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The Siren Site and the Long Transition from Archaic to Late Prehistoric Lifeways on the Eastern Edwards Plateau of Central Texas

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THE SIREN SITE AND THE LONG TRANSITION FROM ARCHAIC TO LATE PREHISTORIC LIFEWAYS ON THE EASTERN EDWARDS PLATEAU OF CENTRAL TEXAS

Prepared for

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ABSTRACT

On behalf of the Texas Department of Transportation (TxDOT), SWCA Environmental Consultants (SWCA) conducted testing and data recovery investigations at the Siren site (41WM1126), a prehistoric multi-component site in the Interstate Highway 35 right-of-way along the South Fork of the San Gabriel River in Williamson County, Texas. The work was done to fulfill TxDOT's compliance obligations under the National Historic Preservation Act and the Antiquities Code of Texas. The testing investigations were conducted under Antiquities Permit 3834, and the subsequent data recovery was under Permit 3938. Kevin Miller served as Principal Investigator on both permits. Though the site extends far beyond the area of potential effects both horizontally and vertically, the investigations focused on Late Archaic and Late Prehistoric components within a relatively limited area that would be subject to project impacts. The investigations were conducted in February 2006.

The investigations identified five isolable components that were intermittently laid down from approximately 2600 to 900 years ago. A substantial Late Prehistoric Austin phase occupation is represented by Scallorn projectile points, stone tools, burned rock, faunal materials, and radiocarbon dates from cooking features. The component feature assemblage includes a cluster of discrete, well-preserved burned rock features that range from small fire-cracked rock concentrations to a large, slab-lined feature that dominates the cluster.

The underlying components include four cultural strata representing a series of phases in the final millennium or so of the long Archaic period. These components span approximately 2600 to 1500 B.P., though earlier, deeply buried components were also noted on the site. These deeper deposits were not the focus of the investigations, however, since they would not be affected by the project. The Archaic components revealed a suite of small side-notched dart points such as Ensor, Fairland, and Frio, as well as many earlier broad-bladed styles such as Castroville, Montell, Marshall, and Pedernales. These robust components contained numerous burned rock features of varying size and function, abundant tools, well-preserved faunal materials, macrobotanical remains including geophytes from several earth ovens, and a large suite of radiocarbon dates. The features include an incipient burned rock midden, burned rock clusters, a debitage reduction area, a biface cache, slab-lined hearths, basin-shaped hearths, and small circular hearths. The distributions of artifacts and features within the Archaic components across the excavation blocks showed significant variations. These differences reflect sequential components that provide a view of diachronic trends in technology, subsistence, economy, and a suite of other behaviors and activities during the long transition from Archaic to Late Prehistoric adaptations.

As previously determined by the testing excavations and further substantiated by the data recovery investigations, the Siren site, most notably the Late Archaic and Late Prehistoric components, is eligible for the National Register of Historic Places under Criterion D, 36 CFR 60.4, and eligible for State Archeological Landmark designation under Criteria 1 and 2 of the Rules of Practice and Procedure for the Antiquities Code of Texas, 13 TAC 26.8. The excavations and subsequent analysis have mitigated the adverse effects of the bridge construction by recovering the vast majority of the affected components within the area of potential effect. No further archaeological work is recommended. Portions of the site outside the area of potential effects have not been fully evaluated, and any future impacts beyond the mitigated areas warrant further assessment.

ACKNOWLEDGEMENTS

The Siren site investigations took place intermittently over the course of seven years and involved the efforts of many, most unseen and far removed from the center stage. The authors appreciate the auspices and input from Texas Department of Transportation archaeologists Jon Budd, Scott Pletka, Jim Abbott, Alan Bettis and others. Kevin A. Miller, serving as Principal Investigator, oversaw the project from beginning to end. Field crews endured the usual slings and arrows of Texas weather, from the blazing heat in the summer of 2005 to the cold, biting winds in the winter of 2005–2006. The crew included Laura I. Acuña, Mike Chavez, Mercedes C. Cody, Owen Ford, Josh E. Gibbs, Jim Guillentine, Josh Haefner, Diamond Kapanday, Kim Kersey, John Lowe, Christine Meyer, Christina Nielsen, Logan Ralph, Steven Roberts, Beth Sain, Lisa Shaddox, Jason Smart, and Ernest Wingate. The analysis and reporting rests considerably on the expertise of Dr. Charles Frederick serving as Project Geoarchaeologist and Dr. Walter E. Klippel, who served as Project Faunal Analyst. John Lowe conducted many of the lithic analyses. Christina Nielsen and Laura I. Acuña supervised the curatorial process for the collection. Lisa Putman and Kendall Duncan managed the report production. Through it all, Mercedes C. Cody deserves substantial credit for coordinating the many details and layers of data that underlie the analysis, reporting, and curation. And finally, Brett Houk edited the final work, assisting in clarifying what needed clarity. For what good and useful contributions may come of this, the credit is fully shared with all of the contributors. For what of this does not withstand the test of time, the authors assume responsibility.

MANAGEMENT SUMMARY

Project Title: The Siren Site (41WM1126) and the Long Transition from Archaic to Late Prehistoric Lifeways on the Eastern Edwards Plateau of Central Texas

TxDOT CSJ Number: 0015-08-119.

Project Description: TxDOT constructed an access road and new bridge across the South Fork of the San Gabriel River on the western side of existing Interstate Highway 35 south of Georgetown. The new bridge structure is 520 feet long and 66 feet wide. Within the vicinity of the site, rows of four 42-inch concrete bents would support the deck of the bridge. The substantial subsurface impacts associated within these supports would fall just beyond the site limits. Consequently, the majority of the site would be spared direct deep impacts, but surficial impacts associated with transporting construction material and building the new bridge would take place within the boundaries of the site. For the purposes of investigations, the area of potential effects includes the existing right-of-way on the western side of IH 35 to a depth of 2 m below ground surface, with deeper impacts taking place in the off-site locations for new bents.

Location: The Siren site is located on the southern terrace of the South Fork of the San Gabriel River in the western right-of-way of Interstate Highway 35 in the southern city limits of Georgetown, Williamson County, Texas. The site is located within public property controlled by TxDOT, extending beyond the right-of-way onto adjacent private land. The data recovery investigations were confined to TxDOT property. The site area appears on the Georgetown, Texas USGS 7.5-minute topographic map.

Excavated Volume and area: 105.6 cubic meters and approximately 97 square meters.

Principal Investigator: Kevin A. Miller.

Texas Antiquities Permit: 3834 and 3938.

Dates of Work: June 27 to August 1, 2005 and September 2005 and November 15, 2005 to February 3, 2006.

Purpose of Work: As the construction project will involve federal funds from the Federal Highway Administration (FHWA) and involves state land controlled by the Austin District of TxDOT, investigations were conducted in compliance with the Antiquities Code of Texas; the National Historic Preservation Act; the Programmatic Agreement between the FHWA, the Advisory Council on Historic Preservation, TxDOT, and the Texas Historical Commission (THC); and the Memorandum of Understanding between TxDOT and the THC.

Recommendations: The site is eligible for listing on the National Register of Historic Places and for designation as a State Archeological Landmark. The investigations have mitigated the adverse effects within the project's area of potential effects. No further work is recommended within this area. However, the known site limits extend far beyond, in both depth and breadth, the impacts of the current project area. As the significance of these deposits is unknown, any future undertakings should assess the potential for yet unassessed contributing components.

Curation: The artifacts and records from the project are curated at the Texas Archeological Research Laboratory, The University of Texas at Austin.

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Chapter 1

Introducing the Siren Site

Stephen M. Carpenter and Mary Jo Galindo

On behalf of the Texas Department of Transportation (TxDOT), SWCA Environmental Consultants (SWCA) conducted testing and data recovery excavations on the Siren site (41WM1126), a stratified prehistoric site on the southern terraces of the South Fork of the San Gabriel River near Georgetown, Texas (Figure 1.1). The site contains components deposited intermittently from Archaic through Late Prehistoric times, and perhaps earlier. The primary components investigated in the excavations span the final Late Archaic period and into the Austin phase of the Late Prehistoric, a timeframe from roughly 2600 to 900 years ago. The field investigations, conducted in the summer of 2005 and the winter of 2005/2006, included geomorphological study with mechanical excavations and subsequent hand excavations.

The work was conducted to fulfill TxDOT's compliance with Section 106 of the National Historic Preservation Act and its implementing regulations in 36 CFR Part 800. All work was conducted under the terms and conditions of the First Amended Programmatic Agreement among TxDOT, the Federal Highway Administration, State Historic Preservation Officer (SHPO), and the Advisory Council on Historic Preservation. Additionally, the investigations were conducted under the Antiquities Code of Texas. The state and federal regulations mandate the evaluation of the site's eligibility for listing on the National Register of Historic Places (NRHP) or for designation as a State Archeological Landmark (SAL). The testing investigations were conducted under Antiquities Code of Texas Permit 3834, and the subsequent data recovery was under Permit 3938. Kevin A. Miller served as Principal Investigator on both permits.

The Site – Possibilities and Limitations

The Siren site contains stratified components that cover one of the most significant transitions in prehistory, that from Archaic to Late Prehistoric lifeways. Accordingly, addressing the fundamental changes that occurred over this time period constitutes an overarching objective in the study of the Siren site. However, as is true of much of the regional record, the components have varying degrees of integrity. Repetitive occupations on the same surfaces and a suite of other processes have obscured the boundaries and associations between and among some, but not all, artifacts, features, and components. The site is a complex mix of discrete clarity in some areas and mixed assemblages in other areas. Consequently, the study of the site bears an obligation to consider both the possibilities and limitations simultaneously, and to underestimate neither.

To briefly describe the site and its setting, the archaeological remains of many prehistoric occupations were laid down in deep alluvial terraces that aggraded intermittently throughout the Holocene. The depositional setting is conducive to the preservation of a long-term archaeological sequence. The San Gabriel River has cut deeply into the Cretaceous limestone bedrock, forming a fairly narrow valley in the vicinity of the site. During the early to mid-Holocene, the terraces aggraded rapidly, but over time the landform gradually stabilized as overbank deposition slowed. With the decreasing rate of aggradation, components formed in more compressed units with less stratigraphic separation. Consequently, the materials were subject to palimpsest processes, disturbances caused by subsequent occupations. These processes pose the main interpretive difficulties. The site, nevertheless, retains reasonably good integrity, both horizontally and vertically, which renders the site more significant given the relative rarity of sites with similar sequences in Central Texas.

In the specific site area, the northern (riverside) edge of the terrace drops steeply for approximately 7 m to a narrow floodplain, which is only 50 to 100 cm above the level of the river (Figure 1.2). The southern edge of the terrace abuts the rocky valley wall, which rises quickly above the site. To the west and east of the Interstate Highway (IH) 35 right-of-way, vertical limestone bluffs form the valley wall, but south of the

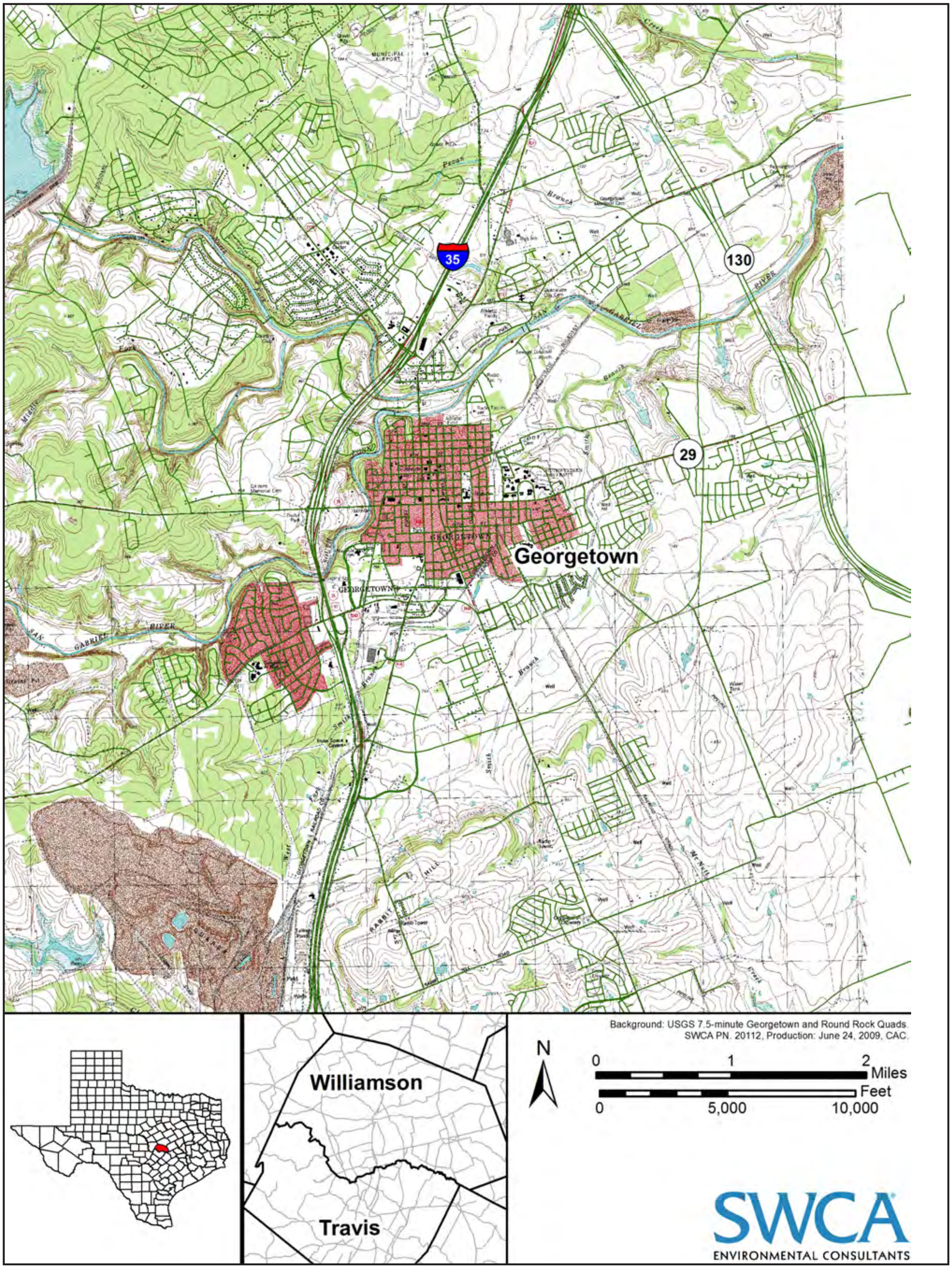

Figure 1.1. Project location map.

excavated portion of the site the valley margin has been artificially graded and now bears little resemblance to its prehistoric configuration.

The investigated portion of the site is entirely within land owned by the TxDOT on the river terrace. Archaeological investigations that are covered by this report were confined to the portion of the site west of the IH 35 (Figure 1.3). In an unrelated project, SWCA conducted later investigations on the eastern side (Peyton et al. 2013), and from time to time throughout this report some of the data from those investigations are drawn into this report to illuminate trends. Beyond these spatially limited studies, the site is known to extend well beyond the limits of the right-of-way to the west and east.

Site cultural deposits occur in 4- to 6-m-deep Holocene alluvium. The survey conducted prior to SWCA's involvement with the project documented site deposits on both sides of the bridges (Paul Price Associates, Inc. [PPA] 2005). SWCA's work determined that cultural material extend from the base of the valley wall to the northern edge of the T1 terrace. Therefore, the known extent of the site is estimated to be 183 m east-west (the width of the 600-foot wide right-of-way) by 30 m north-south. Vertically, the site extends from the bottom of a modern fill layer, which varies from 20 to 100 cm thick and covers the eastern half of the right-of-way, to at least 3.5 m below surface. Based on soil cores, a layer of gravels occurs at approximately 4.5 m below surface, with bedrock approximately 5 m below surface. Therefore, the maximum extent of cultural material is potentially 4.5 m below surface in most areas of the site.

Project Description and Area of Potential Effects

At the time of archeological investigations, IH 35 was a multi-lane, divided highway without frontage roads at the South Fork of the San Gabriel River. A large retail development on the northern side of the river prompted TxDOT to propose the construction of a southbound access road on the western side of IH 35. The project does not require new right-of-way as the existing 600-foot-wide right-of-way provides sufficient area for the expansion. The access road would require a new bridge to cross the river, and the Siren site is located within the area of potential effects (APE) of direct and indirect impacts related to construction of the bridge.

The new bridge structure would be 520 feet long and 66-feet-wide. Pre-stressed concrete beams supported by rows of four 42-inch concrete bents would support the deck of the bridge. On the southern bank of the river, only two rows of bents would be required. The southern row of bents would be placed near the southern edge of the site, at the base of the steeply sloping valley wall. This row would be 65 feet north of the southern end of the bridge. The second row of bents would be 130 feet north of the first on the T0 terrace of the river. The site, therefore, is located between the bents beneath the 130-foot span over the terrace of the river. The majority of the site would be spared direct deep impacts from bent installation, but indirect impacts associated with transporting construction material and building the new bridge would take place within the boundaries of the site. For the purposes of

Figure 1.2. South Fork of the San Gabriel River looking upstream (west) from the Siren site (on the left).

Figure 1.3. Overview of Siren site during early data recovery investigations; facing northeast towards IH 35 and across the river.

investigations, the APE includes the existing right-of-way on the western side of IH 35 to a depth of 2 m below ground surface, with deeper impacts taking place in the off-site locations for new bents.

The testing and data recovery investigations were designed to address the localized construction impacts. The unaffected portions of the site beyond the APE (both horizontally and vertically) provide a significant archaeological context for the site investigations, but were not directly targeted in the excavations.

A Brief History of Investigations at the Siren Site

Over the course of three years, the Siren site was investigated at varying levels to fully explore its nature, contents, and significance. Investigations progressively became more focused on the areas with the highest data yield.

The Siren site was recorded as 41WM1126 during a survey of the project area in May 2005 by Paul Price Associates, Inc. The surveyors excavated nine shovel tests, seven of which were positive. The materials recovered from shovel tests included flakes, tools, charcoal, bone, and an un-typed projectile point fragment. Flakes were observed on the surface of the site, and a burned rock feature and debitage were visible in the river's cutbank. Based on these findings, the surveyors recommended further assessment of the site to determine the site's significance (PPA 2005).

In accordance with these recommendations, in the summer of 2005, SWCA conducted testing excavations under the aforementioned antiquities permit. In the course of the investigations, SWCA conducted backhoe trenching, hand excavations, special sampling, and other documentation at the project area. Three backhoe trenches provided an initial cross-section of the site. Subsequently, hand excavation of 13 test units, a total of 9.5 cubic m of site deposits, was designed to systematically determine the extent, integrity, and nature of the archaeological deposits.

Four cultural components were documented during the testing project, although only two of the components were assessed in detail. The four components included a shallowly buried Late Prehistoric component and several underlying Archaic components that included an apparent Late Archaic component distinguished by Castroville points, as well as at least one deep, earlier undated component. Despite impacts to the site's upper deposits from construction of the existing bridges, the site appeared to have good integrity with stratified components. The stratigraphic position of abundant, diagnostic artifacts were generally consistent with radiocarbon, suggesting intact components.

With respect to potential data yield, testing found the site contained dateable materials, good preservation of faunal material, discrete features, abundant artifacts, and diverse artifact assemblages. The potential data yield of the deeper components at the site could not be fully explored given the limitations imposed on testing. The portion of the Siren site within the TxDOT right-of-way was therefore determined eligible for NRHP listing under Criterion D, 36 CFR 60.4. and eligible for SAL designation under Criteria 1 and 2 of the Rules of Practice and Procedure for the Antiquities Code of Texas, Title 13, Part 2, Chapter 26.8. Based on these determinations of eligibility and because impacts to the site could not be avoided, a plan to mitigate the effects was developed, and data recovery work commenced.

From November 15, 2005, to February 3, 2006, SWCA performed data recovery investigations. The staged investigations included re-excavating two of the backhoe trenches from the testing phase, mechanically stripping overburden of construction fill, excavating broad horizontal areas by hand, and conducting additional geomorphological investigations. During data recovery, 91.6 cubic m of site deposits were excavated by hand in four large blocks.

The data recovery investigations further refined the cultural components at the site. Whereas the testing phases yielded a predominantly disturbed and fairly meager Late Prehistoric component, the subsequent phase identified a more substantial Austin phase occupation represented by Scallorn projectile points, stone tools, burned rock, faunal materials, and radiocarbon dates from seven well-preserved cooking features. Although partially truncated, the Late Prehistoric component nevertheless includes a cluster of discrete, well-preserved burned rock features that range from small fire-cracked rock concentrations to a large, slab-lined feature that dominates the cluster. Despite being impacted by previous scraping and filling associated with prior bridge construction, the features associated with the Late Prehistoric component were discrete and concentrated in a relatively small area. The additional findings show the component is a viable assemblage.

The second primary component, which is subdivided into at least four more discrete units in this report, covers the later millennia of the long Archaic period. These components cover approximately 2600 to 1500 b.p., though earlier, deeply buried components were also noted on the site. These deeper deposits were not the focus of the data recovery investigations, however. The Archaic components comprised the majority of the excavated deposits at the site. These assemblages revealed a suite of small side-notched dart points such as Ensor, Fairland, and Frio, as well as many earlier broad-bladed styles such as Castroville, Marshall, and Pedernales. These robust components contained numerous burned rock features of varying size and function, abundant tools, well-preserved faunal materials, macrobotanical remains including geophytes from several earth ovens, and a large suite of radiocarbon dates which span the final millennia of the Archaic. The features investigated include a variety of hearths, an incipient burned rock midden, clusters of burned rock, a debitage cluster or cache, and a biface cache. The features in the component include two well-constructed and preserved large slab-lined hearths, a small slab-lined hearth, basin-shaped hearths, and small circular hearths. The distributions of artifacts and features within the Archaic components across the excavation blocks showed significant variations. These differences are believed to reflect the presence of discrete subcomponents and the different types of behavior and activities that occurred across the site. In all, the data recovery gathered additional information that firmly supported the prior determination of significance, concurrently mitigating the effects of construction. The bridge is now in place (Figure 1.4).

Focus and Organization of this Report

This report documents SWCA's investigations of the cultural remains at the Siren site. The focus is firmly placed on the prehistoric occupations from the Late Archaic through the Late Prehistoric periods (approximately 2600 to 900 years ago). The quality and robustness of the recovered site data offer many previous unseen views on our understanding of the critical time period of transition in Central Texas, as all aspects of society underwent rapid changes. Numerous research topics are postulated in the study, critical steps along the path of answering one pertinent and overarching regional research question: "Is the 'transition' from the end of the Archaic period to the beginning of the Late Prehistoric period in Central Texas a viable chronological interval, and, if so, what are its characteristics?"

This report is structured to present relevant background information, data from the investigations, and interpretations based on a research design that guided the investigations and analyses. The goal of the report structure is to form a logical progression of background and site data that assists in the exploration of the five primary research questions and ultimately culminates in reaching our objective of obtaining a new understanding of the final phases from the Archaic to Late Prehistoric times. Chapters 2 and 3 provide background environmental and cultural setting discussions, which serve to frame the site contextually within the ecotonal region along the Balcones Escarpment and the Blackland Prairie and, more specifically, within the South Fork of the San Gabriel River drainage basin. The methods and objectives of the study are presented in Chapter 4.

Chapter 5 presents an overview of the findings. Chapter 6 covers site formation processes, focusing on the micro-scale of site structure and interpretation before expanding into an examination of the archaeological implications of the preservation of the Siren site in the South San Gabriel River drainage. Chapter 7 presents the data on the artifacts, features, and ecofacts recovered from the site.

The final chapters are interpretative. Chapter 8 is an examination of site structure, defining finer subdivisions in the substantial mass of data. Once site structure is established, the subsequent five chapters are based in the primary research topics that form the framework of the study. Chapter 9 looks at the Siren site chronology in light of previous chronologies for Central Texas. Chapter 10 is a detailed examination of burned rock technology with a focus on large, slab-lined cooking features. Chapter 11 explores prehistoric foraging strategies, the diachronic changes in the basic economic approaches in prehistoric subsistence. Chapter 12 looks at metric discrimination of the large projectile point assemblage from the site with the goal of distinguishing between dart and arrows.

Chapter 13 the concluding chapter, takes the research topics and provides a synthesis of the new information gleaned from the site studies to present a new understanding of the end of the Archaic and beginning of the Late Prehistoric. Supporting data are presented in 13 appendices to this report. The majority of the appendices are special study results and the analyses data.

Figure 1.4 Photo shows IH 35 bridge on left and newly constructed frontage road bridge on right, south bank of the South Fork of the San Gabriel River with the river in the foreground, the T_0 and T_1 terraces in middle and T_2 terrace with concrete apron in background; facing south.

Chapter 2

The Environmental Setting, Past and Present

Stephen M. Carpenter and Ken Lawrence

"The orderly way in which to study the Southwest would be to take up first the land, its flora, fauna, climate, soils, rivers, etc., then the aborigines, next the exploring and settling Spaniards, and, finally, after a hasty glance at the French ....." J. Frank Dobie (1942:12)

The study of the Siren site begins with the material conditions of existence, the backdrop, the Binfordian "stage for the evolutionary play" (Binford 2001:55). As a general principle, variation in physical context of any given site, on an ever-widening geographic scale, creates inequities in the distribution of fundamental resources that past societies needed to exist. These inequities, in turn, affected the distribution and adaptive patterns of those who mapped onto them. This premise, which re-emerges in the final chapter, requires an understanding of the physical geography. The basic parameters of such a context are laid out in this chapter, and more specific environmental data are introduced throughout the later interpretive chapters of this report.

An increasingly common analytical approach in Central Texas archaeology is to interpret cultural trends and variations in the archaeological assemblage in light of changes in environmental conditions, which constitute an economic basis of past cultures. The very substrate underlying any given society provides both possibilities for and limitations on the adaptive patterns of those that live on it. Some aspects of environmental setting remained constant, but many variables were in constant flux. For those aspects in flux, the primary time of concern is the last several millennia, but for comparative purposes a wider purview is considered here.

Physiographic Setting

A significant aspect of the Siren site's setting is its ecotonal position at the margins of several macro-regions, including the Edwards Plateau to the west, the Blackland Prairie to the east, the Gulf Coastal Plain to the south, and Grand Prairie to the north. Each of these are subdivisions of much larger physiographic regions, and each supported different biotic communities.

The Siren site is on the eastern edge of the Edwards Plateau along the South Fork of the San Gabriel River, a tributary of the Brazos River (Figures 2.1 and 2.2). The plateau's southern and eastern margins are well defined by the Balcones Escarpment, a steep scarp formed by the Balcones fault zone. Subsequent to the uplift along the fault, the edges of the plateau have slowly eroded away, creating much more of a textured, osmotic boundary between the plateau and prairies. Waterways, which drain the plateau into the adjacent prairies to the east and coastal plain to the south, become more deeply incised heading westward. In the vicinity of the site, the river has cut deeply into the limestone bedrock, creating prominent bluffs.

The plateau is distinguishable from surrounding physiographic regions by its prominent Cretaceous-age limestone, dolomite, sandstone, and shale deposits. The Edwards Plateau physiographic region is broad and diverse with the western plateau margins blending slowly into the mountain and basin physiographic regions westward and abruptly transitioning into the plains regions to the east. The elevation of the western Edwards Plateau is approximately 2,000 feet above mean sea level (amsl) and gradually decreases eastward to about 600 feet amsl along its eastern margins. Despite the higher elevation, the western and northern margins of the plateau are relatively flat in comparison to the diverse topographic relief of its eastern and southern margins. This abrupt separation of the eastern and southern extent of the Edwards Plateau from the plains to the east is clearly demarcated by flat-topped hills with eroded tiers that early Spanish explorers likened to balconies (*balcones*) from which the feature gets the name Balcones Escarpment (Swanson 1995:28). For roughly 300 miles, the uplifted and elevated Balcones Escarpment divides the Edwards Plateau from the physiographic regions of the Blackland Prairie to the east and South Texas Plain to the south (Spearing 1991; Swanson 1995). Thus, the liminal zone of the eastern Edwards Plateau and adjacent prairies, periodically

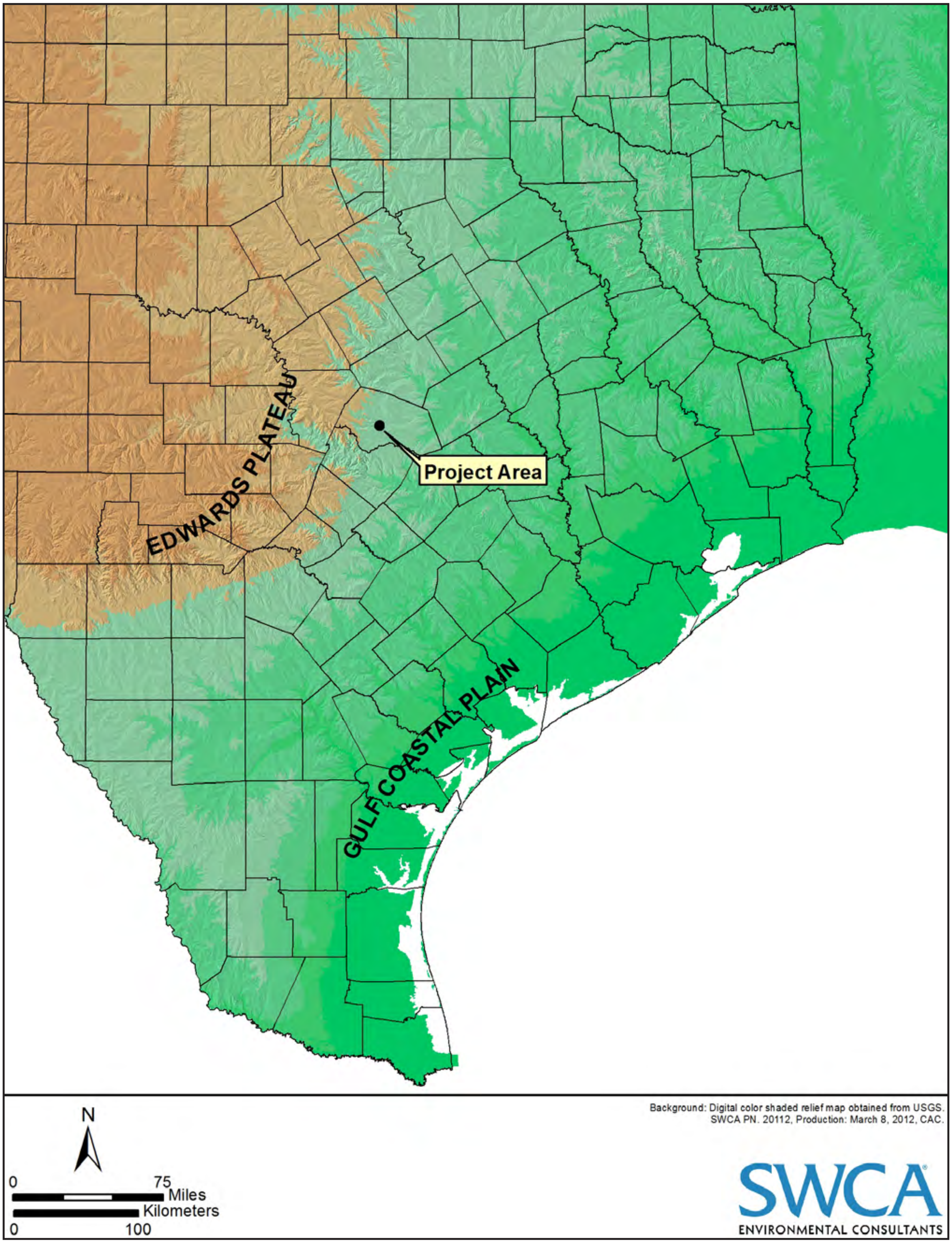

Figure 2.1. Elevation model showing macro-scale context of the Siren site.

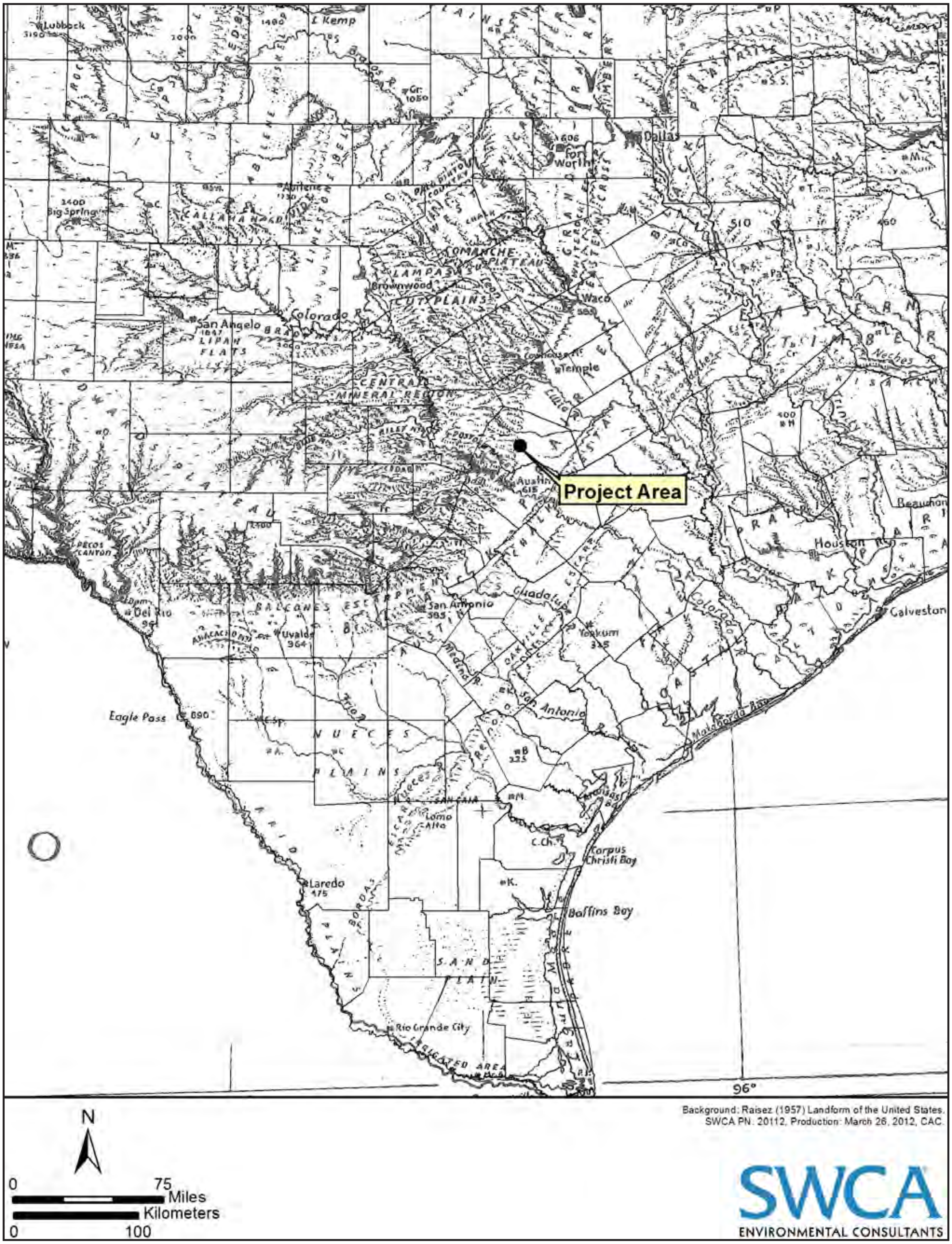

Figure 2.2. Physiographic map showing context of the Siren site.

intersected by waterways draining the plateau, offered a broad spectrum of resources for prehistoric and historic inhabitants.

Geology

The Edwards Plateau has a surface geology formed from shallow Cretaceous seas that covered the area from 144 to 66 million years ago. Thick layers of limestone formed as calcareous animals died and settled to the bottom of the sea floor, gradually building massive sedimentary rock formations (Spearing 1991:9–10, 17). The Cretaceous rocks comprise nearly level layers of sandstone, marl, and limestone.

In the vicinity of Georgetown, IH 35 passes along the base of the Balcones Escarpment running along a Lower Cretaceous limestone of the Edwards formation (Spearing 1991:60–61). The light-gray and thick-bedded Edwards formation, while present here, has been nearly completely eroded away farther west on top of the Edwards Plateau (Spearing 1991:127). Significantly, Edwards Limestone is well known as a chert-bearing formation (Banks 1990).

In the immediate project area, the surface geology along the South Fork of the San Gabriel River channel comprises Late Pleistocene low terrace deposits and Holocene alluvium (Proctor et al. 1974). These alluvial deposits are characterized as largely calcareous clays and silts, quartz sands, and chert, quartzite, and limestone gravels (Proctor et al. 1974). Lining the drainage and the site, Lower Cretaceous limestone and marl of the Fredericksburg group (Edwards Limestone, Comanche Peak Limestone, and Keys Valley Marl) are indicated (Figure 2.3). The Edwards Limestone is characterized as limestone, dolomite, and chert. The limestone and dolomite ranges in bed thickness while the chert occurs in nodules and plates in varying amounts. Below the Edwards Limestone, the Comanche Peak Limestone is described as a fairly hard fine-grained limestone that has been extensively burrowed and thins out along the eastern margins of the escarpment. Underlying the Comanche Peak Limestone is the Key Valley Marl that is characterized as soft with abundant marine megafossils and also feathers out along the eastern escarpment margins (Proctor et al. 1974).

As is common with many streams and rivers in the Edwards Plateau, large numbers of chert cobbles are present in the bedload of most drainages. This is certainly true within the South Fork of the San Gabriel River. Therefore, the prevalent chert cobbles near the Siren site assuredly originate from the eroded Edwards limestone, which surrounds the site and vicinity. As such, lithic raw materials were easily obtainable and readily exploitable for prehistoric inhabitants of the Siren site.

Immediately east of the Siren site, the Blackland Prairie region of the Gulf Coastal Plain begins (Kutac and Caran 1994). The Blackland Prairie is a long and narrow region encompassing 47,860 square km that parallels the Balcones Escarpment forming its western boundary (Kutac and Caran 1994; Oksanen 2008). This region is at its widest at the Red River and extends southward to San Antonio where it pinches out (Kutac and Caran 1994). It is characterized by its relatively flat topography, and its dark soils derived from the underlying soft limestones and marls of the down-fault Upper Cretaceous (Kutac and Caran 1994; Swanson 1995). The surface geology of this roughly 31-km wide region typically consists of four Upper Cretaceous and one Eocene geologic units (Oksanen 2008). These units from west to east include the Eagle Ford Group, Austin Chalk Formation and the Taylor, Navarro, and Midway Groups (Spearing 1991). The Upper Cretaceous groups are generally characterized as limestone and chalk and marl while the Eocene-aged Midway Group is described as containing clay, silt, and sand (Proctor et al. 1974).

Soils

Broadly defined, the soils of the South Fork of the San Gabriel River valley are classified as the Oakalla-Sunev unit, alluvial deposits of deep calcareous loamy soils (Figure 2.4). The surrounding uplands contain varying depths of calcareous and noncalcareous stony loam soils of the Eckrant-Georgetown unit (Werchan and Coker 1983).

More specifically, the southern terrace of the South Fork of the San Gabriel River at the Siren site is characterized as channeled Oakalla soils found on bottom land in narrow stream valleys (Werchan and Coker 1983). A typical pedon of the channeled Oakalla soil consists of a 18-cmthick surface layer of dark brown loam above a 40-cm thick horizon of dark brown clay loam overlying a 66-inch thick stratum of calcareous dark brown sandy clay loam (Werchan and Coker 1983). Upslope and along the northern bank of the South Fork of the San Gabriel River across from

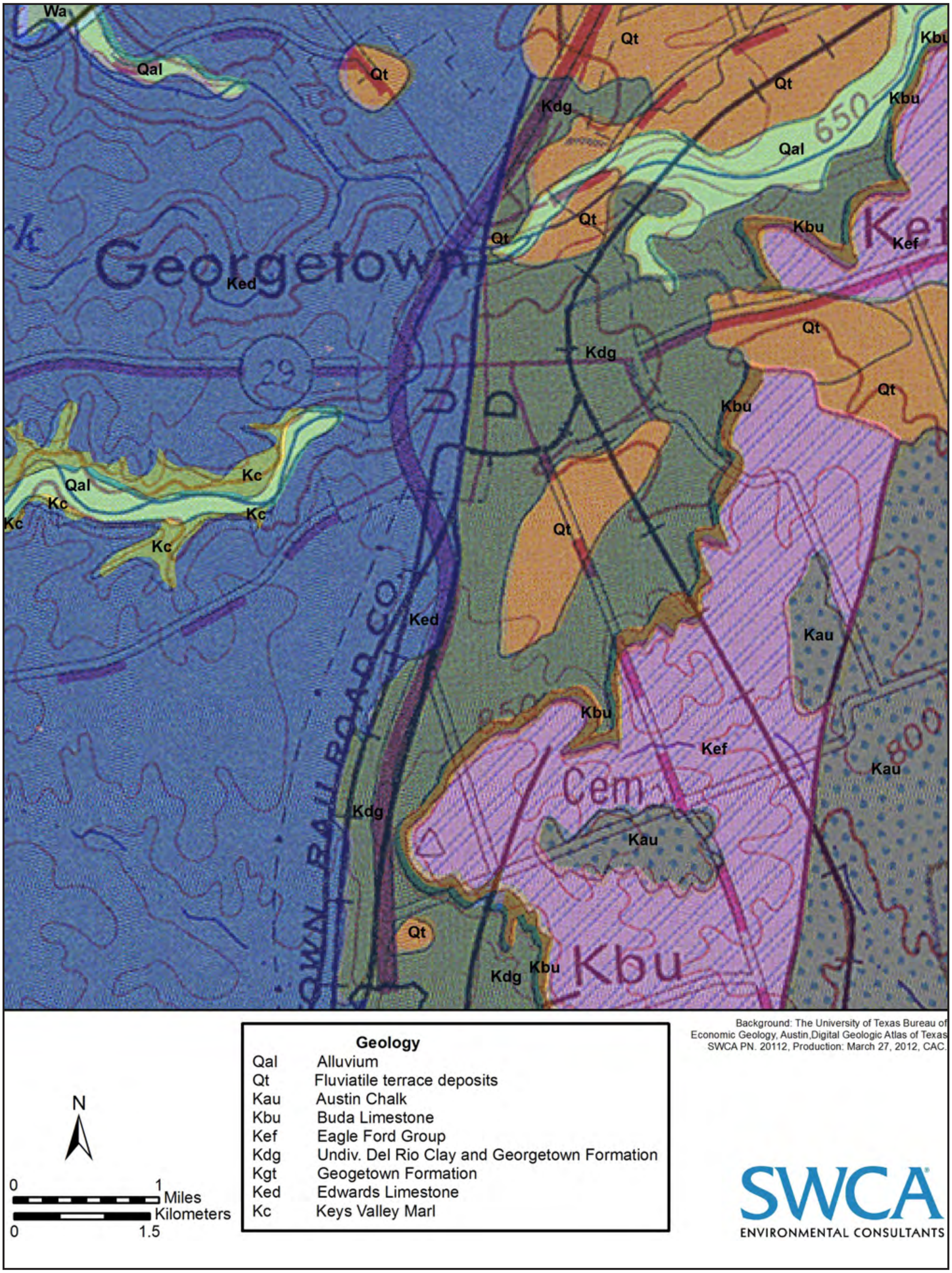

Figure 2.3. Site geological map.

Figure 2.4. Soils in the vicinity of the Siren site.

the Siren site, the soils are recorded as belonging to the Eckrant-Rock outcrop complex. A typical profile of these soils are described as an 20-cm thick surface horizon of dark grayish brown clay that is extremely stony and calcareous overlying fractured limestone bedrock. The Eckrant-Rock outcrop complex occupies slopes along drainages and hills with slopes that range from 5 to 16 percent (Werchan and Coker 1983).

On the uplands flanking the sinuous San Gabriel River channel clays and clay loams of the Georgetown and Crawford map units are also mapped. The overwhelming majority of the soils are Georgetown stony clay loam characterized as a brown clay loam surface horizon above a reddish brown clay overlying fractured limestone. The Crawford soils are directly upslope from the Siren site and are described as shallow surface horizon of brown and dark reddish brown clay above fractured limestone bedrock (Werchan and Coker 1983).

Hydrology

The Edwards Plateau provides the backdrop for a complex system of aquifers, springs, and rivers (Figure 2.5). The Balcones Escarpment faulted along a hinge line (the Paleozoic Ouachita structural belt) which, based on sedimentation, tectonics, and hydrology, distinguishes the Edwards Plateau from the Rolling Plains and the Gulf Coastal Basin (Foley and Woodruff 1986). This faulting is responsible for much of the region's hydrology.

The Edwards Aquifer is a large (67,200 square km) underwater reservoir in west-central Texas in which water percolates through Lower Cretaceous limestone directly overlying relatively impermeable pre-Cretaceous formations (Barker et al. 1994). This percolation results in excellent water sources, including springs, creeks, and rivers.

The Siren site is on the right (southern) bank of the South Fork of the San Gabriel River. The headwater of this waterway is southeast of Burnet, Texas, in Burnet County about 48 km upstream from the Siren site on the Edwards Plateau. The South Fork winds southeastward, draining the Plateau until its confluence with the North Fork forms the San Gabriel River roughly 3.2 km miles downstream from the Siren site. The San Gabriel River runs eastward draining the Blackland Prairie for about 55 km until intersecting the Little River in Milam County. From there, the Little River meanders north and east until its confluence with the Brazos River in eastern Milam County. From this confluence near Hearne, the Brazos River runs south-southeast draining the Post Oak Savannah and Coastal Plain for more than 255 km before emptying into the Gulf of Mexico near Freeport, Texas in Brazoria County.

At the Siren site, the South Fork of the San Gabriel River is a gradually meandering drainage with a low (approximately 1.15 sinuousity ratio) sinuousity (Charlton 2008). The perennial channel of the river is roughly 3 to 4 meters wide with less than a meter of water in its deepest pools in the site vicinity. It bedload deposits are a mix of sand, gravel, and limestone cobbles and few boulders that attest to very high energy flooding at times. The Siren site, on the southern bank, is positioned on an exterior bend of this waterway, while the northern side has a broad, gradually sloping, point bar.

Flora

Texas has been subdivided into natural regions based upon variations is topography, geology, soil, flora, fauna, and climate. Blair (1950) divided the state into seven biotic provinces that corresponded to animal habitat and vegetation regions, and generalized physiography. These provinces, from west to east are Chihuahuan, Navahonian, Kansan, Balconian, Tamaulipan, Texan, and Austropirian. The project area is at the intersection of the Balconian and Texan biotic provinces. Blair's division of seven provinces was later refined into the present system of 10 or 11 "ecoregions," or natural vegetation regions (Figure 2.6). The two principle physiographic regions within the project area, the Edwards Plateau and the Blackland Prairie, are also separate ecoregions as defined by Omernik (1987). Ecoregions are defined by water availability, soil types, topography, potential natural vegetation and current land use. Omernik's boundaries were subsequently further refined (Griffith et al. 2004). Within the ecoregions, additional, specific divisions can be made by dominant vegetation communities into physiognomic regions (Frye et al. 1984).

The natural regions are further divided into subregions (Diamond et al. 1987; Diggs et al. 1999; Lyndon B. Johnson School of Public Affairs 1978). The Balcones Canyonlands is one such subdivision within the Edwards Plateau, and the prairies to the east comprise a series of other subdivisions. Of significance, the project area is at the ecotonal boundary of

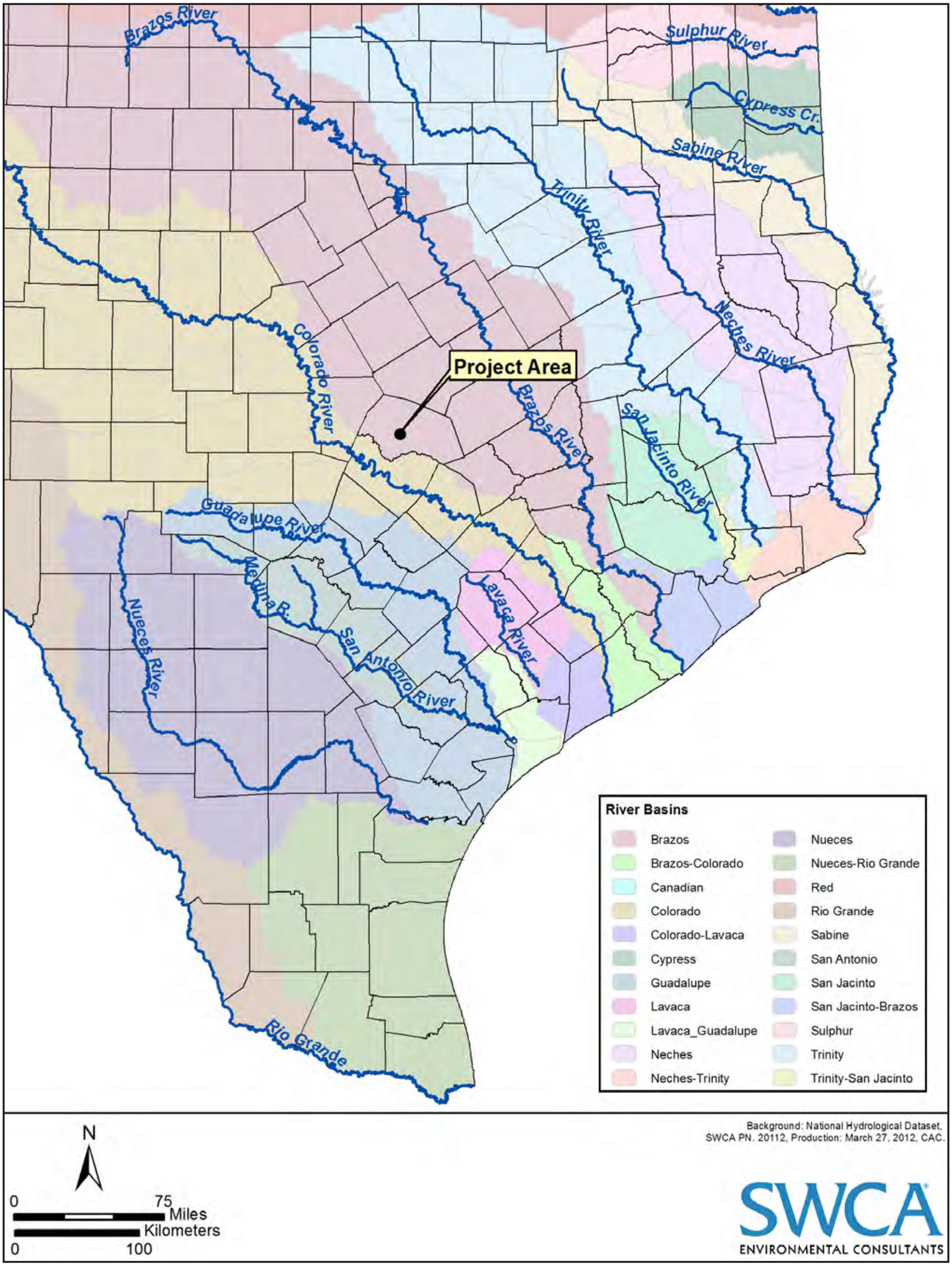

Figure 2.5. Regional hydrology.

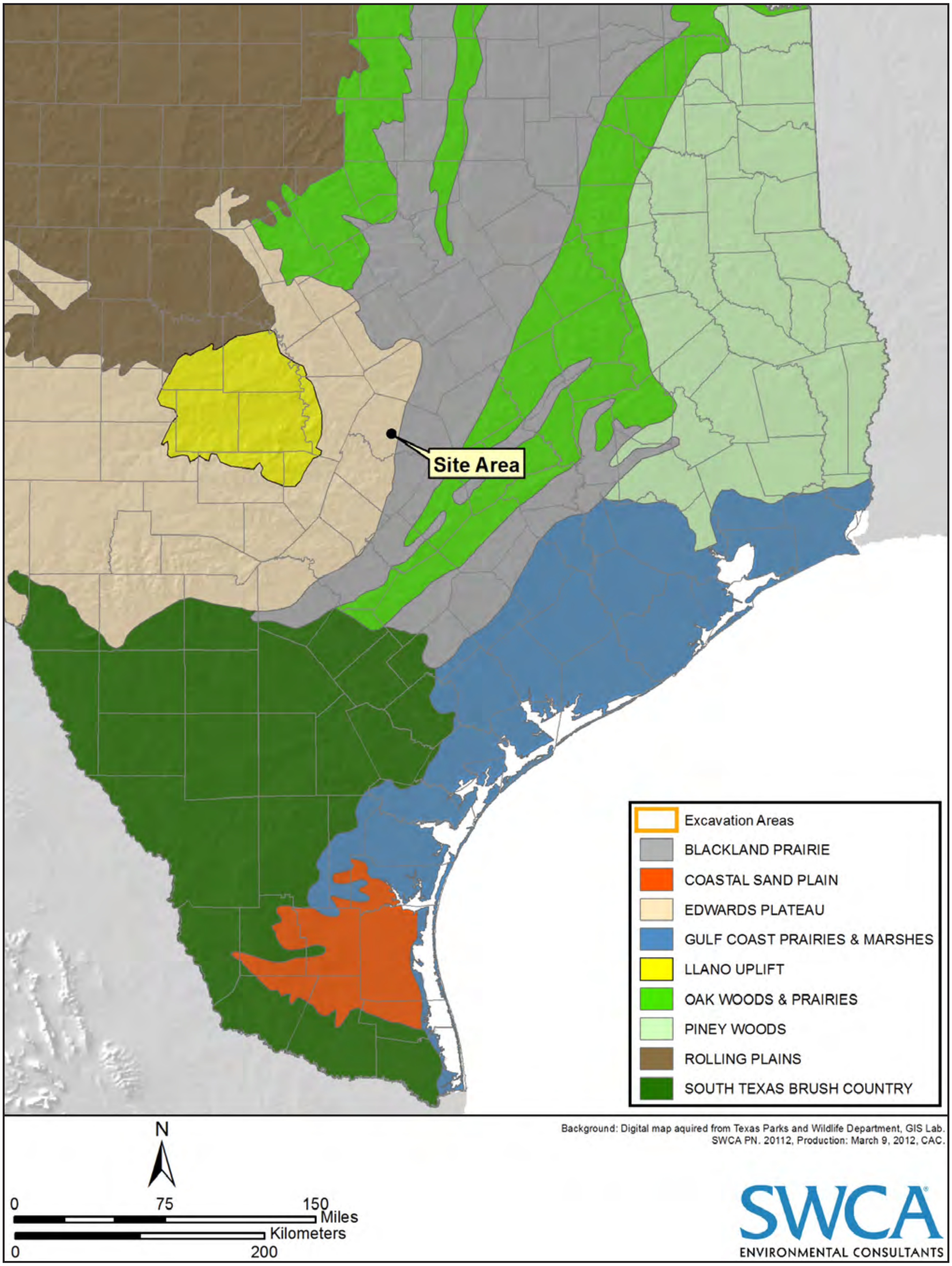

Figure 2.6. Ecoregions of eastern central Texas and surrounding areas.

distinctive vegetation regimes along the eastern edge of the Edwards Plateau and eastward to the Blackland Prairies. Although modern and historic impacts to the Edwards Plateau and to the Blackland Prairies have substantially altered the vegetation composition of both regions, remnant populations of these regions still exist, providing an insight into the prehistoric plant communities (Riskind and Diamond 1986; Diamond and Smeins 1985; Fowler and Dunlap 1986; Smeins and Diamond 1983).

The Blackland Prairie

The Blackland Prairie Region is tall grass prairie that is a southern extension of the True Prairie of the Midwest by virtue of rainfall totals and grassland dominant species, and it also contains all species of the Coastal Prairie. Two further subregions of prairie are indicated in the Natural Subregions of Texas: the Blackland Prairie and the Grand Prairie (Lyndon B. Johnson School of Public Affairs 1978). The Blackland Prairie subregion is a true tall grass prairie, while the Grand Prairie is a mid-height grass prairie that developed over shallower soils. The Grand Prairie is along the northern edge of the Edwards Plateau and west of the Blackland Prairie subregion (Lyndon B. Johnson School of Public Affairs 1978). Other authors do not discriminate between the divisions of the Blackland Prairie (e.g., Diamond and Smeins 1985) and all further references refer to the combined Blackland Prairie.

The Blackland Prairie regime is characterized as humid based upon soil moisture retention and rainfall. In upland settings, the Prairie resembles a lowland grassland (Collins et al. 1975). Prehistoric maintenance of the Blackland Prairie depended upon disturbances such as wildfire, small mammals, and insects, and herbivorous grazers, for serial stage advances by helping suppress shrub and tree growth, promoting species diversity, and maintaining equilibrium of the various species (Collins 1987; Gibson 1989; Kaiser 1998). Originally the Blackland Prairie was relatively open grasslands with clusters of shrubs and trees, and riparian tree and shrub vegetation along the banks of dissecting streams.

Less than one percent of the Blackland Prairie remains, and only as remnant patches isolated by modern croplands and development (Collins et al. 1975). No significant tracts remain in the vicinity of the project area. Currently there are seven habitat classes within the Blackland Prairie: grassland, forest, native and introduced grasses, parkland, parkland woodland mosaic, woodland, forest, grassland mosaic, and urban (Texas Parks and Wildlife Department 2005). The grasslands represent the early historic condition of the Blackland Prairie, which was already in serious decline by 1900 (Dyksterhuis 1946; Strong 1938). The results of overgrazing and farming destroyed much of the original prairie, allowing invasive species—such as honey mesquite (*Prosopis glandulosa*), sugar hackberry (*Celtis laevigata*), honey locust (*Gleditsia triancanthos*), Johnson grass (*Sorghum halepense*)—and the Post oak Savannah to encroach.

The grasslands are composed of seven grassland plant community types associated with locally varied soils, topography, and average rainfall (Collins et al. 1975; Texas Parks and Wildlife Department 2005). Collins et al. (1975) and Diamond and Smeins (1985) defined the three communities closest to the project area. From west to east these include: *Schizachyrium-Andropogon-Sorghastrum* (Little bluestem-Big bluestem-Indiangrass), the most xeric of the types and closest to the Balcones Escarpment on soils formed over Austin Chalk; *Schizachyrium-Sorghastrum-Andropogon* (Little bluestem-Indiangrass-Big bluestem), found on Houston Black-Heiden Ferris soils, and *Schizachyrium-Sorhastrum* (Little bluestem-Indiangrass), with the other species present, but with Little bluestem accounting for more than 80 percent of the basal cover. It is found on Wilson-Crockett-Burleson soils (Collins et al. 1975).

The riparian tree and shrub communities within the Blackland Prairie are Post Oak Woods, Forest, Grassland Mosaic, and Oak-Elm-Hackberry Parks/Woods (Riskind and Diamond 1986). The Post oak communities are found along the sandier soils and were originally mottes or groves of Post oak (*Quercus stellata)* and blackjack oak (*Quercus marilandica)*. Eastern red cedar (*Juniperus virginiana*), mesquite (*Prosopis glandulosa*), yaupon (*Ilex vomitoria*), poison oak (*Toxicodendron toxicarium*), hawthorn (*Crataegus* sp.), black hickory (*Carya texana*), and cedar elm (*Ulmus crassifolia*) are some of the other overstory species found along the periphery of the Post oak Savannah and Blackland Prairie (Frye et al. 1984; Texas Parks and Wildlife Department 2005).

The Oak-Elm-Hackberry Parks/Woods are along the larger stream drainages such as the San Marcos and Guadalupe Rivers and contain pecan (*Carya illinoinensis*); American sycamore (*Platanus *occidentalis*), sugar hackberry (*Celtis laevigata*); American elm (*Ulmus americana*); eastern cottonwood (*Populis deltoids*); and boxelder (*Acer negundo*), among other woody stemmed plants (Frye et al. 1984; Kutac and Caran 1994). Bald Cypress is frequent along rivers south of the Colorado, while Bastard oak occurs from the Colorado north to the Brazos (Riskind and Diamond 1986).

The Edwards Plateau

The Edwards Plateau Region has been divided into three natural vegetation subregions because of its varied physiography, these being Live Oak-Mesquite Savannah, Balcones Canyonlands, and Lampasas Cut Plain (Frye et al. 1984; Lyndon B. Johnson School of Public Affairs 1978). The Siren site is within the Balcones Canyonlands subregion, which has the highest rainfall, is deeply incised, and is generally the most mesic, with forest and woodland vegetation on slopes and bottomlands. Comparatively, the Lampasas Cut Plain is flatter and contains more grasslands while the Live-Oak Mesquite Savannah is in the central and western Plateau and is composed of more xeric open grasslands with trees in better-watered areas (Riskind and Diamond 1986).The Edwards Plateau is within the Balconian biotic province and represents a distinct physiographic unit that contains endemic species (Blair 1950; Van Auken et al. 1981). The plateau is a complex and diverse environment that has undergone numerous changes in its history. Evidence of changing environments includes remnant populations of temperate deciduous Maple-Linden-Oak forest and evergreen Texas pistache-Oak-Lacey oak, woodlands in mesic canyons, pygmy pines, tropical ferns in sinkholes and the rapid dominance of ashe juniper from the southern margins. The northern plateau is similar to the Great Plains Grasslands and the Rolling Plains and, the southern plateau contains Tamaulipan and Chihuahuan species, while the Balcones Escarpment contains prairie species and eastern Austroriparian deciduous trees. In the north central plateau, oak-hickory forests are similar to the Cross Timbers in the east (Riskind and Diamond 1986).

Along the boundaries of the provinces are ecotone regions of overlapping species' habitats and ranges. The Balcones Escarpment, also referred to as the Hill Country, is one region of intersection of both flora and faunal species. Riskind and Diamond (1986) note that although the vegetation of the Balcones Escarpment subregion has been extensively and quantitatively studied, little attention has been directed towards defining plant communities and associations. Evergreen woodlands and deciduous forests are the dominant vegetation, with grasslands along the upland divides and in the open woodlands.

An idealized vertical profile of the Balcones Canyonlands describes three major plant communities, streamsides, floodplains, and steep slopes. Streamside vegetation along the perennial streams south of the Colorado are dominated by bald cypress (*Taxodium disticum*), sycamore (*Platanus occidentalis*) and less frequently, black willow (*Salax nigra*). Shrub growth is buttonbush (*Cepalanthus occidentalis*). Bald cypress can form a monodominant stand. The streamside community is very narrow, and within 2 m of the channel banks (Riskind and Diamond 1986). In Slope Woodlands, north and east facing exposures have deeper soils and more moisture and contain more species than the south and western exposures on shallow soils. Riskind and Diamond (1986) recorded nine tree species in the north and east exposures: Texas oak (*Quercus texana*), scrub live oak (*Quercus fusiformis*), ashe juniper (*Juniperus ashei*), Texas black walnut (*Juglans major*), Texas ash (*Fraxinus texensis*), black cherry (*Prunus serotina*), cedar elm (*Ulmus crassifola*), Limestone Durand oak (*Quercus sinuate*), and Texas Madron (*Arbutus xalapensis*). Conversely, they recorded only three species along the south and western exposures, ashe juniper, scrub live oak, and Texas persimmon (*Diospyros texana*). Open mixed-oak woodlands occur on interfluvial divides over karstic substrate (Riskind and Diamond 1986). Overstory includes post oak, live oak, cedar elm and Texas oak.

The modern vegetative community in vicinity of the Siren site consists of overstory hardwoods that include scrub live oak (*Quercus fusiformis*), Durand oak (*Quercus sinuate* var. *breviloba*), cedar elm (*Ulmus crassifola*), and sycamore (*Platanus occidentalis*), while the understory contains a shrub growth of buttonbush (*Cepalanthus occidentalis*), and poison ivy (*Toxicodenron radicans*) (Stein et al. 2003; Wrede 2005).

Fauna

The use of natural ecoregions is also applied to the distribution of fauna, although reference is also made to the biotic provinces. The use of biotic provinces as proposed by Blair (1950) has been updated and further refined, but for studying mammals, Davis and Schmidly (1997) reduced the number of regions in Texas to four: the Trans-Pecos, Plains Country, East Texas, and the Rio Grande Plains. The Blackland Prairie is included in the East Texas region, and the Edwards Plateau is within the Plains Country. The Balcones Escarpment separates the Plains from the Rio Grande Plains and East Texas. Between the San Antonio and Guadalupe Rivers, the boundary between East Texas and Rio Grande Plains is where pedocal and pedalfer soils intersect (Davis and Schmidly 1997). There are 141 species of native terrestrial mammals, the largest of species by order are Rodentia (68 species), followed by Chiroptera (bats, 32 species), Carnivora (28 species), and Artiodactyla (14 species).

There are five distinct patterns to the distribution of mammals in Texas: 1) species that are or were endemic to the whole state; 2) species found within a particular region; 3) western species in the Trans-Pecos and Plains Country; 4) western species in the Trans-Pecos, Plains, and South Plains; and 5) eastern species east of the 100th meridian. Species do occur outside of their designated boundaries, which makes the Balcones Escarpment region potentially rich and diverse in mammal species.

Davis and Schmidly (1994) list 25 species that are or were found in most of the regions. Larger species include bison (*Bos bison*), black bear (*Ursus americanus)*, white-tailed deer (*Odocoileus virginianus*), mountain lion (*Felis concolor*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), common gray fox (*Urocyon cinereoargenteus*), American beaver (*Castor* canadensis), common raccoon (*Procyon lotor*), and Virginia opossum (*Didelphis virginiana*). Smaller mammals include ringtail (*Bassariscus astutus*), long-tailed weasel (*Mustela frenata)*, striped skunk (*Mephitis mephitis*), eastern cottontail (*Sylvilagus floridanus*), black-tailed jackrabbit (*Lepus californicus*), hispid cotton rat (*Sigmodon hispidus)*, five species of bats, and four species of mice. Rodents are the most numerous and account for the majority of regionally specific species.

The diverse vegetation and environment along the Balcones Escarpment, with close proximity to both upland Edwards Plateau and the Blackland Prairie, has resulted in several examples of species paripatricy (adjacent or bordering ranges), sympatry (same geographic range) and allopatry (distinct separate ranges) (Neck 1986). Although Neck lists 128 as the total terrestrial species for Texas, as based upon *The Mammals of Texas* (Davis 1974), the most recent publication of the *Mammals of Texas* (Davis and Schmidly 1997), lists 141 native species of mammals. Neck's (1986) analysis shows that approximately half of the mammal species occur along the Balcones Escarpment, and approximately half of these species (34) are bounded within the escarpment. Of these species, 53 percent occur only west of the escarpment, 35 percent are east of the escarpment, while 35 percent are found only along the line. Endemic species include a number of aquatic species that are found only within the spring fed streams along the escarpment such as freshwaters mussels *Quincuncina mitchelli* (False spike), *Lampsilis bracteata* (Texas fatmucket), *Quadrula petrina* (Texas pimpleback), and *Quadrula aurea* (Golden orb). These species are dependent upon flowing water and are not found in ponding areas or in temporary drainages.

An example of the biotic richness at the intersection of the Blackland Prairie and the Edwards Plateau is depicted by Kutac and Caran (1994). Although slightly south of the project area, their south Central Texas region reflects the diversity expected within the project area. Kutac (1994) lists 349 species of bird regularly associated with the region; Toomey and Caran (1994) list 82 species of mammals; and Hampton (1994) lists 41 amphibians and 94 reptiles. Caran and Hubbs (1994) note 130 species of fishes, including both historic and extinct taxa. Overall, the majority of mammals are small, from the orders of rodentia and chiroptera (bats). The overwhelming majority of the fish species are small as well with *Cypriniformes* (minnows and carps) as the most numerous family.

More specific to the Siren site area, common mammals include the oppossum (*Didelphis virginiana*), eastern fox squirrel (*Sciurus niger*), eastern cottontail rabbit (*Sylvilagus floridanus*)*,* pocket gopher (*Geomys breviceps*)*,* fulvous harvest mouse (*Reithrodontomys fulvescens*), white-footed mouse (*Peromyscus leucopus*), coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), and white-tailed deer (*Odocoileus virginianus*). Historically, red wolf, gray wolf, bison, jaguar, pronghorn, and black bear ranged into or near this area (Schmidly 2004).

Similarly, the general reptilian assemblage for the Siren site area include the Great Plains rat snake (*Elaphe guttata emoryi*), Eastern yellowbelly racer

(*Coluber constrictor flaviventris*), Yellow mud turtle (*Kinosternon flavescan flavescan*), bullfrog (*Rana catesbiana*), and the southern leopard frog (*Rana utricularia*) (Blair 1950; Kutac and Caran 1994).

Paleolandscape

Reconstructing past environments has increasingly become a primary concern in archaeology over the past several decades. Theoretical approaches such as cultural ecology provided substantial interpretive avenues regarding the relationship between humans and their environment. These developments, as well as other technical and methodological advances, fostered an emphasis on paleoenvironmental and subsistence reconstruction. However, research has not produced a consensus on the past environments, and variation across the landscape on the micro- and mesoscale is always possible due to niches and biotic "islands" (Ellis et al. 1995). Nevertheless, larger trends are discernible in the differing views. The general trends noted here are looked at in significantly finer detail in Chapter 11 of this report. The specific data discussed there do not entirely agree with some of the interpretations presented here.

Middle Holocene

Data for the Middle Holocene (7500–5000 B.P.) and the end of the Middle Archaic exhibit slight inconsistencies that may reflect fluctuations in the environment characterized as a comparatively long, dry climatic interval sometimes referred to as the Hypsithermal. Across the Edwards Plateau researchers have documented a decrease in precipitation rates and an increase in temperature during this time period (Bousman 1998; Collins 2004; Johnson and Goode 1994). Specifically, soil evidence from Hall's Cave suggests severe desiccation on the Edwards Plateau (Toomey et al. 1993). Similarly, pollen records—according to Bryant and Holloway (1985)—indicate dry conditions, although Bousman's (1994:80) interpretation of the pollen record is that "arboreal pollen continues to drop until 6800 B.P. After a slight rise in arboreal pollen around 6000 B.P., arboreal pollen declines until 5000 B.P." Prairie dogs are absent from the Hall's Cave deposits during this time, suggesting a loss of preferred soil habitats due to erosion (Toomey et al. 1993). Bison returned to the southern plains around 6000–5200 B.P. (Dillehay 1974), indicating extensive grasslands were present by then. Tree species that prefer humid environments (e.g., hazelnut, basswood, and birch) disappeared by the end of the Middle Holocene from Boriack Bog in Lee County (Bryant and Holloway 1985).

Bousman's (1998:211) reinterpretation of central Texas pollen evidence concluded that "by 7000 B.P. little arboreal cover remained on the eastern edge of central Texas and it is likely that open plant communities covered much of central Texas in the Middle Holocene." Overall, the palaeoclimatic conditions during the Middle Archaic were quite xeric, the early part of the mid-Holocene dry period. The precise timing and extent of the Hypsithermal interval is has yet to be conclusively determined.

Late Holocene

Environmental reconstruction efforts suggest the environment of the Late Holocene (5000–1000 B.P.) fluctuated greatly. Toomey et al. (1993:309) consider the period of 5000–2500 B.P. "drier than at any time during the last 20,000 years," a conclusion that is supported by a complete absence of mammals requiring mesic conditions in Late Holocene deposits from Hall's Cave, Schulze Cave in Edwards County (Dalquest et al. 1969), and Bering Sinkhole in Kerr County (Bement 1991). Pollen evidence generally supports this claim (Bousman 1994). However, contradictory geomorphic evidence suggests the Pedernales River was continually aggrading due to mesic conditions (Blum and Valastro 1989).

Bryant (1966) hypothesized a brief arid interlude around 2300–2500 B.P. that he described as the Juno Interval for the Lower Pecos. Within the larger trends towards an amelioration of warm dry conditions of the prior mid-Holocene, this period appears to have been a fluctuation back to earlier conditions.

The second half of the Late Holocene (2500–1000 B.P.) may have witnessed the return of more mesic conditions, but that is open to interpretation because some of the more prominent sites have yielded fairly minimal information for the last 2,000–3,000 years. For example, Boriack Bog in Lee County, roughly 64 km east of the Balcones Escarpment, and Gause Bog in Milam County, have yielded detailed Holocene pollen records, but the Late Holocene is not represented in these records (Bryant 1977). Likewise, farther to the south, Hershop Bog is lacking the final 2,000 years of the pollen record (Larson et al. 1972). Hall's Cave deposits in Kerr County are fairly vague for the Late

Archaic period (Johnson and Goode 1994; Toomey 1993; Toomey et al. 1993).

The best data on the latter half of the Late Holocene derive from Weakly Bog in Leon County, which provides a pollen record spanning the last 2,400 years (Holloway et al. 1987). According to the data, from 2,400–1,500 years ago, *Quercus* pollen counts were relatively high, suggesting the presence of oak woodlands and relatively mesic conditions. At 1,500 years ago, a sudden rapid decrease in *Quercus* pollen, coinciding with a rise in grass pollen is interpreted as indicative of the advent of the modern oak-savanna assemblage and comparatively drier conditions (Holloway et al. 1987). According to Bryant and Holloway (1985:63), other data from the region indicate the trends identified in Weakly Bog are regional in scope rather than local.

Bousman (1998:206), however, suggests otherwise in regards to the interpretation of the Weakly Bog data. Holloway et al. (1987) interpret the data as revealing a shift from forest to woodland (i.e., trending toward savanna conditions with increased grasses) coinciding with gradual warming and drying of the climate during the last 3,000 years. Bousman (1998), in part based on the lack of a measurable increase in grass and composite pollen that should mark the proposed vegetation shift, indicates the perceived rate of pollen influx is a factor of a "very local change in the depositional environment." According to Bousman's (1998:207) interpretation, the sequence at Weakly Bog indicates an oak woodland changing to oak-hickory woodland and the climate becoming "progressively moist through the Late Holocene, and this is exactly the reverse of the interpretation offered by Holloway et al. (1987)." To leave it on that note, a consensus on many issues has yet to be reached.

Chapter 3

Cultural Context

Stephen M. Carpenter and Ken Lawrence

The data recovery investigations at the Siren site identified stratified archaeological components dating from approximately 2,600 to 900 years ago, a timeframe that covers the final centuries of the long Archaic and subsequent Late Prehistoric stages of regional prehistory. As Collins (2004:122) notes of this period, "diverse and comparatively complex archaeological manifestations toward the end of the Late Archaic attest to the emergence of types of human conduct without precedent in Texas." Johnson and Goode (1994:40) characterize the termination of the Late Archaic as the most difficult and complex of all the period boundaries, noting that it may have ended either with the arrival of small dart points types like Darl or 800 years later with the Toyah phase. Since the site investigations revealed a rather uncommon stratified series of occupations in this timeframe, the site offers a potential to clarify the developments in this highly ambiguous period. The site assemblage contributes to an understanding of broader patterns and so the interpretive tack is to place it in an ever-widening context, in part using the substantial data from nearby areas to elicit broader patterns.

The cultural chronology as well as the long history of previous investigations in Central Texas has been thoroughly and authoritatively addressed many times in recent cultural resource reports. Rather than reiterate what has previously been said so well, this chapter is rather specifically focused on aspects of the cultural chronology that develop an interpretive context for the site and aspects that frame the primary research problems. The intent is to characterize the prevailing views and data, identifying particular sites and studies that will be cited later. The Siren site lies on the very edge of the eastern Edwards Plateau, and so the comparative database likewise focuses on prominent studies on this margin as well as a few outliers (Figure 3.1). The San Gabriel River valley, in particular, has likewise been the subject of much study. The principle concern, as addressed in later chapters of this report, is the technological and social trends of the time as well as the environmental resource structure that provided the economic bases of the lifeways. A fundamental theme of this report is the nature of the "transition" from Archaic to Late Prehistoric patterns. Accordingly, this chapter provides the basic parameters of the time.

Defining the Archaic

Since the analysis of the Siren site focuses on the developments at the end of the Archaic, the meaning of the term warrants definition. The "Archaic" has been used in any number of ways, whether referring to an evolutionary "stage", an adaptive strategy, a technological assemblage, or a chronological period. The history of the term provides some clarity on the traditional usage of the concept.

As first used well over a century ago, Archaic mainly referred to pre-Classic Mesoamerican cultures, but the so-called Ford-Willey synthesis (Ford and Willey 1941) largely established its modern usage. Ford and Willey (1941) formally defined Archaic to refer to pre-ceramic cultures in the eastern United States. This usage was later more explicitly defined with Willey and Phillips (1958) firmly fixing its prevailing usage when they defined five basic stages of North American prehistory: Lithic, Archaic, Formative, Classic, and post-Classic. Lithic describes primarily the highly mobile Paleoindian societies. By contrast, Archaic referred to "the stage of migratory hunting and gathering cultures continuing into environmental conditions approximating those of the present" (Willey and Phillips 1958:107).

This later usage dovetailed with the seminal divisions of Texas prehistory laid out in *An Introductory Handbook of Texas Archeology* (Suhm et al. 1954), which divided Texas prehistory into four stages: Paleo-American, Archaic, Neo-American and Historic. The usage by Suhm et al. (1954) of the Archaic generally parallels Willey and Phillips' later definition, though Suhm et al. (1954:18) define the stage as that which "bridges the time between the Paleo-American nomadic hunting people on the one hand, and the settled agricultural, pottery-making Indians on the other." So, the Archaic was as much defined by what it was not (neither a settled agricultural society nor a

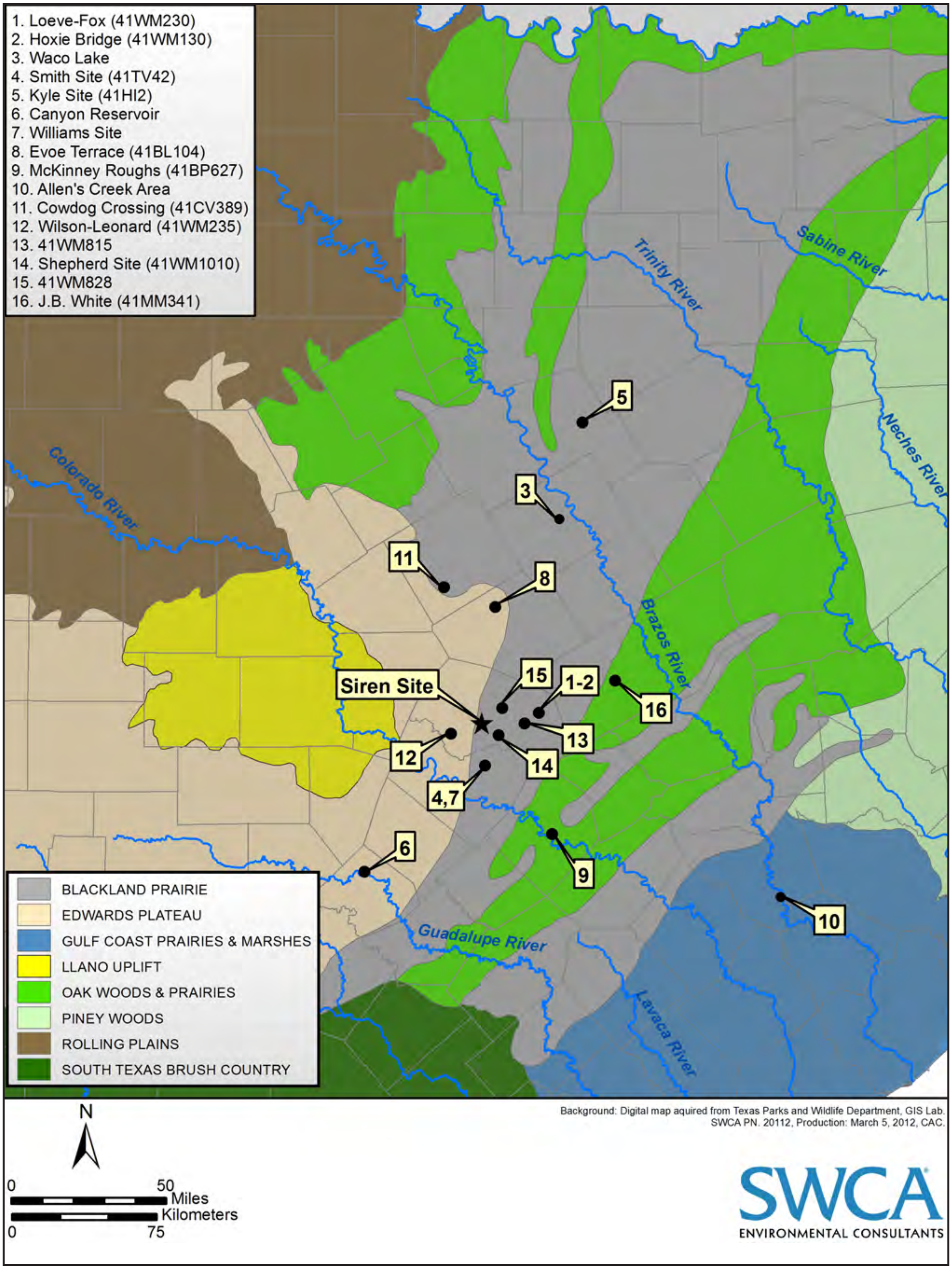

Figure 3.1. Locations of relevant previously studied sites in the vicinity of the Siren site.

highly mobile Paleoindian society), as by what it was (an intervening "bridge" of development from one stage to another).

In 1975, a group of prominent archaeologists held a symposium on the "Texas Archaic" at the annual Texas Archeological Society meeting in San Antonio. The published papers largely defined for each region of Texas precisely what was meant by the term "Archaic," but also highlighted many of the problems and misunderstandings of its usage (Hester 1976). Shafer (1976:6) defined it for the Lower Pecos as an "extractive technological continuum." Throughout the papers comprising the Texas Archaic symposium, this seems to have been the prevailing usage, though Prewitt (1976a) and Corbin (1976) addressed it more as an adaptive ecological strategy, though largely from the assemblage standpoint.

If a review of the 1995 *Bulletin of the Texas Archeological Society* (*BTAS*), which provides culture histories of regions throughout the state, is a true representation, most researchers 20 years later approached the Archaic as an ecological adaptive strategy, though Turpin (1995) and Perttula (1995) address the social development in the Lower Pecos and Caddo areas, respectively. Ecological views tend to interpret technological assemblages in terms of adaptation to changing environmental conditions. Environment, in the ecological sense, can equally refer to the human setting as well as the physical one, but quite often focuses more on the latter. Rapid advances in the understanding of the past environments over the last four decades have contributed to the approach. Analytical technical advances (such as in use wear, organic residues, etc.) coupled with a burgeoning body of data on palynology, climate change, bison presence and absence, changing prehistoric faunal and floral assemblages and other factors offered a wealth of information that illuminated the functions of various technologies such as burned rock middens, other features, and forms of lithic tools.

Accordingly, a main thrust of Texas archaeology became the search for correlations between the environmental conditions and archaeological record—cultural ecology provided a robust theoretical toolkit to develop a causal nexus between the corresponding datasets. Chronologies are now commonly juxtaposed with graphical representations of environmental trends. A review of *The Prehistory of Texas* (Perttula 2004), which is largely a republication of the 1995 *BTAS*, reveals continuity of the earlier (1995) trends. The point of all this is that the "Archaic" term, as employed in Texas archaeology, has primarily been used in technological and adaptive terms. The interpretations in this report use the prevailing approach as a foundation, but also push in broader directions, incorporating other aspects of society, such as political economy.

A Brief History of Archaeological Investigations

Since the early 1900s, archaeologists have documented more than 1,200 sites in Williamson County. About 1,000 of these have been recorded since 1970 as the county has grown into part of the Austin metropolitan area. Conversely, substantial investigations in the form of testing and data recovery projects have not been as common in the county. The majority (70 percent) of the 24 testing and three data recovery permitted projects on record since the 1970s have occurred during the last decade.

The early investigations in Williamson County, dating from the 1900s through the mid-1960s, were sporadic and poorly reported, but nevertheless provided the basis for the first cultural chronologies. The first formally recorded site, 41WM1, consisted of four burned rock middens visited by James E. Pearce in 1905 (41WM1 TARL site file). As documented in the 41WM1 site files, he and Roy Bedicheck excavated two of them 14 years later, in one of the earliest investigations in the county. Pearce drew the maps; Bedicheck took notes, but, like many early sites, that is as close as it came to being published. Federal and State antiquities laws passed in the 1960s led to many more formal investigations in the county as infrastructure, including dam building, was being developed. The Siren site is flanked by reservoirs: Lake Georgetown is about 8 km northwest, and Granger Lake is about 27 km downstream. Investigations of these locations began in 1963 and resulted in the initial recording of 109 prehistoric sites (Shafer and Corbin 1965).

Test excavation at the John Ischy and Barker sites (41WM49 and 41WM71) at the North Fork Reservoir (now Lake Georgetown) began in 1967 (Sorrow 1969, 1970). An additional 42 sites were recorded during this period, and five of these were subsequently tested, including 41WM197 in 1971 (Jackson 1974). Finally, in 1974 five additional sites were recorded, of which one, 41WM263, was also tested (Jackson 1974).

Investigations at Granger Reservoir (now Granger Lake) continued in 1968 when three sites were tested by the Texas Archeological Salvage Project, including 41WM133, the Loeve site (Eddy 1973). Test excavations at the 41WM230 (the Loeve-Fox site) were accomplished between 1972 and 1974 (Prewitt 1974). Additional work was undertaken between 1976 and 1977 along with the testing of six other sites, including 41WM130, the Hoxie Bridge site (Bond 1978). Finally, in 1978 the Texas Archeological Survey conducted data recovery at Loeve-Fox, Loeve, and 41WM165 (Prewitt 1981a).

Since the 1970s, a substantial amount of archaeological investigations have been conducted in Williamson County. TxDOT and LCRA have provided much of the financial support, although numerous, smaller utility projects by county and local governments and residential developments have contributed. Some of the more pertinent archaeological studies, namely previous excavations on sites with components and features comparable to those at 41WM1126, in Williamson County and surrounding areas are discussed below (see Figure 3.1).

Blockhouse Creek

Prior to residential development along Blockhouse Creek, archaeological investigations in 1996 included the excavation of portions of 37 burned rock middens at seven sites: 41WM616, 41WM617, 41WM619, 41WM620, 41WM623, 41WM632, and 41WM640 (Keetley et al. 1999). Milburn Homes, Inc. sponsored the work within the Blockhouse Creek National Register District. A total of 41 radiocarbon samples from these seven sites dated between 1730 to 150 B.P. (Keetley et al. 1999:66). Work at Blockhouse Creek revealed that central features are more common in small burned rock middens than previously thought (Keetley et al. 1999:224).

Although the features at each of these sites may be comparable to those at the Siren site, 41WM632 contained two slab-lined thermal features from which geophytes were recovered. Seven radiocarbon samples date these two features to between 1730 to 590 B.P. (Keetley et al. 1999:66).

Loeve-Fox (41WM230)

As previously mentioned, the Loeve-Fox site was excavated during the 1970s as part of U.S. Army Corps of Engineers-sponsored investigations for Granger Lake. Containing a series of discrete episodes of occupation from 3400 to 650 B.P., this site along the San Gabriel River is noteworthy because of its Austin phase cemetery component. The site is approximately 27 km downstream from the Siren site. Nine radiocarbon samples from the Twin Sisters phase suggest this period spanned 1750 to 1400 B.P. (Prewitt 1981a:29–30). Nine large, basin-shaped, and rock-lined hearths were identified at the Loeve-Fox site (Prewitt 1981a:34). The Twin Sisters phase represents the most intensive usage of the site, containing nearly half of the features and artifacts from the site (Prewitt 1981a:188–189).

41WM1010

This prehistoric site was excavated in 2002 about 10 miles southeast of the Siren site and along Brushy Creek in the Blackland Prairies region of the county, on behalf of TxDOT. Seventy-two cultural features with relatively good stratigraphic integrity and preservation were investigated (Dixon and Rogers 2006). Of these, 39 yielded radiocarbon samples dated approximately 2350 to 750 B.P. Analytical unit 1b (AU 1b) at 41WM1010 is comprised of 30 features that represent occupations during the Driftwood phase of the Late Archaic, roughly 1350–1050 B.P. (Dixon and Rogers 2006:47). AU 2 represents the Austin phase of the Late Prehistoric, beginning about 1150 B.P., and is comprised of six features (Dixon and Rogers 2006:50).

Although AU 1b contains numerous burned rock features, the most directly comparable one for the Siren site is Feature D56, which is an oval-shaped, stone-lined earth oven from which a geophyte sample was recovered. A radiocarbon sample from the feature's matrix yielded a calibrated 2-sigma date of 1230 to 990 B.P. (Dixon and Rogers 2006:99).

41WM828

Test excavations were conducted in 2001 at site 41WM828 on behalf of the City of Georgetown, prior to construction of the Pecan Branch Wastewater Treatment Plant (Karbula et al. 2004). The site is at the confluence of Pecan Branch and Berry Creek, about 5.5 miles northeast of the Siren site. From this confluence, Berry Creek flows into the San Gabriel River. Investigators identified 19 features in five analytic units, including AU 4, which is dated to the Late Archaic and is deeply buried with excellent organic preservation (Karbula et al. 2004:15). A radiocarbon sample from Feature 7 at the deepest elevation for AU 4 yielded an AMS assay of 1710+/-40 B.P. (Beta 160704). Comparative data for the Siren site is limited by the lack of slab-lined features or geophytes at 41WM828; however, similar diagnostic projectile points at the two sites suggest good temporal correlation.

41WM815

On behalf of TxDOT, this prehistoric site was excavated in 1999 about 14 miles east of the Siren site. Site 41WM815 is along Brushy Creek in the southeastern corner of the county. The primary component of the site was a stone-lined oven (Feature 9) dating to the Late Archaic period and containing eastern camas bulbs (Brownlow 2003:67). The site was the first one beyond the Balcones Escarpment found to have geophytes, and only the fourth overall to have bulbs in association with burned rock cooking features (Brownlow 2003:40).

Wilson-Leonard (41WM235)

The Wilson-Leonard site is included here because it is among the most noteworthy of all sites excavated in Williamson County. Specifically, it is selected because of its contribution to the study of geophytes in Texas. Excavated during the 1990s, a time when the analysis of flotation samples was emphasized, Feature 181 at the Wilson-Leonard site provided several complete, charred bulbs that facilitated future identification. The geophytes and associated earth oven at Wilson-Leonard date to 8000 B.P. (Collins 1998); although much earlier than the deposits at the Siren site, the information provides a broad context.

McKinney Roughs site (41BP627)

On behalf of Bastrop Resort Partners, this stratified, prehistoric site was excavated in 2002 and 2004 about 35 miles southeast of the Siren site. Site 41BP627 is along the Colorado River within the Post Oak Savannah of the Oak Woods and Prairies ecotone region of Bastrop County. Three discreet prehistoric living surfaces dating to the Late Archaic II phase were revealed, including Ensor I 2060 B.P., Ensor II 1830 B.P., and Darl 950 to 850 B.P. (Carpenter et al. 2006). A total of 15 features were investigated, including Features 12, 13, and 15, which all had carbonized geophyte samples. Thus, the McKinney Roughs site offers ample comparative data for the Late Archaic transition.

41MM340 and 41MM341

These two sites in Milam County are both in the floodplain of the Little River, a segment of the San Gabriel River, about 46 miles northeast of the Siren site. Together they represent the Late Archaic (41MM340) and the Late Prehistoric (41MM341) periods and offer potential comparisons to the Siren assemblage. Both sponsored by TxDOT, site 41MM340 was excavated by CAR in 2001 (Mahoney, Tomka et al. 2003), while 41MM341 was excavated 2002 by Prewitt and Associates (Gadus et al. 2006).

Cultural Chronology

Cultural chronology, primarily for the timeframe covering the final few millennia of prehistory, is a focus of the Siren site investigations. A more thorough discussion of the history of chronology building in Central Texas is provided in Chapter 9 of this report. The following chronology draws from a fairly substantive body of literature that, when considered cumulatively, yields a consensual view only in very general terms. The principal sources for this overview include Collins (2004), Johnson and Goode (1994), Prewitt (1981b; 1985); Story (1985), Ricklis and Collins (1994). There are significant differences of opinions on the timing and many other aspects of the cultural and environmental changes that take place. Of particular note, we agree with quite a few of Prewitt‘s observations and interpretations, but rather strongly disagree with his dates on the critical timeframe discussed in this report, preferring instead those offered by Johnson and Goode (1994). Nevertheless, in general the following is an overview of the economic, ecological, social, and technological development during the Late Archaic to Late Prehistoric times, the periods of significance for the Siren site. Some of the following is interpretive, and the analysis of the Siren site is designed to challenge or support these views.

Late Archaic I

The regional paleoenvironmental data for Central Texas indicate the long, dry altithermal prevailed from at least 6000 B.P., until finally dissipating around 2500 B.P. as the setting yielded to relatively wetter conditions (Ricklis and Collins 1994:320; Toomey et al. 1993). Bison were present during the end of this time, from roughly 4000 to 2500 B.P. or so (Dillehay 1974). Johnson and Goode (1994) define the Late Archaic I subperiod as extending from about 2300 to 600 B.P., which coincides with these environmental conditions at the end of the long mid-Holocene dry spell.

Authors have suggested that during the altithermal, the general foraging strategy of the area's occupants can be characterized as "approaching a logistical collector strategy" (Ricklis and Collins [1994:324]; for similar interpretations in adjacent regions see also Dering [1999a] and Turpin [2004] for the Lower Pecos, and Story [1985] for the broader western Gulf Coastal Plain). In a landscape with highly variable distributions of resources, principally between resource-poor uplands and rich riparian zones, populations concentrated in optimal locations on the landscape where game or plant resources could be extensively exploited. Larger groups occupied base camps for longer periods of time, creating high-visibility sites with large cumulative features such as burned rock middens. Johnson and Goode (1994:34) note that groups "came to thrive on upland semi-succulents" during this time, and burned rock middens are interpreted as a signature of such exploitation.

Such a strategy would have relied on smaller, task specific groups foraying out onto the land to procure needed resources, leaving behind relatively low visibility resource procurement and short-term camps in upland areas. Technologically, projectile point forms exhibited a gradual stylistic evolution, but the business end, the blade, remained fairly consistent. Bulverde, followed by Pedernales, Marshall, and Montell forms are distinctively broad-bladed and researchers have discerned an evolutionary relationship among the styles (see for example Carpenter and Paquin 2010; Johnson and Goode 1994).

The period includes the Marshall Ford, Round Rock, and San Marcos phases as defined by Weir (1976a, b) and Prewitt (1981b). Prewitt (1981b:79–80) notes that the diagnostic artifacts (notably Bulverde and Pedernales points) of the first two phases have a predominantly Central Texas distribution. However, in the following San Marcos phase, Marshall points begin to extend far beyond the Central Texas area. Concurrently, the presence of exotic materials such as whelk suggest "an extensive trade network" (Prewitt 1981b:80).

Juno Interval and the Advent of the Late Archaic II

Several sources of paleoenvironmental data show a distinct but relatively short-lived climatic interval, perhaps analogous to what Bryant (1966) defined as the Juno Interval for the Lower Pecos area. With the exception of the detailed Lower Pecos chronology (see for example the Flanders Subperiod as described in Turpin [2004]), few regional chronologies discern a distinct lifestyle shift during this period. Nevertheless, at the terminus of the Edwards Interval, a brief, but significant, xeric period is inferred around 2500 B.P. This period is perhaps the most elusive to characterize, in part because it was fairly short-lived and pushes the limits of chronological resolution.

The depositional record on Cowhouse Creek has a missing segment, perhaps a hiatus that dates from approximately 2720 to 2380 B.P. (Nordt 1992:21). Nordt (1992:65–66) implies, but is not directly explicit, that such a discontinuity indicates widespread erosion as a result of drier conditions and reduced ground cover. This indication is reinforced by stable carbon isotope data that indicates a shift to C4 grasslands at about this time (Nordt et al. 1994:117,119) and a decrease in arboreal canopy in Central Texas (Bousman 1998:212).

In this dry interval bison appear more commonly in the archaeological record, coinciding with the end of Montell points, but more distinctively with Castroville and Marcos point styles. In the Lower Pecos, where chronological resolution has been refined as much as anywhere in the state, a concurrent brief period is archaeologically evident by the prevalence of Shumla dart points, broad-bladed points that contrast sharply with the more narrow-bladed points of the following period (Turpin 2004:273). Accordingly, the suggestion is that this brief subperiod or phase was apparently short-lived, but widespread and archaeological highly visible.

Prewitt's (1985:81) Uvalde phase coincides with this era of bison, for which he notes "middens apparently did not accumulate during this period." However as Johnson and Goode (1994:35) note, the regional inhabitants continued "baking of semi-succulent xerophytic plants, and accumulated or added to burned rock middens during the same period that they sometimes barbecued buffalo." And so the period around 2500 B.P. seems to be a lessening of the more intensive processing strategy of earlier times, but earlier practices continued as most clearly evident in burned rock midden formation. While bison were surmised to have been around for some time, it was not until the terminus of the Edwards Interval and transition into the Mesic Interval (around 2500 to 2100 B.P.) that bison became such an economic mainstay (Story 1985:50), a distinction of this time that contrasts with the subsequent era. As previously noted, the causal relationship between bison presence and climate is indirect and has yet to be fully understood.

The distinction of this brief time period was a basic economy shift towards a more narrow diet breadth, focusing instead on high-ranking resources such as bison. Evidence of intensive processing, such as large cumulative burned rock middens and formal ground stone seem to have diminished from the preceding millenia, though was still evident. However, over the course of time from about 2500 to 2100 B.P., the climate looks to have gone through a distinct dry period, after which bison gradually disappeared.

Late Archaic II–The Mesic Interval

The dry interval appears to have gradually lessened after about 2300 B.P., and by most accounts the climate was wetter until roughly 1200 B.P. Bison disappeared and the distribution of xerophytic succulents, which are so often cited as the primary resources exploited by burned rock midden technology, receded to the south and west. The strongly heterogenous ecological patterns of the earlier drier times lessened to create a more equitable distribution of resources across the landscape. Between the riparian corridors and the higher upland areas was "a wide transitional zone composed of both arboreal and prairie elements, the well-watered eastern half of the Edwards Plateau ordinarily furnished plant and animal food resources for a moderately sized human population practicing Archaic hunting and gathering methods" (Johnson and Goode 1994:41). While bison decrease, geophytes appear more often in the archaeological record (Acuña 2006).

The later part of the Archaic period is marked by the appearance of a variety of small, side- and corner-notched dart point types including Fairland, Frio, Ensor, Ellis, and Edgewood (Turner et al. 2011). Darl points followed, and are often cited as the final Archaic dart point type. Johnson and Goode (1994:37) point to social interaction with the eastern United States as a possible source for these new point types. These projectiles may have been part of a package of new cultural items related to the spreading of Eastern religious ideas as far as the Edwards Plateau—these included the exotic items noted above such as marine shells and atlatl weights (Johnson and Goode 1994:37).

A critical break in the cultural chronology appears to have taken place around 1800 to 1600 B.P. Most chronologies do not recognize this change as very substantial. However, Prewitt's (1981b) work, though refined and critiqued over the years, is one of the few efforts to define an archaeological assemblage associated with Darl points, which he then called Mahomet points (see discussion of Darl studies at the end of this chapter). These points were defined as the "key index marker" of the Driftwood phase, and the characteristics of the phase, to a degree, is the closest picture yet defined of a Darl "culture". The artifact assemblage of the period includes, in addition to Darl points, Hare bifaces, small concave unifaces, gravers, fresh water mussel shell pendants, bone beads, and bone awls. Features consist of medium and small basin hearths. Burials, based on a limited database, are isolated flexed burials, a distinction between this and the later phases. Subsistence, Prewitt (1981b) hypothesized, "appears to be a definite emphasis on the gathering aspect in the basic hunting and gathering system." On a wide social scale, the general paucity of exotic materials during the phase indicate the lack of extra-regional trade networks (Prewitt 1981b:82), a marked change from previous and later phases. Settlement patterns shifted to an increased utilization of rockshelters, though terrace sites continued to predominate as the preferred site location.

The differences between Prewitt's Twin Sisters phase, marked by diagnostic artifacts such as Ensor, Frio, Fairland, and other points, and the later Driftwood phase, marked by Darl points, are important and need to be highlighted. Hall (1981) theorized a contracting economic sphere during portions of this period, and his observations are perhaps consistent with Prewitt's assertion that the widespread trade network observed in the earlier phase was not evident in the later phase. In terms of subsistence, Prewitt also sees a change from a relatively prominent focus on hunting to the gathering side of the hunter-gatherer economy in the subsequent phase based on both direct floral and faunal data but also technology.

An important cultural trait of the first centuries of Late Archaic II is the appearance of formal cemeteries off the

Edwards Plateau—on the plateau sinkholes continued to be used as repositories for the dead (Johnson and Goode 1994:37–38). Cemeteries, where many of the exotic items noted above have been found, suggest that groups were tied to specific territories but participated in widespread interaction networks (Johnson and Goode 1994:38). During this vaguely defined transitional period that Johnson and Goode describe, the eastern Central Texas archaeological area was on the periphery of several major cultural networks. To the east, the Woodland complexes developed during the first centuries A.D. The westernmost extension of the Adena-Hopewell sphere, as defined in the Marksville regional culture is represented in eastern Texas, most notably by the Jonas Short mound site (likely dating to shortly after 2000 B.P.) along the Angelina River (TBH 2010).

End of an Era and Advent of the Late Prehistoric

The research design for the Siren site defined the long shift from Archaic to Late Prehistoric patterns as a central theme. Regarding the timing of the end of the Archaic and beginning of the Late Prehistoric, the two periods are intentionally left intertwined in this discussion since the literature offers numerous possibilities. Though Johnson and Goode (1994) place the end of the era at 1400 B.P. or so, they acknowledge the vagaries of the transition from the Archaic to later lifestyles. They are open to the possibility that the Archaic lifestyle continued to about 800 B.P., when the climate shifted from a mesic to a more xeric setting, perhaps fostering the return of the bison that persisted throughout the remainder of prehistory (Johnson and Goode 1994:40–41).

Despite the uncertainties in the criteria for defining a clear break between the Archaic and Late Prehistoric, there is a general consensus that the Late Prehistoric period dates from 1250 to 260 B.P. (Collins 1995) and is characterized by small arrow points like Scallorn and Perdiz as well as a variety of specific use tools such as end scrapers, small perforators, and beveled knives. The Austin and Toyah intervals of the Late Prehistoric remain accepted divisions for the period. These style intervals may represent distinct cultural entities (Johnson 1994), although others challenge this view (Black and Creel 1997).

The Late Prehistoric was one of increased populations (though this is contended), inter-group conflict, increased territoriality, and the introduction of new artifact types and ideas into Central Texas (Johnson and Goode 1994; Prewitt 1981b). Cemeteries are more common in the early Late Prehistoric archaeological record, and many individuals buried in them show clear evidence of violent deaths (Johnson and Goode 1994:40). Prewitt (1982:Table 4) provides an exhaustive, if somewhat dated, list of cemeteries and burials in eastern Central Texas and notes many incidences of Scallorn arrow points either with a skeleton or clearly imbedded in the skeleton. The Loeve-Fox site (41WM230) contained an Austin phase cemetery where warfare was "suggested by the direct association of Scallorn arrow points with fatal positions in several skeletons" (Prewitt 1982:12).

Though the Austin phase has long been recognized as a distinct assemblage, components have typically lacked clear stratigraphic separation. Most of the defining sites for the phase, including Smith Rockshelter (41TV42), Williams (41TV75), Wilson-Leonard (41WM235), Mustang Branch (41HY209), Graham-Applegate (41LL419), Pat Parker (41TV88), and others contained mixed deposits. Consequently, this lack of clarity further contributes to vagueness on the nature and timing of the transition from Archaic to Late Prehistoric patterns.

To date, no Toyah assemblage has been recovered from the Siren site, but the assemblage's distinct attributes provide a pertinent context. The most identifiable element of Toyah culture is the Perdiz arrow point type, which first appears in the archaeological record around 700 B.P. Since it was first recognized, Toyah was characterized by both a lithic assemblage—consisting of Perdiz arrow points, beveled knives, scrapers, and various perforators based primarily on a flake/ blade technology (Johnson 1994:269)—and a ceramic assemblage marked by undecorated bone tempered bowls and jars (Johnson 1994:187–210; Ricklis 1995:196–197; Suhm et al. 1954). Bison hunting has long been identified as a central focus of Toyah lifeways. The phase marks the final commonly recognized prehistoric Central Texas archaeological culture, which succumbed to the numerous changes to the cultural landscape that emerged with the first historic developments.

Brief Review of Darl Studies

To circle back briefly to Johnson's comment regarding the difficulties in sorting out the end of the Archaic, one of the problems is the chronological and typological uncertainty regarding Prewitt's Driftwood phase and the diagnostic Darl points. This style and subperiod are not prominent at the Siren site, but, as will be argued, they are nevertheless significant to understanding the regional chronology. Accordingly, a brief review of Darl studies clarifies, perhaps, some of the issues in this regard.

Darl points have long been recognized as the final Archaic style, perhaps a transitional form between dart and arrow technology, and between Archaic and Late Prehistoric stages. However, though the point style is common in the archaeological record, the lack of isolated and well-dated Darl components has limited our understanding of the nature of the transition.

Though the style had yet to be defined, Pearce (1932) placed points resembling what would later be defined as Darl, in the upper kitchen midden level of Central Texas midden deposits. These points, he noted, were in the same stratum as arrow points (see Johnson et al. 1962:120 for this observation), therein first defining a chronological association for the point type.

In 1952, Miller and Jelks (1952:175–179) first designated the type as "Darl Stemmed" based on specimens collected from Belton Reservoir on the eastern side of Fort Hood. Soon thereafter, Suhm et al. (1954), in large part based on data from the Smith site in Williamson County, further defined the type, shortening the designation to simply Darl, based on a wider set of data. Based on this classification, Darl points were "believed to have appeared toward the end of the Edwards Plateau Aspect, Archaic Stage, and to have continued into Central Texas Aspect, Neo-American Stage", or an estimated date of about 2000 to 1000 B.P. (Suhm et al. 1954:414). Spatial distribution of the points was considered much broader than is now commonly accepted for the type (see Prewitt's [1995] distribution for example), extending from Central and North Central Texas and as far west as the Lower Pecos (Suhm et al. 1954:414).

In 1981, Prewitt (1981b:96–104) proposed the Darl type should be discarded—divided and obviated by three distinctive types, Mahomet, Zephyr, and Hoxie. As Hoxie points, which are Early Archaic, are temporally discontinuous, the type was not considered a subdivision of the Darl type, which, consequently, should be subdivided into the Zephyr and Mahomet types. In his 1981 cultural chronology of Central Texas, Prewitt (1981b) places the Mahomet variety in the temporal position (the Driftwood phase at the end of the Archaic) that is typically recognized as Darl points in the current scheme of things. Temporally, Prewitt (1981b) dated the phase to 1250 to 1400 B.P., though at sites such as McKinney Roughs in Bastrop County data suggests greater continuity of the phase to perhaps as late as 900 B.P. or so (Carpenter et al. 2006). As a refinement in the spatial distribution over previous works, Prewitt (1981b:82) suggested Mahomet points are primarily found in the eastern part of Central Texas, indicating west Central Texas cultures had greater affiliation with Lower Pecos cultures during that time. Prewitt, however, later reconsidered (see Prewitt 1995:84), and in his later classifications he (Prewitt 1995) reinstates the Darl name rather than the Mahomet designation, but still retains the Zephyr as a distinctive type.

Turner et al. (2011) define the Darl type with a Central Texas distribution consistent with that described by Suhm et al. (1954) and Suhm and Jelks (1962). These authors do not formally distinguish between the Zephyr and Darl, instead maintaining the Darl style that includes Mahomet and Zephyr. For a temporal affiliation, the authors describe the style as Transitional Archaic dating to circa 1800 B.P., a date that is within, but on the early end, of the previous temporal ranges. The date also precisely coincides with the Hoxie Bridge site radiocarbon date, though this date is not directly cited as the basis for the temporal affiliation of the style.

Chapter 4

Research Objectives and the Methods and Techniques to Attain Them

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The Siren site investigations entailed multiple phases, from survey (conducted by Paul Price and Associates [PPA 2005]), to testing, and finally to data recovery. At each phase, the fundamental objectives changed, and accordingly the means evolved to attain the changing ends. Techniques and methods were first adapted to define the limits and significance of site deposits, and then subsequently modified to gather solid, non-redundant data that would contribute to an understanding of the broad patterns of regional prehistory. This chapter presents a synopsis of the research objectives followed by a detailed review of the methods and techniques that SWCA used to investigate the site. While the research objectives are introduced here, each of the specific topics is fleshed out more fully in their respective chapters, namely Chapters 6, 9, 10, 11, and 12.

Research Objectives

As noted, the objectives change by phase, but the overall process is continuous and the stages dovetail into one another rather seamlessly. There are nevertheless important distinctions. Testing focuses on defining the boundaries of all aspects of data, the feasibility of certain analytical tacks, and sufficient characterization of data to see whether it would support the weight of significant interpretations. Data recovery, then, is the intensive gathering of those aspects of the site that have been shown to be worthwhile. Testing has an exploratory component, while data recovery is an objective-driven targeting of known quantities, for the most part. The specific Siren site research framework is presented for each of the two phases.

Testing Research Issues

SWCA's initial research design was based on information provided from the PPA (2005) survey regarding the nature of the archaeological deposits at the Siren site. With so little known about the site prior to testing, SWCA developed a broad research design with few expectations about the nature of the site or its components. The project's stated goals were to systematically identify, record, and assess the significance of archaeological materials discovered at the Siren site. Levels of artifactual and contextual integrity, chronology, potential data yield, and preservation potential were key criteria in this evaluation. The investigations focused specifically on two of these main issues: integrity and potential data yield. These focal issues are briefly discussed here in light of the findings of the testing investigations. Chronology and preservation are subsumed within these main issues.

Research Issue 1: Integrity of the Archaeological Deposits

A primary factor in determining the potential significance of the site was the integrity of its archaeological deposits. Among the goals of these investigations were acquisition of data on depositional context, defining any relationships between natural strata and subsurface cultural features/deposits, and determination whether the buried deposits retained sufficient integrity to allow the definition of components within a clear chronological framework, whether relative or absolute. Seven radiocarbon samples were run on charcoal associated with cultural contexts, providing the basis for an initial chronology of the site components. The radiocarbon results are internally and stratigraphically consistent, providing another means of evaluating integrity.

Testing Research Issue 2: Potential Data Yield

A second, but just as important, factor in determining the significance of the site was the potential for additional excavations to recover meaningful data that could be used to address specific research questions. Given the limited knowledge about the site, detailed research questions could not be formulated based on survey data. Therefore, the broad general questions at the outset of testing included site size, function, and chronology. Preservation potential for macrobotanical or faunal remains was also a criterion used to evaluate potential data yield.

Evaluation of Significance

Prior to testing, SWCA proposed that for the site to be found significant under Criterion D of the NRHP, the deposits must demonstrate sufficient integrity and yield data with the potential to address specific, detailed research questions that would contribute to the understanding of the regional prehistory. If a site has good integrity but contained a low density of artifacts, with no dateable materials, no discrete or intact features, and poor preservation of organics, it would be less likely to contribute new or important information. Similarly, if the site had abundant artifacts and materials but poor archaeological integrity, eligibility would be contraindicated. In either case, an assessment of eligibility hinges on a site's ability to address one or more explicit and important questions about prehistory.

Data Recovery Research Objectives and Framework

The data recovery at the Siren site took place within a compressed timeframe due to a variety of factors, primarily the construction schedule previously established by the Austin District of TxDOT. Typically, TxDOT requires a detailed research design be in place prior to data recovery excavations, but the project schedule precluded such a process. As such, SWCA prepared and submitted a preliminary research design for data recovery as an element of the interim report on testing, but this document was not well received by TxDOT. As there was not sufficient time to negotiate an acceptable research design, SWCA was instructed to proceed with the data recovery using the preliminary research design as a general guide, but with the understanding that a new research design would be required once the fieldwork had been completed. This chapter presents a condensed summary of the final research design and describes the methodology used during the fieldwork.

The final research design was developed in consultation with TxDOT, and some of the main topics reported herein are attributable to Jon Budd and others at TxDOT. The metric discrimination of projectile points and the assessment of competing cultural chronologies were suggested by TxDOT and adopted as central themes in the site analyses. While the differences between SWCA and TxDOT have covered the range from profound to trifling, there have been many agreements as well, and the overall direction is a collaborative effort.

Research Framework

While the purpose of archaeology may be the study of past cultures and lifeways, as is often the case in Cultural Resource Management (CRM), to achieve that purpose we investigate a place and how it changed through time, in large part due to the interaction of humans with their environment. This place does not contain prehistoric cultures. It does not contain people, nor does it contain actions, strategies, or agency. It contains artifacts and features—the cultural residue of human action and interaction—within a matrix of soil and sediment. The archaeologist must first tease out the relationships between these artifacts and features within space and time. Once that is accomplished, it is the role of theory to bridge the gap between archaeological "fact" and the people whose actions and behavior created those facts, allowing archaeologists to reconstruct, to a certain degree, the past lifeways of humans.

There was often heated debate among archaeologists in the 1960s–1980s about theoretical orientation and theory in general. Now however, it seems that the heady days of spirited arguments and rebuttals between the likes of Binford and Odell in *American Antiquity* about the nature of research questions are gone. "North American archaeology today involves relatively little discussion of general theory and relatively few attempts to build or contribute to such theory" (Hegmon 2003:233). Most North American archaeologists fall into the category that Hegmon (2003:217) calls processual-plus, practicing a broad array of approaches incorporating many elements of postprocessual archaeology into the processualism of previous decades. There is an interest in specific cases as they relate to larger contexts, and less of a concern with explicitly addressing general laws of cultural processes (Hegmon 2003:217, 233).

The goals of modern archaeology incorporate elements of all three major paradigms from the 1950s through 1980s (Shafer 1997; Sharer and Ashmore 1993:35). These goals include form, function, process, and meaning (Shafer 1997:18–19). The first goal has its roots in the cultural-historical approach. The study of function can also trace its origins to the cultural-historical approach, but has greatly benefited from systemic approaches to culture advocated by the processual archaeologists. Studying cultural process was a major contribution of the processual paradigm, while studying meaning, the most difficult to achieve, stems from the postprocessual school (Shafer 1997:19).

The Siren site research design could be characterized as proceeding generally from a processual-plus orientation. In our approach, rather than viewing adaptation as "somehow something that happened to cultures," it is thought of as how humans lived on the landscape, "conceptualized as a result of human problem solving, a land use or subsistence strategy" (Hegmon 2003:228). This is a melding of the post-processual concern with agency and the processual concern with adaptation. This is essentially what Whitley (1998:11) called a moderate post-processual approach. In such an approach, "there is a true and objective past, although we may not be able to recognize it", and the purpose of archaeology is "not necessarily to discover truth (an objective past), but to attempt to move increasingly closer to it" (Whitley 1998:11). This is done not through the critical tests of processual archaeology (i.e., emphasizing falsification as the preferred means of testing theories), but—as this research design prefers—through a procedure of "inference to the best hypothesis," using empirical evidence to select the best hypothesis from a group of competing hypotheses (e.g., Kelley and Hanen 1988). In the final analysis, however, there is always a dialectic between the inductive and deductive processes.

This approach is strongly reflected in the examination of technology (i.e., material cultural) at the site. Technology in the processual-plus approach has social significance, "both in the sense that some technologies are symbolically charged…and regarding the linkage of technological styles with social identity" (Hegmon 2003:224). This is not to say that technology cannot or should not be viewed systemically, but rather, that it should also be viewed in other ways. This is apparent in the approaches to investigating both lithic and hot rock cooking technology at the site as outlined in the research topics discussed later in this chapter.

To say, however, that the research would proceed purely along processual-plus or moderate post-processual means would be inaccurate. The nature of not only the archaeological record in Texas, but also the way in which that record has been studied in the past, demands that research begin with more traditional approaches, such as the culture historical approach. In fact, several characteristics of the archeological dataset recovered at the Siren site make the study of material culture patterns through time (culture history) at the site valuable within a regional framework rather than merely a site-focused perspective.

The realities of CRM archaeology offer additional challenges to theory and interpretation. In the case of the Siren site, our interpretations are slightly hindered by the fact that the site probably extends well beyond the right-of-way to the west and to a lesser extent, the east. Therefore, we are studying an unknown sample of the actual site and must recognize this fact prior to drawing conclusions about the range of cultural activities that may be represented there. This holds particularly true when evaluating the large, slab-lined burned rock features, or when defining activity areas in the context of the site as a whole. In such situations, comparisons with other sites in the region are necessary to examine larger patterns of land use, settlement, and subsistence strategies. The excavation methodology at the Siren site was designed to collect a valid sample of the portion of the site located within the right-of-way, which we have assumed to be representative of the types of materials and features that occur across the site as a whole.

Synopsis of Data Recovery Research Design

SWCA proposed to investigate five specific research topics during the analysis of the data recovery and testing materials from the Siren site. By addressing these topics, SWCA hoped to answer one pertinent and overarching regional research question: "Is the 'transition' from the end of the Archaic period to the beginning of the Late Prehistoric period in Central Texas a viable chronological interval, and, if so, what are its characteristics?" This question forms the thematic framework that guided all levels of analytical investigations.

A Brief Review of Cultural and Archaeological Context

Archaeological deposits at the Siren site include materials and features that encompass the time range that spans the end of the Archaic and the beginning of the Late Prehistoric periods, dating from about 2600 to 900 B.P. As Collins (1995:384–385) notes, diverse and comparatively complex archeological manifestations toward the end of the Late Archaic attest to the emergence of types of human conduct without precedent in Texas. Several researchers believe that increased interaction between groups at the end of the Late Archaic constituted an important catalyst for cultural change (Collins 1995; Johnson and Goode 1994). One of the distinctive aspects of the period is evidence of the influence of ideas and possibly religions from the more complex cultures of the Eastern United States (Johnson and Goode 1994). This change may have included increased regional stress and clashes between groups as contact became more recurrent.

As is discussed in Topic 1, below (and subsequently in greater detail in Chapter 9), there are some provocative issues and disagreements about the nature of the end of the Archaic and the beginning of the Late Prehistoric. Collins (2004:122) notes, "much remains to be learned about the hunter-gathers of central Texas in Late Archaic times." About the Late Prehistoric, Collins (2004:122) has noted that archaeologists have not been able to characterize the nature of material culture change, nor its importance, in Central Texas around 1200 B.P.

Generally, the Archaic is considered to have ended when the bow and arrow appeared in Central Texas, causing lifeway changes that altered the dynamics of human adaptive strategies. However, Johnson and Goode (1994) note that termination of the Late Archaic is the most difficult and complex of all the period boundaries. They suggest that the Archaic may have ended either 400 years later with the Toyah phase or even 400 years earlier, when small dart points types like Darl appeared (Johnson and Goode 1994:40).

Johnson et al. (1962) were the first to designate the end of the Archaic period the "Transitional Archaic" subperiod based on similarities between the latest dart point types and the earliest arrow point types. By the end of the Transitional Archaic, the bow and arrow technology were introduced across South and Central Texas. The Transitional Archaic as a chronological interval failed to gain wide acceptance and is not used by Collins (2004) or Johnson and Goode (1994) in their more recent chronological schemes.

The Late Prehistoric period dates from 1250–260 B.P. (Collins 1995). Characteristic artifacts of this period include pottery, small arrow points like Scallorn and Perdiz, and a variety of specific use tools such as end scrapers, small perforators, and beveled knives. The Austin and Toyah intervals of the Late Prehistoric remain accepted divisions for the period. These style intervals may represent distinct cultural entities (Johnson 1994), although others challenge this view (Black and Creel 1997).

An important characteristic of this time period is the climatic condition of the eastern margin of the Edwards Plateau. While discussed in greater detail in Chapter 11, a brief review of paleo-environmental conditions is presented here to establish context for the research issues. With one notable exception (41WM989), available environmental data indicates that the general return of mesic climatic conditions across the Edwards Plateau began to occur about 3,500 to 2,500 years ago except in areas to the west and southwest (Johnson and Goode 1994:36). The climatic history reconstructed from data recovered at 41WM989 suggests that a stable mesic environment had already returned to the area over 5,000 years ago (Karbula et al. 2007:269). However, 41WM989 is situated on a perennial spring. Overall, the change in climate was accompanied by a change in vegetation, resulting in the gradual disappearance of bison from the region at the end of what Johnson and Goode (1994) have identified as the Late Archaic I. The stability in general lifeways alluded to by Johnson and Goode (1994:40) and Collins (2004) correspond to this mesic environmental interval. These mesic conditions remained until the end of the Austin interval, and, with the return of more xeric conditions, bison returned to the region during the Toyah interval. Data from Hall's Cave in Kerr County indicate that the climate of central Texas began to dry around 1000 B.P. (Toomey 1993; Toomey et al. 1993). These data conflict with other data sources, such as pollen found in bogs (see Collins 1995:377). Although the precise causal relationships between climate and the migratory habits of bison are typically indirect and have yet to be precisely defined, changes in vegetation patterns during this time may have made Central and South Texas more conducive to bison migration into those areas. Bison remains become common at archeological sites in central Texas after 750 B.P. (Dillehay 1974; Huebner 1991).

SWCA's review of the archaeological work in the San Gabriel River basin revealed other "gaps" and research questions. The most well-studied and documented sites in this study area include the Wilson-Leonard site, located on Brushy Creek (a prominent tributary of the San Gabriel River), and the Loeve-Fox site. The

Wilson-Leonard site (Collins 1998) contains a well-stratified record of the Paleoindian through Early to Middle Archaic cultural periods, but the later stages are compressed and poorly preserved. Conversely, the Loeve-Fox site provides moderately well preserved data from the Late and Transitional Archaic, as well as the Late Prehistoric period. However, the chronology developed from the Loeve-Fox site is almost entirely contradicted by the Siren site data. For example, based on data from Loeve-Fox and other sites, Prewitt (1982:25) places the dates of Ensor and Fairland points within the Transitional Archaic dating from 1,800 to 1,200 years ago. Collins (1995, 2004) retains these general dates for the chronology of the Transitional Archaic. However, the suite of dates from the Siren site puts the range of Fairland and Ensor components as ranging from 2,600 to 2,000 years ago. The Siren site dates are consistent with other dates from Ensor materials that have been recovered from sites such as the McKinney Roughs site (41BP627) in Bastrop County (Carpenter et al. 2006).

SWCA's study of the Siren site was designed to investigate these and other issues regarding the nature of the transition from Archaic to Late Prehistoric lifeways. The extensive Siren site investigations revealed a diverse artifact assemblage. Cultural components exhibited high-integrity featuring abundant dateable materials, good preservation of faunal material, numerous discrete features, and abundant artifacts. The quality and robustness of these data provided a unique opportunity to explore the overarching research themes (i.e., what is the nature of the transition and how is it characterized) and to fill in the critical gaps in our understanding of this time period. For instance, as explored in later chapters, the artifact assemblages allow for a diachronic examination of technology and a study of how technological changes relate to changes in subsistence practices and adaptive strategies. The most obvious technological change is the shift from dart points to arrow points, which represents a much larger change in terms of subsistence strategies, hunting systems, and, perhaps, group interaction.

Data Recovery Research Topics

To focus the study to several salient, explicit topics that the Siren site data can directly address, SWCA developed five research topics with related questions for the study of the Siren site. These topics themselves are tied into broader research domains of subsistence, technology, paleoenvironment, and social organization. The specific topics are:

1. **Regional Chronology and the Siren site –** a comparative assessment of four regional chronologies to the Siren site to clarify regional chronology in eastern Central Texas.
2. **Site Formation Processes –** an analysis of the depositional context and preservation of components at the Siren site, as well as the consequences to understanding the regional archaeological record.
3. **Foraging Strategies –** a study of prehistoric foraging strategies from the diachronic perspective of the long sequence from Archaic to Late Prehistoric periods at the Siren site.
4. **Slab-lined Cooking Features –** an analysis of complex, well-constructed, slab-lined, burned rock features to explore implications for subsistence economy, use of the landscape, group size, and length of occupation at the Siren site.
5. **Metric Discrimination of Projectile Points –** application of metric discrimination techniques to the dimensions of the projectile points recovered at the Siren site to distinguish between dart and arrow points. The objective is to investigate the nature and timing of the technological transition.

The overall analytical approach by SWCA was comprehensive, covering a wide range of techniques and issues within these broad topics to fully explore all aspects of the site data and answer these specific research questions. This approach examined the site at various scales from the microscale (the artifacts and ecofacts themselves from the site), through the mesoscale (the intrasite relationships between these artifacts across the site and between its components), to the macroscale (the broader relationship of the site within the regional setting of the San Gabriel River valley and beyond). This approach was based on the results of the extensive bibliographic research performed by SWCA earlier in the Siren site study. In the following sections, investigative strategies explicit to answering the five research questions are outlined within each topic discussion.

Research Topic 1: Regional Chronology and the Siren *Site*

Radiocarbon, feature, and artifact data from the Siren site are compared to four existing cultural chronologies for Central Texas to refine the timing of the Late Archaic to Late Prehistoric transition in the San Gabriel River valley. The radiocarbon results from the Siren site indicate that the major period of site occupation began about 2600 B.P. and lasted to around 900 B.P. The interval of time represented by the bulk of the cultural material at the Siren site spans what is commonly known as the end of the Late Archaic and the beginning of the Late Prehistoric. There is, however, a great deal of inconsistency and disagreement between the multitude of published chronologies for Central Texas and adjacent areas regarding the terminology, timing, and nature of the chronological periods in this approximately 1,650 year span of time. The variations in chronological schemes reflect (1) disagreement about the nature of the archaeological record and (2) differing interpretations of natural and cultural contexts, as well as published radiocarbon ages.

The Archaic stage, as originally defined for the eastern United States by Willey and Phillips (1958:107), was "the stage of migratory hunting and gathering cultures continuing into environmental conditions approximating those of the present." Today, the Archaic is generally referred to as a "period", which, by definition, is a "length of time distinguished by particular items of material culture, such as house form, pottery, or subsistence" (Thomas and Kelly 2006:224). In older archaeological texts, the term horizon was often used to describe a major cultural transition (such as the appearance of pottery or agriculture) that would accompany the end of one period and the beginning of the next. Horizon, however, has fallen out of common use because of its association with "an outdated evolutionary paradigm" and because it is apparent that many transitions were more gradual than originally believed (Thomas and Kelly 2006:224).

In Texas, the Archaic period was typified by "mobile groups across the state all characterized by a generalized hunting-foraging economy" (Perttula 2004:8). The Archaic was followed by Ceramic and/or Woodland periods in the parts of Texas where Indian groups adopted pottery and became more sedentary than their hunter-gatherer neighbors and ancestors. In other parts of the state, including South and Central Texas, the Late Prehistoric period followed the Archaic, and the transition was signaled initially by the adoption of the bow and arrow and, subsequently, the adoption of ceramics (Perttula 2004:8).

Some researchers employ or have employed the label "Transitional Archaic" to refer to the end of the Archaic period, but that designation is just one of several competing terms. As this discussion demonstrates, the issue of what to call the end of the Archaic in Central Texas is part of a larger research problem—how to characterize the nature of cultural change and continuity at the end of Archaic and the beginning of the Late Prehistoric.

Research Topic 2: Site Formation Processes

Site formation processes typically entail both natural and cultural aspects, but this research topic generally focuses on the former, the natural depositional context. The topic addresses implications on how preservation of components at the Siren site shed light on the regional archeological record. How may the results at the site be used to predict the preservation of contemporary sites along the San Gabriel River?

The data recovery investigations determined that the stratigraphic setting of the site was more complex than envisioned during testing, with two different alluvial deposits abutting one another, and a thin veneer of the younger draping the older deposit. The preservation and stratigraphic separation of the prehistoric occupations in this setting is most likely a direct result of the nature and timing of alluvial sedimentation at the site. This topic examines site formation and preservation processes at the Siren site with the general goal of addressing the following questions:

1. What natural and cultural processes contributed to the preservation of archaeological record?
2. How does the local stratigraphic record compare to the regional depositional record, and what aspects of this record are climatically significant?

In particular, this topic can be divided into two main subsidiary research issues that as a group explore the formation processes and stratigraphic record of the site. These include sedimentation rates and the sedimentary and chemical evidence of discrete occupations.

Research Topic 3: Foraging Strategies

As a mainstay of cultural ecology, the study of foraging strategies has long been a focus in Central Texas archaeology. Foraging strategies pertain to the ways in which the site occupants organized themselves and their technology to interact with their physical setting. The archaeological materials at the Siren site indicate variation in ecological adaptations through time. The research question on the topic regards the comparison of Siren site patterns to prevailing models, particularly the transition from Archaic to Late Prehistoric lifeways in the eastern Edwards Plateau cultures.

The general approach to the analysis of these strategies at the Siren site was to look at the relationships among three data sets: 1) environmental data, 2) subsistence-related data, and 3) technological data. A large body of middle range theory, much of it deriving from ethnographic studies, was utilized to understand the dynamics among the datasets. The intent was to develop a site-specific model of adaptive change for comparison to the regional data.

Research Topic 4: Slab-lined Cooking Features

Research Topic 4 examines prehistoric cooking technology at the Siren site with the goal of inferring feature functions and changes in technology and resource exploitation over time to further our understanding of broader issues regarding settlement patterns, foraging strategies, and social organization in the transition to the Late Prehistoric. The suite of well-preserved features recovered from the Siren site presents a unique opportunity to diachronically compare and contrast burned rock technology between the Archaic and Late Prehistoric periods. This uniqueness is based in the diversity of the features, the excellent state of preservation of the features themselves, as well as, their contents, the suite of associated tools, and the nature of several large, more formal slab-lined cooking features that hint at specialized resource exploitation. The study of the contexts and functions of these features as they relate to investment of labor and resource availability yielded new information on economical and organizational aspects of landscape use, planning, and shifting resource bases over time.

Questions addressed in this topic focused on the technology and behavioral implications of burned rock technology on the Siren site with an emphasis on the large slab-lined features and the development of Feature 8, the Archaic ring midden found in the site. Technological issues include the significance of the construction techniques of many of the large hearths at the Siren site and their implications for types of food processed as well as labor investment. For example, what is the range of edible food remains with which the features are associated? On a broader scale, investigating questions of how these features at the Siren site compare morphologically with others ones from the region can yield clues to the chronology and functionality of these phenomena. For instance, how does the distribution of geophytes recovered in archeological contexts (similar to the Siren site's Feature 35) compare to the distribution pattern of the larger rock-lined features in the region?

Research Topic 5: Metric Discrimination of Projectile Points

One pervading issue in Texas archaeology is the timing of the advent of bow and arrow technology. Some have suggested that the smaller dart points commonly attributed to the final Archaic phases may have been arrow points rather than darts, indicating the arrow arrived much earlier than commonly construed (e.g., Johnson and Goode 1994). Using data from other parts of the United States, numerous studies designed to statistically discriminate between arrows and darts (Thomas 1978; Shott 1997) have been applied to Texas data (Patterson 1985) and other areas (Bettinger and Eerkens 1999; Bradbury 1997; Nassaney and Pyle 1999; Odell 1988, 1996). Some studies have been more successful than others. To address the overarching question of when bow and arrow technology arrived in eastern central Texas, these statistical methods are applied to the Siren site projectile point collection.

Two primary approaches to discriminating metrically between dart and arrow points are assessed, in part to determine the best approach for the current task. Following the background information is a discussion of the relevance of this research topic as an avenue of inquiry. The section concludes with a description of the investigative strategies and analytical units that was used to (1) apply metric discrimination techniques to the projectile points from the Siren site, and (2) examine whether or not the results of this technique correspond to differences in foraging strategies (as developed in Topic 3) and (3) whether or not the results support the current models of technological shift evident between the end of the Archaic and Late Prehistoric periods.

Methods and Techniques for Investigating the Siren site

The discussion of the field techniques and methods is presented in somewhat of a narrative form, in part to capture the development of technical approaches to address the findings. Each site is approached with a standard array of well-established archaeological techniques and methods, but as the particular conditions of any given site become apparent, there is an inevitable experimental process to determine what works and what does not in the preservation conditions and findings at hand.

Site Testing Narration and Summary of the Excavations

SWCA began test excavations on June 27, 2005, and initial activities included site clearing with a chainsaw and weed eater and establishing a primary datum for the site. The datum, which was set well south of the northern edge of the terrace (Figure 4.1), was a wooden stake pounded into the ground. An arbitrary elevation of 100 m was assigned to the top of the stake. Once the datum was established, the crew began cutting back the northern edge of the terrace to expose a clean profile. The prefield expectations were that only the upper 1 m of deposits needed to be examined, but it was immediately apparent that the cutbank had over 3 m of alluvium (Figure 4.2). Rather than profiling one long section to only 1 m below surface, the crew cleaned two shorter sections of the cutbank to approximately 2.5 m below surface. The examination of the cutbanks suggested that in addition to the possible feature originally noted by PPA (2005) at approximately 50 to 60 cmbs, a deeper cultural component was present approximately 1.5 m below surface.

While cutbank profiling was in progress, the project archaeologist established Test Unit (TU) 1, the first of three planned 1 × 1-m units to be excavated to 1 m below surface (Figure 4.3). TU 1 was placed near PPA's Shovel Tests (STs) 4, 5, and 6 (Figure 4.1). The matrix in TU 1's initial five excavation levels was originally interpreted to be colluvial slope wash from the steeply sloping valley margin to the south, but, after a piece of plastic was found in Level 5 (98.4 to 98.3 m), it became apparent that the upper five levels contained construction fill.

On the second day of excavations, two more test units were opened east of TU 1. These units, by the end of the day, had encountered only construction fill from the surface through Level 3 (98.1 to 98.0 m) in TU 3 and Level 5 (98.0 to 97.9 m) in TU 2. Excavators in TU 1, however, had penetrated the fill and encountered dense fire-cracked rock concentrations in Levels 6 and 7 (98.3 to 98.1 m). This was later designated Feature 1. During the fieldwork, Feature 1 was tentatively dated to the Austin phase of the Late Prehistoric period based on the presence of several Scallorn arrow points.

Also on June 28, 2005, representatives from TxDOT, including Jon Budd, Dr. James Abbott, and Dr. Scott Pletka, visited the site, and it was determined that the contingency of three additional cubic meters would be necessary to test the nature and integrity of the deposits identified deeper than 1 m. Subsequent to their visit, the excavation methodology was adapted to reflect the new goal of assessing the deeper cultural material.

On June 29, excavations continued in all three of the original test units. TU 3 was abandoned at 80 cmbs because massive limestone boulders in the construction fill covered the floor of the unit. TU 2, however, managed to go through the fill layer into apparently undisturbed deposits in Level 8 (97.7 to 97.6 m). TU 1, which contained Feature 1, was expanded by the addition of TU 4 on its eastern side. The upper 50 cm of matrix were removed without screening. A fifth test unit was opened on the edge of the northern terrace to target the deeper deposits.

Excavations proceeded on the planned 6 m^3 of deposits from June 30 through July 7. During this time, TU 2 was excavated through 13 levels then stepped to a 50 × 50-cm unit within the center of the 1 × 1-m unit at Level 14 through Level 17 (97.1 to 96.7 m). TUs 1 and 4 were excavated through Level 9. A 1 × 1-m unit was placed in the center of these two adjacent units and designated TU 1/4. Excavations in this new unit had proceeded through Level 12 by July 7.

Also by July 7, the emerging picture of the site was that an upper component dating to the Austin phase of the Late Prehistoric had been largely truncated by the construction that was thought to extend across the right-of-way. Older material, however, had been encountered in TUs 2, 1/4, and 5 at deeper depths. This component—or components—dated to the final part of the Archaic based on the presence of Frio, Ensor, and Fairland dart points (Turner et al. 2011). This earlier

Restricted
Contains Confidential Site Information

Figure 4.1. Testing phase project area map.

Figure 4.2. Exposing profile of natural cutbank along northern margin of site terrace.

component also contained bison bone and discrete features. The geomorphology of the site as presented by PPA (2005) seemed to be completely inaccurate because most of their shovel tests had never penetrated the construction fill layer at the site (which would have been quite a task by hand through the dense, rubble-laden fill).

On July 7, TxDOT representatives and Mark Denton from the THC visited the site. Discussions at the site revolved around the need to determine the horizontal and vertical extent of deposits at the site, and a plan was developed to excavate intersecting backhoe trenches to explore the north-south and east-west extent of the site. It is worth noting at this point that the general assumption was that the entire site was truncated and capped by a layer of fill that thickened from west to east. The densely wooded area east of the excavations was beyond the project area. The revised plan, therefore, called for trenching to extend from the edge of the wooded area to approximately 30 m west. The north-south trench was to extend from the northern terrace edge south to the base of the steep valley margin. Once the trenches had been examined and profiled, the backhoe was to return and excavate several areas as deep as possible to prospect for cultural material below the depth accessible through hand excavations. While the trenches would not be entered, a sample of dirt from the deeper trenches was to be screened. This plan required a supplemental agreement to the original work authorization that would allow for the excavation of three additional cubic meters, with a contingency for three more if warranted with prior approval from TxDOT.

The initial 6 m^3 of hand excavations were completed July 12, the same day that TxDOT's backhoe crossed the river to conduct the trenching. Trenching began with the north-south trench, Backhoe Trench (BHT) A (Figures 4.4 and 4.5). The trench began at the southern wall of TU 5 and was excavated south for approximately 9 m (see Figure 4.1). The eastern end of BHT B, the intersecting east-west trench, was then excavated from the tree line west to BHT A. The backhoe removed intrusive fill from two areas adjacent to the trenches to allow for the placement of hand units. The trenching was completed the following day. BHT A extended a total of 19 m south of TU 5; because of the sloping southern valley wall, the machine could not extend the trench as far south as originally planned. BHT B was excavated another 10 m to the west, for a total length of 19 m. This trench was not excavated as far west as planned because the project archaeologist suspected that a buried natural gas pipeline was in the area.

Both trenches were profiled, and hand excavations on the next three cubic meters began. These excavations targeted what were referred to at the time as the Transitional Archaic component(s). It was immediately observed that the fill covering the site was not uniform and did not thicken to the east as expected. In fact, the fill thinned to approximately 20-cm-thick at the eastern end of BHT B. This was an important discovery

Figure 4.3. Initiation of TU 1.

Figure 4.4. Excavation of north-south BHT A. BHT B runs east-west, intersecting BHT A. Facing south.

because it meant that the Late Prehistoric component could be preserved in areas where the fill was thin.

On July 15, Jon Budd, Dr. Abbott, and Waldo Troell from TxDOT visited the site. Discussions between them and Steve Carpenter and Brett A. Houk of SWCA produced the following determinations: (1) the so-called Transitional Archaic component was significant and additional testing of it would be unnecessary since sufficient evidence had already been gathered to make that determination; (2) the potential for deeply buried, older components had to be further addressed through the deep trenching; and (3) the extent, integrity, and significance of the shallower, Late Prehistoric deposits was not well understood.

On July 19, TxDOT authorized the excavation of the final three cubic meters. SWCA and TxDOT developed a plan to excavate fill probes on an informal 5–10-m grid east of the backhoe trenches to map the thickness of the fill across the site. The final hand excavations would target areas on the trenches and near the fill probes where the fill was thin and the upper component could be preserved. This work was to be done concurrently with the previously planned deep trenching.

SWCA conducted the deep trenching on July 21 and July 22. The southern end of BHT A and the western end of BHT B were deepened to 3.5 m below surface. The excavations progressed in 25-cm levels with a sample of the backdirt from each level screened. Low quantities of cultural materials were recovered in both trenches to 3.5 m below surface, and two stratified zones of burned rock were noted. BHT C, a 13-m east-west trench was also excavated parallel to the valley wall.

SWCA completed the excavations of the fill probes and final cubic meters on August 1, 2005. The trenches and hand units were all backfilled once the excavations were completed.

Data Recovery Investigations

Data recovery excavations and a geomorphological assessment were conducted from November 15, 2005 to February 3, 2006. In consultation with TxDOT and the THC, all parties concurred that the investigation would focus on those components shown to have the highest potential for yielding well-preserved data with high integrity. Due to safety concerns and other limitations, the deeper components were deemed beyond reach of formal hand excavations. As the project avoided deep impacts, these deposits are still preserved. Accordingly, based on the testing findings and nature of the project impacts, a reasonable level of effort was mapped out to address the upper deposits.

Figure 4.5. Overview of site after excavation of BHTs A and B, facing northeast.

Targeted Cultural Components

The work plan was designed to recover sufficient quantities of features, artifacts, and samples from the components to address the proposed research issues. The basic excavation strategy employed block excavations; this approach creates a large aerial exposure of the various occupation zones allowing for the recovery of meaningful spatial data related to site structure and patterning. At that time, the project area was considered to extend from the existing IH 35 structure to the western edge of the right-of-way and be 2-m-deep.

Prior to the data recovery fieldwork, SWCA estimated that the "Transitional" Archaic component (now designated Components 2 and 3 as defined in Chapter 8) horizontally covered approximately 880 m^2 of the area west of IH 35 within the right-of-way. The extent of the Late Prehistoric component was more difficult to calculate because it had been impacted in various places by grading. SWCA estimated that the Late Prehistoric component was preserved over approximately half of the site, or about 440 m^2. The greatest likelihood of encountering Late Prehistoric component deposits was believed to be in the vicinity of TU 1 (along the northern limits of BHT A) and along the eastern extent of BHT B, and near TUs 11 and 12.

The thickness of the two components varied, but reasonable averages were estimated to be 50 cm for the Late Prehistoric component (where it was believed to be preserved) and 60 cm for the Transitional Archaic component. Therefore, SWCA estimated that approximately 220 m^3 of Late Prehistoric component were present at the site and 528 m^3 of Transitional Archaic component were present. The extent and thickness of the Late Archaic component was not assessed, but based on the testing results it was estimated that deposits related to this period would be within the investigated area, which extends to 2 m below surface.

SWCA recommended excavating, ideally, 100 m^3 of deposits at the site, excluding modern fill. The total excavation volume was to be divided among the three components as follows: 30 m^3 of Late Prehistoric deposits, 40 m^3 of Transitional Archaic deposits, and 30 m^3 of Castroville (i.e., Late Archaic) deposits, for a total of 100 m^3 regardless of the exact breakdown between components. Minimum targets were established for each component. It was proposed that if the excavations became unproductive once the minimum volume was reached for a component, some of the remaining excavation volume would be shifted to another component. In this way, excavations were designed to target the most productive components at the site while recovering data from a prescribed minimum in each component.

The actual level of effort differed from the proposed plan because data recovery excavations proceeded more slowly than anticipated. The reduced pace was due to several factors, most notably, a burned rock midden that entailed highly meticulous excavation. TxDOT authorized the contingency for additional excavations to allow for more time to investigate the site. In all, over 80 m^3 were excavated.

Mechanical Trenching and Stripping

A backhoe was used to reopen BHTs A and B from testing and extend BHT B approximately 10 m to the east. This allowed for a preliminary determination of the thickness of the modern fill, at least adjacent to the trenches. Two additional trenches (BHTs D and F) were excavated to facilitate the geomorphological study of the site. BHT D was excavated at the base of the sloping valley wall that marks the southern boundary of the Siren site, and BHT F was placed on the face of the scarp, extending to the T_0 terrace (Figure 4.6). Finally, BHT E was excavated within the major burned rock Feature 8 to assess its structure.

Mechanical stripping of the overburden followed the reopening of BHTs A and B (Figure 4.7). The backhoe removed the construction fill (Stratum 1) from four quadrants, created by the intersecting backhoe trenches. A greater amount of fill was removed from the northwestern and northeastern quadrants. Due to the extremely irregular nature of the fill, the northeastern quadrant was ultimately subdivided into two excavations areas: a northeastern block and an eastern block. The fill in the eastern block, which was adjacent to the eastern extension of BHT B, was only 10- to 20-cm-thick, but in the northeastern block the fill varied from 50 cm to over 100-cm-thick. In the other quadrants the fill averaged about 50-cm-thick. In the southwestern quadrant the fill was extremely irregular and included massive limestone boulders. Ultimately, this quadrant was excluded from the data recovery excavations.

Restricted
Contains Confidential Site Information

Figure 4.6. Data recovery phase project area map showing location of proposed bridge in relation to excavations.

Figure 4.7. Mechanical stripping of overburden, facing southwest.

A brief walking tour of the site and its local environment was performed early in the data recovery phase in order to form an opinion of the macro-stratigraphic setting. This was done because the results of the five unit stratigraphic framework identified during the testing excavations and inferences made from this depositional sequence were couched in terms of relevance to regional geomorphic and stratigraphic events, and the veracity of these inferences could only be assessed if the stratigraphic position of the site is known.

The results of this brief reconnaissance suggested that the site was part of the middle to late Holocene alluvial fill, which was consistent with the age of the cultural deposits but at odds with the general age of the lower deposits as determined from the testing excavations. Subsequent geomorphic work set out to examine and date the base of the terrace by coring, additional backhoe trenching, and examination of the cutbank along the northern edge of the site.

Excavation Grid and TDS Mapping

Once the site was stripped, a TDS was used to establish a horizontal grid across the site. Each 1-m increment grid point was established with a nail and labeled using flagging tape. The TDS was used to maintain provenience control, plot artifacts, and map features and activity areas. For the majority of the project, the TDS was used to record the location of each fire-cracked rock, tool, bone, and sample left in situ. However, this methodology was modified near the end of the project to save time and allow for the excavation of more volume.

During excavations, 2 × 2-m units were designated using the previously established grid. The southwestern corner of each 2 × 2-m unit served as the unit's designation. These larger units were excavated in 1 × 1-m quadrants.

Geoarchaeological Investigations

The methods and techniques used in the geoarchaeological work are discussed on more detail in Chapter 6 of this report, but are briefly addressed here in the context of the overall site methodology. The investigations included a reconnaissance of the site's setting, coring, field observations of excavations and natural exposures, and sample collecting, all conducted by project geomorphologist, Charles Frederick.

In addition to the macro-stratigraphic investigations, two types of samples were collected to permit examination of the formation processes and structure of the site cultural deposits: column samples and feature samples. Column samples consisted of two sample columns collected through the site deposits, one at the north end of BHT E, and another in the Eastern Block. These sample columns of bulk sediment were collected in 5-cm increments and were to be used for physical and chemical analyses that may contribute to understanding the structure of the site deposits. Features samples were collected from the big pit feature (Feature 35) and the burned rock midden (Feature 8 in BHT E), and these consist of matched pairs of bulk sediment and micromorphology samples. A total of nine samples of each type was collected from the two features.

Three cores were attempted at the site on two cold January mornings. The first one was placed at the rear of the terrace at the toe of the colluvial slope, east of the end of BHT C. This core was terminated at 82 cm on top of a massive limestone boulder, and the profile exposed only the A horizon. A second core was attempted near the cutbank just northeast of the Eastern Block, but, as a result of operator inexperience and complications later determined to be associated with the cold weather, the corer became lodged in the hole and had to be extracted by shovel. The next day, a 4.2-m core was recovered from the southeastern corner of the Eastern Block, near the middle of the terrace. From these experiences, it became clear that examination of the deposits would best be achieved with a backhoe.

Figure 4.8. Hand excavation on the northeastern excavation block, facing southwest.

Hand Excavations

The hand excavations comprised excavation blocks to expose broad horizontal exposures (Figure 4.8). Hand excavations, whether in 2 × 2-m units, 1 × 1-m units, or 1 × 1-m quadrants of larger units, were conducted in arbitrary 10-cm levels. The excavations were divided into four blocks designated Northwestern (NW), Northeastern (NE), Southwestern (SW), and Eastern (E). Matrix resulting from the excavations was screened through 1/4-inch mesh, except in the case of features, which were excavated as described below. Artifacts recovered from the excavations were collected by unit, quadrant, and level. Excavations occurred across the each block level by level. While each level was being excavated in any given 2 × 2-m unit, all structural elements (artifacts and ecofacts larger than 5 cm in maximum dimension) were left in situ. Once each level in a 2 × 2-m unit was complete, the artifacts and materials remaining in situ were plotted with the TDS, photographed, and collected.

The hand excavations included areas that were excavated and screened as part of the data recovery and areas that were manually stripped of over burden. Including the testing and data recovery work, approximately 91.6 m^3 were excavated by hand. The distribution of excavation volume by block is shown in Table 4.1.

Northwestern Block

Based on the testing results, the NW Block was the initial focus of the data recovery excavations. Sixteen 2 × 2-m excavation units were opened in the NW Block along the N1020, N1022, N1024, N1026 and N1028 lines at E1000, E1002, E1004, E1006, and E1008. All four quadrants in 10 units were excavated in 5–9 levels, with six units terminating at 97.8 m and the others at 97.6, 97.7, and 97.8 m. Twenty-one features were recorded in the NW Block: Features 1, 8, 12, 13, 14, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 30, 31, 35, and 42.

Northeastern Block

Extensive mechanical stripping of construction fill was necessary in the NE block as it thickened to the east across the site. Once the fill was removed, it was apparent that the majority of upper Late Prehistoric deposits were missing in this area. The construction of the extant bridge and placement of fill had apparently truncated the upper 20- to 50-cm of the site in this area. However, the intent of this block was to create a larger horizontal exposure of the Transitional Archaic deposits, and in this regard the block was successful, as a dense concentration of materials dating to this period was recovered.

Table 4.1. Distribution of Hand-Excavated Volume by Block during Data Recovery

Excavation Block	Volume (m^3)
Hand Stripped (total)	10.3
Southwestern	3.7
Northwestern	37.4
Northeastern	23.3
Eastern	16.8
Total	**91.6**

Six 2 × 2-m excavation units were opened in the NE Block along the N1024 and N1026 lines at E1010, E1012, and E1014. All four quadrants in each unit were excavated in nine to 13 levels, with all units terminating at 97.0 m. Seven features were recorded in the NE Block: Features 28, 29, 33, 34, 36, 37, and 41.

Southwestern Block

The SW Block was initially opened to follow Feature 8, the incipient burned rock midden, to the south and explore its dimensions and composition. Two 2 × 2-m excavation units were opened in the SW Block along the E1006 line at N1016 and at N1018. Three and five levels, respectively, were excavated at these units before massive limestone boulders were encountered that prompted investigators to focus on more productive areas of the site.

Eastern Block

The E Block was the last excavation area opened, with a goal of exposing a larger portion of the Late Prehistoric component. The larger burned rock features in the NW Block had been largely exposed and E Block was established to determine whether similar, large burned rock features were also present in this portion of the site and if so, how distinct were they and how did they compare in diversity and size with those from other blocks. Discerning off-midden activity areas was also a goal for the E Block.

Five 2 × 2-m excavation units were opened in the East (E) Block along the N1022 and N1024 lines at E1020, E1022, and E1024. All four quadrants in four units were excavated in 10 to 13 levels, with three units terminating at 97.5 m and one at 97.4 m. Unit N1024 E1020 was excavated in two levels in only the southwest and southeast quadrants to 98.5 m. Nine features were recorded in the E Block: Features 38, 39, 40, 43, 44, 45, 46, 47, and 48.

Feature Excavation Methods

As an important data set, features were focal points of the archaeological investigations. Each feature, and a total of 48 were recorded, discovered during hand excavations was numbered; the project archaeologist maintained a list of consecutive numbers. Most features were exposed in plan, drawn, and photographed (Figures 4.9 and 4.10). To expedite recording, smaller features were not plan mapped, but were photographed and recorded with the TDS. Each feature was described and documented on a special feature form. Larger features were cross-sectioned, and all were thoroughly sampled. Bulk matrix samples were taken from various contexts, and the coarse matrix (burned rock) was size-sorted, counted, and weighed. A sample of rocks was collected for possible organic residue analysis from discrete features. The fine matrix was quantified by volume and sampled as follows: for features with less than 20 gallons of fine matrix, all the fine matrix was collected; and for features with more than 20 gallons of fine matrix, a sample of 20 gallons was collected and the percentage of total volume noted. Approximately 2 gallons of matrix from each feature was reserved for flotation or pollen/phytolith analyses, and the remaining sample was water screened after the excavations were finished.

Artifact Collection and Sampling Strategy

All artifacts and samples recovered from each provenience unit, quadrant and level were collected, bagged and labeled accordingly, and were assigned a general bag number in the field inventory. Point provenienced artifacts and samples were assigned an individual bag number in the field inventory. Additionally, most artifacts of special interest (e.g., projectile points, drills, gravers, formal bifaces, formal scrapers, manos, metates, antler and bone tools, etc.) were assigned a unique item (UI) number in addition to the general or individual bag number. Burned rock was size-sorted, weighed, and counted for each unit by level and/or feature but not collected, with the exception of special sample analysis. Snails were counted but not collected, with the exception of special sample analysis.

In conjunction with the excavations, special samples were collected from appropriate contexts across the site. Special samples included materials for radiocarbon dating (from features, geomorphic units, and other appropriate contexts, with AMS dating to be used when necessary), matrix samples for flotation and/or fine screening, geomorphic samples, and pollen/phytolith samples to aid in paleoenvironmental reconstruction. Samples of fire-cracked rocks from feature contexts were collected for possible lipid residue analysis.

Additionally, a 5-gallon bulk matrix sample was collected from each 2 × 2-m unit excavation level. In general, the samples were collected from the

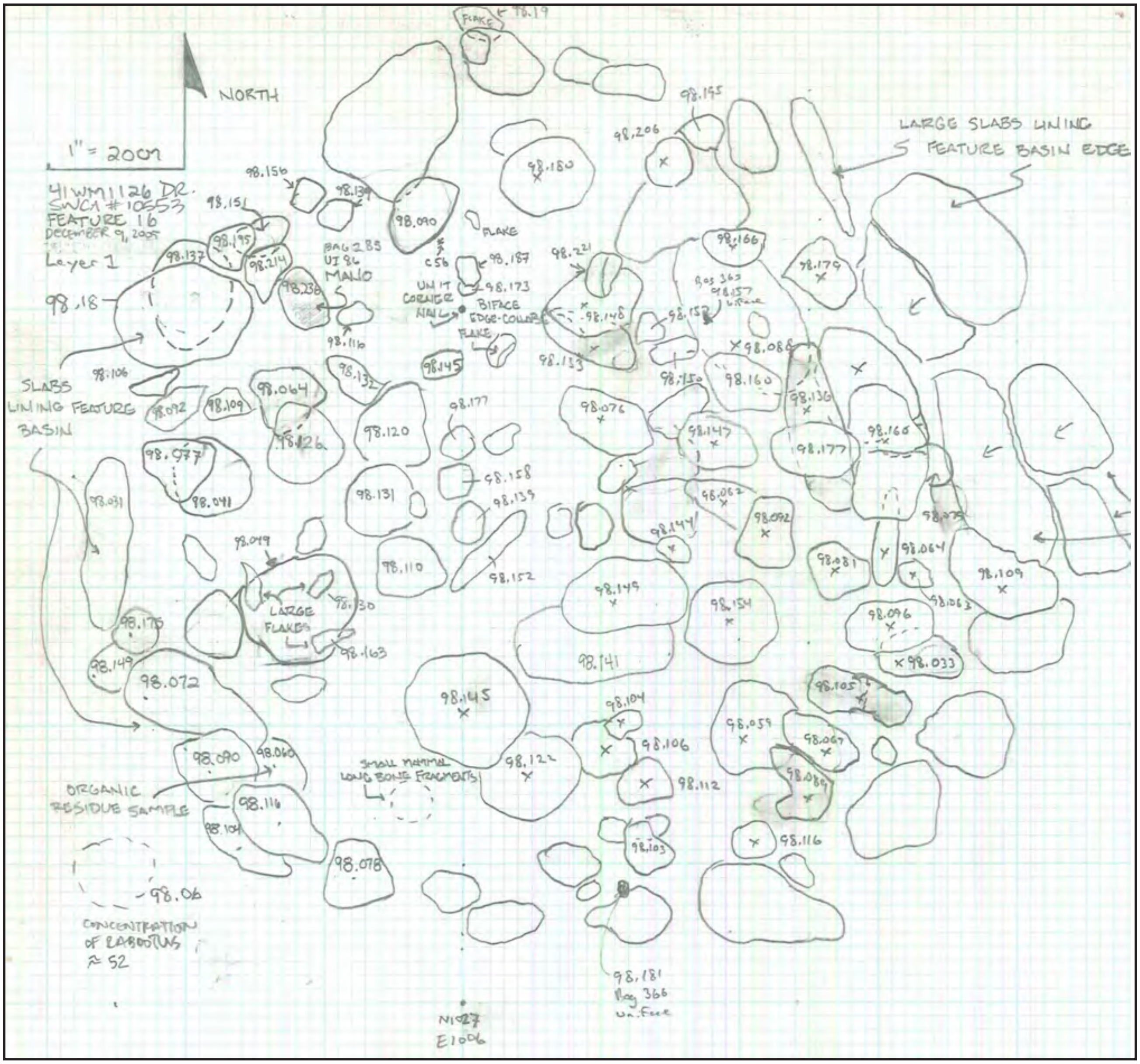


Figure 4.9. Plan view drawing of representative feature.

southwestern corner of each 2 × 2-m unit. These samples were water screened as discussed below.

Modifications to Field Methodology

During the course of fieldwork, it became necessary to modify certain elements of the methodology. The significant modifications had to do with the treatment of Feature 8 (an incipient burned rock midden), feature documentation, and TDS recording in the Eastern Block.

Feature 8 Methods

Feature 8, first noted during testing as a 5-m wide lens of burned rock in the northern profile of BHT A, proved to be an incipient burned rock midden covering nearly all of the NW excavation block. The original excavation plan called for the block to be excavated through the elevation range containing the midden, but it became apparent that this was not possible given the need to record each burned rock's, size, weight, and position (with the TDS). Therefore, the project staff decided to leave most of Feature 8 in situ, exposed in plan, but not completely excavated.

Figure 4.10. Cross-sectioning of representative feature for profile.

Small 50 × 50-cm units were excavated through the feature to sample its thickness and composition, and, in two areas, contiguous 1 × 1-m units were excavated through the midden. While the 50 × 50-cm units terminated at the base of the midden, the 1 × 1-m units were excavated several levels below the midden, to the base of the investigated area. This included three contiguous 1 × 1-m units in the southeastern corner and two contiguous 1 × -1-m units in northwestern corner of the NW Block.

On the final day of excavations, a backhoe trench (BHT E) was excavated through Feature 8 to look for a central feature and to provide a better profile of the midden.

TDS Recording in Eastern Block

With approximately three weeks remaining in the field schedule, SWCA proposed to TxDOT that the contingency for an additional week of field time be authorized. This was requested because the excavations were yielding unexpectedly diverse artifact assemblages, large numbers of artifacts and features, and numerous faunal remains. Furthermore, the artifacts and features in the NW Block were very different from those in the NE Block, suggesting different types of activities took place in each excavation area.

SWCA proposed using the additional time to expand the excavations of the E Block, which had been originally opened at the beginning of the project, but abandoned when the targeted Late Prehistoric component proved unproductive in that portion of the site. Excavations in the re-opened block targeted the Transitional Archaic component, which involved manually removing several levels without screening to reach the cultural component. Additionally, SWCA recommended modifying the excavation methodology to increase the excavated volume. Therefore, in the eastern block, the TDS was not used to record the location of non-feature fire-cracked rock after January 17, 2006, which was the date the E Block was reopened and deepened to target Transitional Archaic deposits. TDS data were still collected for tools, faunal remains, samples, and feature rock.

Laboratory Processing Methods

Artifact Processing

The artifact processing and cataloging system was done in compliance with the Texas Archeological Research Laboratory (TARL) curation standards and guidelines. Artifact processing included washing, sorting, and tabulating the recovered materials with the resulting data compiled into the specimen inventory cataloging system. The field inventory was translated into the specimen inventory, which included the assignment of lot numbers to the bag and UI numbers previously designated in the field. As a result, the UI and lot numbers are interchangeable and both are included in the specimen inventory (Appendix M). The processing was accomplished at SWCA's laboratory per the terms of the contract between TxDOT and SWCA.

Bulk Matrix Sample Processing

The excavations at the Siren site generated approximately 865 gallons of bulk matrix collected from each 2 × 2-m unit/level and 315 gallons from feature contexts. SWCA rented the water-screening facility at the Vertebrate Paleontology Laboratory at The University of Texas at Austin to process the bulk matrix samples. Non-feature matrix was water screened through 1/8-inch mesh, while the material from features was water screened through nested 1/8- and 1/16-inch mesh screens. The artifacts recovered from the 1/8-inch screens were sorted and tabulated, but the material from the 1/16-inch screens was simply bagged for future analysis.

Radiocarbon Sample Analysis

SWCA selected an initial batch of 16 and a second batch of 33 radiocarbon samples from a variety of archaeological and geomorphological contexts for analysis by Beta Analytic Inc. Finally in June 2011, five additional samples were submitted. Combined with the 11 radiocarbon samples from testing for a total of 65 samples, these data form the radiometric dataset for the cultural deposits at Siren (Appendix A).

Other Special Samples

Karen R. Adams analyzed charred macrobotanical remains from 36 flotation samples and 109 macrobotanical samples from a diverse range of features (Appendix B). Pollen, phytolith, and starch grain analyses were conducted by Chad Yost and Linda Scott Cummings of PaleoResearch Institute (Appendix C), Susan C. Mulholland of the Duluth Archaeology Center (Appendix G), and the Texas A&M Palynology Laboratory (Appendices E and F), respectively. Leslie L. Bush analyzed the recovery from three flotation samples (Appendix D). Dr. Walter E. Klippel with the University of Tennessee conducted the faunal analysis of 18,530 bones from the site (Appendix H).

Summary

The Siren site investigations entailed multiple phases, from survey to testing to data recovery. At each phase, the fundamental objectives changed, and, accordingly, the means evolved to attain the changing ends. Techniques and methods were first adapted to define the limits and significance of site deposits, and then subsequently modified to gather solid, non-redundant data that would contribute to an understanding of the broad patterns of regional prehistory. The overall process was continuous, and the stages dovetailed into one another rather seamlessly, as detailed in this chapter.

To focus on several salient, explicit topics that the Siren site data could directly address, SWCA developed five research topics with related questions. These topics themselves were tied into broader research domains of subsistence, technology, paleoenvironment, and social organization. The overall analytical approach by SWCA was comprehensive, covering a wide range of techniques and issues within these broad topics to fully explore all aspects of the site data and answer these specific research questions. The results are presented in the subsequent chapters and appendices.

Chapter 5

Overview of Results at the Siren Site

Kevin A. Miller, Brett A. Houk, Charles D. Frederick, and Stephen M. Carpenter

The two SWCA phases of investigations, as noted, were distinct in terms of objectives, methods, and techniques, but overall comprise a continuous and comprehensive study of the site. Through the course of events, the feedback of newly discovered data informed shifts in perspectives and directions. This chapter presents the findings by each phase. The full descriptions of the recovered materials from the entire site, as well as interpretations of the cumulative data are provided in the chapters following this one. The purpose of this chapter is to systematically report how the site was studied and the findings through the successive phases. Some of the initial conclusions have been rendered obsolete by subsequent data and analyses.

Test Excavations

SWCA conducted significance testing excavations at the Siren site in the summer of 2005. The testing was initially conceived as a weeklong field effort, but as the complexity and extent of the archaeological deposits became apparent, the project turned into a month-long investigation. The initial survey data suggested the site was small and shallow, but testing discovered a much larger, stratified prehistoric occupation. The following discussion of testing phase findings presents a number of divisions and interpretations that were subsequently revised or abandoned based on additional data recovery investigations. While obsolete, the intent is to accurately present the testing phase data and conclusions that formed the basis for the research objectives in data recovery.

Natural Stratigraphy

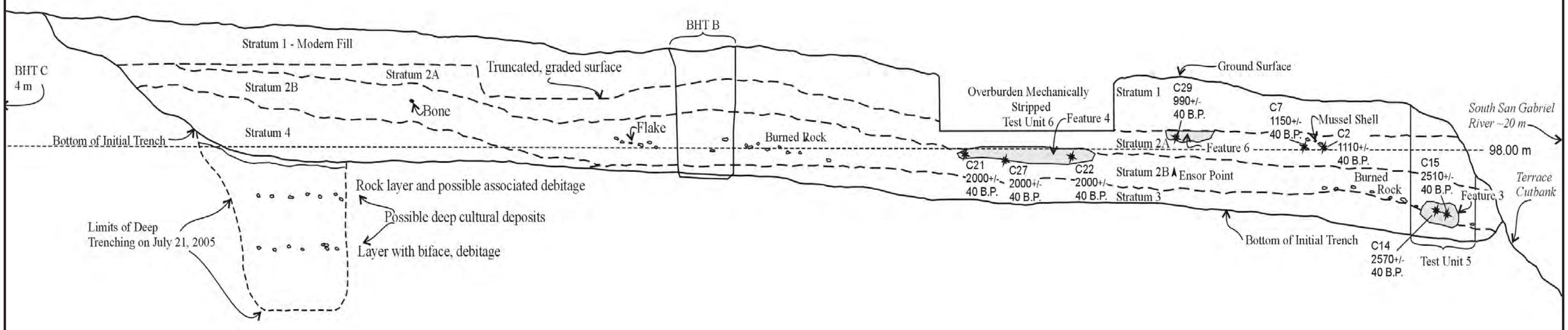
An assessment of the site by a professional geomorphologist was not part of the testing program, but was conducted in the later data recovery phase. During testing, SWCA archaeologists utilized soil-stratigraphic profiles from backhoe trenches and test units to develop a basic understanding of the site's natural and cultural stratigraphy. Other sources of information utilized in the testing phase included the results of an engineering test hole conducted to assess the nature of the sediments, as well as the terrace profile recorded along the northern margin of the site. Using these data, five stratigraphic units were defined for the site following the testing phase. These were designated as Stratum 1 through Stratum 5, and generally numbered from top to bottom. Two strata are not horizontally continuous across all profiles (Figures 5.1–5.4). These strata have since been revised based on a more detailed understanding of site's deposits as obtained by the geomorphologist during data recovery phase (Chapter 8). However, for the purposes of understanding the results and interpretations of the testing program, the stratigraphic relationships are briefly discussed here as they were originally understood.

Stratum 1, modern fill that caps the site, was likely introduced during construction of IH 35 in the 1960s or possibly during later work as recent as the 1990s. Modern fill was identified in all profiles during the testing, distinctly varying in composition as a result of using different source areas for the fill. In some areas, the natural stratum underlying the intrusive fill had been truncated by mechanical landscape remodeling associated with previous construction activities prior to the introduction of Stratum 1.

Stratum 2, the culture-bearing unit that was the focus of the test excavations, was a very dark grayish brown (10YR3/2), subangular blocky, silty loam. The stratum unconformably overlay the lighter-colored Stratum 3. The stratum was defined as approximately 75 to 80 cm thick throughout most of the site, expanding to 100 to 110 cm along the edge of the terrace at the northern edge of the site.

Two subdivisions, designated Stratum 2A and Stratum 2B from top to bottom, respectively, were defined. The two substrata, nevertheless, were interpreted as originating from a continuous depositional process of very gradual accumulation derived from occasional alluvial input, fine-sediment slope wash, as well as cultural contributions. Stratum 2A, the upper subdivision, is distinguished by a slightly lighter color, which is partly or largely the effect of relatively less

41WM1126
BHT A
Western Wall Profile



Strata Descriptions

Stratum 1. Brown (7.5YR4/4) coarse to fine gravelly loam, introduced modern fill with horizontally discontinuous deposits of gravels, clays , loams, silts. Abrupt smooth boundary. Modern glass, metal, plastic found throughout stratum. Decreases in thickness upslope to the south.

Stratum 2. Very dark grayish brown (10YR3/2) silty loam, subangular blocky, very hard, clear to abrupt boundary, becoming more abrupt upslope. Main culture-bearing stratum. Majority of materials at base of stratum on or above contact. See below for descriptions of Strata 2A and 2B. The unit appears to rest on an unconformity between Strata 2 and 3.

Strata 2A and 2B. Stratum 2 is interpreted as one general geomorphic unit because of similar texture and structure that suggest continuity in depositional processes. However, Strata 2A and 2B can be defined within it. Stratum 2A, the upper of the two, is a slightly lighter-colored silty loam with notably less cultural material. Stratum 2B has higher densities of cultural material and is possibly an anthropogenic soil based on the substantial organic input from cultural occupation.

Stratum 3. Strong brown (7.5YR4/6) silty loam, subangular blocky, moderately hard, marked decrease in cultural materials based on current exposure. Few roots, Rabdotus and Polygyra shells and fragments are common.

Stratum 4. Brown (7.5YR4/4) silty clay loam with ~5% medium to course gravels (angular) and cobbles. Blocky angular, hard structure. Clear boundary. Little or no cultural material. The stratum is a horizontally discontinuous unit that forms a wedge exposed in the southern 5 to 6 m of BHT A.

Legend

- Unique Item
- Radiocarbon Dates
- Feature

MN

1 m

SWCA ENVIRONMENTAL CONSULTANTS

Figure 5.1. Profile of BHT A.

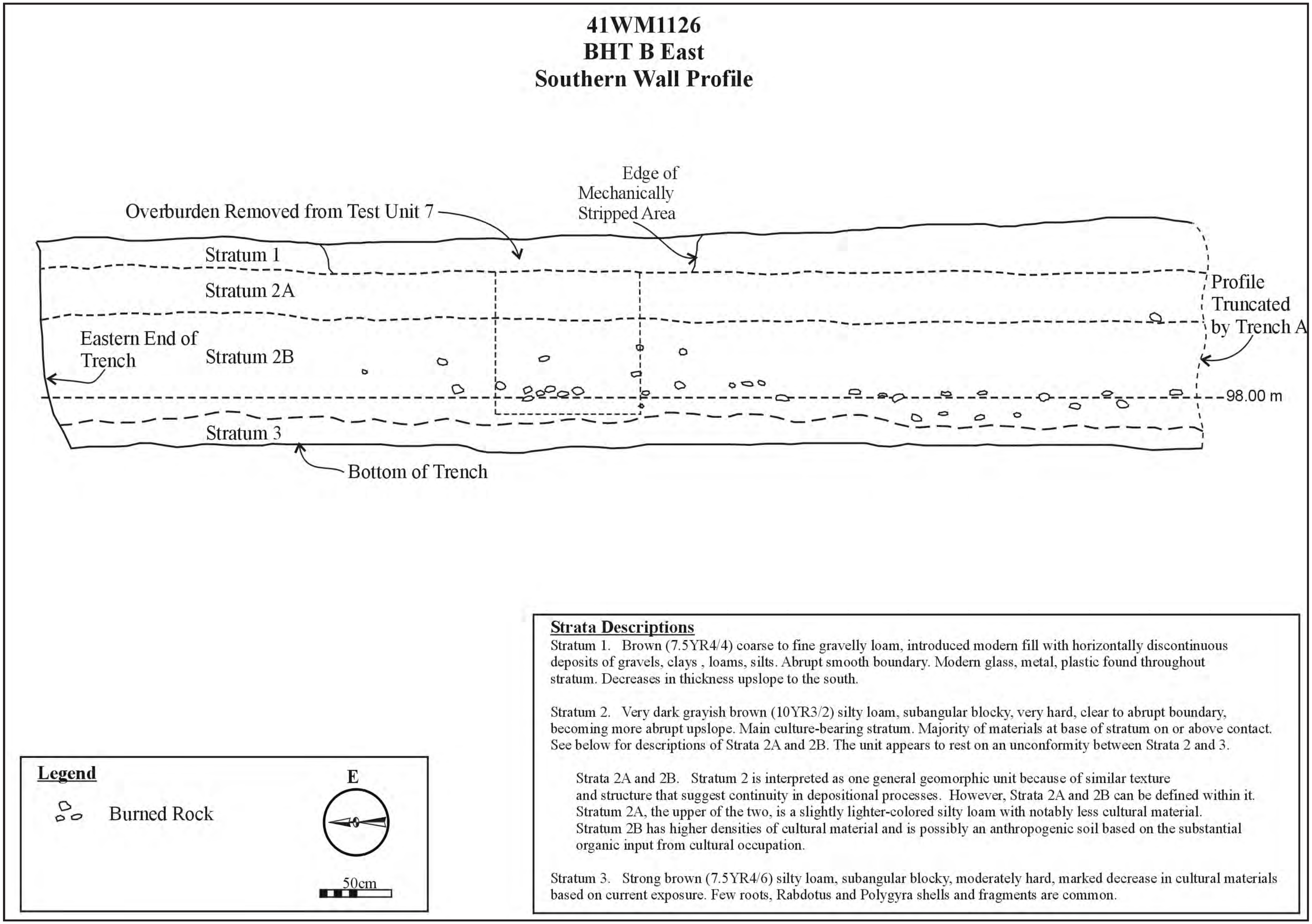


Figure 5.2. Southern profile of eastern end of BHT B.

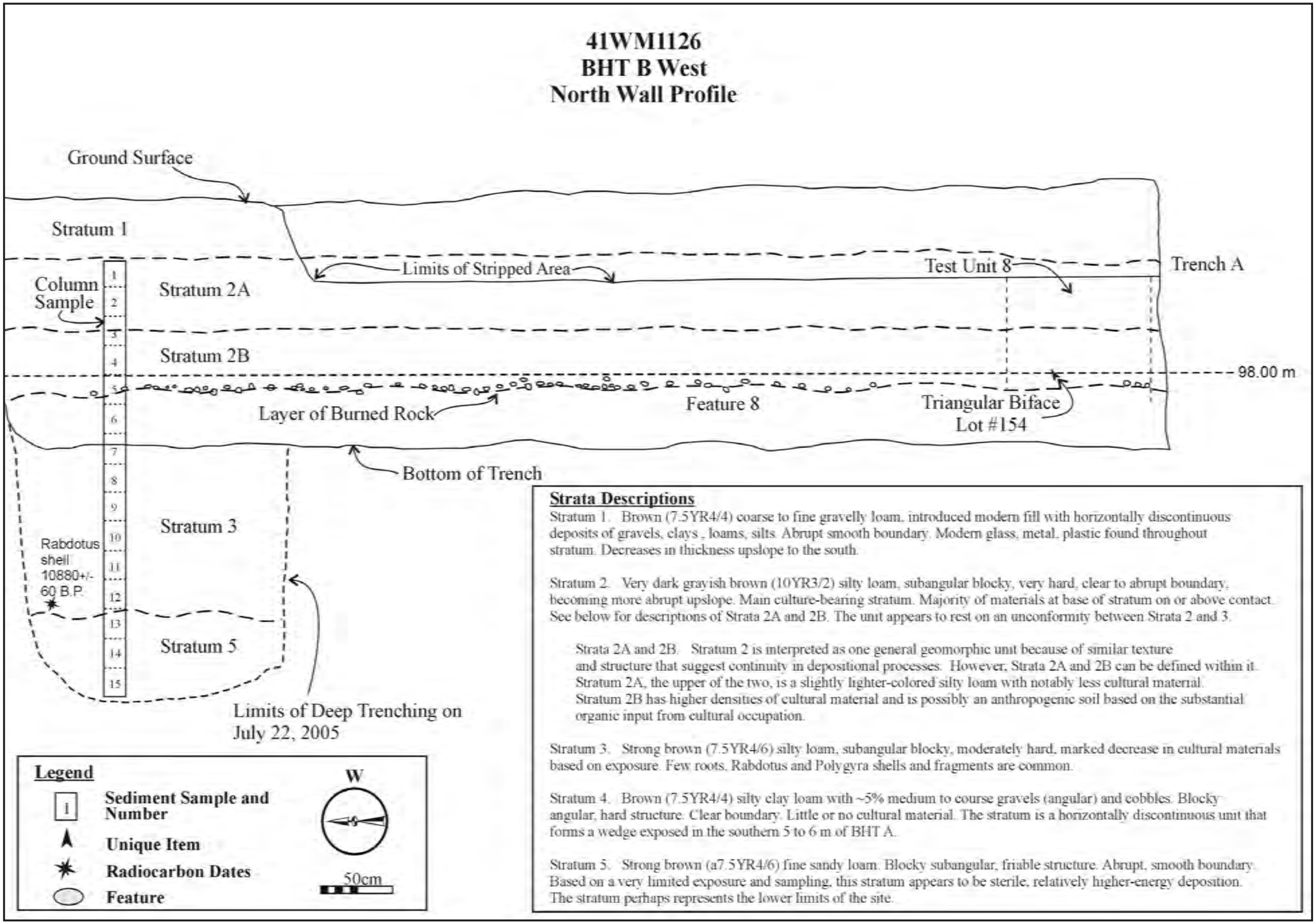


Figure 5.3. Northern profile of western end of BHT B.

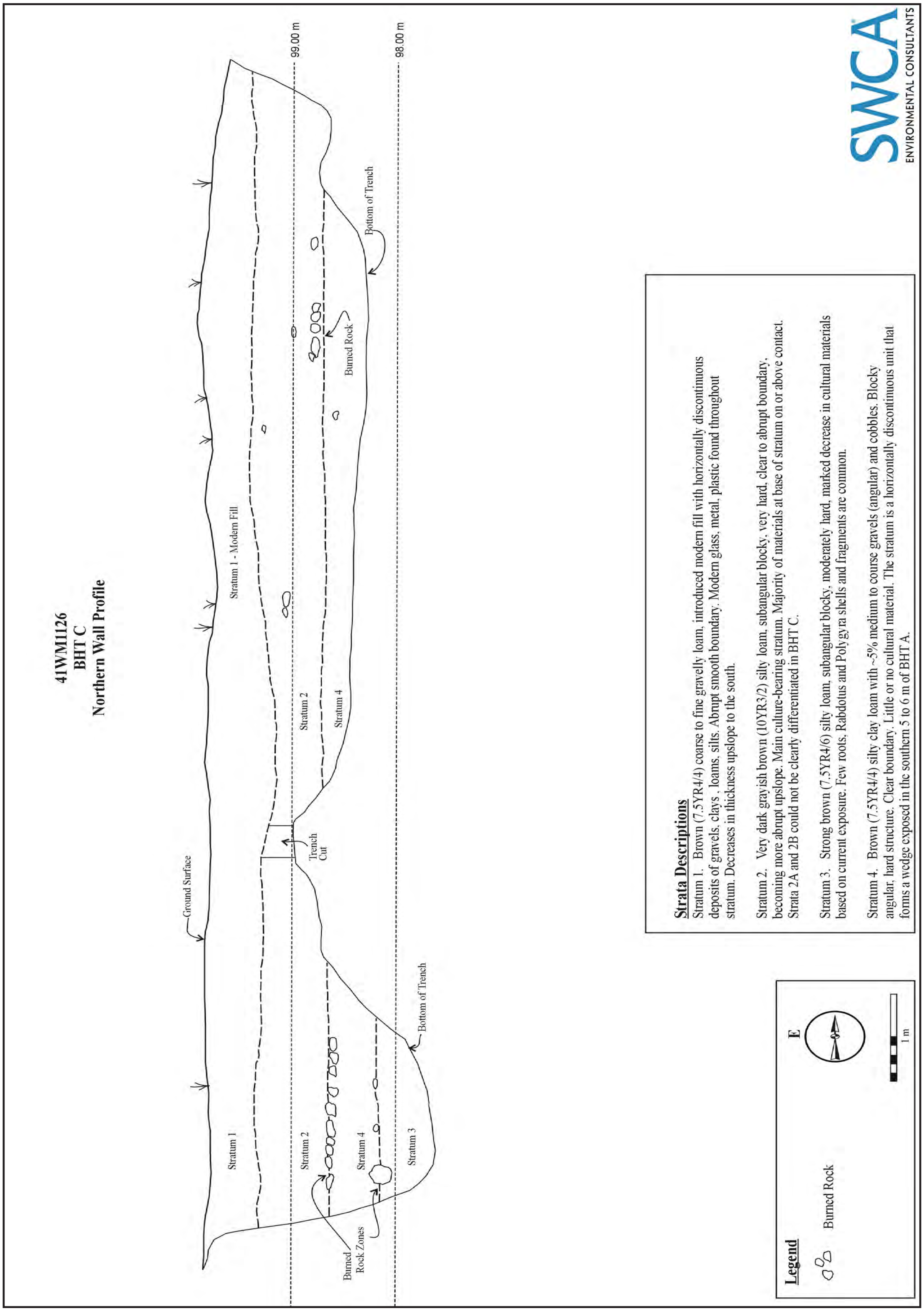


Figure 5.4. Northern profile of BHT C.

cultural materials such as charcoal. Diagnostic artifacts in Stratum 2A consist of Scallorn arrow points, which date to about 1200 to 700 B.P. (Collins 1995), consistent with the radiocarbon dates (discussed below).

The underlying Stratum 2B was slightly more clayey and slightly darker than the overlying subdivision. In large part, these characteristics were surmised to derive from the substantial input of cultural material; the stratum is tentatively interpreted as a cumulic anthrosol containing burned rock, ash, charcoal, and other organic materials. Several layers of cultural features in Stratum 2B were associated with Frio, Ensor, and Fairland points, which are typically dated to about 2200 to 1400 B.P. or so (Turner et al. 2011). Based on these dates, we believe that Stratum 2B began accumulating at or before about 2500 B.P. Accordingly, Stratum 2 as a whole was estimated to date to approximately 2500 to 1000 B.P.

Stratum 3 was a strong brown (7.5YR4/6), subangular blocky silty loam identified sitewide in all trenches and cutbanks. Except for a narrow exposure on the western end of BHT B, the lower geomorphic contact was unclear. The deep exposure uncovered the base of the stratum at about 95.95 m, or 285 cm below surface. However, the deep excavation in the southern end of BHT A, which was excavated to approximately 350 cm below surface, did not reveal the base of Stratum 3, suggesting that the base of the stratum is undulating, varying by at least 65 cm across the site.

Several Castroville points, which date to 2400 to 2800 B.P., were recovered from within the upper part of Stratum 3. However, the temporal parameters for the beginning of deposition for the stratum remained poorly defined at the time. An AMS date on a *Rabdotus* shell from the deep deposits (approximately 3 m below surface) yielded a date of 10,650 B.P. Dates on snail shell are often much older as a result of old carbon ingested by the animal, and so inferences on the chronology await further information (see Sample #S-8 in Table 5.1, Appendix A).

Stratum 4 was a wedge of sediments along the lower slopes of the valley wall on the southern margin of the site. Identified in BHT C and the southern end of BHT A, the stratum was a brown (7.5YR4/4), subangular blocky silty clay loam with about 5 percent angular gravels. Stratum 4 was interpreted as toeslope colluvial and slopewash deposits. In BHT C, Stratum 4 overlay Stratum 3. No intact cultural materials or temporal data was obtained from this stratum.

Stratum 5 was the most poorly defined of all strata because of its limited exposure. Sediments within the stratum were exposed at approximately 3 m below surface (96.30 m) in the deep excavation on the western end of BHT B, and were described as strong brown (7.5YR4/6) loamy fine sands or fine sandy loams. No cultural materials were observed in the limited exposure, though the stratum was inadequately sampled to clearly make a determination as to the presence or absence of archaeological deposits. No data capable of providing the chronological parameters of the unit were obtained, but its deposition is known to have predated the formation of Stratum 3. Stratum 5 was interpreted as moderately high-energy alluvial deposition.

At the time of testing, the alluvial stratigraphic framework of the site suggested the site represented short-term encampments when the modern flood terrace was still an actively aggrading floodplain. The cumulic nature of the deposit suggests that Stratum 2 may have formed slowly, and excavations revealed notable vertical separation between components. The flood terrace surface stabilized somewhat after the river downcut to its present location. The soil-stratigraphic framework established at the site demonstrated a high preservation potential for cultural materials, especially within Stratum 2.

Cultural Components

Although the above described stratigraphic divisions (see Chapter 8 for final division of the site's cultural components) were later revised, they proved to be fairly accurate in depicting the relative structure of the site. Four cultural components were defined at the Siren site during testing investigations. These are a shallowly buried Late Prehistoric component, a "Transitional Archaic" component that appeared to contain multiple discrete occupations, a Late Archaic component, and an earlier, undated component. The term "Transitional Archaic" was used in testing, but since the validity of this culture-temporal division is a primary research objective of this report, we have since abandoned its use to avoid assuming what we have yet to prove. The final verdict is discussed in Chapter 13. Nevertheless, it is used here to depict the testing phase site division. In addition to the three upper components with temporally diagnostic artifacts, preliminary evidence suggested

Table 5.1. Summary of Radiocarbon Dates and Proveniences from Testing

TAU	SWCA Sample #	Beta #	Elevation (m)	Context	Measured ^{14}C (BP)	$^{13}C/^{12}C$ Ratio	Conventional ^{14}C (BP)*	2-Sigma Calibrated Age Estimate	Dated Material
	C-29	207247	98.2-98.18	Feature 6	990 ± 40	-25.3 o/oo	990 ± 40	AD 990 to 1160 (BP 960 to 790)	Quercus wood
1	C-2	207238	98.17	Feature 1	1110 ± 40	-25.5 o/oo	1110 ± 40	AD 880 to 1010 (BP 1070 to 940)	carbonaceous sediment
	C-7	207239	98.06	Feature 1	1150 ± 40	-24.9 o/oo	1150 ± 40	AD 780 to 990 (BP 1170 to 960)	unidentified charred material
	C-21	207244	97.95	Feature 4	1990 ± 40	-25.4 o/oo	2000 ± 40	BC 50 to AD 100 (BP 2000 to 1860)	Quercus wood
	C-22	207245	97.92	Feature 4	2010 ± 40	-25.4 o/oo	2000 ± 40	BC 80 to AD 80 (BP 2030 to 1870)	Quercus wood
	C-27	207246	97.72-97.70	Below Feature 4	2030 ± 40	-26.6 o/oo	2000 ± 40	BC 80 to AD 80 (BP 2030 to 1870)	Quercus wood
2	C-13	207241	97.1-97.09	Below Feature 2	2480 ± 40	-25.1 o/oo	2480 ± 40	BC 790 to 410 (BP 2740 to 2360)	Quercus wood
	C-15	207243	97.15	Feature 3	2510 ± 40	-24.7 o/oo	2510 ± 40	BC 790 to 500 (BP 2740 to 2450) and BC 460 to 430 (BP 2410 to 2380)	unidentified charred material
	C-14	207242	97.25	Feature 3	2570 ± 40	-26.4 o/oo	2550 ± 40	BC 800 to 750 (BP 2760 to 2700) and BC 700 to 540 (BP 2650 to 2490)	Rosaceae wood
	C-12	207240	97.15	Feature 2	2600 ± 40	-27.2 o/oo	2560 ± 40	BC 810 to 760 (BP 2760 to 2710) and BC 680 to 550 (BP 2630 to 2500)	Quercus wood
4	S-8	207248	~96.27	Base of Stratum 3	10650 ± 60	-10.9 o/oo	10880 ± 60	BC 11180 to 10860 (BP 13130 to 12810) and BC 10780 to 10700 (BP 12730 to 12650)	shell

* Conventional Radiocarbon Age is the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C.

Dates not clearly associated with archaeological contexts: used to define depositional chronology the presence of two or more stratified cultural zones in the lower component.

For the purposes of this discussion, these occupations have been divided into testing analytical units (TAU). Each is described below. As a general observation, the cultural components were found to be stratified and could be correlated to the natural stratigraphy at the site. Therefore, at the very southern edge of the site, as exposed in BHT C, the analytical units occurred at higher elevations than they did in much of the site. All the components sloped downward to the north, making statements about elevation ranges somewhat complicated. Therefore, the following descriptions generally refer to the elevations of strata and occupations within the central and northern portions of the site where the testing excavations focused. For each analytical unit, the summary includes descriptions of its temporal association, stratigraphy, horizontal extent, and associated features and artifacts.

Testing Analytical Unit 1

TAU 1, the uppermost prehistoric component at the site, is a Late Prehistoric occupation. Though a portion of the component has been disturbed or removed by modern bridge construction, significant, intact parts of the component were identified.

Time Period

TAU 1 dates to the Austin phase of the Late Prehistoric period, based on the presence of multiple Scallorn arrow points. The Austin phase dates to approximately 1200 to 700 B.P. (Collins 1995). Three radiocarbon ages from TAU 1 all fall within this range. They are 990 B.P., 1110 B.P., and 1150 B.P. The calibrated ages for these samples are presented in Table 5.1.

Stratigraphic Position and Spatial Limits

At the conclusion of testing investigations, the geomorphology of the Siren site was not entirely understood, and an unknown portion of the stratigraphic record had been truncated by construction fill. The Late Prehistoric component was identified by Scallorn arrow points and the radiocarbon samples stated above, which were obtained from Features 1 and 6. The upper limits of this analytical unit were not well defined because of the irregular thickness of the fill, but the top of the unit was considered to begin at the base of the fill. Based on the vertical distribution of diagnostic artifacts, TAU 1 was defined in the testing as occurring between 98.72 m to 98.2 m, but extending lower in certain areas, such as at the location of some features and at the northern edge of the site where the stratigraphy dips.

The horizontal extent of TAU 1 was not determined in testing. Given the irregular nature of the overlying fill and modern disturbance, the extent of intact deposits was undetermined.

Features

This section presents a summary of the features revealed during test excavations (Figure 5.5; Table 5.2). More detailed descriptions are presented in Chapter 7. TAU 1 was originally recognized during the excavation of Feature 1 in TUs 1 and 4 (Figure 5.6). Other features related to TAU 1 were Features 6, 10, 11, and 12 (Figure 5.7).

Feature 1 was a large fire-cracked rock hearth encountered in TUs 1 and 4. The rocks making up the deposit were densely packed in two or three layers, and the base of the feature was irregular, possibly containing several individual basins. Two charcoal samples from Feature 1 returned dates of 1110 and 1150 B.P. (see Table 5.1). These ages place the feature at the beginning of the Austin phase as presented by Collins (1995).

Feature 6, originally identified in the western profile of BHT A, was a burned rock hearth targeted for investigation in TU 10. This feature was immediately east of Feature 11 and approximately 1.5 to 2 m southeast of Feature 1 (Figure 5.8). A radiocarbon sample for Feature 6 returned a date of 990 B.P. (see Table 5.1).

Feature 11 was another discrete hearth associated with TAU 1 that was initially discovered during the excavation of TU 10 and Feature 6. It became necessary to open TU 13 along the western side of TU 10 to explore the feature. This resulted in the discovery of a third feature (Feature 12) immediately west of Feature 11 (Figure 5.9).

Feature 12 was partially exposed in TU 13 and appeared to be a slightly dispersed hearth. Unlike the nearby Features 10 and 11, this feature had a flat base. Given its proximity to Feature 1 (which was approximately 1 to 1.25 m north), the two may represent part of a single very large fire-cracked rock feature.

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Figure 5.5. Locations of features investigated during testing.

Table 5.2. List of Features from 41WM1126 Testing Excavations

Feature	AU	Provenience	Elevation (m)	Description
1	1	TUs 1 and 4	98.31 to 97.90	Large hearth composed of fire-cracked limestone
2	2	TU 2	97.30 to 97.09	Small basin-shaped hearth composed of fire-cracked limestone
3	2	TU 5	97.33 to 97.03	Basin-shaped hearth composed of fire-cracked limestone
4	2	TU 6	98.10 to 97.80	Large hearth composed of fire-cracked limestone
5	2	BHT B (east)	ca. 98.00	Fire-cracked limestone earth in northern profile of BHT B (not excavated)
6	1	TU 10	98.29 to 98.02	Small basin-shaped hearth composed of fire-cracked limestone
7	2	BHT A (south)	ca. 98.00	Fire-cracked limestone earth in eastern profile of BHT A (not excavated)
8	2	BHT B (west)	ca. 98.00 to 97.90	5.5-m long lens of fire-cracked limestone in northern profile of BHT B (not excavated)
9	2	TU 7	98.18 to 98.09	Small hearth composed of fire-cracked limestone with slight basin
10	1	TU 12	98.63 to 98.51	Small cluster of fire-cracked limestone
11	1	TUs 10 and 13	98.3 to 98.08	Small basin-shaped hearth composed of fire-cracked limestone
12	1	TU 13	98.32 to 98.04	Small, flat-bottomed hearth composed of tabular fire-cracked limestone

Materials Recovered

The materials from TAU 1 encountered in test units comprise over 2,000 pieces of debitage and fire-cracked rock, several dozen tools, hundreds of animal bone fragments, and nearly a dozen projectile points (Table 5.3). The projectile points included eight arrow points or arrow point preforms and three dart points (a Fairland, a Marshall and an untyped point). When compared to the recovery from TAUs 2 and 3, the densities of debitage, faunal remains, and fire-cracked rock were lower than in TAUs 2 and 3 (Figure 5.10). A cursory examination of the faunal material from TAU 1 revealed that the assemblage was highly fragmentary, whether a result of cultural or natural taphonomic processes was undetermined. Observed taxa, however, included deer, fish, and rabbit.

Testing Analytical Unit 2

The most extensive component documented in testing at the site was a Transitional Archaic occupation. The Edgewood Ensor, Frio, and Fairland points associated with the analytical unit date to ca. 1300 to 1700 B.P. (Collins 1995:Table 2).

Time Period

TAU 2 dates to the Transitional Archaic period, based on the presence of multiple dart points including

Figure 5.6. Feature 1 after being cross-sectioned, facing west.

Figure 5.7. Overview of excavations within TUs 10 and 13 and Features 11 and 12.

Edgewood Frio, Ensor, and Fairland types. Collins (1995:Table 2) dates these style intervals to ca. 1700 to 1300 B.P. Turner et al. (2011:Figure 3-6), however, place these types around 2250 to 1250 B.P,, which is slightly older than Collins's (1995) estimate. Johnson and Goode (1994:38) date Frio and Ensor points to 2100 to 1250 B.P.

Seven radiocarbon ages from TAU 2 range from as young as 1990 B.P. to as old as 2600 B.P. (see Table 5.1). The ages clustered in two groups, however, separated by approximately 500 years, suggesting two separate Transitional Archaic occupations could be present.

The calibrated ages for the seven samples are presented in Table 5.1. These dates highlight the inconsistencies—and perhaps inaccuracies—in the three chronologies referenced above, but more closely correspond to the age estimates presented by Turner et al. (2011) and Johnson and Goode (1994).

Stratigraphic Position and Spatial Limits

TAU 2 sloped downward from south to north, but was generally 40 to 50 cm thick. Stratigraphically, TAU 2 was found within Stratum 2B at the site. TAU 2 extended from the northern edge of T_1 terrace south to the base of the valley wall. It was thought that the component extended the width of the western side of the right-of-way, although its presence could not be confirmed beyond the limits of SWCA's testing without additional excavations. The Transitional Archaic component was deep enough that it had apparently been largely spared by the modern construction activities that impacted TAU 1.

Features

To reiterate, this section presents a brief summary of the features revealed during test excavations. More detailed descriptions are presented in Chapter 7. Excavated features associated with TAU 2 included Features 2, 3, 4, and 9 (see Figure 5.5). Additionally, Features 5, 7, and 8, which were noted in backhoe trench walls but not excavated, were associated with TAU 2 (see Table 5.2).

Feature 2 was a tight cluster of fire-cracked rock comprising a small, basin-shaped hearth that was partially exposed in TU 2. The feature appeared to be circular in outline with a diameter of 55 cm. The base of the feature occurred at or near the contact between Stratum 2B and Stratum 3, in the same excavation level as a Castroville point and one level below a small concentration of bison bone. Two charcoal samples associated with Feature 2 returned dates of 2480 and 2600 B.P. (see Table 5.1).

Figure 5.8. Feature 6 (right) and portion of Feature 11 (left), facing north.

Figure 5.9. Feature 11 (right) and Feature 12 (left), facing north.

Feature 3 was a roughly circular hearth measuring 90 cm north-south by 85 cm east-west with a distinct basin-shaped cross-section. The feature occurred in TU 5, near the northern edge of the T_1 terrace. One piece of antler was associated with this feature (Figure 5.11).

Feature 4 was encountered south of Features 2 and 3 and nearly 70 cm higher in elevation. Feature 4 was still contained within Stratum 2B, but near the top of the stratum rather than at the bottom, where Features 2 and 3 had been encountered. This large hearth was truncated by BHT A and extended beyond the southern and western limits of TU 6 (Figures 5.12 and 5.13). The feature had a basin-shaped bottom, marked by charcoal staining. Three radiocarbon samples associated with the feature returned remarkably consistent dates, all at 2000 B.P. (see Table 5.1).

Materials Recovered

Archaeological materials encountered in test units in TAU 2 included over 6,400 pieces of debitage, 5,800 pieces of fire-cracked rock, and 800 pieces of animal bone. The analytical unit also contributed more projectile points (n=18), bifaces (n=38), cores (n=7), and unifaces (n=36) than the other two analytical units combined (Table 5.3). While this in part reflects that more cubic meters of TAU 2 were excavated, the density of material was also greater (see Figure 5.10). Perhaps significantly, the only two categories with lower densities in TAU 2 were mussel shell and projectile points. With comparison to TAU 2, a greater quantity of mussel shell was associated with TAU 1, and TAU 3 had a higher density of dart points.

The faunal assemblage from TAU 2 yielded numerous fragments of animal bone, including bison and deer. Only 12 mussel shells were recovered from TAU 2.

Testing Analytical Unit 3

Little information was gained in testing with regard to the third analytical unit identified at the site because it occurred approximately 1.5 m below surface, near the base of SWCA's excavations. Two Castroville points provided the temporal-cultural dimension to TAU 3. Stratigraphically, TAU 3 was in the upper portion of Stratum 3.

Time Period

TAU 3 was defined as a Late Archaic component, as dated by the two Castroville points (Collins 1995:Table 2). Based on stratigraphic position, TAU

Table 5.3. Materials Recovered from Test Units by Analytical Unit

	TAU 1		TAU 2		TAU 3	
Artifact	Count	Density*	Count	Density*	Count	Density*
Arrow points	8	2.1	0	0.0	0	0.0
Dart points	3	0.8	18	3.9	4	5.0
Bifaces	20	5.1	38	8.1	4	5.0
Unifaces	13	3.3	36	7.7	3	3.8
Cores	2	0.5	7	1.5	0	0.0
Debitage	2368	607.2	6430	1375.4	850	1062.5
Faunal count	271	69.5	811	173.5	69	86.3
Bone tools	0	0.0	2	0.4	0	0.0
Mussel shell count	30	7.7	12	2.6	0	0.0
FCR Count	2353	603.3	5858	1253.0	1043	1303.8
FCR Weight (kg)	417.69	107.1	634.5	135.7	87.95	109.9

*Density is the approximate number of items per cubic meter of excavation.

3 was presumably older than 2500 B.P., calling into question Collins' (1995:Table 2) age estimates for the Castroville style interval (which he places ca. 1900–2100 B.P. The dates are much more consistent with Johnson and Goode's (1994) placement of Castroville at the end of their Late Archaic I period, which ends at 2550 B.P.

Stratigraphic Position and Spatial Limits

The Castroville points associated with TAU 3 occurred at elevations of 97.85 m, 97.70 m, 97.2 m, 97.0 m, from south to north. These elevations reflected the natural slope of the subsurface material as it dips downward near the creek edge. The analytical unit was stratigraphically contained within Stratum 3, which generally begins at approximately 97.9 m across most of the excavation area.

The horizontal extent of the Late Archaic cultural component was not determinable, but the stratigraphic layer in which it was contained was presumed to extend the width of the right-of-way from the base of the valley to the edge of the terrace.

Features

No features that could be clearly associated with TAU 3 were documented. This may be a reflection of the sampling strategy employed, since the testing investigations only minimally exposed and explored this component.

Materials Recovered

In TAU 3, over 1,000 pieces of fire-cracked rock, 850 pieces of debitage, and approximately 70 pieces of animal bone were encountered in test units (see Table 5.3). The density of material, particularly, fire-cracked rock, was high considering the fact that no features were designated within the TAU. As stated above, two of the four dart points from the analytical unit were Castroville points. Of the remaining two dart points from the analytical unit one was an Ensor and one was a possible Lange. The small amount of faunal material from TAU 3 was largely fragmented. The preliminary examination of the assemblage noted deer and bison, but no other taxa could be clearly identified.

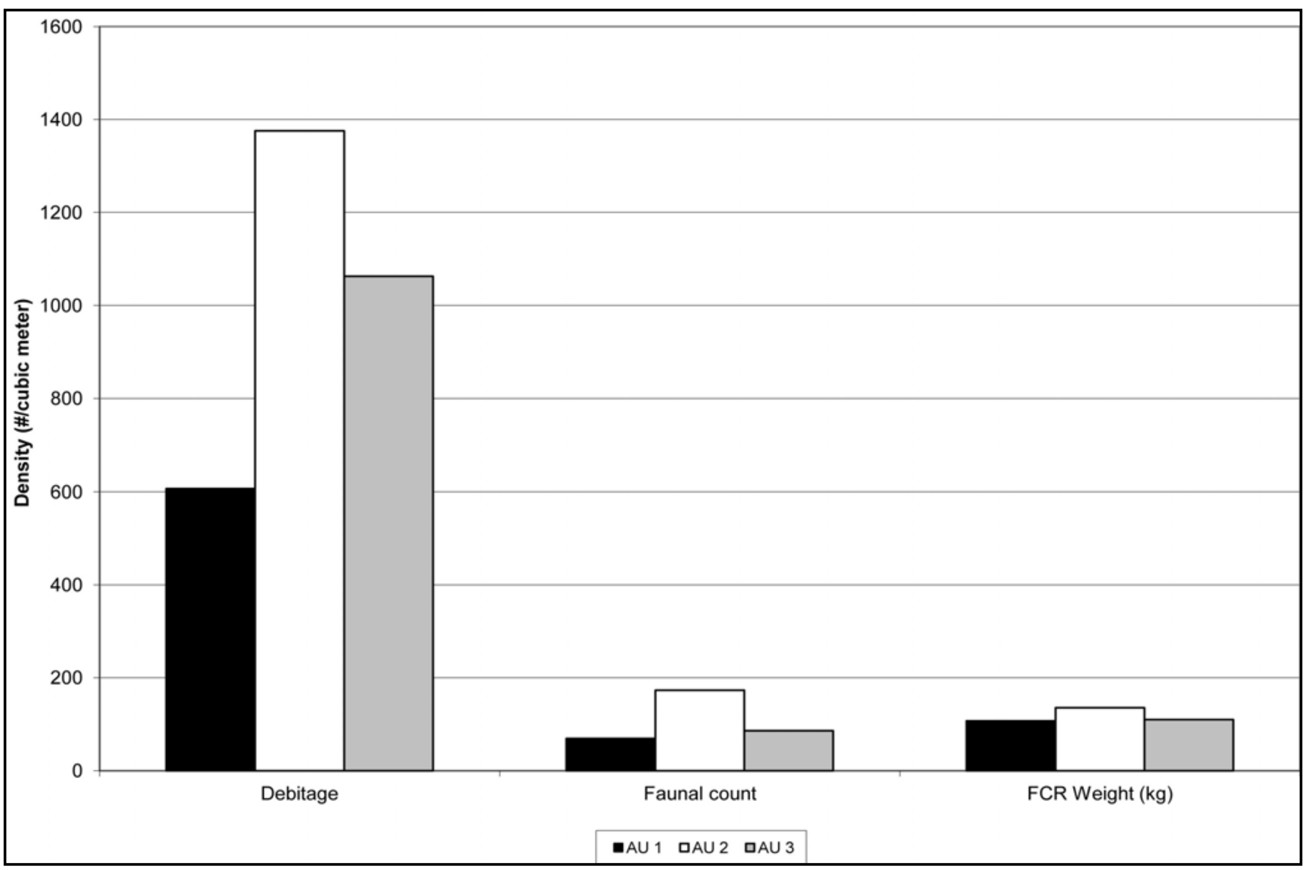


Figure 5.10. Densities of cultural materials from test units.

Figure 5.11. Feature 3, facing north

Testing Analytical Unit 4

Limited information was gathered with respect to the material at the site that was deeper than 1.6 m below surface because SWCA's testing was constrained by safety limitations. Based on limited deep trenching, cultural material was identified as deep as 3.5 m below surface. The designation TAU 4 was arbitrarily applied to everything below the Castroville component.

Time Period

The age of the material in TAU 4 could not be determined. A single snail sample was dated from an elevation of 96.27 m (approximately 1.75 m below the bottom of TAU 2 in BHT B). The measured ^{14}C age of the snail was 10,650 B.P. (see Table 5.1). According to Lain Ellis (personal communication, 2005), "given the ±700 year age anomaly in *Rabdotus*, the deposits are fairly likely to be Paleoindian since the apparent date of the shell is only 700 years or so too old relative to the actual age of the shell." Unfortunately, with only one sample, it was not possible to assess the components within TAU 4, nor was it possible to determine the integrity of the deposit.

Figure 5.12. Feature 4, facing west.

Stratigraphic Position and Spatial Limits

TAU 4 began at approximately 97.4 m in the southern portion of the site and 96.7 m along the northern edge of the T_1 terrace. Stratigraphically, TAU 4 was contained within Stratum 3, which is known to extend to a depth of at least 96.0 m (3.7 m below surface) in BHT A. The horizontal extent of TAU 4 was undetermined. The stratum in which it was contained presumably covered the entire right-of-way from valley wall to T_1 terrace edge.

Features

No features were documented in TAU 4 because the crew could not enter the trenches once they were excavated deeper than 1.6 m below surface. Large fire-cracked rocks, some in apparent clusters or layers, were observed in all three deep trench tests, suggesting features were present in TAU 4.

Recovered Materials

At the testing level, artifact recovery from TAU 4 was low—limited by the fact that only a small sample of the matrix was screened. The artifacts recovered from the deep trenching in BHTs A and B included 25 flakes, one biface, and one uniface (Table 5.4). No temporally diagnostic artifacts were recovered.

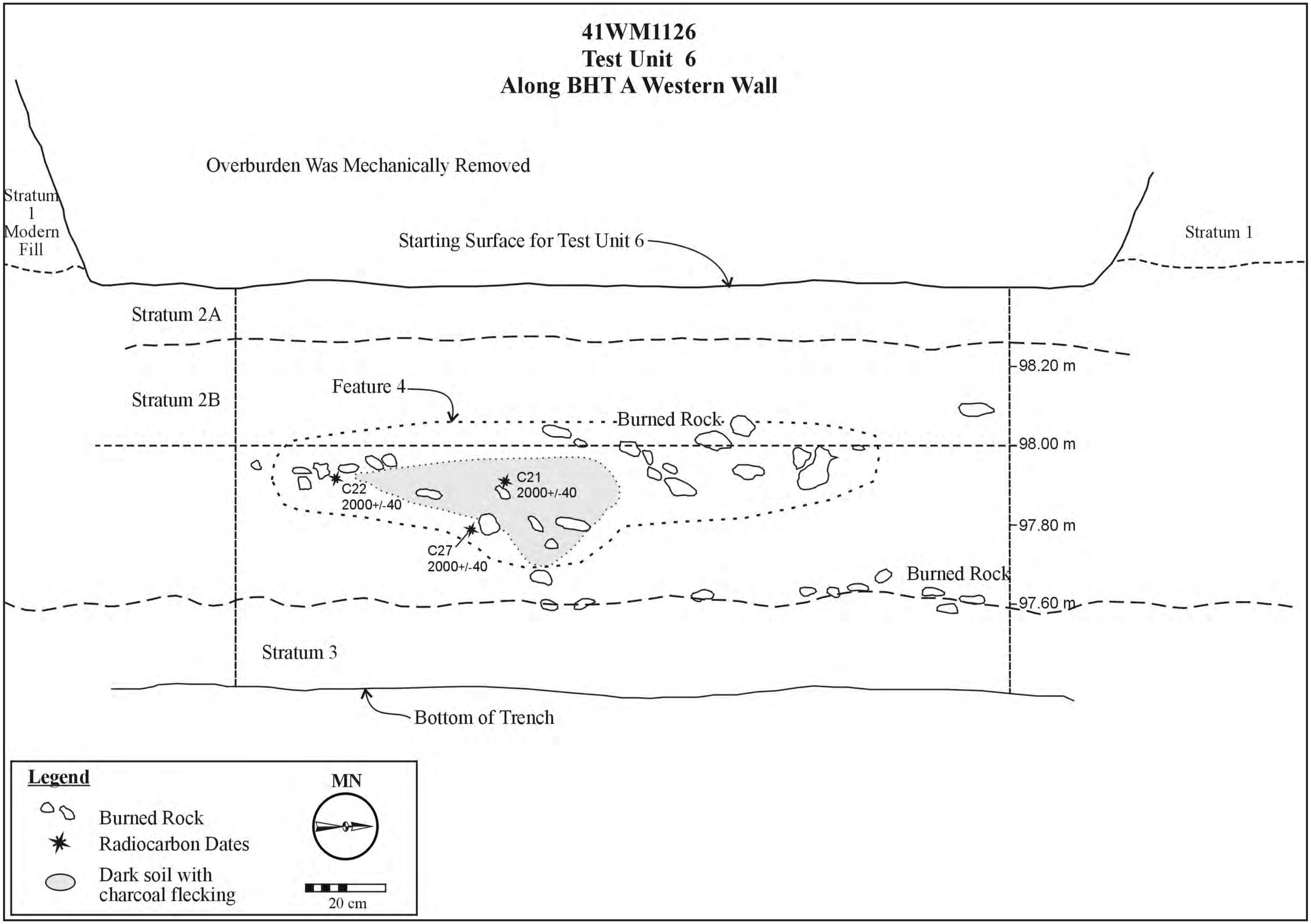


Figure 5.13. Western profile of TU 6 showing Feature 4 radiocarbon dates.

Table 5.4. Artifacts Recovered from Deep Trenching in BHTs A and B

Elevation (m)				
Top	Bottom	Debitage	Unifaces	Bifaces
97.50	97.25	3	0	0
97.25	97.00	8	0	0
97.00	96.75	1	0	0
96.75	96.50	13	1	1

Discussion and Comparisons of Testing Analytical Units

Upon completion of the testing fieldwork and analysis of the data, observations were made about the components at the site that highlight similarities and differences in the artifact assemblages. For instance, based on the radiocarbon dates from testing, there was an approximately 900-year gap in the archaeological record from ca. 2000 B.P. to ca. 1100 B.P. This gap separated TAU 1 from the upper component in TAU 2. The reasons for this gap were unclear, possibly related to a sampling error, a missing segment of the stratigraphy caused by degradation of the landform, or an indication that at least a portion of the site was unoccupied for nearly a millennium.

As was noted previously, TAU 2, which was defined as associated with the Transitional Archaic component at the site, yielded the greatest quantities of cultural material. Furthermore, the densities of materials were higher in TAU 2 for most categories. Other comparative statements include:

- The density of fire-cracked rocks (by count) in TAUs 2 and 3 was over twice has high as in TAU 1. However, when the weights of fire-cracked rock were compared, the difference in density between analytical units was much lower. This indicates that the average fire-cracked rock from TAU 1 was much larger than the average fire-cracked rock from TAUs 2 and 3. The average piece of fire-cracked rock from TAU 1 weighed 1.63 times as much as the average rock from TAU 2 and 2.1 times as much as the average rock from TAU 3. It was presumed that these were significant differences that reflected structural changes in feature composition through time. Another possibility is the rocks were not as intensively reused in later times.
- The density of animal bone fragments (count of fragments per cubic meter) in TAU 2 was more than twice as high as in TAUs 1 and 3. This was potentially significant because of the differences in faunal assemblages between analytical units. Not only did TAU 2 have more bone in it, it had bison bone, whereas TAU 1 did not. Bison bone was recovered from the bottom half of TAU 2, suggesting the analytical unit straddled a paleoenvironmental climatic shift, as further explored in Chapter 9.
- Three bone tools—two awls and a possible antler billet—found during testing all came from TAU 2.
- The highest density of projectile points was in TAU 3. This is a measure of points per cubic meter of excavated material; the greatest number of projectile points came from TAU 2 (Figure 5.14). Four Castroville points were recovered during the limited exploration of TAU 3.

Testing Conclusions and Recommendations

Once the testing was complete, the main questions of the research design were revisited to make a clear determination on site eligibility and quickly aid TxDOT in assessing mitigation options.

Discussion of Integrity and Eligibility

The tested portions of the site were found in a preserved, stratified archaeological record. Within the investigated area, the integrity of TAU 1, the Late Prehistoric component, had been affected by grading, which presumably occurred prior to the deposition of fill across the right-of-way. However, the testing determined that the thickness of construction fill was variable across the site and that sizeable portions of TAU 1 were preserved at the site. Where preserved, TAU 1 was found to be isolable, containing features, numerous artifacts, faunal material, and dateable material.

Below the Late Prehistoric component, testing revealed an extensive Transitional Archaic component, TAU 2. TAU 2 included several Transitional Archaic

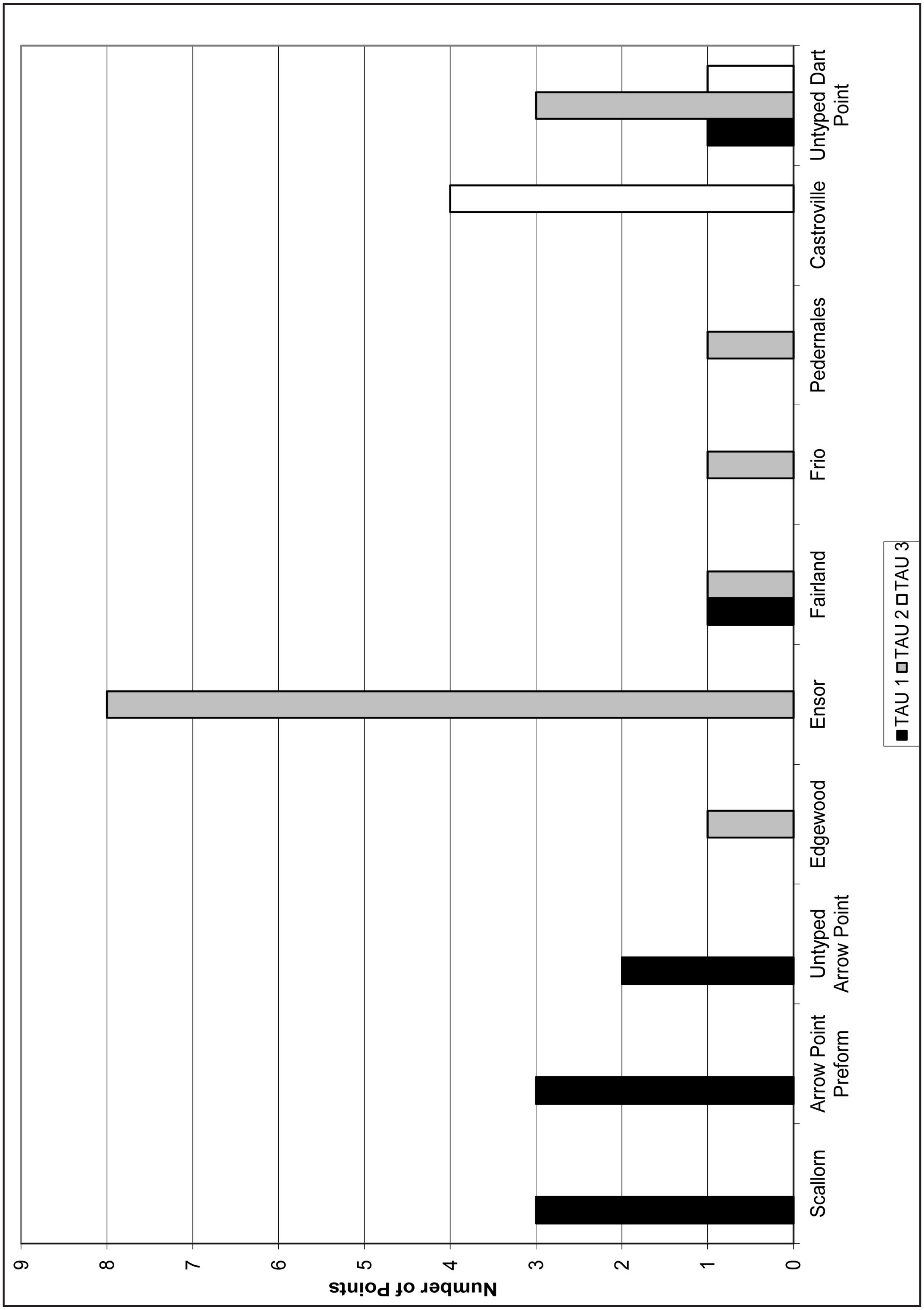


Figure 5.14. Projectile point types by testing analytical units.

occupations as indicated by radiocarbon dates from features. These were stratified vertically and isolable from one another. The more impressive of these was the lower occupation, which was observable in the profiles of all backhoe trenches near the transition between Strata 2B and 3. This component included features, abundant artifacts, dateable materials, and faunal remains.

The deepest deposits at the site were not visibly disturbed but were not sufficiently sampled during testing to evaluate their integrity. For management purposes, the integrity of the lower components was considered to be good pending further evaluation.

Despite impacts to the site's upper deposits, the Siren site appeared during testing excavations to have good integrity with stratified components. The stratigraphic position of temporal chronological markers conformed exceedingly well to the positions and ages of radiocarbon samples, and proved capable of addressing several chronological controversies in the literature for Central Texas.

With respect to potential data yield, the site was found to have dateable materials, good preservation of faunal material, discrete features, abundant artifacts, and diverse artifact assemblages within TAUs 1 and 2. Furthermore, it seemed possible that living surfaces could be identified associated with some of these occupations. The potential data yield of the deeper components at the site could not be fully evaluated given the limitations of the excavations.

SWCA recommended that the portion of the Siren site within the investigated area was eligible for NRHP listing under Criterion D, 36 CFR 60.4. Furthermore, SWCA recommended that the site was eligible for SAL designation under Criteria 1 and 2 of the Rules of Practice and Procedure for the Antiquities Code of Texas, 13 2 26.8. TAUs 1 and 2 were recommended as contributing to the site's eligibility. TAUs 3 and 4 may contribute to the site's significance, but they could not be adequately evaluated given the limitations of the testing investigations. SWCA recommended that data recovery investigations be conducted on portions of TAUs 1 and 2 to mitigate any indirect impacts to the site that would result from the proposed bridge construction.

Data Recovery Findings

Based on these findings and understanding of the site, data recovery excavations targeted the agreed upon components. As discussed previously, the excavations proceeded under a provisional research design.

Backhoe Trenches

For the data recovery, a backhoe was used to reopen BHTs A and B from testing and extend BHT B approximately 10 m to the east (Figure 5.15). Two additional trenches were excavated at the base of the sloping valley wall that marks the southern boundary of the site (BHT D), and on the face of the scarp, extending to the T_0 terrace (BHT E).

Mechanical stripping of the overlying construction fill followed the reopening of BHTs A and B. Four quadrants were created by the intersecting backhoe trenches. The northeastern quadrant was ultimately subdivided into two excavations areas (NE Block and E Block) based on the extremely irregular nature of the fill. The fill in the E Block, which was adjacent to the eastern extension of BHT B, was only 10 to 20 cm thick, but in the NE Block the fill varied from 50 cm to over 100 cm thick. In the other quadrants the fill averaged about 50 cm thick. In the SW Block the fill included massive limestone boulders and, ultimately, this quadrant was excluded from the data recovery excavations.

Results of Geoarchaeological Investigations

The following chapter (Chapter 6) provides a thorough reporting of the geoarchaeological findings. This section presents introductory information to provide a context for the more detailed information in the subsequent chapter. Geoarchaeological work on the site aimed at contributing towards understanding the macro-stratigraphic setting, and collecting samples that may contribute towards the goal of understanding the formation processes responsible for the preservation of the prehistoric cultural occupations. The investigations included a reconnaissance of the site's setting, coring, field observations of excavations and natural exposures, and sample collecting.

A brief walk along the channel upstream and downstream from the site identified three constructional alluvial surfaces in the immediate vicinity of the site, a low modern floodplain surface (T_0) and a first (T_1)

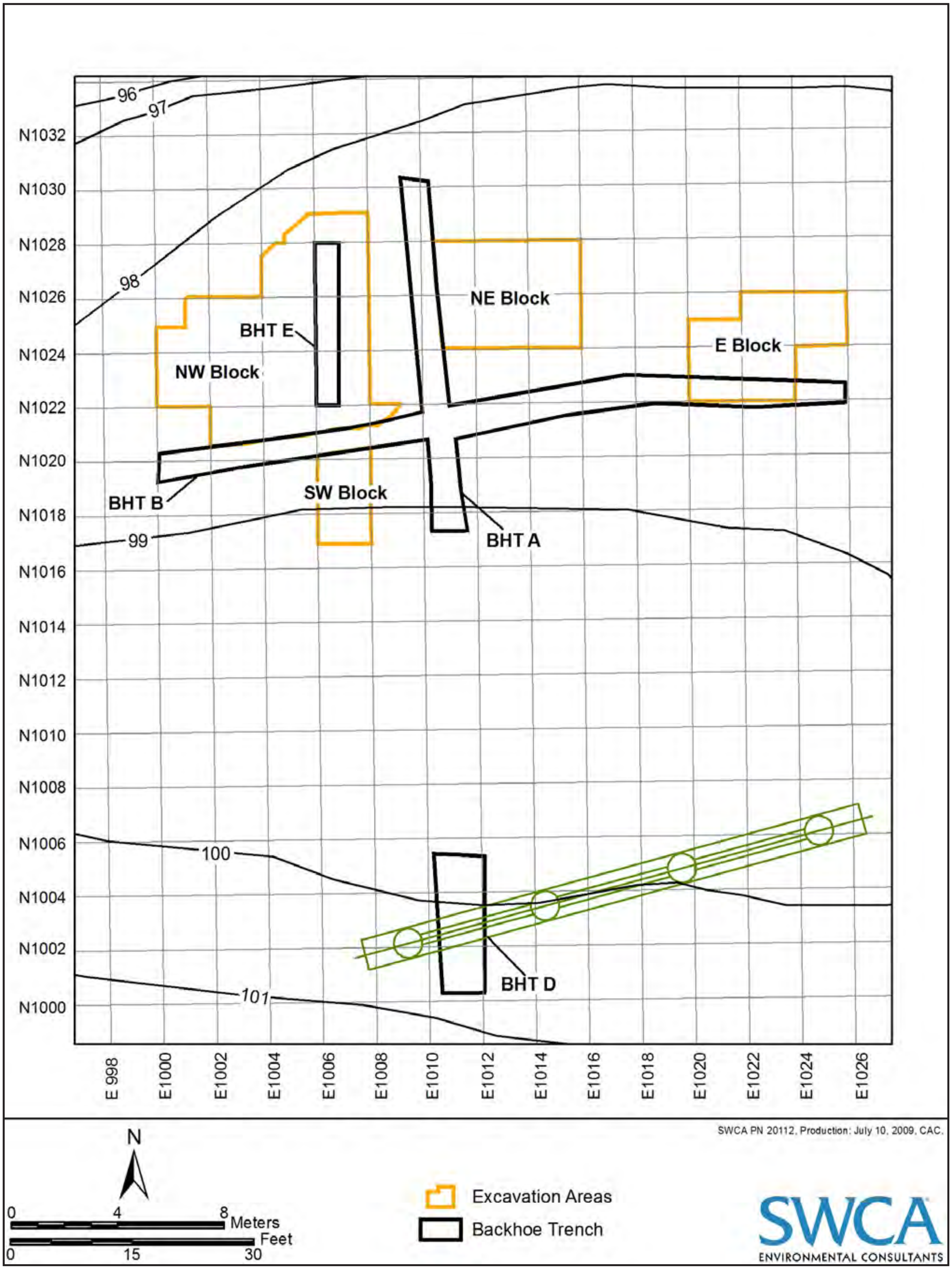


Figure 5.15. Map of data recovery excavations.

and a second terrace (T_2), which are underlain by at least three Holocene age allostratigraphic depositional units (Figure 5.16). The modern floodplain presents constructional surfaces in two different depositional settings: channel and overbank. The channel facies consists of several prominent gravel bars that rise in elevation up to about 3 m above the thalweg and are part of a wide (>50 m in places) channel assemblage in this area. Occasional large boulders can be seen cropping out beneath the gravels, which are silent testimony to past flash floods, and the colonization of these gravel bars by small trees in places at the margin of the T_1 surface suggests that large floods have a fairly long return interval. The floodplain of the modern depositional regime that has formed by a combination of vertical and lateral accretion is a relatively narrow surface that rises about 1.5 to 2 m above the thalweg, and has a flat to slightly undulose tread. This surface was noted to be boggy in several places where springs and seeps emerged from the T_1 alluvial deposits at the rear of the floodplain. A fragment of this deposit is present abutting the site on the north, immediately adjacent to the low water channel of the South Fork of the San Gabriel River.

The first terrace (T_1) rises to an elevation of roughly 7 m above the channel and is the surface upon which the site is situated. The leading edge of this surface was found to be either a nearly vertical cutbank or a gradual slope. Cutbank exposures revealed this terrace to be underlain by 4 to 7 m of buff colored (generally 10YR hue) alluvium. In some places, such as immediately west of the TxDOT right-of-way there is a 2.5- to 3-m-high bedrock strath, which is mantled with what looks to be a middle- to late-Holocene age alluvial deposit presumably correlative with the West Range alluvium described by Nordt (1992). Elsewhere, such as immediately below the site, there are more than 6 m of this alluvial deposit present.

The T_2 surface is only preserved as fragments and was best observed downstream (east) of the site, where the deposits had once been mined to extract gravel. From vertical profiles left by mining it was apparent that the deposit beneath this terrace was quite coarse (gravelly) and of a strong brown-red color (primarily 7.5YR hues), which is consistent with the Fort Hood alluvium of Nordt (1992). The elevation of this surface was measured by hand level in one place and found to be about 10.5 m above the thalweg, but, in this particular place, it was mantled by about 2 m of colluvium derived from the north valley wall. Therefore, the actual elevation of the early Holocene alluvial deposits may have been only slightly higher than the middle to late Holocene age T_1 deposits.

The results of this brief reconnaissance suggested that the site was part of the middle to late Holocene alluvial fill, which was consistent with the age of the cultural deposits but at odds with the general age of the lower deposits as determined from the testing excavations. Subsequent geomorphic work set out to examine and date the base of the terrace by coring, additional backhoe trenching, and examination of the cutbank along the northern edge of the site.

Backhoe Trench D: Colluvial Slope, South Side of the Terrace

Following several rather futile attempts at coring in the site deposits, a trench was excavated into the toe of the

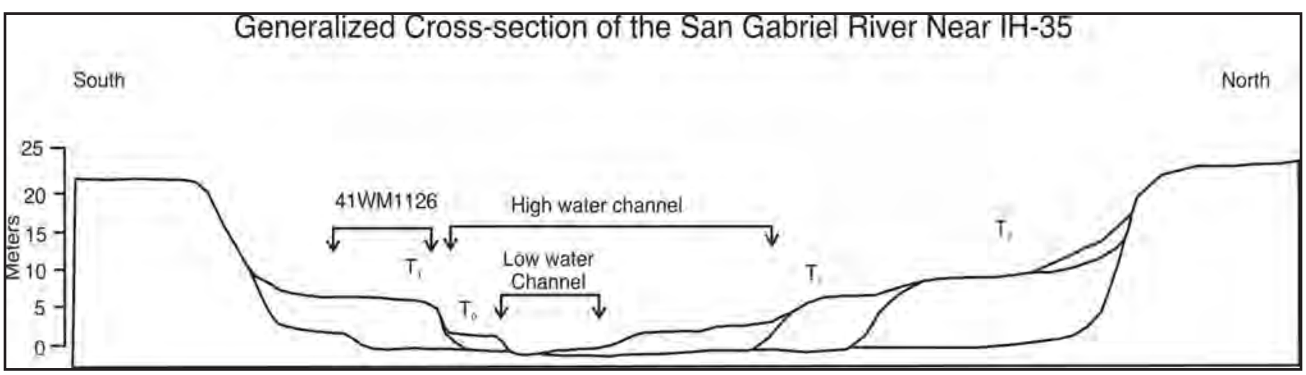


Figure 5.16. Generalized cross-section depicting the constructional geomorphic surfaces observed along the South Fork of the San Gabriel River in the vicinity of the Siren site. At least three allostratigraphic depositional units are present in this area, at least one beneath each surface, and these are also depicted. Alluvial surface heights are relative, and were not precisely measured. Horizontal is not to scale.

colluvial slope at the rear of the terrace. The northern limit of this trench (BHT D) was predicated by the natural gas pipeline that crossed the site parallel to the colluvial slope. This excavation (Figure 5.17) revealed a thin veneer of recent fill deposits, unconformably resting upon a very dark gray (7.5YR3/1) slightly gravelly to gravelly clay A horizon that contained two distinct tongues of coarse colluvial debris consisting of angular limestone and chert fragments (Zone 2). Zone 2 can be correlated with the previously defined cultural Stratum 2, but, given its location and clear colluvial origins, this correlation may merely be an artifact or coincidence of pedogenesis rather than one of chronological significance. Zone 2 rested on Zone 3, which was a dark brown (7.5YR3/2) slightly gravelly clay, which was also of colluvial origin. Zone 3 is tentatively correlated with Stratum 4, which was identified in BHT A and BHT C during testing. A tongue of brown (7.5YR4/4) alluvial silty clay (Zone 4) was observed to pinch out midway up the trench between Zone 3 and another colluvial deposit (Zone 5). A *Rabdotus* snail collected from near the upslope end of Zone 4 returned a radiocarbon date of 7010 years B.P., which suggests, in combination with the snail dated from BHT B during testing, that an early Holocene alluvial unit is present at the rear of the site, probably perched upon a bedrock strath. Two columns (termed north and south) of bulk sediment samples were collected from this exposure in order to characterize the colluvial and alluvial deposits.

Terrace Edge Profile

Close to the end of the data recovery excavations a backhoe was used to clean a vertical profile from the cutbank along the leading edge of the T_1 surface, immediately overlooking the channel of the South Fork of the San Gabriel River. This profile was situated just west of the Eastern Cutbank profile that was examined early in the testing phase excavations. This 5.6 m exposure (Figure 5.18) was designed to expose the core of the T_1 terrace in order to collect samples for radiocarbon dating, because, following the reconnaissance, the terrace was now believed to be of middle to late Holocene age, rather than early Holocene. Four radiocarbon samples were collected from the base of this deposit, two bulk sediment samples and two *Rabdotus* snails. Although there are minor inconsistencies within this group of dates, they convincingly demonstrate that this is a middle- to late-Holocene age alluvial fill correlative with the West Range alluvium at Fort Hood. The two bulk sediment samples are statistically the same age (the mean age differing by only 10 years), but the snail sample collected from the same depth as the upper bulk sediment sample is about 640 years younger, which suggests that the upper bulk sediment date may be too old, possibly due to a mean residence effect. Likewise, the lower of the two snail ages appears to be too old. Regardless of these inconsistencies, these dates clearly indicate that the alluvial architecture of the site is more complex than originally envisioned.

Overall, this profile exhibits a fining upward trend, but there are two finer textured beds, which denote short-term depositional variations. Zone 9, in particular, appears to be a possible palustrine deposit, and contained numerous aquatic snails. In the trench, this deposit looked like it contained slightly more organic matter, although the Munsell colors fail to support this field impression. The fining of the deposit towards the top of the exposure is probably more an artifact of vertical aggradation than lateral movement of the stream channel.

Macro-Stratigraphic Summary

Alluvial Architecture

The results of the data recovery phase geomorphic investigations suggest that two alluvial fills are present at the site and that the cultural deposits are preserved in the top or waning phase of the younger depositional unit. The older unit is present at the rear of the terrace and appears to be roughly correlative with the Fort Hood alluvium of Nordt (1992), having yielded *Rabdotus* snail radiocarbon ages between 10,900 and 7000 B.P. Although it is possible that these dates are in error, owing to erosion and subsequent redeposition, it is considered unlikely that both are, and there is no compelling evidence that would support rejecting the dates.

The younger alluvial fill occupies the front half of the T_1 surface and is of middle to late Holocene age and is correlative with the West Range alluvium of Nordt (1992) and the Columbus Bend Alloformation Member 2 of Blum (1992). The base of this fill is probably slightly older than 4300 years B.P., and, as the radiocarbon dates from the excavation demonstrate, this surface was still receiving small increments of alluvial overbank deposits as recently as about 900 years ago. The cultural deposits excavated at this site

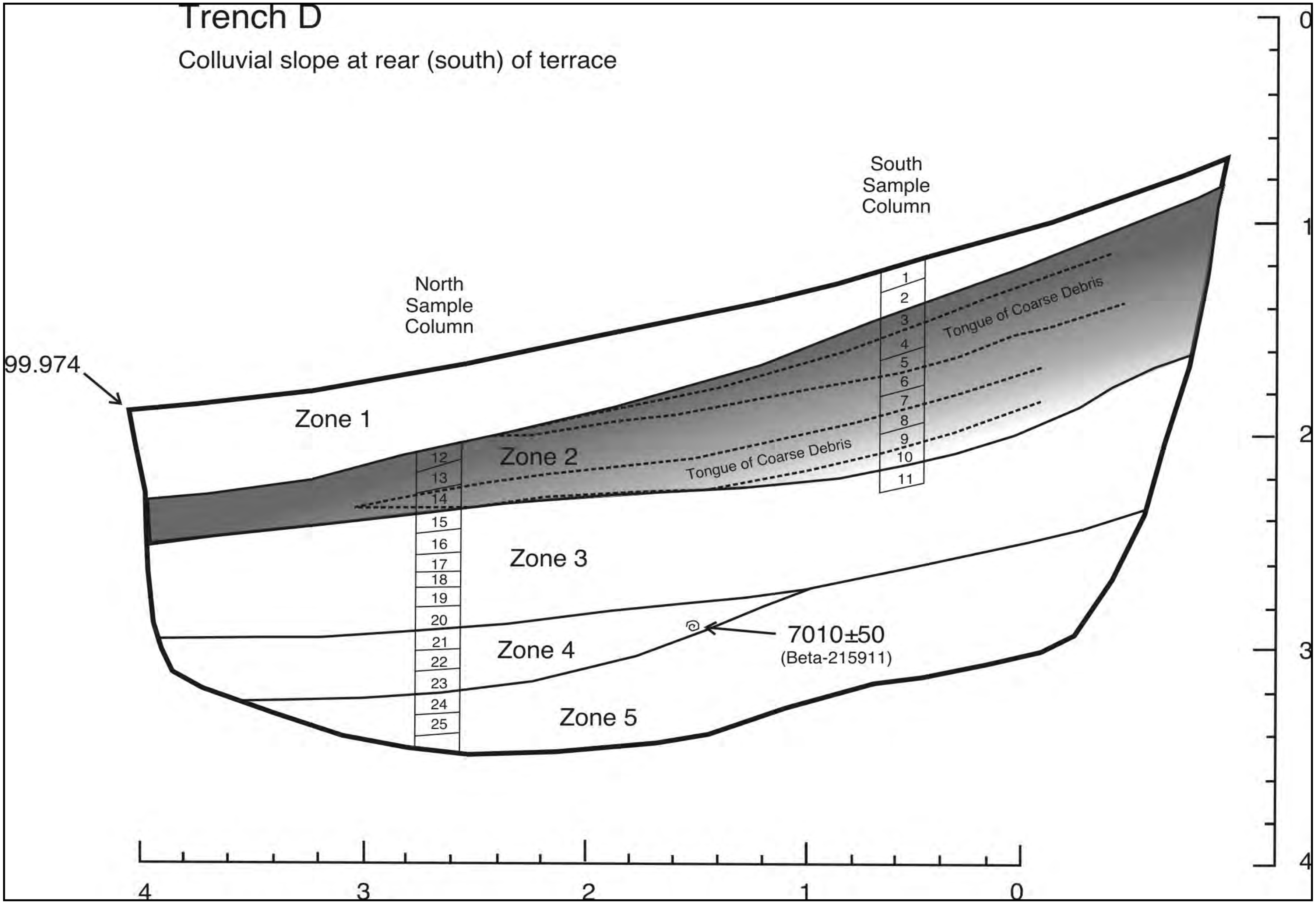


Figure 5.17. Drawing of the east wall of BHT D, located at the toe of the colluvial slope at the south end of the Siren site. Horizontal and vertical scales are in meters, and the elevation of the northeast corner of the trench is shown. Strata illustrated are described briefly in the text.

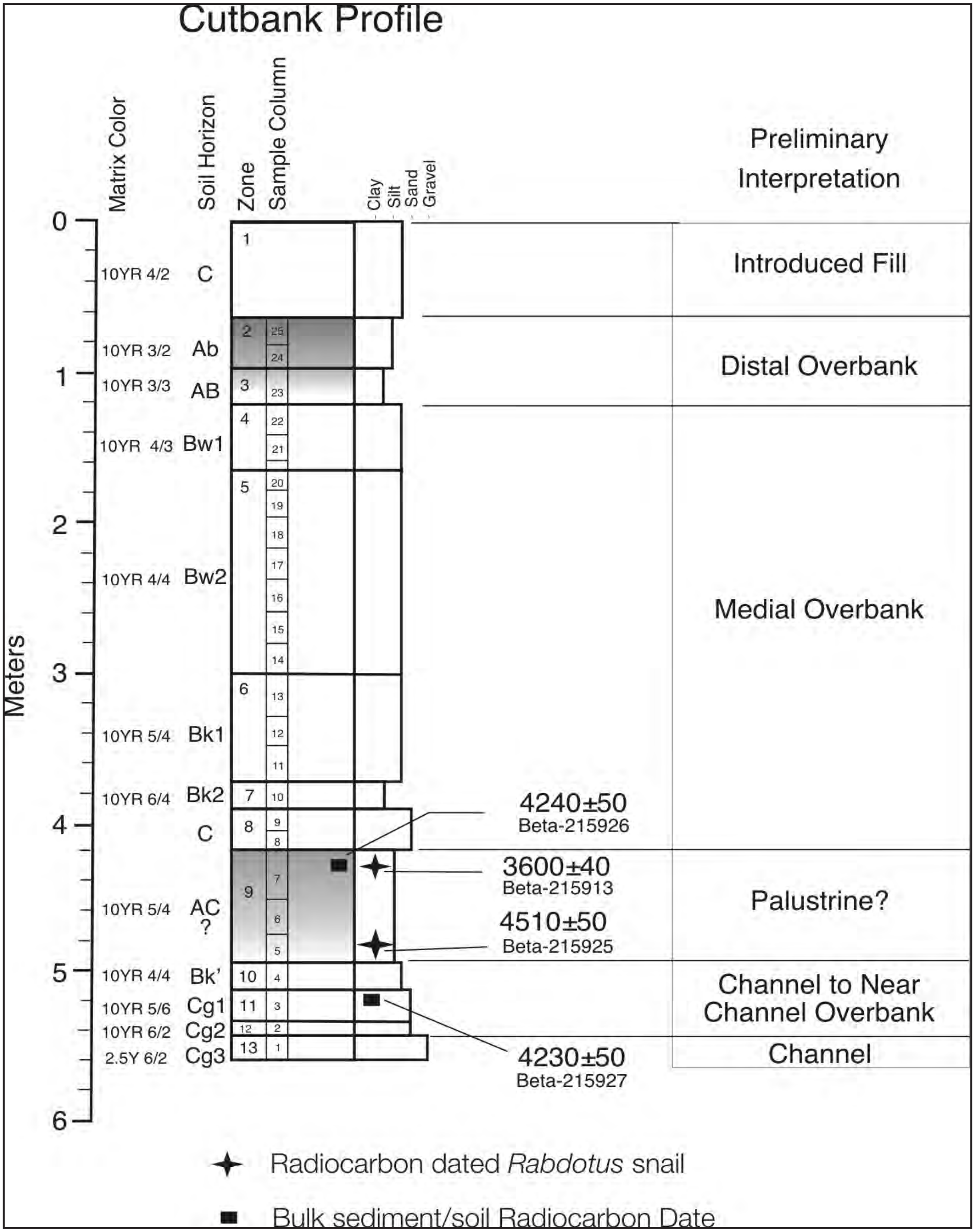


Figure 5.18. Measured section recorded from the cutbank of the T_1 surface at the northern edge of the Siren site. General lithology, soil horizons, color, results of radiocarbon dating, and samples collected for subsequent analysis are illustrated.

reside within the upper, or waning phase, segment of this depositional unit. Clarification of the relationship between the two presumed alluvial deposits was thwarted in the field by a natural gas pipeline that appears to be located in about the same place as the presumed bounding unconformity.

Chronological Structure

Though the sedimentation rate and chronology of the deposits are discussed in more detail in the following chapter, a few preliminary observations are presented here. The young alluvial deposit aggraded rapidly near its base (between 92 m and 97 m arbitrary elevation) where it appears that about 5 m of sediment accumulated in approximately 1500 years or at a rate of about 33 cm/century. This is considered to be an approximate figure given the minor age discrepancies obtained from the cutbank profile. Towards the top of the fill the sedimentation rate decreased dramatically with less than 1.4 m of sediment being deposited in about 1600 years, for a sedimentation rate of about 8.7 cm per century. It is because of this decline in sedimentation rate that the site has reasonably good archaeological visibility as well as any stratigraphic compression.

Furthermore, this decline in sedimentation rate is a general property of terraces that form primarily from vertical aggradation of overbank sediment. With every flood, the height of the floodplain increases slightly, and, at some point, the height of the floodplain reaches the height of the most common flood, after which it becomes less and less frequently inundated. Hence the change in sedimentation rate is not likely to be of regional significance, but rather is a structural attribute of alluvial fills in cut and fill depositional regimes, as has been discussed elsewhere (cf. Frederick and Abbott 2004). It is clear that the South Fork of the San Gabriel River channel probably entrenched to its present position sometime around 1,000 years ago as did most central Texas rivers, but it is difficult say exactly when that occurred on the basis of information derived from this work.

Results of Data Recovery Archaeological Investigations

The cultural material within the investigated area of the project is found in the upper segment, or waning phase, of the T_1 depositional unit. This includes the top of Stratum 3 and all of Stratum 2. The youngest cultural material is found in Stratum 2A, which was partially truncated by construction several decades ago. The majority of the cultural material is contained within Stratum 2B, which is lower portion of Stratum 2.

Excavation Blocks

Looking only at features from data recovery, the horizontal distribution of feature types is thought to be reflective of spatial variations in prehistoric activities at the site. The greatest number and diversity of feature types was found in the NW Block, which contained concentrations of FCR, a variety of hearths, the midden, a biface cache, and a debitage cache or cluster. The radiocarbon results for the NW Block also exhibited the best preserved stratigraphy at the site.

The NE Block contained six features, split between basin-shaped hearths and FCR clusters. The E Block had the least diversity and contained eight clusters of FCR and only one basin-shaped hearth.

Northwestern Block

Based on the testing results, the NW Block was the initial focus of the data recovery excavations. Sixteen 2 × 2-m excavation units were opened in the NW Block along the N1020, N1022, N1024, N1026 and N1028 lines at E1000, E1002, E1004, E1006, and E1008. All four quadrants in 10 units were excavated in five to nine levels, with six units terminating at 97.8 m and the others at 97.6, 97.7, and 97.8 m. Twenty-one features were recorded in the NW Block: Features 1, 8, 12, 13, 14, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 30, 31, 35, and 42.

Feature 8 was an incipient burned rock midden that was originally designated during testing excavations at the Siren site. An approximately 5-m-long lens of fire-cracked rock was visible in the northern profile of BHT B. At first, it was not recognized that Feature 8 was a midden; it was thought to be possibly a large hearth or simply a scatter of burned rock, until the central hearth feature was revealed at the end of the investigations. Because this feature overlays much of the site, it will be discussed separately at the conclusion of the excavation unit section.

Eight of the features in the NW Block were large hearths (1, 12, 16, 17, 20, 30, 31, and 35) and four of these (16, 20, 30, and 35) had discrete slab linings. A mano was recovered from Feature 16 that contained starch granules consistent with geophyte exploitation.

Geophytes themselves were recovered at two of the hearth features (30 and 35). Fifteen radiocarbon assays from seven of these features resulted in 2-sigma age estimates ranging from 960–2470 B.P., with six of these overlapping at about 1000 B.P. Four of the remaining nine age estimates clustered around 2000 B.P., with another four clustered at 2400 B.P. and one at 1400 B.P. (Table 5.5).

Ten of the NW Block features (13, 14, 18, 19, 21, 23, 24, 25, 27, and 42) were smaller clusters of burned rock in various circular or oval shapes with flat to shallow basins. Two burned geophyte bulbs were recovered from Feature 23. Nine radiocarbon assays from six of these features resulted in 2-sigma age estimates ranging from 950 to 2350 B.P., with six of these overlapping at about 1000 B.P. The remaining three age estimates clustered around 2000 B.P.

The last two features in the NW Block are a biface cache and residue from a flint knapping event. Neither feature had associated radiocarbon samples.

Other artifacts encountered in the NW Block include 74 dart points, 10 arrow points, 195 bifaces, 30 cores, 37 scrapers, 46 modified flakes, seven pieces of groundstone, a bone tool, nearly 2,000 kg of burned rock, more than 50,000 pieces of debitage, mussel shell, and almost 4 kg of faunal remains. The projectiles from this block included seven Scallorn, an Edwards, and two untyped arrows in the upper levels with 19 Ensor, eight Fairland, seven Frio, four Castroville, three Frio-Ensor, two Ellis and a Marcos. Table 5.6 provides an overview and a breakdown of the artifact counts by level; however, artifacts from some features that spanned several levels are not included in the counts and weights by level. Artifacts from features are included in the total counts for the block. Despite the lack of some feature artifacts, a spike in artifacts is evident in Levels 4 through 6. All four component are present in the NW Block.

Northeastern Block

Extensive mechanical stripping of construction fill was necessary in the NE Block as it thickened to the east across the site. Once the fill was removed, it was apparent that the majority of upper Late Prehistoric deposits were missing in this area. The construction of the extant bridge and placement of fill had apparently truncated the upper 20-50 cm of the site in this area. However, as the intent of this block was to create a larger horizontal exposure of the "Transitional Archaic" deposits, the block was successful as a dense concentration of materials dating to this period was recovered.

Six 2 x 2-m excavation units were opened in the NE Block along the N1024 and N1026 lines at E1010, E1012, and E1014. All four quadrants in each unit were excavated in 9 to 13 levels, with all units terminating at 97.0 m. Seven features were recorded in the NE Block: Features 28, 29, 33, 34, 36, 37, and 41.

Two of the features in the NE Block were slab-lined hearths (36 and 41), while the others were smaller clusters of burned rock in various circular or oval shapes with shallow basins. Three radiocarbon assays from the slab-lined features resulted in 2-sigma age estimates for Feature 36 of 2360–2310 and 2230–2200 B.P., while Feature 41 has two associated radiocarbon samples whose resulting dates do not overlap. One 2-sigma calibrated age estimate for Feature 41 is 2770–2720 B.P., while the other is 2320–2100 B.P. and 2090–2060 B.P. These discrepancies reflect contextual mixing in the block due to the reuse of rock features on a semi-stable surface.

Artifacts encountered in the NE Block include 82 dart points, 160 bifaces, 26 cores, 32 scrapers, 42 modified flakes, six pieces of groundstone, three bone tools, about 1,200 kg of burned rock, nearly 27,000 pieces of debitage, mussel shell, and more than 4 kg of faunal remains. The projectiles from this block included 24 Ensor, 10 Frio, four each of Castroville and Frio-Ensor, three each of Fairland, Marshall, and Pedernales, one each Ellis, Marcos, and Montell, as well as 28 untyped points. Table 5.7 provides an overview and a breakdown of the artifact counts by level; however, artifacts from some features that spanned several levels are not included in the counts and weights by level. Artifacts from these features are included in the total counts for the block. Despite the lack of some feature artifacts, a spike in artifacts is evident in Levels 4 and 5. Three (AUs 2a, 2b and 3) of the four component AUs are present in the NE Block.

Southwestern Block

The SW Block was initially opened to follow Feature 8, the incipient burned rock midden discussed in greater detail in Chapter 7, to the south and explore its dimensions and composition. Two 2 x 2-m excavation units were opened in the SW Block along the E1006

Table 5.5. Summary of Radiocarbon Dates and Proveniences from Data Recovery

SWCA Sample #	Beta #	Elevation (m)	Context	Measured ^{14}C(BP)	$^{13}C/^{12}C$ Ratio	Conventional ^{14}C (BP)*	2-Sigma Calibrated Age Estimate	Dated Material
C-97	215915	97.96-97.928	Feature 25	990 ± 40	-25.6 o/oo	980 ± 40	AD 990 to 1160 (BP 960 to 790)	Quercus wood
C-44	250549	98.30	Feature 14	1040 ± 40	-25.4	1030 ± 40	AD 900 to 920 (BP 1050 to 1040) and AD 960 to 1040 (BP 990 to 910)	carbonaceous sediment
C-47	250552	98.2	Feature 12	1050 ± 40	-25.4	1040 ± 40	AD 900 to 920 (BP 1050 to 1030) and AD 950 to 1040 (BP 1000 to 920)	carbonaceous sediment
C-91	250560	98.02-97.98	Feature 25	1080 ± 40	-24.2	1090 ± 40	AD 880 to 1020 (BP 1070 to 930)	Quercus wood
C-48	215912	98.28	Feature 13	1120 ± 40	-26.5 o/oo	1100 ± 40	AD 880 to 1010 (BP 1070 to 940)	carbonaceous sediment
C-45	250550	98.23	Feature 13	1100 ± 40	-24.5	1110 ± 40	AD 870 to 1010 (BP 1080 to 940)	carbonaceous sediment
C-46	250551	98.31	Feature 14	1140 ± 40	-26.3	1120 ± 40	AD 810 to 1010 (BP 1140 to 940)	carbonaceous sediment
C-56	250554	98.08	Feature 16	1130 ± 40	-25.2	1130 ± 40	AD 780 to 1000 (BP 1160 to 950)	Quercus wood
C-74	215914	98.02	Feature 16	1170 ± 40	-25.0 o/oo	1170 ± 40	AD 770 to 980 (BP 1180 to 970)	Quercus wood
C-67	250555	98.05	Feature 16	1170 ± 40	-23.9	1190 ± 40	AD 710 to 750 (BP 1240 to 1200) and AD 760 to 900 (BP 1190 to 1050); AD 920 to 960 (BP 1040 to 990)	Quercus wood
C-72	250557	98.00	Feature 16	1260 ± 40	-24.8	1260 ± 40	AD 660 to 880 (BP 1280 to 1070)	Quercus wood
C-60	215913	98.21	Feature 17	1560 ± 40	-25.8 o/oo	1550 ± 40	AD 420 to 610 (BP 1530 to 1340)	unidentified charred material
C-53	250553	98.5-98.4	Feature 15	1740 ± 40	-25.6	1730 ± 40	AD 230 to 410 (BP 1720 to 1540)	unidentified charred material
C-157	299315	97.94	n/a	1750 ± 30	-25.0 o/oo	1750 ± 30	AD 230 to 380 (BP 1720 to 1570)	unidentified charred material
C-187	250580	97.00	n/a	1810 ± 40	-25.8	1800 ± 40	AD 120 to 330 (BP 1830 to 1620)	unidentified charred material
C-133	250569	97.64	n/a	1820 ± 50	-25.6	1810 ± 50	AD 80 to 340 (BP 1870 to 1610)	unidentified charred material
C-118	250566	97.78	Feature 30	1900 ± 40	-26.2	1880 ± 40	AD 50 to 230 (BP 1900 to 1720)	carbonaceous sediment
C-75	250558	98.12	Feature 18-A	1900 ± 40	-25.7	1890 ± 40	AD 30 to 230 (BP 1920 to 1720)	unidentified charred material
C-83	250559	98.03-97.98	Feature 20	1900 ± 40	-25.3	1900 ± 40	AD 20 to 220 (BP 1930 to 1730)	unidentified charred material
S-29	299317	98.03	Feature 23	1940 ± 30	-23.2 o/oo	1930 ± 30	BC 40 to AD 80 (BP 1990 to 1870)	Liliaceae bulb fragment
C-68	250556	98.2-98.18	Feature 17	1970 ± 40	-25.1	1970 ± 40	BC 50 to AD 120 (BP 2000 to 1830)	Quercus wood
C-116	250565	97.90	Feature 30	1970 ± 40	-24.8	1970 ± 40	BC 50 to AD 120 (BP 2000 to 1830)	unidentified charred material
C-101	299314	97.77	n/a	2050 ± 30	-25.2 o/oo	2050 ± 30	BC 160 to AD 10 (BP 2110 to 1940)	unidentified charred material
C-181	215921	97.59	Stratum 3	2070 ± 40	-25.1 o/oo	2070 ± 40	BC 190 to AD 20 (BP 2140 to 1930)	carbonaceous sediment
C-160	299316	97.85	n/a	2080 ± 30	-25.4 o/oo	2080 ± 30	BC 170 to 10 (BP 1720 to 1570)	Quercus wood
C-162	215919	97.31	Stratum 3	2110 ± 40	-26.1 o/oo	2090 ± 40	BC 200 to 10 (BP 2150 to 1960)	unidentified charred material

Table 5.5. Summary of Radiocarbon Dates and Proveniences from Data Recovery (continued)

SWCA Sample #	Beta #	Elevation (m)	Context	Measured ^{14}C(BP)	$^{13}C/^{12}C$ Ratio	Conventional ^{14}C (BP)*	2-Sigma Calibrated Age Estimate	Dated Material
C-98	250561	98-97.9	Feature 23	2210 ± 40	-26.9	2180 ± 40	BC 370 to 150 (BP 2320 to 2100) and BC 140 to 110 (BP 2090 to 2060)	unidentified charred material
C-163	250575	97.43	Feature 41	2180 ± 40	-25.1	2180 ± 40	BC 370 to 150 (BP 2320 to 2100) and BC 140 to 110 (BP 2090 to 2060)	unidentified charred material
C-140	215917	97.59	Feature 36	2200 ± 40	-25.5 o/oo	2190 ± 40	BC 380 to 160 (BP 2330 to 2100)	unidentified charred material
C-173	250577	97.70	Feature 44	2250 ± 40	-26.3	2230 ± 40	BC 390 to 190 (BP 2340 to 2140)	unidentified charred material
C-174	250578	97.73	Feature 45	2250 ± 40	-26.3	2230 ± 40	BC 390 to 190 (BP 2340 to 2140)	Juglans wood
C-152	250573	97.59	Feature 37	2270 ± 40	-25.4	2260 ± 40	BC 400 to 340 (BP 2350 to 2290) and BC 330 to 200 (BP 2280 to 2150)	unidentified charred material
C-110	250563	97.96	Feature 27	2300 ± 40	-26.9	2270 ± 40	BC 400 to 340 (BP 2350 to 2290) and BC 320 to 210 (BP 2270 to 2160)	unidentified charred material
C-144	250571	97.56	Feature 36	2350 ± 40	-27.7	2310 ± 40	BC 410 to 360 (BP 2360 to 2310) and BC 280 to 260 (BP 2230 to 2200)	unidentified charred material
C-114	250564	97.83		2330 ± 40	-24.7	2330 ± 40	BC 410 to 370 (BP 2360 to 2320)	Quercus wood
C-189	215922	97.44	Feature 35	2400 ± 40	-26.8 o/oo	2370 ± 40	BC 520 to 380 (BP 2470 to 2330)	carbonaceous sediment
C-172	250576	97.23	Feature 35	2390 ± 40	-25.2	2390 ± 40	BC 730 to 690 (BP 2680 to 2640) and BC 540 to 390 (BP 2500 to 2340)	carbonaceous sediment
S-36	299318	97.54	Feature 31	2370 ± 30	-23.3 o/oo	2400 ± 30	BC 720 to 700 (BP 2670 to 2650) and BC 540 to 40 (BP 2490 to 2350)	Liliaceae bulb & bulb fragments
C-154	215918	97.54	Feature 37	2460 ± 50	-26.6 o/oo	2430 ± 50	BC 780 to 390 (BP 2730 to 2340)	Quercus wood
C-191	250581	97.35	Feature 35	2460 ± 40	-26	2440 ± 40	BC 760 to 400 (BP 2710 to 2350)	carbonaceous sediment
C-128	215916	97.76	Feature 8	2490 ± 40	-26.8 o/oo	2460 ± 40	BC 780 to 410 (BP 2730 to 2360)	unidentified charred material
C-121	250567	97.72	n/a	N/A	N/A	2470 ± 40	BC 780 to 410 (BP 2730 to 2360)	bone (burned)
C-149	250572	97.50	Feature 8	2500 ± 40	-26.4	2480 ± 40	BC 780 to 410 (BP 2730 to 2360)	Quercus wood
C-129	250568	97.69	Feature 8	2490 ± 40	-25.1	2490 ± 40	BC 780 to 410 (BP 2740 to 2360)	unidentified charred material
C-180	250579	97.08	n/a	2510 ± 40	-23.6	2530 ± 40	BC 800 to 530 (BP 2750 to 2480)	unidentified charred material
C-164	215920	97.54	Feature 8	2590 ± 40	-25.3 o/oo	2590 ± 40	BC 820 to 770 (BP 2770 to 2720)	Quercus wood
C-107	250562	97.83	Feature 8	2580 ± 40	-24.5	2590 ± 40	BC 810 to 760 (BP 2760 to 2710) and BC 680 to 670 (BP 2630 to 2620)	unidentified charred material
C-138	250570	97.37	Feature 35	2610 ± 40	-25.5	2600 ± 40	BC 820 to 760 (BP 2770 to 2710)	unidentified charred material
C-161	250574	97.41	Feature 41	2620 ± 40	-25.7	2610 ± 40	BC 820 to 760 (BP 2770 to 2720)	unidentified charred material

Table 5.5. Summary of Radiocarbon Dates and Proveniences from Data Recovery (continued)

SWCA Sample #	Beta #	Elevation (m)	Context	Measured ^{14}C(BP)	$^{13}C/^{12}C$ Ratio	Conventional ^{14}C (BP)*	2-Sigma Calibrated Age Estimate	Dated Material
C-192	215923	Zone 9 425-430 cm	BHT E	3370 ± 40	-10.7 o/oo	3600 ± 40	BC 2040 to 1880 (BP 3990 to 3830)	shell
C-197	215927	570-580 cm	BHT E	4160 ± 50	-20.6 o/oo	4230 ± 50	BC 2910 to 2850 (BP 4860 to 4800) and BC 2820 to 2670 (BP 4770 to 4620)	organic sediment
C-196	215926	425-430 cm	BHT E	4170 ± 50	-20.6 o/oo	4240 ± 50	BC 2920 to 2850 (BP4860 to 4800) and BC 2820 to 2680 (BP 4770 to 4630)	organic sediment
C-194	215925	Zone 9 485 cm	BHT E	4220 ± 50	-7.6 o/oo	4510 ± 50	BC 3360 to 3020 (BP 5310 to 4970)	shell
C-41	215911	2.35m-1.5cmbs-92. cm	BHT D base of slope	6760 ± 50	-9.6 o/oo	7010 ± 50	BC 5990 to 5760 (BP 7940 to 7710)	shell

* Conventional Radiocarbon Age is the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C.

Dates not clearly associated with archaeological contexts: used to define depositional chronology

Table 5.6. NW Block Artifact Counts and Weights

Artifact Type	Total Count	Total Weight (g)
Arrow Point	10	7.3
Burned Rock	30,322	1,962,765.0
Biface	195	4,062.3
Bone	N/A	3,793.3
Bone Tool	1	0.8
Core	30	4,501.5
Dart Point	74	402.4
Debitage	50,260	N/A
Groundstone	7	3,046.1
Hammerstone	1	457.3
Misc. Formal Tool	6	624.5
Mussel Shell	25	N/A
Modified Flake	46	1,911.8
Scraper	37	2,327.8
Total	**81,014**	**1,983,900.1**

Level	Total Count	Total Weight (g)
1	3,704	47,872.8
2	7,127	227,848.8
3	8,339	133,016.2
4	12,244	197,237.6
5	17,698	262,071.4
6	13,487	230,642.9
7	7,772	163,952.7
8	2,862	128,133.3
9	700	9,800.0
10	211	2,902.4
11	186	319.3
12	63	400.1
13	27	200.0

line at N1016 and at N1018. Three and five levels, respectively, were excavated at these units before massive limestone boulders were encountered that prompted investigators to focus on more productive areas of the site. Feature 15 was a shallow basin-shaped concentration of burned limestone rocks. One radiocarbon sample from Feature 15 (Beta 250553) was analyzed, and the resulting 2-sigma calibrated age estimate is 1720–1540 B.P. A Fairland point was within a 2-m radius of the feature's center and within 10 cm

Table 5.7. NE Block Artifact Counts and Weights

Artifact Type	Total Count	Total Weight (g)
Burned Rock	16,799	1,207,050.0
Biface	160	3,397.4
Bone	N/A	4,180.4
Bone Tool	3	2.8
Core	26	7,026.0
Debitage	26,964	N/A
Dart Point	82	547.8
Ground Stone	6	6,107.1
Misc. Formal Tool	4	87.8
Mussel Shell	11	N/A
Modified Flake	42	2,456.0
Scraper	32	1,788.2
Total	**44,129**	**1,232,643.5**

Level	Total Count	Total Weight (g)
1	2,522	34,523.0
2	8,130	174,617.1
3	7,937	205,387.5
4	7,757	193,282.7
5	7,972	169,945.2
6	4,267	117,855.8
7	2,568	119,612.1
8	815	21,995.5
9	646	9,091.8
10	519	3,442.0
11	182	2,689.6
12	121	1,314.3
13	66	700.0

of the estimated elevation of the feature's origination surface.

Other artifacts encountered in the SW Block included four projectile points (Ensor, Fairland, and two untyped), 18 bifaces, two cores, one modified flake, one bone tool, over 116 kg of burned rock, nearly 2,500 pieces of debitage, small amounts of mussel shell, and a small amount of faunal remains. Table 5.8 provides an overview and a breakdown of the artifact counts by level. Only Stratum 2B is present in the SW Block.

Table 5.8. SW Block Artifact Counts and Weights

Artifact Type	Total Count	Total Weight (g)
Burned Rock	1,677	116,350.0
Biface	18	206.6
Bone	N/A	163.1
Bone Tool	1	1.7
Core	2	300.6
Debitage	2,447	N/A
Mussel Shell	3	N/A
Modified Flake	1	8.8
Projectile Point	4	12.8
Total	**4,153**	**117,043.6**

Level	Total Count	Total Weight (g)
1	250	2,369.5
2	542	33,633.3
3	972	26,658.9
4	1,353	21,003.2
5	1,036	33,377.0

Eastern Block

The E Block was the last excavation area opened, with a goal of exposing a broader portion of the site. When it was opened, the larger burned rock features in the NW Block had been largely exposed, and E Block was established to determine whether similar, large burned rock features were also present in this portion of the site and, if so, how distinct were they and how did they compare in diversity and size with those from other blocks. Discerning off-midden activity areas was also a goal for the E Block.

Five 2 × 2-m excavation units were opened in the E Block along the N1022 and N1024 lines at E1020, E1022, and E1024. All four quadrants in four units were excavated in 10–13 levels, with three units terminating at 97.5 m and one at 97.4 m. Unit N1024 E1020 was excavated in two levels in only the southwest and southeast quadrants to 98.5 m. Nine features were recorded in the E Block: Features 38, 39, 40, 43, 44, 45, 46, 47, and 48.

All nine features were clusters of burned rock in various circular or oval shapes with flat to shallow basins. Two radiocarbon assays from Features 44 and 45 (Beta 250577 and 250578) each resulted in identical 2-sigma age estimates of 2340–2140 B.P.

Artifacts encountered in the E Block include 60 dart points, a Scallorn and two untyped arrow points, 143 bifaces, 28 cores, 22 scrapers, 41 modified flakes, five pieces of groundstone, four bone tools, nearly 600 kg of burned rock, more than 25,000 pieces of debitage, mussel shell, and almost 5 kg of faunal remains. The dart points from this block included 12 Ensor, 10 Fairland, six Frio, four Castroville, one each of Frio-Ensor, Kinney, Marcos, Marshall and Pedernales, and 23 that were untyped. Table 5.9 provides an overview and a breakdown of the artifact counts by level; however, artifacts from Feature 40, which spanned Levels 7 and 8, were not included in the counts and weights by level. Artifacts from Feature 40 are included of the total counts for the block. Despite the lack of feature artifacts, a spike in artifacts is evident in Levels 7–9 and faunal remains were denser in the E Block. The E Block contains AUs 1, 2a, and 2b.

Feature 8 – Burned Rock Midden

During data recovery, Feature 8 was initially encountered in the southern units of the NW Block at approximately 98.0 m and misinterpreted as a dense cluster of burned rock extending from BHT B approximately 1.2 m into the excavation block. As excavations progressed, it became apparent that Feature 8 extended much farther than originally believed, essentially covering the entire NW Block. The midden appeared in some places to have been either cut into the underlying strata, or filled voids left by earlier features, such as Feature 35.

Due to the nature of the feature and the complications it caused for the excavations, much of the fabric of the midden was left in situ. Ten 50 × 50-cm column samples were excavated through the midden to characterize its thickness and composition, and BHT E was excavated near the end of the season through the midden along the E1006 line to get a better north-south profile of the feature.

BHT E, which was excavated after the top of the midden had been exposed, located a central pit within the midden. The central pit was a concave basin cut into the underlying strata and lined with large limestone slabs.

In general, the density of artifacts within the fabric of the midden was very low when compared to deposits above and east of the feature. Very little faunal material

Table 5.9. E Block Artifact Counts and Weights

Artifact Type	Total Count	Total Weight (g)
Arrow Point	3	2.0
Burned Rock	9,935	564,250.0
Biface	143	3,420.2
Bone	N/A	4,930.0
Bone Tool	4	7.1
Core	28	5,171.1
Dart Point	60	396.2
Debitage	25,032	N/A
Mussel Shell	16	N/A
Groundstone	5	2,110.2
Glass (Historic)	1	N/A
Misc. Formal Tools	2	62.7
Modified Flake	41	1,657.2
Tested Cobble	1	302.9
Scraper	22	1,450.9
Worked Shell	1	3.8
Total	**35,294**	**583,764.3**

Level	Total Count	Total Weight (g)
1	374	3,055.2
2	427	3,063.9
3	108	1,610.3
4	2,791	36,688.0
5	3,863	32,602.9
6	3,167	45,526.1
7	5,137	99,198.3
8	6,300	120,498.3
9	5,324	84,498.5
10	4,647	118,778.7
11	1,723	18,367.8
12	1,106	16,833.8
13	201	3,035.4

and only small amounts of charcoal were recovered from the midden. Five radiocarbon samples from Feature 8 were analyzed (Beta 215916, 250572, 250568, 215920, and 250562) and the resulting dates cluster at 2700 B.P. A geophyte was collected from the base of the midden rocks.

Findings by Geomorphic Strata

Chapter 8, which regards site structure, will break down the site into finer cultural components, but for the purposes at hand, a basic overview of the major stratigraphic divisions is presented here, setting up the more detailed analysis of components. Accordingly, in broad terms three basic geomorphic units defined in the field are generally correlated with the archaeological findings: the deep Archaic deposits predating approximately 2600 B.P., the Archaic deposits spanning approximately 2600 to 1550 B.P., and the Late Prehistoric component. The deeper deposits, as agreed upon based on multiple considerations, were not the subject of data recovery investigations. Consequently, the post-2600 Archaic and the overlying Late Prehistoric components were investigated. These fall within previously discussed geomorphic depositional units 2A, 2B, and 3. Based on the general distributions of radiocarbon dates, the basic temporal parameters of the depositional units are evident (Figures 5.19–5.22),). These patterns are explored in greater detail in Chapter 8.

Depositional Unit 2A

The Late Prehistoric component, Unit 2A, was disturbed in some areas but well preserved in others. As was known from testing, the component had been partially destroyed by the disturbances associated with the original construction of IH 35. The data recovery determined that an even smaller sample of the Late Prehistoric component remained than had been anticipated.

Intact Late Prehistoric deposits related to this component were found in the northeastern corner of the NW Block and in the E Block. However, significant amounts of cultural material related to the Late Prehistoric component were only found in the NW Block. While the E Block contained intact deposits below the fill layer, very few artifacts and no features were discovered in that portion of the site.

The Late Prehistoric component was temporally defined by 14 radiocarbon dates that clustered around 1000 B.P. (see Table 5.5). These samples were obtained from seven of the nine features assigned to the component. The features were assigned to this component on the basis of proximity to one another, stratigraphic position, and associated temporally diagnostic artifacts.

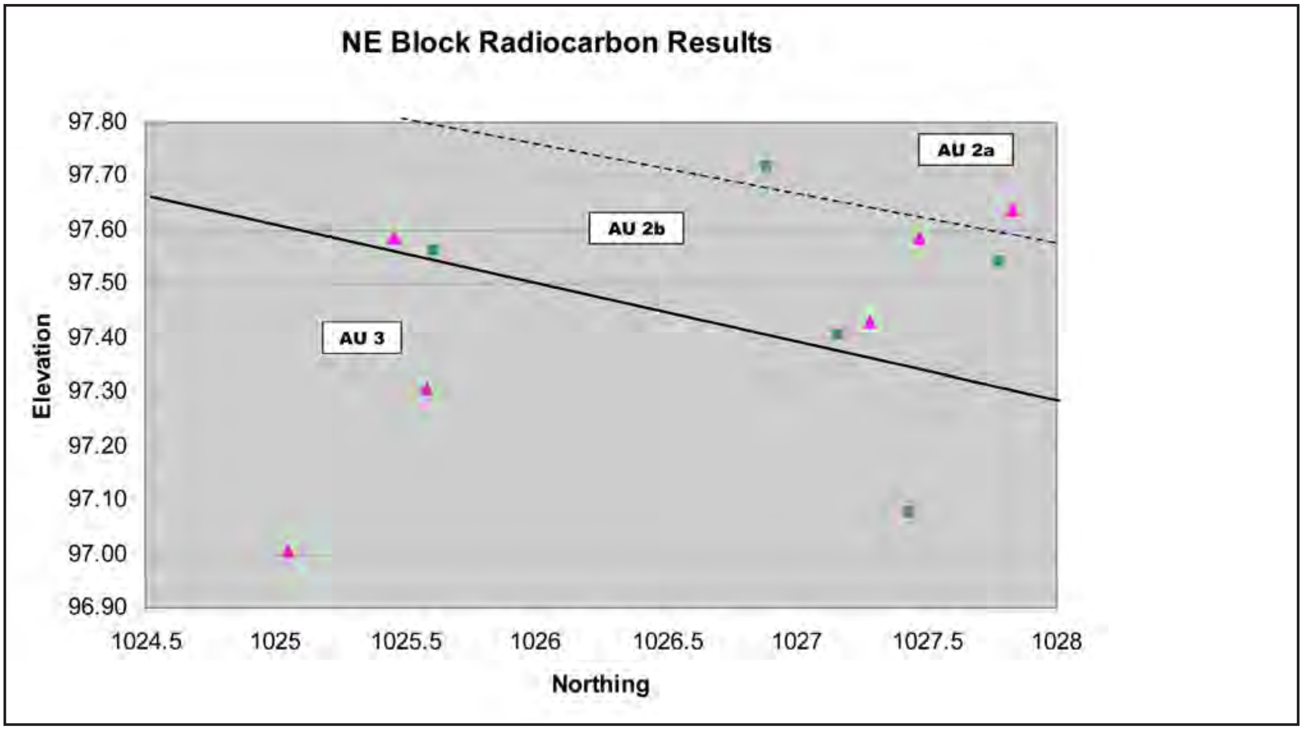


Figure 5.19. Distribution of radiocarbon results for the NE Block. AU 2 is represented by pink triangles and AU 3 dates are represented by green squares.

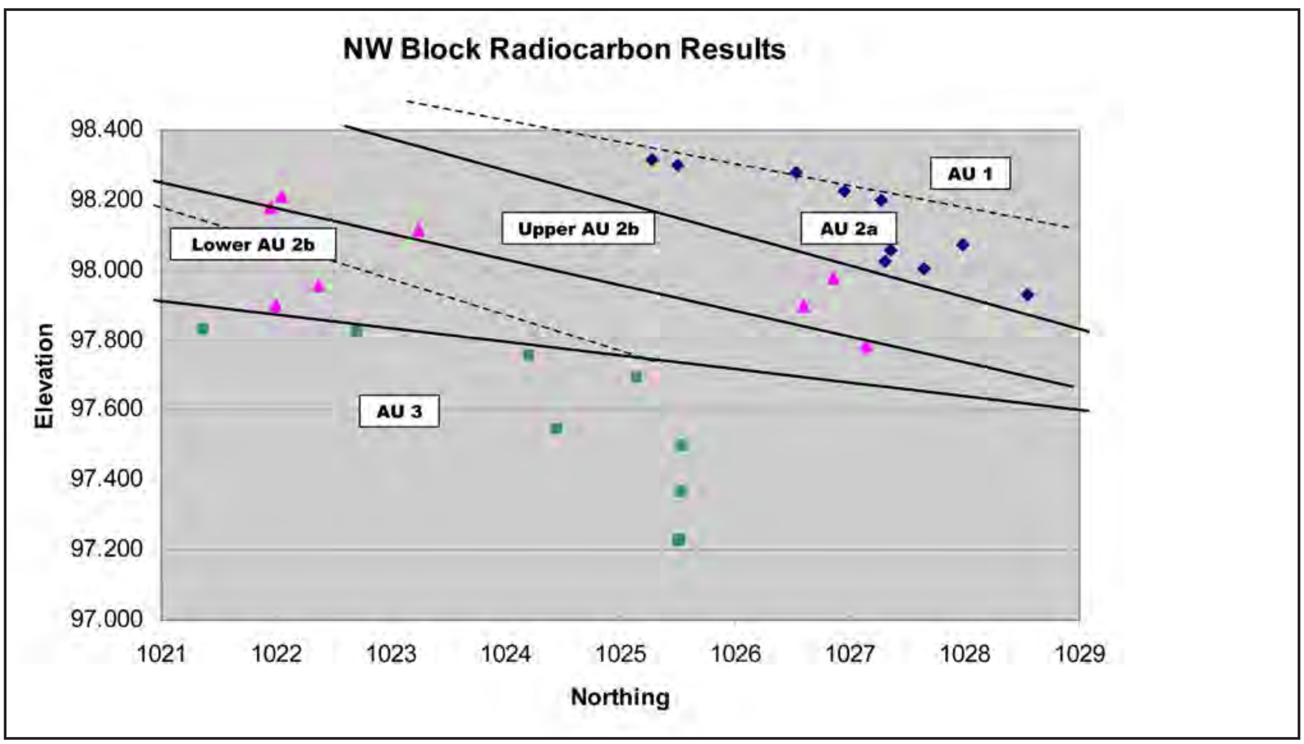


Figure 5.20. Distribution of radiocarbon results for the NW Block. Blue diamonds represent AU 2a dates, AU 2b is represented by pink triangles, and AU 3 dates are represented by green squares.

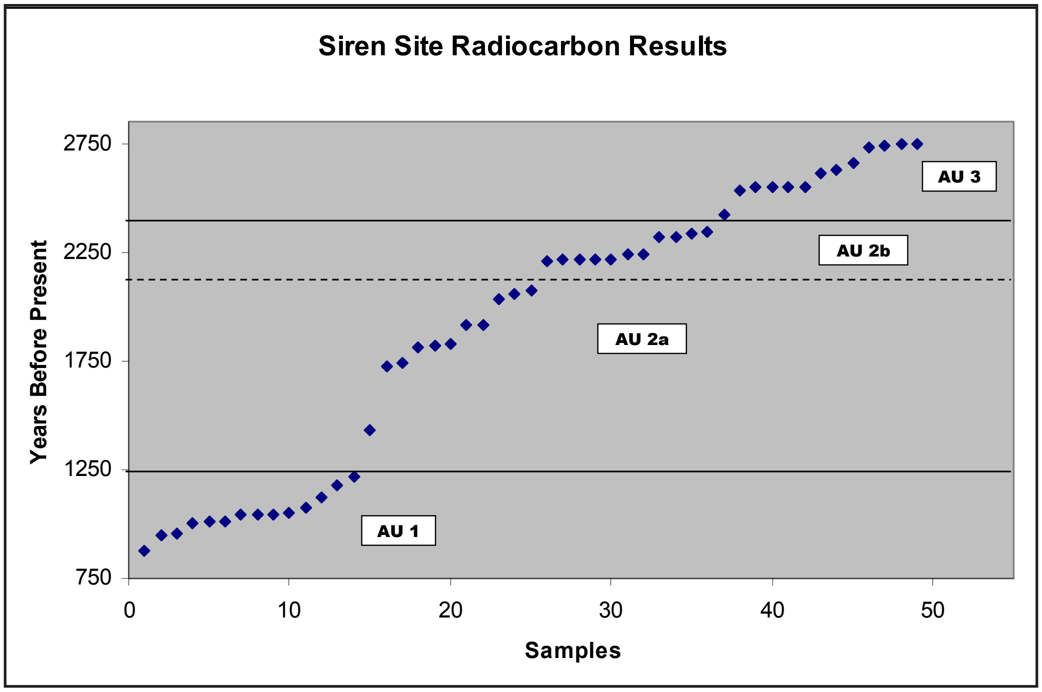


Figure 5.21. Radiocarbon results with AUs indicated.

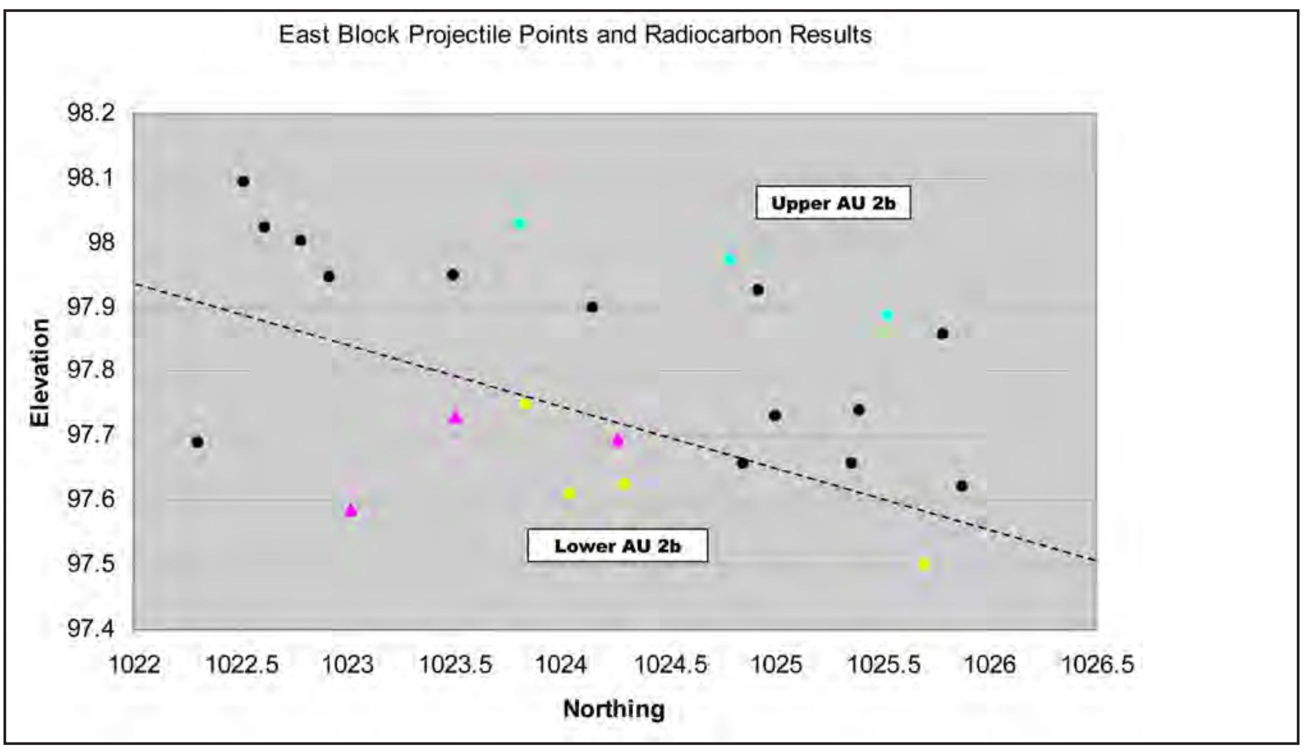


Figure 5.22. Distribution of radiocarbon results and projectile points for the E Block. Ensor, Fairland, and Frio are represented by black circles, earlier Archaic points are blue circles, Late Archaic points are yellow circles, and the pink triangles represent the AU 2b radiocarbon results.

Although small and partially truncated, the Late Prehistoric component at the Siren site is extremely interesting. It includes a cluster of discrete burned rock features that range from small fire-cracked rock (FCR) concentrations to the large, slab-lined Feature 16 (Figure 5.23). The cluster, which comprises nine features, including five from testing, is contained within an area covering approximately 20 m^2. More extensive descriptions of the features are presented in Chapter 7 of this volume.

Date Ranges

Unit 2A is a Late Prehistoric component that spans ca. 1250–980 B.P. The analytical unit is defined by a combination of radiocarbon results from testing and data recovery, as well as features and diagnostic artifacts. Features 1, 6, and 12 were identified during testing and produced four radiocarbon assays. The four features from data recovery (13, 14, 16, and 25) produced 10 radiocarbon results, including two dates each from Features 13, 14, and 25 and four dates from Feature 16.

Diagnostics

Overall, Unit 2A contained nine arrow points (six Scallorn, Edwards, and two untyped) as well as two dart points (Ellis and untyped). Feature 1 was dated to the Late Prehistoric period based on the presence of several Scallorn arrow points. Features 6 and 12 did not have diagnostic artifacts in association. Temporally diagnostic artifacts within a 2-m radius of the Feature 13's center and within 10 cm of the estimated elevation of the feature's origination surface included an Edwards arrow point. Feature 14 was also associated with the Edwards arrow point. Feature 16 was associated with four arrow points (three Scallorn and an Edwards) and an Ellis dart point. Feature 25 was associated with two Scallorn arrow points.

Artifacts in General

The artifact assemblage of Unit 2A contains ground stone, faunal remains, lithic debitage and chipped stone tools, and FCR (Table 5.10). The groundstone assemblage consists of one mano recovered at elevation 98.236 in the N1028 unit. Faunal remains comprise 2.85 kg of bones, and as discussed in Chapter 11, white-tailed deer are the most prominent species.

The lithic artifact assemblage of Unit 2A has both formal and informal tools present. Formal tools within this analytical unit consist of 18 bifacially worked artifacts as well as three scrapers. Further, three cores were recovered from Unit 2A. In contrast, informal tools or those that suggest expedient use account for five artifacts (i.e., modified flakes) within Unit 2A. Regarding the debitage assemblage, 3,783 flakes are within Unit 2A. Finally, the weighed FCR of Unit 2A accounts for more than 188.6 kg of rock.

Features

Unit 2A includes Features 1, 6, 11, 12, 13, 14, 16, and 25. Comprehensive information about each feature is contained in Chapter 7, however, a summation is provided here. Feature 1 was a large FCR hearth encountered approximately 5 cm beneath the construction fill zone. Feature 6, originally identified in the western profile of BHT A, was a burned rock hearth with a distinct basin-shaped cross-section. Feature 11, a discrete, ovate-shaped hearth, was initially discovered during the excavation of Feature 6 and was approximately 1.5 m southeast of Feature 1. Feature 12 was a slightly dispersed hearth comprised of large, generally tabular, FCR in a tight cluster and with a flat base.

The other four features from Unit 2A were identified in the NW Block during data recovery. Feature 13 was a shallow, basin-shaped hearth with two overlapping layers of limestone cobbles. Feature 14 was a cluster of FCR in a single layer with dark charcoal staining. Feature 16 was a large slab-lined hearth with a 25-cm-deep basin and represents the most formal of all features in Unit 2A. Feature 25 was a shallow, basin-shaped hearth located immediately south of Feature 1.

Within 1 m of the margins of Feature 16 were three smaller features, two excavated during data recovery (Features 13 and 25) and one documented during testing (Feature 12). The three form an arc around the eastern side of Feature 16, although this could be an incomplete pattern as comparable excavations did not take place west of Feature 16. A second arc of features was found approximately 1 m farther east of Feature 16. This group comprised, from south to north, Feature 14 from data recovery, Feature 11 from testing, and Feature 1 from testing. The final feature in the Late Prehistoric cluster was Feature 6, also from testing, immediately east of Feature 11 (see Figure 5.8).

Of the features closest to Feature 16 (the slab-lined hearth), Features 13 and 25 were basin-shaped hearths measuring approximately 90 cm and 60 cm in diameter,

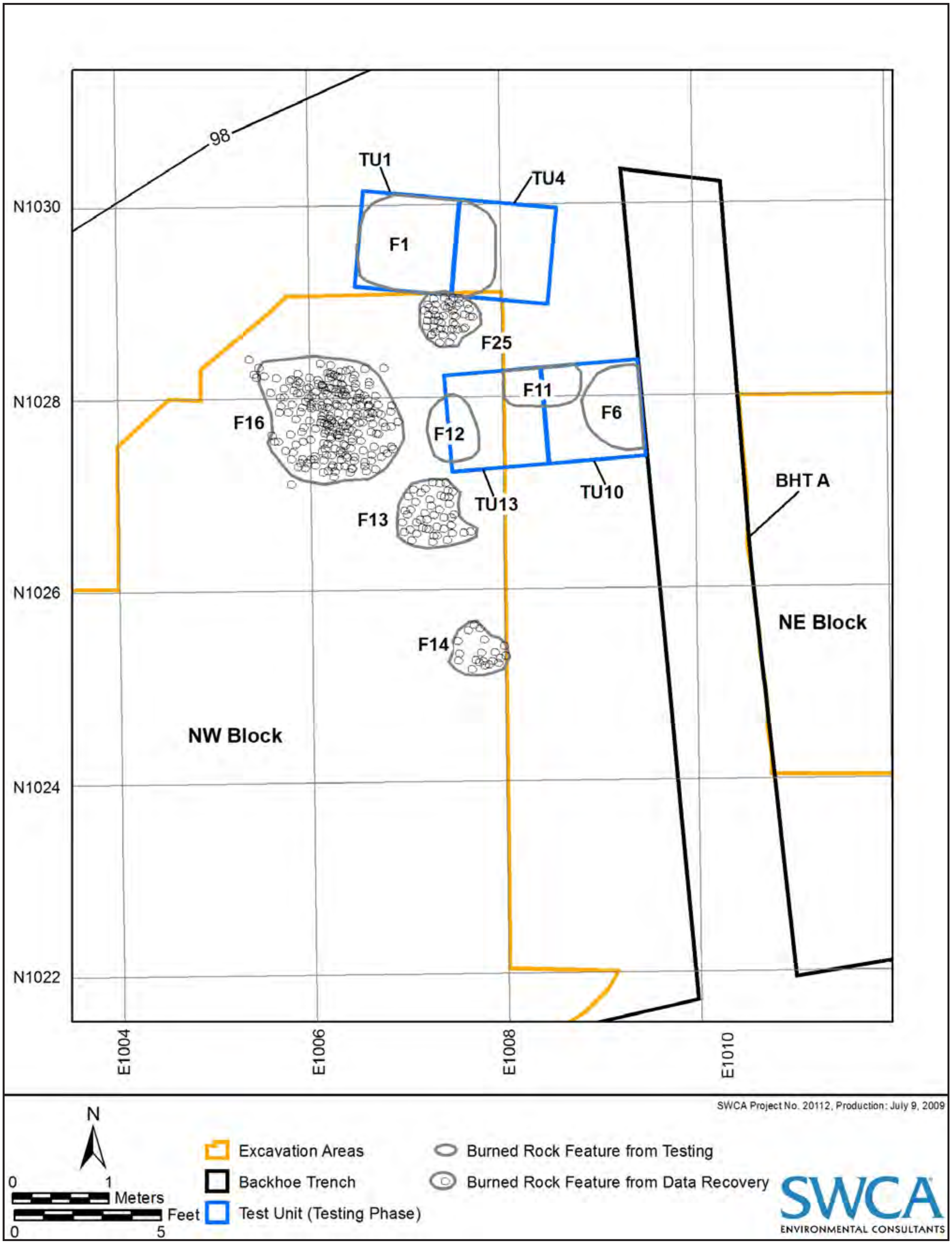


Figure 5.23. Map of Late Prehistoric feature cluster.

Table 5.10. Unit 2A Artifact Counts and Weights

Artifact Type	Total Count	Total Weight (g)
Burned Rock	1,748	188,607.7
Biface	18	106.5
Bone	N/A	285.7
Core	3	264.4
Debitage	3,783	N/A
Scraper	3	54.6
Groundstone	1	512.0
Modified Flake	5	71.0
Arrow Point	9	5.5
Dart Point	2	8.4
Total	**5,572**	**189,915.8**

respectively (Figures 5.24 and 5.25). Feature 12, was a cluster of FCR, less formally arranged than the hearths, and sitting on a flat surface. Only partially exposed during testing, the portion of Feature 12 in the data recovery excavations was damaged by vandals, but the feature probably represents a dump pile cleaned from one of the nearby hearths.

The feature cluster is dominated by Feature 16, a large slab-lined hearth measuring 150 x 127 cm (Figures 5.26 and 5.27). The hearth had been excavated into an approximately 25-cm deep basin, cutting into the underlying strata. In cross-section, the bottom of the feature was slightly concave. The margins of the basin were lined with large tabular pieces of limestone on the northern margin and stacked cobbles on the southern side. The tabular rocks were tilted approximately 45 degrees on average. The center of the feature was filled with limestone cobbles, and the bottom of the feature, while not slab-lined, was clearly defined by a lens of charcoal stained soil.

Figure 5.24. Feature 13, facing north. Note Feature 16 visible in upper left corner of the photograph.

Depositional Unit 2B Upper Division

The data recovery excavations encountered cultural material related to the final Archaic phases, distinguished most prominently by Ensor, Frio, and Fairland points, in every excavation block (Figure 5.28). This spatially extensive unit occurs below the Late Prehistoric occupation or directly below the fill layer in areas where the overlying component has been destroyed.

Date Ranges

Depositional Unit 2B spans roughly 2100/2050 to 1550 B.P. The analytical unit is defined by a combination of radiocarbon results from testing and data recovery, as well as features and diagnostic artifacts. Feature 4 was identified during testing and produced three radiocarbon assays. The five features from data recovery (Features 15, 17, 18, 20, and 30) produced seven radiocarbon results, including one date each from Features 15 (Beta 250553), 18 (Beta 250558), and 20 (Beta 250559), and two dates each from Features 17 (Beta 215913 and 250556) and 30 (Beta 250566 and 250565).

Diagnostics

Ninety-five projectile points were identified within Unit 2B consisting of 92 dart points and three arrow points (two Scallorn and one untyped). The temporally diagnostic artifacts identified (n=33) consist of 26 Ensor, 11 Fairland, six Frio, three Ensor-Frio, two Castroville, and one each of Ellis, Kinney, Marshall, and Pedernales. Of note, 18 of the dart points were encountered within a 2-m radius of a cultural feature. Feature 15 had a Fairland in association, while Feature 17 had one each of Ensor and Fairland. Feature 18 notably had one Frio and seven Ensor points. Feature 20 had one each of Ensor and Fairland, while Feature 30 had an Ellis, a Fairland, and three Ensor dart points.

Figure 5.25. Feature 25, facing north. Note the nearly vertical rocks at northern edge of the excavation. They are part of Feature 1, excavated during testing.

Artifacts in General

The artifact assemblage of Unit 2B contains ground stone, faunal remains, bone tools, lithic debitage and chipped stone tools, and FCR (Table 5.11). Eight pieces of groundstone were recovered in this component. At this stage, the faunal remains within Unit 2B have not been thoroughly examined. However, the weight measurement of this category indicates that about 3.8 kg are present within Unit 2B. Of note, four bone awls are also present within the AU 2B assemblage.

The lithic artifact assemblage of AU 2B has a noticeable quantity of formal and informal tools present. Formal tools consist of 244 bifacially worked artifacts as well as 25 scrapers and 32 cores. In contrast, informal tools account for 56 modified flakes. Regarding the debitage assemblage, almost 44,000 flakes are present within Unit 2B. Finally, the weighed FCR accounts for more than 776.4 kg of rock.

Features

Unit 2B includes Features 4, 15, 17, 18, 20, and 30. Feature 4 was a large basin-shaped hearth marked by charcoal staining truncated by the excavation of BHT A during testing. Feature 15, was an oval concentration of FCR in two layers with a shallow basin shape. This feature was encountered in the short-lived SW Block during data recovery. Feature 17 was encountered in the NW Block and was only partially excavated. The feature was a large circular hearth with a concave basin, which unfortunately was the target of vandals during the data recovery. Feature 18 consisted of two clusters (i.e., Clusters A and B) of FCR in the NW Block. Cluster A had two layers of limestone rock with the lower layer consisting of large tabular rocks, several of which exhibited in situ fracturing. By comparison, the rocks in Cluster B were very dispersed and fragmented. Feature 20 was a circular hearth consisting of large tabular rocks that tilted toward the center and formed a shallow basin. Finally, Feature 30 was a slab-lined hearth encountered immediately above Feature 8 (the burned rock midden at the site). Feature 30 had a shallow rock-lined basin that may have partially truncated the top of Feature 8.

Depositional Unit 2B Lower Division

During excavations, some areas contained a fairly discrete subcomponent marked by bison bone and broad-bladed dart points. It lies within Unit 2B, but during the lower part of the unit.

Figure 5.26. Overview of Feature 16 during initial excavations, facing north.

Date Ranges

The lower division of Unit 2B is an Archaic component spanning ca. 2300 to 2050 B.P. The analytical unit is defined by radiocarbon results exclusively from data recovery, as well as features and diagnostic artifacts. The seven features (23, 27, 36, 37, 41, 44, and 45) produced 10 radiocarbon results, including one date each from Features 27, 37, 44, and 45, and two dates each from Features 23, 36, and 41.

Diagnostics

Ninety-six projectile points, all darts, are associated with the lower Unit 2B. The temporally diagnostic artifacts include 22 Ensor, 16 Frio, eight Castroville, five Fairland, five Ensor-Frio, three Marcos, two Pedernales, an Ellis, and one Marshall, with the remainder are untyped (N=33). The diagnostics indicate a degree of mixing, but the analysis of structural site components in Chapter 8 shows somewhat better resolution.

Artifacts in General

The artifact assemblage contains groundstone, bone tools, faunal remains, lithic debitage and chipped stone tools, and FCR (Table 5.12). The groundstone component consists of five groundstone fragments. The faunal remains comprises 7.4 kg of bone. Further, two bone awls have been identified within the unit.

The lithic artifact assemblage has a noticeable quantity of both formal and informal tools present. Formal tools within this analytical unit consist of 196 bifacially worked artifacts as well as 52 scrapers and 39 cores. In contrast, informal tools account for 50 artifacts (i.e., modified flakes). The debitage assemblage includes 41,191 flakes. Finally, the weighed FCR accounts for 748.7 kg of rock.

Features

Lower Unit 2B includes Features 23, 27, 36, 37, 41, 44, and 45. Three of these were encountered in the NW Block (23, 27, and 41), while Features 36 and 37 were in the NE Block, and Features 44 and 45 were in the E Block. Feature 23 is a large, roughly oval cluster of FCR consisting of large, tabular limestone slabs that overlapped and were tilted slightly towards the center. Two geophyte samples were recovered from Feature 23. Feature 27 is a small hearth consisting of an oval cluster of limestone rocks on a flat surface. Feature 36 is a shallow, basin-shaped hearth whose margins are formed by several large, vertically aligned tabular limestone slabs and smaller rocks. Feature 37 is a shallow basin-shaped hearth consisting of a tight cluster of large, angular FCR. Feature 41 is a small hearth with several large, tabular limestone rocks lining the basin. Rocks were also stacked on top of the slabs in the center of the hearth. Feature 44 is a cluster of angular and tabular limestone rocks. A metate fragment was encountered during its excavation. Finally, Feature 45 is a small cluster of tabular FCR in a single layer.

Depositional Unit 3

Date Ranges

The oldest of the defined units, Unit 3 is composed of several features located on the western end of the site, mainly Feature 8 and 35. Based on radiocarbon analyses, as well as features and diagnostic artifacts, Unit 3 spans a period of ca. 2610–2300 B.P.

Diagnostics

Thirty-eight dart points are associated with the unit. Temporally diagnostic artifacts include eight Ensor, five Castroville, three Frio, two Marshall, and one each of Marcos, Montell, Pedernales, Ellis, and Fairland types.

Figure 5.27. Feature 16 after cross-sectioning, facing east.

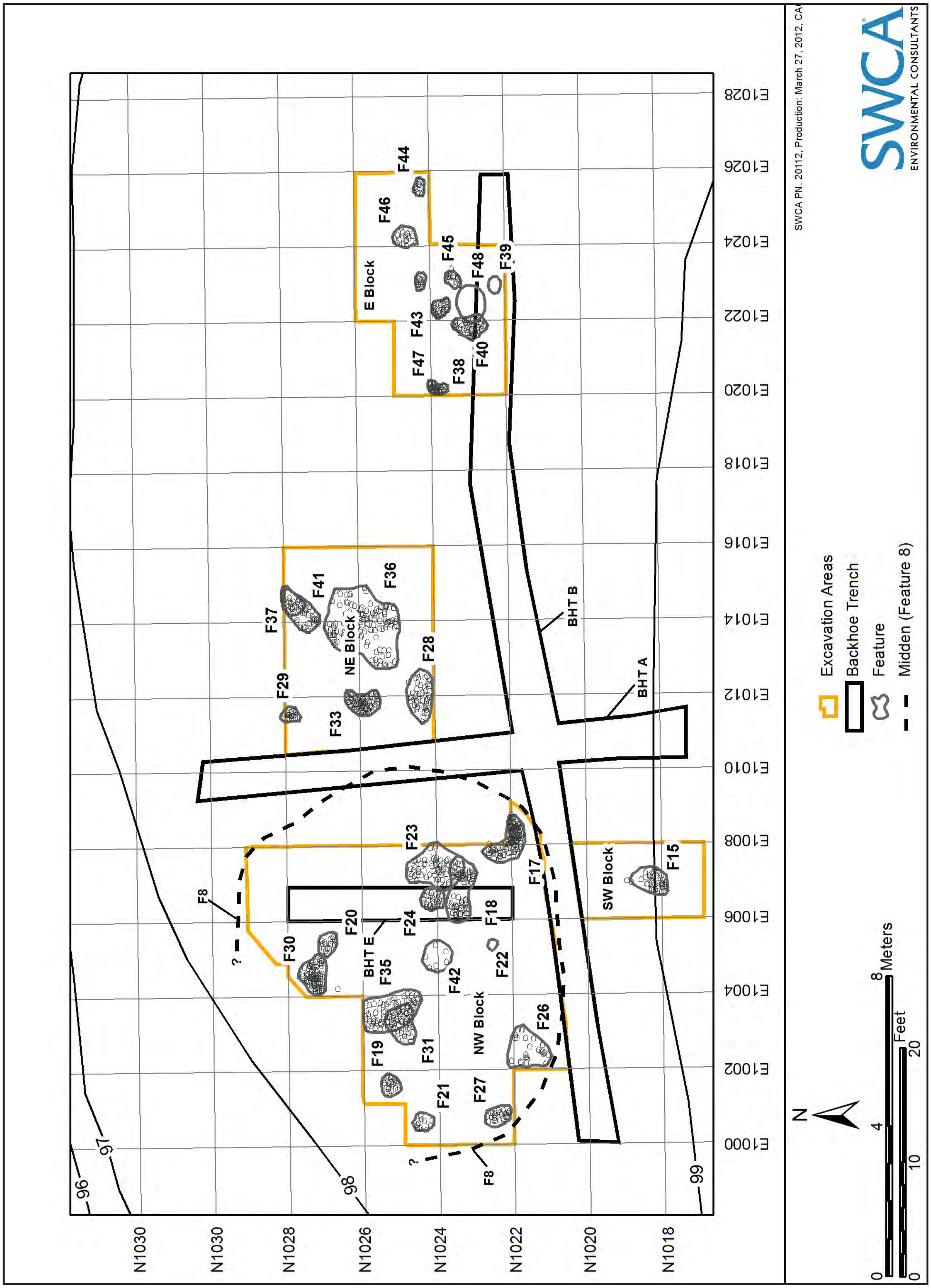


Figure 5.28. Map of post-2300 B.P. Archaic feature locations from data recovery.

Table 5.11. Unit 2B Upper Artifact Counts and Weights

Artifact Type	Total Count	Total Weight (g)
Arrow Point	3	N/A
Burned Rock	26,072	776,481.6
Biface	244	4,543.6
Bone	N/A	3,803.3
Bone Tool	4	N/A
Core	32	6,379.5
Debitage	43,931	N/A
Dart Point	92	N/A
Groundstone	8	5,353.8
Modified Flake	56	1,885.4
Scraper	25	1,338.3
Hammerstone	1	457.3
Axe	1	246.3
Chopper	1	300.5
Graver	1	N/A
Total	**70,471**	**800,789.6**

Table 5.12. Unit 2B Lower Artifact Counts and Weights

Artifact Type	Total Count	Total Weight (g)
Burned Rock	21,201	748,729.3
Biface	196	5,087.4
Bone	N/A	7,395.7
Core	39	8,210.6
Dart Point	96	291.4
Debitage	41,191	N/A
Scraper	52	3,220.2
Groundstone	5	753.3
Modified Flake	50	2,228.1
Drill	1	25.9
Bone Awl	2	0.2
Total	**62,833**	**775,942.1**

Artifacts in General

The artifact assemblage from the unit contains ground stone, faunal remains, chert debitage and chipped stone tools, and FCR. The groundstone assemblage consists of one mano recovered at elevation 97.9 along the N1022 unit. The faunal remains weighed more than 2.1 kg.

The lithic artifact assemblage has a noticeable quantity of formal and informal tools present (Table 5.13). Formal tools of this analytical unit consist of 66 bifacially worked artifacts as well as 15 scrapers and 14 cores. In contrast, informal tools or those that suggest expedient use account for 14 modified flakes. The debitage assemblage comprised more than 18,000 flakes. Finally, the weighed FCR accounts for 1,298 kg of rock.

Features

AU 3 includes some of the largest features at the site: Features 2, 3, 8, 35. Feature 2 was a tight cluster of FCR comprising a small, circular basin-shaped hearth. Two charcoal samples associated with Feature 2 (Beta 207241 and 207240) returned 2-sigma calibrated age estimates of 2740–2360 B.P. and 2760–2710 and 2630–2500 B.P., respectively (see Table 5.5). These dates roughly overlap at 2740–2500 B.P.

Feature 3 was a roughly circular hearth with a distinct basin-shaped cross-section. The feature was near the northern edge of the T_1 terrace. Notably, a piece of antler was associated with Feature 3. Two charcoal samples from Feature 3 (Beta 207243 and 207242) returned 2-sigma calibrated age estimates of 2740–2450 and 2410–2380 B.P., and of 2760–2700 and 2650–2490 B.P. respectively (see Table 5.5). These dates overlap at 2740–2490 B.P.

Table 5.13. Unit 3 Artifact Counts and Weights

Artifact Type	Total Count	Total Weight (g)
Burned Rock	13,982	1,298,900.0
Biface	66	2,201.5
Bone	2,128	N/A
Core	14	2,339.5
Debitage	18,345	N/A
Scraper	15	974.9
Groundstone	1	N/A
Modified Flake	14	796.4
Dart Point	38	183.8
Drill	1	2.3
Bone Tool	2	2.6
Total	**34,606**	**1,305,401.0**

Feature 8 was the largest feature within the NW Block and the site as a whole. Feature 8 is an incipient burned rock midden that overlies Feature 35 and actually thickens within the center of Feature 35. Seemingly, Feature 35, a massive slab-lined hearth, created a depression on the landscape that filled in as Feature 8 formed. In profile, the overlying midden is clearly distinguishable from Feature 35 based on (a) a clear stratigraphic separation of the two in the northern profile of the excavation block and (b) differences in the coarse matrix of the two features. Rocks within Feature 8 were comparatively small, angular, and highly fractured, while the rocks within Feature 35 were larger and much less fractured.

Figure 5.30. Central pit feature in midden, Feature 8, BHT E, facing west.

The Feature 8 midden essentially covered the NW Block and dipped in elevation from south to north, mirroring the natural stratigraphy at the site (Figure 5.29). The midden, sampled with ten 50 × 50-cm column samples, ranged in thickness from 8 cm to as much as 33 cm, with an average thickness of approximately 25 cm. The coarse matrix varied in composition, with some column samples containing more very small rocks (less than 5 cm) and others containing more small (5–10 cm) rocks. In all of the column samples, however, there were few (generally less than 10 percent by count) rocks larger than 10 cm in maximum dimension and almost no other cultural materials such as debitage, tools, etc.

The excavation of BHT E succeeded in locating a central pit within the midden (Figure 5.30). Exposed along the E1006 line, the central feature extended from N1023.85 to N1027.10 (3.25 m). The central pit was a concave basin cut approximately 30 to 45 cm into the underlying strata and lined with large limestone slabs. From the profile, the pit exhibits evidence of at least one episode of modification during the use of the midden. Specifically, an older pit appears on the northern side of the central feature, truncated by a younger pit to the south. The central feature was largely infilled with fine matrix rather than burned rock. Five radiocarbon samples from Feature 8 were analyzed (Beta 215916, 250572, 250568, 215920, and 250562) and the resulting dates cluster at 2700 B.P., placing the midden within Unit 3.

Figure 5.29. Midden, Feature 8, in Northwestern Block, facing north/northwest.

Feature 8 effectively forms a structural blanket in the NW Block, providing a stratigraphic layer separating Feature 35 below and younger features above. Other features in this part of the site were encountered above Feature 8, indicating they are younger than the midden. Features higher in the profiles in these two areas are likely to be associated with the features above the midden.

The previously mentioned Feature 35 was roughly circular, with a diameter of approximately 180 cm. The basin was about 43 cm deep from the top of the outer rocks to the base of the deepest rocks. The interior of the feature contained primarily large, burned, but not fractured, limestone cobbles. The rocks and fine matrix at the bottom of the feature were darkly stained by charcoal. Many of the basal and margin rocks were either unfractured or fractured in situ, generally breaking into two or three pieces when they were removed from the feature. No diagnostic artifacts were encountered within or near this feature, but four radiocarbon samples (Beta 215922, 250576, 250581, and 250570) returned 2-sigma calibrated age estimates of 2740–2330 B.P., 2680–2640 and 2500–2340 B.P., 2710–2350 B.P., and 2770–2710 B.P. These dates overlap roughly between 2680–2350 B.P., placing the feature within AU 3.

Summary

The two phases of testing and data recovery investigations at the Siren site were distinct in terms of objectives, methods, and techniques; however, overall they comprise a continuous and comprehensive study of the site. This chapter was a systematic report of how the site was studied and the cumulative findings through the successive phases. As evident in this narrative, some of the initial conclusions have been rendered obsolete by subsequent data and analyses. For example, at the conclusion of testing, it appeared there may have been a 900-year hiatus of occupation at the site; however, subsequent radiocarbon analyses during data recovery refined the occupation sequence and revealed a smaller gap instead from about 1250 to 1750 B.P.

Based on testing results, SWCA recommended that the site was eligible for SAL designation and TAUs 1 and 2 were recommended as contributing to the site's eligibility. For the data recovery, extensive backhoe trenching created four quadrants within the site and mechanical striping was used to remove the overburden of construction fill. Geoarchaeological work at the site contributed an understanding of the macro-stratigraphic setting, and of the formation processes responsible for the preservation of the prehistoric cultural occupations. The two analytic units from testing were refined into three basic geomorphic depositional units as defined during data recovery (2A, 2B, and 3) and these generally correlate with the archaeological findings: the deep Archaic deposits predating approximately 2600 B.P., the Archaic deposits spanning approximately 2600 to 1550 B.P., and the Late Prehistoric component. The deeper deposits were not the subject of data recovery investigations; consequently, the post-2600-B.P. Archaic and the overlying Late Prehistoric components were investigated.

The Late Prehistoric component, Unit 2A, was temporally defined by 14 radiocarbon dates that span ca. 1250–980 B.P. Depositional Unit 2B spans roughly 2100/2050 to 1550 B.P. The lower division of Unit 2B is an Archaic component spanning ca. 2300 to 2050 B.P. Based on radiocarbon analyses, as well as features and diagnostic artifacts, Unit 3 spans a period of ca. 2610–2300 B.P.

The cultural material within the investigated area of the project is found in the upper segment, or waning phase, of the T_1 depositional unit. This includes the top of Stratum 3 and all of Stratum 2. The youngest cultural material is found in Stratum 2A, which was partially truncated by construction several decades ago. The majority of the cultural material is contained within Stratum 2B, which is lower portion of Stratum 2.

The greatest number and diversity of feature types was found in the NW Block, which contained concentrations of FCR, a variety of hearths, the midden, a biface cache, and a debitage cache or cluster. The radiocarbon results for the NW Block also exhibited the best preserved stratigraphy at the site. The NE Block contained six features, split between basin-shaped hearths and FCR clusters. The E Block had the least diversity and contained eight clusters of FCR and only one basin-shaped hearth.

Feature 8 was the largest feature within the NW Block and the site as a whole. Feature 8 was an incipient burned rock midden that was originally encountered during testing excavations at the Siren site and subsequently found to overlay much of the site and to contain a central hearth feature that was revealed at the end of the investigations. Five radiocarbon samples from Feature 8 were analyzed and the resulting dates cluster at 2700 B.P. A geophyte was collected from the base of the midden rocks, suggesting the hearth was used to bake root foods.

Full descriptions of the recovered materials from the entire site, as well as interpretations of the cumulative data are provided in the subsequent chapters and appendices.

Chapter 6

Site Formation Processes and Implications for Archaeology in the South Fork of the San Gabriel

Charles D. Frederick

Searching for Trace Evidence of Human Habitation at the Siren Site

One of the principal goals of the geoarchaeological investigations at the Siren site was searching for trace evidence of human occupation within the sedimentary deposits. The occupation levels that were excavated were in a slowly aggrading portion of a Late Holocene alluvial fill, and some of these surfaces, such as the Late Prehistoric, appeared to be relatively discrete, whereas others, such as the Transitional Archaic, appeared to consist of multiple occupation surfaces superimposed or separated by a small amount of sediment. Although the sedimentation rate appears to vary somewhat across the site, at its most rapid this deposit appears to have aggraded at a rate of around 10 cm per century, which means that more than two generations could have occupied these areas within the thickness of a single excavation level. Because the excavation levels were relatively coarse with respect to the apparent sedimentation rate, we wanted to examine whether a finer excavation level, specifically 5 cm, would permit discrimination of distinct occupation levels, and what forms of additional evidence, specifically trace evidence of human activity, could be found to support this.

Elemental Analysis and Identifying Areas of Ancient Human Activities

Human activities influence soils in a variety of ways, ranging from the visibly dramatic effects of erosion and sedimentation to the much more subtle shifts in their elemental composition. The latter process may occur through deliberate as well as unintentional additions made to soils by various activities, such as the addition of waste products associated with general habitation (disposal of ash, feces, and food residues such as bones and organic material), food production (byproducts of grown or gathered and processed food plants or animals), animal husbandry, and a wide range of craft activities (e.g., metallurgy and pottery production). Soils may retain evidence of these additions for long periods of time through the chemical sequestration of various elements. Although the concentration of elements such as phosphorous (P) in soils by human activity has been known for a long time and is relatively well understood (see Holliday and Garter [2007] for a comprehensive review), recent research has focused on searching for other chemical evidence of human habitation. The expansion of this work to elements other than phosphorus is in part a reflection of changing chemical analysis technology that now permits relatively rapid, precise and inexpensive assay of a wide variety of elements simultaneously (Middleton 2004).

A number of elements other than phosphorous are known to be concentrated by human activity, including carbon (C), nitrogen (N), sodium (Na), calcium (Ca), potassium (K), magnesium (Mg), sulphur (S), zinc (Zn), and various other metals. Unfortunately, understanding of the linkages between ancient human activities and the concentration of these elements lags considerably behind the linkages established for phosphorous (Oonk et al. 2009). These relationships are complex and may be complicated by lithological, diagenetic, and pedogenic processes. The majority of studies that have examined the relationship between elemental concentration and human activity have examined spatial variation of elements across the floors of prehistoric houses (cf. Middleton and Price 1996; Oonk et al. 2009), variations in the elemental concentration of specific cultural features and control samples outside an occupation area (e.g., Wilson et al. 2008), or ethnoarchaeological studies of modern household activity surfaces.

For this project we sought a slightly different approach, namely searching for various lines of trace evidence of human habitation within vertical profiles of the alluvial deposits in order to more fully understand the stratigraphic structure of the occupational debris. In the field it was quite easy to distinguish the Late Prehistoric and Transitional Archaic occupations on the basis of their relative stratigraphic positions, but neither occupation exhibited well defined occupation surfaces, and the older components, specifically the Transitional Archaic, were thought to have experienced two or more occupations. Hence the principal goal of this work was to see if there were any forms of trace evidence of human occupation that could clarify the stratigraphic position of the prehistoric occupations.

Our attempt to use elemental evidence as one of the fundamental avenues of this investigation is somewhat speculative given that most elemental analysis of prehistoric occupations have been performed on occupations associated with sedentary groups who inhabited permanent domiciles. It is logical to expect that there would be long-term enrichment of an occupation surface that had been inhabited for a generation or more, but it is less certain that chemical evidence of activity area patterns would be retained on surfaces occupied for short periods of time by hunter-gatherers. That said, the quantity of occupation debris associated with features such as burned rock middens are typically vast and often thought to represent repeated visits to the same location over numerous years. The stratigraphic superposition of relatively discrete features like Feature 35/Feature 8 appears to be prima facie evidence of repeated occupation of this site over a short period of time and reuse of the same site appliance, namely an earth oven. Hence, although the Transitional Archaic occupation may look like a single event, it is likely to be a short term palimpsest, and, as such, the potential for elemental enrichment of the occupation surface is expected to be higher than what one might expect for a single short term stay. Previous studies of elemental variation at hunter-gatherer sites, such as Konrad et al. (1983), found elevated levels of phosphorous (P), magnesium (Mg), and calcium (Ca) at the Munsunglake Thoroughfare site (Maine), in both spatial as well as stratigraphic profile studies of elemental variation.

Magnetic Susceptibility

In addition to elemental analysis, magnetic susceptibility analysis was performed to see if this method could be correlated to the occupation levels. Magnetic susceptibility is one of the most commonly documented magnetic properties of a material, and it is easily measured in the field or lab. The rationale behind the analysis of magnetic susceptibility in archaeological contexts is that human activities often create or concentrate magnetic minerals and that location of these activities may identified by examining the stratigraphic or spatial distribution of these minerals.

Magnetic susceptibility analysis is a rapid, nondestructive technique that is based upon the principle that magnetic minerals become more strongly magnetized in the presence of a weak external magnetic field. As Dalan and Bannerjee (1998:6) note, it is essentially a measure of the degree to which a sample may be magnetized. The magnetic susceptibility is the ratio of the magnetism induced in the sample to the strength of the applied magnetic field. In small alternating magnetic fields, the process of induced magnetization is reversible and the magnetism of the sample returns to its original state after the field is removed. The magnitude of the magnetic susceptibility of any given sample reflects: 1) the mineralogy, 2) the concentration of magnetic minerals, and 3) the magnetic mineral grain size and shape. Magnetic susceptibility is not very useful in identifying which magnetic minerals are present, but rather is a rough index of the amount of magnetic minerals present. It reflects the concentration of magnetic minerals in a sample if only one magnetic mineral is present.

Topsoil magnetic susceptibility enhancement may occur through biologic and inorganic processes. Biological processes thought to be responsible for increases in soil magnetic susceptibility include the creation of magnetite or maghaemite by bacteria (specifically magnetotactic bacteria, e.g. *Magnetospirillum* sp.) and the anaerobic reduction of iron by microbial action and subsequent oxidation (Dering et al. 1996, 2001; Rivers et al. 2004). Inorganic processes that lead to magnetic enhancement in soils include the abiological weathering of iron (III) minerals followed by oxidation (e.g., Mullins 1977; Rivers et al. 2004) and high temperature chemical reactions. The most common process in prehistoric archaeological contexts in the New World is the formation of magnetite or maghaemite during heating of earth or rocks in thermal features like hearths and ovens (Dalan 2008:27; Linford and Canti 2001). Reuse of thermal features, and the cleaning and disposal of thermal refuse results in the spread of an anthropological sediment (ash, burned rock and small fragments of burned earth) with elevated magnetic susceptibility across the occupation surface. This refuse may be spatially discrete if the dump is small and the site is occupied but once, or it may be scattered across the occupation surface through natural (e.g., sheetwash and wind) and anthrogenic (trampling, kicking, and reuse) processes after disposal, especially on sites that experience repeated visits and relative surface stability.

Because topsoils exhibit enhanced magnetic susceptibility, this property is often used in conjunction with other evidence, to support the presence of buried surface soils. In addition to the magnetic susceptibility, another parameter that is often enhanced in topsoils is the coefficient of frequency dependency (χ_{fd}), which is the percent difference in magnetic susceptibility measured at low (470 Hz) and high (4700 Hz) frequencies ($\chi_{fd} = (\chi_{lf} - \chi_{hf}) / \chi_{lf})*100$). Topsoils often exhibit increased concentrations of fine-grained ferrimagnetic minerals which lead to elevated values of χ_{fd} (Gale and Hoare 1991:213), and together the use of χ_{lf} and χ_{fd} may permit identification of former soil epipedons and materials eroded from them.

Like the elemental analyses, archaeological applications employing magnetic susceptibility most often determine the spatial variation of this property rather than the stratigraphic variation. Although examined briefly by Dalan and Bannerjee (1998), Dalan (2008:12) has recently revisited the issue and provides several illustrations of vertical magnetic susceptibility profiles from archaeological contexts. One such example shows the magnetic susceptibility profile with depth within and outside a pit and demonstrates how that thermal refuse within the pit exhibits magnetic susceptibility values several times greater than the background values outside the pit or the fairly modest magnetic susceptibility readings from the occupation surface. Another example from an alluvial stratigraphic sequence at the Canning site on the Red River shows how magnetic enrichment of a deposit by prehistoric occupation can clearly delineate occupation zones within vertical profiles. Additionally, on the adjacent Trinity River watershed, Mauldin et al. (2006) provide a thoughtful archaeological application, specifically the discrimination of natural stratigraphic clusters of red sandstone created by colluvial processes from hearths.

The Research Design

The data for this analysis largely derive from two sample columns collected from different parts of the site, specifically the E Block (Column 1), and the NW Block (Column 2). A small suite of samples was also collected from within and adjacent to two burned rock features (specifically Feature 8, the burned rock midden) and Feature 35 (the large slab-lined hearth beneath Feature 8). The search for evidence of human habitation centered on elemental analysis of soil samples from each column, as well as various other properties which are known to have been influenced by past human activities, specifically the concentration or organic carbon, the carbon isotopic composition of the organic carbon, and the magnetic susceptibility. The values for these properties were statistically compared to the depth distribution of cultural material present in the column samples (specifically the counts of microscale and macroscale burned rock and lithic debitage). The original research design considered using the artifact counts obtained from adjacent excavation units, but the direct counting of the cultural material within the column samples was found to be a better option. Other physical properties of the column samples, specifically the texture, were determined to provide a basic comparison between the two sections. The methods used in the analyses are described in detail below.

Methods

Physical Characterization

A total of 60 bulk samples was analyzed from the two columns cut from the excavation walls. Twenty-seven samples were examined from Column 1, which was located on the south wall of BHT B, immediately south of the E Block excavation (Figure 6.1). A suite of 33 samples that were collected from Column 2, located at the north end of BHT E, was also characterized. Another nine samples were analyzed from Feature 8 and Feature 35. For each sample, the texture (or particle size distribution), calcium carbonate content, magnetic susceptibility, organic carbon content and stable carbon isotopic composition were determined. A select suite of samples was also collected for thin section preparation and soil micromorphological analysis. In addition to these analyses, splits of the <2-mm fraction of each sample were submitted for elemental analysis. The details of the analytical methods employed are described below, and the results of the lab work are presented in Appendix I (Tables I.1 through I.3).

Particle Size Analysis (Texture)

Texture analysis was performed using the hydrometer-sieve method (cf. ASTM 1985; Bouyoucos 1962; Gee and Bauder 1986). For this analysis the total sample was air dried and weighed, then crushed with a rubber pestle and mortar, and subsequently passed

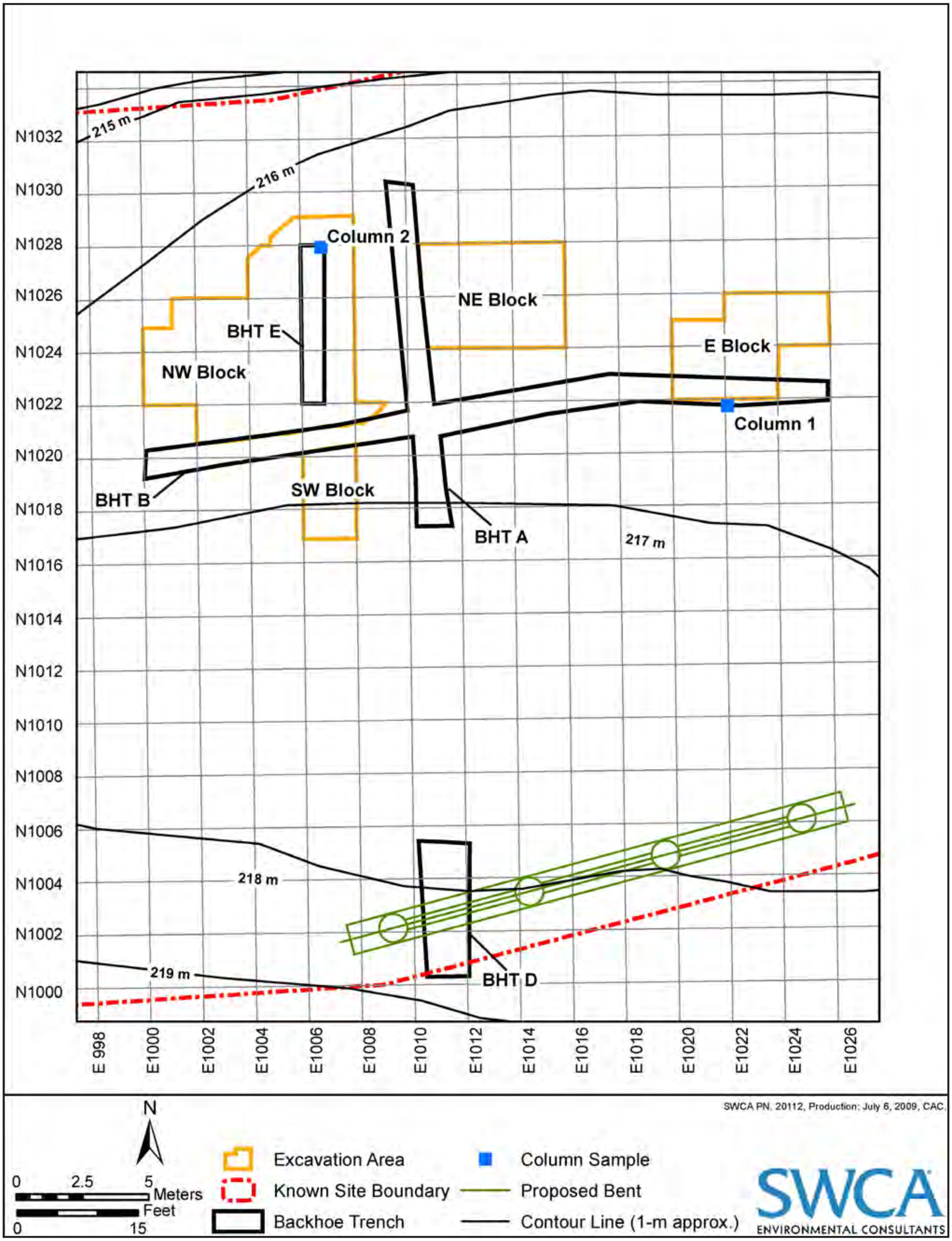


Figure 6.1. Overview map of Siren site data recovery excavations.

through a 2-mm sieve. Coarse material caught on the 2-mm sieve, if detrital sediment, was then sieved at a 1-phi interval, and the mass on each sieve recorded. In this particular case, cultural material (burned rock, debitage and bone) were counted and weighed separately for each size class, so their depth distribution could be examined, as well as to exclude them from the detrital totals used to determine the properties of the alluvial sediments. A split of the <2-mm-sized material (roughly 40 grams) was then soaked in 50 ml of a 5 percent sodium hexametaphosphate solution overnight, and then mixed in a mechanical mixer for 5 minutes before being diluted to 1 liter with distilled water. This mixture was placed in a 1-liter settling jar, mechanically agitated for 1 minute, and then set on a table, after which point hydrometer readings were made at different time intervals (specifically 1, 3.5, 15, 45, 300, and 1,440 minutes). A control hydrometer and temperature reading on an empty jar with nothing but distilled water and the sodium hexametaphosphate solution was made at intervals throughout the analysis to permit calibration of the hydrometer. A small split of the <2-mm-sized soil was also oven dried to determine the moisture content and correct the sample mass used in the hydrometer analysis (hygroscopic moisture correction). After 24 hours, the contents of the hydrometer jar were wet sieved through 37 micron sieve, and the sand retained on the sieve was transferred to a beaker and oven dried at 105˚C. This sand was subsequently sieved at 0.5-phi intervals once dry and the mass retained on each sieve recorded. From these data the percentage of gravel, sand, silt and clay, as well as various descriptive statistics were calculated for the grain size distribution using a spreadsheet written by Paul Lehman.

Calcium Carbonate Content

A small split (either 1.7 g or 0.85 g) of the ground <2-mm fraction of each soil sample was used to determine the calcium carbonate equivalent (CCE) by means of a Chittick apparatus (Dreimani 1962; Machette 1986). This sample was finely ground (to pass a 0.075 mm sieve), and then weighed, and placed into a small (250 ml) Erlenmeyer flask. Once attached to the Chittick apparatus, the liquid level in the measuring burette was set to -10 ml, then the stopcock was closed to prevent gas from leaving the system, and the leveling bulb was dropped in order to establish a vacuum inside the sample chamber. At this point the barometric pressure and temperature in the room were recorded. Then 10 ml of 50 percent hydrochloric acid (ca. 6 N HCl) was delivered to the sample flask, which was agitated intermittently until the reaction had ceased (usually 1–2 minutes). At this point, the leveling bulb was raised to the point that the liquid level inside of it was equal in elevation to the liquid in the burette, and the volume of gas evolved was then measured and the calcium carbonate equivalent calculated.

Organic Carbon

In order to determine the carbon content of each sample, splits of the <2-mm-sized fraction were submitted to the Analytical Chemistry Lab at the Institute of Ecology, University of Georgia. The carbon content was determined on a Micro-Dumas NA1500 Combustion Elemental (C/H/N) Analyzer (Carlo Erba Strumentazione, Milan). Details of the procedures used at in the procedure may be found on the institute's web page (http://www.uga.edu/~sisbl/soilerb.html) and general aspects of the method are discussed by Schulte and Hopkins (1996). Prior to submission calcium carbonate was removed from the samples by treating a 2-gram split of the <2–mm-sized soil with 6 N HCl. The samples were allowed to sit five hours or until the supernant liquid was clear, and then decanted and subsequently refilled three times in order to remove all traces of acid. After the third rinse, the decanted sample was dried at 105˚C, and subsequently finely ground once dry.

Stable Carbon Isotopic Composition

The stable carbon isotopic value of the organic carbon for each sample was determined at the Stable Isotope/Soil Biology Laboratory at Institute of Ecology, University of Georgia. These values were determined from the carbonate free <2-mm soil used to determine the organic carbon content and were determined on a element ratio mass spectrometer by converting the organic carbon to a gas phase by extremely rapid and complete flash combustion of the sample material.

Magnetic Susceptibility

To determine the magnetic susceptibility, splits of <2-mm, oven-dried soil were packed into small 8 cc magnetically inert plastic boxes, weighed, and then the low and high frequency magnetic susceptibility were measured on a Bartington MS2 meter and MS2B sensor. Each value was measured twice and the average values were used to calculate the reversible, low and high frequency mass susceptibility (χ_{lf} and χ_{hf}). Both of these values are reported in SI units ($10^{-8}m^3kg^{-1}$) and are presented on Table I.1 in Appendix I. The coefficient of frequency dependency (χ_{fd}) was also calculated and is reported as a percentage. The precise methods and equations used may be found in Gale and Hoare (1991:222–226) and Dering (1999a, 1999b).

Petrographic Thin Sections

Small blocks of sediment cut from the bulk samples collected from Features 8 and 35 were vacuum embedded with plastic resin (Epotek 301) and subsequently cut into blanks when hardened. The blanks were then submitted National Petrographic, Inc. in Houston, Texas for thin section preparation, and were subsequently examined at a range of magnifications. Low magnification examination was performed with the aid of a flat bed scanner and the slides were scanned at 1200 dpi using transmitted light (slide mode). Full-page, color, laser prints of the slides were used to perform the first pass assessment of each slide. Areas of interest were then identified and examined with a Leica S8 APO binocular microscope fitted with transmitted light base and polarizing filters. Higher magnification examination employed a Leica DMEP polarizing light microscope.

Elemental Composition

Small (approximately 10 g) splits of <2-mm dry soil from each column sample and the feature samples were submitted to SGS Minerals for elemental determination by means of a four acid digestion and subsequent elemental determination using inductively coupled plasma atomic emission spectrometry. The multi-acid digestion employed a combination of hydrochloric acid (HCl), nitric acid (HNO_3), hydrofluoric acid (HF) and perchloric acid ($HClO_4$). Because the hydrofluoric acid dissolves silicate minerals, these digestions are often referred to as "near-total digestions". Although some loss of volatile components may occur during the digestion process (e.g. boron [B], Arsenic [As], Lead [Pb], Germanium [Ge], and Antimony [Sb]) none of these elements were considered critical for this analysis. This form of digestion avoids issues of selective leaching of different elements that can be a prominent and contentious issue with partial digestion methods (such as weak hydrochloric acid digestion which is favored by some workers [e.g., Middleton 2004; Wells 2004]), and recent research that has examined the issue of which kind of chemical extraction is most useful in this type of study have concluded that "strong acid" digestions are preferable (Wilson et al. 2006). At this time there is no consensus in the literature as to which method is more appropriate for this kind of investigation, and side-by-side studies are relatively uncommon. The concentration of 32 elements was determined by this method, and 24 of these returned potentially useful results. The elemental concentrations for each sample are provided on Table I.2 in Appendix I. Unfortunately, it was not noticed until after the results were in hand that the chosen analytical suite was insensitive to high concentrations of calcium, which was one of the elements of interest.

Stratigraphic Manifestations of Cultural Material Abundance

It was originally thought that we could use the artifact counts from adjacent test pits for comparison with the elemental abundance data, but the facts that the values for the hand excavation data set were of lower stratigraphic resolution (10 cm rather than 5 cm) and did not penetrate the deposits to the same depth as the column samples precluded their use. Instead, the stratigraphic locations of zones of prehistoric cultural activity were determined by counting and weighing cultural material that was found in each bulk sample during the particle size analysis. Four measures were determined: macro-FCR, micro-FCR, macro-debitage, and micro-debitage. For this work the micro-artifact category was defined as materials that passed the 4 mm sieve screen and were retained on the 2 mm sieve screen (<-2 phi and >-1 phi). The results of the artifact tallies (by count and weight) are listed on Table I.3 in Appendix I.

Results

General Description of the Deposits

The block excavations stripped the upper meter of a middle to late Holocene alluvial fill within which the occupation remains were shallowly buried. Pictures of each profile and plots of the basic physical properties described below are provided in Figures 6.2 and 6.3. The surface of this terrace appeared to slope from east to west approximately 80 cm, but the soil profiles exposed within the block excavations were essentially identical, consisting of a veneer of introduced fill, that rested unconformably upon a buried A horizon, which in turn gave way to a cambic subsoil (Bw horizon). The introduced fill was of variable texture, ranging from a

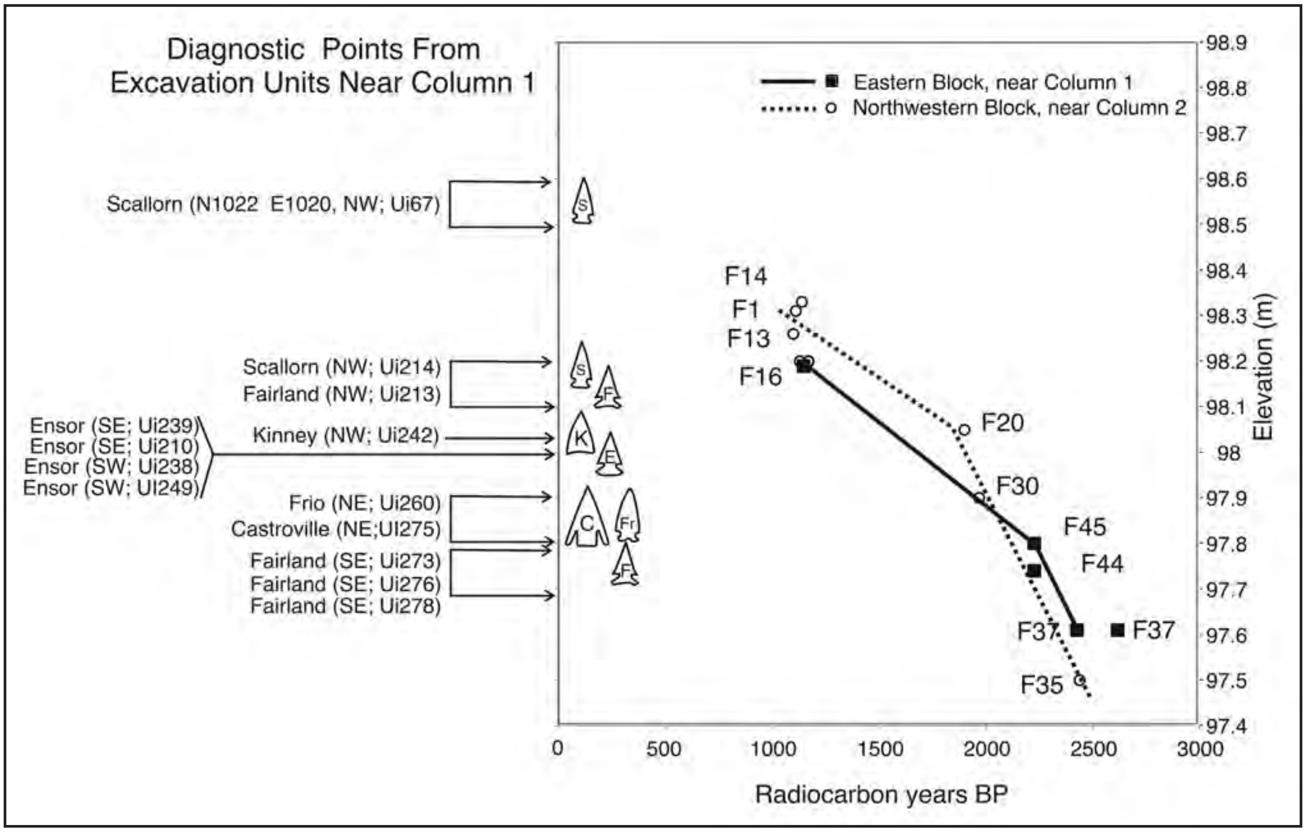


Figure 6.2. Chart showing the apparent sedimentation rates for Column 1 and Column 2 using radiocarbon ages from nearby features. The left side of the diagram illustrates the elevation of diagnostic artifacts recovered near Column 1 in the eastern block, which are shown because there is no radiocarbon age available for the top of Column 1 and the age used in the calculation is as-sumed using the first and nearest occurrence of Late Prehistoric artifact in a nearby test unit.

slightly gravelly clay loam to slightly gravelly sandy clay loam. The A horizon was about 50 cm thick, and the organic carbon decreased gradually through this horizon in both columns. In the E Block (Column 1) the A horizon was a sandy clay loam in the top 15 cm, and fined to a clay loam below that. The cambic horizon was primarily clay. In the NW Block (Column 2) the top 20 cm of the A horizon was clay loam, and fined to clay between 20 and 40 cm. The cambic horizon coarsened slightly below 40 cm to a clay loam once again. The calcium carbonate content of the sediment was highest in both columns at the top of the A horizon and decreased slightly with increasing depth, and this variation probably reflects variations in the detrital calcium carbonate of the flood sediment.

Neither the laboratory analysis of the deposits nor the field inspection of the profiles revealed any solid evidence that would permit correlating the profiles on the basis of the sediments alone. This suggests that the sedimentation was slow enough to not interrupt soil development (a cumulic soil).

Stable Carbon Isotopes

$\delta^{13}C$ values of soil organic carbon from the two column records ranged from -22.3 to -17.9 during the last 3,000 years. Few of the previously published records of soil organic carbon stable isotopic variation have good temporal resolution in this time frame (with only Trenches 1 and 5 of Nordt et al. [1994] coming close). Both columns exhibit similar trends consisting of four distinct phases:

1. Relatively high values (ca. -19 to -20 per mil PDB) indicative of a period of C_4 plant productivity early on (before approximately 2400 B.P.);
2. Followed by a period of decreasing values during the Transitional Archaic occupations when C_3 plant productivity was relatively high (near -21 per mil PDB);
3. An increase in $\delta^{13}C$ values to around -19.6 to -17.9 per mil PDB sometime around the late Prehistoric occupation; and

4. Decreased values in the period following the Late Prehistoric occupation.

In order to better understand the temporal relationships present in these data, the radiocarbon ages of nearby features were used to establish a sedimentation rate for each column (Figure 6.4), and then these data were used to extrapolate an age for each stable carbon isotope sample. The origin elevation listed in Houk et al. (2006) for each feature was used in the calculations in order to remove elevation anomalies associated with radiocarbon ages derived from pit features. Given the lack of radiocarbon-dated, Late Prehistoric features in the E Block, an age and stratigraphic position had to be assumed in order to calculate a sedimentation rate for Column 1. In order to do this we examined the elevations of the three arrow points (Lots 283.1, 403.6, and 525) that were recovered from the E Block. The one closest to Column 1 (Lot 403.6) was recovered from the northwest quad of unit N1022 E1022 at an elevation of 98.1 to 98.2 m. Given that a Fairland point was also recovered from this level, the Late Prehistoric occupation was assumed to be near the top of the level or about 98.2 m, and an age of 1100 years B.P. was used in the calculation. Both columns appear to have aggraded at a rate of approximately 10 cm per century during the Transitional Archaic, after which sedimentation appears to have slowed to almost half that rate.

Figure 6.5 illustrates the temporal trend of $\delta^{13}C$ in the two column samples using the extrapolated radiocarbon ages. As is apparent from this figure, the trends in the stable carbon isotopes appear to be significantly mismatched, which may mean there is an error in the sedimentation rate calculations. Hypothetically

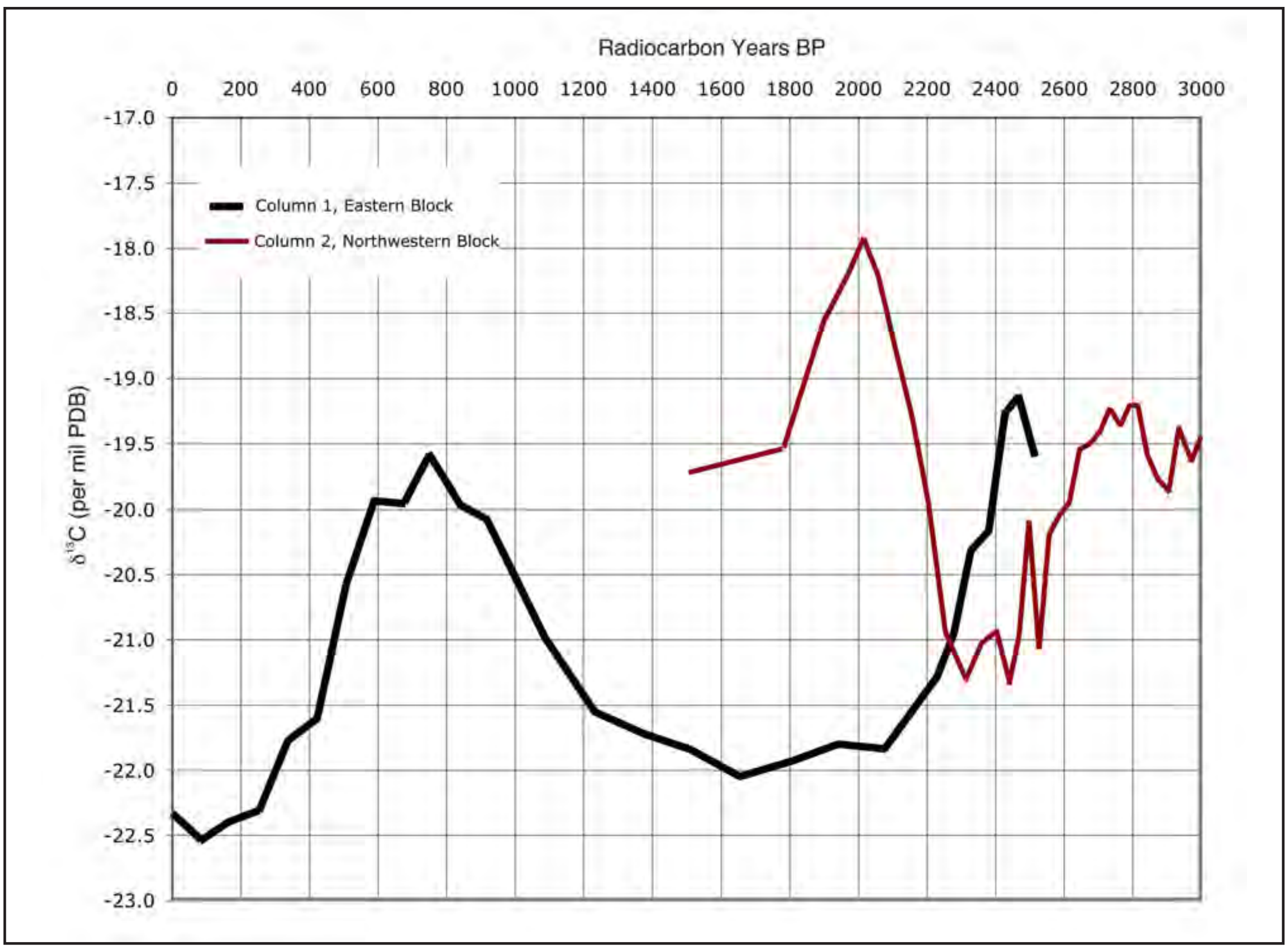


Figure 6.3. Plot of the temporal trend in stable carbon isotopes using ages extrapolated for each sample from the sedimentation rate curves depicted on Figure 6.2. Given the prominent disparity in the chronology, it is perhaps best to restrict comment on the relative shifts in $\delta^{13}C$ to broad periods of time associated with the different occupational phases.

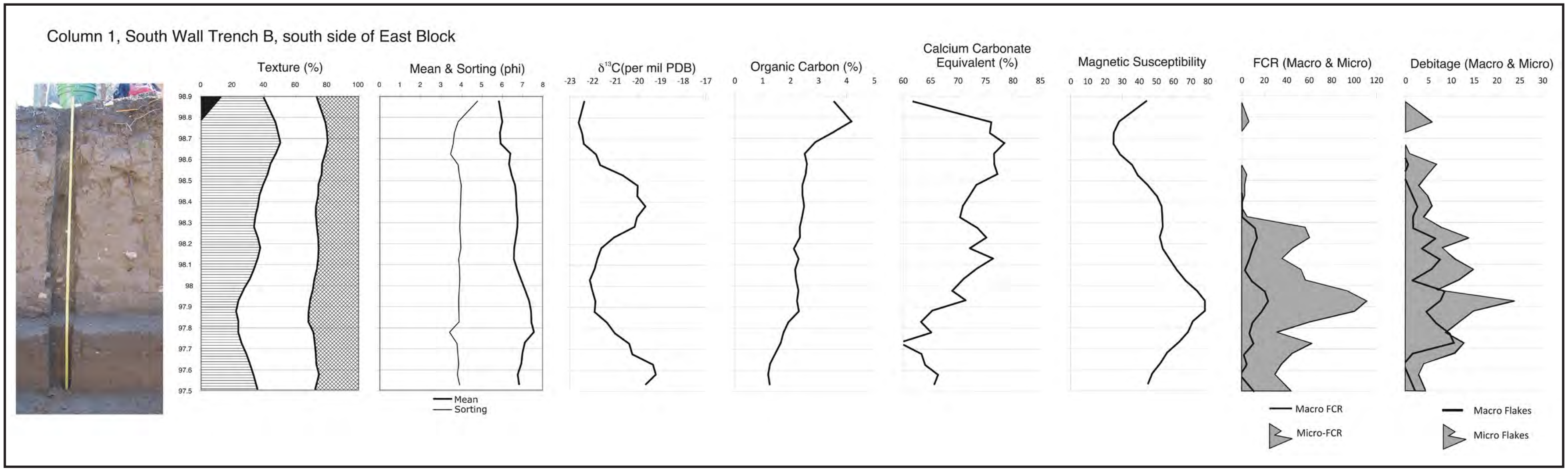


Figure 6.4. Illustration of the main physical properties derived from the analysis of the 27 sediment samples in Column 1, south wall of BHT B, E Block. The stratigraphic distribution of cultural material in the analyzed samples is shown on the far right, with the gray toned areas portraying the distribution of micro-artifacts and the heavy lines the macro-artifact distributions.

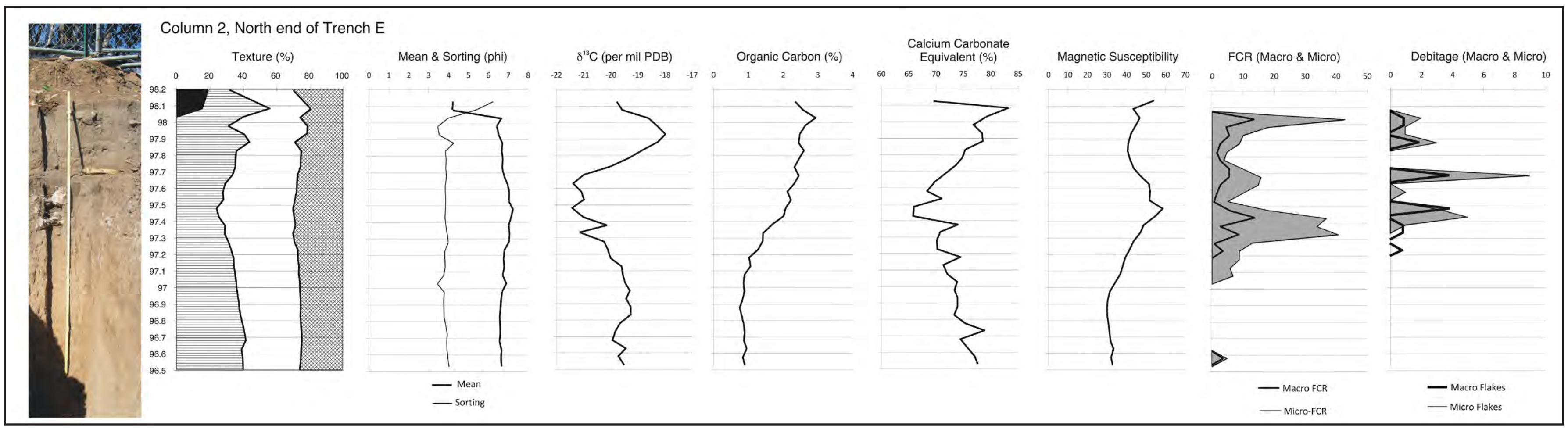


Figure 6.5. Illustration of the main physical properties derived from the analysis of the 33 sediment samples in Column 2, north end wall of BHT E, NW Block. The stratigraphic distribution of cultural material in the analyzed samples is shown on the far right, with the gray toned areas portraying the distribution of micro-artifacts and the heavy lines the macro-artifact distributions.

speaking, the peaks and valleys of the stable carbon isotopic trends are assumed to occur at the same time, but arriving at a more precise chronological record than is described at the start of this discussion seems problematic. The general trends of the Late Holocene stable carbon isotopic record obtained here is similar to those in Nordt et al. (2002), obtained for the late Holocene at Applewhite Reservoir, but the magnitude and timing of the variations are distinctly different. It is likely that the peak in $\delta^{13}C$ values observed here around the Late Prehistoric occupation is associated with the Medieval Warm period (A.D. 800–1300).

Depth Distribution of Prehistoric Cultural Material

One of the principal questions in this analysis concerns the discreteness of the prehistoric occupation surfaces within the excavated area. The most direct assessment of this is the depth distribution of macro- and micro-artifacts within the column samples. Figures 6.6 and 6.7 show the depth distribution of FCR and debitage with respect to the physical properties of the sediment samples. These figures plot the artifact counts rather than the weights.

Column 1

When the two main artifact categories are considered together, the occupation debris in this profile appears almost continuous, although the burned rock record is a little more punctuated than the debitage profile. Overall, there is a relatively strong correlation between all of the classes of cultural material in this column (Table 6.1). The burned rock and debitage curves coincide at four points in the profile: 97.73 m, 97.93 m, 97.23 m, and 98.78 m, which may represent distinct occupation surfaces within the profile. The continuity in cultural material that is present in both the macro-artifacts and the micro-artifacts suggests that there was mixing between different occupation surfaces, most likely by trampling.

Column 2

The cultural material in Column 2 is less continuous than Column 1, and in many ways more peaked, especially in terms of the macro-artifacts. There are several subtle mismatches between the lithic and burned rock records, where one peaks 5 cm above the other, and this relationship appears to be the source of lower correlation between burned rock and lithic distributions in this column (see Table 6.1). The significance of this apparent stratigraphic mismatch is not clear. There appears to be about 6 peaks in the debitage and burned rock records in this profile: 1) 95.58 m, 2) 97.33 m, 3) 98.43–98.48 m, 4) 97.63–97.68 m, 5) 97.88 m, and 6) 97.98–98.03 m. As with Column 1, the microartifact record is slightly broader down profile than the macro-artifact record, and this is probably a result of either trampling or post-depositional movement of materials.

Whether the points of overlap or peaks in the cultural material distributions in each column are truly distinct "occupation surfaces" or merely zones of repeated occupation is impossible to tell from these data alone. But together these profiles suggest that the site was occupied repeatedly and that a thinner stratigraphic recovery might have yielded assemblages that are culturally significant. That said, the absence of clear stratigraphic markers to facilitate identification of different occupation surfaces in the field, together with a prominent slope to the deposits within the excavation area would hinder the application of a finer excavation resolution. The excavation of slightly dipping, closely spaced surfaces by horizontal levels would result in the mixing of slightly different aged assemblages, but recognition of this would only occur if the occupations were of significantly different age.

Site Structure and Correlations

Comparison of the two column profiles is facilitated by examining the results of selected analyses side by side. Figure 6.8 plots the macro and micro-FCR counts, magnetic susceptibility and the stable carbon isotopic values for each profile. The top half of this figure shows the results at their actual elevations (the points of obvious correlation between the magnetic susceptibility and stable isotopic curves are highlighted) whereas the lower panel shows the results of the two profiles when they are "wiggle-matched" by aligning the top two peaks in macro-FCR category. By doing this manipulation it appears that the distributions of the cultural material are fairly similar, and the extrapolated radiocarbon ages appear to align fairly well, also. But the discrepancies in the stable carbon and magnetic susceptibility curves are drawn into clear mismatch with respect to apparent age.

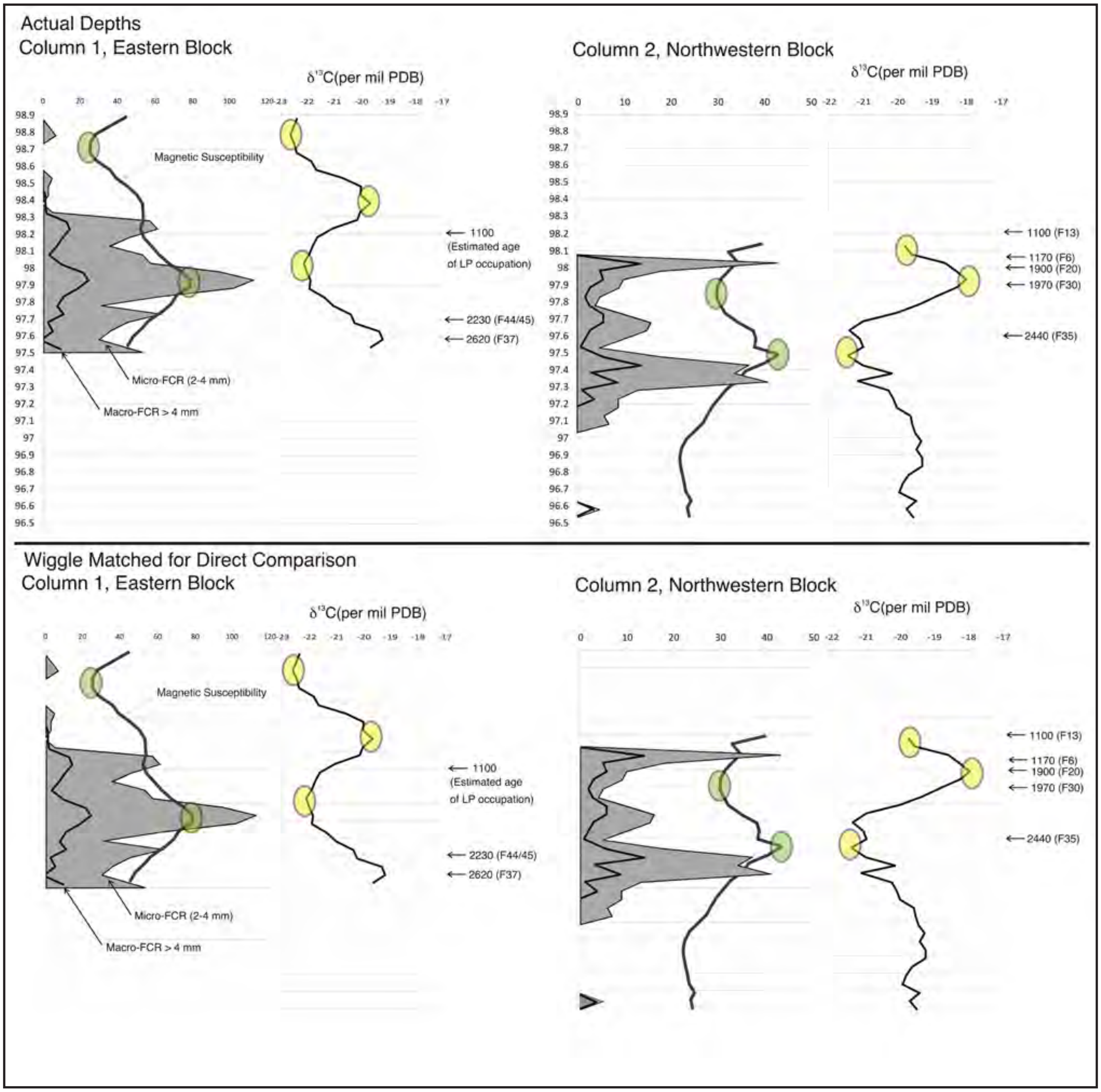


Figure 6.6. Expanded view comparing the distribution of cultural materials in Columns 1 and 2, with the magnetic susceptibility and δ13C of the organic carbon. Theoretically, the stable carbon isotopic curves should be approximately the same age at the three highlighted points (yellow circles) but this does not seem to be the case when using radiocarbon dates from nearby features. In Column 1 there appears to be nearly half a meter of sediment above the Late Prehistoric occupa-tion, whereas in Column 2 there is a mere 10 cm before encountering the introduced fill. Some of this may be due to uneven truncation of the former surface, but this should have resulted in a more truncated stable carbon isotopic curve. Likewise, the second correlation point (~93.4 in Column 1 and 97.9 in Column 2) appears to be above the Late Prehistoric occupation in Column 1 and below it in Column 2. A similar problem is apparent with the third correlation point. The magnetic susceptibility curves also share a similar shape and initially appear correlative, but the upper correlation point (as indicated by the green circle at 98.7 m on Column 1, and at 97.8 m on Column 2) occur in different positions with respect to the Late Prehistoric occupations.

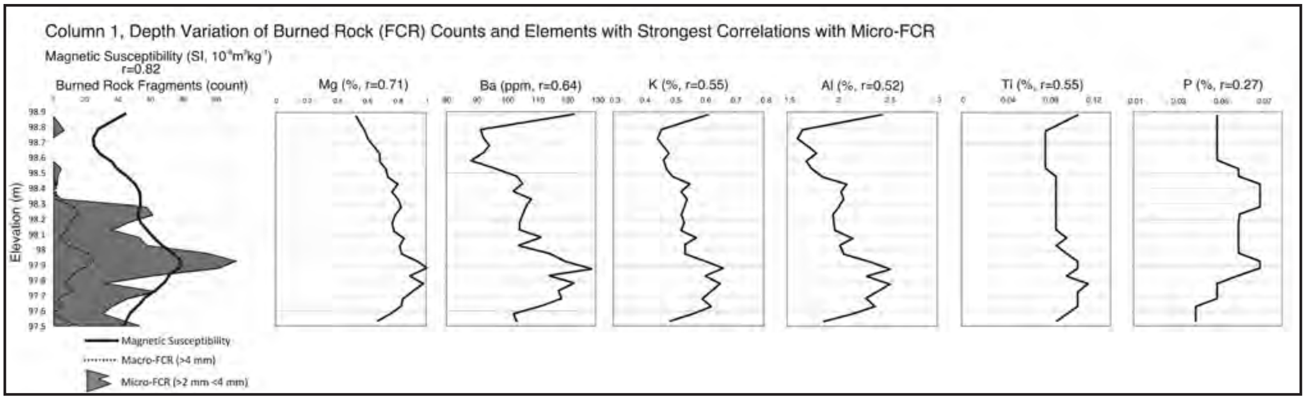


Figure 6.7. Plot depicting the depth distribution of macro- and micro-burned rock in Column 1, with respect to the magnetic susceptibility, as well as the five elements most closely correlated with the cultural material distribution and phosphorous. The correlation coefficient between the element and micro-burned rock is shown on the header next to element label.

Elemental Variation and Correlations with Cultural Material

The inductively coupled plasma-atomic emission spectroscopy (ICP-AES) analysis determined the concentrations of 32 elements, but several were eliminated from consideration because they were present in concentrations too low to be detected by the analytical method employed (e.g., silver [Ag], bismuth [Bi], cadium [Cd], Molybdemum [Mo], antimony [Sb], tin [Sn], and tungsten [W]). The remaining 24 elements, as well as values for the magnetic susceptibility, stable carbon isotopic composition, the organic carbon content, and the calcium carbonate equivalent content, were statistically correlated with the four main indices of prehistoric occupation (macro-FCR, micro-FCR, macro-debitage, micro-debitage), and the results of these comparisons are presented on Table I.4 in Appendix I. Most of elements clearly exhibited no significant correlation with cultural levels in the site (arbitrarily defined as r<0.5), and only one property exhibited a reasonably strong correlation. The elements that did exhibit potentially significant correlations were different between the two columns, but one property exhibited a significant correlation with both profiles.

The strongest correlation observed within the entire data set was in Column 1 between micro-FCR and the magnetic susceptibility (r=0.82 in Column 1, and r=0.61 for Column 2 (see Figures 6.2 and 6.3). This is a logical correlation given that burned rock exhibits elevated magnetic susceptibility and the mechanical breakdown and subsequent discard of rock used in thermal features is one of the hallmarks of prehistoric occupations in this region. In Column 1 the next most correlated elements are magnesium (Mg), barium (Ba), potassium (K), titanium (Ti) and aluminum (Al). All of these elements occur in elevated amounts in ash, and it may be that this is the source of these apparent correlations. But other than the magnetic susceptibility, all of the correlations observed are fairly weak. In Column 2, phosphorous is moderately correlated with micro-FCR (r=0.49) and macro-FCR (r=0.61), but this may be more a consequence of the

Table 6.1. Cultural Material Correlations

	Micro-FCR	Macro-FCR	Micro-Debitage	Macro-Debitage
Micro-FCR	1	0.9389995888	0.8023873531	0.6743191742
Macro-FCR		1	0.7354712265	0.7018170666
Micro-Debitage			1	0.6997473252
Macro-Debitage				1

Column 2

	Micro-FCR	Macro-FCR	Micro-Debitage	Macro-Debitage
Micro-FCR	1	0.8565862934	0.4234518385	0.3710831858
Macro-FCR		1	0.5388785471	0.3748393061
Micro-Debitage			1	0.7480084567
Macro-Debitage				1

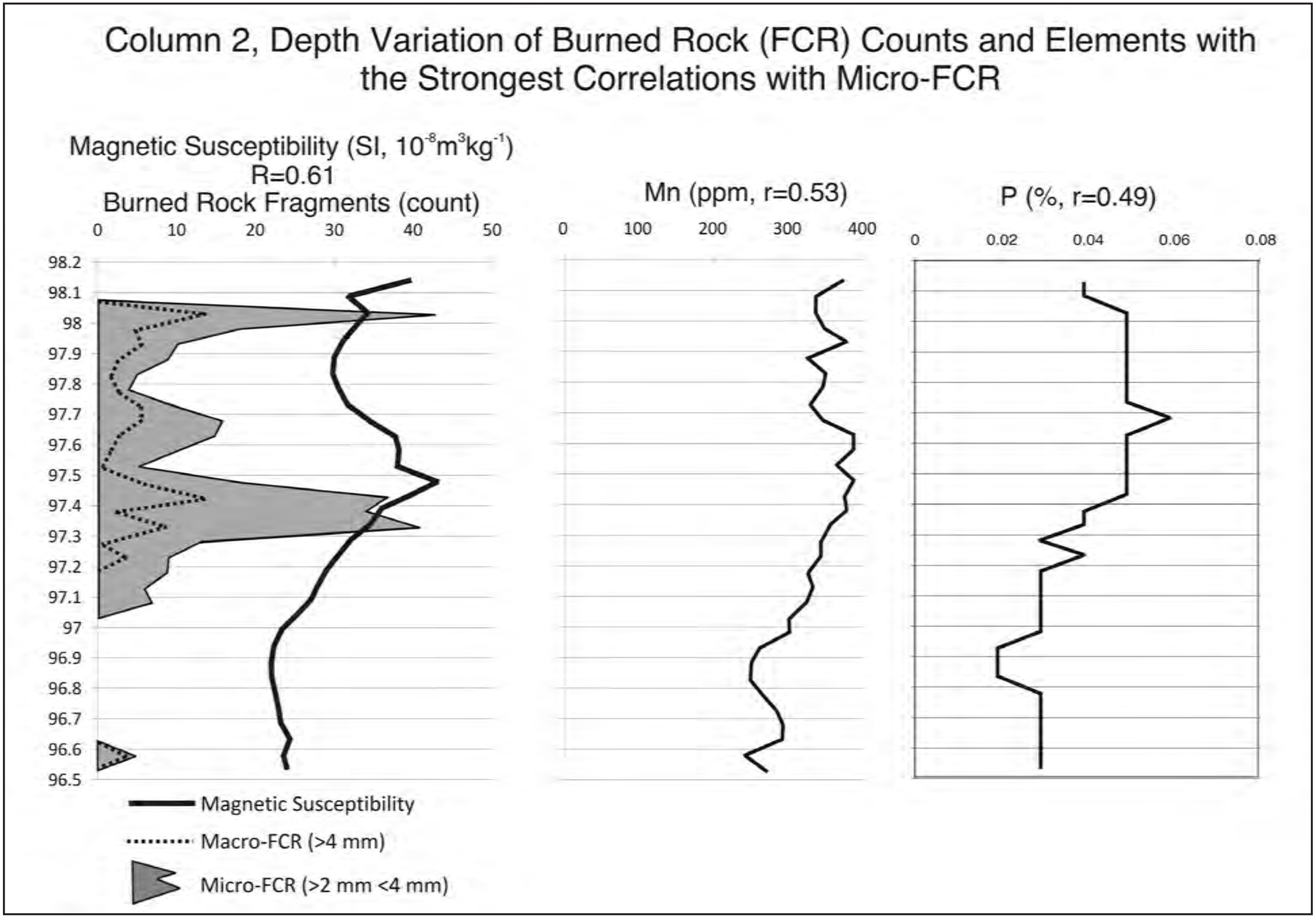


Figure 6.8. Plot of the depth distribution of the macro- and micro-FCR from Column 2, with respect to the magnetic susceptibility and the two most strongly correlated elements (manganese and phosphorous).

occupation levels in Column 2 being more fully within the zone of organic enrichment (the top soil) than in Column 1. Support for this assertion is that the correlation between organic carbon and phosphorous is quite strong (r= 0.90).

Feature Specific Investigations

Samples were collected from Features 8 (the burned rock midden) and 35 (a slab-lined hearth immediately below it). These two features appeared to be intimately related in the field, but at that time it was unknown how much time separated their formation. It is now clear from the results of radiocarbon dating of nine samples from the two features that nearly all of the radiocarbon ages overlap at 2-σ standard deviations, which makes it impossible to precisely date them using radiocarbon. In the north wall profile of Feature 35 there appears to be about 10 cm of sediment separating the top of the slabs defining the margins of the feature and the base of the rocks scattered around the periphery of Feature 8. Given the apparent sedimentation rate during the Transitional Archaic occupation, this may equate to as much as a century of time.

For each feature, the sample suites consist of widely spaced horizontal transects of samples that consisted of pairs of bulk sediment and micromorphology blocks. These paired samples were intended to be examined together in order to assess trends within the feature and how these may relate to the cultural formation processes and the issue of anthrogenic elements concentrations associated with thermal features. The results of some of these analyses are plotted on Figures 6.9 and 6.10. The top part of each figure plots the results of the organic carbon, stable carbon isotope, calcium carbonate equivalent, and magnetic susceptibility for these samples across the feature, and these plots are lined up with the location of each sample depicted in the stratigraphic image on the middle panel. The lower half of the figure consists of scans of the thin sections, which provide a general impression of the variation in the fine sediments.

Feature 8

Feature 8 is an incipient burned rock midden, and a suite of five samples was collected from the west wall profile exposure in BHT E (see Figure 6.9). Samples 1 and 2 were collected from the fine-grained fill of the two phases of shallow basin features in the center of the midden. Sample 1 was collected from the most recently used pit feature, and Sample 2 was collected from the fine earth fraction of a slightly older pit feature located directly to the north of the first and separated from the first by a prominent layer of burned rock that was interpreted as resting upon the interface between the two pit fills. Samples 3, 4 and 5 were all collected from the discard scatter that surrounded the central feature, but at increasing distances to the north. Unlike Feature 35, no local control sample was collected, but Sample 1 from Feature 35 serves as a functional base line or control value. All of these samples are from anthrogenic sediment, but their context varies from the in situ detritus of relatively recent use (Samples 1 and 2) to material that was discarded in the annulus of debris surrounding the central feature. Hence, one of the main differences between these two groups is the period of time that has elapsed since the material was discarded.

The analysis of the basic physical properties yielded some expected, and some unexpected results. First, all of the sediments exhibited a clearly enhanced magnetic susceptibility in comparison to the Feature 35 Sample 1 control (outside Feature 35, and about 10 cm below Feature 8) as well as the Column 1 and Column 2 averages (Table 6.2). But the horizontal trend in magnetic susceptibility is opposite of what would be expected in that the values increased away from the central features. Perhaps this is a reflection that the earth that is eventually discarded in the annulus is from the base of the feature where magnetic susceptibility is most likely to be greatest. The samples collected from the central features were from fine earth fill but not at the base of either feature.

Somewhat more surprisingly, the magnetic susceptibility values varied inversely with the calcium carbonate content (CCE). It was initially assumed that these two properties would track together given that they are both by-products of thermal features, and this relationship was observed in Feature 35, but the transect samples across Feature 8 exhibit a significant inverse correlation (-0.922). The highest calcium carbonate content is observed in the central features, and the values decline into the annular discard area. Given that the main difference between these two sample groups is time since discard, these results may suggest that ash-derived calcium carbonate is rapidly degraded upon discard onto an unprotected or unsheltered surface.

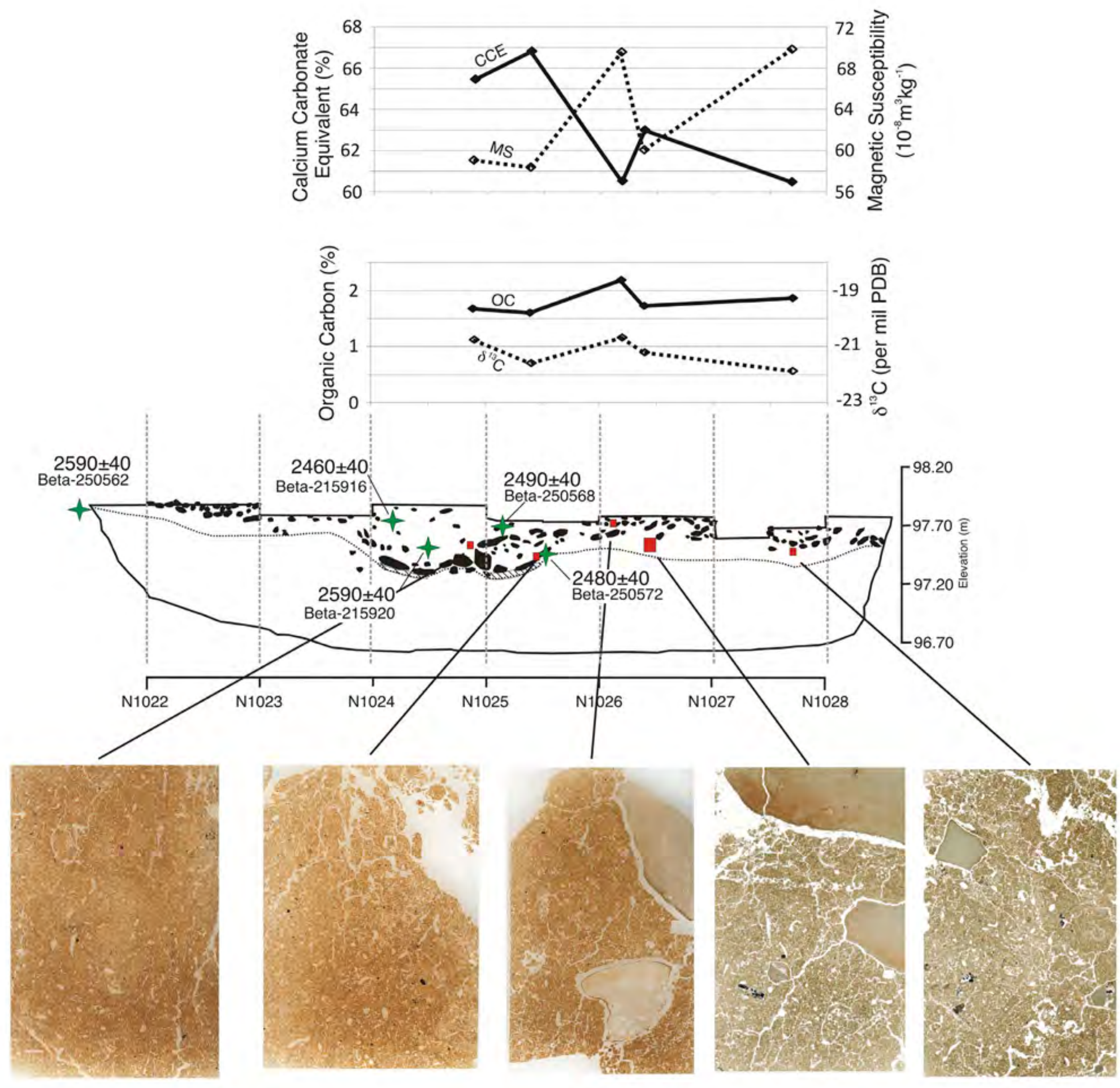


Figure 6.9. Three part Figure illustrating the location of samples collected from Feature 8 and results from some of these analyses. Top Panel: Two line charts that show the lateral changes in calcium carbonate equivalent, magnetic susceptibility, organic carbon content, and the stable carbon isotopic composition in a transect across Feature 8, from the central pit features on the left, into the discard annulus on the right. Middle Panel: Line drawing of Feature 8 showing the base of the feature and the location of burned rocks (black), radiocarbon ages (green stars) and samples collected for bulk and micromorphological examination (red squares). Bottom Panel: Transmitted light scans of the petrographic thin section slides from Feature 8, which provide a subjective impression in the change in the sediment across the midden.

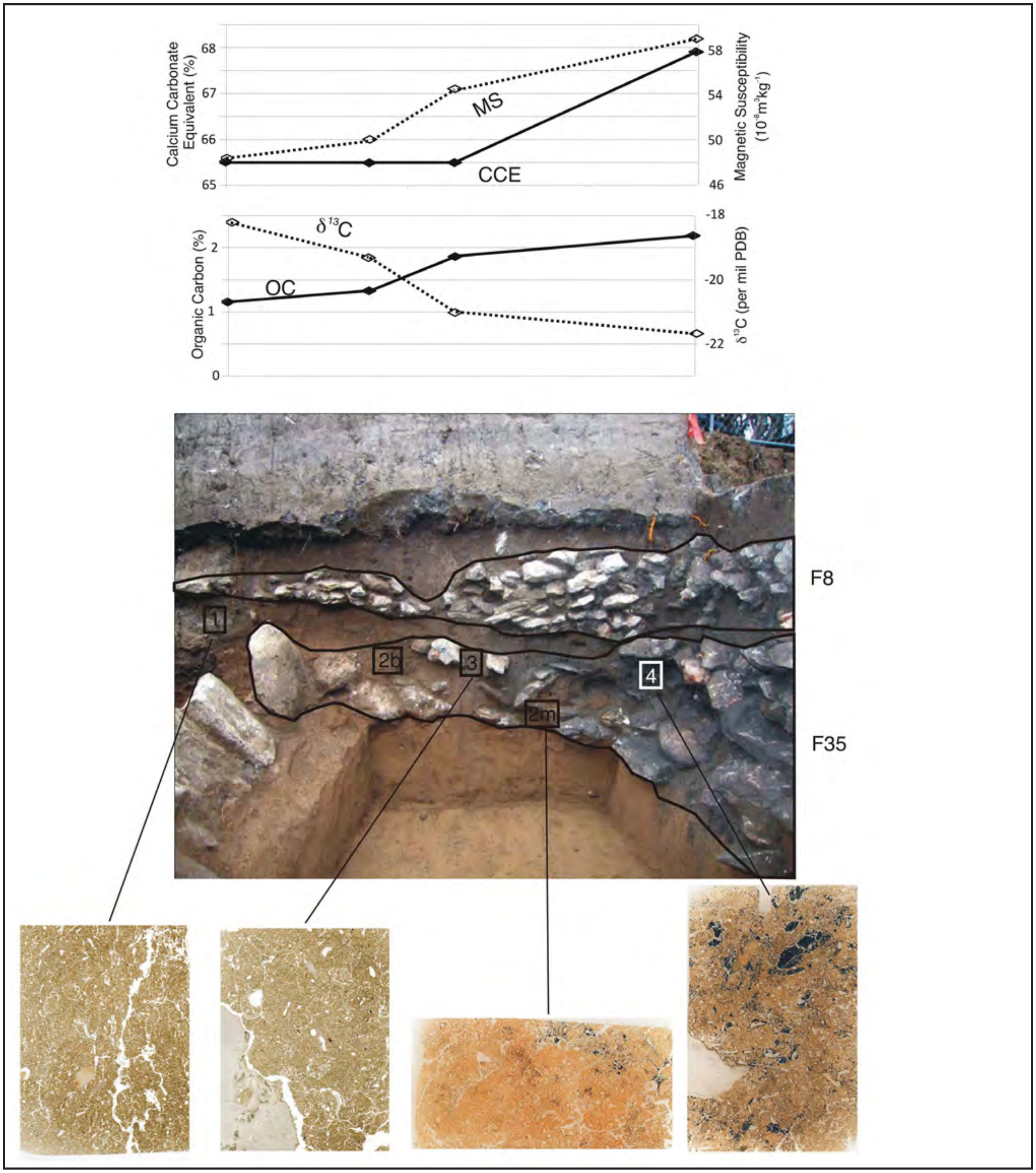


Figure 6.10. Three part Figure illustrating the location of samples collected from Feature 35 and results from some of these analyses. Top Panel: Two line charts that show the lateral changes in calcium carbonate equivalent, magnetic susceptibility, organic carbon content, and the stable carbon isotopic composition in a transect across Feature 8, from the central pit features on the left, into the discard annulus on the right. Middle Panel: photograph of Features 8 and 35 with outlines of each feature and the location of samples collected for bulk and micromorphological examination (1, 2b, 2m, 3, and 4). Bottom Panel: Transmitted light scans of the petrographic thin section slides from Feature 35. Note the abundant macro-charcoal in Sample 4 (bottom right) near the center of the feature.

Table 6.2. Feature Elements

Element / Property	Within Feature 35	Within Feature 8	Control (Sample 1, outside of F35)	Column 1 Average	Column 2 Average
Aluminum (Al), %	2.12 to 2.36	2.26 to 2.49	2.03	2.07	2.09
Barium (Ba), ppm	109 to 119	117 to 126	101	107	102
Potassium (K), %	0.55 to 0.61	0.58 to 0.65	0.51	0.55	0.55
Magnesium (Mg), %	0.74 to 0.82	0.78 to 0.91	0.72	0.79	0.84
Phosphorous (P), %	0.03 to 0.04	0.04 to 0.07	0.03	0.06	0.04
Titanium (Ti), %	0.1	0.07 to 0.11	0.09	0.09	0.09
Magnetic Susceptibility ($10^{-8}m^3kg^{-1}$)	49.8 to 58.7	58.9 to 69.7	48.3	52.9	41.8

The organic carbon content along the transect varies between 1.6 percent and 2.18 percent with slightly larger values observed in the annulus scatter. These values are significantly greater than the control samples, which suggest that carbon enrichment has occurred within these deposits. But unlike the Feature 35 samples that contained abundant sand-sized and larger charcoal fragments, these samples contain only a few widely dispersed sand-sized charcoal fragments in thin section, which suggests that the apparent carbon enrichment (if once visible like Feature 35, Sample 4) has been significantly reduced in size through faunal activity. The stable carbon isotopic values vary about 1.2 per mil across the transect with no clear lateral trend. In terms of elemental variation, aluminum, barium, and potassium all appear to have significantly larger values within Feature 8, but the other most common anthrogenic elements (magnesium, phosphorous, and titanium) exhibit values that are larger than but also overlap with the control samples.

Feature 35

A suite of four bulk samples was collected from Feature 35, and these form a transect from immediately outside the feature, into the center (see Figure 6.10 for the location of the samples). For all feature specific samples except Sample 2, the bulk and micromorphological samples were collected from the same location. However, on Feature 35, the second bulk sample and the micromorphological sample were collected from different points, and the locations are shown on Figure 6.10 (2m denotes the location of the micromorphological sample and 2b is the location of the bulk sample used for elemental analysis). Sample 1 was from immediately outside the slab-lined hearth and Sample 2b was from immediately inside the slabs. Sample 3 was collected between a line of rocks that dip down into the core of the feature, and Sample 4 was collected from fine earth near the center of the thermal feature. Examination of the basic physical properties of these sediments shows a clear set of trends that follow expectations. In general terms, the organic carbon content doubles from the outside to the inside of the feature, and the stable carbon isotopic composition of this carbon shifts from -18.22 per mil to -21.69 per mil which suggests almost a doubling in the carbon contributions from C_3 biomass as one would expect if wood was the dominant fuel. Somewhat surprisingly, the amount of calcium carbonate is static in the first three samples, and increases only slightly in Sample 4. Given that wood ash is dominantly calcium carbonate (Canti 2003) a more prominent lateral trend in calcium carbonate was anticipated. A 20 percent (or 10.4 $10^{-8}m^3kg^{-1}$) increase in magnetic susceptibility was observed from the outside to the inside of the feature, which is consistent with idea that earth used in such features acquires an enhanced magnetic susceptibility. This is consistent with previous feature specific work in Central Texas, such as Takac and Göse (1998) who examined the magnetic susceptibility of multiple features at the Wilson-Leonard site and noted that some (they note four in particular) appeared to have experienced significant magnetic susceptibility enhancement and exhibited χ values on the order of 20–30 percent above background values. The increase in magnetic susceptibility into the center of the feature is similar to observations made by Mauldin et al. (2006) for a relatively in situ feature at 41PR44 at Fort Wolters, but the magnitude of the enhancement here is less than they observed.

Micromorphological examination of the four samples collected from F35 support the general trends observed in the bulk analyses. These samples, unlike the bulk samples progress from the outside to the inside of the feature in the following order: 1, 3, 2 and 4. Charcoal is almost completely absent from Sample 1, as are burned rocks or other cultural material. Sample 3, within but close to the outer edge of the feature, contains several burned rocks, as well as traces of very small (<0.1 mm), widely dispersed charcoal fragments, and exhibits a moderately clear subangular blocky microstructure, as did Sample 1. Sample 2 was located at the base of the feature and sampled the thermally altered sediment beneath it. This sample was clearly reddened, and the top third of this thin section contained a moderate amount of charcoal, all of which appeared to have been ingested and expelled from a worm at least once, as this material was concentrated in linear traces and often still retained the pelletal form of the worm excrement. Sample 4, like Sample 2, contained significantly reddened fine matrix and abundant charcoal which ranged from large undisturbed pieces to small fine disseminated fragments, the latter of which dominate the slide and appears to have been reworked by worms (Figure 6.11).

Of the elements that showed correlations with the cultural deposits in the two column samples, two patterns emerge. Barium (Ba) shows a consistent increase into the center of the feature, a trend that is also exhibited by lanthanum (La), although the latter showed no significant correlation with cultural material in the column samples. Magnesium (Mg), aluminum (Al), and potassium (K) exhibit a stepwise increase towards the center of the feature. Another way of considering the possible enrichment of these elements is to compare the values obtained from within the feature to the averages for all the samples in Column 1 and 2, as well as Sample 1, which because it is outside the feature may serve as a local control sample (see Table 6.2). By this measure, aluminum, barium, and potassium appear to be enriched within Feature 35, but magnesium, phosphorous, and titanium are not. Magnetic susceptibility, not surprisingly, shows a prominent increase within the feature compared the control sample and to the Column 1 and Column 2 averages.

Feature summary

Overall, the analysis of the two thermal features confirms that they have acquired modest chemical and elemental enrichment through anthrogenic alteration. In specific, the sediments associated with these two features exhibit enhanced magnetic susceptibility, as well as increased concentrations of various elements such as carbon and barium. Other elements, such as aluminum, magnesium, phosphorous, and titanium, occasionally exhibit elevated or apparently enriched values but the results are not consistent between the two features. The specific behavioral mechanism of elemental enrichment is not known at this time, but given the nature of these features it is likely due to introductions made by fuel and its thermal decomposition byproducts. Other pathways of elemental enrichment are possible (such as the decomposition of organic refuse associated with harvesting and processing food stuffs, or the construction and decomposition of perishable [brush] structures) but were not examined here. The majority of activities identified by the site features involve the concentration of organic materials and the suite of relative elements. Activities likely to result in the enrichment of rarer elements often involve gathering and processes mineral resources, such as pigments. The groundstone does reveal some ochre processing on the site, but these are expected to be fairly uncommon activities.

Unfortunately there are few comparative data sets from other Texas archaeological sites. There is a small body of comparative literature for magnetic susceptibility (e.g., Mauldin et al. 2006; Tacak and Göse 1998). Perhaps one of the most comprehensive data sets is the work of Takac and Göse (1998) at the Wilson-Leonard site, which examined three long columns of the entire stratigraphic sequence, as well as samples of specific features and a short vertical column through the burned rock midden. Feature samples were compared with similar samples in the vertical columns in order to assess the possibility of anthrogenic magnetic susceptibility enhancement. Although they examined approximately 60 different feature fills, Takac and Göse (1998) found significant magnetic susceptibility enhancement in just four features, while most of the samples did not appear to be significantly different than background samples. The general lack of significant anthrogenic enrichment of the magnetic susceptibility was attributed to the open-air nature of the site and post-depositional bioturbation of the sediments, both of which work against the preservation of the magnetic susceptibility signal.

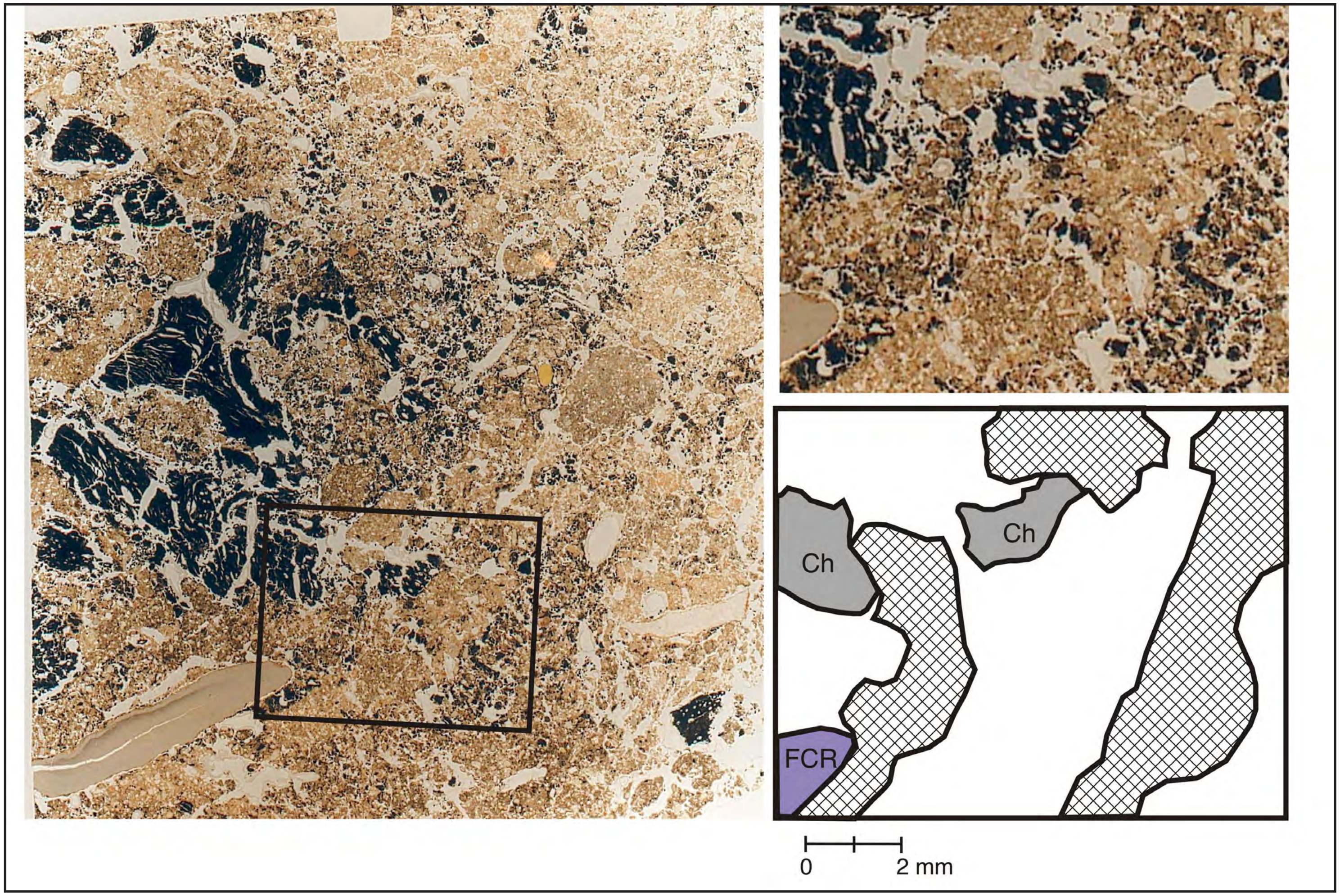


Figure 6.11. Photomicrograph of Sample 4, Feature 35, showing in situ charcoal fragment adja-cent to several excrement pedofeature (worm casts) containing numerous small fragments of charcoal. The large photo on the left is a view of the entire slide, with the square highlighting the area enlarged on the right. The two images on the right consist of a plane light photomicrograph (top), and a line drawing of the same view highlighted to point out specific features (bottom). The scale bar for the enlarged view is shown below. On the lower right line drawing the cross-hatched areas are worm passages, within which much smaller charcoal fragments are visible. Many of the other fine-grained matrix portions of this image are also worm passages, but are ei-ther older or lack fine charcoal content. The physical destruction of charcoal by ingestion and subsequent excretion by worms appears to be one of the primary causes of charcoal degradation in these deposits.

Discussion

The work performed here provides a different but complimentary image of the structure of the Siren site deposits than is available from the archaeological excavation. Although the sedimentary deposits at the site change slowly throughout the last three millennia, a few properties vary significantly in this period and reflect changes in the local vegetation and detrital sediment composition, as well as pedogenic and anthrogenic alteration. Unlike the artifact record, which can be stratigraphically discrete and reflect only human activity at a site, the properties examined here are attributes of sediments that may be enhanced by human occupation, and as such their depiction of anthrogenic activity is often less discrete than the artifacts themselves.

Detailed characterization of the two, 5-cm-increment, column samples, one in the E Block, and a second in the NW Block, revealed several apparently correlative trends, the most notable are the stable carbon isotopic composition of the organic matter, and the magnetic susceptibility. The stable carbon isotopic record from the two columns show similar cyclical shifts in the vegetation composition, but the apparent timing of these changes obtained from the two columns are not consistent internally or with other records of this type. The two periods of increased $\delta^{13}C$ values depicted by both records most likely fall prior to 2500 B.P. and again during the Mediaeval Warm Period, approximately 1200 and 800 years B.P. (see Nordt et al. [2002] for similarly shaped latest Holocene record).

The depth distribution of micro- and macro-artifacts, specifically burned rock and lithic debitage, provide a more finely resolved stratigraphic image of the cultural deposits than is available from the 10-cm excavation levels, and the lithic and burned rock records are generally complimentary but not identical to one another. The micro-artifacts, as expected, tend to have a wider (and more continuous) stratigraphic range than the macro-artifacts, and this undoubtedly reflects the greater post-depositional mobility of small material by soil fauna and flora. The number of prehistoric occupations that can be inferred from this record depends upon how literally one views these results, but there is unambiguous evidence of at least three occupations, and a compelling case can be made for as many as six occupations if each peak in the artifact distribution plot is considered a distinct occupation event.

Examination of the relationship between human activity and indices of anthrogenic alteration of the fine earth fraction of the sedimentary record provides some support for the assertion that human activities at the site have enriched the deposits in some elements, but few of these relationships are statistically strong. The property most closely correlated with the occupational record is magnetic susceptibility, and this was clear within the column and the feature specific studies. Elements that exhibited the strongest correlation with the artifact distribution in the two column samples were magnesium, barium, potassium, aluminum, titanium, and manganese, where as elements that were clearly enriched in the features were barium, aluminum, magnesium and potassium. Organic carbon, which can be demonstrated to be enhanced in association with thermal features such as Feature 35 and the burned rock midden (Feature 8) exhibits a poor correlation with the artifact depth distribution owing to pedogenic over printing, and the fact that its enrichment appears to be related closely to the discard of thermal refuse. The micromorphological observations corroborated previous work by Goldberg (1998) that indentified faunal reworking as the main vector responsible for the breakdown of charcoal in occupational settings such as these.

A number of suggestions for future research follow directly from this work. First, the analytical method chosen for this work was found to be insufficiently precise for phosphorous and calcium, two elements which are known to be anthrogenically enhanced. Phosphorous was determined by the ICP-AES method and the values were found to be poorly correlated with prehistoric occupation, but a more sensitive method (measuring phosphorous in parts per million rather than in percent) may have yielded more useful numbers. It was assumed that calcium carbonate would be a sufficient proxy for elemental calcium, but that assumption is open to question. Second, the results of the calcium carbonate distribution within Feature 8 (the burned rock midden) suggest that ash may be significantly altered/dissolved soon after discard. It would be interesting to see if this trend is apparent in other burned rock middens. If so, this suggests that more work on the taphonomic fate of ash deposited on an unsealed surface is in order. Specifically, research focused on how and how rapidly ash is dissolved and/or altered by meteoric water would clarify some aspects of its preservation in prehistoric contexts. Third, when surveying the results of the elemental analysis, it became apparent that there were repeated patterns among groups of elements that most likely represent how these elements are bound in different minerals. Given the existing discourse on total dissolution and partial or "weak acid" dissolution methods in this literature, it would be interesting to perform a more comprehensive feature analysis using both methods to see which is more sensitive to anthrogenic alteration of sediment associated with hunter-gatherer remains. A more comprehensive feature sampling method in the field may provide a broader understanding of the kinds of cultural processes that lead to anthrogenic enhancement of ancient occupation sediments. Fourth, directly dating carbon found within the column samples rather than attempting to correlate to nearby radiocarbon dated features might have avoided some of the chronological uncertainty present in these records. Finally, although the Siren site did not present physically distinct occupation surfaces, it would be interesting to perform a broad spatial sampling of a prehistoric hunter-gatherer site where the occupation surfaces are obvious in the field in order to see what kinds of chemical and magnetic enhancement might be present and how this may correlate with activity area patterns revealed by more traditional artifact patterns.

The Siren Site in Context: An Examination of the Role of Alluviation in Providing Archaeologically Advantageous Opportunities

> "Disturbed deposits, such as mixed 'plow zone' aggregates of tools, are the most common remains we encounter; if we had to hold out for the very few sites where we may 'recognize' undistorted 'analytical units,' then we will have very few remains from the past with which to work. The challenge is how to use the 'distorted' stuff, not how to discover the rare and unusual Pompeiis" (Binford 1981:205).

Introduction

It is a fact that in an effort to obtain better quality archaeological information archaeologists in Texas during the last 20 years have increasingly looked towards alluvial depositional environments. The reason for this is generally well understood. In addition to their obvious attraction to past populations such as proximity to water and their habitat for game, alluvial lowlands also offer stratigraphic situations that enhance and facilitate understanding of archaeological residues, namely multi-component geologically stratified archaeological sites. This type of site, the gisement, has been discussed in some detail by Collins (2004), who notes that they often exhibit high data quality in the form of rapid burial, minimal post-depositional disturbance and relatively homogeneous artifact assemblages. Such sites can be found in various depositional settings other than valley bottoms as Collins has noted (e.g., eolian, slope), but alluvial environments have been examined in more detail than most, especially with respect to the role of sedimentation in providing differing archaeological opportunities.

In a seminal paper on the subject, Ferring (1986) describes how sedimentation rates vary within alluvial depositional environments and the basic effect they have on archaeological sites. Specifically, Ferring (1986) notes how the sedimentation rate directly affects artifact densities, spatial patterning and preservation, with slow rates favoring the formation of palimpsests, as the same surface may be repeatedly occupied by different groups over a long period thereby resulting in artifact records that are difficult to interpret. Fast rates favor the preservation of discrete occupation surfaces of relatively short temporal duration. Although the basic validity of the sedimentation rate argument is undeniable, the driving factors in the formation of a given alluvial archaeological assemblage/site that influence the interpretability and compression of the archaeological record are more accurately described as a combination of sedimentary, behavioral, post-depositional, and stratigraphic factors.

One of the hallmarks of the Siren site is the superposition of multiple occupation surfaces in a relatively short period of time with the Transitional Archaic being the period that this occurs most clearly and frequently. Two features in particular drew attention in the field owing to their geographic proximity and behavioral similarity, namely Feature 8, which was an incipient burned rock midden, and Feature 35, which was a large slab line pit feature located immediately below and slightly offset from the central feature of the burned rock midden. Were these two features, as they seemed in the field, part of the same behavioral process but separated by a small amount of sedimentation? Although the answer to this question will be addressed in more detail in Chapter 11 of this volume, the question and chronological relationship between the two features, and the formation of the Transitional Archaic record remains a salient question, and the partial impetus for this discussion.

The chronological relationship between the two features was unclear in the field, but with the benefit of nine radiocarbon ages it appears that the creation of the two features are essentially indistinguishable by the radiocarbon method given that most of the ages overlap at two standard deviations. However, it is likely that the two features were created in a period of no more than 200 years and are most likely about a century apart in age. At most, they are separated by about 10 cm of sediment. This approximate sedimentation rate is consistent with broader impressions observed across the site, as discussed in detail earlier in this chapter. Although this rate of sediment accumulation is slow (see Ferring 1986) and the deposits preserved in a cumulic soil, the site preserves details of past activities that would be more difficult to understand if they had been compressed onto a single, unsealed surface.

The goal of this section of this chapter is to examine the processes influential in the formation of alluvial archaeological sites like the Siren site, that appear to provide glimpses into serial human habitation of the landscape and how this kind of setting can be found elsewhere. Although Binford (1981) argues that we should learn to understand and work with the distorted record associated with the average archaeological site, it is clearly counterproductive to not want to seek out and find those "rare and unusual Pompeiis" that hold the least distorted and most clear images of the distant past. The following discussion seeks to explore some of the processes that have led to the formation of sites like the Siren site, which come close to approximating one of the "little Pompeiis," in order to see how we might more proactively understand their stratigraphic and spatial distribution in the landscape as well as how sites such as this provide windows onto the development of complex, long use-life features like burned rock middens.

Sedimentary Factors

The depositional environment strongly conditions the kinds of sediments present in an alluvial environment, and this has been discussed in detail elsewhere (e.g., Brown 1997; Ferring 1986; Gladfelter 2001; Huckleberry 2001; Waters 1992). These references, however, examine the processes that dominate the alluvial environment rather than examining the presentation of archaeological sites within these settings. The following discussion, drawing on observations in the taphonomic literature (e.g., Kidwell and Behrensmeyer 1993; Martin 1999; Miller 2007), and in light of the voluminous archaeological literature on site formation processes (e.g., Schiffer 1987; Wood and Johnson 1978) examines some of the attributes of different kinds of accumulations in the sedimentary record, be they ancient human occupation surfaces or fossil occurrences, in order to examine situations that are most conducive to understanding ancient human activities.

Site Types

A perusal of the paleobiological literature yields some interesting observations on the nature of natural accumulations of fossil assemblages that hold direct relevance to archaeological sites. Of particular interest are specific kinds of sites that have been described in the taphonomic literature that reflect the dynamic interplay between sedimentation and fossil preservation. Two specific types of fossil accumulations are considered relevant here: 1) time averaged accumulations and 2) obrution events.

Time Averaging

Paleontologists use the term time averaging to refer to "the process by which organic remains from different time intervals come to be preserved together" (Kidwell and Behrensmeyer 1993:4) and often construe this as a form of "blurring" of the stratigraphic record which limits one's ability to resolve the record into fine time slices (Graham 1993:105). A number of different processes can contribute to the formation of time-averaged assemblages in nature, with the two principal processes being slow or non-sedimentation and mixing. Mixing is discussed later under post-depositional factors, so the following discussion examines the issue with respect to sedimentation. Long periods of no sedimentation or slow sedimentation are perhaps the typical manner in which archaeologists consider the formation of time averaged or palimpsest assemblages. This is the classic concept inherent in Ferring's (1986) paper, whereby slow sedimentation rates permit different period groups to inhabit the same surface, and their refuse becomes co-mingled and difficult to distinguish unless cultural material of temporally diagnostic nature is encountered (e.g., temporally diagnostic lithics or pottery sherds) or material datable by an absolute means is found (e.g., charcoal).

Time averaging is, of course, a gradational phenomenon, with all sites, by definition, including some measure of it. But, the process becomes deleterious when it results in sufficient overprinting that it obscures trends or events that may once have been clear, or when it results in the co-mingling of material from two or more significantly different periods. However, examination of archaeological manifestations associated with extremely short duration hunter-gatherer occupations preserved in rapidly aggrading settings illustrates how some time averaging may be a desirable attribute. Recent work on Onion Creek near Austin exposed a series of prehistoric occupations that appear to contain a very low level of time averaging, and these occupations demonstrate the ephemerality of what may be a "normal" short stay by a hunter-gatherer group (Thompson 2006). In general terms, these occupations exhibited high stratigraphic resolution but low artifact ubiquity, and the near absence of cultural residues limits what can be said about past activities at these localities. If all of these short-term occupations were compressed onto a single surface, as would occur if they were to be time-averaged, we would see what most archaeologists would consider to be a modestly good archaeological site, but, in reality, it would be the effects of the time averaging that has rendered the assemblage meaningful. Although it is impossible to say that these very short term, minimally time averaged occupations are meaningless or worthless, to archaeologists who relate most to tangible artifacts rather than color variations in the dirt, and for many of whom a good site is one with lots of diagnostic tools, this is a hard sell.

At the far end of the time averaging spectrum are the palimpsests that early Texas archaeologists excavated and that to this day avocational archaeologists and pot-hunters alike target because of the overwhelming ubiquity of cultural material. Today, the Texas archaeological community generally avoids sites with extreme time averaging because of their greatly diminished interpretive utility (Collins 2004), but this is not to say that geomorphic surfaces with the potential for such time averaging cannot have short-term occupations. Rather, our ability to demonstrate the true duration of an occupation on such surfaces is extremely limited owing to the deleterious effects long-term surface exposure has on the preservation of datable remains.

Between these two extremes lies a large gray area where individual occupation surfaces may experience significant time averaging that may or may not be deleterious to the interpretation of the resulting cultural residues. "How long is too long?" is the most salient question to ask, and in absolute terms it is impossible to answer. There appears to be a sliding perceptual scale within the archaeological community. Sites with built environments, such as are common in Mesoamerica, may exhibit considerable time averaging and yet still yield interpretable remains, whereas hunter-gatherer sites, with a lower quantity of temporally diagnostic artifacts, may be significantly compromised by similar degrees of time averaging. However, even within the paleobiological community, where time averaging is viewed negatively, it is recognized that this process can be advantageous because it dampens short-term noise and highlights longer-term trends within fossil communities (Martin 1999:4).

Obrution Deposits

The concept of obrution refers to the burial of a surface by a single sudden depositional event and it is applied to fossil assemblages that are exceptionally well resolved temporally (hours to days) and thus offer brief "snapshots" of ancient conditions (the frozen moment) and communities. Although often associated with Pompeiian-like qualities, obrution surfaces can be single short-lived occupation surfaces or almost any kind of time-averaged surface and therefore do not necessarily afford exemplary preservation or interpretive insight (Simoes et al. 1998). Beyond the archaeological and paleontological world, the obrution concept can be found in other disciplines such as soil science, where it is implicit in the Soil Survey Staff (1999:10) definition of a fossil soil or paleosol, which generally has to be buried by 50 cm or more, and for a buried soil to be preserved this burial generally is assumed to occur rapidly (or at least at a rate greater than the rate of soil development).

Archaeological examples of obrution surfaces that provide extraordinary insights into past human activities are present in the Texas archaeological literature, with at least four that come to mind immediately: 1) the Late Prehistoric component at the Rocky Branch site (41RN169; Treece et al. 1993); 2) the Late Prehistoric component of the Elm Creek site

(41CN95; Treece et al. 1993); 3) the Late Prehistoric occupation at the Corral site (41PT186; Quigg et al. 2008); and 4) the Rush site (41TG346; Quigg and Peck 1995).

The late Prehistoric component of the Rocky Branch site consisted of several stratigraphically discrete occupation surfaces that were sealed between beautifully stratified, event specific flood deposits of the Colorado River. Although at least three occupation surfaces with similar preservation and stratigraphic integrity were recognized at this locality, one surface, designated Cultural Unit I, a Toyah Phase occupation broadly dated to ca. A.D. 1450, was extensively excavated. This occupation surface contained the remains of at least two bison kills and possibly the vestiges of two household groups sandwiched between two thin Colorado River flood events. Numerous ash features, a presumed wall trench and bison rib peg alignments (presumably the vestiges of where a hide was stretched and cleaned) are some of the more impressive attributes of this occupation.

At the Elm Creek site in Coleman County, Cultural Unit I consisted of an extensive occupation surface that was radiocarbon dated to approximately A.D. 1511 and contained four discrete activity areas. Like the Rocky Branch site, the occupation surface was sandwiched between two flood deposits in a well-bedded sequence of flood event sediments associated with the Colorado River and its tributary Elm Creek. As with the Rocky Branch site, other occupation surfaces were present in this sedimentary sequence (one other of which was excavated; Cultural Unit II, ca. A.D. 440) but most of these were only briefly examined and not targeted for broad scale excavation (they were recorded as unassigned materials).

At the Corral site (41PT185) in the panhandle near Amarillo, Quigg et al. (2008) found a buried Protohistoric occupation surface buried within a recent alluvial deposit that was radiocarbon dated to around 220 B.P. The occupation surface rested upon a paleosol and had been buried by a sizeable flood event, and the materials observed during testing consisted of a discrete ash feature, a cluster of butchered bison, and a few pieces of lithic debitage.

At the Rush site in Tom Green County, Quigg and Peck (1995) identified five occupation surfaces widely scattered within 1.7 m of alternating light and dark colored flood sediments on the floodplain of the North Concho River. Occupations 1, 2, and 3 dated to the last 300 years and were determined to be too sparse to excavate, whereas Occupations 4 and 5 yielded more abundant remains. Occupation 4 received the greatest attention. A total of 30 cm of sediment separated the two lowest occupations, and it appeared to have accumulated in approximately 240 years (12 cm/year or 12.5 m/century). Occupation 4, which was radiocarbon dated to A.D. 1405–1954, revealed a wide range of very well-preserved occupation debris, including abundant bone, discrete ash features (hearths and dumps), and lithic scatters.

Although none of these sites was necessarily buried by a single massive event (arbitrarily conceived of as >50 cm of near-instantaneous sediment deposition that could represent a span of hours or days), all of these sites share two common characteristics: 1) they retain clear stratigraphic evidence of the rapid depositional events that bury and preserve these occupations, and 2) the occupation surfaces themselves are sharp and preserve exceptionally good spatial activity area patterning. Although not specifically stated, one of the more useful attributes of the obrution deposit is the clearly distinguishable stratigraphic sequence that permits an independent means of demonstrating stratigraphic separation of the buried surface. Many alluvial depositional environments lack this attribute—and this particular attribute is missing from the Siren site deposits—but when present it greatly enhances interpretational clarity, especially in terms of evaluating the degree of time averaging that may be present.

Three of the previously mentioned sites also share another attribute, namely that multiple occupation surfaces were preserved in similar stratigraphic circumstances, but that one was selected for excavation on the basis of its ubiquity of artifacts. A couple of possible explanations for the different appearance/presentation of these occupations (specifically the artifact ubiquity) come to mind. First, the surfaces differ in terms of their degree of time averaging with those containing more materials representing longer duration surfaces with a greater degree of time averaging and therefore a greater artifact ubiquity. Second, the surfaces with lower artifact ubiquity may represent the margins of these occupation areas rather than the center, and that the different occupation surfaces may spatially overlap each other like a Venn diagram. Clearly, there are many cultural processes that also contribute to the ubiquity, or lack thereof, of artifacts.

Although a variety of other taphonomic deposit patterns recognized by paleontologists have archaeological applications, these two concepts, time averaging and obrution, bring together the key factors useful in defining the most favorable depositional circumstances for interpreting human activity in the sedimentary record.

Behavioral Factors

The literature on human activities that contribute to the formation of archaeological sites is vast (e.g., Schiffer 1985, 1987), and this is not intended to be the focus of this section. Rather, a much more limited issue is of concern here; specifically, what are the cultural/behavioral factors that led to the repeated occupation of the same locality through time? In some cases, such as places where sedimentation has been significant and no trace of previous inhabitants was visible on the ground surface, this appears largely to be a function of chance. The Richard Beene site (Thoms and Mandel 2007) would seem to be a classic case in point. In some situations, like the Siren site, the same locality is repeatedly occupied over a relatively short period of time, and the construction of long use-life site appliances like burned rock middens appears to suggest that the serial re-occupation of the locality may be associated with an attraction or pull factor.

A number of different attractions, either individually or in combination with one another, could lead to the repeated occupation of a locality, such as the proximity to a specific resource (e.g., a particularly productive food source such as geophytes [Mehalchick et al. 2004], or a reliable water source), proximity to shelter, tradition within a particular group on a seasonal round, the intrinsic value or appearance of the place, or its strategic location. Many of these are impossible to determine thousands of years later from archaeological evidence alone.

Consider for a moment, however, the significance of the construction of features like burned rock middens (such as Feature 8 at the Siren site). These long-term, point-source activity areas that Steve Black (Black and Creel 1997) has referred to as "site appliances" were not really laboriously built structures with which the builders had a significant labor investment (say one might have with a building or irrigation network), but rather appear to grow to be large structures through the repeated use and maintenance of the same central feature over a long period of time and the incidental accumulation of secondary refuse (after Schiffer 1985:29). Despite not necessarily being intentionally "built" features, however, when situated on stable, non-aggrading landforms these structures often grew to be very large monuments to long-term bulk food processing. The mere existence of such large features suggests that there was an advantage to the reuse of these structures, which may have been functional, or merely traditional, and this behavior transcends Texas to other regions (Thoms 2009). The radiocarbon dating of multiple samples from such features (e.g., Black and Creel 1997; Kleinbach et al. 1999; Treece 1993) demonstrates that they were clearly recognized by later generations for what they were and reused, often over periods of time longer than a thousand years. The attraction of such features may play a role in the repeated occupation of the site by serving as a landmark to a food resource or ancestral settlement or a point where the users perceived they could more easily process large quantities of food, and, for this reason, were more likely to re-occupy such site rather than occupy another location lacking such middens. These topics are addressed in more detail in Chapter 11 of this volume.

Post-Depositional or Diagenetic Factors

Post-depositional factors such as pedoturbation and pedogenesis work against the preservation of stratigraphic and spatial fidelity of the artifact patterns left by people by mixing the deposits. As noted previously, this is one of the main processes that results in time averaged assemblages. There are a myriad of different natural formation or disturbance processes that have been described in considerable detail concerning the formation of archaeological deposits (e.g., Schiffer [1987]; Wood and Johnson [1978] to name but two broad surveys), but the goal here is to examine the larger relationships between alluvial deposition, disturbance, and exceptional preservation situations.

Post-depositional disturbance is typically most common and destructive near the air-sediment or water-sediment interface, and depositional environments that have slow sedimentation rates typically have the most pervasive disturbance and mixing owing in part to what is often referred to as exposure effects (the period of time an assemblage is close to the sediment-air or sediment-water interface [Johnson 1960]). One of the principal reasons high sedimentation rate environments result in exceptional preservation is the ability to deeply bury a deposit before post-depositional disturbance processes can significantly affect the integrity of the assemblage. These disturbance processes can occur before burial and contemporaneously with the occupation (as in the case of trampling), long after abandonment (as in the case of most pedoturbative processes), or even during the excavation and analysis phases (by lumping different age strata into a single analytical unit or through inabilities to accurately date temporally divergent strata [Graham 1993]).

Beyond the process or vector specific disturbance often discussed in the archaeological literature (e.g., floralturbation, faunalturbation, cryoturbation, etc.), pedogenesis clearly plays a role in blurring the clarity of the depositional record. The role of organisms is widely acknowledged in the creation of soils (Jenny 1941), but the passage of time compounds the influence of these processes. Indeed, the effect of time in the preservation of sedimentary features in the upper 4 m of alluvial deposits in Texas is very tangible when comparing similar depositional environments of different age units in alluvial stratigraphic sequences. Young deposits (< 1,500 years) typically preserve primary sedimentary structures with little or no post-depositional disturbance below the top soil, but with the passage of a few thousand years (e.g., late Holocene alluvial deposits; ca. < 5,000 years old) the deposits are clearly more homogenized at both macro- and microscopic levels. This is attributable to long-term post-depositional bioturbation as well as the effects of other soil forming chemical and mechanical processes.

Stratigraphic Factors

In light of all of the other factors that play a role in the formation of sites like the Siren site, one of the more critical concerns is the way in which Texas streams arrange their deposits through time. It is well established that most central Texas rivers exhibit a cut-and-fill alluvial architecture, where different age deposits accumulate side-by-side, separated by an erosional unconformity that represents a period of channel entrenchment and widening between two phases of valley aggradation. This process inevitably juxtaposes two surfaces that experience significantly different sedimentation rates because of disparities in elevation with respect to the stream channel. Lower surfaces generally experience higher sedimentation rates because they are more frequently flooded, whereas higher surfaces experience much slower accumulation rates because they are much less frequently flooded and the depth of floodwaters is generally much less that lower surfaces experience. As the lower surface grows in elevation its sedimentation rate will decrease through time and generally approach that of the older, higher surface.

The net effect of this general process is to result in different burial rates for what at any given point in time may have been a single ground surface. When past populations lived on two of these different surfaces simultaneously, the burial potential of the lower surface will often greatly exceed the higher surface, and it is in this context that a gisement is likely to form. A brief examination of the stratigraphic context of other sites where buried incipient burned rock middens have been found reveals that the stratigraphic juxtaposition of an aggrading surface and a stable surface upon which burned rock middens are present is a common theme (Figure 6.12). Although there is no record of a burned rock midden on the older surface within the TxDOT right-of-way at the Siren site, examination of the older surface immediately outside the right-of-way to the west suggests that one or more such features are present there. At least two other sites have revealed incipient buried burned rock middens and both of these, (the Woodrow Heard site [41UV88; Decker et al. 2000] and the Elm Creek site [41CN95; Treece et al. 1993]) exhibited the same stratigraphic situation.

At the Woodrow Heard site, a middle Holocene alluvial fill dating roughly between 6500–4000 B.P. was deposited against a Late Pleistocene-era alluvial surface. The latter surface was exposed for most of the Holocene and multiple prominent burned rock middens had been constructed upon this surface (Decker et al. 2000:84). An incipient burned rock sheet midden and oven (Feature 37/49) was discovered buried within the relatively rapidly aggrading middle Holocene alluvial deposit adjacent to the older surface and was radiocarbon dated to 4670±60 B.P. (Decker et al. 2000:192).

An extensive burned rock scatter and central pit hearth that was interpreted as an incipient burned rock midden (Feature 10) was discovered within Cultural Unit 2 at the Elm Creek site (Treece et al. 1993). This occupation

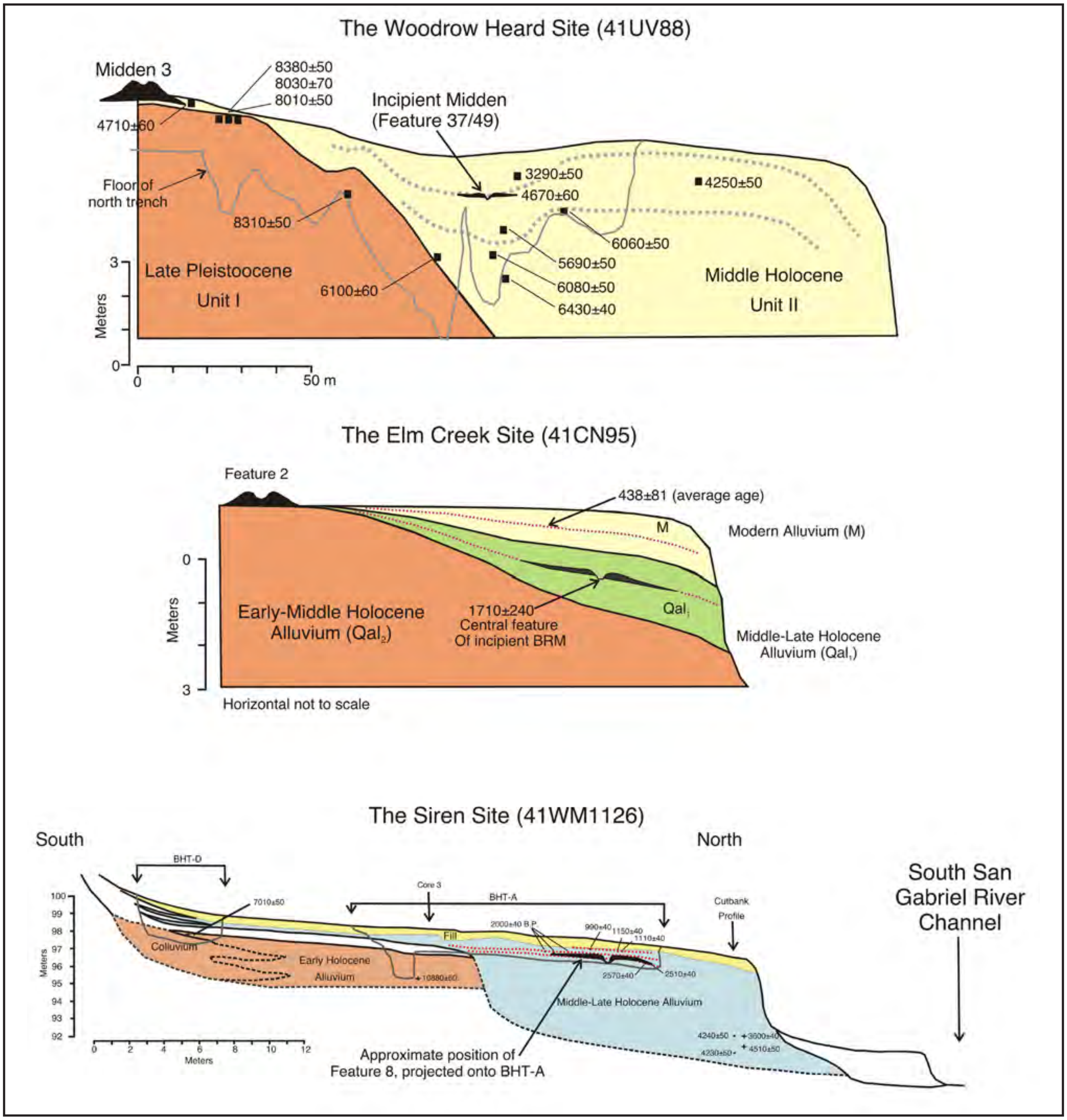


Figure 6.12. IIllustration of the macro-stratigraphic context of two other sites that revealed buried, incipient burned rock middens, The Woodrow Heard site, and the Elm Creek site, with respect to the stratigraphy of the Siren site. Top Panel: Drawing of the stratigraphy at the Woodrow Heard site (41UV88) modified from Decker et al. (2000:Figure 54) showing the approximate relative positions of the buried incipient burned rock midden with respect to the two alluvial fills recognized at the site. Dashed gray lines represent approximate time lines through Unit II. Middle Panel: Illustration of the stratigraphic context of the buried, incipient burned rock midden discovered during data recovery excavations at the Elm Creek site (41CN95) at O. H. Ivie Reservoir. Bottom Panel: Illustration of the stratigraphy of the Siren site annotated to show the approximate position of Feature 8, the incipient burned rock midden. Feature 8 did not crop out in BHT A, but was sectioned by BHT E, which was located parallel to A but a few meters to the west.

was radiocarbon dated to A.D. 440±100, and like the Woodrow Heard site, the incipient midden was situated within a more rapidly aggrading surface that was inset into and draped an older alluvial terrace upon which multiple large burned rock middens had been built.

Relevance to the Siren Site

Together, all three of these sites share common stratigraphic situations whereby a younger, more rapidly aggrading alluvial surface lies immediately adjacent to a non-aggrading or more slowly aggrading surface upon which one or more burned rock middens were present. The burned rock middens on the non-aggrading surface provided the visual continuity to the former populations, and stand as silent witness to a once productive patch of geophytic food plants or other factor that attracted former groups to that particular spot.

Summary

In general terms, the formation of well-preserved archaeological occupation surfaces is contingent upon multiple factors, of which sedimentation rate is one. Martin (1999:390), in a broad survey of taphonomy elucidated a number of "taphonomic rules" that describe general trends observed by paleobiologists studying fossil assemblages; one in particular seems very applicable to archaeological assemblages with respect to sediment rate:

> "Good preservation of fossil assemblages depends not just upon rapid burial but also optimal sediment accumulation rates…If sedimentation is too slow, fossils of different stratigraphic zones are mixed together and information is lost, but if sediment accumulation is too fast, fossil assemblages are "diluted" and less likely to be preserved and discovered."

This rule is predicated upon the fossil input being constant, but, as was discussed previously, this is one place where direct analogy to the archaeological record is problematic. The residues left by prehistoric populations are highly variable and are contingent upon the types of activities engaged in and the length of the occupation. A short hunter-gatherer stay (say overnight away from a base camp) may leave a feature or two and no or few artifacts, whereas a farm house inhabited by a sedentary group over the course of a year or two may leave a tremendous variety of deposits, yet both of these could conceivably occur in a rapidly aggrading setting (say at a rate of 0.5 to 1 cm per year; scale of Ferring [1986]). Nevertheless, when hunter-gatherer sites are considered, this rule seems very salient. Short-term occupations within rapidly aggrading depositional environments are frequently observed at sites with the best preservation (obrution sites) but are often dismissed on the basis of a lack of artifact ubiquity. Hence, the existence of some time averaging, which is rarely acknowledged at such sites, may result in the formation of more interpretable assemblages. The absence of or minimal time averaging, on the other hand may condemn such occupations to obscurity.

Beyond the depositional factors, the formation of sites such as the Siren site are created by repeated occupation of the same location through a long period of time. This can be the result of coincidence or random selection, but the existence of gisements, or serially re-occupied locations, often implies that such places posses one or more attributes that attracted former inhabitants to that place. The Siren site is one such location, as it was repeatedly occupied during the last three millennia. Although we can debate how many times the site was occupied in this period, the slow sedimentation rate at the site (ca. 1 cm per decade, as detailed earlier in this chapter) suggests that more than two generations could have repeatedly occupied any given "occupation surface," and, owing to the effects of trampling (cf. Gifford-Gonzalez et al. 1985), we would be none the wiser. However, because the surface was slowly aggrading, it nevertheless preserved a record that permits us to comment upon how this surface was used over this period of time If we were to juxtapose the record from this excavation with the palimpsest, deeply time-averaged surface situated at the rear of the terrace and outside of the right-of-way to the west, the archaeological benefits of this incremental sedimentation would become very clear.

If we were to search for similar sites elsewhere, it is clear that finding locations with similar macro-stratigraphic settings would be one way, but without the adjacent attraction of a special place (in this case the proximity of highly visible burned rock middens on an older immediately adjacent geomorphic surface) the search could be rather fruitless. However, the combination of the two factors, which has been observed in at least two other sites, appears to provide a clue that might useful in terms of predicting where other such sites may lie buried. The preservation of such repeated occupations is useful for a variety of reasons (such as clarifying use life of diagnostic artifact styles or discriminating artifact assemblages contributed by different groups that occupy the same landscape in the same period), but they are particularly enlightening when it comes to understanding the creation of large, typically complex features like burned rock middens that have use-lives that far exceed a single generation.

Chapter 7

Artifacts, Features, and Ecofacts

John D. Lowe, Kevin A. Miller, Abby Peyton, and Mary Jo Galindo

Introduction

The nature and composition of a site's assemblage of artifacts and features is directly related to a host of environmental and behavioral phenomena, allowing for the analysis of diachronic changes in site use and function and inferences about group size, mobility, subsistence practices, and social organization and affiliation. The Siren site assemblage is one key element in the exploration of the specific research topics and questions posed for the site's study. A description of the assemblage is therefore a critical element to establish a basis for subsequent site interpretations.

The testing and data recovery investigations identified 115,633 artifacts and 18,530 faunal remains, and documented 48 cultural features. Additionally, numerous samples, such as feature matrix and radiocarbon, were also collected and processed. The basic analytical artifact and feature categories used in this chapter are based on definitions derived from Kleinbach et al. (1995a) for the burned rock features and Tomka et al. (1999) for lithic artifact classes. The complete artifact assemblage from the Siren site has been divided into categories and sub-categories reflecting the various artifact types and manufacturing technologies (Appendix M). Within the categories and sub-categories, the assemblage is further defined by characteristics reflecting specific nominal and metrical attributes of artifacts in each class. At the broadest level, the assemblage is divided into several primary categories: chipped stone tools, non-chipped stone tools, faunal remains, and features. The chipped stone tool assemblage includes the sub-categories of projectile points, bifaces, modified flakes, unifaces, and cores, while the assemblage of non-chipped stone tools consists of groundstone and battered stone. This chapter provides analytical descriptions for the various feature types and artifact classes encountered during the investigations.

Artifacts

The cultural materials recovered during the testing and data recovery excavations consist of 273 projectile points and point fragments, 582 bifaces, 97 scrapers, 162 edge modified flake tools, 96 cores and core tools, nine drills, three gravers, one chopper, one handaxe, one hammerstone, 15 groundstones, nine bone and antler tools, 114,384 pieces of debitage, one possible worked shell, and ten pieces of ochre. Scaled photographs of all diagnostic projectile points are included in Appendix K, Figures K.1–K.33. More detailed metric data tables for projectile points and various tool types are provided in Appendix L.

Projectile Points

An 11,000-year regional chronology has been established for Central Texas, and this broadly applicable chronology is primarily based on specific projectile point types (Collins 2004:113, Fig. 3.9a). However, sub-regional temporal and spatial variation in projectile point technology and morphology has not been widely addressed (see Johnson [1995] and Tomka et al. [2003] for exceptions). Nevertheless, the use of the cultural-historical approach has achieved many objectives for which it is designed, namely developing chronological schemes and culturo-temporal diagnostics throughout the state, especially the Central Texas, South Texas, and Lower Pecos regions (Hester 2004; Shafer 2005).

Pre-industrial technologies were sensitive to ecological changes and adjusted to conform to changing ecological circumstances across a broad region and through time, circumstances that could, for example, occur with the ebb and flow of bison across the Southern Plains and Canyonlands. Ecological changes brought about by long-term xeric or mesic intervals may seem minor overall, but may indeed have resulted in technological adjustments and stylistic trends that left their mark in the material record, such as changes in projectile point styles.

Typological sorting is based on the original ordering provided by Suhm et al. (1954) and Turner et al. (2011). As Johnson (1995) recognized, current typologies are not necessarily fixed or standardized, but decisions are often made on the whims or biases (or years of experience) of the analyst. In sorting and analyzing the collection, Krieger's (1944) guidelines for formally identifying a type and Suhm et al.'s (1954) application of Krieger's concept were firmly recognized. Suhm et al. (1954) emphasized morphological attributes and did not consider technology and technological styles as factors in defining their types. Typology is but a mere analytical tool for ordering phenomena through time and space, and not all specimens, indeed often not even the majority, will conform to the "norm" because of changes and modification in form and size during the course of use, retouch, and resharpening. Subtleties in blade technology (e.g., thinning by pressure flaking instead of punch or soft hammer) may prove to be either a regional phenomenon or a functional one. These kinds of attributes were given attention during the analysis. Variability in form, style, blade retouch, or base treatment can be expected, and therefore may lead to problematic circumstances as to which specific type is linked to a specific artifact. Overall technology, base and stem attributes, patterning in blade thinning and resharpening, were all taken into consideration when typological decisions were being made.

Following typological designations, nominal (qualitative) and metrical (quantitative) attributes were recorded for each point specimen and entered into a database. Recorded nominal attributes included information such as cortex, raw material type, color, patination, evidence of heat treatment, breakage, beveling, and reworking. Metrical attributes recorded for each specimen were similar to those measured by Hudler (1997), including variables such as blade and stem dimensions (length, width, thickness, weight), haft length, base depth, base width, and neck width.

During the sorting, it was noted whether a particular specimen was a preform or not, whether it was complete or not, and, if not, how it was broken. Comments were made regarding technological nuances such as fine pressure thinning or retouch, edge twisting, edge beveling, blade retouch, stem grinding, and burning. These observations were synthesized in the narrative descriptions of each type.

A total of 273 projectile points was recovered from the excavation efforts on the west side of the Siren site (Table 7.1). This total includes 23 arrow points and preforms, along with 250 dart points. The identifiable arrow point types include Scallorn and Edwards points. A variety of dart point types were recovered as well; the most prominent are Ensor, Fairland, Frio, and Castroville points. Additionally, there are a number of fragments that could not be assigned to a recognizable type category, including both arrow and dart specimens. All of the projectile points were made from chert, and all appear to be derivatives of the Edwards Group cherts, which are locally abundant. In fact, a high number appear to be a blue/gray local variant found at or near the site.

Table 7.1. Projectile Points from Siren Site West Side

	Type	Count
Arrow Points	Scallorn	13
	Edwards	1
	Untyped Arrow Point	9
Dart Points	Bulverde	2
	Castroville	16
	Darl	3
	Edgewood	4
	Ellis	3
	Ensor	72
	Fairland	32
	Frio	35
	Frio/Ensor	8
	Lange	2
	Marcos	6
	Marshall	6
	Montell	2
	Morrill	4
	Pedernales	5
	Untyped Transitional Archaic	3
	Untyped Dart Point	47
Total		**273**

Arrow Points

Scallorn Points

The majority of the diagnostic arrow points (n=13, or 57 percent) are characterized as Scallorn type arrow points (Table 7.2, Figure K.1). These points are found across almost all of Texas and are one of the type markers for the Austin phase of the Late Prehistoric period (ca. A.D. 700–1200) (Turner et al. 2011:209). Scallorn arrow points are triangular in overall shape with corner notches, straight to convex lateral edges,

Table 7.2. Scallorn Projectile Points Attributes Measurements

		N	Mean	Min	Max	Std Dev
Scallorn (Total = 13)	Max L (mm)	12	27.6	17.5	51.2	8.4
	Max Blade W (mm)	12	13.6	11.6	17.6	1.6
	Max Blade Thickness (mm)	12	3.2	2.3	4.6	0.6
	Stem Neck W (mm)	12	6.3	4.7	8.1	1.0
	Stem Base W (mm)	13	10.6	8.3	15.2	1.8
	Weight (g)	13	0.87	0.4	1.9	0.45

and well barbed shoulders; the blade is often finely serrated (Turner et al. 2011:209). The expanding stem can exhibit some variation in width, and the base can be straight, convex, or concave (Turner et al. 2011:230).

Of the 13 Scallorn arrow points collected, only two are complete (Figure 7.1), three are missing only the distal tip, six are proximal-medial fragments, one is missing a lateral margin, and one is a proximal fragment. Morphologically, all but two of the Scallorn bases are within the 0–2-mm range between corners indicated by the TxDOT chipped stone analytical protocol as "straight" (TxDOT 2010); note that these protocols were not applied to the current analysis. Within this slight margin, six are very slightly concave, two are very slightly convex, and three are essentially level. The remaining two include one deeply concave base and one with a shallow basal notch.

Figure 7.1. Arrow points. **Edwards:** a) Lot # 2043; **Scallorn:** b) Lot # 75.1, c) Lot # 2028, d) Lot # 13.1, e) Lot # 2089.1, f) Lot # 1970.1.

Serrated blade edges are present on nine of the 12 Scallorn points with extant medial sections comprising 75 percent of the assemblage. The level of serration varies, which could be a result of manufacture or usage. One of the Scallorn points without serration shows evidence of extensive reworking, which may have eliminated the ability to create finely serrated edges. As with the basal variations, there are no apparent patterns in the distribution of serrated Scallorn points.

Point stems and proximal fragments are considered to be use-fractured tools that were removed from their hafts and discarded. Likewise, proximal-medial fragments may also be indicative of haft discard and retooling, particularly when there is evidence of an impact fracture. Several of the proximal-medial fragments also had impact fractures.

Three of the points are made from non-local cherts, based on color and the coarse-grain of the material (see Figure 7.1c, e). All of these show evidence of reworking, and one has a burin spall removed. These artifacts may have been brought to the site and discarded in favor of newer points made from the high-quality local chert. Scallorn points were recovered in association with Features 1, 16, and 25.

Other Arrow Points and Fragments

Only one other arrow point from the Siren west side assemblage, an Edwards type (see Figures 7.1a and K.2), could be positively identified. Edwards points are typified by large, prominent, pointed barbs or shoulders, an expanding stem, and a deeply divided and recurved base with strongly projecting ears. The Edwards type is common across south central Texas and dates from ca. A.D. 900–1040 (Turner et al. 2011:190). This is contemporaneous with Scallorn points, but not included by Prewitt (1981b, 1985) in the Austin phase toolkit. The Siren site specimen is complete and extremely well made, with serrated margins.

The remaining nine arrow points include two complete untyped points, an untyped proximal-medial section, three untyped point bases, and an untypable distal-medial section/preform (Figure K.3). A broken preform and a distal section are also included with the arrow point assemblage, although they could also have been assigned to the biface assemblage. Many probable projectile point distal sections and preforms were classified as bifaces for analysis and are discussed below.

All of the stem/base fragments are likely Scallorn bases, but lack enough clearly diagnostic attributes to know for sure. One is a narrow wedge shape with a straight base (Figure K.3f), the second is gently convex (Figure K.3a), and the third is deeply convex, resembling one of the typed Scallorn points (Figure K.3i).

The complete point does not resemble any of the arrow point types in Turner et al. (2011); rather, it resembles a small Ensor-like dart point. It is tentatively classed as an arrow point based on its diminutive size. The specimen is thick, with side notches, weak shoulders, and rounded stem ears. It was recovered from Feature 1. The proximal-medial fragment has been extensively reworked, to the extent that the shoulders are no longer present. The base is straight, and the stem was formed by corner notching, similar to Scallorn points. It is reddish, which may be from burning or indicative of a non-local material. Finally, the distal-medial preform has serrated margins and one corner notch. The dorsal face still has cortical remnants along the medial ridge. Half of the stem is broken off, likely a result of manufacturing failure associated with the creation of the second corner notch.

Dart Points

Darl Points

Three points were identified as Darl dart points (Figures 7.2c, d and K.7). Darl points, distributed mainly in Central Texas, are characterized as long, slender, and carefully flaked with expanding or rectangular stems; the lateral edges and stems are sometimes beveled (Turner et al. 2011:101). Prewitt (1981b:96) divided the Darl type into three varieties corresponding in part to chronological and geographic variations. Of these, the Mahomet type dates to the Late Archaic Driftwood phase in Central Texas, and essentially corresponds with the Darl type. These points are among the final types of dart points, and may mark a transition towards arrow point technology (Johnson 1994:40). They are dated to the later portion of the Archaic, although specific date ranges vary, including ca. 1800 B.P. (Turner et al. 2011:101), 1250 to 1400 B.P. (Prewitt 1981b, 1985), and 1350 to 1550 B.P. (Johnson and Goode 1994).

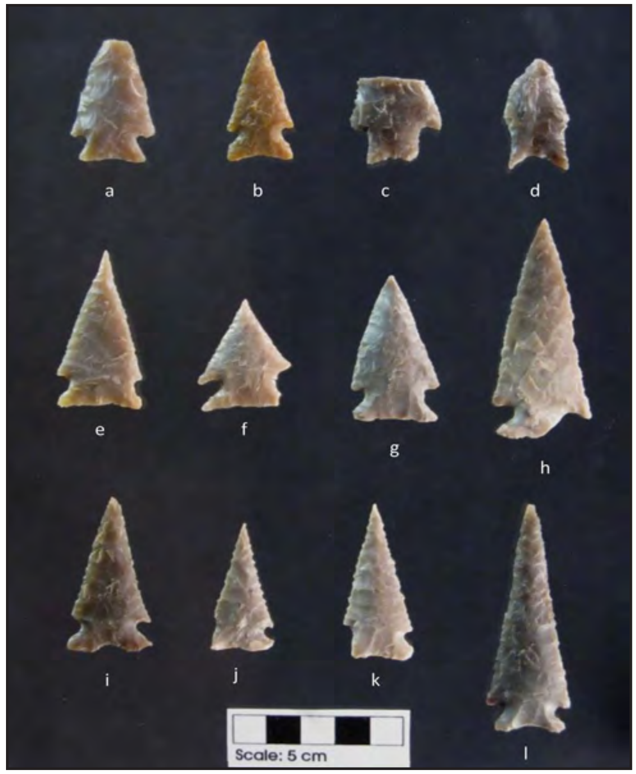


Figure 7.2 **Late Archaic dart points. Edgewood:** a) Lot # 1238, b) Lot # 127; **Darl**: c) Lot # 217, d) Lot #1842; **Fairland**: e) Lot # 261, f) Lot # 11; **Ensor:** g) Lot # 312, h) Lot # 1172; **Frio:** i) Lot # 692.2, j) Lot # 1386; **Frio/Ensor**: k) Lot # 1168.3, l) Lot # 951.

Morphologically, all three of the collected Darl points have slightly expanding stems. Two have deeply concave bases, while the third has a shallow concave bases. Two of the points, both proximal-medial fragments, have finely flaked serrated edges. The third point has been reworked to the point of exhaustion, as the stem length is almost equal to the blade length.

Table 7.3. Ensor Projectile Points Attributes Measurements

		N	Mean	Min	Max	Std Dev
Ensor (Total = 72)	Max L (mm)	57	48.3	21.7	70.4	9.6
	Max Blade W (mm)	58	23.2	18.8	31.2	2.9
	Max Blade Thickness (mm)	68	5.2	2.9	7.2	1.1
	Stem Neck W (mm)	68	14.7	10.5	19.9	2.1
	Stem Base W (mm)	70	21.0	4.1	27.7	3.5
	Weight (g)	72	4.83	0.7	9.6	2.1

Ensor Points

Ensor points were the single largest type recovered from the Siren site, with 72 specimens accounting for just over 26 percent of the total assemblage (Table 7.3, Figures K.10–K.15).

Ensor dart points are not a well-defined type, and there is a range of variation within the type. Generally, the Ensor type has a broad stem with shallow side-notches and a straight base (Karbula 2000:272; Turner et al. 2011:94). This type is widespread in Central Texas and dates to the Archaic period from 200 B.C. to A.D. 600 (Turner et al. 2011). Ensor points are the diagnostic projectile point for the Twin Sisters phase in Prewitt's (1981b, 1985) Central Texas chronology, directly predating Darl points and the Driftwood phase. Collins (2004) lists Ensor points as contemporaneous with Frio and Fairland type points. Karbula (2000:272) reviews the typological overlaps with Ensor, Frio, and Fairland (see also Black and McGraw 1985:105; Collins 2004:113). Further discussion regarding Fairland and Frio point can be found in the Frio subsection.

The Ensor assemblage includes 25 complete or almost complete points (Figure 7.3), 33 proximal-medial fragments, eight proximal fragments, four fragments missing lateral margins, one distal-medial fragment, and one indeterminate fragment. The latter two fragments retain sufficient basal elements to be accurately classified. Several of the specimens also possess characteristics similar to those classified as Frio or Fairland points.

The complete/almost complete points include several large specimens that show little signs of use-wear, along with a number of smaller, extensively reworked points (see Figure 7.3f, g). Many of the fragments are also extensively reworked. Some of the complete specimens have missing tips (see Figure 7.3d, e, j) or stem ears (see Figure 7.3a, c). Five points were noted by the analyst as possible knives based on asymmetry and margins (see Figure 7.3b). Two are classified as possible late-stage preforms.

The large sub-set of proximal-medial fragments includes a mix of larger pieces that exhibit manufacturing or reworking failures. The smaller fragments are likely use-broken points that were discarded from hafts. Three of the Ensor points appear to be made from non-local material, including two red chert artifacts and one made from banded chert (see Figure 7.3e). Another complete point is black chert, which may be a type often referred to as Round Rock chert.

Figure 7.3. **Ensor dart points**. a) Lot # 1172, b) Lot # 1078, c) Lot # 1262, d) Lot # 1260, e) Lot # 873, f) Lot # 1892, g) Lot # 1263, h) Lot # 373.1, i) Lot # 421, j) Lot # 1729.

As previously mentioned, there is a range of variation within the Ensor type that is evident in the assemblage from the Siren site. The majority of the points have a straight base, but 12 specimens have a concave base (see Figure 7.3b, f), and nine specimens have a convex base (see Figure 7.3d, e). Within the straight base assemblage, a number have thick, somewhat flared ears that bear a resemblance to the Frio point type (see Figure 7.3j). In addition to the basal variation, many of the Ensor points are corner-notched rather than side-notched (see Figure 7.3g, h, j). The variation in the Ensor points illustrates Turner et al.'s (2011:94) conclusion that there is much gradation of basal forms from Frio to Ensor, which may be expanded to include the Fairland type as well.

Fairland Points

Thirty-two of the dart points recovered were identified as Fairland type points, accounting for 13 percent of the total dart point assemblage (Table 7.4, Figures K.16–K.18).

Fairland dart points are large, broad, triangular points with narrow shoulders, an expanding stem, and a wide, strongly expanding base. The Fairland type dates very late in the Archaic, essentially contemporary with Darl, Frio, and Ensor (Turner et al. 2011:99). Black and McGraw (1985:106) estimate its date as A.D. 200–700. Goode (2002:Fig. 32) reports only three specimens from the Anthon site in Uvalde County. A large sample of Fairland points (n=23) were recovered from Area C/D at the Millican Bench site (41TV163), but the specimens were only listed and not described or illustrated (Mauldin et al. 2004:Table 5-2).

The Fairland assemblage includes 11 complete or almost complete points (Figure 7.4), nine proximal-medial fragments, five proximal fragments, four basal fragments, two points missing lateral margins, and one indeterminate fragment. The distinctive Fairland base makes it easier to identify basal and proximal fragments than with other dart point types. Some of the points within this assemblage also possess characteristics such as deep basal concavity and flared ears that bear a resemblance to the Frio point type (see Figure 7.4d). Similarly, the analyst also noted several of the specimens as being similar to Ensor points.

Figure 7.4. **Fairland dart points**. a) Lot # 1261, b) Lot # 1918, c) Lot # 556, d) Lot # 1936, e) Lot # 11, f) Lot # 13.

The complete points include several large specimens that show little signs of use (see Figure 7.4a, c); along with several smaller, extensively reworked points (see Figure 7.4e, f). The specimens in the large number of stem and proximal fragments were likely broken during use and discarded from hafts during retooling. One

Table 7.4. Fairland Projectile Points Attributes Measurements

		N	Mean	Min	Max	Std Dev
Fairland (Total = 32)	Max L (mm)	19	46.7	31.2	57.9	7.8
	Max Blade W (mm)	22	25.8	21.6	36.9	3.9
	Max Blade Thickness (mm)	23	5.0	2.0	6.9	1.2
	Stem Neck W (mm)	25	16.9	12.9	23.0	3.0
	Stem Base W (mm)	27	24.1	18.7	32.4	3.7
	Weight (g)	32	4.46	0.8	8.1	2.03

Table 7.5. Frio Projectile Points Attributes Measurements

		N	Mean	Min	Max	Std Dev
Frio (Total = 35)	Max L (mm)	24	45.6	26.7	61.0	9.0
	Max Blade W (mm)	27	22.3	16.7	26.5	2.8
	Max Blade Thickness (mm)	29	5.2	2.7	8.1	1.3
	Stem Neck W (mm)	33	14.0	10.5	18.0	2.0
	Stem Base W (mm)	31	21.9	16.7	26.5	2.6
	Weight (g)	35	4.13	0.5	8.8	2.04

of the proximal-medial fragments is a banded chert that may be non-local material, while the remaining specimens are made from locally available chert.

Frio Points

Thirty-five of the dart points recovered are identified as Frio type points, accounting for 13 percent of the total dart point assemblage (Table 7.5, Figures K.19–K.21).

Frio dart points are triangular, often short and broad, with wide side or corner notches. The most distinguishing element is the concave basal indention often formed by a deep notch (Turner et al. 2011:106). This type dates to the Archaic period (Turner et al. 2011), contemporaneous with Fairland and Ensor points (Collins 2004), but not included in Prewitt's (1981b, 1985) central Texas chronology.

The Frio assemblage includes 12 complete or almost complete points (Figure 7.5), 15 proximal-medial fragments, three proximal fragments, two basal fragments, and three points missing lateral margins. Similar to the Fairland points, the distinctive Frio base makes it easier to identify basal and proximal fragments than with many other dart point types. Note, however, that a number of the points have a shallow basal concavity that is similar to Ensor bases (see Figure 7.5a, c). Turner et al. (2011:114) note that there is much gradation of basal forms from Frio to Ensor, and that some points are referred to as Ensor-Frio. Several points from the Siren site are identified as such, and are discussed below. A number of the Frio points were also noted by the analyst as resembling the Fairland type.

The complete/almost complete points include both specimens that show little signs of use and extensively reworked points. The proximal-medial fragments form half of the assemblage, and many appear to have been reworked, while several may be thinning failures. It may be that Frio points break closer to the tip during use, leaving a larger fragment that can be reworked into a usable point.

Two clusters, each with three points, were identified in unit N1024/ E1024 Level 7 and N1024/E1010 Level 5. A Frio point was also recovered in association with Feature 4.

Frio-Ensor Points

Eight of the dart points recovered were identified as Frio-Ensor type points, accounting for three percent of the dart point assemblage (Table 7.6, Figure K.22). This is not a type recognized by Turner et al. (2011), although they note that this terminology has been used elsewhere, in particular at the Blue Hole site in Uvalde County (Mueggenborg 1994).

Figure 7.5. **Frio dart points**. a) Lot # 12.1, b) Lot # 692.2, c) Lot # 1386, d) Lot # 748, e) Lot # 1074.

Table 7.6. Frio-Ensor Projectile Points Attributes Measurements

		N	Mean	Min	Max	Std Dev
Frio-Ensor (Total = 8)	Max L (mm)	7	49.5	31.7	74.1	13.6
	Max Blade W (mm)	7	21.3	19.9	24.2	1.9
	Max Blade Thickness (mm)	7	5.3	4.0	6.5	1.0
	Stem Neck W (mm)	8	13.5	11.6	14.6	1.0
	Stem Base W (mm)	7	21.0	17.6	25.2	2.3
	Weight (g)	8	4.51	2.5	9.3	2.19

Frio-Ensor dart points are side notched, with a shallow basal concavity that may be formed by a v-shaped notch (Turner et al. 2011:106). Specimens from the Siren site also had the larger, more flared ears similar to the Frio type. Presumably, this type dates to the Late Archaic period and is contemporaneous, or nearly so, with Frio and Ensor types.

The Frio-Ensor assemblage includes four complete or almost complete points (Figure 7.6), three proximal-medial fragments, and one heavily burned partial proximal-medial fragment. The fragments are either reworked or manufacturing failures, alluding to the possibility that the Frio-Ensor type at the Siren site may actually be a combination of unfinished, or reworked Frio and Ensor points. The absence of use-fractured basal and proximal specimens may serve as additional support for this observation.

Two Frio-Ensor points were recovered from unit N1022/E1006 within Level 5. Within this unit, a total of seven projectile points was recovered that include two Ensor points and one Frio point. The remaining Frio-Ensor points were recovered in close association with other Frio, Ensor, and Fairland dart points.

Edgewood Points

Four points were identified as Edgewood dart points (Table 7.7; Figures 7.2 a, b and K.8). These are short triangular points with prominent-to-well-barbed shoulders and a widely expanding stem (Turner et al. 2011:91). Bases range in shape from concave to straight. This type is more commonly found throughout northeast Texas, and is typically associated with the later part of the Archaic period (Turner et al. 2011:91).

The assemblage includes one very well-made complete point, two points with missing tips, and a proximal-medial fragment. All but the complete specimen show evidence of retouch, and two are heavily reworked.

Ellis Points

Three points were identified as Ellis dart points (Figures 7.7b and K.9). This type has a short, thick body with corner notches that form barbs, and a wide, slightly expanding stem (Turner et al. 2011:93). The Ellis type is very similar morphologically to the Edgewood type and is typically found throughout East Texas. Specimens have been recovered in South and Central Texas (Turner et al. 2011). The date for this type is generally defined as around 1000 B.C. (Turner et al. 2011:93).

Morphologically, all three of the Ellis points have slightly expanding stems, corner notches, and straight bases. All are proximal-medial fragments, and two have snap/end-shock fractures. The third, recovered from Feature 12, is badly burnt. All appear to be made from locally available materials.

Figure 7.6. **Frio-Ensor dart points**. a) Lot # 1168.3, b) Lot # 951, c) Lot # 1659.

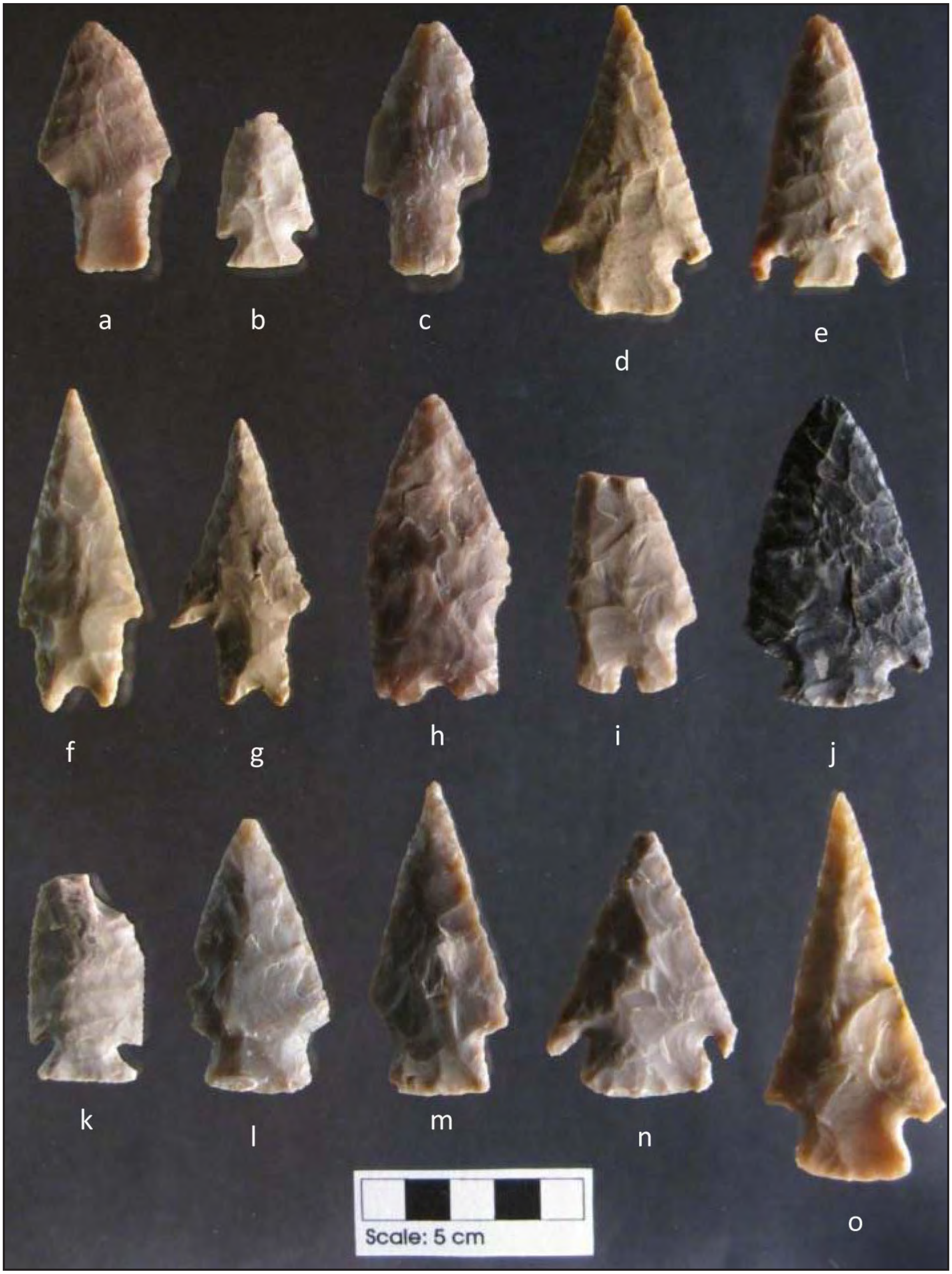


Figure 7.7. **Late Archaic dart points**. **Bulverde**: a) Lot # 1120; **Ellis:** b) Lot # 1733.2; **Morrill:** c) Lot # 579; **Marshall:** d) Lot # 882.1, e) Lot # 1188; **Pedernales:** f) Lot # 1063, g) Lot # 642; **Montell:** h) Lot # 1599, i) Lot # 933.3; **Marcos:** j) Lot # 1249, k) Lot # 411; **Lange:** l) Lot # 1237.6, m) Lot # 879.2; **Castroville:** n) Lot # 27, o) Lot #976.2.

Table 7.7. Edgewood Projectile Points Attributes Measurements

		N	Mean	Min	Max	Std Dev
Edgewood (Total = 4)	Max L (mm)	4	40.2	34.5	46.0	4.9
	Max Blade W (mm)	4	21.3	19.2	25.0	2.7
	Max Blade Thickness (mm)	4	4.6	3.7	5.4	0.7
	Stem Neck W (mm)	4	14.2	12.6	15.4	1.2
	Stem Base W (mm)	4	20.0	18.9	22.4	1.6
	Weight (g)	4	4.13	3.2	5.6	1.03

Castroville Points

The fourth largest individual point type group recovered from the Siren site is the Castroville type (Table 7.8, Figures K.5 and K.6). Castroville points are large, with long barbs formed by basal notching. The most distinctive element is a broad, generally straight stem and straight lateral edges (Turner et al. 2011:71). Castroville points date to the Late Archaic, ca. 800 to 400 B.C., and are principally dispersed throughout central Texas (Turner et al. 2011).

Sixteen Castroville points were recovered accounting for six percent of the total projectile point assemblage (see Figure 7.7n, o). Seven are complete/almost complete, six are proximal-medial fragments, two are proximal fragments, and one fragment is missing a lateral margin. Seven show evidence of retouch, and two of these are noted as having a possible knife function based on the asymmetrical blade margins and possible usewear. Two specimens were identified as probable late-stage preforms that were discarded due to manufacturing failure. All are made of locally available material.

Marcos Points

Marcos dart points are broad triangular points, deeply corner notched and always barbed, with an expanding stem (Turner et al. 2011:130). The Marcos type is principally a central Texas point, and dates to the Late Archaic from about 600 B.C. to A.D. 200 (Turner et al. 2011). Prewitt (1981b, 1985) and Collins (2004) place the Marcos type in the Late Archaic from about 300 B.C. to A.D. 200 (Prewitt 1981b:76), roughly contemporary with the Montell and Castroville types. Turner et al. (2011) note that Marcos points are similar in construction to Castroville points, but with a more sharply expanding stem and corner rather than basal-notching. It is interesting that Marcos distribution is irregular in the southwestern Edwards Plateau. For example, at excavated sites in the Sabinal Canyon, none were found at La Jita (Hester 1971), yet 18 were found at 41UV159 (Mueggenborg 1994), and Baker (2003:Table 3) tabulates (but does not illustrate) 10 specimens from the Smith site (4lUV132).

Six Marcos points were recovered from the Siren site west side (Table 7.9; Figures 7.7j, k and K.24). Two are complete/almost complete specimens, three are proximal-medial fragments, and one is missing a lateral margin and other pieces. Two show signs of retouch, and may have been utilized as knives. Two were noted as being rather small for Marcos points. One very well-made, nearly complete fragment is made of black chert, also known as Round Rock chert. No clusters were noted, and one point was recovered in association with Feature 31.

Montell Points

Montell dart points are distinguished by a v-shaped basal notch that forms a bifurcated, relatively short stem. These point types are also often barbed, with strong shoulders predominately found throughout central Texas, and associated with the Late Archaic Period, ca. 1000 B.C.–A.D. 200 (Turner et al. 2011). Prewitt (1981b, 1985) and Collins (2004) place the Montell type in the Late Archaic, ca. 300 B.C.–A.D. 200, roughly contemporary with Marcos and Castroville types.

Only two Montell points were recovered from the Siren site west side (Figure 7.7h, i and K.26). One is almost complete, while the other is a proximal-medial fragment. The fragment was retouched as evidenced by the near complete absence of one shoulder and the presence of a long, straight margin. The other specimen was noted by the analyst as a possible preform, or more likely a stemmed bifacial knife, and exhibits similar evidence of retouch. In this respect, both of the Montell points may have been used as, or converted to, bifacial knives.

Both of these points were recovered in association with Features 22 and 36. Interestingly, one of the drills recovered from the site (discussed below), also appeared to have been fashioned from a Montell point.

Table 7.8. Castroville Projectile Points Attributes Measurements

		N	Mean	Min	Max	Std Dev
Castroville (Total = 16)	Max L (mm)	14	65.9	43.5	85.2	13.2
	Max Blade W (mm)	13	42.8	35.1	48.7	4.0
	Max Blade Thickness (mm)	16	6.3	4.8	10.4	1.3
	Stem Neck W (mm)	14	23.0	19.8	27.8	2.3
	Stem Base W (mm)	15	25.2	22.0	30.2	2.6
	Weight (g)	16	14.58	7.6	22.4	3.8

Table 7.9. Marcos Projectile Points Attributes Measurements

		N	Mean	Min	Max	Std Dev
Marcos (Total = 6)	Max L (mm)	6	59.7	48.0	70.6	9.3
	Max Blade W (mm)	6	36.2	25.9	44.7	6.8
	Max Blade Thickness (mm)	6	6.0	3.7	7.2	1.3
	Stem Neck W (mm)	6	19.8	14.2	23.0	3.1
	Stem Base W (mm)	6	24.5	22.6	26.3	1.4
	Weight (g)	6	11.55	6.5	18.2	4.71

strongly barbed Marshall points (such as Lot 1188; Figure 7.7e) resemble the Castroville type (cf. Black and McGraw 1985:111).

Five of the specimens are complete or almost complete, while the sixth is a heavily burned proximal-medial fragment. Three of the almost complete points are missing a part of the stem. Four of the points were originally classed as untyped dart points, and one of these (see Figure 7.7e) resembles a hybrid of Marshall and Castroville. Three of the specimens are made from uncommon chert, which may indicate that these points were made elsewhere and discarded at the site. No clusters were noted, and one point was recovered in association with Feature 34.

Marshall Points

Six Marshall dart points are included in the projectile point assemblage (Table 7.10; Figures 7.7d, e and K.25). This type is broad and triangular, with strong shoulders that are often deeply barbed; the expanding stem is short, and has a concave base. Marshall is principally a Central Texas point. Turner et al. (2011:131) date the type to the Late Middle Archaic, ca. 1000 B.C or earlier. Prewitt (1981b:80, 1985:215) also places the type in the Middle Archaic, ca. 650–300 B.C, roughly contemporary with Williams and Lange types. Common in the Central Texas Late Archaic (Collins 2004:113), Marshall points sometimes seem to overlap typologically and technologically with Pedernales and Lange (Karbula 2000:264). For example, both Pedernales and Marshall types have stems typically thinned by broad flute-like flakes; reworked specimens in both types sometimes overlap. The expanding stem found on Marshall can also cause problems with separating these points from Lange (cf. Turner et al. 2011:127); additionally,

Lange Points

Two Lange dart points are included in the projectile point assemblage (Figures 7.7l, m and K.23). These are large points with prominent shoulders and an expanding stem, usually with a straight base, that date to the middle part of the Late Archaic (Collins 2004). Lange typology is often an exercise in guesswork. Various analysts will sort corner-notched dart points into Marcos, Marshall, Castroville, and Lange. All are very close in terms of chronology, in the middle part of the Late Archaic (Collins 2004:113). The specimens

Table 7.10. Marshall Projectile Points Attributes Measurements

		N	Mean	Min	Max	Std Dev
Marshall (Total = 6)	Max L (mm)	5	66.1	56.0	78.3	9.6
	Max Blade W (mm)	5	33.6	29.9	38.2	3.4
	Max Blade Thickness (mm)	5	5.3	4.6	6.6	0.8
	Stem Neck W (mm)	5	16.4	13.5	21.6	3.2
	Stem Base W (mm)	6	19.3	15.4	25.9	3.8
	Weight (g)	6	10.47	6.4	14.8	3.15

from the Siren site fit well into the type as defined and illustrated by Karbula (2000:261), where a large sample (n=36) was available from the Eckols site. The Lange points are both mostly complete with one missing a tip, and the other missing a shoulder barb. The specimens are very similar in appearance with only slight differences in basal shape (one straight, one gently convex).

Morrill Points

Four Morrill dart points are included in the projectile point assemblage (Figures 7.7c and K.27). These are long, slender points with weak-to-squared shoulders and a long, wide, rectangular stem (Turner et al. 2011:160). The Morrill type is found primarily in the central part of East Texas and is associated with the Early to Middle Archaic periods (Turner et al. 2011).

All four points were originally classified as untyped dart points. Of these, two were thought to be Darl-like, while a third resembled a stemmed bifacial knife. All of the Morrill points exhibit extensive retouch, which likely contributed to the initial classification confusion. Two of the specimens are mostly complete, while the remaining two are proximal-medial fragments. None of these points were recovered at depths associated with Early to Middle Archaic-age components. The more Darl-like specimens were recovered from contexts more closely associated with the final phase of the Archaic period. Overall, the Morrill type is not common in Central Texas, and it is possible that the examples from the Siren site represent curated tools, or those that have been misclassified.

Pedernales Points

Pedernales dart points are distinguished by a rectangular, bifurcated stem, with the basal concavity frequently thinned by a flute-like flake removal from one or both faces (Turner et al. 2011:148). The Pedernales type is extremely common in Central Texas, and dates to the Middle Archaic, ca. 2000–1200 B.C. (Turner et al. 2011:148). Prewitt (1981b:80,) includes this point in the Middle Archaic Round Rock phase (ca. 1550–650 B.C.). Collins (2004:113), however, aligns it with the "middle" part of his Late Archaic period, roughly 2500–300 B.P. A radiocarbon date from a hearth with associated Pedernales points comes from the Blue Hole site in the Sabinal Canyon (Mueggenborg 1994; TX-7057). Uncorrected, the assay is in the 4420–4100 B.P. range.

Table 7.11. Pedernales Projectile Points Attributes Measurements

		N	Mean	Min	Max	Std Dev
Pedernales (Total = 5)	Max L (mm)	5	65.1	55.4	72.4	6.4
	Max Blade W (mm)	5	31.4	29.2	34.2	2.2
	Max Blade Thickness (mm)	5	7.3	5.1	8.8	1.4
	Stem Neck W (mm)	5	18.8	17.2	20.4	1.5
	Stem Base W (mm)	5	16.7	15.3	20.3	1.9
	Weight (g)	5	11.1	8.7	12.4	1.44

Five Pedernales points were recovered from the Siren site west side (Table 7.11; Figures 7.7f, g and K.28). Three of these are complete/almost complete specimens, while the other two are proximal-medial fragments. Two of the points show evidence of retouch, and one of the fragments is fashioned from black chert that is often referred to as Round Rock chert.

Bulverde Points

Bulverde dart points are distinguished by a thin, finely-chipped base with a wedge-shaped cross-section (Turner et al. 2011:67). The blade may be strong-shouldered to barbed. Black and McGraw (1985:115) report 24 specimens from the Panther Springs Creek site, and Decker et al. (2000) tabulated 11 Bulverde points. Bulverde points predate Pedernales points. Turner et al. (2011:67) place the Bulverde point type in the late part of the Early Archaic, ca. 3000–2500 B.C. Collins (2004:113) places it in the early part of the Late Archaic, ca. 2000–1500 B.C., while Houk et al. (2008) assign it to the late Middle Archaic/Late Archaic period.

Two Bulverde points were recovered from the Siren site west side, both from relatively deep contexts (Figures 7.7a and K.4). Both points were originally classified as untyped dart points and somewhat resemble heavily re-worked Pedernales points. One is almost complete, and the other is a proximal-medial fragment.

Untyped Dart Points and Fragments

A total of 50 untyped dart points and fragments was recovered from the Siren site (Figures K.29–K.33). These artifacts generally retain enough identifying characteristics, such as shoulders or stem remnants, to be clearly distinguished as projectile point fragments. However, they are either too fragmentary to be positively identified, or did not correspond with the point types as presented in Turner et al. (2011). This includes three specimens identified as Archaic untyped, based on technology and stem and base morphology. Other possible projectile point fragments, generally missing these diagnostic morphological attributes, are categorized as bifaces and are discussed in that section.

The untyped dart point assemblage includes only one complete point, which is small and reworked to near the point of end of its use-life (Figure 7.8a). Just under half of the assemblage is composed of basal and proximal fragments. Overall, these fragment types have the highest likelihood of retaining diagnostic attributes that distinguish a point fragment from a more generally defined biface fragment. Within this category, there are 10 proximal-medial fragments (see Figure 7.8b), seven proximal fragments (see Figure 7.8c), and seven basal fragments (see Figure 7.8d). The remaining artifacts include eight distal-medial fragments (see Figure 7.8e), six medial fragments, two distal sections, three stem ear or tang fragments, two barbs or shoulders (see Figure 7.8f), one fragment missing a lateral edge, and three indeterminate fragments.

An additional 16 of the fragments are badly burned, thus precluding positive identification (Figure 7.8g). This pattern may be indicative of use-related point fracture, and subsequent haft discard. The remainder of the assemblage exhibits predominately manufacturing failures.

Seven of the untyped fragments are made of uncommon chert. This includes a basal and a proximal-medial fragment from the same level made of the same material (see Figure 7.8h, i); these are likely pieces of the same tool but could not be refitted. Three others are basal or proximal fragments, and the final two are medial sections.

One of these medial sections refit with a biface fragment and may represent a probable point fragment (see Figure 7.8j). Interestingly, the two fragments were recovered from two separate units, at a minimum distance of 2.5 m apart. Furthermore, the two pieces were at elevations separated by 10 to 20 cm. This may be evidence of a degree of sloping of the site's original surface.

Figure 7.8. **Untyped dart points**. **Complete:** a) Lot # 49.1; **Proximal-medial:** b) Lot # 7; **Proximal:** c) Lot # 1180.3; **Base:** d) Lot # 1909.1; **Distal-medial:** e) Lot # 1658; **Barb/Shoulder**: f) Lot # 975.1; **Badly burned:** g) Lot # 1460; **Uncommon chert, match:** h) Lot # 735.1, i) Lot # 730.4; **Uncommon chert, distance refit:** j) Lot # 1342.2 and Lot 1948.1.

No obvious distribution patterns are noted for the untyped points. A cluster of one proximal and two basal fragments was recovered from one unit; all were noted as possible Castroville fragments and may represent a small discard or retooling area. One untyped point was recovered in association with Feature 36.

Bifaces

Simply defined, bifaces are characterized by "sequential flake removal that has occurred on both surfaces of a flake or core to form a single edge" (Oksanen et al. 2008). Bifacial tools include a variety of types, distinct in terms of function and/or morphology. Odell (2003:65) notes that these include "projectile points, drills, axes, adzes, and generic oval, rectangular, or triangular forms called simply bifaces."

Lithic bifacial reduction has consistently been viewed as a stage or step-like production process along a trajectory, from raw material to finished tool (Callahan 1979; Whittaker 1994). As a biface is reduced, it goes through several sequential stages or steps differentiated from one another by the manufacturing implement employed, the size and thickness of the biface, and its form. The sequence and nature of these stages or steps differ, depending upon numerous variables, including the desired end product of the reduction process, the form and quality of the parent raw material, and the style or technique in which flint knapping is performed. Previously completed tools may be reintroduced into the production trajectory and be repaired, rejuvenated or recycled into a different form.

Bifaces form the largest chipped stone tool category at the Siren site, consisting of 582 specimens. No microscopic use-wear analysis was conducted on the Siren west side artifact assemblage. For this reason, none of the bifaces were specifically categorized as knives; although some were noted as possible knives by the analyst.

All of the specimens were categorized according to stages using Callahan's (1979) width/thickness ratio index for biface reduction, supplemented by the biface reduction sequences described by Andrefsky (2002) and Odell (2003). The two primary variables used to define the stages of the reduction sequence were the width/thickness ratio and average edge angle measurement. The edge angle and width/thickness ratios can vary between sites and within assemblages based upon the parent source material and the desired finished product (Andrefsky 2002; Callahan 1979). In Callahan's (1979) model, width/thickness ratios increase as the biface is thinned in each successive stage. The final shaping stage can reduce the ratio when no further thinning occurs and the edge is trimmed. Resharpening and rejuvenation also can reduce the ratio. Morphological attributes, including edge sinuosity, biface cross section, and flaking patterns are also used to characterize each reduction stage. Two other attributes that were noted for bifaces were the outline shape of complete specimens and the fracture patterning on fragmentary specimens.

Briefly summarized, Stage 1 bifaces are crude with few reduction flakes that lack intentional shaping. The width/thickness ratio of Stage 1 is generally 2:1. Stage 2 bifaces are still thick, but the initial edging and shaping of the tool has occurred, creating a sinuous edge. These stages are grouped below as Early Stage Bifaces. Stage 3 bifaces exhibit primary thinning with all major irregularities removed. By this stage, the final tool shape has been determined, or at least limited. The width/thickness ratio has increased to a range of 3:1–4:1. Stage 3 bifaces are referred to as Mid-Stage Bifaces in this report. Stage 4 bifaces are preforms, where secondary thinning has taken place, creating more acute edge angles and a width/thickness ratio exceeding 4:1. The final tool shape is determined, lacking only the detailed fine pressure flaking along the margins and notches that form the stem (for certain tool types). Finally, Stage 5 bifaces are completed tools. Stages 4 and 5 are combined in this report as Late Stage Bifaces.

Breakage occurs during manufacture, use, and discard, and myriad post-depositional factors. Using breakage pattern criteria found in Andrefsky (2002), Callahan (1979), and Whittaker (1994), breakage patterns were summarized into five stages as most formally defined by Callahan, as well as an undetermined stage usually comprising fragmentary pieces.

Manufacturing breaks that occur when the biface is being made. These can occur at different stages in production depending on the raw material, method of manufacture, and the desired final product. Breakage rates increase at later stages as bifaces become thinner and are more susceptible to bending type fractures. Use fractures include impact fractures on projectile points and snap and bending fractures on slicing and cutting implements. Chopping activities can cause impact fractures as well. Post depositional breaks occur after a specimen is no longer used and can occur as a result of human agents such as trampling and camp maintenance activities, and from the modern effects of mechanical equipment during plowing and during excavation of a site.

Natural fractures are caused by natural forces. The taphonomic effect of erosion can tumble artifacts and cause scree slides and ceiling falls in caves. The mechanical effects of soil formation, freezing, thawing, and tree throws also affect artifacts (Odell 2004). Thermal fractures occur when the specimen is exposed to a heat source high enough to cause diagnostic pot lid scars. Thermal damage can be caused during the use of the tool, such as drills or adzes used to work hot wood or charcoal, although it is thought to usually occur after the specimen is discarded. Sustained forest and grass fires may reach sufficient heat to fracture chert, although larger specimens with greater mass would have a greater resistance to this type damage (Buenger 2003). Indeterminate breaks have no diagnostics traits to assign them to a category.

The biface assemblage is dominated by late stage preforms and/or completed tools, including 206 Stage 4, and 144 Stage 5 bifaces. By contrast, a total of only 68 Early Stage bifaces was collected, including 15 Stage 1, and 53 Stage 2 blanks. There are 139 Stage 3 bifaces forming the Mid-Stage biface category. In addition, 25 artifacts are too fragmentary or small to be categorized.

Late Stage Bifaces

Possible Projectile Point or Finished Knife Fragments

The biface assemblage includes 69 artifacts that are considered possible projectile point or finished knife fragments (Figure 7.9). However, because most lack clearly diagnostic attributes, they have been conservatively classified as late-stage bifaces, rather than explicitly categorized as possible projectile point fragments.

This assessment is based on reduction stage, Callahan's (1979) index, and morphology. Three specimens originally identified as possible point fragments were found to refit with actual projectile point fragments, suggesting at least some degree of accuracy in the identification of this subcategory.

Sixty-six of the possible point fragments are Stage 5 in the biface reduction sequence, while the other three are indeterminate due to small size. These are presumably from completed projectile points.

The fragments range in size from indeterminate small pieces, to several that are near complete (see Figure 7.9a–c). Twenty-eight are distal fragments (see Figure 7.9e), accounting for over 40 percent of the collection. An additional 18 are distal-medial fragments (see Figure 7.9d) and comprise roughly one-quarter of the assemblage. Thirteen fragments are medial sections (see Figure 7.9f, g) and make up almost 20 percent of the collection. The remainder includes three proximal/basal fragments (see Figure 7.9h, i), two proximal-medial fragments, two barbs or shoulders, two marginal fragments, and an ear/tang.

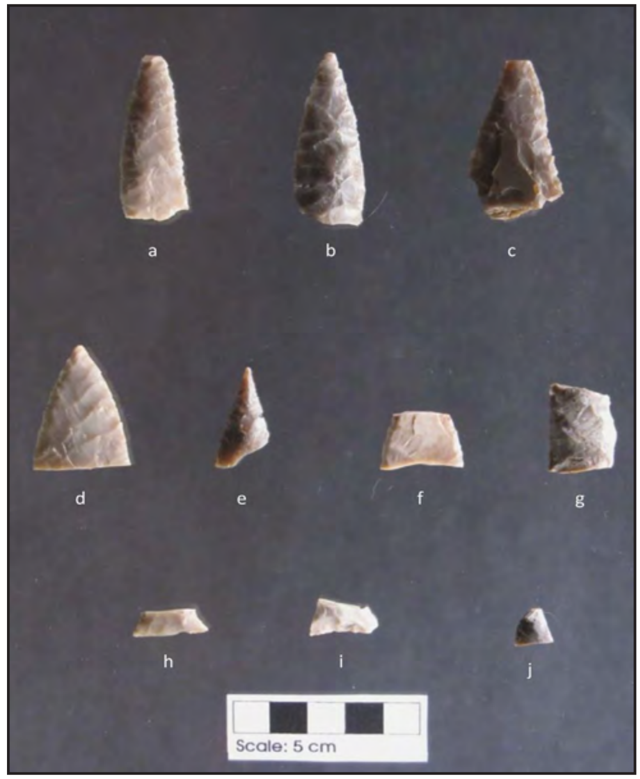


Figure 7.9. Late Stage bifaces. **Mostly complete:** a) Lot # 23.2, b) Lot # 1384.4, c) Lot # 1164.2; **Distal:** d) Lot # 1578, e) Lot # 2205; **Medial:** f) Lot # 310.1, g) Lot # 1288.2; **Basal:** h) Lot # 979.1, i) Lot # 1727.1; Arrow: j) Lot # 44.1.

Three of the distal fragments are identified as probable arrow points, based on thinness (see Figure 7.9j). Three more fragments were recovered from Late Prehistoric components, but were generally too large to be considered arrow points. The remaining specimens, accounting for 90 percent of the assemblage, are likely dart point fragments. This is consistent with the ratio of arrows to darts in the projectile point assemblage.

The predominance of distal sections is likely a result of a combination of hunting activity and tool manufacturing at the site. Projectile point tips can break off inside the prey, particularly when impacted by bone. They might also break off during the removal of the shaft from the kill. However, a number of the pieces still have very sharp tips and fine edges that presumably would have been damaged during hunting activities. These are likely manufacturing failures.

The three basal sections are considered to be use-fractured tools that were removed from their hafts and discarded. Likewise, proximal-medial fragments may also be indicative of haft discard and retooling, particularly when there is evidence of an impact fracture. Several of these specimens have snap/end shock fractures consistent with impact.

Fifteen of the specimens have evidence of excessive heating. In some cases, this may have been the cause of the fracture, but most appear to have been burned post-break. No clearly exotic materials were identified in the assemblage, and all the bifaces are likely made from locally available chert.

Projectile Point Preforms

Another prominent subcategory in the Late Stage biface assemblage is projectile point preforms, which includes 59 examples. Simply defined, a preform is a "blank that has been partly, but not completely, shaped into a finished tool" (Odell 2003:45). One distinguishing characteristic of the preform, which is also Callahan's Stage 4 secondary thinning phase, is a width/thickness ratio generally greater than 4:1 (Callahan 1979). The entirety of the preform assemblage is categorized as Stage 4 in the reduction sequence, although not all of the specimens meet Callahan's width/thickness ratio criteria.

The preforms are also distinguished by shape and size. The specimens have been divided into four distinct forms: arrow preform, straight base, convex base, and other. At this stage, the ideal preform is at the approximate size and shape of the finished tool, and is ready for notching and shaping of the stem and fine edge flaking (Turner et al. 2011:18).

Most of the preforms collected during the data recovery efforts appear to be manufacturing failures. Several of the complete specimens have large, deep flake scars that may have precluded further thinning. Likewise, the incomplete specimens may have broken during the thinning phases, perhaps due in part to material flaws. Oksanen et al. (2008) note that as blanks become thinner, unseen material flaws are exposed, and the consequences of misplaced hammer blows are magnified. Large knots composed of multiple stepped flake removal scars also indicate that some of the complete specimens could not be adequately thinned, and were abandoned.

The arrow point preforms (Figure 7.10a–c) show comparative similarities with the arrow point preforms depicted in Figure 2.15 in Turner et al. (2011:19). In terms of size, all are small and narrow in comparison to the overall biface assemblage, and are roughly consistent with the dimensions of many arrow points. Five of the six arrow point preforms were recovered from the Late Prehistoric component at the site.

A range of preform styles was recovered from the excavations, which is to be expected considering the diversity of projectile points recovered across the site. In addition to the arrow preforms, three somewhat arbitrary subcategories were identified: straight base, convex base, and other. These were separated in an attempt to correlate specific preform styles to identifiable point types.

Twenty-one preforms were identified as having a straight base (see Figure 7.10e, h). Note that not all of the specimens are identified as having a straight basal shape; the category is based on a comparative visual assessment. Many of the complete specimens have

Figure 7.10. Preforms. **Arrow point:** a) Lot # 183, b) Lot # 1843.1, c) Lot # 379.1; **Dart point:** d) Lot # 872, e) Lot # 1647, f) Lot # 1377.1, g) Lot # 1996; **Unique preforms:** h) Lot # 88, i) Lot # 600.2, j) Lot # 698.

a width/thickness index outside of Callahan's Stage 4 range. This is likely due to these preforms being discarded following thinning difficulties, which skews the thickness of the specimen. The higher index for the incomplete specimens likely reflects other types of manufacturing failure.

Convex base preforms account for a slight plurality of the assemblage, with 23 specimens (see Figure 7.10f). As with the straight base preforms, the complete specimens have a lower Callahan's index resulting from thinning difficulties. One of the specimens was identified as a probable Castroville preform (see Figure 7.10i), based on width; this preform was recovered from the same unit and level as a Castroville point.

Finally, other preforms included nine examples, primarily with concave bases (see Figure 7.10g). Among the distinct artifacts in this subcategory are two probable Fairland performs, both with shallow concave bases and at least one corner notch, and another specimen with one shallow corner notch similar to a corner-tang biface (see Figure 7.10h). One preform is a somewhat crude, thick, stemmed biface (see Figure 7.10i) that almost looks like a practice piece.

No patterns were identified between the separate preform types in terms of distribution or correlation with specific point types. Straight base preforms and Ensor dart points, which generally have a straight base, were often recovered together. However, the large number of Ensor points recovered from the overall excavations makes this correlation non-significant. Furthermore, straight and convex types were recovered from the same unit/level in several instances.

Friday Bifaces

Turner and Hester (1999:254) define a Friday biface as an unstemmed, relatively thin knife with a straight base, finely flaked and mildly convex edges, and a sharply pointed tip. The base is also notable for having been thinned by the removal of broad, thin flakes. This tool type dates from the Late Archaic to the Late Prehistoric (Turner and Hester 1999).

Seven artifacts were recovered that are identified as probable Friday bifaces, although two are less certain. The specimens recovered from the Siren site do not match Turner et al's (2011) description entirely. All seven have slightly concave bases (Figure 7.11a–c), all with several broad, thin basal thinning flakes. The edges are finely flaked, and some have a slight serration. There is a strong degree of uniformity between most of the specimens.

The two outliers are both longer and narrower, and one has a straight margin from extensive reworking. One of the outliers is a refit of two point-provenienced fragments recovered roughly 1 m apart horizontally and within 2 cm of the same elevation. Both of the outliers were recovered from the same unit/level as one of the more uniform examples.

While the date range for the Friday biface is broad, all of the specimens recovered from the current excavations were from Late Archaic period contexts. A very similar Friday biface was recovered from the east side of the Siren site, dating to the early part of the Late Prehistoric period (Peyton et al. 2012).

Hare Bifaces

Hare bifaces were originally identified by Prewitt (1981a) based on excavations at the Loeve-Fox site. According to Turner and Hester (1999:262), this type

Figure 7.11. **Unique thin bifaces/knives**. **Friday bifaces:** a) Lot # 291, b) Lot # 413, c) 639; **Hare bifaces:** d) Lot # 13.3 / 151.2, e) Lot # 1335.1 / 1340.1; **Pipe Creek biface:** f) Lot # 357; **Notched base:** g) Lot # 216, h) Lot # 308; **Stemmed knife:** i) Lot # 1934.

is long and narrow "with convex lateral edges, well-defined basal corners and a straight-to-gently convex base." They have also been referred to as parallel-edged knives, and date to the later part of the Archaic period (Turner and Hester 1999).

Three artifacts were recovered that are identified as probable Hare bifaces (see Figure 7.11d, e). The specimens recovered from the Siren site match the type description well and are more finely made than the example depicted in Turner and Hester (1999:262). There is a strong degree of uniformity between the specimens, as all have roughly the same width and thickness, and a Callahan's index between 3.32 and 3.45. Of note, these would not be considered finished tools if width/thickness ratio was the sole measure of reduction stage.

Two of the three possible Hare bifaces are refits of broken, complete tools. In one case, the two pieces were recovered from the same excavation unit, but in two levels; neither is point-provenienced so the actual vertical separation is unknown. The other refit is interesting, as one piece was found in trench spoils, while the other was recovered from a test unit.

All three specimens date to the Archaic period occupations at the site. There is no pattern to the distribution of the tools.

Thin Bifaces/Possible Formal Knives

Formal knives are a category Odell doesn't mention, but which likely fall under his general biface or "reduction stage III bifaces" (Odell 2003:101). Knives are defined as "tools with acute working edges, with or without unifacial and/or bifacial retouch, exhibiting use wear in the form of scalloped working edges on unmodified flakes" (Tomka et. al 1999:30).

Thin bifaces and possible formal knives are late-stage or finished bifaces intentionally thinned and shaped for use as a finished tool. This category is distinct from late stage reduction blanks or preforms. Most likely, these tools were intended to be knives, or cutting implements; however such functional definitions can only be identified through high-power macroscopic or microscopic use-wear analysis. As such, the current analysis uses these more general subcategories.

Thin bifaces, to borrow from Oksanen et al.'s (2008) analysis of the Gatlin site (41KR621) lithic technology, are typically Stage 5 specimens less than 8 mm thick and a Callahan's index of 6 or greater. None of the specimens meet the Gatlin site standard for Callahan's index, but that assemblage had an unusual amount of very large thin bifaces. The Siren site, by comparison, has a number of long, more narrow bifaces that are generally less than 8 mm thick.

There are 27 thin bifaces and fragments in the Siren west side assemblage, including nine complete tools (Figure 7.12c–d). The assemblage also includes six proximal or proximal-medial (Figure 7.12f), four medial (Figure 7.12g), six distal or distal-medial (Figure 7.12h), and two indeterminate fragments. One of the proximal-medial fragments is a refit of two pieces from the same unit/level.

Two unique specimens have basal notching creating the appearance of a short stem (Figure 7.12g, h). One is much longer and narrower, and the other has deeper notches. However, in addition to the notching, both have one relatively straight margin and one convex margin, and both are very finely flaked. These tools do not fit any of Turner et al.'s (2011) named biface

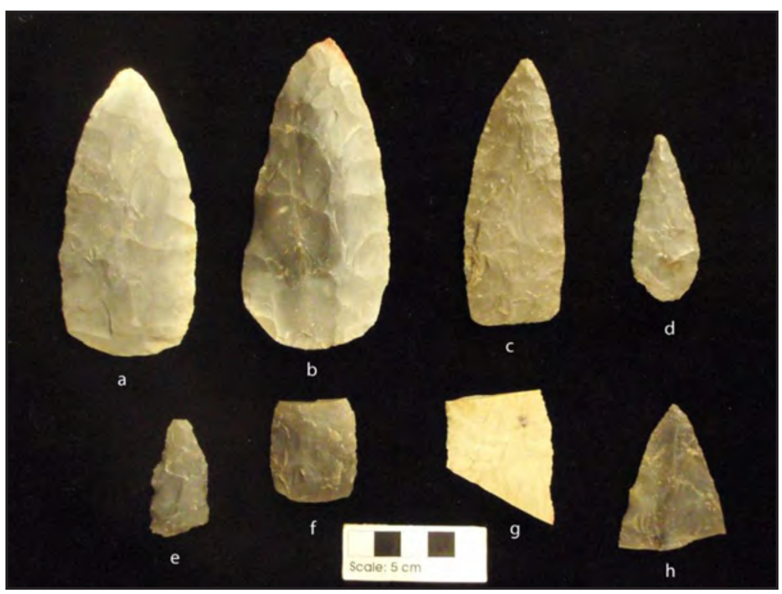


Figure 7.12. Thin bifaces/knives and other bifaces. From Feature 22 (biface cache): a) Lot # 1600, b) Lot # 1601; **Other complete forms:** c) Lot # 292, d) Lot # 534, e) Lot # 1674; **Basal fragment:** f) Lot # 730.2, **Medial fragment:** g) Lot # 1937, **Distal fragment:** h) Lot # 1597.

types, but may indicate a local technology or a new formal bifacial tool type.

Two other unique specimens are present in the complete thin biface assemblage. One is a Pipe Creek biface, which are arrow point-sized bifaces with "a single, deep corner notch" (Turner et al. 2011:242). This example (Figure 7.12f) is extremely well made, with a straight margin along the longest edge. These tools are usually associated with Edwards arrow points, and date from A.D. 960–1040 (Turner et al. 2011). Finally, there is a stemmed biface that may be reworked from a large dart point (Figure 7.11i). One shoulder is well formed, with a convex edge along that margin, while the other shoulder is very weak, with a straight margin that almost incorporates the stem. This tool is not dissimilar to a modern metal knife with a tang that is fitted into a handle.

The remaining five complete specimens vary in size but are relatively long and narrow, and are either subtriangular or pointed ovate in morphology. Most have one straight margin and one convex margin.

The various fragments are roughly equally divided between distal, medial, and proximal fragments. Most of the fractures are snap breaks, followed in frequency by perverse breaks. Both types of breaks may result from bending while slicing or cutting. One of the medial sections (Figure 7.12g) is made of an uncommon tan, banded chert that may be an imported material. The rest of the assemblage is made from the locally available, high quality chert.

Other Late Stage Bifaces

There are seven complete Stage 5 bifaces that did not fit into the above categories. Two of these are the large bifaces that were part of the Feature 22 biface cache (Figure 7.12a, b). It seems likely that these were intended as cutting tools, but their shape is different than the specimens in the possible knife category. Four more are very small, ovate tools that would normally be considered point preforms if not for their size. Three of these were recovered from within an approximate 3 m radius at an elevation of 98.0–97.9 m.

The 34 remaining Stage 5 specimens are too small and fragmentary to identify. Many of these are likely point fragments or thin biface pieces. Most are lateral sections, and many are burnt.

There are 14 complete Stage 4 bifaces not included in the point preform category. Two of these are very small specimens, similar to the small Stage 5 specimens discussed above. One was recovered roughly 4 m south of Feature 22 at an elevation of 98.00 m. The rest of the complete specimens are long and narrow tools that may be unfinished knives. Some may also be large projectile point preforms.

Stage 4 biface fragments form the largest single biface subcategory, with 133 artifacts, or 23 percent of the total assemblage. These range in size and shape, and include several relatively large, wide pieces. The assemblage includes 58 distal and distal-medial sections, 38 proximal and proximal-medial pieces, 23 lateral fragments (including for burin spalls), eight medial sections, and six indeterminate fragments. An attempt was made to identify refits, but only two matches were made.

The large number of Stage 4 fragments indicates that tool production was a major activity at the Siren site. Most of the tool fragments are made of the high-quality, locally available gray chert, and no obvious exotic materials were noted.

Mid-Stage Bifaces

As discussed above, Stage 3 bifaces form the mid-stage biface category. This stage of reduction is where the initial biface thinning and tool shaping have been concluded. These are often referred to as "blanks" (Turner and Hester 1999). The Callahan's index for Stage 3 bifaces ranges from 3:1 to 4:1.

There are 41 complete Stage 3 bifaces that vary in size and morphology (Figure 7.13e, f). Twenty of these may be blanks for projectile points, as their size and shape is similar to the Stage 4 point preforms. One of these is likely an arrow point blank and was recovered from the Late Prehistoric deposits at the site. The remaining Stage 3 specimens include several that may have been intended to be knives. All are of the high quality, locally available chert.

Stage 3 fragments form the second largest biface subcategory, consisting of 98 pieces, or 17 percent of the total biface assemblage. As with the complete specimens, the fragments vary in size and shape. Eight possible projectile point blanks were identified using the same criteria discussed above. The assemblage includes 40 proximal and proximal-medial pieces, 27 distal and distal-medial sections, 14 lateral fragments

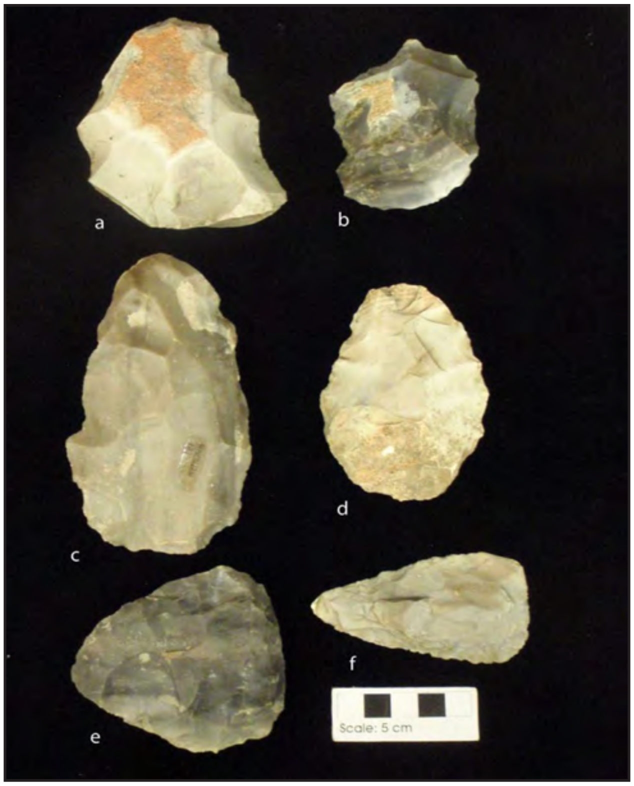


Figure 7.13. Bifaces (Stages 1, 2, and 3). Stage 1: a) Lot # 77.1, b) Lot # 1168.1; **Stage 2:** c) Lot # 668, d) 1607; **Stage 3:** e) 700, f) 1436.

(including three burin spalls), 10 medial sections, and seven indeterminate fragments.

As with the Stage 4 fragments, the large number of Stage 3 bifaces indicates that tool production was a major activity at the Siren site. Some of the fragments are of non-local cherts, including some made from coarse-grained materials. None appear to be exotic materials, and it may be that these were broken or abandoned due to material flaws.

Early Stage Bifaces

Early Stage bifaces include Stage 1 and Stage 2 bifaces. As mentioned earlier, Stage 1 bifaces are crude with few reduction flakes, and lack intentional shaping. Stage 2 bifaces are still thick, but the initial edging and shaping of the tool has occurred, creating a sinuous edge. The Callahan's width/thickness index is generally 2:1.

Stage 1 bifaces are the smallest category in the biface assemblage, consisting of 11 complete specimens and only four fragments (Figure 7.13a, b).

Stage 2 bifaces are more numerous, with 28 complete specimens and 25 fragments (Figure 7.13c, d), but still account for only 9 percent of the overall biface assemblage. Many of the Stage 2 bifaces have a pointed ovate or subtriangular shape, but are still thick and have sinuous edges. All of the Stage 1 and Stage 2 bifaces are made from locally available cherts.

The low number of Early Stage bifaces recovered from the Siren site suggests that initial tool reduction did not take place on site. It may be that the initial reduction was conducted during the procurement of raw materials, so that more blanks were brought back to the site for final reduction. There may also be early stage reduction areas in parts of the site that were not excavated.

Scrapers

Scrapers are defined as "unifacially flaked artifacts… and unretouched flakes characterized by relatively acute working edges, often exhibiting unifacially distributed microflaking and more commonly edge rounding on either distal and/or lateral working edges" (Tomka et al. 1999:30). Scrapers are further divided into subcategories based on the degree of effort of manufacture. These categories include formal, minimally retouched, and expedient scrapers (Tomka et al. 1999:32). Both minimally retouched and expedient scrapers were classified as edge-modified flakes during the artifact analysis, and are therefore discussed separately under that category below. Scrapers are also subdivided based on the location of retouch and/or use wear; categories include end scrapers, side scrapers, and end/side scrapers (Tomka et al. 1999:32).

Variation in scraper morphology equates overall shape to an analytical unit, with little accounting for use life events such as reuse and resharpening (Bisson 2000; Dibble 1995; Odell 2001; Shott 1995). Certain tasks such as hide softening do not require a sharp edge, and scrapers used for such tasks may resemble exhausted scrapers. When hafted, scrapers are more easily resharpened than replaced, with resharpening taking less than a minute (Boszhardt and McCarthy 1999).

A variety of nominal (e.g., morphology, condition, breakage, cortex, heat, patination, retouch type, retouch distribution, and retouch location) and scalar attributes (e.g., overall specimen measurements, platform measurements, and measurements associated with retouch scars) were recorded for each specimen.

Nominal and scalar attributes for each uniface and modified flake specimen were then entered into a database and used to search for patterning within and between uniface and modified flake production and usage (e.g., resharpening techniques, reduction sequences, and edge modification). One measurement in particular, percentage of edge used, is a composite measurement derived from the maximum potential useable edge and the utilized edge. High percentages can indicate more intensive usage or more formalized tool design. As a specimen is resharpened the overall perimeter is reduced in relation to the worked edge. However, a smaller percentage can occur with forms of end scrapers, such as those made on long blades.

Ninety-seven scrapers were recovered from the Siren site west side. With one exception, all the scrapers can be classified as formal, based on such elements as intentional tool shaping and extensive, continuous flaking along the use-areas.

A slight majority of the assemblage, totaling 47 specimens, consists of end scrapers (Figure 7.14a–c). These are all unifacially trimmed on the distal end to create a 45 to 75 degree angle on the bit. Some have a degree of edge modification along the lateral edges, but it is unclear if this is use-related, or the effect of shaping during tool production. Twenty-nine more are identified as end/side scrapers, where both the distal end and one or both lateral margins have been retouched (Figure 7.14d–f, j). Eleven of these are retouched along both margins, with four more showing evidence of proximal retouch as well. This proximal re-touch could be a product of tool shaping. Fourteen of the specimens are side scrapers, with five exhibiting retouch along both lateral margins (Figure 7.14g–i). One specimen is a transverse scraper, defined by Oksanen et al. (2008:68) as "fashioned along a transverse fractured edge of a flake." Finally, five specimens are too fragmentary to be positively typed, although four are potentially lateral margin fragments.

Over two-thirds of the scrapers, totaling 71 specimens, are complete tools, and only four of these are identified as exhausted. Seventeen complete specimens were likely nearing exhaustion, based on a high Kuhn's (1990) Index of Reduction (greater than 0.80). This index is a ratio of retouch height to maximum tool thickness for unifacial scrapers. A higher index number generally indicates more intensive reuse and resharpening of the tool (Kuhn [1990]; see Carpenter et al. [2010] for application of this index to Nueces tools). Three more had edge angles greater than 75 degrees, another measure used for unifacial scrapers to indicate extensive resharpening and possible exhaustion of use-life.

Taking into account the exhausted specimens that were likely discarded, 43 complete formal scrapers with some presumed use-life were recovered from the west side of the Siren site. It is possible that some of these tools were left behind at the site as caches or site furniture, to be reused during later visits to the site, although no specific scraper caches were identified during the excavations. Some of the complete scrapers may be late-stage manufacturing failures that were discarded. No use-wear analysis was conducted on the

Figure 7.14. Scrapers of various types. End: a) Lot # 765.2, b) Lot # 1277, c) Lot # 1376.1; **End/side:** d) Lot # 597.2, e) Lot # 1066, f) Lot # 2070; **Side:** g) Lot # 558, h) Lot # 725, i) Lot # 1413; **Large end/side:** j) Lot # 473.

scraper assemblage that might identify manufacturing failures.

A cursory glance at distribution patterns identified several interesting concentrations. In the E Block excavation area, seven scrapers were recovered at elevations from 97.7 to 97.6 m, and four more were recovered from 97.6 to 97.5 m. In the NE Block, four scrapers were recovered from the SE quad of unit N1026/E1012 at an elevation of 97.8 to 97.7 m (Figure 7.15). Eight more scrapers were recovered from this same elevation across the excavation block. Finally, in the NW Block, six scrapers were recovered from the western half of unit N1025/E1006 at an elevation of 98.0–97.9 m. These concentrations may indicate activity areas, perhaps where processing of hides took place. In general, the scraper assemblage exhibits a large degree of formal shaping, and consequently a great deal of investment of labor in manufacture.

Miscellaneous Formal Chipped Stone Tools

As suggested by the category, miscellaneous formal tools are those formal chipped stone tools with functions not directly associated with projectile points, bifaces/knives, and unifaces/scrapers. This category can include drills, perforators, gravers, adzes, and spokeshaves, among others. For the west side of the Siren site, nine drills and three gravers are included this category. No use wear analysis was conducted on any of the miscellaneous formal tools.

Drills are bifacial tools "characterized by a long and tapered bit that is diamond-shaped in cross-section" (Turner et al. 2011:239). These tools were utilized to bore holes in various materials, ranging from hide to bone to wood. Basal shape varies, and Turner et al. (2011:239) note that Archaic drills are often probably reworked from projectile points, while Late Prehistoric drills were typically fashioned from flakes.

Both types are present in the current assemblage, as four of the specimens are reworked from projectile points, and four more are made from flakes. Three of the drills are reworked Castroville points, while the fourth is a reworked Montell point (Figure 7.16a). It is not clear whether these drills were hafted during use. However, the Castroville type may have been selected

Figure 7.15. Scraper cluster. a) Lot # 953; b) Lot # 964.2; c) Lot # 964.3; d) Lot # 965.

Figure 7.16. Drills, gravers, and chopper. **Drills:** a) Lot # 1093.2, b) Lot # 1588, c) Lot # 662.1 / 1547.1; **Gravers:** d) Lot # 311.3, e) Lot # 1468; **Chopper:** f) Lot # 1769.1.

for reuse due to the large, broad stem that can be easily gripped as an unhafted tool.

Three of the flake drills have a round base (Figure 7.16b, c), while the fourth has a square base. The relative lack of proximal tool shaping suggests that these were not hafted, but hand-held. One of the round base drills is a refit of two pieces, recovered from units more than 20 m apart. This may indicate that one of the broken pieces was intentionally (i.e., thrown) discarded following the break. The basal portion of the tool was slightly burned following the breakage.

It should be noted that none of these drills were found associated with the Late Prehistoric component on the site. The reworked Castroville drills were recovered from levels consistent with Castroville dart points, and generally from elevations below the flake drills.

Gravers are “intentionally retouched to form a point or projection” or “minimally retouched specimens that have naturally occurring or incidentally formed sharp projections” (Tomka et al. 1999:30). These tools are thought to be used for incising or perforating (Oksanen et al. 2008). All three of the gravers have evidence of intentional modification along the margins adjacent to the graver denticulate, although the area may have been selected due to a natural projection. Two of the gravers have a single denticulate (Figure 7.16d), while the third, the largest specimen, has two denticulates along the same margin (Figure 7.16e). All three of the gravers were made on cortical flakes and are unmodified outside of the immediate use area, suggesting a relatively informal, almost expedient tool usage.

The chopper (Figure 7.16f) is similar to the core tools discussed below, consisting of a large cobble with a distinct bifacial bit at one end. The distinctive aspect of this tool is that it is made from what appears to be a siltstone cobble, as opposed to chert.

The handaxe is has an extremely battered bit. Due to the heavy use damage to the bit, it is not clear whether it was unifacially or bifacially modified. The overall morphology more closely resembles a scraper, with a planar ventral surface, as opposed to a bifacial chopper with a biconvex shape. The heavy battering indicates that the tool was likely used to work hard material, such as wood.

Edge-Modified Flake Tools

Edge-modified flake tools, often referred to as modified flakes, are flakes with intentionally retouched edges that lack standard formal and locational characteristics (Odell 2003). Also included in this category are flakes with edges that have been modified as a result of use as tools, also called utilized flakes. Both forms are considered informal tools, having been minimally modified through use or minimally trimmed when manufactured. Typically, flaking scars do not extend into the interior of the flake surface and are confined to less than 10 mm of the lateral margins. Modification may be unifacial or bifacial, and these tools may have served multiple purposes as expedient knives, scrapers, or gravers. Utilized flakes can be the most difficult to identify accurately since edge damage through use is created through intensity, duration, and type of use. Edge damage can also occur through post-depositional processes such as trampling or crusing, mimicking use wear.

Figure 7.17. Edge-modified flake tools. Unifacial-dorsal: a) Lot # 933.2; **Unifacial-ventral:** b) Lot # 448.3; **Bifacial:** c) Lot # 470.2; **Possible graver:** d) 455.2

A total of 162 edge-modified flake tools was recovered (Figure 7.17). The specimens range from lightly modified, highly expedient flakes to finely flaked, almost formal tools. Many are modified along two or more margins, suggesting a more formal technology. Two of the specimens have no intentional modification, with only traces of use wear present. The majority is made from fine-grained Edwards chert, similar to the formal tool assemblage; however several of the tools are made from medium- or coarse-grained chert.

Most of the assemblage is unifacially modified, with 95 modified on the dorsal face (Figure 7.17a) and 18 modified on the ventral face (Figure 7.17b). Thirty-eight of the tools are bifacially modified (Figure 7.17c), and nine are indeterminate. Four tools were identified as having possible graver denticulates (Figure 7.17d). One large tool had deep utilization flake scars and signs of battering that suggest possible use as a chopper or cleaver.

As noted, no detailed use-wear analysis was conducted on the assemblage. Odell (2003) notes that most use-wear cannot be observed through macroscopic examination, making a positive determination of a tool's function impossible without microscopic examination. For this reason, none of the edge-modified flake tools were categorized as knives or scrapers.

It is possible to use the average edge angle as a proxy for determining possible function. Fifty specimens have an average edge angle greater than or equal to 55 degrees. This is within the range of formal scrapers, and one of the tools is described as resembling a scraper. Forty-eight tools have an average edge angle less than or equal to 40 degrees, including both utilized flake tools. These may have functioned as cutting tools.

No significant distribution patterns are evident in the edge-modified flake tool assemblage. Four specimens were recovered from a single 1 × 1-m test unit, and three isolated specimens were recovered from an additional three other 1 × 1- m units/quads.

Cores and Core Tools

Cores are objective pieces of lithic material from which another piece is detached (Andrefsky 1998). Although they can be utilized as tools, they are part of the lithic reduction sequence. They exhibit negative flake scars created by fracturing, a reductive process that involves the removal of flakes from the core by striking it with a percussor such as a billet or hammer stone. Flakes may also be detached through indirect percussion using a punch and through pressure. The primary purpose of cores is a source of flakes, which may be utilized or further reduced into stone tools. In some instances, a sharp margin of the core itself may be utilized as tool. The butted or backed bifaces probably functioned in this role.

The cores from the Siren site were examined and classified according to their reduction attributes. Nominal attributes (e.g., cortex type, raw material type, color, heat exposure, striking platform, number of flake scars, morphology) and metrical attributes (e.g., weight, dimensions) were noted for each core specimen and recorded in a database.

Maximum flake scar length was calculated along the longest flake scar from platform to termination, parallel to the scar surface. Overall length, width, and thickness measurements were recorded as maximum dimensions with the orientation of the core in the perceived position of use. The core assemblage was further divided into categories based upon the flaking patterns of remnant flake scars and the location of platforms where flakes were detached. The categories are multidirectional, bidirectional, bifacial, unidirectional, slab, bipolar, and indeterminate. Indeterminate specimens were blocky fragments that did not exhibit characteristics of the other categories.

Multidirectional cores have striking platforms on different axes, and flakes are removed in numerous directions. Bidirectional cores have opposing or perpendicular platform surfaces, with flakes detached in two different directions. Bifacial cores have flakes detached along both faces of an edge, with the edge serving as the platform. This category may have been used as tools. Unidirectional cores have a single platform surface, and flakes are detached in the same direction. This creates a conical shape tapering towards the distal end when flake removals continue around the platform perimeter. Bipolar cores are held against an anvil at the distal end as a flake is detached from the opposing ends. This can split the core longitudinally. The resulting pieces may then be used for further reduction, using the new ventral surface as a platform. Small pebbles may be split this way.

Cores were divided into complete and incomplete or fragmentary specimens. Fragmentary specimens were determined by fracture scars that intersected flake scars. Complete cores were further subdivided into two stages: exhausted and unexhausted. Exhausted cores are assumed to be discarded after no more usable flakes could be detached and therefore had exhausted their utility as a core. Unexhausted specimens are capable of providing additional flakes.

The core assemblage collected from the site consists of 96 specimens, including five core tools. With two exceptions, the cores and core tools appear to be locally available cherts, with one quartzite specimen and one identified as chalcedony. Fifty-three of the cores are complete, while 38 are core fragments. All five of the core tools are complete.

The assemblage is dominated by multidirectional cores, accounting for over two-thirds of the total (Figure 7.18a, b). These core types were used to produce large flakes that could then be turned into formal stone tools or used expediently. Twenty of these appeared to have been flaked by hard hammer percussion, struck by a hammerstone. Five more appeared to have been worked through soft hammer percussion, which likely involved an antler billet. The percussion method for the remainder of the cores could not be accurately determined. The number of flake removals range from two to 19, with the majority of the specimens having less than 10 scars. Nineteen of the multidirectional cores were identified as exhausted.

Ten of the cores are bifacial (Figure 7.18c, d). Several of these appeared to have started as large macroflakes, and may have been early-stage bifaces or scrapers. Some of these cores may also have been intended to produce a specific type of flake. Two of the cores were reduced through soft hammer percussion, while the rest are indeterminate. The number of flake removals range from nine to 23, although some of the flake scars are from striking platform preparation. Two cores are believed to be near exhaustion.

The remaining cores include four parallel platformed (Figure 7.18e), one bidirectional, one unidirectional (Figure 7.18f), one unifacial, and six indeterminate specimens. Two of the parallel-platformed cores and the unifacial core are identified as possible blade cores. Specialized blade technology in Texas has been documented in the Early Paleoindian period and the Late Prehistoric Toyah phase (Collins 2004). As such, these blade cores do not outwardly coincide with the cultural components represented on the site. However, there have been suggestions that an informal blade technology was present during the Austin phase (Shafer 2006), so the presence of blade cores at the Siren site could serve as additional evidence to support this theory.

The five core tools are all probable chopper/cleavers (Figure 7.18g, h). These are tools with a distinct unifacial or bifacial bit at one end of the cobble, formed by the removal of several large flakes. The tool often retains a large amount of cortex, likely to facilitate gripping during use. Uses for these tools

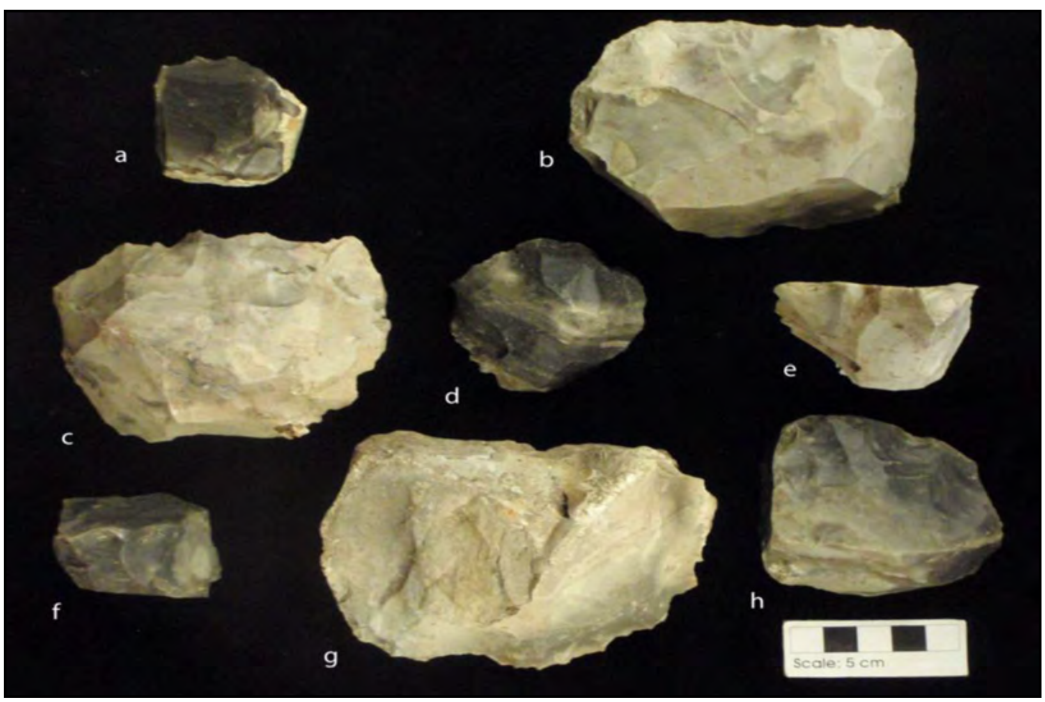


Figure 7.18. Cores and core tools. Multi-directional: a) Lot # 1676.1, b) Lot # 1685; **Bifacial:** c) Lot # 823, d) Lot # 846; **Unidirectional:** e) Lot # 323; **Parallel/ platformed:** f) Lot # 405; Core tools: g), Lot # 604, h) Lot # 1034.

include chopping vegetal matter, woodworking, and butchering. Core tools can be distinguished from bifacial cores by the presence of heavy use-wear along the working edge, as well as the location of the flaked edges. On three of the tools, the vast majority of the flaking took place on the tool edge. Use-wear in the form of crushed edges and microflake impact scars was noted on all five specimens, although no microscopic use-wear analysis was conducted.

One distinct concentration of cores located in the E Block (Unit N1025/E1024) may represent a lithic reduction area. Ten cores and core fragments and one core tool were recovered from 97.9–97.6 m, accounting for more than 10 percent of the total core assemblage. Six of these came from Level 8 (97.8–97.7 m), including four from the SW quadrant. Feature 44 was identified in the SE quad of this unit and level, and one of the cores was directly associated with the feature. As discussed above, a large number of bifaces and several projectile points were also recovered from these levels in unit N1024/E1024, namely Level 8. This seems to indicate a possible lithic reduction and tool production area.

An isolated cluster of cores was documented in unit N1022/E1002 of the NW Block. Three cores were recovered in the NE quad within a 15 × 20-cm area at an elevation range of 98.08–97.98. A large, early-stage biface fragment was also recovered from this quad, roughly 50 cm to the north. The debitage count for this quad was 362 pieces, which was the fifth highest total for any quad at the site. The count for the adjacent NW quad was 409 pieces of debitage, the highest at the site. This evidence is suggestive of a very intensive lithic reduction area.

Lithic Debitage

There were 114,384 pieces of debitage recovered from the west side of the Siren site excavations. No detailed analysis of the assemblage was conducted. All stages of reduction are present, and a large amount of microdebitage and pressure flakes were recovered from the flotation samples.

Ground Stone/Non-Chipped Stone Tools

The ground stone/non-chipped stone tool assemblage is divided into several categories, determined by inferred function, as well as morphological and material attributes. The categories include manos, grinding slabs, smoothing stones, nutting stones, and manuports.

Manos are small-to medium-sized oval to rounded cobbles that exhibit smoothing and pecking (Tomka et al. 1999:32). The smoothing is created as a result of grinding activities, while the pecking is used to rejuvenate use surfaces, making them rougher. The use of milling stones/manos is seen as a hallmark of an Archaic lifestyle (Collins 2004). Manos may have been used and maintained by women and may, therefore, indicate gender divisions of labor. For example, specimens of manos and grinding slabs were interred with female burials at Loma Sandia (Taylor and Highley 1995).

Eight manos were recovered from the Siren site west side. Four of these are complete, two are missing edges or ends, and two are marginal edges. Seven of these are granite, with five being the pink variety associated with the Llano formation. Granite is not a locally available material. The other mano is macrocrystalline quartz, which is a naturally rough material due to the large crystal size. Multiple use surfaces were noted on all but one mano.

Grinding slabs, often broadly referred to as metates (see Oksanen et al. [2008] for comments on distinction), are “medium to large tabular limestone or sandstone specimens with a shallow to deeply concave surface exhibiting an even, smooth surface” (Tomka et al. 1999:32). The abrasive surfaces of these slabs are used for grinding, with the aid of a mano. Depressions are often created by pecking and become larger and deeper through repeated usage. As with manos, pecking is used to rejuvenate use surfaces. Six grinding slabs were recovered from the Siren site. One of these is complete, one is almost complete, two are corner fragments, and two are medial fragments. The material type divided evenly between limestone and sandstone, both of which can be locally procured. The limestone slabs had only one use surface, while the sandstone slabs were used on two faces. This may indicate different functions by material type, or perhaps heavier usage of the less easily obtained and more abrasive sandstone.

Nutting stones are anvil stones where nuts and seeds are placed in depressions to be pounded, pecked, or cracked (Oksanen et al. 2008). One face and one edge of this coarse quartzite cobble have grinding surfaces. The opposing face, which is convex, is heavily battered. This side was likely used for pounding or hammering.

Smoothing stones are usually marked by polished and striated surfaces. They are often associated with pottery making, where they are used to smooth the surface of vessels prior to firing. Non-ceramic use may related to hide preparation. Two possible smoothing stones were recovered at the Siren site. Both are long, thin silicified limestone cobbles. One of the tools is very smooth and polished on one face, and has an end that comes to a point, possibly intentionally shaped. The other is oddly tapered along the edges, and has multi-directional striations. However, more than 80 percent of the striations are more prominent, and parallel each other and the edge of the tool. There is also a possibility that these modifications were created by natural processes. This distinction is often difficult to determine given the soft nature of the limestone.

Ten of the ground stone tools collected from the west side of the Siren site were submitted for starch analysis. Six of these returned traces of starch residues associated with the past usage of the tools. Four contained starch grains associated with grasses or small seeds, while the other two had starch grains derived from geophytes.

Figure 7.19. Bone and antler tools. Bone awls: a) Lot # 85, b) Lot # 331, c) Lot # 1850.1; **Awl from different bone type:** d) Lot # 402; Antler billet: e) Lot #95.

Appendices C and F contain a detailed reports of the ground stone tool residue analysis. One of the manos was associated with Feature 16. The grinding slabs were associated with Features 44 and 47.

Worked Bone and Antler

Eleven worked bone tools and one antler tool were recovered from the site (Figure 7.19). All of the bone tools are awls, which are pointed tools generally made from long bones. The working end may have polish and/or striations from use. There is visible polish on several of the awls. Most of the awls recovered are small distal fragments (Figure 7.19c). Two awls appear to be made using a deer foot bone (3rd phalange) rather than a long bone (Figure 7.19d). The antler tool is a section of the antler shaft and base (Figure 7.19e). The basal end is battered, suggesting use as a billet, probably for tool knapping. The other end appears to be somewhat hollowed out, and may have served as a haft for a tool. The antler billet was associated with Feature 3.

Faunal Remains

At the request of TxDOT, the robust faunal assemblage was submitted to Dr. Walter Klippel for analysis at the University of Tennessee. The analysis addressed all recovered elements and included taxon to the lowest level practical, and when possible identified the element represented; the age and sex of the individual; the character and degree of weathering; the presence and degree of thermal alteration; the character of fractures present (e.g., green bone vs. dry bone); and the presence, character, and intensity of modification by humans or carnivores. Number of individual specimens (NISP) and minimum number of individuals (MNI) for each taxon were determined.

The faunal assemblage from the Siren site west side includes 18,530 bones, teeth and antler, excluding worked bone (Appendix H). The majority of the bone assemblage showed significant modification as a result of taphonomic factors. Approximately 74 percent of the bone assemblage was identifiable to class, with mammals comprising an overwhelming majority (73 percent). Twelve mammal genera were noted, with white-tailed deer (*Odocoileus virginianus*) being the most common. Other species identified included deer, bison (*Bos bison*), black bear (*Ursus armericanus*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), striped skunk (*Mephitis memphitis*), cottontail (*sylvilagus* sp.), blacktail jack rabbit (*Lepus californicus*), beaver (*castor canadensis*), southeastern pocket gopher (*Geomys bursarius*), and woodrat (*Neotoma* sp.).

Within the unidentifiable mammal categories, medium-sized mammal taxa makes up 88 percent of the assemblage, followed by large mammal taxa, which comprised only 2 percent of the class. Amphibians, reptiles, and birds (turkey) combined to make up 1 percent of the remains identified to class.

The assemblage is dominated by portions of long bones from both large and medium-sized mammals (i.e., bison, deer, and pronghorn). Specifically, within the bison collection, 100 percent are dense distal humeri. Similarly, 83 percent of the denser ends of medium-sized artiodactyls humeri, radii, and tibiae are represented. Comparatively, only 17 percent of the less dense ends of these same bones are present.

An important aspect of the faunal analysis is the inference of seasonal site occupation in which groups from elsewhere, probably from the east, were moving onto the edge of the Edwards Plateau in late fall/early winter and intensively exploiting deer. This area on the plateau is an ecotonal boundary known for high concentrations of whitetail deer. The presence of teeth and feet, and bone condition, from all four artiodactyl species indicate that they were being harvested in the area, transported to the site, and processed for hides, meat, marrow, and grease. Cut marks, on the plentiful deer bones in particular, are positioned such to suggest skinning (e.g. lateral margins of phalanges), disarticulating (e.g. between vertebrae and at long bone joints), and defleshing (e.g. mid-shafts of meat-bearing long bones).

In addition to processing the artiodactyls for their hides and meat, there is strong evidence that the bones of all four taxa were being heavily processed for marrow and grease (Appendix H). Similar to what Binford (1978) describes for the Nunamiut, there is clear evidence for bone grease/”juice” production at Siren where practically all of the artiodactyl bones have been broken and crushed. In fact, it appears it was a major activity and there was frequent reuse of bone for grease production at the site. Klippel proposes that the fragmented artiodactyl bones of low marrow utility (e.g. phalanges) so often cited as evidence of human nutritional stress, may well be evidence for the repeated use of an ecotone in central Texas that included an efficient, systematic, production of bone grease/”juice”. The lack of a broad utilization of the potentially varied animal recourses that should have been available in a riparian setting at this ecotone between the Blackland Prairie and the Lampasas Cut Plain ecoregions substantiates this interpretation of the faunal remains from Siren.

Other faunal remains encountered during excavations on the west side of the Siren site included a total of 19 mussel shell umbos and numerous observed fragments. The mussel shells were collected from a number of context. However, given poor preservation conditions and a general lack of diagnostic attributes a detailed analysis was not conducted.

Special Samples

The data recovery excavations on the west side of the Siren site recovered 350 special samples from appropriate contexts across the site. These included materials for radiometric dating, matrix samples for flotation and/or fine screening, flora and wood identification samples, pollen/phytolith samples to aid in paleoenvironmental reconstruction, burned rocks for possible lipid residue analysis, and geomorphic samples. Additionally, a 5-gallon bulk matrix sample was collected from each 2-x-2-m unit excavation level for water screening.

A total of 191 charcoal samples was recovered from various contexts throughout the site, with the majority collected from features such as hearths. Of these, 65 samples were submitted for radiocarbon dating, including 49 from feature contexts. These results are provided in Appendix A.

Other samples included 49 feature matrix samples from each of the features identified on the site. Selected samples were subjected to flotation. The heavy fraction of the flotation samples was sorted for debitage, bone, mussel shell, and burned rock. Selected light fraction of the flotation samples, as well as selected flora and wood identification samples recovered from the excavations were subjected to macrobotanical analysis,. The results of the macrobotanical analysis, including the flora and wood identification samples, are discussed in the feature section below and in Appendices B and D. A total of 49 pollen/phytolith samples were collected from sealed feature contexts. Pollen/phytolith results are provided in Appendices E and G. There were 24 burned rocks collected for possible lipid analysis. However, the analysis was not performed.

Additionally, feature matrix samples were water screened through nested 1/8- and 1/16-inch mesh screens The artifacts recovered from the 1/8- inch mesh water screens were sorted and tabulated, and are included in the specimen inventory provided in Appendix M. The material from the 1/16-inch screens was simply bagged for future analysis.

The non-feature bulk matrix samples were water screened through 1/8-inch mesh. The artifacts recovered from the 1/8-inch screens were sorted and tabulated, and are included in the specimen inventory (see Appendix M).

Features

During the SWCA testing and data recovery investigations at the western side of the Siren site, 48 features, designated Features 1 through 48, were recorded (Table 7.12). Of these, 46 were burned rock features. Two of the features were originally identified in backhoe trench wall profiles during the testing phase of the project and were not subsequently excavated. Two features were eventually combined, resulting in a total of 43 burned rock features investigated. The remaining features consisted of a biface cache and the remnants of a knapping episode. Following this more generalized feature discussion is a Feature Manual that provides detailed information about each of the features documented during the testing and data recovery efforts.

The overall research design detailed issues of synchronic and diachronic patterning of artifacts, activity areas, and features at the Siren site. The horizontal distribution of feature types was thought to be reflective of spatial variations in prehistoric activities at the site. The diachronic patterning also had the potential to reveal changes in size, type, and morphology of burned rock features. To identify subtle shifts in thermal technology, it was essential to first establish distinct categories for different burned rock features types.

The feature categories used in this chapter follow the definitions provided by Kleinbach et al. (1995a) in the Fort Hood significance testing investigation report, with supplemental details from Ellis' (1997) overview of hot rock technology and Johnson's (2000) definitions of burned rock feature types.

Kleinbach et al. (1995a) created a detailed prehistoric feature typology, adapted from Trierweiler (1994). This typology can be used to sort features based on their component elements, such as rock or faunal materials, followed by morphology. Within the burned rock category, types include concentrations, mounds, middens, and hearths. Hearths are further subdivided by rock shape and presence/absence of a basin. A type for basin hearths with little to no rock is also included.

The types include Type 1 flat hearths with angular rock, Type 2 flat slab-lined hearths, Type 3 basin-shaped hearths with a matrix of ash and/or charcoal and little to no burned rock, Type 4 basin-shaped hearths with angular rock, Type 5 slab-lined, basin-shaped hearths, and Type 6 dispersed hearths (Kleinbach et al. 1995a). Also included is a category for burned rock concentrations, which is an amorphous grouping of rocks with a low amount of charcoal and associated cultural materials (Kleinbach et al. 1995a).

It should be noted that the term "flat" does not imply a completely level surface. Kleinbach et al. (1995a:777) note that the bases of flat hearths are "relatively flat, indicating that the rocks were horizontally laid, and therefore show no evidence of a purposefully prepared surface."

In some cases, a hearth may have functioned as an oven, which is defined by Johnson (2000:73) as "a facility used for covered roasting or baking." This is accomplished by placing hot rocks into a shallow basin or deep pit to form a basal heating element, followed by a layer of food (Johnson 2000). This is then capped by earth, other plant parts, or another layer of rocks, in order to seal in the heat and cook the food (Johnson 2000).

What follows is a brief overview of the types of features identified at the site. These will be placed within the overall site structure and associated with specific occupation periods in subsequent chapters. Detailed information for each of the features, including associated metrics, radiocarbon dates, and associated artifacts, is also provided.

Incipient Burned Rock Midden

During data recovery, Feature 8 was initially encountered in the southern units of the NW Block at approximately 98.0 m. Though first thought to be small burned rock cluster, as excavations progressed, it became apparent that Feature 8 extended much farther than originally believed, essentially covering the entire NW Block. The midden appeared in some places to

Table 7.12. Features

Feature #	Type	Kleinbach et al. (1995a) Typology	Dimensions (cm)	Pollen and Phytolith Samples	Bulk/Flotation Samples	Radiocarbon Age (Conventional BP)	Associated Diagnostic Artifacts (Lot No.)
1	**Slab-lined hearth**	5	100+ x 140+	P1	F1, F2, F3: charred *Acacia* wood; charred *Quercus* wood, ring porous	1110 ± 40 (Beta 207238); 1150 ± 40 (Beta 207239)	Untyped arrow (60), Scallorn arrow (68.2)
2	**Small, basin-shaped hearth**	4	35+ x 55	P2	F4: charred *Quercus* wood, ring porous	2560 ± 40 (Beta 207240); 2480 ± 40 (Beta 207241)	none
3	**Ovate, basin-shaped hearth**	4	90 x 85	P3	F5: charred *Rosaceae* wood; charred Unknown Type 1 wood	2550 ± 40 (Beta 207242); 2510 ± 40 (Beta 207243)	Antler billet (95)
4	**Slab-lined hearth**	5	110+ x 140+	P4	F6, F7: charred *Quercus* wood, diffuse porous and ring porous (includes C-14 samples)	1980± 40 (Beta 207244); 2000 ± 40 (Beta 207245); 2000 ± 40 (Beta 207246)	Frio dart (115)
5	**Burned rock feature**	Feature not investigated					
6	**Small basin-shaped hearth**	4	90 x 45+	P6	F10: charred *Juniperus* wood; charred *Quercus* wood, diffuse porous and ring porous; charred Unknown Type 1 wood, diffuse porous; charred *Vitis* wood	990 ± 40 (Beta 207247)	Utilized blade (177), End scraper (176)
7	**Burned rock feature**	Feature not investigated					
8	**Incipient burned rock midden**	Incipient Burned Rock Midden	10 x 10 (m)	P30, P31: negative analysis (pollen and phytolith)	F35, F36: charred *Quercus* wood, ring diffuse and ring porous	2460 ± 40 (Beta 215916); 2590 ± 40 (Beta 215920); 2590 ± 40 (Beta 250562); 2490 ± 40 (Beta 250568); 2480 ± 40 (Beta 250572); 2400 ± 30 (Beta 299318-from Feature 31)	Undetermined
9	**Small hearth or oven**	1	40+ x 60+	P5	F8	none	none

Table 7.12. Features (continued)

Feature #	Type	Kleinbach et al. (1995a) Typology	Dimensions (cm)	Pollen and Phytolith Samples	Bulk/Flotation Samples	Radiocarbon Age (Conventional BP)	Associated Diagnostic Artifacts (Lot No.)
10	**Small hearth**	1	40 x 55	P7	F11: charred *Quercus* wood, ring porous	none	none
11	**Small hearth**	4	60+ x 90	P8	F12: charred *Quercus* wood, diffuse porous and ring porous; charred *Vitis* wood	none	Arrow point preform (183)
12	**Dispersed hearth**	2	85+ x 50+	P9	F13: charred *Quercus* wood, ring porous	1040 ± 40 (Beta 250552)	none
13	**Shallow, basin-shaped hearth**	4	93 x 85	P10: negative analysis (pollen and phytolith)	F14: charred *Quercus* wood, ring porous	1110 ± 40 (Beta 250550); 1100 ± 40 (Beta 215912)	Edwards arrow (2043)
14	**Cluster of FCR**	1	59 x 57	P11: negative analysis (pollen and phytolith)	F15: charred *Quercus* wood, ring porous	1030 ± 40 (Beta 250549); 1120 ± 40 (Beta 250551)	none
15	**Shallow, basin-shaped hearth**	4	83 x 66	P14: negative analysis (pollen and phytolith)	F18: charred *Quercus* wood, ring porous	1730 ± 40 (Beta 250553)	none
16	**Slab-lined hearth**	5	150 x 127	P15, P18: negative analysis (pollen and phytolith)	F19, F21: charred *Quercus* wood, diffuse porous and ring porous	1130 ± 40 (Beta 250554); 1190 ± 40 (Beta 250555); 1260 ± 40 (Beta 250557); 1170 ± 40 (Beta 215914)	Mano (2143): starch on two surfaces consistent with geophytes, Scallorn arrow (2084.1)
17	**Basin-shaped hearth**	5	130 x 105	P17	F20, F22: charred *Quercus* wood, ring porous and diffuse porous	1550 ± 40 (Beta 215913); 1970 ± 40 (Beta 250556)	none

Table 7.12. Features (continued)

Feature #	Type	Kleinbach et al. (1995a) Typology	Dimensions (cm)	Pollen and Phytolith Samples	Bulk/Flotation Samples	Radiocarbon Age (Conventional BP)	Associated Diagnostic Artifacts (Lot No.)
18	**Two clusters of FCR**	5	140 x 80 (combined); 60 x 60 (Cluster A); 50 x 50 (Cluster B)	none	none	1890 ± 40 (Beta 250558)	none
19	**Cluster of FCR**	5	55 x 45	P19	F23: charred *Quercus* wood, ring porous and diffuse porous	none	none
20	**Basin-shaped hearth**	5	42 x 36	P20	F24: charred *Quercus* wood, ring porous and diffuse porous	1900 ± 40 (Beta 250559)	Mano (1983): starch on two surfaces consistent with grasses
21	**Cluster of FCR**	Burned rock concentration	55 x 42	P21	F25: charred *Quercus* wood, ring porous and diffuse porous	none	none
22	**Biface Cache**	Lithic Cache	29 x 24	none	none	none	Montell dart (1599), thin biface (1600), thin biface (1601)
23	**Cluster of FCR**	Burned rock concentration	146 x 125	P24	F27: charred *Juglans* wood; charred *Quercus* wood, ring porous; charred Unknown Type 1 wood, diffuse porous	2180 ± 40 (Beta 250661); 1970 ± 30 (Beta 299317)	none
24	**Small hearth**	2	70 x 60	P22	F26: charred *Quercus* wood, ring porous	none	none
25	**Small, basin-shaped hearth**	5	64 x 60	P23	F28: charred *Quercus* wood, diffuse porous and ring porous	980 ± 40 (Beta 215915); 1090 ± 40 (Beta 250560)	Scallorn arrow (2103)
26	**Knapping event**	Flint Knapping Station	20 x 20	none	none	none	none
27	**Small hearth**	1	56 x 37	none	F29: charred *Quercus* wood, diffuse porous and ring porous	2270 ± 40 (Beta 250563)	none
28	**Cluster of FCR**	Burned rock concentration	115 x 65	P33	F38: charred *Quercus* wood, diffuse porous	none	none

Table 7.12. Features (continued)

Feature #	Type	Kleinbach et al. (1995a) Typology	Dimensions (cm)	Pollen and Phytolith Samples	Bulk/Flotation Samples	Radiocarbon Age (Conventional BP)	Associated Diagnostic Artifacts (Lot No.)
29	**Shallow, basin-shaped hearth**	5	42 x 34	P34	F39: charred *Quercus* wood, ring porous	none	none
30	**Slab-lined hearth**	5	162 x 150	P25: negative analysis (pollen and phytolith)	F30: charred *Juglans* nutshell fragment; charred *Liliaceae* bulb fragment; charred *Quercus* wood, ring porous	1880 ± 40 (Beta 250566); 1970 ± 40 (Beta 250565)	none
31	**Circular hearth**	5	124 x 105	P27	F32: charred *Quercus* wood, ring porous	2400 ± 30 (Beta 299318- see Feature 8)	Marcos dart (2135)
32	**Burned rock feature**	Subsumed by Feature 8					
33	**Cluster of FCR**	4	73 x 60	P28	F33	none	none
34	**Cluster of FCR**	5	54 x 50	P35	F40: charred *Quercus* wood, diffuse porous and ring porous	none	Marshall dart (1188)
35	**Slab-lined hearth**	5	180 x 180	P36, P37: negative phytolith analysis, P36: positive for *Onagraceae* pollen	F41, F42: charred *Quercus* wood, ring porous	2370 ± 40 (Beta 215922); 2390 ± 40 (Beta 250576); 2440 ± 40 (Beta 250581); 2600 ± 40 (Beta 250570)	none
36	**Shallow, basin-shaped hearth**	5	170 x 135	P29: negative analysis (pollen and phytolith)	F34: charred *Celtis* seed fragment; charred *Liliaceae* bulb fragment; charred *Quercus* wood, ring porous	2190 ± 40 (Beta 215917); 2310 ± 40 (Beta 250571)	Montell dart (933.3), Untyped dart (943)
37	**Basin-shaped hearth**	4	78 x 57	P39	F44: charred *Quercus* wood, ring porous	2260 ± 40 (Beta 250573); 2430 ± 50 (Beta 215918)	none
38	**Shallow, basin-shaped hearth**	5	50 x 30 (partial)	P40	F45: charred *Quercus* wood, ring porous; charred Unknown Type 1 wood, diffuse porous	none	none

Table 7.12. Features (continued)

Feature #	Type	Kleinbach et al. (1995a) Typology	Dimensions (cm)	Pollen and Phytolith Samples	Bulk/Flotation Samples	Radiocarbon Age (Conventional BP)	Associated Diagnostic Artifacts (Lot No.)
39	**Cluster of FCR**	Burned rock concentration	46 x 30	P41: negative analysis (pollen and phytolith)	F46	none	none
40	**Cluster of FCR**	Burned rock concentration	75 x 65	P42	F47: charred *Quercus* wood, ring porous; charred Unknown Type 1 wood, diffuse porous; charred *Vitis* wood	none	none
41	**Small, slab-lined hearth**	5	75 x 58	P43	F48	2180 ± 40 (Beta 250575); 2610 ± 40 (Beta 250574)	none
42	**Small hearth**	1	70 x 56	P44	F49: charred *Quercus* wood, diffuse porous; charred Unknown Type 1 wood, diffuse porous	none	none
43	**Cluster of FCR**	4	64 x 47	P45	F50	none	none
44	**Cluster of FCR**	1	50 x 36	P46: positive for *Caryophylleaceae* pollen, negative for phytolith analysis	F51: charred *Prosopis* wood; charred *Quercus* wood, diffuse porous and ring porous; charred Unknown Type 1 wood, diffuse porous	2230 ± 40 (Beta 250577)	Metate fragment (675): no starch recovered
45	**Cluster of FCR**	2	54 x 57	P47	F52: charred *Juglans* wood; charred *Quercus* wood, ring porous	2230 ± 40 (Beta 250578)	none
46	**Cluster of FCR**	Burned rock concentration	70 x 55	P48	F53	none	none
47	**Cluster of FCR**	5	35 x 30	P49	F54: charred *Quercus* wood, ring porous	none	Groundstone (506): no starch recovered
48	**Cluster of FCR**	2	100 x 75	P50	F55: charred *Quercus* wood, ring porous	none	none

have been either cut into the underlying strata, or filled voids left by earlier features, such as Feature 35. Five radiocarbon samples from Feature 8 were analyzed (Beta 215916, 250572, 250568, 215920, and 250562) and the resulting dates cluster at 2700 B.P. A geophyte was collected from the base of the midden rocks.

Type 5 Hearths

Type 5 hearths, which are basin-shaped and slab-lined, are perhaps the most formal hearth feature type. These require a significant investment of labor in their construction. The larger features in particular can be seen as site furniture, reused during repeated visits to the site. These may be central features of large occupation areas, with a variety of activities taking place in the vicinity.

Seventeen Type 5 hearths were identified at the west side of the Siren site. These are further divided into large and small, with large hearths having a diameter of greater than 1 m. Using this standard, eight are large Type 5 hearths, and provide strong evidence for the repeated and intensive occupation of the site.

The temporal and spatial associations of the Type 5 hearths within the Siren site are detailed in Chapter 8 of this report, delimiting the site structure. Chapter 10 of this report contains a detailed examination of slab-lined cooking features both within the region and beyond, as well as a discussion and in-depth analysis of three of the largest of these features at the Siren site.

A prime example of the large Type 5 feature is Feature 35 (see Feature Manual). This large roughly circular hearth measured 180 cm in diameter. The cross section revealed a concave basin, 43 cm deep from the top of the rocks to its base. Large (>15-cm maximum dimension), tightly packed slabs formed the base of the feature, while even larger slabs, measuring 20–30 cm, formed the margins of the feature. These outer rocks were oriented nearly vertically (60–90 degrees) and placed side-by-side around the edge of the hearth. The rocks and fine matrix at the base of the feature were darkly stained by charcoal. This feature had the "classic basin" morphology. Kleinbach et al. (1995a) also note that some hearths have a "pie plate" morphology, where the base is flat, with horizontally laid rocks.

Type 4 Hearths

The Type 4 hearth, like the Type 5 hearth, has a basin-shaped morphology. The primary difference between the two is that Type 4 hearths are lined with small to medium-sized angular rocks and cobbles rather than large, flat slabs (Kleinbach et al. 1995a). Type 4 hearths can also have either the "classic basin" morphology, with a rounded bottom, or "pie plate" morphology, with a flat bottom (Kleinbach et al. 1995a).

These hearths also represent a significant investment of labor, and larger examples likely denote a central activity area of an occupation. The distinction in the rock type may be influenced in part by the raw materials available in the vicinity of the site or reuse of heating elements.

Nine Type 4 hearths were identified at the site. All of these are small hearths using the 1 m diameter standard. In general, these are also shallower than the Type 5 hearths at the site. The temporal and spatial associations of the Type 4 hearths at the Siren site are detailed in Chapter 8 of this report.

Feature 13 is the largest example of the Type 4 hearth feature at the site. The oval-shaped feature measured 93 × 85 cm (see Feature Manual). The shallow basin was 9 cm deep and consisted of two overlapping layers of angular limestone cobbles. Most of the cobbles were fractured in situ. Thermally altered sediment and charcoal staining were observed throughout the feature matrix and below the rocks.

Type 2 Hearths

Type 2 hearths are constructed of medium to large-sized, thin tabular slabs laid "flat" horizontally on the ground surface (Kleinbach et al. 1995a). They generally comprise a single layer of rock. The lesser amount of rock and the lack of a basin indicate a much lower investment of labor in overall construction. These types of hearths may indicate a shorter term of use, or may be secondary elements intended for specific functions distinct from the larger basin-shaped hearths.

Only four Type 2 hearths were identified at the site. Two of these are relatively large, with one oval-shaped feature measuring 1 m in length. The larger features were more than one layer thick, while the smaller features had only a single layer of rock. The temporal and spatial associations of the Type 2 hearths within the Siren site are detailed in Chapter 8 of this report.

Feature 24 is an example of a Type 2 hearth documented at the Siren site west side. The circular limestone cluster measured 70 × 60 cm (see Feature Manual).

The cross section revealed that the feature was on a flat surface, and the single layer of rocks was 11-cm-thick. The rocks were either fractured in situ or intact. Most of the rocks were tabular and adjacent to each other. There was charcoal staining observed below the rocks, and a few mottles of burned soil throughout the matrix.

Type 1 Hearths

Type 1 hearths are the most informal of all the defined hearth types. These are flat features with one or two layers of small to medium sized angular burned rocks and/or cobbles (Kleinbach et al. 1995a). The rocks typically exhibit a haphazard arrangement, with random overlap of feature rocks (Kleinbach et al. 1995a). These may be distinguished by simple burned rock clusters with evidence of burning along or below the base of the features.

Seven Type 1 hearths were identified at the site, and all were characterized as rather small and vertically thin. The temporal and spatial associations of the Type 1 hearths within the Siren site are detailed in Chapter 8 of this report.

Feature 14 is an example of a Type 1 hearth documented on the Siren site west side. The small circular cluster of rocks measured 59 × 57 cm. The northeastern corner of the feature appeared to be truncated or clipped. The limestone rocks were distributed in a single layer, and dark charcoal stains were observed in the western portion of the feature matrix. The layer of rocks and feature matrix was approximately 10-cm-thick. The feature appeared to be on a flat surface with some overlapping rocks in the southern portion. Most of the larger rocks were rounded and fractured in situ.

Burned Rock Concentrations

Kleinbach et al. (1995a:776) define a burned rock concentration as “a relatively shallow, amorphous grouping of burned rocks, typically one to two clasts thick” located on a surface. This type is considered distinct from a burned rock scatter, where the rocks are more diffuse.

Five of the features recorded at the Siren site west side are burned rock concentrations. Two of these are large, with at least one dimension greater than 1 m, although one of these is relatively diffuse and consisted of a relatively low number of burned rocks. The other large feature contained some elements that suggested a dispersed hearth or oven feature, and is not typical of the remainder of the burned rock concentrations. The temporal and spatial associations of the burned rock concentration are detailed in Chapter 8 of this report.

Feature 39 is more typical of the smaller burned rock concentrations. The feature was a 46 × 30-cm cluster of rounded, angular, and tabular fire-cracked limestone rocks, all small to medium in size. The rocks were loosely clumped and adjoining, with very light charcoal flecking present in the matrix. The morphology and absence of distinct soil discoloration within the feature suggests this rock cluster may have been a discard pile.

Lithic features

Two non-thermal features were identified at the west side of the Siren site. Feature 22 was a biface cache consisting of two large, thin bifaces and one Montell dart point. This point may also be a stemmed bifacial knife. The artifacts associated with this cache are discussed below. Feature 26 is a discrete knapping event. The concentrated assemblage within a 20 × 20-cm area consisted of bifacial thinning flakes, micro debitage, bone fragments, a modified flake, and a biface. The feature contained 36 flakes and 52 microflakes clustered together, with some flakes stacked on top of others. Two different types of raw material were represented in the feature. The biface and small flake debris were of a dark material, and the larger flakes were a lighter material.

Feature Manual

The following Feature Manual provides specific data on the 48 features recorded during the testing and data recovery investigations. Two features, Features 5 and 7, were noted during testing, but were never formally investigated. A third feature, Feature 32, was initially recorded as a separate feature during data recovery, but on further investigation was deemed to be part of the larger Feature 8. Feature 32 is thereby subsumed. Accordingly, these three features are not discussed in detail here. Pertinent data of the remaining 45 features are presented here, forming the basis for the following interpretive chapters.

Feature 1

Type	Slab-lined hearth
Kleinbach et al. (1995a) Typology	Type 5 hearth (large)
Geomorphic Stratum	2A, intruding into 2B
Cultural Component	1B
Block	n/a
Units	TUs 1 & 4
Center	n/a
Top Elev. (m)	98.31
Bottom Elev. (m)	97.90
Origination (m)	98.20
Dimensions (cm)	100+ x 140+
Pollen and Phytolith Samples	P1
Bulk/Flotation Samples	F1, F2, F3: charred *Acacia* wood; charred *Quercus* wood, ring porous
Special Samples	S1 (FCR), S2 (FCR)
C-14 Samples	C2, C4, C5, C6, C7, C92
Radiocarbon Age (Conventional BP)	C2– 1110 ± 40 (Beta 207238), C7– 1150 ± 40 (Beta 207239)
Associated Diagnostic Artifacts (Lot No.)	Untyped arrow (60), Scallorn arrow (68.2)

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	178	11.5
5–10	111	25.6
10–15	62	66.1
15+	79	143.1
Total	430	246.3

Feature 1 was encountered in TUs 1 and 4 during the testing excavation phase of the project. The feature was a large slab-lined hearth, with the exposed portions measuring 100 × 140 cm. The hearth originated in Stratum 2A but had been excavated into an approximately 20-cm-deep basin, which cut into Stratum 2B. In cross-section, the bottom of the feature was irregular, with several possible basins. Several large tabular pieces of limestone were tilted towards the feature center and were nearly vertical. The center of the feature was 2–3 layers of densely packed, mixed limestone rocks with charcoal and some occasional ashy soil. The bottom of the feature was clearly defined by a lens of charcoal-stained soil. Despite the irregular rock lining at the bottom, the feature is still interpreted as a large Type 5 hearth (Kleinbach et al. 1995a) and potentially an earth oven (Johnson 2000).

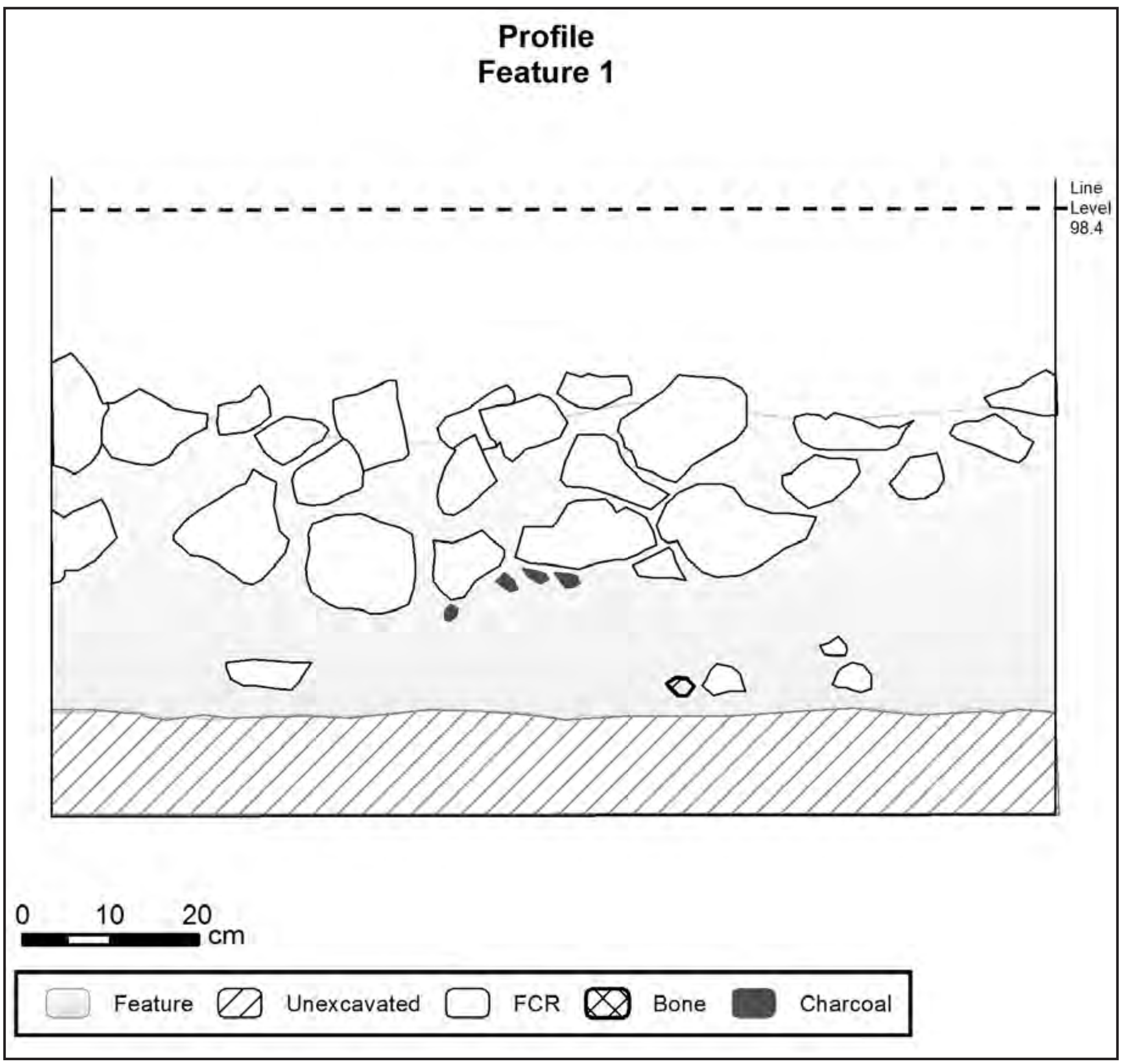
The artifacts associated with the feature include a Scallorn arrow point (Lot 68.2), an untyped arrow point (Lot 60), two biface fragments (Lots 67.1 and 68.1), 127 pieces of lithic debitage, 21 pieces of bone, and three mussel shell fragments. The majority of the feature matrix was screened in the field, with the remainder collected as special samples. Scallorn arrow points are the primary diagnostic artifact of the Late Prehistoric Austin phase, and date from ca. B.P. 800–1250 (Turner et al. 2011:209).

Six charcoal samples were collected from the feature; two of these were submitted for radiocarbon dating. The returned dates ranged from 1110–1150 ± 40 B.P. (Appendix A). The radiocarbon results place Feature 1 in the Late Prehistoric Austin phase component, consistent with the stratigraphic position of the feature and the associated diagnostic artifacts. Feature 1 is the largest feature associated with the Austin phase on the west side of the Siren site.

Three flotation samples were collected from the feature. Macrobotanical analysis of one flotation sample and two charcoal samples identified charred acacia wood and charred ring porous oak wood (Appendix B, Tables 11 and 12 and Appendix D, Table 5). A pollen and phytolith sample was collected but not submitted for analysis. Two burned rocks were collected for lipid residue analysis, but not analyzed.

Feature 1, Continued

Feature 1, as initially exposed, facing west.



Feature 1, profile sketch map of cross section.

Feature 2

Type	Small, basin-shaped hearth
Kleinbach et al. (1995a) Typology	Type 4 hearth (small)
Geomorphic Stratum	2B/3 contact
Cultural Component	5
Block	n/a
Units	TU 2
Center	n/a
Top Elev. (m)	97.30
Bottom Elev. (m)	97.09
Origination (m)	97.20
Dimensions (cm)	35+ x 55
Pollen and Phytolith Samples	P2
Bulk/Flotation Samples	F4: charred *Quercus* wood, ring porous
Special Samples	S3 (FCR)
C-14 Samples	C9, C12, C13
Radiocarbon Age (Conventional BP)	C12– 2560 ± 40 (Beta 207240); C13– 2480 ± 40 (Beta 207241)
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count***	**Weight (kg)***
0–5	91	0.3
5–10	41	4.8
10–15	12	3.9
15+	2	1.5
Total	146	10.5

*partial feature

Feature 2 was encountered in TU 2 during the testing investigations on the site. The feature was at the Stratum 2B/3 contact. The circular concentration of limestone rocks measured 35 × 55 cm, and extended into an unexcavated area to the north. The feature had two layers of burned rocks on the edge, with three possible layers in the center, and was approximately 19-cm-thick. A 10-cm basin was observed in cross-section in the center of the feature. Charcoal staining and burned soil was observed throughout the feature matrix, although the charcoal was more prevalent below the rocks. Based on these factors, the feature is a Type 4 hearth (Kleinbach et al. 1995a).

Artifacts recovered from the feature matrix include 99 pieces of debitage, 13 bone fragments, and a mussel shell fragment. No temporally diagnostic artifacts were recovered from the feature.

Three charcoal samples were collected from the feature, and two submitted for radiocarbon dating. The returned dates were 2560 ± 40 B.P. and 2480 ± 40 B.P. (Appendix A). The radiocarbon results place Feature 2 in the Late Archaic component. This is consistent with the stratigraphic position of the feature.

Macrobotanical analysis of a flotation sample from the feature matrix identified ring porous oak wood (Appendix B, Table 5). A pollen and phytolith sample was collected but not submitted for analysis. A burned rock was collected for lipid residue analysis, but not analyzed.

Feature 2, overview of feature.

Feature 3

Type	Ovate, basin-shaped hearth
Kleinbach et al. (1995a) Typology	Type 4 hearth
Geomorphic Stratum	2B/3 contact
Cultural Component	5
Block	n/a
Units	TU 5
Center	n/a
Top Elev. (m)	97.33
Bottom Elev. (m)	97.03
Origination (m)	97.18
Dimensions (cm)	90 x 85
Pollen and Phytolith Samples	P3
Bulk/Flotation Samples	F5: charred *Rosaceae* wood; charred Unknown Type 1 wood
Special Samples	S4 (FCR)
C-14 Samples	C14, C15, C16
Radiocarbon Age (Conventional BP)	C15– 2510 ± 40 (Beta 207243); C14– 2550 ± 40 (Beta 207242)
Associated Diagnostic Artifacts (Lot No.)	Antler billet (95)

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	140	2.2
5–10	153	19.3
10–15	45	23.2
15+	29	44
Total	367	88.7

Feature 3 was encountered in TU 5 during the testing investigations. The feature was at the Stratum 2B/3 contact. The circular concentration of limestone rock measured 90 × 80 cm and had a distinct basin-shaped cross-section. The basin had a thickness of approximately 15 cm. The feature consisted of two layers of angular rock, although flatter pieces were also present in the lower layer. Approximately 40–50 percent of the rocks were fractured in situ. Charcoal staining was present throughout the feature matrix, with a charcoal and burned soil lens below the feature.

Artifacts recovered from the feature matrix include 58 pieces of debitage, three bone fragments, seven mussel shell fragments, a piece of ochre, and a possible antler billet (Lot 95). No temporally diagnostic artifacts were recovered from the feature.

Three charcoal samples were collected from the feature, two of which were submitted for radiocarbon dating. The returned dates ranged from 2510–2550 ± 40 B.P. (Appendix A). The radiocarbon results place Feature 3 in the Late Archaic component. This is consistent with the stratigraphic position of the feature and is contemporaneous with Feature 2.

Macrobotanical analysis of a flotation sample from the feature matrix identified charred rose family wood and charred diffuse porous Unknown Type 1 wood (Appendix B, Table 4). A pollen and phytolith sample was collected but not submitted for analysis. A burned rock was collected for lipid residue analysis, but not analyzed.

Feature 3, plan view of feature.

Feature 4

Type	Slab-lined hearth
Kleinbach et al. (1995a) Typology	Type 5 hearth (large)
Geomorphic Stratum	2B
Cultural Component	3
Block	n/a
Units	TU 6
Center	N1024.70 E1008.70
Top Elev. (m)	98.10
Bottom Elev. (m)	97.80
Origination (m)	97.90
Dimensions (cm)	110+ x 140+
Pollen and Phytolith Samples	P4
Bulk/Flotation Samples	F6, F7: charred *Quercus* wood, diffuse porous and ring porous (includes C-14 samples)
Special Samples	S5 (FCR), S6 (Possible burned seed): 2 charred *Liliaceae* bulb halves
C-14 Samples	C18, C19, C20, C21, C22, C27
Radiocarbon Age (Conventional BP)	C21– 1980± 40 (Beta 207244), C22– 2000 ± 40 (Beta 207245), C27– 2000 ± 40 (Beta 207246)
Associated Diagnostic Artifacts (Lot No.)	Frio dart (115)

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	275	5.8
5–10	223	26.9
10–15	65	32.6
15+	31	67.8
Total	594	133.1

Feature 4 was encountered in Test Unit 6 during the testing excavation phase of the project. The feature was a large slab-lined hearth with the exposed portions measuring 110 × 140 cm. The main basin area measured 70 × 70 cm, with the remainder of the feature consisting of discard or clean-out areas. The hearth is located near the top of Stratum 2B. In cross-section, the feature had a distinct basin shape marked by charcoal staining, extending 10 cm below the larger discard area. The feature was largely flat slabs along the edges with a mixture of flat and angular rocks stacked 2–3 layers deep. The feature is interpreted as a Type 5 hearth (Kleinbach et al. 1995a) and probable oven (Johnson 2000).

The artifacts associated with the feature include a Frio dart point (Lot 115), two biface fragments (Lots 108 and 114.3), two modified flakes (Lots 114.1 and 114.2), one scraper (Lot 116), 295 pieces of lithic debitage, and 73 pieces of bone. The majority of the feature matrix was screened in the field, with the remainder collected as special samples. Frio dart points date from ca. 200 B.C. to A.D. 600 or later (Turner et al. 2011:106). One of the biface fragments (Lot 114.3) was identified as a possible projectile point fragment, but was too burned for positive identification.

Six charcoal samples were collected from the feature; three of these were submitted for radiocarbon dating. All three dates consistently fall around 2000 B.P. (Appendix A). The radiocarbon results place Feature 1 in the Late Archaic component, consistent with the stratigraphic position of the feature and the associated diagnostic artifacts.

Two flotation samples were collected from the feature. Macrobotanical analysis of one flotation sample and four charcoal samples identified abundant charred oak wood.

Macrobotanical analysis of a possible burned seed sample identified the specimens as two charred *Liliaceae* bulb halves (Appendix B, Table 9). The presence of these bulb fragments is evidence that the feature functioned as an earth oven, where geophytes were roasted.

Feature 4, overview, facing west.

Feature 6

Type	Small basin-shaped hearth
Kleinbach et al. (1995a) Typology	Type 4 hearth
Geomorphic Stratum	2A
Cultural Component	1A
Block	n/a
Units	TU 10
Center	n/a
Top Elev. (m)	98.29
Bottom Elev. (m)	98.02
Origination (m)	98.20
Dimensions (cm)	90 x 45+
Pollen and Phytolith Samples	P6
Bulk/Flotation Samples	F10: charred *Juniperus* wood; charred *Quercus* wood, diffuse porous and ring porous; charred Unknown Type 1 wood, diffuse porous; charred *Vitis* wood
Special Samples	S9 (FCR)
C-14 Samples	C29, C30, C31, C32
Radiocarbon Age (Conventional BP)	C29– 990 ± 40 (Beta 207247)
Associated Diagnostic Artifacts (Lot No.)	Utilized blade (177), End-scraper (176)

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count***	**Weight (kg)***
0–5	55	1.6
5–10	90	23.3
10–15	25	18.6
15+	3	9.3
Total	173	52.8

Feature 6 was encountered in TU 10 during the testing investigations. The feature was in Stratum 2A, just below Stratum 1, and was roughly 1.5–2 m southeast of Feature 1. The exposed portion of the semi-circular feature measured 90 × 45 cm; much of the feature was removed by BHT A. The basin was roughly 20-cm-deep and consisted of angular limestone cobbles with a dark, charcoal-stained, ashy matrix. Rocks were stacked in a roughly circular fashion, with some sloping inward along the basin edge. Most of the cobbles were fractured in situ. Thermally altered sediment and charcoal staining were observed around and below the feature rocks.

The artifacts associated with the feature include a utilized blade (Lot 177), an end scraper (Lot 176), 36 pieces of lithic debitage, and a mussel shell fragment. The majority of the feature matrix was screened in the field, with the remainder collected as special samples. No temporally diagnostic artifacts were recovered from the feature.

Four charcoal samples were collected from the feature; only one of these was submitted for radiocarbon dating. The returned date was 990 ± 40 B.P. (Appendix A). The radiocarbon results place Feature 6 in the Late Prehistoric Austin phase component. This is consistent with the stratigraphic position of the feature.

Macrobotanical analysis of a flotation sample and the four radiocarbon samples from the feature matrix identified a variety of wood types. The float sample contained charred juniper wood and charred grape wood. The macrobotanical samples included charred juniper wood, charred diffuse porous and ring porous oak wood, and charred Unknown Type 1 wood (Appendix B, Tables 11 and 12). A pollen and phytolith sample was collected but not submitted for analysis. One burned rock was collected for lipid residue analysis, but not analyzed.

Feature 6, plan view of feature.

Feature 8

Type	Incipient burned rock midden
Kleinbach et al. (1995a) Typology	Incipient Burned Rock Midden
Geomorphic Stratum	2B/3 contact
Cultural Component	5
Block	NW
Units	Entire NW Block
Center	ca. N1024.80 E1006.00
Top Elev. (m)	See description
Bottom Elev. (m)	See description
Origination (m)	97.70 See description
Dimensions (m)	10 x 10 (m)
Pollen and Phytolith Samples	P30, P31: negative analysis (pollen and phytolith)
Bulk/Flotation Samples	F35, F36; charred *Quercus* wood, ring diffuse and ring porous
Special Samples	S35 (Flora ID)
C-14 Samples	C107, C109 (*Liliaceae* bulb fragments), C127, C128, C129, C149, C153, C164
Radiocarbon Age (Conventional BP)	C107– 2590 ± 40 (Beta 250562); C128– 2460 ± 40 (Beta 215916); C129– 2490 ± 40 (Beta 250568); C149– 2480 ± 40 (Beta 250572); C164– 2590 ± 40 (Beta 215920); S36 (Feature 31)– 2400 ± 30 (Beta 299318)
Associated Diagnostic Artifacts (Lot No.)	Undetermined

Burned Rock Characteristics (note, only 25% sample)		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	3645	51.5
5–10	1848	157.2
10–15	218	84.7
15+	39	47.6
Total	5750	341

Feature 8 was an incipient burned rock midden. It was originally designated during testing excavations at 41WM1126. An approximately 5-m-long lens of fire-cracked rock visible in the northern profile of BHT B was visible at the contact between Strata 2B and 3. At the time, it was not known that Feature 8 was a midden; it was thought to be possibly a large hearth or simply a scatter of burned rock.

During data recovery, Feature 8 was initially encountered in the southern units of the NW Block at approximately 98.0 m and identified as a dense cluster of burned rock extending from BHT B approximately 1.2 m into the excavation block. As excavations progressed, it became apparent that Feature 8 extended much farther than originally believed, essentially covering the entire NW Block and dipping in elevation from south to north. In N1026 E1006, for example, the top of the midden occurred at 98.84 m. The midden appeared to be on the contact between Strata 2B and 3 and the dipping elevation simply mirrored the natural stratigraphy at the site. In some places, however, the midden either cut into Stratum 3 or filled depressions left by earlier features (see Feature 35).

Due to the nature of the feature and the complications it caused for the excavations, much of the fabric of the midden was left in situ. Ten 50 x 50-cm column samples were excavated through the midden to characterize its thickness and composition, and a backhoe trench (BHT E) was excavated near the end of the season through the midden along the E1006 line to get a better north-south profile of the feature.

The column samples determined that the midden ranged in thickness from 8 cm to as much as 33 cm, with an average thickness of approximately 25 cm. The coarse matrix varied in composition, with some column samples containing more very small rocks (<5 cm) and others containing more small (5–10 cm) rocks. In all of the column samples, however, there were few (generally less than 10 percent by count) rocks larger than 10 cm in maximum size. A 25 percent sample of the feature counted 5,750 rocks weighing 341 kg; only 4.5 percent of the sampled rocks are larger than 10 cm.

BHT E, which was excavated after the top of the midden had been exposed, succeeded in locating a central pit within the midden. Exposed along the E1006 line, the central feature extended from N1023.85 to N1027.10 (3.25 m). The central pit was a concave basin cut approximately 30–45 cm into Stratum 3 and lined

Feature 8, continued

with large limestone slabs. From the profile, it appears that the pit was modified at least once during the use of the midden; an older pit appears on the northern side of the central feature, truncated by a younger pit to the south. The central feature was largely infilled with fine matrix rather than burned rock.

In general, the density of artifacts within the fabric of the midden was very low when compared to deposits above and east of the feature. The lithic assemblage included 809 pieces of debitage, mainly recovered from water screening of collected feature matrix, along with a core (Lot 1444), a biface (Lot 1439.1), and a modified flake (Lot 1439.2).

Very little faunal material, including bones and several mussel shell fragments, and only small amounts of charcoal were recovered from the midden. One geophyte sample (C109) was collected from N1022 E1006 from the base of the midden rocks at an elevation of 97.71 m. This was identified as five fragments of charred *Liliaceae* bulb (Appendix B, Table 9). Wood from a flotation sample and a two of the large charcoal samples was submitted for wood type identification, resulting in at least two different varieties of oak (Appendix B, Tables 4 and 5).

A suite of radiocarbon dates were obtained for Feature 8, consisting of six samples submitted over three rounds. These dates suggest multiple use episodes, as three dates cluster at 2460–2490 ± 40 B.P., while two others are both 2590 ± 40 B.P. The final date, from a geophyte associated with the bottom of intrusive Feature 31, yielded the most recent date of 2400 ± 30 B.P. (Appendix A).

Feature 8, facing north/northwest.

Feature 8, Central feature in midden, facing west.

Feature 9

Type	Small hearth or oven
Kleinbach et al. (1995a) typology	Type 1 hearth
Geomorphic Stratum	2B
Cultural Component	Undetermined
Block	n/a
Units	TU 7
Center	n/a
Top Elev. (m)	98.18
Bottom Elev. (m)	98.09
Origination (m)	98.12
Dimensions (cm)	40+ x 60+
Pollen and Phytolith Samples	P5
Bulk/Flotation Samples	F8
Special Samples	S7 (FCR)
C-14 Samples	none
Radiocarbon Age (Conventional BP)	none
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count***	**Weight (kg)***
0–5	70	0.8
5–10	20	2.8
10–15	10	7.8
15+	10	17.6
Total	110	29

* partial feature

Feature 9 was encountered in the northeast corner of TU 7 of the testing investigations, partly truncated by BHT B east. The feature was within Stratum 2B. The exposed concentration of limestone rocks measured 40 × 60 cm, and was likely roughly 1 m in diameter before being truncated by the backhoe trench. The 9-cm-thick feature was largely a single layer of burned rocks along its margins, with some stacking in the central depression. No evidence of burning was observed within or around the feature.

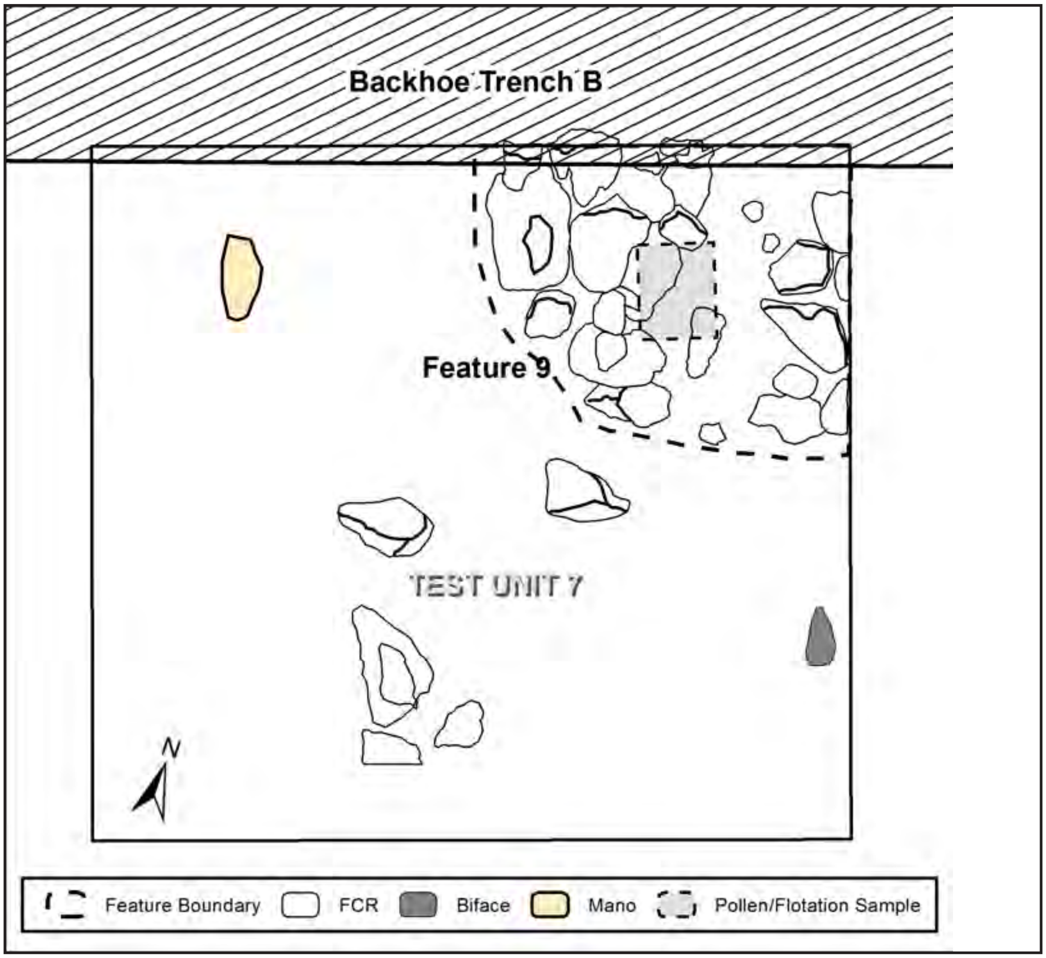
Artifacts recovered from the feature matrix include 96 pieces of debitage, 21 bone fragments, and a biface fragment (Lot 139.3). No temporally diagnostic artifacts were recovered from the feature. As noted, no evidence of burning was identified, so no charcoal samples were collected.

A flotation sample was collected, but did not yield identifiable macrobotanical specimens. A pollen and phytolith sample was collected but not submitted for analysis. A burned rock was collected for lipid residue analysis, but not analyzed.

Based on the stratigraphic position and artifacts recovered in the vicinity, Feature 9 is associated with a Late Archaic component at the site. The lack of radiocarbon dates and diagnostic artifacts precludes a more specific association.

Feature 9, plan view of feature.

Feature 9, continued



Feature 9, plan view sketch map of feature.

Feature 10

Type	Small hearth
Kleinbach et al. (1995a) Typology	Type 1 hearth
Geomorphic Stratum	2A
Cultural Component	Undetermined
Block	n/a
Units	TU 12
Center	n/a
Top Elev. (m)	98.63
Bottom Elev. (m)	98.51
Origination (m)	98.55
Dimensions (cm)	40 x 55
Pollen and Phytolith Samples	P7
Bulk/Flotation Samples	F11: charred *Quercus* wood, ring porous
Special Samples	S10 (FCR), S11 (Wood ID): charred *Quercus* wood, ring porous
C-14 Samples	C34
Radiocarbon Age (Conventional BP)	none
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	54	0.5
5–10	15	3.1
10–15	11	4.8
15+	0	0
Total	80	8.4

Feature 10 was encountered in TU 12 during the testing excavations. The feature was in Stratum 2A, just below Stratum 1. The circular small cluster of rocks measured 40 × 55 cm and was 12-cm-thick. The mix of rounded and angular limestone rocks was tightly clustered in two layers, with abundant charcoal between the two. There may have been a slight pit in the center of the feature, but most of the rocks were at a consistent elevation more indicative of a flat surface.

The artifacts recovered from the feature during excavation consisted of four pieces of debitage and 52 pieces of bone, primarily a fragmented long bone. No temporally diagnostic artifacts were recovered from the feature. A charcoal sample was collected from the feature, but not submitted for radiocarbon dating.

Macrobotanical analysis of a flotation sample and a macrobotanical sample from the feature matrix identified ring porous oak wood (Appendix B, Tables 11 and 12). A pollen and phytolith sample was collected, but not submitted for analysis. A burned rock was collected for lipid residue analysis, but not analyzed.

Based on the stratigraphic position of the feature, it is associated with the Late Prehistoric Austin phase component at the site. However, the lack of radiocarbon dates and clearly associated diagnostic artifacts precludes clear assignment of the feature to a cultural component.

Feature 10, plan view of feature.

Feature 11

Type	Small hearth
Kleinbach et al. (1995a) Typology	Type 4 hearth
Geomorphic Stratum	2A
Cultural Component	Undetermined
Block	n/a
Units	TUs 10 & 13
Center	n/a
Top Elev. (m)	98.30
Bottom Elev. (m)	98.08
Origination (m)	~98.25
Dimensions (cm)	60+ x 90
Pollen and Phytolith Samples	P8
Bulk/Flotation Samples	F12: charred *Quercus* wood, diffuse porous and ring porous; charred *Vitis* wood
Special Samples	S12 (FCR)
C-14 Samples	C35
Radiocarbon Age (Conventional BP)	none
Associated Diagnostic Artifacts (Lot No.)	Arrow point preform (183)

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count***	**Weight (kg)***
0–5	105	1.8
5–10	48	7.3
10–15	10	5.2
15+	4	3.5
Total	167	17.8

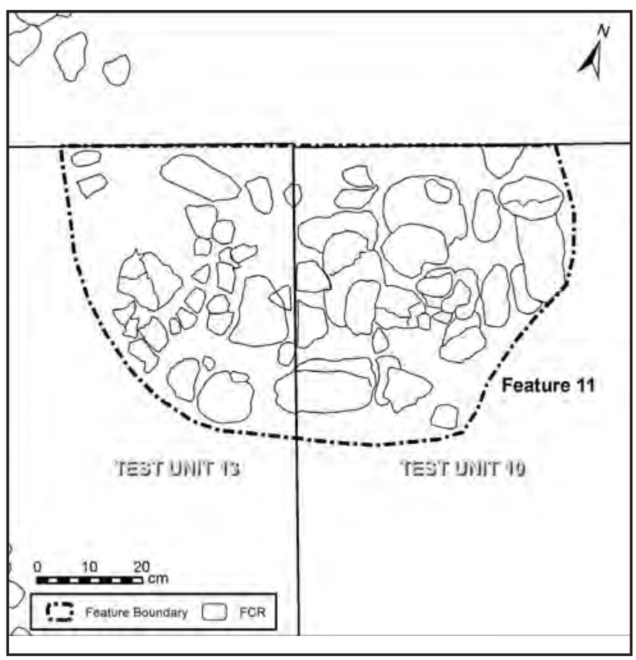
* ~2/3 of feature

Feature 11 was encountered in TUs 10 and 13 during the testing investigations, just west of Feature 6 and just east of Feature 12. The feature was in Stratum 2A, just below Stratum 1. The exposed portion of the ovate cluster of rock measured 60 × 90 cm with a basin-shaped cross-section. The basin had a thickness of approximately 15 cm. The feature was a mix of limestone and quartzite cobbles, with some layering. Approximately 40–50 percent of the rocks were fractured in situ. Charcoal staining was present throughout the feature matrix, with some ash below the rocks and some burned soil outside the feature edge.

Artifacts recovered from the feature matrix include 52 pieces of debitage, a bone fragment, and an arrow point preform (Lot 183). The arrow preform is only broadly temporally diagnostic, associated with the Late Prehistoric period in Central Texas. A charcoal sample was collected from the feature, but not submitted for radiocarbon dating.

Macrobotanical analysis of a flotation sample from the feature matrix identified charred grape wood and charred diffuse porous and ring porous oak wood (Appendix B, Tables 11 and 12). A pollen and phytolith sample was collected but not submitted for analysis. A burned rock was collected for lipid residue analysis, but not analyzed.

Based on the stratigraphic position, presence of the arrow point preform, and proximity to Feature 6, Feature 11 is associated with the Late Prehistoric Austin phase component at the site, and is part of a large cluster of features from this phase. However, the lack of radiocarbon dates precludes clear assignment of the feature to a cultural component.



Feature 11, plan view sketch map of feature.

Feature 12

Type	Dispersed hearth
Kleinbach et al. (1995a) Typology	Type 2 hearth
Geomorphic Stratum	2A
Cultural Component	1A
Block	n/a
Units	TU 13
Center	n/a
Top Elev. (m)	98.32
Bottom Elev. (m)	98.04
Origination (m)	~98.20
Dimensions (cm)	85+ x 50+
Pollen and Phytolith Samples	P9
Bulk/Flotation Samples	F13: charred *Quercus* wood, ring porous
Special Samples	none
C-14 Samples	C36, C47
Radiocarbon Age (Conventional BP)	C47– 1040 ± 40 (Beta 250552)
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count***	**Weight (kg)***
0–5	45	0.7
5–10	38	8.4
10–15	7	9.3
15+	2	3.2
Total	92	21.6

* ~1/2 of feature

Feature 12 was encountered in TU 13 of the testing investigations, just west of Feature 11 and roughly 1.5 m west of Feature 6. The feature was in Stratum 2A, just below Stratum 1. The exposed portion of the feature cluster measured 85 × 50 cm with a flat cross-section. The feature was a mix of angular and tabular limestone, with some stacking in the center of the feature and some rocks fractured in situ. Charcoal staining is present throughout the feature matrix, with some ash below the rocks and some burned soil outside the feature edge.

Artifacts recovered from the feature matrix include 15 pieces of debitage, three bone fragments, two modified flakes (Lots 207.1 and 2039). Two charcoal samples were collected from within and/or adjacent to the feature. One of these was submitted for radiocarbon dating and returned a date of 1040 ± 40 B.P. (Appendix A).

Macrobotanical analysis of a flotation sample from the feature matrix identified charred ring porous oak wood (Appendix B, Table 12). A pollen and phytolith sample was collected but not submitted for analysis.

Based on the radiocarbon dating results and the stratigraphic position, Feature 12 is associated with the Late Prehistoric Austin phase component at the site. The feature is part of a large cluster of features associated with this phase.

Feature 12 (left), plan view of feature.

Feature 13

Type	Shallow, basin-shaped hearth
Kleinbach et al. (1995a) Typology	Type 4 hearth
Geomorphic Stratum	2A, directly below 1
Cultural Component	1B
Block	NW
Units	N1026 E1006 SW, SE, NE
Center	N1026.70 E1009.15
Top Elev. (m)	98.31
Bottom Elev. (m)	98.22
Origination (m)	98.26
Dimensions (cm)	93 x 85
Pollen and Phytolith Samples	P10: negative analysis (pollen and phytolith)
Bulk/Flotation Samples	F14: charred *Quercus* wood, ring porous
Special Samples	S14 (FCR)
C-14 Samples	C45, C48
Radiocarbon Age (Conventional BP)	C45– 1110 ± 40 (Beta 250550); C48– 1100 ± 40 (Beta 215912)
Associated Diagnostic Artifacts (Lot No.)	Edwards (2043)

Burned Rock Characteristics		
Burned Rock Size (cm)	Count	Weight (kg)
0–5	38	0.7
5–10	50	7.8
10–15	20	11.2
15+	3	3
Total	111	22.7

Feature 13 was encountered in the northeastern corner of the NW Block approximately 40 cm southeast of Feature 16 and 20 cm south of Features 11 and 12 from testing. The feature was in Stratum 2A, just below Stratum 1. The oval-shaped feature measured 93 × 85 cm. The shallow basin was 9 cm deep and consisted of two overlapping layers of angular limestone cobbles. Most of the cobbles were fractured in situ. Thermally altered sediment and charcoal staining were observed throughout the feature matrix and below the rocks.

The artifacts recovered during water-screening of the feature matrix include 30 bone fragments and approximately 66 pieces of debitage. One temporally diagnostic artifact, an Edwards arrow point (Lot 2043), was recovered from the feature. This point type is common to Central Texas, and dates to approximately A.D. 900–1100 (Turner et al. 2011:190).

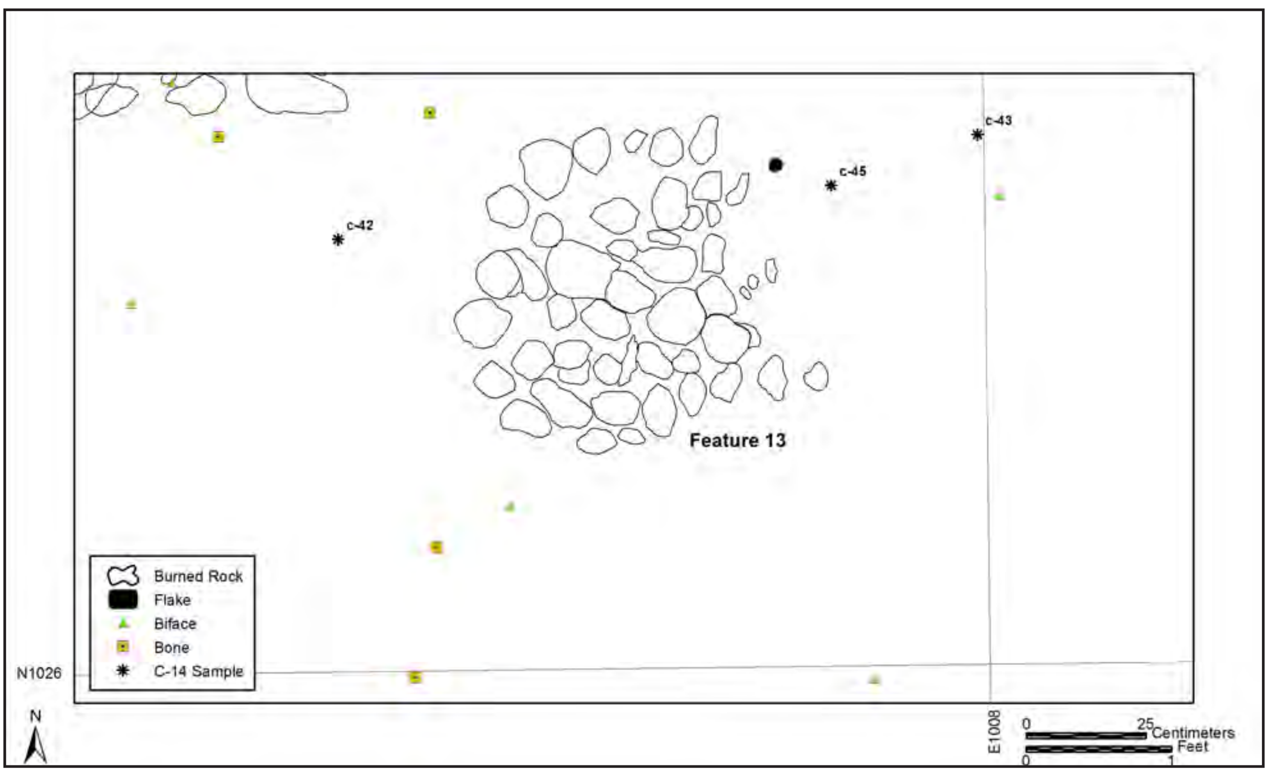
Two charcoal samples were collected from the feature and submitted for radiocarbon dating. The returned dates are from 1100–1110 ± 40 B.P. (Appendix A), slightly earlier than the Turner et al. (2011) dates for the Edwards type. The radiocarbon results and the diagnostic artifact place Feature 13 in the Late Prehistoric Austin phase component. This is consistent with the stratigraphic position of the feature.

Macrobotanical analysis of a flotation sample from the feature matrix identified ring porous oak wood (Appendix B, Table 12). Pollen and phytolith analysis for a matrix sample yielded negative results (Appendixes E and G). A burned rock was collected for lipid residue analysis, but not analyzed.

Feature 13, plan view of exposed feature.

Feature 13, continued

Feature 13, profile view of feature.



Feature 13, plan view sketch map.

Feature 14

Type	Cluster of FCR
Kleinbach et al. (1995a) Typology	Type 1 hearth
Geomorphic Stratum	2A, directly below 1
Cultural Component	1B
Block	NW
Units	N1024 E1006 NE
Center	N1025.40 E1007.60
Top Elev. (m)	98.38
Bottom Elev. (m)	98.28
Origination (m)	98.33
Dimensions (cm)	59 x 57
Pollen and Phytolith Samples	P11: negative analysis (pollen and phytolith)
Bulk/Flotation Samples	F15: charred *Quercus* wood, ring porous
Special Samples	S16 (Wood ID)
C-14 Samples	C44, C46
Radiocarbon Age (Conventional BP)	C44 – 1030 ± 40 (Beta 250549); C46 – 1120 ± 40 (Beta 250551)
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	16	0.3
5–10	12	2.2
10–15	8	3.4
15+	n/a	n/a
Total	36	5.9

Feature 14 was encountered in the NW Block. The feature was in Stratum 2A, just below Stratum 1. The circular small cluster of rocks measured 59 × 57 cm. The northeastern corner of the feature appeared to be truncated or clipped. The limestone rocks were distributed in a single layer, and dark charcoal stains were observed in the western portion of the feature matrix. The layer of rocks and feature matrix was approximately 10-cm-thick. The feature appeared to be on a flat surface with some overlapping rocks in the southern portion. Most of the larger rocks were rounded and fractured in situ. Based on these factors, the feature is interpreted to be a small Type 1 hearth (Kleinbach et al. 1995a) or small fireplace (Johnson 2000). However, it may also be a dump or clean-out from a larger earth oven or hearth feature.

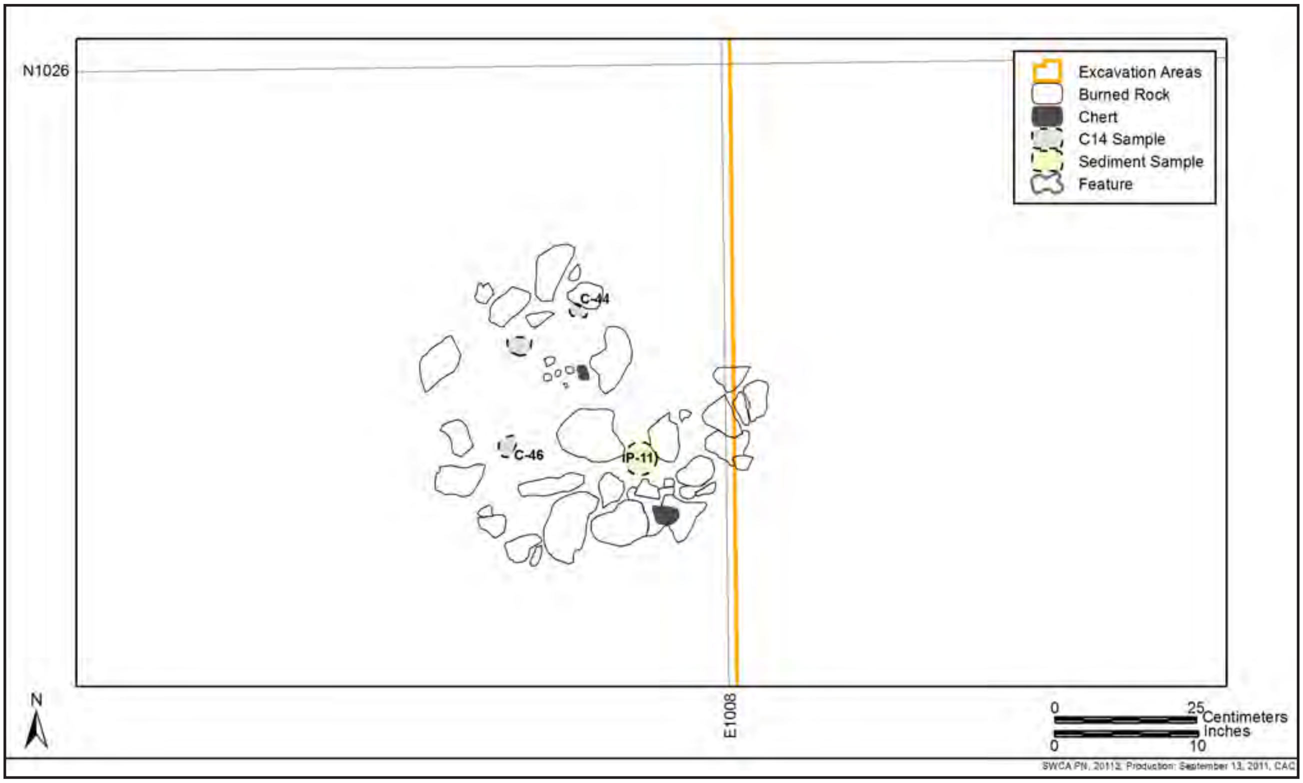
The artifacts recovered from the feature during excavation consisted of nine pieces of debitage. During the water-screening of the feature matrix, 55 pieces of debitage were recovered along with bone fragments. No temporally diagnostic artifacts were recovered from the feature.

Two charcoal samples were collected from the feature and submitted for radiocarbon dating. The returned dates are 1030 ± 40 B.P. and 1120 ± 40 B.P. (Appendix A). The radiocarbon results place Feature 13 in the Late Prehistoric Austin phase component. This is consistent with the stratigraphic position of the feature.

Macrobotanical analysis of a flotation sample from the feature matrix identified ring porous oak wood (Appendix B, Tables 11 and 12). Pollen and phytolith analysis for a matrix sample yielded negative results (Appendixes E and G). A burned rock was collected for lipid residue analysis, but not analyzed.

Feature 14, plan view of feature.

Feature 14, continued



Feature 14, plan view sketch map.

Feature 15

Type	Shallow, basin-shaped hearth
Kleinbach et al. (1995a) Typology	Type 4 hearth (small)
Geomorphic Stratum	2A/2B contact
Cultural Component	2
Block	SW
Units	N1016 E1006 NW, NE N1018 E1006 SW, SE
Center	N1018.10 E1007
Top Elev. (m)	98.58
Bottom Elev. (m)	98.4
Origination (m)	98.5
Dimensions (cm)	83 x 66
Pollen and Phytolith Samples	P14: negative analysis (pollen and phytolith)
Bulk/Flotation Samples	F18: charred *Quercus* wood, ring porous
Special Samples	S17 (FCR)
C-14 Samples	C53
Radiocarbon Age (Conventional BP)	C53 – 1730 ± 40 (Beta 250553)
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	n/a	n/a
5–10	22	3.4
10–15	21	8.9
15+	6	5.9
Total	49	18.2

Feature 15 was encountered in the SW Block. The feature was at the Stratum 2A/2B contact. The oval concentration of limestone rocks measured 83 × 66 cm and consisted of two layers of burned rocks approximately 18-cm- thick. A very shallow basin was observed in cross-section in the center of the feature. The largest rocks were concentrated towards the center of the unit and a few were tilted at an angle. Approximately 40 percent of the rocks were fragmented in situ. Charcoal staining or flecking was observed within the feature matrix, particularly beneath the rocks.

The artifacts recovered from the water-screened feature matrix include bone fragments, a distal biface fragment (Lot 274.1), and 132 pieces of debitage. No temporally diagnostic artifacts were recovered from the feature.

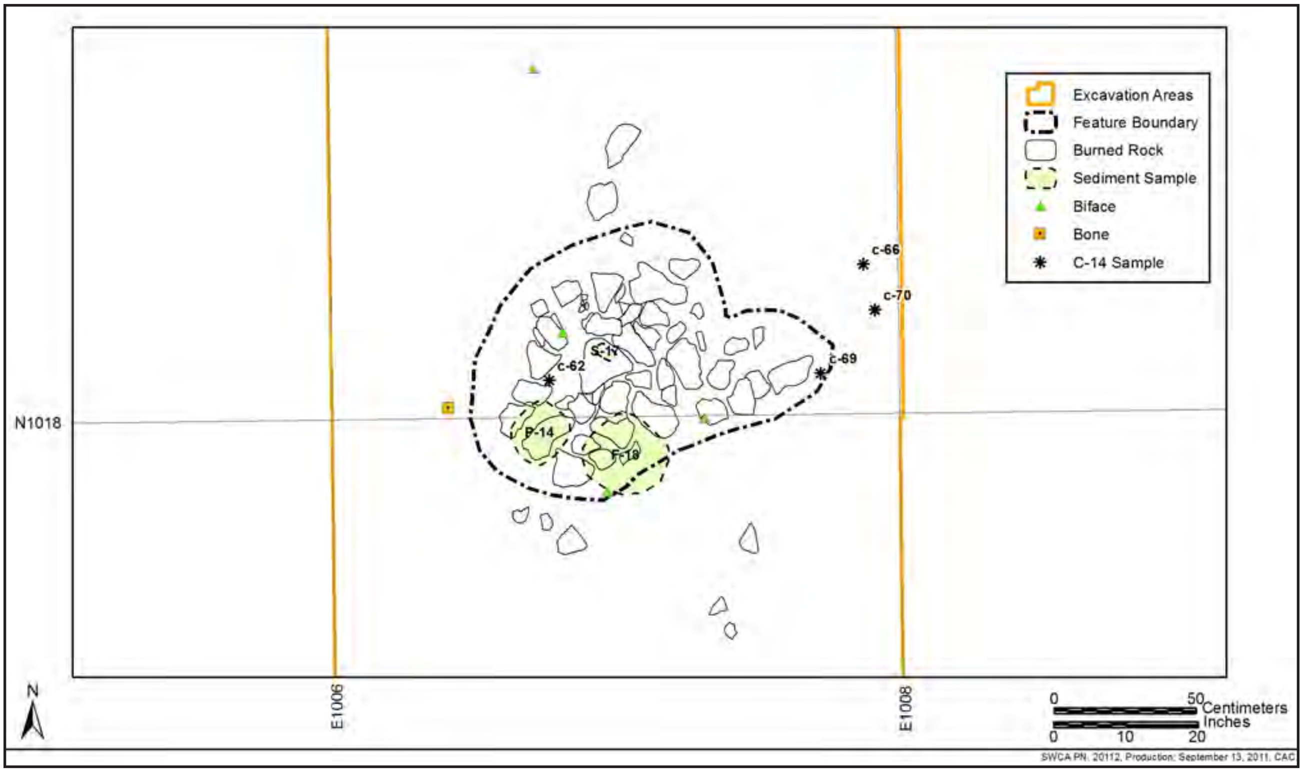
A charcoal sample was collected from the feature and submitted for radiocarbon dating. The returned date is 1730 ± 40 B.P. (Appendix A). The radiocarbon results place Feature 15 in a Late Archaic component. This is consistent with the stratigraphic position of the feature.

Macrobotanical analysis of a flotation sample from the feature matrix identified ring porous oak wood (Appendix B, Table 5). Pollen and phytolith analysis for a matrix sample yielded negative results (Appendixes E and G). A burned rock was collected for lipid residue analysis, but not analyzed.

Feature 15, plan view of feature.

Feature 15, profile view of feature.

Feature 15, continued



Feature 15, plan view sketch map of feature.

FEATURE 16

Type	Slab-lined hearth
Kleinbach et al. (1995a) Typology	Type 5 hearth (large)
Geomorphic Stratum	2A, intruding into 2B
Cultural Component	1B
Block	NW
Units	N1026 E1006 NW, N1026 E1004 NE, N1028 E1006 SW, N1028 E1004 SE
Center	N1027.70 E1006.20
Top Elev. (m)	98.33
Bottom Elev. (m)	97.96
Origination (m)	98.2
Dimensions (cm)	150 x 127
Pollen and Phytolith Samples	P15; P18: negative analysis (pollen and phytolith
Bulk/Flotation Samples	F19, F21: charred *Quercus* wood, diffuse porous and ring porous
Special Samples	S20 (FCR), S23 (FCR), S24 (Wood ID), S25 (FCR)
C-14 Samples	C55, C56, C57, C58, C64, C65, C67, C72, C73, C74
Radiocarbon Age (Conventional BP)	C56– 1130 ± 40 (Beta 250554), C67– 1190 ± 40 (Beta 250555), C72– 1260 ± 40 (Beta 250557), C74– 1170 ± 40 (Beta 215914)
Associated Diagnostic Artifacts (Lot No.)	Mano (2143): starch on two surfaces, consistent with geophytes, Scallorn arrow point (2084.1)

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	75	1.1
5–10	151	26.2
10–15	118	74.9
15+	72	166.4
Total	416	268.6

Feature 16 was encountered in the northeastern corner of the NW Block during the first two weeks of the data recovery project. The feature was a large slab-lined hearth measuring 150 × 127 cm. The hearth originated in Stratum 2A but had been excavated into an approximately 25-cm-deep basin, which cut into Stratum 2B. In cross-section, the bottom of the feature was slightly concave. The margins of the basin were lined with large tabular pieces of limestone on the northern margin and stacked cobbles on the southern side. The tabular rocks were tilted approximately 45 degrees on average. The center of the feature was filled with limestone cobbles, and the bottom of the feature, while not slab-lined, was clearly defined by a lens of charcoal-stained soil. Despite the lack of a slab-lined bottom, the feature is still interpreted as a large Type 5 hearth (Kleinbach et al. 1995a).

The artifacts associated with the feature include a Scallorn arrow point (Lot 2084.1), mano (Lot 2143), two scrapers (Lots 2144 and 2146), and a biface fragment (Lot 2145). Water screening of the feature matrix yielded bone fragments, 488 pieces of debitage, and two additional biface fragments (Lots 2141.2 and 2141.3). Scallorn arrow points are the primary diagnostic artifact of the Late Prehistoric Austin phase, and date from ca. A.D. 700–1200 (Turner et al. 2011:209).

Ten charcoal samples were collected from the feature; four of these were submitted for radiocarbon dating. The returned dates ranged from 1130 to 1260 B.P. (Appendix A). Whether the array of dates suggests multiple uses of the feature or simply the margins of error in radiometric data is uncertain. Three of the dates overlap from 1130 to 1190 B.P., and the outlier of 1260 B.P. could possibly be attributable to older wood. The radiocarbon results place Feature 16 in the Late Prehistoric Austin phase component. This is consistent with the stratigraphic position of the feature and the Scallorn arrow point. Feature 16 is the largest feature in a cluster of Austin phase thermal features, which may represent a discrete living area.

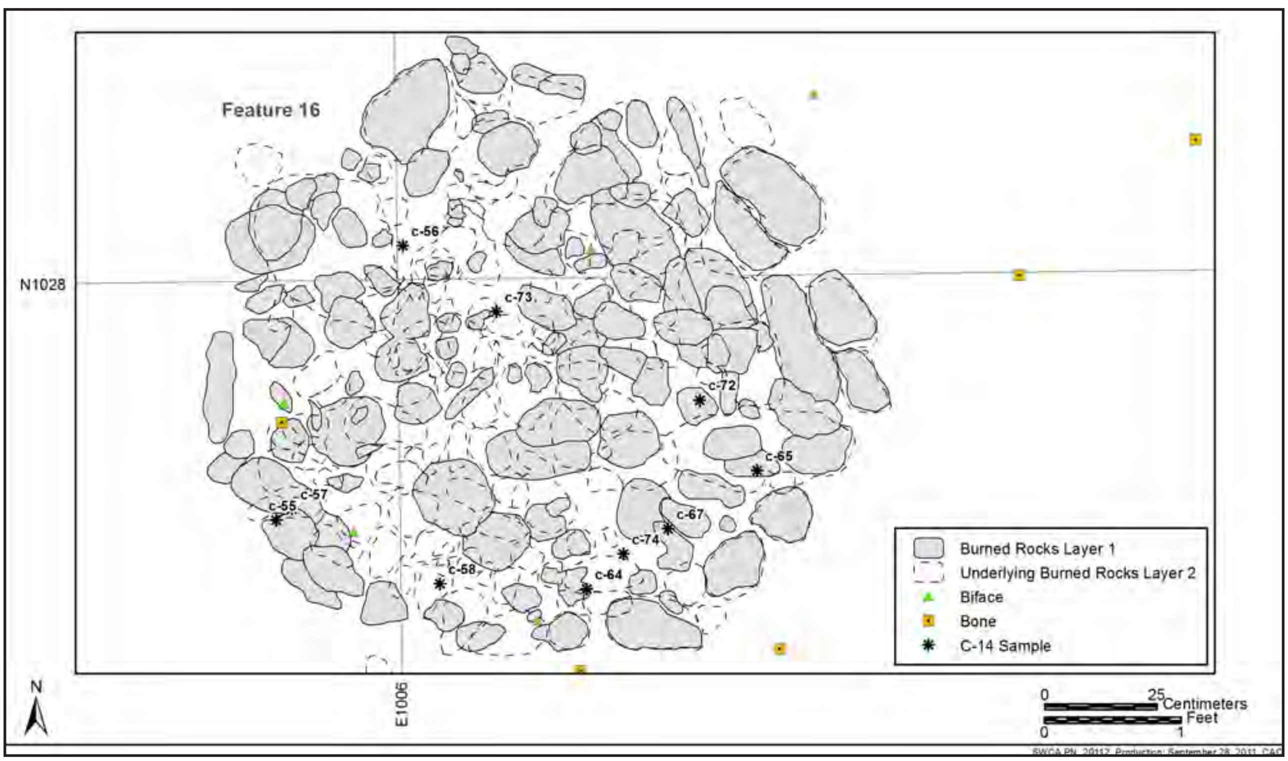
Macrobotanical analysis of two flotation samples and a wood identification sample from the feature matrix identified abundant diffuse porous and ring porous oak wood (Appendix B, Tables 5 and 11, and Appendix D, Table 5). Pollen and phytolith analysis for a matrix sample yielded negative results (Appendixes E and G). Three burned rocks were collected for lipid residue analysis, but not analyzed.

Feature 16, continued

The mano was submitted for starch residue analysis. The results indicated the presence of starch grains on two faces of the mano consistent with the processing of geophytes (Appendix F). Interestingly, this is the only evidence of geophytes from the Austin phase at the west side of the Siren site.

Feature 16, after cross-sectioning, facing north.

Feature 16, as initially exposed, facing north.



Feature 16, plan view sketch map of top of feature.

Feature 17

Type	Basin-shaped hearth
Kleinbach et al. (1995a) Typology	Type 5 hearth (large)
Geomorphic Stratum	Top of 2B
Cultural Component	2
Block	NW
Units	N1020 E1006 NE, N1020 E1008 SW, N1022 E1006 NW, N1022 E1008 SW (unexcavated)
Center	N1022.30 E1008.10
Top Elev. (m)	98.45
Bottom Elev. (m)	98.15
Origination (m)	98.32
Dimensions (cm)	130 x 105
Pollen and Phytolith Samples	P17
Bulk/Flotation Samples	F20, F22: charred *Quercus* wood, ring porous and diffuse porous
Special Samples	S26 (FCR)
C-14 Samples	C60, C68, C78
Radiocarbon Age (Conventional BP)	C60– 1550 ± 40 (Beta 215913); C68– 1970 ± 40 (Beta 250556)
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	91	1.2
5–10	203	16.5
10–15	53	18.7
15+	8	8.1
Total	355	44.5

Feature 17 was encountered in the southeastern corner of the NW Block and was only partially excavated. The feature extended into the balk separating the NW Block from BHT A. During its early stages of excavation, vandals damaged the southwestern corner of the feature. The feature lies at the top of Stratum 2B. The large circular hearth measured 130 × 105 cm. The cross section revealed a concave basin, 30-cm-deep from the top of the rocks to its base. The limestone rocks were three layers thick, and large tabular rocks lined the basin. The base was approximately 70 cm in diameter. The rocks in the upper layers were angular and fragmented. The feature sloped slightly towards the west and contained a dark charcoal stained matrix. Large patches of orange and brown burned soil were observed within the matrix. Based on these factors, the feature is a large Type 5 hearth (Kleinbach et al. 1995a), although the high amount of smaller, angular rocks in the upper layers suggests that the feature may have been an oven (Johnson 2000).

One large core (Lot 2115) was recovered from the feature during excavation. Bone fragments, a burned biface (Lot 2113.1), and approximately 496 pieces of debitage flakes were recovered from the water-screened feature matrix. No temporally diagnostic artifacts were recovered from the feature.

Three charcoal samples were collected from the feature, two of which were submitted for radiocarbon dating. The returned dates had a wide range, with one sample dated 1550 ± 40 B.P. and the other 1970 ± 40 B.P. (Appendix A). The later date places Feature 17 in a Late Archaic component, consistent with the stratigraphic position of the feature.

Macrobotanical analysis of two flotation samples from the feature matrix identified ring porous and diffuse porous oak wood (Appendix B, Tables 4 and 5). Pollen and phytolith analysis for a matrix sample yielded negative results (Appendixes E and G). A burned rock was collected for lipid residue analysis, but not analyzed.

Feature 17, plan view of feature.

Feature 17, continued

Feature 17, east wall profile of feature.

Feature 17, profiles of feature, facing northeast.

Feature 18

Type	Two clusters of FCR
Kleinbach et al. (1995a) Typology	Type 5 hearth (small)
Geomorphic Stratum	2B
Cultural Component	3 (Cluster A); Undetermined (Cluster B)
Block	NW
Units	N1022 E1004 NE, SE, N1022 E1006 All Quads
Center	N1023.30 E1006.30 (Cluster A); N1023.10 E1007.30 (Cluster B)
Top Elev. (m)	98.2
Bottom Elev. (m)	98.08
Origination (m)	98.14
Dimensions (cm)	140 x 80 (combined); 60 x 60 (Cluster A); 50 x 50 (Cluster B)
Pollen and Phytolith Samples	none
Bulk/Flotation Samples	none
Special Samples	none
C-14 Samples	C75
Radiocarbon Age (Conventional BP)	C75– 1890 ± 40 (Beta 250558)
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	38	0.7
5–10	59	6.6
10–15	26	9.7
15+	8	8.9
Total	131	25.9

Feature 18 was encountered in the southeast corner of the NW Block, south/southwest of Features 23 and 24. The feature consisted of two discrete fire-cracked rock clusters, designated Cluster A and Cluster B. The clusters were each within Stratum 2B and, combined, they measured 140 × 80 cm. Cluster A consisted of two layers of limestone rock and measured 60 × 60 cm. The lower layer had large tabular rocks with several fractured in situ. Cluster B was located approximately 20 cm east of Cluster A and measured 50 × 50 cm. Most of the rocks in Cluster B were very dispersed and fragmented. The matrixes of each cluster contained charcoal and some burned soil. Based on the layered tabular rock fractured in situ, Cluster A is a probable small, shallow Type 5 hearth (Kleinbach et al. 1995a), more likely used as a small oven (Johnson 2000), and Cluster B may be the removed "lid" of the oven.

The artifacts recovered from the water-screened feature matrixes for both clusters consist of bone fragments and 355 pieces of debitage. A few fragments of mussel shell were also observed in Cluster A during excavations. No temporally diagnostic artifacts were recovered from the feature.

A charcoal sample was collected from the feature and submitted for radiocarbon dating. The returned date is 1890 ± 40 b.p. (Appendix A). The radiocarbon results place Feature 18 in a Late Archaic component. This is consistent with the stratigraphic position of the feature. No other samples were collected.

Feature 18, Clusters A and B plan view.

Feature 18, continued

Feature 18, Cluster A plan view.

Feature 18, Cluster B plan view.

Feature 19

Type	Cluster of FCR
Kleinbach et al. (1995a) Typology	Type 5 hearth (small)
Geomorphic Stratum	Top of 2B
Cultural Component	Undetermined
Block	NW
Units	N1024 E1000 NE
Center	N1025.25 E1001.50
Top Elev. (m)	98.22
Bottom Elev. (m)	98.11
Origination (m)	98.16
Dimensions (cm)	55 x 45
Pollen and Phytolith Samples	P19
Bulk/Flotation Samples	F23: charred *Quercus* wood, ring porous and diffuse porous
Special Samples	none
C-14 Samples	C77
Radiocarbon Age (Conventional BP)	none
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	13	0.3
5–10	12	1.7
10–15	12	5.9
15+	4	2.6
Total	41	10.5

Feature 19 was encountered in the eastern portion of the NW Block approximately 1 m northeast of Feature 21. The feature was at the top of Stratum 2B. The oval concentration of limestone rock measured 45 × 55 cm. The feature consisted of two layers of rock approximately 11-cm-thick within a shallow basin. The rocks consisted of large slabs and rounded cobbles with several fractured in situ. Charcoal staining and flecks were observed within the matrix during excavation.

The artifacts recovered from the water-screened feature matrix consisted of bone fragments and 25 pieces of debitage. No temporally diagnostic artifacts were recovered from the feature.

One charcoal sample was collected, but not submitted for radiocarbon dating. Likewise, a pollen sample was collected but not submitted for analysis. Macrobotanical analysis of a flotation sample from the feature matrix identified ring porous and diffuse porous oak wood (Appendix B, Tables 4 and 5).

Feature 19 is associated with a Late Archaic component at the site, based on stratigraphic position and recovered diagnostics in the units adjacent to the feature. However, the lack of radiocarbon dates and clearly associated diagnostic artifacts precludes clear assignment of the feature to a cultural component.

Feature 19, plan view of feature.

Feature 20

Type	Basin-shaped hearth
Kleinbach et al. (1995a) Typology	Type 5 hearth (small)
Geomorphic Stratum	Base of Stratum 2B
Cultural Component	3
Block	NW
Units	N1026 E1004 SE, NE
Center	N1026.80 E1005.30
Top Elev. (m)	98.11
Bottom Elev. (m)	97.98
Origination (m)	98.05
Dimensions (cm)	42 x 36
Pollen and Phytolith Samples	P20
Bulk/Flotation Samples	F24: charred *Quercus* wood, ring porous and diffuse porous
Special Samples	none
C-14 Samples	C83
Radiocarbon Age (Conventional BP)	C83– 1900 ± 40 (Beta 250559)
Associated Diagnostic Artifacts (Lot No.)	Mano (1983): starch on two surfaces, consistent with grasses

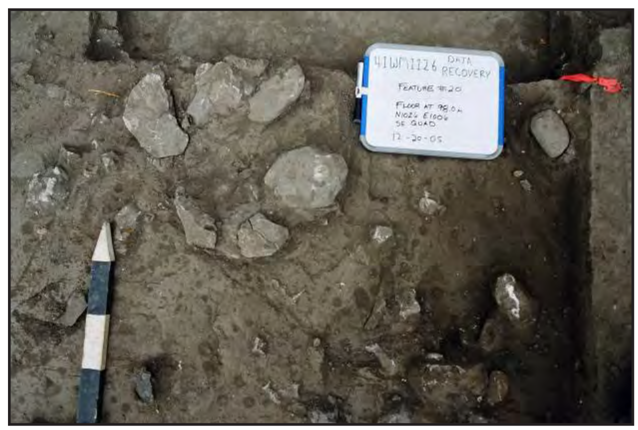
Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	2	0.1
5–10	10	3.6
10–15	3	4.4
15+	3	5.9
Total	18	14

Feature 20 was encountered in the NW Block approximately 30 cm southwest of Feature 16, but approximately 20 cm lower in elevation. The circular limestone rock cluster was at the base of Stratum 2B and measured 42 × 36 cm. The feature was made up of large tabular rocks that tilted towards the center, forming a shallow basin 13-cm-deep. Most of the rocks were adjacent to each other, and almost all were fractured in situ. Approximately 60 cm south of the feature was a dense concentration of stacked or piled rocks. Although it was not included as part of the feature, it may be secondary discard related to Feature 20, suggesting that the feature may have functioned as a small oven (Johnson 2000).

Bone fragments and 29 pieces of debitage were recovered from the feature matrix during water-screening. One mano (Lot 1983) was immediately adjacent to the feature, and is considered to be associated. The mano was submitted for starch residue analysis. The results indicated the presence of starch grains on two faces of the mano consistent with the processing of grasses (Appendix F).

A charcoal sample was collected from the feature and submitted for radiocarbon dating. The returned date is 1900 ± 40 b.p. (Appendix A). The radiocarbon results place Feature 20 in a Late Archaic component.

Macrobotanical analysis of a flotation sample from the feature matrix identified diffuse porous and ring porous oak wood (Appendix B). A pollen and phytolith sample was collected but not submitted for analysis.



Feature 20, plan view of feature.

Feature 20, continued

Feature 20, profile view of feature.

Feature 20, feature in background with rock concentration (discard pile) in foreground.

Feature 21

Type	Cluster of FCR
Kleinbach et al. (1995a) Typology	Burned rock concentration
Geomorphic Stratum	2B
Cultural Component	Undetermined
Block	NW
Units	N1024 E1000 NE
Center	N1025.25 E1001.50
Top Elev. (m)	98.22
Bottom Elev. (m)	98.11
Origination (m)	98.09
Dimensions (cm)	55 x 42
Pollen and Phytolith Samples	P21
Bulk/Flotation Samples	F25: charred *Quercus* wood, ring porous and dif-fuse porous
Special Samples	none
C-14 Samples	C80
Radiocarbon Age (Conventional BP)	none
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	0	0
5–10	8	0.4
10–15	4	2.3
15+	1	2.1
Total	13	4.8

Feature 21 was encountered in the eastern portion of the NW Block approximately 1 m southwest of Feature 19. The small cluster was at the top of Stratum 2B and measured 55 × 42 cm. The limestone rocks were angular and tabular and formed a rough oval. A few of the rocks were overlapping, and most were fractured in situ. The cross section revealed that the feature was on a flat surface and the single layer of rock was 8.5-cm-thick. Charcoal flecks were observed within the feature matrix.

The artifacts recovered from the water-screened feature matrix consist of bone fragments and 82 pieces of debitage. No temporally diagnostic artifacts were recovered from the feature.

A charcoal sample was collected from the feature but not submitted for radiocarbon dating. Macrobotanical analysis of a flotation sample from the feature matrix identified diffuse porous and ring porous oak wood (Appendix B, Table 5). A pollen and phytolith sample was collected but not submitted for analysis.

Based on stratigraphic position, Feature 21 is associated with a Late Archaic component at the site. However, the lack of clearly associated diagnostic artifacts or radiocarbon dates precludes more detailed placement within the site occupation history.

Feature 21, plan view of feature.

Feature 22

Type	Biface Cache
Kleinbach et al. (1995a) Typology	Lithic Cache
Geomorphic Stratum	Base of 2B
Cultural Component	Undetermined
Block	NW
Units	N1022 E1004 SE
Center	N1022.85 E1005.48
Top Elev. (m)	98.08
Bottom Elev. (m)	98.00
Origination (m)	98.04
Dimensions (cm)	29 x 24
Pollen and Phytolith Samples	none
Bulk/Flotation Samples	none
Special Samples	none
C-14 Samples	none
Radiocarbon Age (Conventional BP)	none
Associated Diagnostic Artifacts (Lot No.)	Montell dart (1599), thin biface (1600), thin biface (1601)

Feature 22 was encountered in the NW Block west of Feature 23 and south of Feature 24. The feature was a biface cache near the base of Stratum 2B, but stratigraphically above Feature 8, the burned rock midden. The bifaces were clearly associated with each other and were within a 29 × 24 cm area.

The biface cache consisted of two thin bifaces and one dart point. The dart point (Lot 1599) has the characteristics of a Montell, though not fully completed, and was slightly above one thin biface (Lot 1600). The preform was 67.13-mm-long, 32.41-mm-wide, and 8.58- mm-thick. The adjacent thin biface (Lot 1600) was 111.89-mm-long, 50-mm-wide, and 10.83-mm-thick. The second thin biface (Lot 1601) was found 5 cm south of Lot 1600. The biface was 119.22-mm-long, 56.25-mm-wide, and 14.27-mm-thick. Both bifaces exhibited microwear along the edges, indicating they may have been used as knives.

There was no evidence of a pit, and there were no distinctive sediment changes surrounding the bifaces. No burned rocks were directly associated with the feature, but there was a dense scatter of rocks in the surrounding units. The bifaces were found lying flat and may have been stored together in a perishable bag or pouch.

None of the tools is temporally diagnostic, although a large number of Late Archaic dart points were located within a 2-m-radius of the feature, and within 10 cm of the estimated elevation of the feature's origination surface. Based on stratigraphic position, the feature is associated with a Late Archaic component, most likely the earlier occupations.

Feature 22, plan view of biface cache.

Feature 22, biface cache: Lot 1599, Lot 1600, Lot 1601 (not to scale).

Feature 23

Type	Cluster of FCR
Kleinbach et al. (1995a) Typology	Burned rock concentration
Geomorphic Stratum	2B
Cultural Component	3
Block	NW
Units	N022 E1006 NW, NE, N1024 E1006 SE
Center	N1023.85 E1007.40
Top Elev. (m)	98.18
Bottom Elev. (m)	97.9
Origination (m)	98.04
Dimensions (cm)	146 x 125
Pollen and Phytolith Samples	P24
Bulk/Flotation Samples	F27: charred *Juglans* wood; charred *Quercus* wood, ring porous; charred Unknown Type 1 wood, diffuse porous
Special Samples	S29 (Geophyte), C99 (Geophyte): 29 *Liliaceae* bulb fragments total
C-14 Samples	C98
Radiocarbon Age (Conventional BP)	S29– 1930 ± 30 (Beta 299317), C98– 2180 ± 40 (Beta 250561)
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	59	1.5
5–10	100	12.4
10–15	37	13
15+	16	22.9
Total	212	49.8

Feature 23 was encountered in the southeastern portion of the NW Block, east of Feature 24 and northeast of Feature 18. The feature was in Stratum 2B, and Feature 8 extended beneath it. The large, roughly oval cluster measured 146 × 125 cm oriented north-south. The northern portion of the feature consisted of large tabular limestone slabs that overlapped and were tilted slightly towards the center of the feature. The southern portion consisted of fragmented rocks fractured in situ. No distinctive basal configuration was observed during the excavations; however, it appeared the feature was on a flat surface. The northern portion consisted of two rock layers, with smaller fragmented rocks composing the lower layer. The feature ranged from 17 to 28 cm in thickness. There were charcoal flecks throughout the feature matrix, and two geophyte specimens were recovered from the northern portion of the feature.

The feature does not fit neatly into any of the Kleinbach et al. (1995a) types, particularly the lack of a basin and the layering of slabs over smaller rocks in the northern portion. It may be the dispersed remnants of a slab-lined hearth or oven. The presence of geophytes would indicate more of an oven function for the feature.

The artifacts that were recovered during excavations include bone fragments, a proximal biface fragment (Lot 2128), and 82 flakes. In addition, 732 pieces of debitage, along with bone fragments, were recovered from the water-screened feature matrix. Mussel shell was also observed during water-screening and excavations. No temporally diagnostic artifacts were recovered from the feature.

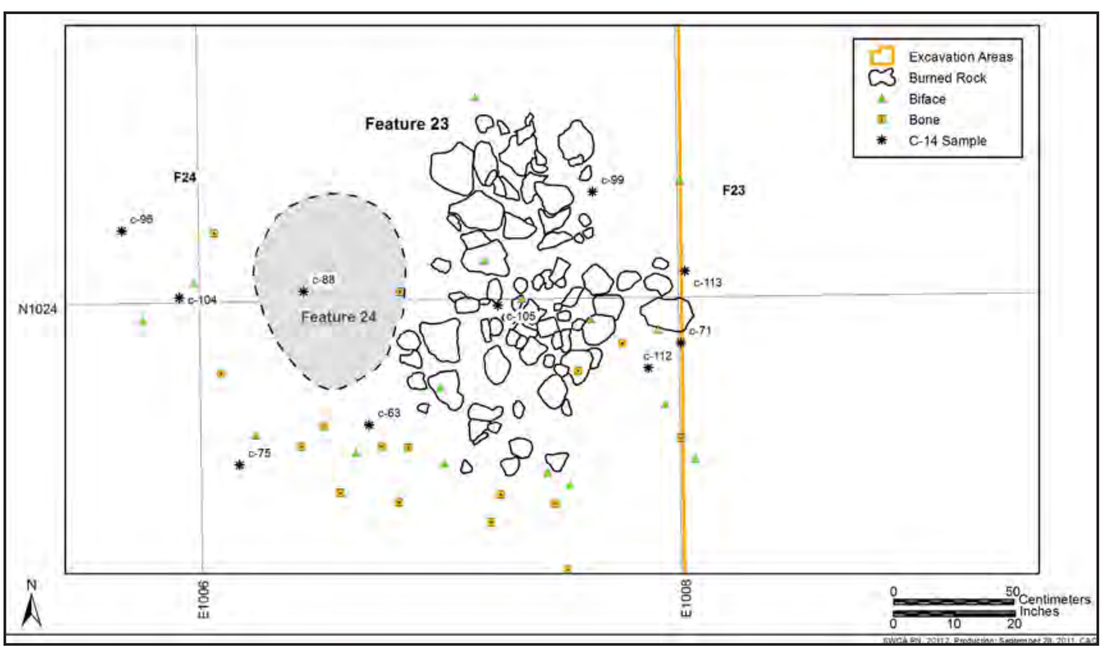
Only one charcoal sample was collected from the feature; this was submitted for radiocarbon dating. The returned date is 2180 ± 40 B.P. (Appendix A). However, one of the geophyte samples was also submitted for dating, returning a date of 1930 ± 30 B.P. (see Appendix A). The radiocarbon results place Feature 23 in a Late Archaic component, consistent with stratigraphic position. Furthermore, as geophytes are short-lived species, the result from this specimen gives a very specific date range for at least one usage of this feature. The older charcoal date may be associated with the use of old wood.

Macrobotanical analysis of a flotation sample identified ring porous oak wood, an Unknown Type 1 wood, and walnut wood (Appendix B, Table 5). A pollen and phytolith matrix sample was collected but not submitted for analysis.

The two geophyte samples were also submitted for macrobotanical identification. A total of 29 Liliaceae bulb fragments were identified from the two specimens (Appendix B, Tables 4 and 9).

Feature 23, continued

Feature 23, plan view of feature.



Feature 23, plan view sketch map.

Feature 24

Type	Small hearth
Kleinbach et al. (1995a) Typology	Type 2 hearth
Geomorphic Stratum	Base of 2B
Cultural Component	Undetermined
Block	NW
Units	N022 E1006 NW, N1024 E1006 SW
Center	N1024.5 E1006.0
Top Elev. (m)	98.09
Bottom Elev. (m)	97.93
Origination (m)	98.01
Dimensions (cm)	70 x 60
Pollen and Phytolith Samples	P22
Bulk/Flotation Samples	F26: charred *Quercus* wood, ring porous
Special Samples	none
C-14 Samples	C88
Radiocarbon Age (Conventional BP)	none
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	8	0.2
5–10	12	1.7
10–15	19	9.8
15+	3	1.8
Total	42	13.5

Feature 24 was encountered in the southeastern portion of the NW Block, west of Feature 23. The feature was at the base of Stratum 2B. The circular limestone cluster measured 70 × 60 cm. The cross section revealed that the feature was on a flat surface and the single layer of rocks was 11-cm-thick. The rocks were either fractured in situ or intact. Most of the rocks were tabular and adjacent to each other. There was charcoal staining observed below the rocks and a few mottles of burned soil throughout the matrix.

The artifacts recovered from water-screening of the feature matrix consist of bone fragments and 57 pieces of debitage. No temporally diagnostic artifacts were recovered from the feature matrix.

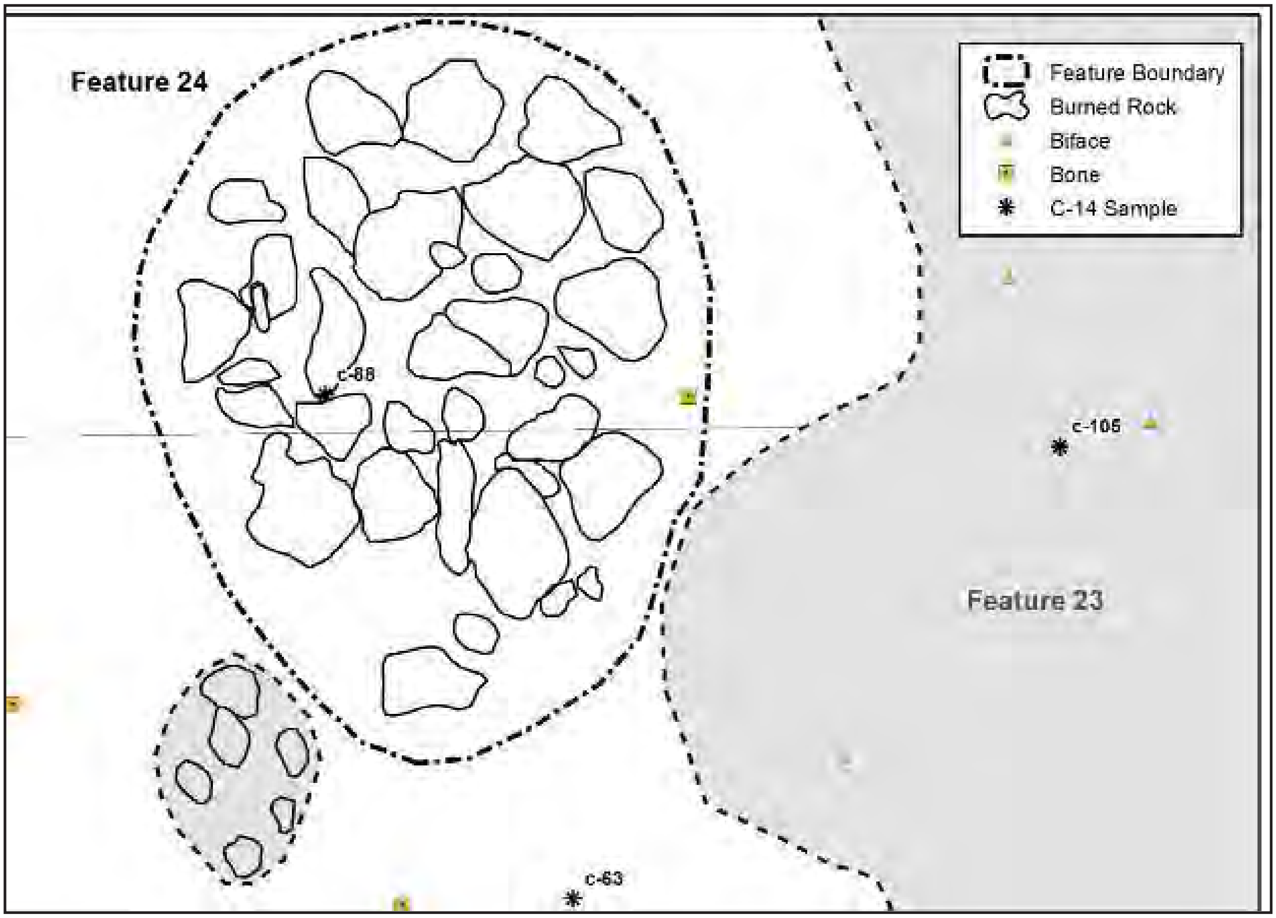
Macrobotanical analysis of a flotation sample from the feature matrix identified charred ring porous oak wood (Appendix B, Table 5). A charcoal sample and a pollen and phytolith sample were collected, but neither was submitted for analysis.

Based on stratigraphic position and diagnostic artifacts in the feature vicinity, Feature 24 is associated with a Late Archaic component at the site, most likely with the earlier occupations. However, the lack of radiocarbon dates and clearly associated diagnostic artifacts precludes clear assignment of the feature to a cultural component.

Feature 24, plan view of feature.

Feature 24, profile view of feature.

Feature 24, continued



Feature 24, plan view sketch map.

Feature 25

Type	Small, basin-shaped hearth
Kleinbach et al. (1995a) Typology	Type 5 hearth (small)
Geomorphic Stratum	2A
Cultural Component	1A
Block	NW
Units	N1028 E1006 SE
Center	N1028.70 E1007.35
Top Elev. (m)	98.09
Bottom Elev. (m)	97.83
Origination (m)	98.09
Dimensions (cm)	64 x 60
Pollen and Phytolith Samples	P23
Bulk/Flotation Samples	F28: charred *Quercus* wood, diffuse porous and ring porous
Special Samples	S30 (FCR)
C-14 Samples	C89, C90, C91, C95, C97
Radiocarbon Age (Conventional BP)	C97– 980 ± 40 (Beta 215915); C91– 1090 ± 40 (Beta 250560)
Associated Diagnostic Artifacts (Lot No.)	Scallorn arrow (2103)

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	0	0
5–10	19	1.5
10–15	30	18.5
15+	12	15.5
Total	61	35.5

*note: all 0–5 cm rock left in bulk matrix sample

Feature 25 was encountered in the northeastern corner of the NW Block immediately south of where Feature 1 was excavated during testing. Several rocks apparently related to Feature 1 were exposed in the northern limits of the unit, overlapping on the rocks of Feature 25.

The small circular cluster was in Stratum 2A and measured 64 × 60 cm. The cross section revealed that the feature had a distinct basin approximately 26 cm in depth. Limestone slabs lined the basin in a semi-flat layer, and the flat rocks on outer margin were slanted towards the center of the feature. A few of the stones were fractured in situ. The feature matrix around and below the basin rocks was darker than the surrounding sediment. Burned soil was also observed below and around the rocks.

The artifacts recovered from the water-screened feature matrix consist of bone fragments and 209 pieces of debitage. Mussel shell and bone fragments were also observed during excavation of the feature. A Scallorn arrow point (Lot 2103) was recovered from the area where Feature 1 overlaps Feature 25, and is clearly associated with one or both of the features.

Five charcoal samples were collected from the feature; two of these were submitted for radiocarbon dating. The returned dates are from 980 ± 40 B.P. and 1090 ± 40 B.P. (Appendix A). This may suggest multiple use of this feature, or perhaps the use of old wood for fuel. The radiocarbon results place Feature 25 in the Late Prehistoric Austin phase component. This is consistent with the stratigraphic position of the feature and the associated diagnostic artifact.

Macrobotanical analysis of a flotation sample and a wood identification sample from the feature matrix identified abundant diffuse porous oak wood and lesser ring porous oak wood (Appendix B, Tables 5 and 11). A pollen and phytolith sample was collected but not submitted for analysis. Likewise, a burned rock sample was collected for lipid residue analysis, but not analyzed.

Feature 25, continued

Feature 25, plan view of feature.

Feature 25, profile view of north wall of feature.

Feature 26

Type	Knapping event
Typology	Flint Knapping Station
Geomorphic Stratum	Base of 2B
Cultural Component	Undetermined
Block	NW
Units	N1020 E1002 NW
Center	N1021.16 E1002.57
Top Elev. (m)	98.00
Bottom Elev. (m)	97.95
Origination (m)	97.97
Dimensions (cm)	20 x 20
Pollen and Phytolith Samples	none
Bulk/Flotation Samples	none
Special Samples	S31 (micro-debitage)
C-14 Samples	none
Radiocarbon Age (Conventional BP)	none
Associated Diagnostic Artifacts (Lot No.)	none

Feature 26 was encountered in the southwestern portion of the NW Block. The feature represents the remains of a knapping event at the base of Stratum 2B. The 20 × 20-cm-area consisted of bifacial thinning flakes, micro debitage, bone fragments, a modified flake (Lot 1357), and a biface (Lot 1358). The concentration of debitage consisted of 32 flakes and 52 microflakes clustered together, with some flakes stacked on top of others. It appeared that two different types of raw material were represented in the feature. The biface and small flake debris were of a dark material, and the larger flakes were a lighter material.

Eighteen additional flakes within a 1-m-radius of the debitage concentration appeared to be associated with the concentration and were point-plotted, and collected as part of Feature 26. Two point-plotted bones and one tooth were also associated with the concentration.

The biface (Lot 1358) from Feature 26 is a proximal-medial fragment with a tabular cortical base. The breakage is a perverse fracture that likely represents a manufacturing failure. The biface may be a preform that broke during reduction and was abandoned.

No diagnostic artifacts are associated with the feature. Based on the stratigraphic position, Feature 26 is associated with a Late Archaic component at the site, most likely one of the earlier Late Archaic occupations.

Feature 26, plan view within unit.

Feature 26, debitage concentration close-up.

Feature 27

Type	Small hearth
Kleinbach et al. (1995a) Typology	Type 1 hearth
Geomorphic Stratum	2B
Cultural Component	4
Block	NW
Units	N1022 E1000 SW
Center	N1022.31 E1000.71
Top Elev. (m)	98.02
Bottom Elev. (m)	97.91
Origination (m)	97.96
Dimensions (cm)	56 x 37
Pollen and Phytolith Samples	none
Bulk/Flotation Samples	F29: charred *Quercus* wood, diffuse porous and ring porous
Special Samples	none
C-14 Samples	C110
Radiocarbon Age (Conventional BP)	C110– 2270 ± 40 (Beta 250563)
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	4	0.1
5–10	6	1
10–15	16	6
15+	2	1.5
Total	28	8.6

Feature 27 was encountered in the western portion of the NW Block. The feature was in Stratum 2B and measured 56 × 37 cm. The oval cluster was 11 cm thick and consisted of two layers of limestone rocks. Most of the rocks were angular and appeared fractured. The tightly arranged cluster appeared to lie on a flat surface with a few dispersed smaller stones surrounding it. Evidence of charcoal, burned soil, and ash was observed within the rock cluster and in the feature matrix.

The artifacts recovered during excavations include 11 flakes and bone fragments. Smaller bone fragments and 147 pieces of debitage were recovered from the water-screened feature matrix. No temporally diagnostic artifacts were recovered from the feature.

Only one charcoal sample was collected from the feature and submitted for radiocarbon dating. This sample returned a date of 2270 ± 40 B.P. (Appendix A). The radiocarbon results place Feature 27 in the Late Archaic component, relatively consistent with stratigraphic position.

Macrobotanical analysis of a flotation sample identified charred diffuse porous and ring porous oak wood (Appendix B). No other special samples were collected from the feature.

Feature 27, plan view of cluster.

Feature 28

Type	Cluster of FCR
Kleinbach et al. (1995a) Typology	Burned rock concentration
Geomorphic Stratum	Base of 2B
Cultural Component	Undetermined
Block	NE
Units	N1024 E1010 SE, N1024 E1012 SW
Center	N1024.30 E1012.00
Top Elev. (m)	97.95
Bottom Elev. (m)	97.80
Origination (m)	97.88
Dimensions (cm)	115 x 65
Pollen and Phytolith Samples	P33
Bulk/Flotation Samples	F38: charred *Quercus* wood, diffuse porous
Special Samples	none
C-14 Samples	none
Radiocarbon Age (Conventional BP)	none
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	0	0
5–10	29	5
10–15	17	8.1
15+	7	6.2
Total	53	19.3

Feature 28 was encountered in the western portion of the NE Block. The feature was at the base of Stratum 2B and measured 115 × 65 cm. The feature, roughly oriented east-west, appeared to extend out from the southern wall of the excavated units. The amorphous cluster consisted of a single layer of dispersed limestone rocks that was 15 cm thick. The feature contained mostly angular stones with a few tabular rocks. A few of the rocks near the center of the feature were clumped and overlapping, but most were dispersed towards the margins. Evidence of sporadic charcoal staining was observed throughout the feature during excavation.

The artifacts recovered from the water-screened feature matrix consist of bone fragments, 226 flakes, a modified flake tool (Lot 930.2), and an early-stage biface fragment (Lot 930.1). No temporally diagnostic artifacts were recovered from the feature, nor were any charcoal samples collected.

Macrobotanical analysis of a flotation sample identified charred diffuse porous oak wood (Appendix B, Table 5). A pollen and phytolith sample was collected but not analyzed. No other special samples were collected from the feature.

Based on the stratigraphic position of the feature and the nearby dart points, Feature 28 is associated with a Late Archaic component at the site, most likely with the earlier occupations.

Feature 28, plan view of feature.

Feature 29

Type	Shallow, basin-shaped hearth
Kleinbach et al. (1995a) Typology	Type 5 hearth (small)
Geomorphic Stratum	2B
Cultural Component	Undetermined
Block	NE
Units	N1026 E1010 NE
Center	N1027.71 E1011.45
Top Elev. (m)	97.93
Bottom Elev. (m)	97.80
Origination (m)	97.87
Dimensions (cm)	42 x 34
Pollen and Phytolith Samples	P34
Bulk/Flotation Samples	F39: charred *Quercus* wood, ring porous
Special Samples	none
C-14 Samples	none
Radiocarbon Age (Conventional BP)	none
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	9	0.3
5–10	9	0.9
10–15	6	1.4
15+	2	1.9
Total	26	4.5

Feature 29 was encountered in the northwestern corner of the NE Block approximately 25 cm below the mechanically scraped surface. The feature originated in Stratum 2B and measured 42 × 34 cm. The circular cluster consisted of several overlapping tabular limestone rocks in a shallow basin 13-cm-deep. The tabular stones were unfractured, but smaller rocks were fractured in situ. The tabular rocks on the northern margins of the feature appeared to be tilted towards the center. Charcoal staining was observed around the rocks during excavation.

The artifacts recovered from the water-screened feature matrix consist of 29 flakes and bone fragments. No temporally diagnostic artifacts were recovered from the feature, nor were any charcoal samples collected.

Macrobotanical analysis of a flotation sample identified charred ring porous oak wood (Appendix B, Table 5). A pollen and phytolith sample was collected but not analyzed. No other special samples were collected from the feature.

Based on the stratigraphic position of the feature and the nearby dart points, Feature 29 is associated with a Late Archaic component at the site, although a more detailed association is not possible.

Feature 29, plan view of feature.

Feature 30

Type	Slab-lined hearth
Kleinbach et al. (1995a) Typology	Type 5 hearth (large)
Geomorphic Stratum	2B
Cultural Component	3
Block	NW
Units	N1026 E1004 SW, NW
Center	N1026.80 E1004.30
Top Elev. (m)	98.01
Bottom Elev. (m)	97.64
Origination (m)	97.90
Dimensions (cm)	162 x 150
Pollen and Phytolith Samples	P25: negative analysis (pollen and phytolith)
Bulk/Flotation Samples	F30: charred *Juglans* nutshell fragment; charred *Liliaceae* bulb fragment; charred *Quercus* wood, ring porous
Special Samples	S34 (Geophyte)
C-14 Samples	C115, C116, C118
Radiocarbon Age (Conventional BP)	C118– 1880 ± 40 (Beta 250566); C116– 1970 ± 40 (Beta 250565)
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count***	**Weight (kg)***
0–5	52	0.5
5–10	80	6
10–15	37	16.4
15+	13	16
Total	182	38.9

*note: north 1/2 of feature only

Feature 30 was encountered immediately above Feature 8, the burned rock midden at the site, in the northeastern corner of the NW Block. The feature's origination surface was circa 97.9–97.8 m in elevation, although the highest point on the feature was 98.01 m. The entire feature was contained within Stratum 2B. This slab-lined hearth extended west beyond the limits of the excavated area, but its size can be estimated from the portion uncovered by SWCA to be approximately 160 cm in diameter. The feature had a shallow, rock-lined basin that may have been cut into the top of Feature 8. The basin was concave, contained noticeably ashier matrix, and extended as deep as 97.64 m. The feature was composed primarily of flat limestone slabs, many of which appeared fractured in situ.

During the feature excavation, 54 pieces of debitage were collected. Water screening of the feature matrix recovered an additional 176 pieces of debitage, along with bone fragments. No diagnostic artifacts were recovered from the feature. A burned geophyte was collected from the feature matrix during excavation. This small, badly burned bulb was not submitted for macrobotanical identification.

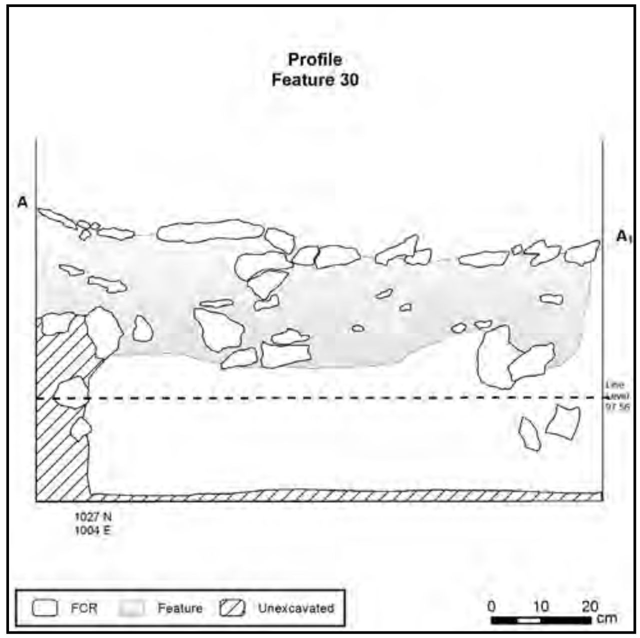
Three charcoal samples were collected from the feature; two of these were submitted for radiocarbon dating. The returned dates were 1880 ± 40 b.p. and 1970 ± 40 b.p. (Appendix A). This may suggest multiple use of this large feature, or the use of old wood as fuel. The radiocarbon results place Feature 30 in a Late Archaic component. This is consistent with the stratigraphic position of the feature.

The flotation sample from this feature yielded some of the most interesting results. Macrobotanical analysis identified charred ring porous oak wood, as well as a charred walnut nutshell and a charred Liliaceae bulb fragment (see Appendix B, Tables 5 and 9). This is the only evidence for the possible use of nuts for dietary purposes at the site, and also indicates that nuts and bulbs may have been cooked together. Pollen and phytolith analysis for a matrix sample yielded negative results (Appendixes E and G).

Feature 30, facing north. Note rocks from Feature 8 barely exposed in floor of excavation unit.

Feature 30, continued

Feature 30, facing north. Note rocks from Feature 8 barely exposed in floor of excavation unit.



Feature 30, profile sketch map.

Feature 30, plan view sketch map.

Feature 31

Type	Circular hearth
Kleinbach et al. (1995a) Typology	Type 5 hearth (large)
Geomorphic Stratum	2B
Cultural Component	5
Block	NW
Units	N1024 E1002 all quads
Center	N1024.87 E1003.15
Top Elev. (m)	97.90
Bottom Elev. (m)	97.76
Origination (m)	97.85
Dimensions (cm)	124 x 105
Pollen and Phytolith Samples	P27
Bulk/Flotation Samples	F32: charred *Quercus* wood, ring porous
Special Samples	S36: 1 *Liliaceae* bulb and 2 bulb fragments (see Feature 8)
C-14 Samples	none
Radiocarbon Age (Conventional BP)	S36– 2400 ± 30 (Beta 299318) (see Feature 8)
Associated Diagnostic Artifacts (Lot No.)	Marcos point (2135)

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	0	0
5–10	13	1.1
10–15	12	8.1
15+	19	28.6
Total	44	37.8

Feature 31 was encountered in the western portion of the NW Block, directly on top of the burned rock midden, Feature 8. The roughly circular hearth feature originated in Stratum 2B and measured 124 × 105 cm. The burned limestone rocks were dispersed near the north-central portion of the feature and increased in density towards the southern margins. Large tabular rocks were concentrated in the center and western margins of the feature, and several were slanted towards the center. These rocks appeared to form the boundaries of the feature within the cluster. A dense scatter of smaller stones surrounded the tabular rocks beyond the inner boundary, but they may have been part of Feature 8. Most of the rock was overlapping and fractured in situ. Charcoal flecking was sparsely scattered throughout the feature matrix and rocks. The basal shape of the feature could not be determined in cross-section due to the density of rocks associated with Feature 8.

Artifacts recovered from the water-screened feature matrix include bone fragments and 241 flakes. A Marcos dart point (Lot 2135) was also recovered from the feature matrix. This type dates to the Late Archaic period from 600 B.C.– A.D. 200 (Turner et al. 2011:130).

The difficulty in separating the bottom of Feature 31 from Feature 8 caused some issues in the analysis, as some artifacts and samples could not be conclusively attributed to one feature and were labeled as "Feature 8/31." This includes 63 pieces of debitage and bone fragments from water screening of feature matrix, as well as a geophyte collected as a special sample. The geophyte sample was also submitted for macrobotanical identification. A complete Liliaceae bulb and two bulb fragments were identified (Appendix B, Tables 4 and 9).

The geophyte sample was submitted for dating, returning a date of 2400 ± 30 B.P. (Appendix A). The radiocarbon results place Feature 31 in the Late Archaic period. It should also be noted that, as geophytes are short-lived species, the result from this specimen gives a very specific date range for at least one usage of this feature.

Macrobotanical analysis of a flotation sample identified charred oak wood (Appendix B, Table 5).

Feature 31, plan view of feature.

Feature 33

Type	Cluster of FCR
Kleinbach et al. (1995a) typology	Type 4 hearth
Geomorphic Stratum	2A/2B
Cultural Component	Undetermined
Block	NE
Units	N1024 E1010 NE, N1026 E1010 SE
Center	N1025.90 E1011.847
Top Elev. (m)	97.70
Bottom Elev. (m)	97.58
Origination (m)	97.64
Dimensions (cm)	73 x 60
Pollen and Phytolith Samples	P28
Bulk/Flotation Samples	F33
Special Samples	none
C-14 Samples	none
Radiocarbon Age (Conventional BP)	none
Associated Diagnostic Artifacts (Lot No.)	none

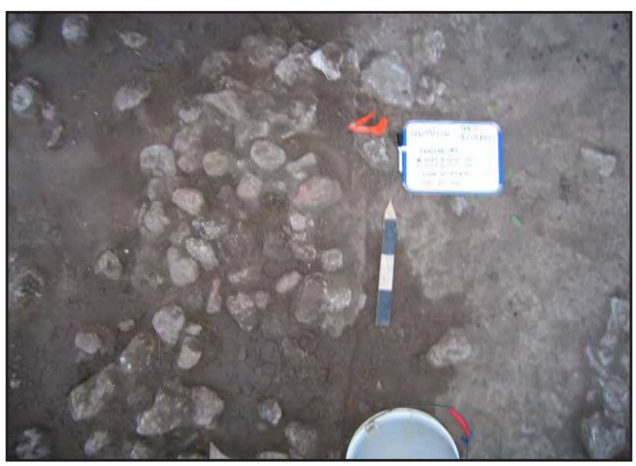
Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	12	0.1
5–10	50	6.8
10–15	25	11.7
15+	3	4.1
Total	90	22.7

Feature 33 was encountered within the two units adjacent to the eastern edge of BHT B, roughly in the central portion of the NE Block. The feature was a tight cluster of angular and tabular fire-fractured cobbles in the shape of a half circle, measuring 73 cm from the northern to southern edges. The cluster originated in Stratum 2A and was excavated into Stratum 2B. In cross-section, the feature was slightly basin-shaped and consisted of one to two tightly stacked limestone cobble layers reaching a total thickness of 12 cm. Most of the cobbles were fractured in situ. The boundaries of the feature were defined by thermally altered sediment, charcoal, and fire-fractured cobbles.

A total of 71 pieces of debitage was recovered from the feature matrix, along with bone fragments. A large amount of debitage and several large bones were also recovered from the immediate area surrounding the feature. No temporally diagnostic artifacts were recovered from the feature matrix. No charcoal was collected. A flotation sample of feature matrix and a pollen sample were collected but not submitted for analysis.

Based on the stratigraphic position and temporally diagnostic artifacts in the vicinity, Feature 33 is likely associated with a later Late Archaic component at the site. However, the lack of diagnostic artifacts or radiocarbon dates for the feature itself precludes positive assignment.

Feature 33, plan view of exposed feature.



Feature 33, plan view and unit overview.

Feature 34

Type	Cluster of FCR
Kleinbach et al. (1995a) typology	Type 5 hearth (small)
Geomorphic Stratum	2B
Cultural Component	Undetermined
Block	NE
Units	N1026 E1012 SW, NW
Center	N1027.10 E1012.559
Top Elev. (m)	97.78
Bottom Elev. (m)	97.60
Origination (m)	97.69
Dimensions (cm)	54 x 50
Pollen and Phytolith Samples	P35
Bulk/Flotation Samples	F40: charred *Quercus* wood, diffuse porous and ring porous
Special Samples	none
C-14 Samples	none
Radiocarbon Age (Conventional BP)	none
Associated Diagnostic Artifacts (Lot No.)	Marshall dart (1188)

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	14	0.6
5–10	26	4.2
10–15	12	6
15+	4	5.8
Total	56	16.6

Feature 34 was encountered in the northeastern unit of the NE Block. The feature was a tight circular cluster of fire-cracked limestone cobbles with a maximum diameter of 54 cm. The feature originated in Stratum 2B. In cross-section, the feature was an 18-cm-deep basin, stacked with angular and tabular limestone cobbles fractured in situ. Charcoal flecking, calcium carbonate filaments, and thermally altered sediment were observed throughout the feature matrix within the cluster of cobbles.

The artifacts recovered during the feature's excavation included a Marshall dart point (Lot 1188), a bone fragment, and a core (Lot 1187). Water screening of the feature matrix recovered 240 flakes and some bone fragments. No charcoal samples were collected from the feature. Turner et al. (2011:131) date the Marshall type to the Late Middle Archaic as they define it. Prewitt (1981b:80) dates the type to ca. 650–300 B.C.

Macrobotanical analysis of a flotation sample identified charred diffuse porous and ring porous oak wood, as well as a charred *Liliaceae* bulb (Appendix B, Tables 5 and 9). A pollen and phytolith sample was collected but not analyzed. No other special samples were collected from the feature.

Based on the Marshall dart point, Feature 34 is associated with the Late Archaic component at the site. However, the lack of radiocarbon dates preclude clear assignment of the feature to a cultural component.

Feature 34, plan view of exposed feature.

Feature 35

Type	Slab-lined hearth
Kleinbach et al. (1995a) Typology	Type 5 hearth (large)
Geomorphic Stratum	3
Cultural Component	5
Block	NW
Units	N1024 E1002 All Quads, N1024 E1004 SW
Center	N1025.40 E1003.75
Top Elev. (m)	97.60
Bottom Elev. (m)	97.17
Origination (m)	97.50
Dimensions (cm)	180 x 180
Pollen and Phytolith Samples	P36, P37: negative phyto-lith analysis. P36 positive for *Onagraceae* pollen
Bulk/Flotation Samples	F41, F42: charred *Quercus* wood, ring porous
Special Samples	S41 (Geophyte), 5 charred Liliaceae bulb fragments; S42 (FCR), S43 (FCR), S44 (FCR)
C-14 Samples	C138, C139, C158, C167, C168, C169, C172, C177, C184, C188, C189, C190, C191
Radiocarbon Age (Conventional BP)	C189– 2370 ± 40 (Beta 215922); C172– 2390 ± 40 (Beta 250576); C191– 2440 ± 40 (Beta 250581); C138– 2600 ± 40 (Beta 250570)
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count***	**Weight (kg)***
0–5	0	0
5–10	1	0.5
10–15	12	10.2
15+	70	160.3
Total	83	171

*3/4 of feature; smaller rocks in bulk matrix

Feature 35 was encountered immediately below Feature 8, the burned rock midden at the site, in the north-central portion of the NW Block. Although somewhat difficult to discern, the feature appeared to be completely contained within Stratum 3; it was the only feature at the site documented within that stratum. Discovered late in the project, Feature 35 was the focus of intensive study during the final week of the data recovery.

Feature 35 comprised a large, slab-lined hearth with a slightly concave basin-shaped bottom. Large (>15-cm maximum dimension), tightly packed slabs formed the base of the feature, while even larger slabs, measuring 20–30 cm, formed the margins of the feature. These outer rocks were oriented nearly vertically (60–90 degrees) and placed side-by-side around the edge of the hearth.

Feature 8, the burned rock midden, overlies the hearth and actually thickens within the center of Feature 35. Perhaps Feature 35 created a depression on the landscape that was filled as the midden was created. In profile, the overlying midden was clearly distinguishable from Feature 35 based on (a) a clear stratigraphic separation of the two in the northern profile of the excavation block and (b) the coarse matrix of the two features. The rocks that made up Feature 8 were small and angular, while the rocks within Feature 35 were larger and much less fractured.

Approximately one half of the feature extended beyond SWCA's excavations to the north and northeast, but it is estimated that Feature 35 was roughly circular, with a diameter of approximately 180 cm. The basin was approximately 43-cm-deep from the top of the outer rocks to the bottom of the deepest rock. The interior of the feature contained primarily large, burned but not fractured, limestone cobbles. The rocks and fine matrix at the base of the feature were darkly stained by charcoal. Many of the basal and margin rocks were either unfractured or fractured in situ, generally breaking into two or three pieces when they were removed from the feature. This feature is a very large Type 5 hearth (Kleinbach et al. 1995a) and likely functioned as an earth oven (Johnson 2000).

Artifact recovery was very sparse from the feature, although the excavation was somewhat expedited. Only 39 pieces of debitage and some bone fragments were recovered from water screening of feature matrix.

Feature 35, continued

Three burned rocks were collected for lipid residue analysis, but were not submitted for study.

Thirteen charcoal samples were collected from the feature; four of these were submitted for radiocarbon dating. The returned dates ranged from 2370–2600 ± 40 B.P. (Appendix A). This may suggest multiple use of this large feature, although two of the dates overlap at 2350-2410 B.P. and a third is 2440 ± 40 B.P. The radiocarbon results place Feature 35 in the Late Archaic component. Further discussion of the component associated with Feature 35 can be found in Chapter 8.

A burned geophyte (S45) was collected from the feature matrix during excavation. Macrobotanical analysis of the sample identified 5 *Liliaceae* bulb fragments (Appendix B, Tables 4 and 9).

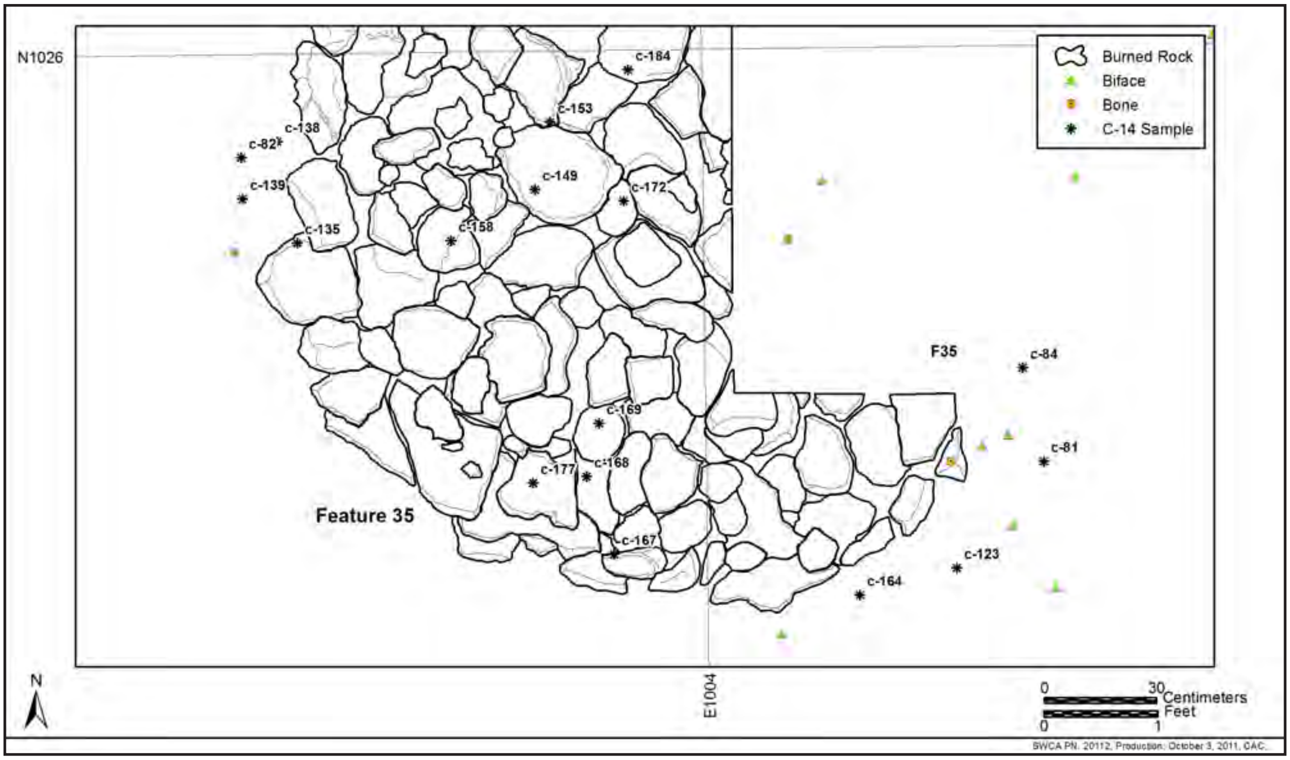
Macrobotanical analysis of two flotation samples identified abundant ring porous oak wood (Appendix B, Table 5). Two pollen and phytolith samples were collected, and one was submitted for analysis. The phytolith examination yielded negative results (Appendix G). However, a grain of *Onagraceae* pollen, or the evening primrose family, was identified (Appendix E).

Feature 35, plan view of exposed feature.

Feature 35, plan view of exposed feature.

Feature 35 profile view.

Feature 35, continued



Feature 35, plan view sketch map.

Feature 36

Type	Shallow, basin-shaped hearth
Kleinbach et al. (1995a) Typology	Type 5 hearth (large)
Geomorphic Stratum	2B/3 contact
Cultural Component	4
Block	NE
Units	N1024 E1012 (All Quads), N1024 E1014 NW, N1026 E1012 SE, N1026 E1014 SW
Center	N1025.5 E1013.5
Top Elev. (m)	97.75
Bottom Elev. (m)	97.46
Origination (m)	97.67
Dimensions (cm)	170 x 135
Pollen and Phytolith Samples	P29: negative analysis (pollen and phytolith)
Bulk/Flotation Samples	F34: charred *Celtis* seed fragment; charred *Liliaceae* bulb fragment; charred *Quercus* wood, ring porous
Special Samples	S39 (FCR)
C-14 Samples	C140, C141, C143, C144, C148
Radiocarbon Age (Conventional BP)	C140– 2190 ± 40 (Beta 215917); C144– 2310 ± 40 (Beta 250571)
Associated Diagnostic Artifacts (Lot No.)	Montell dart (933.3), Untyped dart (943)

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	60	3.3
5–10	81	11.9
10–15	48	31.7
15+	58	141.2
Total	247	188.1

Feature 36 was encountered in the south-central unit of the NE Block. It comprised a hearth and associated cluster of fire-fractured limestone rocks, which originated in Stratum 2B, with the base of the feature in contact with Stratum 3. The main feature was roughly oval, with several blown out areas between the clusters of fire-fractured rock. Several large, vertically aligned tabular limestone slabs and smaller fire-fractured rocks formed the margins of the hearth feature. The associated cluster of approximately 10 large, tabular fire-fractured rocks was adjacent to the western boundary of the main hearth feature. In cross-section, the main feature was a shallow, basin-shaped pit with one basal layer of rocks and several rocks stacked near the edges and in the center. It was defined by the extent of thermally altered sediment, ash, and charcoal flecking.

The artifacts recovered during excavation of the feature include a Montell dart point (Lot 933.3), a untyped dart point basal fragment (Lot 943), a modified flake (Lot 933.2), a scraper (Lot 942), a biface (Lot 933.1), 103 pieces of lithic debitage, and several bone fragments. Water screening of the feature matrix yielded 423 additional pieces of debitage and more bone fragments. The biface (Lot 933.1) is a burned, late-stage distal-medial fragment that appears to have broken by a thinning failure. Montell dart points date to the Late and Transitional Archaic periods, 800 to 400 b.c. (Turner et al. 2011:137.

Five charcoal samples were collected from the feature; two of these were submitted for radiocarbon dating. The returned dates were 2190 ± 40 B.P. and 2310 ± 40 B.P. (Appendix A). This may suggest multiple use of this large feature, or the use of old wood as fuel. The radiocarbon results place Feature 36 in the Late Archaic component. This is consistent with the stratigraphic position of the feature and the diagnostic artifacts.

The flotation sample from this feature yielded charred oak wood, as well as a charred hackberry seed and a charred *Liliaceae* bulb fragment (Appendix B, Tables 5 and 9). Pollen and phytolith analysis for a matrix sample yielded negative results.

Feature 36, continued

Feature 36, plan view of exposed feature.

Feature 36, profile view of feature.

Feature 37

Type	Basin-shaped hearth
Kleinbach et al. (1995a) Typology	Type 4 hearth (small)
Geomorphic Stratum	Base of 2B
Cultural Component	4
Block	NE
Units	N1026 E1014 NW, NE
Center	N1027.71 E1014.47
Top Elev. (m)	97.69
Bottom Elev. (m)	97.51
Origination (m)	97.61
Dimensions (cm)	78 x 57
Pollen and Phytolith Samples	P39
Bulk/Flotation Samples	F44: charred *Quercus* wood, ring porous
Special Samples	none
C-14 Samples	C151, C152, C154
Radiocarbon Age (Conventional BP)	C152– 2260 ± 40 (Beta 250573); C154– 2430 ± 50 (Beta 215918)
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	4	0.1
5–10	13	2.3
10–15	15	10
15+	4	4.3
Total	36	16.7

Feature 37 was encountered in the northeastern unit of the NE Block. The feature was a tight cluster of large, angular, fire-cracked limestone rocks. In plan view, the observed basal configuration was circular and measured 78 × 57 cm. However, the northern portion of the feature extended into the northern wall of the excavation block and therefore was not excavated. This feature was located at the base of Stratum 2B. The shallow basin was roughly 9-cm-deep and consisted of a high density of carbon and overlapping angular limestone rocks of varying sizes, which were stacked in the central portion of the pit. Most appear to have been fractured in situ. Although the basin was not slab-lined, the margins of the basin were clearly defined by thermally altered sediment, ash, and charcoal.

Bone fragments, lithic debitage, and an end scraper (Lot 1311) were recovered from the excavation of the feature. No temporally diagnostic artifacts were recovered from the feature.

Three charcoal samples were collected from the feature; two of these were submitted for radiocarbon dating. The returned dates were 2260 ± 40 B.P. and 2430 ± 50 B.P. (Appendix A). This may suggest multiple use of this large feature, or the use of old wood as fuel. The radiocarbon results place Feature 36 in the Late Archaic component. This is relatively consistent with the stratigraphic position of the feature and the diagnostic artifacts in the surrounding units.

Macrobotanical analysis of a flotation sample identified charred ring porous oak wood (Appendix B, Tables 4 and 5). A pollen and phytolith sample was collected but was not analyzed. No other special samples were collected.

Feature 37, plan view of exposed feature.

Feature 37, profile view of feature.

Feature 38

Type	Shallow, basin-shaped hearth
Kleinbach et al. (1995a) Typology	Type 5 hearth
Geomorphic Stratum	2B
Cultural Component	Undetermined
Block	E
Units	N1022 E1020 NW
Center	N1023.67 E1020.12
Top Elev. (m)	97.99
Bottom Elev. (m)	97.88
Origination (m)	97.94
Dimensions (cm)	50 x 30 (partial)
Pollen and PhytolithSamples	P40
Bulk/Flotation Samples	F45: charred *Quercus* wood, ring porous; charred Unknown Type 1 wood, diffuse porous
Special Samples	none
C-14 Samples	none
Radiocarbon Age (Conventional BP)	none
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count***	**Weight (kg)***
0–5	3	0.2
5–10	10	1
10–15	8	2.5
15+	0	0
Total	21	3.7

*note: only 1/4 of feature excavated; most of small FCR in bulk matrix

A portion of Feature 38 was encountered in the southwestern unit of the E Block. The feature was a relatively tight cluster of small- to medium-sized tabular fire-cracked rocks associated with Stratum 2B. The westernmost portion of this feature extended outside the western boundary of the E Block and was therefore not excavated. However, it is likely the basal configuration was circular or ovate based on the half-circle configuration of the exposed portion of the feature.

The exposed section of the rock cluster measured 50 × 30 cm. In cross-section, the feature was a very shallow basin, 11-cm-deep. One coherent layer of rocks on the top overlapped another layer of rocks tapering in from the eastern edge and into the western wall of the unexcavated portion of the E Block. No thermally altered sediment, ash, or charcoal was observed. It is likely that the exposed portion of the feature represents the outer margins of the central area of the feature, where the darker charcoal-stained sediment would be. All but one of the rocks was fractured in situ.

Six pieces of lithic debitage and some bone fragments were recovered during water screening of the feature matrix. No temporally diagnostic artifacts were recovered from the feature, and no charcoal samples were collected.

Macrobotanical analysis of a flotation sample identified charred ring porous oak wood and charred Unknown Type 1 diffuse porous wood (Appendix B, Table 5). A pollen and phytolith sample was collected but not analyzed. No other special samples were collected.

Based on the stratigraphic position of the feature, it is associated with the general Archaic component at the site. Due to the lack of radiocarbon dates and associated diagnostic artifacts, the feature cannot be more positively associated with a cultural component.

Feature 38, plan view of exposed feature.

Feature 39

Type	Cluster of FCR
Kleinbach et al. (1995a) Typology	Burned rock concentration
Geomorphic Stratum	Base of 2B
Cultural Component	Undetermined
Block	E
Units	N1024 E1022 SW, SE
Center	N1024.18 E1022.98
Top Elev. (m)	98.11
Bottom Elev. (m)	98.01
Origination (m)	98.06
Dimensions (cm)	46 x 30
Pollen and Phytolith Samples	P41: negative analysis for pollen and phytolith
Bulk/Flotation Samples	F46
Special Samples	none
C-14 Samples	none
Radiocarbon Age (Conventional BP)	none
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	0	0
5–10	9	1.5
10–15	5	1.8
15+	1	0.7
Total	15	4

Feature 39 was encountered in the southern half of the north central unit of the E Block. The feature was a cluster of rounded, angular, and tabular fire-cracked limestone rocks all small to medium in size. The cluster measured 46 × 30 cm and was situated near the base of Stratum 2B. The rocks were loosely clumped and adjoining, with very light charcoal flecking present in the matrix. The morphology and absence of distinct soil discoloration within the feature suggests this rock cluster may have been a discard pile. Due to the nature of this feature, it was not bisected.

No artifacts were recovered during excavation of this feature. Water screening of the feature matrix recovered 29 pieces of lithic debitage and some bone fragments. No temporally diagnostic artifacts were recovered from the feature, nor were any charcoal samples collected.

One flotation sample was collected, but processing of the sample did not recover suitable macrobotanical specimens for analysis. Pollen and phytolith analysis for a matrix sample yielded negative results (Appendixes E and G). No other samples were collected.

Based on the stratigraphic position of the feature, it is likely associated with the general Archaic component at the site. The lack of radiocarbon data and diagnostic artifacts precludes a positive association with a specific occupation.

Feature 39, plan view of exposed feature.

Feature 40

Type	Cluster of FCR
Kleinbach et al. (1995a) Typology	Burned rock concentration
Geomorphic Stratum	2B
Cultural Component	Undetermined
Block	E
Units	N1022 E1020 SE, NE, N1022 E1022 SW
Center	N1022.89 E1021.74
Top Elev. (m)	97.88
Bottom Elev. (m)	97.75
Origination (m)	97.81
Dimensions (cm)	75 x 65
Pollen and Phytolith Samples	P42
Bulk/Flotation Samples	F47: charred *Quercus* wood, ring porous; charred Unknown Type 1 wood, diffuse porous; charred *Vitis* wood
Special Samples	none
C-14 Samples	none
Radiocarbon Age (Conventional BP)	none
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count***	**Weight (kg)***
0–5	8	0.9
5–10	33	6.8
10–15	17	8.1
15+	7	7.1
Total	65	22.9

*note: some small rocks collected in bulk matrix

Feature 40 was encountered in the southern and central units of the E Block. The feature was a cluster of angular burned and fire-cracked limestone with one small angular piece of chert. This cluster measured 75 x 65 cm and was located in Stratum 2B. Most of the rocks were unfractured, and no coherent basin shape was observed during excavation, suggesting this feature may have been a discard pile. Within the feature matrix, below the clumped layers of rocks, minor charcoal flecking and bone fragments were observed, and thermally altered soil was apparent around the feature. Due to the morphology and absence of distinct soil discoloration, this feature was not bisected. Based on the amorphous shape and lack of structure, the feature is considered a burned rock concentration or cluster (Kleinbach et al. 1995a), although it may also be a somewhat dispersed Type 1 hearth.

Water screening of the feature matrix recovered 125 pieces of debitage, along with bone fragments. Abundant rabdotus shell was observed in the feature matrix during excavation. No temporally diagnostic artifacts were recovered from the feature, nor were any charcoal samples collected.

Macrobotanical analysis of a flotation sample identified charred ring porous oak wood, charred Unknown Type 1 diffuse porous wood, and charred grape wood (Appendix B, Table 5). This is the only evidence from a feature for the presence of grapes at the site, although it does not indicate dietary use. A pollen and phytolith sample was collected but not analyzed. No other samples were collected.

Based on the stratigraphic position of the feature, it is associated with the general Archaic component at the site. The lack of radiocarbon data and diagnostic artifacts precludes a positive association with a specific occupation.

Feature 40, plan view of exposed feature.

Feature 41

Type	Small, slab-lined hearth
Kleinbach et al. (1995a) Typology	Type 5 hearth (small)
Geomorphic Stratum	2B/3 contact
Cultural Component	4
Block	NE
Units	N1026 E1012 NE, N1026 E1014 NW
Center	N1027.29 E1014.07
Top Elev. (m)	97.50
Bottom Elev. (m)	97.37
Origination (m)	97.48
Dimensions (cm)	75 x 58
Pollen and Phytolith Samples	P43
Bulk/Flotation Samples	F48
Special Samples	none
C-14 Samples	C161, C163
Radiocarbon Age (Conventional BP)	C163– 2180 ± 40 (Beta 250575); C161– 2610 ± 40 (Beta 250574)
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	12	0.2
5–10	28	3.6
10–15	8	4.2
15+	5	4.2
Total	53	12.2

Feature 41 was encountered in the north central unit of the NE Block and extended into the eastern unit. The feature was an ovate slab- and rock-lined hearth with a slightly dispersed eastern boundary. The feature measured 75 × 58 cm and 13-cm-thick. This feature originated in Stratum 2B, with the base of the feature in contact with Stratum 3. In cross-section, several large, tabular limestone rocks lined the basal portion of the basin. Additionally, several angular limestone rocks were stacked on top of the slabs in the center of the hearth. Although many of the rocks were highly fragmented, most of the rocks appeared to be fractured in situ. The margins of the feature were defined by thermally altered sediment and scattered charcoal.

The distal-medial portion of a large, late stage biface (Lot 1236) was recovered from the slightly dispersed eastern section of the feature. Water screening of the feature matrix recovered 36 pieces of lithic debitage as well as some bone fragments. No temporally diagnostic artifacts were recovered from the feature matrix.

Two charcoal samples were collected from the feature, and both were submitted for radiocarbon dating. The returned dates were 2180 ± 40 B.P. and 2610 ± 40 B.P. (Appendix A). This may suggest the use of old wood as fuel, or some intrusive charred materials. The earlier dated sample was recovered 2.5 cm below the later dated sample. The radiocarbon results place Feature 36 in the Late Archaic component. This is consistent with the stratigraphic position of the feature and the diagnostic artifacts. The 2610 ± 40 B.P. date is the earliest date from a feature context at the site, and is comparable to Feature 35.

A flotation sample and a pollen and phytolith sample were collected, but were not submitted for analysis. No other samples were collected.

Feature 41, plan view of exposed feature.

Feature 42

Type	Small hearth
Kleinbach et al. (1995a) Typology	Type 1 hearth
Geomorphic Stratum	Base of 2B
Cultural Component	Undetermined
Block	NW
Units	N1022 E1004 NW, NE, N1024 E1004 SW, SE (Unexcavated)
Center	N1023.97 E1004.92
Top Elev. (m)	97.95
Bottom Elev. (m)	97.82
Origination (m)	97.90
Dimensions (cm)	70 x 56
Pollen and Phytolith Samples	P44
Bulk/Flotation Samples	F49: charred *Quercus* wood, diffuse porous; charred Unknown Type 1 wood, diffuse porous
Special Samples	none
C-14 Samples	none
Radiocarbon Age (Conventional BP)	none
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	36	0.6
5–10	36	4.1
10–15	18	9.1
15+	6	6.4
Total	96	20.2

Feature 42 was encountered in the western portion of the NW Block. The feature was a tight ovate cluster of angular burned limestone rocks recovered from the base of Stratum 2B immediately above Feature 8. This rock cluster measured 70 × 56 cm; the northeast quarter of the feature was unexcavated. Adjoining rocks formed two layers within the feature, and the feature matrix was slightly darker in color than the surrounding soil. However, no distinct basin-shaped configuration or thermally altered sediment further defined the margins of the feature. Due to the morphology and absence of distinct soil discoloration, this feature was not bisected.

Water screening of the collected feature matrix recovered 77 pieces of lithic debitage and some bone fragments. No temporally diagnostic artifacts were recovered from the feature, nor were any charcoal samples collected.

Macrobotanical analysis of a flotation sample identified charred diffuse porous oak wood and charred Unknown Type 1 diffuse porous wood (Appendix B, Table 5). A pollen and phytolith sample was collected but not analyzed. No other special samples were collected.

Based on the stratigraphic position of the feature, it is associated with the either aLate Archaic component at the site. Due to the lack of radiocarbon dates and associated diagnostic artifacts, the feature cannot be positively associated a particular occupation.

Feature 42, plan view of exposed feature.

Feature 43

Type	Cluster of FCR
Kleinbach et al. (1995a) Typology	Type 4 hearth (small)
Geomorphic Stratum	2B
Cultural Component	Undetermined
Block	E
Units	N1022 E1022 NW
Center	N1023.64 E1022.27
Top Elev. (m)	97.93
Bottom Elev. (m)	97.80
Origination (m)	97.86
Dimensions (cm)	64 x 47
Pollen and Phytolith Samples	P45
Bulk/Flotation Samples	F50
Special Samples	none
C-14 Samples	none
Radiocarbon Age (Conventional BP)	none
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	2	0.1
5–10	11	1.6
10–15	16	8.5
15+	3	3.2
Total	32	13.4

Feature 43 was encountered in the northwestern quadrant of the south central unit of the E Block. The feature was a tight ovate cluster of mostly angular limestone rocks, recovered in Stratum 2B. This rock cluster measured 64 × 47 cm. In cross-section, the feature was a shallow basin 13-cm-deep, with many of the angular stones tilted inwards toward the center of the feature. Two tight layers of unfractured rocks and slightly charcoal-stained sediment were observed. The feature matrix was not distinguishable from the surrounding soil.

One lateral biface fragment (Lot 464) and two bone fragments were recovered during the excavation of the feature. Water screening of the feature matrix recovered 121 pieces of lithic debitage and some bone fragments. No temporally diagnostic artifacts were recovered from the feature matrix, and no charcoal samples were collected.

A flotation sample and a pollen and phytolith sample were collected from the feature, but not submitted for analysis. No other special samples were collected.

Based on the stratigraphic position of the feature and diagnostic artifacts in the vicinity, Feature 43 is associated with the Archaic components at the site. Due to the lack of radiocarbon dates and associated diagnostic artifacts, the feature cannot be positively associated with a cultural component.

Feature 43, plan view of exposed feature.

Feature 44

Type	Cluster of FCR
Kleinbach et al. (1995a) Typology	Type 1 hearth
Geomorphic Stratum	2B
Cultural Component	4
Block	E
Units	N1024 E1024 SE
Center	N1024.19 E1025.51
Top Elev. (m)	97.79
Bottom Elev. (m)	97.68
Origination (m)	97.74
Dimensions (cm)	50 x 36
Pollen and Phytolith Samples	P46: *Caryophylleaceae* pollen, negative for phytoliths
Bulk/Flotation Samples	F51: charred *Prosopis* wood; charred *Quercus* wood, diffuse porous and ring porous; charred Unknown Type 1 wood, diffuse porous
Special Samples	none
C-14 Samples	C173
Radiocarbon Age (Conventional BP)	C173– 2230 ± 40 (Beta 250577)
Associated Diagnostic Artifacts (Lot No.)	Metate fragment (675): no starch recovered

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count***	**Weight (kg)***
0–5	0	0
5–10	9	1.5
10–15	7	6.1
15+	2	1.4
Total	18	9

*small FCR in bulk matrix

Feature 44 was encountered in the southeastern quadrant of the northeastern unit within the E Block. The feature was a cluster of angular and tabular limestone rocks recovered in Stratum 2B. This feature extended into the eastern wall of the excavation block and therefore was not completely excavated. The exposed portion of the feature measured 50 × 36 cm. During excavation of the feature, loosely stacked larger rocks were observed overlapping the smaller rocks that made up the base of the feature. All rocks were fractured in situ. Charcoal pieces and ashy soil were also observed. Thermally altered sediment defined the margins of the feature. The feature was not bisected.

One metate fragment (Lot 675) was recovered during the excavation of the feature. In addition, the matrix adjacent to the basal surface of the fragment was collected for a pollen analysis. Water screening of the feature matrix recovered 110 pieces lithic debitage, some bone fragments, a biface fragment (Lot 676.1), and a core (Lot 676.2). No temporally diagnostic artifacts were recovered from the feature matrix.

A charcoal sample collected from the feature yielded a date of 2,230 ± 40 B.P. (Appendix A). The places Feature 44 in the Late Archaic component, consistent with the stratigraphic position of the feature.

Macrobotanical analysis of a flotation sample identified charred oak wood, charred unknown Type 1 wood, and charred mesquite wood (Appendix B, Table 5). This is the only evidence of mesquite from the site excavations. Starch residue analysis of the metate fragment yielded negative results (Appendix F).

As noted above, a pollen and phytolith sample was collected from beneath the metate fragment. The phytolith examination yielded a grain of *Caryophyllaceae* pollen, or the carnation family (Appendix E). Several varieties of this plant have medicinal properties.

Feature 44, plan view of exposed feature.

Feature 45

Type	Cluster of FCR
Kleinbach et al. (1995a) Typology	Type 2 hearth (small)
Geomorphic Stratum	Base of 2B
Cultural Component	4
Block	E
Units	N1022 E1022 NW, NE
Center	N1023.29 E1023.07
Top Elev. (m)	97.85
Bottom Elev. (m)	97.75
Origination (m)	97.80
Dimensions (cm)	54 x 57
Pollen and Phytolith Samples	P47
Bulk/Flotation Samples	F52: charred *Juglans* wood; charred *Quercus* wood, ring porous
Special Samples	none
C-14 Samples	C174
Radiocarbon Age (Conventional BP)	C174– 2230 ± 40 (Beta 250578)
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count***	**Weight (kg)***
0–5	0	0
5–10	6	0.7
10–15	4	1.8
15+	6	5.9
Total	16	8.4

*small FCR in bulk matrix

Feature 45 was encountered in the south central unit of the E Block. The feature was a small cluster of tabular burned limestone rocks recovered from the base of Stratum 2B. The ovate cluster measured 57 × 54 cm. The margins of the feature were defined by a single layer of slightly overlapping burned rocks, with one outlying rock 10 cm to the east. Most of the rocks were intact. No thermally altered sediment or apparent basin shape were observed; therefore, the feature was not bisected. Although no charcoal was found during excavation of the feature, charcoal flecking was observed in the surrounding soil.

Water screening of the feature matrix recovered 90 pieces lithic debitage and some bone fragments. No temporally diagnostic artifacts were recovered from the feature matrix.

A charcoal sample was collected from the feature and submitted for radiocarbon dating. The returned date was 2230 ± 40 B.P. (Appendix A). The radiocarbon results place Feature 45 in the Late Archaic component. This is consistent with the stratigraphic position of the feature and the diagnostic artifacts in the vicinity. The dates for Features 44 and 45 are identical, and the proximity of the features suggests the potential for an isolable occupation area associated with the features.

Macrobotanical analysis of a flotation sample identified charred ring porous oak wood and charred walnut wood (Appendix B, Tables 4 and 5). This is one of two features with evidence for the use of walnut wood for fuel. The other, Feature 23, yielded one date of 1970 ± 40 B.P., which overlaps with the date from Feature 45.

Feature 45, plan view of exposed feature.

Feature 46

Type	Cluster of FCR
Kleinbach et al. (1995a) Typology	Burned rock concentration
Geomorphic Stratum	2B
Cultural Component	Undetermined
Block	E
Units	N1024 E1024 SW
Center	N1024.55 E1024.20
Top Elev. (m)	97.72
Bottom Elev. (m)	97.67
Origination (m)	97.70
Dimensions (cm)	70 x 55
Pollen and Phytolith Samples	P48
Bulk/Flotation Samples	F53
Special Samples	none
C-14 Samples	none
Radiocarbon Age (Conventional BP)	none
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	9	0.1
5–10	20	2.9
10–15	10	3.7
15+	0	0
Total	39	6.7

Feature 46 was encountered in the north central and northeastern units of the E Block. The feature is a tight ovate cluster of angular fire-cracked limestone rocks recovered near the base of Stratum 2B. The feature measured 70 × 55 cm. No thermally altered sediment, apparent basin configuration, or rock layering were observed, suggesting this rock cluster was a discard pile. In addition, the cluster of rocks was surrounded by abundant bone and charcoal fragments, further implying that this feature was refuse from a hearth.

One badly burned biface tip (Lot 2205) was recovered during the excavation of the feature. Water screening of the feature matrix recovered 41 pieces of lithic debitage and some bone fragments. No temporally diagnostic artifacts were recovered from the feature matrix, although the recovered biface fragment may be a projectile point tip. No charcoal samples were collected. Many chipped stone tools were observed in the areas adjacent to the feature.

A flotation sample and a pollen and phytolith sample were collected from the feature, but not submitted for analysis. No other special samples were collected.

Based on the stratigraphic position of the feature and diagnostic artifacts in the vicinity, Feature 46 is likely associated with a Late Archaic component at the site. Due to the lack of radiocarbon dates and associated diagnostic artifacts, the feature cannot be positively associated with a particular site occupation.

Feature 46, plan view of exposed feature.

Feature 47

Type	Cluster of FCR
Kleinbach et al. (1995a) Typology	Type 5 hearth
Geomorphic Stratum	Base of 2B
Cultural Component	Undetermined
Block	E
Units	N1022 E1020 NW
Center	N1023.85 E1020.14
Top Elev. (m)	97.73
Bottom Elev. (m)	97.62
Origination (m)	97.67
Dimensions (cm)	35 x 30
Pollen and Phytolith Samples	P49
Bulk/Flotation Samples	F54: charred *Quercus* wood, ring porous
Special Samples	none
C-14 Samples	C183
Radiocarbon Age (Conventional BP)	none
Associated Diagnostic Artifacts (Lot No.)	Groundstone (506): no starch recovered

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count***	**Weight (kg)***
0–5	0	0
5–10	10	1.7
10–15	7	2.7
15+	1	1.2
Total	18	5.6

* ~1/4 of feature; smaller rocks in bulk matrix

Feature 47 was encountered in the western unit of the E Block. The feature extended into the northwestern corner of the unexcavated area west of the excavation block; therefore, only a small portion of the feature was exposed. The feature was a layered cluster of tabular fire-cracked limestone rocks recovered from the base of Stratum 2B. The exposed portion of the feature measured 35 × 30 cm. Three layers of overlapping rocks angled down toward the northwest in a circular configuration and rested in a shallow flat-bottom basin. Thermally altered sediment and charcoal flecking defined the margins of this feature. The rocks composing the feature were a mixture of burned and fractured in situ specimens. Despite the limited exposure, the morphology of the feature is that of a Type 5 hearth (Kleinbach et al. 1995a), likely a large one.

Some articulated bones and one piece of groundstone (Lot 506) were recovered during the excavation of this feature; the groundstone was not submitted for starch residue analysis. Water screening of the feature matrix recovered 54 pieces of lithic debitage and some bone fragments. No temporally diagnostic artifacts were recovered from the limited feature excavation.

A charcoal sample was collected but not submitted for radiocarbon dating. A pollen and phytolith sample was also collected but not submitted for analysis. Macrobotanical analysis of a flotation sample identified charred ring porous oak wood (Appendix B, Table 12). One fragment of groundstone was submitted for starch and phytolith analysis (Appendix C). Though no starches were identified, phytoliths were similar to those of the sunflower family, local grasses, and sedges (Appendix C-4).

Based on the stratigraphic position of the feature and diagnostic artifacts in the vicinity, Feature 47 is associated with the earlier Late Archaic component or the Late Archaic component. Due to the lack of radiocarbon dates and associated diagnostic artifacts, the feature cannot be positively associated with a site occupation.

Feature 47, plan view of exposed feature

Feature 48

Type	Cluster of FCR
Kleinbach et al. (1995a) Typology	Type 2 hearth
Geomorphic Stratum	Base of 2B
Cultural Component	Undetermined
Block	E
Units	N1024 E1022 SW, NW
Center	N1024.80 E1022.40
Top Elev. (m)	97.72
Bottom Elev. (m)	97.56
Origination (m)	97.64
Dimensions (cm)	100 x 75
Pollen and Phytolith Samples	P50
Bulk/Flotation Samples	F55: charred *Quercus* wood, ring porous
Special Samples	none
C-14 Samples	none
Radiocarbon Age (Conventional BP)	none
Associated Diagnostic Artifacts (Lot No.)	none

Burned Rock Characteristics		
Burned Rock Size (cm)	**Count**	**Weight (kg)**
0–5	29	0.6
5–10	62	8.3
10–15	26	12.6
15+	7	9
Total	124	30.5

Feature 48 was encountered in the western half of the north central unit in the E Block. The feature was a tight ovate cluster of fire-cracked rock recovered from the base of Stratum 2B. This cluster measured 100 × 75 cm. The margins of the feature are made up of a flat layer of adjoining rounded, angular, and tabular limestone rocks. Approximately half of the rocks were fractured in situ. No apparent basin shape or thermally altered sediment were observed within the feature matrix or surrounding the feature. Due to its discovery on the last day of field excavations, this feature was not bisected.

No artifacts were recovered during the excavation of this feature. Water screening of the feature matrix recovered 21 pieces of lithic debitage and some bone fragments. No temporally diagnostic artifacts were recovered and no charcoal was collected.

Macrobotanical analysis of a flotation sample identified charred ring porous oak wood (Appendix B, Table 12). A pollen and phytolith sample was collected but not submitted for analysis.

Based on the stratigraphic position of the feature and diagnostic artifacts in the vicinity, Feature 48 is associated with a Late Archaic component at the site. Due to the lack of radiocarbon dates and associated diagnostic artifacts, the feature cannot be positively associated a specific occupation period.

Feature 48, plan view of exposed feature.

Chapter 8

Site Structure - The Order of Things

Stephen M. Carpenter

> *"The siren who lures the hapless prehistorian onto the Rock of Misinterpretation uses no enticing melody: she merely presents him with site strata rich in artifacts but obscure in origin"* LeRoy Johnson (1987:5).

On the literal level, Johnson's analogy may seem apt since this is, after all, the Siren site, but that convergence is entirely coincidental and inconsequential. The site was not named in reference to Johnson or the mythical divas that lured sailors to their rocky shores, but for a public warning system located on the site. The quote is, however, salient for deeper reasons that strike at the heart of the objectives in the study of the Siren site. First, Johnson's (1987) diagnosis of the "plague of phases" is among the more withering critiques of chronology building in Texas over the last several decades. Since chronology is among the main research topics of this report, it is worthwhile to address his critiques head on, incorporating his cautionary tale in the analysis of site structure. Secondly, on a more local level, it certainly seems his critiques were leveled directly at a small group of sites that formed the foundations of Prewitt's (1981b; 1985) Central Texas chronologies. Paramount among them were several sites in the San Gabriel River valley that bear great resemblance to the Siren site.

Imprecise associations among features, dates, artifacts, whole assemblages, and strata have contributed to long-term problems in the prehistoric culture sequence of Central Texas. To redress these flaws, emphasis has increasingly been placed upon the analysis of site structure. Clear definition of terms and associations is needed to provide a solid basis for sorting out the mass of data. Towards that end, this chapter briefly lays out the objectives and methods for analyzing site structure, then systematically breaks down the findings to develop meaningful Siren site components, which in turn form the basis for the subsequent synthesis chapters.

A Brief Review of Structure and its Study in Archaeology

"Structure" has been used in so many ways through the years that its meaning has become obscure. To precisely define the approach employed in this chapter, the evolution of the term in hunter-gatherer studies is briefly reviewed here. In the fields of linguistics, folklore, mythology, and art, structuralism caught fire in anthropology during the mid-twentieth century. In such a context, structure often referred to the construction of meaning and universal principals of the human mind. Along these lines, Deetz (1967:83) argued that the study of the arrangement of attributes in archaeological materials could reveal the "mental template" that governed the combination of these attributes.

Under such a narrow definition, the main stream of archaeology quite often rejected the approach outright (for example, Binford 1965:203–211). While classic structuralist analyses are often ideational or symbolic, the notion of structure has been widely applied to hunter-gatherer theory. Adapting the structuralist approach to hunter-gatherer campsites, Leroi-Gourhan and Brezillon (1972) developed a methodology for the study of hunter-gatherer site structure by identifying two organizing principles of archaeological materials: *evidentes* and *latentes* structures. The former are hearths and similar focal points analogous to what Binford (1983) later called site furniture. Activities are organized around these. Latentes structures are the arrangements of debitage, tools, bone, and other items (Figure 8.1). These general principles can be applied to the archaeological record on different scales. Binford (1983:144) defined site structure as the spatial distribution of artifacts, features, and faunal remains on an archaeological site. The objective of the study of such structure is the organization of behavior, rather than ideas.

Ascher (1961, 1962, 1968) was among the early observers to note that the archaeological record was not a preserved past, which is "an erroneous notion, often implicit in archaeological literature, that might

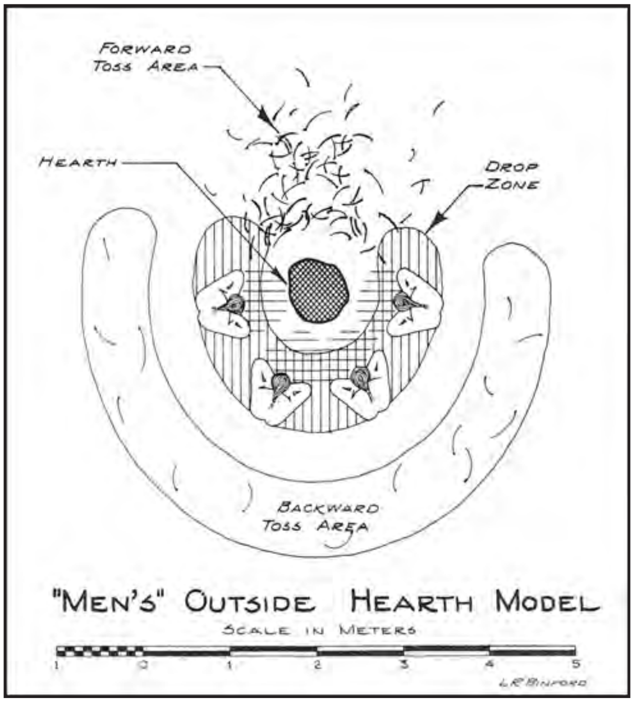


Figure 8.1. Binford's classic illustration of how behavior around central features structures patterning in the archaeological record. Adapted from Binford (1983:153).

be called the 'Pompeii premise'" (Ascher 1961:324). Rather, the record was the results of many depositional and post-depositional processes or filters. Following Ascher's early critiques, Binford (1981), Schiffer (1987) and many others further advanced the notion that the archaeological record is not a static picture, but conversely the result of dynamic formation processes. Cultural and natural transformations are constantly at work in altering the site structure. Over the last half century or so, despite the many challenges, middle range theory has addressed limitations and possibilities in drawing inferences from the archaeological record.

The objective in the Siren site analysis is not ideational or symbolic, but is designed to lead to an interpretation of archaeological materials in the context of their material conditions, as well as the prehistoric settings (including cultural attitudes, beliefs, etc.) that were inherited from the past. For example, the later chapter in this report on long-term foraging strategies seeks to place the site in larger economic and technological contexts that, to some degree, affected the options and constraints in prehistoric adaptations. These intents are in partial alignment with more recent trends, such as in the fields of agency theory and Bourdieu's (1977) notion of habitus. Pragmatic linkages between this social theory and the material record have been the focus of sustained study in the last few decades (e.g., Barrett 2001).

Structure Defined

From these developments, structure, as commonly defined in archaeology, is the relationship among attributes or objects. The purpose in studying structure derives from an overarching premise: how things are ordered reveals something of their underlying organizational principles. In other words, patterns in prehistoric behavior created patterns in the material record. However, the record is always in flux, and any such inferences must be considered through the lens of cultural and natural post-depositional processes. Time's arrow, structure's relentless assassin, is the inevitable dissolution of archaeological patterns as time goes by (Ascher 1968).

Upon these premises, archaeologists have long sought to interpret the spatial and temporal arrangement of features and artifacts to reconstruct past behavior. Accordingly, the objective of this chapter is to analyze the relationships among strata, features, artifacts, radiocarbon dates, and floral and faunal remains to piece together a view of activities and behaviors that contributed to the site's formation. The post-depositional processes, both natural and cultural, have undoubtedly affected the site's archaeological record to varying degrees, but sufficient integrity remains in portions of the site to achieve certain objectives.

Defining associations, the basis of site structure analyses, is an inherently interpretive process that relies on a series of low-level inferences, each of which has to be fairly cautious to avoid untenable assertions. The Siren site is very much the siren's song referenced by Johnson. To ferret out some of the problems and possibilities in the approach, prior to addressing the Siren site patterns, the general framework and premises involved in the study are briefly presented here. What we can say of the site structure and its behavioral implications follow afterwards.

Siren Site Structure – Limits and Possibilities

To address limitations on discerning the Siren site structure up front, the analysis must confront two main problems: palimpsest processes and the issue of contemporaneity. The former is basically the erasing of the organization of structural elements by subsequent occupations. Relatedly, the depositional context of the site rarely allows preservation of pristine ethnographically "present" surfaces in which associated, contemporary structural components can be discovered. Due in part to a very gradually aggrading depositional context over the last 2500 to 3000 years on the site (see Chapter 6), repetitive occupations tended to disturb the earlier components. Basin-shaped or pit features often cut into earlier, underlying ones, a process that created a complex stratigraphy. The simple partition of the site components based on elevation alone is therefore infeasible.

To address these problems, two basic analytical tacks are employed for the study of the Siren site data, including 1) a focus on the "skeletal morphology" or "site framework" as Binford (1983:145) called it, and 2) the development of sufficiently broad components that align with the limits of certainty afforded by the data. Regarding the first, of the various classes of data that survived on the site, the more substantial site furniture, or features, which have strong chronometric data, constitute the framework for the analysis. Many artifact classes, such as debitage, are more subject to mixing through post-depositional processes. Consequently, there are strong limitations on attributing any given provenience unit to a particular component for these classes. Where reasonable certainty of associations can be made, by all means, such are made. However, upon this frame, this skeleton of primary features, assemblages are fleshed out to the degree possible. Diagnostic artifacts, floral, and faunal remains from direct feature association are the most viable elements for defining archaeological assemblages.

Time and Structure on the Siren Site

As noted, the temporal and spatial aspects are two basic dimensions of structure. For the most part, diachronic patterns are expressed stratigraphically, or vertically, through sequentially-deposited units. Synchronic (or roughly contemporaneous) patterns are expressed horizontally along common surfaces or within strata. For the Siren site, radiocarbon dates provide the principal data for establishing the site's temporal structure. This section looks solely at the raw chronological data to identify patterns that can then be overlain on the site's depositional and cultural architecture in the subsequent sections of this chapter.

To provide an opening caveat, in terms of chronology interpretive precision is largely dictated by the degree of temporal resolution (the "grain") in the assemblage. For example, six radiocarbon dates from the Siren site fall within the range from 2610 to 2550 years ago. It is worth noting that throughout this report, unless stated otherwise, chronological data are in conventional radiocarbon years before present, which are corrected for carbon isotope ratios but are not calibrated or converted to calendrical dates. Given the lack of stratigraphic separation and the inherent standard deviation of the dates, we cannot clearly discern whether these are from the same occupation, multiple occupations by the same group through a series of years, or occupations separated by a half-century or more. Binford (1982:16–17), noting an ethnographic case in which hunter-gatherers occupied the same site seven times over the course of 4.5 months, argued that site structure quite often derives from regularities of site use. Because of such uncertainties, interpretations mainly focus on larger swaths of time, or "time-averaging" as Frederick discussed in Chapter 6.

Sixty-five radiocarbon dates comprise the primary dataset for the occupational and depositional sequence on the western part of the Siren site. If the eleven dates from SWCA's later excavations on the eastern side are added to the mix (see Peyton et al. 2013), there are a total of 76 radiocarbon dates from the site (Table 8.1). Projectile points and other temporally diagnostic artifacts also contribute to chronological considerations. However, since the temporal placement of cultural phases, periods, and artifacts is among the primary research objectives in this report, we would be remiss to assume what we seek to prove. Accordingly, the body of absolute dates forms the foundation for the following considerations of the Siren sites cultural timeframe.

A few comments on the body of radiocarbon data are warranted. The vast majority (70 of the 76 dates) are directly associated with cultural features and accordingly represent dates of occupation. Six dates, however, including one from a Rabdotus snail shell, are on noncultural materials and were used to date natural strata below the cultural zones excavated by SWCA. These six dates do not necessarily reflect cultural use of the site. Therefore, if only the dates from investigated features are considered, the occupational chronology of the Siren site, as recovered from the testing and data recovery excavations, span from 2610 to 480 B.P. There

Table 8.1. Siren Site Radiocarbon Data

SWCA Sample #	Beta #	Context	Measured ^{14}C(BP)	$^{13}C/^{12}C$ Ratio	Conventional ^{14}C (BP)*
C-97	215915	Feature 25	990 ± 40	-25.6 o/oo	980 ± 40
C-29	207247	Feature 6	990 ± 40	-25.3 o/oo	990 ± 40
E342C34	291306	See Peyton et al. 2013	1050 ± 40 BP	-26.8 o/oo	1020 ± 40 BP
C-44	250549	Feature 14	1040 ± 40	-25.4	1030 ± 40
E303C30	291304	See Peyton et al. 2013	1020 ± 30 BP	-24.4 o/oo	1030 ± 30 BP
C-47	250552	Feature 12	1050 ± 40	-25.4	1040 ± 40
E349C36	291307	See Peyton et al. 2013	1060 ± 40 BP	-25.1 o/oo	1060 ± 40 BP
E305C28	291302	See Peyton et al. 2013	1050 ± 30 BP	-24.3 o/oo	1060 ± 30 BP
C-91	250560	Feature 25	1080 ± 40	-24.2	1090 ± 40
C-48	215912	Feature 13	1120 ± 40	-26.5 o/oo	1100 ± 40
C-2	207238	Feature 1	1110 ± 40	-25.5 o/oo	1110 ± 40
C-45	250550	Feature 13	1100 ± 40	-24.5	1110 ± 40
C-46	250551	Feature 14	1140 ± 40	-26.3	1120 ± 40
C-56	250554	Feature 16	1130 ± 40	-25.2	1130 ± 40
C-7	207239	Feature 1	1150 ± 40	-24.9 o/oo	1150 ± 40
C-74	215914	Feature 16	1170 ± 40	-25.0 o/oo	1170 ± 40
C-67	250555	Feature 16	1170 ± 40	-23.9	1190 ± 40
2224C3	284541	See Peyton et al. 2013	1210 ± 40 BP	-25.6 o/oo	1200 ± 40 BP
C-72	250557	Feature 16	1260 ± 40	-24.8	1260 ± 40
C-60	215913	Feature 17	1560 ± 40	-25.8 o/oo	1550 ± 40
C-53	250553	Feature 15	1740 ± 40	-25.6	1730 ± 40
C-157	299315	No clear feature association	1750 ± 30	-25.0 o/oo	1750 ± 30
C-187	250580	No clear feature association	1810 ± 40	-25.8	1800 ± 40
C-133	250569	No clear feature association	1820 ± 50	-25.6	1810 ± 50
C-118	250566	Feature 30	1900 ± 40	-26.2	1880 ± 40
C-75	250558	Feature 18-A	1900 ± 40	-25.7	1890 ± 40
C-83	250559	Feature 20	1900 ± 40	-25.3	1900 ± 40
S-29	299317	Feature 23	1940 ± 30	-23.2 o/oo	1930 ± 30
C-68	250556	Feature 17	1970 ± 40	-25.1	1970 ± 40
C-116	250565	Feature 30	1970 ± 40	-24.8	1970 ± 40
C-27	207246	Feature 4	2030 ± 40	-26.6 o/oo	2000 ± 40
C-21	207244	Feature 4	1990 ± 40	-25.4 o/oo	2000 ± 40
C-22	207245	Feature 4	2010 ± 40	-25.4 o/oo	2000 ± 40
C-101	299314	No clear feature association	2050 ± 30	-25.2 o/oo	2050 ± 30
C-181	215921	Stratum 3	2070 ± 40	-25.1 o/oo	2070 ± 40
C-160	299316	No clear feature association	2080 ± 30	-25.4 o/oo	2080 ± 30
C-162	215919	Stratum 3	2110 ± 40	-26.1 o/oo	2090 ± 40
C-98	250561	Feature 23	2210 ± 40	-26.9	2180 ± 40
C-163	250575	Feature 41	2180 ± 40	-25.1	2180 ± 40
C-140	215917	Feature 36	2200 ± 40	-25.5 o/oo	2190 ± 40
C-173	250577	Feature 44	2250 ± 40	-26.3	2230 ± 40
C-174	250578	Feature 45	2250 ± 40	-26.3	2230 ± 40
C-152	250573	Feature 37	2270 ± 40	-25.4	2260 ± 40
C-110	250563	Feature 27	2300 ± 40	-26.9	2270 ± 40
C-144	250571	Feature 36	2350 ± 40	-27.7	2310 ± 40

Table 8.1. Siren Site Radiocarbon Data (continued)

SWCA Sample #	Beta #	Context	Measured ^{14}C(BP)	$^{13}C/^{12}C$ Ratio	Conventional ^{14}C (BP)*
C-114	250564	No clear feature association	2330 ± 40	-24.7	2330 ± 40
C-189	215922	Feature 35	2400 ± 40	-26.8 o/oo	2370 ± 40
C-172	250576	Feature 35	2390 ± 40	-25.2	2390 ± 40
S-36	299318	Feature 31	2370 ± 30	-23.3 o/oo	2400 ± 30
C-154	215918	Feature 37	2460 ± 50	-26.6 o/oo	2430 ± 50
C-191	250581	Feature 35	2460 ± 40	-26	2440 ± 40
C-128	215916	Feature 8	2490 ± 40	-26.8 o/oo	2460 ± 40
C-121	250567	Isolated burned bone	N/A	N/A	2470 ± 40
C-13	207241	below Feature 2	2480 ± 40	-25.1 o/oo	2480 ± 40
C-149	250572	Feature 8	2500 ± 40	-26.4	2480 ± 40
C-129	250568	Feature 8	2490 ± 40	-25.1	2490 ± 40
C-15	207243	Feature 3	2510 ± 40	-24.7 o/oo	2510 ± 40
C-180	250579	No clear feature association	2510 ± 40	-23.6	2530 ± 40
C-14	207242	Feature 3	2570 ± 40	-26.4 o/oo	2550 ± 40
C-12	207240	Feature 2	2600 ± 40	-27.2 o/oo	2560 ± 40
C-164	215920	Feature 8	2590 ± 40	-25.3 o/oo	2590 ± 40
C-107	250562	Feature 8	2580 ± 40	-24.5	2590 ± 40
C-138	250570	Feature 35	2610 ± 40	-25.5	2600 ± 40
C-161	250574	Feature 41	2620 ± 40	-25.7	2610 ± 40
C-192	215923	BHT E	3370 ± 40	-10.7 o/oo	3600 ± 40
C-197	215927	BHT E	4160 ± 50	-20.6 o/oo	4230 ± 50
C-196	215926	BHT E	4170 ± 50	-20.6 o/oo	4240 ± 50
C-194	215925	BHT E	4220 ± 50	-7.6 o/oo	4510 ± 50
C-41	215911	BHT D; base of slope	6760 ± 50	-9.6 o/oo	7010 ± 50
S-8	207248	Base of Stratum 3	10650 ± 60	-10.9 o/oo	10880 ± 60

* Conventional Radiocarbon Age is the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C.

Dates not clearly associated with archaeological contexts: used to define depositional chronology.

Denotes dates from eastern side of site reported in Peyton et al. (2013).

are undoubtedly earlier, deeply buried components, but, as noted, these were not investigated.

A histogram charting the frequency of dates by 100-year segments shows a tri-modal distribution with peaks from about 2600 to 2400 B.P., 2200 to 1800 B.P., and 1200 to 850 B.P. (Figure 8.2a, b). For the sake of reference, these will be designated early, middle, and late clusters. Within these three general times, the archaeological data suggests further subdivisions are possible within the middle cluster based on stratigraphic distinctions. No interpretations in terms of occupational intensity, relative group size or otherwise are offered at this point. The main intent, here, is to simply identify patterns in the temporal data that can be juxtaposed with the other, relatively independent lines of evidence.

Gaps in the data are as significant as dates themselves. The suite of dates shows consistent data throughout nearly two millennia, except the notable exception from about 1730 to 1260 B.P. During this 500-year period, a single date of 1550 B.P. from Feature 17 constitutes the only radiocarbon evidence of site occupation (Figure 8.2), but this date is contradicted by a date of 1970 B.P. from the same feature. This lack of dates stands in sharp contrast to 24 dates from the preceding 500-year period, 18 dates in the half millennium before that, and 23 dates in the 500 years after the gap. As noted in Chapter 6, there is no evidence in the site's depositional record to indicate that this segment of time was scoured away. Additionally, it is improbable scouring would have been such a clean process, leaving strata immediately below so unscathed. By all appearances it seems the investigated portions of the site were either abandoned, or there was a dramatic shift in the archaeological visibility of groups during this time.

Perhaps as notable is the lack of components postdating 850 B.P. Two radiocarbon dates indicate later occupations, but no diagnostic artifacts (such as Perdiz points or ceramics) or features dating to the later periods were clearly identified. There is a distinct possibility that later components, if they were once present, were stripped away by modern construction.

Terminus Post Quem – *A Parting Caveat in the Interpretation of Radiocarbon Dates*

Theoretically, "all radiocarbon samples provide a *terminus post quem* ('date after which') for their find context" (Bowman 1990:51). In other words, any dated material would have ceased exchanging biospheric carbon prior to its cultural use. The lag between the radiocarbon date and the actual cultural event being studied has been described as a "disjunction" (Dean 1978). Failure to recognize this discrepancy, especially in wood radiocarbon dates, has long been emphasized as a bias in archaeology that pushes chronologies towards excessive antiquity (Schiffer 1996:309).

On the Siren site, the majority of radiocarbon dates are on unidentified wood charcoal or long-lived species, most notably oak (*Quercus* sp.). The "old wood" problem, which is very applicable to oaks, is based on this principle, as described by Bowman (1990:15):

> "It is well known that trees grow by addition of rings, usually though not always annually. Once laid down, rings cease to exchange with the biosphere. Hence if one considers a long-lived tree, say a 300-year old oak, the innermost heartwood will give a radiocarbon result 300 years older than the sapwood."

There are other problems contributing to the old wood problem. Juniper, for example, is resistant to decay and can remain viable firewood for some time after death of the tree. For these reasons, to the extent possible, the Siren site analyses attempted to date short-lived species or elements such as seeds or annuals. However, in most cases, options were limited, and wood charcoal constituted the majority of dateable materials in the site. In most cases, the outer rings could not be identified in the wood sample, and so the part of the tree being dated could not be determined. Such were the limitations of the data.

To assess the old wood problem on Siren site dates, four geophytes were dated from several different features. Wood charcoal dates were also run on these features to allow direct comparisons. Comparing the dates on the short lived *Liliaceae* bulbs and the unidentified wood or long-lived *Quercus* revealed a consistent bias: the bulbs were considerably younger dates than the wood (Table 8.2). Of the seven wood dates and four bulb dates, the geophytes were younger by a range of 60 to 250 years. A charcoal-laden sediment date from Feature 35 yielded a date comparable to the geophytes. The sample is rather small, but the consistency of the bias is a cautionary tale that will be considered in parsing out the chronology of the Siren site in this and later chapters. In a broader context, it is a shot across the bow in developing unduly refined chronologies without considering the sources (Stafford [1994] provides a thorough analysis of these and other dating issues from the nearby Wilson-Leonard site).

Natural Stratigraphy

While Chapter 6 contains a detailed discussion of the geoarchaeological findings, salient details from that discussion are considered in a broader regional context to aid in further analyzing the alluvial architecture. Clearly, depositional and cultural units are entirely independent variables, but the natural strata provide data on boundaries, correlations, and contexts.

To return to one specific analysis discussed by Frederick in Chapter 6, his two geoarchaeological columns exhibit similar trends in stable isotopic carbon consisting of four distinct phases. These are reiterated here because it provides the clearest evidence of the site chronostratigraphy. The phases include:

1) Relatively high values indicative of a period of C4 plant productivity before approximately 2400 years B.P.;

2) Followed by a period of decreasing values during the subsequent Archaic occupations when C3 plant productivity was relatively high;

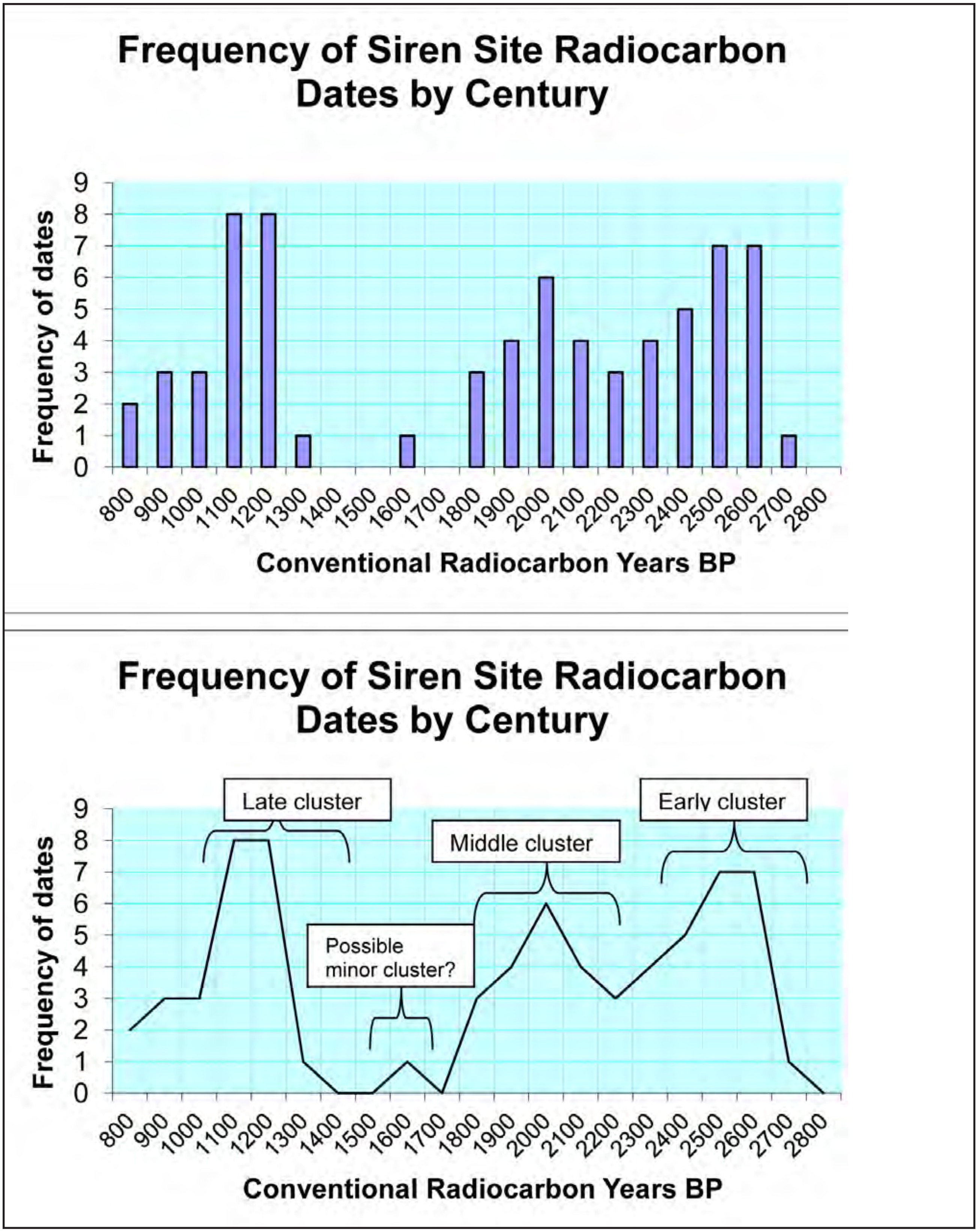


Figure 8.2. Graphical representations of the Siren site radiocarbon data. a) The histogram (top) is the technically correct method of representing frequency data. Interconnecting imposes false continuities, but is presented here for strictly illustrative purposes; b) The line graph (bottom) shows three prominent modes or clusters and a possible minor cluster of radiocarbon dates.

Table 8.2. Discrepancy Between Radiocarbon Dates on Short-lived Species Versus Unidentified Wood or Long-lived Species

Context	Date from Short-lived Species			Date from Long-lived Species or Unidentified Wood Charcoal			Discrepancy in Radiocarbon Ages
	Dated Material	Beta#	Conventional ^{14}C (BP)	Dated Material	Beta#	Conventional ^{14}C (BP)	
Feature 23	Geophyte (*Liliaceae*)	299317	1930 ± 30	Unidentified wood charcoal	250561	2180 ± 40	Geophyte date 250 years younger
Feature 8	Geophyte (*Liliaceae*)	299318	2400 ± 30	Two oak (*Quercus* sp) samples and three unidentified wood charcoal	215916 250572 250568 215920 250562	2460 ± 40 2480 ± 40 2490 ± 40 2590 ± 40 2590 ± 40	Geophyte date 60 to 190 years younger
Feature 35	Two Geophytes (*Liliaceae*)	215922 250581	2370± 40 2440± 40	Unidentified charred material	250576 250570	2390±40 2600±40	Geophyte dates equivalent to one and 160 to 230 years younger than other

3) An increase in delta ^{13}C values sometime around the Late Prehistoric (post-1250 B.P.) occupation; and

4) Decreased values in the period following the Late Prehistoric occupation.

As depicted in Figure 8.3, the quadripartite division is also generally reflected in the debitage and burned rock frequencies. These four depositional "phases" then, include one prior to roughly 2400 B.P., followed by one postdating that time, but possibly extending only to roughly 1750 B.P. based on the previously discussed radiocarbon data from the site. The 500-year chronological gap in the Siren site record is a significant question—whether it is simply a cultural hiatus or whether that section of the depositional record is missing. Regardless, the geoarchaeological study did not discern a readily apparent unconformity to indicate discontinuous depositional processes, but rather continued cumulic aggradation, and so the default suggests cultural processes. Following the gap in temporal data, the Late Prehistoric period is well represented after approximately 1100 B.P., though the dates suggest the component extends back to as early as 1260 B.P. Importantly, the depositional record shows partitions also observed in the radiocarbon data.

To assess this depositional framework within the large context, the basic strata on the Siren site have strong parallels to depositional units identified in the larger region. Fort Hood, located about 45 miles north of the Siren site, has been subject to numerous geoarchaeological studies (e.g., Abbott et al. 1996, Abbott and Trierweiler 1996; Nordt 1992, 1993, 2004) that provide an apt database for drawing broader correlations. Both the Siren site and Fort Hood are within the Brazos River drainage basin, situated along the mid- to upper stretches of prominent tributaries thereof, and occupy ecotonal settings at the margin of the Edwards Plateau.

In terms of the strata defined in Fort Hood, Nordt (1992) defined the Ford alluvium, upper West Range, and lower West Range, though the last two are perhaps subdivisions of one unit. The upper part of the generalized Fort Hood profile is an episodically cumulic surface that was draped by alluvial sediment during historic times. The upper Ford alluvium dates to

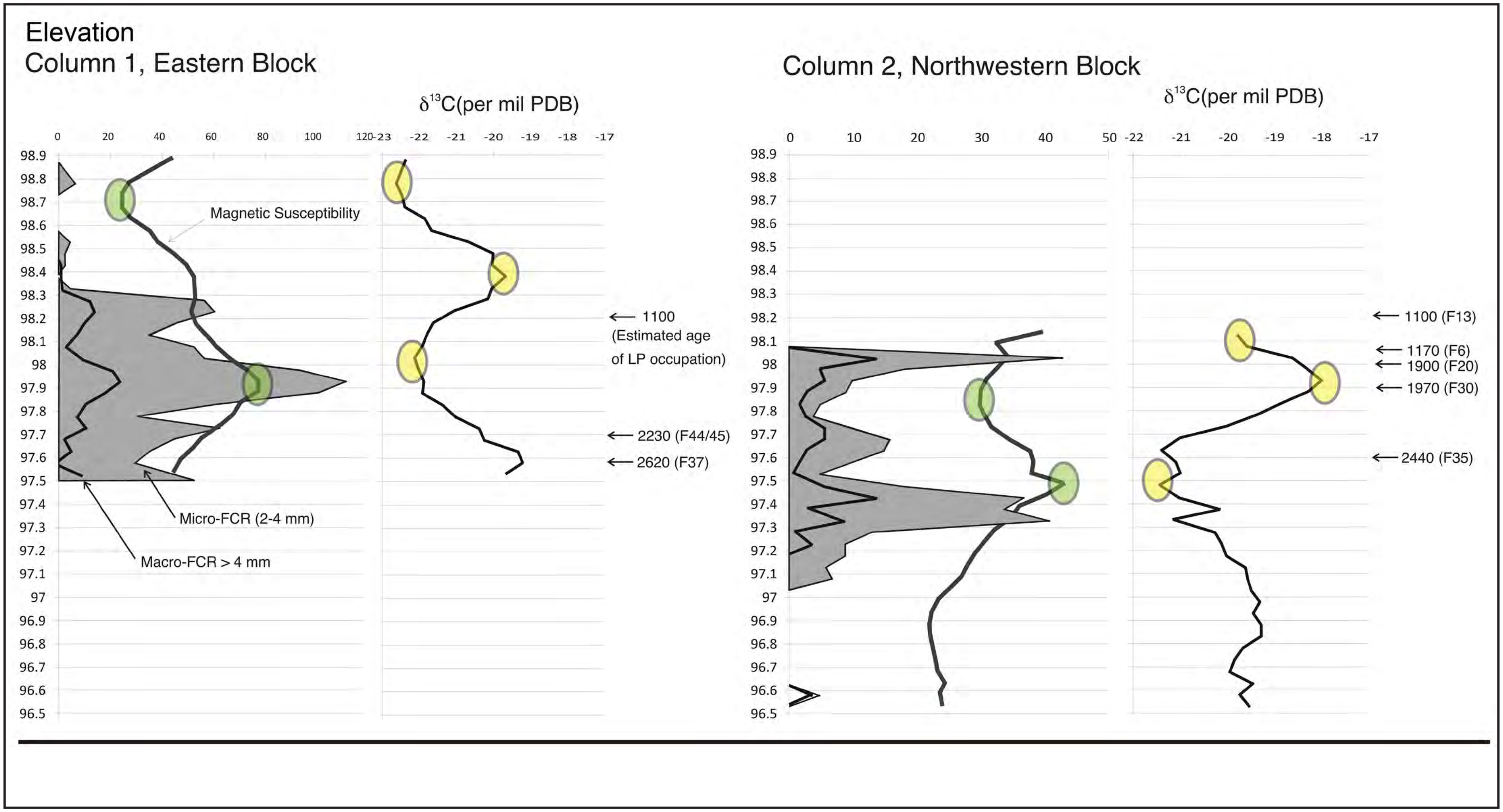


Figure 8.3. Frederick's (see Chapter 6) geomorphic, archaeological, and δ13C isotopic data showing correlations among the datasets.

400 B.P. or later based solely on the Cowhouse Creek drainage samples (Nordt 2004). On the Siren site, deposits of this time have been substantially disturbed or entirely removed by modern activities.

The core of the Siren site contains deep alluvial sediments, designated Unit 3, that began aggrading prior to 4220 B.P. (based on the earliest date in BHT E, excluding the date of 10,880 B.P. on a snail shell and a date of 7010 B.P. in a different depositional unit in BHT D) (Figure 8.4). Deposition ended sometime prior to 2610 B.P. according to dates on Features 8, 35, and 41, all of which lie immediately atop the unit. The Siren site dates are consistent with those of the lower West Range in Fort Hood, which was laid down between approximately 4200 B.P. and sometime prior to 2400 B.P. (Nordt 1995, 2004).

The division between the upper and lower West Range alluvium, according to Nordt (2004:297), was a brief erosional event with increased hydrological flow that occurred around 2400 B.P. or so. In addition to this event, Nordt (1992:21) sees a lack of alluviation between roughly 2720 and 2380 B.P. On the Siren site, there appears to be a very clear unconformity between the lower and upper depositional units, but according to the suite of dates any such erosional event would have occurred a bit earlier, perhaps prior to 2600 B.P. The Cowdog Crossing site in Fort Hood revealed a similar finding: a feature on the surface between the upper and lower West Range units yielded a date of 2590 B.P. (Carpenter, Hartnett et al. 2010:78), comporting well with the earliest Siren site dates atop the lower unit of 2610, 2600, and two dates of 2590 B.P.

The data recovery investigations were almost entirely focused upon the upper alluvial unit, Unit 2, which slowly aggraded from sometime after approximately 2600 to as late as 480 B.P. according to the latest date from the eastern side of the site (see Peyton et al. 2013). On the western side, the latest dates are about 1000 B.P., though as previously noted, the upper portion of the profile may have been entirely removed by modern construction. Chronologically, Unit 2 on the Siren site is consistent with the upper West Range alluvium in Fort Hood, which dates from roughly 2400 to 600–400 B.P. One pertinent question is the duration of the surface atop Unit 3—how long was the landform a stable surface prior to the resumption of aggradation by Unit 2? Nordt's (1992) date for the aggradation of the upper West Range at 2400 B.P., and fairly consistent dates on sites such as Cowdog Crossing and Siren, could suggest a timeframe of perhaps a few centuries of a depositional hiatus. The lack of soil development upon this contact, whether in Fort Hood or the Siren site, suggests obrution prior to notable pedogenesis. Nevertheless, the significant quantities of cultural material and substantial burned rock features on top of Unit 3 indicate this was a repetitively occupied surface of some duration.

Within Unit 2, which correlates temporally with the upper West Range, at least two subdivisions (Units 2A and 2B) are defined on the Siren site, but the depositional distinction between the two is not very clear. As noted above and in Chapter 6, the geoarchaeological study showed a distinct, post-2400 B.P. spike in C3 isotopes, followed by a relative decline at or around 1100 B.P. Between the two signatures, we know there is a 500-year gap in the radiocarbon sequence. Whether there was a corresponding depositional or erosional event could not be discerned. The nature of this gap in the sedimentary record, if there were an unconformity, may well have been obscured by pedogenic processes, particularly given the cumulic aspect of the soil. Therefore, based on the cumulative data, the upper West Range on the Siren site, began aggrading sometime after 2600 B.P., but more likely after 2400 B.P. and dates to as late as 980 B.P.

In Fort Hood, between 600 and 400 B.P., the depositional record indicates a final period of channel incision, deeply entrenching the modern channels (Nordt 1992:22). Though the upper portions of the Siren site have been removed in some areas, data from both the eastern and western sides of the site indicate a decline in alluvial aggradation after the Austin phase components at around 1000 B.P., and perhaps ending at or near the latest date of 480 B.P.

Cultural Components

Upon this chrono-stratigraphic framework, the cultural components can be defined. Following the previously discussed methodology, the initial step is to strictly look at the spatial distribution of dated features to anchor the site structure.

Site Framework or "Skeletal Morphology"

As previously detailed on Table 8.1, a total of 25 of the site's 48 features was dated using organic materials, mainly wood charcoal directly associated with human activity. One feature (Feature 41 with dates of 2180 B.P. and 2610 B.P.) yielded highly contradictory dates,

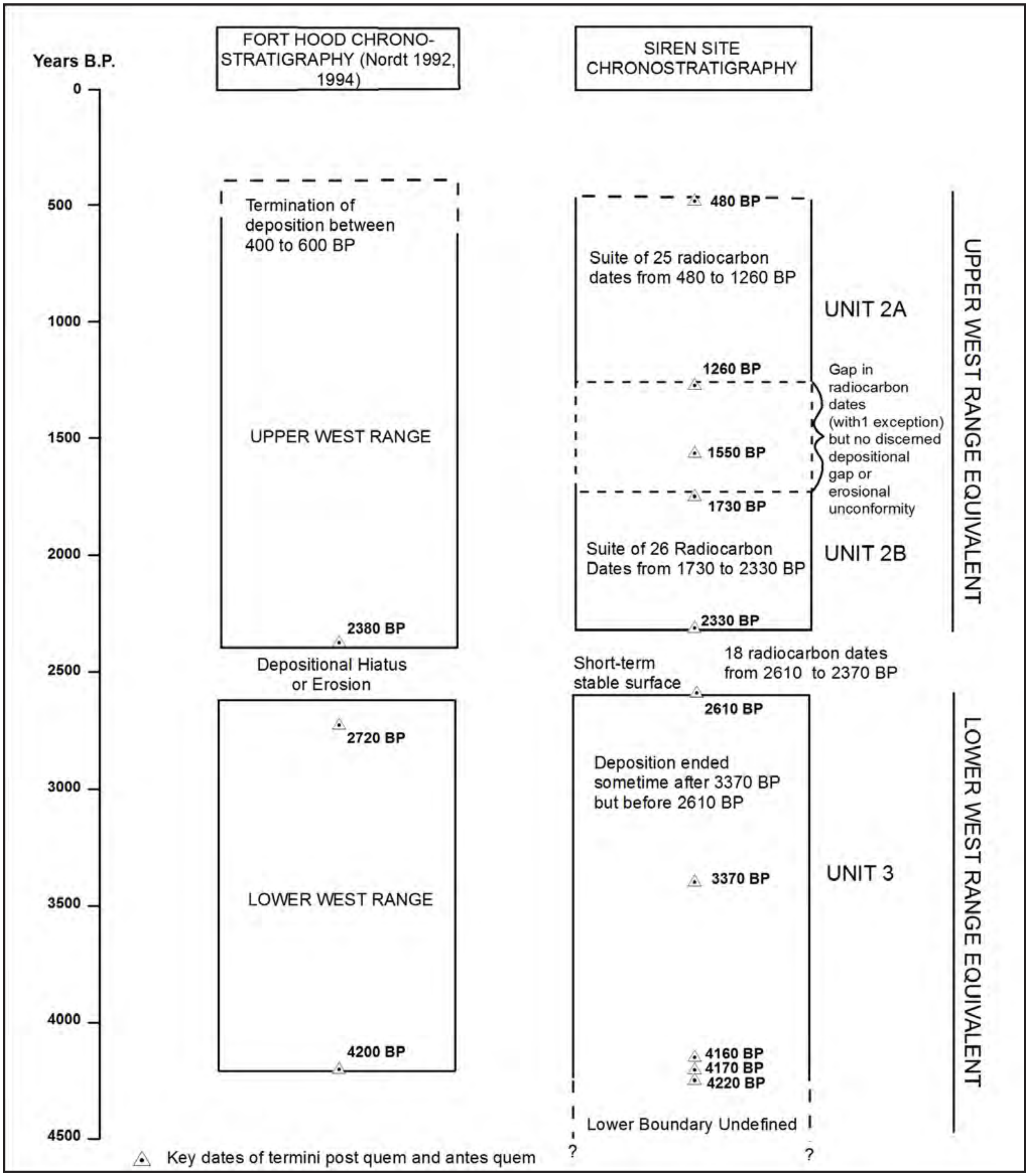


Figure 8.4. Comparison of Siren site and Fort Hood chronostratigraphies.

but the younger of the two dates is used based on the following consideration. In principle, if any two dates are associated with a feature, both representing *termini post quem* dates, then the younger of the two is the more correct. The assumptions inherent in that principle are true in all cases of radiocarbon dating, and so the logic pertains across the board. The divergent dates might be explained by the old wood problem, which is likely the case in Feature 23, in which the younger dates came from a geophyte. So although some are problematic, all 25 features comprise the database for assessing the site framework (Table 8.3). The intent is consider all of the data rather than practice the fine art of selectively throwing out those that do not fit or are otherwise problematic.

The dated features are sorted according to the temporal partitions previously addressed in the analysis of the radiocarbon data and by geoarchaeological depositional units. All non-feature dates are removed from the total suite of dates that were previously presented at the outset of this chapter, leaving only those that form the basis for the structural analysis. The resulting dates are directly associated with culturally modified organics, primary wood charcoal (i.e., omitting humate dates and snail shell dates that cannot be clearly associated with human occupation of the site). Based on the data, if interpreted in light of the slope of the natural strata, the chronological information is stratigraphically consistent, suggesting a degree of traceable cultural strata, or components. Some of the components are horizontally, as well as vertically, discrete, while others are present throughout all excavation blocks.

A second line of evidence is the other temporally indicative data, namely diagnostic artifacts. The distributions of these suggest several additional subdivisions based on distinctive correlations between features and diagnostic artifacts. The justifications for these partitions are addressed in the individual component discussions below.

Results of the Analysis: Components

Based on the analysis of correlations in distributions of features, radiocarbon dates, temporally diagnostic artifacts and stratigraphic breaks, five cultural components, or analytical units, are defined. Additionally, there is a lower undefined component that was not thoroughly investigated in the excavations.

Of the tripartite division previously discussed in the radiocarbon data, the late (980 to 1260 B.P.) and early (2370 to 2600 B.P.) clusters cannot be clearly subdivided. However, analysis of the middle cluster (dating from approximately 2310 to 1550 B.P.) supports further subdivision into three cultural components: one associated with Darl points dating from roughly 1750 to 1550 B.P., one associated with Frio, Fairland, and Ensor points dating from about 1880 to 2000 B.P., and a lower partition associated with Castroville points dating from about 2190 to 2310 B.P. The justification for this subdivision comes from the stratigraphic position of features and their consistent associations with diagnostic artifacts. Whereas Frio, Fairland, and Ensor points are inexorably intertwined stratigraphically, Darl and Castroville points, as well as temporally clustered features with similar proveniences, fall out rather distinctly from the overall middle cluster of dates. Plottings of the diagnostic artifacts by northing and elevation in each of the excavation blocks shows the statistical trend lines shows Castroville points situated below the intermixed Frio, Fairland, and Ensor points in all blocks (Figures 8.5–8.7). The NW Block shows slight ambiguity between Castroville and Frio point distributions, but the data is otherwise consistent.

Using these five divisions, the tabulated features showing the different components are plotted by northing and elevation (Table 8.4, Figure 8.8). The stratigraphic and horizontal distribution of the features is discernible. Some of the strata could conceivably be further subdivided, and future work may gather additional data to "pop the grain" (develop fine-grain analyses for higher resolution distinctions), but the divisions discussed here are reasonably conservative. Regarding a note on nomenclature, archaeologists typically prefer to designate the components consecutively from earliest to latest, but in circumstances such as in the Siren site where the earliest components are unidentified, ordering from latest to earliest is warranted. So it is here: the cultural components are defined as Components 1 through 6, from top to bottom (Figure 8.9).

The basic cultural components in the Siren site include:

- Component 1: Austin phase components - one, possibly two, sub-strata associated with Edwards and Scallorn points dating from roughly 1100 to 1000 B.P. within the upper West Range equivalent.
- Component 2: A rather ephemeral Darl-associated component dating to 1730 to 1550 B.P.

Table 8.3. Dated Features Comprising the Basis for the Analysis of Site Framework

Feature #	Beta #*	Geoarcheological Stratum	Conventional ^{14}C (BP)**
Feature 1	207238, 207239	Unit 2A	1110 ± 40; 1150 ± 40
Feature 2	207240	Atop Unit 3	2560 ± 40
Feature 3	207243, 207242	Atop Unit 3	2510 ± 40; 2550 ± 40
Feature 4	207244, 207245, 207246	Unit 2B	2000 ± 40; 2000 ± 40; 2000 ± 40
Feature 6	207247	Unit 2A	990 ± 40
Feature 8	299318, 215916, 250572, 250568, 215920, 250562	Atop Unit 3	2400 ± 30; 2460 ± 40; 2480 ± 40; 2490 ± 40; 2590 ± 40; 2590 ± 40
Feature 12	250552	Unit 2A	1040 ± 40
Feature 13	215912, 250550	Unit 2A	1100 ± 40; 1110 ± 40
Feature 14	250549, 250551	Unit 2A	1030 ± 40; 1120 ± 40
Feature 15	250553	Unit 2B	1730 ± 40
Feature 16	250554, 215914, 250555, 250557	Unit 2A	1130 ± 40; 1170 ± 40; 1190 ± 40; 1260 ± 40
Feature 17	215913, 250556	Unit 2B	1550 ± 40; 1970 ± 40
Feature 18-A	250558	Unit 2B	1890 ± 40
Feature 20	250559	Unit 2B	1900 ± 40
Feature 23	299317, 250561	Unit 2B	1930 ± 30; 2180 ± 40
Feature 25	215915	Unit 2A	980 ± 40; 1090 ± 40
Feature 27	250563	Unit 2B	2270 ± 40
Feature 30	250566, 250565	Unit 2B	1880 ± 40; 1970 ± 40
Feature 31	299318	Atop Unit 3	2400 ± 30
Feature 35	215922, 250576, 250581, 250570	Atop Unit 3	2370 ± 40; 2390 ± 40; 2400 ± 40; 2600 ± 40
Feature 36	215917, 250571	Unit 2B	2190 ± 40; 2310 ± 40
Feature 37	250573, 215918	Unit 2B	2260 ± 40; 2430 ± 50
Feature 41	250575, 250574	Atop Unit 3	2180 ± 40; 2610 ± 40
Feature 44	250577	Unit 2B	2230 ± 40
Feature 45	250578	Unit 2B	2230 ± 40

*Beta numbers listed in same order as radiocarbon dates.

** Conventional Radiocarbon Age is the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C.

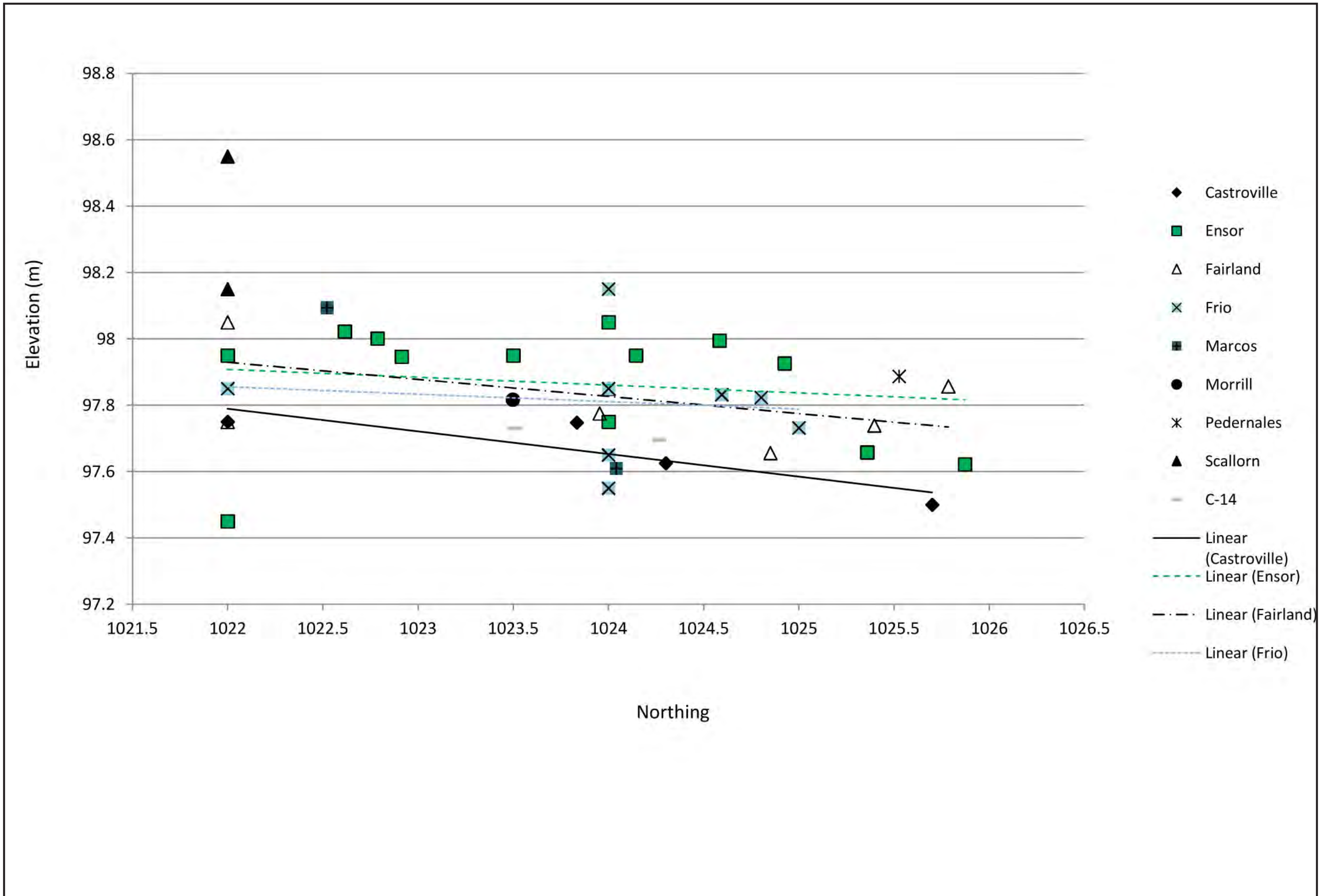


Figure 8.5. Distribution of diagnostic artifacts by northing and elevations in the E Block. Lines are statistical trend lines for select point styles. Trends reveal intermixed Frio, Fairland, and Ensor point distributions, but clear occurrence of Castroville below all three.

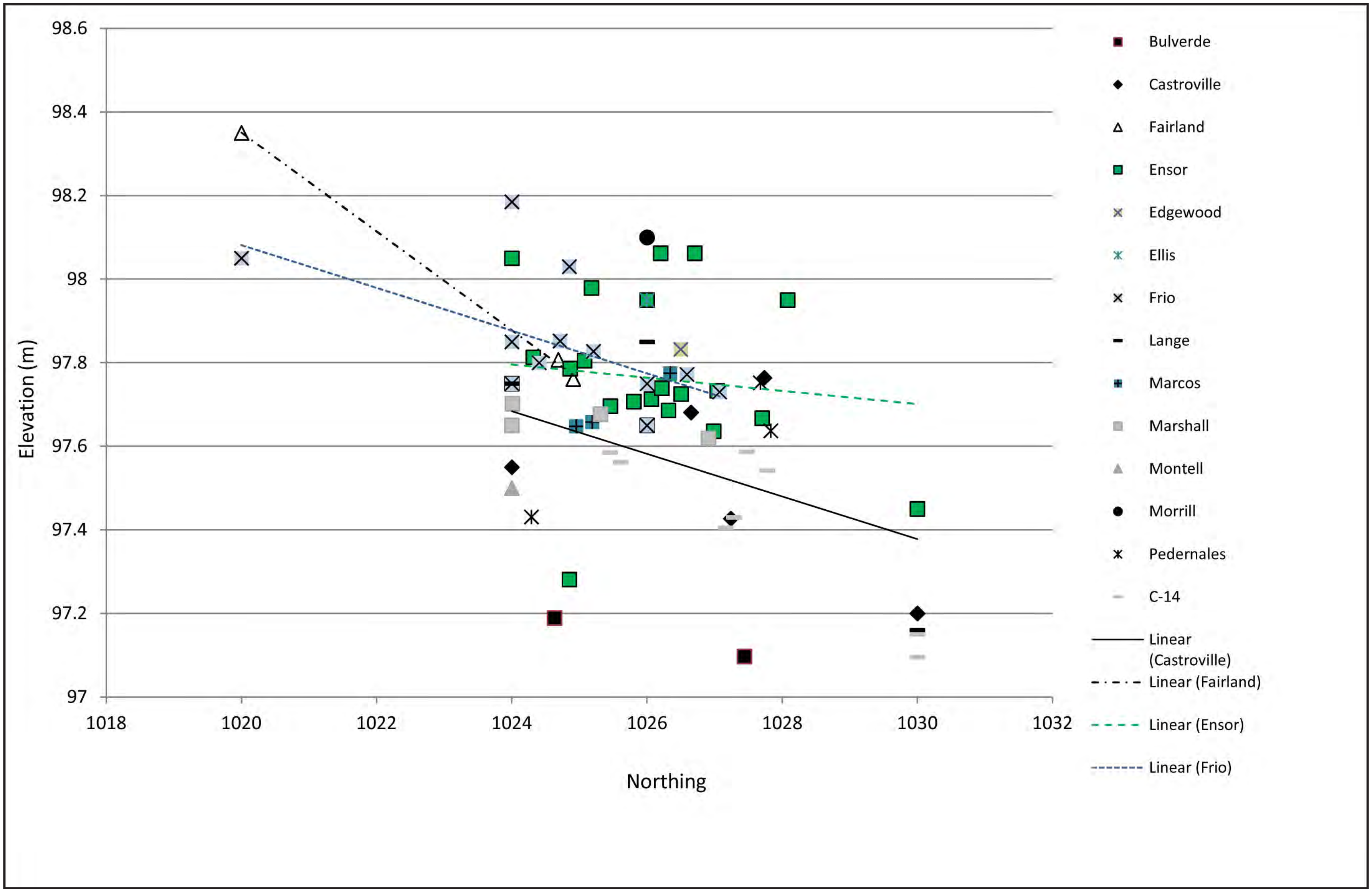


Figure 8.6. Distribution of diagnostic artifacts by northing and elevations in the NE Block. Trend lines show Castroville points below Frio, Fairland, and Ensor points as discerned in the E Block.

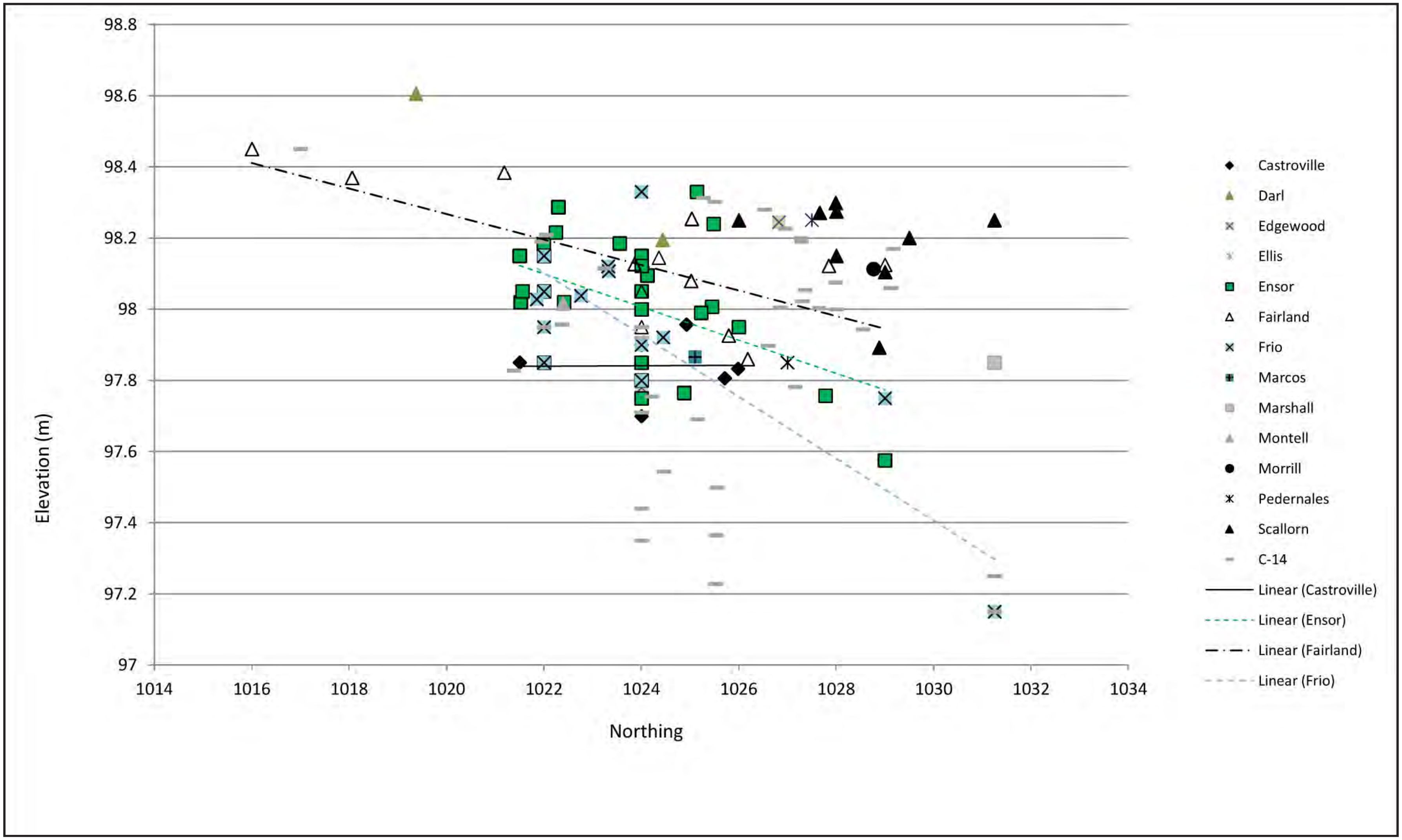


Figure 8.7. Distribution of diagnostic artifacts by northing and elevations in the NW Block. Trend lines show Castroville points generally below Frio, Fairland, and Ensor points as identified in other blocks, but the trend line crosses Frio points indicating less stratigraphic integrity in the block.

- Component 3: Two possibly distinct components associated with Ensor, Frio, and Fairland projectile points dating to 2000 and 1900 B.P., firmly within the upper West Range equivalent.
- Component 4: A component, apparently associated with Castroville points, that dates to about 2250 B.P. and is situated within the upper West Range equivalent.
- Component 5: Dense occupational debris dating from 2600 to 2400 B.P. lying on a short-lived stable surface at the contact between the upper and lower West Range equivalent units.
- Component 6: Deeply buried, undifferentiated Archaic components in the lower West Range equivalent pre-dating circa 2600 B.P.

The evidence for these components and their associations are laid out in this section. The units have differing degrees of clarity in their stratigraphic separation. As noted, a suite of circumstances have resulted in creating complex stratigraphic relationships. Nevertheless, using the methods previously discussed, the framework is discernible.

Component 1

Component 1 falls within depositional unit 2A and dates from 1260 to 980 B.P., although the dates tend to center at 1100 to 1000 B.P., falling within the well-established dates of the Austin phase within the early part of the Late Prehistoric period. Edwards and Scallorn arrow points are associated with the component. The dated features are all on the northern side of the excavations, close the current terrace edge as it drops

Table 8.4. All Dated Cultural Features Ordered by Components (color coded to correlate with Figure 8.8)

Cultural Component	Context	Conventional ^{14}C (BP)
1A	Feature 25	980 ± 40; 1090 ± 40
1A	Feature 6	990 ± 40
1A	Feature 12	1040 ± 40
1B	Feature 14	1030 ± 40; 1120 ± 40
1B	Feature 13	1100 ± 40; 1110 ± 40
1B	Feature 1	1110 ± 40; 1150 ± 40
1B	Feature 16	1130 ± 40; 1170 ± 40; 1190 ± 40; 1260 ± 40
2	Feature 17	1550 ± 40; 1970 ± 40
2	Feature 15	1730 ± 40
3	Feature 30	1880 ± 40; 1970 ± 40
3	Feature 18-A	1890 ± 40
3	Feature 20	1900 ± 40
3	Feature 23	1930 ± 30; 2180 ± 40
3	Feature 4	2000 ± 40; 2000 ± 40; 2000 ± 40
4	Feature 36	2190 ± 40, 2310 ± 40
4	Feature 44	2230 ± 40
4	Feature 45	2230 ± 40
4	Feature 37	2260 ± 40; 2430 ± 50
4	Feature 27	2270 ± 40
4	Feature 41	2180 ± 40; 2610 ± 40
5	Feature 35	2370 ± 40; 2390 ± 40; 2400 ± 40; 2600 ± 40
5	Feature 31	2400 ± 40
5	Feature 8	2400 ± 30; 2460 ± 40; 2480 ± 40; 2490 ± 40; 2590 ± 40; 2590 ± 40
5	Feature 3	2510 ± 40; 2550 ± 40
5	Feature 2	2560 ± 40

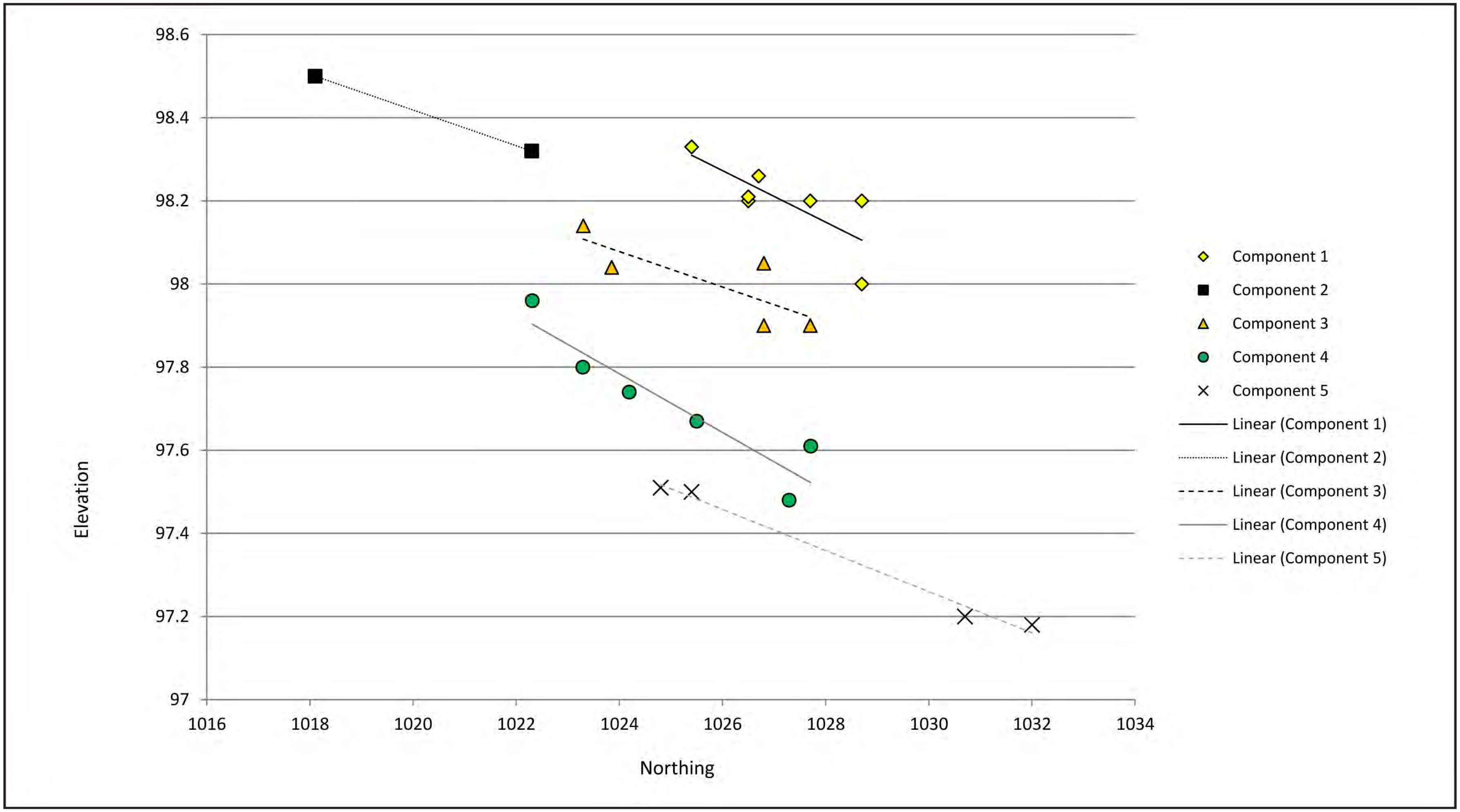


Figure 8.8. Distribution of dated features by northing, elevations and components. The lines are statistical trend lines showing mid-lines for each component. Trend lines reveal sloping, but stratigrapically distinct components, some of which (such as Component 2) are horizontally segregated as well.

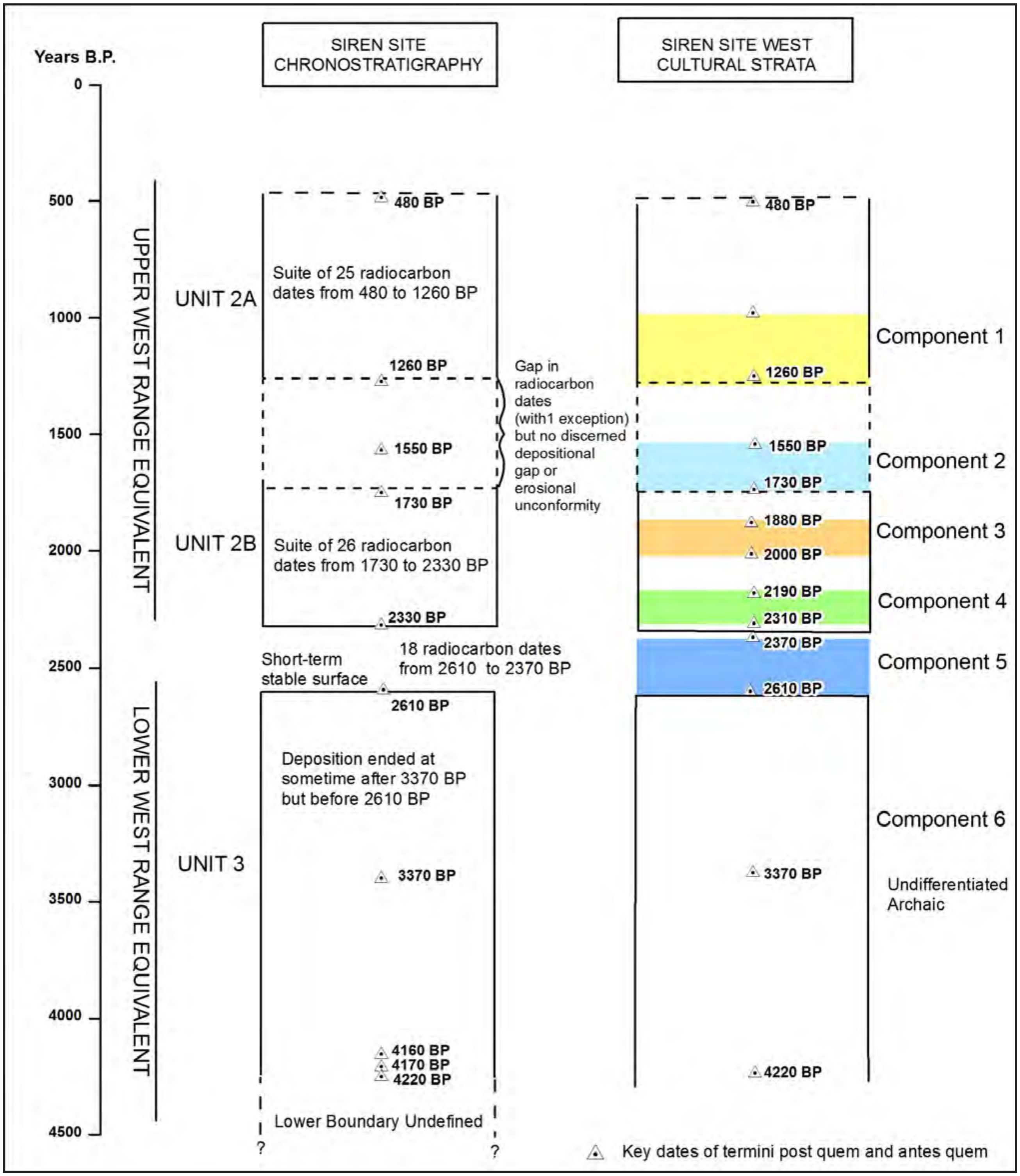


Figure 8.9. Cultural components in relation to natural strata.

to the San Gabriel River. At risk of over-interpreting the data, there is a possibility that there are two distinct components within Component 1, one that dates to around 1000 B.P. and one that dates roughly a century later (Component 1A and 1B on Table 8.4). This possibility is distinctly realized on the eastern side of the site (see Peyton et al. 2013) where two Austin phase components are very clearly stratigraphically isolable. In the final analysis, however, on the western side, there are probably insufficient data to firmly establish such distinctions. Nevertheless, a brief discussion of subtle shifts in feature technology is ventured here to address certain possibilities. The meaning of the distinction will be made clear afterwards.

There is one rather curious matter in the Component 1 features: the three later features in the Component are below the four earlier dates, a case of apparent reverse stratigraphy. In one case, that of Feature 25, the reason is clear: it is a pit feature that was dug down and below the earlier Austin phase features (Figure 8.10). Any such pits in the other Component 1 features are unclear. It is difficult to say with certainty given the small sample size, but the use of pits on the Siren site may have been a technological distinction that occurred in the later end of the Austin phase. At the Hoxie Bridge site and elsewhere in the San Gabriel River valley, hearth features that dated to 800 B.P. (associated with a Scallorn point) and later were often constructed in straight walled pits dug 20 to 30 cm below the occupational surface (Bond 1978:124). Bond notes two hearths styles, those with in deep, vertical-sided pits and those in shallow basins. "The tentative evidence… suggested there was a temporal separation of these types, the former possibly being typical of the Toyah and/or Austin Phase occupations while the latter might be related to the Darl point related to the Twin Sisters" (Bond 1978:124). To this observation, we can add that such pit features do appear to be temporally distinct between the earlier Archaic and Late Prehistoric phases on the Siren site, but the advent of the deeper pits may be a technological change introduced *during* the Austin phase, rather than at the beginning. Further evidence is needed to corroborate these observations.

Overall, the Component 1 feature assemblage represents a stratigraphically distinct component primarily distributed on the northern edge of the site terrace (i.e., north of the N1025 grid line). Within the features, there is a possible stratigraphic and technological distinction that suggests further site structure implications.

Figure 8.10. Feature 25 showing possible pit wall (noted by white arrow) in profile, indicating intrusion into underlying stratum.

However, the dataset is rather small to draw clear conclusions.

Component 2

Component 2, among the most elusive of components, is evident by two burned rock features dating to 1730 B.P. and a split date of 1550 B.P. and 1970 B.P. on Feature 17. The highly discrepant dates on Feature 17, varying by 420 years, cast a bit of uncertainty over clear temporal resolution of this component. Two Darl points, both of which were found in relative proximity to the features, are tentatively associated with the component.

Collectively, the features and points are situated along the southern edge of the terrace, higher up on the landform than the other components. The spatial distribution of the component is almost entirely exclusive of the Austin phase materials, very little if any overlap exists between the two components. The Component 2 position would have been nearer the valley wall where shelters and overhangs formed in the limestone bluffs. These, however, were graded back in modern times when the interstate was constructed.

Of note, Prewitt (1981b:82), in describing the Darl-era site distribution patterns stated: "While sparse occupation of rockshelters occurred during several of the preceding Archaic phases, there seems to be a decided shift toward the occupation of those site types during the Driftwood phase." So perhaps, in a subtle way, the distinctive lack of Darl component features in the central excavation blocks, and their focus on the upper slope, reflect the much more widely observed settlement pattern shift characteristic of the time. Such a pattern could explain the previously mentioned 500-year gap in the site's radiocarbon chronology—conceivably the lower terrace was abandoned in favor of the sheltered bluffs during the time. This is an untested possibility, though, and, within the right-of-way, these deposits may have been destroyed or deeply buried by road fill and a concrete apron.

Component 3

Component 3, in contrast to Component 2, has high archaeological visibility and is represented by five features, nine radiocarbon dates, and numerous Fairland, Frio, and Ensor projectile points. The total collection of date centroids range from 1880 to 2180 B.P., and, based on a seemingly bimodal distribution of the radiocarbon dates, it is possible there are two subdivisions of the component. As shown in Figure 6.4, there is some stratigraphic corroboration of the subdivision as the three older dated features are consistently below the younger features. If true that there are two substrata, the earlier perhaps dates to around 2000 B.P. and the later to about 1900 B.P.

The dated features attributable to the component are found only in the NW Block. Spatially, however, all of the Component 3 features are intermingled and clustered around a centroid of approximately N1026 E1007. Diagnostic artifacts associated with the components, however, are common throughout all blocks. As previously noted and depicted in Figures 8.5–8.7, the distribution of points show Ensors, Fairland, and Frio points in a rather consistent stratigraphic position, sloping downward to the north, above Castroville, Marshall, Marcos, and other broad-bladed point types. At least this is true in the higher elevation portions in the site center. An odd thing occurs on the northern part of the excavations as earlier point types seem to begin appearing above or intermingled with later points. There is insufficient data to clearly discern the reasoning behind this—possibly the northern edge of the site served as a toss zone. As features were excavated into earlier deposits, those materials were tossed beyond the central occupational areas. Regardless, in all blocks stratigraphic positions of diagnostic points, features, and radiocarbon dates are typically consistent in the central portion of the site, becoming more jumbled on the periphery.

One distinguishing characteristic of Component 3 is the relative high numbers of projectile points. The site yielded a total of 215 projectile points that could be typed. Of these 215, a total of 147 points, or 68 percent, are types (Frio, Fairland, and Ensor) assigned to Component 3. Such a prominent discard rate could be suggestive of several possibilities, including intensity of occupation during the time, a strong pattern of base camp retooling characteristic of collector-logistical strategies, a comparatively high need for missile weaponry for hunting or warfare, among other possibilities. The later interpretive chapters consider these variables in more detail.

Component 4

Component 4, a rather prominent component, comprises five or possibly six dated features and broad-bladed points such as Castroville and possibly Marcos. The distribution of Component 4 features entirely contrasts the patterns in Component 3. All dated features from Component 4 are in the eastern blocks; no dated components are identified in the NW Block, though there are diagnostic artifacts from Component 4 in the western excavation areas. The total collection of date centroids are rather tightly clustered from 2190 to 2310 B.P. One feature, Feature 41, has two highly discrepant dates of 2180 and 2610 B.P. and so its chronological affiliation is not entirely clear, but, following the reasoning previously addressed, the younger date is considered closer to the date of occupation.

Stratigraphically, the E Block data shows the most distinctive association of Castroville points and the Component 4 features. While the unit clearly slopes downward to the north, the three Castroville points in the block, as well as one Marcos point, are consistently below the Ensor, Fairland and Frio points. In the NE Block, Castroville points likewise fall out below the later point types, though the northern portions of the show stratigraphically mixed deposits with numerous types intermixed throughout the profile.

Component 5

Component 5 is most notable for substantial burned rock features, including Feature 8, a burned rock midden, and Feature 35, a formal slab-lined pit or oven. The component is interpreted as having formed on a stable surface atop the lower West Range equivalent between approximately 2600 and 2400/2300 years ago. The stable depositional context was perhaps, in part, responsible for the large quantities of debris, but the feature technology of the times is clearly a contributing factor to the sheer quantity of materials. In the western excavation blocks, where the majority of features associated with Component 5 are located, mixing obscures stratigraphic integrity. In the eastern blocks, there is a slight suggestion that Marshall points are below the Castroville points and possibly associated with the component. Montell points were also recovered, mainly in the western blocks, but the association of these with either Components 4 or 5 is not clear.

Component 6

Component 6 comprises undifferentiated Archaic components in the deep lower West Range equivalent, which are relatively rapidly aggrading sediments. These deposits were not the focal point of the investigations, in part for lack of clearly discernible intact deposits, but also since these would not bear the brunt of proposed project impacts. Dates of 3600 B.P., a cluster of three dates ranging from 4230 to 4510 B.P., and two earlier dates of 7010 and 10,880 B.P. were obtained for the deep deposits. The earliest of these dates was on a snail shell and warrants extreme caution until such dates can be assessed for affects of local environmental carbonates. The three dates of 4230, 4240, and 4510 B.P., which were recovered from 4.25 to 5.8 m below surface, are consistent with Nordt's (1992) early dates of circa 4200 B.P. for initial deposition the lower West Range.

No in situ features or diagnostic artifacts were recovered from Component 6, although Bulverde and Pedernales points, most of which appear to be clearly displaced, were found in the site assemblage and may reflect poorly defined components just beneath Component 5. Some chronologies indicate Pedernales points date to as late as 2600 B.P. (e.g., Collins et al. 2011:19), but most place them earlier. Nevertheless, there may have been a component in Component 6 associated with these styles that was heavily impacted by the substantial and intrusive features of the subsequent component.

Assemblages

Defining assemblages in the Siren site data is an interpretive process based on associations. Whereas the feature framework shows fairly consistent stratigraphic separation, the artifacts are more mobile and conducive to mixing among strata. To develop the best estimation of discrete assemblages in the site materials, a conservative approach is adopted here. As discussed at the outset, the methodology for site structure is a several tiered process: the skeletal morphology was established based on features and natural depositional units, then the artifacts are added to flesh out the overall picture. To assign proveniences to the different strata, we key on well-dated features of known stratigraphic affiliation and assign all proveniences in a 1-m-radius to the respective cultural component. Regarding elevation, the feature's surface of origination is used. So for example, Feature 35 is the well-dated, large basin feature assigned to Component 5. During its construction, the basin was excavated down roughly 30 to 40 cm into the underlying Component 6. For purposes of defining assemblages, the contents of the feature and all proveniences within a meter surrounding the margin of the feature at its surface of origination are assigned to Component 5. The intent in the method is to excise much of the uncertainty by strongly focusing on close associations to known structural components. In so doing, however, only 30 percent of the total provenience units were assigned to cultural strata. As noted, it is a conservative approach, but the caveat regarding the siren's call stated at outset of this chapter warrants such measures.

By these methods, Table 8.5 provides the assemblages for each component, excluding Component 6, which yielded no features to clearly key on. The data are simply introduced here, withholding interpretations regarding the implications of the internal ratios among categories until Chapter 11. However, a few preemptive observations are noted here. In terms of richness (diversity of categories) and robustness (statistical viability within categories), Component 2 has a low archaeological visibility, whereas Component 4 is by far the most prominent. The other components are somewhat equitably represented, but there is a general trend towards increasingly substantial assemblages through time, the implications of which are discussed in the subsequent chapters.

The temporally diagnostic artifacts provide some of the most telling information on the nature of the Siren site assemblages. Table 8.6 shows an underlying trend of integrity veiled by incongruities. Component 1, the Late Prehistoric Austin phase component, includes 10 arrow points, as it should, but also four dart points that are typically surmised to date earlier. Though one arrow point was recovered from Component 4, 10 of the 11 arrow points assigned to components fall within the expected strata, indicating a degree of integrity.

Table 8.5. Artifact Assemblages by Cultural Strata

Artifact Type	Component 1		Component 2		Component 3		Component 4		Component 5	
	#	Weight (g)	#	Weight (g)	#	Weight (g)	#	Weight (g)	#	Weight (g)
Antler Tool	0	0.0	0	0.0	0	0.0	0	0.0	1	86.5
Arrow Point	10	7.7	0	0.0	1	0.3	2	2.9	0	0.0
Biface	15	116.4	4	22.5	45	944.6	66	1,598.8	17	590.8
Bone	36	31,661.7	NA*	225.4	92	931.2	NA*	2,949.1	38	439.6
Bone Tool	0	0.0	0	0.0	1	3.0	3	2.6	0	0.0
Burned Rock	1,742	182,800.0	1,654	103,500.0	6,684	350,300.0	8,071	756,600.0	5,693	440,284.5
Core	1	135.3	1	124.2	2	594.9	15	2,730.0	4	766.9
Dart Point	4	12.0	0	0.0	25	90.5	37	230.3	7	44.6
Debitage	3,787	32,506.5	1,670	201.2	10,895	533.0	17,568	0.0	5,130	842.1
Drill	0	0.0	0	0.0	0	0.0	1	17.4	0	0.0
Flake Tool	1	60.3	0	0.0	0	0.0	0	0.0	0	0.0
Graver	0	0.0	0	0.0	1	13.9	0	0.0	0	0.0
Mano	1	512.0	0	0.0	1	336.0	1	679.0	0	0.0
Metate	0	0.0	0	0.0	0	0.0	1	1,750.0	0	0.0
Modified Flake	7	116.1	0	0.0	12	581.1	16	564.7	6	157.8
Mussel Shell	8	0.5	3	0.8	2	3.2	0	0.0	8	0.0
Ochre	0	0.0	0	0.0	0	0.0	0	0.0	2	138.9
Scraper	3	72.1	0	0.0	5	185.6	20	1,110.7	1	12.6
Tested Cobble	0	0.0	0	0.0	0	0.0	1	302.9	0	0.0
Total Counts and Weights	**5,615**	**248,000.6**	**3,332**	**104,074.1**	**17,766**	**354,517.3**	**25,802**	**768,538.4**	**10,907**	**443,364.3**

*NA - data not available

Component 3 likewise retains a semblance of integrity with the style dominated by Ensor, Fairland, and Frio, with minor contributions of an earlier and later style (according to most chronological placements). Strata 4 and 5 are perhaps the more problematic, probably as a result of several processes. The natural depositional context during this time was one of stability or gradual aggradation, a setting conducive to mixed deposits. Secondly, post-depositional processes, such as intrusive features from later occupations, were likely substantial. Nevertheless, both the underlying intact sequence and the obscuring processes have to be considered simultaneously.

Summary and Implications of Siren Site Structure

In the final analysis, the Siren site is one with "strata rich in artifacts but obscure in origin" (Johnson 1987:5). But, if Johnson's cautionary tale of the hapless prehistorian lured by the siren's call is woven into the interpretations, all is not lost. Some might look at mixed diagnostic artifacts and put wax in their ears, passing by in a quixotic quest for purity. The fact of the matter is that the Siren site is highly representative of the regional archaeological record, and finding ways of responsibly drawing good data from among the bad and ugly will offer considerable advances to Texas archaeology (as well as far beyond the state's borders). Such palimpsest processes are worldwide. Analytical methods that target the structural components of the site indicate there are fundamental, intact portions of the site. The structural aspects of the Siren site will support the weight of meaningful interpretations. The assemblage data, the flesh on the skeletal morphology, is less certain and constitutes a "data cloud" that offers only general trends. These should not to be underestimated either. With sustained scrutiny, ranges of probabilities can be increasingly defined. The information is there.

Table 8.6. Diagnostic Artifacts in Assemblages of Each Cultural Component

Cultural Component	Diagnostic Artifacts
1	6 Scallorn, 1 Edwards, 3 untyped arrow points, 1 Ellis, 1 Ensor, 2 untyped dart points
2	None
3	9 Ensor, 6 Fairland, 4 Frio, 1 Castroville, 1 Darl, 4 untyped dart points
4	1 Castroville, 1 Marcos, 3 Marshall, 1 Lange, 1 Morrill, 9 Ensor, 2 Fairland, 10 Frio, 1 Montell, 8 untyped dart points, 1 untyped arrow point
5	1 Marcos, 4 Frio, 2 Ensor, 1 Castroville

Chapter 9

Chronology and the End of the Archaic

Stephen M. Carpenter and Brett A. Houk

Introduction

Battles that are never decisively resolved tend to be refought until some resolution is attained, for better or worse. Cultural chronology has been a central, and often contentious, issue in Texas archaeology from the beginning. While much ink has been spilled, and through quite a bit of lateral movement, there has been gradual progress in developing finer resolution in the spatial and chronological divisions of archaeological units. But the conflicting views have never been conclusively resolved, and they likely never will. The most consequential differences have centered upon the final phases of the Archaic, namely the Uvalde, Twin Sisters, and Driftwood phases as defined by Prewitt (1981b, 1985), which form the basis for many of the more general works. A long string of critiques have asserted these are flawed, casting confusion on one of the two most pivotal transitions in all of prehistory, the transition from Archaic to Late Prehistoric lifeways. The Siren site, which offers comparative clarity on this obscure part of the archaeological record, strongly contradicts some well-established temporal constructs, but in the end is highly consistent with the regional data.

The long road to the current understanding of Central Texas chronology is littered with debates of the proper taxonomic units and their formulation. We have no interest in resurrecting these, but we do need to very briefly wade into the fray to establish a context. In comparing the Siren site record to the many extant chronologies, there is a need to sort out the different classifications and underlying premises so that true contradictions can be drawn to the front. Prior to 1987, most chronologies were focused on the finer divisions of chronology and used phases as the primary division. Subsequent to 1987, none of the major chronologies have used phases, preferring instead more general categories of stages or periods.

To indicate where the undercurrents of this chapter are heading and to avoid adding to the discord, a key to the analysis in this chapter is drawing careful partitions between spatial, temporal, archaeological, and socio-cultural aspects of classification. The conflation of these differing aspects in cultural taxonomy has long been a source of great confusion. In drawing clear distinctions, some clarity might be projected onto the multiple layers of evidence, allowing development of a perspective on the cultural processes happening at the end of the Archaic. Salient among these processes is the nature of the transition between two major stages of prehistory, the Archaic to the Late Prehistoric.

This chapter necessarily begins with a review of important terms and concepts, before reviewing the literature on Central Texas chronology, with a focus on the various schemes for the end of the Archaic period. The Siren site chronology is then compared to the existing models, and similarities and differences are addressed to propose a revised chronology for the latter part of the Archaic and the beginning of the Late Prehistoric. Finally, some thoughts on future research directions are offered.

Culture History Systematics—A Brief Definition of Terms

In 1958, Willey and Phillips (1958), building upon the efforts of many before them, established a workable blueprint for the basic archaeological unit concepts. That work has been cited as the authority in many of the Central Texas cultural chronologies addressed in this chapter (i.e., Black 1989; Johnson 1987; Prewitt 1981b, 1985). Accordingly, a brief look at the basic concepts in that work is reviewed prior to moving on to the implications for Central Texas chronology.

Underlying Willey and Phillips's (1958) effort was a clear distinction between descriptive and explanatory units—we return to that premise below. There are three primary partitions of descriptive units: temporal, spatial, and archaeological. For the temporal aspects, there are local and regional sequences. For spatial divisions, there are sites, localities, regions, subareas, and areas. Archaeological units include components, phases, and subphases (Figure 9.1). To draw broader correlations among some of these categories, horizons (broad spatial distributions with shallow time depth) and traditions (fairly spatially specific patterns with

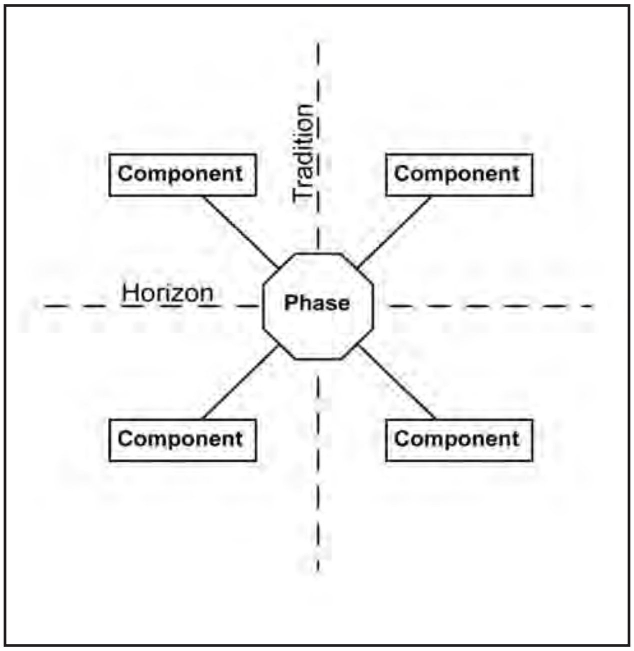


Figure 9.1. Willey and Phillips's (1958) archaeological units. Components compose a phase, dependent on time depth, phases can be horizons or region-specific traditions.

deep time depth), were called integrative units. For the most part these are all descriptive categories of analysis. The explanatory level is triggered when inferring social aspects of the descriptive units. Crossing that threshold is the crux of many problems. The conflation of different descriptive categories is another source of confusion. For example, while phases are often inferred to correlate with regional spatial contexts, the Toyah phase is identified in at least five established archaeological regions in Texas. The archaeological and spatial units ought not be inextricably bound.

Chimeras and Gordian Knots – Moving Beyond the Plague of Phases

The mythical chimera is a figure with a lion's head vomiting fire, a goat's body, and serpent's tail. In more common usage, a chimera is an entity composed of incongruous parts. The concept of a "phase" is at once the keystone of culture history, but also a source of unending confusion, largely because of its chimerical nature. Originally, it was defined as an archaeological unit consisting of comparable components on different sites that contained unifying characteristic distinguishing them from others (Kidder et al. 1946; Willey and Phillips 1958:21–22). As noted, it was largely a descriptive unit. However, the meaning of a phase became so intertwined with social and ethnic correlations, developmental implications, and spatio-temporal parameters that it became an unwieldy construct, one comprising incongruous parts.

Johnson's (1987) previously mentioned critique of the "plague of phases" slashed through the intractable complications. However, he did so by wedding the notion of phase to ethnic and social connotations, thereby making it a theoretically untenable construct. This is clearly the case in his 1987 critique, but, in his earlier discussion of the same issue, he seems to go into a fair amount of detail on the careful delineation between archaeological and socio-cultural facets (Johnson 1967:1–10). That distinction is almost entirely lost in his 1987 work, where Johnson repeatedly refers to phases as socio-cultural or ethnic units, and uses that definition as the basis for critiquing previous efforts in Texas archaeology. He furthermore noted that Willey and Phillip's (1958) "failure to illustrate in more detail the mechanics of phase recognition has brought more than one archaeologist to grief" (Johnson 1987:5).

The effect of Johnson's critique seems to have been the abandonment of the notion of phase in Central Texas chronology, though it has continued in most other portions of the state. Prior to 1987, nearly all Central Texas chronologies (e.g., Kelley 1947; Prewitt 1981b, 1985; Shafer 1963; Sorrow et al. 1967; Weir 1976a, 1976b) used phases or foci as the basic unit. Since that time, the phase designation has not been used in the more recent chronologies (e.g., Black 1989; Collins 1995, 2004; Johnson 1995; Johnson and Goode 1994), and has become increasingly uncommon in the literature.

However, Johnson's formulation of phase oversteps the bounds of interpretive responsibility. A barrage of social theory applied to archaeology over the last 40 years has increasingly made the case that the archaeological record is not "fossilized society" (see overviews by Schiffer 1995 and Earle 2008). Willey and Phillips (1958:49) said the social "equivalent of 'phase' ought to be 'society,' and in a good many cases it probably is." They also warned that "finding social equivalents for archaeological units is beset by the most formidable difficulties, most of which stem from the fact that the kinds of data archaeology depends on are precisely those elements of culture that diffuse most readily across social and political boundaries" (Willey and Phillips 1958:48).

There is a strong need to maintain the distinction of a phase as strictly an archaeological unit separate from a socio-cultural one. First, the interpretive gap between the two, which has been a primary theoretical field in archaeology over the last few decades, has revealed the complexity of the interrelationship between the material remains and the society that produced them, precluding direct correlations (Hodder 1991, 1999; Meskell 2005; Preucel 1991:3–14; Webster 2008:22). Secondly and relatedly, careful maintenance of the long-recognized dictum that the archaeological record is not culture itself is warranted to uphold objectivity to the extent feasible. An "archaeological culture" (Ford 1954:47), the material remains of the cultures that produced it, serves as the most fundamental building blocks of prehistoric reconstruction. By maintaining a separation of the archaeological evidence from the interpretation, the two aspects can be considered independently without undue prejudicial influences.

Though the Gordian Knot was slashed, the problem did not go away. The utility of the "phase as the 'manageable' unit of archaeological study" still holds true for many of the reasons Willey and Phillips (1958:40) discuss, most notably at the basic comparative level within and among sites. The problem can be ignored by presenting broad syntheses, but the nature of our objectives in this report is to build up from the components at the Siren site towards the broader frameworks. How do our components compare to other archaeological units? While Johnson's critique is based on what "ought" to be, and the direction that culture history needs to go, more latitude is needed to define basic archaeological units currently unencumbered by incongruous aspects. The phase, as originally defined, is that construct. Ultimately, it is true that "New World archeology is anthropology, or it is nothing" (Phillips 1955:246–247), but archaeology must arrive at anthropology through the material record.

Objectives of Siren site Chronology

The research design comprised five specific questions that would lead towards addressing one pertinent and overarching regional research question: Is the 'transition' from the end of the Archaic period to the beginning of the Late Prehistoric period in Central Texas a viable chronological interval, and, if so, what are its characteristics? The question is largely one regarding an analysis of long-term change, but also looking at the social and economic cycles that affected the changes from Archaic to Late Prehistoric lifeways. The intent of this chapter is to tie the Siren site cultural chronology into the regional information to establish a temporal framework for addressing the issues.

Accordingly, the chronology research issue is designed to build upon previous efforts by using radiocarbon, feature, and artifact data from the Siren site to compare to prevailing chronologies for Central Texas. Chapter 8 presented much of the data that forms the basis for this chapter. The focus is the prehistoric sequence from 2600 to 900 B.P., the timeframe of the primary components on the Siren site, but also the era that covers the end of the Archaic and the advent of the Late Prehistoric periods.

The End of the Archaic: Competing Schemes and the Notion of a Transitional Period

The long efforts at imposing chronological order on the archaeological record in Central Texas have been discussed many times (e.g., Black 1989; Ellis 1994; Prewitt 1981b; Suhm 1960). The literature, especially the vast collection of reports, is rife with competing chronologies and terminologies, a condition that reflects, in part, the differing views surrounding the nature of cultural change and/or continuity at the end of the Archaic. A review of the major works underlying the main differences provides a foundation for a comparative assessment and an unraveling of the transition at the end of the Archaic in Central Texas.

Prior to 1960, most efforts used the Midwestern Taxonomic System, and consequently aspects and foci were common divisions in early Central Texas schemes (Figure 9.2). Johnson et al. (1962) mark an important change in classificatory designations by using time periods and stages, dropping the use of aspects, though parenthetically retaining the Toyah and Austin foci (Figure 9.3). Importantly, Johnson et al. (1962) designated the final centuries of the Archaic stage as the Transitional Archaic subperiod, in part because of the similarities between the latest dart point types, namely Darl and Figuroa points, and the earliest arrow point types. The late dart points preceded the first Late Prehistoric arrow point types and may have overlapped temporally with them. By the end of the Transitional Archaic, the bow and arrow technologies were introduced across South and Central Texas, probably around A.D. 700.

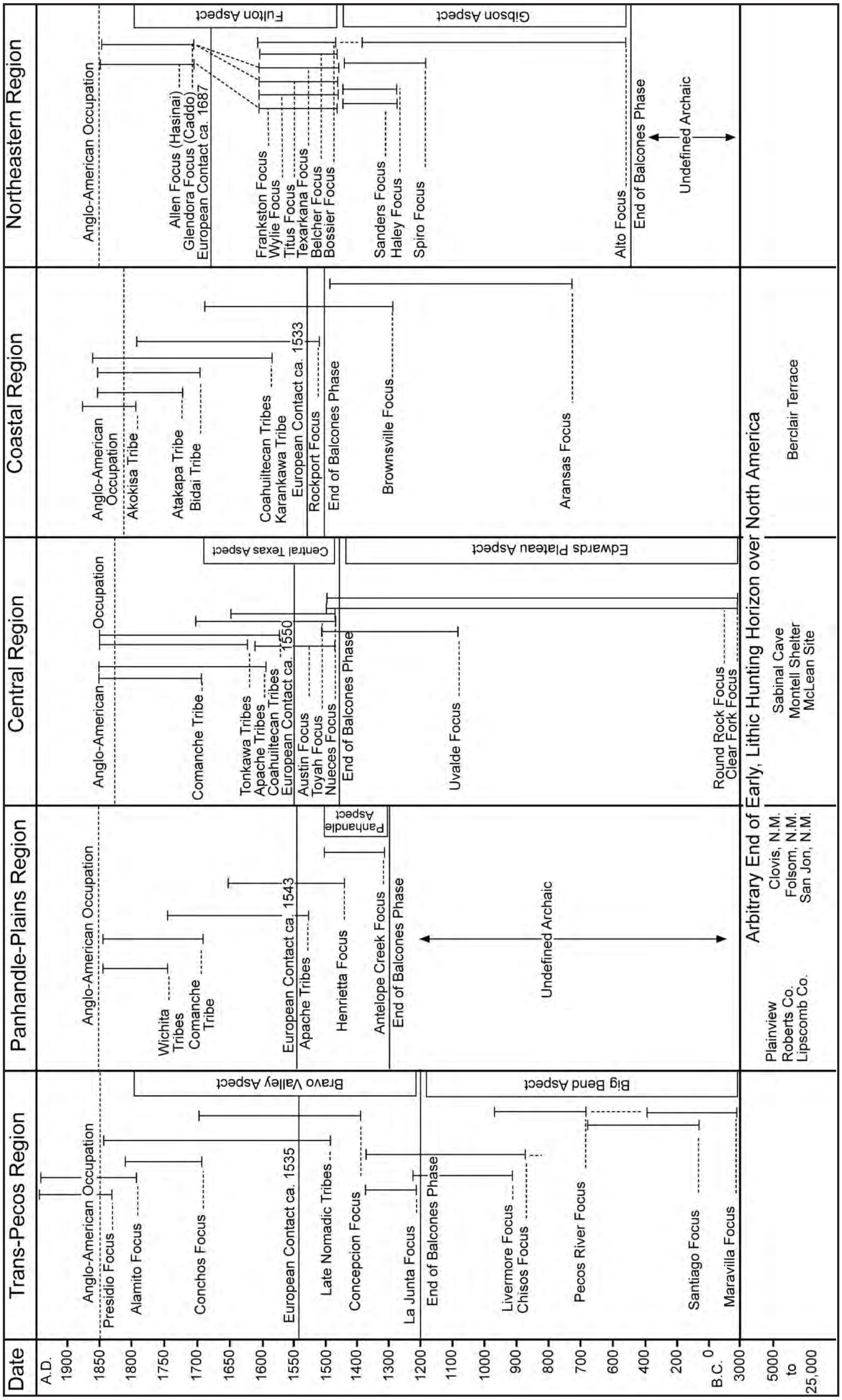


Figure 9.2. Stephenson's (1950) early chronology that reflects terminology used in early schemes in Texas archaeology.

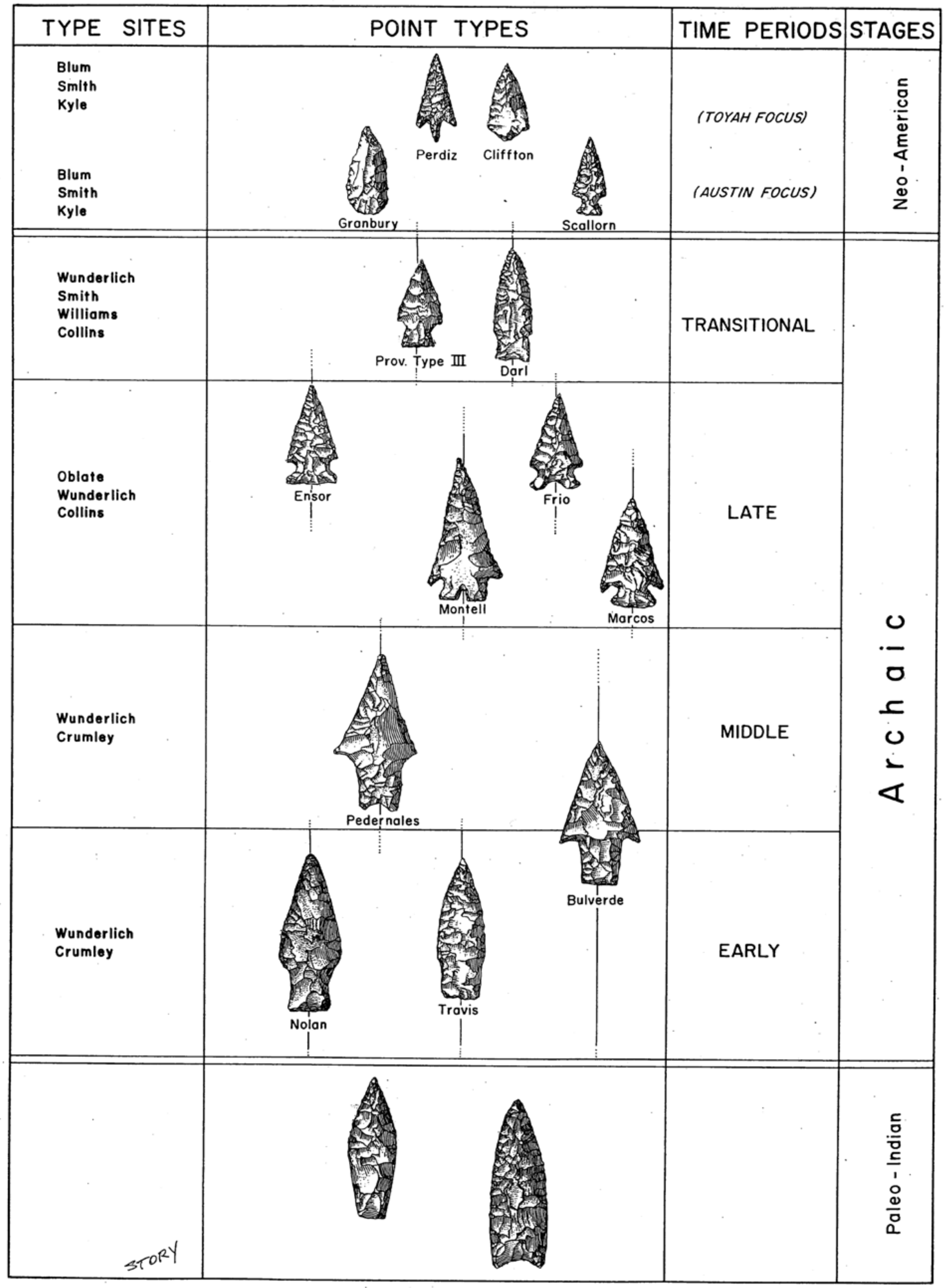


Figure 9.3. A distinct change from Stephenson's earlier classification, the seminal chronology by Johnson et al. (1962). The authors define the Transitional Archaic as a final time period.

In looking back, Johnson and Goode (1994:17) later note that the label Transitional Archaic was originally adopted in 1962 on the advice of Dee Ann Story in an effort to draw correlations with developments in the Eastern Woodlands. For some reason, perhaps because of the connotations with developments to the east, Johnson quickly dropped the term (note for example the lack of it in his 1964 work), never using it again. Since its introduction, the Transitional Archaic designation has been carried on by a few, but overall has failed to be universally accepted by researchers.

From the mid-1960s to mid-1970s, several notable developments substantially refined the regional sequence on the eastern margin of the Edwards Plateau. Numerous sites investigated in the San Gabriel River valley and thereabouts yielded a substantial amount of data, and multiple competing chronologies developed in a small area. Figure 9.4, drawn from Bond's (1978) Hoxie Bridge report, shows the juxtaposition of several of these efforts, revealing the variation in nomenclature, as well as the continued use of the Transitional Archaic in one of the works. On the heels of these, Weir (1976a, 1976b) introduced a five-part division of the Archaic using named phases, two of which (Clear Fork and Round Rock) derive directly from J. Charles Kelley's earlier foci. His rationale for using names rather than numbers, as Sorrow et al. (1967) had done for Stillhouse Hollow, was that divisions could be added or dropped as needed without a needed for incessant re-numbering.

Spurred by the need to synthesize the various efforts from a fairly small geographical area, Prewitt's (1981b) chronology (Figure 9.5) is notable in one primary regard. It is one of the only systematic attempts to flesh out archaeological assemblages as the foundation of a cultural sequence. His effort to do so is firmly and explicitly grounded in Willey and Phillip's cultural-historical model. Prewitt's (1981b) objectives were defined as moving systematically from components to "temporal" phases to developmental stages of prehistory. A stage, he states, is a segment in cultural-historical development characterized by a dominant economic model (Prewitt 1981b:68). In this regard, he designates the final prehistoric era, rather than the Late Prehistoric as others defined, the Neo-Archaic because the Archaic hunter-gatherer pattern continued. In Central Texas, neither the Toyah nor Austin phase groups adopted an agricultural economic basis. Accordingly, Prewitt, in directly addressing the issue of long-term developmental change, sees continuity between the Archaic and Late Prehistoric, but otherwise does not clearly address the notion of a transition.

Black (1989) uses the Terminal Archaic designation to cover Weir's (1976a, 1976b) Twin Sisters phase, which Prewitt had further subdivided into Driftwood and Twin Sisters. Black's division between the Late and Terminal Archaic follows Weir's divisions, with the former stylistically distinguished by the broad-bladed dart point forms (such as Montell, Castroville, and Lange) and the latter by the smaller sorts such as Ensor, Frio, Fairland, and Darl. One thing Black (1989:30) draws a bead on is the differing opinions regarding events from A.D. 300 to 800. On one side, some (such as Weir) saw it as a period of a return to high mobility, cessation of burn rock midden formation, and lack of bison. Others (such as Peter et al. 1982a; Skelton 1977), conversely, viewed it as a time of continued midden use, intensification in the exploitation of local resources, increased occupational intensity, and diversification of tool forms. The Siren site trends strongly towards one of these interpretations as is discussed.

In his latest works, Johnson (1995, see also Johnson and Goode 1994), as he had done long before, does not use the "Transitional Archaic" (Figure 9.6). His objectives were broader, however, and so addressing the finer divisions was not warranted. Rather, his intent was to uncover "gross patterns of human behavior and their changes" (Johnson and Goode 1994:16). His objectives were not of the social or ethnic sort at all, but more in line with Braudel's (1972) structural level of change, the long durée. From this larger perspective, he saw a gradual low-key drama unfolding over an 8,000-year period. Within this long period of time, however, his works are replete with specific references to the timing of economic strategies, environmental changes, and technological shifts, particularly in major stylistic markers. He never systematically synthesizes the data in an assemblage analysis as did Prewitt, but rather in a narrative way. He refers to the era after the Archaic simply as the "Post-Archaic." From his level of analysis, that of gross patterns, he too sees a rather distinctive continuity between Archaic and the later phases or intervals.

The most recent of the comparative chronologies are those by Collins (1995, 2004). Like Johnson's, these are broader chronologies both spatially and content-wise. Whereas Johnson limited his works to the eastern Edwards Plateau, Collins necessarily took a more

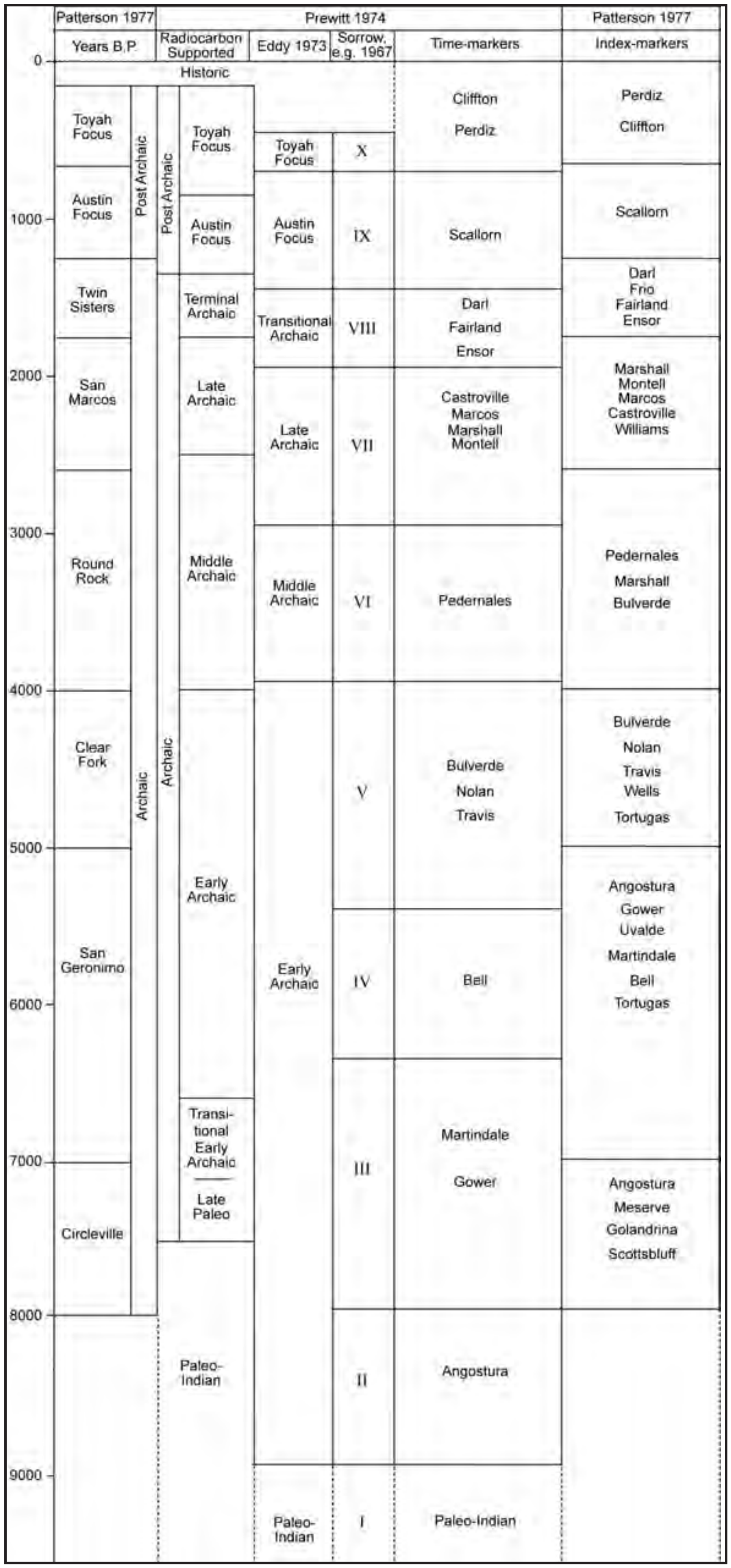


Figure 9.4. The comparison of several chronologies formulated in the 1970s based on the archaeological record of the San Gabriel River basin and immediate vicinity. The "Prewitt 1974" column reflects some of the data sets that were foundations to his 1981 and 1985 syntheses. Adapted from Bond (1978).

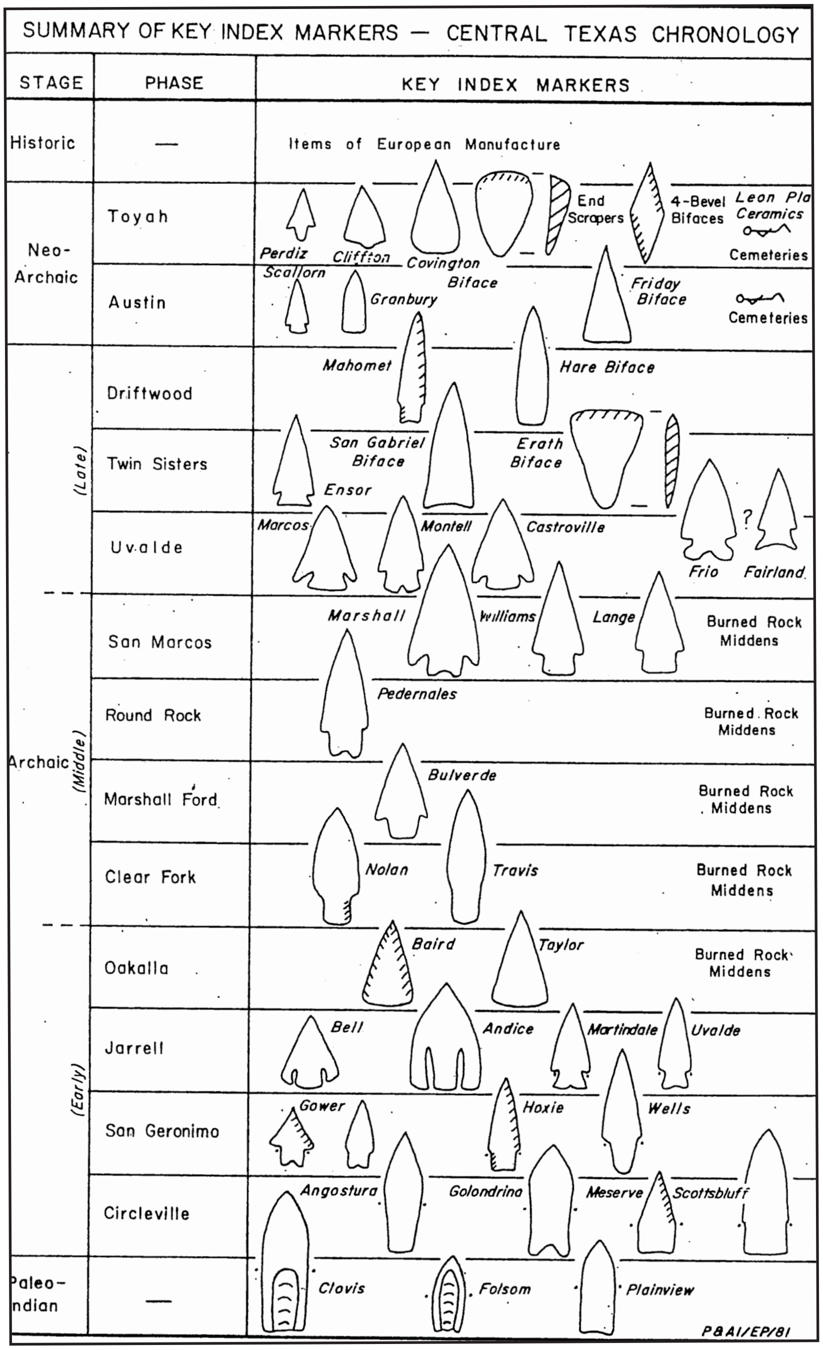


Figure 9.5. Among the most widely recognizable chronologies in Texas, Prewitt's (1981b) depiction shows stage and phases with key index markers.

with paleoenvironmental (including depositional) factors (Figure 9.7).

Collins retains the Late Prehistoric designation, but points to the fact that the original basis for its formulation proved false. Suhm et al. (1954:20) defined the Neo-American Stage, which Collins as well as many others called the Late Prehistoric period, based on the unproven presumption that the bow and arrow, ceramics, and agriculture would be its distinguishing marks. Agricultural, as a primary economic basis, has never been archaeologically shown in Central Texas. Consequently, the fundamental economic basis for the definition of the new period or stage, never materialized, perhaps lending credence to the many schemes that do not recognize the legitimacy of the cultural break at the end of the Archaic.

On a final relevant point, Collins's (2004) style intervals and major period breaks precisely correlate with Prewitt's (1981b) chronological phase divisions for the latter part of the Archaic. For example, Collins's temporal placements of Darl, Ensor, Frio, Fairland and others are the same as Prewitt's. Collins points to Loeve-Fox as the only site with components of good integrity for the timeframe, and so it makes sense the two are consistent.

A final comparative work, Turner et al.'s (2011) typological guide to Texas stone artifacts, was never designed to be a cultural chronology. Where it is relevant here is that it defines the chronological placement of artifacts and attributes diagnostic forms to particular periods or absolute dates. For example, Ensor points are associated with the Transitional Archaic and date to approximately 200 B.C. to A.D. 600 or later (Turner et al. 2011:94). As another example, Pedernales points are defined as diagnostic of the Middle Archaic and date to approximately 2500 to 3500 B.P. (Turner et al. 2011:148). Comparison of our data to Turner et al.'s

general approach that could be comprehensively applied to the entirety of Central Texas, which had long been recognized as a sufficiently diverse realm that archaeological trends on one side poorly match those on the other (e.g., Black 1989:22–23; Peter et al. 1982b). Collins (2004:116) provides a "generalized cultural history of central Texas" that relies upon periods and sub-periods as well as stylistic intervals, all juxtaposed

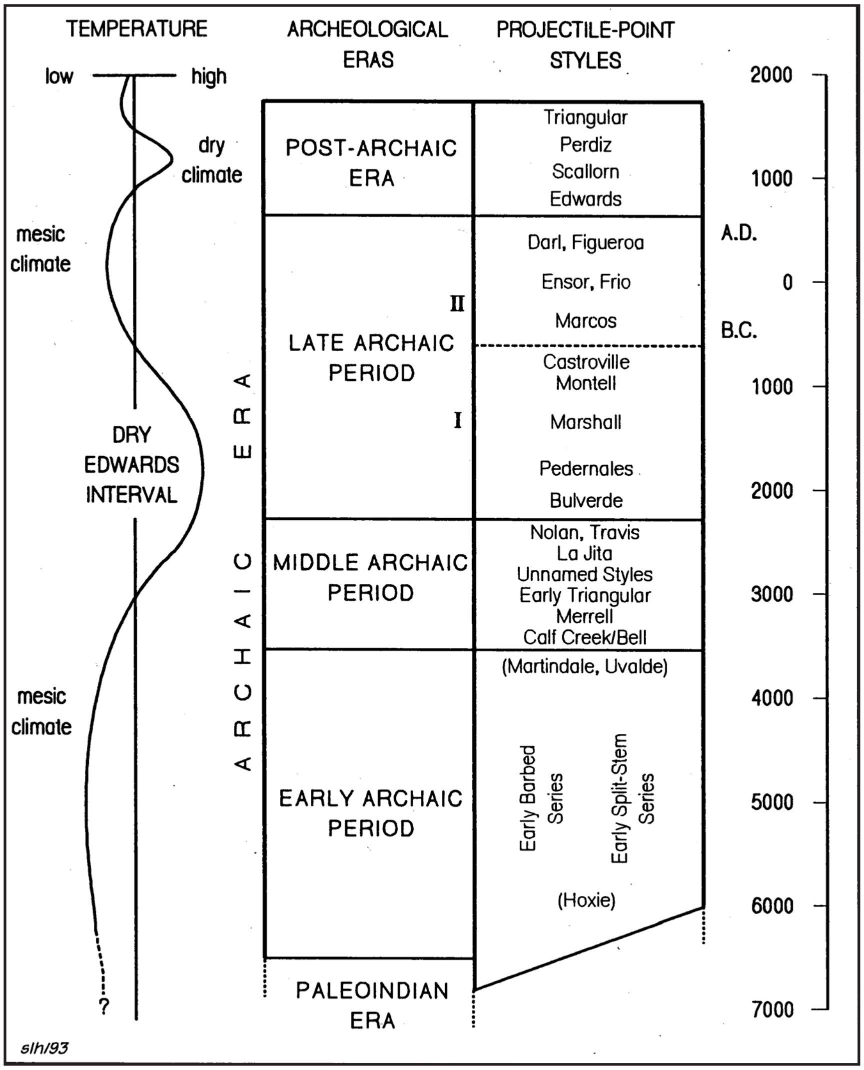


Figure 9.6. Johnson and Goode's (1994) depiction of the eastern Central Texas chronology, consistent with Johnson et al.'s (1962) but with no Transitional Archaic.

(2011) data proceeds cautiously with the full understanding that their designations are highly generalized, often necessarily applicable to regions far beyond Central Texas. However, the main concern here is specifically addressing the correlations, or lack thereof, between the dates and affiliations that they reference and the revised chronological data on the eastern margin of Central Texas. For example, Ensor points may have a different temporal range in some areas compared to those along the eastern Edwards Plateau.

Comparison of Siren site to Regional Chronologies

Before launching into comparisons, a few caveats and considerations need mention. Our chronological data are in conventional radiocarbon years before present, which are corrected for carbon isotope ratios but are not calibrated or converted to calendrical dates. Collins's (2004) data are likewise in conventional dates. Prewitt's (1985) data are in both radiocarbon years as well as corrected dates. Black (1989), Johnson (1995), Johnson and Goode (1994), and Turner et al. (2011) all apparently use calibrated dates. On the timeframe of concern (2600 to 900 B.P. or so), the deviation between calibrated and uncalibrated dates is not typically substantial. There was a time when labs did not take readings on the isotope ratios, and so no corrections can be made on many of the published dates in older reports. Nevertheless, for the sake of direct comparison, all schemes will be placed on a like scale, in radiocarbon years before present. To do so, calibrated dates are converted back by simply subtracting the dates from A.D. 1950 to get years before present. The method imposes some inaccuracy but provides estimates within a reasonable margin of error for the times of concern here.

One further consideration, the schemes are not directly comparable since each is dealing with different things, scales, or classificatory units. Some are phases, some are strictly eras, or periods, or stages, or stylistic intervals. Regardless, if limited to the appropriate scale or data category, meaningful comparisons can be drawn for each.

Figure 9.8 shows the different chronologies laid side by side. Looking first solely at the major chronological breaks, there are four critical divisions that have broad consensus, give or take a half century:

- ❖ 1250 B.P. – all chronologies place the advent of the Scallorn and Edwards stylistic interval at around this time. Four chronologies define this as the end of the Archaic and advent of the Late Prehistoric, while Johnson and Goode

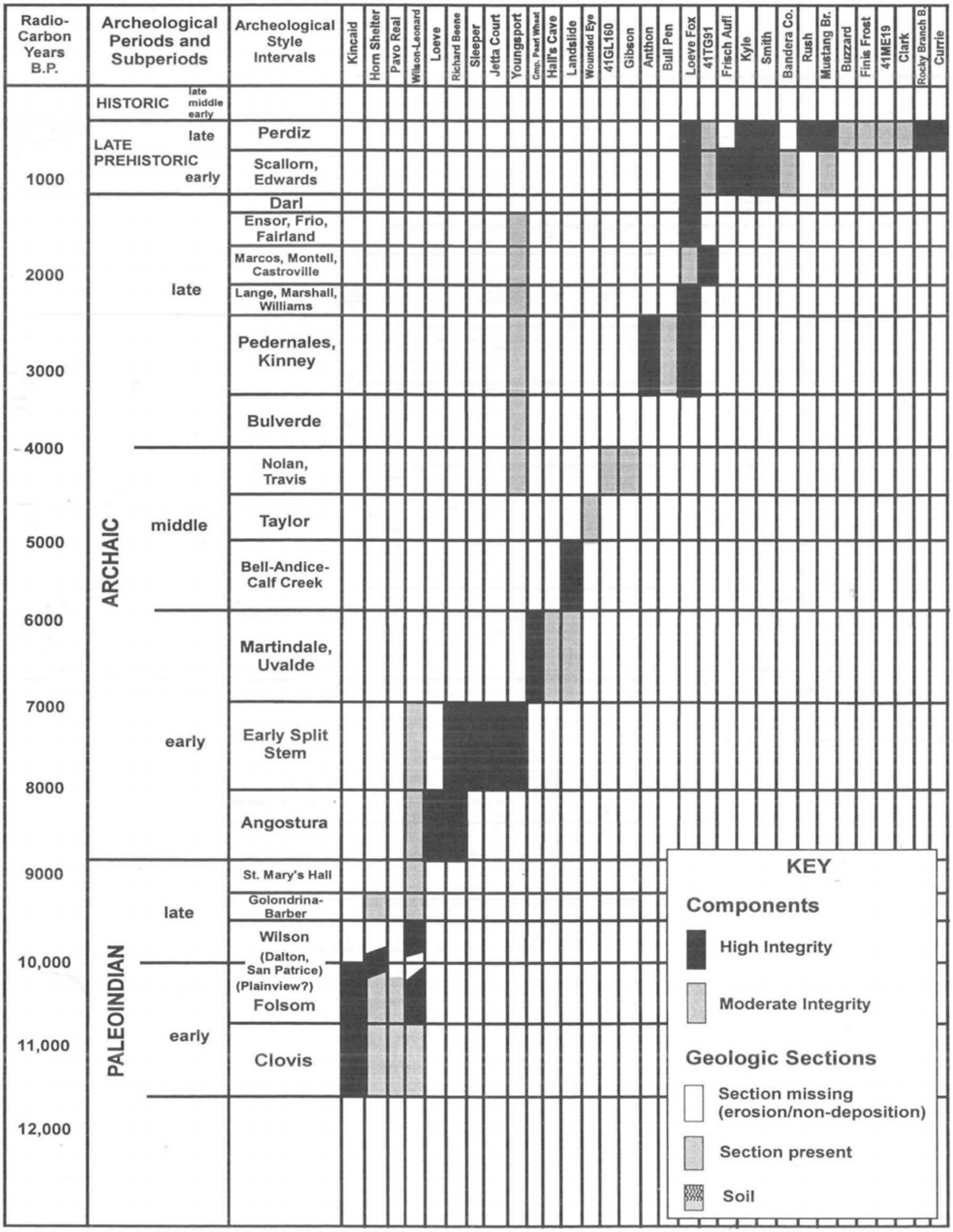


Figure 9.7. Collins's (1995, 2004) chronology using periods and subperiods, archaeological style intervals, and contributing site components.

(1994) indicate the Post-Archaic perhaps began earlier with smaller dart points. Siren site dates concur with the 1250 B.P. as the earliest extreme of the break, though most of the Austin phase dates are between 1100 and 900 B.P.

- 1800 B.P. – all but Johnson and Goode (1994) show a stylistic interval break, but only two show this to be a major cultural-historical break here. Siren data concurs with the existence of a stylistic break at this time, but entirely disagrees with most on which styles are ending and beginning. Collins (2004), Black (1989), and Prewitt (1985) place Ensor, Frio, and Fairland points after this time, whereas the Siren site, Johnson and Goode (1994), and Turner et al. (2011) show them prior to this time, though the two chronologies also extend them beyond 1800 B.P. as well.
- 2250 B.P. – all but Black (1989) show a stylistic interval break at this time, and Prewitt (1985) and Turner et al. (2011) show the time to be a cultural-historical division. The Siren site concurs with the stylistic break, notably the advent of Castroville, though shows it a slight bit earlier. The earliest range (back to 2300 B.P. is expected to be too early considering the old wood problem, discussed earlier in this report.
- 2600 B.P. – all but Black (1989) show a stylistic interval break at this time, and Prewitt (1985) and Johnson and Goode (1994) show it as a cultural-historical division. The Siren site concurs with the stylistic break, and agrees with Prewitt (1985) and Collins (2004) on which type emerged at the time.

Besides these major division lines, the only internal partition in the Siren site data that is not reflected in any of the regional chronologies is the stylistic interval line between Castroville and the Ensor, Frio, Fairland triumvirate. The Siren site data show a break at some time between 2150 and 2050 B.P., a division not shown elsewhere, although somewhat consistent with Turner et al.'s (2011) dating of the three point types as beginning around 200 B.C. Johnson and Goode (1994:38) notes that the time from 200 B.C. to A.D. 500 is a major cultural-historical division in the eastern United States, but does not explicitly translate that timeframe into the Central Texas record.

For the most part, the Siren site data concur with most of the regional chronologies until about 2000 B.P. Major discrepancies appear between the various chronologies and with the Siren site data until about 1250 B.P., when the various efforts come back into sync. In Prewitt's (1985) chronology, which carries over into Collins's (2004) work, the end of the Uvalde, Twin Sisters, and Driftwood phases are key to unraveling the problems. Since Prewitt's (1985) scheme is the only one with fine partitions comparable to the Siren site components, his will be the starting point.

Unraveling the Transition from Archaic to The Late Prehistoric

> "Convenience, authority, and tradition rather than strength of evidence are in large part responsible for the widespread acceptance of the conventional factor." Pribyl (2010:75)

The chronological placement of the Twin Sisters and Driftwood phases has long been criticized as fundamentally flawed, a mismatch of dates with archaeological materials. However, until a systematic analysis determines where the problems lie and presents a more viable alternative, the prevailing scheme has served as the default position. The Siren site data, one site alone, does not entirely resolve the issue, but when tied into regional data and past critiques points towards a resolution. The Siren data substantially disagree with the timing of the Twin Sisters and Driftwood phase assemblages, and the ending of the Uvalde phase. We theorize that the gap in the Siren site's chronological record, which was previously unseen in the Central Texas archaeological record, almost entirely accounts for the discrepancies. Before turning to that, the problems with the timing of these critical phases need to be addressed.

More than one author has highly commended Prewitt on his efforts right before critiquing his efforts (e.g., Johnson 1987; Ellis 1994:47). In honor of that well-trod tradition, we will do the same. The intent here is not just to tear down, but rather to build upon the more valid aspects of Prewitt's efforts. The reason folks keep coming back to Prewitt's chronology is that he hit a resonant chord—he synthesized the archaeological evidence from technology to mortuary practices to economic evidence to compile assemblages at a fairly precise chronological interval. He outran the data, and the theory, perhaps, and has been criticized for it. In moving forward, there are valid critiques that are worth

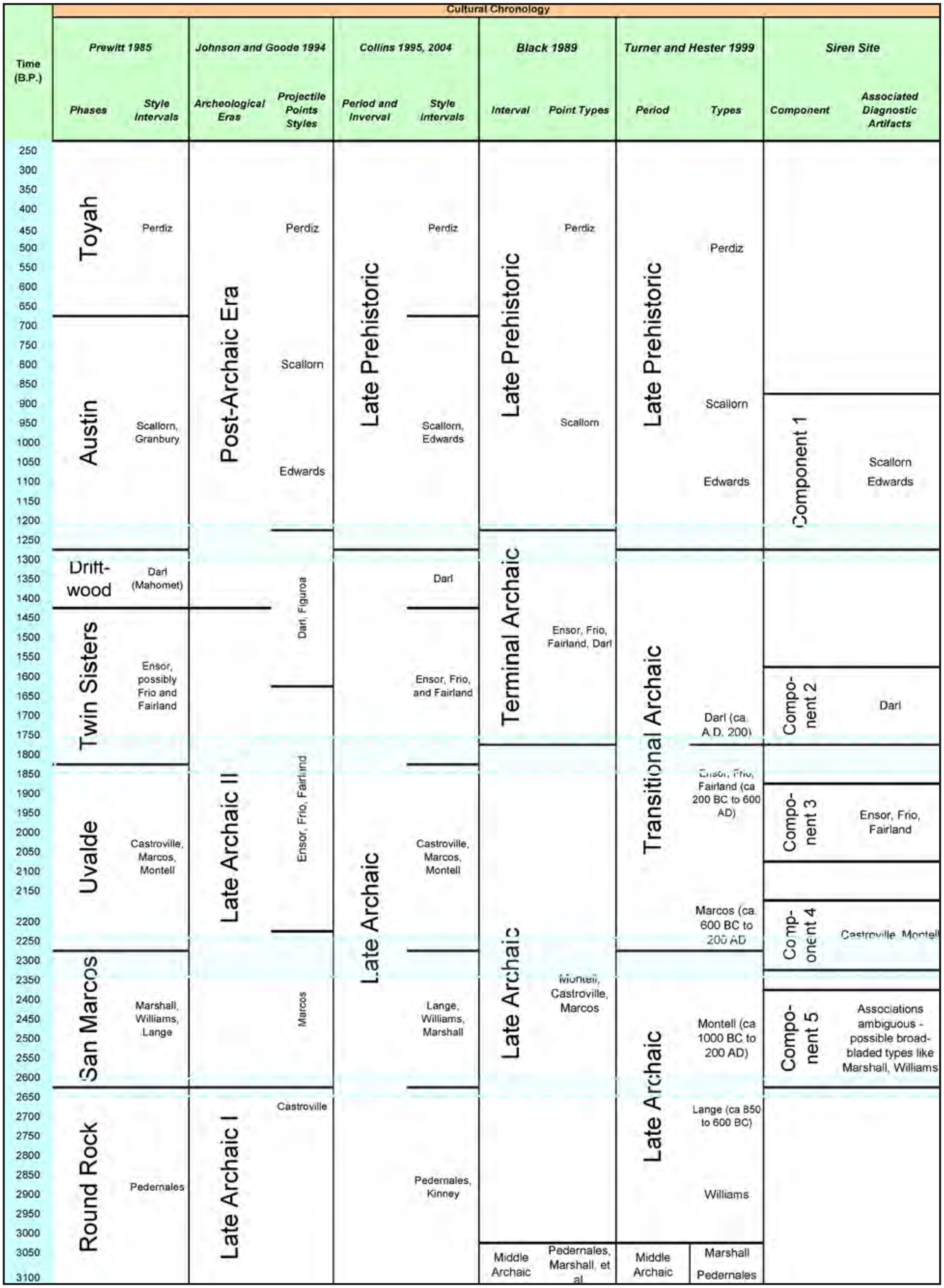


Figure 9.8. Comparative chronologies. Light blue boxes represent concurrence of boundaries among several chronologies.

drawing to the forefront, but there are also substantial accomplishments worth retaining as foundations on which to build. Before returning to foundations, we have to turn a destructive glance towards portions of the edifice that are structurally unsound.

Johnson (1987:12) leveled a harsh indictment: "Whatever the cause of the poor correspondence of the phase assays and the phase diagnostics, it clearly exists and places in doubt the temporal details of Prewitt's entire Central Texas chronology." Wayne Young (n.d.), in an unpublished manuscript, provided the most thorough, date-by-date analysis of Prewitt's chronology. As a general overview, he noted that of the 147 dates that Prewitt relied upon, 38 were unpublished or insufficiently so to clearly assess their context, six were on snails or soil, seven do not have associations with diagnostic artifacts, 58 are from mixed components, and 22 are associated with phase diagnostics different from that to which they are attributed (Young n.d.:1). Accordingly, only 14 dates could be assigned to "pure" components. Those dates on pure contexts are significant — if looking solely at those for the two components of primary concern here, they are highly consistent with the Siren site dates. A close look at the Uvalde, Twin Sisters, and Driftwood dates unravel some of the long-standing chronological confusion for the final phases of the Archaic.

Driftwood Phase Reconsidered

The Driftwood phase (1250 to 1400 B.P. as Prewitt [1981b] defined it) has an artifact assemblage that includes Darl points, Hare bifaces, small concave unifaces, gravers, fresh water mussel shell pendants, bone beads, and bone awls. Features consist of medium and small basin hearths. Burials, based on a limited database, are isolated flexed burials, a distinction between this and the later phases. Subsistence, Prewitt (1981b:82) hypothesized, "appears to be a definite emphasis on the gathering aspect in the basic hunting and gathering system."

Regarding the critique of dates used for the Driftwood phase, there are two dates from sites lacking reported provenience tables, none from pure components, five from Driftwood-Austin phase mixed components, two from Driftwood-Twin Sisters phase mixed components, and two dates from contexts lacking Driftwood phase components (Table 9.1; Young n.d.). Because of the lack of clear associations, none of the dates can be clearly associated with the Driftwood phase assemblage. Two dates (Tx-3404 and Tx-2731, as listed in Table 9.2) attributed to the Twin Sisters phase are from components that contain Darl points but not Ensors points or other Twin Sisters phase diagnostic artifacts. If the two dates of 1640 B.P. (Tx-3404) and 1740 B.P. (Tx-2731) are the closest there is to a "pure" Driftwood components, then these dates are highly consistent with the dates from Component 2 at the Siren site.

There is additional evidence that suggests the Driftwood phase may have been a longer lived phase than thought, beginning much earlier than the 1400 B.P. start dates depicted by Prewitt (1981b, 1985) and Collins (1995, 2004), but consistent with Turner et al.'s (2011) placement. Prewitt (1985:217), using the ratio of components to the duration of the phase in years, inferred a stunning population explosion during the Driftwood phase. Driftwood, according to his formulation, is the shortest lived at 150 years, and so the 63 components attributable to the phase yielded a relative population density nearly twice any other in prehistory. Although he urged caution in relying too heavily upon the data, such a dramatic increase during this short time makes no sense in light of all other lines of evidence, including subsistence, site distribution patterns, socio-economic context, mortuary, supporting paleoenvironmental evidence, or otherwise. There is no evidence of an economic engine (agriculture, for example) for population increase during the time, or expected changes in residential mobility. Some authors have suggested a widespread collapse of the macroeconomic sphere during this time (Carpenter and Hartnett 2011; Hall 1981). The problem, we surmise, is an unduly short phase that should be 500 years long rather than 150. Recalculating based on that estimate would place the Driftwood population in alignment with the following Austin phase, and much more consistent with expectations derived from the archaeological record.

Further evidence of the relatively longer duration of the Driftwood phase comes from several sources. On the early side, as previously noted, the purest dated components associated with the phase assemblage date to as early as 1750 B.P. and these dates are supported by the Siren site dates, but also perhaps those from the Cowdog Crossing site in Fort Hood (Carpenter, Hartnett et al. 2010). While not clearly suggestive of an early date in and of itself, the overlap of Ensor and Darl is seen in a burial from Mather Farm (41WM7), which had a Darl point embedded in the skull and an

Table 9.1. Prewitt's Driftwood Phase Dates and their Problematic Associations

Laboratory Number	Corrected Date	Site	Provenience	Young (n.d.) and Weir (n.d.) Analysis of Associations
RI 1088	990±290	Bigon Kubola	Backhoe Trench, Hearth 3	No direct associations. A Darl and Scallorn were found above feature.
Tx 515	1120±80	Smith Shelter	Stratum 1	Stratum contains 1 Scallorn, 1 Fresno, 2 Young, 16 Darl, 1 Pedernales, 2 Ensor, 2 Abasolo points. Tx 515 date is also used for the Austin phase.
Tx 28	1165±120	Smith Shelter	Stratum 1	
Tx 27	1180±210	Smith Shelter	Stratum 1	
UGa 2471	1155±95	41WM53	Fea 4, Area B & D	6 Darl, 1 Scallorn in Level 4.
UGa 2484	1260±150	41WM53	Fea. 3a	Fairland and Ensor associations in addition to 1 Scallorn, 6 Darl.
Tx 1926	1300±60	Loeve Fox	Stratum 3a	1 arrow point fragment, 7 Ensor, 2 Darl, 1 dart point fragment.
Tx 804	1350±70	Dobias-Vitek	Hearth 1	4 sand-tempered sherds in association with hearth.
Tx 2941	1340±60	Bear Creek	na	No provenience tables.
Tx 2940	1380±100	Bear Creek	na	No provenience tables.

Table 9.2. Prewitt's Twin Sisters Phase Dates and their Problematic Associations

Laboratory Number	Corrected Date	Site	Provenience	Young (n.d.) and Weir (n.d.) Analysis of Associations
Tx-686	1460±80	La Jita	N10/E40 Lv. 2	Mixed Late Archaic and early Late Prehistoric diagnostics, including Edwards.
UGa 2481	1460±80	41WM328	Feature 17	Darl beneath hearth suggesting later context than Twin Sisters.
UGa 2483	1610±165	41WM328	Feature 15	
Tx 1767	1480±170	Loeve Fox	Stratum 3a	1 arrow point fragment, 7 Ensor, 2 Darl, 7 dart point fragments.
Tx 1927	1480±80	Loeve Fox	Stratum 3a	
Tx 1766	1600±110	Loeve Fox	Stratum 3a	
Tx 2952	1550±60	Loeve Fox	Stratum 3(?)	
Tx 3409	1620±60	Loeve Fox	Stratum 3b	
Tx 1922	1670±100	Loeve Fox	Stratum 3a	
Tx 3404	1640±140	Loeve Fox	Stratum 2	12 Darl, 9 dart point fragments in stratum. No Ensor points.
Tx 2378	1580±60	Anthon	na	"would seem to be a reliable date of Weir's Twin Sisters phase" Goode (2002:200).
Tx 2384	1640±60	Anthon	na	"lacks close association with any features or diagnostic artifacts" Goode 2002:200.
Tx 122	1600±70	Pohl	12-18" deep	Late Archaic point found in same unit and level.
Tx 2539	1620±70	41WM53	Level 5, Unit D	9 Darl, 2 Fairland/Ensor from Areas A and B which are adjacent to Unit D. Unit D is not provenienced separately.
RI 1586	1700±120	Cervenka	Area D, Fea 16	Associations difficult to determine in Hay (1982), but no diagnostic artifacts recovered from Area D with the date.
Tx 2731	1740±100	Hoxie Bridge	Feature 16	Darl point in situ.
UGa 2476	1745±85	Bryan Fox	Feature 1	Fairland/Ensor and 1 Montell in feature fill.
Tx 2942	1570±60	Bear Creek	na	No provenience tables.
Tx 2964	1770±140	Bear Creek	na	No provenience tables.

Ensor point between the second and third ribs (Prewitt 1982:47).

On the later end of the temporal spectrum for Darl points, Suhm and Jelks (1962:179) originally placed the points as extending to A.D. 1000 (roughly 950 B.P.) and other studies, such as at McKinney Roughs (Carpenter et al. 2006) and a site in Young County (Quigg et al. 2011), have likewise suggested the perpetuation of the style interval into relatively late times. On the eastern side of the Siren site, a Darl point was recovered in possible association with dates of about 1050 B.P., but the association in not entirely clear.

Overall, the Siren site data are not strong, but what are there suggests an earlier advent for the Driftwood phase than some chronologies allow. More importantly, the timing of the Driftwood phase needs to be rectified to provide the needed room for the more robust components on the site.

Twin Sisters Twisters

The Twin Sisters phase (1800–1400 B.P. as Prewitt [1985] defines it) is marked by the appearance of a variety of small, side- and corner-notched dart point types including Fairland, Frio, and Ensor. Johnson and Goode (1994:37) point to social interaction with the eastern United States as a possible source for these new point types. These projectiles may have been part of a package of new cultural items related to the spreading of Eastern Woodland religious ideas as far as the Edwards Plateau; these included the exotic items noted above such as marine shells and atlatl weights (Johnson and Goode 1994:37).

Young's (n.d.) analyses of the Twin Sisters phase dates are likewise rather critical. The dates include four unprovenienced or unpublished dates, none from pure components, eight from mixed Twin Sisters and Driftwood components, two from Twin Sisters and Uvalde mixed components, and five from components lacking any Twin Sisters phase diagnostics (Table 9.2; Young n.d:4). With the publication of the Anthon site report (Goode 2002), however, two of the previously unpublished dates are now available for scrutiny. The one seemingly pure date comes from Stratum 4, Feature 31 at the Loeve-Fox site, but was assigned to the preceding Uvalde phase (Table 9.3). This date of 1960 B.P. (Tx 3407) came from a stratum with five Ensor points and one dart point fragment. Such a date is highly consistent with the Siren site's Component 3, dated to circa 1900–2000 B.P. Although this Loeve-Fox date has a 210-year standard deviation, the salient point here is that closest thing to a pure Twin Sisters phase component has the 1-sigma deviation that falls entirely outside of his 1400 to 1750 date range for Ensor points and the Twin Sisters phase. The 2-sigma has some overlap with the phase dates, but the bell curve of probabilities would favor the Siren site dates over Prewitt's Twin Sisters dates.

Turner et al. (2011) place the major Twin Sisters diagnostic styles (Ensor, Frio, and Fairland) from A.D. 200–600, and Johnson and Goode (1994) indicate a similar range. The Siren site data show a narrower temporal range, but the shorter timeframe from the site may be a site-specific occurrence. Whereas the site dates support at least a portion of the abovementioned works, the Component 3 dates entirely contradict Prewitt (1981b, 1985), Collins (1995, 2004), and Black (1989). The temporal ranges of the stylistic intervals are mutually exclusive. Instead, the Siren site data, which are robust from this component, strongly indicate the major hallmarks of this phase were in place centuries before the 1800 B.P. date asserted by some temporal frameworks. The Siren site indicates the termination of the phase by 1800 to 1750 B.P., but the lack of data on one site cannot be cited as proof positive that the phase did not continue beyond those dates elsewhere. For example, the previously mentioned Mather Farm burial, which contained both a Darl and Ensor points embedded in the skeleton, is compelling evidence for an overlap in at least the stylistic intervals. The duration of the overlap is yet to be determined.

Earlier Phases

Prewitt's (1981b:81) Uvalde Phase, which he dates from 2250–1750 B.P. (although later revised it to end at 1800 B.P.) coincides with a notable increase in bison remains in the archaeological record, the lack of clear evidence of extensive trade networks, and an apparent abandonment of midden use so distinctive of preceding phases. Some would argue this last point, however, as Johnson and Goode (1994:35) note, the regional inhabitants continued "baking of semi-succulent xerophytic plants, and accumulated or added to burned rock middens during the same period that they sometimes barbecued buffalo."

Once the major temporal adjustment to the Driftwood phase is made, and the Twin Sisters is accordingly pushed back, the earlier preceding phases begin to

Table 9.3. Prewitt's Uvalde Phase Dates and their Problematic Associations

Laboratory Number	Corrected Date	Site	Provenience	Young (n.d.) and Weir (n.d.) Analysis of Associations
Tx 233	1865±95	Britton	Feature 35	
Tx 234	1940±110	Britton	Feature 10	Godley points, but no Uvalde Phase diagnostics found on site.
Tx 200	2080±80	Britton	Feature 10	
Tx 119	1870±160	Pohl	B2 and B4	No direct associations.
Tx 323	1950±130	Pecan Springs	na	2 Montell points in possible association with cremation.
Tx 3407	1960±210	Loeve-Fox	Stratum 4, Fea. 31	5 Ensor, 1 dart fragment
Tx 30	1970±150	Oblate	Zones 1-2	12 Uvalde phase dart points with 1 Bulverde, 15 Ensor, 3 Fairland, 11 Frio, 1 Marshall.
Tx 121	2040±130	Pohl	18-24" deep	Frio point in same square and level as dated hearth.
Tx 2959	2110±150	Bear Creek Shelter	na	No provenience tables.
Tx 692	1850±180	La Jita	n10/E40, Lev. 4	Montell, Pedernales, Marshall (1 each).

align fairly well with the Siren site record, although slight revisions towards greater antiquity are needed. The Uvalde phase marked by Castroville, Marcos, and Montell points, according to the Siren site dates fall around 2200 to 2300 B.P., rather than 1800 to 2250 B.P. as Prewitt (1985:215) depicts it. Prewitt's San Marcos phase more or less concurs on all fronts (temporally and artifact assemblage-wise) with the Siren site Component 5, although the Siren site would have it end a bit prior to when Prewitt does.

Prewitt's Accomplishments

Prewitt's chronological breaks are largely supported by the Siren site data. As has long been pointed out, there is a mismatch between the archaeological content of several critical phases. If these are rectified, all of the various chronologies fall into alignment, and, of them all, Prewitt's chronology provides a detailed, assemblage-based cultural chronology for Central Texas. Many of the particulars in the assemblages need to be reassessed in light of much new data that have emerged since his analyses, but the major components seem to hold up to scrutiny. The following chapters of this report reassess and flesh out finer distinctions.

As Childe (1956:121) stated, "a culture is not constituted by the few types used as diagnostic fossils but by the whole assemblage of types and traits associated." Prewitt (1981b, 1985) provided one of the few systematic attempts to define assemblages that included all archaeological classes, as well as behavioral ones. On many occasions, his work has been a lightning rod. For reasons previously discussed, Johnson's critique that phases were inappropriately defined because they lacked social or ethnic correlations is dismissed here. The descriptive and the interpretive ought to remain distinct; there needs to be an archaeological unit that classes together similar components from different sites within a region. Regarding another general critique, the assertion that Prewitt's chronology is fundamentally a stylistic interval sequence of projectile points is likewise unfounded. Few if any other Central Texas chronologies are so completely assemblage-based.

The Inability to See What is Not There

Minds and models typically look at data, not the gaps between the data. Few projects in the past have been afforded such a sweeping suite of radiocarbon samples from a continuously aggrading site. Without this vantage point afforded by the Siren site, in cobbling together the radiocarbon data in a highly piecemeal fashion from widely disparate sites, any gaps can be attributed to the narrow segments of the overall strand that each site provides. A complete picture is difficult to discern given the many biases and other limitations in the archaeological record. But, with the donut that is the Siren site, the hole becomes readily apparent, and just maybe the hole offers insights into the whole. The chronological gap from about 1250–1750 B.P. on the Siren site raises important questions that can be answered by other sites. The Siren site yielded 72 Ensor points and three Darl points. The Loeve-Fox site yielded 57 Darl points and 18 Ensor points (Prewitt's [1982:74–78] Variant I; his Variant II equates to this report's Fairland points). Clearly, what is poorly represented on one site is well represented on the other. By matching the two, there are somewhat complementary patterns. Five of the 10 Loeve-Fox radiocarbon dates reported by Prewitt (1982:18) date from 1670–1300 B.P., filling in the gap from 1750 to 1250 B.P. on the Siren site. The remaining dates reported by Prewitt include four that fall within a Late Prehistoric timeframe from 850 to 1080 B.P. (Late Prehistoric), and one date of 2100 B.P., which was discarded because of an 880-year standard deviation range that eclipsed any confidence in its accuracy.

Accordingly, gaps, if well-bounded, equally contribute to the data. The Siren and Loeve-Fox sites provide highly complementary perspectives on the overall chronology. The Loeve-Fox site captures only a relatively small portion of the Twin Sisters phase, and likely reveals a more extensive Driftwood component than previously envisioned.

A Critical View

The culture-historical approach, once an end in and of itself in Texas archaeology, is gradually becoming a means to an end, and rightly so. Cultural-historical analysis is simply a taxonomic method of developing meaningful categories that can then be used to map out prehistoric changes and processes at multiple scales. To reframe the critique of Johnson's definition of phase as a socio-cultural entity, a further breakdown of the processes that go into the development of the archaeological record is worth noting This critique needs to be briefly established here as a foundation for later caveats against over interpreting the record.

To take one model from social theory, using Braudel's (1972:20–21) three-tiered model of historical change, archaeologists have, for some time, developed a more nuanced perspective of what the material record actually represents—and it is not society. According to the model, there are multiple scales at operation in history, and each has archaeological implications:

1) Structure involves the longue durée of macro scale processes, stability and change directed by the currents of biology, paleoenvironment, and forces of production.

2) Conjuncture is the smaller cycles of social and economic variables that exert pressure on structural cycles to develop stable episodes within the larger cycles.

3) Event is the short-term actions of individuals that history is often made of.

Translating these to the archaeological record as many have done, it could seem that the structural level could correlate with a stage or period, the Archaic perhaps. The conjunctural level could be seen as a phase in Johnson's socio-cultural sense. An event could be the individual activities within any site that contributes to a component. But, those correspondences disintegrate on further inspection and cannot be used as law-like generalizations. Willey and Phillips (1958) cited one influential critique that gave them pause in attaching socio-cultural correlations to archaeological units. Spaulding (1960) argued that the world did not fall out as simply as objective typologists would have it. Types and taxonomic units had several empirical aspects, namely time, space, and form, the so-called "dimensions of archaeology" (Spaulding 1960), and the relationships between any two aspects were relatively autonomous. One aspect may change, but there could be continuity in other aspects. Arbitrary typological divisions cut across all dimensions simultaneously. So, taxonomy or systematics needed to capture incremental change, often very complex change. Archaeological patterns can transcend socio-political boundaries and morph over time and space, such as in migration. There may or may not be one-to-one correlations among archaeological, social, and typological units; to force the issue is to create incongruities, the siren's song.

So to return to Braudel's model, structural and conjunctural analyses look at independent variables, some emergent and some submerging, that comprise ever-changing cultural *processes* rather than socio-cultural *entities*. For example, the Jumano could live among the Patarabueye for periods, even adopting similar material culture and dress, but then revert to being bison hunters again (Kelley 1986). Similarly, Speth (1986), based on archaeological and human osteological remains from the Pecos Valley, concluded the populations could dramatically change their economic basis from agriculture/horticulture to hunter-gatherer on short notice. They apparently did so quite often in prehistoric times. The point is, the highly fluid social entities depicted in the Late Prehistoric and ethnohistorical records are quite possibly unassailable without a direct historical approach, and the data for that fade quickly in peering into the prehistoric past beyond the cusp of history.

What the archaeological record can more responsibly yield are the events (individual behaviors), cycles within lines of material evidence that suggest social, political, and economic patterns (conjuncture), and long-enduring structural processes. These are interrelated, but each is a relatively autonomous variable that can crosscut socio-cultural boundaries. The future is moving towards careful analysis of what the archaeological record actually represents, and taxonomy needs to disencumber the data from socio-ethnic prerequisites. A phase can be used to infer society, but the latter should not be the precondition for defining a phase.

Regarding future directions, a viable research avenue is to address not necessarily the phases themselves, but the magnitude of change at their margins, at the origins and demises. Did the advent of any given phase coincide with change at all levels or only some (subsistence economy, technology, mortuary behavior, trade goods, stylistic attributes, etc.)? As has been critiqued, it seems that the vast majority of chronological breaks coincide with stylistic interval breaks, but do the other lines of evidence concur with stylistic breaks as neatly as phase delineations would have it? By juxtaposing the various datasets, Figure 9.9 provides an initial indication of the changes that occurred at each of the major chronological breaks, at 1250, 1800, 2250, and 2600 B.P. The profundity of the change could provide a much more textured approach to when true structural change occurred, when it was social and economic cycles, and when it was incremental behavioral drift distinguished by continuity.

The catastrophist paradigm of years past held that history is a "saga punctuated by a series of devastating natural cataclysms" (Feder 2005:20). It could have equally been socially induced catastrophes. While few if any still subscribe to the theory, it is worthwhile to

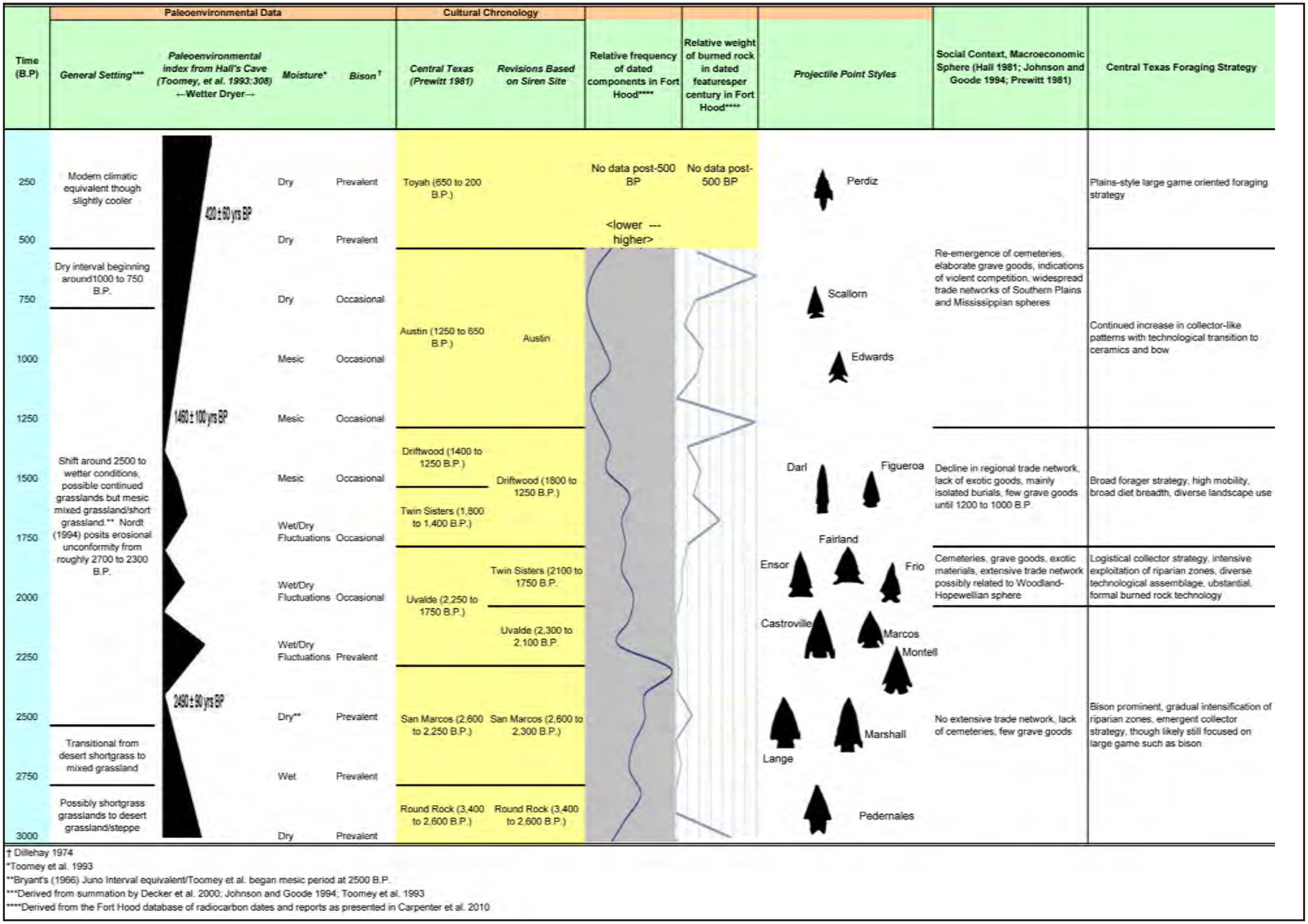


Figure 9.9 Comparative Environmental and Cultural Data for Eastern Edwards Plateau and Surrounding Regions

begin to inventory the nature of the changes at each break. The intent is to begin to unravel the depth of change and processes at the junctures. In context of the objectives of this report, what was the nature of the transition from Archaic to Late Prehistoric ways? Some have said the shift was primarily one of technology (introduction of the bow and ceramics), but otherwise there was quite a bit of continuity in most other aspects. More will be said of this in the following chapters, and the final synthesis chapter will present a proposed updated chronology once all the cards have been laid on the table.

A Parting Thought

The whole edifice of culture-historical chronology is likely leaning towards somewhat greater antiquity than is actually the case (see discussion on old wood problem in Chapter 8). We suspect most periods or other chronological units could be given a smart blow towards the recent side of time, and the truth would be better represented. It is a testable hypothesis. On a case-by-case basis, winnowing out dates taken on short-lived species versus longer-lived ones, and statistically comparing the two bodies of data may reveal the magnitude of the problem and greater resolution of the actual occupational ranges.

Chapter 10

Burned Rock Cooking Features at the Siren Site

Kevin A. Miller and J. Kevin Hanselka

Introduction

This chapter addresses prehistoric cooking technology at the Siren site with the goal of inferring feature function and changes in technology and resource exploitation over time, in order to further our understanding of broader issues regarding settlement patterns, foraging strategies, and social organization over the transition from the Archaic period to the Late Prehistoric period. The feature assemblage documented on the west side of the Siren site presents a unique opportunity to diachronically compare and contrast burned rock technology between the Late Archaic and Late Prehistoric periods. This opportunity is based on the diversity of features at the site, their contents and excellent state of preservation, and the nature of several large, more formally-constructed slab-lined cooking features that may represent evidence for the existence of specialized resource exploitation strategies. These slab-lined features were documented in both Archaic and Late Prehistoric contexts on the Siren site.

Most notably, two unique, large slab-lined cooking features were present within strata dating to the Late Archaic. One of these formed the central pit of a thin, well-preserved incipient burned rock midden (Feature 8) located in the NW Block on the site. Also attributed to the Late Archaic is a large formally constructed slab-lined feature located directly under this midden (Feature 35). Many other less formal burned rock features were also documented from this zone. In addition, several smaller but just as well-constructed slab-lined features dating to the Late Prehistoric were documented in the same area of the site. While rare, this type of feature is certainly not unknown in Central Texas; similar well-constructed burned rock cooking facilities have been documented in Archaic and Late Prehistoric contexts at sites in the Paluxy sands formation on Fort Hood, the Middle Onion Creek Valley in Hays County, and numerous other locales (Black 2003; Collins 1994; Mehalchick, Ringstaff, and Kibler 2004).

The series of slab-lined features at the Siren site, very similar in form and construction yet spanning the transitional time period between the Archaic and the Late Prehistoric, represent an unusual chance to further explore this particular phenomenon and a series of questions regarding foraging strategies, resource and land use, the transmission of knowledge, and group organization. How do the Late Archaic cooking features compare to those of the Late Prehistoric period at the Siren site in terms of size, form, complexity, and patterning? What do the differences suggest about subsistence economy, use of the landscape, group size, and length of occupation at the site? An examination of the contexts and functions of these features as they relate to investment of labor and resource availability and utilization may yield new information on economical and organizational aspects of landscape use, planning, and shifting resource bases over time.

Technological issues considered here include the significance of the construction techniques of many of the large formal features at the Siren site and their implications for organization of labor and for types of food processed. To explore this, we examine the range of edible food remains associated with slab-lined cooking features in Texas, as well as the physical attributes of this feature type and how these attributes may provide benefits in the processing of certain kinds of foods.

Before addressing these issues and answering questions regarding the Siren site suite of features, the following discussion briefly examines the evolution of research in the archaeology of burned rock cooking technology and middens in Central Texas. Both cultural and natural formation processes are considered concerning the construction, accumulations, and development of these ubiquitous archaeological phenomena. A review of the current state of knowledge of large, slab-lined features in Texas is then presented before the examination of the Siren site features.

Investigating Burned Rock

Burned rock is the most frequently encountered archaeological material in Central Texas, with perhaps the exception of lithic debitage. Long recognized as an indicator of prehistoric occupation, concentrations of burned rock have been the focus of a great deal of speculation over the last century. These burned rock accumulations occur in a variety of forms including (1) very large, dense mounds known as middens; (2) smaller, discrete, structured groups of rocks commonly referred to as features; and (3) thin, irregularly patterned scatters of burned rock. In the past few decades, systematic archaeological investigations have led to a more comprehensive understanding of these ubiquitous cultural features (Black et al. 1997; Collins and Ricklis 1994; Creel 1986; Hester 1991; Potter et al. 1995; Nickels et al. 1998; Tennis et al. 1997; Weir 1976a).

The residues of burned rock technology occur in a number of different forms related to available rocks or raw materials, levels of reuse, post depositional processes, and a host of other variables. Black and Creel (1997:271) define the classic Central Texas burned rock midden as a "¼ complex, accumulative, episodic, multi-causal phenomena that characteristically formed over long spans of time on stable land surfaces...."As the most visible archaeological manifestations at many Central Texas sites, middens have been classified in to various forms such as sheet or incipient middens; large, domed middens that are convex in cross section; and ring or annular middens.

The most common function attributed to burned rock features is their utilization as ovens or hearths (Black et al. 1997). The thermal properties of stone, specifically limestone and sandstone, were clearly recognized by the ancient indigenous groups of Central Texas. Over the years, a number of theories regarding the function of burned rock features and middens have been suggested. Perhaps most relevant is the link between the processing of plants foods to the distribution of burned rock middens across the landscape (Black et al. 1997; Creel 1986; Hester 1973; Wilson 1930). Black et al.'s (1997) comprehensive work on hot rock cooking strongly indicates that certain plant foodstuffs were critical to indigenous lifeways and likely played a causal role in the development of large concentrations of burned rock. They "hypothesize that, collectively, middens may have been in use year-round for different seasonally important plant resources; sotol and geophytes in the winter and spring, prickly pear in the summer, acorns in the fall, etc." (Black and Creel 1997:305).

Johnson and Goode (1994) have asserted that rock oven cooking became established in Central Texas by 7000 B.C. They assert that between this point in time and roughly 3000 B.C., burned rock middens formed on stable land surfaces on the Edwards Plateau, then the technology spread steadily from east to west across the plateau. These facilities, many of which were located in prepared areas and repeatedly used, were no doubt well known fixtures on the landscape for foraging societies. Growing accumulations of burned rock may also reflect an enhanced reliance on starch-based plants (Black and Creel 1997). It is clear that populations during the Middle and Late Archaic (2500–800 B.C.) utilized burned rock technology fairly extensively (Black and Creel 1997). Although there are gaps in the radiocarbon record from regional burned rock midden sites during Late Archaic times, these features clearly were still being utilized through the Late and Transitional Archaic and into the Austin and Toyah phases (Black and Creel 1997:301). Comprehensive work by Black et al. (1997) has resulted in a highly detailed chronology of burned rock accumulation and use, extending the time frame of burned rock technology and midden accumulation into the Protohistoric period, when Spanish interlopers disrupted aboriginal lifeways (Black and Creel 1997:305).

Recent comprehensive studies of burned rock middens have been instrumental in obtaining structural data and elucidating the technological function of Central Texas burned rock features (Black et al. 1997; Hester 1991; Potter et al. 1995). Studies have also integrated systematic recovery techniques, experimental cooking investigations and ethnographic research regarding burned rock technology (Black et al. 1997; Leach et al. 1998; Thoms 1989, 2008a). For instance, in Texas, the Lipan Apache were observed utilizing heated rocks and earth to process and cook sotol crowns (Ellis 1997). This and similar recent studies follow in the footsteps of earlier ethnographic researchers who described the aboriginal use of hot-rock fueled cooking facilities. For example, Castetter and Opler (1936:36–39), Castetter et al. (1938), and Bell and Castetter (1941:58) illustrate in detail how various Apache and other groups baked agave, sotol, and yucca in large stone-lined earth ovens.

Stemming from this continued development of systematic recovery and interpretive techniques, broader theoretical issues have been articulated addressing thermal stone cooking technology and the accumulation of burned rocks in archaeological contexts. The development of relevant middle range theories has provided a link between the archaeological data and the behavior that resulted in what we are able to observe archaeologically (Binford 1962, 1968; Ellis 1997). The hypothesis that burned rock middens were used to some extent as focus-centered activity areas that often included preparing and cooking foods provides a starting point in terms of interpreting the role these facilities played in prehistoric life (see also Black 1997; Black and McGraw 1985).

Assessing the Form and Function of Large Cooking Features

A broad spectrum of burned rock features was encountered on the west side of the Siren site, ranging from small, shallow, haphazard concentrations of angular burned rocks to very large cooking features including an incipient midden (Feature 8) and the formal slab-lined features that are a focus of this chapter. Black (1997) hypothesizes that large slab-lined features were typically ovens that functioned as fixed appliances on the landscape, enhancements that prompted hunter-gatherers to return to the same location repeatedly over long periods. Large, well-constructed slab-lined features have been documented at numerous Central Texas sites (Black et al. 1997; Ricklis and Collins 1994; Weir 1976a). These features may be found as singular entities or they may be encountered in the center of a larger burned rock midden.

In terminology developed by Kleinbach et al. (1995a) for burned rock features on Fort Hood, these manifestations are referred to as "Type 5 hearths," defined as basin-shaped pits lined with large, tabular limestone slabs, one to three layers thick. Often the basin of the feature is characterized as having a "pie plate-like" morphology, in that the base is flat rather than concave. The interior matrix commonly contains charcoal. The floor of the feature may have a layer of tabular stones as well. These features stand apart from many other types of recorded burned rock features due to their size (usually 1 m in diameter or greater), formal level of construction, use of large rock slabs to line the basin or pit, and apparent large investment of energy in their manufacture. As a caveat, it is recognized that many similar features may not be preserved in the archaeological record, as their structure and coherence have broken down over periods of reuse and reoccupation.

A Review of Slab-lined Features in Texas

SWCA conducted a review of 61 individual sites with Late Prehistoric or Late to Transitional Archaic components, or combinations of both, distributed along drainages within the Colorado, Leon, Little, and San Gabriel river watersheds, and more than 30 percent (n=19) had slab-lined burned rock features documented in them (Figure 10.1).

Recent geoarchaeological investigations of several sites located in the Paluxy sands formation on Fort Hood resulted in the discovery of several such features (Mehalchick et al. 2004). On the prehistoric encampment known as the Firebreak site (41CV595), Features 11 and 15 in Area 2 are of particular interest. Feature 11 is described as a well-defined cooking pit or earth oven consisting of a well-prepared densely lined pit constructed with rings of tabular limestone slabs up to 38 by 25 cm in size, and no less than 5 cm thick. The known dimensions of the feature are 200 by at least 136 cm, and the base held a layer of charcoal stained sediment. Flotation samples of the matrix produced acorn and pecan nutshell fragments. Although it is possible that such nuts were being processed in this feature, it is also possible the materials were introduced incidentally as they are ideal for use as tinder. Feature 11 yielded conventional radiocarbon dates of 2140 ± 40, 2050 ± 40, and 1580 ± 110 B.P. (Mehalchick et al. 2004:95–97).

Adjacent to Feature 11 on the Firebreak site was a second, larger cooking pit or earth oven designated Feature 15. Although portions of this feature extended into unexcavated areas, the exposed portion indicated that its dimensions exceeded 210 by 206 cm. Feature 15 was structurally similar to Feature 11, except the slabs were not as densely packed. Most of the construction material consisted of slabs between 5–25 cm in size, but several tabular rocks measured up to 45 cm. Charred eastern camas bulb fragments were recovered from a flotation sample from Feature 15, and yielded a radiocarbon age of 1870 ± 40 B.P. Both Features 11 and 15 dated to the Late Archaic period, and appear to represent the beginning of a burned rock midden accumulation (Mehalchick et al. 2004).

In Area 1 of the Firebreak site, Feature 6 was partially destroyed by backhoe trenching. Despite its partial destruction, it bears attributes that suggest it was once a slab-lined cooking feature. The feature was composed

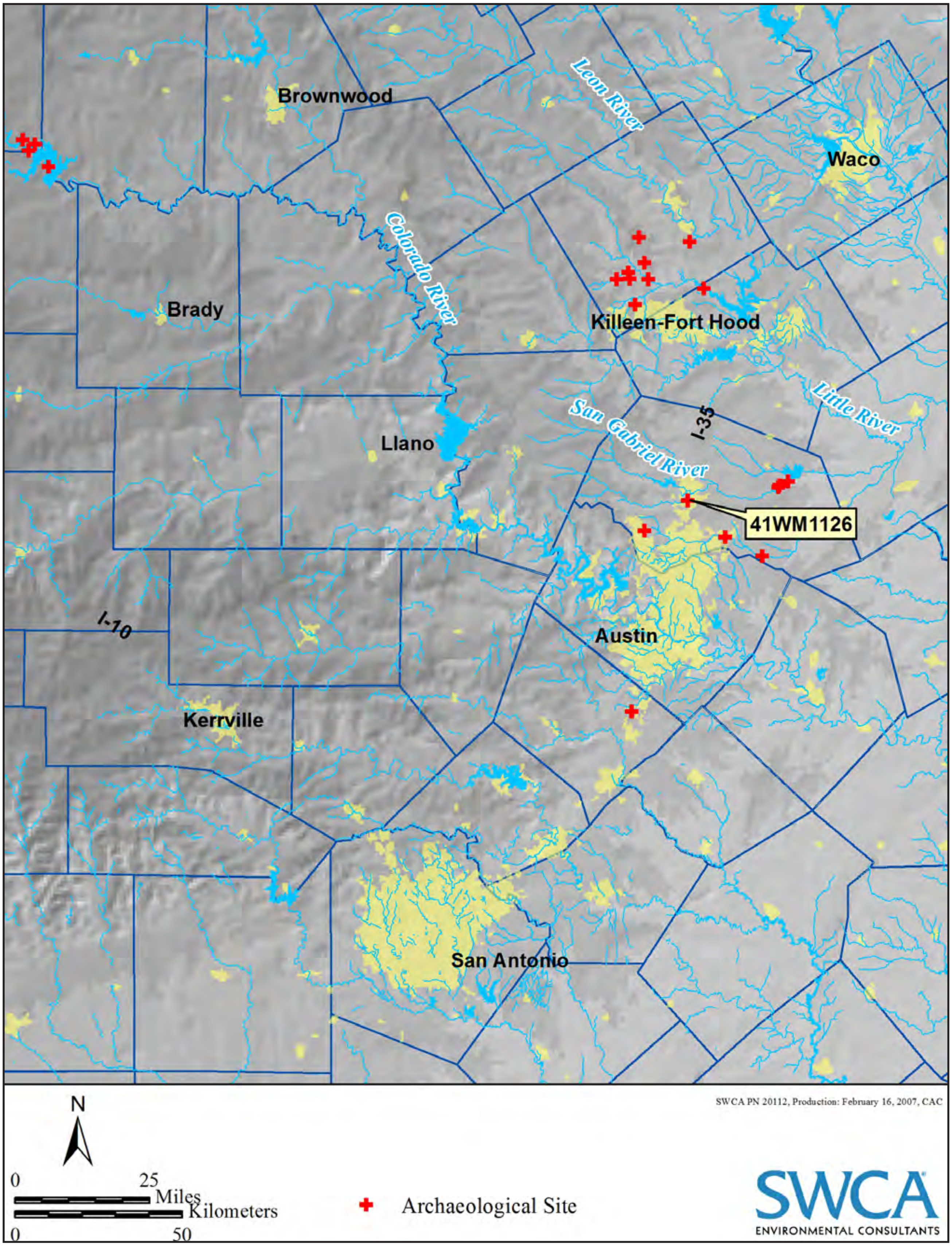


Figure 10.1. Distribution of Late Archaic and Late Prehistoric age sites with reported slab-lined features.

of one to two layers of limestone rocks, most of which were tabular slabs up to 25 cm in size. Most of the slabs either lay flat or sloped inward at various angles. It is estimated that it once measured about 137 by 100 cm. Charcoal from Feature 6 yielded a radiocarbon age of 970 ± 40 B.P., placing it early in the Late Prehistoric period (Mehalchick et al. 2004). No edible plant parts were found in the feature fill.

Feature 2 at the Mustang Branch site (41HY209-M), in Hays County, is described as a large slab-lined pit found near the center of a burned rock midden (Collins 1994:105–110). Morphologically this feature is similar to Feature 35 on the Siren site. Feature 2 appears to have been rebuilt at least once after its initial construction; it has a complete inner and another incomplete outer layer of burned limestone slabs. The base of the interior layer measured about 1 m in diameter, and the feature flared out to over 1.5 m wide at the top of the outer layer. The pit, which was excavated to bedrock upon construction, averaged about 25–30 cm deep, and the bedrock base was covered with numerous small burned stones. The association of faunal and macrobotanical material with Feature 2 is uncertain, so the age of the hearth was not conclusively established, but the most closely associated artifacts were Late Archaic in nature (Collins 1994:110).

Two slab-lined features were investigated at the Millican Bench site (41TV163) in Travis County (Mauldin et al. 2004). Feature 1 was discovered beneath a dense, 10-cm thick lens of snail shells; it is described as roughly circular and about 1.5 m in diameter. The slabs lining the pit are depicted as burned and generally sloping downward towards the center, though they did not extend all the way to the base of the 75 cm deep pit. A single date from Feature 1 indicated a radiocarbon age of 1510 ± 40 B.P., near the end of the Late Archaic (Mauldin et al. 2004:33). While no evidence of plant-related subsistence was obtained from Feature 1, animal bone fragments were recovered from the feature fill.

To the northwest of Feature 1 on the Millican Bench site was Feature 5. Bisected by a backhoe trench, it is estimated that the complete feature originally measured about 1.5 m in diameter and was about 30 cm deep. The many large slabs (most exceeding 30 cm) lining the walls sloped towards the center of the feature. Unfortunately, no dateable material was recovered, but an associated Fairland dart point indicates use during the Archaic period (Mauldin et al. 2004:41). Interestingly, both Features 1 and 5 had small caches each containing a large uniface and two large mussel shell valves directly associated with them (Mauldin et al. 2004:33, 41).

Feature D33 at the Shepherd site (41WM1010) in Williamson County is described as a circular, basin shaped hearth with several large limestone slabs surrounding, filling, and lining the feature (Dixon and Rogers 2006). Feature D33 was dated to the Late Prehistoric period with no associated midden.

Several slab-lined burned rock features were recorded at sites in the O. H. Ivie Reservoir project area near the confluence of the Colorado and Concho rivers in Central Texas. Of particular interest is Feature 9 at the Turkey Bend site (41CC112). The feature was a large burned rock midden (Feature 9a) with associated slab-lined features (Features 9b, 9d, and 9e) and burned rock concentrations (Features 9c and 9f). The slab-lined features were all described as inward sloping tight clusters of primarily tabular limestone rocks (Treece et al. 1993). Although no individual dating was done of the features, the overall complex was dated to the Late Prehistoric based on humates from a sample recovered in Feature 9b.

Morphology and Technology

Concerning their technology and structure, what is striking about many of these features is the material selection processes and labor that went into their construction. As evidenced by the stones of which they are composed, diligent selection appears to have taken place when gathering the necessary building materials for this type of cooking feature. Relatively large, flat, slab-like stones were carefully chosen to form the outer ring, interior lining, and often floor of these features. For example, the aforementioned Feature 2 at the Mustang Branch site was composed of two rings of very large, flat tablets of limestone, defining a 1.75 m wide cooking pit (Collins 1994:105–110). Similarly at the Siren site, the outer walls and floor of the 1.7-m-diameter Feature 35 were composed of over 40 very large, flat, limestone slabs, likely procured from the adjacent limestone cliffs and formations. These slabs on average were greater than 15 cm in maximum dimension on the floor and over 30 cm in maximum dimension in the outer walls.

The specific selection of stones with large, tabular morphologies suggests they had certain attributes that were desirable to the prehistoric oven manufacturers. Most likely, these attributes centered on the slabs' ability to contain and/or transmit heat during the cooking process and possibly their durability (due to size), allowing a better chance of reusing the feature. The creation of these into a deep basin is also a characteristic of these features. The size and depth of the features are often much greater than the typical burned rock scatter or hearth feature. Their size suggests that a large quantity (bulk plants) or large-sized resource (whole animal) was being processed within these features.

In examples where the slab-lined feature represents a central focal point within a larger midden, the midden itself may be a variation on the same slab-lined feature theme. As Black (1997) has noted, middens tend to accumulate upward and outward from the central cooking facility, with the outside rings exhibiting a much lower rock density than the interior of the feature. As this central facility or oven is reused, the midden becomes denser and develops into larger, more amorphous forms. Of course, this likely does not account for all possible variations on the midden theme observed throughout Central Texas.

Hypothesized Functions of Slab-lined Features

To date, studies in Texas have strongly suggested that the specific function of these large features is likely related to the baking of plants. It has been hypothesized that slab-lined cooking facilities and other pit ovens were specifically designed for baking vegetable foods containing large proportions of complex carbohydrates or resistant starches that require extended cooking times to facilitate consumption (Wandsnider 1997). Black et al. (1997) describe several variations on the pit cooking scenario with numerous iterations on the interior structure and composition of the fill. Overall, however, the rock-lined pits are hypothesized to be earth ovens where the rocks serve as thermal storage devices to "bake" large quantities of foodstuffs. According to Black et al. (1997:67), "… ovens constructed in this manner would leave a particular signature." This signature would include little evidence of burning on the bottom of the pit, few visible chunks of charcoal and ash (though some burned soil and charred fragments may remain), and the rocks lining the base of the feature would appear as an arranged hot rock bed rather than a jumble of rocks. Minimally, this is the case with Feature 35 from an Archaic component and Feature 16 from the Late Prehistoric component on the Siren site (see below).

Black et al. (1997:297) postulate that in Texas, the main food resources baked in these ovens likely included "acorns, sotol, several of the bulbous plants in the lily family, prickly pear, and various geophytes (perennials with underground storage bulbs/roots) including prairie turnip." In the xeric regions of west Central, Lower Pecos, and Trans Pecos Texas, it clear that agave, sotol, and other desert succulents were primary target species cooked in these ovens (Dering 1999). In Central and South Texas, recent archaeobotanical analyses have revealed that geophytes, plants with underground storage organs such as wild onion, wild garlic, and eastern camas, were important (Acuña 2006; Dering 2004; Mehalchick et al. 2004; Thoms 2008b). As later touched upon in this chapter and in Chapter 11, the large slab-lined facilities may have also been utilized to cook other foods such as meat or produce alcohol from plant resources.

Despite the lack of direct evidence as to what kinds of foods were being cooked, Collins (1994:170) suggests that the well-constructed slab-lined feature at the Mustang Branch site (Feature 2) may have been used for steaming foods rather than baking them. He does this based on the relative abundance within the feature fill of phytoliths representing sedges and riparian grass species. He suggests that such plants, if used as packing material in the oven, would produce ample moisture to steam the cooking food. In addition, shells of aquatic snails were found in and around the feature, suggesting the deliberate application of water and/or aquatic vegetation during the cooking process.

Siren Site Burned Rock Technology

To answer questions regarding diachronic change in features at the Siren site and explore the features within the framework of broader studies outlined above, a quantitative and qualitative examination of the Siren site features was conducted. This includes a general examination of the feature types and their components, followed by comparisons and a review of slab-lined features.

General Feature Discussion

The following is a brief review of the types of burned rock features recognized at the Siren site; a more thorough treatment of the general features can be found in Chapter 7, and analytical details of the individual features are provided in the Feature Manual section of that chapter. In order to render the information gleaned from 43 burned rock features excavated on the Siren site more comparable to a broader data set in Central Texas, we employ in this study terminology proposed by Kleinbach et al. (1995a) in their descriptions of burned rock features on Fort Hood (Table 10.1).

Type 1 hearths are defined as having a relatively flat base with one to two layers of small (0–5 cm) and medium (5–10 cm) angular burned rocks and/or cobbles, that are haphazardly arranged and partially overlapping. At Siren, six features conform to the characteristics of this type; two (Features 27 and 44) are securely dated to Archaic contexts, and one (Feature 14) dates to the Late Prehistoric; an additional three (Features 9, 10, and 42) belong to unknown components. The Siren Type 1 features range from 40 x 55 cm to 70 × 56-cm in dimension, and have 28–110 burned rocks.

Type 2 features are flat-based and lined with a single layer of burned rocks/slabs that are at least 5 cm, but usually more than 10 cm, in diameter. At Siren, four features have characteristics typical of Type 2 hearths; one (Feature 45) is attributed to the Archaic, and another (Feature 12) is ascribed to a Late Prehistoric context. Two more features of this type (Features 24 and 48) are from undated and are therefore from unknown components. The Siren Type 2 features range from 54 × 57-cm to 100 × 75-cm in dimension, and have 16–124 burned rocks.

Type 3 features are basin-shaped with a matrix of ash and/or charcoal, occasionally an underlying oxidation rind, and little to no burned rock. However, no examples of this type were identified among the features excavated at the Siren site.

Type 4 hearths are basin-shaped and filled with medium and a few small angular burned rocks and cobbles. These generally occur in one to two layers, sometimes more, and the fine matrix often includes dense charcoal fragments and ash. Type 4 hearths can also have either the "classic basin" morphology, with a rounded bottom, or "pie plate" morphology, with a flat bottom (Kleinbach et al. 1995a). At Fort Hood, Type 4 hearths were found to measure between 7 and 31 cm thick. At Siren, nine features are consistent with Type 4 hearths; four (Features 2, 3, 15, and 37) are attributed to the Archaic, two (Features 6 and 13) are ascribed to the Late Prehistoric, and three (Features 11, 33, and 43) are from undated contexts. The Siren Type 4 features range from 35 × 55-cm to 93 × 85-cm in dimension, and have 32–367 burned rocks.

Type 5 features are most relevant to the present discussion, as they represent the highly formal, well-constructed slab-lined features of interest here. As previously stated, these are basin-shaped pits lined with limestone slabs. The excavated portion of the Siren site revealed 17 features that have been classified as formal slab-lined cooking facilities. Nine are attributed to the Archaic, three are attributed to the Late Prehistoric, and five are from unclear contexts. By these counts Type 5 features outnumber all other feature types on the Siren site by at least eight examples (Table 10.1). Examples of these will be discussed in more detail below.

Table 10.1. Siren Site Features by Type and Component

	Feature Numbers and Type						
Component	Type 1	Type 2	Type 4	Type 5	Incipient BRM	Burned Rock Concentration	Total Count
1	14	12	6, 13	1, 16, 25			**7**
2			15	17			**2**
3				4, 18, 20, 30		23	**5**
4	27, 44	45	37	36, 41			**6**
5			2, 3	31, 35	8		**5**
Undated	9, 10, 42	24, 48	11, 33, 43	19, 29, 34, 38, 47		21, 28, 39, 40, 46	**18**
Total Count	**6**	**4**	**9**	**17**	**1**	**6**	**43**

Type 6 features, or dispersed hearths, are areas of oxidized soil with very few burned rocks; these are interpreted to be expedient hearths. Only one Type 6 feature was identified on Fort Hood, and no examples of this type were found on the Siren site.

Six features (Features 21, 23, 28, 39, 40, and 46) on Siren can be described simply as *burned rock concentrations or clusters*, one of these (Feature 23) is securely attributable to the Archaic, but the others are from undated contexts. On Siren this feature type ranges from 46 × 30-cm to 146 × 125-cm, with 13–212 burned rocks. Finally, a single Siren site feature (Feature 8) was classified as an incipient *burned rock midden*; a range of radiocarbon dates suggests multiple use episodes, but all of these seemingly took place within the Archaic timeframe. While Feature 8 was a midden, its central feature (as revealed by trenching) is a formal slab-lined pit, and it is therefore considered as such in this study.

Siren Features by Component

Burned rock features were found within all of the five cultural components defined at the Siren site. While all of the 43 burned rock features could be assigned within the more basic but broad Late Prehistoric/Archaic classification, only 25 features have radiocarbon dates which allow for confident placement into the more refined component categories. The component analysis therefore focused on these 25 features.

To briefly reiterate, the components defined at the site include:

- **Component 1**: Late Prehistoric Austin phase component, dating from roughly 1100 to 1000 B.P.
- **Component 2**: Ephemeral Darl-associated component dating to 1730 to 1550 B.P.
- **Component 3**: Two possible distinct components associated with Ensor, Frio, and Fairland projectile points dating to 2000 and 1900 B.P.
- **Component 4**: Castroville points related, dates to about 2250 B.P.
- **Component 5**: Dense occupational debris (mixed projectiles) dating from 2600 to 2400 B.P.

An examination of features by component yields some interesting results (Table 10.1, Figure 10.2). In all components, Type 5 (slab-lined) cooking features either equal or outnumber all other individual feature types. The same holds true among the 18 features from unspecified contexts, which include all feature types with the exception of middens. Type 5 features and burned rock concentrations dominate the undated assemblage (n=5 each), followed by Types 1 and 4 (n=3 each) and Type 2 (n=2).

Five features have been securely assigned to the earliest occupations documented on the Siren site (Component 5). These are evenly divided between Type 4 (n=2) and Type 5 (n=2) features; however, the fifth feature (typed as an incipient burned rock midden) contains as its central feature another Type 5 slab-lined facility. Therefore, in Component 5 the Siren burned rock features are slightly dominated by slab-lined earth ovens. This trend continues in the succeeding Component 4, with the addition of one example each of Types 2 and 3. Of the five features dated to Component 3 contexts, all but one, a burned rock concentration, are Type 5. Only two features were found to date to Component 2 contexts; one is a Type 4 and the other a Type 5. Finally, feature Types 1, 2, 4, and 5 were found in the Late Prehistoric Component 1 of the Austin phase; again, Type 5 dominates (n=3), followed by Type 4 (n=2) and Types 1 and 2 (n=1 each).

These data are interesting for several reasons. Assuming for the time being that different types of burned rock features (as defined here) represent different activities, target resources, or preparation methods, it follows that multiple such behaviors occurred on the Siren site during each component of occupation over time. This is reflected in the multiple types of burned rock features found in each occupation zone. For instance, the occupants could have used smaller features to cook small portions of food or to provide warmth while a primary resource (plant or animal) was cooking in the larger, slab-lined oven. However, we must also consider the possibility that different kinds of features may have served similar functions, and that the numbers reflect only personal preference in feature construction among the site inhabitants.

Further, it is also interesting to note that Type 5 features are found in all dated contexts on the west side of the Siren site, followed by Type 4 (Components 1, 2, 4, and 5), Types 1 and 2 (both in Components 1 and 4), and burned rock concentrations (Component 3) and

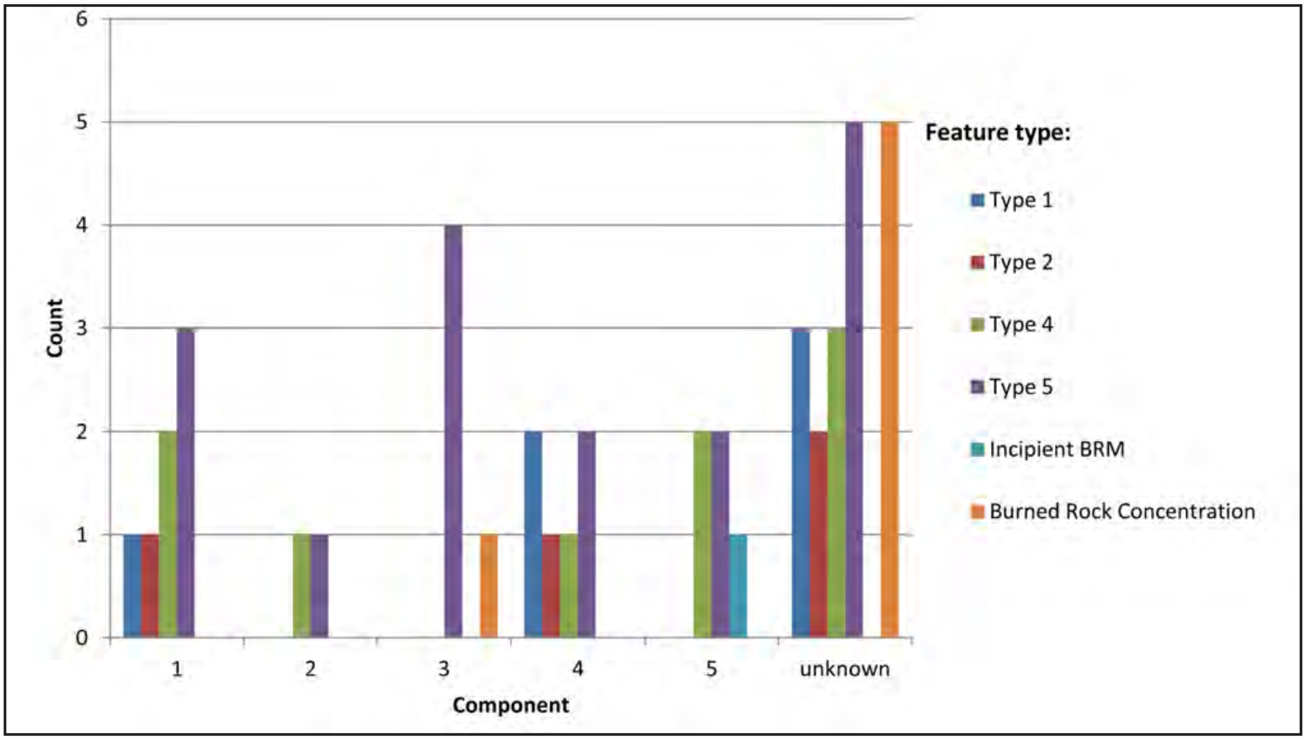


Figure 10.2. Siren site feature types by component.

the incipient burned rock midden (Component 5, although it undoubtedly represents multiple episodes of reuse). The continued use of Type 5 features over time indicates that activities for which slab-lined features were appropriate ranged from Archaic into Late Prehistoric times at the Siren site. Also, the consistent equality or dominance of this feature type both within and between components suggests that such activities may have been a relatively important aspect of all occupations of the site. However, a closer examination of Type 5 features on the site reveals apparent differences in scale, formality, and labor investment among those features broadly classified as Type 5.

A Closer Examination of Siren Slab-lined Features

Excavations at the Siren site revealed 17 burned rock features that conform to the general definition of Kleinbach et al.'s (1995a) Type 5 hearths, the highest number of features by type. The 17 features were discovered in different states of preservation, several with less cohesion and structure, others in excellent condition reflecting their formal construction. Within this category, there are variations in size, formality, and stage of use. The Type 5 features were subdivided into large (greater than 1 m diameter) and small (less than 1 m diameter) classifications.

Twelve of the Type 5 features were radiocarbon dated, and these span all five defined cultural components; the ages of the remaining five are unclear. The dated Type 5 features either equal or outnumber all other feature types in all components (Figure 10.2). Nine of the dated Siren site slab-lined features are ascribed to the Archaic period, while three are attributed to Late Prehistoric times.

When examining the Type 5 feature metrics and burned rock data, the variation within this category becomes clear (Table 10.2). Among those that are dated, large Type 5 features (n=8) dominate over small (n=4) ones. In Component 5, both Type 5 features (Features 31 and 35) are classified as large; later, in Component 4, there is both a large (Feature 36) and a small (Feature 41) one. The subsequent Component 3 contains the most Type 5 features of all components (n=4), two of which are large and two are small. The only Type 5 (Feature 17) found in Component 2, the final occupation dated to the Archaic, is large. In summary, about 67 percent of the Type 5 features dated to Archaic contexts are large. In the Late Prehistoric Component 1 there are two large Type 5 features (Features 1 and 16) and one small (Feature 25). However, as there was a much

Table 10.2. Slab-lined (Type 5) Features on the West Side of the Siren Site

Comp	Feature #	Dimen (cm)	Burned Rock Size Ranges (cm) by Count					Burned Rock Size Ranges (cm) by Weight					Associated Macrobotanical Remains
			0-5	5-10	10-15	15+	Total	0-5	5-10	10-15	15+	Total	
1	1	100+ x 140+	178	111	62	79	**430**	11.5	25.6	66.1	143.1	**246.3**	acorn nutshell, bulrush seed; acacia, juniper, oak, viburnum, plum, hackberry, ring porous wood
	16	150 x 127	75	151	118	72	**416**	1.1	26.2	74.9	166.4	**268.6**	geophyte starch grains on associated mano; oak wood
	25	64 x 60	0	19	30	12	**61**	0	1.5	18.5	15.5	**35.5**	oak wood
2	17	130 x 105	91	203	53	8	**355**	1.2	16.5	18.7	8.1	**44.5**	oak wood
3	4	110+ x 140+	275	223	65	31	**594**	5.8	26.9	32.6	67.8	**133.1**	Liliaceae bulb halves (2); oak wood
	18	140 x 80 (combined); 60 x 60 (Cluster A); 50 x 50 (Cluster B)	38	59	26	8	**131**	0.7	6.6	9.7	8.9	**25.9**	none
	20	42 x 36	2	10	3	3	**18**	0.1	3.6	4.4	5.9	**14**	oak wood; grass starch grains on associated mano
	30	162 x 150	52	80	37	13	**182**	0.5	6	16.4	16	**38.9**	Liliaceae bulb fragment; walnut shell; oak wood
4	36	170 x 135	60	81	48	58	**247**	3.3	11.9	31.7	141.2	**188.1**	Liliaceae bulb fragment; hackberry seed; oak wood
	41	75 x 58	12	28	8	5	**53**	0.2	3.6	4.2	4.2	**12.2**	
5	31	124 x 105	0	13	12	19	**44**	0	1.1	8.1	28.6	**37.8**	Liliaceae bulb fragments; oak wood
	35	180 x 180	0	1	12	70	**83**	0	0.5	10.2	160.3	**171**	Liliaceae bulb fragments; Onagraceae pollen grain; oak wood
	8 (central feature)	no data	no data	no data	no data	no data	**no data**	no data	no data	no data	no data	**no data**	Liliaceae bulb and fragments; oak wood
unknown	19	55 x 45	13	12	12	4	**41**	0.3	1.7	5.9	2.6	**10.5**	oak wood
	29	42 x 34	9	9	6	2	**26**	0.3	0.9	1.4	1.9	**4.5**	oak wood
	34	54 x 50	14	26	12	4	**56**	0.6	4.2	6	5.8	**16.6**	Liliaceae bulb; oak wood
	38	50 x 30 (partial)	3	10	8	0	**21**	0.2	1	2.5	0	**3.7**	oak wood; unknown Type 1 wood
	47	35 x 30	0	10	7	1	**18**	0	1.7	2.7	1.2	**5.6**	oak wood

larger volume of Archaic-age material excavated at the site, this may be a product of sample size.

The use of limestone slabs to line a basin-shaped pit is a defining characteristic of this feature type. In some well-preserved examples these slabs are tightly and formally arranged. Some interesting patterns emerge when the Siren site Type 5 features are examined in this regard. One of the best preserved specimens of this feature type on the site is also among the earliest: Feature 35 (described in detail below), of Component 5 (Table 10.2). Of the 83 stones that went into its construction, 84 percent (n=70) are limestone slabs greater than 15 cm, and only one stone measures under 10 cm. The second most formal in this regard is also from Component 5, Feature 31. It is smaller in scale than Feature 35, and 43 percent of its construction stones are slabs of 15 cm or greater. In the succeeding Archaic components the percentage of large slabs versus smaller stones diminishes to two percent in Component 2, but this likely reflects sampling bias as only one Type 5 feature (Feature 17) is identified from this context. In these terms, there is not a significant difference between slab-lined features in the final Archaic components and those of the Late Prehistoric Component 1, in which the percentage of large slabs relative to smaller stones per feature is between 18–20 percent. In general, those Type 5 features that are classified as large and date to the later components have high total numbers of burned rock relative to those of Component 5.

It is unclear whether the difference in morphology between the large, well-constructed Feature 35 and the smaller or less formal features of subsequent occupations is due to a difference in function or is simply due to preservation. It is possible that other large features may have once started as pristine and formal as Feature 35, but that multiple episodes of use and reuse have deteriorated their condition. If this is the case, Feature 35 may only represent one or very few use episodes.

As stated above, the presence of Type 5 features in all dated contexts implies that if these features served a specific function or range of functions that were carried out over all occupations of the Archaic and into the Late Prehistoric. The difference within and between the two periods, at least as it pertains to the use of slab-lined hearths, may have been one of scale, as indicated by differences in the size of various features (Table 10.2). In terms of macrobotanical remains with these features, it is clear that oak wood was the dominant fuel wood used, as fragments of wood charcoal representing evergreen and/or deciduous oaks (*Quercus* spp.) were obtained from multiple slab-lined features in both Archaic and Late Prehistoric contexts (Appendices B and D). Oaks of various species are abundant in the three vegetation zones within or adjacent to Williamson County, and these would have been ideal fuels. While oaks may have been preferred, other wood types at least occasionally fueled the slab-lined cooking features, as evidenced by the presence of acacia (*Acacia* sp.), viburnum (*Viburnum* sp.), juniper (*Juniperus* sp.), plum (*Prunus* sp.), and hackberry (Ulmaceae) wood fragments in Feature 1 (Component 1) and an unknown wood type found in the undated Feature 38 (Appendices B and D). There is also some evidence of plants that were possibly processed as foods within these features, including acorn nutshell fragments (Feature 1), a bulrush (*Scirpus* sp.) seed (Feature 1), and charred geophyte (*Liliaceae* sp.) bulbs (Features 4, 30, 31, 34, 35, and 36) (Appendices B and D).

Siren Slab-Lined Features: Component 5 (Archaic)

In Component 5, two of the most substantial and formal slab-lined features were excavated: the central pit of Feature 8, the incipient midden, and Feature 35. While not classified as Type 5, Feature 8 was an incipient burned rock midden with a slab-lined central feature similar to Feature 35. Feature 8 essentially covered the entire NW Block at the Siren site. It appeared to be on the contact between Strata 2B and 3, although in some places it either cut into Stratum 3 or filled depressions left by earlier features. The midden ranged in thickness from 8 cm to as much as 33 cm. Backhoe excavation through the midden revealed a large (3.25-m-wide) central pit in its interior. The concave basin was lined with numerous large limestone slabs. Unfortunately, due to time constraints, the central pit feature could only be explored from the sidewall of the backhoe trench and therefore specific rock data for the slab-lined interior of Feature 8 is lacking.

A Frio dart point was recovered south of the central feature, and carbonized *Liliaceae* geophyte remains (C109) were found near the base of the midden rocks. A series of conventional radiocarbon ages suggest multiple use episodes, as three dates cluster at 2460–2480 ± 40 B.P., while two others are both 2590 ± 40 B.P. A final date, from a geophyte associated with the bottom of another, intrusive slab-lined feature (Feature 31) on top of the midden, yielded the most recent date of 2400 ± 30 B.P.

Consistent with the probability of multiple use episodes is the observation that the slab-lined central feature was reconstructed at least once during formation of the midden. The profile of the central feature revealed an original, older construction episode, truncated on its southern side by a more recent pit; a layer of slabs separates the fill between the two construction episodes. Geoarchaeological investigations of Feature 8 revealed enhanced magnetic susceptibility external to the central feature, perhaps indicating that these outside sediments had been discarded from the base of the feature where magnetic susceptibility values are expected to be highest (see Chapter 6).

Underlying Feature 8 and excavated into Stratum 3 in the north-central portion of the NW Block was Feature 35. The incipient burned rock midden thickens immediately above the center of Feature 35, possibly reflecting that the latter was infilled during the formation of the midden. As most of the radiocarbon ages between these two features overlap at two standard deviations, it is not possible to distinguish the time depth between them using this method. There appears to be about 10 cm of sediment separating the top of the slabs defining the margins of Feature 35 and the base of the rocks on the periphery of Feature 8. Given the apparent sedimentation rate during the final Archaic occupation, as much as a century of time may have passed between the final use of Feature 35 and the beginning of burned rock accumulation in the midden, but it is likely that both were formed in a period spanning no more than 200 years.

Feature 35 is a large, formally-constructed feature with a slightly concave basin-shaped bottom (Figure 10.3). Large, tightly packed slabs lined the feature's base and even larger, nearly vertically arranged slabs formed its outer margins. In plan view, Feature 35 was roughly circular in with a diameter of approximately 160–170 cm; the basin measured about 40 cm deep from the top of the outer rocks to the bottom of the deepest. Many of the basal and marginal rocks were either unfractured or fractured in situ. Of the 80 primary rocks that compose the feature, 87 percent (n=70) were tabular slabs 15 cm or greater in diameter, constituting 93 percent of the overall rock weight of the feature.

Geomorphological testing of Feature 35 revealed that its interior was characterized by high organic content and enhanced magnetic susceptibility; differences in stable carbon isotope ratios between the outside and feature interior seemingly reflect high carbon contributions from C_3 biomass (wood was the dominant fuel) (see Chapter 6).

Although artifact recovery was low, some debitage and bone fragments were recovered by water screening the feature matrix. Carbonized geophyte (five *Liliaceace* bulbs) remains were collected from the feature matrix during excavation, and macrobotanical analysis identified that the wood used to fuel the cooking feature was deciduous oak (Appendix B). Radiocarbon dates are consistent with the stratigraphic position of the feature, and ranged between 2370–2600 ± 40 B.P. This spread may indicate multiple episodes of reuse.

Figure 10.3. Overview of Feature 35, Component 5, after exposure and prior to removal of interior rocks.

Siren Slab-Lined Features: Component 4 (Archaic)

Both a small (Feature 41) and large (Feature 36) Type 5 feature were found in Component 4. Feature 36 is an excellent example of what appears to be the remains of a slab-lined cooking facility, which has been repeatedly used and which has lost its

Figure 10.4. Feature 36, Component 4, plan view of exposed feature. Notice large slabs.

coherence and structure (Figure 10.4). The feature was roughly 170 × 135-cm in diameter and was composed of several large tabular slabs and a cluster of rocks forming the remnants of a basin-shaped pit. Of the 247 rocks recovered in the feature, 23 percent (n=58) were greater than 15 cm in diameter, constituting 75 percent of the total weight of all rock in the feature. A Montell dart point (Lot 933.3), debitage, and bone fragments were recovered from the feature matrix, while sediment floatation revealed oak wood, charred Hackberry seed, and a charred *Liliaceace* bulb (Appendix B).

In contrast to Feature 36, Feature 41 was a small Type 5 slab-lined feature, composed of 53 rocks with only 9 percent (n=5) greater than 15 cm in diameter. While many rocks were slab-like in this feature, they were highly fragmented in situ. No macrobotanical remains were recovered. Overall, the feature appeared to be the remnants of the base of a large slab-lined feature.

Siren Slab-Lined Features: Component 3 (Archaic)

Component 3 held four of the dated Type 5 features, Features 4 (large), 18 (small), 20 (small), and 30 (large). Interestingly, three of the four features lack formality and appear to be the disturbed remnants of used and disturbed slab-lined facilities. For example, Feature 18 was a 140 × 80-cm-diameter cluster of layered rock that could be the remnants of a small oven with removed lid (Figure 10.5). Of the 131 rocks comprising the feature, 45 percent (n=59) were in the 5–10-cm-diameter range. Bone fragments, debitage, and a mussel shell fragment were found in association with Feature 18.

The most formal and intact Type 5 feature in Component 3 was Feature 30. The feature was roughly 160 cm in diameter, composed of numerous tabular limestone slabs forming a shallow, basin-shaped pit extending into the block sidewall (Figure 10.6). Half of this feature was not excavated. Of the 182 rocks recovered in the feature, only 7 percent (n=13) were greater than 15 cm in diameter, but they constituted 41 percent of the total weight of all rock in the feature. Most rocks were in the 5–10 and 10–15-cm-diameter size range. Debitage and bone fragments were recovered from the feature matrix, while sediment

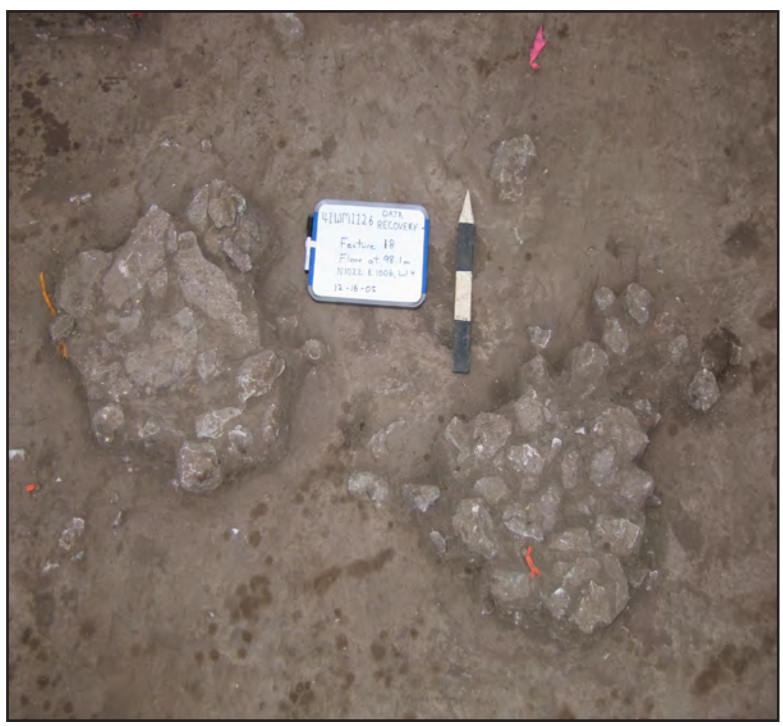


Figure 10.5. Feature 18, Component 3, Clusters A and B plan view.

Figure 10.6. Feature 30, Component 3, facing north. Note rocks from underlying Feature 8 barely exposed in floor of excavation unit.

floatation revealed oak wood, charred walnut nutshell, and a charred *Liliaceace* bulb (Appendix B).

Siren Slab-Lined Features: Component 2 (Archaic)

Component 2 contained one dated Type 5 feature, Feature 17. Similar to the above-mentioned Feature 30, Feature 17 was found in a sidewall and only partially excavated. The circular feature measured 130 × 105-cm in diameter, forming a concave basin with three layers of rocks and larger tabular slabs along the outside. Burned soil and matrix were found in the feature. Of the 355 rocks comprising the feature, 57 percent (n=203) were in the 5–10-cm-diameter range. However, eight rocks greater than 15 cm in diameter were found lining the feature. Debitage and bone fragments were found in association with Feature 18, and charred oak wood was identified in the matrix (Appendix B).

Siren Slab-Lined Features: Component 1 (Late Prehistoric)

Three Type 5 features (1, 16, and 25) were recovered in the Late Prehistoric Austin phase component. Feature 1 was found during testing and was not fully explored but appeared to be the remnants of a large oven. Feature 25 was smaller (64 × 60-cm) and informal, likely the disturbed remains of a more formal cooking feature. Feature 25 had a high percentage of flat, large rocks. Of the 61 rocks comprising the feature, 68 percent (n=42) were greater than 10 cm in diameter.

The most formal feature was Feature 16, a large slab-lined feature encountered in the northeastern corner of the excavated portion of the site. It was the largest feature in a cluster of Austin phase cooking facilities that may represent a discrete living area. It originated in Stratum 2A, but had been excavated into an approximately 25-cm-deep basin that cut into Stratum 2B (Figure 10.7). In planview it measured 150-cm-long by 127-cm-wide. On its northern margin the basin was lined with large tabular pieces of limestone that were tilted towards the center. The center itself lacked slab-lining but was filled with limestone cobbles. Of the 416 rocks comprising the feature, about 36 percent (n=150) were in the 5–10-cm-diameter range, mainly within the central part of the feature. However, the feature also had 72 slab-like rocks over 15 cm in diameter, most of which formed the outer ring of stones. In essence, the feature was lined with large flat stones and in-filled with smaller, angular rocks, similar in construction to Feature 35.

Macrobotanical analysis of the feature matrix indicates that wood from both oak species (evergreen and deciduous) were used to fuel the cooking feature (Appendices B and D). Although no macrobotanical evidence for subsistence was recovered, starch residue analysis of a mano (Lot 285) associated with the feature suggests the processing of geophytes. Interestingly, the aforementioned starch grain evidence is the only support of the use of geophytes during the Austin phase at the Siren site.

Summary of Siren Site Burned Rock Features

The excavated portion of the Siren site yielded 43 burned rock features of varying morphology, size, and function. Of the types defined in the analysis, Type 5 dominates, with 40 percent of the total, followed by Type 4 small hearths and burned rock concentrations. The diversity of these types through temporal components varies, with the most diversity in Components 4 and 1, and little in Components 2 and 3.

Figure 10.7. Feature 16 Composite, Component 1, before/after excavation photo, note large slabs lining exterior.

The analysis classified 17 of 25 confidently dated features as slab-lined (Type 5) cooking facilities. Thirteen are attributed to Archaic components, and, of these, eight are classified as large (greater than 1-m-diameter). By way of comparison, only three such features are attributed to the Late Prehistoric component, and two of these are large. This pattern could reflect an emphasis on particular target plant species (e.g., geophytes) during the Archaic period and a shift to other resources during the Late Prehistoric. It could also reflect occupational intensity or simply sample size error, as Late Prehistoric deposits were much less robust on the west side of the site and had been impacted to an unknown degree by bridge construction, possibly erasing evidence of other features.

Macrobotanical remains recovered from the two primary components offer some support for this hypothesis. While evidence for geophyte use during the Late Prehistoric (Component 1) is limited to starch grains found on the surface of a mano (associated with a slab-lined feature, Feature 16), carbonized *Liliaceae* geophyte remains were recovered from six slab-lined features and the burned rock midden (with an associated slab-lined, central feature) in Late Archaic contexts.

In Chapter 11 we make a more holistic examination of the site, and variation in labor investment and formality of burned rock features through time are explored. By using average number of rocks per feature and individual rock weights, we see that the average number of burned rocks is quite high in Component 5, then declines exponentially in Component 4, before rising to an average of slightly more than 200 per feature over the remaining components. The more formal slab-lined hearths have very high average rock weights. Conversely, the burned rock midden (Feature 8) has the lowest average per rock weight of any feature, reflecting intensive thermal fracturing and feature reuse. By looking at average rock weight per feature, there is a steady decline through time, reaching the lowest average in Component 2 before rising again in the final component.

The important trends revealed in the this analysis are: 1) the Late Archaic Component 5 represents the peak of formality and labor investment in burned rock technology; 2) Component 2 marks the least formality and investment of energy; 3) Component 4 has, by far, the lowest average number of rocks comprising features, but they are typically large rocks; and 4) the Late Prehistoric marks a slight resurgence of large (according to average weight) burned rock features. Overall, the Siren data show a decline in the formality and energy investment in cooking feature technology from a peak around 2600–2400 until 1250 B.P., then a subsequent increase from around 1100 to 900 B.P. Though these trends are present, they are not particularly strong and include a gap in data in the Archaic (Component 2). The consistency of occurrence of Type 5 features through all components appears to be a much stronger pattern than any of the differences, revealing a surprising regularity of hunter-gatherer use of the landscape and resource exploitation through time.

Siren's Slab-lined Features in the Broader Perspective: Interpretations and considerations

As briefly discussed earlier in the chapter, studies have hypothesized that the specific function of large slab-lined rock features is related to the baking of plants. In addition, their formal construction and size may have implications for understanding hunter-gatherer foraging tactics, technology, resource availability, and landscape use. The following section explores the large Siren site suite of slab-lined features in the context of broader studies to elucidate diachronic functional and behavioral trends.

Functional Properties and Labor Investment

One of the more prominent characteristics of this feature type is the often large, slab-like rocks used in feature construction and the formality of the facility. This suggests a level of labor investment greater than your average burned rock hearth. It also suggests that this feature structure may have unique attributes that were sought out to process specific foods or bulk quantities. As Black (2003:38) observes:

Lined features function as containers within which fires are built. The linings also function as thermal elements that both absorb/store heat and reflect radiated heat. In wet soil, experimental work suggests that stone-lined features may allow more efficient heating in comparison to unlined features. In hearths lined with rocks, the lining dries out quickly and seems to insulate the fire whereas wet soil diffuses heat until the moisture is driven out. Most archaeological discussions of slab-lined features are largely silent or vague as to how the features functioned.

The purpose of the large slabs that line the walls and floor of this feature type is an underexplored question. The explanation may be as simple as the lining acting as insulation from surrounding wet sediments in order to make the interior fire burn hotter and more efficiently (Alston Thoms, personal communication to Kevin Miller, September 29, 2011).

Smith and McKnees (1999:123) believe that similar slab-lined features found in southwestern Wyoming were also used to process bulbs and root crops. However, they suggest that the cooking process relied on coals rather than hot rocks as the primary source of heat. The evidence they cite includes dense charcoal staining and general lack of interior rocks. They suggest that a bed of coals was placed on the stones in the bottom of the pit, and the surrounding slab lining focused and distributed the heat throughout the pit for extended periods, baking the foods within. In many of the Siren features, abundant burned rock and sediment were recovered. This is either infilling from subsequent occupations or feature fill which formed part of the thermal storage devices. Siren site feature morphology therefore suggests more of a baking/steaming function (e.g., Black et al. 1997:77).

Of course, one interesting aspect of the large slab-lined features observed at the Siren site and elsewhere is the formal nature of their construction and the relatively high labor investment that it appears to represent. The construction of these facilities would have involved the time to procure the large, flat slabs of limestone, excavate the pit, line the pit with the stones, and perform other associated tasks. This likely could be accomplished by several people in a day and processing of resources could then proceed. Such a construction would also produce a feature that would be durable through many uses, suggesting the prehistoric inhabitants were planning on a return to the site, possibly as part of the seasonal exploitation of a specific resource (see below).

Recently, Carpenter and Hartnett (2011) examined temporal changes in cooking facilities on Fort Hood. They evaluated changes in energy investment in feature construction over time using formality of design (with Type 5 hearths being most formal and Type 3 hearths being least formal), feature diameter, and median burned rock weights. They interpret the feature assemblage on Fort Hood to indicate a general decrease in labor input into burned rock cooking facilities between the Late Archaic and the Late Prehistoric periods. At the Siren site, this trend appears to hold but it is difficult to assess considering some of the gaps in the Siren data, particularly in Components 2 and 3. There appears to be a slight decrease in formality of features between Component 5 and the beginning of Component 1, though this may be a product of preservation.

Foods Processed in Slab-Lined Features: Specialized Towards a Specific Resource?

As stated earlier, the general assumption is that large earth ovens were employed in the cooking of a variety of plant resources. Desert succulents such as agave and sotol were processed in this manner in drier western regions, while in Central Texas geophytes such as wild onion and eastern camas are now believed to have been the targeted foods. The practice of cooking geophytes in hot rock based earth ovens has been well documented in the northern Rocky Mountains, both archaeologically and ethnographically (Thoms 1989), and archaeological evidence is mounting for similar practices in Texas as far back as the Early Archaic period (ca. 8000 B.P.) at the Wilson-Leonard site (Collins et al. 1998:239; Dering 1998; Thoms 2008b). While some geophytes such as camas and onion do not require extensive cooking to render them edible, baking enhances the nutritional value of the inulin-rich bulbs (Black 2003:382).

In a review of 61 archaeological sites within the Colorado, Leon, Little, and San Gabriel river drainages SWCA found that geophytes (bulbs, corms, roots, tubers) were recovered from about 30 percent (n=18) of the sites (Table 10.3). In a separate review covering a wider swath of Texas, Boyd, Ringstaff, and Mehalchick (2004:Table 8.18) list at least 18 more archaeological sites with carbonized geophyte remains in addition to those included in the SWCA review, though they are not focused on formal slab-lined features (Table 10.3).

Three of the sites (41CV595, 41WM815, 41WM1010) identified as having preserved geophyte remains in the SWCA review also had slab-lined burned rock features on them. A single slab-lined feature (Feature 15) on the Firebreak site contained almost 40 eastern camas bulb fragments; no other edible plant parts were recovered from the features (Dering 2004; Mehalchick et al. 2004:85). We can now add to this list evidence from the west side of the Siren site. Carbonized *Liliaceae* geophyte remains were recovered from six slab-lined features and the burned rock midden (with its associated slab-lined, central feature) in Late Archaic contexts. There is also some microfossil (starch grain) evidence for geophyte processing that may be associated with a Late Prehistoric slab-lined feature.

Based on this evidence it seems that regardless of whatever other function or functions such features served, processing of geophytes was likely a part of it. However, it is unclear as to whether these were the only foods prepared in slab-lined hearths, as there is some limited evidence for other plant foods in some features. For example, Feature 11 on the Firebreak site lacked geophyte remains yet contained acorn and pecan shell fragments. Similarly at the Siren site, Late Archaic slab-lined Features 30 and 36 both held geophyte bulb fragments, but also produced a single walnut (*Juglans* sp.) shell fragment and a hackberry (*Celtis* sp.) seed, respectively. Also, the large, Late Prehistoric slab-lined Feature 1 lacked geophytes but contained two acorn

Table 10.3. Archaeological Sites in Central and South Texas with Direct Evidence for Geophyte Use

SWCA review	Boyd et al. 2004 review
41BL797*	41BL797*
41BL1214	41BQ47
41BP627	8 burned rock midden sites on Camp Bowie (Brown Co.)
41BR65	41CV117
41BR87	41CV595*
41BR228	41CV988*
41BR246	41CV1553*
41BR250	41CW54
41BR253	41FT201
41BR420	41GM224
41BR493	41HI1
41CV595*	41ME29
41CV988*	41MK8
41CV1553*	41MK9
41WM235*	41MS32
41WM632*	41NV177
41WM815*	41TV441
41WM1010*	41UV88
	41VV167
	41VV213
	41VV216
	41VV456
	41WM235*
	41WM632*
	41WM815*
	41WM1010*
	Unspecified site on Fort Hood

*Sites in common between the two reviews.

shell fragments and a bulrush (*Scirpus* sp.) seed (see Appendices B and D).

These examples raise a set of alternative possibilities. One is that this feature type is not strictly specialized for geophyte processing, but that geophytes, nuts, and seeds were also prepared in such facilities, possibly alone or in combination with each other and with geophytes. However, if this were the case we would have to account for differences in the seasonal availability of various resources found in the features. For example, geophytes are available in the late spring while nuts are ripe in the fall. Their co-occurrence in the same feature may indicate use of the facility at different times of the year, assuming the nuts were not harvested and stored until the seasonal return of the geophytes in the spring, in which case the two could have been cooked simultaneously (Boyd, Mehalchick and Kibler 2004:223). Thus, the presence of various plant food species in these features may be indicative of multiple uses of the Siren and Firebreak sites throughout the year, and that these slab-lined features were not specialized towards the exploitation of a singular resource.

An alternative scenario is that these features are specialized, and that there is some other explanation for the presence of some plant residues in some features. Most oak species produce edible acorns in the fall, but these may require varying degrees of processing before they are edible, depending on tannin levels in the nuts. Acorns certainly were an important food resource throughout Central Texas in prehistory, and the possibility for acorn cooking in slab-lined features should not be ruled out. Charred acorns have been documented in a number of archaeological sites in Central Texas (Boyd, Ringstaff, and Mehalchick et al. 2004:187), sometimes in burned rock features. However, there are very few ethnographic examples of acorn preparation in earth ovens. While acknowledging the possibility, it seems more likely that acorns in Central Texas were rendered edible in some other manner, such as stone boiling or leaching in water, rather than roasted whole in these features, and there is some other explanation for the presence of acorn shells. Also, regarding pecan nuts, there are very few ethnographic examples of preparation of pecans by cooking; these nuts are perfectly edible and tasty with little or no preparation beyond shelling. Similarly, walnuts can be cooked, but most ethnographic references to walnut use indicate that they were either eaten raw, pounded, or boiled, rather than prepared in earth ovens (Hanselka 2000:111–112). The process of shelling nuts results in large amounts of waste shell fragments, which make ideal tinder (Boyd, Ringstaff, and Mehalchick 2004:187). So the shell fragments in features on the Firebreak and Siren sites may reflect fire-starting practices and not the processing of nuts at all. While the cooking of acorns and other nuts in slab-lined features cannot be ruled out, it is just as likely that the fragments ended up burned in these features incidentally during the preparation of some other unpreserved food resource.

Another possibility is that the floral remains found in many features were somehow incorporated into the cooking process, possibly as packing around the food or as a garnish. A member of the sedge family, bulrush is a water-loving plant, and a charred seed was recovered from Feature 1 on the Siren site (Appendix D). These plants have extensive archaeological and ethnographical records of use (Adams 1988; Hanselka 2000), so it is indeed probable that the residents of the Siren site harvested the seeds for consumption or the stems for basketry or other purposes. However, the significance of a single seed is unclear; most ethnographic references indicate the seeds were either eaten raw or ground into flour. While it is possible that the seed in Feature 1 on Siren was intentionally cooked in it, it is just as likely that the seed blew or was kicked in by accident. Furthermore, the high moisture content of these plants would be ideal for steaming other foods if used in this manner. Notably, abundant sedge phytoliths found in the fill of Feature 2, the large slab-lined oven on the Mustang Branch site, led Collins (1994:170) to suggest this very scenario.

While there is some evidence for other foodstuffs besides geophytes preserved in some slab-lined features in Central Texas, much of this evidence is arguably circumstantial. It is clear that plant resources were not the only foods processed in stone-fueled earth ovens and other burned rock features. Organic lipid residues trapped in the tiny pores of burned rocks from prehistoric sites in South Texas reveal that large herbivores and possibly fish were cooked in features utilizing rocks as heating elements (Quigg 2003). In an ethnographic comparison of earth oven use across North America, Driver and Massey (1957:234: Figure 45) concluded that in Central Texas earth ovens were historically used to cook animals, plants, or a combination of both. While the findings on the Siren site imply that geophytes were at least occasionally prepared in the formally-constructed, slab-lined features, we must also consider the possibility that meat was the target resource. Considering the high degree of large mammal (mainly white-tailed deer) processing occurring on site, the possibility that these features were utilized to roast or slow-cook meat cannot be ruled out. Finally, as discussed below, alcohol production could also have been the main function of these large pit ovens.

Overall, the question still remains as to whether slab-lined features were in some manner specialized facilities for the express purpose of cooking a particular foodstuff. To complicate matters on the Siren site, it is possible that geophytes were not only being processed in formal slab-lined cooking features but also in other feature types, as the presence of two charred bulb fragments in one feature presently classified as a burned rock concentration (Feature 23) suggests. However, it is possible that this feature actually represents the dispersed remains of a slab-lined cooking feature, due to the presence on its northern side of large, overlapping slabs that were tilted slightly towards the center.

Furniture On The Landscape

The sturdy construction and prominence on the landscape of large slab-lined features likely served as site enhancements to prehistoric peoples, possibly prompting continued reoccupation and reuse of the site and feature (Smith and McNees 1999). As many of these features have been found as the central foci of burned rock middens of various shapes and sizes, it seems that they were commonly reused.

In their study of slab-lined cylindrical cooking basins in southeast Wyoming, Smith and McNees (1999) found that the basins served as enhancements to the landscape, prompting hunter-gatherers to return to the same location over long periods, using the space in the same manner to exploit seasonally available plant resources. The study of the slab-lined-basin sites considered the influence that the presence of relatively costly, enduring facilities had on long-term patterns of location. The construction of these costly features for anticipated future reuse suggests a multi-season planning depth (Smith and McNees 1999). It also suggests that mobility patterns were relatively stable and that exploitable resources were predictable and accessible (Smith and McNees 1999; Wandsnider 1992). The repeated use of certain locations by hunter-gatherer groups has typically been interpreted in terms of their relationship to natural features like water, fuel, and food resources (Binford 1982; Brooks and Yellen 1987). Of these three variables, food resources would seem to be the most important. As long as the food resources remained available, the presence of intact and usable features like slab-lined cooking facilities would likely influence the hunter-gatherers' decision to reuse the campsite (Smith and McNees 1999; Wandsnider 1992). Such features must be considered in light of the long-term mobility strategy, which is the cyclical movements of a group among a set of territories, that hunter-gatherers are thought to have employed (Binford 1982; Kelly 1992).

The multiple occupation zones on the Siren site were formed due to repeated occupation of the same location on the southern branch of the San Gabriel River (see Chapters 6 and 8). It is possible that the repeated selection of the spot may have been due to chance, but it is more likely that visitors kept returning to the Siren site because the location had some attractive trait or suite of traits. The proximity to water in the adjacent river would have been influential, high-quality chert raw materials were present, and the spot may have been a productive and predictable resource patch, perhaps for geophytic plants such as those discovered in the burned rock features. However, the establishment of site "furniture" or "appliances" at the location would provide additional incentive to continue visiting the Siren site. What is particularly striking about the spatial arrangement of the Siren site features is their tight clustering on a slightly higher portion of the terrace site. The more prominent slab-lined features (8, 35, 16, and 30 as example) were all found within a roughly 4-m-diameter area, spanning the Archaic through the Late Prehistoric occupations. Over the course of 1600 years, prehistoric peoples returned to the same locale along the riverine corridor and constructed these rock features for processing foodstuffs.

The fact that a burned rock midden formed around the slab-lined central feature in Feature 8 attests to its continued reuse. Over time, this midden would have increased the visibility of the site. Visibility of the location may have also been enhanced by the slab-lined features themselves. To draw on an analogy from a region external to Central Texas, Smith and McKnees (1999) describe slab-lined pits in southwest Wyoming that are similar in form to those in Texas. These features are depicted as having "… vertical or nearly vertical walls lined with closely fitted slabs and flat to slightly rounded bases" (Smith and McKnees 1999:121). The nearly vertical slabs that line the external margin of the pits rise noticeably above the ground surface, making them highly visible and easy to relocate. Similarly, many of the Central Texas examples have vertical or sharply sloping stones on their outer edges, and would have been highly visible before complete burial.

While reuse of a location on the landscape is often tied to hunter-gatherer relationships to natural features (e.g., valued resources such as water or geophytes), once constructed, formal, stable, and reusable cooking facilities would have also been a strong motivator to return to the site. As Charles Frederick stated in Chapter 6, "… the attraction of such features may play a role in the repeated occupation of the site by serving as a landmark to a food resource or ancestral settlement, or a point where the users perceived they could more easily process large quantities of food…."

Further, the high degrees of labor employed in the construction of some of the slab-lined features imply that they were not intended for single use: "They were more elaborate and costly to construct than would have been justified for use during a single, short term occupation" (Smith and McKnees 1999:119). Formalized and of high quality construction, these facilities were seemingly built to last, and could have been used repeatedly with little additional effort at maintenance. The groups that constructed them would have known of their existence, and would likely have reused them over and over when their annual rounds brought them near the location once more. It is likely that they were placed strategically on the landscape in attractive locations where the valued target foods that were cooked in them were predictable and abundant. Geophytes like wild onion and eastern camas are best gathered during the late spring and early summer; after spring rains the blooming, growing plants are plentiful and easy to locate from the surface, and the bulbs have reached their maximum size (Boyd, Mehalchick and Kibler 2004:223). However, there is a brief window of opportunity to take full advantage of this important resource, likely from four to six weeks (Boyd, Mehalchick and Kibler 2004; Smith and McKnees 1999:131). With such a short time frame in which to work, the knowledge of high quality, pre-existing cooking features in areas known for valued, predictable resources would have made the Siren site an even more attractive location, as valuable time and effort could be better spent harvesting the targeted resources rather that preparing a new facility in which to cook them.

Alcohol Production

There is another possible function of large, formally constructed and labor intensive cooking features that should be considered. Dering (1999) demonstrates that the payoff from processing desert succulents such as agave in burned rock earth ovens is minimal relative to the overall labor invested, so from a purely caloric standpoint, labor-intensive facilities for cooking such foods would appear to be less than optimal. On the other hand, many societies willingly invest significant labor and resources in the production of alcoholic beverages. Dietler (2006:238) points out that traditional forms of alcohol tend to constitute a major facet of the domestic economy of their respective societies, and that a large percentage of overall labor and resources can be dedicated to the production of such products. Where data is available, peasant households may dedicate 15–30 percent or more of their grain supply to the production of alcoholic beverages (Dietler 2001). Among various groups in Africa, 10–50 percent of the fuelwood collected is specifically for the brewing process (McCall 2002). Clearly in many societies the production of alcoholic beverages is sufficiently important to justify high investment of labor and resources.

Alcoholic beverages have been essential to the ritual and social lives of traditional societies throughout the world from prehistory into modern times (Bruman 2000; Dietler 2006; Merrill 1978; Parsons and Parsons 1990). Before the introduction of European and Asian stills and distillation methods, alcohol production in the New World depended solely on fermentation (Bruman 2000:4). Although many beverages are prepared by simple fermentation of uncooked fruits or sap of various plants, cooking in earth ovens is occasionally part of the process. The main goal of cooking in the production of alcohol is to thermally hydrolyze reserve polysaccharides (primarily inulin) in the plant tissue in order to obtain fermentable monosaccharides (García-Soto et al. 2005).

While preparation of agave or sotol in earth ovens for food is well documented, these items are also similarly processed for the production of alcohol. The Tepehuan of Chihuahua, northwestern Mexico, baked the stems of sotol and several species of agave in earth ovens, crushed and boiled them for several hours, then left the mixture to ferment for about a week (Pennington 1969:109–110). The Gila Pima, Papago, and Chiracahua and Mescalero Apache similarly prepared a fermented beverage from agave stems that had been roasted in earth ovens (Castetter et al. 1938:60–61). Groups in South Texas enhanced the intoxicating qualities of a drink made from agave leaves by adding the ground red beans of the Texas mountain laurel (*Sophora secundiflora*) (Newcomb 1961:41).

There is some evidence that geophytes such as camas were processed in the burned rock features on the Siren site, and while it is clearly possible that this represents a food resource, cooked camas can be fermented as well. In the mid-1850s the Jesuit missionary-physician Father Anthony Ravalli observed the Salish harvesting copious camas bulbs for food, but he also attests to their alcoholic properties:

> I once made two gallons of splendid alcohol from about three bushels of camas by fermenting, and with the aid of a zigzag worm of tin for a still. I took great care that the Indians should not know of this so as to learn the act (Hart and Moore 1996: 24).

Whether he brewed the alcohol for medicinal purposes or for personal consumption (or both) is not specified.

As has been mentioned, well-constructed earth ovens may reflect continued reuse of the Siren site over long periods of time, and possibly even prompted such repeated visits. While the repeated use of certain locations by hunter-gatherer groups has typically been attributed to proximity and availability of natural resources such as water, fuel, and food, social motivators likely would have also come into play. Usually dispersed Native American groups in Texas would occasionally aggregate on a seasonal basis when particular resources were abundant and ready to be harvested. Such practices have great antiquity in the New World, such as at the 8,600-year-old site of Gheo Shih in the Oaxaca Valley, Mexico (Marcus and Flannery 2004), and are ethnographically documented among historic groups in the Great Basin (Steward 1938) and elsewhere.

While these aggregations had a significant economic function (such as the harvest of seasonally abundant prickly pear tunas or mesquite pods), they also served a variety of other purposes, such as the maintenance of the social fabric through ceremonies and celebrations, the formation of alliances, and the exchange of mates and information. To cite a recent example from Montana, when camas bulbs were in season, the Salish turned their harvest into a gala event. The botanist Geyer observed:

> The digging of the Gamass (*sic.*) bulb is a feast for old and young amongst the Indians; a sort of picnic which is spoken of throughout the whole year. In differing neighboring tribes meet on the same plain and mostly at the same time at the same spot where their forefathers met. Here the old men talk over their long tales of olden times, the young relate hunting adventures of the last winter, and pass most of their time in play and gaming; while on the women alone, young and old, rest the whole labor of gathering that indispensable food. They, especially the young women, vie with each other in collecting the greatest possible quantity and best quality of Gamass, because their fame for future good wives will depend much on the activity and industry they show here; the young men will not overlook these merits, and many a marriage is closed here after the Gamass are brought home (Hart and Moore 1996:26).

These observations demonstrate the social importance of festive gatherings, which could be greatly enhanced by the production and consumption of alcoholic beverages.

Such social interactions are particularly useful in societies with low population densities, as they enhance band solidarity (Steward 1938). Drennan (2003:31) writes "Facilitating contacts between groups is particularly difficult when population densities are low…. The biological requirements of maintaining a successful breeding population would have encouraged regular contact among groups spread over a substantial area." Also, from an economic standpoint, aggregations of usually dispersed groups can be vital in terms of the sharing of information about resources between bands and individuals. Kelly (1995:98) notes that "… the patch structure of an environment is to be measured not only in terms of the physical distribution of food resources but also in terms of foragers' knowledge of those resources;" occasional aggregations among usually dispersed related or allied groups would facilitate such information sharing. Thus, seasonal "fandangos" can be highly adaptive from multiple angles. The potential role played by alcoholic beverages in drawing participants, enhancing social interactions and ceremonies, and mobilizing labor for the harvest of important resources would justify their high-investment preparation. In turn the stability of facilities related to their production would influence the reuse of particular (possibly traditional or ancestral) sites. Also, as most traditional forms of alcohol will spoil within a few days after fermentation, they are almost always intended for immediate consumption (Dietler 2006:238), implying either continuous production or short term social/economic/ritual events.

Theoretically the production of alcoholic beverages could have enhanced the ritual and social lives of the participating hunter-gatherers as well as the productivity and atmosphere of the harvest by placing it in the context of a work feast (Dietler 2006:238). It has been ethnographically shown that such products are important enough in some societies to justify substantial labor and resource investment in their preparation, and sites with formal, stable, and reusable features would be the focal points of seasonal visits under this scenario. While there is no direct evidence to indicate the formal slab-lined features at the Siren site functioned in this manner, ethnographic observations demand that social possibilities beyond simple caloric returns be considered.

Summary and Conclusions

At the beginning of this exploration, the following questions were posed in the study of the Siren site burned rock features: How do the Late Archaic cooking features compare to those of the Late Prehistoric period at the Siren Site in terms of size, form, complexity, and patterning? What do the differences suggest about subsistence economy, use of the landscape, group size, and length of occupation at the site? The study has produced intriguing answers to these questions and provided solid avenues for productive future research.

At the Siren site, numerous feature types were present, spanning 1,700 years of occupation along the banks of the San Gabriel River. A plurality (40 percent) of the 43 burned rock features were Type 5 slab-lined facilities of varying size and formality. The remaining features included small basin facilities and less formal concentrations of burned rock. Peaks in feature diversity occur in Component 4 and Component 1, where all feature types, with the exception of a midden, are present. In addition, the Siren burned rock data show a slight decline in the formality and energy investment in cooking feature technology from a peak around 2600–2400 until 1250 B.P., then a subsequent increase from around 1100 to 900 B.P. in the Late Prehistoric. The initial peak corresponds with the highly formal Late Archaic Feature 35 and its companion, Feature 8, an incipient midden with an internal, slab-lined cooking pit. The second peak appears to occur in Component 1, in the Late Prehistoric with Feature 16. However, while there are peaks in formality, what is more remarkable is the consistency of occurrence of slab-lined features through all components. These facilities occur in all time periods in the same exact location on the site. In short, over 1600 years, prehistoric peoples returned to this same locale along the river and constructed large rock ovens for processing foodstuffs.

Differences in feature formality and size through time are thought to reflect varying foraging patterns and use of specific resources, and, as discussed fully in the subsequent Foraging Strategies chapter, the Siren site features provide important clues to exploring the dichotomy of forager vs. collectors. Interestingly, the presence of Type 5 features in all dated contexts implies that, whether these features served a specific function or range of functions, these purposes were carried out over all occupations at the site, from the Archaic through the Late Prehistoric. The difference within and between the two main time periods, at least as it pertains to the use of slab-lined hearths, appears to be one of scale only, as indicated by differences in the size of various features. In other words, construction technology appears to be relatively similar through time, but the size of the features (and perhaps related intensity of resource processing) diminishes. The smaller features may indicate smaller groups visiting the site in the Late Prehistoric, with larger groups visiting the site in the Late Archaic.

While evidence for geophyte use during the Late Prehistoric (Component 1) is limited to starch grains found on the surface of a mano near Feature 16, carbonized *Liliaceae* geophyte remains were recovered from six slab-lined features and within the slab-lined, central feature of the burned rock midden, all in Late Archaic contexts. The geophyte remains recovered from these features represent some member or members of the family *Liliaceae*. Though some are annual, many of these are spring or early summer resources and they may indicate the season of primary site occupation. Few other edible plant remains were found in Siren feature contexts. While there is abundant evidence of deer consumption on the site, no clear associations with meat processing could be made with the features.

Placed in the broader perspective, the data strongly suggest that the Siren site's features were furniture on the landscape, serving as sturdy facilities built for re-use over what was likely a seasonal pattern of subsistence and movement by the prehistoric occupants. Feature 8, the incipient midden, is a snapshot of this process, illustrating the intensive use and re-use of a formal slab-lined cooking facility in the Late Archaic. Subsequent occupations overprinted atop this midden, with slab-lined facilities constructed through the Late Prehistoric, possibly to harvest the same resources. The investment of labor and well-built structure of many of the slab-lined facilities at Siren reveals a depth of planning and knowledge of reoccurring resources and/or possible forethought concerning occasional congregations of larger groups at one location for economic, social, or ceremonial purposes or a combination thereof.

The Siren site data suggest that a particular resource was available at this spot and was the focus of the burned rock facilities. The macrobotanical results clearly are weighted towards *Liliaceae* geophyte remains, though there is only tangential evidence in the Late Prehistoric. Examination of similar features across Central Texas appears to support this pattern. However, further research is needed into the subject regarding what was being processed in these large, formal cooking ovens. While geophytes are a good candidate, an exploration of caloric returns and labor investment suggests other possibilities and raises many questions. For instance, is the return from cooking hundreds (if not more) small geophytic bulbs worth the investment of such time and labor in constructing a feature such as Feature 35? Could other resources such as meat also be processed in these ovens or geophytes and meats cooked together? Further, as briefly suggested above, is the labor invested in these features indicative of factors related to but beyond basic economics, such as the processing of particular resources into alcoholic beverages for social or ceremonial purposes? Further research into such possibilities is needed.

The Siren site features reflect the patterns and purposes of prehistoric occupants in the San Gabriel River valley. As reconstructed here, these patterns involved repeated visits to a prominent spot in the landscape along the river in the course of a seasonal round. Through the wax and wane of various technologies, resources, and populations over 1,700 years, prehistoric groups appear to have returned to the Siren site to exploit a food resource with a specific technology utilizing burned rocks. These features were slab-lined, large, and often very formal, showing remarkable similarity in structure through time. While slight differences are present, the consistency of these features suggests a long-lived subsistence pattern stretching from the Late Archaic into the Late Prehistoric.

Chapter 11

Long-Term Subsistence Strategies From the Archaic to Late Prehistoric Times

Stephen M. Carpenter

Introduction

Given the body of data that tends to survive in the archaeological record, researching ecological adaptation is among the most feasible analytical tacks in Central Texas archaeology, and that is certainly true of the Siren site. For-aging strategies pertain to the ways in which the site occupants organized themselves and their technology to interact with their physical setting. Ecology quite literally means the study of habitat (oikos), but human or cultural ecology quite often enlarges the purview to mean the processes involved in the interrelationship between people and their environment. Along the lines of this wider perspective, the objectives of this chapter are to assess variation in the long-term subsistence strategies of the site's occupants through time and to compare these trends to the prevailing models regarding transition from Archaic to Late Prehistoric lifeways in the eastern Edwards Plateau cultures.

The general approach to the analysis of these strategies at the Siren site is to look at the relationships among three data sets: 1) environmental data, 2) subsistence-related data, and 3) technological data. This is done within the chronological framework established in Chapters 8 and 9. It is important to note previously discussed caveats, namely the analysis is based, not on any single variable, but the relationship among numerous variables. A large body of middle range theory, much of it derived from ethnographic studies, is utilized to understand the dynamics among the datasets. The intent is to develop a site-specific model of adaptive change for comparison to the regional data.

This chapter provides a brief review of the theoretical framework, followed by an overview, or model, of prevailing notions regarding prehistoric subsistence strategies in Central Texas from about 2600 to 900 B.P. From this model, a series of expectations can be drawn to form testable hypotheses. The Siren site and recent regional findings are then brought to bear upon these expectations to see where the concurrences and differences lie. A synthetic view is then proposed. The ecological processes of prehistoric groups are only one of many facets that contribute to an overall view of the succession of past cultures, but this facet is a significant piece that contributes to a broader synthesis in Chapter 13.

Background and General Theory

Hunter-gatherer subsistence theory has long been a central research domain in archaeology. Its origins are perhaps most explicitly traced to Julian Steward's (1955) development of "cultural ecology", from which many see the foundation of processualism with its ultimate objective of reconstructing cultural processes and change. Subsequently, in 1966, the symposium "Man the Hunter" and publication of its findings by Lee and DeVore (1968) fostered the growing realization that these cultural processes, which were so elusive to the ar-chaeologist, were fully evident in the world's current hunter-gatherers. As Binford (1978, 1980, 1982) and Schiffer (1976) more clearly defined, the great need in archaeology was to develop a means of relating patterns in the archaeological record to behaviors, and then from the behaviors infer societies and cultural systems. Their development of middle range theory set about defining the archaeological signatures of various subsistence strategies. Perhaps the third milestone was the closely dated publications of *Hunter-Gatherer Foraging Strategies* (Winterhalder and Smith 1981) and Butzer's (1982) *Archaeology as Human Ecology*. The former established optimal foraging theory as a viable model for understanding hunter-gatherer economies, and the latter advanced the view of culture within a human ecosystem, or, in other words, the notion of a cultural landscape. These events form the basic framework for foraging theory.

From these seminal developments, a number of models have been developed, including Bettinger and Baumhoff's (1982) traveler and processor model, Binford's (1980) concept of collector and forager, and Woodburn's (1982) delayed return versus immediate return economies. Though the schemes are not precisely equivalent since each addresses a different fundamental aspect of society, all three typically incorporate mobility (Figure 11.1).

Since the literature of Central Texas, and elsewhere for that matter, typically uses Binford's terminology, the collector and forager model is utilized here. To generally describe the model, hunter-gatherers, when confronted with a highly variable distribution of resources across the landscape, often intensify their occupation and exploitation of ecological "sweet spots." Residential mobility decreases, but small task oriented groups are sent out to procure resources. Accordingly, logistical mobility increases. Collector base camps, occupied for relatively longer periods, accumulate substantial debris, large features and other site furniture, and evidence of broad diet breadth that includes low-ranked resources (i.e., those with low caloric returns for the procurement efforts). Conversely, when the landscape offers a more equitable distribution of critical resources or a higher availability of high-ranking resources (such as bison for example), groups often respond by increasing mobility and exploiting the increased biomass availability, dropping the more intensive processing of low ranked resources. So residential mobility increases, and logistical mobility declines. These economic strategies are the driving force in subsistence selection and the organization of technology (Binford 1980; Kelly 1992; Winterhalder and Smith 1981).

For the purposes at hand, the significant aspect of these models is the archaeological signature of the different sides of the spectrum. What sort of material evidence suggest low residential mobility collector sites compared to higher-mobility forager base camps? What are the expectations of faunal assemblage, feature technology, lithic debris, groundstone, etc.? A fair amount of middle range theory has been compiled to draw these inferences (Table 11.1).

Besides the technological data, subsistence remains at sites provide some of the best data on subsistence strategy. The general principle is that subsistence diversification, mainly through adding new species to the diet, raises the carrying capacity of an environment. Evidence of increasing dietary breadth is expected by more species in the diet and/or greater proportional equity among high-ranked and low-ranked food sources as a response to diminished availability of highly ranked resources. Accordingly, species diversity and the number of identifiable species are indicators of a collector strategy (Winterhalder and Smith 1981).

The expectations in the subsistence remains for the two sides of the spectrum, from high to low mobility or forager to collector, are as follows. As the patchiness of the environment decreases (i.e., as uplands have an increased economic biomass), a more highly mobile subsistence strategy is optimal to employ an encounter strategy for high-ranked resources such as medium to large mammals (Binford 1980). Foragers map onto the distribution of resources across the landscape. With

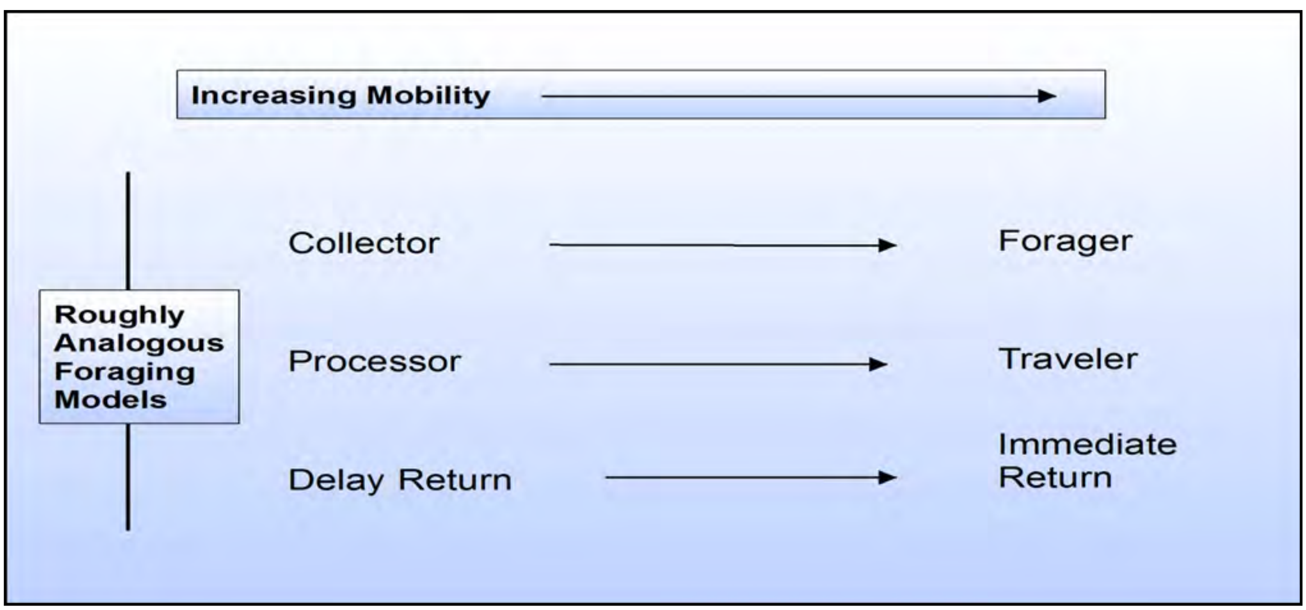


Figure 11.1. Residential mobility and hunter-gatherer economic strategies.

Table 11.1. Ethnographic Site Types and Archaeological Signatures

	Short-term Foraging Base	Long-term Collector Base Camp
Stages of Lithic Reduction	All stages of manufacture, mainly from locally available materials	All stages of lithic reduction
Depositional/Post-depositional Factors	High visibility, likely redundant occupations, relatively low assemblage diversity,	Multiple occupations, high assemblage diversity, caching, large continuous sites
General Technology	Personal and situational tools, mainly local raw materials, broken/exhausted curated technology (bifaces and cores)	All tool forms, formal and informal, discard of all tool types, abundant local and nonlocal debitage from all reduction stages
Site Furniture	Minimal site furniture	Common site furniture

Information taken from Binford (1980), Ebert (1992), Kelly (1992)

the increase in spatiotemporal patchiness of resources, such as when uplands become increasingly xeric and resource poor, intensification of ecological "sweet spots" fosters a logistical collector strategy (Binford 1980). Collector residential bases, which are occupied for relatively longer duration, exhibit a broad diet breadth, and therefore the array of species expectedly includes lower ranked resources such as aquatic species, small mammals, reptiles, and plant resources.

Great Expectations – A Hypothetical Model of Prevailing Views

While the focus of this chapter is on the transition from Archaic to Late Prehistoric lifeways, a slightly broader purview of prevailing views on long-term prehistoric subsistence strategies in the region is adopted here to provide a larger context. The overview draws from a substantive body of literature that, when considered cumulatively, yields a consensual view only in very general terms. The principal sources include Collins (2004), Story (1985), Ricklis and Collins (1994), Prewitt (1981b, 1985), and Johnson and Goode (1994). There are significant differences of opinions on the timing and many other aspects of the cultural and environmental changes that took place. Nevertheless, in general, the following is a hypothetical model of changing subsistence strategies over time in the area, and the analysis of the Siren site is designed to challenge or support these views. Rather than use the typical archaeological periods, climatic intervals are employed here since one of the objectives in the site investigations is a reconsideration of the periods as commonly defined. Climatic eras, which were introduced in Chapter 2, provide a neutral terminology of sorts. However, later in this chapter, the Siren site data are discussed by component as temporally defined in previous chapters to see how it compares to prevailing views.

The Altithermal – Edwards Interval

During the hot, dry, mid-Holocene Altithermal, authors have suggested that the general subsistence model of the area's occupants can be characterized as a logistical collector strategy (Ricklis and Collins [1994]; for similar interpretations in adjacent regions see also Dering [1999] and Turpin [2004] for the Lower Pecos, and Story [1985] for the broader western Gulf Coastal Plain). In a landscape with highly variable distributions of resources, principally between resource-poor uplands and rich riparian zones, populations concentrated in optimal locations on the landscape where game or plant resources could be extensively exploited. Larger groups occupied base camps for longer periods of time, creating high-visibility sites with large cumulative features such as burned rock middens. Such a strategy would have relied on smaller, task specific groups foraying out onto the land to procure needed resources, leaving behind relatively low visibility resource procurement and short-term camps in upland areas. Their technology would have been organized accordingly, with a very high diversity of tool forms (intra-assemblage variability) in the base camps, technology ranging from the very expedient and informal to the highly formal "personal gear." The subsistence strategy would expectedly be broad-based with evidence of intensive processing of low ranked resources such as vegetal materials.

Edwards to Mesic Interval Transition – 2500 B.P. +/- 300 Years

At the terminus of the Edwards Interval, bison appear more commonly in the archaeological record, coinciding with Montell, Castroville, and Marcos point styles (Johnson [1995:95]; Sorrow [1969:62]; Story [1985:50]; see also Turpin [2004:272–273] for similar patterns in the Lower Pecos). This transition seems to have fostered a shift to a more mobile, focused subsistence strategy, though many of the early subsistence practices of intensive succulent processing in burned rock middens continued (Johnson and Goode 1994; Ricklis and Collins 1994; Story 1985). As noted, the principal occupations at the Siren site coincided with an apparently significant amelioration of the climate (Blum et al. 1994:17; Collins 2004:114; Johnson 1995:73; Toomey et al. 1993:310). Additionally, particularly with the increase in availability of high-ranked resources like bison, a more mobile forager strategy is hypothesized for Central Texas. Though more work needs to be done to clarify patterns, site distribution data suggest this time may well reflect a move up into higher reaches of tributaries and onto upland areas (Thoms and Olive 1993:49).

As found in the Mustang Branch site, burned rock technology shifted from plant processing to meat processing, which profoundly affected burned rock feature technology (Ricklis and Collins 1994). Prewitt's (1981b:81) San Marcos or Uvalde Phase coincides with this era of bison, for which he notes "middens apparently did not accumulate during this period." However as Johnson and Goode (1994:35) note, the regional inhabitants continued "baking of semi-succulent xerophytic plants, and accumulated or added to burned rock middens during the same period that they sometimes barbecued buffalo." The period around 2500 B.P. seems to be a lessening of the more intensive processing strategy of earlier times, but earlier practices continued as most clearly evident in midden formation. While bison were surmised to have been around for some time, it was not until the terminus of the Edwards Interval (around 2500–2100 B.P.) that bison became, for at least a brief while, such an economic mainstay (Story 1985:50), a distinction of this time that contrasts with the subsequent era.

Therefore, the distinction of this brief time period is a basic economic shift towards a more narrow diet breadth, focusing instead on high-ranking resources, bison being about as good as it gets, and the lithic assemblage should reflect the changes. At forager base camps, the lithic assemblage could be expected to emphasize personal and situational tools, with a high frequency of broken/exhausted curated technology (bifaces and cores), relatively low diversity of tool forms, and all stages of manufacturing debris from locally available materials. Evidence of intensive processing, such as large cumulative middens and formal groundstone, should be notably less evident than the preceding millennia. However, over the course of time from about 2500 to 2100 B.P., the climate trended back towards a wetter setting, and it appears bison gradually disappeared.

The Mesic Interval

From about 2100 to 1200 B.P., by many accounts, the climate was wetter (Collins 2004; Johnson 1995:96; Toomey et al. 1993), bison disappeared (see Dillehay [1974] for bison absence during most of this period; Johnson [1995:95]; Lohse and Cholak [2011]), and the distribution of xerophytic succulents, which are so often cited as the primary resources exploited by midden technology, receded to the south and west (Johnson 1995:95). The strongly heterogenous ecological patterns of the earlier drier times lessened to create a more equitable distribution of resources across the landscape. Between the riparian corridors and the higher upland areas was "a wide transitional zone composed of both arboreal and prairie elements, the well-watered eastern half of the Edwards Plateau ordinarily furnished plant and animal food resources for a moderately sized human population practicing Archaic hunting and gathering methods" (Johnson and Goode 1994:41). While bison decrease, geophytes appear more often in the archaeological record (Figures 11.2 and 11.3) (Acuña 2006). The archaeological record of the time reflects neither a strongly collector nor strongly forager strategy, but a rather generalized economy that exploited a relatively high-biomass setting.

Though generalized, the subsistence strategy appears to have fostered greater mobility of smaller residential groups. There was very likely highly redundant residential occupancy of the same location by these residential groups, which should be evident in several as-pects of the archaeological record, notably the formality of site furniture. The presence of formal

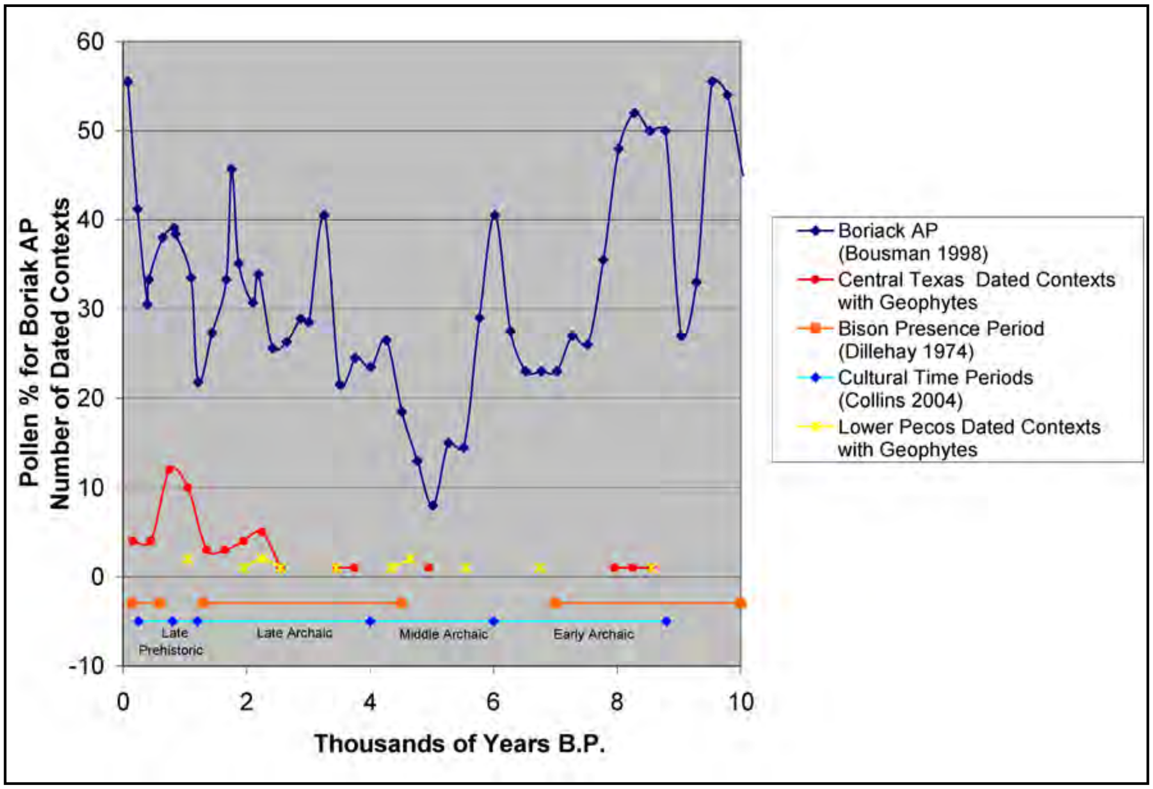


Figure 11.2. Climatic data, archaeological periods, and geophytes occurrence in archaeological contexts suggest an increase of geophytes consumption in Central Texas during wetter times from about 2500 to about 1000 B.P. (adapted from Acuna 2006).

slab-lined features, which are "elaborate and costly facilities for anticipated re-use," have been interpreted elsewhere as signatures of repeated occupations by the same group on a very regular basis (Smith and McNees 1999:118). The reasoning goes, and it is supported by a body of ethnographic data as discussed by Smith and McNees, that a costly feature would not be built for a brief stay, but rather is designed with long-range plans in mind. Other indications of residential redundancy include caching and accumulation of grinding stones, usable tools and raw materials.

This pattern appears to have persisted until about 750 to 800 B.P. when rather dramatic ecological changes are evident. Though technological change, such as the advent of the bow-and-arrow or at least its more widespread use, arrived perhaps circa 1400 B.P., most accounts continue the generalized forager pattern through the middle of the Late Prehistoric until the arrival of Toyah folks.

Investigative Strategies

To investigate long-term subsistence strategies, independent lines of evidence are developed, and then correlations are drawn among the variables. Correlation is not equivalent to causality. The relationship among environmental, technological, and sociocultural factors is not a deterministic one. Subsistence strategies, as the theory has developed over the last half-century, adopt and adapt to various aspects of both the cultural and physical landscape.

Accordingly, the initial step is to develop the independent lines of data including flo-ral/faunal subsistence remains, burned rock technology, lithic assemblage, and paleoenvironmental regional data as discussed below. Each category of data was juxtaposed to show change over time. The subsequent step is to overlay the previously established temporal structure on the independent lines of evidence, then build upon or critique the previous discussed prevailing model.

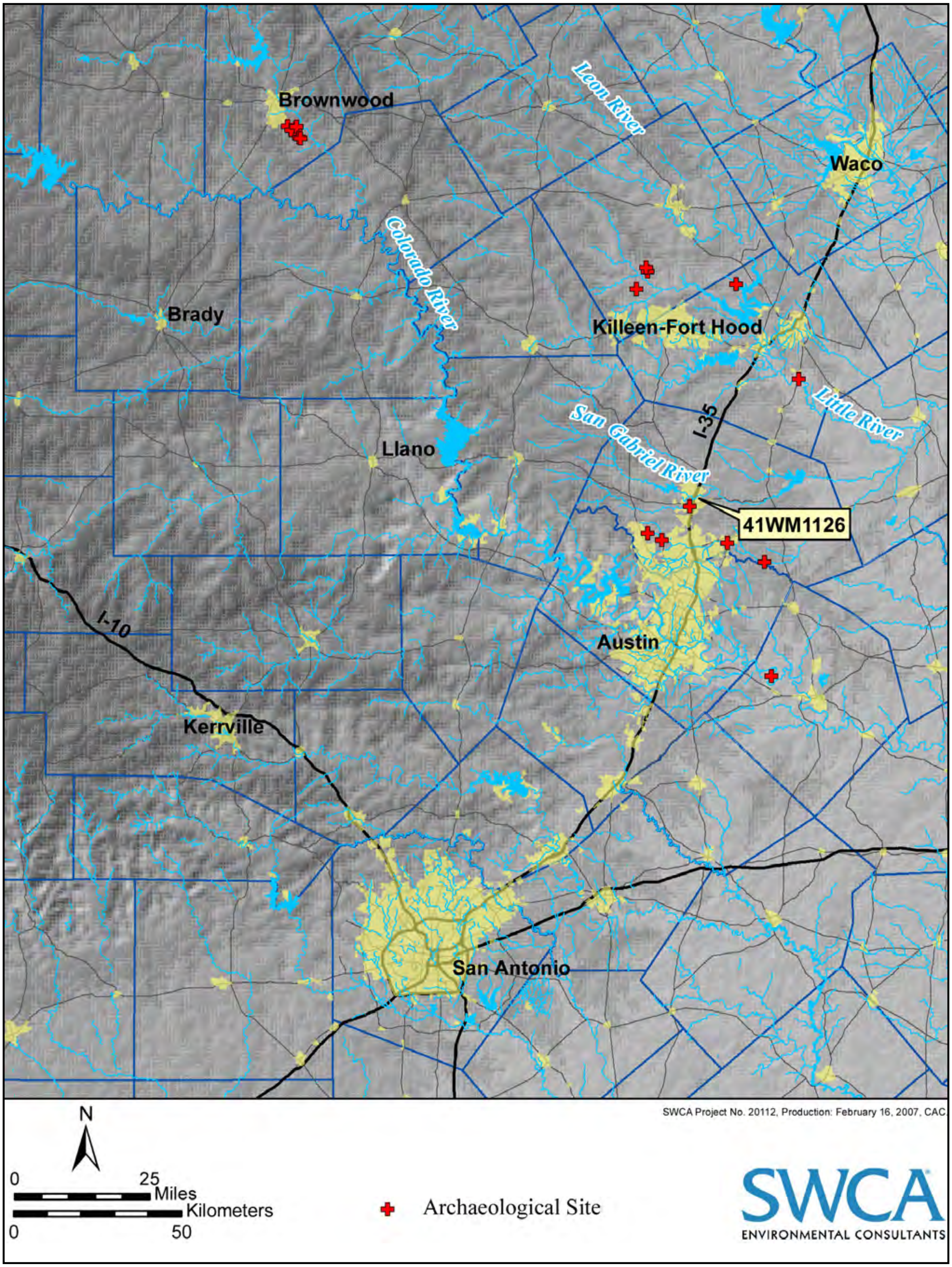


Figure 11.3. Distribution of archaeological sites with geophytes recovery in east Central Texas.

Data: The Three Lines of Evidence

To assess the model, we analyze the relationships among three data sets: 1) environmental data, 2) subsistence-related data, and 3) technological data. The data derive from the Siren site and regional datasets, primarily those located on the eastern flank of the Edwards Plateau. Where feasible and apt, larger datasets are brought in to consider the scale of change, whether environmental circumstances are highly localized or whether they are part of a much larger event.

The Grand Stage: environmental data on Local, Regional, and Worldwide Scales

The broad-brushed strokes of the above-mentioned model do little to paint a nuanced picture comparable to finer divisions discernible in the archaeological record. As noted, the general perspective is one in which the long, dry Altithermal prevailed from as early as 8000 B.P., but at least from 5000 B.P., until finally dissipating around 2500 B.P. as the setting yielded to relatively wetter conditions (Bousman [1998]; Collins 1995:377; [2004:114]; Toomey et al. [1993]; see Nordt et al. [2002:186] for a contradictory view, however). Our interest here is to search for finer resolution.

Refinements, however, must proceed cautiously since any single dataset is beset by many problems, such as its validity in representing regional environmental patterns rather than local ones. To overcome these concerns to a degree, a system of checks and balances among the different data sets can move towards higher levels on confidence in the regional picture. The intent of this section is to overlay a series of lines of evidence at multiple scales to determine whether or not concurring patterns are discernible. The prevailing model theorizes a series of environmental conditions that will be assessed here in light of additional data introduced over the last decade or two. Like the perspectives of subsistence strategies, reconstructions of the paleoenvironment over the last 2600 years are still far from an unequivocal picture. Since the Siren site did not yield substantial or precise data on the paleoclimate, the study generally uses regional data.

On a regional scale (Central Texas), two lines of evidence are emerging as among the more reliable and chronologically precise: eastern central Texas bog pollen data (Bousman 1998) and Hall's Cave faunal data (Toomey et al. 1993). There are flaws in each data set, most notably regarding the precision of chronological control. Nevertheless, these are among the best dated. The bog pollen data derives from locations that range from 30 to 100 miles east of the Siren site. Hall's Cave is approximately 100 miles southwest of the site. The importance of the two is that they should provide complementary perspectives: one showing floral assemblage and the other showing the correlating changes in the fauna. The direct comparison of disparate data is not a simple process. One must be re-scaled to allow comparative trends in the data to be evident, all while maintaining the integrity of the information.

Bousman (1998) presents a synthesis of bog pollen data that shows canopy cover, and by proxy woodland versus grassland settings for central Texas throughout the Holocene (Figure 11.4). His figure serves as the initial baseline for overlaying other data, including the cultural chronology. The peaks mark periods of expanding eastern woodlands, whereas the valleys are expanding grassland settings, presumably drier settings. As will be illustrated later in this chapter, at first glance, several initial impressions are notable. For example, Johnson and Goode (1994) suggested the archaeological record from about 2150 to 1450 B.P. showed evidence of strong influences from the Eastern

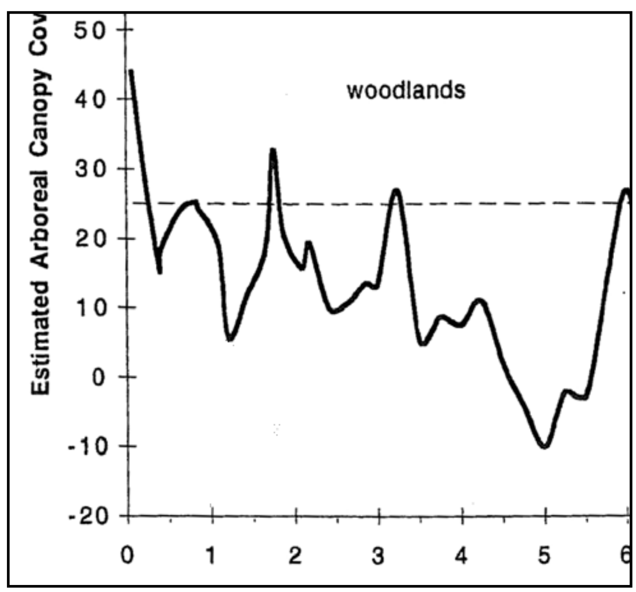


Figure 11.4. Bousman's (1998:Figure 7) synthesis and interpretation of eastern Central Texas bog pollen. Original has been cropped to focus on temporal duration of concern, the final millennia of the Holocene

Woodlands. The pollen data show the highest peak of arboreal cover since the early Holocene at this time. However, before dissecting such trends, the baseline pollen data need to be compared with other sets.

Toomey et al.'s (1993) interpretations are partially based on the relative frequencies of two highly sensitive indicator species: the desert shrew (*Notiosorex crawfordi*) and the least shrew (*Cryptotis parva*). The former currently occupies the Edwards Plateau, while the latter is found to the east. By charting the time periods when the least shrew, which requires significant moisture, was present in the Hall's Cave depositional record, these proxy data provide a basis for inferring climatic settings (Figure 11.5). This is only one of many lines of data used by Toomey et al. (1993), but it is among one of the most precise records. To overlay this information atop the bog pollen requires some mental gymnastics; the figure is flipped and stretched to place it on the same time scale. The dates in Toomey et al.'s (1993) figure are matched up to those on the timeline, and the scale showing relative percentages of the two species is compressed to match the range in pollen data. The integrity of data is not affected by modifying the scales of representation.

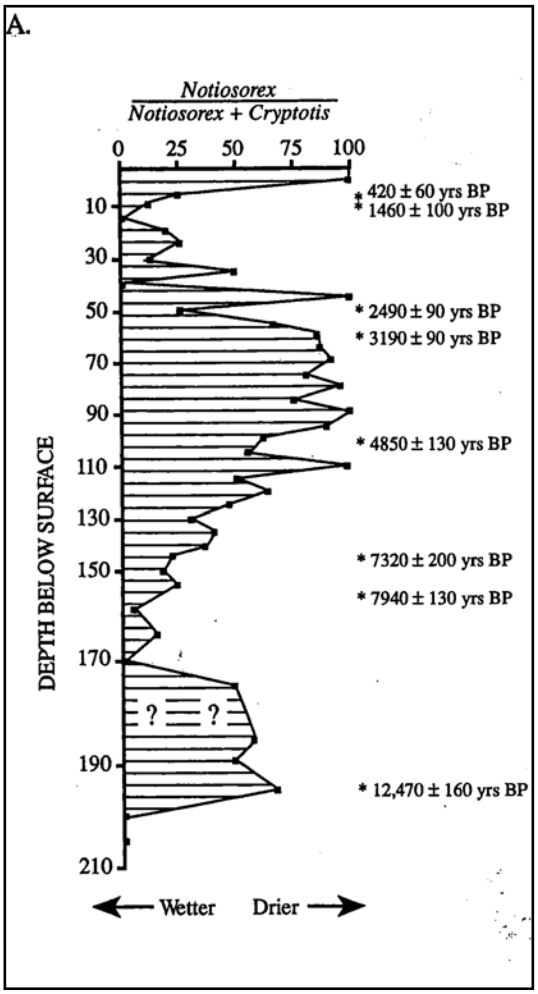


Figure 11.5. Hall's Cave desert and least shrew data showing environmental implications (adapted from Toomey et al. 1993).

To briefly address some of the difficulties that limit the comparability of the datasets, the chronological framework in data from any depositional unit typically comprises a few critical dates. For example, in Toomey et al.'s (1993:Figure 6a) Hall's Cave data, there are seven radiocarbon dates that provide intermittent anchor points for fairly continuous data deposited over an 8,000-year period. Clearly, the rate of deposition was never a constant; it varied over time creating either compressed or expanded time scales. The same is true for the bog pollen data, such as that presented by Bousman (1998). Both sets of data show general trends, but also very specific peaks and valleys. We can correlate general trends, but because of uncertainties in the depositional rates among different contexts, there is considerable uncertainty in precisely drawing correspondences in meso- and microscale variations among datasets. That is the limit of the current data. Refinement of temporal parameters in paleoenvironmental data would be a considerable achievement.

In due consideration of the limits, the two data sets nevertheless show both differences and concurrences on specifics. However, both concur on the major mid-Holocene dry spell commonly referred to as the Altithermal followed by a wetter climate beginning anywhere from roughly 3250 to 2500 B.P. At some point after 2500 B.P., there is a significant shift to grasslands or drier conditions, followed by a substantial period of woodlands and wetter conditions. This general trend is also seen in other atmospheric data (Figure 11.6).

Our chronological analysis discussed in Chapter 9 addressed the need for looking at magnitude of change, discerning if certain cultural and environmental shifts were brief and local or, conversely, if the shifts were major breaks in long-term trajectories and of broad geographical scope. To assess the magnitude of change revealed in the central Texas data, a final comparative dataset is global in scale. Mayewski et al. (2004) synthesized 50 globally distributed paleoclimate records to identify six periods of significant rapid

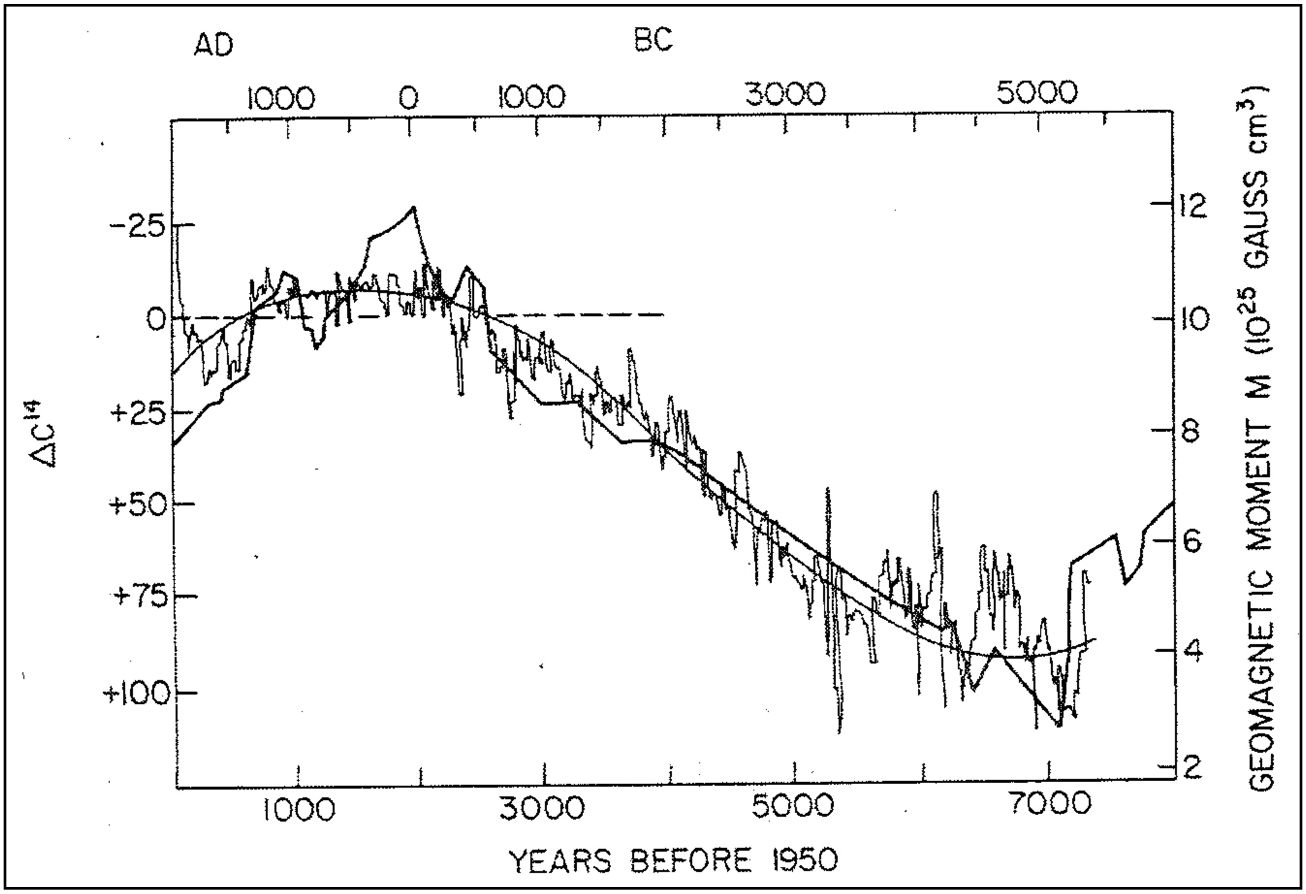


Figure 11.6. Record of deviation of relative C14 concentration in earth's atmosphere (thin abruptly changing line) compared to the 1890 norm (dashed horizontal line) (Bradley 1985;66). Solid fluctuating line is variation of earth's magnetic field. Smooth curved lines are averaged trend lines that parallel basic morphology of the Central Texas bog and faunal data.

climate change (RCC), several of which could be shown to "coincide with major disruptions of civilization, illustrating the human significance of Holocene climate variability" (Mayewski et al. 2004:243). The Greenland Ice Sheet Project (GISP) is among the more stunning sets of data in term of chronological resolution. Based on the cumulative data (Figure 11.7), worldwide data on Holocene climate variability is used to identify major changes. These RCCs are overlain on the central Texas data, including major and minor divisions in Central Texas chronologies as refined in Chapter 9 (Figure 11.8). The following discussion broadens the scope beyond the timeframe of concern for the Siren site in order to illustrate the consistency of correlations between central Texas and globally observed changes.

The initial RCC, between 8100 to 8800 B.P., coincides with the Paleoindian to Archaic transition, as well as changes in both the central Texas pollen and small mammal data. The climate was generally "cool over much of the Northern Hemisphere throughout this interval" (Mayewski 2004:248). Between about 8000 and 6000 years ago, the Texas data indicates drier grassland settings, and global data seems to support that as well. The following RCCs include two major swings, one from about 5900 to 5300 B.P. and the other from about 3300 to 2500 B.P. (Mayewski et al. 2004:248). A shorter, less widespread RCC occurred between about 4200 and 3800 B.P. In all three cases, the central Texas data show a similar pattern: an abrupt increase in arboreal canopy cover coinciding with the advent of these RCCs, followed by a major decline in canopy and increased grassland settings. In each of these RCCs, North American glaciers advanced (Mayewski et al. 2004:Figure 4). The overall interpretation of these RCCs is one of cool poles and arid tropics. While the plunge towards cool dry grasslands in the central Texas data is perhaps predicted by the global model, the preceding sharp rises in arboreal pollen is curious.

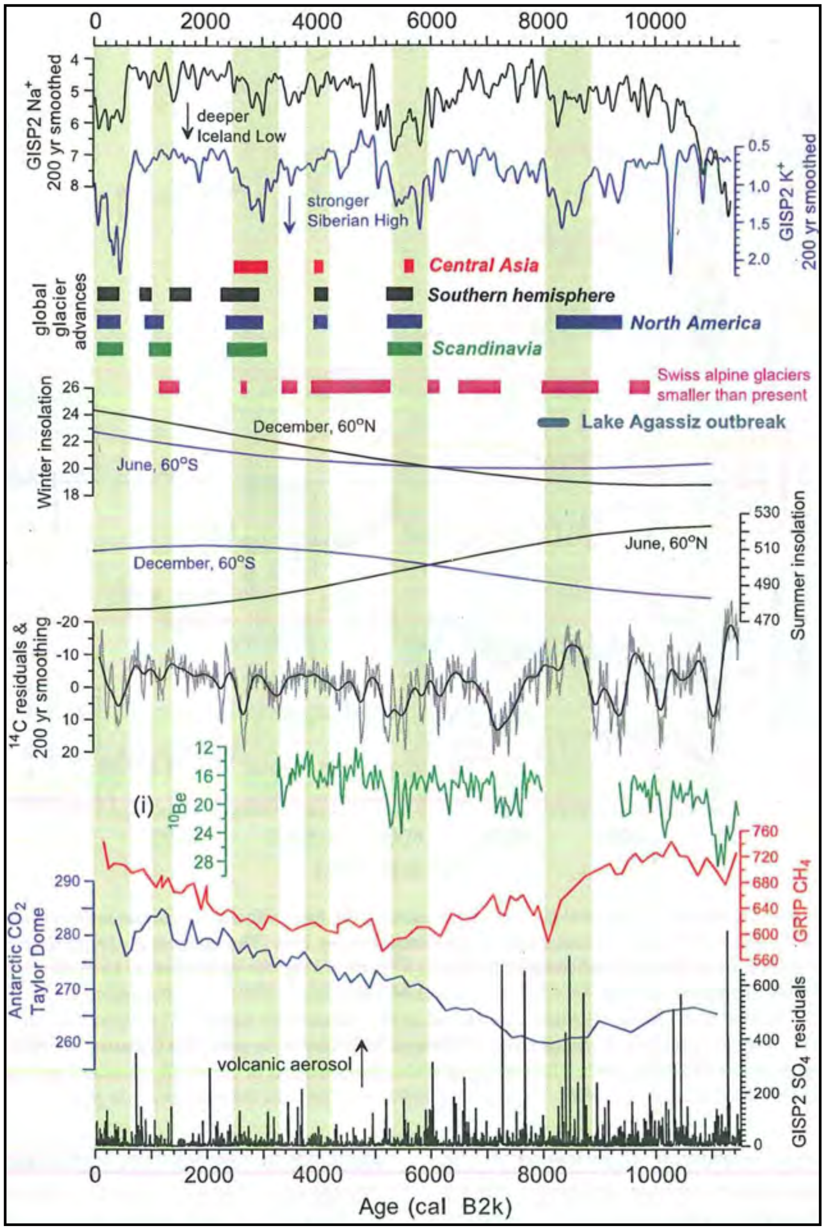


Figure 11.7. Climatic data showing global correlations indicating variability in environmental circumstances (from Mayewski et al. 2004:Figure 4).

Like the 4200 to 3800 B.P. event, the 1200 to 1000 B.P. RCC is also evident in fewer global records, but synchronous evidence is nevertheless fairly widespread. Once again North American glaciers advanced, and the lower latitudes were cooler and dryer.

While many details, correlations, and contradictions have yet to be resolved, and such an undertaking is far beyond the current scope, there are some interesting patterns. The two major prehistoric transitions, the Paleoindian to Archaic and Archaic to Late Prehistoric coincide with widespread periods of rapid climate change that are strongly resonant in the central Texas pollen record. The smaller subdivisions likewise appear to correlate with RCCs. The transition from Early to Middle Archaic, dated to about 5600 B.P. by Johnson (1995) and 5800 by Collins (2004) falls within the second RCC from 5200 to 5800 B.P. The transition from Middle to Late Archaic, which is dated to about 4200 B.P. by Johnson (1995) and 4000 B.P. by Collins (2004), falls within the third RCC from 4200 to 3800 B.P. The fourth RCC, from 3300 to 2500 B.P., covers the transition from Late Archaic I to Late Archaic II, defined by Johnson (1995) as falling around 2600 B.P. The sixth and final RCC, starting at 600 B.P., generally correlates with the shift between the Austin and Toyah phases of the Late Prehistoric, though many place this transition around 700 to 800 B.P.

The salient point is that there are six periods of rapid global climate change, and all coincide with major transitions in Central Texas cultural chronologies. Johnson (1995) has five divisions, which includes a fairly minor one between Late Archaic I and II. Each falls on consecutive RCCs. The only RCC that is not addressed by Johnson is the final one (ca. 600 B.P) since his concern was the Archaic, not the post-Archaic. Collins (1995, 2004) has four Archaic chronological breaks (including the Paleoindian-Archaic partition), and all fall on RCCs. Collins does not further subdivide the Late Archaic as does Johnson, and so the fourth Holocene RCC at 3300 to 2500 B.P. is not a period change. Collins (2004) does divide the Late Prehistoric into early and late subperiods, but places the division at or around 800 B.P. rather than the 600 B.P. date of the final RCC. The two most recent Central Texas cultural chronologies have six major transitions in the prehistoric cultural sequence. Cumulatively, the six major prehistoric Holocene archaeological transitions coincide with the six periods of global climate change.

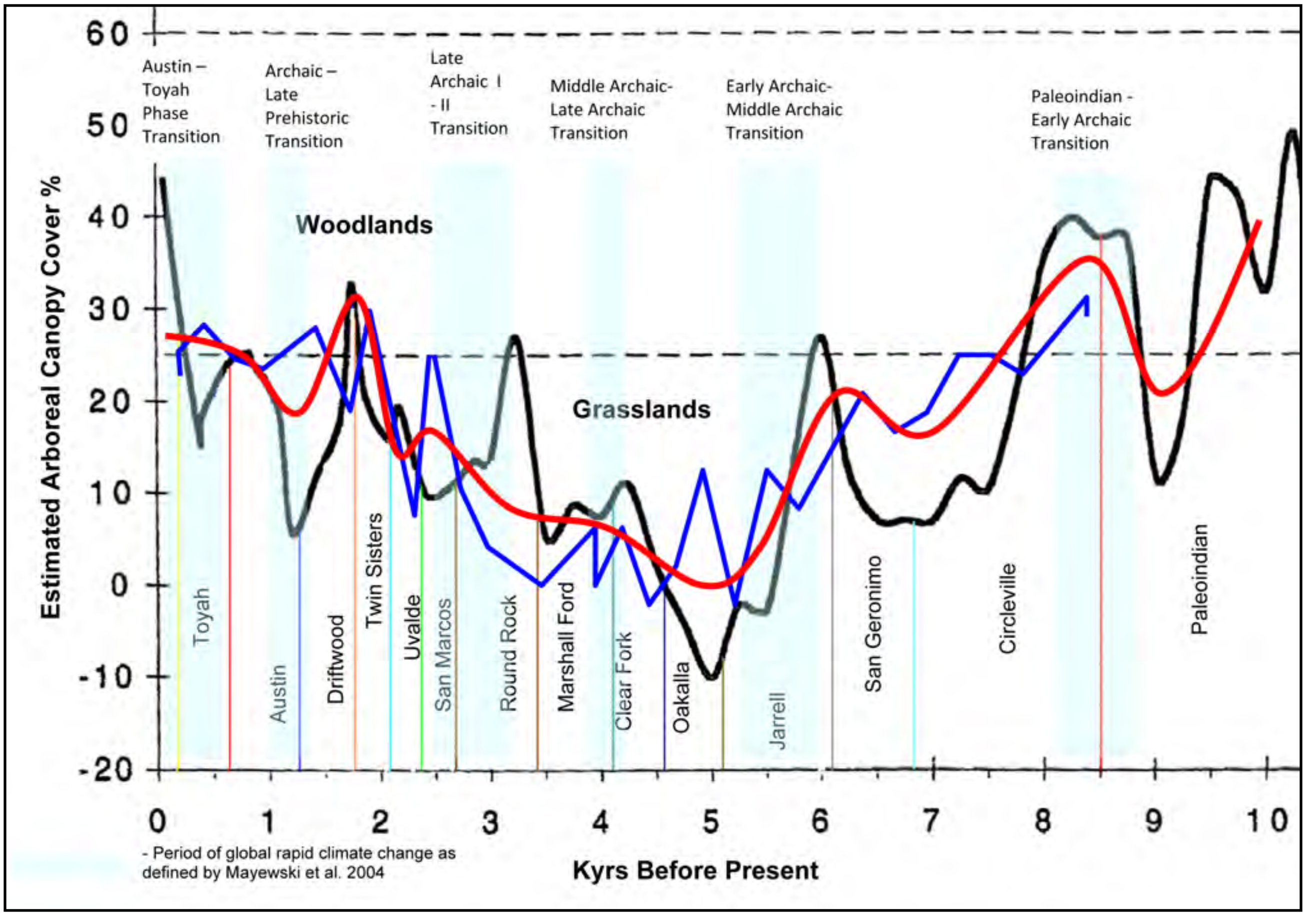


Figure 11.8. Environmental data with cultural chronological partitions. Black line is arboreal pollen indicating fluctuations in woodland and grassland settings for east Central Texas (Bousman 1998:212). Blue line is shrew data from Hall's Cave modified from Toomey et al. (1993) to fit on scale of pollen data. Red line is approximate median between two datasets.

Tying the central Texas data into the macroscale patterns indicates the shifts at these periods transcended local or even regional contexts and probably represent fundamental adaptations in response not only to localized affects, but also to distant events. In hunter-gatherer societies, mobility is one of the adaptive hallmarks, and as the material basis of a group's economy changes, population movement could be expected, resulting in a covariant effect across the larger social landscape.

To draw back to the relevant timescale for the Siren site patterns, the data cited above suggest major, widespread environmental change between 3300 to 2500 B.P. and 1200 to 1000 B.P. The pollen data indicate the predominance of grasslands during the first of these, followed by encroaching woodlands that peak around 1750 or 1800 B.P. Grasslands return after this date. Subsequently, the Austin phase marks a resumption of woodlands before the recurrence of grasslands in Toyah times. An important aspect of the Siren site setting is that it lies on the ecotonal margin of two vast bioregions, the Eastern Woodlands and the Great Plains, and faunal and floral assemblages ebbed and flowed, creating different adaptational circumstances. The implication for these settings on the subsistence patterns is one of shifting "Plains" and "Woodland" adaptations, though tempered by a uniquely central Texas context. These can be expected in the subsistence remains and technological data.

Subsistence Data

The faunal and floral remains at the Siren site provide the primary information on prehistoric subsistence. Of the two, faunal remains proved to be the most productive of the datasets. Cumulatively, the remains reflect adaptations to locally available native species, but within these patterns there is variation through time that contributes to the study of long-term change.

Faunal Remains

Faunal remains, providing a much more substantial assemblage than the floral remains, afford some of the best insights into subsistence patterns, though there may well be a bias towards large mammals as a result of taphonomic factors. A few salient aspects of the faunal remains are discussed here, deferring to Appendix H and Chapter 7 for more detailed discussions. Dr. Klippel with the University of Tennessee analyzed 18,530 bones and bone fragments from the site (Appendix H). Seventy-four percent of the remains were identifiable as to class, with mammals comprising the overwhelming majority (73 percent). A minimum of a dozen mammal genera is represented (*Antilocapra*, *Bos*, *Canis*, *Castor*, *Geomys*, *Lepus*, *Mephitis*, *Neotoma*, *Odocoileus*, *Procyon*, *Sylvilagus*, and *Ursus*). Whitetail deer (*Odocoileus virginianus*) are the most common (number of identifiable specimens=208). Medium-sized remains include those of *Antilocapra americana*, *Odocoileus hemionus*, *Odocoileus virginianus*, *Ursus americanus*, *Artiodactyl* (*Bos* excluded) and "medium mammal." These taxa make up 88 percent of the mammal assemblage. *Bos bison* and "large mammals" constitute 2 percent of the total assemblage. According to Klippel's definition, the large mammal class would comprise only bison or cow; deer-sized species are defined as "medium-sized." Consequently, by exclusion of cow from the prehistoric context, the category should include solely bison.

Fish are not represented in the Siren assemblage. Amphibians, reptiles, and birds, combined, only make up 1 percent of the remains identified to class. However, post-depositional biases may account for sparse numbers. Klippel's (Appendix H) analysis suggests taphonomic factors significantly modified the composition of the Siren bone assemblage. As he reports, portions of long bones from large- and medium-sized mammals (i.e., bison, deer, and pronghorn) are greatly over-represented by the denser ends of humeri (distal), radii (proximal), and tibiae (distal). Of these elements identified for bison, 100 percent (n=69) are dense distal humeri. Similarly, 83 percent (n=74) of the denser ends of medium-sized artiodactyl humeri, radii, and tibiae are represented in the assemblage compared to only 17 percent (n=15) of the less dense ends of these same bones.

The likely bias in the faunal assemblage imposes interpretive limitations, but within these bounds several worthwhile observations can be made. Lacking the smaller end of the faunal spectra, patterns in the remains predominantly reflect prey choice in high-ranking resources, complementing the floral resources, which are typically deemed low in rank (e.g., Dering 1999, 2008). By breaking the identified specimens according to component, a few diachronic changes in economic exploitation intensity of high-ranking resources are evident (Tables 11.2 and 11.3). However, for the most part statistical variation is slight through the components. Deer and/or antelope, which comprise the medium mammal category, remain overwhelmingly predominate throughout all components. Component 3, with Ensor, Frio, and Fairland points, has the highest percentage of deer-sized mammals, but the numbers are fairly consistent through time.

Using the number of mammalian taxa as an indicator of diet breadth, the earlier components show a greater diversity across the scale of animal size. Though Klippel's data contains two categories that may be redundant (deer/pronghorn and deer, both of which could possibly fall within whitetail deer), there are nevertheless 12 mammal categories specified to the level of class (Table 11.2). Of these 12, Components 1 through 3 have from two to four classes. Component 4 has 11 classes, and Component 5 has six of the 12 classes. To an extent the richness could be a factor of sample size since Component 4 is by far the largest faunal population. This may explain part of it, but likely not all of it: Component 5 has half the number of specimens as Component 3 but still shows greater diversity.

By collapsing the taxa, the focus on animal size becomes more readily apparent (Table 11.3). Component 3 appears to be focused on deer hunting, as evident by the highest percentage of deer or medium-sized mammals and lowest percentage of small mammals. Component 1 is likewise focused on deer-hunting but also a greater reliance on small mammals. Looking back at the previously discussed paleoenvironmental data, these two periods are the only ones with Woodlands settings. As a general statement on Woodland archaeological assemblages in the southeastern United States, "deer, as the single and pervasive large mammal in the Southeast for much of the Holocene, is unarguably the single most important taxon for this contribution of meat and fat to the diet, in addition to bone and hide as raw materials for clothing implements and ornaments" (Jackson and Scott 2002:461). Components 1 and 3 perhaps reflect

Table 11.2. Vertebrate Remains Identified from the Siren Site

Taxon	Common name	Component 1	Component 2	Component 3	Component 4	Component 5
		number of identifiable specimens				
Reptiles/Amphibians						
Kinosternidae	musk/mud turtle	0	0	0	0	4
Testudines	turtle	0	2	5	4	2
Anura	toad or frog	0	0	0	0	0
Birds						
Meleagris gallopavo	turkey	0	0	0	5	1
Aves	bird	1	2	1	24	0
Mammals						
Bos bison	bison	0	0	0	6	0
Odocoileus hemionus	mule deer	0	0	0	1	1
Odocoileus virginianus	whitetail deer	0	0	7	65	6
Odocoileus sp.	deer	4	0	0	85	11
Artiodactyl	deer/pronghorn	14	7	59	398	27
Canis latrans	coyote	0	0	0	1	7
Canis sp.	coyote/wolf/dog	0	0	0	0	1
Procyon lotor	raccoon	0	0	0	5	0
Mephitis mephitis	striped skunk	0	0	0	1	0
Sylvilagus sp.	cottontail	1	1	1	6	0
Lepus californicus	blacktail jack rabbit	0	0	1	1	0
Geomys bursarius	southeastern pocket gopher	0	0	0	2	0
Mammalia	large mammal	0	0	0	57	0
	medium mammal	113	38	668	1934	281
	small mammal	7	1	21	80	5
	unidentified	10	3	0	216	17
Total Identified to Class		**150**	**54**	**763**	**2891**	**363**
Unidentified						
Unidentified	unidentified	142	165	616	898	450

Table 11.3. Condensed Taxon by Component from the Siren Site

Taxon	Subcategory	Component 1 #	%	Component 2 #	%	Component 3 #	%	Component 4 #	%	Component 5 #	%
Reptiles/ Amphibians		0	0.00%	2	3.92%	5	0.66%	4	0.15%	6	1.73%
Birds		1	0.71%	2	3.92%	1	0.13%	29	1.08%	1	0.29%
Mammals	large mammal	0	0.00%	0	0.00%	0	0.00%	63	2.36%	0	0.00%
	medium mammal	131	93.57%	45	88.24%	734	96.20%	2483	92.82%	326	94.22%
	small mammal	8	5.71%	2	3.92%	23	3.01%	96	3.59%	13	3.76%
	Total Identified	**140**		**51**		**763**		**2675**		**346**	

hunting organizational strategies geared towards that resource.

Regarding Bison and their significance in interpretations of Prehistory

As previously stated, the Siren site was expected to yield a pattern of early bison exploitation that diminishes rather strongly after about approximately B.P. 2300. Bison and the large mammal category occur only in Component 4, dating from 2200 to 2300 B.P., and are associated with Castroville, Montell and other broad-bladed sorts. Bison, their presence or absence in the prehistoric archaeological record, have been a recurrent focus of study for quite some time. Since the Siren site provides very specific data on bison presence, it is worth considering them in a larger context.

Although bison represent only 2 percent of the overall assemblage, their significance outweighs their frequency, not only for subsistence purposes but also for paleo-environmental implications. In resource ranking models, for the vast majority of the Holocene, these animals constituted the highest ranked resource (see discussion in Mauldin et al. 2010:69). According to many models, it is a general principle that subsistence economies shift towards highly ranked resources in circumstances of widespread availability, all else being equal. Speth (2004) has argued that incipient sedentism and agriculture, as a basic subsistence strategy, was quite often abandoned upon the arrival of bison in eastern New Mexico. When bison declined in availability for prolonged periods, the groups would re-establish an agricultural basis. Central Texans did not adopt agriculture, but the point is that trends towards decreasing mobility are generally reversed with the introduction of bison.

In terms of diet breadth, subsistence can narrow with the abundance of higher ranked species. As Speth (2004:421) notes, it would take 800 cottontail rabbits to equal the weight of a bison bull. If the utility of hide and horn are also considered (as well as the labor in harvesting 800 rabbits), bison provide much sought resources that would diminish the pursuit of lower ranked items. Consequently, in times of high bison presence or abundance, the technological organization of society shifts to what is generically termed a "Plains adaptation."

To address this issue, in many studies over the last 40 years or so, archaeologists have used the frequency of bison in archaeological contexts to infer relative abundance of the animals on the landscape. Along these lines, Dillehay's (1974) classic study of bison presence and absence was among the first. His work has been validated in some aspects, but has been substantially modified in others. Though his study explicitly targeted to the Southern Plains, his data drew from the archaeological record over the vast majority of Texas and consequently is more widely applicable. Since the original formulation, a large amount of data has been recovered, and a series of studies have reassessed the findings (Baugh 1986; Greer 1976; Huebner 1991; Lohse and Cholak 2011; Lynott 1979; Mauldin et al. 2010; Quigg et al. 2010). Many of these are regionally or temporally specific and are not directly relevant to the current study, which is concerned with the eastern Edwards Plateau in the Late Archaic to early Late Prehistoric times. The studies by Quigg et al. (2010) and Baugh (1986) were strictly focused on the Southern Plains of Texas and Oklahoma and so are not directly applicable. Huebner's (1991) and Lynott's (1979) studies focused on the Late Prehistoric, but the former to some degree addresses earlier times. The study by Mauldin et al. (2010), however, draws from eastern Central Texas data and is directly relevant to the current report although their project area is in Zavala County in the South Texas archaeological region. Nevertheless, of particular interest is their contradiction of prevailing notions on Absence Period II, which dates from 1450 B.P. to 700 B.P. Other studies, such as Huebner's (1991) and Lohse and Cholak (2011), seemed to confirm the lack of bison before 700 B.P., and Johnson (1995:95) asserted that "evidence of buffalo hunting has not yet been found in the eastern Plateau for subperiod II (Late Archaic II)." Since the Siren site also seems to confirm the lack of bison during this time, a review of Mauldin et al.'s (2010) data is warranted to clarify the distinct discrepancies. Of additional relevance, all of the data Mauldin et al. (2010) cite as evidence of bison during this period come from sites on the eastern edge of the Edwards Plateau very near the Siren site. So the implications either way are significant.

Mauldin et al. (2010:71–72) used data from 77 sites that yielded 141 Late Archaic and Late Prehistoric components to argue that bison had a more ubiquitous distribution in time and space than Dillehay (1974) postulated.

They determined the temporal affiliations of bison by associations with "either radiocarbon dates or temporally diagnostic artifacts" (Mauldin et al. 2010:71–72). They arbitrarily carved the Late Archaic into Initial, Middle, and Terminal blocks, each with the diagnostic artifacts used to assign the components to the respective periods. Our interest here is the Terminal Late Archaic – they cite evidence showing bison presence in a time that contradicts Dillehay, but also the Siren site data. The data they use draws from all over Texas, but without exception all data for the presence of bison during the Terminal Late Archaic comes from the vicinity of the Siren site on the eastern margin of the Edwards Plateau. Our review of the data yielded a different conclusion.

Of the 77 sites, 30 had components dating to the Terminal Late Archaic. Of those 30 components, six had bison bone attributed to them, a total of 22 individual elements. Seventeen of these 22 elements, came from one site, Evoe Terrace (41BL104), and four came from Hoxie Bridge (41WM130). Accordingly 21 of the 22 elements (or 95 percent) came from two sites a short distance north of the Siren site. The Evoe Terrace site, however, did not yield stratigraphically isolable components dating to this time. Bison bones were recovered from excavation areas A, B, and C, and the zones bearing the Terminal Archaic diagnostic artifacts in each of these areas is highly intermixed with diagnostics from other times. Zone 1 in Area A yielded Perdiz, Fairland, Darl, Ensor, Marcos, Castroville, and Montell, among others (Sorrow et al. 1967:122). In the other two areas, Zones 2 through 4 in Area B and Zones 2 and 3 in Area C are likewise heavily mixed (Sorrow et al. 1967:126;132). The Hoxie Bridge site data is also problematic. The four positively identified bison elements are associated with Feature 47 (Bond 1978:201). Feature 47 has no radiocarbon dates or temporally diagnostic artifacts, and Bond (1978:113) provides only speculative conclusions that the "bones were probably dumped off the side of the levee during Austin and Toyah phase occupations." Rather than segue too far beyond the purpose at hand, we simply say that the other sites that Mauldin et al. cite with evidence of bison during the Terminal Archaic, specifically 41WM2, 41TV42, 41CM1, and 41WM118 warrant caution for lack of stratigraphic separation. At least the reports on these sites from 1947, 1957, 1962, and 1973 provide insufficient detail to clearly make such a determination. All of the more recently and better dated sites with components of the time period (e.g., Mahoney, Tomka et al. 2003; Mauldin et al. 2003; Ricklis and Collins 1994; Thompson et al. 2007; Treece et al. 1993) do not have bison during the period of concern.

Perhaps a more critical point, however, is that none of the sites with bison elements in the Terminal Late Archaic cited by Mauldin et al. (2010) have radiocarbon dates dating to that timeframe. All temporal affiliations derive from diagnostic artifacts, and their temporal ranges of periods and artifacts styles are often entirely divergent from the previous discussion in Chapter 9 of this report. For example, they attribute Ensor, Frio, and Fairland to a range of 1600 to 1250 B.P., whereas the Siren data and other chronologies (Johnson and Goode 1994; Turner et al. 2011) show an entirely different temporal range, placing these styles as early as 2200 B.P. Additionally, many of the preceding broad-bladed forms are listed as continuing up to 1600 B.P., whereas Chapter 8 shows them as discontinuing about a half-millenium before. The importance of these discrepancies lies in the use of entirely diagnostic artifacts to critique Dillehay's (1974) temporal ranges. If using the chronological placement of points to directly contradict the temporal ranges of Dillehay's (1974) periods, then the long quest for more precise dating of the various styles is certainly still an issue.

A review of the best dated regional sites with bison indicates some contradictions with Dillehay's (1974) model, but also some concurrences (Table 11.4). In the final analysis, we agree with Mauldin et al (2010:74) that bison were noticeably more restricted in the Terminal Late Archaic relative to the preceding time, but do not see support for their assertion that, in sites with components of that age, 43 percent (6 of 14) along the eastern margin of Central Texas have bison in their assemblages. In the Siren site and other regional data, we see the presence of bison in assemblages dating as late as 2300 to 2200 B.P., then a notable lack of bison thereafter until the later part of the Late Prehistoric. This pattern is consistent with a more comprehensive review of bison in Central Texas assemblages reported by Lohse and Cholak (2011), who report bison from about 3300 to 2200 B.P. or so, and then complete absence for the remainder of the Archaic. In terms of the other periods, the data for Mauldin et al.'s (2010) other blocks of time, particularly the two with very prominent bison presence (Terminal Late Prehistoric and Middle Late Archaic), are founded on much more solid data.

Floral Remains

The results of the macrobotanical, pollen, and phytolith analyses at the Siren site revealed a few interesting trends, but for the most part reflected traces of fairly common plants that may not have been economic resources, but rather part of the natural context (Appendices B, C, and D). Oak, juniper, and grass pollen in samples from feature contexts and groundstone tools are consistent with pollen rains of the mixed wooded and open grassland setting that has characterized the region for much of the Holocene (Bousman 1998; Bryant 1977; Bryant and Holloway 1985; Toomey et al 1993). However, some findings clearly reflect subsistence resources. Geophytes, walnuts, perhaps hackberry and grass seeds, and possibly sunflowers are likely economic resources with traces in the archaeological record.

Seventeen *Liliaceae* bulbs or bulb fragments were identified, most from direct feature contexts and many burned (Appendix B Table 9). The lily family is a catchall group that includes several edible species reported in central Texas, namely false garlic (*Nothoscordium bivalve*), wild onions (*Allium* sp.), wild hyacinth (*Camassia scilloides*) and dog tooth violets *(Erythronium albidum*) (Cheatam and Johnston 1997). The Siren site bulbs could not be further typed as to specific species, in part because charring obscured distinguishing attributes. All of the bulbs from the site are small, a centimeter or two in diameter. Temporally, 10 bulbs were either directly dated or came from direct associations with dated features. Of the 10, five came from Component 5 features, which date to approximately 2400 to 2600 B.P.; four come from Component 3 contexts that date to around 1900 to 2000 B.P.; and one dates to Component 4 at around 2200 to 2300 B.P. No geophytes were recovered from Austin phase contexts, but floral remains from this component are generally lacking.

Overall, the floral subsistence evidence suggests a fairly diverse exploitation of locally available resources but no intensive processing. Caution is warranted since such remains are the most perishable of all, but the material assemblage partially supports such a view. Classic signatures of plant processing, such as manos, metates, or nutting stones, are not prominent parts of the assemblage, even in relative terms. Conversely, however, as has and is discussed in greater detail, large cooking features are often interpreted as evidence of intensive processing of vegetal materials (e.g., Black et al. 1997; Dering 1999, 2008; Ellis 1997).

Succulents and geophytes are the most commonly cited vegetal resources for oven cooking. Campbell (1988:20) cites ethnographic information (mainly Cabeza de Vaca) from south Texas groups noting that "roots were cooked for two days in some sort of oven, probably a shallow pit oven" and that "women spent considerable time each night preparing ovens for baking roots." However, direct evidence of the xerophytic species, such agave, yucca, and sotol, is entirely lacking in the pollen, phytolith, and macrofloral record at the Siren site.

Given the lack of clear evidence in the Siren site assemblage, and the general evidence that desert succulents were present in sufficient abundance for an economy of scale on the eastern margin of the Edwards Plateau, vegetal baking in middens seems to need greater substantiation. As Dering (1999) notes for the Lower Pecos area, the return rate on sotol and lechuguilla is very low compared to many other resources (Table 11.5). With greater scarcity of the resource, the return rate decreases. Dering (1999)

Table 11.4. Major Prehistoric Bison Hunting Eras of Central Texas

		Revised Model for Eastern Central Texas			
Years BP	**Dillehay's Periods**	**Revised Periods**	**Bison-related Style Interval**	**Periods in kRCYBP**	**Sites with High Integrity**
200, 400, 600	Presence Period III	High Relative Abundance	Toyah, Perdiz	650/700 to 250 BP	Buckhollow (Johnson 1994), Mustang Branch (Collins and Ricklis 1994)
800, 1000, 1200, 1400	Absence Period II	Absence or Low Relative Abundance			
1600, 1800, 2000	Presence Period II	Absence or Low Relative Abundance			
2200	Presence Period II	High Relative Abundance	Castroville	2150 to 2600 BP	Siren (this report), Jonas Terrace (Johnson 1995), John Ischy (41WM49; Sorrow 1969:62), 41TG91 (Creel 1990), Bonfire Shelter (41VV218; Bement 1986; Dibble 1970; Dibble and Lorraine 1968)
2400	Presence Period II	High Relative Abundance	Montell	2150 to 2600 BP	
2600	Presence Period II	High Relative Abundance	Marshall, Marcos	2150 to 2600 BP	
2800, 3000 to 4200, 4400	Presence Period II	Moderate Relative Abundance			
4600, 4800, 5000	Absence Period I	Low Relative Abundance			
5200, 5400, 5600	Absence Period I	High Relative Abundance	Calf Creek, Andice, Bell	5100 to 5600 BP	Royal Coachman (41CM111, Mahoney, Shafer, et al. 2003:63); Landslide (41BL85; Sorrow et al 1967:41); Cervenka (41WM267; Peter et al. 1982:8-260--61)
5800, 6000 to 7200, 7400	Absence Period I	Low Relative Abundance			
7600, 7800 to 9400, 9600	Presence Period I	Moderate Relative Abundance			
9800, 10,000, 10,200, 10,400	Presence Period I	High Relative Abundance	Folsom	9900 to 10,300 BP (Bousman 2004)	Bonfire Shelter (41VV218; Bement 1986; Dibble 1970; Dibble and Lorraine 1968)
10,600	Presence Period I	Moderate Relative Abundance			

Table 11.5. Comparative Post-Encounter Resource Return Rates (from Dering 1999:666 and Kelly 1995:81–82)

Region	Common Name	Scientific name	Resource Type	Return Rate (kcal/hour)
Lower Pecos, Texas	Lechuguilla	*Agave lechuguilla*	Central stem	730
	Sotol	*Dasylerion texanum*	Central stem	486
Great Basin	Deer/Bighorn sheep	*Odocoilus hemionus/Ovis canadensis*	Large game	17,971-31,450
	Cattail	*Typha latifolia*	Pollen	2750-9360
	Jackrabbit	*Lepus* sp.	Small game	13475-15400
	Gophers	*Thomomys* sp.	Small game	8983-10780
	13-lined ground squirrel	*Citellus* sp.	Small game	2837-3593
	Gambel oak	*Quercus gambellii*	Acorns	1488
	Tansymustard	*Descurania pinnata*	Seeds	1307
	Bitterroot	*Lewisia rediviva*	Roots	1237
	Bulrush	*Scirpus sp.*	Seeds	302-1699
	Indian rice grass	*Oryzopsis hymenoides*	Seeds	301-392
Australia		*Ipomea costata*	Roots	1254 (<6345)
		Panicum austaliense	Seeds	1226
		Acacia coriacea	Seeds	<676
		Acacea aneura	Seeds	580
		Vigna lanceolata	Roots	52-448

also noted, the earth ovens require substantial fuel, thereby draining other vital resources. Whether or not the numbers add up, and whether or not diet breadth and optimal foraging models will support the "veggie-baking" theory for this region has yet to be seen.

Thoms (2008a, b) has argued for the association of burned rock technology with intensive geophyte exploitation, but whether this was the driving force in large burned rock feature technology is still a subject of study. In the Pacific Northwest and American Southwest, vegetal cooking in large ovens can be done on an economy of scale that has yet to be substantiated for eastern Central Texas, in part because of the more limited availability of resources in Central Texas. The western camas (*Camassia quamash*), which is a much larger bulb than the eastern camas (*Camassia scilloides*) found in eastern Texas, could be found in dense clusters where large quantities could be obtained in fairly short order (Native American Netroots 2011, Thoms 2008b). In the Pacific Northwest, a person could harvest a bushel (approximately 8 gallons, or 35 liters) of camas from half an acre in a day (Native American Netroots 2011). As Thoms (2008b:127) notes, "camas grounds in Texas are few in number and low in bulb density" compared to the areas in the Pacific Northwest. The small size of the geophytes in Central Texas (those recovered from the Siren site are 1 to 2 cm in diameter) would mandate a high threshold of labor expenditure relative to caloric or nutrient feedback, and could not in the remotest possibilities match the dietary significance of camas in the Pacific Northwest. Nevertheless, the evidence shows they were, in fact, used and cooked in ovens at the Siren site and in the surrounding region, but circumstances indicate a more expedient, low-ranked resource in a diverse dietary assemblage.

Concerning other subsistence related floral remains, walnut and sunflower were identified in small amounts from feature or artifact contexts. A charred walnut shell fragment was found in Feature 30 matrix, which dates to Component 3, dating to approximately 1880 to 1970 B.P. (Appendix B). Walnut wood charcoal was also recovered from features of the same time period and earlier, indicating walnuts were available in the immediate site area (Appendix B). Analysis of groundstone revealed phytoliths from the sunflower family (Asteraceae), which includes economical plants such as marshelder as well as sunflowers (*Helianthus annuus*), suggest seed grinding was a component of the subsistence strategies throughout the occupational sequence. By most accounts, sunflowers were domesticated in the Eastern United States, where seeds have been recovered from archaeological contexts dating from roughly 3000 to 1800 B.P. (Tarighat et al. [2011], see also Hanselka [2011:163–164] for a review of evidence in the debate over Eastern North American versus Mesoamerican origins of domestication). No evidence of domestication has been clearly identified in Texas; the assumption that the Siren site inhabitants were exploiting native undomesticated wild plants is the better part of discretion. However, the degree of reliance on these low-ranked resources is not clear, but the lack of a substantial groundstone assemblage suggests fairly low levels of reliance.

A Brief Theory for Future Research: Social Aspects of Burned Rock Technology

In the context of a chapter on subsistence strategies, it is perhaps apt to offer a brief critique of the inordinate overemphasis on cultural ecology as the end all, be all perspective. The archaeological record is so often interpreted within a systemic context entirely structured on biological premises of a net input and output model, but sociocultural aspects of cultural ecology are often lost in the mix. In a paper presented at the annual meeting of the Texas Archaeological Society in Fort Worth on October 29, 2011, Steve Black (2011) noted the social aspects of burned rock technology have perhaps been overlooked. We suggest that ethnographic information would support such a view, and the implications are significant. In northern Mexico, large burned rock features are quite often associated with the production of vegetal materials, but not for subsistence, per se. Alcohol production is the main reason for sotol cooking, and maguey stalks are cooked to convert starch to sugar for kids and others on communal occasions or trade (Stark 2002). Thoms (2008b:127) cites an account of Comanches' cooking bulbs overnight, and, once cooked, "the bulbs were relished by these Indian children as popcorn or peanuts, having a sweetish taste, a little like sweet potatoes" (Sternberg 1931:223).

Newcomb (1978) and others describe ethnohistorical societies in Central Texas as maintaining a near universal pattern for hunter-gatherers of a cyclical nucleation process. Throughout the year, bands disperse into smaller groups and reconvene periodically on the band and macroband levels. At times, the supraband also convenes. Such convenings, called *fandangos* to the west or *mitotes* in Central and South Texas, which are vital to the perpetuation of societies (e.g., through marriage or other social relations, information sharing, political and economic ties) were times of redistribution of socially valued resources, sugar and alcohol being highly ranked in such regards. If on the eastern margin of Central Texas, burned rock features are focused on vegetal processing, and the statistics on the availability of and subsistence-oriented nutritive value of targeted resources cannot be shown to equate with investment of energy in procurement and processing, then other avenues warrant consideration to explain the common burned rock midden and their locations on the landscape.

Technology

Several aspects of technology contribute to insights into subsistence strategies, most notably burned rock features and lithic assemblages. Burned rock technology and its implications have been addressed in Chapter 10, but a few aspects are noted here to form a basis for ecological inferences, deferring to the previous chapter for more detailed analyses.

Siren Site Burned Rock Technology

To assess variation in labor investment and formality in burned rock technology through the components, Table 11.6 shows basic characteristics of burned rock features. The average weight of burned rock features is relatively high in the bookend components, the Late Archaic Component 5 and Late Prehistoric Austin phase Component 1 (Figure 11.9). The statistics in both are skewed by one or two prominent burned rock features, but, rather than a bias, the effect of these large features is an accurate portrayal of distinctive attributes of technology in the components. The intervening components reveal a distinctive decline on total burned rock feature weight.

The average number of burned rocks per feature correlates, to a degree, with average feature weights: the more rocks, the more the weight. But the size of the rocks is the important intermediary variable that suggests important technological differences. The average number of burned rocks is quite high in Component 5. It then declines exponentially in Component 4, before rising to an average of slightly

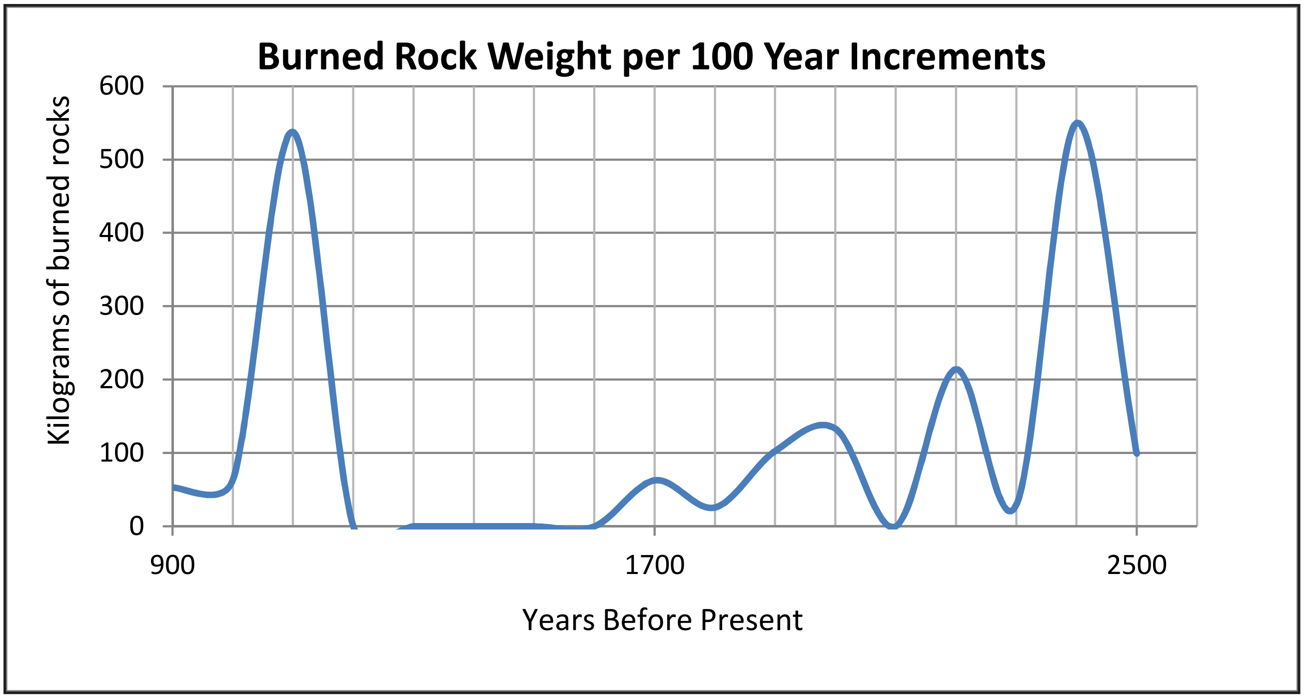


Figure 11.9. Kilograms of burned rock by 100 year increments on the Siren site.

more than 200 per feature over the remaining components. The more formal slab-lined hearths have very high average rocks weights (see Features 35 and 16 in Table 11.6). Conversely, the substantial burned rock midden (Feature 8) has the lowest average per rock weight of any feature, meaning there was likely intensive thermal fracturing. Therefore, in looking at average rock weight per feature, there is a steady decline through time, reaching the lowest average in Component 2 before rising again in the final component (Table 11.6).

Part of what the numbers reveal is a reflection of differences in feature use and function. The average rock size in the burned rock midden (Feature 8) is far smaller than any other feature on the site, a statistic that likely indicates intensive re-use of midden rock until too fragmentary to serve a thermal retaining function (e.g., Black and Creel 1997). If the average rock weight from Feature 35 in Component 5 is disregarded (its rocks are 35 times larger than the average midden rock), the average rock size in Component 4 is significantly larger than any other component, which possibly reflects a distinct functional difference. Whether this is an indication of less occupational intensity or re-use is something that will need to be considered in light of other datasets.

Based on the quantified attributes, the salient aspects of these statistical trends in burned rock features are:

- ❖ The Late Archaic Component 5 represents the peak of formality and labor investment in burned rock technology.
- ❖ Component 2, though the population sample is small, marks the least formality and investment of energy.
- ❖ Component 4 has, by far, the lowest average number of rocks comprising features, but they are typically large rocks.
- ❖ The Late Prehistoric marks a resurgence of large (according to average weight) burned rock features.

The Siren data show a decline in the formality and energy investment in cooking feature technology from a peak around 2600–2400 B.P. until 1250 B.P., then a subsequent increase from around 1100–900 B.P. High investment of energy in burned rock features, such as the central ring midden (Feature 8) and large slab-lined hearth (Feature 35) on the Siren site is often interpreted as an indicator of intensive processing of low-ranked resources such as xeric succulents or geophytes. As previously noted, however, the precise function of these features is still under study. Additionally, feature formality with a high energy investment is interpreted

Table 11.6. Siren Site Burned Rock Characteristics

	Total # of Burned Rocks	Avg	Total Weight (kg) of Burned Rocks	Avg	Average individual rock weight per feature
Component 1 Features					
1	*430*		*246.3*		**0.57**
6	*173*		*52.8*		**0.31**
12	*92*		*21.6*		**0.23**
13	*111*		*22.7*		**0.20**
14	*36*		*5.9*		**0.16**
16	*416*		*268.6*		**0.65**
25	*61*		*35.5*		**0.58**
Totals and Averages	**1319.00**	**188.43**	**653.40**	**93.34**	**0.39**
Component 2 Features					
15	*49*		*18.2*		**0.37**
17	*355*		*44.5*		**0.13**
Totals and Averages	**404**	**202**	**62.7**	**31.35**	**0.25**
Component 3 Features					
4	*594*		*133.1*		**0.22**
18	*131*		*25.9*		**0.20**
20	*18*		*14*		**0.78**
23	*212*		*49.8*		**0.23**
30	*182*		*38.9*		**0.21**
Totals and Averages	**1137**	**227.4**	**261.7**	**52.34**	**0.33**
Component 4 Features					
27	*28*		*8.6*		**0.31**
36	*247*		*188.1*		**0.76**
37	*36*		*16.7*		**0.46**
41	*53*		*12.2*		**0.23**
44	*18*		*9*		**0.50**
45	*16*		*8.4*		**0.53**
Totals and Averages	**398.00**	**66.33**	**243**	**40.5**	**0.46**
Component 5 Features					
2	*146*		*10.5*		**0.07**
3	*367*		*88.7*		**0.24**
31	*44*		*37.8*		**0.86**
8	*5750*		*341*		**0.06**
35	*83*		*171*		**2.06**
Totals and Averages	**6390**	**1278**	**649**	**129.8**	**0.66**

as an archaeological signature of long-range intent of repetitive occupation.

In summary, subsequent to Component 5, the initial implication is that declining investment of labor in feature technology correlates with decreased bulk processing of low-ranked resources, such as "veggies", decrease in "site furniture", and perhaps decreased occupational intensity or redundancy. In part, these may reflect a shift from collector/processor strategies to a more highly mobile foraging strategy in the later time periods, but this assessment will be considered in light of the other lines of evidence. To reiterate a salient point, any one line of evidence, such as assemblages or burned rock technology, offers only suggestive trends; it is the correspondence and correlation of the multiple different trends that form the basis for a more concrete picture of the changes at the end of the Archaic

Assemblages

In broad terms, an assemblage refers to the collective material culture of a community (Deetz 1967:109). Assemblage-based systematics analyze the relative frequency among artifact classes to infer behavioral implications, especially through comparative studies. The basic assumption underlying such studies is that "variation in the structure and content of an archaeological assemblage is directly related to the form, nature, and spatial arrangement of human activities" (Binford and Binford 1966:241). The objective in the study of lithic assemblages from the Siren site is to identify differences in organization of technology and strategies through the sequential components. The interpretive weight of the analysis of Siren site assemblages, however, needs to be tempered by a strong word of caution. As addressed in Chapter 8, the structural components of the site have reasonably good stratigraphic integrity, but the artifacts are more subject to movement. The artifact assemblages for each component, therefore, are undoubtedly mixed to varying degrees, rendering their study a somewhat blunt instrument. These are coarse-grained assemblages, the cumulative debris from many repeated occupations. Within this overarching consideration, the patterns are explored here to search for broad trends that can contribute to the overall picture. That said, there are various comparative categories that can be used to assess behavioral change, but this section focuses on three specific variables: 1) relative frequency of tool categories; 2) ratio of bifaces and cores; and 3) ratio of debitage to stone tools.

In terms of the first set of variables, a primary consideration is the ratio among projectile points, cores, biface, flake tools, and unifaces. A more equitable statistical distribution among the forms would be expected at longer-term collector base camps, partly because repeated occupations causes coarse-grained assemblages. Table 11.7 shows the percentages of the various tools categories by component. Several trends are notable:

- ❖ Projectile points, as a percentage of each component's assemblage, increase through time.
- ❖ Cores tend to be underrepresented in the younger components and overrepresented in the older two components.
- ❖ In all cases, there is an inverse relationship between modified flakes and scrapers, perhaps representing a distinction between informal and formal technology. If one category is above the cumulative site percentages, then the other is below average, and vice versa. The contrast is most distinctive in the earlier components.

Some observations are suspect because of low numbers. For example, in terms of assemblage diversity, the components with the highest numbers of tools have the greatest diversity of tools forms, and so the richness index is likely subject to critical thresholds of population size. Additionally, categories such as perforators, groundstone, and gravers have sample sizes that are too small to explore trends.

The ratios of bifaces to cores show a strong bimodal distribution (Table 11.8). Components 1 and 3 have a very high ratio of bifaces to cores, indicating an emphasis on bifacial technology. The remaining three components are very consistent, with ratios of about four to one. Compared to a collector base camp, a forager residential base ought to reveal a decrease in cores relative to bifaces. In general, biface use increases with mobility, though Tomka (2001) identifies mitigating circumstances, and flake-core use increases with longer occupations. While it depends on the site function, if the Siren site is a residential base camp in both collector and foraging strategies, then the ratio of cores to bifaces should be an index of the changing strategies over time.

Table 11.7. Summary of Lithic Assemblage from Siren Components

Type of Artifact	Component 1		Component 3		Component 4		Component 5		Total	Relative Assemblage %
	#	%*	#	%	#	%	#	%		
Projectile Points	14	33.33	25	27.47	39	24.38	7	20.00	**85**	25.91
Perforators	0	0.00	0	0.00	1	0.63	0	0.00	**1**	0.30
Scrapers	3	7.14	5	5.49	20	12.50	1	2.86	**29**	8.84
Gravers	0	0.00	1	1.10	0	0.00	0	0.00	**1**	0.30
Bifaces	15	35.71	45	49.45	66	41.25	17	48.57	**143**	43.60
Cores	1	2.38	2	2.20	16	10.00	4	11.43	**23**	7.01
Ground Stones	1	2.38	1	1.10	2	1.25	0	0.00	**4**	1.22
Modified Flakes	8	19.05	12	13.19	16	10.00	6	17.14	**42**	12.80
Debitage	3787	NA	17898	NA	17568	NA	5130	NA	**44383**	NA
Total	**42**		**91**		**160**		**35**		**328**	

slightly above average quantities

moderately above average quantities

slighty below average quantities

moderately below average quantities

*percentage of total component's lithic assemblage, excluding debitage

Table 11.8. Biface to Core Ratio among Siren Site Components

Type of Artifact	Siren Component 1	Siren Component 2	Siren Component 3	Siren Component 4	Siren Component 5	Total
	#	#	#	#	#	
Bifaces	15	4	45	66	17	**143**
Cores	1	1	2	16	4	**23**
Ratio	15:1	4:1	22.5:1	4.13:1	4.25:1	6.21:1

Comparing the biface-to-core ratios to other regional data, a four to one ratio is within reasonable expectations of hunter-gatherers according to North American data compiled by Parry and Kelly (1987) (Table 11.9). The ratios from Components 1 and 3, however, are remarkably high. The high numbers could be a problem of sample size: the one core in Component 1 and two in Component 3 may be a sample bias, but the number of bifaces are reasonably high in both cases, suggesting a differential (in one category, not all) bias if at all.

The ratio of debitage-to-lithic tools may perhaps lend credence to the very high biface-to-core ratios in certain components. However, there are multiple variables that affect this ratio. Occupational redundancy, for one, tends to increase the ratio and contributes to a coarser grained assemblage. Raw material availability is likewise a preponderant influence, but many of the environmental factors remain fairly constant when looking at a single site, indicating differences throughout the components should reflect technological variation. One important

Table 11.9. Comparative Biface:Core Ratio Data from Parry and Kelly (1987)

Archaeological Group	Sedentism/Mobility Pattern	Biface to Core ratio according to Parry and Kelly (1987)
Oaxaca Archaic	Quasi-sedentism	**1.09**
Oaxaca Formative	Sedentism	**0.03**
Black Mesa Archaic	Mobile hunter-gatherers	**5.75**
Black Mesa BMII	Quasi-sedentism	**2.38**
Black Mesa PI	Sedentism	**0.45**
Black Mesa PII	Sedentism	**0.04**
SW Colorado Archaic	Mobile hunter-gatherers	**5.75**
SW Colorado BMII	Early quasi-sedentism	**2.83**
SW Colorado BMIII	Quasi-sedentism	**0.71**
SW Colorado PI	Sedentism	**0.95**
SW Colorado PII	Sedentism	**0.7**
Chaco Preceramic	Quasi-sedentism	**0.8**
Chaco Puebloan	Sedentism	**0.13**
Knife River ND Paleo/EA	Mobile hunter-gatherers	**3.52**
Knife River ND Archaic	Mobile hunter-gatherers	**2.92**
Knife River ND Plains Village	Sedentism	**1.34**

factor is that bifacial reduction yields quite a bit of debitage compared to expedient core-flake production. Along this line, Component 3 yielded the highest ratio of debitage to tools, perhaps correlating with and corroborating the high biface to core ratio in the same component (Table 11.10). Component 1 does not show the same correlation between a high biface-to-core ratio and high debitage-to-tool ratio. Component 4 has the lowest debitage to tool ratio, and it also has the second lowest biface-to-core ratio. There seems to be an intriguing possibility of notably high biface production on the site during the end of the Archaic and first part of the Late Prehistoric, and if true it may be for trade as well as subsistence. Future work will be needed to assess this possibility, but formal late stage bifaces, including Friday, Gahagan, and San Gabriel types, are highly distinctive of these times. And these types made of Edwards chert are found far and wide, including in Caddo burials, contemporaneous with the Austin phase, within the George C. Davis mound site in Cherokee County (Miller 2007, Shafer 2006:22–23, 33).

In interpreting these data, there are several general principles. Regarding variation in frequency of tool categories, while the factors influencing the manufacture, use, curation, and discard of tools are

Table 11.10. Ratio of Debitage to Tools by Component on the Siren Site

Type of Artifact	Siren Component 1	Siren Component 2	Siren Component 3	Siren Component 4	Siren Component 5	Total
	#	#	#	#	#	
Debitage	5615	1670	17898	17568	5130	**47881**
Total # of Lithic Tools	41	5	90	158	35	**329**
Ratio of Debitage to Tools - # of Debitage per Tool	136.95	334.00	198.87	111.19	146.57	**145.53**

widely debated, there are a few general principles that can relate to subsistence strategies, often through the ethnohistorical middle range theory (Binford 1979; Kelly 1988; Odell 1996; Parry and Kelly 1987; Shott 1986). Kelly (1992) provides a detailed overview and synthesis of the relationships between mobility and lithic technology. For the purposes at hand, the more important point is that as mobility increases, formal curated technology increases. Foragers tend towards a more efficient use of raw materials, emphasis on bifaces over cores, more formal tools relative to expedient ones, and comparatively low internal variation within the assemblage. Alternatively, as societies move towards a more collector-like pattern, base camps (which is what we interpret the Siren site to be) become distinguished by high assemblage diversity (many tool categories), internally complex assemblages of many stages that includes caching (forager caching is often done in "locations" near expected use, rather than on base camps), more expedient technology, and relatively high occurrence of broken tools. According to these criteria, the earlier two components show more of a collector strategy based on the lower biface to core ratio, but other criteria (such as assemblage diversity) do not provide strong signatures. Component 4 also provides evidence of caching as revealed by Feature 22, a probable Montell preform cache. Conversely, the later Components 1 and 3 have very high biface to core ratios suggesting more of a forager strategy. The debitage-to-tool ratios perhaps indicate intensive biface reduction during these times.

Defining Subsistence Strategies at the Siren Site

If we assume the Siren site data concur with the hypothetical model presented at the beginning of this chapter, then we would expect the earliest part of the site (about 2600 to 2300 B.P.) to reflect a logistical collector archaeological assemblage with substantial burned rock features, formal site furniture, a high ratio of intra-assemblage lithic variation, wide dietary breadth in the floral and faunal species, relatively more ground stone, possible caches, and a relative abundance of utilizable and non-exhausted raw material and tools. Discard patterns should be generalized with all stages of almost all forms present.

Subsequent to that time, and there is generally considered to be a continuity from Archaic to Late Prehistoric lifeways, the evidence should indicate a shift to a more generalized forager strategy with increased mobility. The archaeological signature at the site should be a significant decrease in the formality and size of burned rock features, a lower intra-assemblage variability of lithic tool categories, slightly narrower diet-breadth, fewer ground stone artifacts, discard patterns marked by a relative increase of late-stage, exhausted tools, and more formal tools. The Siren site supports this model overview only in general terms, but also showing a number of significant developments that contradict the broad trends. A breakdown by component, from earliest to latest, provides more detailed chronological resolution.

Component 5

The time right around 2500 B.P. is emerging as a period of substantial cultural and climatic change. The depositional record on the Siren site, Fort Hood, and elsewhere in eastern Central Texas shows a cessation of landform aggradation, a notable unconformity. Pollen data indicate a maximal advance of grassland settings, and many regional models indicate the long, dry Altithermal finally dissipated at this time (see Chapter 2; Toomey et al. 1993). Johnson and Goode (1994) divide the Late Archaic I and II subperiods here, concurrent with the terminus of Dillehay's (1974) mid-Holocene bison presence period (4200 to 2500 B.P.). Global climatic data indicates pronounced environmental change was not a localized phenomenon, but worldwide.

Component 5 lies upon an apparently short-term stable surface that contributed to accumulation of relatively dense occupational debris, including substantial burned rock features. The Siren site data indicate relatively high investment of labor in burned rock technology (site furniture) and a more diverse tool assemblage with many categories of expedient tool forms reasonably well represented. Formal technology such as scrapers and projectile points are poorly represented relative to more expedient forms such as cores and modified flakes, a signature of collector assemblages. The faunal assemblage reflects a clear emphasis on deer-sized animals, but also show relative diversity in low-ranked taxa such as reptiles, amphibians, birds, and small mammals. Bison are not clearly defined in this component, but the regional record is rather clear that they were exploited on occasion during this time.

Based on these data, the general economic strategy of the area's occupants can be characterized as a logistical collector strategy, consistent with the prevailing model. In a landscape with highly variable distributions of resources, principally between resource-poor uplands and rich riparian zones, populations concentrated in optimal locations on the landscape where game or plant resources could be extensively exploited. It is likely that larger groups occupied base camps for longer periods of time, creating high-visibility sites with large cumulative features. Johnson and Goode (1994:34) note that groups "came to thrive on upland semi-succulents" during this time, and burned rock middens are interpreted as a signature of such exploitation. Though the Siren site does not offer evidence of semi-succulents, the burned rock midden in Component 5 is perhaps evidence of such intensive exploitation. The subsistence strategy would expectedly be broad-based with evidence of intensive processing of low-ranked resources such as vegetal materials.

Component 4

Component 4, from about 2300 to 2200 B.P., appears to be somewhat transitional in many ways, both climatically and culturally, but on the other hand it appears to be a very distinctive, short-lived pinnacle of Plains or Prairie-centered adaptation in the Siren assemblage. If Bousman's pollen data can be interpreted rather precisely, the gradual trend towards more mesic woodland conditions is punctuated by a brief, sharp return of grasslands at approximately this time. Bryant (1966) identified such a phenomenon in the Lower Pecos pollen record, calling the return to aridity the Juno Interval. The Lower Pecos chronology recognizes a corresponding, but "elusive" (Turpin 2004:273) time period around 2300 B.P. distinguished by Shumla points, which appear to occur in association with Castroville, Montell, and bison bones in Bonfire Shelter, Val Verde County (Dibble and Lorrain 1968). On the Siren site, aggradation appears to have resumed, which may account for the nearly eight-fold increase in faunal remains from the prior component, as burial may have fostered better preservation.

In Component 4, there are distinctive changes in burned rock and lithic technology. No evidence of midden use or accumulation is discerned. Burned rock technology is formal and tends to comprise fewer rocks, though relatively large ones. If the single slab-lined Feature 35 is discounted from Component 5, the rocks used in Component 4 are markedly larger than any other timeframe. Accordingly, the Siren site data indicate relatively high investment of labor in burned rock technology (site furniture), but perhaps less evidence of intensive reuse that should result in extensive thermal fracturing. The lithic assemblage is an oddly mixed signature. In both formal and informal tools, some categories are poorly represented, but others are well represented. Projectile points, bifaces, and modified flakes are moderately infrequent, while cores and scrapers are more common. Scrapers, in particular, are prominent, four times more frequent percentage-wise than in the preceding component. The biface-to-core ratio is among the lowest at the site, and the debitage-to-tool ratio is the lowest.

The significance of this lithic assemblage may have something to do with the faunal assemblage. Bison show up in Component 4 and no other. Though a fairly small part of the faunal remains, the bison is a highly ranked resource. In addition to bison, however, the component shows the greatest diet breadth in its faunal remains, though as noted this may be an effect of the comparatively large sample. They were clearly high grading to the extent feasible, but apparently maintained a diverse exploitation. Binford's (1980, 2001) hunter-gatherer settlement model is geared towards responses to the structure of a landscape's resource distribution. Regarding the nature of bison distribution, though a herd animal, there are unknown aspects of their patterning in marginal environments such as the eastern flank of the Edwards Plateau. They may have moved through the area seasonally in dispersed groups or maintained large herds, likely on the prairies to the east of the Siren site. The Espinosa, Olivares, Aguirre expedition of 1709, which explored the vicinity of Austin and Bastrop, is likely one of the best ethnohistorical accounts, and they mention seeing many herds along the Colorado River, while seeing no signs of them to the south and west (Campbell 1988). The assumption that Campbell (1988:68) makes is that the herds were moving north and south annually along the grasslands between central Texas and the woodlands to the east (i.e., along the Blackland and Grand Prairies). If this assumption is true and applicable to the Late Archaic, then we would expect clustered resources on a seasonal basis (i.e., seasonally "patchy" in Binford's [1980:5] terms). Such a distribution, temporally and spatially, would tend to highly favor the forager strategy, but there are many complicating factors in the case at hand.

As Tomka (2001:219) notes, bifacial knives and hafted end scrapers are associated with periods of bison presence in Central Texas during the Late Archaic. The high frequency of scrapers in Component 4 may reflect this correlation, but the overall assemblage does not indicate a highly specialized bison-adapted toolkit like those found in Paleoindian or Toyah collections. It is more generalized, showing a balance between formal and informal tools and cores and bifaces.

Based on these data, the general subsistence strategy is characterized as tending towards a logistical collector strategy, but geared for exploitation of opportunistic high-ranking resources. Evidence of intensive exploitation of plant resources, particularly in burned rock technology, is diminished from the prior time period, though the presence of groundstone indicate continued exploitation of plants. The highly dichotomous landscape between resource-poor uplands and rich riparian zones that distinguished the earlier times appears to have given way to a prairie-centered adaptation focused on large and medium-sized mammal procurement during Component 4 times.

Component 3

From about 2100 to 1900 B.P., by most accounts the climate was wetter, bison disappeared, and the distribution of xerophytic succulents, which are so often cited as the primary resources exploited by burned rock midden technology, receded to the south and west. The strongly heterogeneous ecological patterns of the earlier drier times lessened to create a more equitable distribution of resources across the landscape. Between the riparian corridors and the higher upland areas was "a wide transitional zone composed of both arboreal and prairie elements, the well-watered eastern half of the Edwards Plateau ordinarily furnished plant and animal food resources for a moderately sized human population practicing Archaic hunting and gathering methods" (Johnson and Goode 1994:41). The pollen profile shows a long prominent trend towards increasing woodland settings. While bison decrease, geophytes appear more often in the archaeological record (Acuña 2006).

These people, who carried darts tipped with Ensor, Frio, and Fairland points, were deer hunters. Deer-sized mammals are more common (based on percentage of faunal assemblage) than in any other component, and their diet breadth is narrow compared to the previous times. Small mammals and birds have the lowest representation of all site components. Bison are absent. The site's occupants perhaps had a taste for turtles, though, as turtle remains seem to be inordinately common, though the numbers are still small.

Burned rock technology shows a decreased emphasis on feature formality and labor investment. No large midden-like features are present, and all features are shallow basin-shaped hearths. By weight, the average Component 3 feature is larger than the previous Component 4 feature and composed of substantially more rocks, but much smaller rocks. The precise implications for this difference are not readily apparent.

The lithic assemblage suggests a shift towards a more mobile toolkit of less expedient technology. The ratio of bifaces to cores is by far the highest of any component, though the Austin phase ratio is also moderately high (see below). On a broad scale, the ratio is much higher than in other North American hunter-gatherer assemblages. The debitage-to-tool ratio, a possible indicator of intensive bifacial reduction, is also the highest on the site. Though substantial work needs to be done to address the possibilities, one theory suggested here is that the site's occupants, living on the easternmost margin of a lithic rich region, were producing late stage bifaces such as the San Gabriel biface (similar to the Late Prehistoric Gahagan and Friday bifaces) for trade to the lithic poor regions to the east. A number of studies have suggested influences or macroeconomic spheres oriented towards the Woodlands to the east at this time (Carpenter, Hartnett et al. 2010; Hall 1981; Johnson and Goode 1994). The eastern margin of the Edwards Plateau may have been a focal point of lithic trade.

Foragers often rely on resources that are relatively evenly distributed or seasonally patchy, rather than "clumped." In the case at hand, the encroachment of woodlands may have created a more even distribution of resources relative to earlier xeric times distinguished by resource rich riparian zones and depleted uplands. Based on the data, the record reflects an adaptation resembling more of a Woodland-style faunal exploitation pattern compared to the preceding component (see Jackson and Scott 2002 for description of Woodland patterns).

Component 2

Component 2, as previously said, has extremely low archaeological visibility on the Siren site, and its paucity is likely significant in and of itself. The lack of a prominent component suggests a major shift in settlement or site distribution patterns when considered in light of the relatively continuous occupation evident in prior components. Most regional geomorphological models indicate continuous landform aggradation during this time (e.g., Nordt 1992), and no major depositional discontinuity was discerned on the Siren site. Bousman (1998), however, suggests a distinct change in the geomorphic environment took place sometime between 2125 and 1550 B.P. Bousman's (1998) interpretation of the bog pollen shows a prominent retreat of woodlands after about 1750 B.P., and a return of mesic conditions after 1500 B.P. Others do not see the evidence for this sequence of climatic conditions (Decker et al. 2000:26). Regardless, the eastern cultural influences theorized by Johnson and Goode (1994) for the previous timeframe, are thought to have retreated eastward for the interval between 1800–1600 B.P. and 1200–1000 B.P. (Carpenter, Hartnett et al. 2010; Hall 1981).

In this context, the Siren site data for Component 2 indicate low investment of labor in burned rock technology. Two hearths attributable to the time have the lowest average weight of any component, although the small samples size lessens the validity of any conclusions to be drawn from these data. Four bifaces and a single core, but no other formal or informal tools, were identified in the component. The biface-to-core ratio is consistent with the earlier components, but is clearly not on par with the immediately preceding or succeeding components. The debitage-to-tool ratio is vastly higher than the other components, but the small sample of tools undermines the validity of the ratio.

The faunal assemblage shows the ubiquitous emphasis on medium, deer-sized mammals, but less so than in any other component. Low ranked species such as birds, amphibians and reptiles, constitute nearly 8 percent of the assemblage, roughly four times higher than any other time. But, again, all statistics suffer from low statistical populations and warrant caution in interpretations. Nevertheless, within these limitations, the cumulative data indicate a forager signature with low occupational intensity and broad diet breadth.

Component 1

In many ways, Component 1 appears to be a strong re-emergence of patterns established previously in Component 3. The pollen data show the return of mesic, woodland settings by around 1100 to 1000 B.P., before shifting back to xeric grasslands around 800 to 600 B.P. By most accounts, bison are absent during Component 1 times (Dillehay 1974; Huebner 1991). If the pollen data are correct, the resource structure would reflect a more equitable distribution across the landscape. Landform aggradation continued, and on the eastern part of the Siren site, up to a meter of deposits formed during this time (Peyton et al. 2013), providing clearer stratigraphic resolution than on the western side.

The faunal assemblage shows the lowest diet breadth of any component with deer-sized animals being the focus, but also a relatively significant contribution from small mammals, likely rabbit. Other than one bird bone, the lower ranked faunal resources do not appear in the assemblage. Bison are absent.

Burned rock technology shows a high emphasis on the formality and labor investment. No large midden-like features are present, but two large basin-shaped ovens (Features 1 and 16) are second only to the Component 5 midden (Feature 8) in overall weight. Excavations on the eastern side of the site revealed an apparent Austin phase midden (Peyton et al. 2012), and Black and Creel (1994) show that Late Prehistoric middens are much more prominent than previously understood. The Siren site data shows substantial, formal feature technology, perhaps indicating intensive and/or repetitive occupation of the same site.

The lithic assemblage is distinguished by a high percentage of projectile points and modified flakes, and low percentage bifaces and cores. Though the overall percentage of bifaces is low, the biface-to-core ratio is quite high, nearing the same levels as previously noted in Component 3. As previously discussed, the ratio is much higher than in comparative North American hunter-gatherer assemblages, and a plausible explanation for this may well be intensive biface production of widely distributed Late Prehistoric Friday and Gahagan bifaces for trade to the lithic poor regions to the east. Although bifaces are common, the ratio of debitage to tools is rather low.

Overall, the ecological adaptive patterns show some strong similarities with the earlier Component 3, interpreted as a Woodland-style deer-hunter focused pattern. However, Component 1 shows some important distinctions as well. Burned rock technology suggests significantly more intensive occupation.

Expedient tools are more common, but so are formal tools such as points and bifaces. In part, the Late Prehistoric technology changed, and consequently the archaeological signature is different. The bow and arrow is a more efficient and expendable system, which very likely accounts for the substantial relative increase in projectile points. Additionally, studies show the change from atlatl to bow and arrow result in "a proportional and substantial decrease in amount of bifacial debitage" (Railey 2010:280). This may account for comparatively notable decrease in debitage to tool ratio from Component 3 to Component 1. The faunal assemblage shows a narrower diet breadth with some of the lower ranked species dropping out of the assemblage. That this is an effect of the more efficient bow and arrow technology is an intriguing possibility. Overall, the economic strategy of Component 1 has a somewhat mixed signature that straddles the collector to forager continuum, but likely is more the former.

Summary and Conclusions

The Siren site data shows pronounced diachronic shifts in the long-term subsistence strategies. From 2600 to 2400 years ago, groups maintained a classic Archaic subsistence pattern of relatively intensive exploitation of local resources and likely high occupational redundancy suggestive of fixed territoriality. Subsequently, a shift is evident as high-ranked resources such as bison become better represented in the faunal record, likely occurring between 2300 and 2200 years ago. Several lines of evidence indicate possible Plains-like influences during this time, though there is clearly a continuity in many aspects of the archaeological record from the preceding times.

The following time from about 2100 to 1900 B.P. is one of the more notable shifts in the record, quite possibly marking an Eastern Woodland-like adaptive pattern. The faunal assemblage indicates groups occupying the site on a seasonal basis in the late fall to early winter and intensively harvesting deer. Numerous aspects of the faunal assemblage, such as narrow diet breadth, and archaeological record suggests focused, logistical groups with darts tipped with Ensor, Frio, and Fairland points moved into the margin of the Edwards Plateau to exploit the deer populations. The toolkit and feature technology indicates higher mobility during this time.

Between approximately 1750 and 1250 years ago, the Siren site shows minimal occupational evidence. Based on the site evidence as well as the regional record, this period is inferred to be a period of generalized foraging with relatively low occupational intensity. This time of low archaeological visibility is followed by a prominent resumption of patterns identified almost a millennium before. The patterns in Component 1, from 1100 to 1000 years ago are similar to those established previously in Component 3, but with some notable changes. The faunal assemblage shows a low diet breadth, once again focusing on deer. But rather than logistical groups moving in for a short duration to exploit deer, the Late Prehistoric Austin phase groups appear to have more substantial occupational debris, notably marked by more formal and larger site furniture.

Chapter 12

Metric Discrimination of Projectile Points from 41WM1126

Mary Jo Galindo, Kevin A. Miller, and Stephen M. Carpenter

Introduction

The advent of the bow and arrow, like ceramic production, was among the most significant technological changes in prehistory. The new weaponry had a cascading effect that impacted many aspects of society, including subsistence strategies, mobility and settlement patterns, socio-cultural interaction, and economic structures (Knecht 1997a, b; Shott 1993). Because of such importance, the spatial and temporal spread of the bow technology has long been a paramount research question. However, lacking well-preserved bow or arrow components in the material record of many parts of the world, archaeologists have developed various analyses to infer the spread of bow technology through the investigation of stone projectile points. Central Texas is one region where the timing of the advent of the bow has yet to be clearly determined. Since the Siren site has a relatively consistent, diachronic, and well-dated record spanning the transition from spear-thrower to bow and arrow, the site data provide an apt case study for addressing the issue.

Metrically discriminating between dart and arrow points is one way to approach the technological changes that ushered in the Late Prehistoric period. The advent of bow and arrow technology is thought to have heralded great improvements in overall economic efficiency (Morgan 1974). For instance, the bow and arrow are considered much more efficient than the dart or spear, especially in environments of dense brush or forest, or when stealth is desired (Hall 1980). However, the significance and magnitude of the technological change remains widely debated (Bradbury 1997; Odell 1988, 1996; Patterson 1982, 1992, 1994; Seeman 1992; Shott 1993, 1996, 1997). For example, as opposed to Morgan (1974), Shott (1993) argues that the adoption of the bow did not result in a dramatic increase in hunting efficiency compared to the atlatl. In Central Texas, Johnson and Goode (1994:40) have likewise remarked that the bow did not "greatly" change the cultural dynamics. Nevertheless, these authors recognize the impact of the bow to have been substantial, though how substantial is subject to argument.

To address the issue of spread of this technology, what is missing in the literature is consensus regarding the timing of this technological change. A central point of contention is how rapidly the bow and arrow, once introduced, replaced dart point technology, which had persisted for millennia. Equally contentious is whether or not the two technologies were part of a linear process and overlapped temporally, which would suggest that some small dart point types may have been actually used as large arrow points in a transitional, developmental phase.

This chapter presents the results of the application of a mathematical technique for the discrimination of dart and arrow points as applied to the projectile points recovered at the Siren site. Two popular approaches to discriminating metrically between dart and arrow points are discussed below. Emphasis was given to studying the similarities and differences between the approaches and to identifying the process that represents the best approach for distinguishing between arrows and darts. A discussion of the relevance of this research topic as an avenue of inquiry follows the background information. The investigative strategies and analytical units that were used to apply metric discrimination techniques to the projectile points from the Siren site are then described, followed by a discussion of the study's findings and the utility of the approach.

As noted, the impetus for the analysis was the well-dated, robust projectile point assemblage from the Siren site, containing both arrow and dart points straddling the critical time period when the shift to arrow-based technologies occurred in Texas. With this setting, it was hypothesized that the application of metric discrimination would theoretically elucidate whether the many smaller Archaic point styles (Ensor, Fairland, and Frio mainly) where actually utilized as arrows or are possible transitional forms in the development of bow and arrow technology. If the metric formulas define a high number of darts as arrows, this could indicate that many projectile forms traditionally thought to be darts could actually be arrows or the forerunners of such. The transition of technologies could therefore be more accurately dated and explored.

However, should the metric discrimination divide the assemblage into groups mirroring the traditional, morphology-based typologies, then the analysis would suggest that there was not a gradual transition to bow and arrow at the site or that this slice of time is missing from the site deposits. Rather, such results would suggest that the later Archaic forms of Ensor and Frio are darts and the switch to bow and arrow was likely more abrupt.

Metric Discrimination Background

Determining the exact function of projectile points based on morphological traits has long been a challenge for archaeologists. The task is problematic because stone projectile points may have been used on the end of a spear or arrow shaft, or even as multi-purpose tools such as knives (Christenson 1986; Nassaney and Pyle 1999). However, methods have been developed to attack the problem empirically (Shott 1997; Thomas 1978), despite disagreements along the way about results and interpretations (Bradbury 1997; Fawcett 1998; Patterson 1985). The timing and nature of the introduction of the bow and arrow in North America is the background against which much of the debate centers (Bradbury 1997; Nassaney and Pyle 1999; Odell 1988, 1996; Patterson 1982, 1992; Shott 1993, 1997).

Various Central Texas chronological frameworks address the timing of the first use of the bow and arrow. They generally agree that bow and arrow technologies were introduced across South and Central Texas, between about A.D. 600–800 (Black 1989; Johnson et al. 1962; Johnson and Goode 1994; and Turner et al. 2011). However, Patterson (1985 and 1994) has proposed a much earlier introduction for the bow and arrow along the southeastern Texas coast, based in part on his metric discrimination results.

Patterson (1985) applied metric discrimination techniques developed by David Hurst Thomas (1978) and Knight and Keyser (1983) to a set of projectiles recovered from Southeast Texas. His dataset was a large surface collection from site 41HR182 in Harris County, Texas. Based on his results, Patterson (1985, 1992, 1994) proposed that the use of bow-and-arrow technology in this region of Texas began as the Middle Archaic period was ending about 4000 B.P. and continued through the Late Prehistoric. The arrow points that Patterson identified were unifacial and mainly retouched flakes. He further proposed that the start of the more familiar bifacially worked arrow points in Southeast Texas represents an era characterized by the common use of these tools, rather than the abrupt adoption of the bow and arrow (Patterson 1994). His interpretations have met with skepticism in Texas and elsewhere (e.g., Ricklis 2004; Seeman 1992; Shott 1993, 1997), but are cited by others, such as Nassaney and Pyle (1999), to distinguish between the adoption of an existing technology (diffusion), as they propose happened in Central Arkansas, and the incipient development of the bow and arrow that Patterson's analysis suggests for Southeast Texas (invention/innovation).

The exact method and timing of the introduction of the bow and arrow in North America is a subject rife with debate (see Bradbury 1997; Odell 1988, 1996; Patterson 1982, 1992, 1994; Seeman 1992; Shott 1993, 1996, 1997). Adding to the confusion is that the division between the Archaic and Late Prehistoric time periods has largely been defined by the change between atlatls and bows, suggesting a clear and definable transformation in technology accompanied by a host of other economic and social changes. Until recent years, the generally accepted theory was that bow and arrow technology diffused into the Eastern Woodlands from the north and west at ca. 500 B.C. during the late Middle Woodland or Early Late Woodland periods (Blitz 1988; Nassaney and Pyle 1996; Pyle 1995). Dart and atlatl technology is known to have preceded the use of bows; however, both darts and arrows were still in contemporaneous use in parts of the Southeast at least as late as the 1500s, suggesting that the introduction of arrows was not an abrupt shift which wholly replaced the use of darts in the Eastern Woodlands or elsewhere (Hudson 1976:76, 116; Swanton 1938).

Thus, it appears that the long-held diffusion theory, by itself, is inadequate to fully explain the complex nature of the timing and geographical spread of the adoption of the bow and arrow (Nassaney and Pyle 1999). Instead recent investigations have come to see the process as rooted in "larger social, political, and economic transformations within and among regions" (Nassaney and Pyle 1999:244). Bradbury (1997) focusing on the eastern United States, places emphasis on innovation and concludes that bows were in use by the Late Archaic along with atlatls. He proposes that bow technology was perfected through modification and adjustments to increase its efficiency as a hunting weapon from the Late Archaic to the Late Woodlands periods in the eastern United States. This length of time would allow innovations to improve the technology to the point where it could replace the atlatl (Bradbury 1997).

In Texas, projectile point analysis has traditionally focused on the identification and ordering of stylistically regular point "types" for the purpose of developing regional chronologies and culture histories (Collins 1995; Hester 1995; Prewitt 1981b, 1985; Suhm and Jelks 1962; Suhm et al. 1954; Turner et al. 2011; Weir 1976a,b). This method is somewhat limited in its explanation of the prehistoric record since it does not fully explore the relationships shared and variability observed among projectile points. More recently, archaeologists in Texas have begun to explore the variability among conventionally recognized projectile point types using statistical analyses of their nominal and metrical attributes (Hudler 2003; Mahoney et al. 2002). This materialist approach emphasizes that projectile point variation is best explained through strategies of stone artifact reduction, tool maintenance, and use.

From the Known to the Unknown

In order to explore the differences between darts and arrow points, Thomas (1978) used the dimensions of 142 ethnographic and archaeological examples of dart (n=10) and arrow points (n=132) from collections throughout North America that were preserved in a hafted state. Using the dimensional data, he developed two mathematical equations to discriminate between dart and arrow points. Thomas (1978) concluded that neck width is the single most important discriminator between dart and arrow points and that length is the least important among the four variables considered (length, width, thickness, and neck width). Of the 142 specimens, 20 were incorrectly assigned to a category based on his equations, for an overall accuracy rate of 86 percent. However, the accuracy rate for dart points was 70 percent and reflected three incorrectly assigned specimens. As Thomas (1978:468) himself noted, the 10 dart points represented a "painfully small sample." Nonetheless, his two equations provided investigators a method to classify unknown projectile points as either dart or arrow points with reasonable accuracy. Thomas (1978) cautioned that such classification was subject to regional variation and noted that testing these classifications against independent data was the necessary next step.

His functional equations were computed using an algorithm (Thomas 1978; see also Klecka 1975) as follows:

Dart Point Equation

$$C = 0.118 * (\textit{length}) + 1.205 * (\textit{width}) + 0.392 * (\textit{thickness}) - 0.223 * (\textit{neck width}) - 17.552$$

Arrow Point Equation

$$C = 0.108 * (\textit{length}) + 0.470 * (\textit{width}) + 0.864 * (\textit{thickness}) + 0.214 * (\textit{neck width}) - 7.922$$

The metric dimensions of a projectile point are placed into each of the two equations. The proper category (dart vs. arrow) is indicated by whichever formula produces the higher value for C.

Increasing the Dart Sample

Michael Shott (1997) refined Thomas' discriminate analysis by increasing the size of the dart point sample from 10 to 39 hafted artifacts and, subsequently, increasing the rate of successful classification through the increased sample size as well as by evaluating and eliminating some variables. Shott's (1997:89) analysis only included specimens "if: (1) they were hafted to a shaft or foreshaft; (2) all attributes could be measured; (3) they were undoubtedly authentic; and (4) they were not known to be designed for use in marine hunting." In his analysis and exploration of the metric variables, Shott (1997) systematically reduced the number of significant variables from four (length, shoulder width, thickness, and neck width) to one (shoulder width). Thomas (1978) was not explicit about how he determined width, but Shott utilized a shoulder width dimension as the distance between the outer edges of each shoulder (Figure 12.1).

Shott attained 6.9 percent more accuracy for darts using the four-variable approach; however the overall rate of 86.5 percent represents only a marginal improvement over Thomas' result. Errors in dart point identification were confined to diminutive specimens. One was a partially worked flake rather than a complete biface, while another was obsidian and the smallest in the

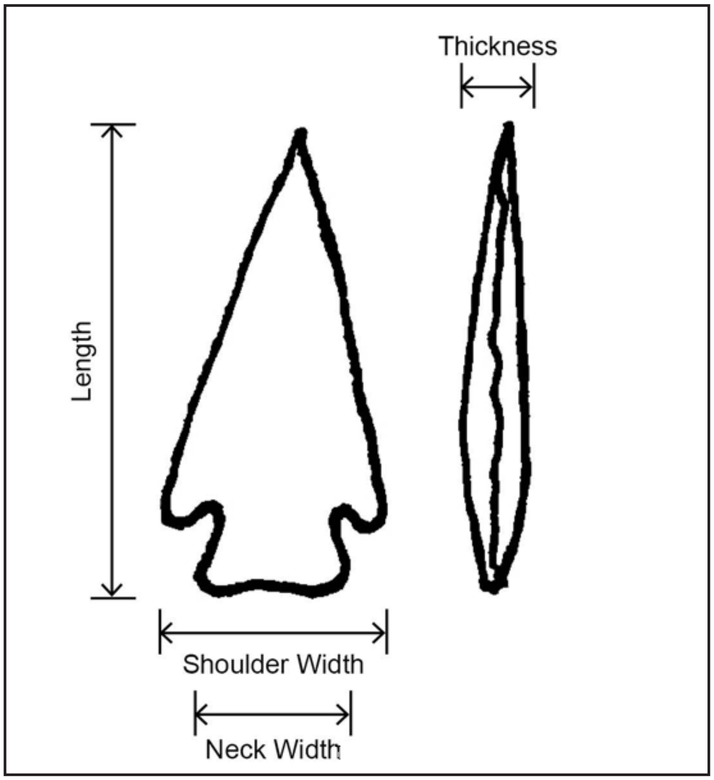


Figure 12.1. Measurements used in the one- through four-variable formulas.

sample. There were other attributes of the obsidian dart point from Peru, including a main shaft composed of reed (more common in arrows than darts), that implied continuities between dart and arrow technologies.

Shott's four-variable functional equations (1997; see also Norusis 1993) are as follows:

Dart Point Equation

C = 0.18 * (*length*) + 0.87 * (*shoulder width*) + 0.72 * (*thickness*) + 0.21 * (*neck width*) - 18.79

Arrow Point Equation

C = 0.07 * (*length*) + 0.49 * (*shoulder width*) + 1.28 * (*thickness*) + 0.14 * (*neck width*) - 8.60

Shott (1997) then removed length from the set of metric variables, citing its susceptibility to alteration by resharpening or from damage through use. He also removed two outliers identified by the four-variable approach from the arrow point category. The removal of outliers, a specimen that is markedly different in value from the others of the sample such as a heavily reworked dart point, reduced skewness in the analysis. In this three-variable approach, Shott identified shoulder width as the strongest contributor to results, followed distantly by neck width and thickness. Using the three-variable approach, Shott achieved an overall accuracy of 89.3 percent, with arrow points being correctly classified 90.8 percent of the time. The accuracy rate for determining dart points increased to 84.6 percent, a marked improvement over Thomas' (1978) 70 percent.

His three-variable functional equations (Shott 1997; see also Norusis 1993) are as follows:

Dart Point Equation

C =1.24 * (*shoulder width*) + 1.94 * (*thickness*) + 0.38 * (*neck width*) - 22.70

Arrow Point Equation

C = 0.69 * (*shoulder width*) + 2.05 * (*thickness*) + 0.19 * (*neck width*) - 10.70

Seeking to further improve the accuracy of the formula, Shott (1997) next eliminated neck width as a variable with a two-variable approach. Although not usually affected by resharpening, wear, or damage, neck width can be problematic when considering unnotched projectile points. Retaining only shoulder width and thickness, two additional arrow points were incorrectly classified. Results obtained for dart point identification remained unchanged at 84.6 percent, and the two-variable approach was found to produce no measurable improvement over the three-variable approach; in fact, overall accuracy fell by 1.1 percent.

Shott's two-variable functional equations (1997; see also Norusis 1993) are as follows:

Dart Point Equation

C =1.42 * (*shoulder width*) + 2.16 * (*thickness*) - 22.50

Arrow Point Equation

C = 0.79 * (*shoulder width*) + 2.17 * (*thickness*) - 10.60

Eliminating thickness, Shott's (1997) one-variable discriminate analysis focused on shoulder width as the most reliable discriminator between dart and arrow point. The accuracy of the results was identical to the results of Shott's three-variable analysis and comparable to Thomas' (1978) overall rate. Using one variable, Shott achieved an overall accuracy rate of

89.3 percent, with dart points being correctly classified 84.6 percent of the time.

Ultimately, one- and two-variable solutions were found to exceed the successful classification rate of a four-variable solution. The one- and two-variable approaches are applicable to a wider range of archaeological specimens, including those that have been resharpened or damaged during use, such as proximal specimens missing the distal blade. Shott's one-variable functional equations (1997; see also Norusis 1993) are as follows:

Dart Point Equation

C =1.40 * (*shoulder width*) - 16.85

Arrow Point Equation

C = 0.89 * (*shoulder width*) - 7.22

Application of the Methods – Leland Patterson's Lithic Studies in Texas

Although the mathematical techniques developed by Thomas (1978) and refined by Shott (1997) have been applied in various contexts in the United States (Bettinger and Eerkens 1999; Bradbury 1997; Christenson 1986, Fawcett 1998; Nassaney and Pyle 1999; Odell 1988, 1996), there exists only one example of the metric discrimination technique being applied in Texas. For his discriminate analysis, Patterson (1985, 1992) used 124 projectile points that he collected on the surface of 41HR182 in Harris County, Texas (Table12.1). The site has an assemblage of projectile points collected from the surface spanning the Late Paleoindian through the Late Prehistoric periods.

The majority of his sample was classified as Gary or Gary-like (n=67). Patterson focused on identifying unifacial arrow points (retouched flakes) that dated to the Middle Archaic period. Based in part on his metric discrimination results, Patterson (1985 and 1994) has proposed a much earlier introduction for the bow and arrow along the southeastern Texas coast (2000 B.C.). Patterson's (1985:85) study determined that, in general, arrow points are less than 5 mm in thickness, less than 2 g in weight, and have necks narrower than 9 mm.

Patterson used two discriminate functions, one based on thickness (mm), neck width (mm), and weight in grams, the other based only on thickness and neck width:

Patterson Formula 1:

DF = 2.382 * (*thickness*) + 1.678 * (*neck width*) + 27.744 log (*weight*)

Patterson Formula 2:

DF = 2.245 * (*thickness*) + 1.593 * (*neck width*)

Besides his utilization of metric discrimination to distinguish darts from arrows, Patterson's studies (1985, 1992) have resulted in numerous hypotheses including: (1) the bow and arrow diffused southward from the Artic into North America 4-5000 b.p.; (2) initial diffusion was with unifacial points, with later standardization of bifacial forms; (3) in many areas, the bow and arrow did not immediately replace the spear-thrower system; (4) diffusion of the bow and arrow technology was not at an even rate; and (5) bow and arrow made important economic contributions in the Late Archaic and Early Ceramic/Early Woodland time periods. As is illustrated below, the analysis conducted for the Siren site, although it followed some of the same methodology of Patterson, is distinct because it focuses on the transition from Archaic to Late Prehistoric periods when the transition from dart to arrow points is commonly believed to have occurred in Central Texas. Importantly, the assemblage from the Siren site differs contextually from Patterson's in that the projectile

Table 12.1. Types of Projectile Points Used in Patterson's (1985) Study

Projectile Point Type	Quantity
Gary	52
Gary-like	15
Kent	14
Kent-like	4
Perdiz	14
Catahoula	6
Yarbrough	5
Ellis	1
Ellis-like	4
Darl	2
Darl-like	2
Scallorn	2
Alba	1
Elam-like	1
Untyped	1
Total	**124**

points were recovered from systematic excavations with stratigraphic and chronological controls during testing and data recovery. Patterson's assemblage was strictly surficial, with relative dating from diagnostic projectiles spanning the Late Paleoindian through the Late Prehistoric only.

Siren Site Data Set

The Siren site data set includes all projectile points recovered from the testing and data recovery investigations. These artifacts consist of 273 Archaic and Late Prehistoric projectile points classified as Bulverde, Castroville, Darl, Edgewood, Edwards, Ellis, Ensor, Fairland, Frio, Frio/Ensor, Lange, Marcos, Marshall, Montell, Morrill, Pedernales, Scallorn, and those not typed (Table 12.2). As a note on terminology, the "Transitional Archaic" is used in this chapter to designate the temporal affiliation of certain point types as defined in Turner et al. (2011). While the temporal division is not used throughout much of this report, it is employed here for the sake of objectively, namely to use an independent source as the basis of chronology rather than imposing the temporal framework adopted herein.

Table 12.2. Siren Site Projectile Point Types

Type	Quantity	% of total	Time period
Bulverde	2	0.73	Early Archaic
Castroville	16	5.86	Late Archaic
Darl	3	1.10	Transitional Archaic
Edgewood	4	1.47	Transitional Archaic
Edwards	1	0.37	Late Prehistoric
Ellis	3	1.10	Middle to Transitional Archaic
Ensor	72	26.37	Transitional Archaic
Fairland	32	11.72	Transitional Archaic
Frio	35	12.82	Transitional Archaic
Frio/Ensor	8	2.93	Transitional Archaic
Lange	2	0.73	Late Archaic
Marcos	6	2.20	Late to Transitional Archaic
Marshall	6	2.20	Middle Archaic
Montell	2	0.73	Late to Transitional Archaic
Morrill	4	1.47	Early to Middle Archaic
Pedernales	5	1.83	Middle Archaic
Scallorn	13	4.76	Late Prehistoric
Untyped	59	21.61	Unknown
Total	**273**	**100.00**	

Of the 273 recovered artifacts, a total of 203 of the diagnostic projectile points are associated with the Transitional Archaic period. The remaining diagnostic point assemblage includes 20 Late Archaic projectile points, eight Late to Transitional Archaic, three Middle to Transitional Archaic, 11 Middle Archaic, four Early to Middle Archaic, 23 from the Late Prehistoric period, and one unknown (Table 12.3).

Of the 273 projectile points recovered during the Siren site investigations, 149 of these artifacts contained sufficient quantifiable attributes to permit measurement for this study. These 149 projectile points compose the dataset for the metric discrimination analysis. Typed and untyped projectile points were included in the metric discrimination analysis depending on the types of measurements available. Of these 149 points, 105 are from the Transitional Archaic, 14 are Late Prehistoric, 13 are Late Archaic, seven are Middle Archaic, three are Early to Middle Archaic, three are Middle to Transitional Archaic, and four are from the Late to Transitional Archaic (Table 12.4). Thus, 70 percent of the 149 points utilized in the study are from the Archaic, and nine percent are from the Late Prehistoric. In contrast, the Middle Archaic composes five percent, the Late Archaic composes three percent, the Middle to Late Archaic composes two percent, and the Early to Middle Archaic composes two percent.

Investigative Strategies

The analysis of the 41WM1126 projectile point assemblage utilized both traditional typological analyses and the application of the metric discrimination technique. The study conducted for the Siren site followed Shott's (1997) methodology. Although Shott (1997) demonstrated that one- and two-variable solutions exceed the successful classification rate of the four-variable solution, he also illustrated the utility of the four-variable approach to identify outliers. Identifying and removing outliers is important because they can skew the results of the study. Also, the assumption of multivariate normality is validated for arrow variables, except shoulder width, only when outliers are removed (Shott 1997:91). Accordingly, SWCA's approach included two basic stages, the exploration and

Table 12.3. Siren Site Projectile Points by Time Period

Quantity	% of total	Time Period
203	74.36	Transitional Archaic
23	8.42	Late Prehistoric
20	7.33	Late Archaic
11	4.03	Middle Archaic
8	2.93	Late to Transitional Archaic
4	1.47	Early to Middle Archaic
3	1.10	Middle to Transitional Archaic
1	0.37	Untyped
273	**100.00**	

elimination of obvious outliers followed by the application of the metric discrimination formulas.

We recorded the length, neck width, shoulder width and thickness values for each projectile point in the Siren site assemblage and were able to apply the four-variable equation to 85 of the 149 possible specimens. However, if a point was damaged through breakage or notably reduced through resharpening, length could not be measured and the three-variable equation was applied. For 85 specimens, three attributes were measurable. Shott's (1997) three- and four-variable equations were used to identify outliers, while the one- and two-variable equations were used to metrically discriminate between dart and arrow points. The two-variable formula increased the data set by two to a total of 87 specimens, while the one-variable formula was applicable to 149 specimens.

Following typological designations, nominal (qualitative) and metrical (quantitative) attributes were recorded for each point specimen and entered into a database. Recorded nominal attributes included information such as cortex, raw material type, color, patination, evidence of heat treatment, and breakage. Metrical attributes recorded for each specimen were similar to those measured by Hudler (2003) and included variables such as blade and stem dimensions in millimeters (maximum length, width, and thickness), haft length, base depth, base width, and neck width.

Table 12.4. Projectile Points Used in the Siren Study

Quantity	% of total	Time Period
105	70.47	Transitional Archaic
13	8.72	Late Archaic
14	9.40	Late Prehistoric
7	4.70	Middle Archaic
4	2.68	Late to Transitional Archaic
3	2.01	Middle to Transitional Archaic
3	2.01	Early to Middle Archaic
149	100.00	

Results

Shott Approach

As previously stated, Shott's (1997) results showed that the three- and four-variable formulas were most useful for identifying outliers; he was able to gauge the success rate of the formulas and identify outliers because he was working with a set of museum artifacts for which it was known whether they were hafted as arrows or darts. This was not the case with the Siren data set, as darts and arrows could not be accurately and clearly defined prior to the study. Thus, following Shott (1997:Figure 3c), a two variable, simplistic approach was used with a chart plotting maximum thickness versus shoulder width was developed. This chart was used to identify outliers and preliminarily discriminate between arrows and darts using Shott's arbitrary cutoff of 20 mm for shoulder width (Figure 12.2). Above this threshold points are identified as darts, and points are identified as arrows when they fall below it.

The exercise identified a set of Castroville points (Lots 27, 1874, 1778.1, 1064, 976.2, and 1203) and the following outliers: Lots 216, 1128.4, 308, 901, and 579 (Figures 12.3 and 12.4). Of the five outliers identified, Lot 901 is a heavily reworked Pedernales point, while the thickness and flaking patterns of Lots 1128.4 and 579 indicate they are preforms rather than finished projectiles. Based on their morphology, the remaining artifacts in the outlier category (Lots 216 and 308) may have been used as knives instead of as projectile points. However, use wear analysis would be needed to confirm this hypothesis. Unfortunately, such studies are beyond the scope of this analysis.

Of the 87 projectile points included, 18 were classified as arrows (n=18) by maximum thickness versus shoulder width. These were then compared to those from the one- to four-variable formulas (Table 12.5). For complete comparison results see Appendix J, Table J.1. Based on the comparison, it would appear that

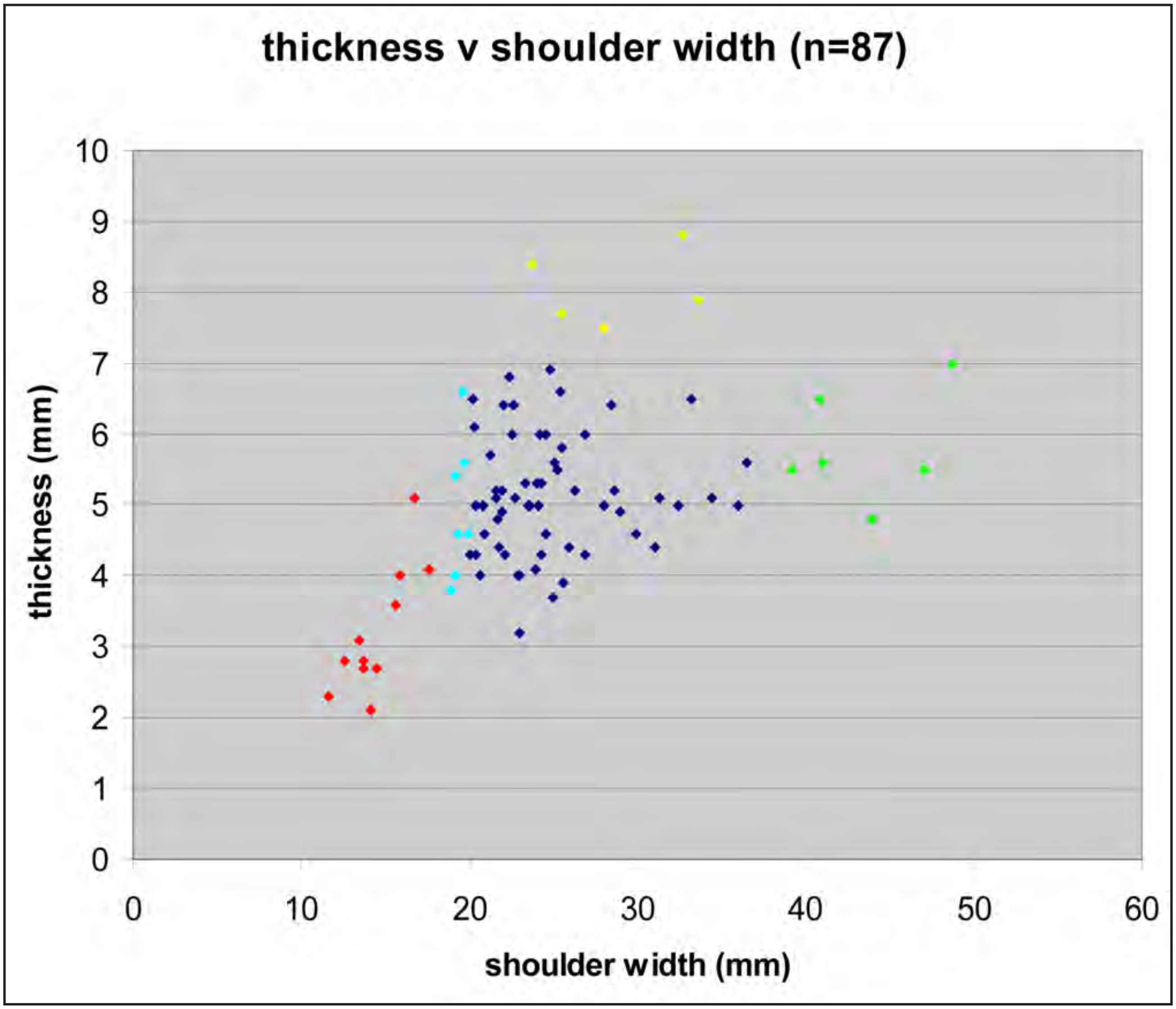


Figure 12.2. Maximum thickness versus shoulder width. Red represents arrows, light blue represents the specimens on the dividing line, dark blue represents darts, yellow represents outliers, and green represents Castroville points.

the cutoff between darts and arrows for the Siren site assemblage is 18.9 mm shoulder width (arrows have narrower shoulders, while darts have a shoulder width equal to or greater than 18.9 mm). Seven specimens classified as arrows by the maximum-thickness-versus-shoulder-width method that are actually classified as darts by other methods include Lots 1, 6, 127, 1077.5, 1957, 1168.3, and 1262 (Figure 12.5).

Following this exercise and using the formulas developed by Shott (1997), the appropriate measurements of the projectile points from the Siren site were inserted and the results were evaluated. In each stage the resulting value of C for each artifact was compared. The higher value was utilized to classify the artifact as an arrow or a dart (Tables 12.6 through 12.9). For complete results see Appendix J, Tables J.2–J.5.

As illustrated by Tables 12.6 through 12.9, 85 of the 273 projectile points had enough metric information to be inserted into the four- and three-variable formulas. Twelve artifacts were classified as arrows using the four-variable formulas (Lots 75.1, 60, 13.1, 127, 2028, 2043, 2089.1, 1077.5, 771, 1164.4, 958.2, and 1970.1). Four of these had been previously categorized as darts, identified as Frio (Lot 958.2), Transitional Archaic untyped (Lot 771), Edgewood (Lot 127), or Fairland (Lot 1077.5) points.

Eight artifacts were classified as arrows using the three-variable formula (Lots 75.1, 60, 13.1, 2028, 2043,

Figure 12.3. Castroville projectile points: a) Lot # 27, b) Lot # 1778.1, c) Lot # 1064, d) Lot # 1874, e) Lot # 976.2, f) Lot # 1203.

2089.1, 1164.4, and 1970.1). Of these, one, identified as a Frio (Lot 958.2) point, had been previously categorized as a dart.

The two-variable formula accommodated 87 of the 273 projectile points and classified 12 artifacts as arrows (Lots 1, 75.1, 60, 13.1, 167, 2028, 2043, 2089.1, 771, 1164.4, 958.2, and 1970.1). Of these, three had been previously identified as darts from the Transitional Archaic untyped (Lot 771), Ensor (Lot 1), or Frio (Lot 958.2) traditions.

The one-variable formula increased the available data set to 149 out of the total 273 projectile points and classified 19 artifacts as arrows (Lots 45, 75.1, 60, 107.1, 13.1, 126, 167, 2028, 2043, 1961, 2089.1, 2089.2, 2103, 771, 403.6, 448.2, 1164.4, 958.2, and 1970.1). Of these, five had been previously identified as darts, including an untyped Transitional Archaic (Lot 771), Ensor (Lots 107.1 and 126), and Frio (Lots 448.2 and 958.2) (Figure 12.6). Among the 19 artifacts classified as arrows by the one-variable formula are 11 that are classified as arrows by the two- or four-variable formulas. The eight additional arrows identified by the one-variable formulas include Lots 45, 107.1, 126, 1961, 2089.2, 2103, 403.6, and 448.2.

To summarize, eight projectile points that had previously been typed by morphology as darts were identified as arrows through the application of the four metric discrimination formulas. Five of the 12 projectile points identified by the four-variable formulas as arrows had been previously assigned to the Ensor, Frio, Edgewood, or Fairland styles, or were previously untyped (refer to highlighted lines in Table 12.5). Of these, Lot 958.2 was also classified as an arrow by each of the three other sets of formulas, even though it had been typed as Frio. The untyped point of the five, Lot 771, was classified as an arrow by the four-, two-, and one- variable formulas. The remaining two points classified as arrows by the four-variable formulas (Lots 127 and 1077.5) are darts according to the other three formulas. The same is true for Lots 1 (classified as an arrow by the two-variable formulas) and for Lots 107.1, 11, and 448.2, which were classified as arrows by the one-variable formulas.

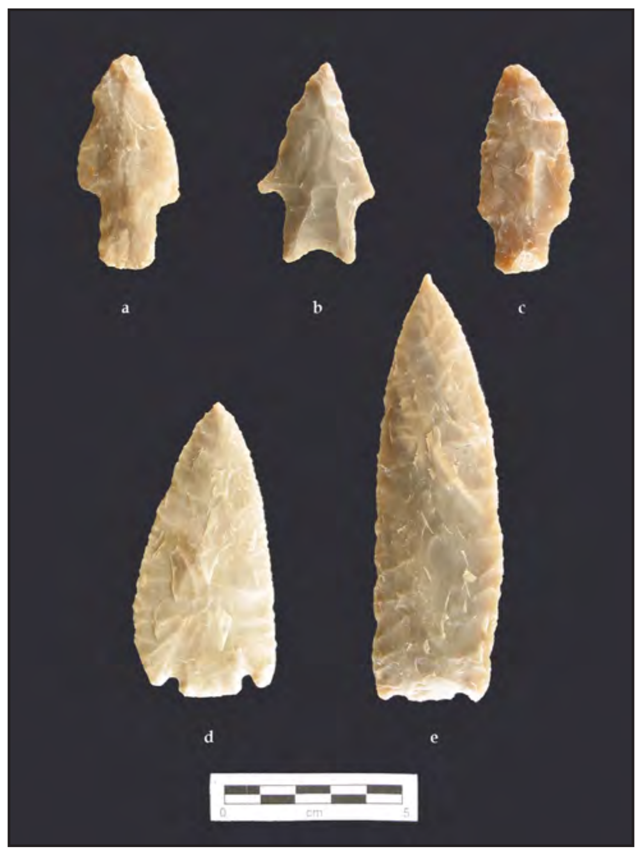


Figure 12.4. Outliers identified by comparing thickness to shoulder width: a) Lot # 579, b) Lot # 901, c) Lot # 1128.4, d) Lot # 216, e) Lot # 308.

Table 12.5. Comparison of Results of All Five Determinations of Arrows

Lot No.	UI No.	Subcategory	Max Shoulder Width (mm)	Medial Blade Thickness (mm)	Arrow according to TH v W	Arrow according to 4V formula?	Arrow according to 3V formula?	Arrow according to 2V formula?	Arrow according to 1V formula?
1970.1	328	Scallorn	11.6	2.3	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
75.1	7	Scallorn	12.6	2.8	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
13.1	39	Scallorn	13.4	3.1	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
167	54	Untyped Arrow	13.7	2.8	**Yes**	No	No	**Yes**	**Yes**
2028	68	Scallorn	13.7	2.7	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
2043	73	Edwards	14.1	2.1	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
2089.1	90	Scallorn	14.5	2.7	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
1164.4	326	Untyped Arrow	15.6	3.6	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
60	14	Untyped Arrow	15.9	4.0	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
958.2	327	Frio	16.7	5.1	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
771	184	TA Untyped	17.6	4.1	**Yes**	**Yes**	No	**Yes**	**Yes**
1	2	Ensor	18.9	3.8	**Yes**	No	No	**Yes**	No
6	26	Ensor	19.2	4.0	**Yes**	No	No	No	No
1077.5	176	Edgewood	19.2	5.4	**Yes**	**Yes**	No	No	No
127	47	Edgewood	19.3	4.6	**Yes**	**Yes**	No	No	No
1262	224	Ensor	19.6	6.6	**Yes**	No	No	No	No
1957	186	Ensor	19.7	5.6	**Yes**	No	No	No	No
1168.3	194	Frio/Ensor	19.9	4.6	**Yes**	No	No	No	No

Highlighted row indicates specimen designated as an outlier; TA=Transitional Archaic

Thus, a comparison between the typology assigned based on physical attributes and the classification from the metric discrimination formulas reveals only minor conflicts as two projectile points (Lots 771 and 958.2) were consistently classified as arrows by metrics but were originally typed as darts. Six others were identified as arrows but by only one of the four sets of formulas (Lots 1, 107.1, 126, 127, 1077.5, and 448.2).

Based strictly on the metric results, the Siren site assemblage appears to contain examples of projectile points that could have been used as either dart or arrow points. The best candidates are the two points (Lots 771 and 958.2) that were classified as arrows by three or four sets of formulas. Unfortunately, once these are examined closely, it is very apparent that their diminutive size is due to heavy reworking/resharpening (Figure 12.6q and s). It therefore seems unlikely that these were actual arrow points and are more properly categorized as heavily used Ensor dart points.

Patterson Approach

Having presented the classification results using Shott's formulas, we now turn to the lone application of a variation of this technique to projectile points from Texas for comparison. Patterson's formulas were applied to 85 of the 149 Siren site projectile points (specimens for which the requisite data was measurable), and each formula classified nine artifacts as arrow points (Table 12.10). For complete results see Appendix J, Table J.6. Comparing the results, the two formulas had seven specimens in common: Lots 75.1, 60, 13.1, 2028, 2043, 1164.4, and 1970.1 (see Figure 12.6d, e, f, j, k, l, and p). Patterson's first formula also classified Lot 958.2 (see Figure 12.6q) as an arrow, while his second formula similarly defined Lot 6 (Figure 12.5b).

Interestingly, one of the two best possible "arrow" candidates from Shott's formulas (Lot 958.2) is also classified by Patterson's formulas as arrows, but the other, Lot 771 is not. Similarly, the other eight points classified by Patterson's formulas as arrows were darts according to Shott's.

Conclusion

The discriminatory analyses of the Siren site assemblage indicate that only a few projectile points—specimens

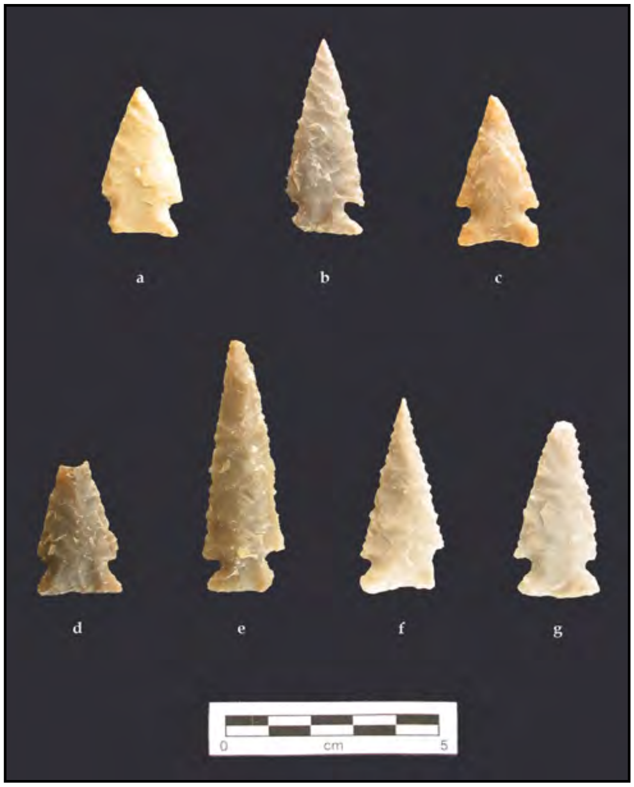


Figure 12.5. Select projectile points classified as arrows by comparing thickness to shoulder width: a) Lot # 1, b) Lot # 6, c) Lot # 127, d) Lot # 1077.5, e) Lot # 1262, f) Lot # 1168.3, g) Lot # 1957.

that by conventional classificatory methods using morphology and manufacturing characteristics would be considered dart points—fall within the quantifiable parameters of arrow points. And each of these specimens have contextual or morphological issues. Notably, the points in question all derive from types (Ensor, Fairland, Frio, and Edgewood) that have temporal distributions that overlap or just precede the commonly recognized dates for the advent of the bow and arrow. None of the earlier points from the Siren site, such as Middle Archaic types, had scores that would place them within the arrow point range. These results suggest several trends and possibilities.

As commonly noted, there is an evident diminution of projectile point size at the Archaic to Late Prehistoric transition. Whether this was a gradual process or represents the introduction of smaller forms is beyond the scope of this inquiry; nonetheless, dart points become smaller, seemingly blending into the dimensions of the later arrow points. This trend does not preclude the possibility that arrow technology may have been initially adopted through diffusion, but many researchers believe it most strongly supports the theory that arrow use developed endemically from dart point technology over a long period of time. Authors have noted the morphological similarity between the earliest bifacial arrow point, Edwards, and late dart points like the Ensor-Frio-Fairland-Edgewood continuum. While this analysis only involves one assemblage from one site, the application of the metric discrimination to the Siren site projectile points appears to refute this idea of a long, gradual evolutionary development of arrows from darts in Central Texas. Rather, the analysis suggests either: 1) ala punctuated equilibrium, a rapid development of darts into arrows over the short slice of time (~500 years) missing from the site's chronology; or 2) arrow technology was introduced through fairly rapid diffusion mechanisms over the same time period. This introduction of new technology may have come from the plains to the north or woodlands to the east, spurred by warfare, shifting subsistence patterns, or other factors.

At best, Thomas's and Shott's analyses yielded a 70 to 89 percent accuracy rate respectively. Of the core sample of 85 Siren site points that could be addressed with the four-variable formula, the known margin of error in the analytical approach would eclipse any specimens that were classified as arrow points contrary to conventional classification as darts. There is quite a bit of metric variation within and among projectile point classes, and this variation obscures discrete class demarcations. Overall, the analysis of the Siren site points does not provide evidence to counter the prevailing temporal placement of the introduction of the bow and arrow in Central Texas at circa 1250 B.P., commonly cited as the advent of the Late Prehistoric period.

While dates associated with the two primary dart specimens that were identified as arrow points (Lots 771 and 958.2) range between 2730–2360 B.P., the identification of only two specimens among the assemblage does not provide sufficient evidence to conclusively state that introduction of the bow and arrow occurred at that date.

Finally, as noted above, an important caveat to the conclusions is that the radiocarbon dates from the site indicate an occupational hiatus at the site between 1250–1550 B.P. (see Chapter 9), so it is possible that the transition to bows and arrows may lie at that interval. If so, the evidence for the transition may simply be missing from the site.

Table 12.6. Partial Results of the Four-Variable Formula Applied to the Siren Site Projectile Points (n=85)

Lot No.	UI No.	Subcategory	Max Length (mm)	Max Shoulder Width (mm)	Medial Blade Thickness (mm)	Neck Width (mm)	four variable equation DARTS	four variable equation ARROWS	Classification
1970.1	328	Scallorn	22.3	11.6	2.3	5.8	-1.81	2.40	ARROW
2089.1	90	Scallorn	22.1	14.5	2.7	5.6	0.92	4.29	ARROW
2043	73	Edwards	36.4	14.1	2.1	6.0	2.80	4.39	ARROW
2028	68	Scallorn	28.1	13.7	2.7	7.5	1.71	4.59	ARROW
13.1	39	Scallorn	27.8	13.4	3.1	5.4	1.24	4.64	ARROW
75.1	7	Scallorn	51.2	12.6	2.8	5.6	4.58	5.53	ARROW
1164.4	326	Untyped Arrow	38.2	15.6	3.6	12.2	6.81	8.03	ARROW
60	14	Untyped Arrow	36.9	15.9	4.0	9.8	6.62	8.27	ARROW
771	184	TA Untyped	25.3	17.6	4.1	15.8	7.35	9.26	ARROW
958.2	327	Frio	26.7	16.7	5.1	12.4	6.82	9.72	ARROW
1	2	Ensor	38.1	18.9	3.8	13.6	10.10	10.10	DART
6	26	Ensor	49.4	19.2	4.0	10.8	11.95	10.90	DART
127	47	Edgewood	38.2	19.3	4.6	12.6	10.84	11.18	ARROW
1659	122	Frio/Ensor	37.0	20.4	4.3	12.6	11.36	11.25	DART
1069.1	329	Frio/Ensor	41.3	20.6	4.0	13.4	12.26	11.38	DART
761	150	Frio	46.6	20.0	4.3	12.1	12.64	11.66	DART
447	265	Fairland	41.2	23.0	3.2	16.9	14.49	12.02	DART
1892	71	Untyped	31.1	22.9	4.0	15.3	12.82	12.06	DART
1168.3	194	Frio/Ensor	48.3	19.9	4.6	14.5	13.57	12.45	DART
12.1	28	Frio	45.2	20.4	5.0	11.9	13.19	12.63	DART
1077.5	176	Edgewood	42.0	19.2	5.4	14.3	12.37	12.66	ARROW
753	166	Ensor	40.6	22.1	4.3	15.0	13.99	12.68	DART

Highlighted row indicates specimen typed as a dart but discriminated as an arrow; TA=Transitional Archaic

Summary

Determining the function of lithic tools has long been a challenge for archaeologists, but recent methodological refinements have been developed to attack the problem empirically (Shott 1997). This chapter presented the results of a metric technique to discriminate between dart and arrow points at the Siren site. The various Central Texas chronological frameworks generally agree that bow and arrow technologies became prevalant across South and Central Texas, between about 1350–1150 B.P. However, Patterson (1985 and 1994) has proposed a much earlier introduction for the bow and arrow (primarily unifacial flake arrows) along the southeastern Texas coast, based in part on his metric discrimination results. Patterson's conclusions have been criticized in part for not taking into account the marginal quality of the raw materials available to projectile point manufacturers in southeastern Texas. Conversely, Siren site residents would have had ample supplies of quality chert. The assemblage from the Siren site also dramatically differs from Patterson's in terms of context and quality. Patterson's work utilized a strictly surficial assemblage, spanning 7000 years of occupation, with no absolute dating. Assemblages of this type are rife with interpretative and associative concerns. In contrast, the Siren site projectile points were recovered from solid, datable contexts during testing and data recovery excavations. Just as importantly, the Siren assemblage includes multiple examples of provenienced points from isolable later Archaic components that have numerous smaller point styles (Ensor, Frio, Fairland, etc.) which have often been thought to be transitional forms in the development of bow and arrow technology.

The advent of bow and arrow technology is thought to have heralded improvements in overall economic

Table 12.7. Partial Results of the Three-Variable Formula Applied to the Siren Site Projectile Points (n=85)

Lot No.	UI No.	Subcategory	Max Length (mm)	Max Shoulder Width (mm)	Medial Blade Thickness (mm)	Neck Width (mm)	three variable equation DARTS	three variable equation ARROWS	Classification
1970.1	328	Scallorn	22.3	11.6	2.3	5.8	-1.65	3.12	ARROW
2043	73	Edwards	36.4	14.1	2.1	6.0	1.14	4.47	ARROW
75.1	7	Scallorn	51.2	12.6	2.8	5.6	0.48	4.80	ARROW
2028	68	Scallorn	28.1	13.7	2.7	7.5	2.38	5.71	ARROW
2089.1	90	Scallorn	22.1	14.5	2.7	5.6	2.65	5.90	ARROW
13.1	39	Scallorn	27.8	13.4	3.1	5.4	1.98	5.93	ARROW
1164.4	326	Untyped Arrow	38.2	15.6	3.6	12.2	8.26	9.76	ARROW
60	14	Untyped Arrow	36.9	15.9	4.0	9.8	8.5	10.33	ARROW
1	2	Ensor	38.1	18.9	3.8	13.6	13.28	12.72	DART
6	26	Ensor	49.4	19.2	4.0	10.8	12.97	12.8	DART
771	184	TA Untyped	25.3	17.6	4.1	15.8	13.08	12.85	DART
958.2	327	Frio	26.7	16.7	5.1	12.4	12.61	13.63	ARROW
761	150	Frio	46.6	20.0	4.3	12.1	15.04	14.21	DART

Highlighted row indicates specimen typed as a dart but discriminated as an arrow; TA=Transitional Archaic

Table 12.8. Partial Results of the Two-Variable Formula Applied to the Siren Site Projectile Points (n=87)

Lot No.	UI No.	Subcategory	Max Shoulder Width (mm)	Medial Blade Thickness (mm)	two variable equation DARTS	two variable equation ARROWS	Classification
1970.1	328	Scallorn	11.6	2.3	-1.06	3.56	ARROW
2043	73	Edwards	14.1	2.1	2.06	5.10	ARROW
75.1	7	Scallorn	12.6	2.8	1.44	5.43	ARROW
2028	68	Scallorn	13.7	2.7	2.79	6.08	ARROW
167	54	Untyped Arrow	13.7	2.8	3.00	6.30	ARROW
13.1	39	Scallorn	13.4	3.1	3.22	6.71	ARROW
2089.1	90	Scallorn	14.5	2.7	3.92	6.71	ARROW
1164.4	326	Untyped Arrow	15.6	3.6	7.43	9.54	ARROW
60	14	Untyped Arrow	15.9	4.0	8.72	10.64	ARROW
771	184	TA Untyped	17.6	4.1	11.35	12.20	ARROW
1	2	Ensor	18.9	3.8	12.55	12.58	ARROW
6	26	Ensor	19.2	4.0	13.40	13.25	DART
958.2	327	Frio	16.7	5.1	12.23	13.66	ARROW
1069.1	329	Frio/Ensor	20.6	4.0	15.39	14.35	DART

Highlighted row indicates specimen typed as a dart but discriminated as an arrow; TA=Transitional Archaic

Table 12.9. Partial Results of the One-Variable Formula Applied to the Siren Site Projectile Points (n=149)

Lot No.	UI No.	Subcategory	Max Shoulder Width (mm)	one variable equation DARTS	one variable equation ARROWS	Classification
1970.1	328	Scallorn	11.6	-0.61	3.10	ARROW
2089.2	91	Scallorn	12.4	0.51	3.82	ARROW
75.1	7	Scallorn	12.6	0.79	3.99	ARROW
403.6	214	Scallorn	13.3	1.77	4.62	ARROW
13.1	39	Scallorn	13.4	1.91	4.71	ARROW
45	4	Scallorn	13.6	2.19	4.88	ARROW
167	54	Untyped Arrow	13.7	2.33	4.97	ARROW
2028	68	Scallorn	13.7	2.33	4.97	ARROW
1961	74	Scallorn	13.8	2.47	5.06	ARROW
2043	73	Edwards	14.1	2.89	5.33	ARROW
2089.1	90	Scallorn	14.5	3.45	5.69	ARROW
1164.4	326	Untyped Arrow	15.6	4.99	6.66	ARROW
60	14	Untyped Arrow	15.9	5.41	6.93	ARROW
958.2	327	Frio	16.7	6.53	7.64	ARROW
2103	147	Scallorn	17.6	7.79	8.44	ARROW
771	184	TA Untyped	17.6	7.79	8.44	ARROW
448.2	260	Frio	17.8	8.07	8.62	ARROW
107.1	35	Ensor	18.8	9.47	9.51	ARROW
126	46	Ensor	18.8	9.47	9.51	ARROW
1	2	Ensor	18.9	9.61	9.60	DART

Highlighted row indicates specimen typed as a dart but discriminated as an arrow; TA=Transitional Archaic

efficiency. What is missing in the literature is consensus regarding the timing of the technological change from hand-held or atlatl spears to bow and arrows. At issue is how rapidly the bow and arrow, once introduced, replaced the dart point technology, which itself had persisted for millennia. Equally compelling is whether or not the two technologies overlapped temporally, which has been documented in many areas of North America.

The application of Shott's and Patterson's formulas to the Siren site assemblage identified few specimens that were originally typed as darts but that were consistently classified by the formulas as arrows. The metric discrimination divided the assemblage into groups mirroring the traditional, morphology-based typologies, suggesting that there was not a gradual transition to bow and arrow at the site and the smaller later Archaic projectile forms are dart points, not arrows. The small number of projectile points identified on the dart/arrow dividing line suggests that while the transition to bows and arrows may have begun during occupations at the Siren site, its evolution is incompletely captured in the assemblage. A hiatus in occupation between 1250–1550 B.P. may contribute to this incomplete picture of the transition from darts to arrows at the Siren site. Conversely, this gap comports well with other studies that suggest the introductory "window" of arrow technology in Central Texas to a roughly 300 year span, and suggest that arrows did not slowly develop out of darts. A site with stratified deposits dating to this interval could contribute significantly to the timing of the bow and arrow debate. Finally, the metric study does indicate that the conventional means utilized to type prehistoric projectiles in Texas (morphology and comparative study) into dart or arrow categories is relatively accurate.

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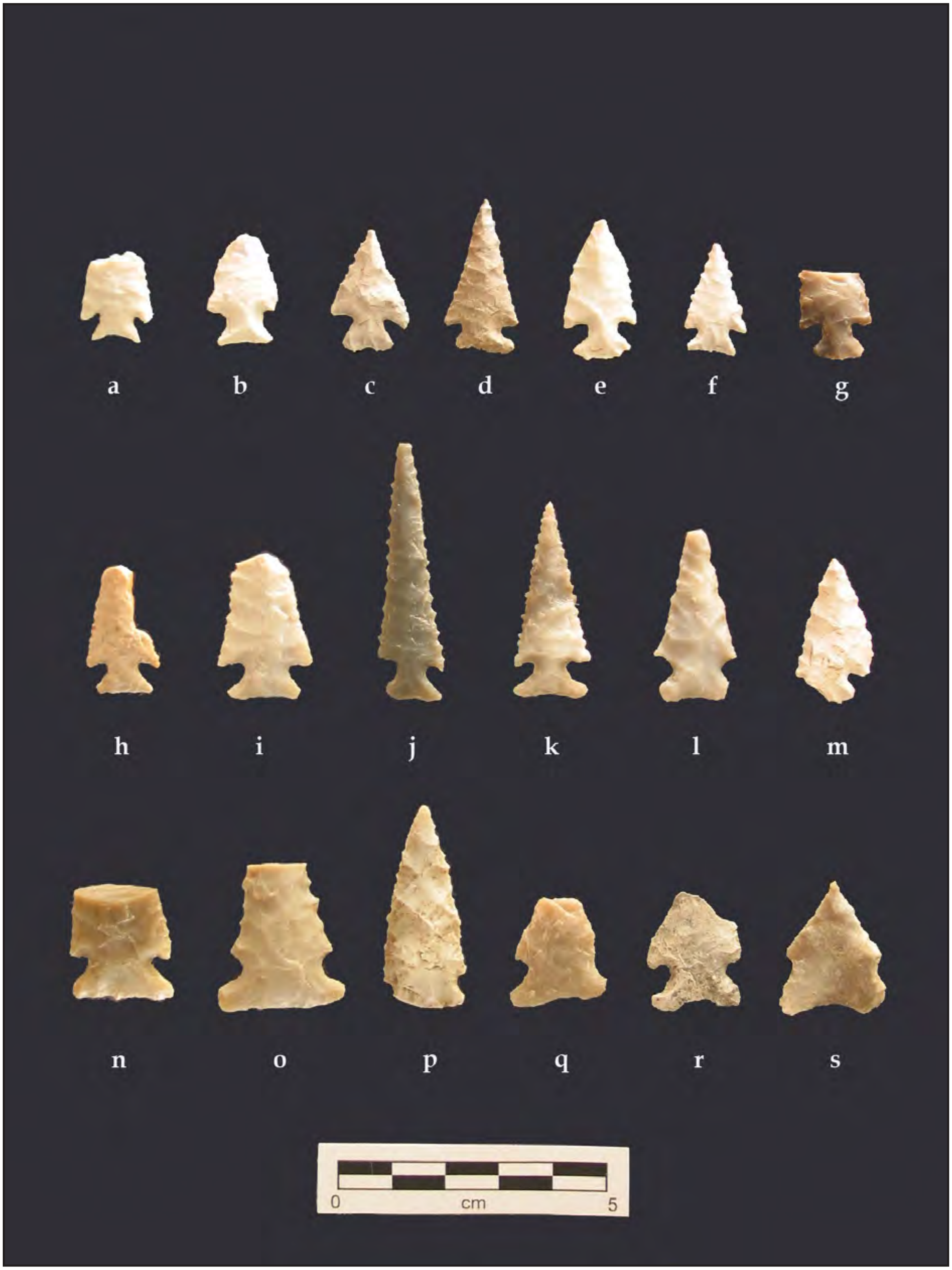

Figure 12.6. Nineteen projectile points classified as arrows by the one-variable formulas: a) Lot # 403.6, b) Lot # 2089.2, c) Lot # 2089.1, d) Lot # 2028, e) Lot # 13.1, f) Lot # 1970.1, g) Lot # 45, h) Lot # 1961, i) Lot # 2103, j) Lot # 75.1, k) Lot # 2043, l) Lot # 60, m) Lot # 167, n) Lot # 126, o) Lot # 107.1, p) Lot # 1164.4, q) Lot # 958.2, r) Lot # 448.2, s) Lot # 771.

Table 12.10. Partial Results of the Metrics of Siren Site Projectile Points According to Patterson (1985)

Lot No.	UI No.	Subcategory	Weight (g)	Medial Blade Thickness (mm)	Neck Width (mm)	Patterson's 1st formula	Patterson's 1st formula Classification	Patterson's 2nd formula	Patterson's 2nd formula Classification
1970.1	328	Scallorn	0.4	2.3	5.8	4.1659523994	ARROW	14.4029	ARROW
2089.1	90	Scallorn	0.6	2.7	5.6	9.6678282906	ARROW	14.9823	ARROW
13.1	39	Scallorn	0.9	3.1	5.4	15.1697041819	ARROW	15.5617	ARROW
2028	68	Scallorn	0.8	2.7	7.5	16.3223285991	ARROW	18.009	ARROW
2043	73	Edwards	1.2	2.1	6	17.2628044903	ARROW	14.2725	ARROW
75.1	7	Scallorn	1.7	2.8	5.6	22.4543748747	ARROW	15.2068	ARROW
60	14	Untyped Arrow	2.2	4	9.8	35.4645748567	ARROW	24.5914	ARROW
1164.4	326	Untyped Arrow	2.2	3.6	12.2	38.5397748567	ARROW	27.5166	ARROW
958.2	327	Frio	1.8	5.1	12.4	40.0274803816	ARROW	31.2027	DART
6	26	Ensor	3.8	4	10.8	43.7279161045	DART	26.1844	ARROW
1659	122	Frio/Ensor	3	4.3	12.6	44.6140520909	DART	29.7253	DART

Chapter 13

Synthesis - The Long Transition from Archaic to Late Prehistoric Times in Central Texas

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To play out the analogy that Johnson (1987:5) made regarding the siren's lure of the "hapless prehistorian onto the Rock of Misinterpretation," the synthesis presented here of the Siren site will go straight at the data and all its limitations. The intent is not to navigate around the fore-warned issues, but attempt to devise some means of dealing with them. Sites rich in artifacts but rife with contextual problems are much more representative of the Central Texas archaeological record than the pristine isolable Pompeii-premise sort of sites. The resolution advanced here, as employed in some of the previous chapters, is to use a complementary set of different approaches to structure and context, covering a wide array of their permutations, to address the issues. Every site has its limitations, but those limitations are defined as much by the analytical or interpretative framework as by the site itself.

The Siren site is very much the type of site that Johnson (1987) warned of. But by punching through the data cloud of the artifact assemblage directly to the structural components, the site framework reveals a degree of intact cultural stratigraphy that would otherwise be lost in the assemblages. Similarly, shifting scales or contexts allows mapping onto the level of resolution that the site has to offer. Due to mixing, short duration events are obscure on the Siren site, but the data offers significant insights at the phase level and higher. Tailored theoretical approaches may offer similar clarity on broader interpretive issues.

This chapter presents a brief summary of the Siren site, a review of the research objectives and related findings, then turns to the interpretive aspects, beginning with a sketch of a theoretical approach that has been a theme throughout this report. The approach draws on the main tenets of several sources. In the interpretive part of the chapter, the findings of the Siren site are woven into broad contexts, including geography, chronology, paleoclimate, macroeconomy, technology and otherwise. In the end, this chapter circles back to the overarching question – what is the nature of the transition from the Archaic to the Late Prehistoric, and is the "Transitional Archaic" a viable construct?

A Brief summary of the Siren site

On the southern terraces of the San Gabriel River in Williamson County near Georgetown, the Siren site comprises stratified archaeological remains discarded by prehistoric groups that occupied the site intermittently over the span of thousands of years. The site's natural sediments accumulated over the last 10,000 years or more, and deeper site deposits might yet yield discrete occupational remains from the early to middle Holocene. However, the investigations focused almost entirely on the dense, upper deposits that date from roughly 2600 to 900 B.P. Within these, five components were defined based on a structural analysis of the site. While artifacts and ecofacts were subject to displacement by various processes and therefore retained less integrity, the feature assemblage revealed a relatively high degree of stratigraphic integrity.

The interpretive value of the Siren site is not so much in discerning living floors, discrete activity areas, or isolable specific behaviors. Highly specific associations are often suspect. Rather, the site and its basic underlying structure offer insights into broad patterns of prehistory. The temporal components span one of the two great transitions in prehistory, the shift from Archaic to Late Prehistoric adaptive patterns. Consequently, the nature of that transition was a central research issue.

The study of the Siren site structure used two basic analytical tacks, including 1) a focus on the "skeletal morphology," or site framework, and 2) the development of sufficiently broad components that align with the limits of certainty afforded by the data. Features proved to retain good stratigraphic integrity, though the artifact assemblages were clearly mixed to varying degrees. Since the overwhelmingly vast majority of chronometric data derived directly from features, the temporal framework of the site provides a solid foundation for developing the site and regional chronologies.

Sixty-five radiocarbon dates constitute the primary dataset for the occupational and depositional sequence on the western part of the Siren site. If the eleven dates from SWCA's later excavations on the eastern side are added to the mix (see Peyton et al. 2013), there are a total of 76 radiocarbon dates from the site. Six dates, however, including one from a Rabdotus snail shell, are on non-cultural materials and are discarded since these do not necessarily reflect cultural use of the site. Therefore, if only the dates from investigated features are considered, the occupational chronology of the Siren site, as recovered from the testing and data recovery excavations, span from 2610 to 480 B.P. There are undoubtedly earlier, deeply buried components, but, as noted, these were not investigated.

The basic cultural components in the Siren site include:

- ❖ Component 1: Austin phase components - one, possibly two, sub-strata associated with Edwards and Scallorn points dating from roughly 1100 to 1000 B.P. within the upper West Range equivalent.
- ❖ Component 2: A rather scant Darl-associated Driftwood phase component dating to 1730 to 1550 B.P.
- ❖ Component 3: Two possibly distinct Twin Sisters phase components associated with Ensor, Frio, and Fairland projectile points dating to 2000 and 1900 B.P., firmly within the upper West Range equivalent.
- ❖ Component 4: A Uvalde phase component, apparently associated with Castroville points, that dates to between 2300 and 2100 and is situated within the upper West Range equivalent.
- ❖ Component 5: Attributable to the San Marcos phase and consists of dense occupational debris dating from 2600 to 2400 B.P. lying on a short-lived stable surface at the contact between the upper and lower West Range equivalent units.

From this basis and the specifics presented in the previous chapters, the Siren site can be tied into broader contexts to address long-term regional trends.

Review of Research Questions and Findings

The research objectives in the study of the Siren site are structured around five specific questions that pertain to chronology, site formation processes, foraging strategies, burned rock features, and the metric discrimination of projectile points to discern the transition from dart to arrow technologies. All of the specific research questions are designed to contribute to addressing the fundamental question on the viability and utility of the notion of a Transitional Archaic.

Regional Chronology

The reason chronology holds such a prominent place in the history of archaeology is that the basic sequence needs to be understood, to some reasonable degree, in order to establish any context. To compare an archaeological component to environmental circumstances or developments elsewhere, the datasets have to be on comparable timelines. The robust suite of radiocarbon dates combined with associated diagnostics made the Siren site an ideal candidate to examine, and perhaps revise the established chronology for Central Texas from the Late Archaic through the Late Prehistoric. The chronology research objective was to compare extant chronologies with the Siren site data to clarify discrepancies among them and consequently bring some resolution to the sequence of changes during this critical period.

In comparing the chronologies, the Siren site supports a growing consensus of major chronological breaks at or near 2500, 2250; 1750; and 1250 to 1100 B.P. In addition to these major partitions, the Siren site reveals finer subdivisions, but those listed are the more widely recognized ones found in most, but not all, models (such as Collins 2004; Johnson and Goode 1994; Prewitt 1981b, 1985). We see another important division around 2000 B.P. Despite emergent consensus on the timing of major changes, the various existing chronologies have widely varying notions on which assemblages and stylistic intervals are associated with these major chronological breaks. The Siren site shows Ensor, Frio, and Fairland points from about 2000 to 1900 B.P., a timeframe within the ranges presented by Turner et al. (2011) and Johnson and Goode (1994), but entirely contradictory to all other chronologies. Castroville points, possibly contemporaneous with Montell points, occur within a relatively discrete component on the Siren site that dates to between

2300 and 2100 B.P., a timeframe consistent with the early temporal range proposed by Collins (2004) and Prewitt (1981b, 1985). The dates for the Edwards and Scallorn points on the Siren site range from 1100 to 1000 B.P., which is consistent with almost all models, but later than the 1250 B.P. advent in many sequences.

Perhaps the most intriguing aspect of the Siren site is a prominent half-millenium gap in the chronological record from 1750 to 1250 B.P. Component 2 covers a portion of this gap, but it is an exceedingly ephemeral manifestation. This occupational absence, when considered within the context of the regional record, is a keystone in a revised regional chronology. Because of low archaeological visibility, the timeframe is perhaps an underestimated portion of the cultural chronology. If the time that Prewitt (1981b, 1985) defines as the Twin Sisters phase is extended, pushing back the dates of the preceding phases and stylistic intervals, the Siren site data fall into full accord with Prewitt's and Collins's chronologies.

Site Formation Processes

The archaeological record is formed by two intertwined processes: cultural and natural deposition. Most of the terrace formation was the result of alluvial sedimentation at the site. At times, aggradation was sufficient to preserve isolable cultural components, but at other times landform stability resulted in intermixing of debris from multiple occupations on the same surface. To address the processes, two interrelated issues were addressed. The first entailed the identification of the natural and cultural processes that contributed to the preservation of the archaeological record. The second involved placing the Siren site stratigraphic record in the larger regional context, including the climatic circumstances.

Regarding the first, in general terms, the formation of well-preserved archaeological occupation surfaces is contingent upon multiple factors, of which sedimentation rate is one and the rate of cultural deposition is another. The Siren site stratigraphy is divided into four general parts. These four depositional "phases" include one prior to roughly 2600 B.P., followed by one postdating that time, but possibly extending only to roughly 1750 B.P. based on the previously discussed radiocarbon data from the site. After 1750 B.P., there is a 500-year chronological gap in the Siren site record that brings up a significant question—whether it is simply a cultural hiatus or that section of the depositional record is missing. Regardless, the geoarchaeological study did not discern a readily apparent unconformity to indicate discontinuous depositional processes, but rather continued cumulic aggradation, and so the default suggests cultural processes. Following the gap in temporal data, the Late Prehistoric period is well represented after approximately 1100 B.P., though the dates suggest the component extends back to as early as 1260 B.P. Importantly, the depositional record shows partitions also observed in the radiocarbon data.

Regarding the second issue, to assess this depositional framework within the large context, the basic strata on the Siren site have strong parallels to depositional units identified in the larger region. Fort Hood, located about 45 miles north of the Siren site, has been subject to numerous geoarchaeological studies (e.g., Abbott et al. 1995, 1996; Nordt 1992, 1993, 2004) that provide an apt database for drawing broader correlations. Both the Siren site and Fort Hood are within the Brazos River drainage basin, situated along the mid- to upper stretches of prominent tributaries thereof, and occupy ecotonal settings at the margin of the Edwards Plateau.

The core of the Siren site contains deep alluvial sediments, designated Unit 3, that began aggrading prior to 4220 B.P. Deposition ended sometime prior to 2610 B.P. according to dates on features that lie immediately atop the unit. The Siren site dates are consistent with those of the lower West Range in Fort Hood, which was laid down between approximately 4200 B.P. and sometime prior to 2400 B.P. (Nordt 1995, 2004).

The division between the upper and lower West Range alluvium, according to Nordt (2004:297), was a brief erosional event with increased hydrological flow that occurred around 2400 B.P. or so. In addition to this event, Nordt (1992:21) sees a lack of alluviation between roughly 2720 and 2380 B.P. On the Siren site, there appears to be a very clear unconformity between the lower and upper depositional units, but according to the suite of dates any such erosional event would have occurred a bit earlier, perhaps prior to 2600 B.P.

The upper alluvial unit defined as Unit 2, which was the main focus of our investigations, slowly aggraded from sometime after approximately 2600 to 1000 B.P., though the later components may have been entirely removed by modern construction. Chronologically, this depositional unit on the Siren site is consistent with the upper West Range alluvium in Fort Hood, which dates from roughly 2400 to 600–400 B.P. One pertinent question is the duration of the surface atop Unit 3—how long was the landform a stable surface prior to the resumption of aggradation by Unit 2? Nordt's (1992) date for the aggradation of the upper West Range at 2400 B.P., and fairly consistent dates on other Fort Hood sites and the Siren site, could suggest a timeframe of perhaps a few centuries of a depositional hiatus. The lack of soil development upon this contact, whether in Fort Hood or the Siren site, suggests obrution prior to notable pedogenesis. Nevertheless, the significant quantities of cultural material and substantial burned rock features on top of Unit 3 indicate this was a repetitively occupied surface of some duration.

One of the principal questions in this analysis also concerned the discreteness of the prehistoric occupation surfaces within the excavated area of Siren. The depth distribution of micro- and macro-artifacts, specifically burned rock and lithic debitage, provided a more finely resolved stratigraphic image of the cultural deposits than is available from the 10-cm excavation levels. The micro-artifacts, as expected, were found to have a wider (and more continuous) stratigraphic range than the macro-artifacts, and this undoubtedly reflects the greater post-depositional mobility of small material by soil fauna and flora. Unambiguous evidence of at least three occupations could be inferred from this record but a compelling case could be made for as many as six occupations if each peak in the artifact distribution plot is considered a distinct occupation event. Undoubtedly, the Siren site was occupied repeatedly over several thousand years.

Finally, a detailed examination of the relationship between burned rock features and indices of anthrogenic alteration of the fine earth fraction of the sedimentary record provided some support for the assertion that human activities at the site have enriched the deposits in some elements, but few of these relationships were found to be statistically strong. The property most closely correlated with the occupational record is magnetic susceptibility, and this was clear within soil column and the feature specific studies. Elements that exhibited the strongest correlation with the artifact distribution in column samples were magnesium, barium, potassium, aluminum, titanium, and manganese, where as elements that were clearly enriched in the features were barium, aluminum, magnesium and potassium.

Foraging Strategies

Foraging strategies pertain to the ways in which the site occupants organized themselves and their technology to interact with their physical setting. The archaeological materials at the Siren site indicate variation in ecological adaptations through time. The research question on the topic regards the comparison of Siren site patterns to prevailing models, particularly the transition from Archaic to Late Prehistoric lifeways in the eastern Edwards Plateau cultures. The general approach to the analysis of these strategies at the Siren site was to look at the relationships among three data sets: 1) environmental data; 2) subsistence-related data; and 3) technological data.

Based on these relationships, the Siren site data shows pronounced diachronic shifts in the long-term subsistence strategies. From 2600 to 2400 years ago, hunter-gatherer groups maintained a classic Archaic subsistence pattern of relatively intensive exploitation of local resources and likely high occupational redundancy suggestive of fixed territoriality. Subsequently, a shift is evident as high-ranked resources such as bison become better represented in the faunal record, likely occurring between 2300 and 2200 years ago. Several lines of evidence indicate possible Plains-like influences during this time, though there is clearly a continuity in many aspects of the archaeological record from the preceding times.

The following time on the Siren site, from about 2100 to 1900 B.P., is one of the more notable shifts in the record, quite possibly marking an Eastern Woodland-like adaptive pattern with intensive exploitation of deer. The faunal assemblage indicates groups occupied the site on a seasonal basis in the late fall to early winter, intensively harvesting deer. Numerous aspects of the faunal assemblage, such as narrow diet breadth, and the artifact assemblage suggests focused, logistical groups with darts tipped with Ensor, Frio, and Fairland points moved into the margin of the Edwards Plateau to exploit the deer populations. The toolkit and feature technology indicates higher mobility during this time.

Between approximately 1750 and 1250 years ago, the Siren site shows minimal occupational evidence. Based on the site evidence as well as the regional record, this period is inferred to be a period of generalized foraging with relatively low occupational intensity. This time of low archaeological visibility is followed by a prominent resumption of patterns identified almost a millennium before. The patterns in Component 1, from 1100 to 1000 years ago are similar to those established previously in Component 3, but with some notable changes. The faunal assemblage shows a low diet breadth, once again focusing on deer. But rather than logistical groups moving in for a short duration to exploit deer, the Late Prehistoric Austin phase groups appear to have more substantial occupational debris, notably marked by more formal and larger site furniture.

Burned Rock Cooking Features

As a prominent component of the Siren site and the Central Texas archaeological record, burned rock features have been a central focus of the site investigations. At the Siren site, numerous feature types were present, spanning 1,700 years of occupation along the banks of the San Gabriel River. The questions posed of the Siren site burned rock features centered upon whether there are discernible diachronic trends in investment of labor, formality, and other aspects. Relatedly, how do observed trends provide insights into subsistence economy, use of the landscape, group size, and length of occupation at the site?

Of the 43 burned rock features, 40 percent were Type 5 slab-lined facilities of varying size and formality. The remaining features included small basin facilities and less formal concentrations of burned rock. The Siren burned rock data show a slight decline in the formality and energy investment in cooking feature technology from a peak around 2600–2400 until 1250 B.P., then a subsequent increase from around 1100 to 900 B.P. in the Late Prehistoric. The initial peak corresponds with the highly formal Late Archaic Feature 35 and its companion, Feature 8, a ring midden with a reused internal, slab-lined cooking pit. The second peak appears to occur in Component 1, during the Late Prehistoric occupation. However, while there are peaks in formality, there is a strong consistency of occurrence of slab-lined features through all components at the site. These facilities occur in all time periods. Over the course of roughly 1600 years, prehistoric peoples returned to this same locale along the river and constructed these rock ovens for processing foodstuffs.

The difference within and between the site components, at least as it pertains to the use of slab-lined hearths, appears to be one of scale only. Construction technology appears to be relatively similar through time, but the size of the features (and perhaps related intensity of resource processing) diminishes.

Placed in the broader perspective, the data strongly suggest that the Siren site's features were furniture on the landscape, serving as sturdy facilities built for re-use over what was likely a seasonal pattern of subsistence and movement by the prehistoric occupants. Feature 8, the midden, is a snapshot of this process, illustrating the intensive use and re-use of a formal slab-lined cooking facility in the Late Archaic. Subsequent occupations overprinted atop this midden, with slab-lined facilities constructed through the Late Prehistoric, possibly to harvest the same resources. The investment of labor and well-built structure of many of the slab-lined facilities at Siren reveals a depth of planning and knowledge of recurring resources and/or possible forethought concerning occasional congregations of larger groups at one location for economic, social, or ceremonial purposes or a combination thereof.

High investment of energy in burned rock features, such as the central ring midden (Feature 8) and large slab-lined hearth (Feature 35) on the Siren site is often interpreted as an indicator of intensive processing of low-ranked resources such as xeric succulents or geophytes. The macrobotanical results clearly are weighted towards *Liliaceae* geophyte remains, though there is only tangential evidence in the Late Prehistoric. Examination of similar features across Central Texas appears to support this pattern. However, further research is needed into the subject regarding what was being processed in these large, formal cooking ovens.

The inordinate focus on the interpretation of features from a subsistence and cultural ecological viewpoint needs reconsideration, and to be fair many are starting to broaden their conceptions of the role of feature technology. While geophytes are a common candidate, an exploration of caloric returns and labor investment suggests other possibilities and raises many questions. For instance, is the return from cooking hundreds (if not more) small geophytic bulbs worth the investment of such time and labor in constructing a feature such as Feature 35? Could other resources such as meat also be processed in these ovens or perhaps meat with a geophyte garnish cooked together? Further, is the labor invested in these features indicative of factors related to but beyond basic subsistence or economics, such as the processing of particular resources into alcoholic beverages for social or ceremonial purposes? In contemporary practices in northern Mexico, sotoleros and maguey harvesters primarily use large burned rock ovens to convert starches in these xerophytic species to sugars and alcohol, likely presenting a model of cultural continuity that can be applied to the Central Texas burned rock features. Regardless, the Siren site does not have data to directly address these issues, but these alternative scenarios temper the interpretations of burned rock features as direct indicators of the intensification of low ranked resources in a subsistence framework.

In sum, there are discernible diachronic trends in the burned rock data that indicate changes in occupational intensity, subsistence, and perhaps group size. While slight differences are present, the technological consistency of these features suggests a long-lived subsistence pattern stretching from the Late Archaic into the Late Prehistoric. However, the specifics in this regard needs to be considered in the context of the multiple lines of evidence as noted later in this chapter in the interpretive section pertaining to diachronic changes in subsistence patterns.

Metric Discrimination of Projectile Points

At the behest of TxDOT, one research issue was the application of metric discrimination techniques to explore the transition from dart to arrow technology. A primary question posed was: Are the smaller Archaic points (Ensor, Frio, etc.) of the final phases of the Archaic actually arrow points or perhaps transitional forms? The advent of the bow and arrow, like ceramic production, was among the most significant technological changes in prehistory. The new weaponry impacted many aspects of society, including subsistence strategies, mobility and settlement patterns, warfare, socio-cultural interaction, and economic structures (Knecht 1997; Shott 1993). Because of such importance, the nature of the spatial and temporal spread of the bow technology has long been a paramount research question.

The application of methods devised by Shott (1997) and Patterson (1985, 1994) to 149 projectile points from the Siren site assemblage identified only a few individual specimens typed as dart points that fell within the statistical range documented for arrow points. Notably, the points in question all derive from types (Ensor, Fairland, Frio, and Edgewood) that have temporal distributions that overlap or just precede the commonly recognized dates for the advent of the bow and arrow. However, the known margin of error in the studies undercuts confidence in these marginal specimens. There is quite a bit of metric variation within and among projectile point classes, and this variation obscures discrete demarcations.

None of the earlier points from the Siren site, such as the broad-bladed Late Archaic types, had scores that would place them within the arrow point range. One caveat that is worth noting in the study of Siren site points, however, is the occupational gap in the archaeological record from 1250 to 1750 B.P., a critical time that may foster an incomplete picture of the transition from darts to arrows at the Siren site.

Overall, the analysis of the Siren site points does not provide evidence to counter the prevailing temporal placement of the introduction of the bow and arrow in Central Texas around 1350 to 1150 B.P. The statistical analyses largely supported the standard assignments of dart and arrow points in the Central Texas projectile point classification. Darts are darts and arrows are arrows as generally defined. There is a possibility of a rather nuanced transition, however. While this analysis only involves one assemblage from one site, the application of the metric discrimination to the Siren site projectile points appears to refute this idea of a lengthy, gradual development of arrows from darts in Central Texas.

A Review of the Special Studies

The suite of special studies conducted during the course of analysis form the underlying data on which much of the site interpretations rest. The studies include radiocarbon dating, macrobotanical analyses, pollen and phytolith studies, faunal analysis, and the application of the TxDOT artifact protocols to the lithic assemblage. In addition to these, the geomorphogical study comprised an array of independent analyses. Some were much more productive than others, often reflecting differential preservation rates among the lines of evidence.

Faunal remains were quite abundant and the analysis of the assemblage proved very informative. Dr. Klippel with the University of Tennessee analyzed 18,530 bones and bone fragments from the site (Appendix H). Seventy-four percent of the remains were identifiable as to class, with mammals comprising the overwhelming majority (73 percent). A minimum of a dozen mammal genera are represented (Antilocapra, Bos, Canis, Castor, Geomys, Lepus, Mephitis, Neotoma, Odocoileus, Procyon, Sylvilagus, and Ursus). Whitetail deer (*Odocoileus virginianus*) are the most common (number of identifiable specimens=208). Medium-sized (defined as deer-sized) remains include those of *Antilocapra americana, Odocoileus hemionus, Odocoileus virginianus, Ursus americanus*, Artiodactyl (Bos excluded) and "medium mammal." These taxa make up 88 percent of the mammal assemblage. *Bos bison* and "large mammals" constitute 2 percent of the total assemblage.

An important aspect of the faunal analysis is the inference of seasonal site occupation in which groups from elsewhere, probably from the east, were moving onto the edge of the Edwards Plateau in late fall/early winter and intensively exploiting deer. This area on the plateau is an ecotonal boundary known for high concentrations of whitetail deer. The presence of teeth and feet, and bone condition, from all four artiodactyl species indicate that they were being harvested in the area, transported to the site, and processed for hides, meat, marrow, and grease. Cut marks suggest skinning, disarticulating, and defleshing.

In addition to processing the artiodactyls for their hides and meat, there is strong evidence that the bones of all four taxa were being heavily processed for marrow and grease. Similar to what Binford (1978) describes for the Nunamiut, there is clear evidence for bone grease ("juice") production at Siren where practically all of the artiodactyl bones have been broken and crushed. In fact, it appears a major activity was frequent reuse of bone for grease production at the site. Klippel proposes that the fragmented artiodactyl bones of low marrow utility (e.g. phalanges) so often cited as evidence of human nutritional stress, may well be evidence for the repeated use of an ecotone in Central Texas that included an efficient, systematic, production of bone grease. The lack of a broad utilization of the potentially varied animal recourses that should have been available in a riparian setting at this ecotone between the Blackland Prairie and the Lampasas Cut Plain ecoregions substantiates this interpretation of the faunal remains from the Siren site.

The results of the macrobotanical, pollen, and phytolith analyses revealed a few noteworthy trends, but for the most part reflected traces of fairly common plants that may not have been economic resources, but rather part of the natural context (Appendices B through G). Oak, juniper, and grass pollen in samples from feature contexts and ground stone tools are consistent with pollen rains of the mixed wooded and open grassland setting that has characterized the region for much of the Holocene. However, some findings clearly reflect subsistence resources. Geophytes, walnuts, perhaps hackberry and grass seeds, and possibly sunflowers are likely economic resources with traces in the archaeological record. Seventeen Liliaceae bulbs or bulb fragments were identified, most from direct feature contexts and many burned (Appendix B, Table 9). Overall, the floral subsistence evidence suggests a fairly diverse exploitation of locally available resources but no intensive processing. Caution is warranted since such remains are the most perishable of all, but the material assemblage partially supports such a view. Classic signatures of plant processing, such as manos, metates, or nutting stones, are not prominent parts of the assemblage, even in relative terms.

The suite of 65 radiocarbon dates is one of the most significant datasets. The cultural and natural depositional sequence in Central Texas during the shift from the end of the Archaic to Late Prehistory has long been a difficult one to sort out. The lack of well-dated sites with components from this time has been a main contributing factor. The site's suite of dates contribute to unraveling the site's depositional sequence, and with it the regional sequence. One note of caution rises from data, however. The old-wood issue, illustrated in Chapter 8 by comparing dates from wood charcoal with those of short-lived species such as lily bulbs, can result in discrepancies of a century or two. This disjunction, or lag, between the radiocarbon date and the behavior that is being dated has likely skewed the chronology towards greater antiquity than is actually the case.

Synthesis and Interpretations

Based on these various studies and the findings on the research objectives, the Siren site contributes to an interpretation of the broad patterns of prehistory that cover the transition from Archaic to Late Prehistoric patterns. After laying out the basic theoretical framework, different facets of the prehistoric peoples and their contexts are addressed in the remainder of this chapter.

Brief Theoretical Underpinnings

The Siren site is interpreted here in a context of everwidening spheres of relevance. The "development…

of any society is dependent upon its relations with other societies… cultures are open, not closed systems; and studies…that fail to consider broader patterns of interaction are necessarily incomplete and partial" (Kohl 1990:218). The synthetic model used here relies heavily on Braudel, as well as a theoretical perspective that he heavily influenced, namely world systems theory as formulated by Wallerstein. Neither Braudel nor Wallerstein would likely consider their works applicable to prehistoric groups, though many have reconfigured them to be applicable (e.g., Peregrine 1992, Baugh 1998, Jeske 1996). The tenets of each are highly generalized for the purposes here.

Braudel turned the study of history on its head. Traditional historiography looked at the sequence of significant persons and events. Braudel asserted that these (big events and people) were not the fundamental forces of history, but rather minor players and consequences. He criticized the usual "event-dominated" or episodic history as an undue focus on ephemeral behavior. Such emphasis blinded the observer to more fundamental patterns in structural time, but also the cyclical patterns within it, such as the expansions and contractions of macroeconomic spheres.

Individuals and particular events, which operate in the *courte duree* (short time) are to be understood in response to at least two broader contexts. At the broadest level is geographical time, the long, relentless, often imperceptible change in the cultural and natural environment over millennia. The affects of technology, climate, geography, and other aspects operate at this scale, one at which many models of Central Texas prehistory are best suited. Between the *courte duree* and the *longue duree* are social, economic, and cultural patterns that are the main building blocks of cultural history. These are typically identified over multiple centuries. In this chapter, the Central Texas chronological divisions are lifted from their foundations and set down upon Braudelian divisions. Stages or eras, such as the Archaic, are the long cycles; phases are socio-economic structural patterns; and the occupational debris on the Siren site is representative of the individual activities and events that exist within the meso- and macro-systems. The ultimate question of the nature of the transition from Archaic to Late Prehistoric lifeways necessarily addresses all three levels.

One additional concept of Braudel's needs to be established. It is essentially a middle range theory describing how inferences on the archaeological record translate into the higher levels or scales. He used the term "structure" to refer to organized behaviors, attitudes, and conventions, as well as to physical structures (i.e. buildings and features) and infrastructure (such as roads). Once established, successive waves or generations of peoples perpetuate the structural patterns that can be traced back in time. These structures can be operationalized or applied to the archaeological record. The occupational debris on the Siren site derives from short-term activities by individuals and small groups. Those individuals were carrying out behaviors that were passed down for generations. Relatedly, Paukakat (2001) describes an emergent paradigm called "historical processualism," which draws heavily on agency and practice theory. The approach studies the interplay between human action and the structure, both natural and cultural, that presents both constraints and possibilities. In line with this approach, which is consistent with and partially derives from Braudel, this chapter is a synthesis that moves from the material basis of society to the cultural patterns. The context of the Siren site, whether global climatic conditions or the introduction of religious ideas from the Eastern Woodlands, is an integral part of understanding the patterns on the site. There is nothing deterministic in the approach – the interplay among variables is a dialectic along the lines of historical processualism. This chapter treats separate lines of evidence as relatively autonomous aspects. The main lines discussed here are:

- Environmental context
- Human geography
- Subsistence economy
- Stylistic trends in projectile points
- Political economy

The effort is to look at not just patterns, but ruptures or discontinuities in trajectories. Several theories, such as cataclysmic evolutionism and catastrophe theory as will be discussed later, provide theoretical umbrage for such a focus. Ruptures can be environmental, macro-economic, stylistic, mortuary, subsistence-related, technological, social, or otherwise. This report has addressed geomorphic, subsistence-related faunal remains, stylistic continuities in projectile point, macro-environmental, and technological data. Consequently those constitute the primary data classes.

Once discontinuities are identified, the search for correlating discontinuities in the other lines of evidence serve as the basis for defining critical breaks in the cultural processes and chronology.

Macro-Environment and Catastrophic Change in central Texas prehistory

Within the timeframe discussed above, changes in the archaeological assemblages can be compared to the environmental circumstances. Change of any sort can occur through long-term gradual processes or abrupt, dramatic shifts to produce entirely new cultural forms. And of course there is every permutation in between. The rate and nature of change has long been a central theme in evolutionary theory of processual archaeology (Trigger 1990:323). Catastrophe theory "treats the question of how, as the result of particular conjunctions of internal states, a set of fluctuating variables can produce discontinuous effects" (Trigger 1990:321). As in cataclysmic evolution, catastrophe is not synonymous with disastrous ruin, but rather pertains to fundamental change that can be either adaptive or maladaptive, beneficial or destructive. However, some see the darker side only, defining the view that history is a "saga punctuated by a series of *devastating* (italics added) natural cataclysms" (Feder 2005:20). These cataclysms could have equally been socially induced. While not embracing either of the theories here, a salient point in both perspectives is a strong focus on not just the patterns, but the magnitude of change and the variables that coincide at these critical points. Consequently, to begin to address distinct change, the climatic and geographic contexts serve as a starting point.

Paleoclimate

As addressed in Chapter 11, the major divisions in the Central Texas cultural chronology coincide, without exception, with a globally defined era of rapid climate change (Figure 13.1). If using the two most recent chronologies (Johnson and Goode 1994; Collins 2004), *every globally defined climatic shift corresponds with a major Central Texas chronological break, and every chronological break corresponds with a globally defined climatic shift – no more, no less.* Oddly, all culturally chronological breaks occur during periods of North American glacial advances. The implication is that the magnitude of these changes in the material conditions of existence were sufficient to foster profound structural change. Catastrophic changes in the physical reality incurred deep structural changes in adaptive patterns and technology. The immediate circumstances of any given society might not have been the prime mover, however, but rather there could very likely have been covariant affects, such as migration, from other areas.

Of these major times of change, the Siren site archaeological record captures two – and both are prominently etched in not only the cultural sequence, but also the natural depositional record. The first occurred around 2500 B.P., which falls squarely in the midst of a prominent unconformity in the Siren site record. This same unconformity is common in the regional geomorphic record, best identified by Nordt in comparative profiles from Fort Hood. The second occurs around 1100 or 1200 B.P., and there is likewise a stratigraphic break found on both the Siren site and in the regional record such as in Fort Hood.

If the various lines of data (e.g. Bousman 1998; Mayewski et al. 2004; Toomey et al. 1993) are correct, the long Altithermal ended with a whiplash and a bang: a distinct interval of cooler, wetter climate concurrent with an advance of arboreal cover in the centuries straddling 3000 B.P., followed by a pronounced return to warmer, drier, open grasslands around 2500 B.P.. Then, for a brief time around 2000 B.P., a more enduring woodland setting afterwards, though the data is not entirely consistent on how long this pattern persisted. The pollen data shows a strong swing back to low arboreal cover from roughly 1500 to 1000 B.P., before another resurgence of high arboreal cover after that period.

According to this climatic scenario, the two identified unconformities in the Siren site geomorphological records correspond with prominent intervals of low arboreal cover. The brief grassland hiatus may correlate with landforms stabilization for a short period given the lack of pedogenesis associated with the unconformity in the Siren site and regional record (Nordt 1992).

There are a number of correspondences between climate and assemblages, but the appearance of one diagnostic artifact will serve as an indicator of the trends discussed later in this chapter. There appears to be an uncanny direct correspondence between marine shell, which many cite as one line of evidence for Eastern influences (e.g., Johnson and Goode 1994), and the advance and retreat of woodland settings in eastern central Texas. One piece of marine shell was recovered from the Siren site in Component 5. Prewitt (1981b) attributes marine shell to assemblages of the San Marcos (which is contemporaneous with Component 5), Twin Sisters, and Austin phases. In the phase between San Marcos and Twin Sisters, "marine shell artifacts noticeably are lacking" (Prewitt 1981b:81), and in the intervening Driftwood phase they are also lacking. If the Siren site dates are used for Twin Sisters rather than Prewitt's, the presence of marine shell appears to be a bell weather indicator of Woodland influences, which track rather closely with woodland settings.

The two major environmental breaks form primary data points that are juxtaposed with other lines of evidence, cultural and environmental. There are other divisions that will be discussed here, but within the Siren site purview, these anchor the chronology.

Physical Geography

As a general principle, variation in physical context of any given site, on an ever-widening geographic scale, creates inequities in the distribution of fundamental resources that past societies needed to exist. These inequities, in turn, affected the distribution and adaptive patterns of those who mapped onto them. In the earliest times of prehistory, mobility was a primary adaptive response. However, with gradual population packing and the rise of territoriality through time, socio-cultural constraints brought two primary mechanisms to the forefront – intensification and economic re-distribution, such as through trade.

At a macro-scale, several of the great divisions of the North American landscape converge near the Siren site, including the Great Plains, the Eastern Woodlands, the Gulf Coastal Plains, as well as decidedly unique regions such as the central Texas Edwards Plateau. These regions were never static, rather their boundaries ebbed and flowed through time and so did the peoples who lived in them. The data in fossil pollen mentioned above are evidence of expansions and contractions in the major geographic regions in eastern central Texas. The implication is that the Siren site lay at the ever-shifting boundary between major ecological zones, and that the differing resource structures fostered variation on economic patterns (as will be addressed in greater detail in the following sections). Two major economic patterns in North America are termed Plains and Woodland adaptations, the former highly focused on hunting and the latter on a more balanced hunting and gathering strategy. The importance of this shifting boundary in adaptive patterns will become more apparent in the following section on subsistence.

Binford's (2001:112) map of the prey biomass in North America shows the Siren site in an ecotonal juncture of three differing settings (Figure 13.2). The moderately high corridor immediately east of the Siren site appears as a conduit between the Gulf Coastal Plain and the core of the Great Plains to the north.

The cultural response to differential distribution of resources fostered various social processes, trade being among the paramount. One point that Binford (2001) makes is that the juxtaposition of agriculturalists and hunter-gatherers often creates mutualistic partnerships among the groups. As the figure shows, the Siren site lies in such a position with agriculturalists to the east and hunter-gatherers to the west and south. Large game, such as bison, and lithic raw materials are among the significant distributional inequities between the Eastern Woodlands and Central Texas. These distributions are significant bases in both subsistence and political economy—we return to these momentarily.

Human Geography - Genetic and Physiological Indicators

One perennial question in addressing the prehistoric record is that of migration versus diffusion – whether change in the archaeological record is attributable to new peoples or the spread of new ideas to existing populations. Genetic and dental evidence suggests Central Texas hunter-gatherers remained a distinct and indigenous population well into the Late Prehistoric – they did not mix, nor were they replaced by agriculturalists from the Southeast or Southwest (Taylor and Creel 2011:110–111). As Taylor and Creel (2011:110–111) state:

> "Interestingly, many decades ago, Neumann (1952) and Stewart (1955) concluded (based on cranio-metric analysis) that Texas hunter-gatherers represented a biological group that descended from a more ancient population. Our data and interpretations, based on dental morphology, do not conflict with their findings."

The same cannot be said of the Gulf Coastal Plains or Eastern Texas where genetic, dental, and physiological evidence indicates Late Prehistoric populations likely displaced or absorbed prior indigenous peoples (Lee

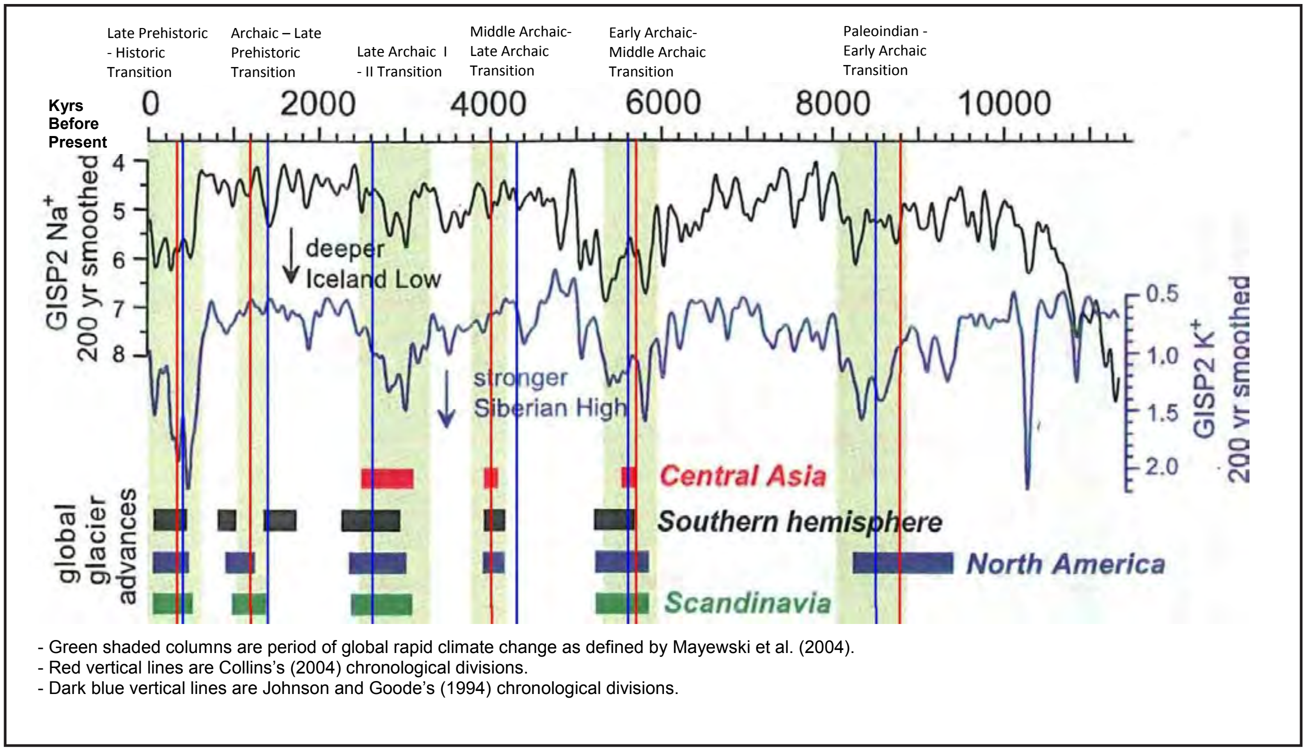


Figure 13.1. Correlations of Central Texas chronological divisions and global climatic change. Note correspondence of North American glacial advance and cultural divisions. Green shaded vertical lines denote Mayewski et al.'s (2004) periods of global rapid climate change.

1999; Taylor and Creel 2011). The continuity of the genetic population from the Central Texas Archaic peoples suggests that change in the archaeological assemblages are more likely the result of evolutionary change within a continuous population, though influenced by new ideas and technologies, rather than dramatic migratory movements. Substantial work is needed to add precision to reconstructions of past human geography, but at a general level biological continuity is a significant foundation for the interpretations of Central Texas prehistory. In light of this evidence, the material record expectedly reflects structural change within a long-term cultural matrix that had long adapted to the regional landscape. There were undoubtedly exceptions, with occasional incursions from time to time from elsewhere.

Subsistence Economics

To interweave the foraging strategies findings with the findings from the other research topics, the study of subsistence economy entails a slightly more inclusive purview. Moving from the environmental context to the archaeological record, subsistence economy is broadly defined as the technological, demographic (including mobility patterns), and ecological interface between a group of people and the environment. Tying the variations in climate and geography to the assemblages has long relied on middle range theory. Binford's global model based on ethnographic data shows Central Texas (and the Siren site), once again, very near a crossroads of different economic strategies (Figure 13.3). The model suggests a hunting-predominant strategy on the Plains and most of the northern portion of the United States, a gathering-dominant strategy in the Gulf Coastal Plain section of the Eastern Woodlands, but a mixed strategy in Central and South Texas. The model is largely based on worldwide correspondences between know ethnohistorical subsistence economies and modern to historical environmental data. As noted, the paleoenvironment in eastern Central Texas was not static, and so applying Binford's model into the past requires due consideration of changing circumstances through time. The main point of Binford's illustration is that the Siren site was situated in area where multiple economic strategies were viable, and the regional inhabitants could shift strategies as circumstances warranted. Accordingly, the Siren site record reflects variation in technology, mobility patterns, and faunal selection that are attributed to changes in subsistence economy. Correspondence among these variables and

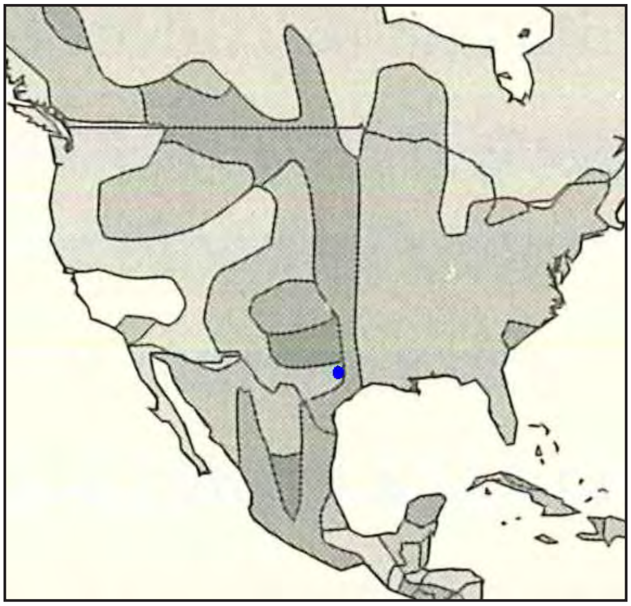


Figure 13.2. Binford's (2001:112) depiction of variation in expected prey biomass. The Siren site (blue dot) is situated at the approximate confluence of moderate, moderately high, and high (from light to dark, respectively) body size in primary prey species. Gradations are scaled by kilograms of moderate-sized ungulates per square kilometer.

the environmental data indicates differing long-term foraging strategies as discussed in Chapter 11.

Diachronic changes in Subsistence strategies

Dating to around 2600 to 2300 B.P., the earliest formally investigated component, Component 5, lies upon the previously mentioned stable surface that coincides with a period of rapid climate change. The Siren site data indicates relatively high investment of labor in burned rock technology (site furniture), a more diverse tool assemblage with many categories of expedient tool forms reasonably well represented. Formal technology such as scrapers and projectile points are poorly represented relative to more expedient forms such as cores and modified flakes, a signature of collector assemblages. The faunal assemblage from this time reflects a clear emphasis on deer-sized animals, but also show relative diversity in low-ranked taxa such as reptiles, amphibians, birds, and small mammals. Bison are not clearly defined in this component, but the regional record is rather clear that they were exploited on occasion during this time. Based on these data, the general economic strategy of the area's occupants can be characterized as a logistical collector strategy. In a landscape with highly variable distributions of resources, principally between resource-poor uplands and rich riparian zones, populations concentrated in optimal locations on the landscape where game or plant resources could be extensively exploited. It is likely that larger groups occupied base camps for longer periods of time, creating high-visibility sites with large cumulative features. Johnson and Goode (1994:34) note that groups "came to thrive on upland semi-succulents" during this time, and burned rock middens are interpreted as a signature of such exploitation. Though the Siren site does not offer evidence of semi-succulents, the burned rock midden in Component 5 is perhaps evidence of such intensive exploitation. The subsistence strategy would expectedly be broad-based with evidence of intensive processing of low-ranked resources such as vegetal materials. However, we question the notion of succulents as a subsistence mainstay—the caloric numbers do not add up. Conversion of starches to sugars and alcohol, in part

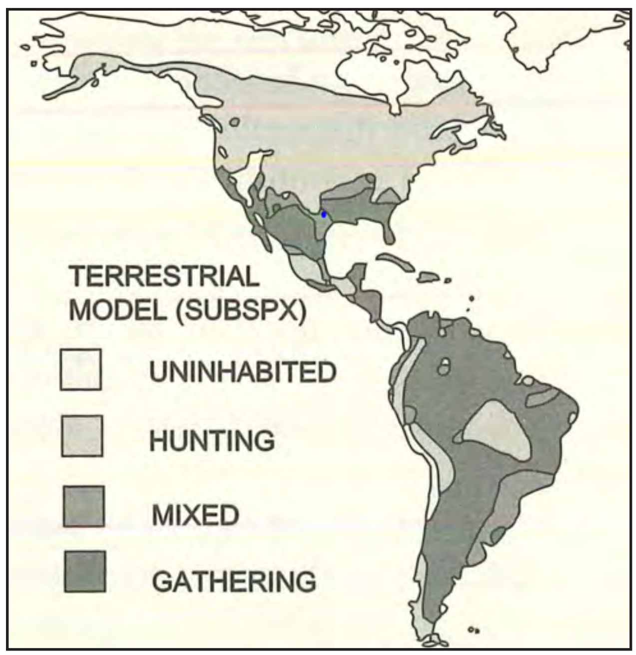


Figure 13.3. Binford's (2001:112) predictive Terrestrial Model based on ethnographic cases and variables that include terrestrial plants and animals and aquatic resources. The Siren site (blue dot) is situated near the confluence of three predicted economic emphases – hunting, gathering, and mixed hunting and gathering.

to address increased scalar social stress inherent in decreased mobility, is an intriguing research avenue. The Siren site did not yield data to directly address the matter, though.

From 2300 to 2200 B.P., a very distinctive, short-lived pinnacle of Plains or Prairie-centered adaptation is evident in the Siren assemblage. If Bousman's pollen data can be interpreted rather precisely, the gradual trend towards more mesic woodland conditions is punctuated by a brief, sharp return of grasslands at approximately this time. In Component 4 on the Siren site, there are distinctive changes in burned rock and lithic technology. No evidence of midden use or accumulation is discerned, but there is nevertheless a relatively high investment of labor in burned rock technology (site furniture). There is less evidence of intensive reuse of burned rock features. The lithic assemblage is distinguished by a high ratio of scrapers and cores, a low debitage to tool ratio, and infrequent projectile points. Bison show up in the Component 4 faunal assemblage and none of the other components. Though a fairly small part of the overall component assemblage, they represent highly ranked resources. In addition to bison, however, the component shows the greatest diet breadth in its faunal remains, though as noted this may be an effect of the comparatively large sample. They were clearly high grading to the extent feasible, but apparently maintained a diverse exploitation. The faunal assemblage shows a focus on large and medium mammal, but a suite of low-ranked resources as well. Based on these data, the subsistence strategy for this brief period is generalized and geared for opportunistic exploitation of high ranking resources. The highly dichotomous landscape between resource-poor uplands and rich riparian zones that distinguished the earlier times appears to have given way to a prairie-centered adaptation focused on large and medium-sized mammal procurement during Component 4 times.

From about 2100 to 1900 B.P., data indicates a wetter climate that fostered increased canopy cover with a woodland expansion, bison disappeared, and the distribution of xerophytic succulents, which are so often cited as the primary resources exploited by burned rock midden technology, receded to the south and west. The site occupants of the time, who carried darts tipped with Ensor, Frio, and Fairland points, were deer hunters. Deer-sized mammals are more common (based on percentage of faunal assemblage) than in any other component, and their diet breadth is narrow compared to the previous times. Small mammals and birds have the lowest representation of all site components. The strongly heterogenous ecological patterns of the earlier drier times lessened to create a more equitable distribution of resources across the landscape. Between the riparian corridors and the higher upland areas was, "a wide transitional zone composed of both arboreal and prairie elements, the well-watered eastern half of the Edwards Plateau ordinarily furnished plant and animal food resources for a moderately sized human population practicing Archaic hunting and gathering methods" (Johnson and Goode 1994:41). The pollen profile shows a long prominent trend towards increasing woodland settings.

Between 2100 and 1900 B.P., large midden-like features are absent, but formal slab-lined, basin-shaped ovens are central features, perhaps bordered by smaller less formal features. A distinctive aspect of the lithic assemblage from the time is a very high ratio of bifaces to cores, comparable only to the Austin phase. On a broad scale, the ratio is much higher than in other North American hunter-gatherer assemblages. This aspect, coupled with the high debitage to tool ratio, suggests several possible scenarios. With the emphasis on deer hunting, the heavy biface production may be related to retooling of projectiles as well as knife production to support groups of hunters prior to expeditions across the plateau/prairie boundary.

An alternate explanation is that the site occupants, located on the easternmost margin of a lithic rich region, were producing mid to late stage bifaces such as the San Gabriel biface (similar to the Late Prehistoric Gahagan and Friday bifaces) for trade to the lithic poor regions to the east. The Siren site, in and of itself, cannot confirm the hypothesis, and further work will be needed. We do know that large bifaces were being produced on the Siren site, and we know that the trade of such bifaces of high-quality central Texas chert occurred in the Late Archaic through the Late Prehistoric (Miller 2007). Trade of bifaces to the east and north is well documented, as numerous caches of such blanks have been found along known prehistoric transportation corridors (Miller 2007). Bifaces of Central Texas chert occur in many Caddo sites to the east (e.g. George C. Davis site [Baskin 1981; Shafer 1973]). During certain time periods, the Siren site may have played a role in a lithic trade system linking the eastern margin of the Edwards Plateau to the east and north.

Dating from roughly 1750 to 1550 B.P., Component 2 has extremely low archaeological visibility on the Siren site, and its paucity is likely significant in and of itself. The lack of a prominent component suggests a major shift in settlement or site distribution patterns when considered in light of the relatively continuous occupation evident in prior components. Most regional geomorphological models indicate continuous landform aggradation during this time (e.g., Nordt 1992), and no major depositional discontinuity was discerned on the Siren site. Bousman (1998), however, suggests a distinct change in the geomorphic environment took place sometime between 2125 and 1550 B.P. Bousman's interpretation of the bog pollen shows a prominent retreat of woodlands after about 1750 B.P., and then a return of mesic conditions after 1500 B.P. Others do not see the evidence for this sequence of climatic conditions (Decker et al. 2000:26). Regardless, the eastern cultural influences theorized by Johnson and Goode (1994) for the previous timeframe, are thought to have retreated eastward for the interval between roughly 1800 and 1200 B.P. (Carpenter, Hartnett et al. 2010; Hall 1981).

The Siren site data for Component 2 is scant, but what is there suggests low investment of labor in burned rock technology. The faunal assemblage shows the ubiquitous emphasis on medium, deer-sized mammals, but less so than in any other component. Low ranked species such as birds, amphibians and reptiles, constitute nearly 8 percent of the assemblage, roughly four times higher than any other time. In all datasets, however, all statistics suffer from low statistical populations and warrant caution in interpretations. Nevertheless, within these limitations, the cumulative data indicates a mobility and subsistence signature of low occupational intensity and broad diet breadth.

In many ways, Component 1 appears to be a strong re-emergence of patterns established previously in Component 3, but after a long intervening lapse. The pollen data shows the return of mesic, woodland settings by around 1100 to 1000 B.P., before shifting back to xeric grasslands around 800 to 600 B.P. By most accounts, bison are absent during Component 1 times (Dillehay 1974; Huebner 1991). If the pollen data is correct, the resource structure would reflect a more equitable distribution across the landscape. Landform aggradation continued, and on the eastern part of the Siren site, up to a meter of deposits formed during this time, providing clearer stratigraphic resolution than on the western side (Peyton et al. 2013).

The faunal assemblage shows the lowest diet breadth of any component with deer-sized animals being the focus, but also a relatively significant contribution from small mammals, likely rabbit. Other than one bird bone, the lower ranked faunal resources do not appear in the assemblage. Bison are absent.

Burned rock technology shows a high emphasis on formality and labor investment. No large midden-like features are present, but two large basin-shaped ovens (Features 1 and 16) are quite substantial in overall weight. Excavations on the eastern side of the site also revealed several additional large ovens associated with Austin phase Scallorn projectiles (Peyton et al. 2013). The Siren site data shows substantial, formal feature technology, perhaps indicating intensive and/or repetitive occupation of the same site.

The lithic assemblage is distinguished by a high percentage of projectile points and modified flakes, and low percentage bifaces and cores. Though the overall percentage of bifaces is low, the biface to core ratio is quite high, nearing the same levels as previously noted in Component 3. As previously discussed, the ratio is much higher than in comparative North American hunter-gatherer assemblages, and a plausible explanation for this may well be intensive biface production of widely distributed Late Prehistoric Friday and Gahagan bifaces for trade to the lithic poor regions to the east. Although bifaces are common, the ratio of debitage to tools is rather low.

The Transition from Subsistence to Political Economy

Couched in Braudel's notion of long cycles and world system's theory, one fundamental aspect of eastern Central Texas subsistence economy advanced here is that subsistence strategies became more and more intertwined with emergent, but cyclical, macrosystems. Similar models have been developed for Plains-Pueblo interactions (Baugh 1991) and Plains-Woodland/Mississippian interaction. This pattern of mutualistic partnerships developing among groups with different economic strategies (hunter-gatherer and agriculturalists for example) is part of a common and universally recognized economic phenomenon (Binford 2001:191–196). In accordance with this process, Central Texas groups occupied a peripheral position engaging in exchange with core societies to the east.

Evidence for the transition from subsistence to political economies is presented in the following sections and is fully addressed in the section on political economy. As will be argued, a basic hunting and gathering economy characteristic of Archaic ways gradually gave way to a mixed strategy of hunting and gathering complemented by exchange. In accordance with the above-mentioned genetic data, it was likely indigenous cultural evolution. The shift from a primarily domestic economic mode to regional political economies is the distinction between the Archaic and post-Archaic ways. So the question of when and how that occurred is central to understanding the transition. Before looking at political economy, stylistic trends offer some insights.

Stylistic Technological Trends

All Central Texas cultural chronologies have used projectile point style as diagnostic indicators of change. Though the Siren site, in terms of highly refined stratigraphic separation, is not the best of sites for sorting out stylistic sequences, the data nevertheless offers some insights, particularly when placed within larger contexts. The concern here is as much on when styles were present but also on the timeframe of stylistic discontinuity, when styles end and are replaced by new ones. As important as the timing is the nature of the geographic distribution of point style as indicators of the direction of cultural influences. Tying style into the theoretical construct established at the beginning of the chapter, the normative patterns regarding food, belief, style, and social customs is termed *habitus*. The social tradition of making a particular point style, such as a Pedernales point for example, is a structure in Braudel's sense, an organized behavioral pattern. Any society comprises a great many such structures from hearth construction to lithic reduction to subsistence patterns. In the following, the intent is to define breaks in the structural continuity of style.

The major climatic milestone of 2500 B.P. generally coincides with a discrete stylistic break. Pedernales points were one of the longest lived styles in prehistory, possibly spanning almost a millennium. But around 2600 B.P., by many accounts (Prewitt 1981b; Collins 2004), use of Pedernales comes to an end. It has been argued that there was a long evolutionary technological continuum from Early Triangular to Bell and Andice (see discussion by Hester 2004:137–138) to Bulverde to Pedernales (Carpenter and Paquin 2010; Johnson and Goode 1994:30). While the earlier cultural strata on the Siren site were not investigated in detail, Pedernales do not appear in the post-2600 B.P. deposits. Rather the broad-bladed tradition of Marshall, Williams, and Lange appear to have displaced the earlier forms. These broad-bladed points have distributions that are notably different the strongly Central Texas focused Bulverde and Pedernales points. Marshall points are considered by some to have developed from earlier Central Texas forms (Johnson and Goode 1994:35), but Williams and Marcos points are found commonly to the east, such as at Poverty Point (Gibson 2001:59), and other parts of the Mississippi Valley (Bell 1960: 96). The implication is that there was some stylistic continuity around 2500 B.P., but in addition to the endemic Central Texas types, new stylistic influences or associations entered from the east.

Montell and Castroville, which postdate Marshall, Williams, and Lange, are often found in the same components, such as at Bonfire Shelter (Dibble and Lorrain 1968:51–54) and the Siren site. In general form, the two are often similar, and if the basal notch were covered in the Montell, the morphology would quite often be indistinct (Figure 13.4). Technologically, however, Montells are often very well thinned, a pinnacle of biface reduction (Johnson and Goode 1994:36; additionally see Dibble and Lorrain's 1968:54 for maximum thickness statistics for two points styles in same component). Additionally, the distribution of the two types, though strongly overlapping in time and space, differ. Castroville points are documented far to the east (Bell 1960:14), similar to Marshall and Williams, whereas Montell are much more specific to Central Texas and immediately to the south and west.

Fairland, Frio, and Ensor points mark an abrupt abandonment of the long-enduring emphasis on broad blades. Why the sudden shift after thousands of years? Some evidence might be found in the design considerations of projectile points. The morphology and mass of a point affects its capabilities. Penetration and wound size are the primary variables considered in the effectiveness of the weapons. "How well a spear point penetrates its target at a given loading speed is strongly influenced by its maximum width perpendicular to its plane of forward motion" (Shea 1997:84). However, mass and sharpness are also equally important factors. Points designed for penetration tend to minimize

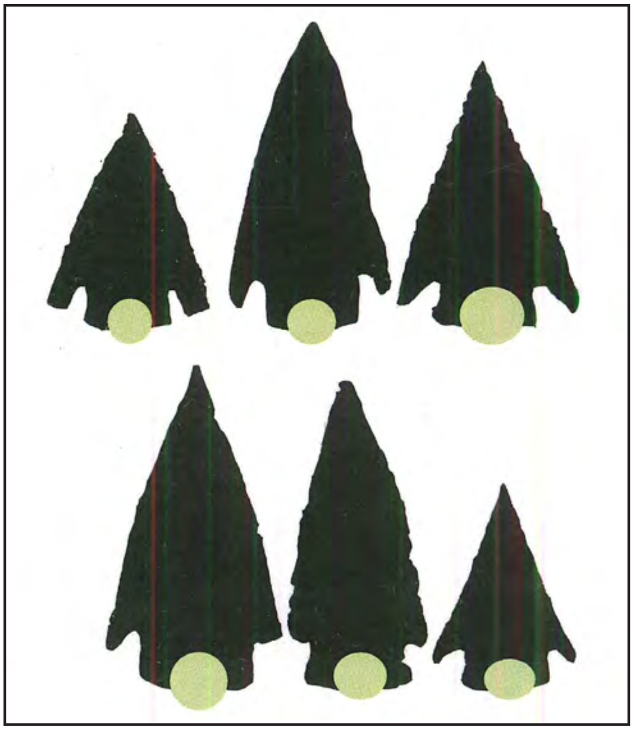


Figure 13.4. Representative Montell and Castroville points from Suhm and Jelks (1962) type collection. The two types overlap spatially and temporally, often found in the same components. Masking a distinguishing attribute of Montell, the central basal notch, shows morphological overlap. Castroville points are top left and right and bottom center. Others are Montell points.

widths, thereby concentrating inertial energy in a small area (Shea 1997:86). In other circumstances, broad blades, which cause laterally extensive wounds, are preferable. When the situation mandates a high certainty in making a kill, wide and heavy points are often best suited.

The shift from broad to narrow projectile forms is inferred to be more than just stylistic, but rather indicates a change in weaponry, hunting techniques, or prey choice. The study in Chapter 12 argues against the possibility that Ensor, Frio, or Fairlands were arrow points. One plausible possibility is that these narrower dart points reflect a Woodland-style logistical hunting strategy focused almost entirely on deer. Archaeologists have noted that with a reduction in residential mobility, there is a concurrent emergence of logistically organized communal hunting focused on large game (Jackson and Scott 2002:462–465; Speth and Scott 1989). Decreased residential mobility taxes the local availability of game, thereby increasing hunting radius and fostering a logistical strategy relying on task specific hunting parties. In so doing, the relative proportion of large game increases relative to small game (Speth and Scott 1989). Several supporting lines of evidence include:

- The faunal assemblage of Component 3, containing Frio, Fairland, and Ensor points, had the highest percentage of deer of all components and among the narrowest species diversity. Lower ranked species such as small mammal and birds had the lowest representation of all components.
- The biface to core ratio is by far the highest of all components, suggesting high mobility of some sort, though whether logistical or residential is undetermined.
- As a general principle, the size and form of projectile points is associated with prey body size (Buchanan et al. 2011). In a time of large game (bison) absence, smaller, narrower points may have been a direct adaptation to a narrow focus medium-sized mammals as reflected in the Siren site faunal assemblage.

These interpretations will need to be further studied, but the primary aspects of projectile point style and morphology that are important for the purposes at hand are the geographic distribution of styles and the functional attributes that mark differences in prey and strategies through time. As part of the overall assemblage these aspects contribute to the cumulative evidence of long-term trends.

Political Economics

It has been argued elsewhere (Carpenter and Hartnett 2011) that perhaps the hallmark of the end of the Archaic in Central Texas is the rise of regional networks in which subsistence and socio-economic systems are increasingly integrally related. The "Archaic" is defined by a band-level social organization, and consequently, the rise of tribal networks is perhaps the defining criteria for the end of the Archaic. Social adaptation, primarily in the form of regional exchange networks, becomes paramount over ecological adaptation at some point. As Flannery noted, the environment in cultural ecology comprises both the human as well as natural setting, but the former likely becomes an increasingly important consideration over time. In the final phase of the Archaic, this distinction is perhaps vital to understanding the changes of the times.

Though the Siren site revealed few lines of evidence regarding external relations or trade networks, by tying the revised site chronology into the regional data, a distinct cyclical pattern in macro-economic spheres is indicated. Prior to 2600 B.P., the Central Texas archaeological record reflects a regionalized adaptive pattern mainly focused on the Edwards Plateau. As noted, diagnostic artifacts from the two to three millennia prior to 2600 B.P. have distributions that are primarily limited to the region, but also extending to the north, south, and west. Additionally, the lack of exotic goods or raw materials suggests poorly developed external relations beyond the regional (Prewitt 1981b:79–80). However, after 2600 B.P., coinciding with the advent of Component 5 on the Siren site, several aspects of the record indicate the development of extra-regional external relations (Prewitt 1981b; Johnson and Goode 1994:37), mainly focused eastward. Point style distributions have ranges extending far to the east, into the Lower Mississippi Valley as mentioned above. Additionally, for the first time marine shell ornaments are cited as components of the archaeological assemblages (Prewitt 1981b).

The Siren site chronology then shows a brief but distinct interlude distinguished by the advent of bison bone with Castroville and possibly Montell points between 2300 and 2100 B.P. This chronological placement contradicts Johnson and Goode's (1994) timeframe, but is roughly consistent with Prewitt's (1981b, 1985) and Collins's (2004) chronologies. Though the Siren site is mute on external relations during this time, Prewitt describes the Uvalde phase as lacking evidence of a widespread trade network and the particular lack of marine shell found in preceding and subsequent phases. Component 4 on the Siren site, which places the main stylistic diagnostic artifact two centuries earlier than Prewitt and Collins have them, appears to fall within a phase with extensive distributions of ornamental marine shell and diagnostic artifacts.

As several studies have argued (Carpenter and Hartnett 2011; Hall 1981; Johnson and Goode 1994), by about 2150 B.P. a widespread economic network spread from east to west, and persisted for several centuries. Johnson and Goode (1994:38–39) caution against using the presence of religious items to infer economic processes, but in light of other lines of evidence, the cumulative data suggests widespread trading. At around 1800 to 1750 B.P., Hall (1981) theorized a contracting economic sphere receding back to the east, and Carpenter and Hartnett (2011) see the lack of a macroeconomic sphere in eastern central Texas for nearly half a millennium until the resumption of eastern ties with the Austin phase.

By at least 1000 B.P., there appears to be a pattern of the groups to the east moving into and utilizing portions of Central Texas, very likely to exploit the economic resources of the area. Shafer (2006) proposed the Prairie Caddo emerged around 1000 B.P., and moved westward to form a "buffer" zone around the George C. Davis site before the complex dissipated around 650 B.P. This buffer encompassed the eastern margin of Central Texas (Shafer 2006:6). Whether this model holds true or not, other lines of evidence indicate the region (eastern Central Texas) formed the periphery in a macroeconomic sphere by 1000 B.P. lasting for the remainder of prehistory. Returning to the previously raised issue of mutualistic partnerships among hunter-gatherers and agriculturalists, Central Texas quite possibly constituted a primary focal point of concentrated highly ranked resources such as hide, horn, protein, and lithic raw materials.

At a general level, the hallmark of Archaic society is the lack of regional integration, the lack of large-scale macro-economic and religious spheres that created an integrated system of interrelated societies, a so-called "world system," (originally defined by Wallerstein 1974, but used here in an unhyphenated form as modified and employed by authors such as Baugh 1998 or Peregrine 1992 for the Caddo or Mississippian societies). Archaic societies were band groups with weakly developed tribal networks, and economies based primarily on localized adaptation to regionally specific ecological niches. Trade was undoubtedly important since Paleoindian times, but it was not the primary engine of Archaic economies – that is the distinction between Archaic and later phases or stages. The economic basis of Archaic society was domestic subsistence production. In studying the end of the Archaic, the archaeological record reveals the gradual emergence of tribal social networks (as defined by Braun and Plog 1982), a macroeconomic sphere, and economic shifts towards a regional integration, signaling the beginning of the end of the Archaic.

So based on the Siren chronology and regional evidence, we see truly Archaic patterns with a low-key economic structure in Central Texas until around 2600 B.P. From 2600 to 2300 B.P. or so, the evidence suggests groups were tapping into larger trade spheres to the east, but the technology, namely the continued use of burned rock middens and broad-bladed points so characteristic of preceding time, suggests a continuation of Archaic adaptive patterns. In other words, there does not appear to have been a structural economic change, but more of a continuity. Coinciding with the hiatus between Early and Middle Woodland times to the east, the Central Texas record indicates a cessation of extra-regional ties and a more endemic subsistence economy that took advantage of the appearance of high ranked resources such as bison.

The cyclical emergence and decline of regional macro-economic spheres for the final two millennia of the Archaic shows a correspondence with the cyclicality in eastern Central Texas chronological developments. As discussed by Johnson and Goode (1994:38), a Middle Woodland-Hopewell-Marksville network dating from about 2200 B.P. to about 1800/1750 B.P. emerged and is represented archaeologically in eastern Texas by the Jonas Short mound and the Coral Snake mound on the Sabine River. At this time on the Siren site, subsistence economy is very distinct from the preceding time as burned rock middens and broad bladed points that had been around for a long time are no longer present. In this regard the Twin Sisters and Austin phases are similar. Though the regional record shows perhaps a structural change in subsistence technology and also a strong macro-economic sphere, some of the primary technologies found in the east, such as ceramics, do not appear at this time in Central Texas. Only with the Austin phase is there clear evidence of the bow and arrow, and only with the Toyah phase do ceramics appear. So technologically, these traits were only incrementally adopted.

Although influences and patterns from elsewhere affected cultural change, to infer diffusion was the prime mover in the final millennia of prehistory is to entirely miss the point. The lines of evidence, including genetic evidence, indicate a gradual development within a long-term cultural matrix. Of significance was the incremental merging of large regional political, economic, and ideological networks that cause structural change in all participating societies. Such a perspective considers broader patterns of interactions as a central force in prehistoric change.

A Transitional Archaic?

One of the overarching questions in this report is the nature of the transition from Archaic to Late Prehistoric lifeways. The notion of a Transitional Archaic was proposed in 1962, and then immediately rejected by its originator, LeRoy Johnson. He never used the chronological division again, and no formal Central Texas chronology has subsequently used it either. To address the issue it is important to segregate two aspects of the issue: taxonomic convention and long-term developmental "history." The use of "transitional" is rejected on both fronts, although there are a number of valid underlying issues regarding evolutionary or developmental change.

Taxonomic Considerations

In taxonomy (literally, the naming of classes of things), conventional wisdom dictates the avoidance of terms such as *transitional*, *emergent*, or *incipient* that have "teleological" (Muller 1997:118), "genetic" (Rouse 1955:718), or developmental implications. Designations should avoid "unwanted interpretive baggage" (Johnson and Goode 1994:18). The Midwestern Taxonomic System, Southwestern Pecos Classification, and other schemes, as generally employed, use partitions designated by Roman numerals (Pecos), or "early", "middle" and "late," (Midwestern), but drop other qualifying terms. European schemes often used "upper", "middle", and "lower" (see for example Bordes 1968). The 2004 synthesis *The Prehistory of Texas* (Perttula 2004) avoids the term "transitional" in all regional chronologies. The terminology will not be espoused here. After initially proposing the partition in 1962, Johnson always avoided further use of the "transitional" label, opting instead for Late Archaic II.

The term additionally engenders confusion on the nature of the transition being referenced. A recent article entitled "The Armstrong Site: A Transitional Archaic Occupation along the Eastern Balcones Escarpment" (Schroeder 2011) refers to the Paleoindian-Archaic transition from 8000 to 9000 years ago rather than the conventional usage addressed throughout this report. Furthermore, as originally and typically conceived "transitional" referred to the incremental shift from hunting and gathering lifeways to agricultural sedentism (e.g. Griffin 1946), which Story hypothesized would eventually be shown to characterize the Central Texas Late Prehistoric groups (Suhm et al. 1954:20). That has never been substantiated.

These various taxonomic problems are valid concerns. The tripartite division of early, middle, and late is common convention in archaeology and others, such as paleontology and geology (Figure 13.5). Yet the Transitional Archaic division seems to persist, in part because Turner et al. (2011:51) use the designation in assigning chronological affiliations to point types.

The Untimely Death of Phases – Concerning

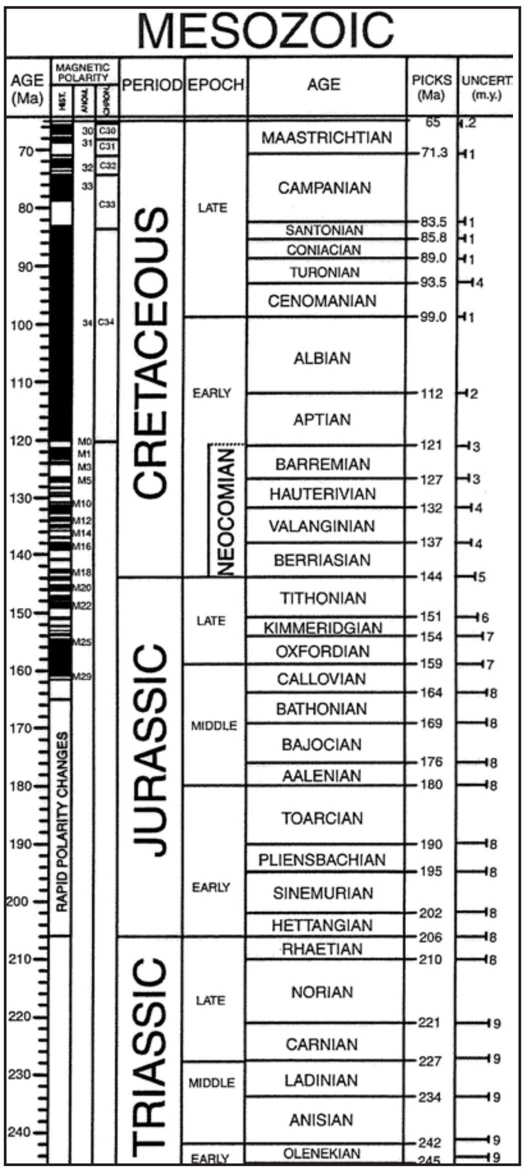


Figure 13.5. Geological timescale showing convention of tripartite division of major periods and hierarchical structure that has been stripped from cultural systematic with the loss of phases. Figure adapted from the 1999 Geologic Society of America timescale.

Categories of Perception

Borges (2005) wrote of a mythical figure that eluded capture by dissolving in its own tears. The basic categories of archaeological observation, such as site or type or phase, similarly tend to elude clear definition and dissolve into vagaries under the harsh glare of scrutiny. In an informal poll of Central Texas archaeologists conducted by one of the authors, there seems to be a common view that the phase concept is dead, irretrievably damaged. There has, however, been nothing to replace it, and chronologies are tending towards greater generalization. Scientific analysis is quite literally the division into finer parts, and broad rubrics such as Late Archaic conceal rather than reveal significant subdivisions in the archaeological record.

Johnson's (1987) critique appears to have substantially contributed to the demise of phases. However, he created untenable criteria. By linking phases necessarily to social processes, he created interpretive categories rather than descriptive archaeological categories. The theoretical architecture to operationalize his criteria, to bridge the interpretive gap, and to show precisely how social processes become manifest in the Central Texas archaeological record given all its problems, is not in place at this time. Looking at the long debate among archaeologists in the eastern United States, arguably the theoretical laboratory in the development of classificatory units such as phases, among the harshest critics there recently seems to be a sense of acceptance of phases if employed within precise confines and relegated to a humble role (Dunnell 2008:64; O'Brien, et al. 2002). Phases and types are worthwhile and practical constructs, though only as originally intended. As Willey and Phillips (1953:617) stated, while "archeo-sociological correlations may eventually be possible, the archaeologist is on firmer footing with the conception of an archaeological culture as an arbitrarily defined unit or segment of the total continuum." Phases should remain in the arsenal of Central Texas archaeologists, but the need to plan for their obsolescence is equally paramount. All classificatory categories, such as phases, types, and sites, need to be destroyed in due time, but only upon the emergence of more precise constructs. They are currently useful heuristic devices for finer divisions. Retreating to greater generalization is a poor option.

The phases formulated by Jelks, Weir, Kelley, Prewitt, Sorrow et al., and many others provide a salvageable basis for moving forward, but these need to be subsumed within the larger chronological divisions established long ago but more recently refined by Collins (2004) and Johnson and Goode (1994). Prewitt (1981b, 1985) was on the right track when he sought to compile the cumulative assemblage data that covered not only technological and subsistence data, but mortuary patterns, evidence of conflict and trade, site distribution patterns, and other aspects.

Developmental Considerations

However, the meaning behind the word 'transitional" remains a vitally important issue, and the history of thought on the matter contributes to an enduring debate. In the original formulation, Story evidently urged the division to denote ties to Eastern Woodland developments and influences (Johnson and Goode 1994:17). If so, the data and interpretations in this report lend some credence to those ties. The Siren site and regional data suggest that from 2600 B.P. onward, eastern Central Texas prehistory might have strong developmental interaction with the east. The defining attributes of Woodland, which dates from 3000 to 1000 B.P., include mound construction, ceremonialism, intensive crop cultivation, sedentism, pottery, and the bow and arrow (Anderson and Mainfort 2002:2–4). Clearly, these have never been conclusively shown to have taken hold in eastern Central Texas, though the arrow was perhaps a late arrival. Rather, eastern Central Texas was a distinct region that tapped into eastern developments. There was very likely structural change within the societies that occupied the Siren site that allowed them to tap into wider spheres.

The crux of the problem is that there was never really the abandonment of Archaic lifeways in Central Texas, something that many have tried to capture in various terminologies (e.g., Prewitt's [1985] or Suhm et al.'s [1954] "Neo-Archaic"). In this area, there was never anything analogous to Woodland developments to the east, Fourche Maline or Plains Village to the north, or Puebloan to the west. Technologies were gradually adopted, usually well after their adoption in adjacent areas. There does not appear to have been a sudden shift in the long-term development, though there were quite distinct changes at the phase level. It was not a smooth process but one of fits and starts, of cyclical economic expansions and contractions.

Eastern Influences

Nevertheless, the long-term chronological developments in eastern Central Texas were related to developments to the east. Early Woodland was well-established by 2700 to 2500 B.P. (Anderson and Mainfort 2002:5) and then the widespread trade network retreated eastward. Component 3 was interlude when influences turned to the north and west from perhaps 2300 to 2100 B.P. The regional record suggests the relative lack of interregional economic ties during this time. The Middle Woodland period from 2200 to 1550 B.P. is the widespread re-establishment of regional integration, but in eastern Central Texas, it was likely of much shorter duration than to the east. The Siren site shows the advent of a new phase by around 2000 B.P., and Hall (1981) theorizes a collapsing economic sphere retreating eastward around 1750 B.P. The Late Woodland from about 1550 to 950 B.P. "has been viewed traditionally as a period of cultural decline and possibly turmoil across much of the East" (Anderson and Mainfort 2002:15, citing Phillips 1970 and Williams 1963). Whatever is said of the conditions to the east, the notable sparseness of the archaeological record from roughly that period on the Siren site is interpreted as being consistent with a widespread decline in social organization in Central Texas. As indicated by multiple aspects of the Central Texas archaeological record, such as the return of marine shell and the aforementioned distribution of Scallorn points, the Austin phase marks a strong resurgence of patterns formed half a millennium earlier. The Caddo were well established to the east and Mississippian cultures were in full swing farther eastward in the Lower Mississippi River valley.

To return to the question, what if anything was the Transitional Archaic? While not adopting the term, there were clearly macroscale developmental changes, but that change was cyclical rather than linear. By 2500 B.P., Central Texas underwent gradual structural changes that marked the end of strictly regional adaptive patterns. By tapping into a much wider realm of Eastern interaction, Archaic subsistence economies transformed into a core-periphery symbiotic relationship. Their fundamental configuration remained Archaic, but the rise of supraregional economic structures warrants demarcation as a macro-scale unit of analysis. It was a game changer and things were never the same. It evolved in a cyclical manner, emergent around 2500 to 2300 B.P. or so then collapsing for a while before returning in fuller form from 2000 to 1750 or 1800 B.P., then collapsing again in something resembling a medieval dark ages (Figure 13.6). By 1000 B.P., coincident with the first clear advent of bow and arrow technology, the patterns were back. While the overall economic organization forms the basis for a macro-scale analytical unit, each cycle is the basis for Braudel's conjunctural scale.

Eastern Central Texas was situated on the margin of enormous macroeconomic spheres to the east. And though by most appearances, the region was never fully invested in these spheres, evidence indicates there were strong cultural influences (e.g., Hall 1981; Johnson and Goode 1994; also Prewitt 1981b for occurrence of marine shell in assemblages). Scallorn points along with other exotic arrow points have been found in burial caches in Cahokia Mounds in Illinois (Justice 1987:222). We have proposed elsewhere that the region was perhaps influenced by the mechanisms of a core-periphery relationship as modeled in world systems theory (Carpenter and Hartnett 2011). Hide, horn, protein, and lithic resources were perhaps of greater abundance in Central Texas and the Plains than to the east. The previously mentioned ecotonal setting of the Siren site provided an advantageous position to exploit inequities in the physical and cultural landscapes. The Gulf Coastal Plain to the east is generally a lithic poor region, while Central Texas has an abundance of the highest quality cherts found anywhere. In a stone-oriented technology, lithics can be a major economic engine.

The definition of the Archaic also entails socio-economic and political organizational aspects. From such a perspective, the data on exotic goods, warfare (or at least violent death), cemeteries, grave goods, and even perhaps dog sacrifice, may indicate rising and falling macroeconomic spheres that can equally be cited as contributing causal factors to the long-term adaptive strategies in the region during the final phases of the Archaic. Specifically, the retreat of the widespread economic network to the east as noted by Hall (1981) may have coincided with more mesic environmental conditions that relieved some of the environmental constraints, factors that had previously pushed intensification of riparian zones and a collector-like strategy. Following the "collapse" of the Middle Woodland macroeconomic sphere, there does appear to be a decline in regional integration and a move towards the forager strategy, but it is not simply a direct response to natural environmental change, but also a response to the cultural environment.

Final Analysis

In the final analysis, the long-held wisdom in scientific taxonomy should be sustained. The "Transitional" Archaic has been removed from all formal Central Texas chronologies over the last half century, and the findings here support that practice. Taxonomically, the term is laden with connotations that obscure rather than reveal the complexity of diachronic change during the timeframe, which covers at least two significant periods of collapsing interaction spheres. The currently defined Late Archaic II covers the significant changes, though our data modifies the timing of the phases and stylistic intervals. However, these recent chronologies have also created fundamental problems.

In large part, the impetus to create additional subdivisions of the major periods or stages is an unfortunate consequence of the dismissal of the phase as a pragmatic construct. Most all scientific classifications have a hierarchy of increasingly precise divisions, such as eons, eras, periods, epochs, and ages in geology. As recent chronologies have abandoned finer subdivisions, the classificatory scheme has become flattened, losing its hierarchical capabilities that are the essence of scientific analysis (breaking into finer parts). To capture the significant variations in cultural chronology, researchers are increasingly breaking down categories that are inherently meant to be very general partitions, such as the Archaic. So instead of the Toyah phase as a subdivision of the Late Prehistoric, there is the Late Late Prehistoric (Collins 2004:113). That direction is a slippery slope. The venerable tripartite scheme could endlessly be subdivided, whether adding a transitional Pre-Archaic as Sollberger and Hester (1972) suggested, or a Transitional Archaic at the end. A hierarchical classificatory scheme of increasingly precise units is a more practical structure (Table 13.1).

Regarding the notion of a transition, defined as a change from one state, stage, or place to another, there were certainly changes, as always. But the question is at a macroscale, of whether the Archaic to Late Prehistoric shift in lifeways was a long, gradual structural change. As we have done elsewhere, if the Late Prehistoric can be defined by the emergence of macrospheres as the primary political economic engine, then early forms of this pattern were in place in Central

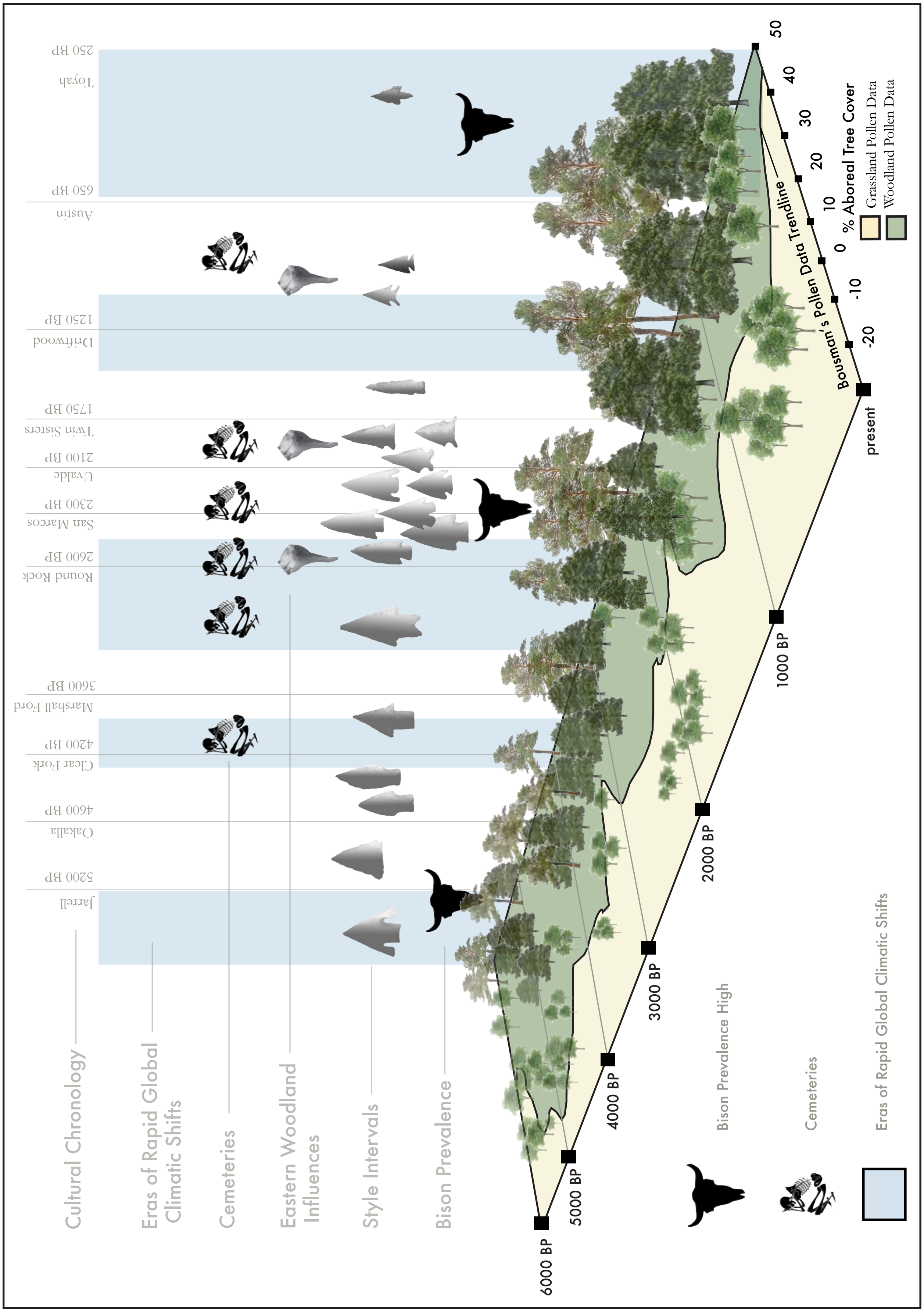
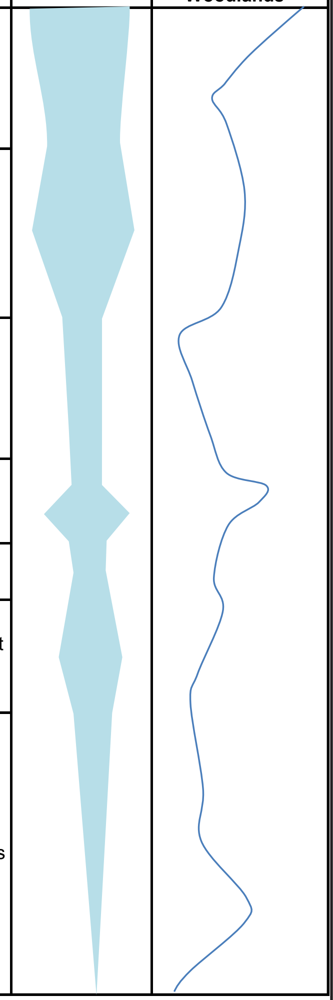


Figure 13.6. Schematic representation of Eastern Central Texas cultural chronology with environmental and cultural trends.

Table 13.1. Cultural Chronology for Eastern Edwards Plateau and Surrounding Regions

Age (Years B.P.)*	Era	Period	Phase	Sub-phase	Stylistic Interval	Macrosphere**	Intensity of Regional Interaction	Arboreal Canopy Cover*** <Grasslands Woodlands>
200				Late	Perdiz			
300								
400		Late	Toyah (650 to 250 B.P.)	Classic	Perdiz	Tejas		
500								
600				Early	Bonham-Perdiz			
700	Late Prehistoric			Late	Scallorn			
800								
900		Early	Austin (1100 to 650 B.P.)	Middle	Scallorn	Caddo-Cahokian		
1000								
1100				Early	Edwards			
1200								
1300								
1400				Late	Darl			
1500			Driftwood (1800 to 1100 B.P.)			Macrosphere Collapse		
1600				Early	Darl-Fairland			
1700								
1800				Late	Fairland			
1900		Late II	Twin Sisters (2100 to 1800 B.P.)	Early	Frio, Ensor	Marksville-Hopewell		
2000								
2100			Uvalde (2300 to 2100 B.P.	Late	Marcos	Southern Plains, Southwestern Texas		
2200				Early	Castroville, Montell			
2300								
2400	Archaic		San Marcos (2600 to 2300 B.P.)	Undiffer-entiated	Marshall, Williams, Lange	Endemic with emergent eastern ties		
2500								
2600								
2700								
2800								
2900								
3000			Round Rock (3400 to 2600 B.P.)	Undiffer-entiated	Pedernales			
3100		Late I****				Endemic, Central Texas		
3200								
3300								
3400								
3500								
3600								



* conventional radiocarbon years before present.

** "sphere" is defined here to denote supra-regional associations. The term is used as an "integrative unit" along the same lines that Willey and Phillips (1958:29-30) used to define "horizon" and "tradition." However, the emphasis is on economic, socio-political, and ideological ties rather than assembalges and "culture traits."

***from Bousman 1998; ****earlier phases of Late Archaic I not shown.

Texas by around 2500 years ago. Johnson and Goode's (1994) identification of Eastern Woodland influence as the hallmark for dividing Late Archaic I and II denotes the early development of the macrospheres.

In considering the end of the Archaic, Johnson and Goode (1994:39–40) mark Archaic/Late Prehistoric transition around 1400 B.P. with the advent of the bow and arrow. However, they suggest the possibility of extending the Archaic until after the Austin phase around 750 B.P., or conversely cutting the Archaic off with the advent of Darl points around 1550 B.P. The Siren site dates revise the timing of the phases and stylistic intervals a bit, but the Archaic/Late Prehistoric boundary is valid for a number of reasons.

If ceramics alone are the criteria for distinguishing between the Archaic and post-Archaic, the Austin phase would be considered in the former and Toyah the sole phase in the Late Prehistoric. However, as Willey and Phillips (1958:110) note, the notion that the Archaic is interchangeable with preceramic is a flawed distinction. The association of ceramics with settled agriculture is a useful generalization, but it is the economic and social integration that comes with stable settlement patterns, not pottery, that are the rightful criteria. The Toyah phase contains ceramics but do not meet the threshold criteria for separating them from the Austin phase.

So what is the rational basis from splitting the Late Prehistoric from the Archaic? By most definitions, the Austin and Toyah phases would be considered Archaic. However, the division is valid on the following basis: the unifying distinction of the Late Prehistoric is the degree of regional social and economic integration. The changes that occurred on the cultural landscape between 1200 and 1000 years ago, with the emergence of the Caddo not far to the east and other developments all around, were among the most significant in prehistory. Central Texas tapped into a macroeconomic sphere that became a driving force in the economic basis of society. The distribution of the Scallorn point is perhaps an expression of such a sphere that spread far to the east (Figure 13.7). For a brief period around 2100 to 1800, this level of integration was foreshadowed during the Twin Sisters phase, but there was a long decline in regional integration thereafter until the reemergence in the Austin phase. Based on the Siren site data, the division between the Late Prehistoric and Archaic is a solid break that occurred around 1200 years ago, but more likely around 1100 to 1000 years ago.

Regarding Integrity – the Lincoln Principle

Abraham Lincoln purportedly had a constituent who tried to bribe him. Lincoln politely refused a series of increasing offers, then forcibly removed the man from his office. When asked about it later, Lincoln said the man was getting too close to his price. All archaeological sites have limits to their integrity. The need is to cut off any line of inquiry before transgressing those bounds, which is the main point of Johnson's (1987) caveat. The limits have important implications on analytical tacks, on what can and cannot be said about the site. The Siren site has structural integrity as defined in Chapter 8, but it becomes increasingly vague on finer and finer scales. That is true of all sites, even the most well-preserved. The effort in this report has been to develop analytical and interpretive frameworks commensurate the level of certainty the Siren site has to offer – then forge a few inroads into extracting useful information from vague datasets.

Figure 13.7. The distribution of Scallorn points, a central diagnostic artifact of the Late Prehistoric Austin phase. Map adapted from Justice (1987:222).

Two approaches have been primary analytical tacks:

1. Establishment of site structure using only features with clearly associated absolute dates, which excluded all diagnostic artifacts and half the features.
2. Contextual approach that explores suggestive trends in the Siren site data, then assesses them in light of broader datasets.

To return to Braudel's three scales of human context, integrity likewise occurs on multiple levels. At the macro-cycles, a site might capture a mixed Late Archaic or Late Prehistoric assemblage. At the meso-scale, a site might reflect a segment of subsistence or technological patterns. The Siren site is likely a fairly accurate representative of what the Central Texas archaeological record looks like. The quixotic quest for "pure" components or assemblages marches on, and such a calling is perhaps a more dangerous siren's song that overlooks the current realities of the regional archaeological record. In the meantime, assaulting the margins of a site's integrity with novel approaches will better reflect a pragmatic approach to capture more information from rapidly fading resources.

The testing and data recovery investigations revealed extensive deposits within stratified components. The sum of material remains significantly contribute to understanding the long record of human habitation in eastern Central Texas and beyond. Of primary importance, the site's deposits cover one of the major transitions in regional prehistory, the shift from Archaic to Late Prehistoric patterns.

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APPENDICES A-N

REFER TO CD