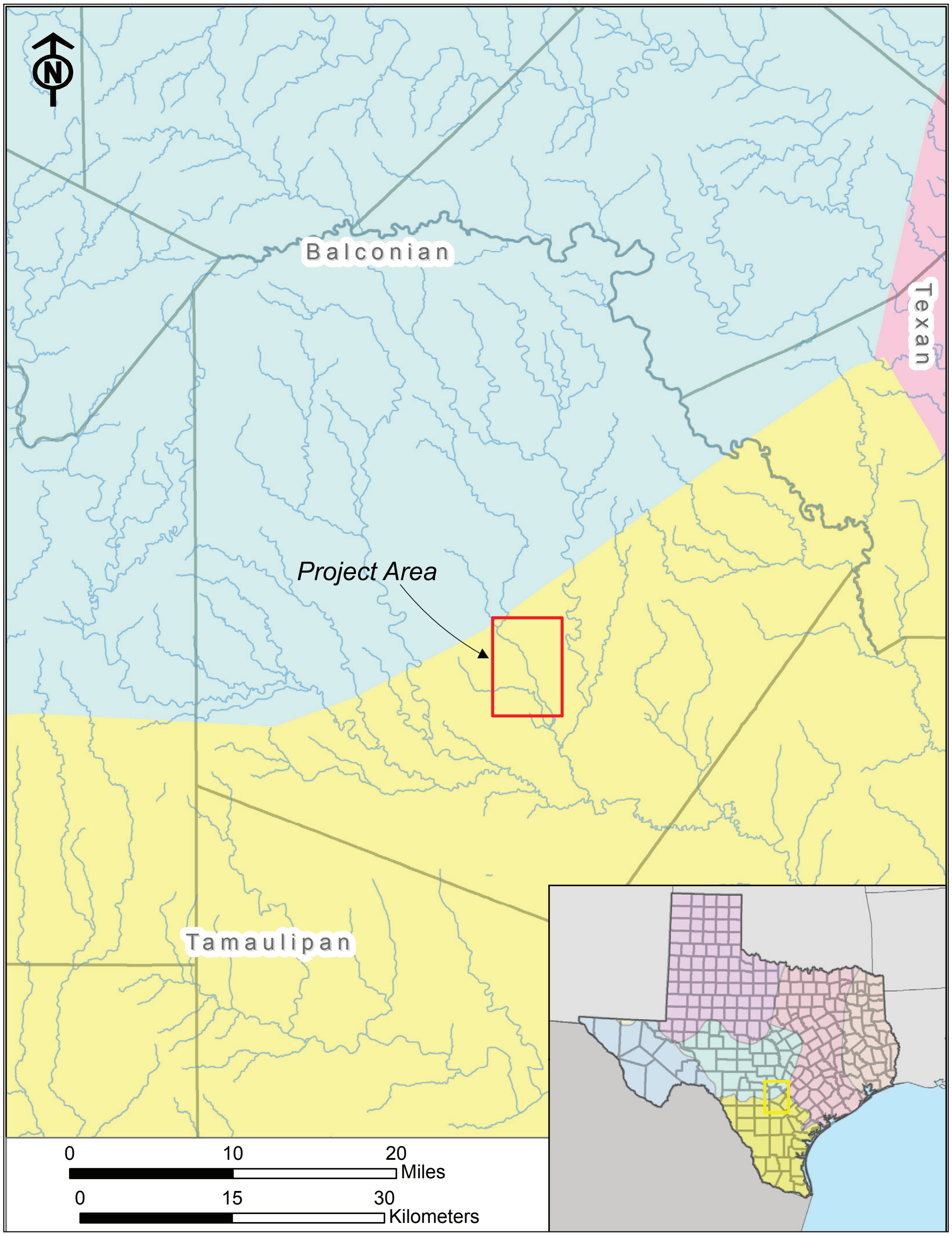

Figure 2-3. Biotic provinces within Bexar County.

2.3.2 Geology

The underlying geology of the project area consists of marl, clay, sandstone, and siltstone of the upper Cretaceous-age Navarro and Taylor Groups; and sandstone, mudstone, clay, and sand from the Eocene-age Wilcox and Midway Groups. Occasional outcroppings of these geological formations occur in various locations in southern San Antonio. These bedrock formations are covered by Fluviatile terrace deposits of gravel, sand, silt, and clay created along the San

Antonio River and its minor tributaries. Gravels predominantly found within these fluviatile deposits consist of limestone, dolomite, and chert (Barnes 1974).

2.3.3 Soils

Soils encountered within the project area consist of the Loire clay loam (Fr) of the Venus-Frio association. Soils of these associations are characteristically deep calcareous soils occupying bottomlands and terraces (Taylor et al. 1991). Frio clay loams are characterized as having slopes ranging from 0 to 2 percent and are commonly found along flood plains. Even though these soils are located in areas that are occasionally prone to flooding, they are typically well drained. They derive from a loamy alluvium parent material and belong to the Frio association (Taylor et al. 1991; USDA 2009). The typical profile of these soil types is as follows:

- 0–25 inches: clay loam
- 25–35 inches: clay loam
- 35–80 inches: stratified fine sandy loam to loam

2.3.4 Historic Land Use Modification

The natural setting of the San Antonio River, especially along the project area, has been dramatically transformed through centuries of continual development. Early modification of the landscape began during the Spanish Colonial period in the 1700s. In an effort to colonize Texas, the Spanish constructed numerous acequias (irrigation canals) throughout much of the region. The most extensive network of these acequias, consisting of up to 50 miles of these irrigation ditches, is found in San Antonio around the cluster of its missions. Construction of these acequias was important for the success of farming and ranching in the area. Many of these historic irrigation canals are still present within the San Antonio Missions National Historic Park. One of the functioning acequias is the San Francisco de la Espada Mission acequia. It was constructed between 1731 and 1745, and is composed of a stone-built aqueduct named the Espada Aqueduct (Cox 2005; Long 2008). In addition to the modification of the landscape with the construction of acequias, dams and other flood control structures were constructed along the river; however these structures do not affect the immediate landscape of the project area.

Improvement projects that directly affected the project area are attributed to the repeated flooding of the San Antonio River. The San Antonio River was first channelized in 1929 to divert water around the city and prevent flooding. Subsequent efforts involving widening, straightening, bank stabilizing, and dam and culvert construction took place in the 1960s and 1980s (Osburn et al. 2007). These modifications altered the landscape along the river. During these projects the natural terraces were cut back and recreated by redepositing much of the construction fill on these land forms. Evidence of this is evident at sites 41BX254 and 41BX1628. Modifications seen at 41BX254 consist of construction fill laid on top of the southeastern portion of the site. At site 41BX1628 this is evident along the northwestern edge of the terrace, where it had been cut and recreated with river gravel fill.

Chapter 3
Cultural–Historical Context

Site 41BX256 is located within South-Central Texas Cultural Context Region (Figure 3-1). For purposes of discussion, South-Central Texas roughly encompasses an area north of the Rio Grande, running from below Laredo, about 50 miles east of San Antonio, then back northwest, following the Balcones Escarpment through Austin, northwest along the northern edge of the Edwards Plateau, toward Sweetwater, then southward, following the eastern edge of the Devil's River to the Rio Grande, and finally, down the Rio Grande to near Laredo (Black 1989a).

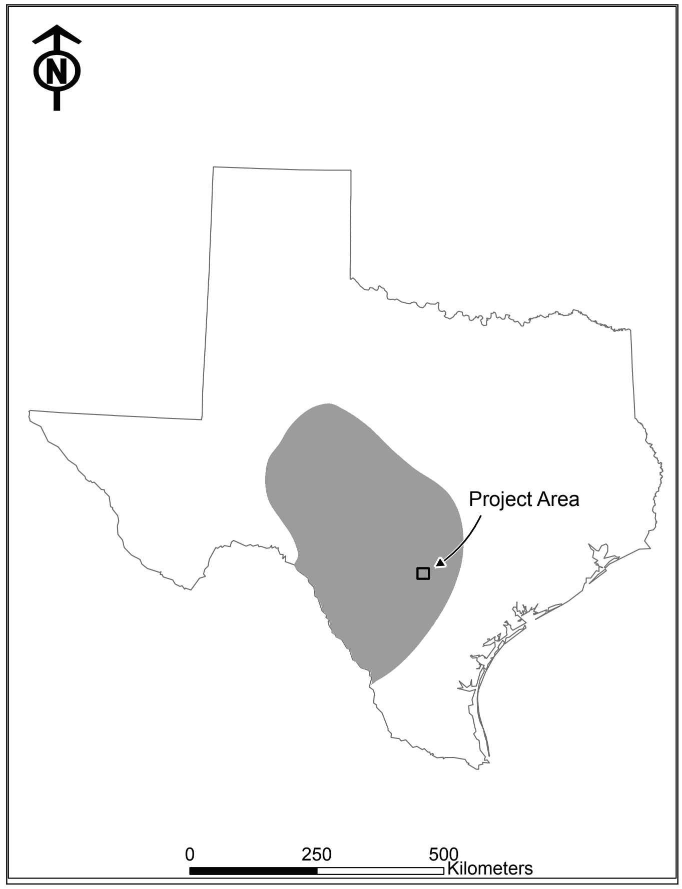

Figure 3-1. South-Central Texas Cultural Context Region.

3.1 Prehistoric Chronology

Several scholars have offered sound but differing arguments for cultural chronologies for Central Texas. Using the earlier works of Suhm et al. (1954), Johnson et al. (1962), and Sorrow et al. (1967) as a springboard, Weir (1976) and Prewitt (1981a, 1985) sorted through the archaeological data from Central Texas and established a chronology defined by phases. Although some of their data has been criticized as unreliable chronological markers and intervals (e.g., Collins 1995; Johnson 1987), they energized colleagues to investigate empirical methods for inferring cultural behavior. Black (1989a, 1989b) synthesized the data of high quality available at the time in South and Central Texas, and offered a synthesis of prehistoric intervals that was widely accepted. Collins (1995) reviewed the archaeological and palynological evidence for Central Texas and offered new chronological estimates for human occupation from the Paleoindian through Historic periods. Johnson and Goode (1994) accomplished the same for the Eastern Edwards Plateau. Unlike the American Southwest and Mesoamerica where changes in technology and style are apparent in ceramics, and the Southern High Plains complexes that are defined more so by shifts in climatic conditions and subsistence than by changes in point style, lithic technology usually serves as the marker of change in South-Central Texas.

Refining a cultural chronology for South Texas is problematic due to the compressed nature of the archaeological record and the scarcity of stratified sites excavated within the region (Hester 1995:433). Hall (1981:463; Hall et al. 1986:393–406) analyzed radiocarbon dates and artifact assemblages from Choke Canyon sites in western Live Oak and eastern McMullen counties to establish a local chronology. Black (1989c:39–62) synthesized available data from South Texas and offered a chronology similar to that of Hall (1981). Both chronologies were considered by Turner and Hester (1999), who offer slightly different chronological periods based on evidence found more recently in South Texas. Supported by data retrieved from Loma Sandia in Live Oak County, Black (1995:31–44) updated his South Texas chronology, again confirming that of Hall (1981). Also considering Hall's scheme, Hester (1995:433) acknowledges the paucity of information that exists for South Texas and offers only a "general framework" for prehistoric periods particular to the region. The dates in Table 3-1 and the following discussion are primarily derived from Black (1995), Collins (1995), and Hester (1995). Generally, the Archaic is broken into the Early, Middle, and Late periods. However, Story (1990) prefers to use the generic term "Archaic" rather than delineate separate periods. A brief discussion of the Transitional Archaic as defined by Turner and Hester (1999) and Hester (1995) is also presented. All dates are given as approximate years before present (BP), i.e., before 1950. Archaeological sites and surveys discussed in this section are illustrated with their respective periods.

3.1.1 Pre-Clovis

Although humans may have inhabited North America before 11,500 BP, solid evidence does not as of yet support their existence. The argument that artifacts recovered from Levi Rockshelter in Travis County are older than Paleoindian (Alexander 1983:133–145) is not supported because the radiocarbon dates are not clustered, and there are no distinct artifact and extinct fauna assemblages within well-defined stratigraphy (Collins 1995:380–381). Other sites where assemblages are purportedly pre-Clovis include Friesenhahn Cave (Krieger 1964) and the Waco Mammoth Site (Fox et al. 1992). Human behavior is inferred on stone artifacts from Friesenhahn Cave, and mammoth bones at the Waco Site. However, problems of context or dating exist at both sites (Collins 1995:380–381). The Gault Site in Bell County, Texas has provided by far the largest Clovis assemblage in all of North America, and with artifacts stratigraphically beneath the known Clovis component, likely has the best chances of providing conclusive evidence for a pre-Clovis culture in Texas (Adavasio and Page 2002:292–294; Collins 2009; Collins and Brown 2000).

3.1.2 Paleoindian

This period is estimated at ca. 11,500–8800 BP in Central Texas (Collins 1995:381–383) and 11,200–7950 BP in South Texas (Hester 1995:433–436). The Paleoindian period began toward the close of the Pleistocene. Diagnostic artifacts of the early Paleoindian interval include Clovis and Folsom projectile points, with late Paleoindian lanceolate forms such as Angostura, Golondrina, St. Mary's Hall, and Barber, and early stemmed points (e.g., Wilson) then appearing. Certainly, the wide distribution of Clovis-type points across most of North America and even

Table 3-1. Cultural Chronology of Central and South Texas (adapted from Nickels et al. 1998).

Geologic Epoch	Central Texas (from Collins 2004) Archaeological Period	Archaeological Style Interval	Calendar Years	Radiocarbon Years BP	South Texas (from Hester 2004) Archaeological Period	Archaeological Style Marker	Calendar Years	Radiocarbon Years BP	South Texas (from Black 1995) Archaeological Period	Archaeological Style Marker	Calendar Years	Radiocarbon Years BP
Late Holocene	Historic		AD 1690–1950	0–260	Historic		AD 1700–1950	0-250	Historic		AD 1700–1950	0–250
	Late Prehistoric	*Toyah Horizon* Perdiz	AD 1250–1690	260–700	Protohistoric		AD 1530–1700	250–420	Protohistoric		AD 1530–1700	250–420
					Late Prehistoric	*Toyah Phase* Perdiz	AD 1250–1650	300–700	Late Prehistoric	*Toyah Phase* Perdiz	AD 1350–1600	350–600
		Austin Phase Scallorn Edwards	AD 750–1250	700–1200		*Austin Phase* Edwards Scallorn	AD 700–1250	700–1250		*Austin Phase* Edwards Scallorn	AD 800–1350	600–1150
	Late Archaic	Darl Ensor, Frio Fairland Marcos, Montell Castroville Lange, Marshall Williams Pedernales Kinney Bulverde	AD 750– 2050 BC	1200–4000	Terminal (Transitional) Archaic	Zavala Catan Matamoras Ensor Frio			Late Archaic	Fairland Ellis Frio Ensor Marcos Tortugas? Corner Tang Knives	AD 900– 400 BC	1050–2350
					Late Archaic	Zavala Catan Matamoras Desmuke Fairland Ellis Frio Ensor Olmos bifaces Montell Marcos Shumla	AD 700– 400 BC	1250–2350				
ca. 3200 BP Middle Holocene	Middle Archaic	Nolan, Travis Taylor Bell-Andice-Calf Creek	2050–4050 BC	4000–6000	Middle Archaic	Dimmit form tools Carrizo Abasolo Tortugas	400–2500 BC	2350–4450	Middle Archaic	Pedernales Morhiss Langtry Lange Kinney Castroville Bulverde	400–2500 BC	2350–4450
	Early Archaic	Martindale, Uvalde Early Split Stem Angostura	4050–6850 BC	6000–8800	Early Archaic	Early Basal Notched	2500–3500 BC	4450–5450	Early Archaic	Bell Andice Early Trianhular Clear Fork Tools Early Expanding Stem Guadalupe Tools	2500–6000 BC	4450–7950
ca. 6000 BP						Bell Andice Early Triangular Clear Fork tools Early Corner Notched Martindale Uvalde Baker Bandy Guadalupe Tools	3500–6000 BC	5450–7950				
Early Holocene	Paleoindian	St. Mary's Hall Golondrina-Barber Wilson Dalton, San Patrice, Plainview Folsom Clovis	6850–9550 BC	8800–11,500	Paleoindian	Lerma Scottsbluff Golondrina Early Stemmed Lanceloate Angostura Early Stemmed Wilson St. Mary's Hall Plainview Clovis	6000–9250 BC	7950–11,200	Paleoindian	Scottsbluff Golondrina Early Stemmed Lanceloate Angostura Plainview Clovis	6000–9200 BC	7950–11,150

into Central America suggests a wide dispersal and interaction of the people who made them (Kelly 1993; Wenke 1990:201). Within Texas's political boundaries, Bever and Meltzer (2007) have documented the presence of 544 Clovis points in 149 of 254 counties. In the Central Texas region, the distribution of Clovis points generally follows the Balcones Escarpment, where high-quality chert is available within an ecotene of natural subsistence resources. However, in South Texas, fewer-than-expected Clovis points have been documented, and increasingly so from the escarpment southward. Four Clovis points have been documented from Bexar County. Other artifacts associated with the Clovis culture include bifaces and prismatic blades, engraved stones, bone and ivory points, stone bolas, ochre, and shaft straighteners.

Although the Paleoindian adaptation had been considered to be one of small bands of nomadic, big-game hunters following herds of Late Pleistocene fauna (e.g., mammoth, mastodons, bison, camel, and horse) across North America (Black 1989b), more recent discoveries have emphasized the wide diversity of plants and animals used for subsistence by these early Americans (Black 1989b; Hester 1983). In addition to bison and deer, smaller animals such as turtles and tortoises, alligators, mice, badgers, and raccoons were eaten (Collins 1995:381), although they undoubtedly hunted the large animals as well (Dibble and Lorraine 1968). The mistaken conception that human hunters caused the demise of the now-extinct megafauna has essentially been debunked (e.g., Cannon and Meltzer 2004; Grayson and Meltzer 2002). Known Clovis sites include killsites, quarries, caches, open campsites, ritual sites, and burials (Collins 1995:381–383; Hester 1995:433–436). A Folsom interval follows the Clovis. Folsom artifacts are fairly common in central and south Texas; however, no campsites or killsites have been found south of a large workshop, Pavo Real (41BX52), in Bexar County (Collins et al. 2003; Hester 1995:434–435).

Most Paleoindian finds in Central and South Texas have consisted of surface lithic scatters on upland terraces and ridges (Black 1989a:25, 1989c:48). A few Paleoindian components deeply buried in alluvium have been discovered, such as Berclair Terrace (Sellards 1940), Berger Bluff (Brown 1987), Kincaid Rockshelter (Collins et al. 1989), Wilson-Leonard (Collins 1998; Collins et al. 1993), and at recent excavations of the Richard Beene site (Thoms and Mandel 2007; Thoms et al. 1996). Collins (1995:Table 2) recognizes three sites that have high-integrity Paleoindian components resting on stable landforms: Kincaid Rockshelter, Horn Shelter No. 2, and Wilson-Leonard. Many Paleoindian points have been recovered from surface contexts in Bexar and nearby counties (Chandler and Hindes 1993; Hester 1968a, 1968b; Howard 1974; Nickels, Leach, Tomka, and Moses 1997). A late Paleoindian component, with apparent moderate integrity, has also been reported at the St. Mary's Hall site in Bexar County (Hester 1990:14–17, 1995:435).

As the warming that marks the transition from Pleistocene to Holocene climates began to take effect in Texas, prehistoric inhabitants adapted with changes in lifestyle. This climatic shift is also marked by the decline and extinction of mammoth, mastodon, horse, camel, and giant bison (*Bison antiquus*). With the possible exception of Berclair Terrace (although not dated; Sellards 1940), archaeological evidence suggests that after 8000 BP, large gregarious game animals were perhaps extinct in Texas. Human hunters were forced to concentrate on deer, antelope, and other medium-sized or smaller game. Changes in the subsistence base required technological shifts that mark the beginning of a new cultural period known as the Archaic.

3.1.3 Early Archaic

Collins (1995:383) dates the Early Archaic from 8800 to 6000 BP in central Texas, with three divisions based on projectile point types, while Hester (1995:436–438) identifies the Early Archaic with Early Corner-Notched and Early Basal-Notched dart points, roughly dating between 7950 to 4450 BP. Bulverde and Calf Creek projectile points are present in the region. The extinction of large herds of megafauna and the changing climate at the beginning of the Holocene stimulated a behavioral change by the Prehistoric inhabitants of South Texas (McKinney 1981). While the basic hunter-gatherer adaptation probably remained intact, an economic shift away from big game hunting was necessary. In general, more intensive exploitation of local and smaller resources in Central Texas—such as deer, fish, and plant bulbs—is indicated by greater densities of ground stone artifacts, fire-cracked rock cooking features, and more specialized tools such as Clear Fork gouges and Guadalupe bifaces (Turner and Hester 1999:246, 256). Weir (1976) speculates that Early Archaic groups were small and highly mobile, an inference based on the fact that Early Archaic sites are thinly distributed and that diagnostic projectile point types are seen across a wide area, including most of Texas and northern Mexico. Story (1985) believes that population densities were low during the Early Archaic, and that groups consisted of related individuals in small bands with “few constraints on their mobility” (Story 1985:39). Their economy was based on the utilization of a wide range of resources, especially such year-round resources as prickly pear and lechugilla, as well as rodents, rabbits, and deer (Story 1985:38).

Sites in or near Bexar County with Early Archaic components include Hausman Road (41BX47) (Tennis 1996), Richard Beene (Thoms et al. 1996), several located on Camp Bullis in northern Bexar County (Gerstle et al. 1978), and at Choke Canyon (Hall et al. 1986). Collins (1995:Table 2) recognizes six sites near 41WN88 that have high-integrity Early Archaic components resting on stable landforms: Loeve-Fox, Richard Beene, Sleeper, Jetta Court, Youngsport, Camp Pearl Wheat.

3.1.4 Middle Archaic

Collins (1995:383) defines this intermediate interval of the Archaic as lasting from about 6000 to 4000 BP in Central Texas, but Hester (1995:438–441) suggests that the period between 4450 and 2350 BP more correctly reflects the Middle Archaic in South Texas. The Middle Archaic appears to have been a time of increased population, based on the large number of sites from this period in South and Central Texas (Story 1985:40; Weir 1976:125, 128). The reasons for this increase are not known, but the amelioration of a very dry period (Altithermal) during the Early Archaic is often seen as the prime mover (Sollberger and Hester 1972:338; Story 1985:40). Weir (1976:126) suggests that as the climate became moister, deer and acorn thrived in Central Texas, attracting groups at least seasonally from all other regions of Texas. And, although he is discussing the Early Archiac, McKinney (1981:114) suggests that as the climate became drier, Central Texas groups, as well as groups from other regions used to arid conditions, would have moved into the Central Texas Hill Country.

A wide variation in projectile point styles at the Jonas Terrace (Figure 3-4) site suggest "a time of ethnic and cultural variety, as well as group movement and immigration." (Johnson 1995:285). On the South Texas Plains, exploitation of widely scattered, year-round resources such as prickly pear continued (Campbell and Campbell 1981:13–15), as did hunting deer and rabbit. However, a shift to concentrated, seasonal nut harvests in the riverine environments of the Balcones Escarpment seems to have occurred (Black 1989b; Hall 1998). Weir (1976) believes that an expansion of oak on the Edwards Plateau and Balcones Escarpment led to intensive plant gathering and acorn processing. He also believes that the widely scattered bands prevalent in the Early Archaic now began to coalesce, at least during the acorn-gathering season, into larger groups who shared the intensive work of gathering and processing the acorn harvest (Weir 1976:126). Many researchers believe burned rock middens are a result of this endeavor (Creel 1986; Prewitt 1991; Weir 1976). Other investigators doubt this conclusion (Black et al. 1998; Goode 1991), but the exact processes that formed the burned rock middens are still a matter of controversy (e.g., Black et al. 1997; Leach and Bousman 1998; Mauldin et al. 2003).

The common presence of deer remains in burned rock middens encourages the view that deer processing took place at burned rock midden sites (Black and McGraw 1985:278; Nickels et al. 1998; Weir 1976:125). Bison bone is encountered in archaeological sites in Central and South Texas, at least occasionally, during all but the earliest part of the Middle Archaic (Dillehay 1974).

There has been a tendency to equate presence of burned rock middens with absence of bison (Prewitt 1981b); however, examinations of several recent faunal reports show that after about 4500 BP bison and burned rock middens are contemporaneous, at least in the southern Edwards Plateau and northern South Texas Plain (Meissner 1993). Collins (1995:Table 2) recognizes only one site in Central Texas that has a high-integrity Middle Archaic component resting on a stable landform. Cemeteries make their first appearance during this period, suggesting a movement toward less mobility and perhaps territorialism. One of the earliest occurrences dating to the South Texas Middle Archaic (Hester 1995:439–440) is Loma Sandia which dates between ca. 2550 and 2750 BP (Taylor and Highley 1995).

3.1.5 Late Archaic

Collins (1995:384) dates the final interval of the Archaic in Central Texas to approximately 4000–800 BP, while Hester believes the Late Archaic in South Texas may better be defined as 2350–1250 BP. Some researchers believe populations increased throughout the Late Archaic (e.g., Prewitt 1985), while others feel populations remained the same or fell during this period (Black 1989a:30). Prewitt (1981a:80–81) asserts that the accumulation of burned rock middens nearly ceased during the course of this period; however, recent excavations provide evidence that large cooking features up to 15 m in diameter were still very much in use, and indeed became more prolific in the following Late Prehistoric period (see Black et al. 1997;

Mauldin et al. 2003). Subsistence is assumed to have become less specialized on acorns in favor of a broad spectrum subsistence base (Black 1989a:30). By about 1450 BP, bison had again disappeared (Dillehay 1974). Story (1985:44–45) believes the presence of cemeteries at sites such as Ernest Witte in Austin County (Hall 1981), Hitzfelder Cave in Bexar County (Givens 1968a, 1968b), and Olmos Dam, also in Bexar County (Lukowski 1988), indicates that Late Archaic populations in Central Texas were increasing, and the indigenous groups were becoming perhaps even more territorial than during the Middle Archaic.

Although inhabitants of the South Texas Plain near Brownsville and Rockport had begun to make pottery by about 1750 BP, the northern part of the plain was still “pre-ceramic” until 1,000 years later (Story 1985:45–47). Late Archaic points tend to be much smaller than Middle Archaic points. The most common are Ensor and Frio types (Turner and Hester 1999:114,122), both of which are short, triangular points with side notches. The Frio point also has a notched base (Turner and Hester 1999:122). Collins (1995:Table 2) recognizes three sites within Central Texas with high-integrity Late Archaic components resting on stable landforms: Anthon, Loeve-Fox, and 41TG91.

3.1.6 Transitional Archaic

A late subperiod or interval of the Late Archaic is frequently referred to as the Terminal Archaic or Transitional Archaic. Weir (1976) defines the Terminal Archaic as 1650–1150 BP, while Turner and Hester (1999) cite data placing the Transitional Archaic at 2250–1250 BP. Although Hester may lump current data into a Late Archaic period, he cautions that more evidence will likely result in what may be termed as a “Terminal Archaic” period during the latter part of the Late Archaic in South Texas. This Terminal Archaic period is represented by diagnostics such as Ensor, Frio, and Matamoras points, which appear to overlap the Late Archaic and Late Prehistoric periods (Hester 1995:442). Weir (1976) believes this marked a transition period to localized area sites, a disappearance of burned rock middens and bison, and a reappearance of highly mobile hunters and gatherers. Others (Black and McGraw 1985; Peter 1982; Skelton 1977) argue that in some locations burned rock middens did not disappear, and sites were more intensely occupied during the Transitional Archaic period.

3.1.7 Late Prehistoric

The term “Late Prehistoric” is commonly used to designate the period following the Late Archaic in Central and South Texas. Generally, the Late Prehistoric period is thought of as spanning the period between AD 700 and 1530 (Collins 1995; Hester 1995). Two distinct phases recognized within the Late Prehistoric are the Austin and Toyah.

Collins (1995:385) recognizes that the commonly used date of 1200 BP for the end of the Archaic and beginning of the Late Prehistoric in Central Texas is arbitrary, and Hester (1995:442) acknowledges the problematic issue of selected tools appearing at both Late Archaic and Late Prehistoric sites. A series of distinctive traits marks the shift from the Archaic to the Late Prehistoric period, including the technological shift to the bow and arrow and the introduction of pottery to Central Texas and the northern South Texas Plain (Black 1989a:32; Story 1985:45–47). Most researchers agree the early Late Prehistoric period was a time of population decrease in Central Texas (Black 1989a:32).

Austin Phase

During the Austin phase, there appears to be a subtle transition from expanding-stem projectile points that may have been used as dart points, as well as early arrow points (e.g. Edwards point). The most prevalent point found in Austin phase sites is the Scallorn arrow point. Though small burned rock middens associated with Scallorn and Edwards points have been found (Goode 1991:71; Houk and Lohse 1993:193–248), they are rare. Settlement shifts into rockshelters such as Scorpion Cave in Medina County (Highley et al. 1978) and Classen Rockshelter in northern Bexar County (Fox and Fox 1967) have been noted (Shafer 1977; Skinner 1981). Cemeteries from this period often reveal evidence of conflict (Black 1989a:32). For example, an excavation of a burial just north of San Antonio (41BX952) revealed an Edwards point between two lumbar vertebra (Meissner 1991), and six human skeletons were exhumed from the Leove-Fox site in Williamson County "with arrow points (all of the Scallorn type) in such a manner as to suggest that the penetration of projectiles was the cause of death" (Prewitt 1974:46, 1981b). Nearby sites from the Austin phase include Quinta Medina (Guderjan et al. 1992, 1993) and Panther Springs Creek, 41BX228 (Black and McGraw 1985). Collins (1995:Table 2) recognizes eight Central Texas sites with high-integrity Late Prehistoric components resting on stable landforms: Loeve-Fox, Frisch Auf!, Smith, Rush, Mustang Branch, Rocky Branch B, and Currie.

Toyah Phase

Beginning rather abruptly at about 650 BP, a shift in technology occurred. This phase is characterized by the introduction of blade technology, the first ceramics in Central Texas (bone-tempered plain wares), a shift from an expanding-stem point type to a narrow contracting-stem point type called "Perdiz," and alternately-beveled bifaces (Black 1989a:32; Huebner 1991:346). The Perdiz arrow point may best represent the appearance of a distinct culture in South-Central Texas that lasted for about 300 years, which archaeologists have labeled the Toyah phase.

Prewitt (1985) and Black (1989a) suggest this technology encroached from North-Central Texas. Patterson (1988), however, notes the Perdiz point was first seen in Southeast Texas by about 1350 BP, and was introduced to the west some 600–700 years later. Hester (1995:444) recognizes this phase as the "best documented Late Prehistoric pattern" throughout South Texas, with dates ranging from ca. 650/700 to 300/350 BP (AD 1250/1300 to 1600/1650).

Johnson (1994) argues that the beveled knives and blades seen in South-Central Texas are the same as those seen in the archaeological record in western Oklahoma and Kansas, and may temporally precede Toyah deposits in Texas. Johnson suggests that the Perdiz point seems to have had its origin along the western periphery of the Edwards Plateau, and perhaps its advanced technology spread quickly. Although its style is unique, and some would argue that style is the indicator of change (e.g. Sackett 1989; Weissner 1983), Johnson (1994) offers that it was functionally designed to hunt bison. He believes the piercing point would have been ideal if shot in adequate numbers to make the bison slowly bleed to death. The Perdiz is widely found throughout Texas, and often associated with bison kills (e.g., Ricklis and Collins 1994). Apparently intrusive arrow points in Toyah assemblages include Fresno points from the North Texas area.

In addition to Perdiz points, evidence of a Toyah culture is manifested as bone-tempered pottery, bone spatulates, awls, and beads, stone endscrapers, beveled knives, and expediently utilized flakes. Briefly, expedient lithic technology involves removing flakes from a core in a nonstandard manner; the purpose is to knock off sharp flakes for immediate use, selecting the ones that best suit the need at the time. This technology differs from formal, standardized core reduction and the manufacture of formal, usually bifacial tools. Expedient lithic technology is a continent-wide phenomonon indicative of increased sedentism, and is observed in Toyah assemblages in Texas.

In the late 1940s, J. C. Kelley (1947a, 1947b) identified the Perdiz arrow point with what he termed the Toyah foci. Six years later, Jelks (1953) demonstrated that in general, Austin-foci Scallorn were found underlying Toyah-foci Perdiz and Cliffton arrow points in the Blum Rockshelter. A few years after that, Suhm (1957) confirmed the predominance of Perdiz and Cliffton points as characteristic of the Toyah assemblage, vertically positioned over Austin foci Scallorn points.

Jelks' Toyah traits include: Perdiz and Cliffton arrow points, double-pointed and beveled knives, gravers, small drills, stone side-scrapers, expedient scrapers, crude bifaces, bison bone scrapers, deer bone spatulates, bone awls, Leon Plain and possibly intrusive pottery, ground stone, hematite pigment, worked mussel shells, smoothed antler tines, pendants, tubular bone beads, fishhooks, and needles, along with perishable wood and grass/mat items (Jelks 1962:86–90).

In Jelks' opinion, "the Toyah focus probably came to an end during the Late Prehistoric period, at which time it was replaced over much or all of Central Texas by a short-lived complex of artifacts that included triangular arrow points, Goliad Plain pottery (described by Monger 1959:164–165), and probably other distinctive artifact styles. This hypothetical complex—if it actually exists—may represent the archaeological remains of the historic and protohistoric Tonkawa and/or Jumano Indians" (1962:99).

The issue is whether the Toyah phase seen in the South-Central Texas archaeological record is a result of a group of people moving into the region, or of adapted technologies from the region's periphery. Johnson (1994) has provided a synthesis of Toyah phase archaeological sites in the region and has argued that the Toyah remains represent groups of people attracted to and following herds of bison. Indeed, there is evidence of bison returning in large numbers to South-Central Texas around the beginning of the Toyah phase (Dillehay 1974).

The argument that Toyah populations adapted to bison hunting is rather convincing in terms of the artifacts. Bone implements and stone perforators were presumably used for penetrating hides, while the commonly occurring stone endscrapers were thought to be used to prepare the hides (Creel 1991). If, as Johnson argues, bison were sought as a highly ranked resource in the diet, they must have attracted an influx of people from all around the periphery of South-Central Texas.

Steele and Assad-Hunter (1986) argue for the occurrence of a distinct change in diet between the Late Archaic and the Late Prehistoric components in two sites in the Choke Canyon Reservoir area in South Texas. Analysis of the number of identified specimens (NISP) shows a marked increase in artiodactyla elements present during the later part of the Late Prehistoric, an increase largely due to the addition of bison to the "menu" (Steele and Assad-Hunter 1986:468). Huebner (1991) suggests that the sudden return of bison to South and Central Texas resulted from a more xeric climate in the plains north of Texas, and increased grasses in the Cross-Timbers and Post Oak Savannah in North-Central Texas, forming a "bison corridor" into the South Texas Plain along the eastern edge of the Edwards Plateau (Huebner 1991:354–355). Sites from this period frequently have associated bison (Black 1986; Black and McGraw 1985; Henderson 1978; Hulbert 1985; Prewitt 1974).

Although bone-tempered pottery with stick-brushed exteriors is considered diagnostic to Toyah, intrusive wares are also present. Sometimes found are asphaltum-coated sherds, a Karankawan, Texas Gulf Coast tradition. Some of the vessels found at Toyah sites are identical in decoration to Northeast Texas Caddoan vessels. Others show a Jornada Mogollon influence, particularly ollas, while others appear very similar to the Los Angeles type found in Sierra de Tamalipas. In many cases, the jars found at Toyah sites contain residue, presumably from boiling bones for grease. The faunal assemblages would seem to support this presumption, as most are severely splintered, crushed, and broken. The fact that crushed bone appears in much of Toyah pottery may not be a coincidence (Hester 1995).

Attempts at estimating prehistoric populations in the region are questionable; however, Johnson (1994) has reviewed the site sizes and campfires and/or structures associated with Toyah sites and argues that they were normally organized in bands of perhaps three or four matrilocal families. He surmises that because these groups were seasonally following the bison in fall and winter, and then pursuing other abundant plant and animal resources available seasonally, there was no need to increase their population; because they were wandering and coming into constant contact with both adequate food resources and neighboring bands, there was no need to organize patrilocally in order to claim territories, and brides were always available.

The only archaeological evidence that domesticated plants were ever introduced into South or Central Texas is a single corncob found in Late Prehistoric context in Timmeron Rockshelter in Hays County (Harris 1985), one found during excavations in Kyle Shelter in Hill County (Jelks 1962:113–114), and Zea mays remains at the Wild Turkey Midden (41MI8) in Mills County (Holloway 1988:4, 8). There simply is not enough evidence to postulate there was ever a significant presence of maize in the area. The arrival of the Spanish during the later Protohistoric/Historic period brought significant cultivars to South and Central Texas.

3.2 Protohistoric And Historic Chronology

The cultural context for the historic groups in the area of study is largely conditioned by the presence of outside ethnic groups and regional power struggles. Linguistically, early Protohistoric accounts of the late 1500s indicate that a large group that spoke Cohuilteco inhabited the area now known as South-Central Texas. Coahuiltecan is a term coined by Mexican linguists in the 1800s, and the name refers to the many small bands of Native Americans who lived in northeastern Coahuila, Mexico, and South Texas. However, today's language researchers (e.g., Campbell and Campbell 1981) now believe that the term is too generic, and in fact there may have been hundreds of different languages and dialects spoken by the many small groups in the region. The numerous small groups of Coahuiltecans encountered by the early explorers and later Spanish intrusions are addressed in many sources (Campbell 1983; Campbell and Campbell 1985; Hester 1989a, 1989b; John 1975; Newcomb 1961; Swanton 1952). The various later intrusive groups, such as Tonkawa, Lipan Apache, and Comanche, are also described by numerous researchers (Ewers 1969; Hester 1989a, 1989b; Johnson and Campbell 1992; Jones 1969; Kelley 1971; Newcomb 1961, 1993; Sjoberg 1953a, 1953b). By most accounts, the Coahuiltecans were rapidly dispersed or killed during the Protohistoric period.

The end of the Late Prehistoric and beginning of the Historic period in both Central and South Texas is characterized by written accounts of European contact with indigenous groups. The Protohistoric period begins in 1528, when Spanish explorer Cabeza de Vaca traversed parts of Southeast and South Texas and left a diary of his five years spent traveling among the hunter-gatherers of Texas and northern Mexico (Covey 1961). Cabeza de Vaca's account of his stay with the Miriami in 1533–34 indicates that groups of Native Americans would normally tether themselves to the easily exploitable riverine environments in the fall, winter, and summer, occasionally sending a hunting party onto the grasslands to hunt deer. In the summer, many groups would live near each other in the semiarid environs of South Texas to harvest prickly pear pads and other succulents (Campbell and Campbell 1981:13–37).

In 1542, Francisco Vasquez de Coronado entered the Texas Panhandle with hopes of finding riches (Flint et al. 2004; Winship 1896); the same year, after assuming command from Hernando de Soto, Spanish explorer Luis de Moscoso Alvarado ventured into Northeast Texas and encountered Caddoan-speaking groups before turning back (Weddle 2011). In 1568, Englishman David Graham returned from Mexico to Nova Scotia passing inland along the Texas Gulf Coast (Cutrer 1985:7–12).

By the 1540s and 1550s, Spanish ranchers had established large ranches in northern Mexico, with several hundred thousand cattle, using Native Americans as slave labor. Large mining ventures in northern Mexico did the same. This encroachment from the south forced Native Americans to escape into the South-Central Texas region. The Spanish pushed into New Mexico and made Santa Fe the capital in 1598. Their harsh treatment of the natives led to the Pueblo Rebellion of 1680. The Spanish and a few loyal native groups fled to the El Paso area and established Isleta Pueblo, but left behind thousands of horses, which provided mobility that would significantly disrupt groups in South-Central Texas forever. Although a few daring Apache had escaped slavery in New Mexico before the rebellion, they now owned a means of transportation that would allow them to hunt and raid with a vengeance. By the mid-1700s they had encroached through the plains of the Texas Panhandle and were taking over hunting grounds in Central Texas (Chipman 1992).

Meanwhile, the Spanish missions in San Antonio were well established and were taking in refugee bands being pushed out by the Spanish and Apaches (Chipman 1992). By the late 1700s the Comanche had acquired horses and swept out of the Rockies southward, for a time allying with the Wichita of western Oklahoma, and forcing the Apache to seek an alliance with their enemy, the Spanish. The alliance culminated in an attack and destruction of Mission San Sabá near Menard, Texas, in 1758. The establishment of the mission, at the request of the Apaches, infuriated the Comanches and Wichita allies. They attacked with not only bow-and-arrows, but also with French-made muskets (Hindes et al. 1995; Weddle 1964). By that time the French and English were encroaching from the east, and establishing trade relations with the natives up and down the Red River (Morris 1970:80–81).

The period between de Vaca's written account and the advent of Spanish missions around San Antonio and East Texas in the late 1600s and early 1700s is referred to as the Protohistoric; a time when few, scant written documents exist detailing Native American life outside the missions, and those that do exist are written from a Eurocentric point of view. The Historic period then, is generally thought of as beginning in the 1700s. Collins (1995:386–387) offers that the Historic period begins ca. 260 BP in central Texas. However, in South Texas Hester (1995:450–451) agrees with Adkins and Adkins (1982:242) when he suggests that the indigenous groups may have been affected by European influence, but we are only able to observe the materials in the archaeological record because the written accounts simply are not available. He would rather label this largely unknown period "Protohistoric."

At the beginning of the seventeenth century, many Native American groups in South Texas were being pushed northward by continual Spanish expansion. By the mid-seventeenth century, a new pressure on the tribes indigenous to the area began to come from the north: a nomadic group, the Apache adapted to a Plains-lifeway of nomadic bison hunting, especially once they acquired horses from the Spaniards (Campbell and Campbell 1985:27). Later, the Apaches were displaced by the Comanches from the High Plains of Texas (Campbell 1991:111).

A combination of migration, demoralization, intergroup conflict, disease, and death due to warfare fragmented the native groups, and forced continual mixing and remixing among them (Bolton 1915; Campbell 1975, 1991:345; León et al. 1961). Most of the native languages have been lost, although recent attempts at reconstruction are enlightening (e.g. Johnson 1994; Johnson and Campbell 1992). The establishment and relocation of Spanish Catholic missions along the San Antonio River in the late 1600s and early 1700s induced many groups to seek the relative comfort and protection offered by a sedentary, apparently well-fed, and peaceful coexistence (Campbell and Campbell 1985; Chipman 1992; de la Teja 1995; Habig 1968a, 1968b; Hard et al. 1995; Inglis 1964). Although fear of the invading Apache and Comanche pressured many of the indigenous tribes to seek the protection of missions, they were now exposed to the exploitation of the Spanish (Campbell 1975:2, 1991:346–347).

Few landowners dared to live on their outlying lands until about 1749, when a treaty with the Apaches brought peace for a while (de la Teja 1995:100). Apaches continued to range over the area between San Antonio and Laredo until the early 1800s, pushed southward by the invading Comanche who had moved into the Hill Country of Central Texas (Campbell and Campbell 1985:27). Weary of warfare with the Comanche, a few Apaches were beginning to seek asylum in the missions (Bonilla 1904[1772]:50; McGraw and Hindes 1987:367).

In the autumn of 1785, a peace treaty established in Santa Fe between the Don Juan Bautista de Anza, representing the Spanish Crown, and Cuera (Leather Jacket), representing the Comanches. The treaty signaled the opening of a period of peaceful coexistence in what is today Bexar County, in which Comanches brought hides, meat, and tallow to San Antonio to trade for goods and services not available elsewhere, such as blacksmithing and gun repair (Fehrenbach 1983:221–224; Poyo and Hinojosa 1991:125–126). The few Comanches who entered the missions were apparently women and children who were captured during punitive raids by Spanish soldiers (Campbell and Campbell 1985:26).

The Historic period is best documented by the records of Spanish priests in charge of the missions. Campbell and Campbell (1981) list dozens of named groups who entered the San Antonio missions at one time or another. The documents also speak of European-induced disease that decimated entire groups both within and outside the missions. In this time of turmoil, groups were forced to meld together to survive. Attacks by various Native American groups impeded westward settlement until around 1836, when Texas gained its independence from Mexico and Texas Rangers offered better protection (Leffler 2001). Although peace was declared under a treaty with the Comanche in 1845, continued attacks occurred to Euroamerican settlers pushing westward, taking farm and ranchlands that were once hunting grounds (e.g., Wilbarger 1985[1889]).

3.3 San Antonio Mission Ranches

Ranching activities in Texas, with their beginnings in the early 1700s and continuing over the past nearly 300 years, are a unique and largely unexplored part of Texas history. Although some of the earlier entradas from Mexico into Coahuila y Tejas in the late 1600s and early 1700s brought livestock with them, the first major cattle drive into today's modern Texas began in 1721. Jack Jackson in his excellent and award-winning book, Los Mesteños, recognizes the Marques de Aguayo's entrada of that year as the beginning of ranching in Texas. Aguayo crossed the Rio Grande with 4,800 Castillian cattle, 6,400 sheep and goats, and 2,800 horses (Jackson 1986:11). With the establishment of two new missions and the relocation of three others from East Texas along the San Antonio River in the first quarter of the 1700s, ranching became a major livelihood and food source for Native American neophytes, or mission converts, as well as new settlers on the largely unsettled frontier.

The few diaries, land grants, and entrada accounts fall far short in describing the everyday trials, tribulations, and pleasures experienced by the tenders of herds at the outlying mission ranch headquarters for the five major missions along the San Antonio River. Each mission was provided vast lands for grazing herds of horses, cattle, sheep, and goats. Because the lands were so vast and stretched several leagues (1 league=2.63 miles) from the missions proper, each mission had a ranch headquarters. The lands called *el monte*, and later *Monte Galván*, were the ranchlands belonging to Mission Valero (the Alamo). They extended from San Antonio east toward Cibolo Creek. Their southeastern boundary and ranch headquarters are believed to have been located near Randolph Air Force Base, Universal City, Texas. The exact location of the ranch headquarters is unknown, and is yet to be found by modern-day researchers. Mission Valero held possession of a second large tract of land in modern-day Atascosa County, south of San Antonio. The ranch headquarters there was called *La Mora*. Its location is surmised, but has not been confirmed by archaeological investigations.

The ranch lands for Mission San Juan Capistrano consisted of around 60,000 acres and lay more southeast of San Antonio, and again stretched to Cibolo Creek in modern-day Wilson County. As with Monte Galván, the location of San Juan's ranch headquarters (if there was one) is unknown. Mission San José's lands extended west and southwest of San Antonio around Pleasanton and Poteet, and were named *El Atascoso*. The ranch headquarters location is unknown. Of the five or six ranch headquarters that may have existed, only one has been documented through archaeology—*Las Cabras*. Las Cabras (the goats) was the ranch headquarters for Mission Espada. It is located near present-day Floresville, Texas, southeast of San Antonio along the San Antonio River (Cargill et al. 1998).

Misión de Nuestra Señora de la Concepción was established in East Texas in 1716 and relocated to the San Antonio River in 1730. Mission Concepción's ranch lands lay east of San Antonio and consisted of approximately 15 square leagues (66,426 acres) that stretched from San Antonio to east of Cibolo Creek. The vast property was called *Rancho del Paistle* (Moss Ranch). The southern boundary of Concepción's lands ran on a line from San Antonio to about where the modern-day community of Sutherland Springs now thrives. Accounts as to the occupation of the headquarters differ. For example, in 1761 after an attack by Native Americans on a ranch further south on the Cibolo, soldiers reported that upon arriving at del Paistle it was deserted (Thonhoff 1992:62). Yet, by 1762 the ranch had "several houses for the caretakers who looked after the two hundred mares, one hundred and twenty horses, six hundred and ten head of cattle, and twenty-two hundred sheep and goats" (Casteñeda 1939:6–8). There is no doubt that the middle 1700s Spanish documents substantiate the existence of a ranch headquarters for Mission Concepción. It is described as "12 leagues" from the mission proper on the San Antonio River, near Cibolo Creek. Rancho del Paistle is believed to be located near Sutherland Springs (Nickels 1998).

However, the political turmoil that permeated early Texas caused the near-complete European desertion of the area that followed the Mexican War for Independence in 1821 (Fehrenbach 1983). The regularly traveled La Bahia Road between San Antonio and Goliad encouraged further settlement, so that after the Texas revolution in 1836, the newly formed government of Texas gave land grants that were large, consisting of around 5,000 acres for each property, and cattle ranching became prevalent (Jackson 1986). Around 1840 settlers from Germany and Alsace-Lorraine, and from other regions of the United States, began to flood into San Antonio. Many of the Germans moved into the Hill Country to the north, settling into communities, and raised sheep or cattle (Freeman 1994:5–9).

The rich farm and ranch lands around prompted an influx of Anglo settlers from the southern United States, as well as Germans and Poles from Europe during the decade of the 1850s. As the sheep and cattle markets emerged in the 1880s, ranchers and farmers settled farther away from San Antonio (Flanagan 1974; Lehmann 1969; Nickels, Pease, and Bousman 1997), and open range cattle ranching dominated the economy until 1884, when it became illegal in Texas to cut the newly patented barb wire fencing (McCallum and McCallum 1965). Since then, the introduction of twentieth-century technologies such as mills and improved methods of production have shaped the area as it exists today (Fox et al. 1989).

3.4 Historical Background For Site 41BX256

Sites 41BX256 is located within the northern limits of the Mission Espada *labores,* which were first permanently settled and cultivated in conjunction with the delineation of mission lands starting in the mid-eighteenth century. However, it is apparent both archaeologically and through documentary sources that indigenous groups occupied the area on a temporary or seasonal basis well before that time.

The expedition party of Domingo Terán de los Rios, which was on its way to establish the missions in East Texas, was the first documented European group to traverse the area. They arrived on the west bank of the San Antonio River on June 13, 1691. Terán named the river San Antonio de Padua. They stopped to camp at a large rancheria of Payaya Indians, who Terán wrote, were "docile and affectionate, naturally friendly, and were decidedly agreeable toward us (Hatcher 1932)." They were so friendly, in fact, that Terán perceived they would be receptive to missionizing efforts. The party stayed at the village, called Yanaguana (meaning refreshing waters) by the Indians, the following day because it was Corpus Christi Day. Fray Damian Manzanet, the priest who travelled with Terán and his group, erected a cross in the center of the village and performed religious rites, while Terán and his men distributed rosaries, pocket knives, cutlery, beads, and tobacco. He gave a horse to the chief (Habig 1968b). According to Marion Habig (1968b), the point at which Terán crossed the river was probably located somewhere near Mission San Juan, which would place them roughly at or very close to site 41BX256. Terán's route across the San Antonio River, however, appears to have been idiosyncratic. Most of the later expeditions crossed the San Antonio near its source at San Pedro Springs within present-day Brackenridge Park. The one exception to this may be the Salinas Varona expedition of 1693, which roughly followed the route Terán had taken (Robbins 1998).

Research for this project found no direct documentary evidence to suggest that the land around 41BX256 was visited or occupied permanently by Europeans until the founding of the Espada Mission in 1731. However, there is some indirect commentary by later historians that suggest that there may have been a few non-indigenous families living in the San Antonio area prior to 1718. The first comes from Casteñeda, who in 1935 annotated Morfi's 1783 Historia de la Provincia de Texas (1673-1779) with a note suggesting that the missions were de facto established long before 1718 (Casteñeda 1935). He cites several documents in the Archivo San Francisco el Grande dating to 1716–1718 that suggest that the area was populated by both indigenous populations and a few non-indigenous families (Casteñeda 1935:190). María Ester Domínguez echoes Casteñeda with information derived from a variety of sources. She writes:

> *Curiosamente, ningún reporte de los expediciones o actividades antes del establicimiento de San Antonio hace mención de españoles residiendo en sus vecindades. Mattie Alice Austin dice 'Pero al menos un grupo de familias ha venido independientemente y antes de 1718; por tanto, la fecha se da usualmente como la de fundación debe ser incorrecta.' En el Memorial, Explicación y Defensa presentado por los ciudadanos de la villa de San Fernando al gobernador don Rafael Martín Pacheco en 1787, se dijo 'Es ciertamente evidente y claro que el asientamento de esta provencia de Tejas comensó en el año 15 del siglo presente.' Luego en el año de 1715, algunos colonos de las provencias adyacentes del Nuevo Reyno de León o Monterrey y Nueva Extremadura, Monclova o Coahuila dejaron sus casas, pues habian oído que los indios estaban en paz, y venieron a sentarse en las orillas del rio San Antonio. Miguel Ramos Arispe, en su discurso que presentó en 1812 a los Córtes de Cádiz como representante de Coahuila y Tejas, en el punto 9 decía que Tejas, discubierta y comenzada a poblar por los habitantes de Coahuila desde la mitad del siglo XVII, estuvo sujeta al gobernador de ésta aún en 1720."*
>
> (Curiously no report on the expeditions or activities before the establishment of San Antonio have mentioned Spanish residents in their [this] vicinity. Mattie Alice Austin states 'At the least, a group of families came independently and before 1718; consequently, the usual date for the founding would be incorrect.' In the Memorial, Explicación y Defensa presented by the citizens of San Fernando to the governor Rafael Martin Pacheco in 1787, it is stated. 'It is certainly evident and true that the founding of this province of Texas began in the year 15 of the current century.' Later in the year 1715, some colonists from provinces adjacent to Nuevo Reyno de León or Monterrey and Nueva Extremadura, Monclova or Coahuila left their houses, and hearing that the Indians were peaceful, came to settle on the banks of the San Antonio River. Miguel Ramos Arispe, in an statement he presented in 1812 to the Courts of Cadiz as a representative of Coahuila y Tejas, in point number nine stated that Texas, discovered and populated by residents of Coahuila since the middle of the seventeenth century, was subject to governance beginning in 1720.)

Later in her text, Dominguez notes that by 1715 several families from Monterrey, Saltillo and Monclova, were established at the place the Indians called Yanaguana (Dominguez 1989: 290). Indeed, given that a mission and presidio—San Juan Bautista—were founded on the Rio Grande by 1700, it is not unreasonable to imagine that early ranching families who settled along the Rio Grande concurrent with San Juan Bautista may have reached close to San Antonio during stock grazing forays. One early account suggests that some livestock may have ranged almost to San Antonio. Pedro de Rivera, who was commissioned to inspect the northern frontier in 1724, observed livestock "sufficient to supply a very large settlement" grazing in a pasture at the confluence of the Medina and San Antonio Rivers (Casteñeda 1935). His report was instrumental in the decision to move the East Texas missions to the San Antonio River in 1731 (Blake 2011).

In 1731, three missions were moved from East Texas and reestablished along the banks of the San Antonio. The missions were Nuestra Señora de la Purísima Concepción, San Juan Capistrano, and San Francisco de la Espada. The southernmost mission, Espada, was located nearly 11 miles from San Antonio de Padua (the Alamo), and its lands encompassed site 41BX256. However, despite its official founding date of 1731, the mission buildings and all its ancillary structures were not completed until more than decade later. This may have something to do with its remoteness. Located nearly 11 miles from the center of San Fernando de Bexar, the area around Mission Espada was difficult to access and supply in the mid-eighteenth century. Indeed, the first major construction project associated with Espada to be completed was not the church or the convent, but was the 3.25-mile acequia, built to draw water from the San Antonio River at a dam above Mission San Juan and bring it to the fields around the Mission Espada. This was completed in 1740. In order for the acequia to cross Piedras Creek and a ravine, a stone canal and aqueduct were built, which still carry water today (Cox 2005). The remaining structures quickly followed and by 1772, Mission Espada consisted of a well-built series of structures that included not only the church, convent, and workshops typical of most missions, but also a large granary, a brick kiln, and ample fields that grew grain, beans, peach orchards, and cotton (Almaráz 1989).

The area where site 41BX256 is situated is within the northern portion of the Mission Espada lands. The records are largely silent about the specific use of these outlying mission lands while the mission was active, though it is probable that indigenous groups lived on them in jacales and practiced some basic horticulture. During the desecularization of the San Antonio missions, which began in 1793 and continued through to the 1820s, the land was claimed by the Bustillos family, and is part of a suerte that was originally granted to Domingo Bustillos. Though the first legal document formalizing his ownership is a petition for lands made to the Republic of Texas in 1838, members of the Bustillos family apparently lived on Espada Mission lands for many years before that date. In fact, the 1838 petition states that Domingo Bustillos had been a resident of the land for about 20 years, and that this tract was known as the Rincon del Alamito (Bexar County Deed Records [BCDR] Vol. E1, p. 175). The Bustillos tract is depicted on the Rullman map of San Antonio (Figure 3-2).

Domingo Bustillos was one of five sons of José Antonio Bustillos de Ceballos, who arrived in Texas from Mexico in 1766 (Chabot 1937). José Antonio Bustillos married Maria Margarita de la Trinidad Salinas—a native of San Fernando de Bexar—in 1772. Incidentally, she was a great grand-daughter of Capitán José de Urrutia, who came to Texas in 1691with Domingo Terán de los Rios, was later named captain of the Presidio de Bexar, and who was known as an expert on Indian affairs (Gibson 2009). Bustillos and his wife had ten children born between 1772 and 1786. Jose Domingo Estevan Bustillos (Domingo) was born in 1779. A wealthy family, the Bustillos' later acquired most of the land around Mission Espada after the final secularization of the missions in the nineteenth century (Torres 1997). Alejo and Domingo owned adjacent parcels along the San Antonio within the Mission Espada lands. Jose Antonio (the elder) owned land directly adjacent to the Mission Espada (BCDR Vol. A2, p. 260).

This figure has been redacted due to site sensitive information.

Figure 3-2. John Rullman's ca. 1912 map of properties along the lower San Antonio River (Texas Historic Sites Overlay).

However, a number of sources suggest that the Bustillos family had an interest in Mission Espada lands possibly as early as the 1760s. According to de la Teja, José Antonio Bustillos y Ceballos (the elder) was among those who petitioned the Governor of Coahuila y Tejas for a land grant within the lower mission labores in 1776. At that time, in response to growing pressure from citizens in the expanding town of San Fernando de Bexar to open water rights to the San Antonio River, Governor Ripperdá allowed citizens to apply for land along the San Antonio River south of town. It is not clear where Bustillos received land rights, though it seems likely that the land he applied for was around Mission Espada.

What is certain is that members of the Bustillos family lived on Mission Espada lands by 1800. An 1824 testimony made by José Antonio Bustillos, Jr., claims ownership of a suerte within the lands of the Mission Espada. In the testimony he states that he was a long-time resident of the mission. This is supported by another 1824 document registering land grants, irrigation rights, and payments for lands at the Espada Mission. This document records that one suerte of land was granted to José Bustillos for five pesos (Almaraz 1989). According to Félix Almaraz, the formal distribution of lands surrounding the Mission Espada during the final secularization period of 1824 was intensely competitive, and those lands were generally assigned to individuals who had been long-term residents of the mission. Finally, documents within the Bexar Archives corroborate that Bustillos was active within Mission Espada lands prior to secularization. Included in the archive are an 1810 report of collections from mission Indians, an 1813 request for sugar at Espada, an 1814 report that Bustillos remitted corn to San Fernando de Bexar, an 1816 report documenting receipt of cartridges for the defense of Espada, and an 1818 petition for the return of lost property after one of the Anglo filibustering expeditions. (Benavides 1989).

Like his father Jose Antonio, Domingo Bustillos appeared to be active not only in San Antonio civil administration but also land acquisition near Espada. Domingo served as a soldier and was recommended for military promotion in 1811, he served in the city government in 1817 (San Antonio Express News, 1940), and he was elected to the state congress and served as a judge in 1834. Records also show him petitioning to arrange a survey of land near Espada for Jose Antonio de la Garza, who was a relation by marriage. He married Petra Martinez, a girl more than 40 years his junior around 1835/1836 and they had seven children (Gibson 2009). He died in 1855 and divided his property among his wife and children. At the time of his death, Domingo Bustillos owned not only the suerte on which Rincon del Alamito was located, but also two additional suertes of in the labor de abajo of Mission Espada, 3550 acres of land on Piedras Creek, a house on the main plaza of San Antonio, and a lot along Quinta Street. Teresa Bustillos received a share on the Rincon del Alamito, encompassing site 41BX256. She married Canuto de Rivas in 1857 and they built an adobe house that is still standing today. The house is located along Espada Road and is recorded as 41BX260 (Scurlock et al. 1976).

Heirs of Domingo Bustillos continued to own much of the property in this area well into the twentieth century. Among the descendants of Domingo Bustillos are members of the Rivas and Olivas families, who still owned the land on which 41BX256 was recorded as late as 1960.

Aerial photos from 1962 indicate that the land around 41BX256 was still cultivated at that time. The fields were arranged in long narrow plots coming off the San Antonio, divided by fences and quite possibly lateral irrigation ditches. Notably, those same aerial photographs also depict the original alignment of the San Antonio River, before it was channelized. Based on these, it is evident that both sites were likely truncated by the channelization of the river. Today the land is owned controlled by the National Park Service as part of the San Antonio Mission State National Historic Park.

Chapter 4

Previous Results

4.1 Testing Investigations In 2006

In 2006, GMI conducted test excavations at 41BX256 to clarify the site's research potential and NRHP eligibility. This work included a magnetometry and GPR survey of certain areas (Osburn et al 2007: 112–114) which revealed a geophysical anomaly in the southern portion of the site. In addition to other work on the site, this anomaly was investigated with a mechanically excavated trench (BHT 3) and with two manually excavated and adjoining 1 x 1 m test units. These test units were originally designated as TU 4 and TU 6 and are here referred to as GMI 4 and GMI 6. Within the upper three levels of these units (0–30 cmbs), GMI encountered a mixture of Spanish Colonial ceramic, lithic debitage, and Native American bone tempered pottery. Artifact density in the subsequent level (30–40 cmbs) decreased and then increased again in Level 5 (40–50 cmbs). During the excavation of Level 5 in the two units, a dense concentration of burned clay was encountered and a Langtry point was recovered. GMI designated the large burned clay mass as Feature 4. Continued excavation of the two units revealed that the feature continued to a depth of 70 cmbs. The burned clay mass was encountered in levels 5, 6 and 7 (40–70 cmbs). Based on the diagnostic artifacts collected and a 2σ Cal B.P 5040–4840 date from charcoal collected at 70 cmbs within Feature 4, GMI identified the possibility of three distinct cultural components within the 1 x 2 m test unit (Table 4-1). The upper component consisted of a possible Spanish Colonial occupation; this was underlain by a Late Prehistoric component which was in turn underlain by a Middle Archaic component (Osburn et al. 2007). Given the density of burned clay, GMI's assessment was that Feature 4 was a possible cooking pit utilizing burned clay heating elements as opposed to burned rock Osburn et al. 2007:138).

Table 4-1. Artifacts Encountered within Initial Test Units and Possible Cultural Affiliations.

Level	Cmbs	TU 4 (GMI 4)	TU 6 (GMI 6)	Possible Cultural Affiliation
1	0–10	14 C, 24 L	3 C, 18 L, 1 Maj	Spanish Colonial/ Late Prehistoric
2	10–20	10 C, 12 L	22 C,18 L, 2 GS	Late Prehistoric
3	20–30	12 C, 9 L, 1 dart pt., 1 Co	5 C, 16 L	Late Prehistoric
4	30–40	6 L	4 L	Unknown
5	40–50	18 L	19 L, 1 Langtry pt., 2 GS	Possible Middle Archaic
6	50–60	4 L	5 L	Unknown
7	60–70	4 L	1 L (B.P. 5040-4840)	Early Middle Archaic

Key: C=native American ceramic, L-lithic, pt.=point, Co=core, Maj=Spanish majolica, GS=groundstone

4.2 Data Recovery Excavations In 2008

In 2008, archaeologists from EComm conducted data recovery excavations at site 41BX256. One of the several goals of the excavation of 41BX256 was to further explore the geophysical anomaly designated as Feature 4 that was encountered in GMI's two test units on the southern portion of the site. An associated objective was to clarify the stratigraphy and nature of the cultural components in this area. To accomplish these objectives, a block of units, designated Block 1, was established immediately surrounding the two test units. Block 1 was located at the southeastern portion of the site and was established parallel to and along the southern edge of BHT 3 and juxtaposed on top of and coterminous with GMI's two test units. Block 1 initially consisted of six new 1 x 1-m units (Units 1–6) plus GMI 4 and GMI 6. This 8 m^2 block was expanded with the incremental addition of eight more 1 x 1-m units (Units 13, 37, 38, 40, 41, 51, 52, 53) for an ultimate area of 16 m^2 (Figure 4-1). Twelve of these units were excavated to a depth of 70 cmbs while Units 5 and 13 were excavated to 100 cmbs. Depths of the units were controlled by the establishment of a subdatum set at 100.00 m. In proximity to Block 1 and north of the trench was a second set of non-contiguous units, designated Block 2, which was established to pursue other research objectives not associated with Feature 4.

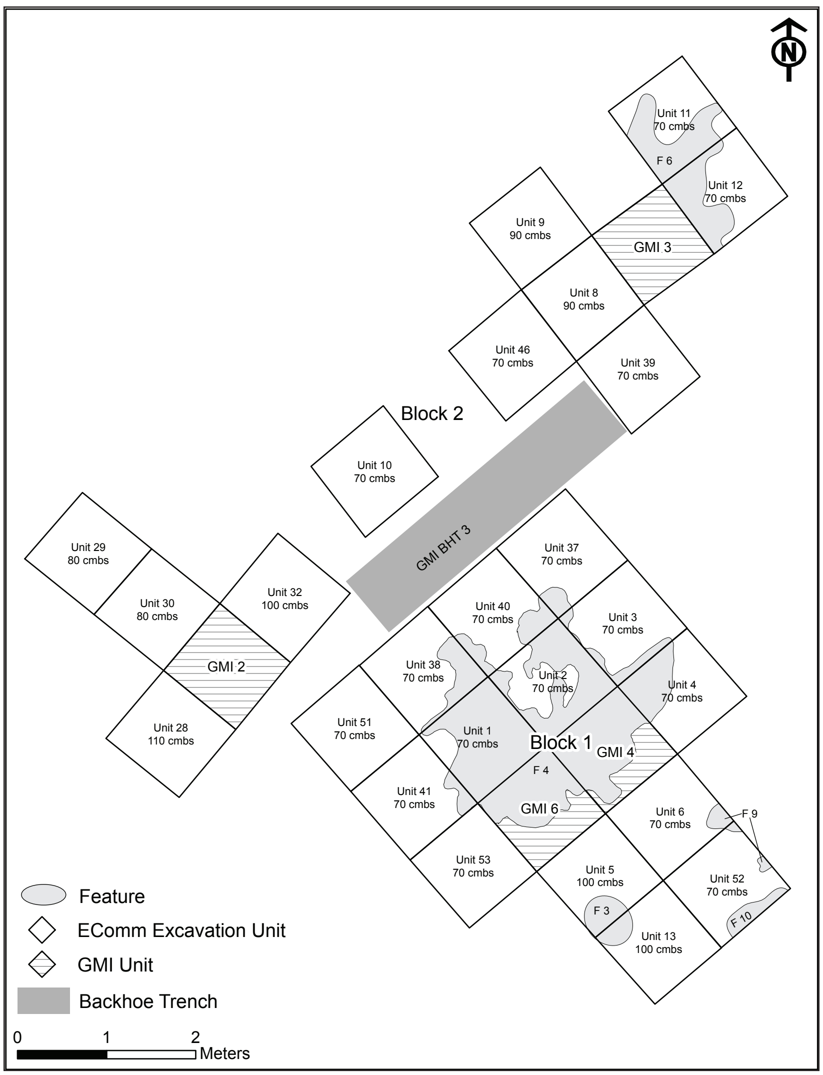

Figure 4-1. Excavation units of Blocks 1 and 2 relative to the two test units and trench.

Disturbances originally observed during the excavation of Block 1 consisted primarily of bioturbation caused by vertical and horizontal root activity. Some animal burrowing was observed, but caused little disturbance. The disturbances were not extensive, and cultural material in Block 1 showed a high possibility of contextual integrity. As an initial measure of overall integrity, the cumulative mean length of complete flakes from

Block 1 was analyzed and is depicted in Figure 4-2. Using the assumption that on occupation surfaces that have been heavily trampled, larger flakes generally remain on the surface, while smaller flakes tend to move downward in the profile, five probable occupation zones were delineated within Block 1. These consist of Zone I at 0–20 cmbs, Zone II at 20–40 cmbs, Zone III at 40–60 cmbs, Zone IV at 60–70 cmbs, and Zone V at 80–90 cmbs (Figure 4-2).

To further identify and define possible occupation zones, pH values were obtained from four soil columns taken from each wall of Block 1. Figure 4-3 illustrates the mean pH values of those four columns. The higher values in the upper 10 cm are likely due to the enriched humus layer. The intermittent peaks in pH clearly show human occupation zones at 15–20 cmbs, 45–50 cmbs, 70–75 cmbs, and again at 85–90 cmbs. These data corroborate the more intense levels of occupation identified in Figure 4-3.

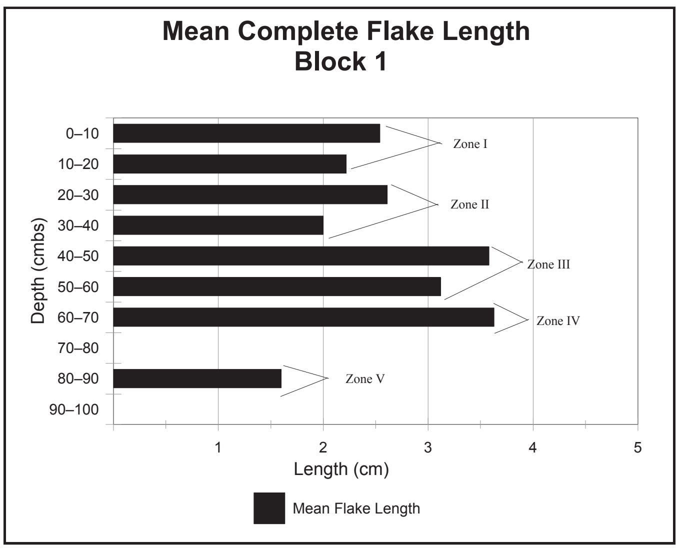

Figure 4-2. Mean complete flake length from Block 1.

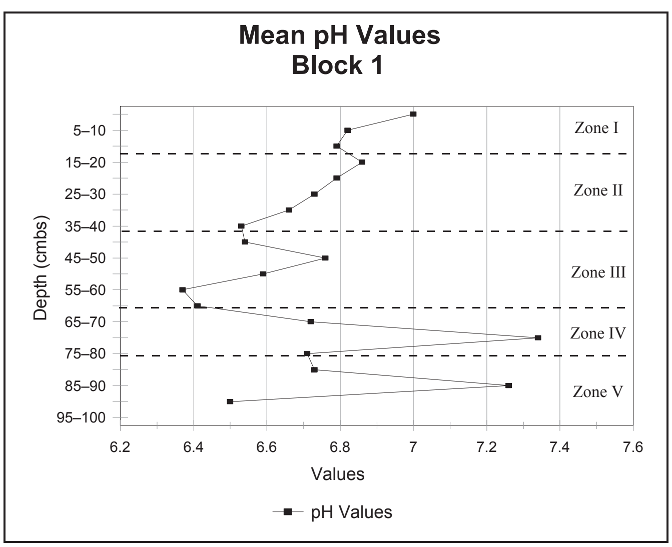

Figure 4-3. Mean soil pH values from Block 1.

Magnetic soil susceptibility samples were also examined for evidence of occupation surfaces. The same samples collected for pH values were also used to asses the magnetic susceptibility of the soil. The mean values are illustrated in Figure 4-4. The trend of increasing values between 0 and 30 cmbs most likely represents the organically enriched A Horizon as well as cultural mixing from plowing, which would facilitate downward translocation of magnetic minerals. The trend of decreasing values below 30 cmbs might reflect steadily decreasing human occupation intensity, although peaks at 40–45 cmbs and at 55–60 cmbs suggest at least some human activity. The steadily decreasing trend containing no marked peaks below 60 cmbs is likely a reflection of well-drained soil. As soon as new magnetic minerals are formed within the soil, they are leached and transported out of the system. Nevertheless, throughout the overall decreasing trend are small but noticeable increases that are likely caused by organics and ashes left behind by humans. These increases are seen at 70–75 cmbs and 90–95 cmbs.

In sum, both the pH and soil susceptibility trends in Block 1 indicate that larger cultural materials such as chipped stone tools and ceramics have not been significantly displaced through time, at least below about 30 cmbs, and are therefore credible chronological markers. Furthermore, the temporally diagnostic artifacts and radiocarbon dates are also chronologically sound in terms of their stratigraphic positions (Table 4-2).

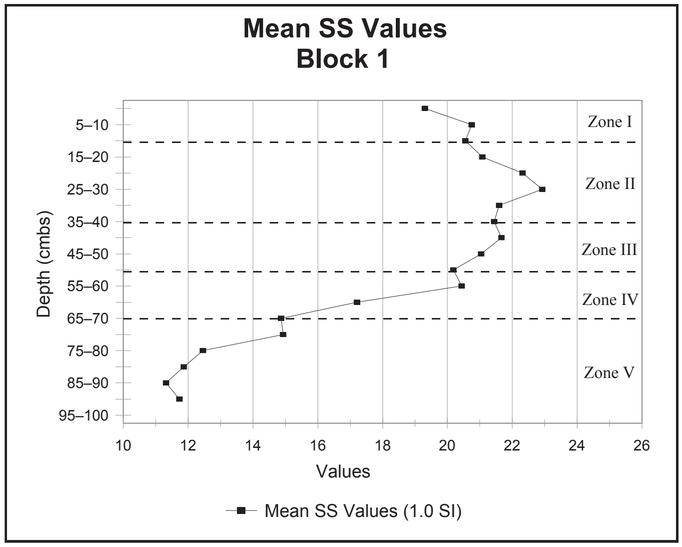

Figure 4-4. Mean magnetic susceptibility from Block 1.

The upper 30 cm contained a whiteware sherd with a maker's mark, a historic lead rifle ball, a Victorian cuff button, Spanish Colonial ceramics, Native American ceramics, and Late Prehistoric points, indicating the degree of mixing that has ocurred in the upper levels (see Table 4-2). Native American ceramics continue into three more levels, 30–40 cmbs, 40–50 cmbs, and 50–60 cmbs; however, only four sherds were found within these lower three levels, as opposed to 203 sherds in the upper three levels. Given the high volume of Leon Plain ceramics in the upper 30 cm, it is assumed that the four sherds in the lower three levels occurred due to bioturbation, and are therefore intrusive in these three levels. Although the Late Archaic is not represented by diagnostic artifacts or radiocarbon assays a separation of components can be seen as high

Table 4-2. Diagnostic Artifacts and Radiocarbon Dates from Block 1.

Depth (cmbs)	Diagnostic Artifacts	Period	Radiocarbon Date cal BP (2σ)
0–10	33 Leon Plain sherds, 1 untypable point, 1 whiteware sherd	Historic/Late Prehistoric/ Protohistoric	–
10–20	92 Leon Plain sherds, 2 Spanish Colonial sherds, 1 Edwards, 1 untypable arrow point	Spanish Colonial/ Late Prehistoric	–
20–30	78 Leon Plain sherds, 1 Spanish Colonial sherd, 1 Perdiz, 1 untypable arrow point (prob. Perdiz), lead rifle ball, Victorian cuff button	Historic/Spanish Colonial/ Late Prehistoric	–
30–40	2 Leon Plain sherds	Late Prehistoric/ Late Archaic?	–
40–50	1 Leon Plain sherd	Late Prehistoric/ Late Archaic?	–
50–60	1 Langtry	Middle Archaic	–
60–70	–	Middle Archaic	5040–4840 (GMI) 5030–5010 and 4980–4840 (EComm)

nodes in complete flake numbers in Figure 4-5. While units located away from Feature 4 display an increase in artifacts, units directly associated with the feature are almost completely devoid of any cultural material at this depth. Based on the dynamics of Feature 4 and artifact distribution (Figure 4-6), it is assumed that the Late Archaic is found at 30–50 cmbs; however it is believed that it is truncated within Block 1. At 50–60 cmbs a Middle Archaic Langtry point was recovered from GMI's Test Unit 6, just above a burned clay feature (GMI Feature 4; EComm Feature 4). Langtry points, commonly found in the Lower Pecos region of Texas, are not very common in South and South- Central Texas. Along with the radiocarbon assays from 60–70 cmbs, this point indicates that level is an intact deposit.

Based on the evidence presented in Figures 4-3 through 4-5, five possible occupation zones were identified. Although Table 4-2 lists diagnostics and radiocarbon dates recovered from Block 1, it does not clearly delineate each cultural component. The cultural components encountered within Block 1 are defined as follows: the Protohistoric and Late Prehistoric are found mixed within the upper 50 cm, underlain by a Middle Archaic component at 50–70 cmbs that is represented by the Langtry point, radiocarbon assays, and Feature 4.

4.2.1 Identification of Cultural Components

During the 2008 excavations of the site, many lines of evidence were considered to identify discrete excavation levels that could confidently be assigned to cultural periods of Central and South Texas. The primary focus of those lines of evidence was to consider the depositional/erosional and subsequent depositional processes that have occurred across all portions of the site over the past several millennia. In some cases, it was clear that turbation from animal burrowing and/or root growth has displaced cultural material in certain areas of the site.

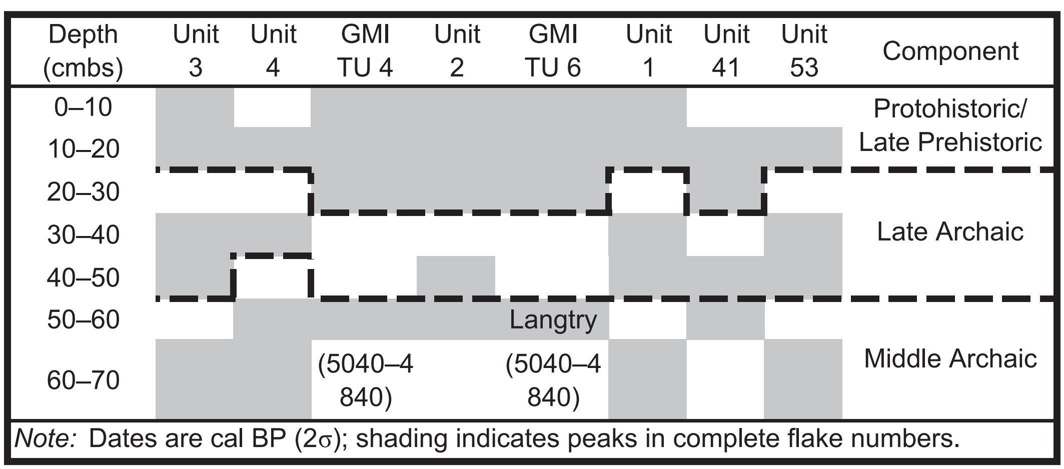

Figure 4-5. Block 1 matrix showing high nodes in complete flake numbers.

Particular attention was given to the possibility of artifacts having been vertically displaced due to vertical cracking of the clayey soils. In addition, the overall frequency distributions of cultural materials were taken into consideration. Those relatively undisturbed levels and data in

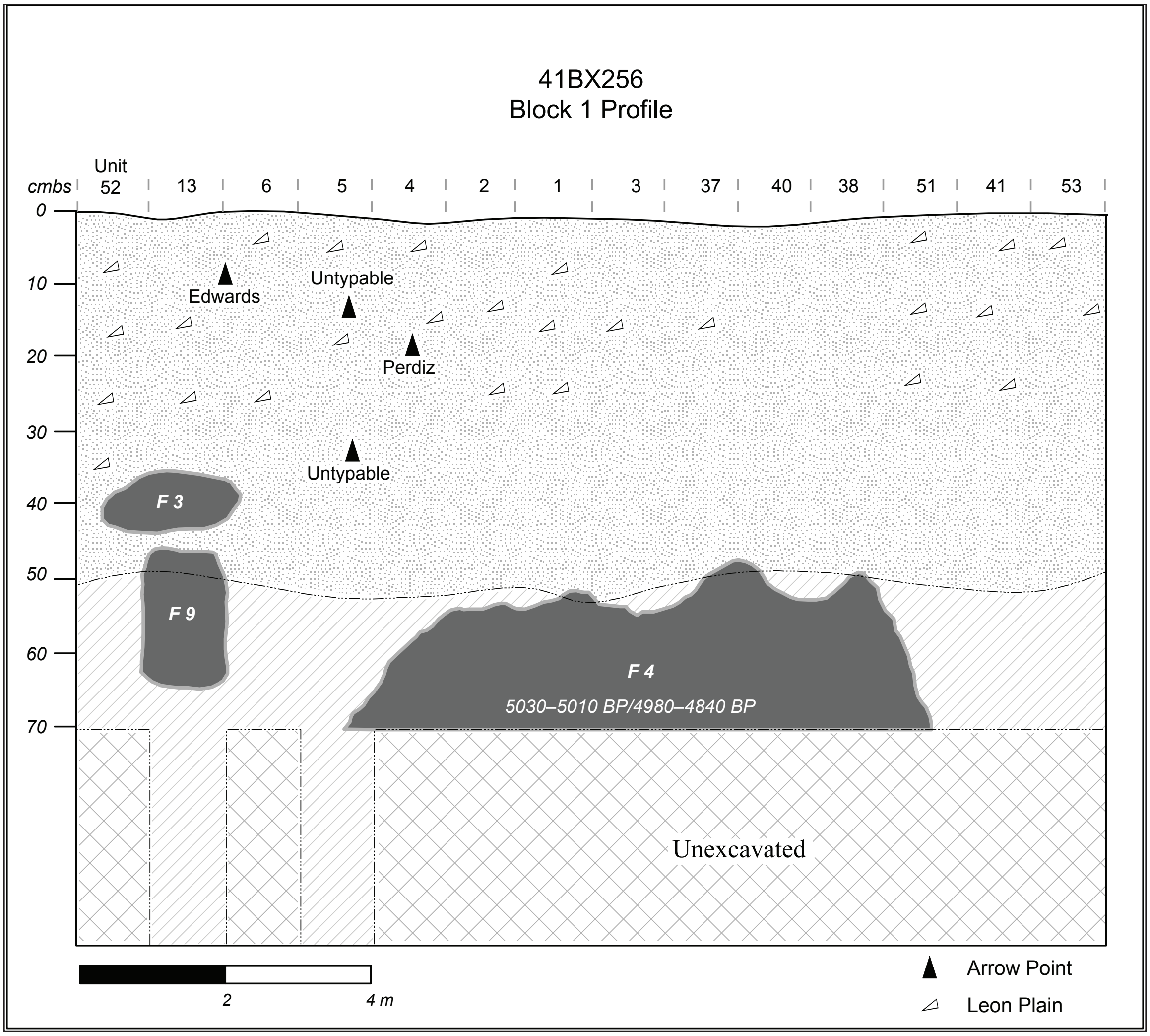

Figure 4-6. Composite profile of Block 1 units showing soil zones, features, cultural materials, and radiocarbon dates.

Block 1 were grouped into analytical units representing a Historic component (1835–present), a mixed Protohistoric and Late Prehistoric component, (consisting of Spanish Colonial as well as Late Prehistoric cultural material, AD 1528–1700 and 1250–250 BP, respectively), and a well defined Middle Archaic component.

4.2.2 Historic Component

A total of 242 nineteenth and twentieth century historic items (not related to the Spanish Colonial period) was recovered from the 2008 excavations of 41BX256. Of those 242 historic items recovered 25 were encountered from Block 1 at various depths, four from level 1, 11 from level 2, nine from level 3, and one from level 4 (Table 4-3). A review of the provenience of items will reveal that these historic items were found in the same upper soil strata with the mixed Protohistoric and Late Prehistoric artifacts, though not in apparent association based on horizontal distribution (Table 4-3).

Table 4-3. Historic Artifacts Encountered in Block 1.

Unit	Level	Artifact	Age Range
1	3	* Musket ball, .42 cal.	ca. 1750–1850
4	2	.22 caliber bullet	Indeterminate
4	2	Metal, heavily rusted (2 each)	Indeterminate
4	3	Metal, unidentified fragments, thin, (3 each)	Indeterminate
4	3	Glass, bottle sherds,slight amethyst hue, slight patina (3 each)	1880–1915
4	3	Glass, bottle sherd, amber, slight patina	1930–present
4	4	Glass, clear with no hue, slight patina (2 each)	1930–present
5	1	Metal, probable toy shovel, non-ferrous, lead?	Indeterminate
5	1	* Whiteware, body sherd with maker's mark, off-white paste	1890–ca.1910
5	2	Screw	1860–present
5	2	Glass,slight amethyst hue, slight patina (2 each)	1880–1915
5	2	Glass, thin, clear with no hue, slight patina	1930–present
5	2	Glass, bottle sherd, thick, light green hue	1880–1920
5	2	Glass, bottle sherd, thick, light green, unidentified embossing	1880–1920
6	1	Glass, clear with no hue, slight patina (4 each)	1930–present
6	1	Metal, unidentified fragment	Indeterminate
6	2	Glass, chimney sherd from lantern	1880–1915
6	2	Glass, clear with no hue, no patina	1930–present
6	2	Glass, bottle sherd, green, no patina	Modern
6	3	Metal, unidentified fragments (15)	Indeterminate
6	3	Glass, bottle sherds, amethyst hue, (11 each)	1880–1915
6	3	Glass, bottle sherd, clear with light green hue, medium patina	1930–present
6	3	Ceramic, historic, glazed terracotta	Modern
6	3	* Cuff button	Indeterminate
41	2	Ceramic, unknown historic body sherd, orange/grey slip	Indeterminate

** selected items described in detail*

Selected unique historic artifacts from Block 1 are described below.

- A thick whiteware sherd with off-white paste and partial maker's mark was recovered from Unit 5, Level 1. The mark reads "C.C.T.P.CO.," with a griffin and "RANITE," presumably referring to semi-granite (Figure 4-7). This is a C. C. Thompson Pottery Company mark used from 1890 to about 1910.

- A molded lead rifle ball was found in Unit 1, Level 3 (Figure 4-8). The lead ball is similar to one that was found in 2008 at 41BX254, in that both have similar attributes, including the caliber, casting seam, and sprue. The only noticeable difference is that this ball has a reddish color on its surface, which may be due to weathering. The rifle ball probably dates to post-1800.

- A cuff button was recovered from Unit 6, Level 3 (Figure 4-9). It is a gold-plated, brass, dumbbell-style front cuff button (Sears, Roebuck & Co. 1897:430, 1902:85). It was fashionable in the Victorian "Gay Nineties," when large ornate buttons of this style with a large jewel in the center were used on coats and cloaks worn as evening wear (Whittemore 1997:29). This cuff button likely dates to the Victorian period, ca. 1890– 1910 or 1920. Front cuff buttons were found advertised in the 1895 Montgomery and Ward catalogues (though none of this particular style), and gold-filled and solid gold cuff buttons of this style were sold in both the 1897 and 1902 Sears and Roebuck catalogues. This particular cuff button most closely matches No. 61,702 in the 1897 catalogue, with its fancy stone setting and decorative, ornamental edges, which sold for $0.30 per pair. This button cuff also has affinities with No. 4R4480 in the 1902 catalogue, which sold for $1.65 per pair, for the shape of its face. The large difference in price may be because the earlier set was gold-filled, and the later set was solid gold.

Figure 4-7. Whiteware sherd with a partial C. C. Thompson Pottery Company maker's mark, Unit 5, Level 1.

4.2.3 Mixed Spanish Colonial/ Protohistoric and Late Prehistoric Components

Figure 4-8. Molded lead rifle ball, Unit 1, Level 3.

Given the extreme mixing of the two phases of the Late Prehistoric and the Spanish Colonial ceramics from the Protohistoric period, the two cultural components (Protohistoric and Late Prehistoric) are discussed as a whole rather than as two discrete components. Diagnostic cultural material associated with the Protohistoric component consists of a unifacial Perdiz point, and 3 sherds of Spanish majolica ceramics. Cultural materials diagnostic of the Late Prehistoric component include an Edwards point and two untypable arrow points (Table 4-4). Two hearth features attributed to these components were recorded. Other cultural material associated with these discrete component levels include: 206 sherds of Native American ceramics, eight bifaces, 11 unifaces, one core, two projectile points, two projectile point fragments, 431 pieces of lithic debitage, and abundant

Figure 4-9. Gold-plated Victorian cuff button, Unit 6, Level 3.

Table 4-4. Protohistoric and Late Prehistoric Proveniences at 41BX256.

Unit	Level(s)	Depth (cmbs)	Feature	Diagnostic Artifacts
1	1–5	0–49		27 LP
2	1–5	0–49		13 LP, 2 Maj.
3	1–5	0–49		6 LP
4	1–5	0–46		5 LP, 1 Perdiz pt.
5	1–5	0–45	3	11 LP, 2 arrow pts.
6	1–4	0–36		25 LP, 1 Edwards pt.
13	1–5	0–45	3	17 LP
37	1–5	0–49		9 LP
38	1–5	0–47		19 LP, 1 untypable dart pt.
40	1–4	0–39		5 LP
41	1–5	0–46		15 LP
51	1–5	0–45		28 LP, 1 Maj.
52	1–5	0–45	10	21 LP
53	1–5	0–46		5 LP

Key: LP=Leon Plain ceramic, Maj.=Spanish majolica, pt.=point

fire-cracked rock. Organic preservation was fair, with eight charcoal samples and eight fragmented pieces of faunal remains weighing 5.3 g collected. The molluscan assemblage is represented by 398 Rabdotus and 10 mussel shell umbos.

The two features encountered within Block 1 were fire-cracked rock hearths associated with the mixed Spanish/ Protohistoric and Late Prehistoric component were designated as Features 3 and 10. Descriptions of the features and diagnostic artifacts taken from Padilla and Nickels (2010: 292–300) are provided below.

Feature 3

Feature 3 was a fire-cracked rock cluster (Figure 4-10) encountered in Units 5 and 13 of Block 1 (see Figure 7-2). The top of the feature was first visible in Level 4 of Unit 5 along the western (grid) wall of the unit. Further excavation of the unit in Level 5 showed that the feature was in situ on a 10YR 3/2 soil. To further define the feature, Unit 13 was then excavated to fully expose the entire extent of the feature. The feature measured 60 cm by 50 cm, began at 33 cmbs, and ended at 44 cmbs. The feature was composed of angular limestone, sandstone, and chert; the majority was sandstone. Cultural material associated with Feature 3 consisted of 10 incomplete flakes, one complete flake, two pieces of non-flake debitage, one ground stone, three bifaces, one marine shell, and 59 Rabdotus shells. No charcoal or faunal material was found in association with the feature. A second-stage reduction biface fragment, an early-stage pointed-ovate chopper, and a complete early-stage rounded biface were also collected. Artifacts were also collected from the heavy fraction of a 4.5-liter flotation sample, including six incomplete flakes, four pieces of lithic debris, and charcoal. Although no charcoal was collected in association with the feature, distribution of diagnostic artifacts in Blocks 1, suggest that Feature 3 is Late Prehistoric in age.

Feature 10

Feature 10 was located along the southern block wall just above Feature 9 in Block 1, Unit 52 and was only partially exposed due to time constraints. The feature was first encountered in Level 4 at a depth of 31 cmbs in a 10YR 3/2 silty loam soil and extended to 48 cmbs into a 10YR 4/2 soil. The feature was a basin shaped fire-cracked rock hearth measuring 86 cm in length and 15 cm in width. The majority of the feature continued into the southern wall (Figure 4-11). In profile the feature appeared to be intact, with a thickness of 17 cm (Figure 4-12). Given the stratigraphic position of the feature and the distribution of diagnostic artifacts from Blocks 1 and 2, Feature 10 was interpreted as Late Prehistoric in age.

Figure 4-10. Feature 3 in Units 5 and 13, facing north-northeast

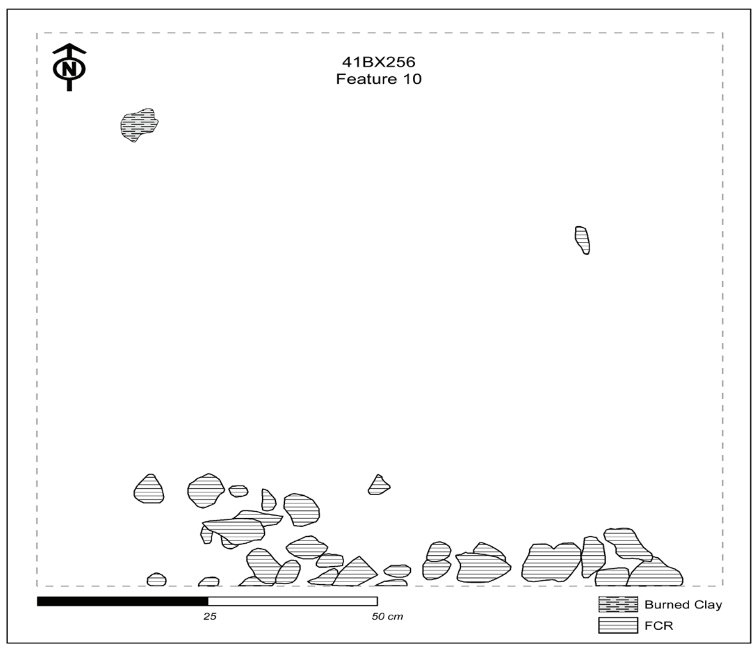

Figure 4-11. Plan view of Feature 10.

Feature 10 was composed of angular limestone cobbles, tabular sandstone, and angular chert. The construction appeared to consist of a shallowly dug pit lined with large- to medium-sized rocks gently flaring outward. In profile, the center of the feature contained the densest amount of fire-cracked rock with a 17-cm thickness, whereas a single lining of rocks appeared to surround it. Cultural material associated with Feature 10 consist of five incomplete flakes, three complete flakes, one biface, two umbos, 19 Rabdotus shells, and charcoal. No faunal material was collected or observed in association with the feature. The biface collected from the feature is a late-stage pointed-ovate biface (Figure 4-13).

Figure 4-12. Profile of Feature 10, facing south-southeast.

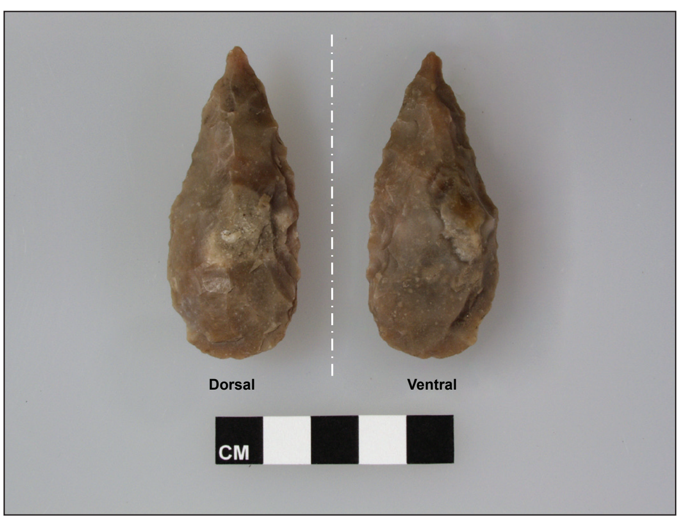

Figure 4-13. Dorsal and ventral side of the pointed-ovate biface from Feature 10.

Diagnostics Encountered within Block 1

A total of three Spanish Colonial ceramic types encountered in Block 1 consisted of a Brown on Yellow, Tin-glazed, and a possible Puebla Blue on White (Figure 4-14). The one sherd tentatively typed as Brown on Yellow, though it does not fall neatly into the type description, has a yellowish glaze on the exterior highlighted by what appear to black accent lines, though it is very eroded. The interior surface is covered with a flat yellowish slip, which does not fit within the Brown on Yellow type as defined by Fox and Urlich (2008). The two remaining sherds—although typed as tin-glazed and possible Puebla Blue on White—are considered to be untypable, because not enough attributes were present to definitely place them in a type.

The majority of diagnostic artifacts encountered consisted of Native American bone tempered pottery totaling 206 sherds (Figure 4-15). Native American ceramics are made of a fine paste, heavily tempered with bone, occasional grog, and organic inclusions. Taken on their own, it is impossible to differentiate Native American ceramics made during the Spanish Colonial period from ceramics made during the Late Prehistoric (and pre-Spanish Colonial period). However, the tight spatial correspondence between Native American wares and Spanish Colonial ceramics implies that some of the Native American ceramics are contemporary with the Spanish Colonial period.

Figure 4-14. Spanish Colonial ceramics encountered in Block 1.

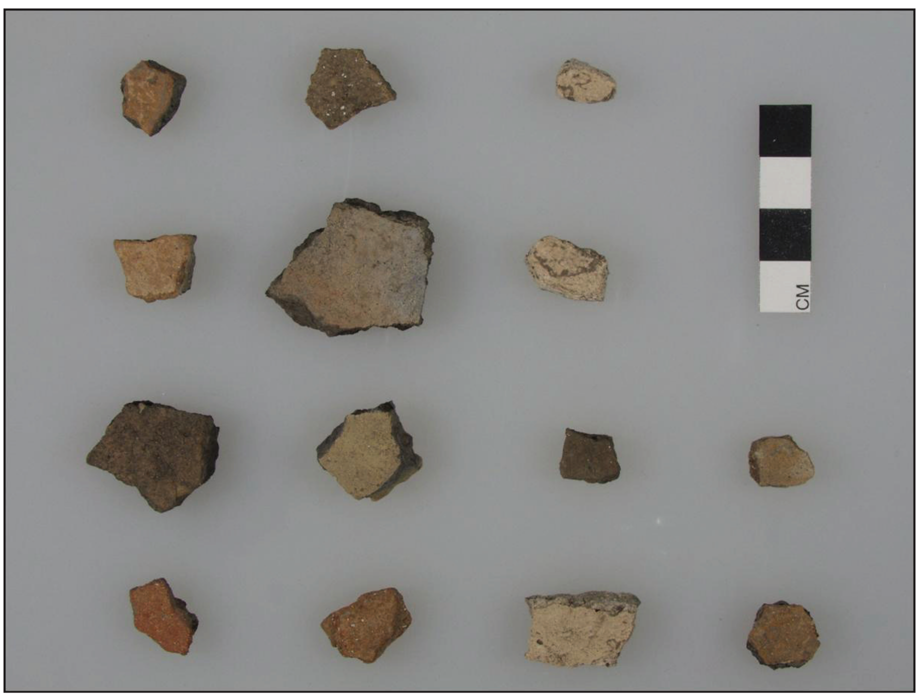

Figure 4-15. Examples of Native American
bone tempered pottery from Block 1.

A Perdiz point, an Edwards point, and two untyped points were encountered in Block 1. All four points from this component fluoresce yellow under UV light; therefore, it is highly probable that the raw material from which they were manufactured is Edwards chert (Hofman et al. 1991).

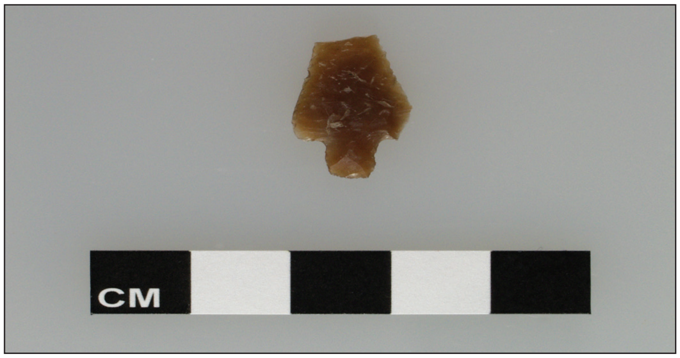

Figure 4-16. Unifacial Perdiz point.

Perdiz

A Perdiz point was found in Unit 4, Level 3 (Figure 4-16). The specimen is a unifacially flaked point made from a dark brown, heat-treated chert flake. Although the point is incomplete, reconstruction of the point shows a maximum length of 30 mm with a blade length of 24 mm and a stem length of 6 mm. The point has a gentle convex base with long barbs that are no longer present and a broken distal tip from a snap fracture. The missing barbs appear to have broken off during use. Flaking along the straight lateral edges has evidence of very minimal serration. Based on Spanish Colonial artifacts found in association with this particular point and the unifacial flaking, we place this particular point in the Protohistoric rather than the Late Prehistoric.

Figure 4-17. Late Prehistoric projectile points recovered at the site: (a) Edwards, UI 4, Unit 6, Level 2.

Edwards

An Edwards point was found in Unit 6, Level 2 (Figure 4-17). The specimen is a proximal section, being broken diagonally during use from a snap fracture, leaving a portion of the medial section with both barbs and the stem and the partially complete base. Despite being broken, the point contained enough diagnostic attributes to assign its typology. Reconstruction of the specimen shows that the point once had a maximum length of 27 mm with a blade length of 19 mm, a stem length of 8 mm, and a base width of 15 mm. The blade width of the point measured 23 mm. The lateral edges of the point were serrated with evidence of resharpening. The point also had a shallow concave base. Manufacturing of the point was from a pale brown chert flake that had been heat treated.

Figure 4-18. Untypable arrow points.

Untypable Late Prehistoric Arrow Points

Two untypable Late Prehistoric arrow points were found in Unit 5, Level 3 (Figure 4-18). The first specimen is a distal end that has been bifacially flaked. The fragment is very thin with a thickness of 1 mm. The breaking point of the fragment suggests that it was broken during manufacturing. The point fragment was made from a very pale brown chert flake that has been heated. The second specimen was also found in Unit 5, Level 3. The specimen is a medial section missing all of its diagnostic attributes, including the tip, due to post-depositional breakage. The minimal serration was observed on the right lateral edge. The specimen was made from a gray, heat-treated chert.

4.2.4 Middle Archaic Component

The Middle Archaic period in Central Texas is defined by Collins (2004) as ca. 6000–4000 BP. Table 4-5 lists proveniences within Block 1 at 41BXC256 with Middle Archaic cultural material. Proveniences in which disturbances were noted by excavators or curation of earlier artifacts was practiced have been excluded. Within the defined Middle Archaic component in Block 1, two burned clay features were documented. Other cultural materials collected from these levels consisted of one biface, four unifaces, 93 pieces of lithic debitage and abundant fire-cracked rock. Organic preservation was fair, with faunal remains found in one level, seven charcoal samples collected and 23.4 kg. of burned clay. The molluscan assemblage is represented by 841 Rabdotus and four mussel shell umbos.

The two Middle Archaic features encountered in Block 1 were designated as Features 4 and 9 and consisted of burned clay. Feature 4 was fully exposed but Feature 9 was only encountered within the eastern profile of Unit 6. The following descriptions of the features are taken from Padilla and Nickels (2010: 326–329 and 333–334).

Table 4-5. Middle Archaic Proveniences Used in Analysis at 41BX256.

Block	Unit	Level(s)	Depth (cmbs)	Feature	Diagnostic Artifacts	Radiocarbon Date cal BP (2σ)
1	1	6–7	49–69	4	–	5030–5010/4980–4840
1	2	6–7	49–69	4	–	5030–5010/4980–4840
1	3	6–7	49–69	4	–	5030–5010/4980–4840
1	4	6–7	49–69	4	–	5030–5010/4980–4840
1	5	6–10	45–95	–	–	–
1	6	5–7	36–66	9	–	–
1	13	6–10	45–95	–	–	–
1	38	6–7	47–67	4	–	5030–5010/4980–4840
1	37	6–7	49–69	4	–	5030–5010/4980–4840
1	40	6–7	49–69	4	–	5030–5010/4980–4840
1	41	6–7	46–66	4	–	5030–5010/4980–4840
1	51	6–7	45–65	4	–	5030–5010/4980–4840
1	52	6–7	45–65	9	–	–
1	53	6–7	46–66	4	–	5030–5010/4980–4840

Feature 4

Figure 4-19. Feature 4, facing southwest, 2008.

Block 1 was placed over the area encompassing GMI's two original test units. Excavation consisted of removing backfill from the original test units and fully exposing Feature 4. The feature was encountered in eight units (1, 2, 3, 4, 37, 38, 40, and 41) of the 14 units of Block 1, plus the two original GMI units (GMI 4, and GMI 6). Within these units, the feature was first encountered at a depth of 47 cmbs and extended to a depth of 70 cmbs. The feature was observed to be a large, dense, burned clay feature measuring 3.0 by 2.5 m, consisting of numerous burned clay nodules ranging in size from 5 to 25 cm, with very few small pieces of fire-cracked rock (Figure 4-19). In plan view, the feature appeared to have a horseshoe shape (Figure 4-20).

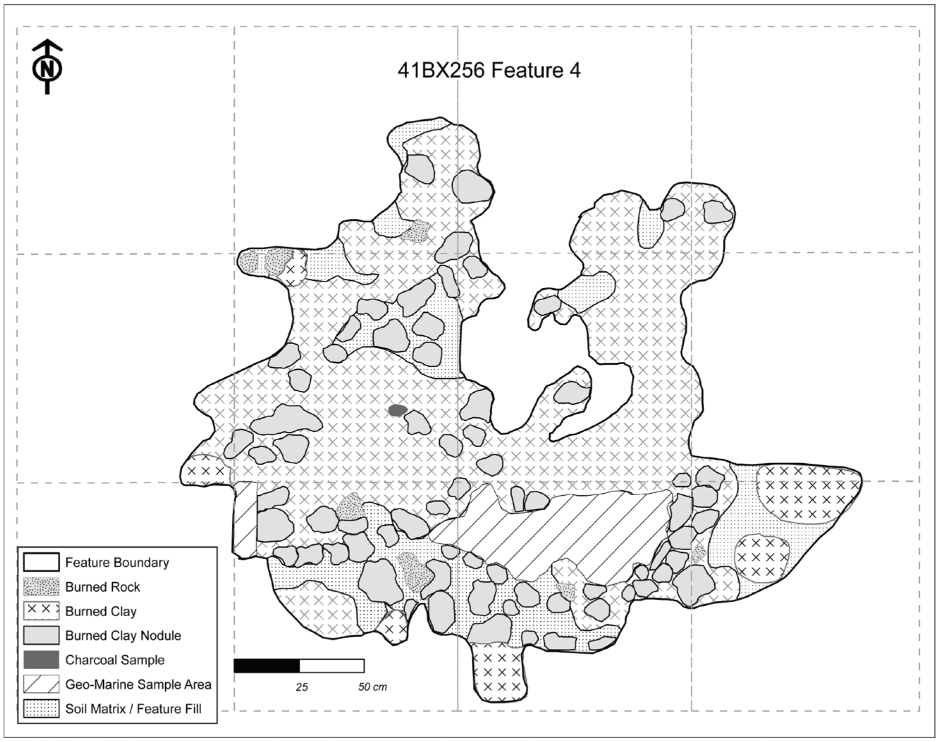

Figure 4-20. Plan view map of Feature 4, 2010.

Recovered cultural material associated with the feature consisted of 61 incomplete flakes and shatter, nine complete flakes, three unifaces, five mussel shell umbos, 479 Rabdotus shells, three charcoal samples, 7.9 kg of fire-cracked rock, and more than 23.8 kg of burned clay.

The three unifaces collected consisted of two minimally retouched flakes and one scraper. One of the three charcoal samples was submitted for radiocarbon dating, and one for macrobotanical identification. The charcoal sample yielded two dates, 5030–5010 and 4980–4840 cal BP (2σ), placing the use of the feature in the Middle Archaic; these dates correspond to the date of 5040–4840 cal BP (2σ) obtained by GMI. The sample sent for macrobotanical identification proved to be a piece of root from a mesquite tree.

The function of Feature 4 was debated. The original GMI investigators proposed that it was a possible cooking pit feature "utilizing burned clay as opposed to burned rock heating elements, …a technology that is more commonly seen in Gulf Coast areas where rock is scarce" (Osburn et al. 2007:138). Upon complete excavation of the feature in 2008, that assessment was tentatively accepted. In an attempt to further explore the feature a backhoe trench (BHT "X") was expediently excavated across the feature within Units 1, 2, and 3. The purpose of the trench was to assess the profile and substrate of the feature. However, due to the compactness of the burned clay mass and underlying sediments the cut was rough and seemed to crack the underlying strata making it difficult to discern any profile characteristics (Figure 4-21). Upon examination of this expedient trench, the excavation block was backfilled.

Figure 4-21. Southern profile of BHT X (facing south), 2010.

Later in the laboratory, further analysis of the clay nodules suggested another possible function for Feature 4. Approximately 23.4 kg (n = 389) of burned clay was collected for further examination. The clay nodules ranged in size from 5 to >10 cm, and all exhibited varying degrees of burning. Of the 389 pieces that were collected, about one in four nodules (n=93) showed evidence of one or more stick impressions that ranged in width from less than 1 mm to 70 mm (Figure 4-22).

These impressions on the burned clay suggested that it was actually daub, which implied that there may have been a perishable structure present. Wattle and daub structures are constructed with wooden frames for walls (and in some cases roofs) that are plastered over with clay (Shaffer 1993). As the wooden frames disintegrate or are burned, impressions are left behind in the hardened clay. Remains of wattle and daub structures are found in both prehistoric and historic archaeological sites, and are identified by the presence of hardened clay with evidence of latching and varying-sized stick impressions, and oftentimes leaf or thatching material impressions. These wattle and daub structural remains often take the form of large, sintered masses of clay as a result of burning. Clearly identifiable walls are usually present, along with massive amounts of hardened daub in the interior or exterior of the structure from collapse. Within these large clay masses, the differing degrees of burning are seen. Although some wattle and daub structures have been found in Texas, they are not common in Central Texas, and especially not within a Middle Archaic context.

Evidence of burning on the daub from Feature 4 consisted of blackened areas on the exterior of the clay; in some cases the burning occurred only on one side of the nodule, and in other cases the specimen would be completely burned on the exterior (Figure 4-23). The majority of clay

Figure 4-22. Selected burned clay nodules with stick impressions.

within the feature and those pieces collected were all hardened with a consistency similar to cement. It is possible that the feature originally consisted of three walls with an opening to the north that later collapsed; debris from the collapse filled and surrounded the feature, resulting in the horseshoe-shaped appearance. Based on the presence of impressions on the burned clay specimens, the burn patterns on those specimens, the horseshoe shape of the feature, and the sintered, conglomerated nature of the feature, it was considered possible that Feature 4 may have been a wattle and daub type structure. However, neither clearly defined walls of such a structure, nor post-molds were observed in the field.

Feature 9

Feature 9 was encountered in Units 6 and 52 and appeared to be two isolated concentrations of heavily burned, cement-like clay 1 m southeast of Feature 4. The feature was first encountered at 45 cmbs within a silty loam soil, and extended to 63 cmbs in the same soil. Only a partial section of the burned clay concentrations was exposed. Figure 4-24 shows how the burned clay continued into the eastern wall of the two units. Very few pieces of fire-cracked rock were associated with the feature. Although the feature was stratigraphically associated with Feature 4, given the distance and paucity of the burned clay between the two features, Feature 9 was considered in the field to be a separate occurrence of burned clay (Figure 4-25). However, after close examination of burned clay samples from Feature 4 in the laboratory, it is very possible that Feature 9 is in fact related to Feature 4. Based on the stratigraphic position of the feature and the presumption of it being related to Feature 4, Feature 9 is also considered to be Middle Archaic in age.

Cultural materials associated with Feature 9 consisted of one biface, two unifaces, two complete flakes, 17 incomplete flakes, two pieces of shatter, 145 Rabdotus shell, charcoal, and 1.2 kg of fire-cracked rock. The biface was a heavily burned, early-stage biface fragment. The unifaces consisted of a flake that was minimally retouched along one lateral edge, and a flake that has been expediently utilized along both lateral edges. No bone, charcoal, or flotation samples were collected from this feature.

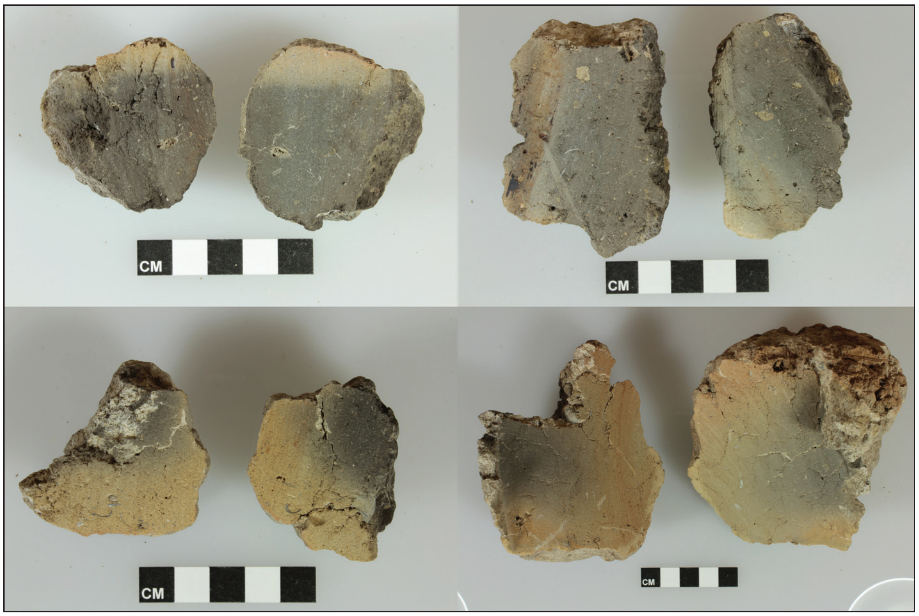

Figure 4-23. Interior profiles of clay nodules, showing burning.

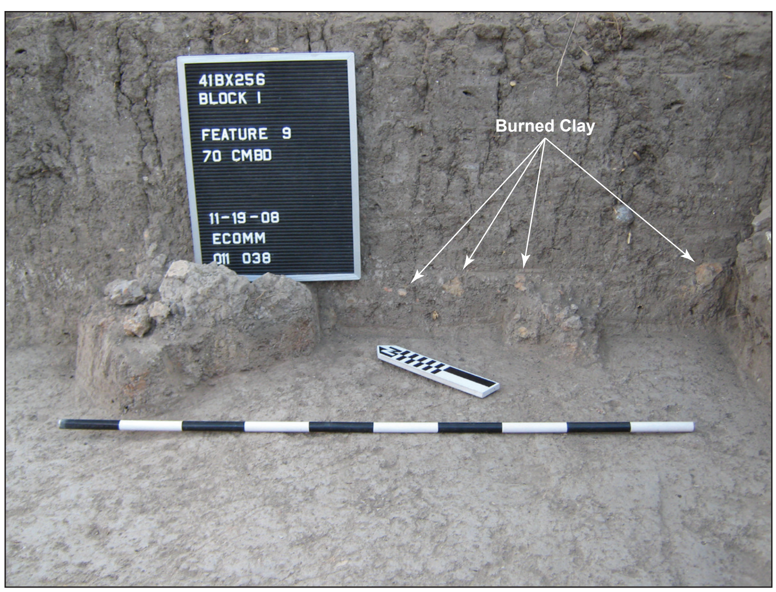

Figure 4-24. Feature 9 across Units 6 and 52, facing north-northeast.

Figure 4-25. Photograph showing the proximity of Feature 4 and Feature 9.

Chapter 5

Theoretical Orientation

Burned or baked clay is observed in a variety of archaeological contexts throughout Texas and has been interpreted in diverse ways. In the archaeological record the presence of burned or baked clay has been variously interpreted as structural daub, as remnants of cooking features, or as evidence of prehistoric wildfires across areas with soils naturally containing a high clay content. Interpretations of baked/burned clay are based on the context in which the clay is encountered and provides insight to the lifeways of the prehistoric peoples of Texas. The following discussion examines the interpretations of burned clay observed on archaeological sites as structural features and as evidence of cooking.

5.1 Brush Fires

Lightning-set wildfires have long been recognized by ecologists as an inherent component in natural ecosystems, especially across grasslands and savannahs (Agee 1993; Pyne 1982). While archaeologists rely heavily on evidence of prehistoric burning as technology markers, relatively little attention has been paid to the manifestation of such wildfires in the archaeological record. Potential markers such as oxidized soils and baked clay nodules have not been widely cited by archaeologists as evidence of landscape burning episodes. Where burning is observed in archaeological contexts, the inclination has been to interpret this as evidence of a cultural system using fire technology, whether cooking (Ellis 1997), manufacturing (ceramic manufacture and firing, stone heat treatment, metallurgy, etc.), ritual abandonment (Miller 2009; Sale and Silberberg 2009), or warfare (Snead 2012).

Intentional landscape burning was prehistorically common, for both agricultural and non-agricultural reasons (Doolittle 2000:186-187). Reasons related to agriculture include preparation and maintenance of fields, enhancement of soil fertility, and control of understory competitors. Non agricultural applications of landscape burning include driving game, increasing game visibility, and as a tactic in warfare. Landscape burning is economically advantageous to horticulturalists not only because it can clear fields of brush and weedy vegetation, but because it converts organics and minerals bound up in those plants into readily available nutrients. Landscape burning can be employed by non-horticulturalists both as short term and as long term strategies to drive game, increase game visibility, and maintain preferred game habitats.

The archaeological evidence of landscape burning is not well documented. Range fires and wildfires, whether anthropogenic or natural events set by lightning, are typically recurring, frequent, and low severity fires that do not leave the same thermal signature as less frequent, more intense fires (Agee 1993). Except in cases where unusually large amounts of woody underbrush and down-wood has accumulated (common for modern range fires where natural burning has been suppressed for decades), such brush fires typically move fast across the landscape and do not result in the higher temperatures characteristic of sustained burning in cooking hearths or other localized thermal cultural features. As such, archaeological evidence of landscape burning, such as soil oxidation and deposits of ash and charcoal, should be more subtle that for cooking fires. Further, archaeological evidence of landscape burning can be expected to be highly patchy, although widespread in extent.

5.2 Baked Clay Cooking

Concentrations of burned clay have been documented on sites in numerous archaeological projects throughout various portions of North America and are often described as clay nodules, lumps, or balls. The occurrence of these types of burned clay artifacts have been debated since the 1930's, particularly on the formation process and functionality of these types of artifacts (Dockall and Black 2011). The most famous occurrence of these types of artifacts has been documented at the Poverty Point site in Louisiana. Numerous earth ovens were encountered containing a large number of 1–2 inch diameter, intentionally formed, fire hardened clay balls. These clay balls were called Poverty Point Objects (PPOs) and were often elaborately decorated and/or contained clear hand and finger marks (Ford and Webb 1956). Based on ethnographic accounts of cooking techniques of Australian aborigines in which baked clay was used as heat-retention elements, Ford et al. (1955:56) states, *"baked clay objects represent an invention, probably more than once, in response to the household needs of a pottery-less people in a stone-less land."*

In a review of prehistoric cooking technologies and their archaeological signatures, Ellis (1997) briefly mentions the use of clay in cooking. Clay baking involves encasing the foods (typically tubers or fish) in clay before baking in an open fire. Stone boiling is also discussed, but the possible use of clay balls as substitutes is not mentioned. Nonetheless, the technological use of clay as cooking implement has been documented in several archaeological investigations in Texas, especially in south Texas and along the coastal plain. Originally the use of clay as a cooking technique was thought to occur in areas where stone is scarce (Ford et al. 1955); however, based on the selected sites described above, burned clay nodules have been occasionally encountered in areas where stone was readily available. Explanation of the presence of burned clay objects in areas that contained an abundance of stone can be due to migration patterns of prehistoric peoples (Turpin in press; Ricklis 1996; Campbell 1988). Turpin (in press: 2) suggests that "clay ball cookery in an area best known for burned rock hearths and midden debris was either introduced by people using a traditional method developed elsewhere or was conceived as a specific technique for specific resource processing." Burned clay nodules have been encountered in various forms ranging from burned clay ball clusters to earth ovens indicating that various techniques were used in cooking during prehistoric time, either based on regional techniques or as transferred technology by migrating groups.

In Texas burned clay nodules, although encountered in various other regions in Texas, are commonly encountered in south Texas and along the coastal plain where the presence of natural rock is sometimes lacking. These clay nodules are commonly found in association to fire-cracked rock hearths, solely clay nodule cluster hearths, middens, or within remnants of an earth oven. Unlike the PPOs found at Poverty Point, clay nodules encountered in Texas vary in size from pea-size to fist-size and were expediently manufactured without attention to detail. Given the location of our project area, discussion of recorded sites containing burned clay nodules will focus on selected sites found predominantly within southern Texas and the Coastal Plain (Table 5-1).

Table 5-1. Selected Sites with Clay Nodules in Southern Texas and the Coastal Plain.

Trinomial	Site Name	Recorder, Date	Period	Context
41AT168	Chamber Site	Turpin; 2004	Middle to Transitional Archaic	Midden deposits
41AT232	Kezar Site	Turpin et al; 2009	Middle to Late Archaic	Midden deposits
41HR206	–	Patterson;1980	Late to Transitional Archaic	Hearth / clay cluster
41NU11	Kirchmeyer Site	Ricklis; 1993	Unknown Prehistoric	Eroding from dune surface
41SP120	–	Ricklis; 2003	Unknown Prehistoric	Midden deposits
41VT1	Morhiss Mound	Dockall et al. 2011	Archaic	Hearth / clay clusters
41VT98	Buckeye Knoll	Ricklis; 2009	Middle to Late Archaic	Hearth / Midden deposits

The Chamber Site (41AT168) is located in Atascosa County, Texas adjacent to a tributary of La Parita Creek. During the excavations conducted by Turpin in 2003, three middens were encountered containing a mixture of organically rich soils, burned sandstone, numerous burned clay nodules, few diagnostic projectile points, and tools. The majority of the midden deposits consisted of ovoid or sub-angular burned clay nodules ranging in diameter from pea sized to 5 cm. Turpin (2004: 41) suggests that "the likelihood is that the nodules filled the same role as burned rock…in earth ovens." Based on radiocarbon dates both fire-cracked rock and burned clay nodules were used contemporaneously in the cooking methods at the site; however, they were used for different food processing.

The Kezar Site (41AT232) is located on an unnamed tributary near Metate Creek in Atascosa County, Texas. The site was excavated by Turpin in 2008 as part of a mitigation prior to the expansion of lignite mining by the San Miguel Electric Corporative Inc. During their excavations investigators encountered numerous burned clay nodules within midden deposits like those found at 41AT168. In addition to the numerous burned clay nodules encountered at 41AT232, three fire-cracked rock features were also encountered. Based on the dates from the fire-cracked features and burned clay objects it shows two cooking technologies were employed at the site at different times. According to Turpin (2011) the occurrence of the two feature types "appear to reflect different temporal components and possibly different cultural affiliations."

Site 41HR206 is located on an old stream bed in Harris County, Texas. The site is characterized as an open campsite that may have been used seasonally by mobile hunter-gather groups during the Middle Archaic through the Late Prehistoric periods (Patterson 1980). During the excavation of the site investigators encountered a large hearth feature consisting of burned clay lumps, caliche balls, fire-cracked rock, burnt wood and turtle shell. A total of 113 clay balls and 11 caliche balls were collected with diameters ranging 1.5–5.5 cm. It is suggested that in addition to the use of fire-cracked rock used for cooking purposes, the clay balls and caliche balls were also used (Patterson 1980).

The Kirchmeyer Site (41NU11) is located approximately 7.3 miles south of Corpus Christi Bay on the western shore of Oso Bay on a clay dune in Nueces County, Texas. The site is characterized as an often utilized site dating from the Late Prehistoric and Historic period. Artifacts collected during the excavations of the site consisted of lithics, shell, and ceramics. In addition to the collection of these artifacts, investigators encountered a total of 24 clay lumps varying in size from the surface of the dune (Headrick 1993: 43). Headrick (1993) believes that the clay lumps eroding from the surface of the dune should be "skeptically viewed" due to Black's (1989c: 47) hypothesis of naturally occurring grass/brush fires that may have contributed to the formation of the eroded nodules. However, experiments conducted by Huebner (1986) offer another possible scenario based on Corbin's (1963) hypothesis that nodules eroding from a surface may be attributed to remnants of old campfires.

Site 41SP120 is located on a bluff overlooking Ingleside Cove in San Patricio County, Texas. Several clay nodules were encountered within midden deposits. Based on the matrix encountered within the midden deposit Ricklis suggested that the burned clay nodules were intentionally used as heat-retention elements in place of rocks (Ricklis 2003, 2009; and Turpin 2011).

The Morhiss Mound site (41VT1) is located on a knoll along the lower Guadalupe River in Victoria County, Texas. During the excavations investigators documented a total of 42 cultural features, 25 of which were hearth features. The hearth features consisted of several "intact relatively small, roughly circular or oval patterns of closely spaced sandstone cobbles and rounded balls of baked clay" (Dockall and Black 2011). Clay balls were encountered mixed with the fire-cracked rock and in one case (Feature 38) as a semi-circular feature consisting solely of grapefruit-sized clay balls. It is surmised that Feature 38 served as an earth oven bed and served the same purpose as the fire-cracked rock features (Dockall and Black 2011).

The Buckeye Knoll site (41VT98) is located on a high knoll along the Guadalupe River in Victoria County, Texas. The site was excavated in 2000–2001 by Ricklis from Coastal Environments Inc. During the excavation of the site a total of 102,217 burned clay nodules were encountered from the Knoll top and West Slope, 5,736 of which contained impressions of grasses and sticks, inferring that these were used in the construction of wattle and daub structures. Despite the presence of burned clay nodules with impressions, several features were encountered where burned clay nodules were used in cooking. These burned clay nodules were encountered in clusters and in association with fire-cracked rock hearths. According to Ricklis (2007:373) "the presence of both burned-clay nodules and angular rocks within some of the exposed hearth features seemingly supports the inference that clay lumps were fired to serve as a substitute for stone in a heat-retention technology."

5.3 Structural Features

Evidence of structural features in Texas is not uncommon; rather, there have been several structural features documented throughout Texas, from the Panhandle Plains to the Coastal Plains. The majority of structural features documented, however, commonly occur in the Caddoan area of east Texas, the Southern High Plains area of Texas, and the Eastern Trans-Pecos region of west Texas. Although identification of structural features in some of the archaeological regions of Texas such as central, north central, parts of western Texas, and south Texas can be difficult, reviews and comparisons of some types of structures in these areas have been conducted by Patterson (1987), Prikryl (1990), Johnson (1997), and Lintz et al. (1995).

A classification of the different stylized structural types found within Texas is not necessarily established; however, Lintz et al. (1995) has attempted to synthesize the various structural feature types. Lintz et al. (1995) identifies four structural types with two additional structure types described as being "pseudo-structures" types. Three of the four structural types and one of the two "pseudo-structures" types are defined by the presence of physical structural evidence, whereas the two other structural types are defined by the patterned distribution of cultural material.

Given the location of our project area, discussion of recorded sites containing structural features resembling the four major structural types defined by Lintz et al. (1995) will focus on those sites found predominantly within central and southern Texas. Each major structural type will be described followed by defining the "pseudo structure types". Within the description of the four major structural types, selected sites identified as containing major structural types will be discussed (Table 5-2).

Table 5-2. Selected sites within Central and South Texas with Structural Features.

Trinomial	Site Name	Number of Structures	Recorder, Date	Period	Structure Type
41HY209	Buda Site	1	Quigg et al., 1990	Undetermined Prehistoric	1
41KM16	Buckhollow	1	Johnson, 1994	Toyha phase	1
41HY163	Zatopec Site	1	Garber, 1984	Late Archaic	2
41NU184	Means Site	1	Ricklis and Gunter, 1986	*Middle Archaic	2
41NU221	McKinzie Site	1	Ricklis, 1986	Protohistoric	2
41BX1920	–	1	DiVito and Oksanen, 2012	Early Late Archaic	2
41ML37	Britton Site		Shafer, 1964	Transitional Archaic	2
41CN74	–	1	Batterman, 1991	Undetermined Prehistoric	3
41CC128	Tipi Ring Site	5	Lintz et al. 1993	Late Prehistoric	3
41BT105	Lion Creek	2	Johnson, 1997	Middle Archaic/ early Late Prehistoric	4
41CC112	Turkey Bend	1	Lintz et al. 1995	Early Archaic	4

** Radiocarbon dates from this site may have been contaminated and the date may not be reliable.*

5.3.1 Type 1 Structures

Type 1 structures are identified by the distribution of cultural material such as debitage and the patterning of hearth features. These structural types lack the presence of wall trenches, post holes, or central hearth features. The cultural material distribution within sites containing these structure types defines abrupt boundaries often implying the presence of windbreaks or a wall (Lintz et al. 1995).

Both the Buda (41HY209) and Buckhollow (41KM16) sites are classified as Type 1 structural types. Site 41HY209 contained patterned distribution of flake debitage and bone splinters in confined locations (Quigg et al. 1990). Site 41KM16 consisted of a patterned distribution of several hearth features and scattered artifact concentrations (Johnson 1994). Although no physical evidence of structural material was encountered either site, spatial patterning of the cultural material observed at both sites indicated clear boundaries, suggesting the presence of a windbreak or house structure.

5.3.2 Type 2 Structures

Type 2 structures are defined by physical material indicative of the presence of a perishable structure such as post holes or daub. These structural types lack the presence of a foundation or rock wall support posts (Lintz et al. 1995). The Zatopec (41HY163), Britton (41ML37), Means (41NU184), McKinzie (41NU221), and 41BX1920 sites represent Type 2 structures.

Site 41HY163, located in Hays County, was excavated by Garber in 1984, and consisted of an irregular arc of 14 postmolds, a storage pit, and a possible central post support consisting of a rock filled pit. The diameter of the feature was determined to measure approximately 8.4 m. Excavations of the postmolds revealed that the structure's walls were either slightly angled towards the center or set in place vertically. Based on the diagnostic artifacts encountered during their excavations, the site is Late Archaic in age (Garber 1987).

In contrast, site 41ML37 in McLennan County, was identified solely on the presence of burned daub. A total of 175 pieces of burned daub was collected from the site; of the 175 pieces collected, 19 contained impressions of grasses or sticks. Based on radiocarbon dates collected from the site, 41ML37 dates to the Transitional Archaic Period (Story and Shafer 1965).

The Means site (41NU184), located in Nueces County, is situated on a terrace overlooking the Nueces River floodplain. Like the Zatopec site, the Means site contained the remnants of an arc shaped pattern of seven postmolds. The postmolds averaged .09 m in diameter and had a depth of .18 m. Although only a portion of postmolds were encountered it is postulated that the remnants represent the footprint of a 5.3 diameter structure. In addition to the exposure of the postmolds, daub or burned clay nodules were encountered; however, it is not known if the clay nodules contained impressions. Dating of mussel shell from the site indicates that the structure may have an occupation dating to the Middle Archaic period; however, it is uncertain (Ricklis and Gunter 1986).

Another south Texas type 2 structure is the McKinzie site (41NU221). The site was encountered by Ricklis near Corpus Christi Bay in Nueces County. Excavators encountered a series of circular storage pits encompassed by a few postmolds. Based on the distribution of storage pits and placement of the postmolds it is inferred that the structure measured approximately 5.6 m in diameter. It is suggested that the structure may have been constructed of a series of long small polls that were shallowly buried and worked in to a framework similar to Karankawan type structures. Based on artifacts associated with the feature, the structure dates to the Protohistoric period (Ricklis 1986).

Subsequent to the preparation of this report in draft form, the authors learned of an additional Type 2 structure that had been recently found in south central Texas (DeVito and Oksanen 2012). Site 41BX1920 is located within Mission County Park in Bexar County, Texas and contains both prehistoric and Spanish Colonial Period components. In the fall of 2011, investigators from the Center for Archaeological Research (CAR) at The University of San Antonio (UTSA) conducted extensive backhoe trenching and auger testing and encountered a large concentration of burned daub at a depth of 65 to 70 cmbs. Designated as Feature 2, the concentration contained numerous fragments of burned daub, a few which were associated with flecks of charcoal and charred plant remains. Examination of the burned daub showed that several burned daub fragments had pole and stick impressions. One piece in particular contained a large impression measuring approximately 7.6 cm (3 inches) in diameter with two other smaller impressions running perpendicular to the large impression. A charcoal sample was collected and yielded an early Late Archaic date, 2σ Cal BP 3450–3360. The feature may well be an additional Type 2 structure. At the time the current report is being prepared for final printing (November 2012), we have received preliminary reports of additional similar discoveries in the vicinity.

5.3.3 Type 3 Structures

Type 3 structures are characterized as structures with cobble-ring enclosures usually found on high landforms in west Texas. These structures are typically associated with few artifact assemblages or contain a mix of cultural material (Lintz et al.1995). Two sites representative of type 3 structures were identified within the O. H. Ivie Reservoir, the Tipi Ring site (41CC128), and 41CN74 (Batterman 1991; Lintz et al.1995).

Site 41CC128 contained five cobble ring features on a Pleistocene terrace overlooking the Colorado. Deposits at the site were shallow and contained diagnostics attributed to the Middle Archaic and Late Prehistoric Periods (Treece et al. 1993). Site 41CN74, located in Coleman County, contained one cobble ring feature; however, no diagnostics were encountered at the site for age determination. Features at both sites ranged in diameter from 4 to 6 m (Lintz et al. 1995).

5.3.4 Type 4 Structures

Type 4 structures contain large central rock-filled hearth features that are typically surrounded by additional clusters of rocks used for support for wall posts (Lintz et al 1995). According to Johnson (1997: 42–43) the purpose for the cluster of rocks was to keep "the posts from sinking" and to provide "lateral support to keep the wall posts upright during construction". Structures encountered at the Lion Creek (41BT105) and Turkey Bend (41CC112) sites represent Type 4 structures.

Two structures were recorded at site 41BT105, House 1 and House 3. Both structures consisted of a central hearth feature surrounded by additional clusters of rock. House 1 contained a 1.8-m central hearth feature within a shallow paved basin encompassed by 10 to 12 circular- to oval-shaped clusters of rocks suggestive of wall post supports (Johnson 1997 and Lintz et al. 1995). Diagnostic artifacts associated with the feature suggest a Middle Archaic occupation of the structure. House 3 at the Lion Creek site was comprised of a 1.2-m flat central hearth feature surrounded by 10 clusters of rock for post supports. Unlike House 1 at the site House 3 showed evidence of the wall supports having been dug .3 m into the sand and evidence of replacement posts. Johnson (1997:45) believes that the structure "was arguably used over a fairly long period of time." Charcoal dates and diagnostic artifacts from House 3 indicate that the structure was in use during the Late Prehistoric Period (Johnson 1997).

At the Turkey Bend Site, the ruins of one type 4 structure were encountered. The house is documented as an Early Archaic structure consisting of a large central hearth feature, measuring approximately 3 m within a shallow basin encompassed by 16 to 17 small circular clusters of rock for wall support. Like House 3 at the Lion Creek Site, the Turkey Bend structure shows evidence of relocated posts suggesting that aboriginal peoples reused the structure over several years during the winter months (Treece et al. 1993).

5.3.5 Pseudo Structures

Lintz et al. (1995) also identifies two "pseudo structure" types. These types consist of "feature complexes that resemble the kinds of structures" originally described (Lintz et al. 1995:175).

The first type of pseudo structure is similar to Type 4 structures consisting of hearth clusters surrounded by other smaller hearths. These hearth clusters can be central hearth features, basin-shaped, large, or shallow (Lintz et al. 1995).

The second type of pseudo structure consists of patterned fire-cracked rock either in clusters or dispersed. Often times these patterns resemble Type 4 structures however they are vague and within a palimpsest surface (Lintz et al. 1995).

5.3.6 Structures within Central and South Texas

Despite the numerous archaeological investigations that have been carried out throughout Texas over several decades either by survey or excavation, the number of prehistoric structures recorded is relatively small in comparison. Though structural features have been recorded in several distinct archaeological regions in Texas the overall distribution of structural features across the state is one sided. According to Hester et al. (1989:21) in central Texas, "prehistoric structural remains are rarely recognized." That can be said for south Texas as well. The problem with the identification of prehistoric structural remains stems from various factors such as poor preservation, poor sampling techniques, change in expectations, and excavation techniques (Sassaman 1993). Although archaeologists are faced with problems in regards to identifying structural features, there have been structural features recorded within central and southern Texas such as the handful previously mentioned.

Currently, there is not a widely accepted typology of structures within Texas; however, Lintz et al. (1995) makes a valid attempt in classifying structural types within Texas based on the data available at the time. These techniques, however, do not necessarily address reasons why the varying stylistic manners were used.

Given the different stylistic manners in which structural features are constructed, it is easy to see that all structures are not created equal. Construction of the previously described structural types varies in degree of construction difficulty and functionality. Difficulty in the construction of certain structure types implies the amount of effort put into the construction of the structure, while functionality implies the use of the structure either as a long-term settlement or lifestyle patterns of the group inhabiting the site—such as semi-mobile groups of hunter-gathers or relatively sedentary groups. Although the structural features described are not stylistically similar in construction, all shared a common characteristic: sites where the structural types were encountered were situated along navigable waterways. These waterways served as a highway of sorts connecting groups of people together and offering exploitable riverine environments.

Use of structures has been documented from the Early Archaic period through the Protohistoric period. During these periods, the lifeways of aboriginal peoples throughout each period gradually changed from hunter-gather societies to more sedentary societies. Depending on the lifeways of aboriginal peoples of each time period the manner in which structures were constructed and used changed as well.

Structure types in central and south Texas dating to the Late Prehistoric and Protohistoric periods are mostly classified as Type 3 structures; however, there are also Type 1, Type 2, and Type 4 structures. Type 1 structures were simply identified based on distinguishing patterns observed on the distribution of cultural material such as hearths and debitage. The Type 2 structure identified dating to the Protohistoric period was based on the presence of storage pits and postmolds. Type 3 structures were identified by cobble rings representative of wiki up or tipi structures. The Type 4 structure (House 3 at Turkey Bend) dating to the Late Prehistoric period was identified based on the presence of a large circular hearth encompassed by a series of clustered rock pile wall supports which had been anchored beneath the living surface. Additionally evidence shows of maintenance and replacement of the wall supports.

The central and south Texas structure types dating to the Early, Middle, Late, and Transitional Archaic Periods are commonly classified as Type 2 and 4 structures. Differences in the construction of these types of structure are apparent based on physical evidence of materials present. Structures attributed to Type 2 structures are identified solely by the presence of postmolds or daub and in some cases both. These structural remnants represent the absence of a possible perishable structure. Construction of the framework of these perishable structures probably consisted of wattle and daub structure. Type 4 structures represented in central and south Texas were more fortified. These structure types contained central hearth features encompassed by clusters of rock piles that serve as wall post supports. In some cases these wall supports were replaced inferring continual use of the structure.

Several archaeological investigations in the southeastern United States document the presence of two types of structures, winter and summer structures (Sullivan 1987). These two structural types were first identified based on ethnological accounts and were further applied to the current archaeological data (Robertson 1933; Bartram 1909; and Adair 1975). Previously in the archaeological record of the southeastern United States, winter type structures were more apparent due to their substantial construction while summer structures were more difficult to identify archaeologically due to their less substantial construction. Currently, with the refinement of modern archaeological techniques, the presence of both types of structures is becoming more apparent in the archaeological record (Faulkner 1978; Schroedl 1986; Smith 1978).

The differences of construction types seen in the southeastern United States can be applied to the difference in structure types observed in central and south Texas. Of the four types of structural features identified by Lintz et al. (1995), structure types 2 and 4 can be used to identify seasonality use and relatively permanent settlement. Due to the physical presence of construction materials observed at these site types, researchers are able to deduce possible intentions for the structural features.

As previously described, two of the Type 4 structures—one at Turkey Bend and House 3 from the Lion Creek site—have shown a more intensified effort in the construction of the structures. Circular patterned clusters of rock piles surrounding a central hearth feature indicated post wall supports that at times show evidence of having been replaced for maintenance purposes. In addition, House 3 shows evidence of wall supports being anchored (dug in) below the living surface. These lines of evidence suggest that the Early Archaic structure at Turkey Bend and House 3 at the Lion Creek site were probably continually re-inhabited. Despite the Late Prehistoric date of the House 3 structure at Lion Creek, peoples in the Late Prehistoric, although considered to be somewhat sedentary, maintained a sense of mobility. Either way, the elaborate construction design and evidence of continual maintenance suggests that these more substantial structures were most likely cold weather adaptations of structural construction methods.

The structures described as Type 2 sites differ stylistically compared to the Type 4 structures. Type two structures are identified on the basis of the possibility of the presence of a perishable structure denoted by the presence of postmolds or daub. Excavations of the postmolds from these type structures show that posts were dug in to the ground at various depths and various diameters. The variation in diameter of the postmolds can be attributed to the size of available resources. These structures seem to be flimsier or lightweight in comparison to Type 4 structures and may have been constructed "during other seasons of the year, or when groups went out on lengthy foraging expeditions" (Johnson 1997:62). These lighter weight structures probably represent a warmer weather shelter.

The remaining two structural types identified (Types 1 and 3) are more elusive and can be based on subjective interpretation. There have been many historical accounts of rock rings used as the foundation for wiki up or tipi type structures. In addition, there have been studies conducted in inferring structures without the presence of physical attributes. These studies have indicated that a structure can be identified by spatial distribution of artifacts or hearth clusters (Sassman 1993).

In any case, the different construction methods of each type of structure and location where they were encountered reflect the lifeways of inhabitants in each period. Traditionally aboriginal peoples of the Archaic period in central and south Texas are portrayed as semi-mobile bands of hunter-gathers, while inhabitants of the Late Prehistoric and Protohistoric periods became more sedentary in nature. Although occupants of the Late Prehistoric and Protohistoric periods were more sedentary they still were mobile. Despite the slight differences of lifeways from each period aboriginal occupants meet the three basic needs: food, water, and shelter.

5.3.7 Wattle and Daub Construction

Wattle and daub is an ancient construction technique for making walls in which a lattice of woven wood is smeared with, and encased within, a layer of mud or clay. The lattice is referred to as *wattle* and the mud or clay is the *daub*. The wattle can be expediently constructed of stripped branches and twigs for temporary constructions or made of pliable wooden lathes or strips for more permanent construction (Figure 5-1). The daub can be mixed with binding agents such as sand, grasses, straw, or animal dung. Wattle and daub construction has been documented in old world Neolithic sites throughout Europe and Western Asia, and is still an important construction method in many parts of the world. For example, circular habitation structures dating to the Iron Age have been discovered in Great Britain with staves driven into the earth, while wattle and daub can still be seen today throughout the United Kingdom forming the infill panels in timber framed houses (Sunshine 2006).

Figure 5-1. Wattle and Daub construction (from Casa de Tierra 2011)

In Mesoamerica, archaeological daub has long been interpreted as evidence of wattle and daub habitation structures. Daub is often marked by impressions of finger-sized cane wattles and is occasionally burned. Flannery (1976:2) claims that permanent villages of wattle and daub structures were widespread in Mesoamerica during the Formative Period (1500 to 500 BC) and remained the standard construction through the Classic. In Mesoamerica, typical construction was rectangular with four corner posts, enclosing an area measuring about 24-35 m2 (Flannery (1976:16). Roof construction was not clear in the archaeological record.

Wattle and daub was a common prehistoric and protohistoric construction technique throughout the Southeastern United States and Mississippi and the Ohio River valleys (Nabokov and Easton 1989). Wattle and daub houses appeared in the Southeastern United States during the Mississippian period (800–1540 AD) and continued to be the traditional Choctaw housing until that nation's removal to Indian Territory in the 1830s. Cherokee homes were similarly wattle and daub and circular in plan, resembling "an upside down basket" (Nabokov and Easton 1989) (Figure 5-2). The Adena cultural tradition in the Ohio River Valley is similarly characterized by circular wattle and daub dwelling with grass thatch roofs (Nabokov and Easton 1989:99). Excavations indicate outward leaning posts driven into the ground surface with central hearths.

Figure 5-2. Wattle and Daub Cherokee Winter House (from Native Arts 2011).

Burned daub is a common indicator of wattle and daub structures. Samples often contain stick impressions (Figure 5-3) can be examined for evidence of seasonality, building styles and resource availability (Rundkvist 2010).

5.4 Test Implications And Data Needs

At the conclusion of the 2008 excavation, Features 4 and 9 were tentatively interpreted as intentional thermal cooking features with baked clay pieces serving as heating elements in either a boiling or baking process. Subsequent observations on the fired clay pieces led to speculations that Features 4 and 9 might be structural with the baked clay pieces being daub, which was unintentionally fired after abandonment. The null-hypothesis alternative is that the baked clay is neither the result of cooking nor structure abandonment, but is a byproduct of wide scale burning of natural vegetation across the landscape.

Figure 5-3. Burned Daub with Stick Impressions from a
9th Century AD Swedish site (from Rundkvist 2010).

5.4.1 Natural Burning

The null hypotheses states that Features 4 and 9 on 41BX256 are the result of prehistoric landscape burning (either natural or culturally induced).

Test Implications

1. Soil textures should be broadly similar across the general area, with minimal evidence of textural patchiness.

   Relevance: a burned landscape is a phenomenon occurring on top of the ground surface with no localized ground disturbance. Naturally occurring soils are not disturbed or moved.

2. Burned zones should be extensive and laterally continuous. They should be bigger than the excavation block.

   Relevance: a burned landscape by definition affects large areas.

3. Burned zones may be patchy, but should not show evidence of containment by constructed perimeters rocks or soil, or by pits dug into the ground surface.

   Relevance: while burned landscapes always have edges where the fire dies, they are not locally confined.

4. Burned woody roots should be randomly located concentrations of ash/charcoal and/or soil oxidation, and show irregular patterns in profile.

   Relevance: The apparent intensity of burning, spacing of burned zones, and volumes of combustion products should reflect the character of the naturally occurring vegetation.

5. Burned zones in profile should exhibit traceable beds evidenced by ash lenses and/or horizons of soil oxidation.

   Relevance: a burned landscape is a large scale phenomenon occurring on top of the ground surface with minimal penetration.

6. Depth of soil oxidation should be minimal and fairly consistent in thickness.

   Relevance: Landscape burns typically move quickly across the landscape and, except for root systems, burn out quickly.

5.4.2 Cooking

Hypothesis 1 states that Features 4 and 9 on 41BX256 represent one or more episodes of baked clay cooking.

Test Implications

1. Soil texture should be patchy across the site, with localized concentrations of clay.

   Relevance: Except where it clearly occurs naturally, clay specifically for cooking purposes must be introduced to the site from elsewhere and should exist in well defined patches within the site, distinct from the naturally occurring soils.

2. Burned zones should show evidence of fire containment by constructed perimeters of rocks or soil, or by pits dug into the ground surface.

   Relevance: Cooking is always centered around contained heat sources which are carefully controlled to prevent escape of the fire and/or accidental injury.

3. Burned zones should be limited in size and area, and smaller than the excavation block.

   Relevance: Intentional cooking is a localized activity. Multiple loci may exist, but each is defined and limited.

4. Sites with such cooking features should be located in areas which lack suitable rock for stone boiling

   Relevance: Stone [presumably] retains heat better than baked clay balls and should be the preferred technology when both are available.

5. Clay balls may be present. Clay balls should be well formed and of generally normalized size.

Relevance: Where clay balls are used in lieu of "stone" boiling technology, an ideal size of ball should be discoverable for the particular combination of heat source, food to process, and natural clay content. Manufactured clay balls should show a normal distribution around this ideal.

6. Clay balls should be infused with lipids and/or starches.

   Relevance: Where baked clay balls are used in cooking, food residues including lipids and/or starches should attach to the clay surface.

5.4.3 Habitation Structure

Hypothesis 2 states that Features 4 and 9 on 41BX256 are burned wattle and daub habitation structure(s)

Test Implications

1. Soil texture should be patchy across the site, with structures indicated by localized concentrations of clay.

   Relevance: Except where it is naturally abundant on a site, clay specifically for structural purposes must be introduced to the site from elsewhere and should exist in well defined patches within the site, distinct from the naturally occurring soils.

2. Burned zones should be limited in size and area, and smaller than the excavation block. Overall dimensions of the clay concentration should be about 2-4 m in diameter.

   Relevance: Most temporary (non-masonry) structures in the Texas archaeological record are at least 2 m and less than 4 m in diameter.

3. Post molds should be discernable along the outside edges of the feature. Post molds may or may not be accompanied by stabilizing rocks.

   Relevance: Superstructure to wattle and daub dwellings are supported by corner posts or by staves along the perimeter.

4. Fired clay pieces should exist in a range of non-normalized sizes and shapes.

   Relevance: Baked clay daub pieces randomly detach from burned wattle and exist in a wide gradation of sizes and shapes.

5. Baked clay pieces should have impressions of sticks and other vegetal matter as thatching.

   Relevance: Daub is molded around the wattle and when the wattle burns and/or decomposes, the mold impressions remain.

6. The spatial distribution of artifacts on the occupation surface should be patterned.

   Relevance: Human activities in a dwelling are spatially patterned and discarded artifacts should result in a pattern

7. A central hearth may be present.

   Relevance: Habitation structures often but not always have interior hearth features. If present, hearths indicate seasonality and duration of habitaton.

8. The soil profile should reveal an oxidized substrate thickness greater than 10 cm.

   Relevance: If burned in place, a wattle and daub structure could result in temperatures high enough to significantly oxidize the ground surface deeper than that typically resulting from cooking features.

Chapter 6
Methodology

6.1 Archaeological Field Methods

During the month of August 2011, archaeologists from EComm revisited 41BX256, one of three sites located along the San Antonio River in Bexar County, Texas that was originally excavated by EComm in 2008. The continued excavations of the site were to focus on Features 4 and 9 located within Block 1 from our previous 2008 field season. All excavations were conducted by six experienced archaeologists who held Bachelors and/or Master's degrees in Anthropology. Prior to the beginning of excavations, information gathered from the 2008 field season was consulted and a research design was created to help facilitate our archaeological investigations.

In addition to the consultation of our previous work, an archaeologist visited the site to relocate and mark two existing datums and define the area of interest (Block 1). One datum was originally placed at the center of the southern half of the site by GMI during their testing of the site in 2006 and consisted of a single rebar marked by flagging tape. The second, which served as a permanent datum, was established by EComm in 2008 and was set in concrete outside of the site's established boundaries for when the site is impacted by the SARIP. The second datum was established approximately 20 m west (grid N) of GMI's 2006 datum.

6.1.1 Brush Clearing

During our original investigations of the site in 2008, all vegetation was removed prior to excavation. As a result of prior clearing and drought, a thin understory developed across the area of interest. For our purposes, the thin overgrowth needed to be removed. The undertaking involved the use of the grading blade of a Gradall XL 4300III. The grading blade was lowered to ground level as the Gradall traversed across the area that would be impacted by our excavations. All underlying brush was removed along with any small trees with a width of 3 inches in diameter; any tree exceeding 3 inches in diameter was left in place. All vegetation cleared was carefully pushed into piles along the boundary of the excavation area. During the clearing of the sites, three archaeologists were present for monitoring purposes.

6.1.2 Relocation of Block 1 and Establishment of New Units

Once all brush had been cleared from the area of interest, archaeologists instructed the Gradall operator to remove the overburden of the 12 x 10 m horizontally marked area above Block 1. The purpose of removing the overburden was to expose the outline of Block 1 and clear the surrounding area where new units were to be placed. During the removal of the overburden, three archaeologists were present to monitor the excavation, making sure the Gradall did not penetrate below the target zone of 60 cmbs. The spoils of the overburden were deposited around the western portion of the cleared area forming a back dirt pile wall.

In the area directly above Block 1, 60 cm of overburden was removed while in the surrounding area only 40 to 50 cm of overburden was removed. The differentiation in the amount of overburden removed was due to the termination depths of excavations in Block 1 and the depth at which Feature 9 was first encountered. During the removal of the overburden, the outline of Block 1 began to appear.

Once the target depths were reached, archaeologists manually excavated the remaining overburden within Block 1 exposing the remaining walls—the remnants of Features 4 and 9 and the backhoe trench (BHT "X") that bisected Feature 4. In addition to exposing the entirety of past excavations within Block 1, the loose dirt within the 12 x 10-m area was also removed. Archaeologists then re-established the grid originally used during the 2008 excavations of Block 1 based on the existing outline of the block.

From the re-establishment of Block 1, archaeologists then identified the placement of 12 new units. Of the 12 newly established units, nine were placed at along the eastern, southern, and western edges of the southern units of the original block; two were placed on the eastern edge of the block just south of the backhoe trench; and one was placed 1 m west of the block. All units within the original block maintained their assigned numbers from the original investigations and GMI's investigations, while the 12 new units were assigned new numbers beginning with 100.

6.1.3 Re-establishment of Horizontal Control

A total of eight sub-datums, identified alphabetically, were established with the use of an AGATEC GAT220 laser level. The laser lever was set up on the site datum established by GMI in 2006, and sub-datums were set in relation to the site datum by means of the laser sensor and stadia rod. The site datum was set at an arbitrary 100 m above sea level. From this elevation, the height of the sub-datum was subtracted from the height of the instrument (laser level), resulting in the height of the sub-datum in relation to the overall site datum.

6.1.4 Re-examination of Trench Faces

During the original examination of the bisecting trench in Feature 4, only the southern profile was examined. In our re-examination of the trench, archaeologists cleared debris from and looked at both the northern and southern profiles. The cleaning of the trench profiles consisted of using trowels to cut back the vertical face allowing for a fresh, smooth, and unweathered face exposure. Approximately 10 cm was cut back on both profiles, and water was sprayed on the walls to enhance the contrast of strata. Upon identifying the different patterning of strata, archaeologists placed a series of toothpicks along lines of identified zones. Profile maps were drawn of both walls and digital photographs were taken of the profiles. All photos were entered into the photo log. These photographs were later digitally stitched together to create composite photographic profiles. After profile maps were drawn and photos were taken, two column samples were taken from the southern profile. The locations of the column samples were later added to the profile drawing and additional photographs were taken.

6.1.5 Manual Excavations

Excavations at the site employed various approaches based on what was discovered over the course of our excavations. As outlined in our research design, the purpose of these excavations was to further explore the two daub features (Features 4 and 9) encountered at 41BX256 during our previous investigations of the site in 2008 and examine the possibility of other clay features.

Archaeological investigations consisted of the excavations of the 16 originally excavated units (14 units excavated by EComm in 2008 and 2 excavated by GMI) in Block 1 and excavations of 12 new units around Block 1. During the excavations of 2008, 14 units were excavated to a depth of 70 cmbs, a depth that was reached in the two original GMI units, and two were excavated to a depth of 100 cmbs. Of the 14 units within Block 1 with original terminal depths of 70 cmbs, 9 were excavated to an average depth of 110 cmbs, two were excavated to a depth of 100 cmbs, and three were excavated to a depth of 90 cmbs. The remaining two units, which were originally terminated at 100 cmbs during the 2008 excavation, were left untouched.

Opening elevations of the 12 new units varied from 40–70 cmbs due to the undulating surface of the 12 x10-m scraped area and their placement within the area. Three units had opening elevations beginning at 40 cmbs, two began at 50 cmbs, four began at 60 cmbs, and three began at 70 cmbs. Termination depths were not as dramatic; six ended at 90 cmbs, and the other six were terminated at 100 cmbs.

Excavations were normally conducted in arbitrary 10-cm levels. Some exceptions in the first level were necessary where elevation differences occurred. In some cases, a 5-cm level was removed, and in other cases, as much as 15 cm were removed.

All levels were screened through ¼-inch wire mesh screen. All cultural materials found were collected and documented in the artifact catalog with their respective proveniences. All information pertaining to the unit and collection of cultural material was recorded on a Unit Level Record Form. In addition to the recordation of the cultural material on the Unit Level Record Form, all artifacts collected were recorded on an Artifact Bag Inventory Form and all samples collected were recorded on a Sample Bag Inventory Form. If a feature was encountered, all information pertaining to the feature was recorded on a Feature Record Form.

6.1.6 Sampling Techniques

During the course of our excavations, several samples were taken either physically or through information generated in the field by special equipment. Samples that were physically collected consisted of flotation sampling, micro-carbon sampling, pollen sampling, daub sampling, lipid sampling, starch sampling, thermal identification sampling, and bulk column sampling. Those samples that were generated in the field by special equipment consisted of soil susceptibility and phosphate (pH) sampling. Although numerous samples were collected not all were submitted for assays. Those that were not submitted for assays will be curated and available for other investigators at a later date when and if needed.

Flotation Sampling

Soils were collected for the purpose of identifying any microbotanical remains that may help understand what types plants were being consumed during different cultural time periods. During the course of our excavations, many features associated with cooking events were encountered. As each feature was encountered, soils in direct association with the feature were collected. Once excavators mapped and photographed the feature, the feature was removed and soils in and around the feature were gathered. Soils were placed in a one-gallon plastic bag, with the provenience information labeled on the outside.

Micro-carbon Sampling

Dating of the micro-carbon sample involves the dating of free floating charcoal within the bulk soil sample. Several micro-carbon samples were collected. Soils were collected in bulk as the level was being excavated. The soils were then placed in a one-gallon bag with the provenience written on the front.

Pollen Sampling

Pollen samples were collected from each level excavated from all 28 units. In collecting the sample, archaeologists collected loose dirt from the center of the unit and placed it in a 4 x 6-in. 4-mil bag. The provenience of the sample was then written on the front of the bag.

Daub/Burnt Clay Sampling

Collection of daub or burnt clay observed loosely on the surface above Feature 4 was collected and stored in a five-gallon bucket. Additional daub collected from the units excavated was encountered during the screening of sediment through ¼-inch mesh screen. The daub was collected with the other artifacts and placed various sizes of 4-mil bags with the provenience written on the front of the bag.

Lipid and Starch Sampling

Lipid and Starch samples were selected from the daub samples collected in the field based on provenience. Two samples were selected from two different fire-cracked rock hearths and two were selected from daub collected from Feature 4 and Feature 9. Each of the samples collected were then bisected and each half was sent for analysis. Samples were separately placed in individual 4-mil bags with their provenience labeled on the outside.

Thermal Identification Sampling

Sampling for thermal identification occurred in the lab. Samples were selected from several small burnt daub pieces collected from different levels and units the in which Features 4 and 9 were present. Each sample exhibited exposure to various degrees of burning within the respected features. Samples selected were bagged separately and placed in 4-mil bags with the provenience information labeled on the outside.

Bulk Column Sampling

Bulk Column samples were collected from two areas of the southern profile of the BHT excavated in 2008. The wall of the BHT was cut back approximately 10 cm and cleaned up for a profile map. Once the profile map had been drawn and labeled, archaeologists placed a 3 x 2-in. vinyl rain gutter with the backside cut off against the profile and traced the sides. After establishing the traced sides of the vinyl rain gutter, archaeologists began to cut into the profile, deep enough to place the vinyl flush with the profile's face. With the vinyl in place a 10-cm section on either side of the vinyl was cut out and the intact bulk encased in the vinyl was cut out in one piece. Tissue was placed in the open gaps within the bulk sample and then the entire sample was wrapped in saran wrap, keeping the sample in place.

Soil Susceptibility Sampling

Soils acquire a magnetic susceptibility from the Earth's ambient magnetic field. This low-field susceptibility is also proportional to the concentration of ferro- and ferromagnetic constituents of the material. The magnetic susceptibility of soils can be altered by both pedogenic and cultural processes. In both cases, the organically induced pedogenic and cultural processes enhance (increase) the susceptibility values. In pedogenic studies, a significant increase in soil susceptibility values has been observed in the A horizon of soil profiles, probably as a result of organic activities, which creates maghemite (see for example, Singer and Fine 1989). Other research (e.g., Heller and Evans 1995) indicates that the susceptibility values can also be altered by changes in climate.

Although the pedogenic and climatic processes that may alter the magnetic susceptibility of soils is important and begs further research on and around archaeological sites, thus far the most significant variability in susceptibility noted by archaeologists and Dr. Wulf Gose, Director of the Paleomagnetism Laboratory at the University of Texas at Austin, has been derived from the presence of wood ash and charcoal. Granted, wood ash can also be present due to past range and forest fires. However, horizontal studies within distinct strata indicate that the increase in values around prehistoric hearths is remarkably distinct, as is the vertical separation of clearly distinguishable cultural strata from natural strata (see for example, Gose and Nickels 1998). This is particularly true if multiple heating events are distinguishable in the archaeological record (e.g., Heller and Evans 1995). In Central Texas, where many of the soils are particularly carbonaceous, the increase in magnetic susceptibility values on archaeological sites is remarkably significant compared to the culturally unaltered surrounding soils (Collins et al. 1994).

The purpose of collecting soil susceptibility readings was to evaluate the peaks in MS of sediment samples collected at regular intervals from a vertical column from either a backhoe trench or unit profile and a horizontal column from a series of contiguous units containing evidence of burning. Ideally, information produced from the analysis of MS values should reflect zones (vertically) in which high frequencies of cultural materials are found and evidence of sediments rich in organic materials.

When all excavations were completed at each site, archaeologists collected magnetic susceptibility readings from preselected wall or walls of a unit, block or backhoe trench. Prior to the collection of the samples a small area where a column would be taken was scraped clean to ensure that the sample was not contaminated. Once the wall was scraped a pull-tape was extended from the top of the profile to the bottom. Readings were collected in approximately 5 x 5-cm intervals in a continuous column, beginning at the top of the unit and continued to the bottom. Each sample was individually bagged and labeled with the provenience of each sample and the depth it was taken from (e.g., 0–5, 5–10…etc.). Reading of horizontal samples was done the same way, but on a horizontal plane rather than vertical. Each horizontal reading was done after each unit was excavated in 10-cm levels and only within those levels that showed evidence of burning.

Phosphate (pH) Sampling

Although according to Lewis (1978:309), "Soil chemists and geochemists have known for many years that phosphorus in the most common form as phosphate does not leach out or move about in the soil," the process of evaluating the degree of phosphates in soils is not without its problems. For example, Crowther (2003) submits that soils of different textures have varying degrees in their capability to retain phosphate. In addition, caution is advised when evaluating the contexts of samples because phosphate content may have been introduced with the introduction of modern fertilizers and large herds of grazing animals (Crowther 2003). Also, "In swamps and areas subjected to prolonged flooding … the phosphate moves from the solid soil material into the water and can be transported from its original location" (Lewis 1978:311; Patrick and Khalid 1974).

A numerical measurement to record the amount of acidity or alkalinity (in terms of phosphate content) in soils is the pH (potential of Hydrogen), a function of the positively charged hydrogen atom in soils. Based on their pH, soils can be categorized as either acidic, neutral, or alkaline (Soiltest, Inc. 1976:129).

Alkaline or calcareous soils are characterized by high pH values, and contain higher degrees of alkaline materials such as calcium and magnesium; calcium and magnesium also are substantial elements of bone. Highly calcareous and alkaline soils are generally found in limestone dominant terrain such as the Edwards Plateau in Central Texas. Acidic soils, which have low pH values, are those in which the alkaline materials have been removed due to water flow-through (Lewis 1978:311 [Patrick and Khalid 1974]), or because the natural phosphates have been absorbed by agricultural crops (Soiltest, Inc. 1976:129). Although pH values can range from 0 to 14, soils that are extremely alkaline can have a high value of 11; a neutral soil pH value is 7; soils that are extremely acidic can have a low value of 2 (Birkeland 1974:21).

The amount of pH (phosphate) present in soils is increased in areas where human occupations have resulted in the accumulation of organic wastes (Lewis 1978:310). Thus, as a vertical soil profile is evaluated, one would expect higher pH values to correlate with stratigraphic levels of increased human occupation. When evaluating pH values horizontally within the same stratigraphic level of an archaeological site, one would expect to see higher pH levels in areas of the site that were more intensively occupied or that served as midden areas. For our purposes, soil samples collected for soil susceptibility were also used for the analysis of pH.

6.2 Archival Research

Archival research was undertaken to identify the history of land ownership, occupation of site 41BX256. Research was conducted in 2009 at the time of our original reporting of the site. At the time of the original investigations, site 41BX256 contained early Spanish Colonial ceramics that likely pre-date the founding of the Espada and San Juan Missions, which geographically bracket the site on the south and north respectively. In addition, two lateral drainage ditches were documented coming off the river and heading west at Site 41BX256. In addition, site 41BX256 contained late nineteenth and early twentieth century debris related to ranching and farming of those properties. Therefore, research aimed to provide context for the historic-period components of the site.

Deed research for Site 41BX256 was conducted online through the Bexar County Clerk's historical land records database. The site was part of the same suerte, or land grant, deeded to Domingo Bustillos during the final secularization of the missions in 1824, though that suerte was likely occupied by the Bustillos family from an earlier date. In addition to online sources, archival research was also conducted at the Center for American History and the Benson Latin American Library in Austin. Sources consulted included Archivo San Francisco El Grande, the Bexar Archives and the Archivo General de Mexico. Researchers visited the General Land Office in Austin and the Spanish Language Archive at the Bexar County Courthouse in San Antonio. Secondary sources pertaining to early Spanish exploration and settlement of Texas were also consulted. Research focused on gathering historical background that would help explain the presence of very early (1650–1750) Spanish Colonial pottery at Site 41BX256, and was by no means exhaustive. Numerous documents are available in both Austin and San Antonio archives, many of them in Spanish, and review and translation was feasible on this project for only a limited subset of these.

6.3 Laboratory Procedures

All artifacts and samples collected during the course of our investigation were brought back to the EComm laboratory. Although the artifacts were not going to be curated through our facilities some preliminary preparation of the artifacts were conducted prior to analysis of the artifacts. These preliminary preparations consisted of bag cross checking, the creation of inventories, and the cleaning and sorting of artifacts.

6.3.1 Initial Processing

All bags collected containing artifacts and samples were logged in on an Artifact Inventory Sheet or on a Sample Inventory Sheet as they were collected in the field. All artifacts and samples from the site were stored in a large plastic container. When the artifacts arrived at the offices of EComm, technicians working in the laboratory went through the site's Artifact Inventory Sheet and Sample Inventory Sheet and accounted for each bag cited. Once all the bags were accounted for, the data recorded on the Artifact Inventory Sheet and Sample Inventory Sheet were then transferred into an Excel file from which a Master Artifact Catalog was created.

All artifacts brought into the lab were cleaned by means of washing and dry brushing. Artifacts consisting of lithics, marine shell, and bone were primarily cleaned by washing and brushing them in tap water with a toothbrush. However, if any bone was noticed to be brittle and/or found to have been poorly preserved, the bone was cleaned using a dry toothbrush. All artifacts were then placed on drying racks and placed to dry for a day's time. Those artifacts that were not washed consisted of fire-cracked rock and daub.

Once the artifacts had completely dried they were then sorted into separate categories: lithics, marine shell, fire-cracked rock, and daub. As the artifacts were being separated a count of the artifacts of each kind for each field lot was documented on the Master Artifact Catalog. Once the artifacts were sorted and documented the artifacts were then placed in new bags labeled with their respective proveniences. In addition to the information written on the bag a bag tag containing the same information was also inserted. After sorting the artifacts according to type (lithics, marine shell, bone, fire-cracked rock, and daub) they were brought to the Field Director for analytical purposes.

6.3.2 Analysis

Analysis of the artifacts and samples collected during our excavations were either processed in-house or sent out to organizations specializing in specific types of analysis. Artifacts and samples that were analyzed or processed in-house consisted of all lithics, samples, daub samples, and fire-cracked rock samples. Artifacts and samples sent out to specialized agencies consisted of charcoal, daub for starch analysis, daub for lipid analysis, and daub for thermal identification. Samples that were not processed are to be curated with all the artifacts at CAR and will be available for processing at a later date.

Lithic Artifacts

All lithic material collected from the excavations were cataloged and further separated into distinctive classes. Each lithic was separated into the following classes: incomplete flake, complete flake, shatter, biface, uniface, core or tested cobble, points, and fire-cracked rock. Separating the lithics into these different classes allowed for total counts of each type of lithic class at each site. Once the lithics were separated into each class, incomplete flakes, shatter, and fire-cracked rock were removed from the assemblage, leaving the complete flakes, bifaces, unifaces, cores, and points to be further examined based on attributes observed. Analyses of the lithics based on attributes provide a technological and morphological characterization of the lithic assemblage at the site.

Projectile Points

Attributes recorded for projectile points consisted of raw material type, raw material grain size, heat treated, point type, serration, beveling, completeness, break type, maximum length, blade length, blade width, neck width, base width, maximum thickness, blank type, stem length, color, and UV color. Points that did not contain any diagnostic information regarding their shape or size were typed as "untypable." Break types were classified as related to use/re-sharpening, manufacturing, post-depositional, or indeterminate. Measurements of the points depended on the completeness of each specimen. Those that were broken in various places lack measurements of certain attributes.

Bifaces

Attributes recorded for all bifaces consisted of raw material type, grain size, heat treatment, percentage of cortex, length, width, thickness, tool completeness, blank type, reduction stage, shape, break type, and color. Grain size was determined by the type of inclusions seen within the raw material and was noted as fine with no inclusions, fine with inclusions, or coarse grained. Heat treatment of the specimen was noted as either heated or not heated. Completeness of the specimen was based on the portion that remained and was noted as either complete, proximal, medial, distal, longitudinal, wedge or indeterminate. Blank type was noted as either flake, nodule, or indeterminate. The reduction stage of the specimen is based on studies conducted by Collins (1975), as early, middle, late, or indeterminate. Shape of the specimen was noted as ovate, pointed-ovate, triangular, indeterminate, or round. Break type was classified as none, manufacture, use, post-depositional, burnt, or indeterminate. Any other attributes observed —such as tool type (e.g., chopper, gun flint, etc.), retouched, and if the tool was utilized—was noted.

Unifaces

Unifaces were classified as stone tools that have flakes removed on one surface. Attributes recorded for unifaces are similar to those recorded for bifaces; however, three additional attribute categories were added. These new categories are degree of retouch, modification location, and edge shape. Classifications for the degree of retouch are noted as expedient, minimal, formal, and indeterminate. Because the degree of retouch seen on unifaces is subjective, a Loupe and magnifying glass was used to examine all pieces of debitage. Expedient unifaces are characterized as flakes that are modified through use, not by intentional flaking. Minimally retouched flakes are flakes that have not been dramatically altered rather some flaking occurred to alter the shape of one or more of its edges. Unifaces noted as formal was determined based on functionality such as scraper, gouge, or unifacial knives. Based on these attributes location of modification and edge shape was noted because in some instances one or more of the edges have been shaped through patterning of flake removal.

Cores

Attributes of cores and tested cobbles consisted of raw material type, grain size, heat treatment, length, width, thickness, percentage of cortex, number of flake scars, direction of flake scars, and color. Direction of flake scars was noted as being unidirectional, bidirectional, multidirectional, and indeterminate. Any other attributes observed were commented on as being battered, and exhausted.

Complete Flakes

All complete flakes were separated from other debitage such as incomplete flakes and shatter, based on two specific attributes: (1) presence of an intact platform and (2) a measurable termination (feathered or hinged). Attributes recorded for all complete flakes consisted of: raw material type, grain size, length, width, thickness, percentage of cortex, flake type, and heat treatment. Flake types were noted as biface manufacture, biface thinning/resharpening, uniface manufacture/resharpening, blade, platform preparation and/or core preparation, notching, sequence, channel, or indeterminate. Definitions of these flake types are presented below.

Biface Manufacture Flakes

These flakes are defined as primary and secondary flakes having moderate to large dorsal flake scar ridges and with minimal to considerable longitudinal curvature. The striking platforms on this type range from single to multi-faceted, although single and double faceting is most common. These flakes are usually removed with a hard hammerstone or large billet, and the dorsal flake scarring is indicative of sequential flake removals and flake removals from opposite edges (Mehalchick et al. 1996). In the system employed during this analysis, overshot flakes are classified as biface manufacture flakes.

Biface Thinning/Resharpening Flakes

In other studies, biface thinning flakes have been separated from biface resharpening flakes (cf. Mehalchick et al. 1996), but because much of the distinction between the two is based on the presence of use-wear, this study did not attempt any such separation. These types of flakes are generally tertiary flakes which were removed by pressure or by a soft hammerstone or billet. They have a moderate to large number of dorsal flake scars, but unlike biface manufacture flakes, this type has shallow flake scar ridges. Longitudinal curvature ranges from moderate to slight depending on the type of parent artifact. The striking platform is generally multifaceted and may be ground (although this was not coded), with some lipping on the ventral edge (Mehalchick et al. 1996).

Uniface Manufacture/Resharpening

As with biface thinning and resharpening flakes, the primary distinction between uniface manufacture and uniface resharpening flakes is that uniface resharpening flakes show evidence of use wear on the platforms. For the purposes of this study, the two flake types are treated as one category. These flakes are generally small to medium in size (no bigger than two centimeters) with single-faceted platforms. Often, there is a slight longitudinal curvature at the distal end of the flake, usually accompanied by a discernable ridge oriented perpendicular to the longitudinal axis of the flake. This ridge is formed by the intersection of the original dorsal surface of the blank and the subsequent flakes scars originating from the lateral edges of the blank. Another characteristic of uniface manufacture/resharpening flakes is that the dorsal surface generally is marked by a series of parallel flake scars and small step fractures, the result of use or previous manufacturing at the proximal end (Mehalchick et al. 1996).

Blades

Generally, a blade is defined as a flake that is twice as long as it is wide (Mehalchick et al. 1996), although in this study, the definition is restricted to flakes removed from a blade core. These flakes are characterized by single or multiple dorsal ridges that are roughly parallel to the longitudinal axis of the flake. These ridges are indicative of earlier blade removals. The longitudinal curvature of blades is slight to moderate. Striking platforms are generally single or corticate faceted, although double and multiple-faceted platforms occur as well (Mehalchick et al. 1996).

Platform Preparation and/or Core Preparation Flakes

Platform and core preparation flakes are highly variable in size, shape, amount of dorsal cortex, and platform faceting, but they all represent an attempt to prepare a platform or core for subsequent flake removals. Size and platform faceting are dependent upon the stage of reduction during which they were removed and the size of the parent material, which may be a core or artifact. Likewise, shape is dependent on the type of core from which they were removed. The amount of dorsal cortex is also highly variable, ranging from 0 to 100 percent, depending on the stage of reduction (Mehalchick et al. 1996).

Notching Flakes

These small flakes are usually 5–15 mm long, and are removed by pressure flaking during the creation of notches on projectile points or other notched tools. The flakes have distinctive U-shaped platforms and scalloped dorsal surfaces indicative of prior notching flake removals (Mehalchick et al. 1996).

Sequence Flakes

Sequence flakes are indicative of a particular core reduction strategy in which a cobble is first split lengthwise and then flakes are removed in sequence beginning at one end of the core. These flakes can be recognized by a double-negative bulb centered above or on the platform with a tabular surface. Sequence flakes are unique to a particular type of core technology, but without a series of them, they are most likely accidental in nature (Jelinek et al. 1971). This method of flake removal may have been useful in an environment where raw material was commonly available as tubular cobbles rather than as tabular or spherical cobbles.

Channel Flakes

Channel flakes are produced as a result of fluting projectile points. They are most commonly found on Paleoindian sites, but may also be found where later point types such as Pedernales have been fluted. “They are generally parallel-sided, flat in longitudinal section, slightly plano-convex in lateral cross section, and have well prepared, isolated, ground platforms” (Frison and Bradley 1980:26).

Incomplete Flakes

If a flake could not be assigned with certainty to one of the types described above, it was coded as indeterminate. Generally, flakes displaying attributes associated with two or more different types were included in the incomplete category.

Fire-Cracked Rock

All fire-cracked rock collected was documented on the Artifact Inventory Sheet. If the fire-cracked rock was encountered in a feature, the entire feature was collected and brought back to the lab. All fire-cracked rock counted and weighed in the lab. These sums were then recorded on the Master Artifact Catalog.

Samples

Samples that were able to be processed at the lab were processed by lab technicians employed by EComm, under the supervision of the Lab Director. Other samples that needed a more specialized approach were sent out to agencies specializing in the processing of these materials such as charcoal, lipids, starches, and thermal identification analysis. The following describes the processing of the samples collected.

Charcoal Samples

All charcoal samples collected in the field were examined to identify the best possible specimens to be tested. Samples were selected based on the integrity of the context from which it was collected and the importance of information that could be provided by the sample. Samples selected for radio carbon assay were sent to Beta Analytic.

Lipid and Starch Samples

Four samples of baked clay were selected for lipid and starch assay. Each sample was split in two using a dry cut high-speed rock saw by Mr. David Day from Austex Drilling & Sawing, Inc. One set of the split samples was submitted for lipid assay to Dr. Mary Malainey at Brandon

University in Canada. The matching set of split samples was sent to Dr. Alston Thoms at Texas A&M University for starch assay.

Thermal Identification Samples

All daub samples selected for thermal identification were from daub samples collected from different levels in units associated with Features 4 and 9. Daub samples were submitted to Dr. Leslie Cecil at Stephen F. Austin State University.

Daub/Burnt Clay Samples

Daub samples collected during the excavation were all weighed in grams using a DigiWeigh Model: DWP-1001 scale and recorded on an electronic spreadsheet. These samples recorded on the spreadsheet represent the daub/burnt clay found in each individual unit that were considered to be isolated finds within each level. Daub/burnt clay samples collected from Feature 4 and 9 were first cleaned of any loose debris covering the samples using a paint brush and toothpick. Once the samples had been cleaned they were separated into three groups based on their size: 0–5, 5–10, and >10. These samples were then further separated into two groups, one with impressions and one without impressions. All samples without impressions were individually weighed and examined. The total count and individual weights of each group (0–5, 5–10, and >10) without impressions were then added up for a total weight. These total weights were then recorded on a separate spreadsheet designated for this specific feature. For each group of samples without impressions, a general description of the samples was included. The description pertained to the color, hardness, degree of burning, and inclusions. Samples which contained impressions were individually cataloged. These samples were first individually weighed and the impressions were measured. Impressions were individually measured using a series of dowel rods increasing every 1/16-inch from 1/8-inch to 1¼-inch Impressions smaller than 1/8-inch were measured using a round toothpick, the tip of the toothpick measured 1/32 inch while the shaft of the toothpick measured 1/16 inch. Impressions measuring larger than 1¼ inch were measured using a 12-inch ruler. Measurements of these larger impressions using the ruler were checked by measuring the accuracy of dowel rod. All measurements were then recorded on the electronic spreadsheet, accompanied with a description of the sample.

6.3.3 Curation

All cultural material, field notes, forms, photographs, and drawings related to the project will be sent to CAR for curation. All documents pertaining to this project will be stored there as well.

Chapter 7
Results

In August 2011, archaeologists from EComm returned to site 41BX256 to conduct further archaeological investigations of two burned clay features which had been partially excavated in 2008. During those 2008 data recovery excavations, a block of 14 units had been established to explore a burned clay mass that had been originally encountered in 2006 in a 1x2 m test unit. Designated as Feature 4, the clay mass was encountered in eight of the 14 units (Units 1, 2, 3, 4, 37, 38, 40, 41), as well as the two original test units (designated GMI 4 and GMI 6). Within these ten units, Feature 4 was first encountered at a depth of 47 cmbs and generally extended to a depth of 70 cmbs for a overall thickness of about 23 cm.

While excavating the 14 units in 2008, evidence of a second, smaller clay mass was encountered within the eastern limits of Units 6 and 52. Designated Feature 9, this clay mass was encountered at a depth of 45 cmbs and extended to a depth of 63 cmbs for an overall thickness of about 18 cm. Based on the stratigraphic position, diagnostic artifacts from the entirety of the block, and AMS dates collected from Feature 4 during the 2008 excavations, both features were considered to be Middle Archaic in age (Figure 7-1).

Figure 7-1. Feature 4 exposed at 70 cmbs during the 2008 excavation.

During the 2011 excavations, both the site datum originally placed by GMI in 2006 as well as the permanent site datum established by EComm during the 2008 excavation were relocated. After relocating the two site datums, Block 1 was re-established and the surrounding area was marked with flagging tape. Because our objective was to further explore the two features within Block 1, our investigations were focused on targeting the Middle Archaic component located within Block 1. Analytical levels of the Middle Archaic component were previously identified in 2008 which ranged from 36 to 69 cmbs and had already been removed during our excavations. Due to the target depth of our investigations, and pursuant to the previously approved work plan, overburden of the upper 40 to 60 cm of Block 1 and its surrounding area was mechanically excavated to expose the top of the two features and identify original units of Block 1 (Figure 7-2). Subsequently, the remaining overburden was removed by hand excavation exposing the units within Block 1, within the trench that bisected the feature, and within the surrounding area and allowing for controlled excavations to begin (Figure 7-3).

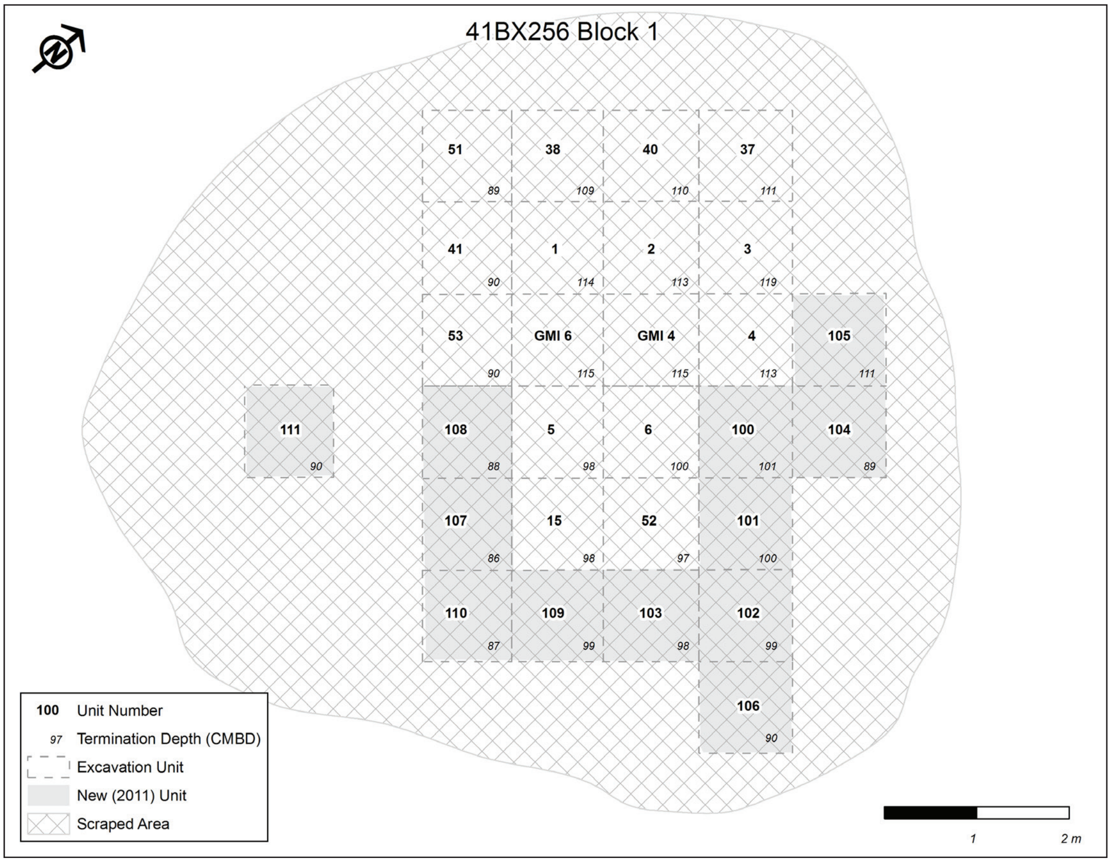

Figure 7-2. Block 1 showing mechanically stripped area, new units, and termination depths of 2011 excavations.

EComm excavated a total of 28 units, consisting of the two test units excavated in 2006, all 14 units excavated in 2008, and 12 new units (see Figure 7-2). Of the 16 units within the original excavations of Block 1, 11 were excavated to an average depth of 110 cmbs, two were excavated to a depth of 100 cmbs, and three were excavated to a depth of 90 cmbs. Six of the new excavation units (numbers 104, 106, 107, 108, 110, 111) were terminated at approximately 90 cmbs while the remaining units (numbers 100, 101, 102, 103, 105, 109) ended at approximately 100 cmbs (see Figure 7-2). Not including the intact soil that was expediently removed above the targeted starting elevation, a total of 8.74 m^3 of soil was removed through controlled manually excavation. Depths of the units were controlled by the establishment of eight sub-datums set off the central datum which was set at 100.00 m.

Figure 7-3. Photograph of Block 1 prior to beginning of 2011 controlled excavations, looking south. Trench bisecting Feature 4 in foreground.

Five features were documented including the two burned clay masses (F4, F9) originally recorded in 2008 and three newly discovered features. The three newly encountered features consisted of fire-cracked rock hearths and were designated Features 14, 15, and 16. In addition, three loci were designated in the field as Features 11, 12, 13 and were sampled but were later determined to be krotovina and/or portions of the larger Feature 4. The excavation recovered 110 pieces of chipped stone debitage, 474 pieces of fire-cracked rock, seven mussel shell umbos, and nearly 11 kg of burned clay pieces. In addition, 18 charcoal samples were collected, plus samples for pollen, microcarbon, and flotation analyses. The pollen and microcarbon samples collected were taken from every excavated level from each unit. Soil columns were also sampled for magnetic soil susceptibility, and phosphate (pH) values.

In addition to the excavation of 28 units, the "mini-trench" that had been expediently used to bisect Feature 4 on the last day of excavations in 2008 was re-examined. This trench had not been designated as a provenience at the time, so it was referred to as trench "X." The trench was cleaned of backdirt and both trench walls were incrementally shaved, photographed, sampled, and drawn.

7.1 Integrity Of The Middle Archaic Component

An understanding of the site's structure, including features, is contingent upon a thorough understanding of the site's stratigraphic and geologic context. The site is situated on a T1 terrace in between a paleochannel of the San Antonio River, to the north of the site, and an unnamed drainage to the south. Block 1 is located on the southern portion of the T1 terrace on which the site is located. It appears that the area was not heavily influenced by episodes of flooding.

During our original investigations of Block 1 several factors were considered in assessing the contextual integrity of the site such as pH values of soils, magnetic soil susceptibility values, cumulative mean flake length, distribution of diagnostic artifacts, and radiocarbon assays. Based on our analysis of these factors collected from our investigations in 2008 and information gathered from GMI's excavation in 2006, evidence of human occupation within Block 1 begins during the early Middle Archaic. Occupation of the site continues into the Late Prehistoric and Protohistoric periods and is marked by the presence of diagnostic artifacts from the two periods which is subsequently followed by the Spanish Colonial period (Table 7-1). With some exceptions due to bioturbation, our previous investigations suggest a high degree of contextual integrity based on diagnostic artifacts, magnetic susceptibility of the soils, pH levels of the soils and radiocarbon assays.

Table 7-1. Cultural Components within Block 1 Based on Previous Investigations.

Cultural Component	Mean Depth (cmbs)	Radiocarbon date cal. BP (2σ)	Diagnostic Artifacts
Spanish Colonial	0–25	–	Spanish Majolica Ceramics
Late Prehistoric / Protohistoric	26–45	–	Leon Plain, Perdiz point, Edwards point
Middle Archaic	46–71	5040–4840 (GMI 2006) 5030–4840 (EComm 2008)	Langtry point

Due to the identification of cultural components in the upper 70 cm of Block 1, during our 2008 investigations, newly excavated levels (within both new and existing units) that fall within 46–71 cmbs are considered to correspond with the Middle Archaic as previously established. Levels excavated beyond 71 cmbs were considered to be unknown; however, in continuing with the assessment of contextual integrity of the site, soil magnetic susceptibility and soil pH values were collected from the southern profile of Trench X. The trench was excavated to a depth of 150 cmbs allowing for examination of possible cultural components that may be deeper. In our excavations the maximum depth reached was 110 cmbs and only allowed for cultural materials to be collected to this depth. Based on the information gathered from soil susceptibility values and pH values coupled with diagnostic artifacts and radiocarbon assays, deposits correspond to the Middle Archaic component (Table 7-2) and appear to demonstrate a high degree of integrity with the exception of one anomalously young date in unit 101. The radiocarbon dates and their contexts are further discussed in section 7.3.1, below.

Table 7-2. Radiocarbon Dates and Temporally Diagnostic Artifacts from Block 1.

Cultural Component	Depth (cmbs) *	Unit	Radiocarbon date cal. BP (2σ)	Temporal Diagnostics
Middle Archaic	60-70	101	4820–4530	–
		106	4980–4850	–
		GMI 4	5040–4840 (GMI 2006)	Langtry (GMI)
		GMI 4	5030–4840 (EComm 2008)	–
	70–80	38	4870–4830	–
		108	–	Untyped Middle Archaic point
	80–90	GMI 4	5060–4880	–
	90–100	101	4540–4420	–

In the original excavations, disturbances observed within Block 1 consisted primarily of bioturbation caused by vertical and horizontal root activity. Some animal burrowing was observed. During the 2011 excavations, disturbances observed consisted of both root activity and animal burrowing. The root activity disturbances observed were not extensive and were limited to the southeastern area of the block within Units 101, 102, and 106. As seen in Table 7-2, a Late Archaic date was encountered in Unit 101 from 90 to 100 cmbs. Based on the root activity observed in those units, it is possible that the sample collected was out of context and thus yielded an earlier date. The animal burrowing disturbances were isolated within the southern profile of Trench X in Units 1 and 2 of which a majority was taken out during the excavation of the trench in 2008. Despite the disturbances observed the overall integrity of the block appear to be intact and reflects a continuation of the Middle Archaic component encountered during the 2006 and 2008 investigations.

Flaked stone artifacts were fairly sparse given the volume of soil that was excavated. Of the 28 excavated units, only 20 contained lithic material. A total of merely 110 pieces of chipped stone was collected and consisted of 37 complete flakes, 64 incomplete flakes, one biface, two cores, one untyped Middle Archaic projectile point, and five pieces of shatter (Table 7-3). Of note, the majority of chipped stone was encountered at a depth between 70 to 90 cmbs (see Table 7-3), reinforcing the interpretation that the Middle Archaic living surface was at about 70 cmbs.

Table 7-3. Distribution of Flaked Debitage from All Excavated Units.

Depth (cmbs)	Projectile Point	Complete Flakes	Incomplete Flakes	Core	Biface	Shatter	Total
40–50	–	9	6	–	–	–	15
50–60	–	5	5	–	–	2	12
60–70	–	6	8	–	–	–	14
70–80	1	4	16	–	1	3	25
80–90	–	8	17	1	–	–	26
90–100	–	5	9	1	–	–	15
100–110	–	–	3	–	–	–	3
Total	**1**	**37**	**64**	**2**	**1**	**5**	**110**

Figure 7-4. Untyped Middle Archaic projectile point.

The untyped Middle Archaic projectile point (see Table 7-2 and Figure 7-4) was lanceolate in shape and had been reworked along the lateral edges and distal end. The tip of the point is missing due to post depositional breakage. The reworking of the point at the distal end shows that the point was continually reworked as it varies in shape from the entire point. The proximal end of the point is beveled on the left lateral edge which also shows evidence of grinding. The flaking patterning of the point was random; however, on the lateral edges where reworking was present, the pattern of flaking is unclear. The point is made of heat treated chert that fluoresces yellow under ultraviolet light, suggesting that the material is Edwards chert.

7.2 Feature Excavation

Five features were documented, including two burned clay masses (F4, F9) and three fire-cracked rock hearths (F14, F15, F16). In addition, three loci (F11, F12, F13) were initially treated as features but were later determined to be non-features. Feature locations within the excavation block are plotted in Figure 7-5.

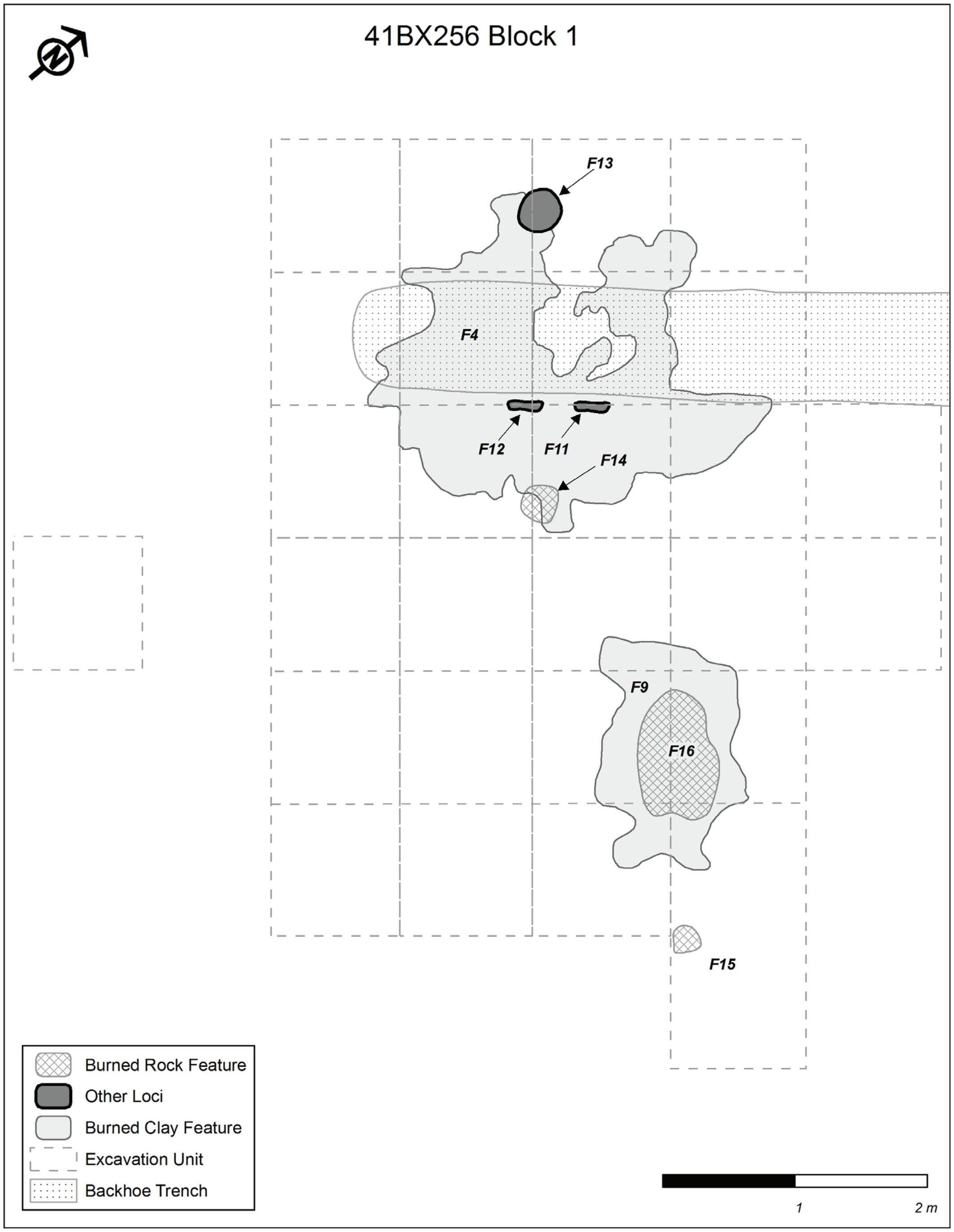

Figure 7-5. Location of Features within Block 1.

7.2.1 Feature 4: Large Burned Clay Mass

During our 2008 investigations, the functional interpretation of Feature 4 was not conclusive. Two possibilities were considered: (1) the clay mass represented a cooking feature based on a technology normally seen in areas where rock was scarce; and (2) the feature represented the remnants of a burned wattle and daub structure. No post molds or other evidence commonly associated with structures were observed and bisection of the feature suggested that it may have been basin shaped. Impressions of vegetation on the numerous burned clay nodules were not observed until after the excavation block had been backfilled.

During the 2011 excavations, numerous factors were considered in determining the function of Feature 4. In our excavations, we re-examined the trench originally excavated at the end of the 2008 season. Additionally, several samples were collected to identify aspects that may be related to cooking and structural construction, such as the presence of starches and lipids on and within the clay nodules, samples that would identify degree of heating with the idea that a cooking feature would display multiple heating events whereas one heating event would suggest a massive burning event that may have occurred during the abandonment of a structure. Furthermore, the field director consulted with several respected Texas archaeologists who have worked in the South, the High Plains, and the Coastal regions of Texas and are more familiar with burned clay features and structures. In addition, several resources were consulted which dealt with clay cooking techniques and structural construction in Texas and the Southeast where these two types features have been encountered. Finally, artifact distribution within the units directly associated with the feature and the surrounding units was looked at for patterning that may be indicative of the presence of a perishable structure.

Trench X

To clearly examine the profile of Trench X through Feature 4, archaeologists incrementally shaved back approximately 10 cm of the trench walls on both the northern and southern faces to better examine the feature in profile. When the trench was originally excavated in 2008, the feature appeared to have been somewhat basin shaped in the southern profile. However, we now believe this apparent basin profile to be an artifact resulting from the manner in which the backhoe created the trench, ripping through the dried and compacted surface at 70 cmbs. After the cleaning of the trench walls and enhancing the soil contrast with gentle water sprays, a very different profile was seen. The profile exhibited two distinct loci of reddened soil (7.5YR 4/6) above the unaltered substrate (10YR 4/3). In both the southern and northern profiles of the trench, soils below the feature exhibited a 25 cm thick thermal reaction zone. This zone consisted of thermally altered substrate sediment mixed with both lithified and unlithified burned clay and sporadic pieces of charcoal (Figure 7-6). Several areas of organically darkened soil (10YR 3/2) located between the reddened zones were initially thought to be cultural and were sampled, but were later identified as intrusive krotovina. In the southern trench profile, the two zones were separated by about a meter with minimal reddening and with minimal inclusions of burned clay.

Figure 7-6. Composite Image of the Southern Profile of Trench X, looking south. Note two loci of reddened soil.

Burned Clay from Feature 4

The majority of the feature's volume had been removed during the 2008 excavations down to 70 cmbs. Nonetheless, the remaining portion contained a sizeable deposit of burned clay. As this deposit of burned clay was excavated, it fragmented into pieces of varying size, ranging from less than 5 cm to more than 20 cm in diameter. These were examined in the field and collected for subsequent analysis. As was observed on the pieces of burned clay previously excavated, many of these pieces contained stick impressions, ranging in diameter from toothpick-sized (i.e. 1–2 millimeters) to thumb- sized (i.e. 1–2 centimeters)

More than 450 pieces of burned clay were collected from units directly associated with Feature 4 (Units 38, 40, 2, 4, GMI 6, and GMI 4) and immediately surrounding it (Units 37, 3, and 41). This total includes 25 pieces that were collected not *in situ* from directly above the starting level of 65–70 cmbs. Of the 444 pieces that were collected *in situ*, 262 were collected from 65–70 cmbs, 143 from 70–80 cmbs, and 39 from 80–90 cmbs (Table 7-4). To some extent, the number of 'pieces' of burned clay was an artifact of the excavation methods in that the burned clay did not exist in discrete packets, but was collected as fragments were detached from the large mass of burned clay. Nonetheless, the pieces were of generally comparable volume, typically ranging from 5–15 cm in diameter. The count of pieces is thus used here to obtain a rough volumetric estimate. Given this limitation, the data show that the overwhelming majority (91 percent) of the burned clay was recovered 65–80 cmbs and that a majority of pieces

(59 percent) was recovered from the 5 cm immediately above the presumed occupation surface (65–70 cmbs).

Table 7-4. Frequency of Burned Clay Pieces within Feature 4 and Associated Units.

Depth (cmbs)	Excavation Unit										Total	% (in situ)
	Surface	2	3	4	GMI 4	GMI 6	37	38	40	41		
Above 65	25	–	–	–	–	–	–	–	–	–	25	n/a
65-70	–	42	20	51	56	26	10	32	12	13	262	59%
70-80	–	–	–	51	21	2	–	45	7	17	143	32%
80-90	–	–	–	2	6	–	–	10	13	8	39	9%
Total	**25**	**42**	**20**	**104**	**83**	**28**	**10**	**87**	**32**	**38**	**469**	**100%**

Table 7-5. Comparison of Burned Clay Samples Collected During 2008 and 2011, by Size Grade.

Size grade	Frequency		Total weight (g)		Mean weight (g)	
	2008	2011	2008	2011	2008	2011
< 5 cm	296	446	5,026	2,650	17	6
5–10 cm	83	16	11,080	1,955	133	122
> 10 cm	10	7	7,305	3,364	731	481
Totals	**389**	**469**	**23,411**	**7,968**	**60**	**17**

The 2008 excavation of Feature 4 recovered 389 pieces of burned clay totaling 23.4 kg. The pieces of burned clay were classified in sizes ranging from smaller than 5 cm, 5–10 cm, and larger than 10 cm. A large majority of the pieces (n=296) was in the smallest size class, with 83 pieces in the middle size class and only 10 pieces in the large size class (Table 7-5). The total number of burned clay pieces collected in 2011 consisted of 469 pieces weighing only 7.9 kg (Table 7-5). For both seasons, most of the burned clay pieces fall within the smallest size grade. However, the mean size of burned clay specimen collected in 2011 weighed only 17 g and was much smaller than the average piece from 2008 weighing 469 g. This striking difference is an artifact of the differing methodologies employed between the two seasons. The 2008 sample consisted primarily of pieces collected from the large mass itself. In contrast, burned clay collected during the 2011 season consisted of all clay encountered within the associated units, below the 70 cmbs occupation surface, as well as loose pieces of burned clay left behind from the preliminary shovel scraping down to 65 cmbs. This shift reflected our significantly increased focus on the individual burned clay pieces themselves. As a result, a much larger portion of the recovered burned clay consisted of very small pieces, representing the remnants of heavily fragmented larger pieces.

Because of the much smaller size of the typical piece of burned clay recovered in 2011, far fewer pieces showed evidence of stick impressions, as compared to 2008. In 2008, nearly one in four pieces (n=93) showed evidence of one or more stick impressions. In contrast, the 2011 sample includes only seven pieces with evidence of stick impressions, despite the large number of pieces collected (Table 7-6). The 2008 sample included 93 pieces of burned clay containing total of 117 different stick impressions. These impressions ranged in size from less than 1 mm to nearly 70 cm in reconstructed diameter. In contrast, in the 2011 sample included only seven pieces with a total of ten impressions (Table 7-6). These impressions ranged in size from about 1.5 mm to about 5.4 cm in reconstructed diameter (Figure 7-7). Comparison of the impression sizes suggests no meaningful difference between the samples.

Table 7-6. Impressions on Burned Clay Samples from the 2008 and 2011 Excavations, By Size Grade.

Size grade	frequency		pieces with impressions		Ratio, impressions to pieces	
	2008	2011	2008	2011	2008	2011
< 5 cm	296	446	46	–	0.2	–
5–10 cm	83	16	39	2	0.5	0.1
> 10 cm	10	7	8	5	0.8	0.7
Totals	**389**	**469**	**93**	**7**	**0.2**	**0.0**

Figure 7-7. Burned Clay with Impressions. Large stick size (left) and smaller stick size (right).

Chipped Stone Associated with Feature 4

We previously concluded that the occupation living surface associated with Feature 4 was located at a depth that varied across the block between 65 and 75 cmbs. The artifact assemblage directly associated with Feature 4 (excavation units 4, 38, 40, GMI-4, GMI-6) at 70–80 cmbs is extremely sparse, consisting solely of two incomplete flakes, one complete flake and one piece of manufacturing shatter at 70–80 cmbs plus four complete flakes and two incomplete flakes at 80–90 cmbs (Table 7-7). In the units surrounding Feature 4, the total number of chipped stone items is higher. This assemblage consists of 21 chipped stone artifacts between 70–80 cmbs and 18 pieces between 80–90 cmbs (Table 7-8) including 27 incomplete flakes, seven complete flakes, two pieces of shatter, one core, one biface, and one untyped Middle Archaic point (Table 7-8). The horizontal distribution of artifacts is illustrated in

Table 7-7. Chipped Stone Artifacts Directly Associated with Feature 4.

Excavation Unit	depth (cmbs)		Total
	70–80	80–90	
4	IF	–	1
38	CF, S	3 CF, 3 IF	8
40	IF	IF	2
GMI 4	–	CF	1
GMI 6	–	–	0
Total	**4**	**8**	**12**

Key: CF=complete flake, IF=incomplete flake, S=shatter

Table 7-8. Chipped Stone from Units Surrounding Feature 4.

Excavation Unit	depth (cmbs) 70-80	80-90	Total
37	2 IF	IF	3
41	IF	–	1
5	–	–	0
6	–	–	0
13	–	–	0
51	IF	–	1
52	–	–	0
53	–	–	0
100	3 IF	2 CF, IF	6
101	–	4 IF	4
102	CF, IF	IF	3
103	IF, B, S	IF	4
104	2 IF	2 CF, 3 IF	7
105	IF	–	1
106	–	–	0
107	–	2 IF, Co	3
108	2 CF, IF, PP, S	–	5
109	IF	–	1
110	–	–	0
111	–	–	0
Total	**21**	**18**	**39**

Key: CF=complete flake, IF=incomplete flake, S=shatter, B=biface, Co=core , PP=projectile point

Figure 7-8. Although comparable data are not available from units 1–3 (these units were trenched), the pattern nonetheless clearly reveals a lower density central zone surrounded by several loci having higher artifact densities Although the total number of items is not sufficient to constitute a reliable sample size, the pattern seen is that the number of chipped stone artifacts increases further away from Feature 4 suggesting that at this depth as seen in our previous investigations represents a living surface. No lithic artifacts were recovered from units 52, 101, 106 or 197.

Thermal Signature

The 12 units directly associated with Feature 4 were excavated in 10 cm levels except for the first level which was excavated from approximately 65–70 cm in order to level all units and to begin the excavations at 70 cm. Once this upper 5 cm was removed, a zone of reddened soil appeared associated with within the outline of the feature (Figure 7-9). The zone was centered on unit 2 but also included portions of units 1, 3, 4 37 38, 40, and GMI-4 and GMI-6 and also was visible in profile within the trench. This zone was described in field notes as a “red stain” but it actually appears to be thermally induced rather than an actual organic stain. The zone varied in intensity horizontally but was quite visible when gently sprayed with water. The reddened zone measured approximately 2.8 m along the trench by 2.5 m perpendicular to the trench and encompassed an area of about 5.25 m^2.

The reddened zone was encountered throughout the next 10 cm level (70–80 cmbs) in all of the nine units where it was seen at 70 cmbs. By 80 cmbs, the zone shifted somewhat in shape (Figure 7-10) but it largely overlapped the pattern seen at 70 cmbs. At 80 cmbs, it measured approximately 2.7 m along the trench by 2.6 m perpendicular to the trench and encompassed an area of approximately 5.15 m^2.

Within the next 10 cm (80–90 cmbs), the reddened zone became increasingly difficult to clearly delineate and large gaps appeared in its expression. By 90 cmbs, the reddened zone was barely visible in just a few isolated patches; within a few cm below that it was no longer present in

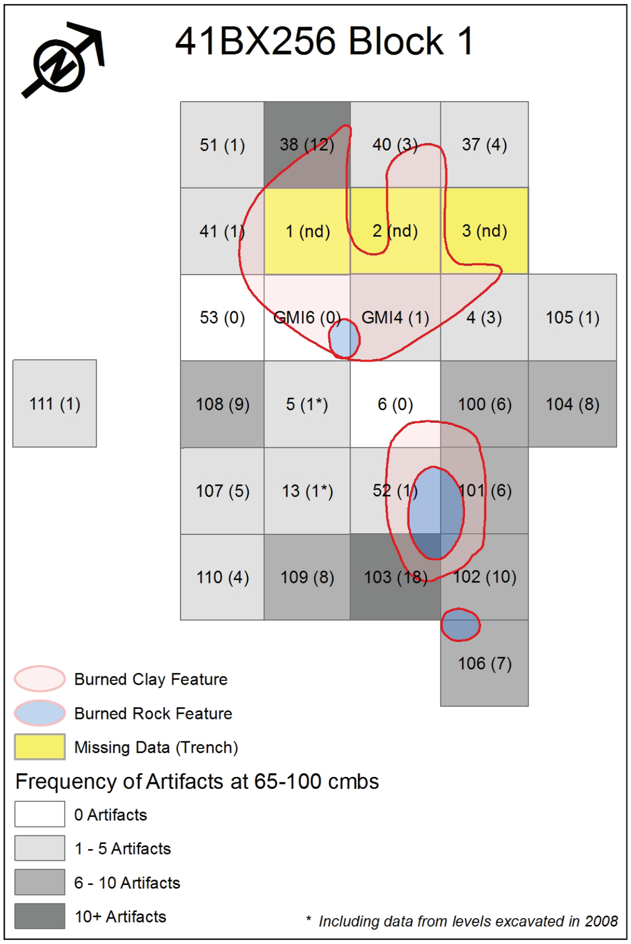

Figure 7-8. Frequency of artifacts at 65–100 cmbs.

any unit. In profile, the reddening was visible between about 65 and 90 cm for a maximum vertical extent of 25 cm. It was concentrated directly beneath the large clay mass documented as Feature 4 (Figure 7-11).

Samples of the burned clay were collected for analysis and several samples were submitted to Dr. Cecil at Stephen F. Austin State University for reconstruction of estimated firing temperature. Results of this analysis (see Section 7.3.4 below) suggest that samples collected from 65–70 cmbs were baked at temperatures ranging between 350°–600° C while samples from 70-80 cm were exposed to slightly lower temperatures ranging between 350°–400° C.

7.2.2 Feature 9: Small Burned Clay Mass

Originally Feature 9 was recorded within the eastern profile of Units 6 and

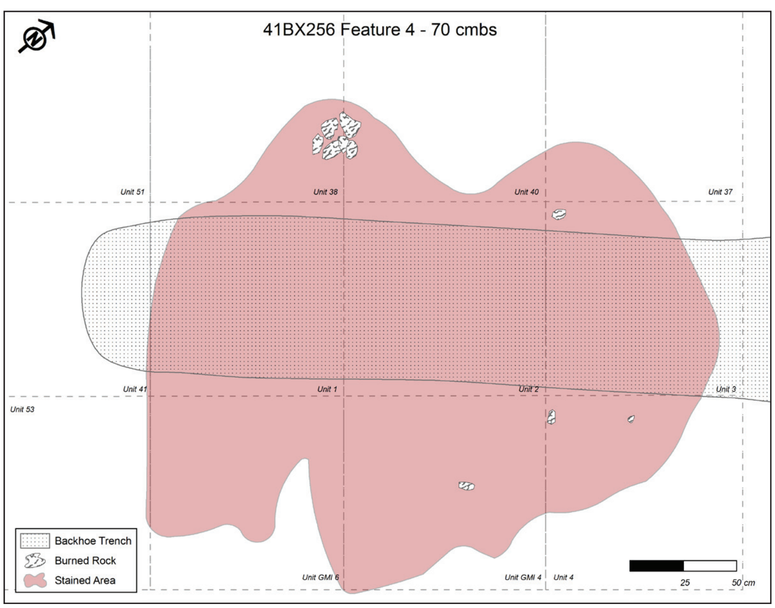

Figure 7-9. Plan view of the reddened zone observed at 70 cmbs.

52 as two isolated concentrations of heavily burned, cement-like clay one meter southeast of Feature 4 at a depth of 45–63 cmbs. Feature 9 was similar in expression and is stratigraphically associated with Feature 4 but due to the physical separation and paucity of the burned clay between the two features, Feature 9 was considered to be a separate occurrence of burned clay.

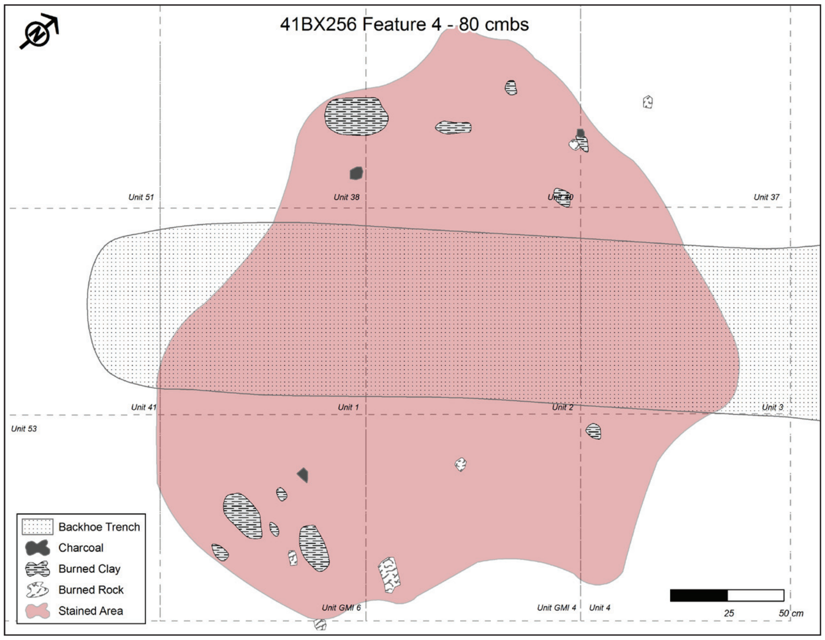

Figure 7-10. Plan view of the reddened zone observed at 80 cmbs.

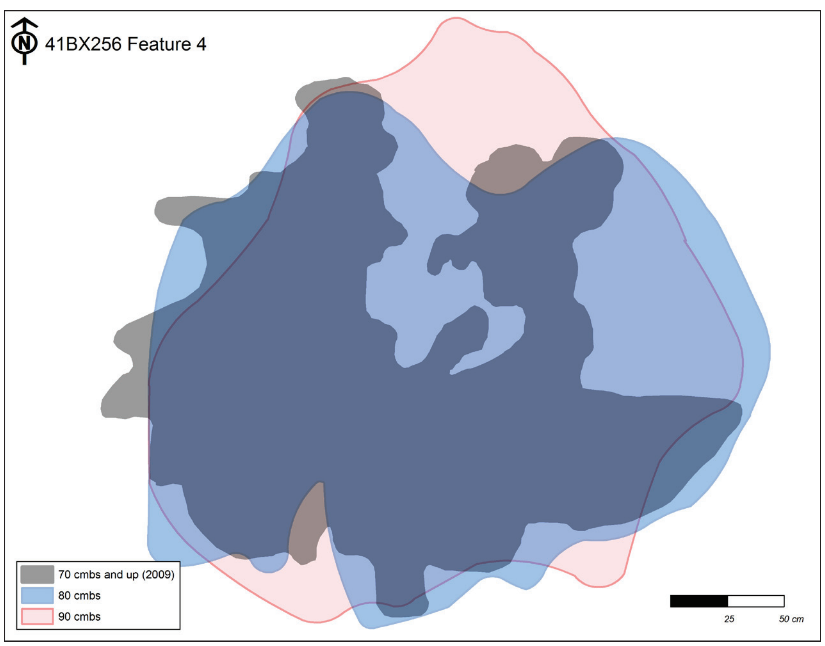

Figure 7-11. Plan view Feature 4 and the reddened zone.

Figure 7-12. Photo of Feature 9 in Units 6, 52, 100, 101, 102, and 103, looking northeast (Feature has been sprayed with water to enhance color).

During the 2011 re-excavation, Feature 9 was re-exposed within units 6 and 52 and four additional units (Units 100, 101, 102, and 103) were placed to the east and south of the existing units. This effort revealed that the majority of burned clay was concentrated in the western corner of Unit 102 and the northern corner of Unit 103 at a depth of 45 cmbs (Figure 7-12). The burned clay was found mixed with fire-cracked rock and was surrounded by a reddened zone at 70–80 cmbs, similar to what was seen associated with Feature 4. The reddened zone encompassed the burned clay and fire-cracked rock and measured approximately 1.6 x 1.3 m. In profile, the zone of reddening was shallower than seen for Feature 4, measuring only 6–9 cm thick (Figure 7-13).

A total of 214 pieces of burned clay were collected from Feature 9 and were carefully examined in the same manner as the burned clay collected from Feature 4. The samples were measured, described, examined for impressions, and analyzed for traces of lipids and starches. The samples collected were relatively small, ranging in size from 1–8 cm. All burned clay collected varied in texture from concrete like to very friable and showed evidence of various degrees of burning. Only one sample had an impression, measuring approximately 1/8 inch in diameter and encountered in Unit 101 at a depth of 60–70 cmbs. Thermal signatures displayed from the burned clay from Feature 9 varied. Temperature ranges from 45–60 cmbs varied from

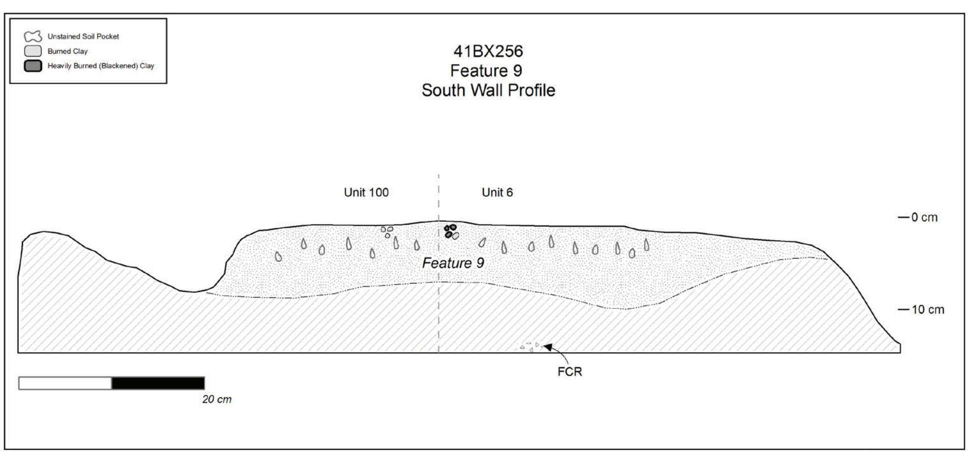

Figure 7-13. Southern profile of bisected Units 6 and 100.

300º–400º C and samples from 60–80 cmbs varied from 350º–500º C. Multiple samples were submitted for lipid and starch assay to determine if they were used in a cooking process.

Feature 9 is a burned clay mass mixed with some pieces of burned limestone and sandstone encompassed by thermally altered sediments which are also found beneath the feature. Unlike Feature 4 the amount of burned clay collected and the sizes of the samples collected were less and smaller in size; however, the similarity of the two features poses the question of whether Feature 9 is a structure like Feature 4. During our assessment of the burned clay collected from Feature 9 only one piece of burned clay displayed evidence of a stick impression, and the red stain observed associated with the feature was shallow; however, despite the single impression observed and the shallowness of the thermal reaction rim, it is plausible to consider Feature 9 as the remnants of another structure similar to Feature 4.

Although little evidence suggests that Feature 9 is a structure, it can be explained by the degree of burning involved. In other investigations where earth is used as a building material in the construction of a structure, the evidence is only apparent if the structure was burned. According to Boyd, Frederick, Rogers and Wolf (personal communication 2011), only a small percentage of daub used in the construction of a structure is encountered and it is only the pieces that have been exposed to fire. Even if the structure was burned either intentionally or naturally, not all clay would have preserved. Given the shallowness of the red stain associated with the feature and the temperatures displayed from the samples, it appears that there was a highly oxidized fire reaching 500º C. The degree to which the clay was fired ranges from 300º–500º C across the feature suggesting that the intensity of the fire varied and that it may have been brief resulting in a shallow thermal reaction rim and the scarcity of daub. Although this is a hypothesis, the evidence observed in Feature 9 is similar to Feature 4 and the presence of the single burned daub sample with the impression indicated that Feature 9 is the remnants of another separate structure dating to the Middle Archaic and is contemporaneous with Feature 4.

7.2.3 Features 11, 12, and 13

During the examination of the southern profile of Trench X, two dark soil concentrations were observed were defined as Features 11 and 12 (see Figure 7-5). The soils were located towards the center of Feature 4 and were separated by 1.2 m in the profile. The dark soils were intrusive into the reddened clay matrix of Feature 4 and were initially thought to be cultural. As a result the dark soil packages were defined as Features 11 and 12 (Figure 7-14) and soil matrix was collected individually. As the soils were collected it became clear that the dark soils were actually krotovina. Features 11 and 12 are considered to be non-cultural.

Additionally, within Units 38 and 40, a 35 x 30-cm clump of friable, burned clay was encountered at a depth of 77 cmbs and was labeled as Feature 13 (Figure 7-15). This locus extended to a depth of 85 cmbs. The feature was exposed and isolated while the surrounding units were excavated to determine if the locus extended laterally. No other friable-burned clay was encountered and Feature 13 is considered to be coincident with and part of Feature 4.

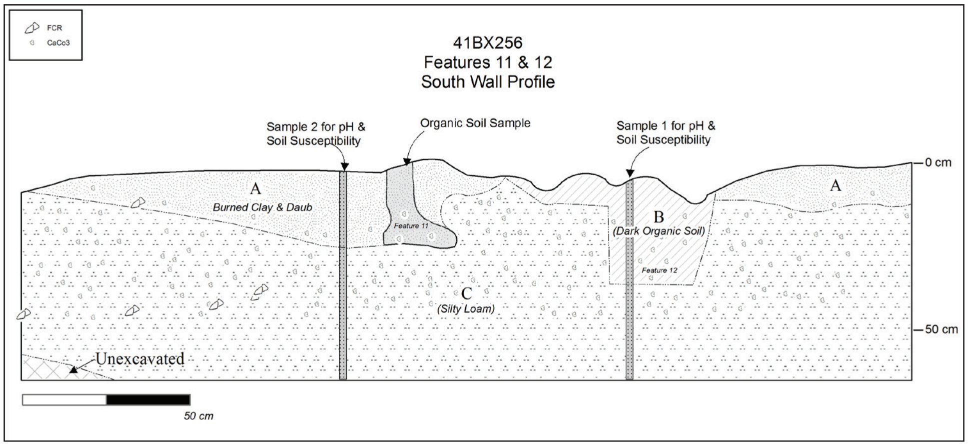

Figure 7-14. Southern Profile of Trench X showing the position of Features 11 and 12.

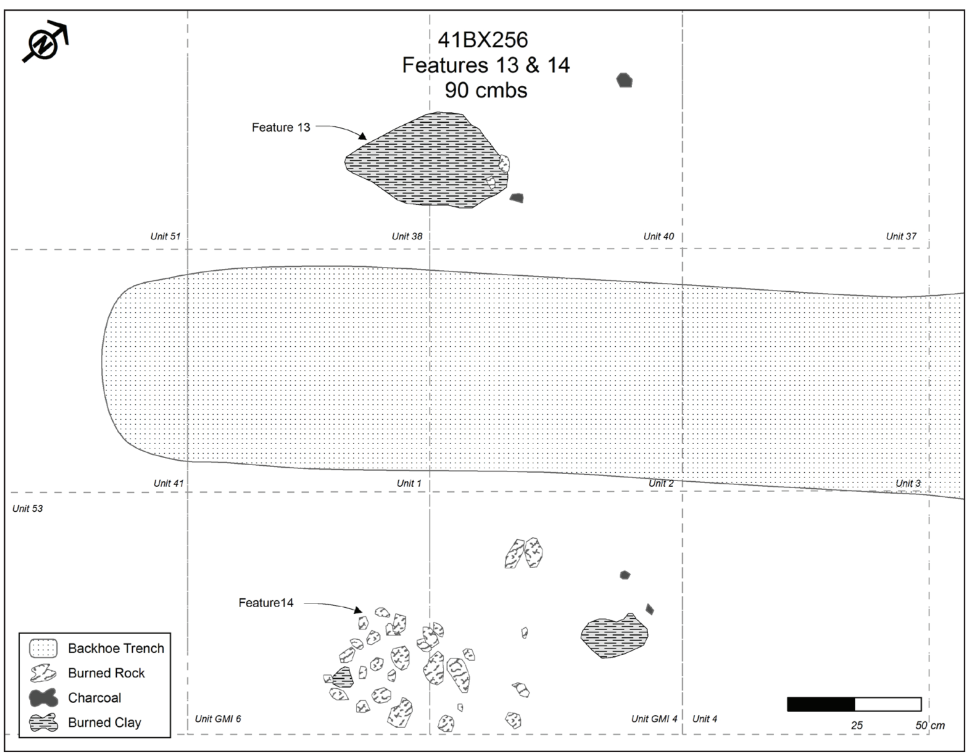

Figure 7-15. Plan view showing Features 13 and 14.

7.2.4 Feature 14: Fire-Cracked Rock Hearth

Feature 14 was recorded as a small-deflated fire-cracked rock thermal feature measuring approximately 65 x 50 cm (see Figure 7-15), with a semi-circular core and a fire-cracked rock scatter along the eastern boundary. The feature was first encountered at a depth of 83 cmbs and extended to a maximum depth of 90 cmbs in Units GMI 6 and GMI 4. Feature 14 was composed of a combination of small (0–5 cm), medium (5–10 cm), and large (> 10 cm) limestone cobbles, angular sandstone, and a single rounded nodule of burned clay. Feature 14 was encountered on a silty loam (10YR 4/3) surface below the thermally altered sediments from Feature 4. The feature was initially thought to be part of Feature 4, perhaps serving as a hearth within the structure; however, after further examination the feature is considered to be an individual occurrence.

Figure 7-16. Rounded nodule of burned clay from Feature 14.

During our investigations of Feature 14, a piece of charcoal was collected and sent to Beta Analytical for AMS dating. The charcoal yielded a date of 5220–5190, 5060–4880 cal BP (2σ; see Beta-304609 in Appendix A). Although the dates yielded are similar to the dates of Feature 4, it is possible that the first date of Feature 14 (5220–5190) cal BP may reflect the correct time period placing the feature within the Early Middle Archaic, 250 years prior to the establishment of Feature 4.

No artifacts were observed directly in association with Feature 14; a single rounded nodule of burned clay was found within the feature (Figure 7-16). This rounded nodule was submitted for lipid and starch assay to determine if it was used in a cooking process.

7.2.5 Feature 15: Fire-Cracked Rock Hearth

Feature 15 was recorded as a deflated fire-cracked rock hearth feature. The feature was encountered in the northwest corner of Unit 106 at a depth of 67 cmbs to 73 cmbs on a silty loam (10YR 4/3) surface and measured approximately 47 cm by 40 cm. The feature consisted of a scatter of medium sized burned sandstone, burned limestone, charcoal flecks, small pieces of burned clay, and a heavily eroded animal bone. The bone was friable and disintegrated into unidentifiable pieces upon excavation but while in situ it was tentatively identified as a long bone of a medium sized mammal. A piece of charcoal yielded a date 5030–5010 and 4980–

4850 cal BP (2σ; see Beta-304612 in Appendix A), similar to the dates obtained for Feature 4. No artifacts in direct association with the feature were observed.

7.2.6 Feature 16: Fire-Cracked Rock Hearth

Feature 16 is a circular, deflated hearth feature measuring approximately 1.25 cm by 1.25 m and consists of burned sandstone, limestone and a single rounded nodule of burned clay (Figure 7-17). The feature was encountered Units 52, 101, and 103, within a silty loam (10YR 4/3) soil below the red staining. Feature 16 was encountered at a depth of 73 cmbs and extended to a depth of 81 cmbs. Due to the stratigraphic location of the feature, it is considered to be an individual occurrence like Feature 14. Based on the stratigraphic positioning of the feature, Feature 16 is Middle Archaic in age. No artifacts were observed in direct association except for the rounded nodule of burned clay (Figure 7-17).

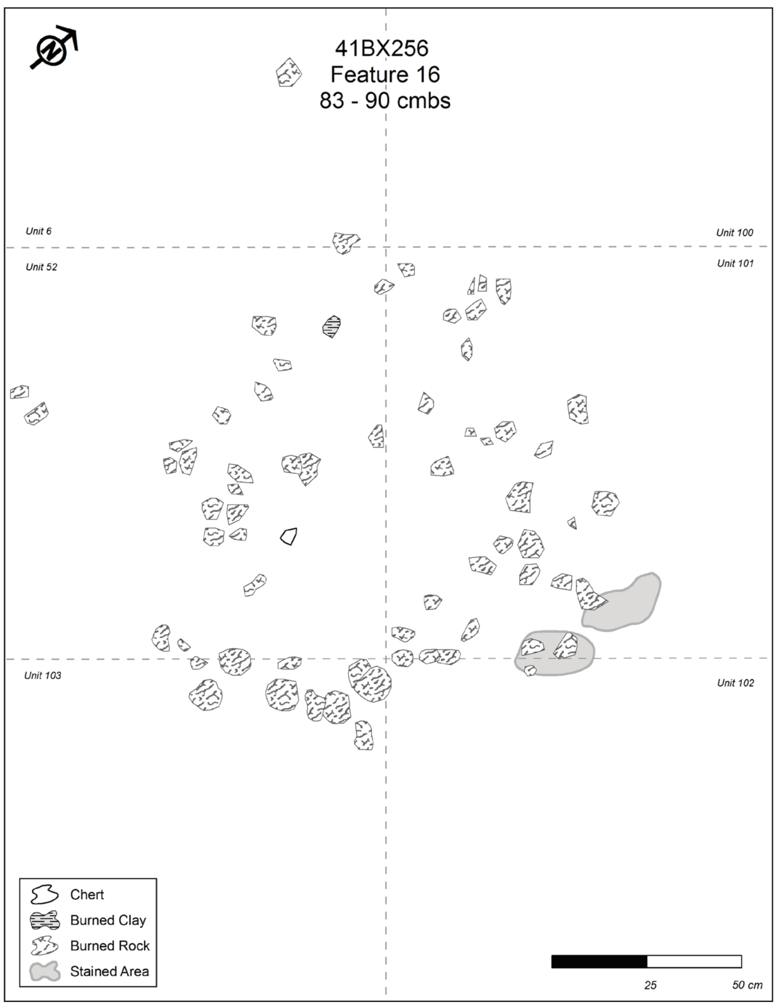

Figure 7-17. Plan view of Figure 16.

7.3 Results Of Analyses

7.3.1 Radiocarbon Dating

Five samples were submitted to Beta Analytic, Inc. for AMS radiocarbon dating. The samples consisted of charcoal and included one from Feature 4, one from F14, two samples from Feature 9, and one from Feature 15. Combined with the two samples from Feature 4 that had been previously analyzed in 2006 and 2008, a total of seven radiocarbon dates are available for interpretation from the clustering of features (Table 7-9). The complete reports of these assays are presented here as Appendix A, including reprints of the 2006 and 2008 data sheets from Osburn (2007: Appendix C) and Padilla et al (2010: Appendix G).

Table 7-9. Summary of Radiocarbon Dates.

Feature	Sampling Year	Unit	Depth (cmbs)	Assayed material	Beta ID	Calibrated Radiocarbon Date, Years BP
4	2006 (GMI)	GMI 4	60-70	charcoal	219932	5040–4840
4	2008 (EComm)	1	60-70	charcoal	260896	5030–5010 / 4980–4840
4	2011	38	70-80	charcoal	304610	4870–4830
F14 / F4	2011	GMI 4	80-90	charcoal	304609	5060–4880
9	2011	101	90-100	charcoal	306188	4540–4420
9	2011	101	60-70	charcoal	304611	4820–4740 / 4730–4530
15	2011	106	60-70	charcoal	304612	4980–4850

Figure 7-18. Burned clay nodule found within Feature 16.

All of the four dates associated with Feature 4 (including the sample taken from F14) are highly clustered and provide a reliable date for the burned clay mass between 5060 BP and 4830 BP (Figure 7-18). The dates obtained by Osburn (2007) and by Padilla et al (2010) from 60–70 cmbs are virtually identical and both significantly overlap the date obtained from Feature 14 from 80–90 cmbs. The sample from the intermediate level (70–80 cmbs) has a tighter error range but the 2 sigma range does overlap with both of the dates obtained at 60–70 cmbs.

The remaining three samples are more problematic. The sample from Feature 15 (Unit 106 at 60–70 cmbs) wholly overlaps the date range obtained for Feature 4 (Figure 7-19), suggesting that this burned rock hearth is contemporaneous with both the large burned clay mass and with the morphologically similar Feature 14. However, the two dates obtained from the smaller burned clay Feature 9 are both significantly younger and neither overlaps with the presumed date of Feature 4. Moreover, the deeper sample (90–100 cmbs) yields a date that is younger than the sample obtained from 30 cm above this level. This inverse stratigraphic dating can perhaps be attributed to rodent disturbance and root activity.

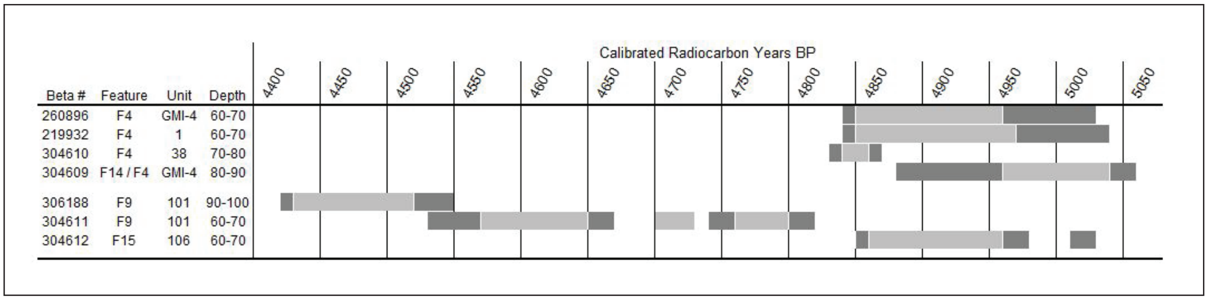

Figure 7-19 Radiocarbon dates from Features 4 and 9, by depth

7.3.2 Lipids and Fatty Acids

Four samples of baked clay were submitted for lipid and fatty acid residue analysis to Dr. Mary Malainey of the Brandon University Department of Anthropology. The samples included one-half of each of four clay nodules/balls from Features 4, 9, and 13 (Table 7-10), with the remaining halves of the split samples being submitted for starch assay (see below). The complete report of this analysis is presented as Appendix B. In general, the samples had low to non-detectable amounts of fatty acids. Dr. Malainey speculates that this could be *"due to their age and stage of degradation"* (Appendix B, Results). This is certainly a possibility, but it could equally be due to the absence of fatty acid enrichment to begin with. If the clay was in close contact with plant remains (Hypothesis 2–burned structure) but not animal byproducts (Hypothesis 1–cooking feature), then low to non-detectable amounts of fatty acids would be predicted. In all cases, the lipid residues appear to match patterns suggested from combinations of plant materials; only one of the four samples has a lipid signature suggesting both plant and animal materials (sample 110 from Feature 9 at 70–80 cmbs).

Table 7-10. Results of Lipid Assays.

Field Sample	Unit	Feature	Depth	wt (g)	Laboratory Sample ID	fatty acid residue	lipid residue interpretation
118-A	40	4	65–70	34.156	11EC 7	Low	Mostly plant products
109-A	102	9	50–70	35.200	11EC 4	quite low	Plant & animal products
110-A	52	9	70–80	35.511	11EC 5	almost no fatty acids	Mostly plant products
114-A	GMI-6	13	80–90	33.716	11EC 6	low	Mostly plant products

Malainey does not explicitly examine the proposition that the samples could be from a context not involving food cooking; indeed her unstated assumption is that the samples are from cooking contexts. This proposition could have been addressed by analyzing control samples of clay from the site not associated with the feature. While the results of the lipid and fatty acid assays do not allow us to reject this interpretation completely, the very low fatty acid content of the samples is at least suggestive of a non-cooking interpretation. Similarly, the results of the lipid residue analyses could support either interpretation: that the samples were in contact with plant remains is expected under either of the two primary hypotheses.

7.3.3 Starches and Phytoliths

The remaining halves of the four samples of baked clay nodules/balls were submitted for starch (micro-fossil) analyses to Dr. Alston Thoms at the Palynology Research Laboratory, Department of Anthropology, Texas A&M University. The research was conducted and reported by Dr. Timothy E. Riley and is presented here as Appendix C. These samples were examined using the multiple working hypothesis approach. If the samples were involved in cooking plant resources, it was expected that the clay would contain remnant starch granules. In contrast, if the samples were from structural daub, evidence of grass phytoliths was expected.

While each sample was examined for the presence of diagnostic phytoliths as well as starch granules, neither was recovered from any of the samples (Table 7-11). Riley speculates that this could be due to poor preservation and/or to the antiquity of the occupation. Unfortunately, the negative evidence does not support either of the hypotheses about the function of the burnt clay features. Moreover, the presence of microscopic charcoal and oxidized minerals in all samples supports the claim that the clay was exposed to fire, which is consistent with either hypothesis.

Table 7-11. Results of Micro-Fossil Analysis.

Field Sample	Unit	Feature	Depth	Starch granules	Grass Phytoliths	Oxidized Minerals	Micro Carbon
118-B	40	4	65–70	No	No	Yes	Yes
109-B	102	9	50–70	No	No	Yes	Yes
110-B	52	9	70–80	No	No	Yes	Yes
114-B	GMI-6	13	80–90	No	No	Yes	Yes

7.3.4 Firing Temperature

Forty-four burned clay samples from Features 4 and 9 were submitted for analysis of estimated firing temperature to Dr. Leslie Cecil at Stephen F. Austin State University in Nacogdoches, Texas. Samples were taken from a full range of elevations, ranging from 45–50 cmbs to 90–100 cmbs for Feature 9 and from 65 cmbs to 70–80 cmbs for Feature 4. After pre-processing, 26 samples were analyzed, 18 from Feature 4 and 8 from Feature 9 (Table 7-12).

Table 7-12. Estimated Firing Temperatures, Features 4 and 9.

Sample Number	Feature Number	Depth (cmbs)	Estimated Firing Temperature (ºC)	Munsell Soil Color at 800ºC
153	9	45-50	350-400	5YR 8/4
154a	9	50-60	300	7.5YR 8/3
154b	9	50-60	300-350	5YR 7/6
167	9	60-70	350-400	7.5YR 8/4
165a	9	70-80	500	2.5YR 8/4
165b	9	70-80	350	7.5YR 8/4
165c	9	70-80	400	7.5YR 8/4
116	9	90-100	<300	5YR 8/4
108a	4	65	450	7.5YR 7/4
108b	4	65	500	7.5YR 8/4
120a	4	65-70	450	5YR 7/6
120b	4	65-70	350-400	5YR 7/6
122a	4	65-70	450	5YR 7/6
122b	4	65-70	450	5YR 7/6
135	4	80-90	400	5YR 6/6
137	4	80-90	400	5YR 6/6
138	4	80-90	450	7.5YR 7/2
139a	4	70-80	450	5YR 7/6
139b	4	70-80	350	5YR 8/4
214*	4	55-65	450	5YR 7/4
215*	4	55-65	600	5YR 6/4
216*	4	55-65	400	5YR 6/4
217*	4	55-65	550	5YR 6/4
218*	4	55-65	600	5YR 6/4-6
219*	4	55-65	450	5YR 6/6
220*	4	55-65	350	7.5YR 7/4

* Excavated in 2008.

With two exceptions, clay samples from Feature 9 have “relatively low” estimated firing temperatures between 300°–400ºC (572–752ºF) (Figure 7-20). The two exceptions are samples 215 (55–65 cmbs) and 218 (55–65 cmbs) which have a higher estimated firing temperature of about 600ºC (1112ºF). The samples from Feature 4 show evidence of being heated/fired at slightly higher temperatures (Figure 7-21). All but one of the samples were heated/fired to a temperature between 400–600ºC (752–1112ºF), with the majority of the samples fired to 450ºC (842ºF). The one exception is sample 139b (70–80 cmbs) which had the lowest estimated firing temperature of 300ºC (572ºF)

While there is no clear correlation between stratigraphic depth of the samples and firing temperatures, it is interesting to note that for both features, the lowest estimated firing temperature was at the lowest depth. This may suggest that at the lowest level of the feature, the fire was not as hot or prolonged as for the levels above.

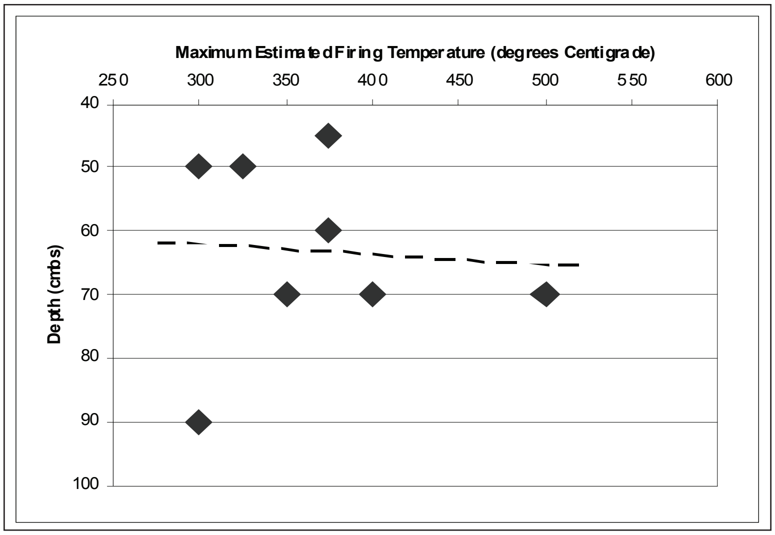

Figure 7-20. Estimated Firing Temperatures by Depth, Feature 9

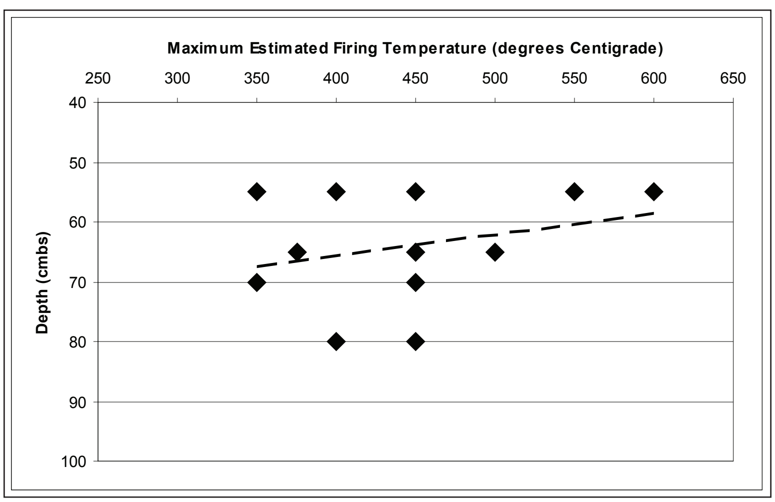

Figure 7-21. Estimated Firing Temperatures by Depth, Feature 4

Chapter 8

Conclusions

8.1 Results of Hypothesis Testing

The null hypothesis (see Chapter 5) states that Features 4 and 9 on 41BX256 are the result of prehistoric landscape burning, whether natural or culturally induced. Observations support few of the test implications (Table 8-1) and this interpretation is strongly rejected.

Table 8-1. Natural Burning Test Implications and Key Observations.

#	Test Implication	Confirmed?	Observation
N-1	Soil textures should be broadly similar across the general area, with minimal evidence of textural patchiness.	No	Soil within the block is highly patchy, with distinct zones of high clay content.
N-2	Burned zones should be extensive and laterally continuous. They should be bigger than the excavation block.	No	The zone of fired clay is well defined within the excavation block and does not appear to extend into other nearby blocks.
N-3	Burned zones may be patchy, but should not show evidence of containment by constructed perimeters rocks or soil, or by pits dug into the ground surface.	Yes	Containment boundaries are not present and no pits were observed.
N-4	Burned woody roots should be randomly located concentrations of ash/charcoal and/or soil oxidation, and show irregular patterns in profile.	Possibly yes	Distinct, random disturbances of dark soil were observed but these could be either roots or rodent burrows.
N-5	Burned zones in profile should exhibit traceable beds evidenced by ash lenses and/or horizons of soil oxidation.	No	Traceable ash / charcoal lenses were not observed.
N-6	Depth of soil oxidation should be minimal and fairly consistent in thickness.	No	The depth of soil oxidation varies considerably across the profile of Trench X.

Hypothesis 1 states that Features 4 and 9 on 41BX256 represent one or more episodes of baked clay cooking. While several of the test implications are supported, on the whole this interpretation is also strongly rejected (Table 8-2).

Hypothesis 2 states that Features 4 and 9 on 41BX256 are burned wattle and daub habitation structures. A review of the evidence suggests that this is the most likely interpretation of Feature 4 (Table 8-3). The interpretation of Feature 9 is more problematic. It shares key morphological attributes with Feature 4 and is stratigraphically associated but is significantly smaller and radiocarbon dates are contradictory. Minimally, Feature 4 is confirmed as a domestic wattle and daub structure.

Table 8-2. Cooking Feature Test Implications and Key Observations.

#	Test Implication	Confirmed?	Observation
1-1	Soil texture should be patchy across the site, with localized concentrations of clay.	Yes	Two zones of clay (Features 4 and 9) are distinct from the surrounding soil matrix.
1-2	Burned zones should show evidence of fire containment by constructed perimeters of rocks or soil, or by pits dug into the ground surface.	No	Containment boundaries are not present and no pits were observed.
1-3	Burned zones should be limited in size and area, and smaller than the excavation block.	Yes	The burned zone is limited in size and clearly defined.
1-4	Sites with such cooking features should be located in areas which lack suitable rock for stone boiling	No	Rock hearth features are located nearby indicating the location does not lack for rock.
1-5	Clay balls may be present. Clay balls should be well formed and of generally normalized size.	No	Very few clay balls are present. Most clay nodules are irregular and of varying sizes.
1-6	Clay balls should be infused with lipids and/or starches.	No	The presence of lipids and starches on clay balls/nodules is negligible.

Table 8-3. Domestic Structure Test Implications and Key Observations.

#	Test Implication	Confirmed?	Observation
2-1	Soil texture should be patchy across the site, with structures indicated by localized concentrations of clay.	Yes	Two zones of clay are distinct from surrounding soil matrix.
2-2	Burned zones should be limited in size and area, and smaller than the excavation block. Overall dimensions of the clay concentration should be about 2-4 m in diameter.	Mostly yes	Zones of burned clay are clearly defined and measure about 2.5 m in diameter (Feature 4) and 1x 2 m (Feature 9).
2-3	Post molds should be discernable along the outside edges of the feature. Post molds may or may not be accompanied by stabilizing rocks.	No	Post molds were not observed.
2-4	Fired clay pieces should exist in a range of non-normalized sizes and shapes.	Yes	Yes; clay pieces ranged broadly in size, shape, and mass and are not standardized.
2-5	Baked clay pieces should have impressions of sticks and other vegetal matter as thatching.	Yes	More than 100 pieces of baked clay contain stick impressions ranging in diameter from about 1.5 mm to about 5.4 cm
2-6	The spatial distribution of artifacts on the occupation surface should be patterned.	Yes	Horizontal distribution of artifacts shows a central zone of low density surrounded by several loci of higher artifact density.
2-7	A central hearth may be present.	No	A rock hearth (Feature 14) is present at the periphery of Feature 4 but is stratigraphically lower and dates slightly earlier. Similarly, a large rock cluster (Feature 16) is located within Feature 9 but is lower in elevation and does not appear to be associated with Feature 9.
2-8	The soil profile should reveal an oxidized substrate thickness greater than 10 cm.	Yes	Oxidized soil profile across Feature 4 varies up to 15 cm in thickness.

Two key morphological attributes of domestic structures were completely absent. Neither of the two burned clay features contained either post molds (TI 2-3) nor centralized hearth features (TI 2-7). Post molds especially were anticipated to be the “smoking gun” evidence confirming the structure hypothesis, but none were observed despite careful searching. Similarly, centralized rock hearths were absent. While rock features are horizontally associated with both of the burned clay features, these are each stratigraphically lower than the larger clay features and they do not appear to be intrusive into them. Both of these rock features are capped by a thin layer of unreddened matrix below the reddened soil associated with Features 4 and 9. Moreover, the rock hearth (Feature 14) that is associated with Feature 4 dates slightly earlier than the clay feature. It is likely that the two rock hearth features represent a slightly earlier occupation within the Middle Archaic.

8.2 Additional Observations

The key observation made in 2008 which originally proposed the domestic structure hypothesis was the presence of numerous stick impressions on the baked clay nodules. These observations were repeated in 2011 (H2-5), strengthening support for this hypothesis. The "smoking gun," as it turned out, was the remarkable profile observed in the southern face of Trench X which bisected Feature 4 (see Figure 7-6). This profile exhibited significant reddening of the substrate directly beneath each of the arms of the U-shaped burned clay mass. The reddening was minimally present between these two zones and under the central portion of Feature 4 where burned clay was less common. With a Munsell value of 7.5YR 4/6, the reddening was in distinct contrast with the unaltered substrate below which had a Munsell value of 10YR 4/3. Coupled with the baked clay above 70 cmbs, this reddening below 70 cmbs is clearly a thermal reaction rim. Such thermal reaction rims are caused by a hot and/or sustained firing in a heavily oxidized environment and are commonly seen in profile underneath hearth features. Whereas such rims that are associated with hearths or cooking features are typically 7 to 10 cm thick (Charles Frederick, personal communication 2011), the thermal rim under Feature 4 is up to 15 cm thick, suggesting a hotter and/or more prolonged firing event. Further, according to Frederick (personal communication 2011), this profile closely resembles that seen at Drover's House (41RB108) which was recently excavated by Doug Boyd. Although the report of that excavation is not yet available (as of May 2012), reportedly a well stratified profile of lithified daub mixed with unlithified daub was underlain by a thick thermal reaction rim (Frederick, personal communication 2011).

The paucity of charcoal in the excavations was troubling. We expected that a significant burning event, whether caused by a cooking feature or burned domestic structure, would result in goodly quantities of charcoal. In contrast, while sufficient charcoal was indeed recovered to permit multiple radiocarbon dates, the samples were small and scattered pieces. We also observed that the substrate beneath the feature contained abundant nodules of calcium carbonate which, while generally consistent with the dated age of the feature, also indicated extensive leaching of soil carbonates over the 5,000 year duration since the firing event. Such significant degradation of charcoal is not unexpected in Middle Archaic deposits (Frederick, personal communication 2011).

8.3 Recommendations for Future Work

Based on the above evidence, we conclude that Feature 4 represents a burned wattle and daub domestic structure dating to the Middle Archaic Period (5060 - 4830 BP). While the dating of Feature 9 is problematic, it stratigraphically matches Feature 4 and is morphologically similar, if somewhat smaller. On this basis, we speculate that additional such domestic structures may well be present along intact portions of the San Antonio River, and in other comparable locations within south central Texas. Feature 4 was initially discovered as an anomaly in a remote sensing geotechnical survey and was verified as cultural through excavation of 1x1 m test units. Geotechnical surveys including magnetometry and ground penetrating radar are thus a proven tactic for discovering burned clay domestic structures and are recommended as an effective technique in future investigations. Shovel testing tactics alone, even if these are densely spaced, may not be sufficient to discover these buried, intact, and highly significant features. Especially in high probability areas like the current study area, such as riverine deposits and near springs, geotechnical survey is recommended during the discovery phase of future investigations.

We also offer several methodological recommendations for future excavation of similar features. Our bisecting trench through Feature 4 was most informative and we recommend following this approach. In retrospect, it was unfortunate that the original trench was dug via backhoe and only given cursory examination on the last day of the 2008 excavation. While the expedient trench allowed confirmation of 70 cmbs as the primary occupation surface associated with Feature 4, the thermal reaction rim below 70 cmbs was not recorded. Moreover, in the subsequent three years, the trench faces dried out so that by the time we returned in 2011, the faces were difficult to clean and prepare a fresh surface for examination and profiling. In addition, the narrow trench made orthogonal photography difficult and as a result, our composite photograph (see Figure 7-6) shows parallax problems. Going forward, we recommend that similar features should be bisected with controlled 1x1-m units, thus creating a fresh exposure as well as allowing for orthogonal photography.

The paucity of charcoal in our excavation was disappointing. Should future excavations contain sufficient quantities to permit wood identification and identification of other plant parts, this would allow examination of structural construction techniques as well as seasonality.

While no post molds were discovered associated with the current features, the full range of variability in Archaic structures is not yet known and it is certainly possible that other wattle and daub structures may well exhibit post molds, wedge rocks, or other evidence of vertical posts/poles. Accordingly, we recommend that future investigations continue to search for such evidence. At least half of the occupation surface immediately surrounding such structures should be incrementally scraped in search of post-molds.

Finally, the thermal signature assays we conducted were both informative and tantalizing. We recommend recovery of abundant point-provenienced samples for thermal signature analysis. If their point provenience was precisely recorded in three dimensions, a large number of samples could help identify firing patterns.

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Appendix A

Radiocarbon Results

BETA ANALYTIC INC.
DR. M.A. TAMERS and MR. D.G. HOOD
4985 S.W. 74 COURT
MIAMI, FLORIDA, USA 33155
PH: 305-667-5167 FAX:305-663-0964
beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Mr. Antonio Padilla — Report Date: 9/27/2011

Ecological Communications Corp. — Material Received: 9/20/2011

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 306188	4040 +/- 30 BP	-26.2 o/oo	4020 +/- 30 BP

SAMPLE : BX2561014
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 2610 to 2600 (Cal BP 4560 to 4550) AND Cal BC 2590 to 2470 (Cal BP 4540 to 4420)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

Page 2 of 3

BETA ANALYTIC INC.
DR. M.A. TAMERS and MR. D.G. HOOD
4985 S.W. 74 COURT
MIAMI, FLORIDA, USA 33155
PH: 305-667-5167 FAX:305-663-0964
beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Mr. Antonio Padilla — Report Date: 8/31/2011

Ecological Communications Corp. — Material Received: 8/24/2011

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 304609	4430 +/- 30 BP	-25.9 o/oo	4420 +/- 30 BP

SAMPLE : BX256GMI4LV3
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 3270 to 3240 (Cal BP 5220 to 5190) AND Cal BC 3110 to 2920 (Cal BP 5060 to 4880)

Beta - 304610	4320 +/- 30 BP	-26.6 o/oo	4290 +/- 30 BP

SAMPLE : BX25638LV3
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 2920 to 2880 (Cal BP 4870 to 4830)

Beta - 304611	4140 +/- 30 BP	-26.0 o/oo	4120 +/- 30 BP

SAMPLE : BX256101LV1
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 2870 to 2800 (Cal BP 4820 to 4740) AND Cal BC 2780 to 2580 (Cal BP 4730 to 4530)

Beta - 304612	4350 +/- 30 BP	-24.1 o/oo	4360 +/- 30 BP

SAMPLE : BX256106LV3
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 3080 to 3060 (Cal BP 5030 to 5010) AND Cal BC 3030 to 2900 (Cal BP 4980 to 4850)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-26.2:lab. mult=1)

Laboratory number: **Beta-306188**

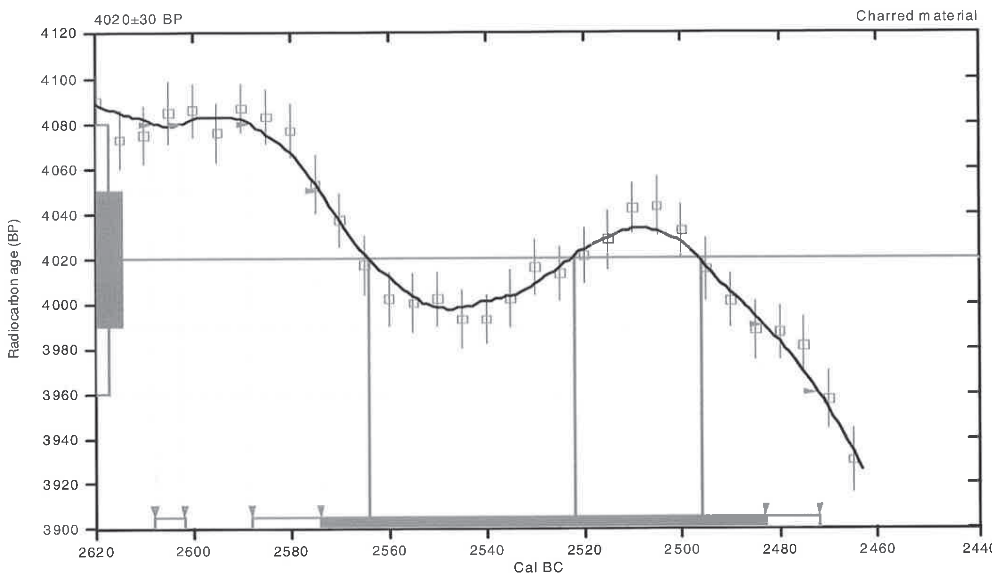
Conventional radiocarbon age: **4020±30 BP**

2 Sigma calibrated results: (95% probability) **Cal BC 2610 to 2600 (Cal BP 4560 to 4550) and Cal BC 2590 to 2470 (Cal BP 4540 to 4420)**

Intercept data

Intercepts of radiocarbon age with calibration curve: Cal BC 2560 (Cal BP 4510) and
Cal BC 2520 (Cal BP 4470) and
Cal BC 2500 (Cal BP 4450)

1 Sigma calibrated result: (68% probability) Cal BC 2570 to 2480 (Cal BP 4520 to 4430)



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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.9:lab. mult=1)

Laboratory number: **Beta-304609**

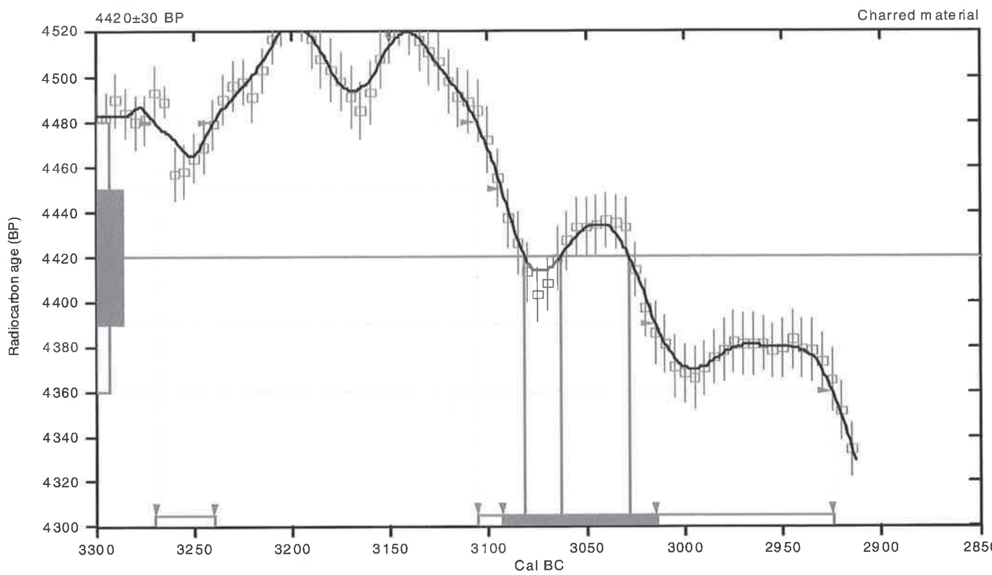
Conventional radiocarbon age: **4420±30 BP**

2 Sigma calibrated results: **Cal BC 3270 to 3240 (Cal BP 5220 to 5190) and**
(95% probability) **Cal BC 3110 to 2920 (Cal BP 5060 to 4880)**

Intercept data

Intercepts of radiocarbon age with calibration curve: Cal BC 3080 (Cal BP 5030) and
Cal BC 3060 (Cal BP 5010) and
Cal BC 3030 (Cal BP 4980)

1 Sigma calibrated result: Cal BC 3090 to 3020 (Cal BP 5040 to 4960)
(68% probability)



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Calibration Database
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IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-26.6:lab. mult=1)

Laboratory number: **Beta-304610**

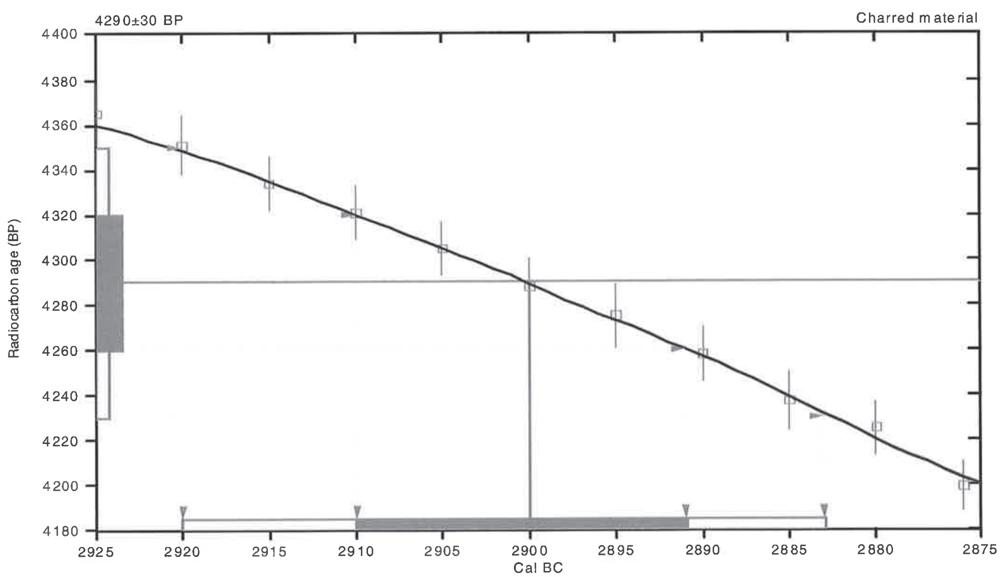
Conventional radiocarbon age: **4290±30 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 2920 to 2880 (Cal BP 4870 to 4830)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 2900 (Cal BP 4850)

1 Sigma calibrated result: (68% probability) Cal BC 2910 to 2890 (Cal BP 4860 to 4840)



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IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-26:lab. mult=1)

Laboratory number: **Beta-304611**

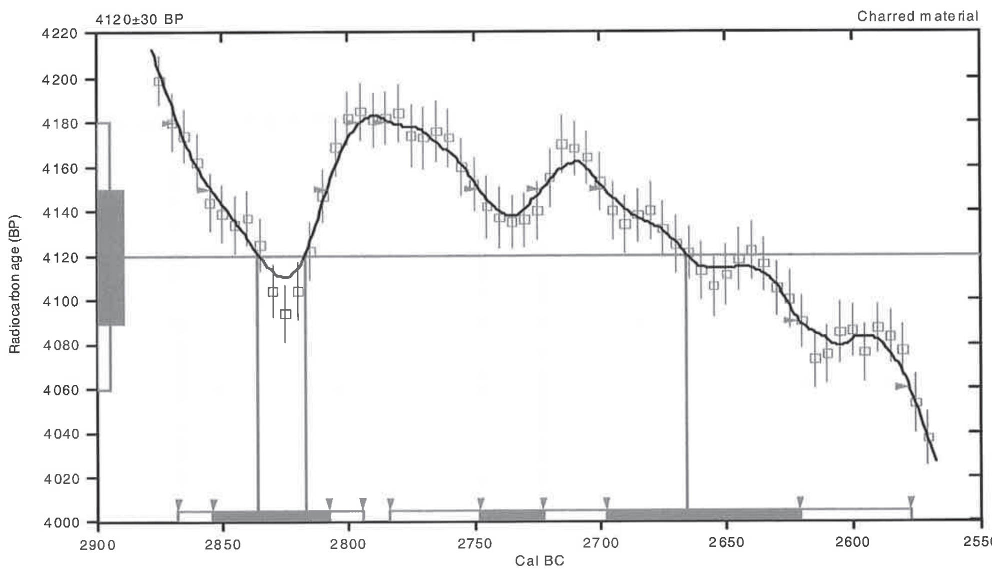
Conventional radiocarbon age: **4120±30 BP**

2 Sigma calibrated results: (95% probability) **Cal BC 2870 to 2800 (Cal BP 4820 to 4740) and Cal BC 2780 to 2580 (Cal BP 4730 to 4530)**

Intercept data

Intercepts of radiocarbon age with calibration curve: Cal BC 2840 (Cal BP 4790) and Cal BC 2820 (Cal BP 4770) and Cal BC 2670 (Cal BP 4620)

1 Sigma calibrated results: (68% probability) Cal BC 2850 to 2810 (Cal BP 4800 to 4760) and Cal BC 2750 to 2720 (Cal BP 4700 to 4670) and Cal BC 2700 to 2620 (Cal BP 4650 to 4570)



References:
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IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.1:lab. mult=1)

Laboratory number: **Beta-304612**

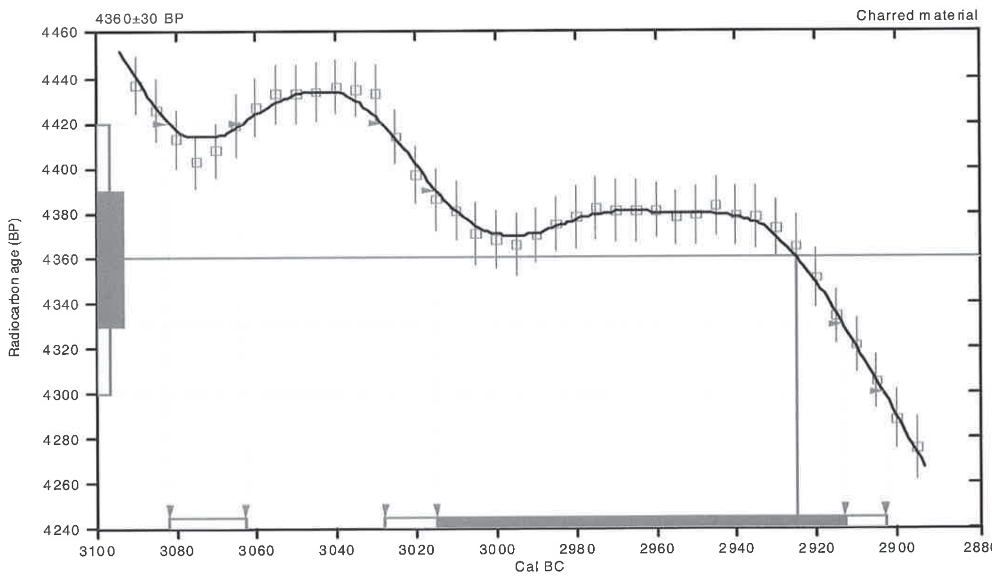
Conventional radiocarbon age: **4360±30 BP**

2 Sigma calibrated results: (95% probability) **Cal BC 3080 to 3060 (Cal BP 5030 to 5010) and Cal BC 3030 to 2900 (Cal BP 4980 to 4850)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 2920 (Cal BP 4880)

1 Sigma calibrated result: (68% probability) Cal BC 3020 to 2910 (Cal BP 4960 to 4860)



References:
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Calibration Database
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DR. M.A. TAMERS and MR. D.G. HOOD
4985 S.W. 74 COURT
MIAMI, FLORIDA, USA 33155
PH: 305-667-5167 FAX:305-663-0964
beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Mr. Antonio Padilla

Report Date: 6/25/2009

Ecological Communications Corp.

Material Received: 6/15/2009

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 260896	4350 +/- 40 BP	-25.9 o/oo	4340 +/- 40 BP

SAMPLE : BX256-1-FEA4
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 3080 to 3060 (Cal BP 5030 to 5010) AND Cal BC 3030 to 2890 (Cal BP 4980 to 4840)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 260897	2450 +/- 40 BP	-24.9 o/oo	2450 +/- 40 BP

SAMPLE : BX256-14/15
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 760 to 400 (Cal BP 2720 to 2350)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 260898	3810 +/- 40 BP	-27.2 o/oo	3770 +/- 40 BP

SAMPLE : BX256-25FEA8
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 2300 to 2120 (Cal BP 4250 to 4070) AND Cal BC 2090 to 2040 (Cal BP 4040 to 3990)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 260899	3450 +/- 40 BP	-26.0 o/oo	3430 +/- 40 BP

SAMPLE : BX256-45-LV5
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 1880 to 1630 (Cal BP 3830 to 3580)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 260900	2530 +/- 40 BP	-27.2 o/oo	2490 +/- 40 BP

SAMPLE : BX1628-9LV12
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 780 to 410 (Cal BP 2740 to 2360)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.9:lab. mult=1)

Laboratory number: **Beta-260896**

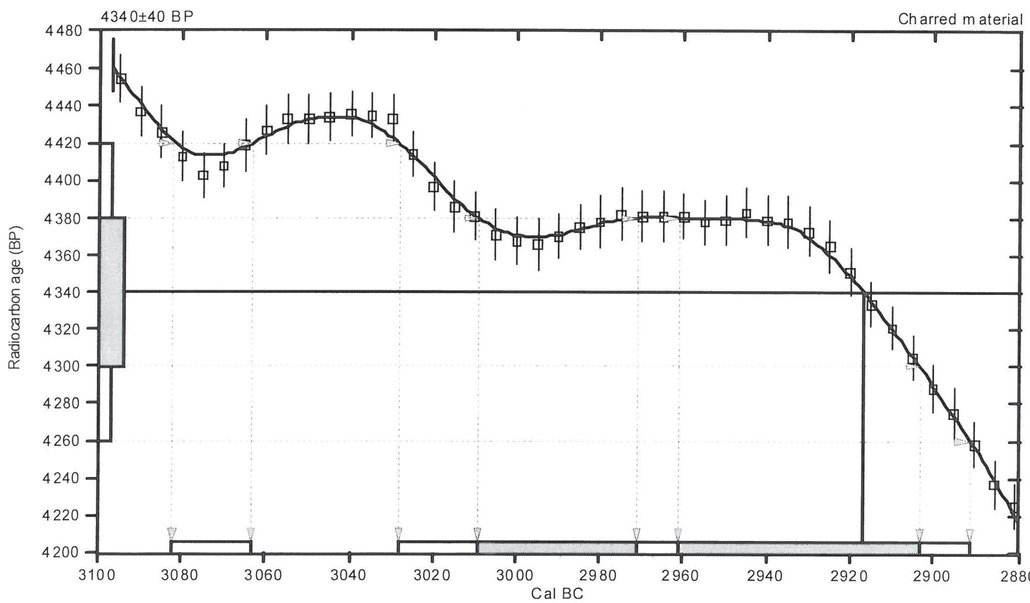
Conventional radiocarbon age: **4340±40 BP**

2 Sigma calibrated results: **Cal BC 3080 to 3060 (Cal BP 5030 to 5010) and**
(95% probability) **Cal BC 3030 to 2890 (Cal BP 4980 to 4840)**

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal BC 2920 (Cal BP 4870)

1 Sigma calibrated results: Cal BC 3010 to 2970 (Cal BP 4960 to 4920) and
(68% probability) Cal BC 2960 to 2900 (Cal BP 4910 to 4850)



References:

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Dr. Tiffany Osburn

Report Date: 9/21/2006

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 219932	4370 +/- 50 BP	-26.3 o/oo	4350 +/- 50 BP

SAMPLE : 41BX256-288
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 3090 to 2890 (Cal BP 5040 to 4840)

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-26.3:lab. mult=1)

Laboratory number: **Beta-219932**

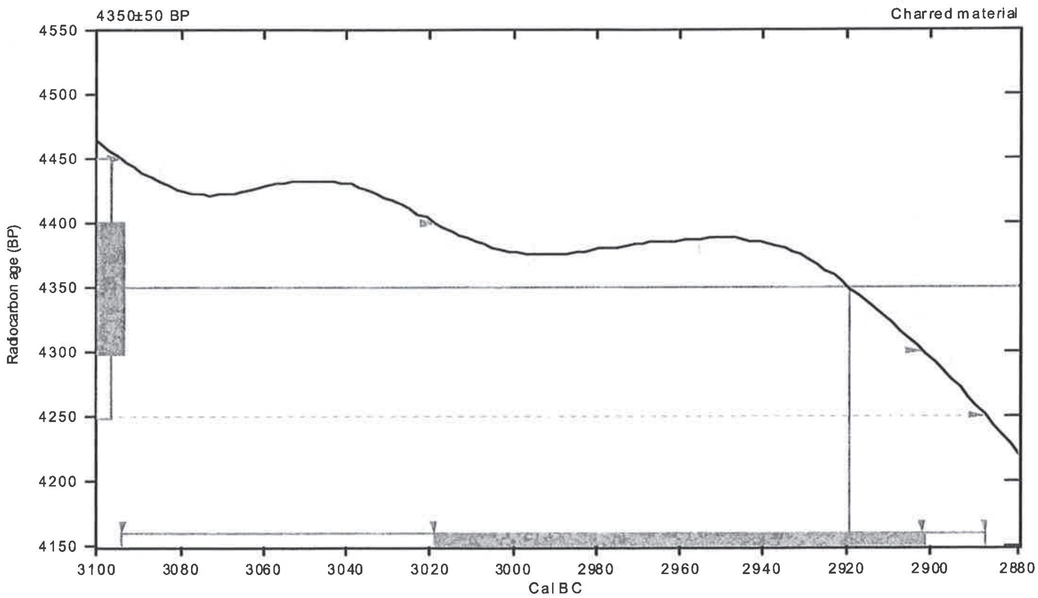
Conventional radiocarbon age: **4350±50 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 3090 to 2890 (Cal BP 5040 to 4840)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 2920 (Cal BP 4870)

1 Sigma calibrated result: (68% probability) Cal BC 3020 to 2900 (Cal BP 4970 to 4850)



References:

Database used

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Appendix B

Lipid Residue Analysis

Analysis of Lipid Residues Extracted from Burnt Clay

Prepared for

Ecological Communications Corporation

By

M. E. Malainey, Ph.D. and Timothy Figol

Department of Anthropology

Brandon University

280-18th Street

Brandon, MB

Canada R7A 6A9

INTRODUCTION

Four pieces of burnt clay were submitted for analysis. Exterior surfaces were ground off to remove any contaminants; samples were crushed and absorbed lipid residues were extracted with organic solvents. The lipid extract was analyzed using gas chromatography (GC), high temperature GC (HT-GC) and high temperature gas chromatography with mass spectrometry (HT-GC/MS). Residue identifications were based on fatty acid decomposition patterns of experimental residues, lipid distribution patterns and the presence of biomarkers. Procedures for the identification of archaeological residues are outlined below; following this, analytical procedures and results are presented.

THE IDENTIFICATION OF ARCHAEOLOGICAL RESIDUES

Identification of Fatty Acids

Fatty acids are the major constituents of fats and oils (lipids) and occur in nature as triglycerides, consisting of three fatty acids attached to a glycerol molecule by ester-linkages. The shorthand convention for designating fatty acids, Cx:yωz, contains three components. The "Cx" refers to a fatty acid with a carbon chain length of x number of atoms. The "y" represents the number of double bonds or points of unsaturation, and the "ωz" indicates the location of the most distal double bond on the carbon chain, i.e. closest to the methyl end. Thus, the fatty acid expressed as C18:1ω9, refers to a mono-unsaturated isomer with a chain length of 18 carbon atoms with a single double bond located nine carbons from the methyl end of the chain. Similarly, the shorthand designation, C16:0, refers to a saturated fatty acid with a chain length of 16 carbons.

Their insolubility in water and relative abundance compared to other classes of lipids, such as sterols and waxes, make fatty acids suitable for residue analysis. Since employed by Condamin *et al*. (1976), gas chromatography has been used extensively to analyze the fatty acid component of absorbed archaeological residues. The composition of uncooked plants and animals provides important baseline information, but it is not possible to directly compare modern uncooked plants and animals with highly degraded archaeological residues. Unsaturated fatty acids, which are found widely in fish and plants, decompose more readily than saturated fatty acids, sterols or waxes. In the course of decomposition, simple addition reactions might occur at points of unsaturation (Solomons 1980) or peroxidation might lead to the formation of a variety of volatile and non-volatile products which continue to degrade (Frankel 1991). Peroxidation occurs most readily in fatty acids with more than one point of unsaturation.

Attempts have been made to identify archaeological residues using criteria that discriminate uncooked foods (Marchbanks 1989; Skibo 1992; Loy 1994). The major drawback of the distinguishing ratios proposed by Marchbanks (1989), Skibo (1992) and Loy (1994) is they have never been empirically tested. The proposed ratios are based on criteria that discriminate food classes on the basis of their original fatty acid composition. The resistance of these criteria to the effects of decompositional changes has not been demonstrated. Rather, Skibo

(1992) found his fatty acid ratio criteria could not be used to identify highly decomposed archaeological samples.

In order to identify a fatty acid ratio unaffected by degradation processes, Patrick *et al*. (1985) simulated the long-term decomposition of one sample and monitored the resulting changes. An experimental cooking residue of seal was prepared and degraded in order to identify a stable fatty acid ratio. Patrick *et al*. (1985) found that the ratio of two C18:1 isomers, oleic and vaccenic, did not change with decomposition; this fatty acid ratio was then used to identify an archaeological vessel residue as seal. While the fatty acid composition of uncooked foods must be known, Patrick *et al*. (1985) showed that the effects of cooking and decomposition over long periods of time on the fatty acids must also be understood.

Development of the Identification Criteria

As the first stage in developing the identification criteria used herein, the fatty acid compositions of more than 130 uncooked Native food plants and animals from Western Canada were determined using gas chromatography (Malainey 1997; Malainey *et al*. 1999a). When the fatty acid compositions of modern food plants and animals were subject to cluster and principal component analyses, the resultant groupings generally corresponded to divisions that exist in nature (Table B1). Clear differences in the fatty acid composition of large mammal fat, large herbivore meat, fish, plant roots, greens and berries/seeds/nuts were detected, but the fatty acid composition of meat from medium-sized mammals resembles berries/seeds/nuts.

Samples in cluster A, the large mammal and fish cluster had elevated levels of C16:0 and C18:1 (Table B1). Divisions within this cluster stemmed from the very high level of C18:1 isomers in fat, high levels of C18:0 in bison and deer meat and high levels of very long chain unsaturated fatty acids (VLCU) in fish. Differences in the fatty acid composition of plant roots, greens and berries/seeds/nuts reflect the amounts of C18:2 and C18:3ω3 present. The berry, seed, nut and small mammal meat samples appearing in cluster B have very high levels of C18:2, ranging from 35% to 64% (Table B1). Samples in subclusters V, VI and VII have levels of C18:1 isomers from 29% to 51%, as well. Plant roots, plant greens and some berries appear in cluster C. All cluster C samples have moderately high levels of C18:2; except for the berries in subcluster XII, levels of C16:0 are also elevated. Higher levels of C18:3ω3 and/or very long chain saturated fatty acids (VLCS) are also common except in the roots which form subcluster XV.

Secondly, the effects of cooking and degradation over time on fatty acid compositions were examined. Originally, 19 modern residues of plants and animals from the plains, parkland and forests of Western Canada were prepared by cooking samples of meats, fish and plants, alone or combined, in replica vessels over an open fire (Malainey 1997; Malainey *et al*. 1999b). After four days at room temperature, the vessels were broken and a set of sherds analysed to determine changes after a short term of decomposition. A second set of sherds remained at room temperature for 80 days, then placed in an oven at 75°C for a period of 30 days in order to simulate the processes of long term decomposition. The relative percentages were calculated on the basis of the ten fatty acids (C12:0, C14:0, C15:0, C16:0, C16:1, C17:0, C18:0, C18:1w9, C18:1w11, C18:2) that regularly appeared in Precontact Period vessel residues from Western Canada. Observed changes in fatty acid composition of the experimental cooking residues enabled the development of a method for identifying the archaeological residues (Table B2).

It was determined that levels of medium chain fatty acids (C12:0, C14:0 and C15:0), C18:0 and C18:1 isomers in the sample could be used to distinguish degraded experimental cooking residues (Malainey 1997; Malainey *et al*. 1999b). Higher levels of medium chain fatty acids, combined with low levels of C18:0 and C18:1 isomers, were detected in the decomposed experimental residues of plants, such as roots, greens and most berries. High levels of C18:0 indicated the presence of large herbivores. Moderate levels of C18:1 isomers, with low levels of C18:0, indicated the presence of either fish or foods similar in composition to corn. High levels of C18:1 isomers with low levels of C18:0, were found in residues of beaver or foods of similar fatty acid composition. The criteria for identifying six types of residues were established experimentally; the seventh type, plant with large herbivore, was inferred (Table B2). These criteria were applied to residues extracted from more than 200 pottery cooking vessels from 18 Western Canadian sites (Malainey 1997; Malainey *et al*. 1999c; 2001b). The identifications were found to be consistent with the evidence from faunal and tool assemblages for each site.

Work has continued to understand the decomposition patterns of various foods and food combinations (Malainey *et al*. 2000a, 2000b, 2000c, 2001a; Quigg *et al*. 2001). The collection of modern foods has expanded to include plants from the Southern Plains. The fatty acid compositions of mesquite beans (*Prosopis glandulosa*), Texas ebony seeds (*Pithecellobium ebano Berlandier*), tasajillo berry (*Opuntia leptocaulis*), prickly pear fruit and pads (*Opuntia engelmannii*), Spanish dagger pods (*Yucca treculeana*), cooked sotol (*Dasylirion wheeler*), agave (*Agave lechuguilla*), cholla (*Opuntia imbricata*), piñon (*Pinus edulis*) and Texas mountain laurel (or mescal) seed (*Sophora secundiflora*) have been determined. Experimental residues of many of these plants, alone or in combination with deer meat, have been prepared by boiling foods in clay cylinders or using sandstone for either stone boiling (Quigg *et al*. 2000) or as a griddle. In order to accelerate the processes of oxidative degradation that naturally occur at a slow rate with the passage of time, the rock or clay tile containing the experimental residue was placed in an oven at 75°C. After either 30 or 68 days, residues were extracted and analysed using gas chromatography. The results of these decomposition studies enabled refinement of the identification criteria (Malainey 2007).

Using Lipid Distribution and Biomarkers to Identify Archaeological Residues

Archaeological scientists working in the United Kingdom have had tremendous success using high temperature-gas chromatography (HT-GC) and gas chromatography with mass spectrometry (HT-GC/MS) to identify biomarkers. High temperature gas chromatography is used to separate and assess a wide range of lipid components, including fatty acids, long chain alcohols and hydrocarbons, sterols, waxes, terpenoids and triacylglycerols (Evershed *et al*. 2001). The molecular structure of separated components is elucidated by mass spectrometry (Evershed 2000).

Triacylglycerols, diacylglycerols and sterols can be used to distinguish animal-derived residues, which contain cholesterol and significant levels of both triacylglycerols, from plant-derived residues, indicated by plant sterols, such as β-sitosterol, stigmasterol and campesterol, and only traces of triacylglycerols (Evershed 1993; Evershed *et al*. 1997a; Dudd and Evershed 1998). Barnard *et al*. (2007), however, have recently suggested that microorganisms living off residues can introduce β-sitosterol into residues resulting from the preparation of animal products. Waxes, which are long-chain fatty acids and long-chain alcohols that form protective coatings on skin, fur, feathers, leaves and fruit, also resist decay. Evershed *et al*. (1991) found epicuticular leaf waxes from plants of the genus Brassica in vessel residues from a Late Saxon/Medieval settlement. Cooking experiments later confirmed the utility of nonacosane, nonacosan-15-one and nonacosan-15-ol to indicate the preparation of leafy vegetables, such as turnip or cabbage (Charters *et al*. 1997). Reber et al. (2004) recently suggested *n*-dotriacontanol could serve as an effective biomarker for maize in vessel residues from sites located in Midwestern and Eastern North America. Beeswax can be identified by the presence and distribution of n-alkanes with carbon chains 23 to 33 atoms in length and palmitic acid wax esters with chains between 40 and 52 carbons in length (Heron *et al*. 1994; Evershed *et al*. 1997b).

Terpenoid compounds, or terpenes, are long chain alkenes that occur in the tars and pitches of higher plants. The use of GC and GC/MS to detect the diterpenoid, dehydroabietic acid, from conifer products in archaeological residues extends over a span of 25 years (Shackley 1982; Heron and Pollard 1988). Lupeol, α- and β-amyrin and their derivatives indicate the presence of plant materials (Regert 2007). Eerkens (2002) used the predominance of the diterpenoid, Δ–8(9)-isopimaric acid, in a vessel residue from the western Great Basin to argue it contained piñyon resins. Other analytical techniques have also been used to identify terpenoid compounds. Sauter *et al.* (1987) detected the triterpenoid, betulin, in Iron Age tar using both ^{1}H and ^{13}C nuclear magnetic resonance spectroscopy (NMR), confirming the tar was produced from birch.

METHODOLOGY

Possible contaminants were removed by grinding off exterior surfaces of each sample with a Dremel® tool fitted with a silicon carbide bit. Immediately thereafter, it was crushed with a hammer mortar and pestle and the powder transferred to an Erlenmeyer flask. Lipids were extracted using a variation of the method developed by Folch *et al*. (1957). The powdered sample was mixed with a 2:1 mixture, by volume, of chloroform and methanol (2 × 25 mL) using ultrasonication (2 × 10 min). Solids were removed by filtering the solvent mixture into a separatory funnel. The lipid/solvent filtrate was washed with 13.3 mL of ultrapure water. Once separation into two phases was complete, the lower chloroform-lipid phase was transferred to a round-bottomed flask and the chloroform removed by rotary evaporation. Any remaining water was removed by evaporation with 2-propanol (1.5 mL); 1.5 mL of chloroform-methanol (2:1, v/v) was used to transfer the dry total lipid extract to a screw-top glass vial with a Teflon®-lined cap. The resulting total lipid extract was flushed with nitrogen and stored in a -20°C freezer.

Preparation of Fatty Acid Methyl Esters

A 400 µL aliquot of the total lipid extract solution was placed in a screw-top test tube and dried in a heating block under nitrogen. Fatty acid methyl esters (FAMES) were prepared by treating the dry lipid with 3 mL of 0.5 N anhydrous hydrochloric acid in methanol (68°C; 60 min). Fatty acids that occur in the sample as di- or triglycerides are detached from the glycerol molecule and converted to methyl esters. After cooling to room temperature, 2.0 mL of ultrapure water was added. FAMES were recovered with petroleum ether (2 × 1.5 mL) and transferred to a vial. The solvent was removed by heat under a gentle stream of nitrogen; the FAMES were dissolved in 75 µL of *iso*-octane then transferred to a GC vial with a conical glass insert.

Preparation of TMS derivatives

A 200 µL aliquot of the total lipid extract solution was placed in a screw-top vial and dried under nitrogen. Trimethylsilyl (TMS) derivatives were prepared by treating the lipid with 70 µL of *N,O*-bis(trimethylsilyl)trifluoroacetamide (BSTFA) containing 1% trimethylchlorosilane, by volume (70ºC; 30 min). The sample was then dried under nitrogen and the TMS derivatives were redissolved in 100 µL of hexane.

Solvents and chemicals were checked for purity by running a sample blank. Traces of fatty acid contamination were subtracted from sample chromatograms. The relative percentage composition was calculated by dividing the integrated peak area of each fatty acid by the total area of fatty acids present in the sample.

In order to identify the residue on the basis of fatty acid composition, the relative percentage composition was determined first with respect to all fatty acids present in the sample (including very long chain fatty acids) (see Table B4) and second with respect to the ten fatty acids utilized in the development of the identification criteria (C12:0, C14:0, C15:0, C16:0, C16:1, C17:0, C18:0, C18:1w9, C18:1w11 and C18:2) (not shown). The second step is necessary for the application of the identification criteria presented in Table B2. It must be understood that the identifications given do not necessarily mean that those particular foods were actually prepared because different foods of similar fatty acid composition and lipid content would produce similar residues (see Table B3). It is possible only to say that the material of origin for the residue was similar in composition to the food(s) indicated. High temperature gas chromatography and high temperature gas chromatography with mass spectrometry is used to further clarify the identifications.

Gas Chromatography Analysis Parameters

The GC analysis was performed on a Varian 3800 gas chromatograph fitted with a flame ionization detector connected to a personal computer. Lipid components were separated using a VF-23 fused silica capillary column (30 m × 0.25 mm I.D.; Varian; Palo Alto, CA). An autosampler injected a 3 µL sample using a split/splitless injection system. Hydrogen was used as the carrier gas with a column flow of 1.0 mL/min. Column temperature was increased from 80°C to 140°C at a rate of 20°C per minute then increased to 185°C at a rate of 4°C per minute. After a 4.0 minute hold, the temperature was further increased to 250°C at 10°C per minute and held for 2 minutes. Chromatogram peaks were integrated using Varian MS Workstation® software and identified through comparisons with external qualitative standards (NuCheck Prep; Elysian, MN).

High Temperature Gas Chromatography and Gas Chromatography with Mass Spectrometry

Both HT-GC and HT GC-MS analyses were performed on a Varian 3800 gas chromatograph fitted with a flame ionization detector and a Varian 4000 mass spectrometer connected to a personal computer. For HT-GC analysis, the sample was injected onto a DB-1HT fused silica capillary column (15 m × 0.32 mm I.D.; Agilent J&W; Santa Clara, CA) connected to the flame ionization detector, using hydrogen as the carrier gas. The column temperature was held at 50°C for 1 minute then increased to 350°C at a rate of 15°C per minute and held for 26 minutes. For HT-GC/MS analysis, samples were injected onto a DB-5HT fused silica capillary column (30 m × 0.25 mm I.D.; Agilent J&W; Santa Clara, CA) connected to the ion trap mass spectrometer in an external ionization configuration using helium as the carrier gas. After a 1 minute hold at 50°C, the column temperature was increased to 180°C at a rate of 40°C per minute then ramped up to 230°C at a rate of 5oC per minute and finally increased to 350°C at a rate of 15°C per minute and held for 27.75 minutes. The Varian 4000 mass spectrometer was operated in electron-impact ionization mode scanning from m/z 50–700. Chromatogram peaks and MS spectra were processed using Varian MS Workstation® software and identified through comparisons with external qualitative standards (Sigma Aldrich; St. Louis, MO and NuCheck Prep; Elysian, MN), reference samples and the National Institute of Standards and Technology (NIST) database.

RESULTS OF ARCHAEOLOGICAL DATA ANALYSIS

Sample descriptions and compositions of the extracted lipid residues are presented in Tables B4 and B5. Sample identifiers take the format "11" (year) followed by "EC" (for Ecological Communications) followed by an arbitrarily assigned number for the four samples. In Table B4 the term "Area" represents the area under the chromatographic peak of a given fatty acid, as calculated by the Varian MS Workstation® software minus the solvent blank. The term "Rel%" represents the relative percentage of the fatty acid with respect to the total fatty acids in the sample. Hydroxide or peroxide degradation products can interfere with the integration of the C22:0 and C22:1 peaks; these fatty acids were excluded from the analysis.

The presence of lipid biomarkers and distributions of triacylglycerols (TAGs) were determined through HT-GC and HT-GC/MS. The data obtained are useful for distinguishing plant residues, animal residues and plant/animal combinations. The sterol cholesterol is associated with animal products; β-sitosterol, stigmasterol and campesterol are associated with plant products. The presence and abundance of TAGs varies with the material of origin. If present, amounts of TAGs in plant residues tend to decrease with increasing numbers of carbon atoms (Malainey *et al*. 2010). The peak arising from C48 TAG is largest and peak size (and area) progressively decreases with the C54 TAG peak being the smallest. A line drawn to connect the tops of the C48, C50, C52 and C54 TAG peaks slopes down sharply to the right. In animal residues, amounts of TAGs tend to increase with carbon numbers, with the C52 or C54 TAG peaks being the largest (Malainey *et al*. 2010). A line drawn to connect the tops of the C48, C50, C52 and C54 TAG peaks either resembles a hill or the line slopes up to the right. A parabola-like pattern, such as the shape of a "normal distribution," can also occur in the residues of oil seeds that contain high levels of C18:1 isomers.

The lipid compositions of residues 11EC 4, 11EC 6 and 11EC 7 are presented in Table B4; fatty acid recoveries from residue 11EC 4 were quite low. Residue 11EC 5 was characterized on the basis of lipid biomarkers alone because almost no fatty acids were preserved (Table B5). In all cases, the archaeological lipid residues appear to arise from combinations of plant and animal materials with plant products dominating residues 11EC 5, 11EC 6 and 11EC 7. Only a small number of fatty acids were preserved in the residues; this is likely due to their age and stage of degradation.

The compositions of residues 11EC 6 and 11EC 7 are very similar and may arise from the same substances. Although the level of C18:1 isomers is slightly lower than 15%, the probable sources of both residues 11EC 6 and 11EC 7 were medium fat content foods. Over time, monounsaturated fatty acids, such as C18:1 isomers, degraded slowly which caused their relative levels to drop and the relative levels of the more resilient saturated fatty acids, such as C16:0 and C18:0, to increase. Both plant and animal foods are known to produce degraded cooking residues similar to the fatty acid compositions of residues 11EC 6 and 11EC 7 (Table B3). Examples of plant foods known to produce medium fat content residues include corn, mesquite beans and cholla; examples of animal foods known to produce medium fat content residues are freshwater fish, *Rabdotus* snail, terrapin and late winter fat-depleted elk. Both the animal sterol cholesterol and plant sterol β-sitosterol were detected in these residues; however, the distribution of TAGs indicates that plant products were dominant. As is typical of plant residues, the C48 TAG peak was largest and the sizes of the peaks progressively decrease as the number of carbon atoms increase. The C54 TAG was not even detected in residue 11EC 6. The ratios of the C48, C50, C52 and C54 TAG peaks in residue 11EC 7 are 17.5: 8.6: 2.7: 1. The biomarker azelaic acid was detected in residue 11EC 7; this short chain dicarboxylic acid is associated with the oxidation of unsaturated fatty acids (Regert *et al*. 1998). Unsaturated fatty acids are most abundant in seed oils so it is possible that this residue in part reflects the processing of plant seeds. Dihydroabietic acid, which is a biomarker associated with conifers, may also be present in this residue.

Although it likely arises from a combination of plant and animal products, the presence of animal products appears to be stronger in residue 11EC 4. The level of the fatty acid C18:0 is higher, 26.80%, and distribution of TAGs is more consistent with a plant and animal combination. Although the C48 TAG is still largest, the C50 and C52 TAGs are only slightly smaller in size. The ratios of the C48, C50, C52 and C54 TAG peaks in residue 11EC 4 are 3.7: 2.7: 2.6: 1. Only traces of the animal sterol cholesterol and plant sterol β-sitosterol were detected in this residue.

Insufficient fatty acids were recovered from residue 11EC 5 to permit characterization but lipid biomarkers were detected (Table B5). The animal sterol cholesterol was detected; the plant sterol β-sitosterol and the conifer biomarker dihydroabietic acid may occur in this residue, as well. The distribution of the TAGs in the residue is most similar to the distribution associated with plants. The C48 peak is the largest and peak size progressively decreases as the number of carbon atoms increases. The ratios of the C48, C50, C52 and C54 TAG peaks are 10.9: 4.0: 11.2: 1.

Table B1. Summary of Average Fatty Acid Compositions of Modern Food Groups Generated by Hierarchical Cluster Analysis.

Cluster	Sub-cluster	Type	C16:0	C18:0	C18:1	C18:2	C18:3	VLCS	VLCU
A	I	Mamma fat and marrow	19.9	7.06	56.77	7.01	0.68	0.16	0.77
	II	Large Herbivore meat	19.39	20.35	35.79	8.93	2.61	0.32	4.29
	III	Fish	16.07	3.87	18.28	2.91	4.39	0.23	39.92
	IV	Fish	14.1	2.78	31.96	4.04	3.83	0.15	24.11
B	V	Berries and Nuts	3.75	1.47	51.14	41.44	1.05	0.76	0.25
	VI	Mixed	12.06	2.36	35.29	35.83	3.66	4.46	2.7
	VII	Seeds and Berries	7.48	2.58	29.12	54.69	1.51	2.98	1
	VIII	Roots	19.98	2.59	6.55	48.74	7.24	8.5	2.23
	IX	Seeds	7.52	3.55	10.02	64.14	5.49	5.19	0.99
	X	Mixed	10.33	2.43	15.62	39.24	19.77	3.73	2.65
C	XI	Greens	18.71	2.48	5.03	18.82	35.08	6.77	1.13
	XII	Berries	3.47	1.34	14.95	29.08	39.75	9.1	0.95
	XIII	Roots	22.68	3.15	12.12	26.24	9.64	15.32	2.06
	XIV	Greens	24.19	3.66	4.05	16.15	17.88	18.68	0.72
	XV	Roots	18.71	5.94	3.34	15.61	3.42	43.36	1.1

VLCS- Very Long Chain (C20, C22 and C24) Saturated Fatty Acids

VLCU - Very Long Chain (C20, C22 and C24) Unsaturated Fatty Acids

Table B2. Criteria for the Identification of Archaeological Residues Based on the Decomposition Patterns of Experimental Cooking Residues Prepared in Pottery Vessels.

Identification	Medium Chain	C18:0	C18:1 isomers
Large herbivore	≤ 15%	≥ 27.5%	≤ 15%
Large herbivore with plant OR Bone marrow	low	≥ 25%	15% ≤ X ≤ 25%
Plant with large herbivore	≥ 15%	≥ 25%	no data
Beaver	low	Low	≥ 25%
Fish or Corn	low	≤ 25%	15% ≤ X ≤ 27.5%
Fish or Corn with Plant	≥ 15%	≤ 25%	15% ≤ X ≤ 27.5%
Plant (except corn)	≥ 10%	≤ 27.5%	≤ 15%

Table B3. Known Food Sources for Different Types of Decomposed Residues.

Decomposed Residue Identification	Plant Foods Known to Produce Similar Residues	Animal Foods Known To Produce Similar Residues
Large herbivore	Tropical seed oils, including sotol seeds	Bison, deer, moose, fall-early winter fatty elk meat, Javelina meat
Large herbivore with plant OR Bone marrow		
Low Fat Content Plant (Plant greens, roots, berries)	Jicama tuber, buffalo gourd, yopan leaves, biscuit root, millet	Cooked Camel's milk
Medium-Low Fat Content Plant	Prickly pear, Spanish dagger	None
Medium Fat Content (Fish or Corn)	Corn, mesquite beans, cholla	Freshwater fish, *Rabdotus* snail, terrapin, late winter fat-depleted elk
Moderate-High Fat Content (Beaver)	Texas ebony	Beaver and probably raccoon or any other fat medium-sized mammals
High Fat Content	High fat nuts and seeds, including acorn and pecan	Rendered animal fat (other than large herbivore), including bear fat
Very High Fat Content	Very high fat nuts and seeds, including pine nuts	Freshly rendered animal fat (other than large herbivore)

Table B4. Sample Descriptions and Lipid Compositions of Burnt Clay Residues.

Fatty acid	11EC 4		11EC 6		11EC 7	
	Area	Rel%	Area	Rel%	Area	Rel%
C12:0	0	0.00	0	0.00	0	0.00
C14:0	0	0.00	0	0.00	0	0.00
C15:0	0	0.00	0	0.00	0	0.00
C16:0	138692	63.50	222287	60.49	240617	64.56
C16:1	0	0.00	0	0.00	0	0.00
C17:0	3539	1.62	4791	1.30	4891	1.31
C18:0	58549	26.80	90235	24.56	77851	20.89
C18:1s	17646	8.08	50154	13.65	49369	13.25
C18:2	0	0.00	0	0.00	0	0.00
C18:3s	0	0.00	0	0.00	0	0.00
C20:0	0	0.00	0	0.00	0	0.00
C20:1	0	0.00	0	0.00	0	0.00
C24:0	0	0.00	0	0.00	0	0.00
C24:1	0	0.00	0	0.00	0	0.00
Total	218426	100.00	367467	100.00	372728	100.00
Peak Ratios of C48, C50, C52 and C54 Triacyl-glycerols (TAGs)	3.7: 2.7: 2.6: 1 Plant with some animal		Most similar to a plant distribution		17.5: 8.6: 2.7: 1 Plant distribution	
Biomarkers	Possibly β-sitosterol; Possibly Cholesterol		β-sitosterol; Cholesterol		β-sitosterol; Cholesterol; Azelaic acid; prob Dehydroabietic acid	
Sample Description	Burnt clay		Burnt clay		Burnt clay	
Catalogue No.	109-A		114-A		118-A	
Mass (g)	35.200		33.716		34.156	
Identification	Plant and animal combination		Medium fat content foods; plant and animal combination with plant products dominant		Medium fat content foods; plant and animal combination with plant products dominant; seed oils may be present; conifer products may occur	

Table B5. Results from Samples with Low Lipid Recoveries.

Sample	11EC 5
Peak Ratios of C48, C50, C52 and C54 Triacyl-glycerols (TAGs)	Plant Distribution
Biomarkers	β-sitosterol; Cholesterol; probably dehydroabietic acid
Sample Description	Burnt clay
Catalogue No.	110-A
Mass (g)	35.511
Identification	Plant and animal combination with plant products dominant; conifer products may occur

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Appendix C

Microfossil Analysis

Microfossil Analysis of Burnt Clay Samples from 41BX256, Bexar County, Texas

Prepared for

Ecological Communications Corporation

4009 Banister Lane, Suite 300

Austin, TX 78704

Prepared by

Timothy E. Riley

Archaeological Ecology Laboratory

Department of Anthropology

Texas A&M University

4352 TAMU

College Station, TX 77844

This report presents the results of a microfossil analysis performed on four samples of burnt clay associated with thermal features encountered during excavation of a Middle Archaic component of an archaeological site (41BX256), near present day San Antonio. These burnt clay masses have been postulated as possible cooking features or collapsed and burnt wattle and daub structures. Microfossil analysis of samples of the fired clay was undertaken to elucidate the function of these features. If the features were used to cook starch rich plant resources, it is expected that the clay samples would contain a number of starch granules resulting from the steam-driven dispersal of starch throughout a sealed oven feature. This is frequently the case with fire-cracked rock samples derived from earth oven features. If the features were collapsed wattle and daub structures, it seems likely that various phytolith shapes distinctive to the grass family (*Poaceae*), or other plant materials used in the daub, would be encountered.

While each sample was examined for the presence of diagnostic phytoliths as well as starch granules, neither were recovered from any of the samples submitted for analysis. This may be due to the preservational context of the site. This negative evidence does not allow for any conclusive statements about the function of these burnt clay features. The presence of microscopic charcoal and oxidized minerals in the samples supports the claim that these clay features were exposed to fire.

Materials and Methods

All four clay samples in this study were processed in the Palynology Research Laboratory, Department of Anthropology, Texas A&M University. These samples were hard nodules of clay exhibiting variable exposure to burning across the surface. These samples were removed from larger masses of burnt clay with a trowel and wrapped in aluminum foil. The exposed surface of these samples was recorded on the foil. Three of the samples had a maximum dimension of 6 cm or less. The remaining sample was significantly larger, with a maximum dimension of 11 cm.

Each sample was subjected to a two-part brushing procedure to minimize the potential for modern starch contamination. After initial examination of a sample, an area of 3cm by 3cm was selected for sampling. This sub-sampling method was designed to reserve as much of the artifact as possible for future corroborative studies while yielding enough microfossil residue for the current study. The sampling area was brushed and washed into a collection beaker until the water was visibly clear. The same area was then brushed again with a sonicating brush (Phillips Sonicare E Series) and the resultant residue was washed into a second collection beaker. While this method undoubtedly removes some potential microfossil residue that is directly associated with the use of the earth oven feature, it is an important step in limiting the mis-interpretation of the feature based on microfossil contamination that post-dates the use of the feature. This removal of potential contaminants allows for a much more secure interpretation of the second residue sample, which contains only those microfossils that required sonication to remove.

The resultant residue samples were transferred to 15 ml centrifuge tubes and placed in a 5% Calgon solution for 6 hours. Following this treatment, each sample was washed in water several times. The samples were then placed in a heavy density solution of ZnBr at a specific gravity of 2.38. After thorough mixing, the sample were centrifuged for five minutes at low speed , followed by five minutes at high speed. The light fraction resulting from this was pipetted off and the procedure repeated. Following this step, the light fraction was washed several times in water and transferred to a dram vial for storage. The heavy fraction was examined microscopically to determine that all starch granules and phytoliths had been recovered in the light fraction. The heavy fractions consisted primarily of weathered minerals, primarily quartz, and no microfossils were observed in any of the heavy fractions. The samples were then placed in a heavy density solution of ZnBr at a specific gravity of 1.8. After thorough mixing, the sample were centrifuged for five minutes at low speed , followed by five minutes at high speed. The light fraction resulting from this was pipetted off and the procedure repeated. Following this step, both the light and heavy fractions were washed several times in water and transferred to a dram vial for storage. Following this procedure, a slide was made of both the light and heavy fraction residue from each sample. The light fraction slide was examined with brightfield and cross-polarized microscopy for starch granules and the heavy fraction slide was examined with brightfield microscopy for phytoliths.

Starch in Archaeology

Starch granules have been observed in archaeological contexts since the late 1970s (Anderson 1980; Ugent, et al. 1982, 1984; Ugent, et al. 1981) but this line of evidence has only recently become a major component of microbotanical research (Torrence and Barton 2006, Fullager et al. 2006, Loy et al. 1992). Starch analysis can provide evidence of the use of plants as food resources where macrobotanical remains are rare or uninformative. In some cases, starch granules have been found that predate other evidence of domestication (Perry et al. 2007). Piperno and Holst (1998) examined ground stones and found maize (*Zea mays*), *Manihot esculenta*, *Dioscorea* sp., and *Maranta arundinacea* starch grains from Central Panama, providing evidence for the use of tuber crops since 8000 ybp. Loy et al. (1992) studied lithic flakes from 28,000 year old cave sediments on the Solomon Islands and recovered starch grains from them. Some of the granules were identified as *Colocasia* sp.

To date, most starch research has focused on tools and soils recovered from the Tropics, with very little focus on the potential of this line of research in temperate climates (Fullagar and

Field 1997; Fullagar, et al. 2006; Fullagar, et al. 1996; Fullagar, et al. 1998; Horrocks, et al. 2004; Horrocks, et al. 2002; Horrocks and Lawlor 2006; Horrocks and Nunn 2007; Horrocks and Weisler 2006; Irwin, et al. 2004; Lentfer, et al. 2002; Pearsall, et al. 2004; Perry 2004a, b, 2005; Perry, et al. 2007; Piperno 1998; Piperno and Holst 1998; Piperno, et al. 2004; Smith, et al. 2001). A handful of temperate Old World sites have been investigated. Shibutani (2008) studied anvil stones, grinding slab, and grinding stones from four archaeological sites in southern part of Japan, dating from Japanese Paleolithic to incipient Jomon period. She recovered intact and damaged starch grains from grinding surfaces of the tools. The recovered starch grains are not identified to taxa conclusively. Piperno et al. (2004) reported the earliest evidence of grass seed processing. They identified starch grains of barley and possibly wheat from an Upper Paleolithic ground stone found in Israel.

While Loy had some early publications on starch recovered from North American artifacts, only two recently published studies examines starch recovered from North America (Boyd, et al. 2006; Zarrillo and Kooyman 2006). The Zarrillo and Kooyman (2006) article focuses on the recovery of maize and berry starch on late prehistoric groundstone from the northern Great Plains. In addition, there have been a handful of studies done for contract projects, mostly from the Southwest and Great Basin (Cummings 1992 a-c, 1993 a-b, 1997 a-b)). Only two studies evaluating starch recovered in Texas has been encountered in the current literature review (Cummings 1993c; Perry 2008). The paucity of publications on the recovery of starch from North American archaeological sites highlights some of the potential for this line of research as well as a dearth of qualified researchers currently investigating starch with a regional focus on North America. This is surprising in light of the fact that much of the continent has copious artifacts associated with both incipient horticulture and hunter-gatherer sites. As Piperno et al. (2004) state, the association of macroscopic remains from economically important plants with potential plant processing tools such as grinding slabs, mortars and pestles is rarely evident. Starch analysis of groundstone and cooking features provides direct evidence of past human food processing.

To date, there has been little research on the recovery of starch from known cooking features in the archaeological record. Recent experimental studies have shown that earth oven cookery results in the dispersal of starch granules and other microfossils throughout the oven feature, depositing residue related to the cooked foodstuffs and packing material used in the oven on many of the rocks used as heating elements (Messner and Schindler 2010).

Starch Reference Collection

Archaeological starch research has seen little application to hunter-gatherer sites in North America (Messner 2008; Zarrillo and Kooyman 2006). This is partly due to the need for a reference collection of major potential food resources for each region. The development of this collection is hindered by the rare recovery of geophytes and small seeds from the archaeological record, as well as the imprecision of the observations available in the the ethnohistoric record (Thoms 2008a). This section presents an overview of the starch reference collection developed over the course of this research following a brief review of the microscopic methods useful in starch grain analysis.

The identification of starch granules recovered from archaeological contexts has become one of the more important components of recent paleoethnobotanical studies over the last decade (see Torrence and Barton (2006) for an recent overview). While this is a relatively new subfield in archaeology, starch microscopy has long had a place in food science (Flint 1994) and botany (Cortella and Pochettino 1994). Starch was first observed and identified microscopically in 1719 by Antonie van Leeuwenhoek (Thomas and Atwell 1999). Since then, many researchers have shown that starch granules can be microscopically associated with botanical source material based on distinguishing morphological characteristics, the most important being shape and size (Badenhuizen 1965; Cortella and Pochettino 1994; Czaja 1978; Evers 1979; Moss 1976; Reichert 1913). This section provides an overview of some of the techniques used in the light microscopy of starch. Many of the diagnostic features of starch used by paleoethnobotanists, such as differences in the lamellae and hilum location, have been observed and described under brightfield light. Transmitted brightfield light can be used to observe starch granules but it can be very difficult to observe the features necessary to distinguish individual differences between starch grains (Barton and Fullagar 2006). Additionally, because starch grains generally exhibit very low contrast in most mounting media, it can be very difficult to observe granules from an unknown specimen with other microscopic components. For these reasons, much of the initial microscopy used to identify the presence of starch in an archaeological sample relies on polarized light microscopy.

All undamaged starch grains have a high degree of molecular orientation (Evers 1979). This structured organization of the granule results in a characteristic birefringence pattern when starch is viewed in cross-polarized light (Thomas and Atwell 1999). This uniaxial birefringent pattern is known variously as an extinction cross or a maltese cross (Barton and Fullagar 2006; Weaver 2003). Birefringence is a complex optical property of many ordered compounds. Light entering the specimen is split into two components which are plane polarized perpendicular to each other. The refractive index of a birefringent specimen varies with the direction of passage, causing one of the components to be retarded relative to the other component. This optical path difference creates either constructive or destructive interference when the two component waves recombine after leaving the specimen. When the resultant recombined light passes through a second polarizing filter (the analyzer) set at a right angle to the original polarizing filter, any light that has not passed through a birefringent compound will be prevented from passing the analyzer. This microscopic method is very useful for the initial investigation of unknown samples since starch grains are readily visible and relatively distinct from other birefringent biological compounds (Canti 1997; Canti 1998; Canti 1999; Haslam 2006; Loy 2006).

While the extinction cross does provide some distinguishing features and is useful for the initial indication of starch ubiquity, many of the attributes used to differentiate between starch types are obscured in polarized light microscopy. This method may also not detect damaged or gelatinized starch grains, which lose birefringence as the molecular order of native starch is disrupted (Evers 1979). Starch grains with very high amylopectin content may also not exhibit birefringent optical properties (Evers 1979).

Under traditional food preparation methods, starch grain structure can be modified by mechanical damage from grinding and milling techniques or gelatinized through wet cooking methods (Babot 2003). Freezing, dehydration, roasting, and charring can also cause damage to starch granules that alters diagnostic features necessary for the identification of native starch granules (Babot 2003). Starch grains recovered in coprolites or latrines may also exhibit enzymatic damage from partial digestion (Autio 2001; Evers 1979). Mechanical damage can result in four different types of modification; 1) radial cracking associated with the hilum, 2) chipping and splitting along the margins of the granule, 3) abrasions and 4) a partial loss of granule structure resulting in a “ghost” granule (Williams 1968).

The current study utilized cross-polarized light microscopy for the initial identification of starch granules in the FCR specimens. Granules identified as starch were further examined under brightfield light to detect features important for botanical source identification.

Reference starch granules were examined for a total of 18 plant taxa known or suspected to be food resources for Texas hunter-gatherer populations. These references are housed in the Archaeological Ecology Laboratory in the Department of Anthropology at Texas A&M University. The collection includes starch and phytolith references for most of the ethnographically documented food resources listed by Thoms (2008b). These resources include grass seeds and geophytes, both common resources encountered across central Texas. Table 1 presents summary data for the starch granules for these resources. Figures 1-3 provide micrographs of the starch granules encountered in each taxa examined.

Table 1. Measurements of Starch Granules from Modern Botanical References

Taxa	Part	Shape	Length (um)	Cross angle	Hilum	Fissures/ Striations	Lamellae	Vacuole/ Visible Hilum
Achnatherum hymenoides	seed	spherical	3.5-4.0	90	centric	Absent	Absent	Absent
Amaranthus sp.	small fruit	spherical	2.0-2.5	90	centric	Absent	Absent	Absent
Andropogon gerardii	seed	spherical	15.0-18.0	100	centric	Absent	Absent	Absent
Callirhoe involucrata	USO	spherical/oval	5.0-25.0	110	eccentric	Some	Present	Absent
Carex comosa	seed	spherical	3.0-5.0	90	centric	Absent	Absent	Absent
Claytonia virginica	USO	bell shaped	5.0-25.0	90	eccentric	Some	Present	Absent
Cooperia drummondi	USO	variable	15.0-50.0	110	eccentric	Present	Present	Present
Erythronium sp.	USO	bell shaped	45.0-55.0	130	eccentric	Absent	Present	Absent
Liatrus mucronata	USO	bell shaped	15.0-25.0	130	eccentric	Absent	Absent	Present
Nothoscordum bivalve	USO	lenticular/spherical	5.0-30.0	110	eccentric	Present	Present	Present
Opuntia sp.	seed	spherical	4.0-6.5	90	centric	Absent	Absent	Absent
Opuntia sp.	cladode	None	N/A	N/A	N/A	N/A	N/A	N/A
Opuntia sp.	tuna	None	N/A	N/A	N/A	N/A	N/A	N/A
Panicum sp.	seed	spherical	4.5-6.0	90	centric	Absent	Absent	Absent
Prosopis glandulosa	seedpod	variable	6.0-30.0	variable	eccentric	Absent	Some	Present
Quercus sp.	nut	ovoid	8.0-15.0	90-120	centric	Absent	Absent	Absent
Setaria lutescens	seed	spherical	6.0-8.0	90	centric	Absent	Absent	Absent
Smilax sp.	USO	bell shaped	7.0-12.0	90	centric	Absent	Absent	Present
Sporobolus sp.	seed	spherical	6.0-8.0	90	centric	Absent	Absent	Absent
Yucca bacata	Leaf	Spherical	13.0-19.0	90	centric	Absent	Absent	Present
Yucca bacata	Caudex	Spherical	10.0-15.0	90	centric	Absent	Absent	Present

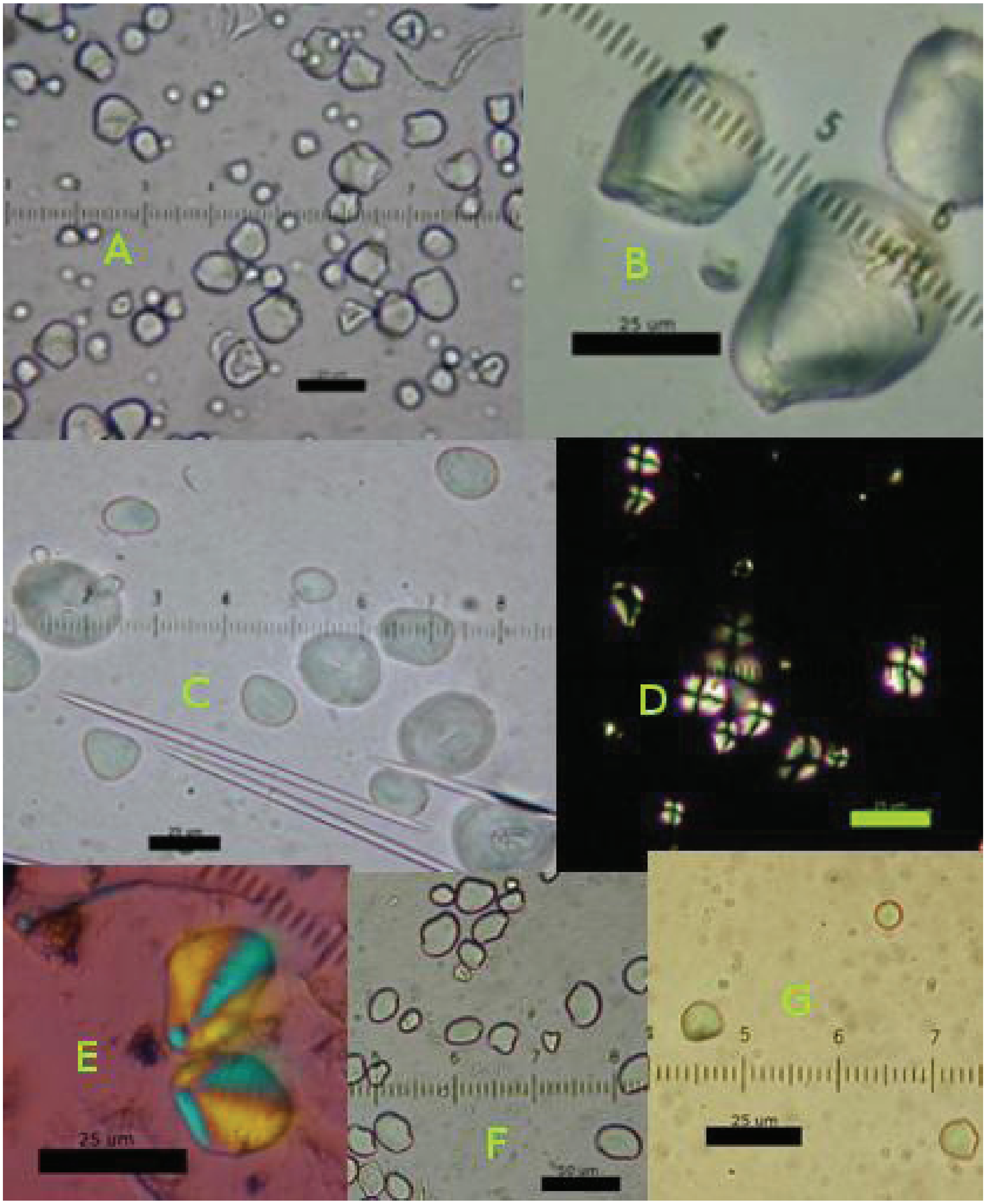

Figure 1. Micrographs of Starch Granules from Geophytes (A- Brightfield Micrograph of *Callirhoe involucrata*, B- Brightfield Micrograph of *Liatris mucronata*, C- Brightfield Micrograph of *Cooperia drummondi*, D- Cross-Polarized Light Micrograph of *Claytonia virginica.*, E- ¼ λ Retarded Cross-Polarized Light Micrograph of *Erythronium sp*, F- Brightfield Micrograph of *Nothoscordum bivalve*, G- Brightfield Micrograph of *Smilax sp.*) 400x

10

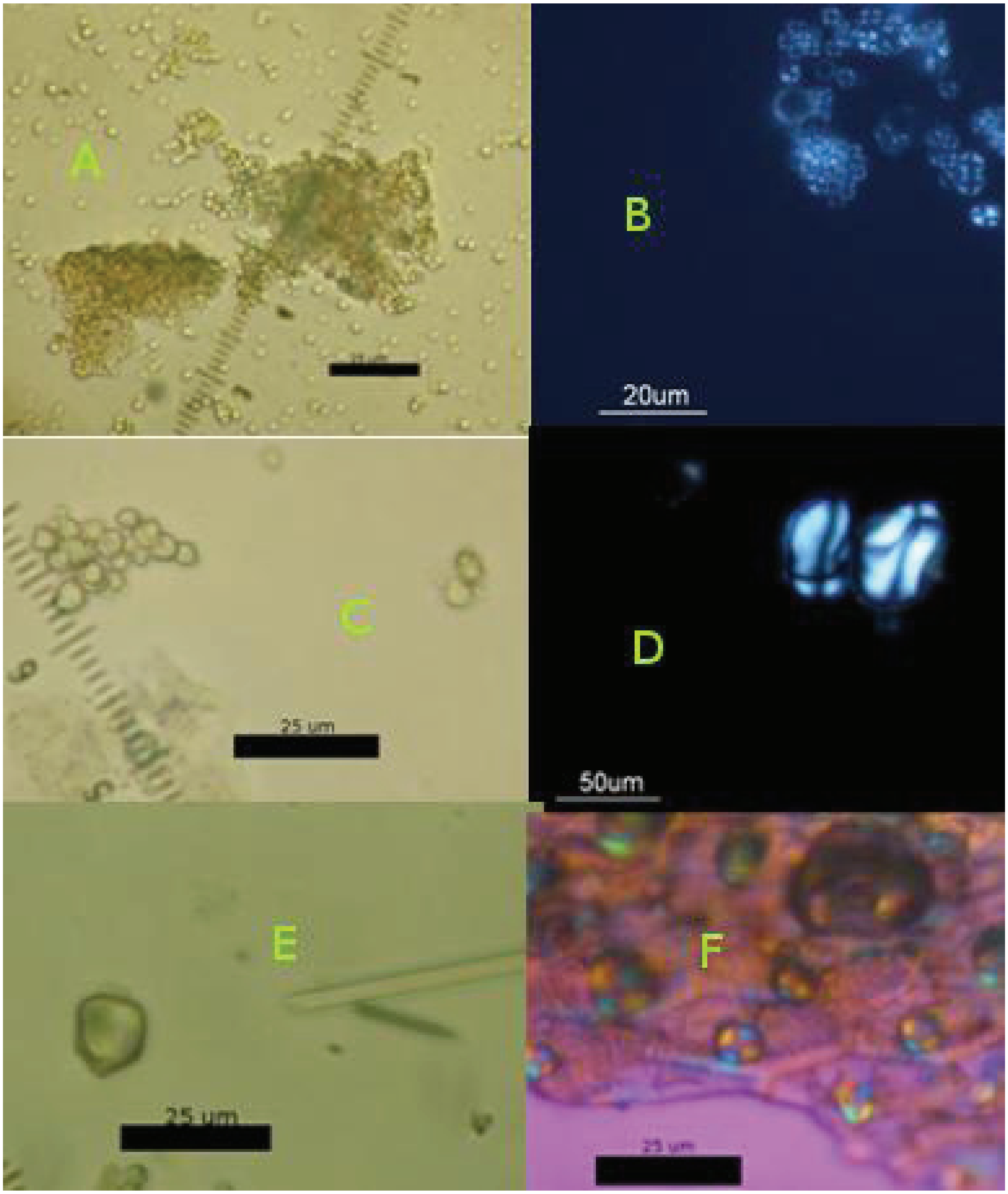

Figure 2. Micrographs of Starch from seeds and meristem (A- Brightfield Micrograph of *Amaranthus sp*., B- Cross-Polarized Light Micrograph of *Carex Comosa*, C- Brightfield Micrograph of *Opuntia sp*., D- Cross-Polarized Light Micrograph of *Prosopis glandulosa*, E- Brightfield Micrograph of *Yucca bacata* caudex, F- ¼ λ Retarded Cross-Polarized Light Micrograph of *Yucca bacata* leaf meristem) 400x

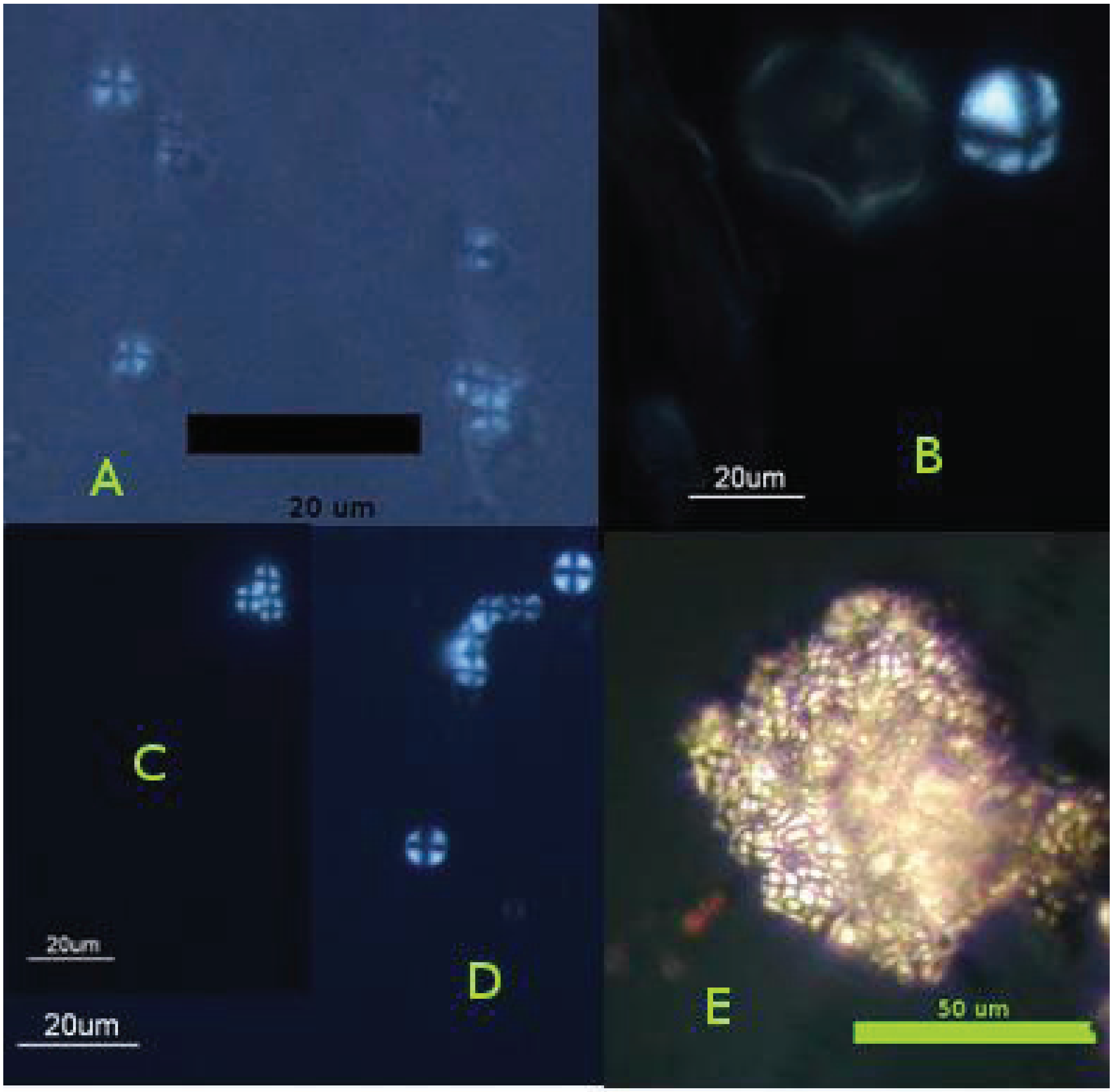

Figure 3. Cross-Polarized Light Micrographs of Starch Granules from Grass Seeds (A-*Achnatherum hymenoides*, B-*Andropogon gerardii*, C- *Setaria lutescens*, D- *Panicum sonorum*, E-*Sporobolus asper*) 400x

Results

None of the four burnt clay samples analyzed yielded starch granules or phytoliths. Many ancient starch studies suggest that starch will only preserve in sediment when protected from microbial action (Barton and Matthews 2006). This could be simply cellulose from plant material or, more likely, a protected context such as the microcracks on stone artifacts or fire-cracked rock. It is possible that the burnt clay masses in this study do not provide protection from the soil microbes that consume starch. The only known study of starch from non-ceramic clay objects is the previously mentioned Poverty Point Objects (PPO) study by Cummings (2006). The large clay masses in the current study do not seem to provide a similar heating element function for earth ovens or stone boiling.

Additionally, no phytoliths were encountered in this study. Phytolith preservation is much less dependent on protected microenvironments than starch granules. A number of factors impact phytolith preservation, including the pH of the sediment, water content, and the presence of free minerals (Piperno 2006). For example, the presence of iron and aluminum oxides in the sediment can enhance phytolith durability, a major factor in tropical soils (Piperno 2006). Highly alkaline soils generally have very poor phytolith preservation (Piperno 2006). Overall, it seems likely that the absence of both starch granules and phytoliths are most likely due to preservational issues. This limits any strong statements on the function of these burnt clay masses. It seems likely that these masses were not used as thermal elements in a manner similar to PPOs or fire-cracked rock. This does not preclude their use in cooking resources, but it does suggest that the method of use would have differed from that observed in rock-based earth ovens. The suggestion that these features were collapsed and burnt wattle and daub structures can also not be disproven with the current study. The lack of any diagnostic plant microfossils, whether from preservation or actual absence in the creation of the features, severely hampers any further understanding of the function of these burnt clay features.

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Appendix D

Thermal Signature Analysis

Estimated Firing Temperature

for Clay Samples from 41BX256

Report Prepared for:

Antonio Padilla
Project Archaeologist
Ecological Communications Corporation
4009 Banister Lane Suite 300
Austin, TX 78704

Report Prepared by:

Leslie Cecil

5109 Northway Dr. #201

Nacogdoches, TX 75965

A total of 44 clay samples (16 from Feature 9 and 28 from Feature 4) were presented for analysis. Twenty-six total samples were used for analysis. In bags where there were multiple samples (for example 154), one half of the clay samples were selected for analysis. This sub-sample was selected so as to represent the variety of clay samples and potential differences in firing temperatures. The preliminary firing temperatures were estimated by the strength it took to break the clay samples (the more strength needed, the higher the firing temperature).

Refiring procedures provide estimates as to the original firing conditions and firing temperatures used in prehistory. Additionally, when fragments of clays (and sherds) are all fired to a high temperature (in this case 800ºC), Cecil also can suggest if the same clays are represented because similar clay types will refire to the same color.

Cecil removed eight smaller fragments from each of the 16 clay samples used for this study. Each fragment was placed into an electric kiln (Fischer Isotemp Programmable Muffle Furnace) with a constant atmosphere (oxidizing) and pressure. The temperature was initially set at 250ºC and the sherds were soaked for 15 minutes to drive off any ambient humidity. After 15 minutes, the temperature was set to 300ºC and the sherds were soaked for 15 minutes. After 15 minutes, one fragment from each sample was taken out of the kiln and placed in a drying oven set at 40ºC to cool. This process was repeated at 350ºC, 400ºC, 450ºC, 500ºC, 600ºC, 700ºC, and 800 ºC. After all of the fragments had cooled, each fragment was compared to the original non-refired sherd sample. The temperature at which there were changes in the pattern seen in the core and the surface colors indicates the first temperature range above which the sherd was originally fired.

The clay samples from Feature 9 (with the exception of sample 165a) have estimated firing temperatures between 300°–400ºC. This indicates a very low heating/firing temperature. There does not seem to be any correlation of estimated firing temperature with the top/bottom of the feature.

Clay samples from Feature 4 tend to be heated/fired at a slightly higher temperature. Most of the samples (with the exception of 139b and 2008-220) were heated/fired to a temperature between 400°–600ºC. The majority of the samples were heated/fired to a temperature of 450ºC. Again, there does not seem to be any correlation of estimated firing temperatures and top/bottom of the feature.

While there are no correlations between top/bottom of the feature and heated/firing temperatures, it is interesting to note that in both cases, the lowest estimated firing temperature was at the lowest depth (or in Feature 4 the bottom two levels). This may suggest that at the lowest level of the feature, the fire (or heating substances) was not as hot or constant as those above. The most variation in heating/firing temperatures occurs in Feature 4 within the second level (65–70 cmbs). The second level had clays with heating/firing temperatures that ranged from 350°–600 ºC. This variety in heating/firing temperatures may indicate the place of heating in the feature or that multiple fires of different temperatures occurred within this level.

When the Munsell soil color measurements were taken from the clays at 800 ºC, some general trends about the clays appear. All of the clays are within the redder YR hue category and the majority of the clays fire to a pink or reddish yellow color. The clays from Feature 9 show a high frequency of variability with fired clay color. There does not appear to be any correlation with level of the feature. On the other hand, the clays from Feature 4 demonstrate the least amount of color (hue) variability. The variability is the difference between the clays at the surface and 55-65 cmbs and those below. This may indicate that Feature 9 is composed of many different kinds of clays that fire to a pink of reddish yellow color and that Feature 4 is composed of two different kinds of clays. The difference in fired clay color could also be due to differences in iron content or other inclusions; however, given that the differences are in the yellow red hues, the differences are most likely due to iron content.

Table 1: Estimated Refiring Temperatures and Colors

Sample Number	Feature Number	Estimated Firing Temperature (ºC)	Munsell Soil Color at 800ºC
153	9 (45-50 cmbs)	350–400	5YR 8/4
154a	9 (50-60 cmbs)	300	7.5YR 8/3
154b	9 (50-60 cmbs)	300–350	5YR 7/6
167	9 (60-70 cmbs)	350–400	7.5YR 8/4
165a	9 (70-80cmbs)	500	2.5YR 8/4
165b	9 (70-80cmbs)	350	7.5YR 8/4
165c	9 (70-80cmbs)	400	7.5YR 8/4
116	9 (90-100 cmbs)	<300	5YR 8/4
108a	4 (surface)	450	7.5YR 7/4
108b	4 (surface)	500	7.5YR 8/4
2008-214	4 (55-65 cmbs)	450	5YR 7/4
2008-215	4 (55-65 cmbs)	600	7.5YR 6/4
2008-216	4 (55-65 cmbs)	400	7.5YR 6/4
2008-217	4 (55-65 cmbs)	550	7.5YR 6/4
2008-218	4 (55-65 cmbs)	600	7.5YR 6/4-6
2008-219	4 (55-65 cmbs)	450	5YR 6/6
2008-220	4 (55-65 cmbs)	350	7.5YR 7/4
120a	4 (65-70 cmbs)	450	5YR 7/6
120b	4 (65-70 cmbs)	350–400	5YR 7/6
122a	4 (65-70 cmbs)	450	5YR 7/6
122b	4 (65-70 cmbs)	450	5YR 7/6
139a	4 (70-80 cmbs)	450	5YR 7/6
139b	4 (70-80 cmbs)	350	5YR 8/4
135	4 (80-90 cmbs)	400	5YR 6/6
137	4 (80-90 cmbs)	400	5YR 6/6
138	4 (80-90 cmbs)	450	7.5YR 7/2

Acknowledgements: This work was conducted by Dr. Leslie Cecil and Melanie Johnson, a student at SFASU obtaining a Sociology/Anthropology degree.