US 70 Northeast of Roswell. Dorothea Lange, 1938, Library of Congress

ARCHAEOLOGICAL AND HISTORICAL STUDIES ALONG U.S. 70 BETWEEN ROSWELL AND PORTALES, NEW MEXICO

Volume I: Introduction and Native American Occupation

NMDOT Cultural Resource Technical Series No. 2003-2
AC-MIP-070(34)350, CN 3392, Consultant Task 4029-8

Environmental Section

New Mexico Department of Transportation

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SWCA
Environmental Consultants

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CPRC Permit No. SE-163
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SWCA Project No. 3835-0008
SWCA Report No. 02-265

June 14, 2004

TABLE OF CONTENTS

TABLE OF CONTENTS, continued

TABLE OF CONTENTS, continued

TABLE OF CONTENTS, continued

TABLE OF CONTENTS, continued

LIST OF TABLES

LIST OF TABLES, Continued

LIST OF TABLES, Continued

LIST OF TABLES, Continued

LIST OF FIGURES

LIST OF FIGURES, continued

ABSTRACT

In 2001, SWCA conducted archaeological data recovery at eight sites along US 70 between Roswell and Portales, in Chaves and Roosevelt Counties, New Mexico. The data recovery was requested by the New Mexico State Highway and Transportation Department (NMSHTD), prior to widening and other improvements to US 70. The westernmost site is 3.4 km (2.1 miles) east of the Pecos River and the easternmost site is about 3.4 km (2.1 miles) east of Kenna. The project took place on NMSHTD, New Mexico state trust, and private land.

The project report includes two volumes. This volume introduces the context, goals, and methods of the data recovery program, and describes the results for five sites (LA 2713, LA 75159, LA 75163, LA 127518, and LA 130557) with Native American components. A second volume describes the Euroamerican components, incorporating extensive archival research completed during the testing phase of the project.

Radiocarbon dates, including on charcoal dust and organic fractions in soil, indicate that the excavated remains date as early as the end of the Middle Archaic period and possibly into the Protohistoric period. For the most part, the current volume adds to existing evidence on the Late Archaic and Ceramic period occupations of southeastern New Mexico—evidence that appears to reflect a highly mobile, non-agricultural adaptation, in the Ceramic period as well as the Archaic period. The primary type of data recovered during the project was flaked stone; an extended analysis of the flaked stone suggests that in the absence of diagnostic artifacts, careful analysis of debitage may help archaeologists date otherwise "undatable" lithic artifact scatters.

NMCRIS Activity NO. 82517

CPRC Permit No. SE-163; State Land Office Permit AE-092

NMSHTD Project No. AC-MIP-070(34)350, CN 3392, Consultant Task 4029-8

SWCA Project No. 3835-0008, Report No. 02-265, Volume 1

Chapter 1

INTRODUCTION

Between February 28 and April 6, 2001, SWCA Environmental Consultants conducted archaeological data recovery at eight sites along US Highway 70 between Roswell and Portales, in Chaves and Roosevelt Counties, New Mexico (Figure 1.1). The New Mexico State Highway and Transportation Department (NMSHTD) requested the data recovery investigations, prior to widening and other improvements to US 70. This report details the goals, methods, and results of the data recovery program.

The project area is 68 km (42 miles) long and extends from Mile Marker 349 to Mile Marker 391. The westernmost site is about 3.4 km (2.1 mile) east of the Pecos River and the easternmost site is about 3.4 km (2.1 miles) east of Kenna. The project took place on NMSHTD, New Mexico state trust, and private land. Excavations on NMSHTD land were conducted under Cultural Properties Review Committee (CPRC) Permit No. SE-163, work on state trust land was conducted under Permit No. AE-092, and work on private land was conducted by written permission of the landowner.

PROJECT PERSONNEL

Dr. Samantha Ruscavage-Barz served as point of contact for the NMSHTD. Kevin Wellman of SWCA was the project director and David Phillips was the principal investigator. Dr. John Acklen and Ms. Katherine Roxlau provided peer review for the project. Harding Polk served as the project manager and field supervisor. The SWCA field crew included Tony Brown, Herman Browne, Cynthia Herhahn, Hollis Lawrence, Nicholas Parker, Mary Quirolo, Sara Stebbins, and Edie Wyndham. Marie Brown and Tod Roberts served as crew chiefs. Kathryn Donoho directed the processing of artifacts at the SWCA artifact lab. Harding Polk analyzed the historic artifacts, Kathryn Donoho and Todd VanPool analyzed the prehistoric artifacts, and Marie Brown analyzed the faunal materials. Report graphics were prepared by David Barz, William Crews, and Zachary Stauber with assistance from Colleen Shaffrey. Jean Haglund produced the report. Clerical support and data entry were provided by Francesca Archuleta, Mary Jean Haglund and Mary Quirolo. Wilson and Associates of Albuquerque and Smith Engineering Company of Roswell provided engineering plans for site locations in Roosevelt and Chavez Counties, respectively.

NATURAL SETTING

Starting just east of the Pecos River in the Middle Pecos River Valley east of Roswell, the project area climbs over a series of alluvial terraces (Lakewood, Orchard Park, and Blackdom), extends across the Mescalero pediment, and enters the Llano Estacado, which is part of the Southern High Plains. Elevation at the west and east ends of the project area are 1,109 m (3,638 feet) and 1,387 m (4549 feet), respectively.

Middle Pecos River Valley

The Middle Pecos River Valley extends from Alamogordo Reservoir (Sumner Lake) south to the New Mexico-Texas state line (Sebastian and Larralde 1989). The Pecos River flows between outwash deposits derived from mountains to the west and the High Plains to the east. Permian limestones have had the greatest effect on topography in the Pecos River Valley, but the local bedrock also includes mudstone, sandstone, shale, limestone, dolomite, and gypsiferous and saline evaporites. Structural subsidence and dissolution of evaporite and carbonate units have resulted in the formation of sinkholes and playas that may have provided water sources for early populations. The streams draining the east side of the Pecos River Valley are intermittent and tend to be small. Bob Crosby Draw is one of the most prominent drainages in the project area.

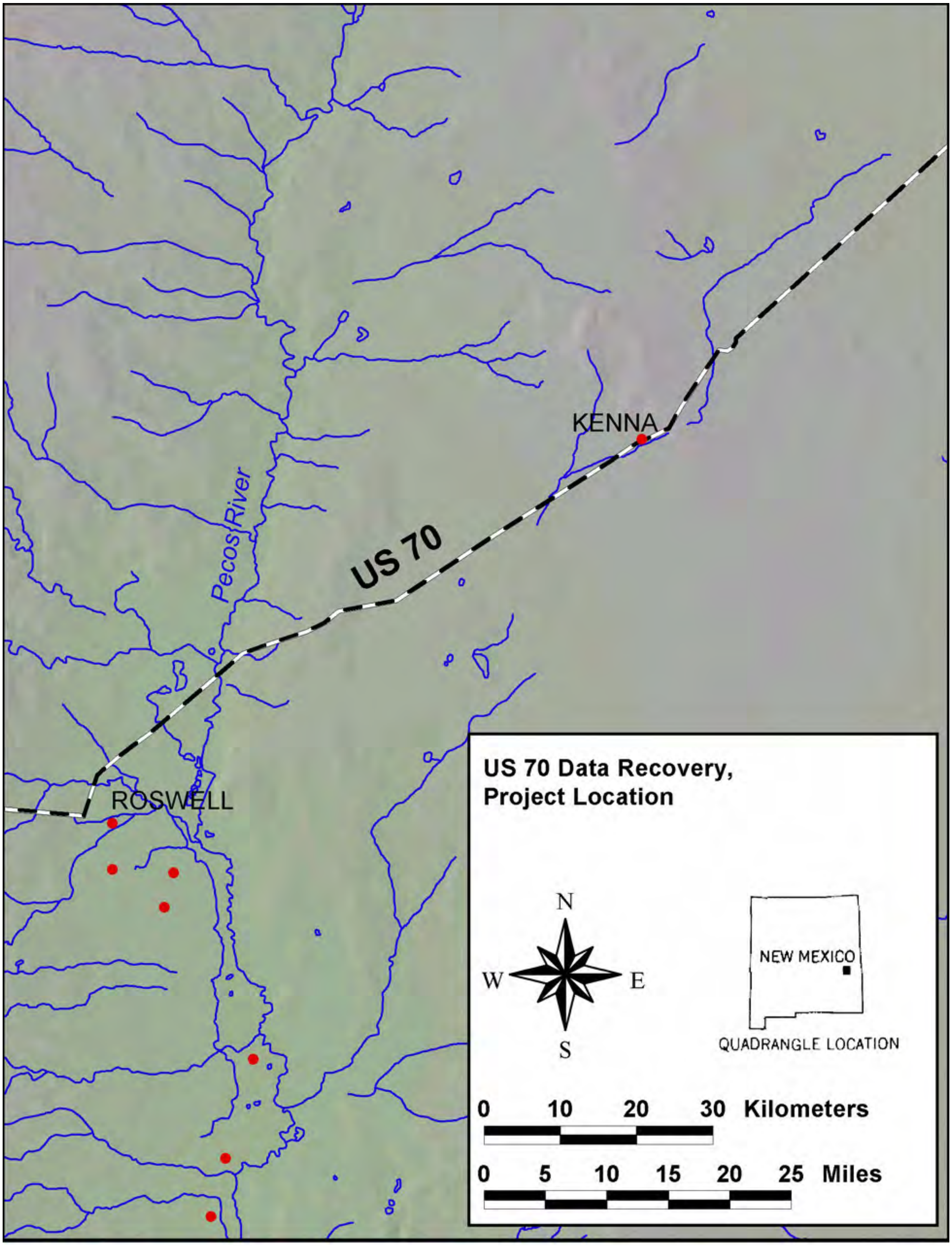

Figure 1.1. Project Location.

The Middle Pecos River Valley area is characterized by drainage basins, rolling uplands, and a few isolated hills and mesas. The Mescalero pediment, which is part of the Middle Pecos River physiographic zone, rises slowly as one travels eastward. It is bound on the east by Mescalero Ridge, a massive caprock formation of soft calcium carbonate called caliche (Sebastian and Larralde 1989). Most of the Mescalero pediment is covered with eolian sand, which has been subject to multiple periods of dune formation (Nials et al. 1977). In 1928, Darton named the local eolian deposits the Mescalero Sands (Sebastian and Larralde 1989).

Hall (2002) has reported that the area's stratigraphy is the results of alternating periods of dune and soil formation. The local bedrock is formed by Permian and Triassic shale and sandstones, which underlie the Mescalero Sands throughout the whole of the region. Between 100,000 and 600,000 BP, soil formation led to the development of a Bk petrocalcic horizon that is now evident as "caliche." This formation, called the Mescalero paleosol, is exposed throughout the region at various elevations and topographic positions and can be as much as 2 m thick.

Above the Mescalero paleosol is a layer of eolian sand composed of yellowish-red to red very fine quartz sand. The sand was deposited after the erosion of the upper layers of the Mescalero paleosol between 70,000 and 90,000 BP. It is more than 3 m thick in some areas, although it is more commonly only 0.4 to 0.6 m thick.

Between 15,000 and 70,000 BP, the sand sheet partially eroded and then stabilized, allowing a soil to form. The soil is a red Bt paleosol, which reflects a moist climate. In fact, the lack of a calcic horizon suggests that precipitation was more than 500 mm (20 inches) per year, which is 50% more than modern precipitation. The Bt horizon ranges between 50 and 70 cm thick, often extending through the entire remnant of the underlying eolian sand layer.

Between 5,000 and 15,000 BP, rainfall decreased significantly, causing the water table to drop, springs to quit producing, and many lakes to become dry. The increased aridity led to the formation of a layer of eolian sand composed of reddish yellow, very fine quartz sand above the Bt soil horizon. The sand layer ranges from about 4 to 5 m thick at the center of the sand sheet to less than 1 m at the sheet's edges. Although humans occupied the adjacent regions of the Southwest and Great Plains, few archaeological sites dating to this period have been found in the Mescalero Sands, perhaps indicating that the area was avoided.

After 5,000 BP, the surface of the eolian sands partially stabilized, although limited dune formation continued. Vegetation consisted of well established desert grassland or desert shrub grassland, although soil formation is not evident. Most archaeological sites rest directly on this somewhat stable surface, and their increased frequency indicates increased human use of this area.

Between 50 and 450 BP, limited soil formation led to the development of the Loco Hills soil in parts of Eddy County, in stream floodplains, and in other areas with comparatively more moisture. The soil was generally between 30 cm and 50 cm thick, containing only an A horizon. Localized soil formation was also common in archaeological sites, where increased organic residue was present.

Finally, grazing and other historic land use has contributed to decreased ground cover, which has in turn led to erosion of the previously stable sand sheet. Dune formation in the form of parabolic and coppice dunes has consequently resumed.

The modern climate in the Pecos River Valley is continental and semiarid. It forms the northeastern edge of the Chihuahuan Desert, transitioning to the semiarid steppe of the Southwest High Plains to the north and east (Hall 2002:1). The mean annual temperature is around 15 degrees C (60 degrees F), although the actual temperature varies greatly with the season; one-half to two-thirds of summer days are above 32 degrees C (90 degrees F) but more than two-thirds of the days between November and March have freezing temperatures (Sebastian and Larralde 1989). The area receives an average of 305 to 355 mm (12 to 14 inches) of precipitation a year, mostly from thunderstorms between April and October. Less than 20 percent of the annual moisture is derived from snow.

The Pecos River Valley supports desert grassland and riparian communities. The desert grassland communities are dominated by blue and black grama, muhly, dropseed, tobosa, and alkali sacaton grasses. These communities may also contain cholla, prickly pear, yucca, saltbush, Apache plume, mesquite, creosotebush, greasewood, tarbush, and shin or shinnery oak (*Quercus havardii*). Local riparian species include cottonwood, tamarisk, bulrush, willow, cattails, cacti, and grasses. These plant communities are largely limited to the area along the Pecos River, although isolated stands of riparian vegetation are present elsewhere. Within the project area, a riparian community is present at only one site, although a second site contains a relict riparian stand.

Pecos River wetlands support a number of bird species, including several migratory species. At Bitter Lake National Wildlife Refuge, west the project area on the other side of the Pecos River, birders have recorded 350 species of birds. Common species include bald eagles (except in summer), turkey vulture, American kestrels, northern harrier, sandhill cranes, egrets and herons, various ducks and geese, ravens, doves, quail, roadrunners, owls, swallows, and many smaller species. Several threatened species may occur in the area, including the Southwestern willow flycatcher, western snowy plover, white-faced ibis, and terns.

Sixty-nine species of mammals have been recorded at Bitter Lake National Wildlife Refuge. The more common large mammals include pronghorn, mule and white-tailed deer, bobcat, cottontail and jackrabbits, coyote and foxes, porcupine, raccoon, skunks, badger, otter, beaver, and weasel. Smaller mammalian species include various bats, squirrels, prairie dogs, mice, rats, shrews, and pocket gophers. Introduced species include nutria and feral domestic swine. The project area is within the historic range of the black-footed ferret but the last (unconfirmed) sighting was in 1979. Except for bats, all mammalian species are year-round residents. Most of the mammals are nocturnal or crepuscular.

The Pecos River and the Rio Peñasco also support populations of fish and amphibians. The fish include small species such as minnows, darters, shiners, and pupfish (Reed 1995) as well as a few larger species including channel catfish, sunfish, carp, and gar. Fifty species of amphibians and reptiles have been recorded at Bitter Lake National Wildlife Refuge. These include a variety of frogs, toads, salamander, turtles, lizards, skinks, and snakes (Anonymous 1997).

Humans have exploited the resources in the Pecos River Valley for thousands of years. Local gravel outcrops contain toolstone including quartzite, siltstone, chalcedony, chert, and silicified wood (Jelinek 1967), and gypsum has been mined during the historic period. The riparian and desert grassland communities contain plant and game species used prehistorically. Acorns from shinnery oak, which are low in tannic acid, may have been an especially important seasonal food source (Wiseman 2000:5). Furthermore, floodwater farming might have been pursued along tributary arroyos, although the high salinity of soils along the Pecos River probably prevented farming along that river.

Llano Estacado

The Llano Estacado (Staked Plain) is the portion of the southern High Plains south of the Canadian River that is bounded by the Pecos Valley to the west and the Rolling Plains of Texas to the east. It begins at the caprock formation known as the Mescalero Ridge. At the top of the caprock, the project corridor has an elevation of 1,372 m (4,500 feet).

The Llano Estacado slopes very slightly to the east and south, with few prominent topographic features (Maker et al. 1978). It is internally drained, with some of the drainages being deeply entrenched. As with the Pecos River Valley, structural subsidence and dissolution of evaporite and carbonate units have resulted in the formation of sinkholes and playas that may have provided ephemeral sources of water for prehistoric populations. A number of springs and seeps are present below the caprock along the west edge of the Llano.

The surface of the Llano Estacado is the remnant of a Tertiary plain that once extended east from the Rocky Mountains (Sebastian and Larralde 1989). The topmost formation is the Ogallala formation.

Three soils of the Dark and Moderately Dark-Colored Soils of the High Plains Region group are present in the project area—the Paleustalfs-Ustipsamments-Paleargids association. These soils are comprised of deep sandy soils on gently undulating to rolling or dune landscapes that formed in sandy eolian and alluvial sediments. The soils support stands of shinnery oak, but are highly susceptible to wind erosion; when the vegetative cover is reduced or removed, dunes quickly form. The Paleustalfs soil is common in Roosevelt County, forming on nearly level to gently undulating topography.

The climate of the Llano Estacado is continental and semiarid. The area receives an average of 430 to 510 mm (17 to 20 inches) of precipitation each year, with 70 to 80 percent of the moisture coming from summer thunderstorms between May and October. Little moisture falls during the winter, mostly in the form of snow. Diurnal and seasonal temperatures vary greatly. Summers are hot with daytime temperatures frequently exceeding 38 degrees C (100 degrees F), although nighttime summer temperatures can be as much as 28 degrees C (50 degrees F) cooler. Winters are cool, with maximum daytime temperatures often between 4 and 9 degrees C (40 and 50 degrees F) and nighttime temperatures occasionally dropping below –19 degrees C (0 degrees F). Sunny days are the norm, and winds are frequent and often strong; gusts as strong as 60 mph have been recorded from across the region (Lotspeich and Everhard 1962; Reed 1995).

The vegetation on the Llano Estacado consists primarily of short grass prairie. Several grass species are common, including black grama, blue grama, sand dropseed, tobosa, bush muhly and alkali sacaton. Other common species include snakeweed, yucca, prickly pear, saltbush, rabbitbrush, and greasewood (Reed 1995; Sebastian and Larralde 1989). Some soils on the Llano Estacado support stands of shinnery oak (Maker et al. 1978).

Common fauna on the Llano are coyote, pronghorn, cottontail rabbits, jack rabbits, rodents, raptors, and, at least during the historic period, bison. Waterfowl make intermittent use of the ephemeral ponds and playas.

On the whole, the Llano Estacado offered a narrow range of resources for people living in the area over the past 5,000 years. Gravels in the Ogallala formation could be used for stone tool production, and stands of shinnery oak could have been exploited for their acorns. Hunters would have found bison, pronghorn antelope, and smaller mammals potential game. Waterfowl using the local playas may also have been hunted. However, the scarce availability of water would have been a limiting factor in the prehistoric use of the area.

PREVIOUS RESEARCH

A number of research projects have included portions of the current research corridor, leading to the discovery of numerous sites (Table 1.1). In the early 1950s, LA 2713, a multi-component sherd and flake scatter with Archaic and Jornada Mogollon remains, was recorded as part of the first pipeline archaeology project in the American Southwest (Wendorf et al. 1956:217). The site was again recorded in February 1963, when the Laboratory of Anthropology surveyed the route along US 70 as part of its Highway Cultural Inventory (Alexander 1964), and in 1978, when the Agency for Conservation Archaeology at Eastern New Mexico University surveyed a portion of the study area during archaeological clearance for a Mountain Bell telephone line (MacLennan 1978).

Human Systems Research surveyed 76 miles (122 km) along the US 70 corridor (including the current project area) in 1989, for a proposed US West fiber-optic line that extended through much of Chavez, Roosevelt, and Curry Counties, New Mexico. HSR found 11 archaeological sites (LA 2713 and 75158–75167) and 50 isolated occurrences (Shields and Laumbach 1989) in the project area. The sites were described as three prehistoric sites of indeterminate age and cultural affiliation, six prehistoric sites with diagnostic materials, and two late historic sites (see Table 1.1). (Four of the sites identified during the HSR survey—LA 2713 (prehistoric), 75159 [prehistoric and historic], 75163 [prehistoric], and 75164 [late historic]—were investigated during the current project.).

Table 1.1. Previously Recorded Sites in the Project Area

Site Number	Description	References
LA 2713	Multicomponent sherd and flake scatter with Archaic and Jornada Mogollon (Late 18 Mile Phase) materials. Sherd types included Jornada Brown Ware, Chupadero B/W, Tabira B/W. and Three Rivers R/T. Multiple hearths.	Wendorf et al. 1956:217 Alexander 1964 MacLennan 1978 Shields and Laumbach 1989:48–51 Polk et al. 2001:3.1–3.19
LA 75157	Artifact scatter from an indeterminate prehistoric occupation. Artifacts include flaked stone, ground stone, and two projectile points, but no temporally diagnostic materials.	Shields and Laumbach 1989:31–32
LA 75158	Artifact scatter from an indeterminate prehistoric occupation. Artifacts include flaked stone artifacts but no temporally diagnostic materials.	Shields and Laumbach 1989:33
LA 75159	Multicomponent artifact site with Paleoindian, Archaic, Jornada Mogollon, Historic, and Recent period materials. Diagnostic artifacts included a San Jose projectile point, a Paleoindian blade, El Paso Brown Ware, Lincoln B/R, Chupadero B/W, Rio Grande Glaze Ware, and historic artifacts.	Shields and Laumbach 1989:33–36 Crawford et al. 1999:58–59 Polk et al. 2001:3.20–3.38
LA 75160	Artifact scatter from an indeterminate prehistoric occupation. Artifacts include flaked stone and ground stone but no temporally diagnostic materials.	Shields and Laumbach 1989:36–39 Crawford et al. 1999:60
LA 75161	Historic period artifact scatter. Diagnostic materials included historic artifacts.	Shields and Laumbach 1989:39–1
LA 75162	Artifact scatter from an indeterminate prehistoric occupation. Artifacts included flaked stone but no temporally diagnostic materials.	Shields and Laumbach 1989:39, 42–43
LA 75163	Multicomponent artifact scatter with Archaic, Jornada Mogollon, and Early Statehood to WW II remains. Diagnostic artifacts included Chupadero B/W, El Paso Bichrome, El Paso Polychrome, El Paso Brown, and Jornada Brown Ware, as well as Historic period artifacts.	Shields and Laumbach 1989:39–44 Crawford et al. 1999:60-63 Wiseman 2000 Polk et al. 2001:3.38–3.59
LA 75164	Territorial to Late Statehood period habitation and commercial site. Diagnostic artifacts included hundreds of historic artifacts. Structures included several sheds and a concrete foundation for a wood frame house.	Shields and Laumbach 1989:43–44 Crawford et al. 1999:63–64 Polk et al. 2001:3.60–3.76
LA 75165	Artifact scatter from an indeterminate prehistoric occupation. Artifacts included flaked stone artifacts but no temporally diagnostic materials.	Shields and Laumbach 1989:45, 47–48 Crawford et al. 1999:65
LA 75166	Artifact scatter with Jornada Mogollon materials. Diagnostic artifacts included El Paso Brown Ware and Chupadero B/W sherds.	Shields and Laumbach 1989:48–49 Crawford et al. 1999:65–66
LA 107641	Artifact scatter containing Historic period artifacts. Diagnostic materials included items dating to the late 1800s.	Zier 1996:294–296

Table 1.1. Previously Recorded Sites in the Project Area (Continued)

Site Number	Description	References
LA 127494	Multicomponent artifact scatter with Paleoindian (Agate Basin Complex), Late Territorial to Early Statehood, and Recent period materials. The site falls within the boundaries of Delphos, an abandoned historic/recent town. Diagnostic artifacts included an Agate Basin projectile point and Historic and Recent period artifacts, primarily related to building construction.	Crawford et al. 1999:79–80 Polk et al. 2001:3.77–3.82
LA 127495	Artifact scatter with features dating to the Late Territorial to Early Statehood periods. Diagnostic materials included historic artifacts.	Crawford et al. 1999:80–81 Polk et al. 2001:3.83–3.91
LA 127496	Early Statehood period homestead. Search of historic records indicated that the homestead was patented on July 29, 1913.	Crawford et al. 1999:81–84 Polk et al. 2001:4.1–4.2
LA 127497	Artifact scatter with features dating to the Early Statehood to Recent periods. Diagnostic artifacts include historic and recent artifacts, primarily related to habitation and ranching. Features included a concrete foundation, a collapsed milled lumber structure, a collapsed windmill, a steel tank, and a stuccoed pump house.	Crawford et al. 1999:84–86 Polk et al. 2001:3.91–3.3.100
LA 127498	Artifact scatter with Jornada Mogollon materials. Diagnostic artifacts included brownware sherds.	Crawford et al. 1999:86–90 Polk et al. 2001:3.100–3.105
LA 127500	Artifact scatter with Jornada Mogollon remains. Diagnostic artifacts included El Paso Brown Ware and Jornada Brown Ware sherds.	Crawford et al. 1999:91–95 Polk et al. 2001:3.105–3.112
LA 127501	Artifact scatter with Jornada Mogollon remains. Diagnostic artifacts included Jornada Plainware and El Paso Brown Ware sherds.	Crawford et al. 1999:95–96 Polk et al. 2001:3.112–3.121
LA 127502	Artifact scatter with features dating to the Late U.S. Territorial to Late Statehood periods. Part of the town of Boaz. Diagnostic artifacts included historic artifacts. Features included numerous concrete foundations for structures such as a store, a school, a church, and a train depot.	Crawford et al. 1999:96–98 Polk et al. 2001:3.121–3.140
LA 127503	Artifact scatter dating to the Late Statehood period. The site is probably part of the town of Elkins. Diagnostic materials included historic artifacts.	Crawford et al. 1999:98–99 Polk et al. 2001:4.3–4.5
LA 127504	Artifact scatter with feature, with Jornada Mogollon materials. Diagnostic artifacts included Jornada Brown Ware, El Paso Brown Ware, and El Paso Polychrome sherds. The only feature was a hearth.	Crawford et al. 1999:99–101 Polk et al. 2001:3.141–149
LA 127506	Artifact scatter dating to an indeterminate prehistoric period occupation. The artifacts included flaked stone and burned caliche but no temporally or cultural diagnostic artifacts were recovered.	Crawford et al. 1999:106 Polk et al. 2001:3.149-156
LA 127507	Artifact scatter from an indeterminate prehistoric period occupation. The artifacts included flaked stone and burned caliche but no temporally diagnostic artifacts were recovered.	Crawford et al. 1999:106–107 Polk et al. 2001:3.156–3.161

Table 1.1. Previously Recorded Sites in the Project Area (Continued)

Site Number	Description	References
LA 127511	Multicomponent artifact scatter with features containing materials dating to the Jornada Mogollon occupation and the Late Territorial to Statehood periods. Diagnostic artifacts included Chupadero B/W sherds and historic artifacts. The features included prehistoric hearths.	Crawford et al. 1999:113–114 Polk et al. 2001:3.162–3.177
LA 127514	Euroamerican artifact scatter with features. The site is part of the town of Kenna. Diagnostic materials included historic artifacts.	Crawford et al. 1999:119–120 Polk et al. 2001:4.5–4.8
LA 127517	Multicomponent artifact scatter with feature, from the Jornada Mogollon occupation and Early Statehood to WW II period. Diagnostic artifacts included Chupadero B/W and historic artifacts. The feature was a Historic period trash dump location.	Crawford et al. 1999:124–125 Polk et al. 2001:3.178–3.187
LA 127518	Multicomponent artifact scatter with Archaic and Territorial to Early Statehood period materials. Diagnostic materials included three Archaic period projectile points and historic artifacts.	Crawford et al. 1999:128–129 Polk et al. 2001:3.188–203
LA 127519	Artifact scatter from an indeterminate prehistoric period occupation. The artifacts included flaked stone, ground stone, and burned caliche but no temporally diagnostic artifacts were recovered.	Crawford et al. 1999:129–130 Polk et al. 2001:3.203–3.211
LA 127523	Artifact scatter with features dating to the Statehood period. Diagnostic materials included historic artifacts and the remains of a residential structure.	Crawford et al. 1999:130–131 Polk et al. 2001:3.212–3.223
LA 127524	Artifact scatter and features dating to the Late Statehood Period. Diagnostic remains included historic artifacts. The features included a house foundation and a root cellar. The house was associated with the nearby town of Elida.	Crawford et al. 1999:138–139 Polk et al. 2001:3.224–3.236
LA 130557	Artifact scatter with materials from the Jornada Mogollon occupation. Diagnostic artifacts included El Paso Brown Ware sherds.	Polk et al. 2001:3.236–3.241

Archaeologists working for HSR ecavated LA 75160, a scatter of flaked and ground stone, and tested LA 75163, a multi-component artifact scatter containing Archaic, Jornada Mogollon, and Historic artifacts (Sechrist and Laumbach 1991). The Office of Archaeological Studies then exavated LA 75163 more intensively in 1994, as part of a bridge replacement and associated highway widening project (Wiseman 2000).

In 1987 and 1990, Charles Haecker of the NMSHTD Environmental Section performed three separate surveys in the project corridor. The two 1987 surveys did not locate any cultural resources; during the 1990 survey, Haecker examined two sites that were previously recorded by HSR and a newly discovered historic trash dump (Haecker 1987a, 1987b, 1990).

In 1995, the Office of Contract Archaeology, University of New Mexico conducted a survey and data recovery for the MAPCO pipeline, which crosses US 70 just south of Railroad Mountain (Bradley and Brown 1998, Brown 1998), but did not discover any archaeological sites along US 70. A year later, Christian Zier (1996) of Centennial Archaeology recorded a historic site within the project corridor (LA 107641, which was not chosen for testing) during a pipeline survey that crossed US 70.

In 1999, the Agency for Conservation Archaeology, Eastern New Mexico University surveyed the entire US 70 project corridor. Of the 53 sites recorded by ACA, 21 (including nine previously recorded sites) were in the current project area (Crawford et al. 1999). As part of the survey, Quivira Research completed an inventory of standing structures along US 70 (Condie 1999). In 2000, SWCA tested the 21 sites and conducted archival research on three other sites (Polk et al. 2001). Eight sites were recommended for data recovery, which was completed in 2001. The results of the data recovery are described in this report.

Several archaeological overviews and related documents are also relevant to the project area. In the 1970s, Camilli and Allen (1979) developed a cultural resources overview for the Roswell District of the Bureau of Land Management. In the early 1980s, Stuart and Gauthier (1988) addressed this area in their statewide review of cultural resources. In the late 1980s Sebastian and Larralde (1989) developed a cultural resources overview for southeastern New Mexico, and in the early 1990s Katz and Katz (1993) again examined that portion of the state. Shelley (1994) provides a geoarchaeological and technological evaluation of the Archaic period on the Llano Estacado and adjacent areas. Finally, Steve Hall (2002) of the University of Texas at Austin conducted geomorphological fieldwork south of the project area to characterize the Mescalero Sands east of Roswell.

CULTURAL SETTING

Humans have inhabited the Middle Pecos River Valley and the adjacent Llano Estacado for at least the last 11,000 years. This occupation reflects a sequence of cultural development stretching from hunting and gathering, through the development of agriculture, to historic and modern life. The culture history of the region is commonly divided into four broad periods—Paleoindian, Archaic, Jornada Mogollon, and Historic—each of which is typified by different cultural adaptations.

Paleoindian Period (10,000–5500 B.C.)

The Paleoindian period is usually dated from 10,000 to 5500 B.C., though recent studies suggest that it may have begun a few thousand years earlier (Fiedel 1999). The regional climate during this period was colder and wetter than in subsequent periods, and the local environment probably included savanna-like settings, with larger game and a greater diversity of fauna and flora than were present in historical times.

Paleoindians in the American Southwest are generally portrayed as small bands of highly mobile hunters who preyed primarily on large mammals that are now extinct (e.g., mammoths, bison, sloth, camelids, and horse). There is increasing evidence that Paleoindians in other regions also hunted smaller animals and collected wild plant resources, however, raising the possibility that some Paleoindian groups in the Middle Pecos River Valley and the Llano Estacado might have employed a more generalized subsistence strategy.

Three Paleoindian complexes have been identified in the region, based on morphologically distinct projectile point styles. The Clovis complex is the oldest of the securely dated occupations. It is characterized by fluted points often associated with remains of mammoths, as well as a well-developed general biface and blade technology (Bradley 1993; Collins 1999:45–71; Gunnerson 1987:10). The Clovis complex lasted from about 12,000 years ago to perhaps as late as 10,500 years ago, and spread throughout North America. Clovis period sites are rare, but several are found near the project area. The type site for the complex, Blackwater Draw (Hester 1972), is just north of Portales. The D.S.E. El Paso Pipeline project located a Clovis point on a site in Chavez County, and a mammoth tusk was found eroding from a nearby arroyo (Phippen et al. 2000:32). Bond (1979) reported additional Clovis period remains from the Haystack Mountain area near Roswell.

The Folsom complex is dated from 9000 to 8000 B.C., and is characterized by points that are generally smaller and more extensively fluted than Clovis points. Hunting focused on now-extinct forms of bison. Folsom remains were found in the area by

Bond (1979) and by the D.S.E. El Paso Pipeline project (Phippen et al. 2000:33). A reworked fluted tool fragment was also recovered from a site about 5.6 km (3.5 miles) northeast of LA 2713 during the MAPCO pipeline project (Brown 1998).

After about 8000 B.C., people began to make new varieties of constricted-base and indented-base projectile points that were laterally thinned. The appearance of these point styles marked the beginning of the Late Paleoindian period, generally called the Plano tradition, which lasted until about 5500 B.C. The complex subsumes a variety of point types, of which the Agate Basin type was perhaps the most common in the area. Compared with the preceding traditions, the Late Paleoindian hunters focused more exclusively on bison, which were then restricted to the Great Plains and adjacent grasslands. As a result, the Plano Complex remains are rare in the study area, and were perhaps largely limited to the Llano Estacado. Agate Basin remains near the study area include butchering tools associated with bison remains found in the Portales level at Blackwater Draw (Agogino and Rovner 1969). Beck and Schermer (1981) also mention an Agate Basin point from the otherwise unreported McCullum site near Blackwater Draw.

Agate Basin, Eden, Plainview, and Firstview projectile point fragments were found during the Haystack Mountain and the D.S.E. El Paso Pipeline projects (Bond 1979; Phippen et al. 2000:33). An additional Agate Basin projectile point base was recovered from LA 127494, a Historic period site that was part of the town of Delphos, during the testing phase of the current project. Although its context suggested that the point was collected by a Euroamerican, Agate Basin materials may have been exposed nearby. A Paleoindian blade probably dating to the Plano Complex was also recovered at LA 75159, a multicomponent artifact scatter (Polk et al. 2001:3.37).

The end of the Paleoindian period coincides with the demise of the winter-dominant precipitation pattern characteristic of the early Holocene, and the onset of a climatic regime more like today's. Irwin-Williams (1979) argues that by 5500 B.C., climatic conditions in the Southwest were unfavorable for bison, forcing Late Paleoindian groups to withdraw to the central and northern Plains (outside the project area) in order to maintain their focal hunting economy.

Archaic Period (5500 B.C.–A.D. 750)

In contrast to the hunting economy of the Paleoindian period, the predominant subsistence pattern during the Archaic period is a “diffuse” economy in which a wider variety of wild plants and animal resources were exploited (Judge 1982:49). The lifeways of people living in the region were most likely similar to those of historic hunters and gatherers in arid environments. Small residential groups, probably composed of related individuals, spent much of the year moving among a series of localities where water was available and food was seasonally abundant. Crawford et al. remark:

> The necessity of water kept these bands within easy striking distance of fresh water, topographically limiting desirable campsites, forming the sites we now see through repeated use. In essence, much of what we determine to be cultural “sites” from this rather nomadic period is probably the accumulation of re-use of the more desirable campsites. In addition, group size and composition likely varied in response to changing economic opportunities, as smaller task groups periodically moved out of residential camps to procure resources in more distant areas [Crawford et al. 1998:18].

Archaic sites lack pottery; they often have flaked stone assemblages that reflect bifacial reduction and ground stone assemblages that include slab or basin metates, reflecting an emphasis on processing wild seeds (Hard et al. 1996). Shallow pit houses are increasingly being documented in Archaic sites across the American Southwest, though such structures may have been used only at winter base camps (e.g., O’Laughlin 1980). Furthermore, Archaic peoples at Blackwater Draw and perhaps in the rest of the region are known to have dug wells near springs and ponds (Evans 1951).

The most diagnostic artifacts on archaic sites are atlatl dart points. These points can vary greatly in shape and usually look less well-made than Paleoindian points. If the different morphological types

reflect different ethnic or kinship groups, the great variety of point forms from Archaic sites in southern and southeastern New Mexico may indicate that several different Archaic groups used the area (McNeish 1993:398; Phippen et al. 2000:468–470; Sebastian and Larralde 1989:42). Another possibility is that the different point types reflect reworking and repair of broken points (Flenniken and Wilke 1989).

Because of the more-or-less stable ground surface from 5000 BP to historic times, and subsequent dune formation, most local Archaic period sites lack stratigraphic integrity. Archaeologists have consequently had considerable difficulty developing a local temporal and cultural sequence for these sites (Crawford et al. 1999:18; Shelley 1994). Elsewhere in the Southwest, however, more highly structured archaeological deposits have been found, which demonstrate significant similarities in Archaic period subsistence patterns across the entire region (Huckell 1996). As a result, archaeologists have increasingly adopted a simple three-part division of the Archaic that was developed by Bruce Huckell (1996) for the entire American Southwest: the Early Archaic period, the Middle Archaic period, and the Late Archaic/Early Agricultural period.

During the Early Archaic Period (6000–3200 B.C.), sites interpreted as base camps were created near permanent water (Huckell 1996:332–333; Irwin-Williams 1973). Special activity sites were also found near ephemeral ponds and on low mesas. Cobble-filled hearths and earth ovens appeared at some sites after 4800 B.C. Flaked stone assemblages included a large number of heavy chopping tools and crude side scrapers.

Sites from the Middle Archaic period (3200–1800 B.C.) occur in the same basic locations as the Early Archaic sites, but tend to be larger. Base camp debris was more concentrated, and cobble-filled hearths and earth ovens increased in size and complexity. This evidence, along with changes in grinding stone morphology, suggests that resource procurement was more intensive than during the Early Archaic—with populations systematically exploiting the most productive micro-environments in the region over the course of an annual cycle (Huckell 1996:337–338; Irwin-Williams 1973:7–9). Unfortunately, few Early or Middle Archaic sites have been excavated in the Middle Pecos River Valley and the adjoining Llano Estacado, so it is difficult to say whether the described patterns extend into the project area.

Late Archaic period (1800 B.C.–A.D. 750) sites are much more common in the area. The Late Archaic period spans the time during which cultigens, especially maize, were introduced into the Southwest (Huckell 1996:343). The Late Archaic period also appears to have seen a trend towards larger populations, more localized and intensive land use, and the development of increasingly permanent “base camps” (e.g., Irwin-Williams 1979).

In eastern New Mexico, an increase in the number of Late Archaic sites suggests that here, too, population levels increased through time. More than half of the Archaic sites tallied by Sebastian and Larralde (1989:43) postdated A.D. 1. These sites also appear to reflect an increased use of more limited resources.

Research by Susanna Katz and Paul Katz in the Brantley Reservoir area, on the Pecos River near Carlsbad (Katz and Katz 1985a, 1985b; see also Katz and Katz 1993), provides a local alternative to the regional models just reviewed. The sites studied by the Katzes date between 3,000 B.C. and A.D. 750 and are generally open-air camps clustered near the river. Through time, sites became more common and showed evidence for increasingly heavy use of upland resources including agave and sotol. However, there is little to no evidence of early use of domesticates or significant changes from a broad spectrum hunting and gathering subsistence strategy in or around the project area. The Katzes' research shows that the regional trends documented by scholars such as Irwin-Williams (1979) and Huckell (1996) do not automatically apply to southeastern New Mexico.

Several Late Archaic sites have been found near the project area. The DSE El Paso pipeline survey recorded a Late Archaic site, LA 107639, near several playas that are adjacent to US 70, about 9 km (5.5 miles) east of LA 2713. A Late Archaic component was identified at LA 75159 and perhaps

also at 127518 during ACA's survey of the project area (Crawford et al. 1999:58,128). Archaic period components were also recorded at LA 2713, 75159, 75163, and 127518 during the excavations conducted by SWCA and reported in this volume.

Ceramic Period (A.D. 750–1350)

As is evident from Table 1.1, many of the known archaeological sites in and near the project area are described as Jornada Mogollon (see Corley 1965; Leslie 1979). The obvious difference between this period and the preceding Archaic period is the use of pottery. Along the Pecos River north of the study area, created somewhat sedentary communities including pottery and pit structures, beginning about A.D. 750 (Jelinek (1967; see Stuart and Gauthier 1988:270–274). Wiseman (2000:7) has documented pockets of comparatively more sedentary occupations in the Roswell area. Based on site records, a few locations east of the Pecos River, below the Llano Estacado, were probably seasonal villages. Even so, local populations were probably highly mobile compared to contemporaneous groups in western and northern New Mexico, and some areas reflects the continuation of Archaic period mobility and subsistence strategies (Lord and Reynolds 1985; Phippen et al. 2000:34; Roney 1985; Wiseman 1985). Lord and Reynolds (1985:237) have dubbed these highly mobile hunters and gatherers the “Neo Archaic,” and characterize them as people applying the same subsistence practices used during the Archaic (except for the use of the bow and arrow). The apparent continuation of Archaic life ways can be explained in a variety of ways (see Phippen et al. 2000:34–35; Wiseman 2000:13), but it is likely that "more sedentary" and "more mobile" groups shared the resources of the area over a period of centuries (see Sebastian and Larralde 1989:83). Wiseman (2000:13) has noted, though, the difficulty in differentiating between occasional hunting and gathering sites created by more sedentary groups and sites created by full-time hunters and gatherers, and cautions against wholesale acceptance of the hypothesis that two distinct types of groups were present.

Despite our poor understanding of the period, archaeologists have been able to develop a sequence for the area. This sequence reflects Anasazi and Mogollon cultural development to the west, but on a more modest scale, especially in the use of domesticated crops (Stuart and Gauthier 1981:275). Trade wares at many sites indicate that local people had sustained contact with their more westerly neighbors (e.g., Wiseman 2000:104). The phase sequence is outlined below.

The Early 18 Mile Phase (A.D. 750–850) reflects the development of the first "more sedentary" settlements in areas suitable for maize cultivation, although wild plants were still heavily used (Jelinek 1967:114). Lino gray ware is the most common pottery type, but pottery is rare.

The shift toward more sedentary settlement continued during the Late 18 Mile phase (A.D. 900–1000) . Shallow pit houses and small contiguous surface rooms were used in some areas (Stuart and Gauthier 1981:272). Continued contact with the eastern Anasazi is indicated by similarities in architectural forms and the presence of pottery types such as Red Mesa Black-on-white (Stuart and Gauthier 1981:273).

In the Mesita Negra Phase (A.D. 1000–1200), increased trade with distant regions is reflected in the appearance of pottery from the Mimbres area, west-central New Mexico, and the Chaco area. Recorded pottery types include Red Mesa, Socorro, Mimbres, Reserve, and Chupadero Black-on-white. Site size and frequency also increased (Stuart and Gauthier 1981:273), perhaps reflecting a more intensive occupation of the region. Subsistence still included an emphasis on wild resources, with limited maize horticulture. Small, simple fire-cracked rock features were replace by larger, formal middens of burned rock, perhaps indicating more intensive use of local resources and more sustained use of specific locations (Phippen et al. 2000:473).

Only a few McKenzie phase (A.D. 1200–1350) sites are known, but they tend to be rather large compared to earlier sites (Shields and Laumbach 1989:25). Pottery includes small amounts of St. Johns Polychrome, Santa Fe Black-on-white, and Three Rivers Red-on-terracotta. The frequency of *Zea* pollen dropped, suggesting a decreased reli-

ance on maize; the number of bison bones in sites increased, indicating an increased emphasis on that species.

Late Prehistoric and Protohistoric Periods (A.D. 1350–1700)

After about A.D. 1350, there is no evidence of sedentary communities in southeastern New Mexico. Bison hunting appears to have been common, suggesting the resurgence of bison in the western High Plains (Stuart and Gauthier 1988:274). Most sites appear to be temporary camps, marked by scatters of flaked stone and pottery. Jelinek (1967) argues that the people living in his survey area north of Roswell, and perhaps across the entire area, abandoned farming in favor of bison hunting.

The primary Protohistoric period occupants of the area may have been Jumano nomads, bison hunters who were closely allied to villages on the lower Rio Grande to some of the New Mexico pueblos (Spielmann 1982, 1983). A single Glaze D sherd found at LA 75159 may reflect their presence (see Polk et al. 2001). The Apache appeared on the southern High Plains by the mid-1500s, and quickly dominated the area (Gunnerson 1979).

Non-Diagnostic Lithic Artifact Scatters (10,000 B.C.–A.D. 1700)

Many sites in southeastern New Mexico cannot be placed in the previously outlined sequence, because they lack diagnostic artifacts. These sites are commonly scatters of flaked stone, sometimes with ground stone (Sebastian and Larralde 1989). Many of the scatters likely most date to the Paleoindian and Archaic periods, but the continued use of such artifacts by "Neo Archaic" and early Athabaskan peoples makes it impossible to date the sites when diagnostic artifacts such as projectile points are not found. All of these sites are likely to predate A.D. 1700, after which the Native Americans in the region relied on metal tools.

Non-diagnostic lithic artifact scatters comprise a significant portion of the local archaeological record. For example, 19 of the 31 prehistoric sites recorded during the US 70 survey were stone artifact scatters of unknown age. These sites constitute a unique subset of the region's archaeological record, and special care is needed to examine their assemblages to possibly identify subtle technological differences that might allow them to be integrated into the larger cultural-historic sequence.

Historic and Recent Periods (A.D. 1700–Present)

Native American populations, as well as Spanish and other Euroamerican people, used the region after A.D. 1700. However, little is actually known about both Native American and early European occupations before the mid-1800s, because of a lack of documentary evidence and the use of hunting and gathering strategies that resulted in a nearly invisible archaeological record (Sebastian and Larralde 1989:93). It is clear, though, that the Mescalero Apache were the primary occupants of eastern New Mexico by 1700. Later, the Comanche also began to use the region.

In the mid-1500s Coronado was the first European to explore eastern New Mexico and the adjacent portion of the Southern High Plains, though his exact route through the region is unknown (Crawford et al. 1999:21). The Spanish later sent military parties through the area, including along the Pecos River, and began to trade with the Plains Indians, especially after the colonization of the Southwest started in 1598. Nonetheless, southeast New Mexico lay beyond the effective Spanish control; until about 1820, New Mexico's Hispanic population was largely confined to the Rio Grande Valley and the uppermost Pecos River (Shields and Laumbach 1989:27).

Substantial Euro-American occupation of the region began after the Mexican War in 1848 (Sebastian and Larralde 1989:117). Military posts were built at Fort Stanton (1855-1896) and Fort Sumner (1862–1868; Frazer 1972:103–104), allowing and encouraging Euroamerican colonization. A freight and stage route between Amarillo and El Paso was established along the modern route of US 70 in 1865, and was used until 1905 (Williams 1986:117–119). Westward emigrants also used this route. By 1880, military conflict between Euroamericans and Native Americans ended as the Comanche were pushed farther onto the plains and the Mescalero Apache were con-

fined to a reservation (Sebastian and Larralde 1989:110–117).

Cattle ranchers were attracted to the pasture along the Pecos River Valley and later on the Llano Estacado. In 1866, Charles Goodnight and Oliver Loving pioneered a cattle trail up the Pecos River, partly to supply beef to the Navajo at Fort Sumner (Pratt and Scurlock 1989:93–94; Sebastian and Larralde 1989:119; Wallis 1957:17). Texas cattlemen seeking new markets after the Civil War quickly followed suit, and the Goodnight-Loving trail was eventually extended to southern Colorado (Simmons 1977:158). John Chisum, who was later called the "Cattle King of America" (Wallis 1957:52), established his headquarters near present-day Roswell and created one of the largest open range ranches in the country, covering most of southeast New Mexico. Other open range ranchers also moved into the area (Meinig 1971:Fig. 4-1) and the first ranch was established along the US 70 corridor by 1881. By 1885, smaller holdings in the area were absorbed by larger ranches such as George W. Littlefield's LFD ranch (Crawford et al. 1999:24–25). In 1889, drought forced a significant decrease in the number of cattle grazing the region, and other economic strategies began to have greater success.

The 1862 Homestead Act promoted settlement in the West by allowing settlers to acquire 160 acres of government land once they lived on the land for five years and made certain improvements to their holding (Pratt and Scurlock 1989:307; Sebastian and Larralde 1989:122). A typical homestead in eastern New Mexico consisted of a dugout, a well, a windmill and water tank, and an outhouse. Additional buildings were also common (Pratt and Scurlock 1989:117). The dugouts were commonly built on south facing slopes (Pratt and Scurlock 1989:118).

Many homesteads were built in eastern New Mexico, but the barrenness of the area and the scarcity of water made it difficult for them to succeed. Ranchers often in fact encouraged homesteading in and on their ranches in the hope that the homesteaders' eventual failure would allow the ranchers to purchase government land at favorable prices (Pratt and Scurlock 1989:95). The potential for successful dry-land homesteading improved during the late 1800s, when water wells began to be drilled (Bauroth 1998:48). By 1901, small towns such as Floyd, Bethel, Kenna, Elida, and Arch were built (Crawford et al. 1999:26).

Homesteading was also stimulated by the expansion of railroads, which connected formerly remote locations to national markets. In 1885 J. J. Hagerman created the Pecos Valley and Northeastern Railroad (PV&NE) and in 1899 completed a link between Roswell and Clovis that ran through Portales, Cameo, and Texico (Myrick 1990:44). The PV&NE was soon after acquired by the Atchison, Topeka & Santa Fe (AT&SF) (Myrick 1990:40–44). This railroad was later linked with a mainline route from Belen, New Mexico, and Clovis became a railroad hub for eastern New Mexico (Pratt and Scurlock 1989:142).

Private investors founded towns along the new railroad lines, many of which are in or near the project area. One of the earliest of these was Kenna, which is about 35 miles southwest of Portales along US 70. Kenna was originally named Urton and was built in 1881, as a shipping point for cattle from the T 71 ranch (Pearce 1965:78). A railroad station was built in 1899, and Kenna grew into one of the most important cattle shipping points in the region. Will McCombs, an early rancher in the Kenna area, reported seeing as many as 13,000 cattle shipped from Kenna in one year (Taylor 1991:5). Taylor (1991:13) cites an *Albuquerque Journal* article from 1908 that stated that Kenna was a vibrant town with a population of 500.

Delphos, another town along the railroad lines, was established about 12 miles southwest of Portales in 1905 (Pearce 1965:46). It is now defunct, but its post office operated until 1940.

Kermit was built about 15 miles southwest of Portales (Pearce 1965:79) in 1906. It was originally named Plateau. Kermit is now defunct but its post office operated until 1918.

Boaz was established about 40 miles northeast of Roswell in 1907. It served as a freight and passenger depot and a mail stop for the surrounding homesteads and ranches, as well as a cattle ship-

ping point (Pearce 1965:19). Its post office closed in 1955 and the town is now defunct (see also Polk 2003).

Acme was established about 25 miles northeast of Roswell in 1906, when the Acme Gypsum Cement Plant built a mill to produce plaster and cement block (Pearce 1965:2). The plant operated until 1936 when, high freight rates caused the plant to end production. The town's post office remained open until 1946. The town is now defunct.

Not all of the railroad communities in this area died. Elida, which is 25 miles southwest of Portales, was established in 1902. It has continued as a viable community, although it has struggle economically in recent decades.

Although in hindsight many of the railroad towns were doomed to be short-lived, in the early 1900s the railroad's arrival seem to guarantee the area's prosperity. The railroad allowed the development of a network towns and facilitated the movement and sale of local agricultural crops and cattle (Bauroth 1998:39). It also brought manufactured goods into the area, and the use of sawed lumber, bricks, cast stone, and glass increased dramatically. The construction of towns and more formal structures in turn encouraged engineers, masons, carpenters, and architects to move into the area, which in turn led to the presence of new building styles (Pratt and Scurlock 1989:212–219). By the first decade of the 1900s, homesteading had surpassed cattle ranching as the most significant economic strategy in the area.

The importance of homesteading further increased relative to ranching after 1904, when the government ordered the ranchers to remove their cattle from the public domain and “nesters” poured into the region by the hundreds (Taylor 1991). The influx is reflected in the number of homestead sites recorded during the preliminary survey. Of the 38 Historic period sites recorded during the survey, 10 have late Territorial period components (see Table 1.1).

The subsequent history of the area parallels that of the adjacent portions of Texas and New Mexico. Southeast New Mexico did experience an economic boom after World War II as a result of the development of local oil and gas fields, but the effects of this economic expansion was felt mainly south and east of the project corridor. The United States military continues to be important to the region. Cannon Air Force base was established near Portales in 1942 and is a significant employer. In 1959, at the height of the Cold War, US 70 also became the home of Atlas ICBM silos, at Bob Crosby Draw, High Lonesome, and Elkins. (Dirt and stone excavated during the construction of the 180-foot deep silo at Bob Crosby Draw covers the northeastern portion of LA 75159.) The silos were deactivated in the mid-1960s. Today, the primary economic activities in southeast New Mexico are oil and gas extraction, ranching, dairy farming, and irrigation farming.

According to a 1916 B.F. Goodrich highway map on file at SWCA, by that year a "secondary" motor route paralleled the railroad between Roswell and Portales. A 1923 state highway map shows that within a few years, an official "rural highway" (mostly just graded) extended between the two towns, but diverged from the railroad between the Pecos River and Kenna. At the river, the road swung northeast, then turned due east to cross the railroad at Elkins. The road then turned due north to rejoin the railroad at Kenna. By 1929 this route was designated a “first class” (year-round, actively maintained) road and a federal highway, US 366. Maps issued in 1932 and 1936 show that by then, US 366 was renamed US 70 and was partly paved. By the late 1930s the entire road had been paved and followed its present route. Other improvements (including minor alignment changes) have continued to the present, resulting in today's four-lane configuration.

Chapter 2

DATA RECOVERY PLAN AND METHODS

Based on the test excavations by SWCA (Polk et al. 2001), eight sites were selected for additional data recovery efforts (Table 2.1). Limited data recovery was recommended for two of the sites and the recommended data recovery did not include excavations within the project corridor for a third site. Thus, only five of the 21 testing phase sites were recommended for extensive data recovery.

Table 2.1 Recommended Data Recovery by Site and Components

LA No., Ownership	Paleoindian	Archaic	Jornada Mogollon	Historic
2713 NM State Trust		X	X	
75159 Hwy./Private	X	X	X	Probably no Historic DR
75163 Hwy./Private		X	X	Probably no Historic DR
75164 Hwy./Private				Non-disturbing DR outside ROW
127502 Hwy./Private			X	Limited DR
127511 Hwy./Private		X	X	Limited DR
127518 Hwy./Private		X		Probably no historic DR
130557 NM State Trust			X	

(X = data recovery effort)

The project hoped to examine Paleoindian period components at one site (LA 75159), Archaic period components at five sites, and Jornada Mogollon components at six sites. It was also possible that one or more Jornada Mogollon sites would yield evidence of slightly later Protohistoric period remains. Six sites with historic Euroamerican remains were also selected for data recovery, although this included the investigation of the portion of LA 75164 outside of the highway corridor using non-intrusive methods.

The remainder of this chapter outlines the plan forfieldwork, analysis, and interpretation for all of the sites recommended for data recovery. The plan defined four problem domains, which in most cases included specific research questions. Each problem domain led to the definition of specific data needs. In turn, the data needs led to the definition of specific research protocols, tailored to yield the types of information that were most likely to address the problem domain and research questions. The plan then defined general field and laboratory methods, to be practiced regardless of the

problem domain being addressed. Finally, the plan defined laboratory and curation methods for the project.

Much of the research design that follows hinges on a specific approach to deciphering dune field sites. In practice, the proposed approach didn't work, and a new interpretive approach was adopted in mid-project. We will present the approach as it was proposed, then discuss the changes that were necessary to adapt the research design to our changing understanding of archaeological sites along the US 70 corridor.

PROBLEM DOMAIN I: DEFINING CONTEXT

Problem Statement

The dune fields of southeast New Mexico contain thousands of archaeological sites, but in most cases the interpretation of dune field sites is frustrating. At the end of a study we know that people camped at a place during some period—the exact period may not be known. We also know that they hunted for large and small game, and gathered wild plant foods in season. If the site is small, we assume that the group was small; if the site is large, we suspect that the group may have been large —or perhaps a small group used the site several times. How many more sites must we excavate to reach the same conclusions?

Part of the problem is the use of field approaches developed in more static environments. Most sites in dynamic settings are soon destroyed; if traces survive, those traces are judged to lack integrity and are dropped from the historic preservation process. Instead, Southwest archaeologists have focused most of their energies on sites in stable settings. Most such sites were, moreover, occupied for a few years to a couple of generations, so superpositioning and human reworking of archaeological deposits was minimal. The sites often consist of a single use surface with associated features and artifact concentrations. One can usually dig such sites with little regard to geostratigraphic relationships and still derive a coherent picture of site history.

In contrast to these "standard" Southwestern sites, dune field sites are in a dynamic environment, yet were not destroyed. They cannot be ignored, but digging them like a "standard" Southwestern site yields little information. Taking such an approach, prehistoric use surfaces are rarely defined—if stable surfaces existed when the site was occupied. Formal features are rare—and in some contexts it may be a mistake to expect them. Once in a while, archaeologists encounter a site where behavioral patterning is obvious—but serendipity is not the answer for most projects. In such contexts it may be more appropriate to study buried archaeological remains more as paleontologists traditionally studied fossil remains, as a series of associations within very carefully defined stratigraphic units.

We are a long way from efficiently extracting buried information from dune field sites, but one obvious step is to do a better job of defining geostratigraphy within the dunes. In the long run there should be a double payoff from this approach. First, geostratigraphic interpretation can help date sites in the absence of diagnostic artifacts or radiocarbon samples. Second, geostratigraphic interpretation of dune deposits within a site – if carried out hand in hand with excavation, not just as an afterthought – can guide archaeologists in defining sequential assemblages that would otherwise be jumbled together during data recovery. Third, reconstructing the histories of dune fields will provide information on changes in the local environment, and thus on changes in the context of changing human adaptations. For agencies (including the NMSHTD) that will sponsor future archaeological studies in dune fields, an attempt to improve geostratigraphic interpretation of those dune deposits is an investment in improving the information return (and thus the cost effectiveness) of future studies.

In 2000, Stephen Hall pointed out that there are few carefully studied dune sequences in the region – the Chaco dune field of northwest New Mexico (Hall 1983a, 1983b, 1990; Wells et al. 1990; see also McFadden 1998, 2000); the Monahans-Midland sand hills and High Plains lunette fields, mostly in west Texas (Holliday 1997; Holliday and Meltzer 1996; Wendorf et al. 1955); and the GBFEL-TIE project area of the southern Tularosa

Basin (Blair et al. 1990; Doleman and Blair 1991; Johnson 1997; Monger and Buck 1995). The sequence in southeast New Mexico, between the Pecos River and the Llano Estacado, had not been studied in detail and was usually interpreted (if at all) by extrapolation from the GBFEL-TIE area. SWCA therefore proposed to use the US 70 geomorphology to assess the applicability of the GBFEL-TIE model to local sites. We will begin our review of the proposed assessment by summarizing the model, then will turn to proposed procedures for assessing its local applicability.

THE GBFEL-TIE MODEL

Overview

In the GBFEL-TIE project area, four stratigraphic units are relevant to cultural resource management needs (Blair et al. 1990). Underlying these units are the sands and gravels of the mid-Pleistocene upper unit of the Santa Fe Group—locally, the Camp Rice Formation. In areas where erosion has been substantial, artifacts may occur as a deflation lag on top of exhumed Camp Rice sediments.

The later stratigraphic units consist of eolian sandsheet, arroyo, and arroyo-mouth pond deposits. Each unit consists of sediments laid down in all the environments in which sediment could accumulate at the time. Each unit can be differentiated by the presence or absence of primary depositional structures, degree of soil formation, and (to a much lesser extent) sediment texture. Degree of soil formation is probably the most diagnostic factor in recognizing different deposits. Soil development implies a stable surface—one that is available for human occupation for a long period. The better developed the soil, the longer the surface was stable. Artifacts on such surfaces result from occupation of that surface, from erosion of overlying sediments and the formation of an artifact lag on the surface, or both.

Unit Q1 immediately overlies the Camp Rice Formation. The diagnostic attributes of Q1 are its advanced stage of soil development and the presence of thick, fine-sediment layers within the deposit. In general, the uppermost portion of the unit, regardless of deposit texture, consists of a Stage III carbonate horizon (characterized by carbonate that has filled the voids between sediment grains, turning it pale and making it cement hard). The carbonate content of Q1 ranges from 50 to 300 g/cc. The K horizons can be more than 1 m thick. K horizons generally form at depth, so the presence of the K horizon at the deposit surface implies erosion of the overlying soil (the A horizon and part of the B horizon). In spots where this erosion was incomplete, a Btk horizon is preserved. Q1 is also characterized by thick mud deposits associated with its arroyo mouths, suggesting sedimentation in large, long-lived ponds. Q1 dates between 50,000 and 250,000 years ago. Artifacts should not be found in this deposit and shovel testing and excavation of Q1 would be fruitless.

There is a significant time gap between the end of Q1 deposition about 50,000 BP and the beginning of Q2 deposition about 15,000 BP. Although soil development in Q2 is weaker than in Q1, it is stronger than in the overlying (younger) deposits. Q2 soils are distinguished by their Stage II carbonate development (in which the carbonate occurs as filaments, root casts, ped-face coatings, and concretions). Carbonate is uncommon in the voids between sediment grains. The maximum carbonate content is 20-75 g/cc. Where pedogenic clay is present on grain and ped surfaces, the deposit is hard to very hard when dry and has an angular to subangular blocky structure. Where pedogenic clay is not present, the deposit is softer and has a single-grain to blocky structure. As with Q1, the A horizon is not preserved, indicating removal through erosion of part of this deposit. The period of Q2 deposition and soil development ended around 9400 BP. Artifacts occurring in this deposit should be early Paleoindian; artifacts on the Q2 surface should be late Paleoindian to early Archaic.

Q3 is characterized by very weak soil development consisting of a weak, darkened A horizon and a B horizon enriched by clay (Bw) or carbonate (Bk). Dry consistency is soft to slightly hard (crushes easily between the fingers) and pedogenic structure is weak. Where a carbonate horizon is present, it is typically Stage I, consisting of disseminated carbonate, filaments, root casts, and rare concretions. The A horizon is rarely preserved. Q3 is thought to

date from 7300 to 100 years BP. Cultural materials preserved in the Q3 deposit should postdate the start of the Early Archaic and continue through the 1800s.

Q4 consists of currently active sediments. It is distinguished from other deposits by the presence of sedimentary structures (crossbeds, etc.) and the absence of pedogenic modification. Q4 is thought to have been actively forming over the past 100 years.

Blair et al. (1990) correlate the GBFEL-TIE units with ones defined by the Desert Project (Gile et al. 1981) near Las Cruces. According to Blair et al., Q1 equals the Desert Project's Jornada II alluvium, Q2 equals the Isaack's Ranch (Leasburg) alluvium, Q3 equals the Organ (Filmore) alluvium, and Q4 equals Recent alluvium. The implication is that the GBFEL-TIE model correlates to a more regional stratigraphic sequence. Both Blair et al. (1990) and Gile et al. (1981) point to changing climate and its effects on vegetation as the primary controls on regional sedimentation, with periods of aridity leading to vegetation loss and sediment mobilization. If this argument is correct, the same episodes of sedimentation, surface stabilization, and soil development should have occurred throughout southeastern New Mexico and west Texas.

APPLICABILITY OF THE GBFEL-TIE MODEL

While the GBFEL-TIE model might apply to southeast New Mexico, that applicability remained to be verified. In early 2001, under a grant from the N.M. Historic Preservation Division, Dr. Hall began evaluating the issue during the same time that SWCA conducted the data recovery efforts reported in these volumes. He completed his research in 2002 and defined a new sequence (Hall 2002), which was not yet available during the current data recovery efforts.

Hall's study centered on southeast Chaves County. During the US 70 data recovery effort, SWCA proposed to conduct a parallel study of the US 70 corridor between Roswell and Portales. The goals of the US 70 geomorphology study were (1) to identify the geomorphic context of archaeological deposits, (2) to evaluate the applicability of the GBFEL-TIE model to the project corridor (or, if it does not apply, to define an alternative), and (3) to evaluate the applicability of the sequence proposed by Hall (2000).

Data Needs

The obvious need is for multiple exposures of local dune deposits, including in association with archaeological deposits. These sequences were to be provided through the excavations at the previously mentioned sites.

Problem-Specific Protocols

The project geomorphologist visited six of the sites chosen for excavation (LA 2713, LA 75159, LA 75163, LA 127511, LA 127518, and LA 130557), and conducted site-by-site descriptions and assessments in order to inform the archaeological effort and to gain a sense of the range of exposures available for intensive study. Based on the initial descriptions and assessments, a number of exposures were selected for intensive stratigraphic study. At these exposures, detailed sediment and soils descriptions were prepared. The descriptions included variables such as color, texture, gravel content by volume, soil structure, wet and dry consistency, carbonate content (reaction to 10 percent HCl), carbonate stage determination, evidence for clay translocation, and pH (determined using a standard soil test kit). Sediment samples were collected and subjected to laboratory analysis as needed. Based on this information, local geologic sequences were created that could then be compared to both the GBFEL-TIE model and Hall (2002).

PROBLEM DOMAIN II: PALEOINDIAN USE OF THE STUDY AREA

Archaeological testing indicated the possibility of a Paleoindian component at LA 75159. Also at that site, bones were found that were probably from bison. The relationship between the two was unknown, but the project was prepared for substantial Paleoindian remains at the site. None were found, so the problem domain is only mentioned in

this report. The full discussion of the problem domain can be found in the testing report for the project (Polk et al. 2001).

PROBLEM DOMAIN III: DECIPHERING SOUTHEAST NEW MEXICO PREHISTORY

Problem Statement

Archaic to Ceramic period Native American components were expected at seven sites. The Archaic and Ceramic period components were expected to be of variable information value, however, depending on how geologically active the site had been since it formed. And for the most part, the remains were only broadly identified during the testing phase, as either Archaic or Jornada Mogollon. A protohistoric component was also conceivably present at LA 75159 and might be found other sites. In other words, the materials collected during the testing phase consisted primarily of scatters of flaked and ground stone tools, sometimes with dart points ("Archaic"), sometimes with pottery ("Jornada Mogollon"), sometimes with neither ("indeterminate prehistoric"). One goal of the current research, then, was to further refine the temporal association of the remains on each site so that they could be evaluated against the more detailed cultural historical sequence outlined in Chapter 1.

Even with additional refinement, however, it was not clear whether the cultural historical labels were behaviorally meaningful. In southeast New Mexico, despite various attempts to define local sequences, it is difficult to argue that archaeological variability has been resolved into consistent packets. Sometimes the opposite seems true—the more detail is achieved, the less patterning is apparent.

The problem may again have much to do with methodology. Southwesternists typically organize archaeological data in terms of phases. That concept requires areas to be the exclusive domain of specific traditions, so that patterns of behavior inferred from well-known excavated sites in an area can be extended to all contemporary sites within the same area. Even for the more sedentary farming cultures of the region, assumptions of territorial homogeneity are sometimes contradicted by ethnohistoric data. For the most part, however, equating patterns of behavior with territories is a useful organizing device. Much of the past work near the study area has therefore taken that approach: "[T]he primary focus has been on defining and establishing discrete cultural areas, and working out the details of temporal developments and phase designation" (Phippen et al. 2000:31). Recently, Wiseman (2000) has suggested that in fairly late prehistoric times, the Pecos River served as a prehistoric boundary where hunter-gatherers and farmers met to trade—implying that each adaptation was associated with a specific part of southeast New Mexico.

Is it safe to assume that phases and other territorial units of analysis are appropriate for southeast New Mexico? As was discussed in Chapter 1, multiple groups (such as the Jornada Mogollon and the Neo-Archaic) may have used the same areas during the same periods. We therefore suggest that archaeologists should explore a different model for the interpretation of local remains: a landscape shared by multiple groups (Sebastian and Larralde 1989:83), whose movement (as measured against archaeological time) was *non-territorial* and thus resulted in a complexly overlapping archaeological record. Indeed, use of "a vast and varied territory" in a non-territorial manner may have been necessary to allow "a higher degree of higher survival security in a somewhat inhospitable and unpredictable environment" (Katz 1983:1–2). As a general analogue of the proposed model, one can recall the historic tribes of the High Plains, fiercely defending an area in one year but living somewhere else completely a generation later.

As a specific example of the issues involved, Ceramic period remains east of the Sacramento and Guadalupe Mountains are usually described as Jornada Mogollon or "Eastern Jornada," in an extension of the Jornada concept (Corley 1965; Leslie 1979) over a vast region where the remains do not resemble those originally considered by Lehmer (1948). Used in this way, the Jornada label has no obvious behavioral content; the only unifying element over the entire Jornada region is the use of plain brown pottery. One can argue that the Eastern Jornada nonetheless formed a meaningful behav-

ioral unit over a defined area—for example, in sharing a horned serpent cult (Newcomb and Kirkland 1967:206, Pl. 150; Schaafsma and Wiseman 1992; Stewart et al. 1990; Stickney 1982). Or one also can argue that except for the shared use of pottery, the Eastern Jornada region was occupied by a myriad of groups with widely differing subsistence approaches (cf. Collins 1971; Lord and Reynolds 1985; Roney 1985; Sebastian and Larralde 1989:82-83, 89, 92). Thus, for example, some Eastern Jornada groups left the pit house sites of the Eastern Jornada area (Leslie 1979; Schaafsma and Wiseman 1992; Wiseman 1985), while completely different groups produced the contemporary rock ring sites of the same area (Katz and Katz 1985a:46–48).

Under a non-phase approach, the basic strategy for studying the archaeology of much of southeast New Mexico prehistory would become one of (1) identifying groups based on factors other than territorial distribution of traits or trait complexes; (2) tracking each group through both time and space, not just through time; and (3) comparing groups to infer changing patterns of cooperation and competition. The first step of this approach is highly inductive; it is important not to begin by projecting past assumptions onto newly obtained data. The approach also implies the need to try new ways to dig sites. It is not enough to isolate broad components (e.g., Archaic versus Ceramic period) within sites, and then trace the changes from one component to the next. Instead, it is important to try to isolate *episodes* of site occupation—in other words, each time a group of human beings arrived on a site, performed various activities, and departed. Only an approach that fine-grained can examine the proposition that a site resulted from different groups who used the same place in rapid succession. Dune environments can be frustrating to archaeologists, but they may also be one of the few places where rapidly overlapping occupations are identifiable—because surfaces are sometimes quickly covered over, and thus isolated from subsequent cultural deposits.

If and when a series of occupation episodes was identified from the sites along US 70, the next project task would be to organize that series of episodes through time (using geomorphological, radiocarbon, and other independent dating means) [1]The next step after that would be to document changing patterns through time, for this one project area. The final step would be to explain the observed variation. Some changes may obviously be correlated with changing environment, as in the case of the late resurgence in buffalo hunting (Collins 1971; Jelinek 1967; Speth 1983; Speth and Parry 1980; Wiseman 1985). However, residual variability (especially in artifact styles) may be attributable to land use by multiple groups, within a relatively static environment.

No single project can evaluate this entire model of land use, but the US 70 project was seen as providing an initial evaluation of the model—in the sense that the project could attempt to collect prehistoric data in terms of fine time slices, organize the data in a time series based on independent dates, define behavioral variation through time, and examine the possible reasons (including cultural ones) for that variation. The success (or lack of success) of this approach would indicate whether the approach is worth pursuing during future work in southeast New Mexico. To link the approach to specific methods, we defined the following specific questions.

III.1.For each component of each site, does that component represent a single use episode; a series of use episodes, one or more of which can be isolated; or a mix of use episodes that cannot be isolated?

III.2.For each use episode that can be isolated within a site, what is the age of that component as determined by independent means? For all of the occupations, how does the sequence based on independent dates compare to that based on "diagnostic" artifacts?

1. Use of “diagnostic” (such as pottery of prejectile points) to seriate remains was not seen as appropriate; our assumption was that as groups ebbed and flowed through the area, Point Type A. Or an “Archaic” group may have been followed by a “Jornada” (pottery-using) group, which was then followed by an “Archaic” group. Each of these examples violates a standard assumption behind archaeological seriation.

III.3.For each use episode that can be isolated within a site, what resources were obtained from the site, how were those resources processed at the site, and were they consumed at the site? For all of the use episodes, how did resource use vary through time? If variation exists, was it most likely due to environmental factors, shifting use of the area by multiple groups, or some other cause?

III.4.In recent years, Southwestern archaeologists have made repeated use of the notion that mobile populations tend to use "curated" stone tool assemblages whereas sedentary populations used "expedient" stone tool assemblages. We are assuming that the area was always used by highly mobile groups; is that assumption borne out in the flaked stone assemblage?

III.5.For each use episode that can be isolated within a site, what can we infer about the length of the occupation and the size of the group using the site? For all of the use episodes, how did length of occupation and group size vary through time? If variation exists, is this evidence for shifting use of the area by multiple groups?

III.6.As the reasons for variation within the US 70 episodic series are identified, are these same sources of variation apparent when published reports on southeast New Mexico are re-examined?

Data Needs

Under the proposed research approach, the most valuable archaeological deposits were ones in which individual site use episodes were most likely to be preserved. In contrast, where fine slices of time were not achievable on a site with multiple occupations, the research value of those sites was less. The practical goal of the project was therefore *not* to excavate as much as possible of every post-Paleoindian Native American site, but to locate the deposits that were most likely to represent individual use episodes, and to excavate and analyze the deposits in terms of those use episodes. In other words, each site was to be opened up and examined, at which point *some* archaeological deposits would be intensively excavated.

The proposed approach can be illustrated by use of counterexamples. A very "standard" and seemingly appropriate approach to excavating a US 70 site would have been to hand excavate multiple small units, each with arbitrary levels unless gross changes in stratigraphy were found. As hearths or similar features are exposed in small units, the approach would call for excavation of the entire feature; otherwise the primary goal of the approach would be to obtain a "controlled" sample of artifacts and possibly other materials such as animal bone. The effort would conclude with a general description of activities at the level of the whole site (e.g., the ground stone indicates plant food processing) and speculations about the group that used the site. However, those field methods would virtually guarantee that even if multiple components were physically discrete, their contents would be conflated—severely limiting what we can learn about the prehistoric sequence in southeast New Mexico.

Regge Wiseman's (2000) field approach at LA 75163 was a distinct improvement over the "standard" approach we have caricatured. By opening up a large area of the site at the surface of a Stage III or IV carbonate deposit, Wiseman was able to define a series of features that might have been missed in smaller exposures, and was also able to define horizontal patterns in artifacts over the excavated portion of the site. Still, the analysis indicates that the excavated area included multiple use episodes. Projectile points indicated a Late Archaic (and possibly earlier) use of the site, while pottery indicated episodes of use towards the end of the local Ceramic period. And, in this case as well, it is difficult to say which remains were associated with which component. Thus, while Wiseman's intensive excavation of a limited area within LA 75163 is a good example to follow, if possible we would take that approach one step further. First, each site would be sampled in such a way that any evidence of stratigraphically segregated use episodes was quickly identified. Second, where such evidence was found, the site would be peeled back episode by episode. Finally, as each episode was fully

exposed, its internal spatial relationships would be documented.

Independent dating was especially important to this approach, given the wish to avoid the possibility of bias resulting from the use of traditional "diagnostic" artifacts. The testing program indicated, however, that crews could not count on finding whole charcoal (even small, scattered pieces) or strongly charcoal stained sediment for use as dating sources. The one charcoal sample recovered during testing proved to be marginal, even with accelerator dating. Wiseman had similarly poor luck at recovering datable material in his excavation of a 450 m^2 area. Thus, while field crews were expected to collect obvious charcoal samples whenever possible, the data recovery plan could rely on such samples. Similarly, obsidian was so rare in the testing assemblage that hydration dating could not be relied on as an alternative dating technique. It was therefore important to include fallback strategies for dating occupations. More specifically, the research design called for collection of bulk soil samples, extraction of charcoal dust from those samples, and accelerator dating of the charcoal dust.

Subsistence practices were to be inferred in part from tool assemblages, and in part from recovered faunal, macrobotanical, and pollen samples. Based on the testing results, some bone was likely to be found but there might be few obvious locations for flotation and pollen samples. During the testing program, based on field evaluations of sampling potential, only one radiocarbon sample and one flotation sample were taken—but during data recovery, the field crew was to “push” sampling even if the visible indicators were not encouraging. For each occupation, if no obvious sampling locations were identified, sampling of general contexts would be pursued instead.

Analysis of flaked stone was to include examination of attributes that would distinguish a “curated” technology from an “expedient” one. The remaining data needs were to be met through standard excavation, analysis, and comparative procedures.

PROBLEM DOMAIN IV: PATTERNS OF CONSUMPTION ALONG THE US 70 CORRIDOR IN THE EARLY 1900S

Problem Statement

Only one Euroamerican component (LA 127511, at Kenna) was specifically recommended for data recovery in the form of excavation—and at that site, recommendation was for limited sampling only. At LA 75164, the recommended data recovery approach was additional study of the site outside the right-of-way. At LA 75159, LA 75163, LA 127502, and LA 127518, limited additional historic deposits might be encountered, in which case the approach recommended for LA 127511 could be applied to those remains as well. In essence, the only substantial Euroamerican remains we expected to encounter within the project corridor during data recovery were trash deposits, so this problem domain was narrowly focused.

Euroamerican towns along the US 70 corridor date after 1900, when a railroad branch was completed between Roswell and Portales (see Chapter 1). One of those towns, Kenna, became an important cattle shipping point (Crawford et al. 1999:32–33). Most of the local towns shriveled after a generation or two. The archaeological deposits recommended for data recovery provided an opportunity to examine patterns of household consumption in an area that was remote even by New Mexico standards, yet connected to the outside world by a railroad and motor roads, at a time when frontier life had already given away to rural life. We assumed that the early 1900s residents of the corridor were plugged into the national economy, and thus had access to its industrial goods, but that their patterns of daily consumption also reflected the highly rural nature of the area. The following questions served to focus the investigation of historic Euroamerican trash deposits at LA 127511, and could be adapted to the study of trash deposits encountered during attempts to study Native American components at other sites.

> IV.1.Historic documents indicate that LA 127511 is near a town (Kenna) that dated from the first decade of the 1900s. The town faded in the mid-1900s. Are the recovered remains

consistent with this picture? Or do they indicate earlier or later occupations?

IV.2.What proportions of the remains fall into the categories of food preservation, food preparation/consumption, other domestic activities, construction, or other categories? How do these proportions compare to those at other, roughly contemporary sites in New Mexico or elsewhere?

IV.3.At LA 127511, what remains reflect the site's connection to the national economy of the early 1900s? What remains, if any, reflect the site's location in rural southeast New Mexico?

IV.4.To the extent that the remains allow, what changes in consumption patterns occur through time?

IV.5.As evidence is gleaned from historic sources regarding daily life along the US 70 corridor, how does that evidence compare to the picture derived from the archaeological record?

Data Needs

The questions just posed required only a representative sample of the trash deposits within the project corridor; there was no need to completely collect those deposits. At LA 127511, therefore, a limited series of spaced excavation units was seen as sufficient. If stratigraphy could be defined within the trash deposits after the first sample unit, excavation was to proceed in terms of stratigraphic layers, in order to allow identification of changes through time.

Given the research questions, this de-emphasis on field time was to be matched with a greater emphasis on laboratory analysis and statistical manipulation of the results than was the case during testing. Based on the same research questions, data recovery was to include comparisons with published excavations of other historic sites, as well as further archival studies to better document the context of the recovered remains.

FIELD AND LABORATORY METHODS

Prior to fieldwork, SWCA obtained the necessary permits and rights-of-entry for the archaeological and geomorphological studies, which were restricted to the existing and proposed US 70 highway right-of-way except where otherwise noted (e.g., the non-disturbing studies proposed at LA 75164). Datums and grid baselines were then established at each site, building on those established during the testing phase. Given the existing surface collections and tallies obtained during the testing phase, surface artifacts were not collected except when they fell within an area that was to be excavated.

For Native American remains, the next step was excavation of backhoe trenches, with an archaeologist serving as a monitor. The trenches were placed to locate subsurface features and artifact concentrations. These in turn would, we hoped, be identifiable in terms of individual use episodes. Possible features and artifacts in the trench wall were flagged for study.

At this point the proposed research approach broke down. The proposed approach assumed that in the dune deposits along US 70, dunes had been forming for a significant portion of the human occupation of the area. Thus, at least in some locations, individual use episodes would be "trapped" in sand deposits and stratigraphically segregated from other use episodes on the same site (Figure 2.1, *top*). When identified, those discrete use episodes would become the priority areas for excavation. In practice, the observed Native American archaeological deposits all appeared to be on the same general level, with the obvious dunes on top of the deposits (Figure 2.1, *bottom*). As a consequence, most of the observed archaeological remains had the potential to represent "palimpsest" deposits, i.e., with remains conflated from multiple occupations and various periods. A new strategy was therefore adopted in mid-project. Based on an analytical approach first developed by Alan Sullivan (1992; see also Phillips et al. 1993), the field strategy become one of identifying contexts that were likely to yield radiocarbon dates (e.g., hearths), and to recover remains in the immediate vicinity of those datable contexts. The assumption was that in

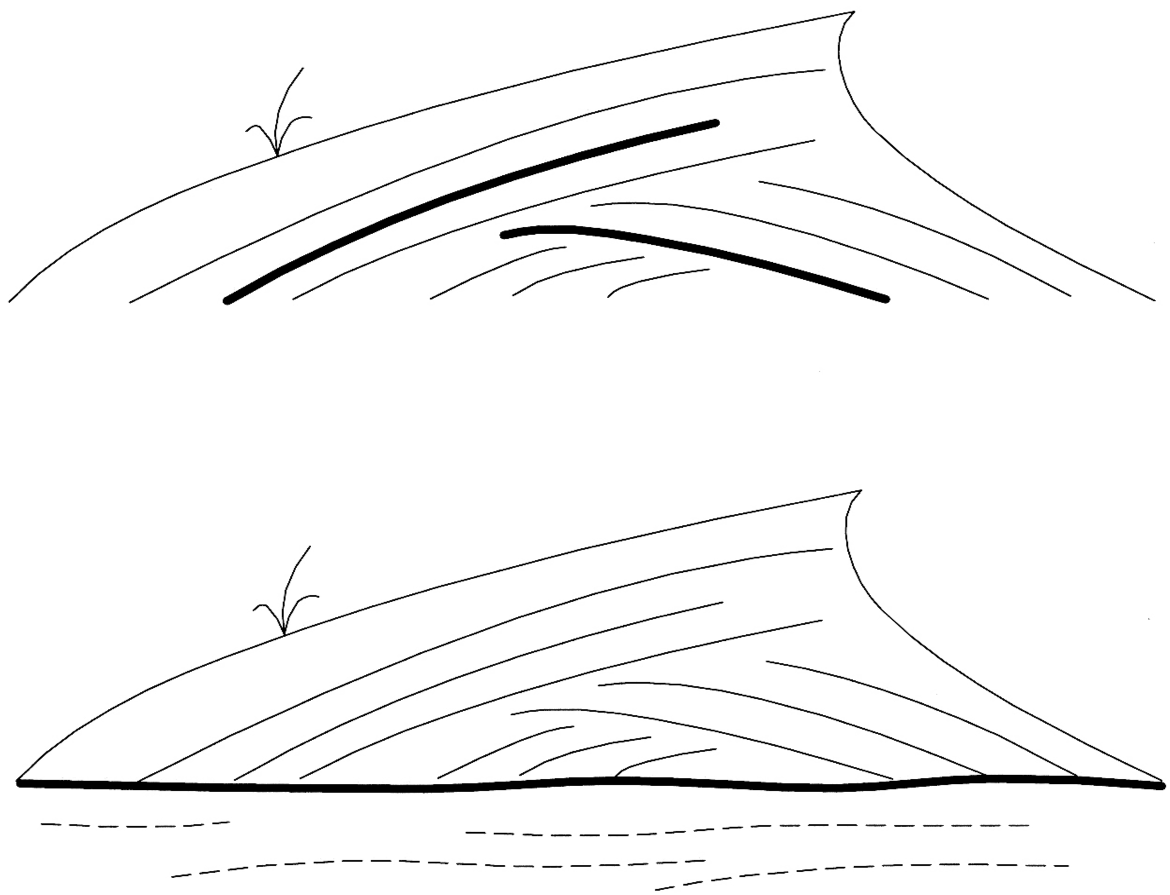

Figure 2.1. Schematic rendering of expected versus actual geomorphological contexts of remains. *Top,* expected conditions: thick lines represent individual use episodes, sealed from each other by progressive eolian deposition. *Bottom:* actual conditions: use episodes occurred on the "same" stable surface at the base of the obvious dune deposits.

potential "palimpsest" deposits, the remains nearest a dated sample are more likely to be associated with that date (and with each other) than with dated samples or other remains at a greater distance. In other words, associations are viewed as probabilistic rather than absolute. Later, during analysis, the probabilistic associations can be sorted using the dates, to understand trends through time, in lieu of a more traditional comparative analysis such as a site-by-site analysis. Thus, field excavation focused on recovering remains from those portionsSince the US 70 data recovery fieldwork, Stephen Hall (2002) completed his field guide to the Mescalero Sands area south of the US 70 project corridor. Hall found that from about 5000 to 500 years ago, a period of "sand sheet quasi-stability" meant that the local surface was somewhat constant, albeit not stable enough to permit obvious soil formation. Greater stability between 500 and 100 years ago led to formation of an A horizon, which Hall labeled the Loco Hills soil. The obvious dunes in the area formed only in the past 100 years (Hall 2002:Table 7). The practical consequence is that for most of the past five millennia, most sites in the Mescalero Sands area were created on more or less the same surface, rather than being encapsulated in successive depositional contexts. Had Hall's results been available a year earlier, the project's proposed field strategy would have assumed an archaeologi-

cal situation like the bottom drawing Figure 2.1, rather than like the top drawing.

Readers may wonder why the geomorphology and stratigraphy of the local sites was so poorly understood even after the sites were tested. Initially, SWCA proposed to conduct extensive backhoe trenching during the testing phase, which would have provided the exposures to fully inform data recovery. During regulatory review we were told that extensive backhoe trenching was too destructive. Instead, given a goal of determining eligibility for the National Register of Historic Places, limited subsurface exposures were more appropriate. The testing phase was therefore based on auger testing supplemented by small numbers of hand-excavated units. The more limited approach was certainly sufficient to evaluate National Register eligibility, but the keyhole glimpses of subsurface remains were a hindrance in defining the most appropriate approach to the next phase of work. We suggest that in the future, regulatory reviewers be more tolerant of the use of backhoe trenching during site testing, in sites of a similar nature and in similar geomorphological contexts.

Once potentially datable contexts were identified, excavation proceed by strata where possible, and by 10 cm levels within strata. When strata differences were not readily apparent, units were excavated in arbitrary 10 cm levels unless otherwise noted. In several cases, observed features were buried under a considerable amount of overburden. In such cases, the backhoe was used to remove sediment to just above the feature. Test units were excavated until sterile sediments were encountered. In cases where it was unclear if the underlying sediment was in fact sterile, an auger hole was dug at the base of the unit and the sediment thus recovered was examined for artifacts and cultural staining.

During the excavations, pond sediments with cultural remains were found at LA 75159. The pond deposits were subsequently determined to be outside the proposed construction area, so study of that part of LA 75159 consisted of a limited sample of the deposits. Most of the pond sediments within the highway right-of-way remain unstudied, and the deposits continued downward from those exposed during the current study. The LA 75159 pond deposits represent an excellent opportunity for non-CRM research into the prehistory and paleoecology of southeastern New Mexico.

Unless otherwise noted, fill excavated by hand was screened using quarter-inch mesh. Sediment from features was excavated using eighth-inch mesh, and pollen, flotation, and radiocarbon samples were collected by strata and levels within features. For formal features, the sampling priority was: (1) identifiable charcoal for radiocarbon analysis, including small samples for accelerator analysis (wrapped in aluminum foil); (2) a bulk soil sample, preferably of the most stained soil, for accelerator analysis; (3) a flotation sample, preferably of the remaining stained soil; (4) a pollen sample, preferably from an actual use surface. Based on advice from Beta Analytic, Inc., bulk soil samples for accelerator analysis consisted of a full 1 gallon locking plastic bag. Samples for flotation analysis contained 2 liters of sediment, preferably stained, collected in paper bags. Samples for pollen analysis consisted of full locking sandwich bags.

To produce excavation phase site maps, the testing phase maps (Polk et al. 2001) were updated as needed to show the existing highway centerline and roadbed edge, the existing right-of-way, the new right-of-way if different, the site datum and key grid points, backhoe trenches and hand excavation units, and the locations of all features or bone beds. Important natural features (e.g., arroyo boundaries) were also included.

Bags containing the recovered artifacts from each excavation unit were numbered in the field. The bag number, contents, and provenience were recorded on a bag form. Sample forms were used to record provenience and contextual information for the specialized samples.

For each backhoe trench, records included a stratum description by depth for at least one point for each 30 m of trench, and profiles were prepared for selected segments. Stratum and level forms were completed for each stratum and level in the hand-excavated units. A photograph was taken of at least one face of the completed unit, and plan views were prepared for each level as deemed necessary

by the field director. Each feature was documented using a feature form, a plan view of the feature, at least one profile through the feature, and photographs of the completed feature. In addition to these records, the field supervisor maintained a daily field log, which is part of the project records. These logs included a record of crew present, hours worked, and the general nature and progress of fieldwork.

The project adhered to SWCA's current safety manual, which is designed to reflect OSHA standards relevant to archaeological fieldwork. Prior to ground-disturbing studies, SWCA contacted New Mexico One Call to determine the location of buried utilities. Fieldwork began with a tailgate meeting that reviewed safety issues. Specific safety measures included:

- The field crew was provided with a cell phone and first aid kit.
- Field crew members were required to wear orange safety vests at all times. Crew members were required to wear hard hats whenever monitoring or working near heavy equipment and whenever there was a danger of objects falling from above.
- No project activities were conducted within the existing road prism. For each side of the road where work was taking place (off the road prism), oncoming motorists were warned with orange warning signs, and cones were placed next to the edge of the roadway for the length of the road area. Warning signs and cones were placed no closer than 50 cm from traffic lanes, lest motorists swerve out of their traffic lane to avoid the signs and cones.
- Trenches (backhoe or hand-excavated) were generally not more than 1.2 m (4.0 feet) deep. If deeper exposures were needed, the ground surface was cut back until the excavations were as wide as they were deep. For the protection of crew and out-of-control vehicles, backdirt was piled (where possible) on the highway side of trenches parallel to the roadway, or on the oncoming side of trenches at an angle to the roadway.
- When trenches were left unattended, they were marked (e.g., with lath and flagging) to warn casual visitors to the site. Such markings were checked (and if necessary, repaired or replaced) on a regular basis. In general, deep excavations were kept open for as little time as was practical.
- Field crews were provided with portable toilets and drinking water.
- Fire-cracked rock was counted and weighed by material type, then discarded. Otherwise, collections were taken to SWCA's laboratory in Albuquerque for cleaning, analysis or submission to specialists, and preparation for curation. Collections and original field records from this project will be submitted to the Museum of New Mexico, Santa Fe, for permanent curation.

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Chapter 3

LA 2713

Site Type: artifact scatter with features
Cultural Affiliation and Age: Archaic, Jornada Mogollon
Size: 463 by 250 m
Area Excavated within Right-of-way: 226 m^2 of trench; 16.7 m^2 of hand excavation

LA 2713 is in a field of coppice dunes covered by mesquite, grasses, narrow-leaf yucca, snakeweed, prickly pear cactus, Russian thistle, composites, and purple aster (Figures 3.1–3.4). It is a two-component site measuring 450 m northwest-southeast by 240 m northeast-southwest, and is 16 km east of the Pecos River. The site, which is about 86,400 m^2, is bisected by US 70. The site extends beyond the north and south edges of the current highway right-of-way, which is not being widened as part of the highway improvements. Most of the site extends along a low ridge, which forms a high point north of the highway. All of the new excavation efforts focused on the portion of the site within the highway right-of-way, which contains only about 10,776 m^2 (12%) of the site.

PREVIOUS RESEARCH

Fenenga and Cummings first recorded LA 2713 during the Permian-San Juan pipeline project in 1953. The site card describes a flaked stone and sherd scatter containing Chupadero Black-on-white, Three Rivers Red-on-terracotta, and Jornada Brown Ware pottery.

The site record was updated by the Museum of New Mexico in 1963. The site was described as a roughly 180 by 120 m habitation site with disturbed hearths, primarily south of the highway. An unspecified number of flaked stone artifacts was collected, along with fifteen brownware sherds, four Chupadero Black-on-white sherds, and one corrugated sherd. According to their field journals, the archaeologists visiting the site felt that LA 2713 “is not worth excavation.”

During a 1978 survey by the Agency for Conservation Archaeology (ACA), for the Mountain Bell Telephone Line Project, part of LA 2713 was mistakenly recorded as a new site and given a new number, LA 16664 (MacLennan 1978). The site was described as a scatter of flaked stone artifacts, ground stone tools, and sherds that included Jornada Brown Ware, Chupadero Black-on-white, Tabira Black-on-white, and Three Rivers Red-on-terracotta (MacLennan 1978).

The site was again revisited during a culture resource survey for a fiber optic cable project conducted by Human Systems Research (Shields and Laumbach 1989:48–51). The site was described as a 300 by 250 m, low-density scatter of flaked stone, ground stone, fire-cracked rock, and sherds. The artifacts were associated with at least 10 hearths, including one that still contained ash. All of the observed pottery (one Lincoln Black-on-red sherd and 20 brownware sherds) was collected. Based on the previously collected pottery and the newly recovered sherd of Lincoln Black-on-red, Shields and Laumbach (1989:51) concluded that the site was occupied by the Jornada Mogollon. However, their analysis of the flaked stone assemblage indicated the extensive use of bifacial reduction technology, prompting them to suggest that the site was also occupied during the Archaic period (Shields and Laumbach 1989:51).

The site description was again updated in 1999, during the preliminary cultural resource survey conducted by ACA as part of the current highway improvement project (Crawford et al. 1999:52–54). ACA described the site as a 365 by 280 m scatter of flaked stone and ground stone artifacts, sherds, and fire-cracked rock. Buried cultural deposits were visible in the northern portion of the site, in areas disturbed during road construction and the instillation of the phone line. ACA also identified

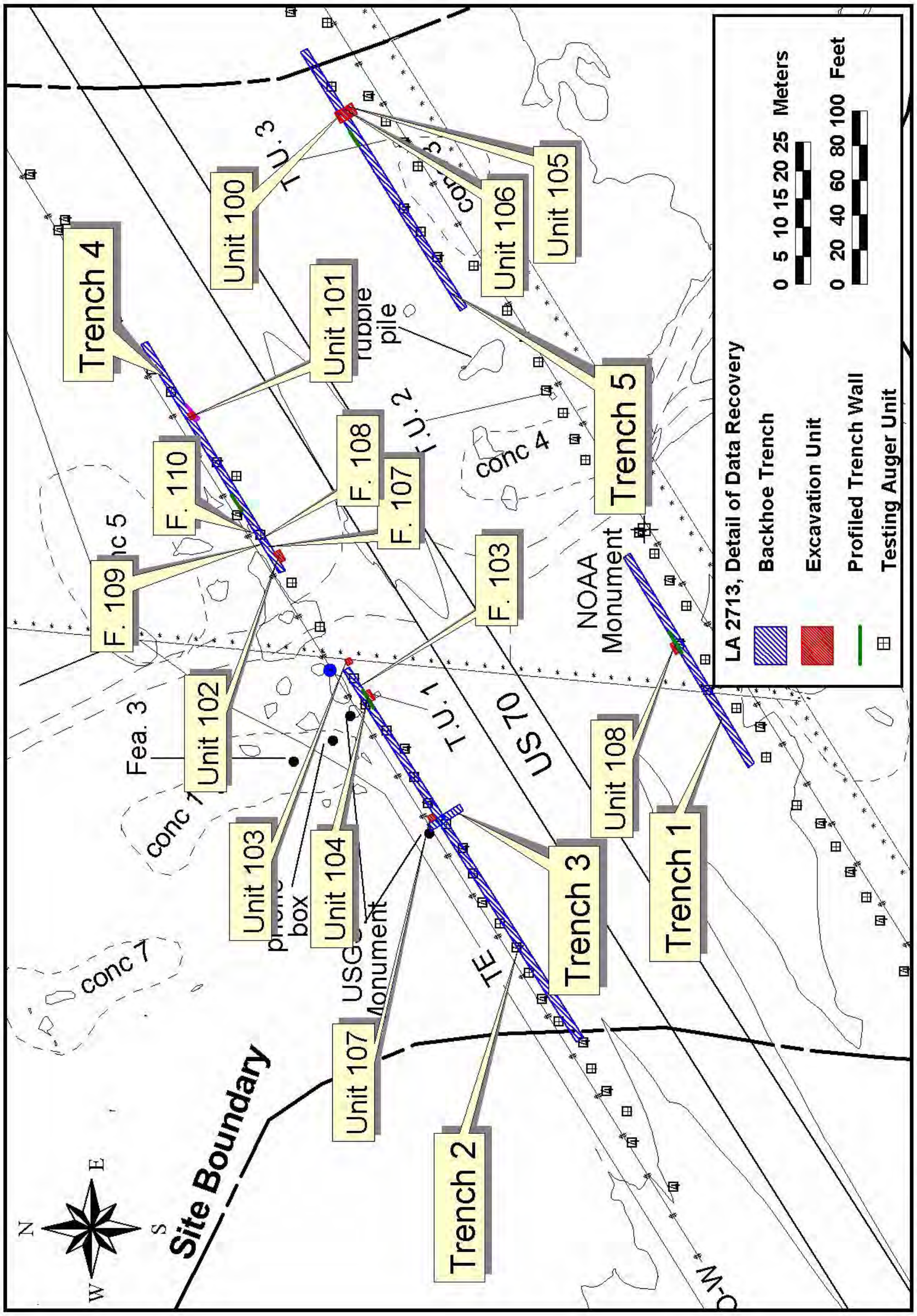

Figure 3.1. Excavations at LA 2713.

Figure 3.2. LA 2713, site overview.

Figure 3.3. LA 2713, Feature 113.

Figure 3.4. LA 2713, Feature 100.

three artifact concentrations and one feature, a hearth. Based on the previously collected diagnostic sherds, Crawford et al. (1999:53–54) concluded the site was occupied during the Late 18 Mile Phase (A.D. 900–1000) and the Mesita Negra Phase (A.D. 1000–1200).

In 2000, SWCA examined, mapped, and tested LA 2713 (Polk et al. 2001:3.1–3.19). As part of this effort, all of the surface artifacts in the highway right-of-way were collected using a 10 by 10 m grid system, and 86 auger holes were placed along the highway right-of-way fence line to test for buried deposits. The auger holes were spaced 5 m apart except at the east and west ends of the site, where the holes were spaced 10 m apart. Eighty-two pieces of flaked stone and two Jornada Brown Ware sherds were recovered from the surface. Three auger holes yielded artifacts, prompting the excavation of 1 by 1 m test units, which confirmed the presence of subsurface remains. The testing phase led to the identification of five new artifact concentrations, two new burned caliche features, and additional artifacts scattered to the northwest of the previously defined site boundaries, along the ridgeline. The pottery indicated that LA 2713 was occupied by the Jornada Mogollon, but SWCA also found evidence of an Archaic period component, including an Archaic projectile point.

Although intact subsurface remains were present, prior construction had disturbed much of LA 2713. US 70 bisects the site from the southwest to the northeast. The construction of dirt roads extending

from US 70 northwest to a nearby gravel pit and southeast to the Rocky Ridge Ranch have disturbed portions of the site outside the highway right-of-way. Both of those dirt roads have acted as drainages during heavy rains and are consequently highly eroded. Additional site disturbance has resulted from the installation of buried phone lines on either side of the highway. The lines extend along the right-of-way fence but swing away from the fences in the middle of the site, in order to avoid the previously defined site boundary. However, the enlargement of the site boundaries during subsequent work now shows the northern line to extend through the site's core. The southern telephone line avoids the site almost completely. Finally, overhead utility lines parallel the right-of-way fences, bisecting the center of the site.

DATA RECOVERY

All of the new excavations at LA 2713 were within the existing right-of-way. A site datum was established five m south of a USGS brass cap monument marked ACME 2-1961, and given the arbitrary coordinates of N600.00/E500.00. The site was remapped with a total station, and the grid system used during the testing phase was re-established for provenience designations. Subsequent data recovery utilized both mechanical and hand excavation.

Mechanical Excavation Units

Five backhoe trenches were excavated at LA 2713 to identify possible subsurface features and artifacts. The provenience, dimensions, and associated features are listed on Table 3.1. When possible cultural features were encountered, effort was taken to limit mechanical excavation to exposing the surface of the features, which were then excavated by hand. The trench walls were cleaned using shovels, and the location of possible features and artifacts exposed in the wall profiles were flagged, mapped, and logged.

Trench 1 paralleled the right-of-way fence, southeast of US 70 and was west of the dirt road extending south from the highway. Three stratigraphic units and one cultural feature (Feature 100) were identified in the trench (Figure 3.5). Stratum 1, a brown, fine sandy loam, was deposited during construction of US 70 and the dirt road. Stratum 2 was a stain about 5 m long, 15 cm thick, and 20 cm below the surface. Stratum 2 was a very dark, gray-brown fine sandy loam and appeared to be an archaeological feature. The stratum was designated Feature 100, and was later excavated by hand. Stratum 3 was a dark red-brown, fine sandy loam. This stratum was eolian in origin and did not contain any artifacts. Limited root disturbance was evident in all three strata.

Trench 2 paralleled the highway right-of-way fence on the northwest side of US 70, west of the dirt road extending north from the highway. Three stratigraphic units and four possible features were defined in the walls of Trench 2 (Figures 3.6 and 3.7). The uppermost layer, Stratum 1, was a brown, fine sandy loam deposited during construction of US 70. Stratum 2 was a mottled brown sandy sediment with yellow-red sand inclusions. Both stratigraphic units were visible in the trench's north and south walls. Stratum 3 was visible only in the north wall. Stratum 3 was a dark red-brown, fine sandy loam. The stratum was divided into Stratum 3a and Stratum 3b based on the increasing hardness of the lower deposits.

The four possible features were labeled Features 102–105. Feature 102, a 70 cm long charcoal stain 10 cm below the ground surface, was later determined to be the result of a natural brush fire. Feature 103, an irregular organic stain visible near the surface, throughout much of the length of the trench, contained burned roots and recent trash, and was also the result of the brush fire. Feature 104 was a 70 by 34 cm charcoal stain containing a piece of burned caliche and a flake, and was exposed at the top of the south wall of the trench. Further excavation of this feature (see below) indicated that it was a hearth used during the Late Archaic period. Feature 105 was a depression measuring 6 m long and 0.5 m deep, beginning 10 cm below the modern ground surface. Feature 105 was evident in both trench walls and was further investigated by excavating Trench 3.

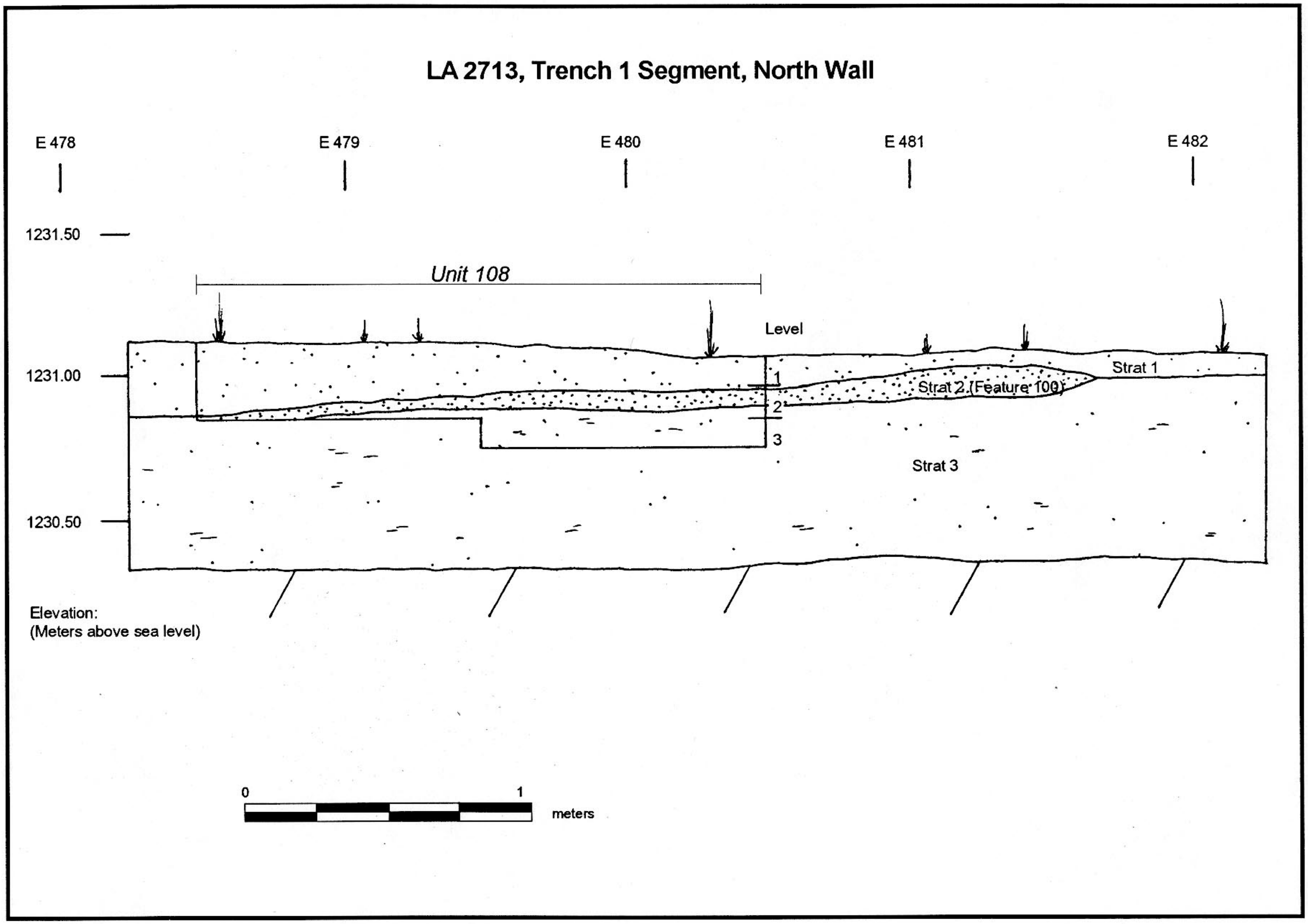

Figure 3.5. LA 2713, Trench 1 Segment, North Wall.

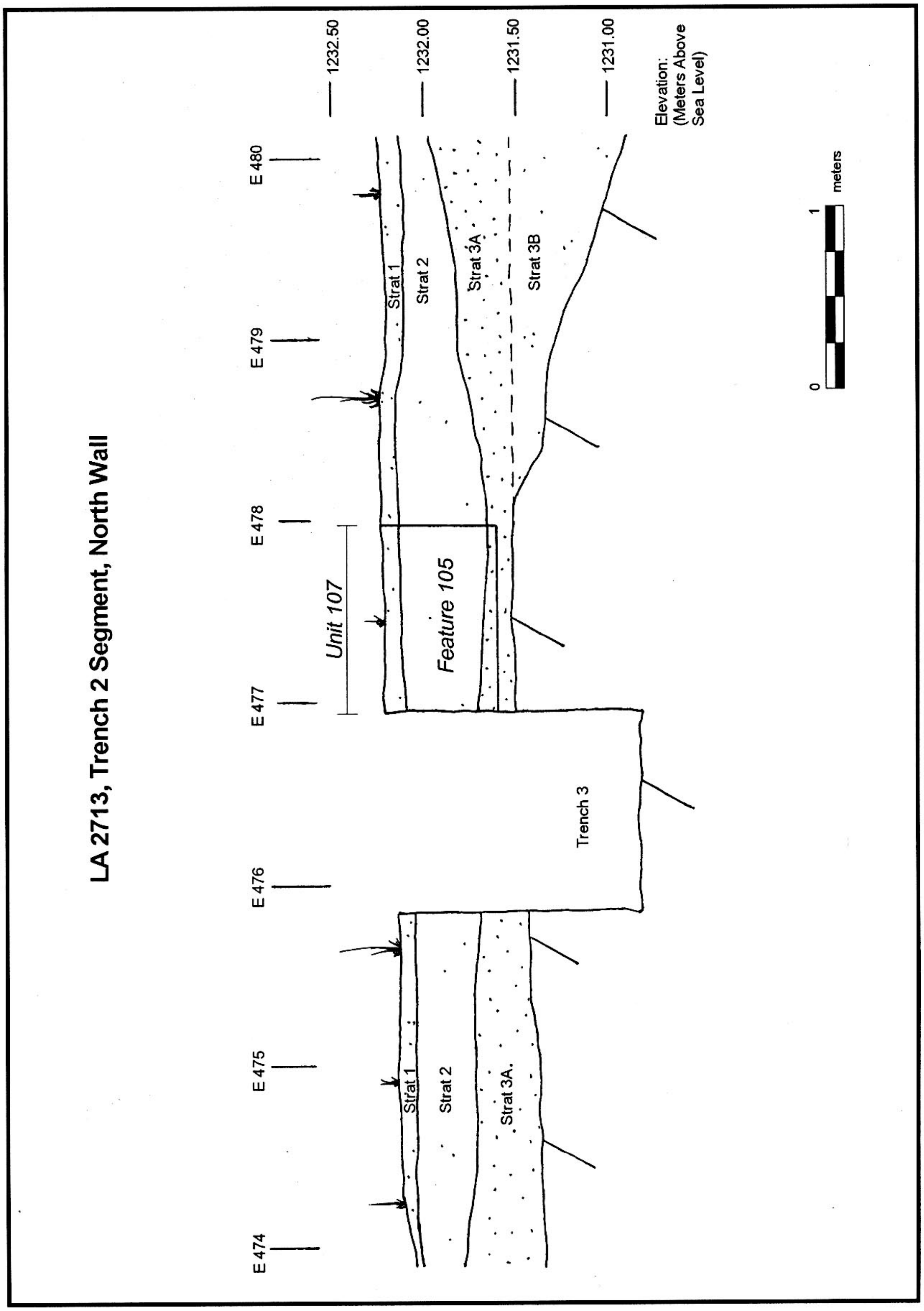

Figure 3.6. LA 2713, Trench 2 Segment, North Wall.

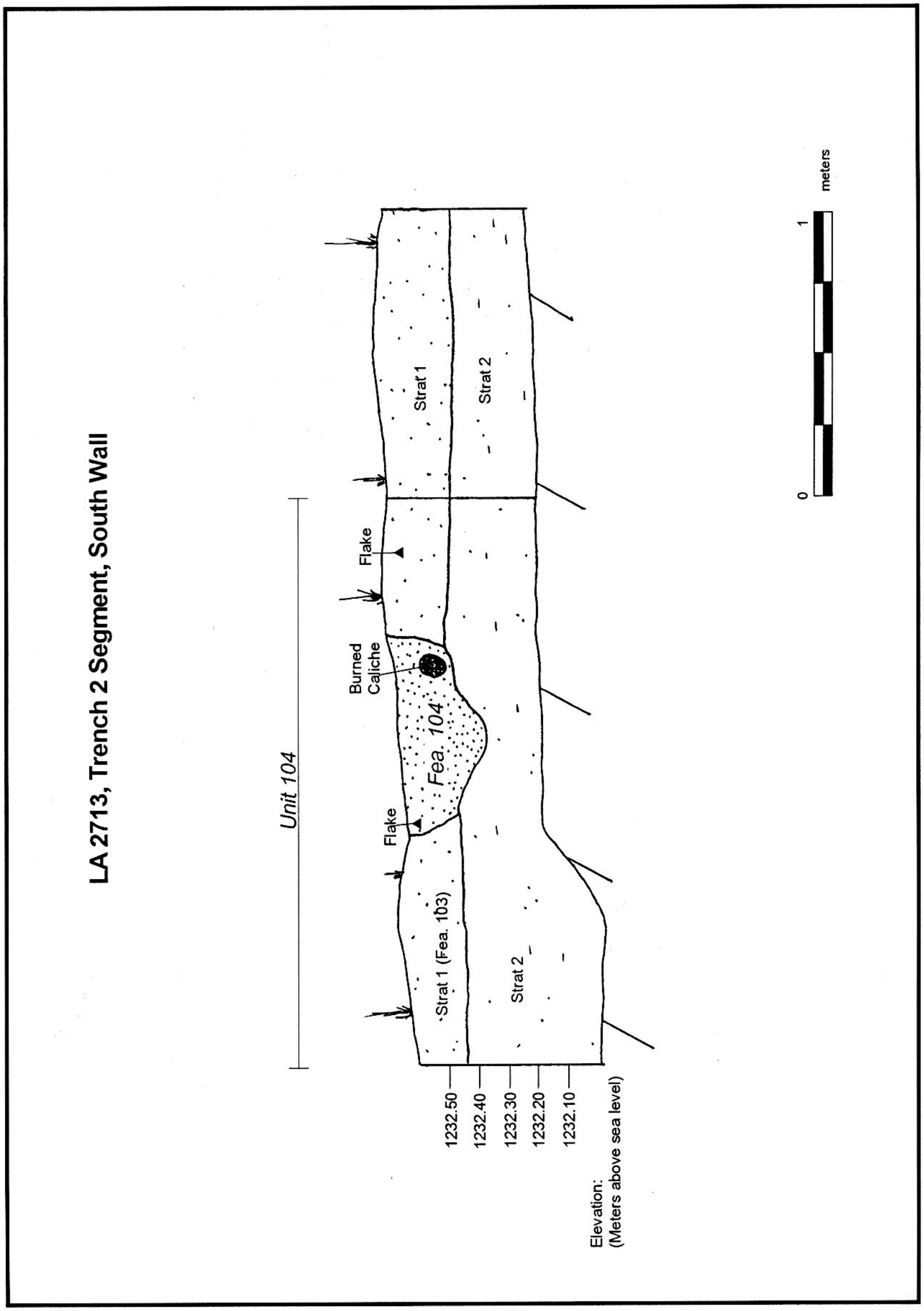

Figure 3.7. LA 2713, Trench 2 Segment, South Wall.

Table 3.1. Summary Information for the Five Trenches Excavated at LA 2713

Trench No.	Location of SW Corner	Dimensions	Associated Features
1	N550.63/E455.14	42.5 m long by 0.8 m deep	Feature 100
2	N601.69/E430.69	78 m long by 1 m deep	Features 104, 105
3	N597.99/E475.49	5.5 m long by 1.6 m deep	Feature 105
4	N601.66/E527.95	48 m long by 1.4 m deep	Feature 106–112
5	N549.96/E549.70	52 m long by 2 m deep	Feature 113, 114

Trench 3 was a 5.5 m long trench excavated at right angles to Trench 2, in order to further expose Feature 105. The stratigraphy exposed in Trench 3 (Figure 3.8) was identical to that in the north wall of Trench 2, with two exceptions. First, an apparent backfilled trench (Stratum 4) was exposed in the northern portion of the trench. Stratum 1, the sandy loam deposited during road construction, overlay the backfilled trench, indicating that the trench was not part of the most recent road construction. The trench may have been dug during installation of utility lines. Second, a layer of gravel, labeled Stratum 1a, underlay Stratum 1 in Trench 3. This gravel was most likely deposited during road construction. Excavation of the backfilled trench and placement of the gravel had disturbed the northern and southern portions of Feature 105. In addition, animal burrowing and other bioturbation had so disturbed the lower portions of Feature 105 that it was difficult to determine a clear break between the feature and Stratum 3a.

Trench 4 paralleled the right-of-way fence on the northwest side of US 70, east of the dirt road extending from US 70. Three strata were identified in the trench profile (Figure 3.9). Stratum 1 was a yellow-red fine sandy loam containing recent glass. Stratum 2 was a dark brown, very fine sandy loam containing a small amount of gravel. Stratum 3 was a dark red sandy clay loam with occasional gravel. Flaked stone artifacts were recovered from each of the strata. Seven possible features (106–112) and two isolated pieces of burned caliche were visible in the trench profile. All of the features were charcoal stains exposed between 40 and 60 cm below the modern ground surface. Features 106 and 112 were further investigated through the excavation of Units 102 and 101.

Trench 5 was placed on the southeast side of US 70, east of the dirt road extending from US 70 and parallel to the right-of-way fence. Three stratigraphic units were defined (Figure 3.10). Stratum 1, the upper 40 to 60 cm of fill, was a brown fine sandy loam containing recent trash including concrete, suggesting that Stratum 1 was associated with road construction. The stratum was divided into two substrata based on the amount of recent debris: Stratum 1a generally did not contain concrete and other large pieces of trash; Stratum 1b did. Stratum 2 was a mottled brown sandy sediment with yellow-red sand inclusions, and Stratum 3 was a dark red-brown colored fine sandy loam without gravels.

Two features were identified in Trench 5. Feature 113 was exposed 25 cm below the modern surface. Feature 113 was a 60 by 55 cm charcoal stain with burned caliche. After the stain was identified, the area around both walls of the trench was scraped to expose some 10 to 15 pieces of burned caliche scattered over an area about 3 m in diameter. Feature 114 was a second ash stain.

Hand Excavation Units

Nine units (100 to 108) were manually excavated to further investigate features exposed in the backhoe trenches (Table 3.2).

Units 100, 105, and 106 were contiguous units excavated at Trench 5, to investigate Features 113 and 114. Unit 100 was placed over Feature 113 and included three levels (Table 3.3; Figure 3.11). Level 1 had been removed during mechanical excavation of Trench 5; it consisted of 25 cm of fine sandy loam deposited during road construction. The fill from Levels 2 and 3 was screened through eighth-inch mesh. Level 2 was an arbitrary 8 cm level containing a mix of the sandy loam evi

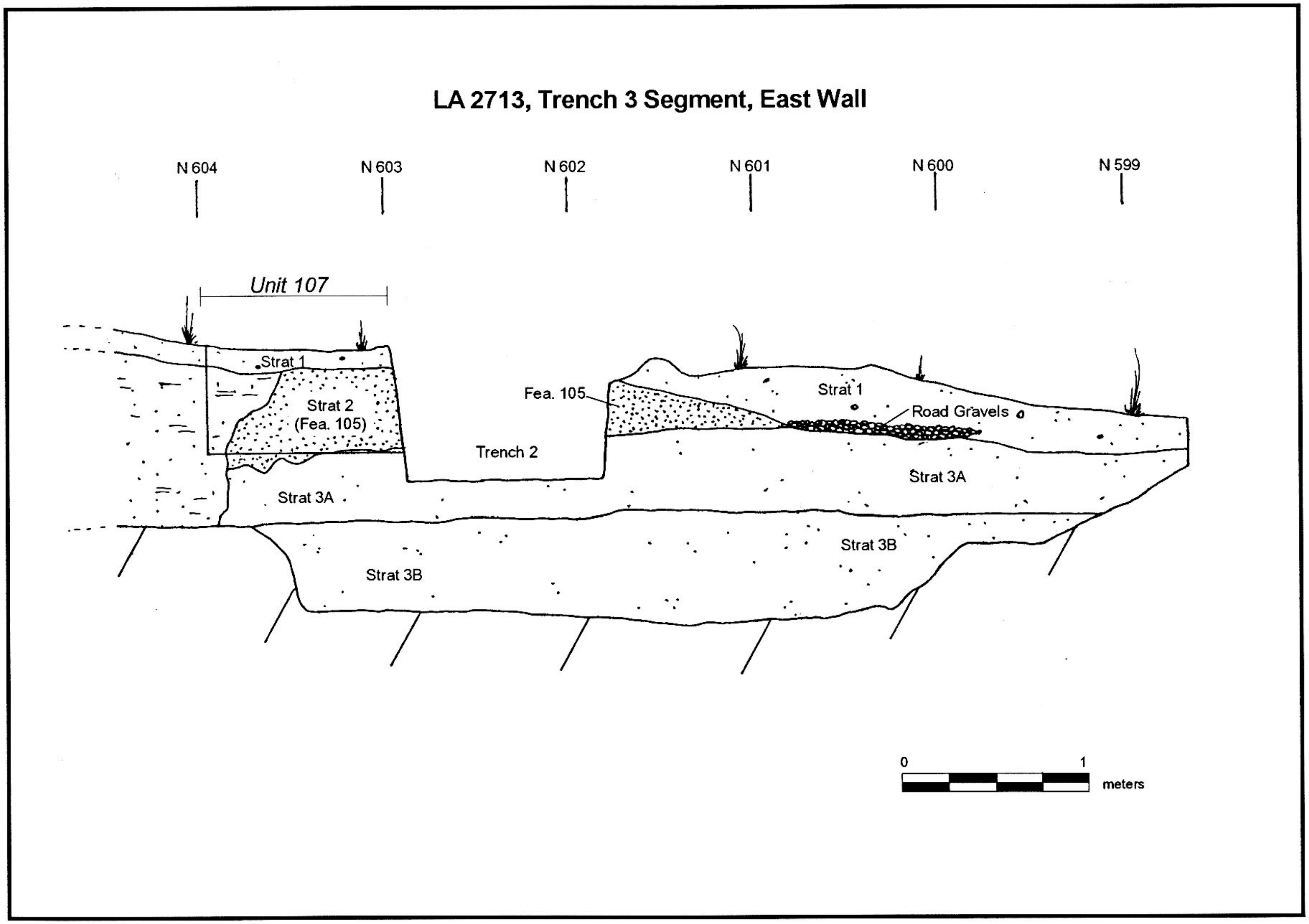

Figure 3.8. LA 2713, Trench 3 Segment, East Wall.

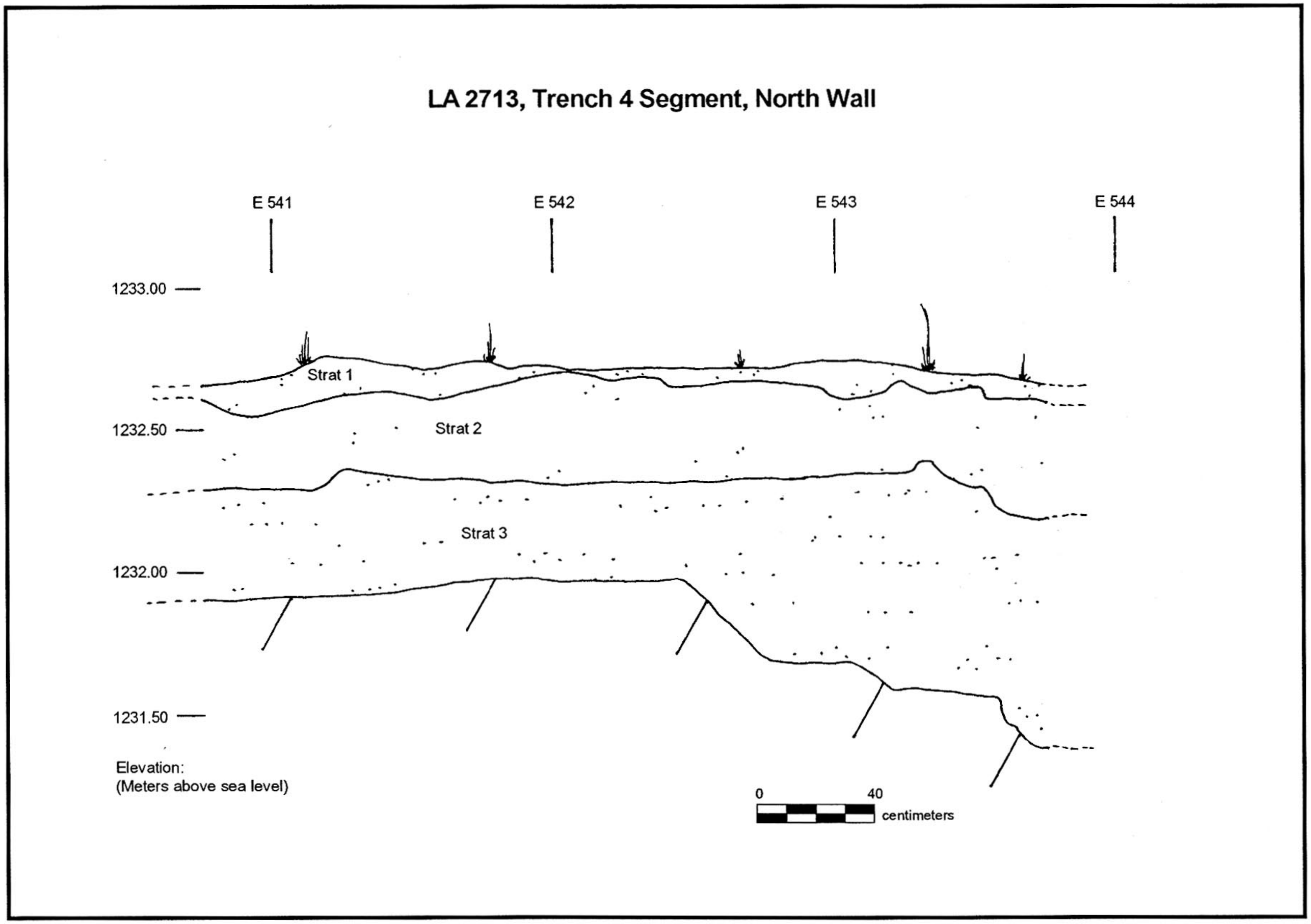

Figure 3.9. LA 2713, Trench 4 Segment, North Wall.

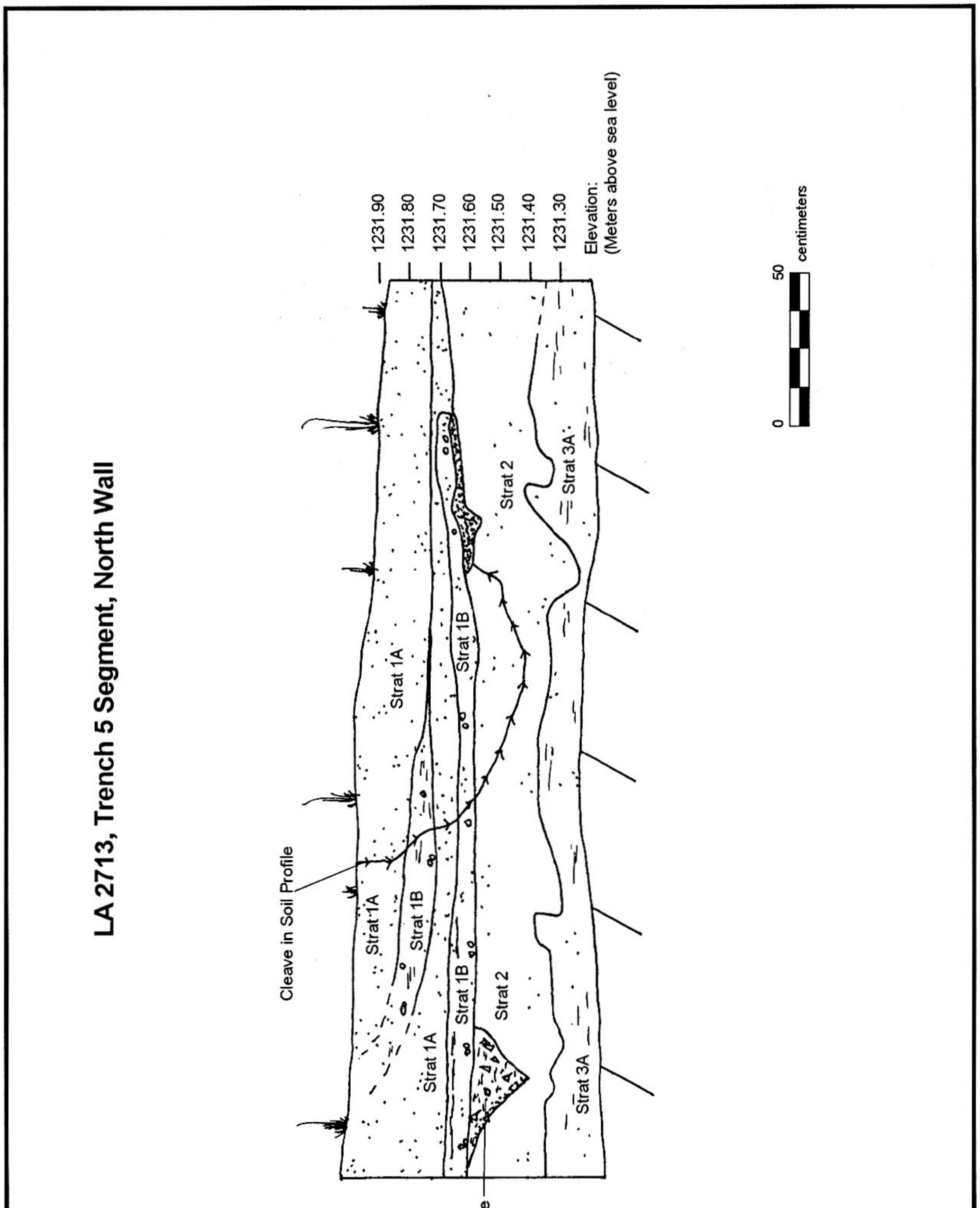

Figure 3.10. LA 2713, Trench 5 Segment, North Wall.

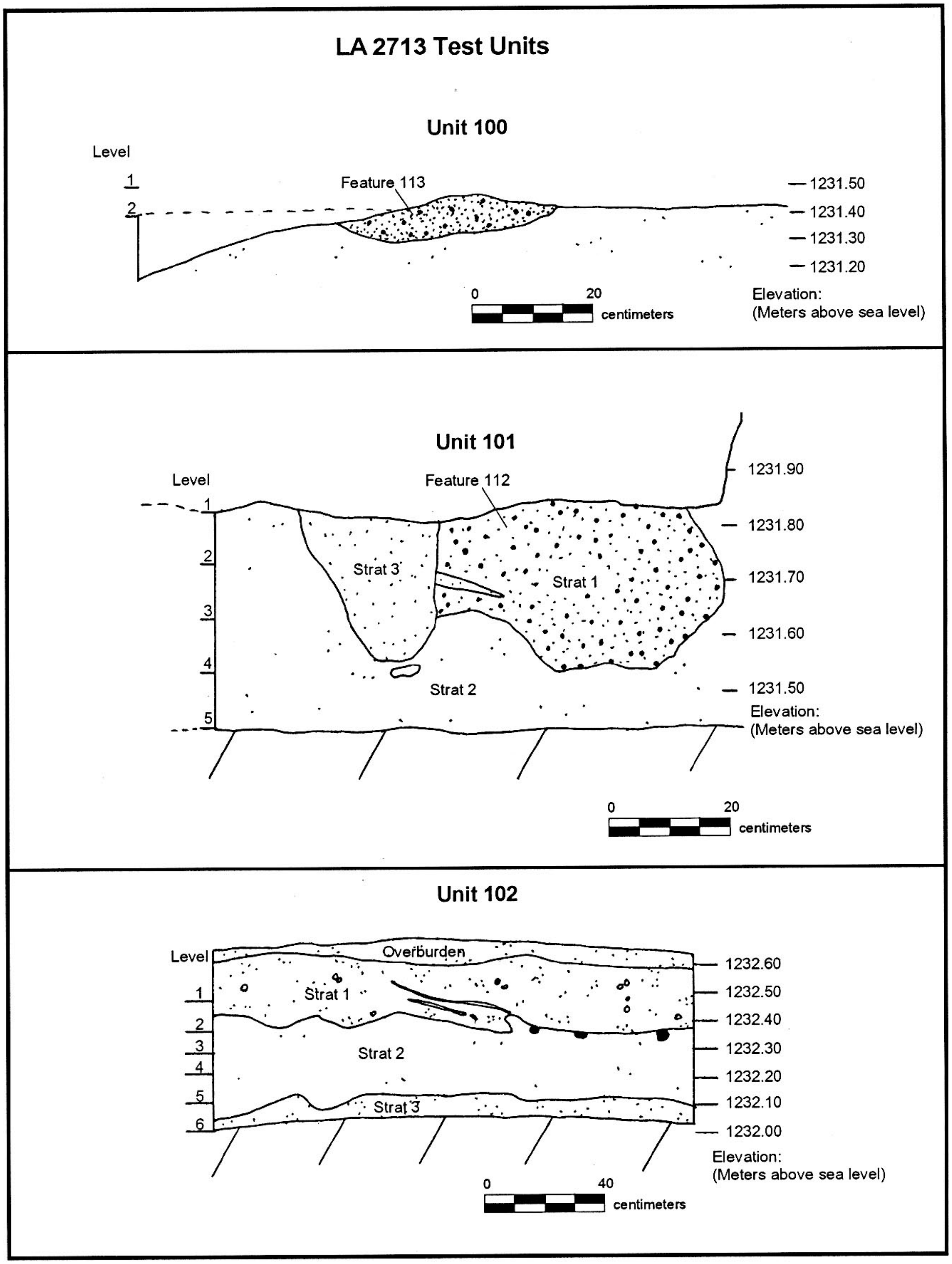

Figure 3.11. Profiles: Units 100, 101, and 102.

Table 3.2. Summary Information Hand-Excavated Units

Unit No.	Location of SW corner	Dimensions	Associated Features
100	N549.04/E588.46	2 by 2 m	Feature 113
101	N600.30/E558.57	1 by 1 m	Feature 112 (non-cultural)
102	N601.07/E529.62	1.5 by 0.8 m	Feature 106
103	N600.40/E507.64	1 by 2 m	Feature 102 (non-cultural)
104	N600.52/E500.17	1 by 2 m	Feature 104
105	N547.97/E588.41	1 by 2 m	Feature 114
106	N547.97/E587.41	1.5 by 1 m	Feature 114
107	N602.90/E476.93	1 by 1 m	Feature 105
108	N550.98/E478.48	1 by 2 m	Feature 100

dent in Level 1 and the uppermost fill of Feature 113. No artifacts were found in Level 2 but burned caliche was recovered and charcoal was also present. In contrast, Level 3 did not yield cultural materials.

Unit 105 was a 2 by 1 m unit south of Unit 100, and was excavated to determine whether the artifact and caliche concentration in the southern portion of Feature 113 continued in that direction. The unit was excavated in three levels corresponding to those in Unit 100 (Table 3.4). The sediment from Level 1 was excavated mechanically, without screening. The remaining sediment was screened through eighth-inch mesh. Level 2 was excavated about 8 cm deep, so that it was at the same depth as Level 2 of Unit 100. Burned caliche was recovered, and a light stain extending into the west wall of the unit was discovered at the base of Level 2. This stain, designated Feature 114, was 35 cm long and 7 cm thick. Level 3 was 10 cm deep.

Table 3.3. Stratigraphic information for Unit 100

Level	Soil Type	Color (dry)	Cultural Materials
1	Backhoe removal		
2	Fine sand, >50% charcoal flecks and chunks	5YR4/4 Brown	96 (1.8 kg) burned caliche
F. 113	Fine sand, >50% charcoal flecks and chunks	7.5YR3/3 Dark Brown	Lincoln B/r sherd, 203 (13 lbs) burned caliche
3	Fine sand	5YR3/4 Reddish Brown	

Unit 106 was a 1.5 by 1.0 m unit west of Units 100 and 105, and was excavated to further investigate Feature 114. The unit was excavated using the same levels as Units 100 and 105, except that two additional 10 cm levels were excavated to more fully expose a large cobble protruding from the unit's north wall (Table 3.5; Figure 3.12).

Table 3.5. Stratigraphic information for Unit 106.
The sediment from Level 1 was again not screened; all of the remaining sediments were screened. Level 2, which was excavated to the same depth as Level 2 in Units 100 and 105, contained burned caliche and flaked stone. Feature 114 was exposed in the lower portion of Level 2. An additional charcoal stain was exposed in the west face of the unit but was considered too small to be designated as a feature.

Level 3 contained burned caliche and flaked stone. A macrobotanical sample was collected and yielded charred mesquite, uncharred *Mollugo* (carpet weed), and uncharred purslane. A radiocarbon sample was also collected and produced an AMS date of 970 ± 40 BP (Beta-158834), which corresponds with a calibrated date of cal A.D. 1050–1100 and cal A.D. 1140–1270.

Table 3.4. Stratigraphic information for Unit 105

Level	Soil Type	Color (dry)	Cultural Materials
1	Backhoe removal		
2	Fine sand, >50% charcoal flecks & chunks	5YR4/4 Brown	10 (1 lb) burned caliche
3	Fine sand	5YR3/4 Reddish Brown	1 flake, 7 (0.5 lb burned caliche)

Table 3.5. Stratigraphic Information for Unit 106

Level	Soil Type	Color (dry)	Cultural Materials
1 and 2	Loose fine loamy sand	7.5YR3/4 to 4/6 Dark Brown to Strong Brown	From Level 2: 5 flaked stone, 1 tool, 23 (0.5 kg) burned caliche
3	Soft fine loamy sand	5YR3/4 Dark Reddish Brown	5 flaked stone, 21 (0.5 kg) burned caliche
4	Soft fine loamy sand	5YR3/4 Dark Reddish Brown	1 flaked stone, 13 (1.9 kg) caliche
5	Soft medium sand	7.5YR4/6 Strong Brown	

Level 4 was excavated for 10 cm and contained a small amount of dispersed charcoal flecking, burned caliche, a piece of flaked stone, and a ground cobble partially exposed in the south wall of the unit (bordering Trench 5). The soil underneath the cobble was collected as a pollen sample, and produced evidence of Cheno-ams (saltbush, goosefoot, or pigweed) and high spine composites (sunflower, aster, or seepwillow), with small quantities of ephedra (Mormon tea) and Onagracea (fireweed).

The final level, Level 5, was also excavated for 10 cm. No cultural materials were recovered, and a 93 cm deep auger hole dug through the bottom of Level 5 did not yield evidence of underlying archaeological remains.

Unit 101 was a 1 by 1 m unit selected to investigate Feature 112, which was identified in profile in the south wall of Trench 4. The unit was excavated in five levels (Table 3.6; Figure 3.11). Level 1 was about 40 cm of recent overburden above Feature 112 and was mechanically excavated without being screened; the sediment was examined for artifacts during removal. The remaining 4 levels were each 10 cm thick. The sediments from Level 2 was screened using eighth-inch mesh, and fill from Levels 3 through 5 were screened using quarter-inch mesh. Level 2 included all of Feature 112; the additional levels were excavated to look for any underlying archaeological materials. No artifacts were recovered from any of the levels, suggesting that Feature 112 was not the result of human activity. As a result, radiocarbon, pollen, and macrobotanical samples collected from Level 2 were not submitted for analysis.

Unit 102 was a 1.5 by 0.8 m unit excavated to investigate Feature 106, which was exposed in the south wall of Trench 4. Level 1 was mechanically excavated to the top of Feature 106, which was 40 cm below the ground surface (Table 3.7; Figure 3.11). The fill from Level 1 was not screened; artifacts noted while monitoring the backhoe were collected.

Five additional levels were excavated by hand. Levels 2 and 3 contained Feature 106, a poorly defined ashy stain with charcoal flecks. These two levels were screened with quarter-inch mesh. Two sherds, a Chupadero Black-on-white jar body sherd and a cord-marked body sherd from an unidentified vessel form, were recovered from Level 2. Four sherds of corrugated brownware were recovered from Level 3. The recent glass in Level 2 indicated that more recent sediments had mixed with the feature fill.

Table 3.6. Stratigraphic Information for Unit 101

Level	Soil Type	Color (dry)	Cultural Materials
1	Backhoe removal		None
2	Sand	2.5YR3/4 Dark Reddish Brown	None
F. 112	Sand	7.5YR2.5	None
3	Sand	2.5YR3/4 Dark Reddish Brown	None
4	Sand	2.5YR3/4 Dark Reddish Brown	None
5	Sand	2.5YR3/4 Dark Reddish Brown	None

Levels 4 through 6 were 10 cm levels stratigraphically below Feature 106—though traces of ash and charcoal were still visible, indicating some mixing of sediments. These levels were screened using eighth-inch mesh. Recovered artifacts included two sherds of corrugated brownware from Level 4 and a Chupadero Black-on-white jar body fragment from Level 5. A radiocarbon sample targeting charcoal flecks in Level 5 yielded an AMS date of 850 ± 40 BP using the AMS technique (Beta-158833). This corresponds with a date of cal A.D. 1000–1170. Macrobotanical analysis of a sample from Level 5 demonstrated the presence of charred mesquite and *Molluga* (carpet weed).

Table 3.7. Stratigraphic Information for Unit 102

Level	Soil Type	Color (dry)	Cultural Materials
0	Surface		Flake, modern glass
1	fine sandy loam	5YR4/6 Yellowish Red	5 flakes, modern glass
2	fine sandy loam	5YR4/6 Yellowish Red	2 sherds, modern glass
3	very fine sandy loam	7.5YR3/4 Dark Brown	6 flakes
4	very fine sandy loam	7.5YR3/4 Dark Brown	9 flakes
5	very fine sandy loam	7.5YR3/4 Dark Brown	21 flakes, 1 sherd, radiocarbon sample, macrobotanical sample
6	sandy clay loam	2.5YR3/6 Dark Red	4 flakes

Unit 103 was a 2 by 1 m unit placed to expose Feature 102, an ash stain at the east end of Trench 2 (Figure 3.12). The unit was excavated using two 10 cm levels, both of which were screened using quarter-inch mesh (Table 3.8). Eight flakes were recovered from the unit, but recent glass was the most common artifact type in both levels. The "feature" was most the result of a recent root burn during a fire.

Unit 104 was a 1 by 2 m unit placed to investigate Feature 104, which was a dark lens containing burned caliche and flakes, in the south wall of Trench 2. The unit was excavated in three 10 cm levels. The first two levels were screened using quarter-inch mesh and the third, which contained Feature 104, was screened using eighth-inch mesh (Table 3.9). Flakes and sherds were recovered from the unit, and burned sandstone was found in the feature fill.

Feature 105, a large, bowl-shaped stain suggestive of a pit structure. Six 10 cm arbitrary levels were excavated (Table 3.10). Levels 1 through 4 contained general feature fill and were screened through quarter-inch mesh. Level 5 contained the bottom of the feature and would have contained the occupation floor, if one were present. Level 6 extended below Feature 105 and was excavated to ensure that the extent of the cultural remains was properly identified. The fill of Levels 5 and 6 was screened through eighth-inch mesh.

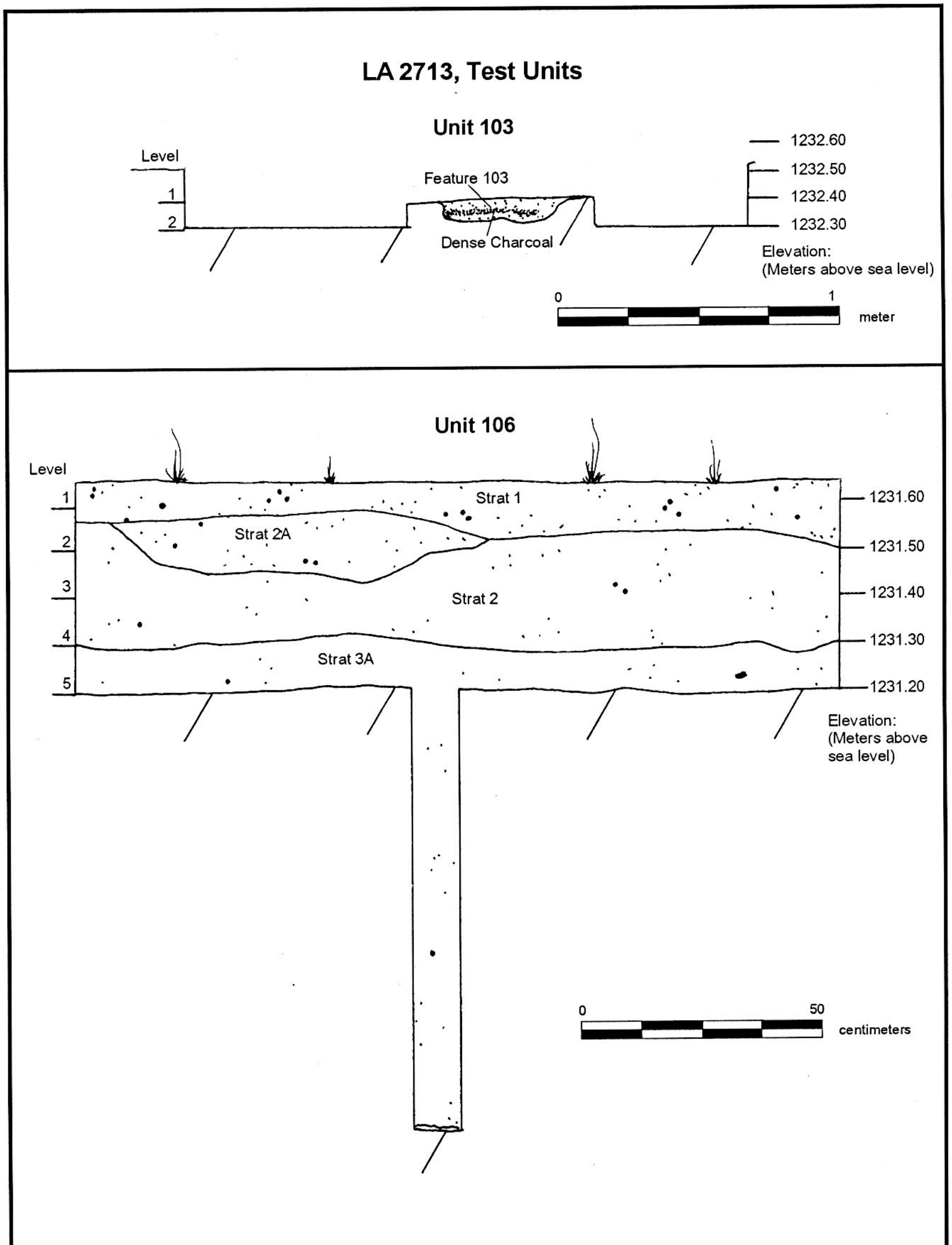

Figure 3.12. Profiles: Units 103 and 106.

Table 3.8. Stratigraphic Information for Unit 103

Level	Soil Type	Color (dry)	Cultural Materials
1	fine sandy loam	5YR3/4 Dark Reddish Brown	6 flakes, 30+ glass
2	fine sandy loam	5YR4/6 Yellowish Red	2 flakes, 2 glass

Table 3.9. Stratigraphic information for Unit 104

Level	Soil Type	Color (dry)	Cultural Materials
0	Surface		3 flakes
1	Loamy sand	7.5YR4/6 Strong brown	1 flake, 1 tool, 1 glass
F. 104	Loamy sand	7.5YR3/3 Dark Brown	5 flakes, 2 burned sandstone, >10 burned caliche
2	Loamy sand	7.5YR2.5/3 Very Strong Brown	12 flakes, 3 sherds
3	loamy sand	5YR3/4 Dark Reddish Brown	

Table 3.10. Stratigraphic information for Unit 107

Level	Soil Type	Color (dry)	Cultural Materials
1	Loamy sand	7.5YR4/6 Strong brown	2 burned caliche
2	Loamy sand, mottled	7.5YR4/6 Strong brown & 5YR4/6 Yellowish red	3 flakes, 4 burned caliche
3	Loamy sand, mottled	7.5YR4/6 Strong brown & 5YR4/6 Yellowish red	2 flakes,1 burned caliche
4	Loamy sand, mottled	7.5YR4/6 Strong brown & 5YR4/6 Yellowish red	2 flakes, 3 burned caliche
5	Loamy sand, mottled	7.5YR4/6 Strong brown & 5YR4/6 Yellowish red	
6	Loamy sand, mottled	7.5YR4/6 Strong brown & 5YR4/6 Yellowish red	1 flake, 4 burned caliche

A small quantity of flaked stone and burned caliche was recovered from Levels 2, 3, 4, and 6. Sediment in the northern 10 to 30 cm of the unit exhibited a very mottled appearance in Levels 2 through 5, suggesting that some of the feature fill had been disturbed. The disturbance extended north into Trench 3 and was most likely from a trench excavated for a utility line.

Unit 108 was a 2 by 1 m unit placed along the north edge of Trench 1 to investigate Feature 100, a 5 m long lens of dark soil. In addition to 15 cm of overburden that was removed in bulk, three 10 cm arbitrary levels were excavated (Table 3.11). Only the east half of Level 3 was excavated. All three levels were screened through eighth-inch mesh. Although Feature 100 was limited to Level 2, all three levels contained flaked stone artifacts.

Features

Fourteen features were identified and investigated during the excavation (Table 3.12). Features 102, 103, and 106–112 were subsequently determined to be natural features caused by grass fires and burning roots.

Feature 100 was exposed in the north wall of Trench 1 and was exposed in Unit 108 (Figures 3.4 and 3.11). Feature 100 was a soil stain containing 17 pieces of flaked stone debitage (Table 3.13) and a sherd of Lincoln Black-on-red pottery. The debitage was consistent with generalized core reduction (Chapter 8). A macrobotanical sample from Feature 100 yielded mesquite (*Prosopis*), a common fuel wood, and uncharred seeds of *Mullugo*, a member of the Carpetweed family (see Appendix D). Feature 100 was most likely a hearth used for

Table 3.11. Stratigraphic information for Unit 108

Level	Soil Type	Color (dry)	Cultural Materials
1	Fine sandy loam	7.5YR4/4 Brown to dark brown	13 flakes
2 and F. 100	Fine sandy loam	10YR3/2 Very dark grayish brown	42 flakes
3	Fine sandy loam	5YR3/4 Dark reddish brown	4 flakes

Table 3.12. Summary information for the fourteen features identified during the excavation of LA 2713

Feature No.	Associated Excavation Units	Description
100	North wall of Trench 1 Unit 108	Soil stain 5 m long, .15 m thick, and .2 m below surface. Probably a hearth from the Mesita Negra Phase of the Jornada Mogollon period.
101	North wall Trench 1	A burned caliche rock with limited staining protruding from the wall. Indeterminate use.
104	South wall of Trench 2 Unit 104	.7 x .34 m charcoal stain visible in south wall of Trench 2, which contained burned caliche and a flaked stone artifact. Produced a radiocarbon date of 1510 ± 40 BP. Probably a hearth from the Late Archaic period.
105	Walls of Trenches 2 and 3 Unit 107	6 m long, 50 cm deep pit shaped depression. Had been disturbed during the installation of utility lines. Could perhaps be the remnants of a pit house, but is too badly disturbed to full evaluate this possibility.
113	Floor of Trench 5 Unit 100	60 x 55 x 6 cm charcoal stain with burned caliche but no artifacts. Produced a radiocarbon date of 1230 ± 40 BP. Likely a Late Archaic period hearth.
114	Floor of Trench 5 Units 105 and 106	A 35 x 17 x 10 cm charcoal stain with burned caliche and flaked stone artifacts. Produced a radiocarbon data of 970 ± 40 BP. Likely a Jornada Mogollon period hearth.
Natural Features		
102	Floor and south wall of Trench 2; Unit 103	0.7-m-wide stain caused by root burn.
103	Walls of Trench 2	Irregular stain caused by brush fire.
106	Floor and south wall of Trench 4; Unit 102	Small stain. Produced a radiocarbon date of 850 ± 40 BP.
107	Floor and south wall of Trench 4	Small stain
108	Floor of Trench 4	Small stain
109	Floor of Trench 4	Small stain
110	Floor of Trench 4	Small stain
111	Floor and north wall of Trench 4	Small stain
112	South wall of Trench 4 Unit 101	Irregular 0.5 by 0.5 m stain. Devoid of artifacts and fire-cracked rock. Most likely caused by a natural fire.

Table 3.13. Flaked stone artifacts from LA 2713

Feature	Artifacts	Material						Total
		Chert	Chalcedony	Fine-Grained Quartzite	Lime-stone	Obsi-dian	Sandstone	
General Site Fill	Flakes	16	5	29				50
Feature 100	Flakes	6	4	7				17
Feature 104	Flakes	12	4	6			1	23
	Tool	1						1
Feature 105	Flakes	3	3	1	1			8
Feature 106	Cores	1						1
	Flakes	20	7	13	5	1		46
	Tool	1						1
Feature 114	Flakes	9	1	2				12
	Tool	1						1

cooking during the Mesita Negra phase. The flaked stone materials were possibly used during food processing.

Feature 101 was a small ash stain around a burned caliche rock that protruded from the north wall of Trench 1 (Figure 3.11). No artifacts were found in the feature, and its small size suggested that much of the feature was removed during excavation of the trench. As a result, Feature 101 was not selected for additional investigation.

Feature 104 was a charcoal stain exposed in the south wall of Trench 2 and further exposed in Unit 104. Twenty-four flaked stone artifacts were recovered, most of which reflected generalized core reduction (Table 3.13; Chapter 8). Macrobotanical analysis of a sample of the feature fill produced mesquite (*Prosopis*) wood. A charcoal sample yielded an AMS date of 1510 ± 40 BP (Beta-158832). This date corresponds with a calibrated date of cal A.D. 440 to 640, or the later portion of the Late Archaic period. Based on the size of the feature, Feature 104 was a hearth.

Feature 105 was a large (6 m diameter by 0.5 m deep) feature exposed in Trench 2, Trench 3, and Excavation Unit 107. Feature 105 had been disturbed by bioturbation (especially rodents) and past construction. Eight flakes recovered from the feature. Based on this limited assemblage, it is likely that initial flaked stone reduction was completed elsewhere and that activities at the feature included the use or repair of flaked stone artifacts. No pollen or macrobotanical samples from this feature were analyzed because of the obvious disturbance (including the introduction of more recent sediment). The size of the feature suggested that it was a pit structure; however, a floor was not found during excavation and the sediments were too disturbed to allow the preservation of internal features such as postholes. No diagnostic artifacts were recovered, but based on the intensity of core reduction, Feature 105 may date to the Archaic period (see Chapter 8).

Feature 113 was a charcoal stain exposed in the floor of Trench 5 and in Unit 100 (Table 3.12; Figure 3.3). This fill was excavated in two sections; the southern half was collected as a flotation sample and the northern half was collected as a bulk soil sample. In addition, large flakes of charcoal were collected from both halves as a radiocarbon sample. Sediment visibly disturbed by rodent burrows was avoided during the collection of the samples. A macrobotanical sample from the south half of Feature 113 yielded charred mesquite and uncharred *Mollugo* (carpetweed). A charcoal sample from Feature 113 was AMS dated to 1230 ± 40 BP (Beta-156277), for a calibrated date of cal A.D. 690–890.

Feature 114 was an ash stain containing 70 pieces of caliche and 13 flaked stone artifacts. Feature 114

was uncovered 1 m from Feature 113 in the floor of Trench 5 and was further investigated during the excavation of Units 105 and 106. After flotation and charcoal samples were collected, the remainder of the feature fill was screened through eighth-inch mesh. The flaked stone assemblage from the feature reflects both bifacial tool production and generalized core reduction. Macrobotanical analysis yielded mesquite and uncharred *Mollugo* and purslane (*Portulaca*) seeds. This feature was most likely a cooking fire in a food preparation area. Based on an AMS date of cal A.D. 1000–1170, Feature 114 dates the Late 18 Mile phase or Mesita Negra phase.

Cultural Materials Not from Features

Most of the flaked stone assemblage and four sherds were not clearly associated with any features. These materials were either on the site surface or were from general site fill. The flaked stone is indicative of the use of both generalized and formal tool reduction technologies, though only one formal tool, a chert biface, was recovered from a non-feature context (Table 3.13). The pottery included two Chupadero Black-on-white sherds, a Lincoln Black-on-red sherd, a cord-marked sherd, and four corrugated brownwares.

SUMMARY AND CONCLUSIONS

At LA 2713, excavation included five backhoe trenches and nine hand-excavated units. Fourteen features were exposed, six of which were cultural (Features 100, 101, 104, 105, 113, and 114) and nine of which were probably natural (Features 102, 103, and 106–112).

Features 100, 104, 113, and 114 were the remains of hearths. All four of these features contained mesquite, a common fuel wood, and Features 113 and 114 contained *Mollugo* seeds. The functions of two other cultural features are less certain. Feature 105 might have been a pit house, but was too badly disturbed to allow a positive identification. Feature 101 may have been a hearth but was almost completely removed by excavation of Trench 1. In addition to the features examined during data recovery, previous research identified the remnants of hearths elsewhere in the site (Crawford et al. 1999:52–54; Polk et al. 2000:3.1–3.19).

The excavations yielded 160 pieces of flaked stone and seven sherds. The flaked stone assemblage appears to indicate the use of local lithic resources and both bifacial and generalized reduction techniques (Chapter 8).

The excavations indicate that LA 2713 was occupied on many occasions during the Late Archaic and Jornada Mogollon periods. The sherds collected during the excavation and previous studies suggest use of the site during the Late 18 Mile, Mesita Negra, and McKenzie phases (A.D. 900–1350). In addition, radiocarbon dates from Features 104 and 113 indicate the repeated use of the site during the Late Archaic period.

Pollen analysis from Feature 114, a Jornada Mogollon period hearth, reflects grassland vegetation similar to that present today. The ubiquity of mesquite and uncharred *Mollugo* indicates that mesquite was the preferred fuel and that possibly that wild plant food resources were important during the entire occupation of the site. Based on a lack of macrobotanical and pollen evidence, domesticated foods were rarely if ever used at LA 2713.

The possible pit house may reflect extended use of the site, but that evidence is ambiguous. The site's inhabitants had access to resources through trade or perhaps travel to other areas. Petrographic analysis of two of sherds from the site indicated that the pottery was probably manufactured in the northern Sacramento Mountain area and transported to this site.

Chapter 4

LA 75159

Site Type: artifact scatter
Cultural Affiliation and Age: Paleoindian (?); Archaic; Jornada Mogollon; Euroamerican, Territorial to Recent
Size: 480+ by 420+ m
Area Excavated within Right-of-way: 291 m2

LA 75159 is a site containing Paleoindian, Archaic, Jornada Mogollon, and Euroamerican components, partly within the platted limits of the village of Kenna. The site is in the upper Kenna Draw drainage basin, in an area covered by mesquite, fourwing saltbush, Russian thistle, buffalo gourd, grasses, narrowleaf yucca, snakeweed, yarrow, aster, thistle, prickly pear cactus, and large cottonwoods (the last of which are found around nearby stock tanks) (Figures 4.1 and 4.2). Until the late 1800s, a spring in the northern portion of the site fed a small pond; the current archaeological studies show that the spring and pond were used repeatedly by Native Americans. The local drainage forms an obvious route from the Pecos Valley onto the Llano Estacado, so the spring and pond may have been an obvious stopping point for Native Americans traveling through the area as well as for those using local resources.

LA 75159 extends beyond an earthen stock tank to the north and the Burlington Northern Santa Fe Railroad (BNSF) tracks to the south, well beyond the project area. Due to lack of right-of-entry, the full extent of the site could not be determined. US 70 and BNSF tracks bisect the site from northeast to southwest. The site encompasses at least 139,640 m^2, 26,035 m^2 (19 percent of the known site) of which is in the current highway right-of-way. The highway right-of-way is being expanded by 10 m in the central portion of the site (Figure 4.2), increasing the area within the highway right-of-way by about 1,000 m^2. The excavations discussed in this chapter were limited to the area within the highway right-of-way, including the proposed expansion. The exception was Trench 3, which was thought to be within the right-of-way based on the plans then available, but later proved to be on private land just outside the southern right-of-way boundary.

LA 75159 has been disturbed by construction and other activities. The spring in the northern part of the site was used as a watering hole during cattle drives as early as 1860, resulting in erosion across nearly the entire site. A large earthen stock tank, several metal stock tanks, and a pump house were built near the spring, causing additional disturbance. The railroad tracks were built in 1898 (as part of the Pecos Valley and Northeastern Railroad), and service roads were later added on either side of the tracks. Archival research revealed that there once were railroad worker section houses just southeast of the site boundary, on the south side of the railroad tracks, which may account for a large historic artifact scatter in the eastern portion of the site. Furthermore, the core of LA 75159 is within the town limits of Kenna, which was platted in 1903.

More recent sources of disturbance include road construction, leading to the current local alignment of US 70 in 1938; the installation of telephone and fiber optic lines on the north side of the US 70 right-of-way during the late 1900s, and construction of right-of-way and ranch fences. In addition, the remnants of an old overhead utility line are present south of the railroad right-of-way fence. In 1995, a second parallel roadbed was prepared southeast of US 70 as part of the proposed expansion of US 70 to four lanes. Historic and recent litter associated with the use of US 70 covers the highway right-of-way. Despite all these sources of disturbance, the testing phase demonstrated that intact subsurface deposits were present (Polk et al. 2001:3.20–3.38).

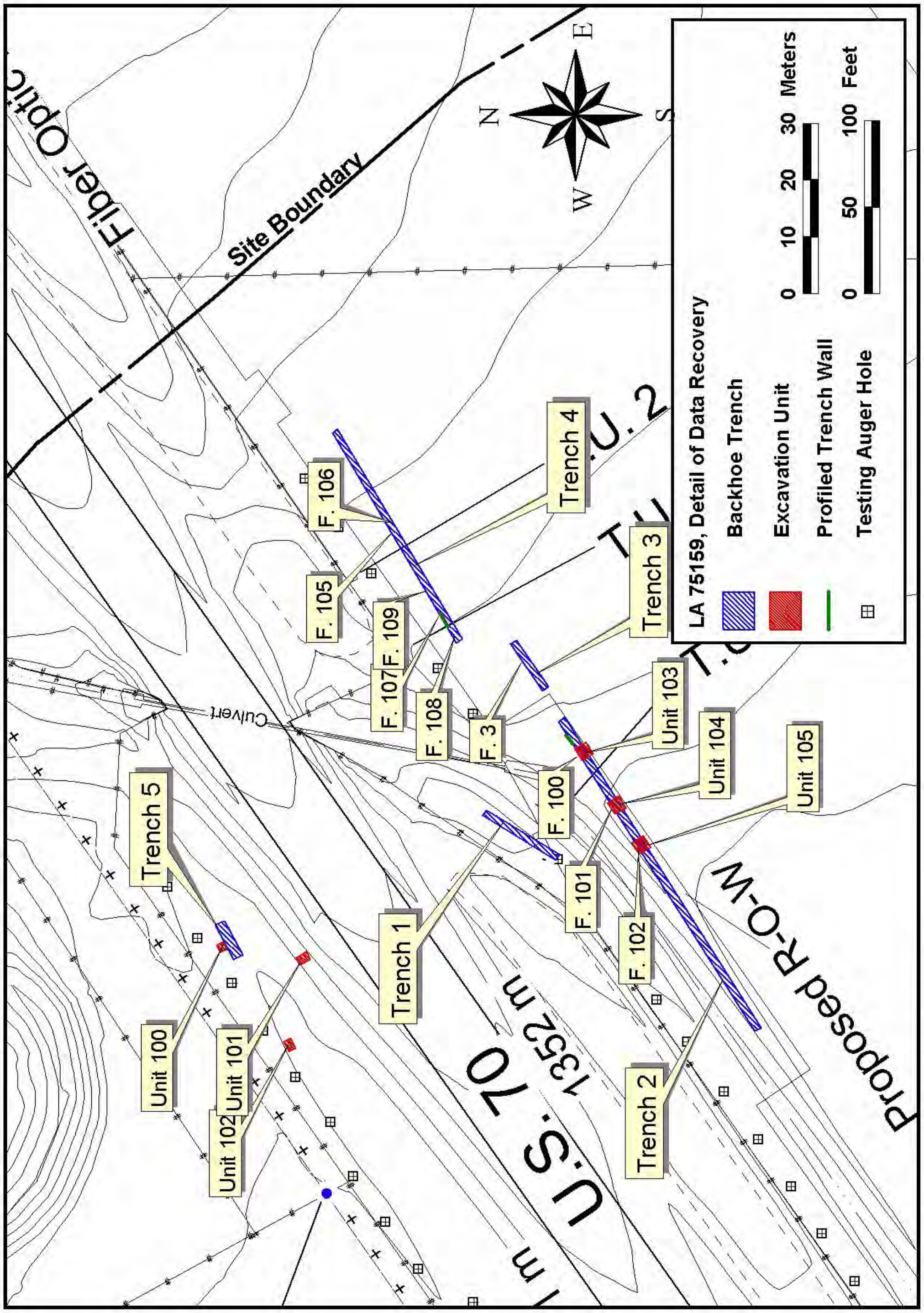

Figure 4.1. Excavations at LA 75159.

Figure 4.2. LA 75159, site overview.

PREVIOUS RESEARCH

LA 75159 was first recorded by Human Systems Research (HSR) in 1989 (Shields and Laumbach 1989:33–36), during a survey for a fiber optic line paralleling the railroad. The site was described as an 800 by 250 m artifact scatter containing prehistoric and historic remains. The prehistoric component was further broken down into a Late Archaic period occupation (as indicated by a stemmed projectile point and three corner-notched projectile points) and a Late Prehistoric period occupation (based on Lincoln Black-on-red, Chupadero Black-on-white, and Glaze B and D wares [A.D. 1385 to 1515]). The historic component consisted of a series of trash dumps dating from 1900 to 1950, probably derived from the occupation of Kenna and the use of the railroad. Much of the trash was concentrated at the east end of the site, on either side of the railroad tracks.

In 1999, the Agency for Conservation Archaeology (ACA) revisited the site for the survey phase of the current highway improvements (Crawford et al.1999:58–59). Based on its survey, ACA extended the site boundary north of US 70, beyond a stock tank so that it included most of a fenced pasture, but drew in the east and west ends of the site by a combined 325 m, resulting in site dimensions of 475 by 350 m. Crawford et al. (1999) report that the survey found three El Paso Brown Ware sherds, four Chupadero Black-on-white sherds, eight bifaces, two unifaces, one chopper/axe, hammerstones, and retouched flakes. ACA's assessment of the historic component mirrors HSR's.

In 2000, SWCA tested LA 75159 prior to the current highway improvements. The boundaries of the site were reviewed and enlarged slightly (however, the area south of the BNSF railroad tracks was not fully surveyed). In addition, 68 auger holes and three 1 by 1 m test units were excavated within the highway right-of-way, and artifacts on the surface within the highway right-of-way, south of US 70, were collected. During the testing, 132 flaked stone artifacts and two sherds were recovered. These materials reflected Paleoindian, Archaic, and Late Prehistoric period site use, as well as Euroamerican refuse from the early 1900s. Paleoindian period artifacts included a parallel-flaked blade and a Marcos or Elko Corner-notched dart point (Polk et al. 2001:3.37), both of which were made of Edwards Plateau chert. A San Jose style dart point

(3000–1800 B.C.) and a sherd of Glaze D pottery (San Lazaro Polychrome; A.D. 1490–1515) reflected the Archaic and Late Prehistoric period occupations identified in the previous surveys (Crawford et al. 1999:33–36; Shields and Laumbach 1989:58–59).

DATA RECOVERY

Excavation was limited to the area within the proposed expanded highway right-or-way (with the exception, already mentioned, of Trench 3). Provenience control was based on the two site datums (one on either side of the highway) and the associated grid system used during the testing phase (Polk et al. 2001:3.23). The datum south and the datum north of US 70 were assigned the respective arbitrary values of N500/E500 and N600/E500. The site was mapped with a total station and then mechanically and manually excavated.

Mechanical Excavation Units

Five backhoe trenches were excavated at LA 75159 to identify possible subsurface features and artifact concentrations (Table 4.1). When possible cultural features were encountered, an effort was made to limit mechanical excavation to exposing the surfaces of the features, which were later further exposed by hand. The trench walls were cleaned using the bits of transfer shovels. Profiles were then prepared and artifacts and possible cultural features exposed in the wall were identified and described.

Table 4.1. Summary Information for the Five Trenches Excavated at LA 75159

Trench No.	Location of SW Corner	Dimensions	Associated Features
1	N491.67/E525.48	14.5 m long by 1.6 m deep	Feature 104
2	N479.67/E481.47	65.0 m long by 1.6 m deep	Features 100-102
3	N484.40/E563.93	9.5 m long by 1.05 m deep	Feature 103
4	N479.67/E481.47	45.5 m long by 1.6 m deep	Features 105-109
5	N547.10/E542.60	6.5 m long by 1.75 m deep	None

Trench 1 was oriented roughly northeast-southwest, parallel with the right-of-way fence on the south side of US 70, along the west side of a drainage channel. Test Unit 1, which was excavated during site testing (Polk et al. 2001:3.23, 3.33–3.34), lay 1 m north of the north end of the trench. Four strata were identified in the trench's profile. The top stratum, which was not assigned a formal stratum designation, was disturbed sediment recently deposited during excavation of an adjacent drainage channel. The top stratum was very mottled, contained a large quantity of pea-sized gravel, and ranged in depth from 25 to 55 cm (with the thicker portion forming a low mound toward the north end of the trench). Pockets of grass that may have been carried into rodent burrows or that may represent the original ground surface were visible along the base of the stratum.

Stratum 1, the next stratum, was a layer of silty clay loam up to 30 cm thick. The base of the stratum was very irregular, suggesting that the sediment was deposited on recently disturbed ground. The stratum was most likely disturbed sediment deposited during past construction. Only one artifact, the end of a quartzite mano, was recovered from this stratum.

Stratum 2 was a silty clay loam grading from brown to pink. It was mottled and showed numerous rodent burrows. The stratum was up to 90 cm thick, and was originally thought to be a cultural feature (Feature 104) because it contained bone fragments and flaked stone artifacts. This stratum may correspond to deposits in Test Unit 1 from which a San Jose-style point base (3000–1800 B.C.) was recovered (60–70 cm below the surface; see Polk et al. 2001:3.33–3.34). Stratum 2 may also be a southern extension of the pond deposits visible in Trench 5.

Stratum 3 was a light brown sandy loam visible only in the deepest portion of the trench. Its thickness was unknown. Stratum 3 did not contain any artifacts.

Trench 2 was placed between the southeast side of a drainage channel and the southeast edge of the expanded highway right-of-way. It was more or less parallel with the highway. The trench had a maximum depth of 1.6 m but typically was slightly less than 1 m deep.

The profiles in Trench 2 reflects the partial survival of a soil column (Strata 2 through 4), which was covered by overburden (Stratum 1) probably deposited during construction of the adjacent drainage channel. In most of the trench, two main strata were identified (Figure 4.3, *top*). Stratum 1, was dark brown loam that was shallower towards the southwest end of the trench. Stratum 1 was most likely recently redeposited during excavation of the nearby drainage. Stratum 2 was a dark yellow-brown, sandy clay loam that was disturbed by burrowing rodents and other forms of bioturbation. Stratum 2 demonstrated evidence of soil development and was the lowest stratum in much of the trench.

Two additional strata were visible at the west end of the trench (Figure 4.3, *bottom*). They are described in detail in Appendix B; to summarize briefly, Stratum 3 and 4 were a brown silty clay and a pinkish brown clay loam, both showing evidence of soil development.

Three features (100–102), all charcoal stains containing low-density clusters of burned caliche and a few artifacts, were identified in Stratum 3, no more than 40 cm below ground surface. These features were excavated in Units 103 through 105, and were determined to be the probable remains of hearths.

Trench 3 was northeast of Trench 2, slightly outside of the highway right-of-way expansion (Figure 4.4). Trench 3 paralleled Trench 2 and US 70. Trench 3's profile also reflected an intact soil column, of three strata similar to Strata 2 through 4 in Trench 2. Stratum 1 was a dark reddish brown, very fine sandy loam 15 to 25 cm thick. Stratum 2 was a dark reddish brown, sandy clay loam 30 to 60 cm thick. Stratum 3 was at least 30 cm of reddish brown clay, which extended below the bottom of the trench. Feature 103, a small ash stain, was exposed in the east end of Trench 3 at a depth of 30 cm below ground surface, in Stratum 2. A sherd from the rim of a mineral-painted polychrome bowl (post-A.D. 1000) was also found in the trench wall, 20 cm below ground surface, at the top of Stratum 2 near the west end of the trench.

Trench 4 was excavated at the edge of the expanded highway right-of-way in the northeast part of the site, 1 m southwest of Test Unit 2, which was excavated during site testing (Polk et al. 2001:3.35–3.36). This portion of the site appeared to have been less heavily disturbed by construction activity than most of the site within the right-of-way. The trench's maximum depth was 1.6 m but it was typically about 1.0 m deep. Six strata and five features (105–109) were identified in the trench walls (Figure 4.4). Six artifacts were recovered from the trench fill during monitoring.

Soil development had modified all of the strata except for Stratum 2. Strata 1 and 2 were silty loam, the only difference being that Stratum 1 showed limited soil formation. Stratum 3 was a gray-brown sandy loam with charcoal flecks. The stratum was irregular, in one place dipping through Strata 4 and 5 (see Figure 4.4) and was later renamed Feature 107. Stratum 4 was a dark gray-brown to black silty clay loam containing bone and charcoal flecks but no artifacts. Despite the lack of artifacts, the bone and charcoal may indicate that this stratum resulted from an occupation surface. Stratum 5 was a light brown silty sand that graded into Stratum 4. No artifacts were recovered from this stratum. Stratum 6 consisted of orange sand and caliche gravel.

Trench 5 paralleled with US 70 on the northwest side of the highway, in a low area between the highway and an earthen stock tank. The excavation revealed a very dark clayey deposit, with caliche pebbles becoming more common with depth. The deposit reflected the slow filling of the former pond fed by the nearby former spring. The Trench 5 profile was not differentiated into strata; instead, Unit 100 was hand-excavated along the northwest side of the trench to clarify the stratigraphy and archaeology of the pond deposits.

Several artifacts were recovered from the Trench 5 backdirt, including two cores, a hammerstone, two flakes, and a metate fragment. These artifacts were

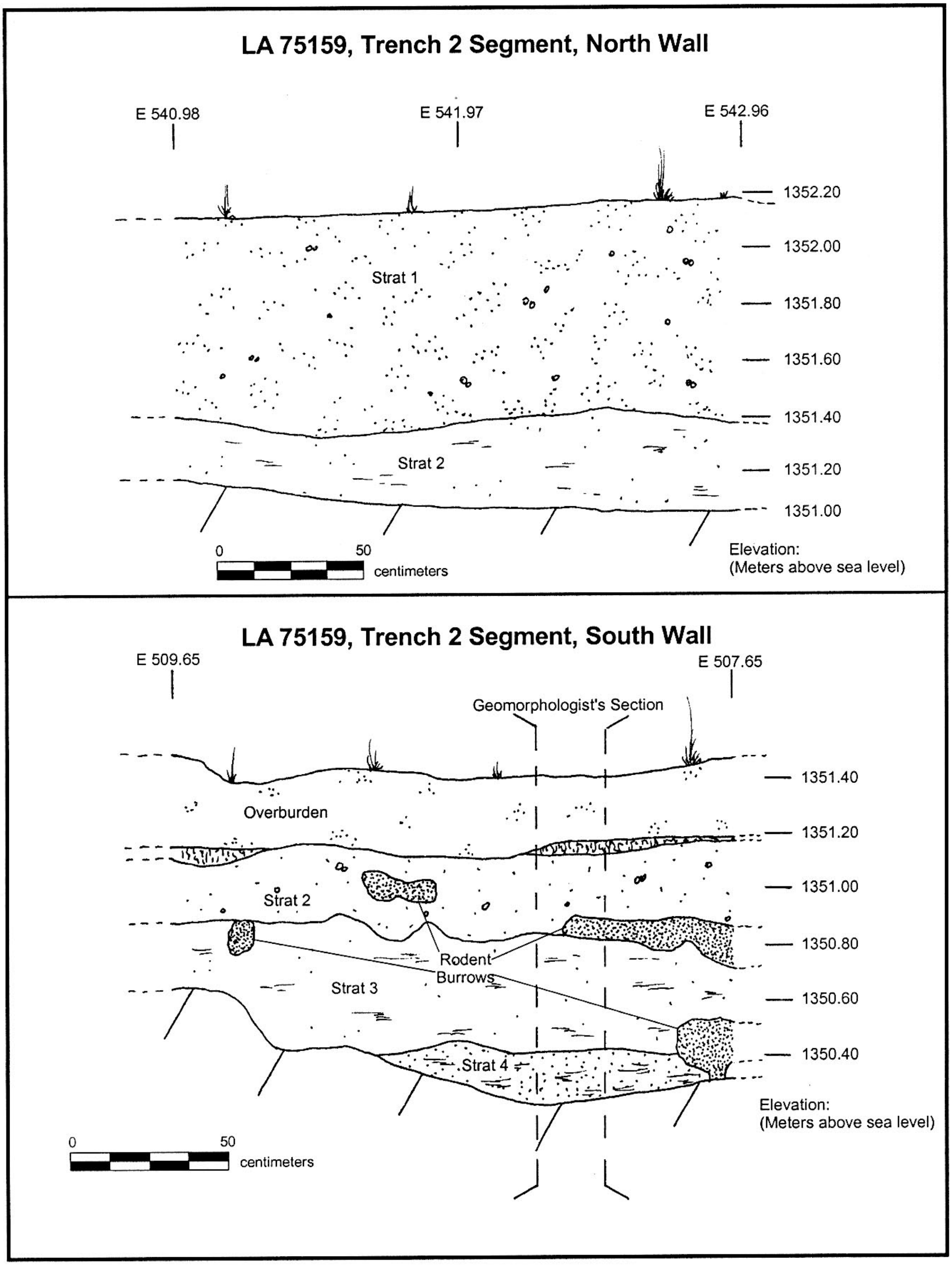

Figure 4.3. LA 75159, Trench 2 profiles.

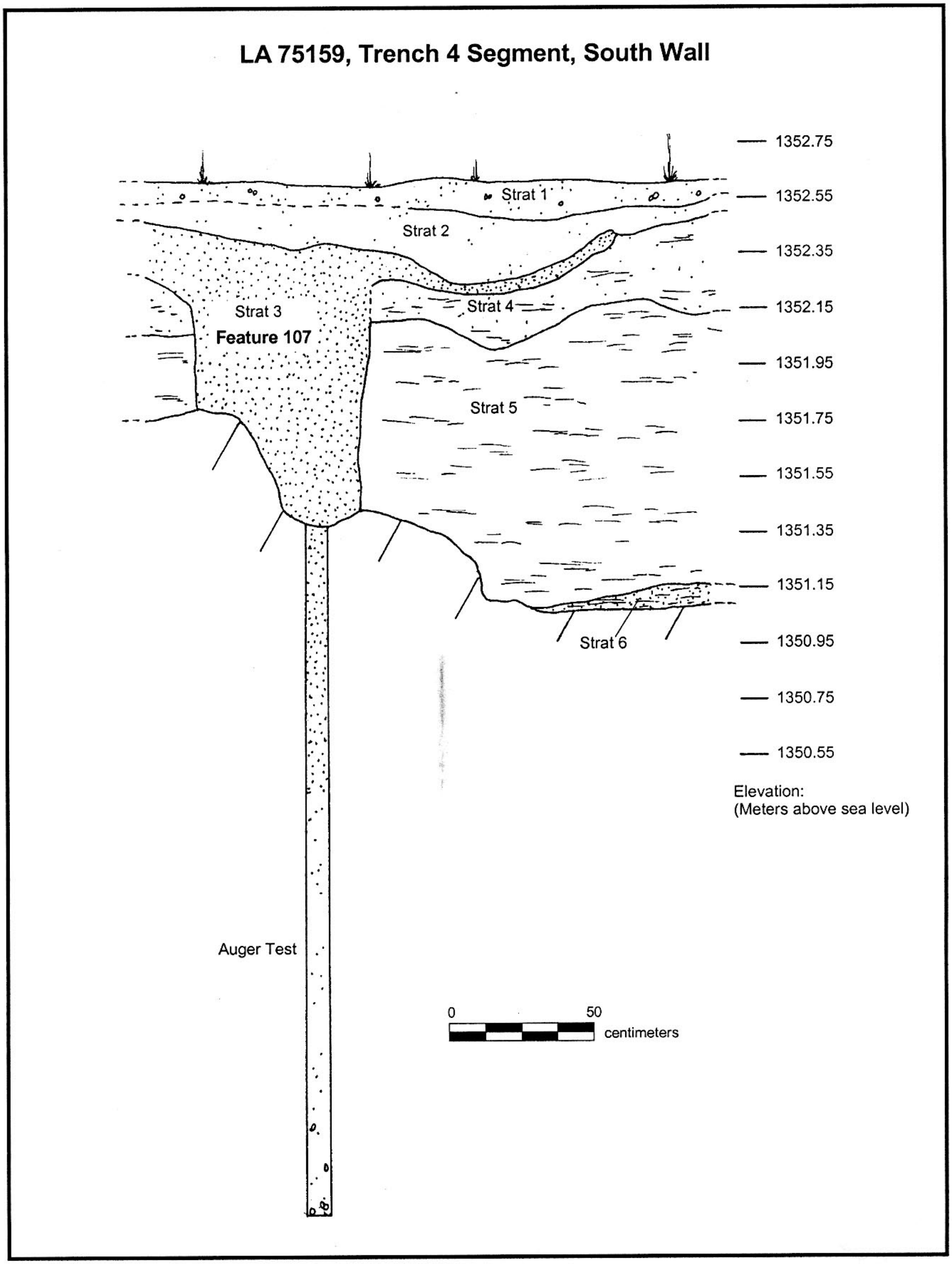

Figure 4.4. LA 75159, Trench 4 profile.

surface, the crew initially suspected that the bottom of the trench represented Paleoindian deposits. Faunal analysis later indicated the bones were from modern bison [Appendix C], as well from a pronghorn-sized animal, and radiocarbon dating confirmed that the trench extended downward into Archaic period rather than Paleoindian period deposits. Nonetheless, the pond deposits continue downward from those exposed during data recovery, so Paleoindian period deposits cannot be ruled out.

A fragment of human bone (from the occipital region of the skull) was found in the trench backdirt, but could not be associated with any of the other remains found during trenching or excavation of Unit 100. Regional tribes were contacted concerning the disposition of this bone fragment, but none responded. The bone consequently will be curated with the rest of the artifact assemblage.

Hand Excavation Units

Six units (100–105) were hand excavated to further investigate features and deposits exposed in the trenches (Table 4.2).

Unit 100

Unit 100 was a 1 by 1 m unit excavated next to the northwest edge of Trench 5, in order to provide more information concerning the geomorphology of and cultural materials in the pond deposits (Figures 4.5 and 4.6). Unit 100 was excavated in nine levels, after which the deeper deposits were auger sampled in three levels. Excavation stopped at the water table, which was encountered 2.14 m below the ground surface. The fill from the fully excavated levels was screened through quarter-inch mesh; the fill from the auger levels was collected for later processing.

Table 4.2. LA 75159, Summary Information for Hand-Excavated Units

Unit No.	Location of SW corner	Dimensions	Associated Features/Deposits
100	N548.19/E545.01	1 by 1 m	Stratified lake deposits from Trench 5
101	N548.62/E523.82	1 by 2 m	Stratified lake deposits from Trench 5
102	N537.93/E535.44	1 by 2 m	Stratified lake deposits from Trench 5
103	N477.02/E537.77	2 by 2 m	Feature 100
104	N477.76/E526.66	2 by 2 m	Feature 101
105	N478.09/E518.56	2 by 2 m	Feature 102L

Seven strata were defined, based on changes in soil consistency and color. Table 4.3 provides a preliminary guide to the age of the strata. Fourteen sets of radiocarbon, macrobotanical, and pollen samples were collected, one from each stratum with additional samples for each 10 cm portion of thicker strata. Ten sets of the samples were analyzed; the four not analyzed included two from Strata 1 and 2 (which showed evidence of recent disturbance and were therefore likely contaminated) and one set each from Strata 4 and 5 (which were closely bracketed by other samples).

Strata 1 and 2 were nearly identical strata of dark gray-brown, fine sandy loam differentiated only by the texture differences caused by recent root disturbance in Stratum 1. The combined strata yielded a fine-grained quartzite tested cobble, two pieces of chert shatter, a chert finishing flake, and a chert biface fragment (probably the basal fragment of a projectile point with a flat or slightly concave base with straight sides. Unfortunately, the possible point was not complete enough to be assigned to a type). A piece of burned caliche (0.7 kg) was also noted.

Samples from the lower portion of Stratum 2, obtained from Level 2, were analyzed. Cheno-Am pollen comprised 40.1 percent of the pollen sample. The analysis also yielded pollen from high spine composites (19.3 percent), low spine composites (1.0 percent), grass (1.5 percent), Ponderosa-type pine (1 percent), piñon (4 percent), and juniper (1 percent) (see Appendix D). The trees are not currently part of the local plant community; their pollen can travel great distances and probably originated from distant stands. The remaining pollen was too deteriorated to allow identification. No macrobotanical fragments could be identified. Organic residue submitted for AMS radiocar

Table 4.3. Temporal Assignments for Unit 100 Strata

Stratum	Temporal Affiliation
1 and 2	Possibly mixed, probably Late Prehistoric or Protohistoric
3	Mesita Negra/McKenzie phases
4	Early 18 Mile phase and/or Late Archaic
5	Late Archaic
6	Late Archaic
7	Late Archaic (also end of Middle Archaic?)

(based on AMS radiocarbon dates)

Figure 4.5. LA 75159, Unit 100.

bon(based on AMS radiocarbon dates)dating produced a date of 1900±60 BP (Beta-158836), which corresponds to cal B.C. 30 to cal A.D. 240.

Stratum 3 was a 10 cm thick layer of dark gray-brown, sandy clay loam with some caliche gravel. Twelve flaked stone artifacts, three bone fragments (from bison and a pronghorn-sized mammal), and a piece of burned caliche were recovered. The flaked stone included an exhausted core of fine-grained quartzite, a chert edge-modified flake, a piece of shatter, and nine flakes.

The Stratum 3 macrobotanical sample, which was the only one from the column to produce identifiable remains, produced a few charred *Chenopodium* seeds. The pollen analysis detected the widest variety of tree pollens from all the samples analyzed, including ponderosa-type pine (0.5 percent, piñon (2.4 percent), oak (0.5 percent), and probable cottonwood (0.5 percent). Cheno-Am (35.1 percent) pollen again dominated the sample, and high spine composites (24.6 percent), grass (4.3 percent), and low-spine composite (0.5 percent) were also present. AMS analysis of two samples of organic residue produced dates of 770±40 BP (Beta-158837) and 690±70 BP (Beta-156280), which correspond to dates of cal A.D. 1200–1290 and cal A.D. 1220–1410.

Stratum 4 was a 40 cm thick layer of very dark gray-brown clay mixed with a limited amount of sandy clay loam excavated in Levels 3 and 4. The caliche gravel evident in Stratum 3 was absent in this stratum, which tended to have a smaller grain size and to be softer than the overlying sediment.

Thirty-seven flaked stone artifacts, one sherd, and twenty-nine bone fragments were recovered from Stratum 4, Level 3. Twenty-one pieces (2.3 kg) of burned caliche were noted but not collected. The flaked stone includes a late stage biface, a projectile point, a multi-directional core, nine pieces of shatter, and twenty-five flakes. The projectile point is a Scallorn point (A.D. 700–1200 [Turner and Hester 1993]) of Edwards Plateau chert (Figure 4.7). Sixty-eight percent of the flakes (n=17) represent late stage reduction or tool production activi-

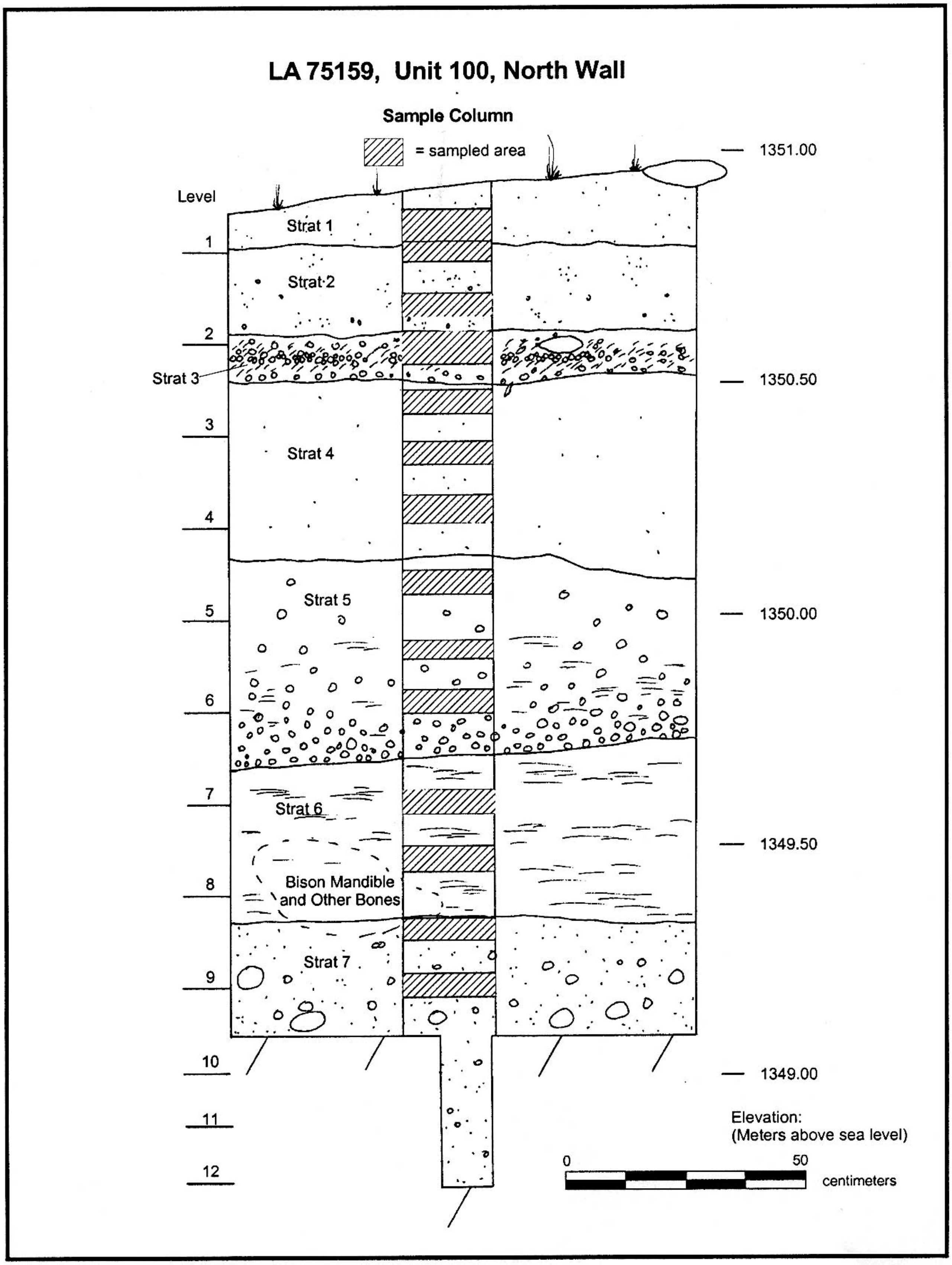

Figure 4.6. LA 75159, Unit 100 profile.

ties, and one chert flake may be part of a burin. The sherd is Jornada Brown Ware, from an unidentified vessel form. The bone came from pronghorn-sized mammals and bison (Appendix C) and were concentrated in the southeast corner of the unit, perhaps indicating a concentration of butchering refuse. However, none of the bone fragments exhibits burning, butcher marks, or other evidence of cultural modification.

Four flakes, a sherd, a piece of ground stone, and eight bone fragments were recovered from the portion of Stratum 4, Level 4. Three pieces of burned caliche (<0.5 kg) were noted but not collected. The sherd, which was in the lowest stratigraphically of all of the pottery in the unit, was an El Paso Brown Ware jar fragment (ca. A.D. 200–1200). The ground stone was the mid-section of a mano. One of the bone fragments was from a pronghorn-sized mammal, five were from a bison-sized mammal, and two were from a Western box turtle. None of the bones were burned or showed other signs of cultural modification.

Macrobotanical, pollen, and radiocarbon samples were collected from the lower portion of Stratum 4, Level 4. The macrobotanical sample did not contain identifiable plant remains. The pollen sample was dominated by Cheno-ams (40.1 percent), with smaller amounts of high spine composites (19.3 percent, low spine composites (1 percent), and grass (1.5 percent). Ponderosa type pine (0.4 percent) and piñon (2 percent) were also evident. The organic residue sample from Level 4 was AMS dated to 1400±40 BP (Beta-158838), which corresponds to cal A.D. 600 to 680.

Stratum 5 was a 42 cm thick layer of gray silty clay with caliche gravel, excavated as Levels 5 and 6. Eight flaked stone artifacts and three bone fragments were recovered from Stratum 5, Level 5. The flaked stone included a bifacially flaked core and a scraper, both of unspecified chert, and five flakes. The three bone fragments were from a bison or a bison-sized mammal.

Stratum 5, Level 6 yielded 19 flaked stone artifacts, a hammerstone, and 14 bone fragments. Twenty-five pieces of burned caliche (2.5 kg) were noted but not collected. The flaked stone artifacts included a biface, two use-damaged flakes, an exhausted core, six pieces of shatter, and nine flakes. The biface was made of Edwards Plateau chert and may be a reworked projectile point. When combined with the flakes from Level 6, the flakes reflect both generalized and bifacial reduction. Nine of the bone fragments were from a bison or a bison-sized mammal and the remaining five were from a pronghorn or pronghorn-sized mammal.

Two pollen samples, one each from Levels 5 and 6, were submitted for analysis. The sample from Level 6 did not contain any identifiable pollen but the sample from Level 5 contained Cheno-ams (22.5 percent), high spine composites (36.2 percent), grass (0.9 percent), and piñon (1.4 percent). Macrobotanical samples were also analyzed but did not contain identifiable materials.

Samples of organic residue were recovered from Levels 5 and 6, near the top and bottom of Stratum 5. The samples yielded dates of 1790±40 BP (Beta-158839) and 2750±40 BP (Beta-156281), which correspond to cal A.D. 130 to 350 and cal 990 to 820 B.C.

Stratum 6 was a 37 cm layer of dark gray-brown silty clay with gravel, excavated as Levels 7 and 8. Artifacts recovered from Level 7 included 46 flaked stone artifacts and 146 bone fragments. The flaked stone includes a biface, an edge-modified flake, a scraper, an exhausted core, a multi-directional core, six pieces of shatter, and 34 flakes. The bone from this level was almost exclusively from bison (n=24) or bison-sized mammals (n=118). The bison remains included a fragmented maxilla, teeth, and thoracic vertebrae. Two of the bones have chop marks. The remaining faunal remains were a bone from a rabbit-sized mammal and three box turtle carapace fragments.

Artifacts from Level 8 included 46 flaked stone artifacts and 143 bone fragments. The flaked stone includes a biface, a scraper, two use-damaged flakes, a bifacial core, 10 pieces of shatter, and 31 flakes. The combined flakes from Stratum 6, reflect the full range of lithic reduction, from initial core reduction to tool finishing.

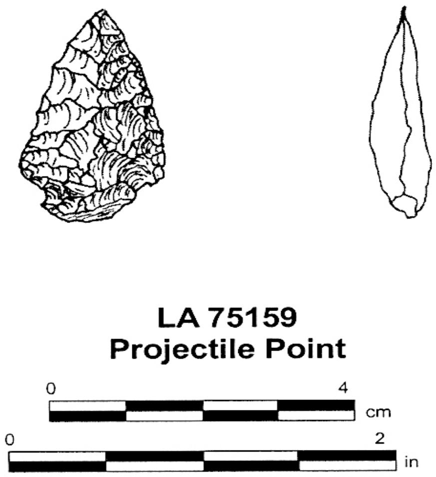

Figure 4.7. Projectile point from LA 75159, Unit 100, Statum 4, Level 3.

The Level 8 bone shows more variation than that from the previous level. Bison (n=16) and bison-sized mammals (n=111) still dominate the assemblage and include a fragmentary mandible, ribs, and long bones and foot bones (perhaps from the same individual). Based on the teeth, the bison was an adult (at least 4.5 years old). One bison-sized bone exhibited burning. Other animals represented by the assemblage include Western box turtle (n=8), jackrabbit (n=2), *Canis* sp. (n=1), rabbit-sized mammals (n=2), and coyote-sized mammals (n=2). One of the turtle carapace fragments showed evidence of burning. Most of the bone was recovered from the southwest corner of the unit.

Pollen and macrobotanical samples recovered from Stratum 6, Levels 7 and 8 were submitted for analysis, but did not contain any identifiable remains. Samples of organic residue from each level were produced AMS dates of 3070±50 BP (Beta-158840) and 3240±40 BP (Beta-158841), which correspond to dates of cal 1430 to 1200 B.C. and cal 1610 to 1420 B.C.

Stratum 7 was a layer of very dark gray-brown silty clay that was at least 35 cm thick, and that extended below the excavation. It was fully excavated in the lowest portion of Level 8 and in Level 9. Levels 10–12 were 10 cm levels excavated with an auger, ending at the water table.

No artifacts were recovered from Stratum 7, Level 8 or from Levels 10 through 12, but 64 flaked stone artifacts and 267 bone fragments were recovered from Level 9. The flaked stone included two use-damaged flakes, an exhausted core, 15 pieces of shatter, and 46 flakes. The flakes show the full range of lithic reduction, from initial reduction to tool finishing. The bone includes bison (n=7), indeterminate bison-sized mammals (n=179), western box turtle (n=60, all from a single individual), jackrabbit (n=3), *Canis sp.* (n=2), pronghorn (n=1), pronghorn-sized mammals (n=7), rabbit-sized mammals (n=5), and coyote-sized mammals (n=3).

Pollen and macrobotanical samples from Levels 8 and 10–12 also failed to produce identifiable remains. The pollen sample from Level 9 contained Cheno-ams (18.8 percent), high-spine composites (39.1 percent), low-spine composites (3.9 percent), grass (4.3 percent), and piñon (2.9 percent).

Two samples of organic residue, one from Level 8 at the top of Stratum 7 and the other from the base of Level 9, produced dates of 2980±40 BP (Beta-158842) and 3550±40 BP (Beta-156282), which correspond to cal 1320 to 1060 B.C. and cal 1970 to 1760 B.C.

As is noted in Chapter 1, much of the local archaeological record formed on a ground surface that was more or less stable for the last 5000 years, with the exception of the dune formation in the past century or so. As a result, archaeologists working in the area rarely have access to stratified sequences of substantial archaeological materials. The deposits sampled in Unit 100 therefore provide an unusual opportunity to examine cultural and environmental change in southeastern New Mexico.

The radiocarbon dates from Unit 100 indicate that the pond stratigraphy is as intact as might be expected in a deposit subject to natural and cultural disturbance. With the exception of samples from Strata 2 and 7, which may reflect the mixing of younger and older materials, the radiocarbon dates correlate strongly with their relative vertical positions. Using these absolute dates, the materials from each unit can be tied to the cultural-historic

sequence outlined in Chapter 1 (Table 4.3). Based on these affiliations, the pond deposits LA 75159 contain the stratified remains from repeated occupations, beginning in the Late Archaic period (if not earlier) and probably continuing through the Late Prehistoric to Protohistoric period.

The pollen analysis suggests that the environment changed slightly through time. Cheno-am pollen becomes more common through time, while high-spine composites decline. Pollen from low-spine composites and grass declines from antiquity to the present day. As a rule, Cheno-am species do better in wetter conditions and in disturbed areas, compared with most high-spine composite species (Nancy Kastning, personal communication 2003). The observed changes can thus result from a general increase in moisture at LA 75159 (perhaps related to increased flow from the spring), from increased ground disturbance at the site by animals and humans, or from both. Additional sampling of the pond deposits could help determine which of these possibilities is correct.

The long occupational history reflected in the Unit 100 assemblage is a result of the spring and pond, which provided reliable water in an arid environment. In all, 241 flaked stone artifacts, two sherds, one piece of ground stone, and 613 pieces of bone were recovered from Unit 100.

The assemblages from Strata 1 and 2, which likely contain the most recent materials, produced few artifacts compared to the other strata. The flaked stone assemblage from Strata 1 and 2 reflects core testing and generalized core reduction, as well as the possible production of tools using bifacial core technology (see Chapter 8).

Stratum 3 probably correlates to the Mesita Negra (A.D. 1000–1200) and McKenzie (A.D. 1200–1300) phases, and perhaps to earlier phases of the Jornada Mogollon occupation. The flaked stone assemblage reflects both generalized and bifacial reduction, suggesting the use of both expedient and curated tools (see Chapter 8). The presence of bison and pronghorn-sized mammal remains indicates that hunting wild game was a significant part of the diet during this period. (Game species as well as humans would have been attracted to the reliable water supply.) The lack of identifiable pollen and macrobotanical remains from maize and other domesticated species suggests that domesticated foods were not consumed at the site, despite their occurrence in contemporary sites in the region. The reliance on wild resources is suggestive of the Neo-Archaic subsistence pattern proposed by Lord and Reynolds (1985).

Stratum 4 contains a Scallorn point (A.D. 700–1200) and a sherd of El Paso Brown Ware (A.D. 200–1200), artifacts consistent with the AMS date of cal A.D. 600–680, which locally corresponds with the end of the Late Archaic period. The stratum therefore is likely to contain remains reflecting the local change (or lack of change) from a Late Archaic to Jornada Mogollon lifeway.

Strata 5–7 represent an extended series of occupations during the Late Archaic. The number of artifacts and bones increases in the lower strata; Strata 7 and 8 contain 67 percent of the entire flaked stone assemblage.

The flaked stone assemblages from the Late Archaic–Jornada Mogollon transition and the Late Archaic period reflect both generalized and bifacial reduction strategies. In fact, the relative proportions of the products of bifacial and generalized core reduction of these occupations are statistically identical to each other and to those of the later Jornada Mogollon occupation (see Chapter 8). Likewise, the faunal assemblages reflect similar patterns of prey choice focused primarily on large game, including bison and possibly pronghorn.

If the number of artifacts reflects the intensity of occupation, LA 75159 may have been less intensively occupied through time, a pattern somewhat at odds with the apparent increase in the intensity of regional occupation during the Mogollon period (Sebastian and Larralde 1989:43). The artifacts and faunal remains themselves reflect extremely stable behavioral patterns, namely broad-spectrum hunting and gathering over a period of about 3000 years. In fact, the only obvious difference in the artifact assemblage is the addition of pottery, which may have been used in limited quantities during the Jornada Mogollon occupation of this part of New Mexico.

Figure 4.8. LA 75159, Unit 101.

Of course, we should also consider the formation processes that affected the materials recovered from Unit 100. Few pieces of bone show clear evidence of human modification, and some of them may be from animals that were killed by non-human predators or died from natural causes. After all, the spring undoubtedly served as a watering hole for many species.

Units 101 and 102

Units 101 and 102 were excavated near Trench 5 and Unit 100 to explore the extent of the pond deposits within the highway right-of-way and to recover additional stratified archaeological materials. Unit 101 was a 2 by 1 m unit 20 m southwest of Unit 100 (Figures 4.8 and 4.9). The entire unit was excavated in three 20 cm levels, with two additional 20 cm levels excavated in the unit's eastern half. An additional 30 cm level was then excavated using a soil auger. The fill from each level was screened through quarter-inch mesh. Because of difficulties in identifying the unit's complex stratigraphy during excavation, each level was excavated irrespective of natural strata.

Level 1 contained Stratum 1, a brown sandy clay loam similar to Stratum 1 of Unit 100, and part of Stratum 2, a dark yellow-brown, loamy course sand. Level 1 yielded 57 flaked stone artifacts, two sherds, and seven bone fragments. A small amount of burned caliche was noted but not tallied or weighed. The sherds were a Chupadero Black-on-white (A.D. 1050–1550) jar body fragment and a cord-marked body fragment from an unknown vessel form. The cord-marked sherd is probably a Plains type. The bones from Level 1 are almost equally divided between pronghorn and bison/cow-sized mammals. None of the bones was burned or culturally modified.

Level 2 included most of Stratum 2, the dark yellow-brown, sandy loam also exposed in Level 1. Within Level 2, Stratum 2 contained a thin lens of caliche. Twenty-three flaked stone artifacts, eight sherds, and 18 bone fragments were recovered from Level 2. Four of the sherds were El Paso Brown Wares, two of which were bowl fragments

and one of which was a jar fragment. The remaining four sherds were fragments of a Chupadero Black-on-white (A.D. 1050–1550) bowl (n=1) and jar (n=3). Seventeen of the 18 bones (including two teeth and one femur fragment) were from bison (n=3) or bison-sized mammals (n=14). The remaining bone was from a pronghorn-sized mammal. None of the bones was burned or culturally modified.

Level 3 included Strata 3 and 4 as well as the remnants of a rodent burrow. Stratum 3 was brown loamy fine sand and Stratum 4 was light brown sandy clay. Items recovered from Level 3 included nine flaked stone artifacts (of chert or fine-grained quartzite) and a bone fragment from a bison or cow.

Excavation of Levels 4 and 5 was limited to the east half of the unit and included portions of Strata 3, 4, and 5 (a brown silt loam). Stratum 3 appeared to have been deposited over Stratum 4, which was disturbed by at least two rodent burrows. Level 4 yielded a single primary flake of fine-grained quartzite, as well as three bone fragments from a pronghorn-sized mammal. Level 5 yielded a single flake of fine-grained quartzite, a piece of limestone shatter, and three bone fragments from a pronghorn-sized mammal.

Radiocarbon, macrobotanical, and pollen samples from Level 5 were analyzed. No identifiable remains were present in the pollen and macrobotanical samples. Organic residue from Level 5 was AMS dated to 2600±40 BP (Beta-156279), which corresponds to cal 820 to 770 B.C.

An auger hole was dug an additional 30 cm in the eastern portion of the unit. The first 24 cm yielded a soil identical to Stratum 5. The last 6 cm reverted to a soil similar to that of Stratum 4, most likely reflecting mixing of sediments caused by rodent burrowing.

The stratigraphy of Unit 101 indicates that it was at the west edge of the pond. The sandy sediments in Strata 2 and 3 are probably to be expected at the edge of the pond, while finer sediment accumulated towards the pond's center. The radiocarbon date of cal 880 to 770 B.C. from Level 5, which correlates with the Late Archaic period, suggests that sediment accumulated more slowly along the pond margins than at the pond's center.

Unit 102 was a 2 by 1 m unit placed 10 m southeast of Unit 100. Unit 102 was hand-excavated to a depth of 1 m, using 20 cm arbitrary levels, and then sampled to an additional depth 77 cm using a soil auger. All of the levels except for Level 1 were screened through quarter-inch screen. Materials were separated according to stratum.

Stratum 1 was light brown clay loam that varied in depth from 20 to 80 cm and was the bulk of the fill from the entire unit. Stratum 1 was deposited during construction work for US 70, to raise the road as it passed over a nearby box culvert. The fill included large rocks, tar, and modern artifacts (such as textiles and fragments of rubber tires) and was very mottled. Other than the Euroamerican trash, the only artifact seen (and the only one collected from the stratum) was a petrified wood primary flake.

Stratum 2 was exposed in the lower portion of Level 2 and the upper portion of Level 3. Stratum 2 was limited to the south half of the unit and was no more than 22 cm thick. Thirteen flaked stone artifacts and 27 bone fragments were recovered from Stratum 2. The bone included Western box turtle (n=1), pronghorn-sized mammals (n=2), and bison-sized mammals (n=24). Fragments of clear glass, cinders or clinkers, and a material that looked like hair were also present but were not collected. The modern artifacts indicated that this stratum was also deposited (or was highly disturbed) during highway construction.

Stratum 3 was a very dark brown clay loam exposed primarily in Levels 4 and 5. The stratum yielded nine flaked stone artifacts and 44 bone fragments. The bone came from Western box turtle (n=1), pronghorn (n=1), indeterminate artiodactyl (n=3), and pronghorn-sized (n=11) and bison/cow-sized (n=28) mammals. A few fragments of clear glass and cinders or clinkers were also present, indicating that this stratum was also redeposited or disturbed.

Two auger holes were excavated to an additional depth of 30 cm and 75 cm below the base of the unit. All of the fill from the auger holes was very

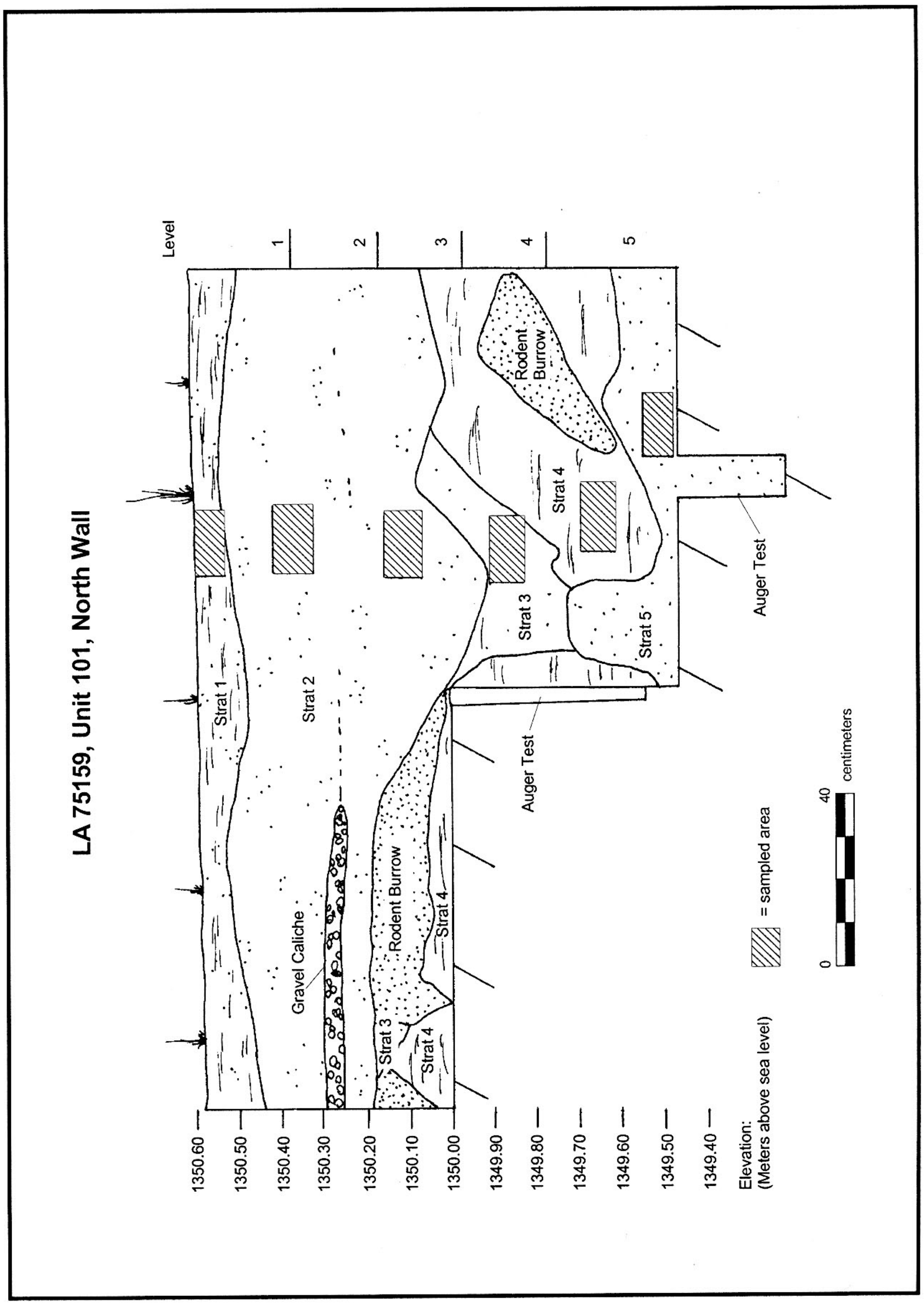

Figure 4.9. LA 75159, Unit 101, North Wall

dark gray-brown clayey loam, possibly reflecting four different strata (as inferred by changing sediment size). Based on their consistency, these strata were most likely extensions of the pond deposits observed in Units 100 and 101. No artifacts were recovered from the auger hole fill.

Unit 102 revealed the extent to which construction activities have affected parts of LA 75159. Most of the unit fill was either disturbed or redeposited. However, the auger-sampled deposits may indicate deeply buried, intact pond deposits that correspond with those in Units 100 and 101.

Other Hand Excavation Units

Unit 103 was a 2 by 2 m unit excavated in the floor of Trench 2, about 5.5 m from the trench's east end. Unit 103 was opened to investigate Feature 100, a hearth represented by a low-density cluster of burned caliche exposed in the floor of Trench 2. The unit was excavated in three 10 cm levels; the third level was excavated only in the unit's southwest quarter (Figure 4.10). The sediment was a brown silty loam with caliche rocks. The fill was screened using eighth-inch mesh.

Unit 104 was a 2 by 2 m unit excavated to investigate Feature 101, a low-density cluster of burned caliche that might a hearth exposed in the floor of Trench 2. Unit 104 was placed about 17 m from the east end of the trench, and was excavated in two 10 cm levels, though the second level was excavated only in the unit's northeast quarter (Figure 4.11). The general unit fill was screened through quarter-inch mesh; the fill of Feature 101 was screened using eighth-inch mesh.

Excavation of Unit 104 yielded a modest quantity of cultural material and some charcoal, indicating prehistoric activity at this location. The overburden, which was mechanically excavated as part of Trench 2, was a dark brown fine sandy loam probably deposited during recent excavation of the adjacent drainage ditch (as indicated by the presence of recent artifacts throughout the fill). Twenty-seven flaked stone artifacts were recovered as the mechanical excavation was expanded to include the entire 2 by 2 m area of Unit 104. The flaked stone included one modified flake, one scraper, twenty-three flakes, and two pieces of shatter. Recent metal artifacts such as soda cans were noted but not collected. Level 1 contained red-brown silty clay loam and Feature 101. Level 2 was excavated in the northeast quadrant of the unit to determine whether Feature 101 continued below Level 1. Level 2 contained brown sandy clay loam similar to that in Level 1, but did not contain any feature fill. Artifacts recovered from Level 2 included a piece of chert shatter and two flakes of fine-grained quartzite.

Unit 105 was a 2 by 2 m unit placed 25 m from the east end of Trench 2 in order to investigate Feature 102, the remnants of a hearth exposed in the trench floor. Unit 105 was excavated in two arbitrary 10 cm levels with a third 10 cm level excavated in the northwest quarter of the unit. All the levels were screened through quarter-inch mesh except for the feature fill, which was screened through eighth-inch mesh.

Level 1 of Unit 105 contained a dark brown, fine sandy loam consisting primarily of material derived from excavation of the adjacent drainage ditch. Twenty-four flaked stone artifacts, two sherds, three pieces of bone, and a piece of burned caliche were recovered from Level 1. The flaked stone included two exhausted cores, a utilized flake, eighteen flakes, and three pieces of shatter. The two sherds are Jornada Brown Ware; they are both body sherds from an unknown vessel form. The bones are from bison and coyote-sized and pronghorn-sized animals.

Level 2 was a red-brown, silty clay loam containing Feature 102, which was primarily in the unit's northwest quadrant. Level 3 was excavated only in the northwest quarter of the unit, and contained the lower portion of Feature 102.

Features

Nine features were identified. Feature 104 was later re-designated as Stratum II in Trench 1. The remaining features are summarized in Table 4.4.

Figure 4.10. LA 75159, Unit 103.

Figure 4.11. LA 75159, Unit 104, north wall.

Table 4.4. Features Identified During Excavation of LA 75159

Feature No.	Associated Excavation Units	Description
Cultural Features		
100	Bottom of Trench 2 Unit 103	Burned caliche and artifact scatter measuring 1.1 m in diameter by 0.4 m deep, starting 0.3 m below the ground surface. Most likely the remains of a cooking fire from the Late 18 Mile Phase.
101	Bottom and north wall of Trench 2 Unit 104	Diffuse stain 0.2 m below the ground surface. Most likely the disturbed remains of a hearth. No diagnostics or absolute dates.
102	Bottom of Trench 2 Unit 105	Disturbed low-density cluster of burned caliche. Most likely the remains of a Jornada Mogollon hearth.
103	Bottom of Trench 3	0.4 m diameter charcoal stain 0.3 m below the ground surface. Most likely the remains of a hearth. No diagnostic artifacts or absolute dates.
105	Trench 4	Two burned caliche cobbles 0.5 m below the ground surface, in the north wall of the trench. Possible hearth?
106	Trench 4	Stain 0.3 m below the surface exposed in the south wall of the trench. Possible hearth?
107	Trench 4	0.6 m wide stain visible on both walls of the trench, 0.3 m below ground surface. Possible hearth?
108	Trench 4	1 m wide by 1.3 m thick diffuse charcoal stain with three pieces of burned caliche. Exposed in both walls of the trench. Possible hearth?
109	Trench 4	1 m wide by 0.1 m thick charcoal stain containing two pieces of burned caliche, 0.1 m below the ground surface. Possible hearth?
Natural Feature		
104	Walls of Trench 1	90 cm thick stratum of brown to pink silty clay loam running the length of Trench 1. Renamed Stratum 2 of Trench 1 once its extent was known.

Feature 100 was a 1.1 m diameter scatter of burned caliche exposed in the bottom of Trench 2. The top 11 cm of the feature was removed during trenching. The feature was then further exposed in Unit 103, which was excavated in three arbitrary 10 cm levels. Level 1 contained burned caliche, 68 flaked stone artifacts including a projectile point, four sherds, and 50 bone fragments. The exposed caliche formed an elongated cluster extending between the northeast and southwest corners of Unit 103.

The projectile point was similar to a Late Archaic Amijo B stemmed point (1900 B.C.–A.D. 400; Turnbow 1997). In contrast with the apparent Archaic period point, the sherds were Jornada Brown Ware (n=2; A.D 200–1200) and Chupadero Black-on-white (n=2; A.D. 1050–1550). The Jornada Brown Ware sherds and one Chupadero Black-on-white sherd were from the bodies of unknown vessel forms; one Chupadero sherd was from the rim of a jar. The 50 bone fragments included western box turtle (n=3), desert cottontail (n=2), artiodactyl (n=2), and rat-sized (n=4), rabbit-sized (n=19), and pronghorn-sized (n=20) mammals. Rabbit-sized and pronghorn-sized mammals comprised almost 80 percent of the remains.
Eighty-eight flaked stone artifacts, six sherds, and 77 fragments of bone were recovered in Level 2, and 40 pieces of burned caliche (5.5 kg) were recorded. The six sherds were all Jornada Brown Ware (A.D. 200–1200). Two of the sherds were from jars but the vessel form of the other four could not be determined. The faunal assemblage included western box turtle (n=6), cottontail (n=6), black-tailed jackrabbit (n=1), black-tailed prairie dog (n=1), pronghorn antelope (n=2), bison (n=3), and an indeterminate rodent (n=1), as well as unidentified mammals of each of these sizes. Rabbit-sized and pronghorn-sized animals each represent about one-quarter of the assemblage.

Level 3 was excavated only in the southwest quadrant of the unit to further investigate a stain containing bits of charcoal, which was most likely a downward continuation of Feature 100. Seventeen flaked stone artifacts and eight bone fragments were recovered, and eight pieces of burned caliche (<0.5 kg) were noted. Most of the flaked stone was either shatter or from bifacial tool production. The bone fragments included black-tailed prairie dog (n=2), artiodactyl (n=1), rabbit-sized mammals (n=9), and pronghorn-sized mammals (n=6).

When fully exposed, Feature 100 measured 1.1 m in diameter and 0.4 m deep. It was most likely the remains of a hearth. The overlap in dates for Jornada Brown Ware (A.D. 200–1200) and Chupadero Black-on-white (A.D. 1050 to 1550) pottery suggests that the hearth was used between A.D. 1050 and 1200, during the Late 18 Mile Phase of the Jornada Mogollon period. The Armijo point may reflects the reuse of an older, collected point, or the type identification may be incorrect.

Charcoal in the stain excavated in Level 3 yielded an AMS date of 1230±40 BP (Beta-156277), which corresponds to cal A.D. 690–890. This date is consistent with the Jornada Brown Ware but is a bit earlier than the range generally associated with Chupadero Black-on-white pottery (A.D. 1050–1550). It is possible that the hearth was used several times during the Formative period. More likely, the discrepancy due to the “old wood problem”; charcoal in hearths can come from inner rings formed decades before the tree was cut and burned.

Feature 100 yielded the second largest number of bones and the widest variety of species from the site (see Appendix C). There was no evidence of butchering in the assemblage but 24 of the bones (including from artiodactyls and from rabbit-, coyote-, and pronghorn-sized mammals) were burned. The burned bones and the large number of bones suggest the hearth was used for cooking, perhaps on multiple occasions or during a period of intensive food preparation.

Feature 101 was a slight stain exposed in the sides and floor of Trench 2, about 0.2 m below the ground surface. The feature was further exposed during the excavation of Unit 104. Three small pieces of burned caliche and eight flaked stone artifacts were recovered from the feature. The flaked stone included a scraper, six flakes, and a piece of shatter. A macrobotantical sample was analyzed but failed to produce identifiable remains. A radiocarbon sample was also collected but was not analyzed because of the disturbance to the feature.

Feature 101 was most likely the remnants of a hearth, though the diffuse nature of the feature suggested heavy disturbance sometime in the past. Flaked stone reduction probably took place near the hearth. No diagnostic artifacts were recovered but Feature 101 was stratigraphically above Feature 100, a hearth from the 18 Mile Phase, suggesting that Feature 101 postdated the early Jornada Mogollon occupation of the area. Regardless of its temporal affiliation, the hearth probably represents a short-term occupation.

Feature 102 was a low-density cluster of burned caliche (Feature 102) exposed in the floor of Trench 2 and further investigated during the excavation of Unit 105. The feature was not clearly defined, which may bioturbation from rodent activity (as was evident in Level 3). Excavation Feature 102 yielded a quantity of cultural materials, indicating substantial prehistoric activity at this location. Despite finding 33 pieces (5 kg) of burned caliche, almost no ash or charcoal was noted. Seventy flaked stone artifacts, three sherds, and 21 bone fragments were recovered. The sherds included two Jornada Brown Ware and one cordmarked. All represent body sherds, of unknown vessel form. The bones included non-poisonous snake (n=1), jackrabbit (n=2), bison/cow (n=4), and indeterminate rabbit- (n=6), coyote- (n=1), and pronghorn-sized (n=7) animals. One of the rabbit-sized bones was burned.

Despite the absence of ash and charcoal, the amount of burned caliche suggests the feature is the remains of a hearth that was disturbed sometime in the past. Based on the burned rabbit bone and other bone, it is likely that game was cooked at the hearth. The users of the hearth also reduced lithic materials and probably were producing tools. The presence of Jornada Brown Ware sherds indicates that the hearth use occurred during the Formative period (A.D. 200–1200). The hearth probably represents a short-term occupation.

Feature 103 was a 0.4 m diameter charcoal stain uncovered in Trench 3, 0.3 m below the ground surface. The feature appeared to be the remains of a hearth or activity area, but was not examined. Features 105 through 109 were identified in Trench 4. None of these features were further examined.

Feature 105 was a cluster of two fire-cracked rocks 50 cm below the surface, in the north wall of the trench. Feature 5 was in Stratum 5, 21.5 m from the east end of the trench.

Feature 106 was a small, dark stain without artifacts in a slight dip in Stratum 4, in the trench's south wall. Feature 106 was 30 cm below the ground surface and 18.5 m from the east end of the trench.

Feature 107 was a mottled stain 18.5 m from the east end of the trench. It was visible in both trench walls, about 30 cm below the ground surface. The feature was about 2.5 m wide and 1 m deep.

Feature 108 was a charcoal stain containing a cluster of three pieces of fire-cracked rock, 40 cm below the ground surface in Stratum 4. Feature 108 measured 25 cm by 40 cm and was 32.5 m from the eastern end of the trench. Two pieces of ground stone that might have been associated with Feature 108 were recovered during mechanical excavation of this portion of the trench. In addition, a Jornada Brown Ware bowl body sherd was recovered from the bottom of the trench about 40 cm below the feature.

Feature 109 was a charcoal strain containing two pieces of fire-cracked rock, 10 cm below the ground surface and 32.5 m from the trench's east end. No other cultural materials were associated with this feature.

Cultural Materials Not from Features

Nine artifacts—two cores, two bifaces, two flakes, a mano, and two metate fragments—were recovered from the trench backdirt and the general site surface. The cores were fine-grained quartzite and sandstone, the bifaces were fine-grained quartzite and Alibates chert, and the flakes were initial stage reduction flakes of fine-grained quartzite. The mano was a quartzite one-hand mano, and the metate fragments were also quartzite.

SUMMARY AND CONCLUSIONS

Data recovery at LA 75159 included the excavation of five backhoe trench with a total length of 141 m and six hand-excavated units exposing a total of 9 m^2. Nine features were identified, as well as pond sediments containing cultural remains. The features included five soil stains and four small clusters of burned caliche (one with associated artifacts).

One of the burned caliche clusters (Feature 100) and two of the stains (Features 101 and 102) were excavated by hand. Feature 101 was probably a hearth used during the Late 18 Mile Phase. Feature 102 dated to the Jornada Mogollon occupation of the area. These features were most likely hearths, and contained bones (including burned bones) suggesting that the hearths were used to cook foods including meat.

Jornada Brown Ware dominates the recovered sherds. Chupadero Black-on-white sherds indicate a late occupation. For identified vessel forms, sherds from jars outnumber sherds from bowls nearly two to one. Petrographic analysis of four Chupadero Black-on-white sherds from the site (Appendix A) was inconclusive but suggests that the sherds were produced in the Capitan Mountains (less likely sources include the Sierra Blanca Peak, Gran Quivira, or Railroad Mountain areas).

Of the 663 pieces of flaked stone recovered from the site, most (n=586) are flakes or shatter from bifacial and generalized core reduction. Most of the debitage represents late stage reduction or tool production. Non-specific cherts dominated the assemblage; fine-grained quartzite was the second most common material. Non-local materials such as obsidian, basalt, and rhyolite were present in small quantities.

Seven pieces of ground stone were recovered. Only one piece, a mano, came from a hand-excavated unit (Feature 100, which was dated to the Late 18 Mile

phase). The other mano and metate fragments were recovered from backdirt, and their age is unknown.

Much of the excavation effort at the site focused on deposits created as a spring-fed pond slowly filled. Such deposits are unusual in the area. In addition to a short but deep trench (Trench 5), three units (Units 100, 101, and 102) were excavated into the pond deposits. A second trench (Trench 1) encountered either the southern limit of the pond deposits or disturbed soils from highway construction. A vertical series of radiocarbon, pollen, macrobotanical, and bulk soil samples was taken from Unit 100. This series spans a time period from about 3500 years ago to historic times. Pollen data from the pond series suggest changes in the local plant community through time. Cheno-am pollen increases through time from 18.8 percent to 40.1 percent of the count, while high-spine composite pollen decreases from 39.1 percent to 19.3 percent.

The setting of the site—at a spring/pond next to a pass between the Pecos Valley and the Llano Estacado—made it attractive to animals and human alike. The human visitors used the site to hunt, as indicated by hearths and burned bone. Radiocarbon results indicate a human presence at the pond since at least the end of the Middle Archaic period, though the intensity of occupation probably varied. The later Middle Archaic and later Jornada Mogollon occupations may have been more intensive, based on the frequencies of artifacts and bone. The Archaic period occupation may have focused on hunting larger game such as bison and pronghorn. Human activity at the spring seems to have reached a nadir prior to about A.D. 500. By that time, the hunting focus had changed toward antelope and smaller species, particularly rabbit.

Alibates and Edwards Plateau cherts from Texas and pottery from west of the Pecos River basin reflect considerable mobility, or participation in a well-established and long-lived trade networks, or both. The site's occupants also made use of local lithic resources such as the fine-grained quartzite and cherts present on the surrounding hills and a short distance eastward at the edge of the Llano Estacado.

Only a small portion of the site was excavated, but the number of recovered artifacts and bone suggests that the site could yield much more information. Furthermore, investigation of the pond deposits was limited by the water table. Given that artifacts were recovered throughout the pond deposits, it is likely that additional remains, predating the end of the Middle Archaic period, are present. We hope that the limited work completed by the current project will encourage additional studies of this site, outside the current construction zone.

Chapter 5

LA 75163

Site Type: artifact scatter with features
Cultural Affiliation and Age: Late Archaic; Jornada Mogollon; Euroamerican
Size: 960 by 580 m
Area Excavated within Right-of-way: 298.5 m of trench; 27 m2 of hand excavation

LA 75163 is a large site that straddles US 70 and Bob Crosby Draw at an elevation of 1,110 m (3,645 feet) (Figure 5.1). The site is in a coppice dune field, which is disturbed within the highway right-of-way. Vegetation includes grasses, four-wing saltbush, stickleaf, wild sunflowers, prickly pear cactus, *Solanum*, creosote bush, narrowleaf yucca, mesquite, and snakeweed (Figure 5.2).

An active spring and pool are present in the northern portion of the site, outside the highway right-of-way, in a small box canyon in Bob Crosby Draw. The vegetation within the box canyon seems lush in comparison to that of the surrounding countryside. Water seeps from the face of the head of the box canyon. The water seems too mineral-laden for long-term human consumption, but might have been consumable during brief visits. The contrast between this small oasis and the surrounding desert may have been just as important as the water itself.

LA 75163 covers about 389,760 m^2. The site is bounded by Bob Crosby Draw to the east, by US 70 to the north, and by the Burlington Northern Santa Fe Railroad (BNSF) railroad right-of-way to the south. About 29,400 m^2 (7.5 percent) of the site is within the current highway right-of-way. The right-of-way will be expanded slightly to the south, increasing the area within the right-of-way by about 117 m^2. The site is bisected by US 70, by an old road bed that was part of the pre-1938 road connecting Portales and Roswell, and by utility lines and maintenance roads. A buried telephone cable extends east-west across the site.

PREVIOUS RESEARCH

Human Systems Research (HSR) first recorded the site in 1989, during a pedestrian survey for a fiber optic line (Shields and Laumbach 1989). HSR excavated backhoe trenches along the north boundary fence of the BNSF railroad right-of-way. The only diagnostic artifact found was a corrugated brownware jar rim sherd.

Laurie Evans revisited the site for the NMSHTD in 1993 and updated the site description. Evans expanded the site boundary and noted a charcoal stain in the middle of a two-track road.

In 1994, Regge Wiseman of the Office of Archaeological Studies (OAS) of the Museum of New Mexico conducted data recovery for proposed bridge improvements on the south side of US 70 (Wiseman 2000). OAS excavated a 50 by 8 m area south and west of the highway bridge and recovered more than 21,000 flaked stone artifacts, 125 sherds, and 30 pieces of ground stone. OAS's work also exposed 10 hearths, seven pits, and one enigmatic ash stain.

John Ware and Steve Lentz of OAS revisited LA 75163 in 1996, as part of OAS’s Archaeological Site Stabilization and Protection Project. Ware and Lentz recommended that at least a sample of the site within the US 70 right-of-way be preserved and possibly stabilized.

ACA visited LA 75163 in 1999 and noted that the site had been further disturbed during the installation of buried lines, during the reshaping of Bob Crosby Draw due to culvert installation, and by ongoing ranching.

In 2002, SWCA conducted "nature and extent testing" at the site, as part of the current highway improvement project. The results confirmed the conclusions reached during OAS’s excavations, that the LA 75163 assemblage consists primarily of

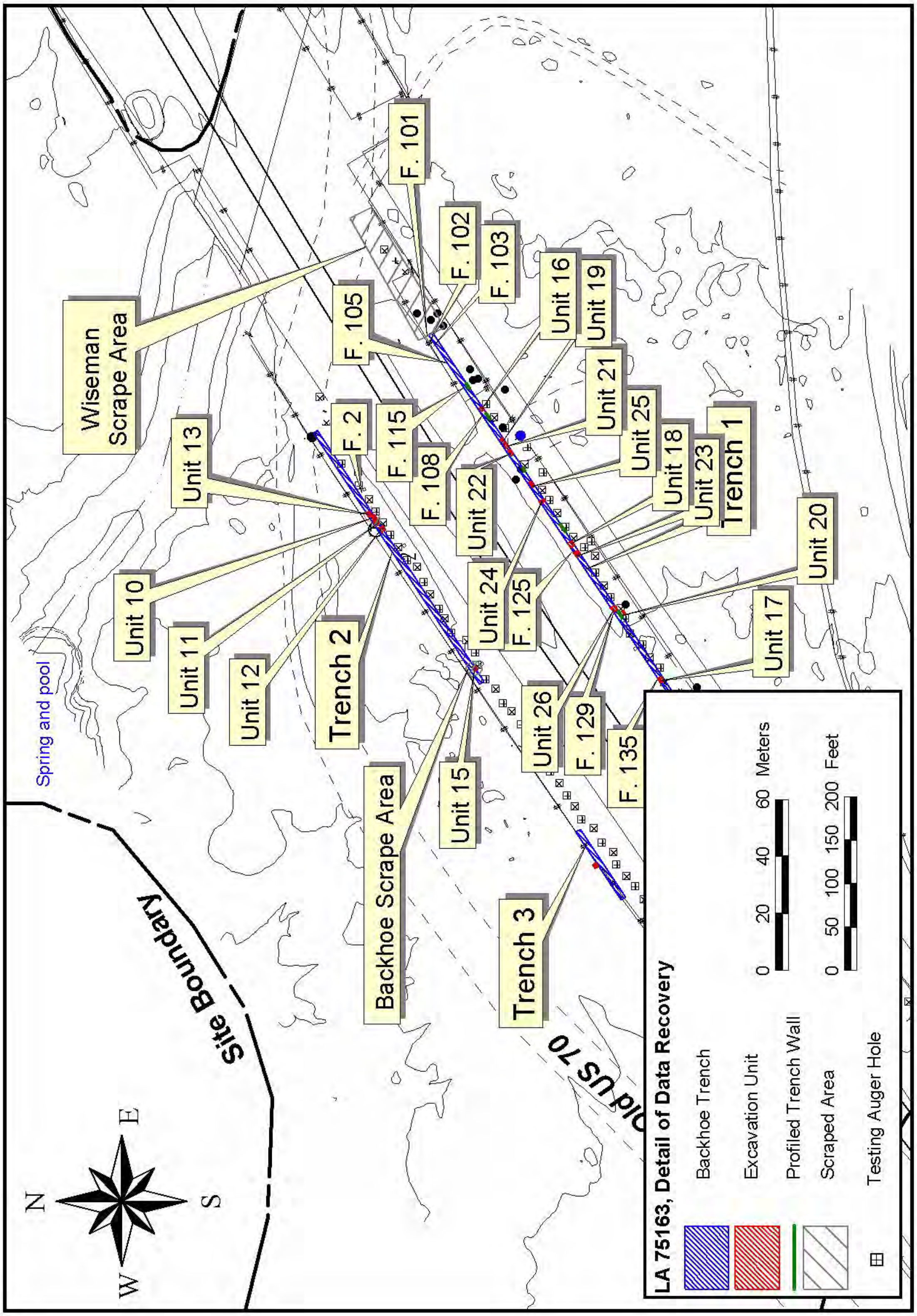

Figure 5.1. Excavations at LA 75163.

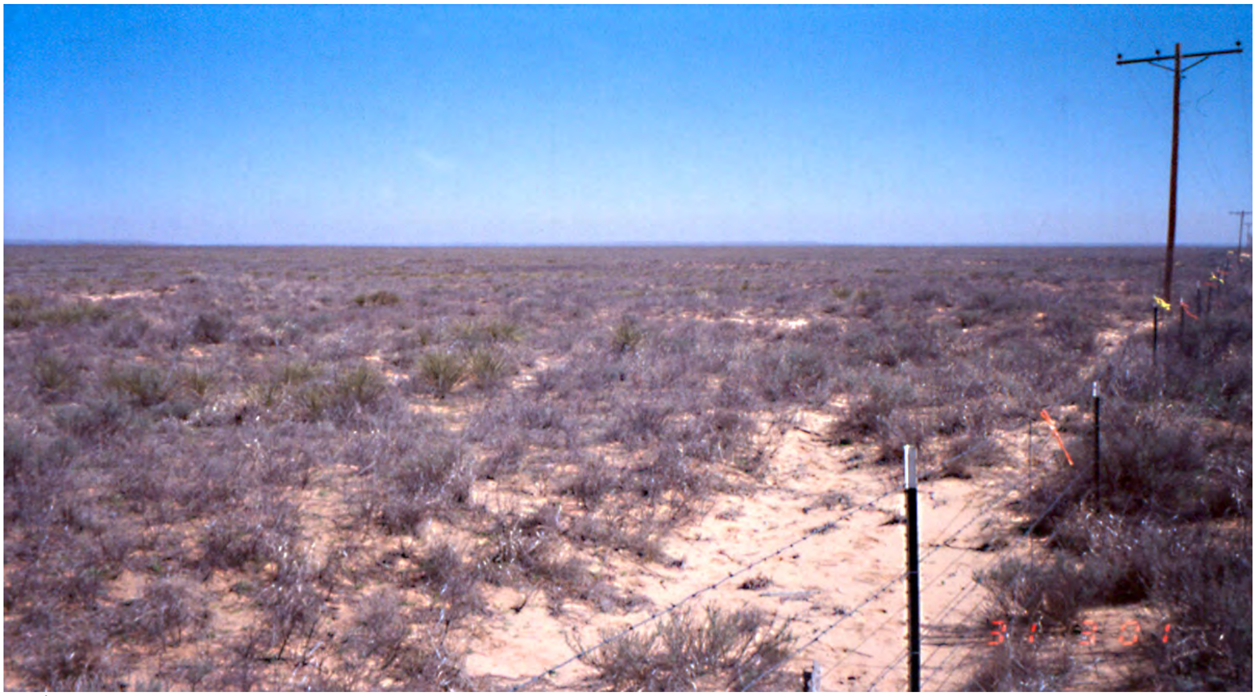

Figure 5.2. LA 75163, site overview.

flaked stone, with few formal tools, ground stone, or sherds. Fourteen features, all clusters of burned caliche or fire-cracked rock, were recorded duringthe testing program, including some still exposed in the area excavated by OAS (Polk et al. 2001). The features contained up to 50 pieces of burned caliche or fire-cracked rock, ranged in diameter from 0.5 to 3 m, and were often associated with flaked stone artifacts. Four features (1–4) were within the existing right-of-way.

SWCA's testing phase included surface collection, augering, and excavation of six 1 by 1 m test units. All surface flaked stone tools, sherds, and ground stone artifacts were collected from within the current and expanded right-of-way. In addition, 250 pieces of flaked stone debitage were collected, from both sides of US 70. The testing crew then excavated 121 auger holes at 5 m intervals on both sides of the highway. Artifacts recovered from the auger holes include a small quantity of flakes, angular debris, Jornada Brown Ware sherds (A.D. 200–1200), and fire-cracked rock. Three test units were excavated on each side of the highway. Numerous flakes, angular debris, and fire-cracked rock were recovered from the units, as well as sherds and animal bone.

Based on the test investigations, LA 75163 was determined to have considerable information potential, even after Wiseman's excavations.

DATA RECOVERY

Excavation was limited to the area within the existing and expanded highway right-of-way. The site datum and grid system used during the testing phase (Polk et al. 2001) were reestablished for provenience designations. The datum was assigned the arbitrary value of N500/E500. The site was mapped with a total station and then mechanically and manually excavated.

Mechanical Excavation Units

Three backhoe trenches were excavated at LA 75163 (Table 5.1). When possible features were encountered, trenching was limited to exposing the surface of the feature for later hand excavation. After the trenches were excavated, the walls were cleaned with a transfer shovel. Possible features and artifacts in the trench walls were flagged, mapped, collected, and logged.

Table 5.1. Summary Information for Three Trenches at LA 75163

Trench No.	Location of SW Corner	Dimensions	Associated Features
1	N503.30/E655.00	165 m long by 1.5 m deep	Features 101–135
2	N554.25/E707.74	105 m long by 1.1 m deep	Features 136–144
3	N441.59/E617.62	28.5 m long by 0.6 m deep	Feature 145

Trench 1 was on the south side of US 70, parallel to the highway, 3.5 m north of the existing right-of-way fence. The east end of the trench abutted the west end of the large area excavated by Wiseman in 1994. The maximum depth of the trench was 1.5 m deep, and three strata were identified (Figures 5.3 and 5.4). Features 101–135 were noted in the walls and bottom of Trench 1 (Table 5.2)

Table 5.2. Summary Information for Each Hand-Excavated Test Unit

Test Unit No.	Location of SW corner	Dimensions	Associated Features
100	N555.49/E776.16	1 by 1 m	Feature 138
101	N555.71/E774.36	1 by 1 m	Feature 139
102	N554.87/E771.27	1 by 1 m	Feature 141
103	N554.87/E771.27	1 by 1 m	Feature 137
104	N553.77/E631.80	1 by 1 m	Feature 145
105	N553.54/E713.01	2 by 2 m	Feature 144
106	N503.59/E788.36	1 by 1 m	Feature 107
107	N500.27/E674.99	1 by 2 m	Feature 135
108	N501.75/E731.22	1 by 2 m	Features 122 and 123
109	N503.12/E775.58	1 by 1 m	Features 108 and 109
110	N499.91/E701.29	1 by 2 m	Feature 129
111	N503.06/E772.61	1 by 2 m	Features 110 and 111
112	N502.91/E769.77	1 by 2 m	Features 112 and 113
113	N501.67/E727.94	1 by 1 m	Feature 125
114	N502.05/E749.88	1 by 2 m	Feature 119
115	N502.76/E756.23	1 by 2 m	Feature 114
116	N501.16/E704.70	1 by 1 m	Feature 128

Stratum 1 was a brown fine sandy loam that was between 20 and 75 cm thick, depending on the thickness of the local dune. Stratum 1 contained few artifacts and had been affected by dune formation.

Stratum 2 was brown to red-brown fine sandy loam. This layer was 10 to 15 cm thick and contained most of the cultural features and artifacts, indicating that it corresponded with the stable surface identified by Hall (2002) for the Mescalero Sands area the region.

Stratum 3 was a very pale brown to yellow-red, slightly hard, fine sandy loam. This stratum was sterile and rested on white gypsum bedrock in the eastern portion of the trench. In the rest of the trench, the stratum extended below the bottom of the trench.

Trench 2 was on the north side of US 70, parallel to the highway, 2 m south of the existing right-of-way fence. The trench averaged 75 cm deep but was up to 1.1 m deep. Three strata, which were very similar to those in Trench 1, were observed (Figure 5.5).

Stratum 1 was loosely consolidated, brown loamy fine sand. This layer was sterile and reflected recent dune formation. It was between 20 and 60 cm thick, depending on the size of the local dune.
Stratum 2 was a 20 cm thick layer of soft, brown, loamy fine sand. This layer contained most of the cultural features and artifacts. As with Trench 1, this stratum corresponded with the stable surface present between 5000 and 100 years BP. Stratum 3 consisted of a yellow-red, slightly hard, loamy fine sand. This stratum was sterileFeatures 136–144 were found during excavation of Trench 2

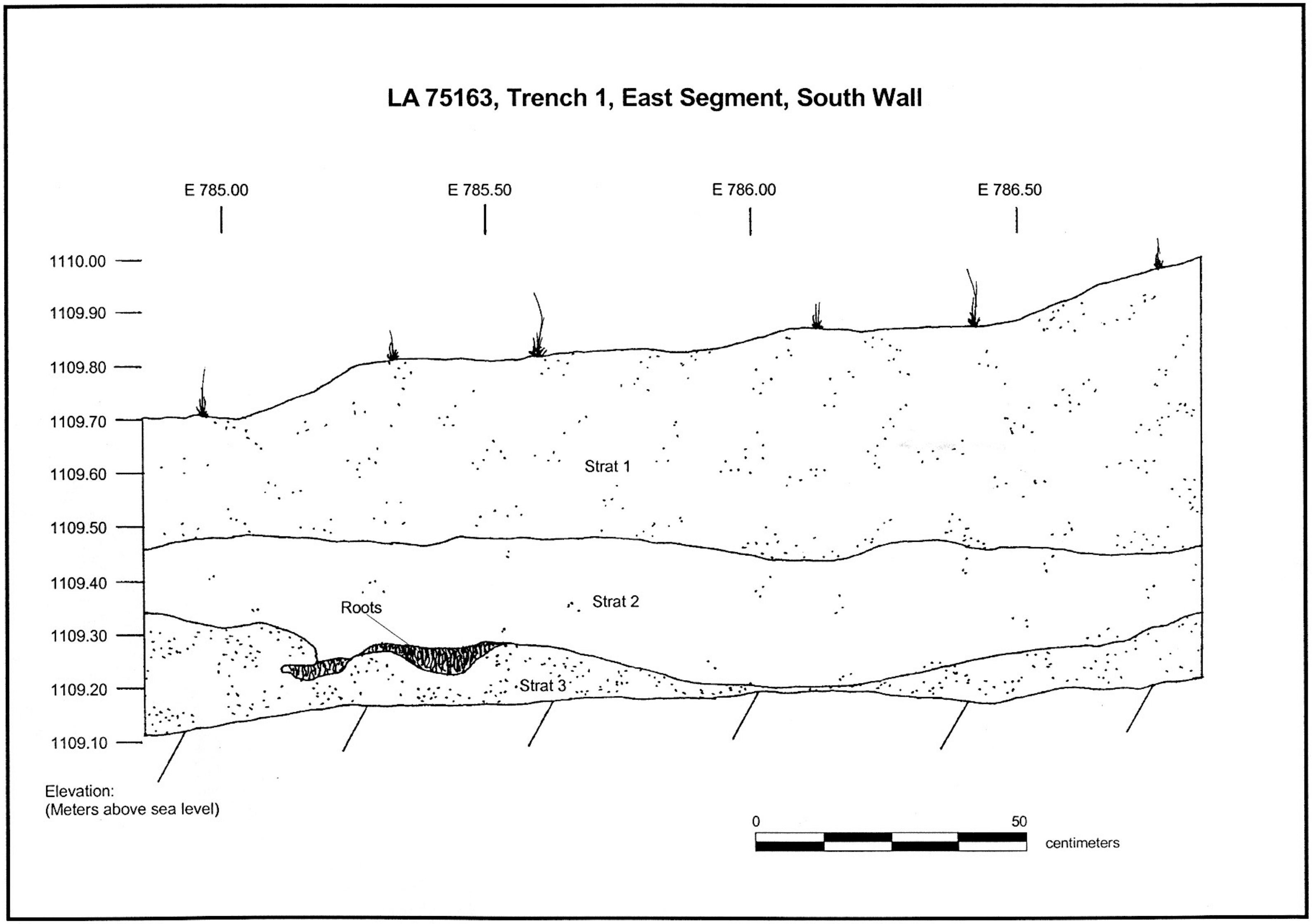

Figure 5.3. LA 75163, Trench 1, east segment, south wall.

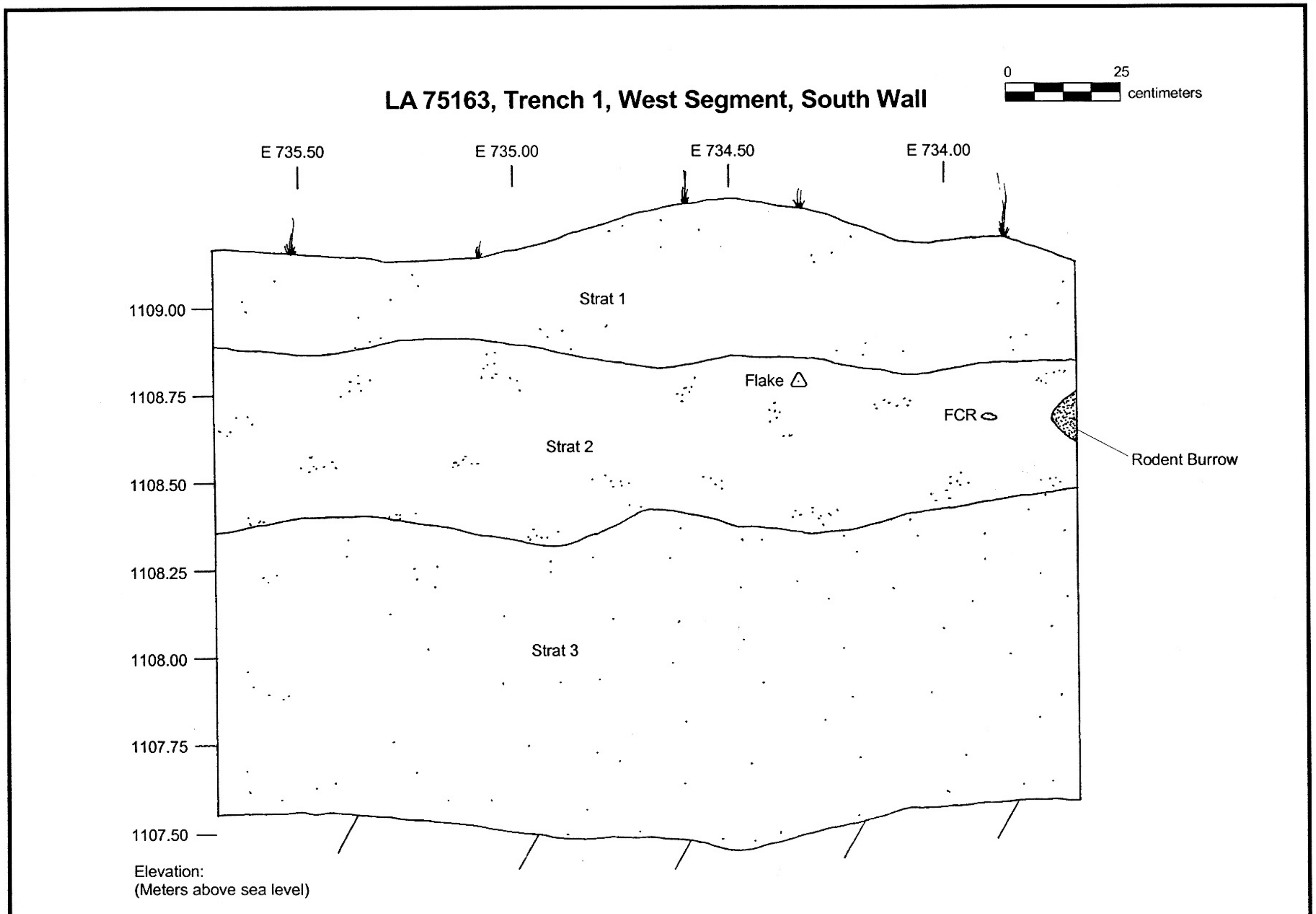

Figure 5.4. LA 75163, Trench 1, west segment, south wall.

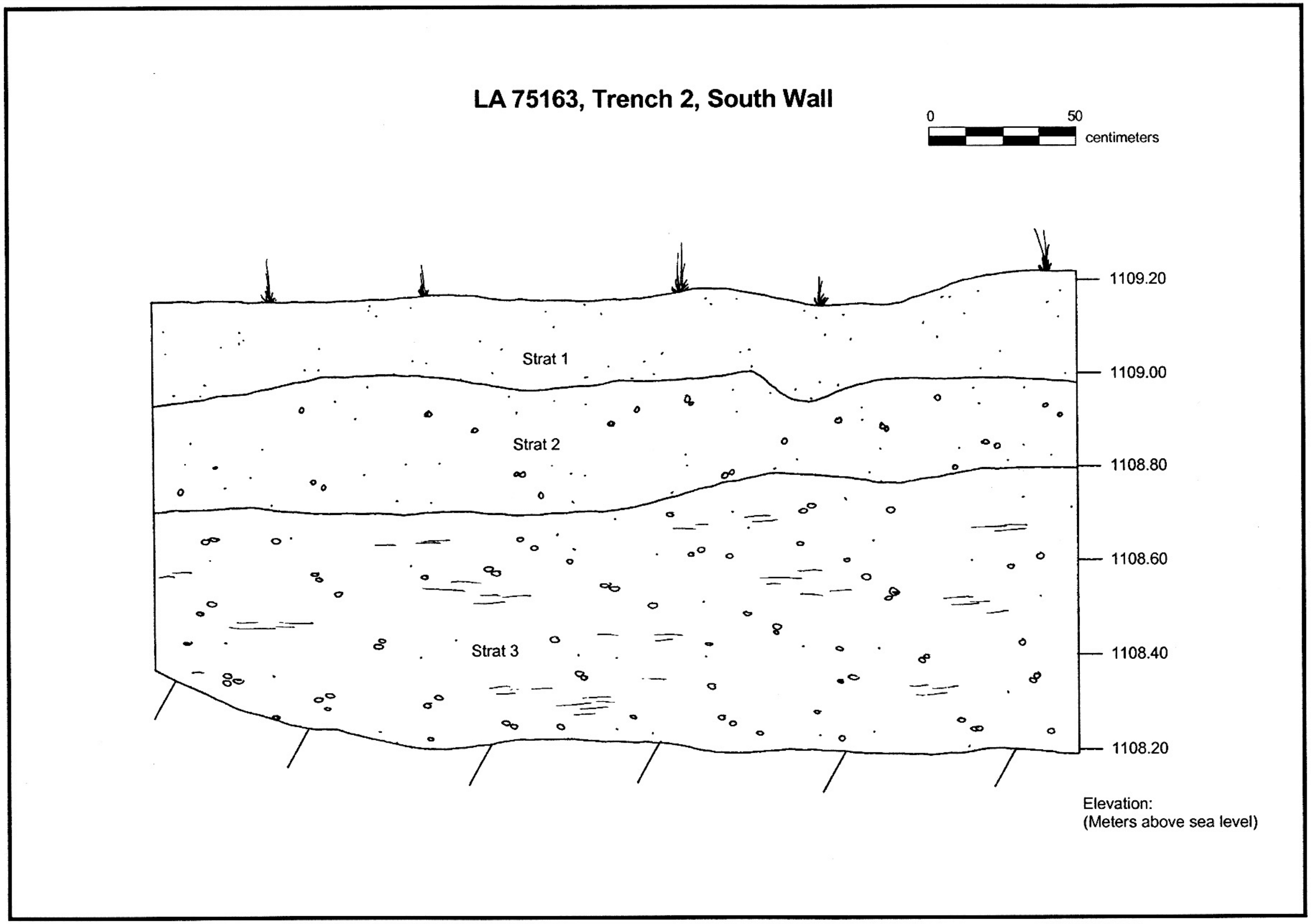

Figure 5.5. LA 75163, Trench 2, south wall.

(Table 5.3). Three artifacts not clearly associated with any of the features were also recovered. The first, a Jornada Brown Ware jar rim sherd (A.D. 200–1200), was recovered from the back dirt but most likely came from the dark ashy soil identified as Feature 136. The second artifact was a quartzite metate fragment recovered in situ, less than 20 cm below ground surface between Features 137 and 138. The third artifact was a quartzite pestle found in situ, 60 cm below ground surface, east of Features 137–141.

The backhoe was also used to remove 10 to 20 cm of fill from two areas adjacent to Trench 2. The first mechanically stripped area straddled the trench near its west end, and was excavated to more fully expose Features 143 and 144. The mechanically excavated area was 3.5 m long and extended 1 m north and 2 m south of the trench. The second mechanically stripped area straddled the trench near its middle. The second area was 5.5 m long and extended 1.25 m north and south of the trench. The second area was stripped to more fully expose Features 137, 138, and 139.

Trench 3 was excavated north of US 70, parallel with the highway, 2 m south of the existing right-of-way fence and 62 m west of Trench 2. Trench 3 was placed in a low-density artifact cluster that was about 60 m from the artifact scatter that marked the rest of the site. Trench 3 averaged 50 cm deep and was up to 60 cm deep. Only one stratum was identified. Stratum 1 was a slightly hard, yellow-red, very fine sand that contained only one feature, Feature 145 (Table 5.4). Given the similarity between this stratum and Stratum 3 in Trenches 1 and 2, it seemed likely that the upper strata noted in Trenches 1 and 2 had eroded from this area, thereby exposing the lower stratum.

Hand Excavation Units

Seventeen units covering 27 m^2 were manually excavated at LA 75163 to further investigate 19 features exposed during trenching (Table 5.5). Most of the features were ash stains and/or small clusters of burned caliche.

Unit 100 was a 1 by 1 m unit excavated to investigate Feature 138, an ash stain with burned caliche and fire-cracked rock, exposed in the floor of Trench 2. The unit was excavated using one 20 cm level and two 10 cm levels. The last two levels were screened through eighth-inch screen.

Test Unit 101 was a 1 by 1 m unit excavated to investigate Feature 139, a cluster of burned caliche and fire-cracked rock exposed in the floor of Trench 2. The unit was just west of Unit 100. The unit was excavated in three arbitrary 10 cm levels, the fill of which was screened through eighth-inch mesh.

Unit 102 was a 1 by 1 m unit excavated 2 m west of Unit 101 to investigate Feature 141, a cluster of burned rock exposed in the south wall of Trench 2. The unit extended 65 cm south of Trench 2 to encompass Feature 141, and was excavated using three 20 cm arbitrary levels, the fill of which was screened through eighth-inch mesh.

Unit 102, Level 1 was excavated in order to level the unit surface. Consequently, actual excavation was limited to the southeast portion of the unit, where the ground was higher. At least 15 pieces (1 kg) of heat-altered rock was scattered about the unit, most of it in the southwest quadrant. Three pieces of flaked stone were recovered from Level 1, all of them chert flakes. Levels 2 and 3 contained Feature 141. Two flakes and a biface recovered from Unit 102 are likely to have been associated with the feature.

Unit 103 was a 1 by 1 m unit excavated to investigate Feature 137, an ash stain containing a metate. The feature was visible in both walls of Trench 2, 1 m east of Unit 100. Unit 103 was excavated 45 cm, in four levels. The upper level was not screened; Levels 2–4 were screened through eighth-inch mesh. The metate fragment was recovered in the northwest corner of the unit. A tree stump was present at the unit's east edge.

Unit 103, Level 1 was 15 cm of overburden removed using the backhoe. This material was windblown dune sand and did not contain any artifacts. The remaining levels were 10 cm arbitrary

Table 5.3. Summary of Features in Trench 1

Feature No.	Easting	Depth below Ground Surface	Location in Trench	Description	Size
101	819.04	25	floor, 10 cm from south wall	light stain with small amount of charcoal	14 cm diameter
102	817.55	42	floor, 3 cm from south wall	1 small piece of burned caliche, no stain or artifacts	
103	816.53	35	south wall	3 small pieces of burned caliches, no stain or artifacts	15 cm diameter
104	812.85	25	south wall	1 burned caliche, no stain or artifacts	
105	810.70	10	north wall	3 burned caliche (10 cm)	20 by 5 cm
106	806.15	40	floor, 42 cm from south wall	2 burned caliche	4 cm apart
107	788.95	10	Floor, center	2 burned caliche, may be related to Fea. 1, 1.8 m to the north, no stain or artifacts	10 cm apart
108	775.90-787.20	40	north and south walls	faint lens, not easily defined, 1 fire-cracked rock.	ca. 11.3 m
109	776.00	45	floor, at base of north wall	8 burned caliche, Fea. 108 may be related	40 by 30 cm
110	774.45	25	floor, 40 cm from south wall	4 burned caliche	28 cm diameter
111	773.10	30	floor, 30 cm from south wall	4 burned caliche	40 by 10 cm
112	771.40	25	floor, 40 cm from north wall	1 burned caliche	6 cm
113	770.20	20	floor, 45 cm from south wall	2 burned caliche	adjacent
114	757.50	20	floor, 42 cm from south wall	1 burned caliche with ash pocket	15 cm apart, ash 8 cm diameter
115	804.30	80	south wall	ash stain	45 by 8 cm
116	755.10	30	floor, 40 cm from south wall	1 burned caliche; probably natural root burn	Small piece
Feature No.	**Easting**	**Depth below Ground Surface**	**Location in Trench**	**Description**	**Size**

Table 5.3. Summary of Features in Trench 1 (Continued)

117	754.10	50	floor, 60 cm from south wall	ash and charcoal pocket	15 cm diameter
118	752.20	100	floor and north wall	ash stain	40 by 37 cm
119	750.30	45	floor and under north wall	ash stain	60 by 7 cm
120	749.40	70	floor, 70 cm from south wall	2 burned caliche	10 cm diameter
121	745.40	80	floor, 15 cm from north wall	ash stain and chalcedony flake	25 by 20 cm
122	732.80	30	floor, 35 cm from south wall	charcoal pocket with 2 chert and chalcedony flakes; root stain	20 by 10 cm
123	731.50	40	floor and south wall	5 burned caliche	35 by 25 cm
124	729.90	30	north wall	1 burned caliche	
125	728.40	20	floor, 50 cm from north wall	5 burned caliche	30 by 15 cm
126	722.50	45	south wall	rounded cobble (possible mano)	12 by 10 by 6 cm
127	707.70	25	south wall	3 burned caliche with stain	80 by 20 cm
128	704.80	20	floor, 20 cm from south wall	ash stain with chert flake (55 cm to west)	35 cm diameter
129	702.20	15	south wall	3 burned caliche	25 by 10 cm
130	701.60	60	floor, 50 cm from south wall	Isolated burned caliche cobble	
131	699.80	80	south wall	Isolated burned caliche cobble	
132	690.40	40	north wall	1 burned caliche	
133	687.90	60	floor, 55 cm from south wall	chert scraper	
134	678.50	50	north wall	1 burned caliche	
135	675.20	15	floor, 15 cm from north wall	9 burned caliche	40 cm diameter

Table 5.4. Summary of Features in Trench 2

Feature No.	Easting	Depth below Ground Surface	Location in Trench	Description	Size
136	763.35-813.35	20-70, but varies	north and south walls	large ashy stratum with scattered burned caliche, pinches up to surface at west end	105 m by ca. 50 cm
137	779.00	20	scraped surface above north wall	ash stain with metate, some charcoal visible	25 cm diameter
138	777.05	20	10 cm from south wall	ash stain with 15+ burned caliche, no charcoal visible	60 by 40 cm
139	775.35	25	floor, center	7 burned caliche	50 by 30 cm
140	772.35	20	floor abutting south wall	ash stain, little bit of charcoal, may be associated with Feat. 141	20 cm diameter
141	772.25	10	scraped area above south wall	3 burned caliche	60 by 10 cm
142	757.95	10	north wall	ash stain, no charcoal	30 by 20 cm
143	715.05	30	floor 40 cm from south wall	2 burned caliche	25 by 10 cm
144	714.35	20	scraped area 1.0 m south of south wall	ash stain with small quantity of charcoal	10 cm diameter

Table 5.5 LA 75163, Summary Information for Hand-excavated Units

Test Unit No.	Location of SW Corner	Dimensions	Associated Features
100	N555.49/E776.16	1 by 1 m	Feature 138
101	N555.71/E774.36	1 by 1 m	Feature 139
102	N554.87/E771.27	1 by 1 m	Feature 141
103	N554.87/E771.27	1 by 1 m	Feature 137
104	N553.77/E631.80	1 by 1 m	Feature 145
105	N553.54/E713.01	2 by 2 m	Feature 144
106	N503.59/E788.36	1 by 1 m	Feature 107
107	N500.27/E674.99	1 by 2 m	Feature 135
108	N501.75/E731.22	1 by 2 m	Features 122 and 123
109	N503.12/E775.58	1 by 1 m	Features 108 and 109
110	N499.91/E701.29	1 by 2 m	Feature 129
111	N503.06/E772.61	1 by 2 m	Features 110 and 111
112	N502.91/E769.77	1 by 2 m	Features 112 and 113
113	N501.67/E727.94	1 by 1 m	Feature 125
114	N502.05/E749.88	1 by 2 m	Feature 119
115	N502.76/E756.23	1 by 2 m	Feature 114
116	N501.16/E704.70	1 by 1 m	Feature 128

levels that contained a brown sandy loam, along with Feature 137 and an associated diffuse stain. A few fire-cracked rocks extended southwest from the stain.

Unit 104 was a 1 by 1 m unit excavated to further expose Feature 145, an ash stain visible in the north wall of Trench 3. The unit was excavated in three arbitrary levels. All of the fill was screened through quarter-inch mesh except for the feature fill, which was screened using eighth-inch mesh.

Unit 104, Level 1 contained the sediment overlying Feature 145 and yielded 21 pieces of flaked stone (a use-damaged flake, two pieces of shatter, and 18 flakes).

Unit 104, Level 2 contained Feature 145, which consisted of two small stains in the southeast quadrant of the unit. The shapes of the stain suggested that the feature was actually a rodent burrow or root stain. A single quartzite flake was the only artifact recovered from Level 2.

Unit 104, Level 3 contained 20 cm of sterile fill underlying Feature 145. The fill was disturbed by roots, which gave it a mottled appearance.

Unit 105 was a 2 by 2 m unit placed over Feature 144, a stain with fire-cracked rock identified in the south wall of Trench 2, 6 m from the west end of the trench. Unit 105 was excavated in three 20 cm arbitrary levels. Level 1 was not screened but Levels 2 and 3 were screened through eighth-inch mesh.

Unit 105, Level 1 was wind-blown sand, part of the dunes mantling the site. Level 1 was removed using the backhoe. Two flakes and an edge-modified flake were recovered during this mechanical excavation. Feature 144 was evident at the bottom of the level. The feature consisted of two dark stains, with a light scatter of heat-altered rock in and between the stains. Levels 2 and 3 contained Feature 144 as well as fine sandy loam.

Unit 106 was a 1 by 1 m unit excavated to investigate Feature 107, an ash stain and two pieces of burned caliche exposed in the floor of Trench 1. The unit was 31 m west of the area excavated by Wiseman in 1994. About 13 cm of dune sand overlying Unit 106 had been removed by the backhoe during excavation of Trench 1; trenching exposed two pieces of flaked stone, in the northeast and southeast corners of the unit. Two pieces of burned caliche were also identified in the unit after the trenching.

Unit 106 was excavated in a single 10 cm arbitrary level; the fill was screened through eighth-inch mesh. Level 1 contained a fine loamy sand resting on bedrock. The level varied from 2 to 10 cm thick,

depending on the depth of the bedrock. Forty-two pieces of flaked stone and seven pieces (1 kg) of heat-altered rock were recovered, the latter mostly from the central and south-central portions of the unit. Much of the heat-altered rock lay directly on the bedrock, suggesting that the feature had been deflated and subsequently reburied.

Unit 107 was a 2 by 1 m unit placed at right angle to Trench 1 in order to investigate Feature 135, a cluster of burned caliche cobbles in the trench's floor. (Additional fire-altered rock was noted 1 m north of the unit.) Unit 107 was 19 m from the west end of Trench 1. About 60 cm of overlying dune sand was removed by the backhoe during excavation of Trench 1. No artifacts were noted in the overburden. The remaining fill of Unit 107 was excavated in a single 18 cm level; this fill was screened through eighth-inch screen. Level 1 contained brown loamy fine sand.

Unit 108 was a 1 by 2 m unit excavated to investigate Feature 122, a small ash stain and two pieces of flaked stone near the unit's southeast corner, and Feature 123, a cluster of heat-altered rock in the unit's southwest corner. Both features were exposed in the floor of Trench 1. The unit was aligned with the trench and was excavated in two 10 cm arbitrary levels, both of which were screened through eighth-inch mesh.

At Unit 108, between 25 and 30 cm of overburden had been removed during excavation of the trench. No artifacts were recovered from this overburden. Levels 1 and 2 were brown, very fine sandy loam. Initially the unit was split into haves, each half corresponding with one of the features. After the eastern half was excavated 5 cm, however, it became obvious that Feature 122 was actually from rotting roots that had been covered by dunes. Excavation in this portion of the unit was stopped, but not before four flakes were recovered and one piece of heat-altered rock was noted.

The west half of Level 1 revealed a cluster of rock (Feature 123) concentrated in the southwest corner of the now 1 by 1 m unit. The rock weighed 10 kg and included a metate fragment. The uppermost rocks did not appear to be heat-altered, but the lower rocks were burned. No charcoal, ash, or soil staining was noted.

Three chert flakes were recovered from Feature 123, in Level 2 of the unit. Pollen and flotation samples were also recovered from Feature 123, but were not analyzed.

Level 3 was excavated below Feature 123. A single piece of chert angular debris was recovered and three pieces of fire-altered rock weighing less than 0.5 kg were noted.

Unit 109 was a 1 by 1 m unit in Trench 1, excavated to investigate the west end of a 10 m long lens of dark sediment (Feature 108) and a cluster of burned caliche and fire-altered rock (Feature 109), which were exposed in the walls and floor of Trench 1. The unit was excavated in two 10 cm arbitrary levels. All of the sediment was screened though eighth-inch mesh. Prior to excavation of Unit 109, 35 cm of dune sand overburden had been removed during the excavation of Trench 1. No artifacts were noted in the overburden.

The sediment in both of the unit's levels was a brown loamy fine sand. Twelve pieces (2 kg) of heat-altered rock, mostly burned caliche, and 18 pieces of flaked stone were recovered from Level 1. No artifacts or burned rock were found in Level 2, which ended at bedrock.

Unit 110 was a 2 by 1 m unit placed over Feature 129, a dark stain and fire-altered rock exposed in the south wall of Trench 1. The unit was excavated in three arbitrary levels to a depth of 60 cm. The sediment was screened through eighth-inch mesh. Two isolated pieces of fire-cracked rock (Features 130 and 131) were noted immediately east of the unit but were not further investigated.

Four pieces (0.25 kg) of fire-altered rock, mostly burned caliche, and 30 flaked stone artifacts were recovered from Level 1, an arbitrary 10 cm level excavated to expose Feature 129. The sediment was brown loamy fine sand.

Levels 2 and 3 also were brown loamy fine sand. These two levels contained a dense concentration

of heat-altered rock in the north-central portion of the unit, as well as rock scattered across most of the unit. The concentration and scatter of rock were defined as Feature 129. Level 2 was a 5 cm arbitrary level excavated to fully expose Feature 129. Level 3 was a 35 cm thick level that contained the bulk of the feature. Sixteen flaked stone artifacts were recovered from Level 2, and nine were recovered from Level 3. The burned caliche and other fire-crack rock included at least 132 pieces weighing more than 34.5 kg.

Unit 111 was a 2 by 1 m unit excavated to expose Feature 110 (four fire-cracked rocks) and Feature 111 (a small cluster of four fire-altered rocks), which were exposed in the floor of Trench 1. Unit 111 was 1 m west of Unit 109, and was aligned with the trench. Feature 110 was exposed in the eastern quarter of the unit, while Feature 111 was exposed in the southwest corner. Prior to excavation of Unit 111, 20 cm of overburden had been removed during excavation of Trench 1. No artifacts were recovered from the overburden. The unit was excavated in a single 10 cm arbitrary level; the fill was screened through eighth-inch mesh.

Unit 111 yielded 24 pieces (16 kg) of fire-altered rock and 91 flaked stone artifacts. All of the flaked stone was associated with Feature 110. There was no charcoal, ash, or soil staining at either feature. The features were at the same level, perhaps indicating that they were both deflated and then reburied.

Unit 112 was a 2 by 1 m unit placed 1 m west of Unit 110 to investigate Feature 112 (a burned caliche cobble) and Feature 113 (two burned caliche cobbles), which were exposed in the floor of Trench 1. The unit was aligned with the trench; Feature 112 was in its eastern portion and Feature 113 was in its western portion. Prior to excavation of Unit 112, 15 to 20 cm of overburden had been removed during the excavation of Trench 1. No artifacts were recovered from the overburden. The unit was excavated in a single 10 cm level; the fill was screened through eighth-inch mesh.

The sediment in the level was brown loamy fine sand. The unit yielded 50 flaked stone artifacts and seven fire-cracked rocks, all of which were associated with Feature 112. In addition, a single Jornada Brown Ware sherd was recovered. No additional fire-cracked rock or artifacts were found with Feature 113. No charcoal, ash, or soil staining was found in the unit.

Unit 113 was a 1 by 1 m unit excavated to expose Feature 125, a cluster of five fire-cracked rocks in the floor of Trench 1. The unit was 2 m west of Unit 108. Prior to excavation of Unit 113, 25 cm of overburden was removed during excavation of the trench. No artifacts were recovered from the overburden. Unit 113 was excavated in a single 5 cm level. The fill was screened through eighth-inch mesh. The sediment was brown, very fine loamy sand.

Excavation of Unit 113 yielded 18 flakes and 11 fire-cracked rocks (0.5 kg). All of these materials came from Feature 125. There was no evidence of charcoal, ash, or soil staining in the unit.

Unit 114 was a 2 by 1 m unit excavated to further expose Feature 119, a 60 cm wide stain in the floor and north wall of Trench 1. The long axis of the unit was oriented at right to the trench, with most of the unit extending north from Trench 1. Unit 114 was excavated in two levels. Level 1 was a roughly 20 cm arbitrary level, consisting of sand deposited during coppice dune formation. Within the trench, Level 1 had been removed by the backhoe. Outside the trench, the Level 1 fill was removed with a shovel, without screening. No artifacts were recovered from Level 1.

Level 2 was a 15 cm arbitrary level that contained Feature 119. The Level 2 fill was excavated by hand and screened through eighth-inch mesh. Ten flakes were recovered, along with three pieces (<0.5 kg) of fire-altered rock, but the stain seen in the trench wall was not as evident in the unit.

Unit 115 was a 2 by 1 m unit placed over Feature 114, a piece of fire-cracked rock and a small scatter of charcoal exposed on the floor of Trench 1 5.5 m east of Unit 114. The unit was oriented with the trench. Prior to excavation of Unit 115, 30 cm of overburden had been removed during excavation of Trench 1. Unit 115 was excavated in a single

arbitrary level of 10 cm. The sediment was screened using eighth-inch mesh.

Unit 115 yielded 21 flaked stone artifacts and 15 pieces (0.5 kg) of fire-cracked rock. The small charcoal pocket observed in the trench floor proved to be a burned root. A radiocarbon sample was collected from the root burn but was not analyzed.

Unit 116 was a 1 by 1 m unit 1.5 m east of Unit 110, and was excavated to further expose Feature 128 (a 35 cm diameter ash stain in the bottom of Trench 1, with a chert flake nearby in the south wall of the trench). Before Unit 116 was excavated, 30 cm of overburden had been removed during excavation of Trench 1. Unit 116 was excavated in a single layer, which was 13 cm thick. The sediment was screened through eighth-inch mesh.

Unit 116 produced two pieces of flaked stone. Feature 128 was extremely thin. Given the small number of artifacts and the nature of the stain, Feature 128 was most likely from burning roots. Radiocarbon, pollen, and macrobotanical samples collected from the unit were not submitted for analysis.

Features

Forty-five features were identified in the trenches. Most of these were clusters of fire-cracked rocks or ash stains. Summary information for each feature is presented on Tables 5.3 through 5.5. Several of these features were more thoroughly investigated, and are described below.

Feature 107 was an ash stain with two burned caliche rocks, exposed in the floor of Trench 1 (Figure 5.6). The feature was excavated in Test Unit 106, in a single 10 cm arbitrary level that ended at bedrock. Forty-two flakes and seven fire-cracked rocks (1 kg) were collected from the feature. Many of the artifacts rested directly on the bedrock, suggesting that the feature had deflated before being reburied. The fire-cracked rock indicates that Feature 107 was a hearth. Given the lack of diagnostic artifacts and radiocarbon samples, Feature 107 could not be dated, but the intensity of flaked stone reduction may indicate that it dates to the Jornada Mogollon occupation (see Chapter 8).

Feature 109 was a cluster of fire-cracked rock exposed in the bottom of Trench 1 (Figure 5.7). It was excavated in Level 1 of Test Unit 109, and contained 18 flakes and 12 pieces of fire-cracked rock (2 kg). No charcoal, ash, or staining was found to collect for an AMS date, the flotation and pollen samples from the feature were not analyzed. The feature was most likely the remains of a hearth, as indicated by the fire-cracked rock. The intensity of flaked stone reduction is indicative of the Jornada Mogollon occupation (see Chapter 8).

Feature 110 was a loose cluster of burned caliche that measured 28 cm in diameter. The feature was identified in the floor of Trench 1 and excavated as part of Unit 111. Ninety-one flakes were recovered, most of which were tool finishing or retouching flakes, indicating that bifacial tool production and repair was completed at or near the feature. No charcoal, ash, or staining was found to collect for an AMS date, so pollen and flotation samples were not collected. Feature 110 may have been a hearth, but was too diffuse to allow a secure identification. The intensity of flaked stone reduction may indicate that Feature 110 dates to the Jornada Mogollon occupation (see Chapter 8).

Feature 111 was a cluster of four fire-crack rocks exposed in the floor of Trench 1. The feature measured 40 by 10 cm and was excavated as part of Unit 111. No artifacts were found associated with the feature, which was next to Feature 110. No charcoal, ash, or staining was found.

Features 110 and 111 were less than 1 m apart, at the same level. They may have been derived from the same behavioral event, and thus could be combined into a single feature. It is also possible that they were on the same deflated surface that was later buried.

Figure 5.6. LA 75163, Trench 1, Feature 107.

Feature 112 was a burned caliche cobble found in the floor of Trench 1, and was excavated as part of Unit 112. The feature contained 50 flaked stone artifacts and 7 pieces (1 kg) of fire-cracked rock. The former included a unifacially retouched flake and 49 flakes. In addition, a single Jornada Brown Ware sherd was identified. No charcoal, ash, or soil staining was present. The feature was probably a hearth used during the Jornada Mogollon occupation.

Feature 113 was a cluster of two rocks 1 m west of Feature 112, in Trench 1. The feature was excavated as part of Unit 112 but no additional rocks were found. No artifacts, charcoal, ash, or staining were present. Features 112 and 113 were at the same level, and thus may have been associated. If so, Feature 113 probably contained fire-cracked rocks that were part of a hearth used during the Jornada Mogollon period occupation.

Feature 114 was a fire-cracked rock and small stain found in the floor of Trench 1. The feature was excavated in Test Unit 115. During excavation, it became clear that the stain was from a burned root. A radiocarbon sample from the stain was therefore not submitted for dating. Twenty-one flaked stone artifacts were recovered, including two tools, a chert edge-modified flake, and a limestone use-damaged flake. A small scatter of 15 fire-cracked rocks (1 kg) was also discovered. Given the fire-cracked rock, the feature may have been a hearth, albeit of unknown age and cultural affiliation.

Feature 119 was a 60 cm long stain extending across the floor of Trench 1 and into the north wall of the trench. An attempt was made to further define the feature, by excavating Unit 114, but the stain could not be traced in the unit. Nonetheless, 10 flakes were recovered from the unit and may have been associated with Feature 119. These include a piece of angular debris and nine flakes. Fifteen pieces of fire-cracked rock (0.5 kg) were also discovered, suggesting that Feature 119 was a hearth. The intensity of flaked stone reduction is indicative of the Jornada Mogollon occupation (see Chapter 8).

Figure 5.7. LA 75163, Unit 19, Feature 109.

Feature 123 was a cluster of fire-cracked rock initially exposed in the floor of Trench 1, and further exposed in the southwest portion of Test Unit 108. The feature was excavated in two arbitrary 10 cm levels. The first level contained a metate fragment and three pieces of flaked chert (a middle-stage core reduction flake, a bifacial thinning flake, and a piece of angular debris) as well as 10 kg of caliche (some of which was burned). The second level contained a piece of chert angular debris and three pieces of burned caliche (<0.5 kg). No charcoal, ash, or staining was noted in either level.

The burned caliche suggests that Feature 123 was a hearth. The metate fragment may indicate that food was processed at or near the feature, though the fragment could have been collected along with the other rock.

Feature 125 was a cluster of five fire-cracked rocks exposed in the floor of Trench 1. The feature was excavated as part of Unit 113. During the excavation, 18 flakes and 11 fire-cracked rocks (0.5 kg) were recovered. The flaked stone reflected tool manufacturing and bifacial tool production. The feature itself was 30 by 15 cm across and just under 5 cm thick. No charcoal or ash was present but the feature was probably the remains of a hearth (as indicated by the fire-cracked rock). The age and cultural affiliation of the feature could not be determined.

Feature 129 was a cluster of fire-cracked rock identified in the south wall of Trench 1, and further exposed in Unit 110 (Figure 5.8). The surface of the feature was exposed in Level 2 of Unit 110, a 5 cm thick level. This level contained 72 pieces (19 kg) of fire-altered rock and 14 flaked stone artifacts including a fine-grained quartzite edge-modified flake, a chert unidirectional core, and 12 flakes. The feature measured 45 by 30 cm, and was concentrated in the north-central portion of the unit. Level 3 of Unit 110, a 35 cm arbitrary level, contained the rest of the feature. An additional 60 pieces (16 kg) of fire-altered rock were removed and six flaked stone artifacts were recovered from Feature 129 in Level 3.

Figure 5.8. LA 75163, Unit 20, Feature 129.

Pollen and flotation samples were recovered from Feature 129, but failed to yield identifiable specimens. A possible piece of ground stone was recovered from the feature and washed for pollen, but did not produce any identifiable remains. Due to a lack of charcoal, ash, a radiocarbon sample was not taken.

Feature 129 was likely a roasting pit despite the lack of ash or charcoal. Excavation showed the feature to be roughly 40 cm deep. The intensity of flaked stone reduction may indicate that the feature dates to the Jornada Mogollon occupation (see Chapter 8).

Feature 135 was a cluster of nine burned caliche cobbles exposed in the floor of Trench 1 (Figure 5.9). The feature was excavated in a single layer of Unit 107. Only one artifact, a chert flake, was recovered. Additional rocks were removed from Feature 135, but it was not clear that these rocks were heat-altered. Given the single artifact and the lack of charcoal, ash, or staining, no flotation, pollen, or radiocarbon samples were collected. Feature 135 was probably the remains of a small hearth that was not used extensively. The feature's age and cultural affiliation could not be determined.

Feature 137 was exposed in the sides of Trench 2 and excavated as part of Unit 103. The feature was excavated in three 10 cm levels (Levels 2–4). The feature was in the northeast quadrant of the unit and was a dark 25 by 18 cm stain surrounded by a more diffuse stain (40 cm in diameter) and burned caliche.

Level 2 produced 13 flakes and 25 pieces (0.5 kg) of burned caliche. Level 3 yielded 14 pieces of flaked stone and 27 pieces (1 kg) of burned caliche. A Jornada Brown Ware bowl sherd was also recovered from this level. Level 4 contained five flakes, all in the upper portion of the level, and no fire-altered rock. Taken together, the 32 flakes reflect both generalized core reduction and bifacial tool production.

Flotation and radiocarbon samples were collected from each level within the feature, but were not submitted for analysis because of likely disturbance by the roots of a nearby stump. The root tracks were well defined throughout the feature, and growth of the roots had undoubtedly affected the feature's integrity. The feature most likely represents a small campfire. The sherd indicates that the feature was used during the Jornada Mogollon

Figure 5.9. LA 75163, Unit 123, Feature 153.

occupation, and may have been more or less contemporaneous with Features 138 (Unit 100) and 139 (Unit 101) to the west.

Feature 138 was exposed in the floor of Trench 2 and excavated in Unit 100. The unit was excavated in three levels. Level 1 consisted of 20 cm removed during excavation of Trench 2, and contained at least 22 pieces of fire-cracked rock/burned caliche and a chert flake. The burned rock was distributed across the unit, with some clustering noted in the central and southeastern portion of the unit.

Level 2 exposed a tight cluster of fire-cracked rock and burned caliche. At this depth, the feature measured 70 by 40 cm and was concentrated in the southeast quadrant of the unit (Figure 5.10). Forty pieces of fire-cracked rock (3.5 kg) and 6 pieces of burned caliche (0.5 kg) were recovered from the feature. An additional 2 kg of fire-cracked rock and 0.25 kg of burned caliche were scattered around it. Thirty-two pieces of flaked stone were recovered from the level, including two cores, a utilized flake, eight pieces of shatter, and 20 flakes. Five sherds were also recovered from the level, more than from any other location at the site. Four of the sherds were Jornada Brown Ware and one was El Paso Brown.

A flotation sample was recovered from under heat-altered rock from Level 2, and yielded very small bits of mesquite charcoal. AMS analysis of some of this material produced a date of 1240 ± 40 BP (Beta-156284), which corresponds to cal A.D. 680 to 890. This date spans the local end of the Late Archaic period, the Early 18 Mile phase (A.D. 750 to 850), and part of the Late 18 Mile phase (A.D. 850 to 950). The sherds are diagnostic of the Jornada Mogollon occupation, indicating that the feature was built after A.D. 750.

Level 3 yielded 36 pieces of flaked stone and two sherds, but no burned caliche. The flaked stone includes 30 flakes and six pieces of shatter, and reflects the production of bifacial tools. The sherds are both Jornada Brown Ware; they are fragments of a jar and a bowl.

Feature 138 most likely represents a small roasting pit. The fire was fueled by mesquite and was likely built during the Early 18 Mile phase or Late 18 Mile phase.

Feature 139 was a cluster of fire-cracked rock exposed in the floor of Trench 2, less than 1 m from Feature 138 (Figure 5.11). The overburden removed during excavation of Trench 2 contained at least nine pieces of fire-cracked rock, but no artifacts were recovered. The feature was excavated in Unit 101, which was excavated in three arbitrary 10 cm levels.

Level 1 contained a tight cluster of burned caliche measuring 55 by 50 cm. Twenty-eight pieces of burned caliche (9.5 kg), which comprised the bulk of the feature, were removed. The 31 flakes in and around the feature mostly reflected the production of bifacially flaked tools. Flotation and pollen samples were collected but were not analyzed; a suitable radiocarbon sample could not be defined. Level 2 yielded a flake, a sherd, and three pieces of burned caliche (0.5 kg) from the bottom of Feature 139. The sherd was Jornada Brown Ware. Eight

Figure 5.10. LA 75163, Feature 138.

Figure 5.11. LA 75163, Feature 139, view to northeast.

flakes were recovered from just below the feature, in what appeared to be a rodent burrow. The flakes, which reflect the production of bifacial tools, were most likely associated with the feature, having been moved through bioturbation.

Viewed as a whole, Feature 139 was a cluster of heat-altered rock containing flaked stone artifacts and a single sherd. The amount of burned caliche suggests that the feature was a small rock-lined roasting pit, which was used during the Jornada Mogollon occupation (as indicated by the sherd). There was no evidence of reddening of the adjacent sediment, perhaps further indicating that the feature was a rock-lined pit.

Feature 141 was a cluster of fire-cracked rock exposed in the south wall of Trench 2 and in Levels 2 and 3 of Unit 102 (Figure 5.12). The feature fill consisted of fine silty sand stained with ash and very small bits of charcoal. Slightly darker staining was present in the northeast and southwest portions of the feature, and the sediment was mottled red below the rock, indicating enough heat to oxidize the sediment. Two pieces of flaked stone were recovered from Level 2: a chert biface and a chalcedony tool-finishing flake. Pollen and flotation samples were collected from Level 2 and were submitted for analysis. The pollen sample yielded Cheno-am (49 percent), high-spine composite (19.4 percent), piñon (1.5 percent), oak (1.0 percent), ponderosa pine (0.5 percent), and grass (1.5 percent). The remainder of the pollen was too deteriorated to identify. Although fragments of charcoal were noted in the flotation sample, they were too small to identify.

Level 3 of Unit 102 yielded one piece of flaked stone and 0.5 kg of heat-altered rock, which formed the bottom of Feature 141. The flake was a chert tool-finishing flake. A radiocarbon sample of charcoal from indeterminate species was recovered from the bottom of Feature 141. The resulting AMS date was 2480±40 BP (Beta-156283), which corresponds to cal 790 to 410 B.C., or the Late Archaic period. Feature 141 most likely represents a small hearth. This feature predates Feature 138, a Jornada Mogollon hearth which only 4.5 m to the east, by as much as 1100 years. The fact that Feature 138 is only 15 cm above Feature 141 demonstrates that the landscape in and around the site was very stable during much of the prehistoric occupation.

Feature 144 was exposed in the south wall of Trench 2 and was excavated in Levels 2 and 3 of Unit 105. At first, the feature appeared to be two dark stains (one 25 cm in diameter, in the unit's northeast quadrant; the other 10 cm diameter, near the center of the unit's south edge). A light scatter of heat-altered rock was scattered in and between the stains (Figure 5.13). Level 2 yielded 68 pieces of flaked stone, including a chert use-damaged flake, and a Jornada Brown Ware bowl sherd. In addition, 169 pieces (16 kg) of fire-cracked rock were removed from the feature. Most of the fire-cracked rock came from the northeast quadrant of the unit. Level 3 yielded 29 pieces of flaked stone and 88 pieces (7.5 kg) of burned caliche.

Flotation and radiocarbon samples were taken from Level 2. The flotation sample yielded a few charred *Portulaca* and *Mollugo* seeds and small fragments of charcoal from indeterminate species. Two samples of the charcoal were submitted for AMS analysis; both samples dated to the modern era (Beta-156285 and Beta-158843; see Appendix E), and are probably from roots from a nearby tree. The flaked stone assemblage indicates that bifacial tools were manufacture at the feature. The sherds indicate that the feature was used during the Jornada Mogollon occupation.

Figure 5.12. LA 75163, Feature 141, view to southeast.

Figure 5.13. LA 75163, Feature 144, view to northwest.

SUMMARY AND CONCLUSIONS

LA 75163 is a large prehistoric and historic site (see Volume 2 for a discussion of the historic component). Three backhoe trenches totaling 298.5 m and 17 hand-excavated units covering 27 m^2 were excavated. Forty-five features, most of which were likely hearths, were exposed in the trenches. Twenty-one of the features were further investigated in the hand excavated units. Most of these features were in similar stratigraphic positions, reflecting a semi-stable landscape during most of the prehistoric occupation.

The excavations yielded 589 pieces of flaked stone, 13 sherds, and three ground stone fragments. Almost all of the flaked stone reflects tool manufacturing. Chert and chalcedony were the most common raw materials. The sherds were Jornada Brown Ware, except for one sherd of El Paso Brown. The ground stone fragments were from two metates and a pestle.

Pollen and macrobotanical samples from the site yielded little information. Pollen samples from Features 129, 138, and 141 were analyzed but only the sample from Feature 141 yielded identifiable remains. The pollen profile from Feature 141 contained no cultigens and was similar to what might be expected in a modern sample. Macrobotanical samples were recovered from Features 129, 138, 141, and 144. The samples from Features 138, 141, and 144 yielded very small fragments of charcoal, but only the sample from Feature 138 contained identifiable remains, which were a few charred *Portulaca* and *Mollugo* seeds.

Four radiocarbon samples were submitted for analysis. These samples produced dates ranging from the Late Archaic period (cal 790 to 410 B.C.), to the Late Archaic or early Jornada Mogollon occupations (cal A.D. 680–890), to the modern era. The last dates appear to be from intrusive roots.

When combined with Wiseman's (2000) efforts, the current excavations indicate that LA 75163 was extensively used since the Late Archaic period. The local spring and pool undoubtedly attracted prehistoric people to the site. In addition, game would have been attracted to the water, and the box canyon would have allowed hunters to trap herd animals. During the current project, however, no projectile points or faunal remains were recovered from the site. Within the US 70 right-of-way, the portion of LA 75163 excavated by Wiseman seems to have been far richer in cultural materials than the portion examined by SWCA. Additional remains are present outside the right-of-way, and based on surface indications, other areas of concentrated remains (similar to the one excavated by Wiseman) are present.

Chapter 6

LA 127518

Site Type: artifact scatter with features
Cultural Affiliation and Age: Archaic; Euroamerican
Size: 334 by 227 m
Area Excavated within Right-of-way: 59.3 m of backhoe trench, 9 m2 of hand excavation

LA 127518 is a site on the northwest side of US 70 that contained prehistoric and historic materials (Figures 6.1 and 6.2). The site covers about 59,100 m^2. About 2,400 m^2 (4 percent of the entire site) is within the US 70 right-of-way. The historic component is a surface scatter of Euroamerican artifacts, which were not investigated during data recovery. The prehistoric component consists of at least 17 Archaic period burned caliche features and an associated artifact scatter.

The site is on a broad, gentle slope southeast of a mesa that forms the north side of a pass at the headwaters of Kenna Draw, at the west edge of the Llano Estacado. Local vegetation includes grasses, narrowleaf yucca, mesquite, prickly pear cactus, snakeweed, milkweed, Russian thistle, ground holly, and cholla. The site elevation is 1,386 m (4,549 feet).

Past construction of US 70 disturbed the southeast edge of the site. Two two-track roads, one in use and the other abandoned, extend along the north and east edges of the site, respectively. An overhead utility line crosses the site from southwest to northeast. Livestock grazing has reduced the density of surface vegetation, which has resulted in wind and water erosion, particularly sheet wash.

PREVIOUS RESEARCH

The Agency for Contract Archaeology (ACA) first recorded LA 127518 in 1999 (Crawford et al. 1999:128–129). The site was described as a 205 by 190 m, multi-component artifact scatter with features. The Archaic component was based on three Archaic period dart points (Crawford et al. 1999:129). Two Archaic period artifact concentrations and three features were identified, and 33 flaked stone artifacts (including the three projectile points), three pieces of ground stone, a hammerstone, 30 pieces of burned caliche, and 85 pieces of fire-cracked rock were recorded in addition to the projectile points.

Crawford et al. (1999) also discovered a 40 m diameter artifact concentration dating to the U.S. Territorial period. The concentration contained aqua and sun-colored amethyst bottle glass, whiteware ceramics, hole-in-top cans, and two pieces of cast iron farm equipment.

The site was revisited by SWCA during the testing phase of the current project (Polk et al. 2001:3:188–3.202). The testing results confirmed ACA’s assessment that LA 127518 contained Archaic and Historic period components. The prehistoric component was a low-density scatter of flaked and ground stone with burned caliche features. SWCA discovered 14 burned caliche features in addition to the three reported by Crawford et al. (1999:128). All of the features were on deflated surfaces; 14 of the 17 features were outside the highway right-of-way (Polk et al. 2001:202–203).

Testing of the Archaic period features was limited to the three burned caliche scatters within the US 70 right-of-way. Four 1 by 1 m test units were excavated into or near the features and yielded flaked stone artifacts. Based on the testing results, data recovery was recommended for the portion of the Archaic component within the highway right-of-way, but no further study or treatment of the Euroamerican component was recommended.

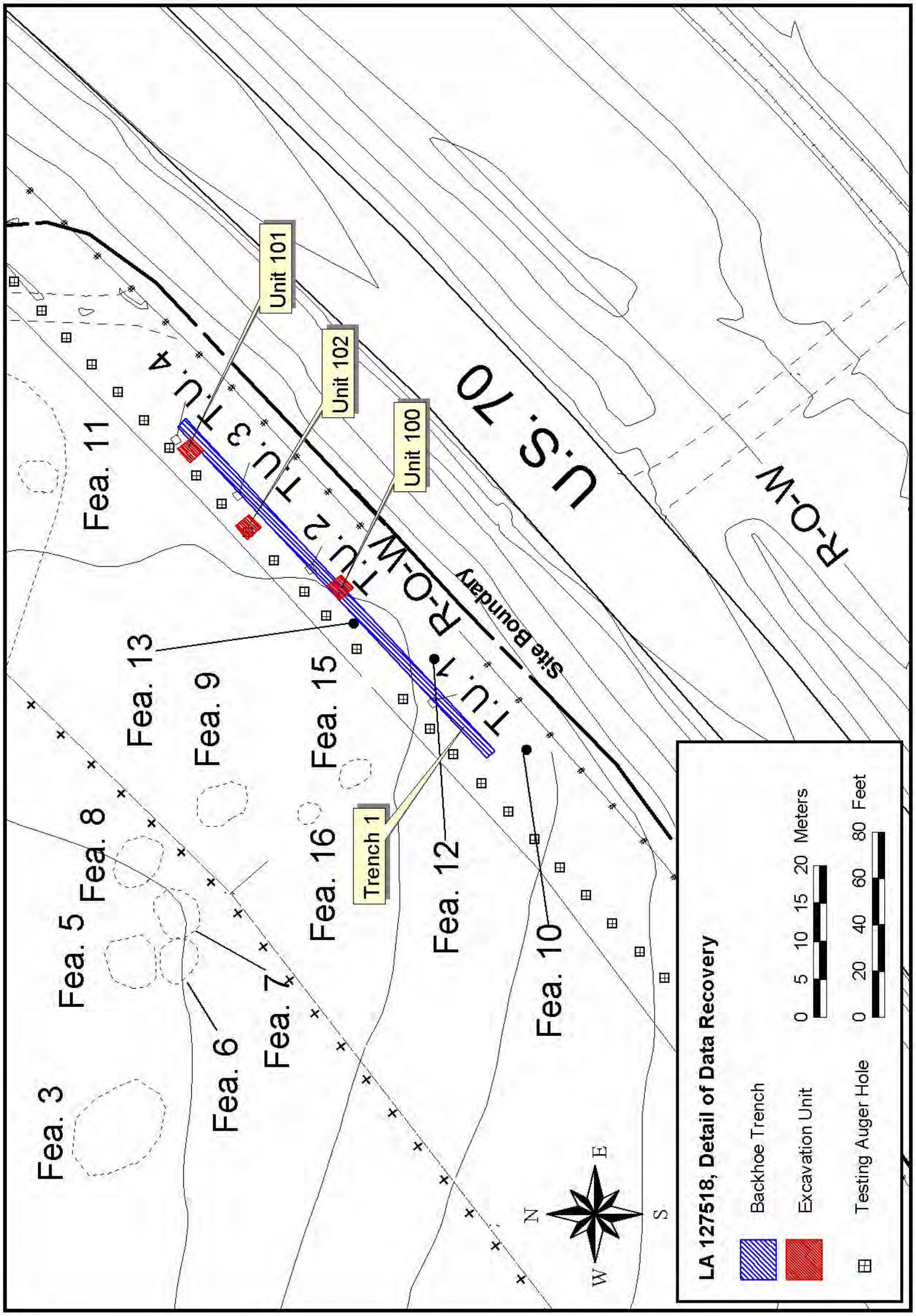

Figure 6.1. Excavations at LA 127518.

Figure 6.2. LA 12718, site overview.

DATA RECOVERY

Data recovery at LA 127518 was limited to the portion of the site within the highway right-of-way, and consequently focused on the area around Features 10, 12, and 13, which were burned caliche features on the spine of a low ridge. The site datum and grid system used during site testing was reestablished for provenience designations. The datum was given an arbitrary value of N500/E500. The site was mapped with a total station and then mechanically and manually excavated.

Mechanical Excavation Unit

One backhoe trench (Trench 1) was excavated near Features 10, 12 and 13 to locate subsurface features and artifact concentrations. When possible features were encountered, excavation was limited to exposing the surface of the feature for later hand excavation. After the trench was excavated, the walls were cleaned with a transfer shovel. Possible features in the trench wall were flagged, mapped, and logged.

The trench was 59.3 m long and ranged from 50 to 120 cm deep. It paralleled US 70, with its southwest corner at N494.30/E541.50. The trench contained a single stratum of a red-brown, slightly hard clay loam. No artifacts were collected from the trench walls or the backfill, but three soil stains were identified as possible features. These were then further exposed in Units 100 through 102, and were determined to be natural features.

Hand Excavation Units

Three units were excavated to further expose Features 101 through 103 (Table 6.1)

Unit 100 was 2 by 2 m unit excavated to investigate Feature 101, a 30 by 20 cm dark stain exposed in the trench floor, 10 cm below ground surface . The unit was centered over the stain and extended 0.5 m beyond the edges of the trench. Although the stain appeared to be a rodent burrow, its proximity to Feature 12 (a burned caliche scatter) prompted further investigation. The unit was excavated in three 10 cm levels, and all of the unit fill was screened through quarter-inch mesh.

Hand-Excavated Units.

Excavation of Level 1 was limited to excavating the areas adjacent to the trench down to the level of the Excavation of Level 1 was limited to excavating the areas adjacent to the trench down to the level of the exposed stain in the trench floor. The fill was a red-brown, slightly hard clay loam. One piece of quartzite shatter was collected. Levels 2 and 3 were excavated only in the west half of the unit in order to bisect the stain. The stain itself con

Table 6.1. LA 127518, Summary Information for Hand-Excavated Units

Test Unit No.	Location of SW Corner	Dimensions	Associated Features
100	N494.27/E510.23	2 by 2 m	Feature 101
101	N495.36/E537.32	2 by 2 m	Feature 102
102	N497.29/E524.48	1 by 1 m	Feature 103

sisted of yellow-red, hard silty clay. A quartzite flake was the only artifact recovered from Level 2 and no artifacts were recovered from Level 3. Based on the stain's profile, the stain was the result of animal burrowing, so excavation of the unit was halted.

Unit 101 was a 2 by 2 m unit placed along the wall of Trench1 to investigate Feature 102, a 1.6 m long stain exposed in the trench's north wall. The stain extended from the surface to 40 cm below ground surface. The unit was excavated to a depth of 50 cm, in four levels.

Level 1 was 10 cm thick; the fill was screened through quarter-inch mesh. The sediment was culturally sterile, yellow-red, very hard silty clay.

Level 2 was 20 cm thick; the lower 15 cm were excavated only in the southern portion of the unit. The upper 5 cm of fill was screened using quarter-inch mesh; the lower 15 cm of fill was not screened. The entire level contained the same sterile, yellow-red, very hard silty clay found in Unit 100.

Levels 3 and 4 were 10 cm levels excavated in the southern portion of Unit 101. These levels contained the strongest staining in Feature 102, and were screened using eighth-inch mesh. The sediment was again culturally sterile, yellow-red, very hard silty clay, which was a bit darker than the overlying sediment. No artifacts were recovered from these levels but a flotation sample and a pollen sample were collected from Level 4.

No cultural materials or structure of any kind were found in Feature 102, which was most likely an animal burrow. As a result, the pollen and flotation samples from Level 4 were not analyzed.

Unit 102 was a 1 by 1 m unit excavated into the floor of the trench to further investigate Feature 103, a 6 m long stain containing burned caliche, exposed in the north wall and floor of the trench. The stain extended from 30 cm below the ground surface into the floor of the trench, which at that location was 1.2 m below ground surface. Unit 102 was excavated in a single 10 cm level. The fill was screened using eighth-inch mesh.

The surface of the unit contained 12 fragments of burned caliche (0.2 kg) and six pieces of fire-cracked rock (0.1 kg). An additional 1.1 kg of burned caliche and 0.2 kg of fire-cracked rock were recovered from the rest of the level. Three pieces of flaked stone were collected from the unit, including a basalt flake, a quartzite flake, and a chert core. Pollen and flotation samples were collected but were not analyzed because of the lack of significant cultural remains. The feature may be the remains of a hearth but if so, it was very diffuse and lacked integrity as a feature.

SUMMARY AND CONCLUSIONS

Despite excavation of one backhoe trench and three hand excavation units, data recovery LA 127518 resulted in the collection of only a small quantity of non-diagnostic artifacts; only five pieces of flaked stone were collected from LA 127518. Materials included. quartzite, basalt, and chert. Though ACA located ground stone on this site during their survey, none was encountered during testing and data recovery . Two of the features excavated during data recovery were not the remains of human activity. Within the highway right-of-way, at least, occupation of LA 127518 was minimal.

Data recovery did little to enhance the information obtained during the survey and testing phases of this project. As a result, the tentative assignment of the prehistoric component of the site to the Archaic period is not changed. The presence of at least 17 burned caliche and fire-cracked rock features sug-

gests repeated uses of the site over an unspecified length of time. The site may have also been occupied to utilize abundant lithic resources eroding from the adjacent hillside. Other nearby natural features that may have encouraged site occupation are a playa (0.7 km to the northeast) and a pass (1 km to the southwest). The two features may have attracted and funneled game through the area.

Chapter 7

LA 130557

Site Type: artifact scatter with feature
Cultural Affiliation and Age: Middle Archaic; Jornada Mogollon
Size: 110 by 85 m
Area Excavated within Right-of-way: 60 m trench, 3 m2 hand excavation

LA 130557 is a prehistoric site on the southeast side of US 70, east of High Lonesome (Figures 7.1 and 7.2). The site covers roughly 7,290 m^2. About 300 m^2 (4 percent of the entire site) is within the US 70 right-of-way. The site is on a broad, gentle slope on the east side of a low hill, amid low sand dunes at an elevation of 1,230 m. The local plant cover includes mesquite, greasewood, grasses, narrowleaf yucca, prickly pear cactus, snakeweed, stickleaf, aster, and wild sunflowers and other composites.

PREVIOUS RESEARCH

LA 130557 was first recorded by the Agency for Contract Archaeology (ACA) in 1999, as an isolated occurrence (Crawford et al. 1999:166). IO-29 consisted of an abrader fragment, a metate fragment, two flakes, and a core. The flaked stone raw materials were quartzite and chert. In 2000, during the testing phase of this project, SWCA revisited IO-29 and collected three brownware sherds and more than 100 flaked stone artifacts including a projectile point, a scraper, and two retouched flakes (Polk et al. 2001:3.236–3.241). Based on the number of artifacts, SWCA reclassified IO-29 as a site, LA 130557, and noted that it might be an outlier of LA 2713, which is 150 m to the west. SWCA tested the site and based on the results, recommended data recovery at the site (Polk et al. 2001:3.241).

The northwest edge of the site falls within the current highway right-of-way and may have been disturbed by prior highway construction. A fiber optic line extends through the southeastern portion of the site. The path cleared by installation of the fiber optic has become a cattle trail.

DATA RECOVERY

Excavation was limited to the portion of the site within the highway right-of-way. The site datum and grid system used during testing was reestablished for provenience designations. The datum was given an arbitrary value of N500/E500. The site was mapped with a total station and then mechanically and manually excavated.

Mechanical Excavation Unit

One backhoe trench (Trench 1) was excavated 5 m in from the southeast highway right-of-way fence, to search for subsurface features and artifacts. After the trench was excavated, the walls were cleaned with a transfer shovel. The one possible features was then flagged, mapped, and logged. Trench 1 was 60 m long and from 1 to 1.5 m deep. It paralleled US 70, with its southwest corner at N504.50/E534. The trench stratigraphy consisted of one layer of dark red-brown to yellow-brown, soft, fine sandy loam with very few gravels. No artifacts were collected from the trench or backfill; one possible feature (Feature 100) was identified in the north wall of Trench 1, near its east end. The feature was further investiing the excavation of Unit 100.

Hand Excavation Units

Two hand-excavated units were placed within the site (Table 7.1).

Unit 100 was a 1 by 1 m unit placed south of the west end of Trench 1, in order to investigate a location where two pieces of burned caliche were noted in the trench wall. The unit was excavated in three 10 cm levels, to a depth of 30 cm. The fill was dark red-brown to yellow-brown, fine sandy loam and was screened through quarter-inch mesh.Level 1

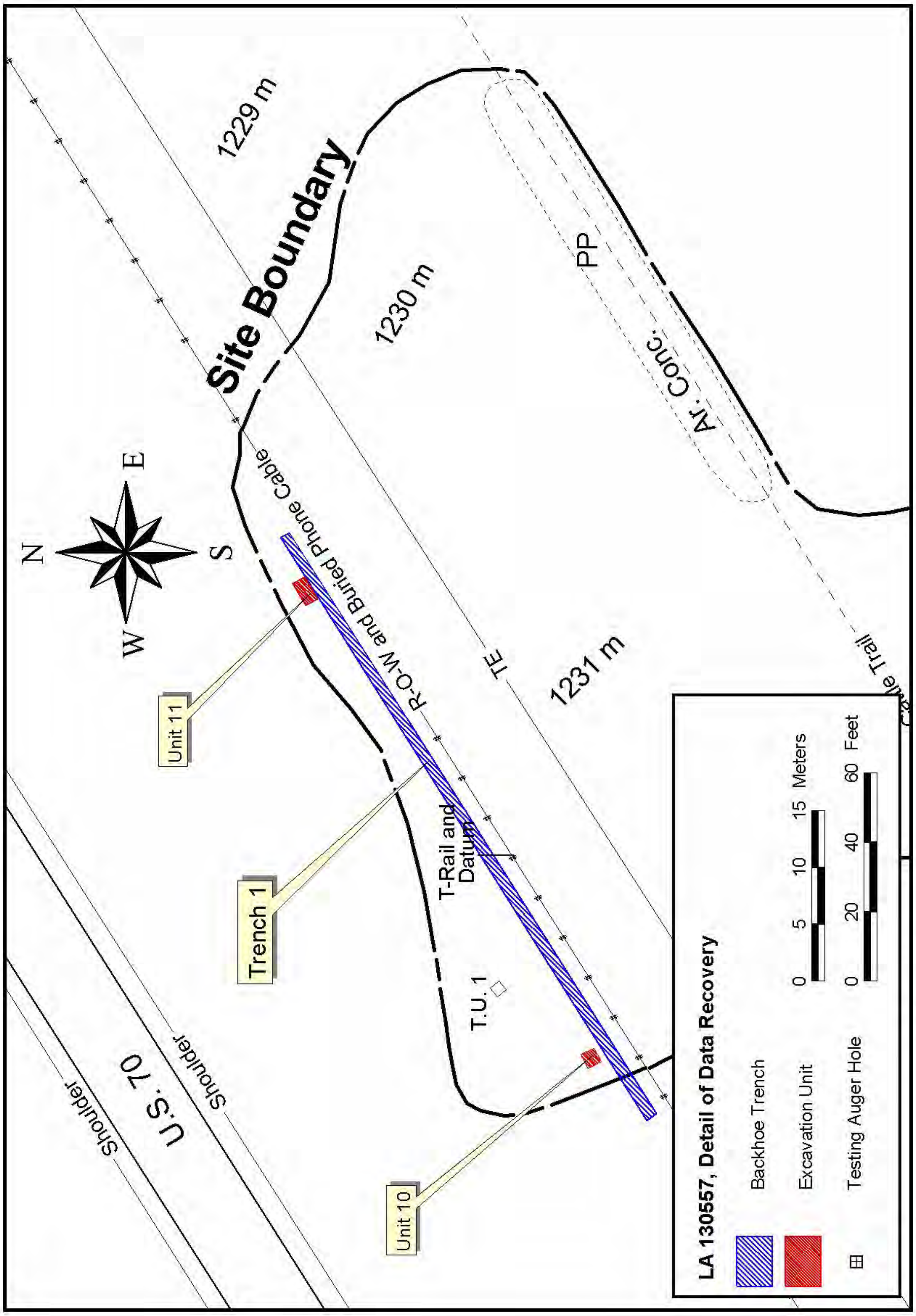

Figure 7.1. Excavations at LA 130557.

Figure 7.2. LA 130557, site overview.

Table 7.1. LA 130557, Summary Information for Hand-Excavated Units

Test Unit No.	Location of SW Corner	Dimensions	Associated Feature/Deposits
100	N503.21/E480.54	1 x 1 m	Two pieces of burned caliche
101	N505.31/E527.40	1 x 2 m	Feature 100

contained two small pieces of burned caliche, each measuring 2 cm across. Level 2 contained a piece of flaked quartzite and a piece of burned caliche. A flotation sample collected from Level 2 contained uncharred *Mollugo* and Caryophyllaceae (Pink family) seeds. Level 3 contained one piece of burned caliche. In the unit as a whole, no evidence of features or other structured activity was discovered.

Unit 101 was a 2 by 1 m unit placed along the north wall of Trench 1 to investigate Feature 100, a stain that began about 15 cm below ground surface and that measured 68 cm wide and 112 cm deep. The long axis of the unit paralleled the trench. The unit was excavated in four 10 cm levels. An additional level, 17 cm deep, was excavated in the feature fill only.

The fill in Levels 1 through 3 was the same red-brown to yellow-red, fine sandy loam found throughout the trench. The fill was screened through quarter-inch mesh. Two flakes were found in Level 2 and one flake in Level 3.

Feature 100 began in Level 4. Fill from the feature was screened through eighth-inch mesh. Charcoal flecks that were up to 2 mm in diameter caused the staining that marked the feature. The presence of partly burned roots in the upper fill of the feature suggested that at least some of the charcoal was from a root burn. Some evidence of a rodent burrow was found in the middle fill and bottom of the feature. Although the feature fill appeared to be at least partly the result of natural processes, the darkest portion of the fill was collected as radiocarbon and bulk soil samples, and was submitted for analysis. AMS analysis of this fill yielded a date of 3930 ± 40 BP (Beta-156286), which corresponds with cal 2550 to 2540 and 2490 to 2300 B.C. Macrobotanical analysis revealed the presence of charred *Prosopis* (mesquite), and uncharred *Mol-*

lugo seeds. The ash suggests that the feature may have been a hearth, but the feature was too badly disturbed to allow a determination of its function.

SUMMARY AND CONCLUSIONS

LA 130557 is a Native American site containing flaked stone and Jornada Mogollon pottery. Data recovery efforts were concentrated in the 4 percent of the site that fell within the US 70 right-of-way, and included a backhoe trench and two hand-excavated units. The recovered artifacts consisted of only four flakes, even though the previous surface collection yielded more than 100 flaked stone artifacts.

A single feature, Feature 100, was identified. It was a 68 cm wide by 112 cm deep charcoal stain first exposed in a trench wall. The feature produced a radiocarbon date of cal 2550–2540 and 2490–2300 B.C., which indicates the presence of a previously unidentified Middle Archaic period component. Feature 100 may have been a hearth; the fuel for the hearth was mesquite, a common species even today. A rodent burrow and more recent root burn had disturbed the feature, however, reducing our confidence in the results.

LA 130557 yielded the earliest date for the entire project. Subsurface artifacts and features were nearly lacking within the right-of-way, but 96 percent of the site area is outside the right-of-way. With so little of the site to work with, it is difficult to say much about its age, affiliation, and function—except that a Middle Archaic period component appears to be present.

Chapter 8

LITHIC & CERAMIC ANALYSIS

Todd L. VanPool

This chapter presents an analysis of prehistoric artifacts recovered during excavation of LA 2713, LA 75159, LA 75163, LA 127518, and LA 130557. All of the artifacts are stone and pottery, which are quite durable. Undoubtedly, the inhabitants also used tools made of wood and other perishable materials, but these artifacts have not been preserved in the excavated contexts. As a result, the following analysis will be divided into two sections, one focused on lithic artifacts and one on pottery.

FLAKED STONE AND GROUND STONE ARTIFACTS

During data recovery, 1,416 flaked and ground artifacts were recovered from LA 2713, LA 75159, and LA 75163; LA 127518 and LA 130557 did not produce appreciable assemblages. The analysis of these materials was undertaken to identify reduction techniques employed by the inhabitants of the sites and to address the research issues identified in Chapter 2. These issues include: (1) chronology; (2) subsistence, diet, and resource exploitation; and (3) exchange and trade. More specifically, the analysis focused on addressing four questions:

- What differences, if any, are present in lithic reduction and the associated activities between components/behavioral episodes within each site?

- What are the differences in lithic reduction and the associated activities in components of the same site through time (e.g., what changes are present between Late Archaic and Jornada Mogollon lithic assemblages?)

- What differences are present between sites, especially between contemporaneous occupations between sites?

- Does raw material selection provide evidence of trade patterns and mobility?

Answering these questions would allow an evaluation of the research issues outlined in Problem Domain 3. For example, identifying reduction technology would shed light on the relative reliance on curated versus expedient reduction technology. Likewise, comparing roughly contemporaneous Jornada Mogollon assemblages might allow the identification of differences between “Neo-Archaic” and more sedentary “Mogollon” groups.

Methods and Definitions

The analysis focused on flakes and cores as well as formal flaked stone and ground stone tools from the sites.

Analysis of Formal Tools

The analysis of formal flaked stone and ground stone tools should be context specific, reflecting the types of tools within assemblages as well as the questions being posed (see Odell 2000). In this particular analysis, the approach can be divided into three broad domains: manufacturing technology, performance analysis, and chronological and cultural affiliation.

"Manufacturing technology" refers to both the materials used to produce a tool, and how these materials were used to manufacture a given artifact. Understanding manufacturing technology provides insight into the behaviors that led to the creation of a tool. Two broad categories of stone tool manufacturing technologies are commonly used in the Southwest: flaked stone and ground stone.

Flaked stone tools are created by removing pieces from an isotropic, homogenous rock that is usually glassy or cryptocrystalline, through the application of force (Cotterell and Kamminga 1992:130–151).

Both the flake (the piece of material removed from the larger stone) and the core (the piece of material from which the flake was removed) will have the same general characteristics as glass shards: sharp, fairly fragile edges. Flaked stone tools are created by removing multiple flakes until the core (which itself may be a flake) has the desired morphology. In contrast, ground stone tools are frequently composed of durable crystalline materials, which are reduced through pecking and abrading the stone's surface until it has the desired morphology (Cotterell and Kamminga 1992:151–155). Flaked stone techniques can be used to shape cores that are subsequently reduced to final form using ground stone methods (Huckell 1986).

The sharp edges from flaked stone reduction tend to be ideal for tasks related to cutting and piercing, whereas the durable, often coarse surfaces created on ground stone tools make them ideal for grinding, polishing, and related activities. Common flaked stone tools include projectile points and knives, and common ground stone tools include manos and metates.

In the U.S. Southwest and elsewhere, an additional distinction is frequently made between bifacial and generalized flaked stone reduction. These two reduction techniques differ in the shape of their cores and the sequence of reduction. Bifacial reduction is completed by forming a core that is generally broad and flat with a series of flake scars running across the core's surface. Flakes are removed from the core's margin and tend to parallel the preceding flake scars. The flakes' platforms are created by the intersection of the previously formed flaked scars. Formal lithic tools such as projectile points, knives, and scrapers are commonly formed using bifacial reduction. Generalized cores are reduced by opportunistically removing flakes from one or more surfaces of the core, without attempting to maintain a uniform shape or platform area; the goal is generally to produce flakes that are themselves used as tools. Nonetheless, some generalized cores can also take the form of unifacially flaked cores from which the resulting flakes, often called blades, are fairly standardized.

"Performance analysis" provides insight into the reasons why people made the tools that they used. Schiffer and Skibo (1987, 1997) observe that artifacts are tools, and as a result, must have specific morphological characteristics that allow them to be useful for completing certain activities. By identifying an artifact's performance characteristics, archaeologists can potentially identify the task for which an artifact was constructed. For example, the characteristics of a projectile point reflect the activities for which it is designed, in the same way that a hammer reflect its use in driving nails. As a result, performance studies of lithic tools allow the intended use of tools to be determined from their morphology.

Identifying the chronological and cultural affiliation of tools allow the tools and their associated artifacts to be placed in their behavioral contexts. For reasons including changes in performance requirements and stylistic differences related to ethnicity, the morphology of stone tools changed over time (Beck 1998); documenting these changes allows archaeologists to use stone tools as cultural and temporal markers. This fact is most completely expressed in the study of projectile points; Folsom points, for example, are associated both with a cultural adaptation and a specific period. Similar determinations are possible using other stone artifacts, such as metates (Hard et al. 1996).

As was mentioned in Chapter 2, a distinction can also be made at the level of the entire assemblage, between expedient and curated flaked stone tool technologies (Abbott et al. 1996; Parry and Kelley 1987). Southwestern assemblages dominated by curated technologies have high frequencies of bifacially flaked stone tools, which were often hafted and could be repaired between uses. Assemblages dominated by expedient technologies demonstrate less formal preparation and are often little more than unmodified flakes removed from generalized cores. When these concepts were first applied in the Southwest, these technologies were often viewed as mutually exclusive: assemblages of curated tools were thought to indicate Paleoindian and Archaic period occupations, while expedient assemblages were thought to reflect later agricultural occupations (e.g., Kelley 1988; Parry and Kelley 1987). Research has since

demonstrated that while the frequency of curated flaked stone tools decreases after the adoption of cultigens in the Southwest, almost all flaked stone assemblages in the region derive from both curated and expedient techniques. Thus, the distinction is best viewed as a heuristic device, in which the shifting balance between curated and expedient lithic technology has temporal and cultural implications.

Analysis of Non-formal Flaked Stone Tools

Flakes that are not modified into formal tools are generally either expedient tools (used for some task without extensive modification) or are the unused byproducts of the creation of formal or expedient tools. Flakes that are used for a task are often called utilized flakes or expedient tools, while the unused waste material is called debitage (e.g., Fish 1981; see Shott 1994:70, 85). Unfortunately, it is often impossible to distinguish flakes removed for use as tools and flakes that are unused byproducts—especially given that utilized flakes can show little to no macroscopic traces wear, while non-utilized flakes can possess significant edge damage due to bioturbation such as trampling. I therefore shy away from trying to distinguish these two groups, and instead differentiate "formal tools" and "flakes" based on the presence or absence of systematic retouch.

Under the terminology used in this report, most formal tools are cores, in the sense that they were formed by removing flakes from their surfaces. Not all cores are formal tools, however. Some cores allowed the production of flakes for various tasks (i.e., expedient tools). A distinction is therefore necessary between cores shaped as tools and cores shaped to allow the removal of flakes used as tools. Cores that are formal tools were analyzed using the concept of performance characteristics. Cores that are not formal tools are generalized or irregular cores, and were analyzed as outlined below.

"Attribute analysis" (Andrefsky 2001) is frequently used for studying flakes and cores. The attribute analysis approaches used here rested on measuring specific attributes of all of the flakes and cores within an assemblage. Variation in these attributes was then tied to inductively derived distributions reflecting different flaked stone reduction technologies. A major advantages of this approach is that attributes such as maximum dimension could be reliably measured. Thus, the results of various analyses can be compared with those from other studies, and are replicable (Andrefsky 2001; Sullivan and Rozen 1985).

One of the most commonly applied forms of attribute analysis, and an approach used here, was proposed by Sullivan and Rozen (1985). Their methodology is useful for identifying the intensity and technique of core reduction through the amount of breakage of the resulting flakes. It rests on the premise that bifacial flaking produces more broken flakes than generalized core reduction. Sullivan and Rozen's approach has several advantages, including the fact that it provides clear interpretations and views core reduction as a continuum that includes both bifacial and generalized core reduction.

Unfortunately, experimental data demonstrate that Sullivan and Rozen's (1985) underlying assumption concerning the probability of flake breakage is somewhat problematic. Several studies support their basic proposition but suggest there is considerably more variation in breakage patterns than was originally recognized (Baumler and Downum 1989; Bradbury and Carr 1995; Ensor and Roemer 1989; Mauldin and Amick 1989; Prentiss 1998; Prentiss and Romanski 1989; Tomka 1989). Still, Prentiss (2001) finds that Sullivan and Rozen's approach does help identify the degree of reduction and reduction technology, especially when the size of flakes is taken into account, and is therefore a useful component of flaked stone analysis when supplemented by other approaches.

Sullivan and Rozen (1985) advocate recording the presence or absence of three distinct variables for flakes. The first of these is the presence or absence of a "single interior surface," which is characterized by the presence of positive flake morphology such as bulbs of force, fissures, rings of applied force, and undulations. The second is the presence or absence of a "point of applied force," which is indicated by the intersection of the bulb of

applied force and the flake platform. By definition, a point of applied force is only possible if a single interior surface is present. The third variable is the completeness of the flake margins. Flake margins are considered intact if the distal end of the flake has a hinge or feather termination and if any lateral snaps that are present do not interfere with the accurate measurement of the flake's length or width.

Sullivan and Rozen's (1985) variables allow the classification of flakes into one of five groups: complete flakes, broken flakes, flake fragments, split flakes, and angular debris. Complete flakes possess all three of the variables listed above; a single interior surface, a point of applied force, and complete margins. Broken flakes are flakes that have a single interior surface and a point of applied force, but have a broken distal end, broken margins, or both. Flake fragments are defined as those flakes that have a single interior surface but lack a point of applied force. These are the distal ends and margins of broken flakes. Split flakes have the characteristics of a complete flake except that one of the lateral margins is missing. Finally, angular debris, which is also called shatter, completely lacks recognizable flake morphology or has two or more faces with positive flake morphology (possibly including multiple points of applied force). As a rule, assemblages composed of many small, broken flakes and flake fragments, with little angular debris, are the product of bifacial reduction, while assemblages dominated by large, complete proximal flakes and split flakes are from generalized core reduction (Prentiss 1998, 2001:171).

Additional strategies for identifying reduction technique consider the frequency of various types of striking platforms, the thickness of flakes, and the amount of cortex on flakes (Ahler 1989; Andrefsky 1998:110–135; Shott 1994). These approaches rely on the distributions of flakes by size categories in order to determine the intensity of reduction—on the assumption that heavy reduction will produce more small flakes than light reduction, and that bifacial reduction will result in the creation of flakes with specific platform types.

The approaches outlined above can be used to address two different but related aspects of reduction: technique (e.g., bifacial reduction, generalized reduction) and intensity (the degree to which cores were reduced). Identifying technique is useful because it reflects the greater context of the reduction behavior. For example, many Mesoamerican groups relied on the production of blades, which were set into wood or bone hafts to create composite tools. Differences in assemblages thus reflect the cultural background of the knapper as well as factors such as the intended function and the lithic reduction technology. Technique thereby provides insight in the decision making, and thus the "behavioral chains" (Schiffer 1995:57–66) of knappers.

Identifying the intensity of lithic reduction is useful because it can help determine the general strategies of reduction. For example, sites such as quarries may be characterized by limited reduction of cores, as measured against sites where cores are further reduced to create tools. Differences in reduction between sites can thus reflect different activities across the landscape. In addition, differences in the intensity of reduction may reflect differential use of raw materials. Materials such as obsidian may be used primarily for formal tools, for example, while more crystalline materials such as basalt might be used for expedient tools. The production of bifacial tools requires more intensive reduction than the production of expedient tools, so differences in the use of materials will be reflected in differences in intensity of reduction.

Attributes Monitored

In addition to provenience and morphology, nine attributes were measured for each lithic artifact.

Artifact Category and Type

Lithic artifacts were classified as ground stone, flaked stone tools, and flakes. Ground stone included artifacts shaped by abrasion. Flaked stone tools were artifacts from which flakes were removed to create a tool with the desired morphology. This category therefore included retouched flakes (ones with modified edges). Flakes were defined as artifacts (including angular debris) created during core reduction, which were not themselves reduced.

Flaked and ground stone tools were further assigned to morphological types when possible. For ground stone, these categories included one-hand manos, two-hand manos, basin metates, and trough metates. Flaked stone tool types included previously defined projectile point types.

Raw Material

Raw material was recorded using common geologic terms, including obsidian, chalcedony, chert, silicified wood, basalt, and quartzite. Cherts were further examined to determine whether they were from the Edwards Plateau source of Central Texas, by using a Raytech ultraviolet light. Edwards Plateau chert fluoresces a distinct amber-yellow-orange when exposed to ultraviolet light (Hofman et al. 1991).

Condition

Flakes were classified as complete (unbroken), proximal (broken fragment with a bulb of force), distal (broken fragment without a bulb of force), and angular debris (a fragment lacking a single interior surface). Formal flaked stone tools such as projectile points were classified as complete (unbroken), distal (tool tip), proximal (base of the tool, including the likely hafting point), and medial (portion of the tool between the tool base and the tool tip). For ground stone and formal flaked stone tools, items were also classified in terms of evidence of use-related wear. Finally, some ground stone was classified as burned.

Cortex

The amount of cortex on the dorsal side of flakes (and on the total surface of formal ground stone and flaked stone tools and cores) was recorded using four divisions: 0 percent, 1–24 percent, 25–89 percent, and 90–100 percent. Flakes with cortex covering 90 to 100 percent of their dorsal surfaces are typically produced early during core reduction. Flakes with some cortex on their dorsal surfaces are then removed, and flakes without cortex are typically produced when most of the surface of the original nodule has been eliminated. As a result, as the intensity of reduction increases, the proportion of cortical flakes decreases. The amount of cortex on cores shows the same relationship with intensity of reduction, in that heavily reduced cores have less cortex.

Flake Platform Morphology

Five platform types were defined for flakes: collapsed, cortical, single-faceted, multifaceted, and stepped.

Collapsed platforms were defined as ones crushed during the application of force, thereby destroying the platform.

Cortical platforms were defined as platforms that are partly or entirely covered by cortex. Because cortex is progressively removed during core reduction, cortical platforms are good indicators of the early stages of core reduction.

Single-faceted platforms are indicated by the presence of a single unbroken surface without cortex. These platform surfaces are commonly portions of negative flake scars and often indicate generalized core reduction.

Multifaceted platforms exhibit more than one negative flake scar. In other words, they are formed by the juncture of two or more flake scars, with a ridge or ridges between them. This platform type is especially common on, but not limited to, bifacial thinning flakes.

Dimensions and Weight

Length, width, thickness, and weight were measured for ground stone and formal flaked stone tools. Artifact length was measured to the nearest millimeter and was defined as the distance from the tool tip to the tool haft for hafted tools, or as the maximum dimension for non-hafted tools such as manos and metates. Width was defined as the maximum dimension as measured at right angles to the length, and thickness was defined as the measurement made at right angles to both the length and width. These attributes were also measured to the nearest millimeter. Weight was measured using a digital scale, to the nearest milligram.

The maximum dimension of flakes was recorded using 1 cm size grades (e.g., 0.1 to 1 cm, 1.1 to 2 cm, 2.1 to 3 cm, and so on). The maximum dimension was often but not always the distance from the bulb of force to the farthest point of termination.

A Note on the Analysis of Frequencies

While statisticians have developed a variety of analytical tools, the Chi-square Test (Thomas 1986:264–283) is statistically robust, easy to calculate, and easy to interpret—characteristics that make it very attractive to archaeologists. The test does involve several assumptions, however. The most important of these is that samples must be large. More specifically, at least 80 percent of the expected frequencies for the test must be five or more (e.g., Bernard, 1994:438, 442; Drennan, 1996:196–198; Rose and Altschul, 1988:197; Shennan, 1990:71; Thomas, 1986:298). In cases where this assumption is violated, archaeologists are encouraged to use other statistical tests such as Fisher's Exact Probability Test (e.g., Drennan, 1996:198; Thomas, 1986:298) or the Kolmogorov-Smirnov Test. This rule has been demonstrated to be overly conservative, however (Larntz 1978; Lewontin and Felsenstein 1965; Roscoe and Byars 1971; Slakter 1966; Yarnold 1970; see also Everitt, 1992:39). In fact, the Chi-square Test is still frequently applicable in cases when the expected frequency is as low as 0.5 (Lewontin and Felsenstein 1965:31). This is important because the analysis of Chi-square residuals allows the identification of the source(s) of statistically meaningful variation, which is not possible using methods frequently suggested as alternatives.

Archaeologists do continue to accept the assumption that the Chi-square Test requires 80 percent of the expected frequencies to be 5 or greater. As a result, when faced with small sample sizes, I will use the Fisher's Exact Probability Test to establish that a statistically significant difference is present, and will then use a Chi-square Test to explore the relationships driving any observed difference. The use of the Fisher's Exact Test is in truth unnecessary, but will calm those who would otherwise feel uncomfortable with my conclusions.

Results of Lithic Artifact Analysis

Based on dates derived from radiocarbon analysis and diagnostic artifacts, the assemblages from LA 2713, LA 75159, and LA 75163 reflect lithic technology from the Middle Archaic period to the McKenzie Phase of the Jornada Mogollon occupation—or the transition from aceramic hunting to a limited reliance on pottery and domesticated foods. The lithic assemblages of these sites should provide insights into behavioral changes among the inhabitants of eastern New Mexico over a number of centuries.

The following discussion will be organized by site. As was mentioned in Chapter 2, the research design for the project held that within sites, spatially discrete assemblages could reflect isolated behavioral episodes that can ideally be ordered in time. The behavioral episodes were not stratigraphically isolated as was first hoped, so the fall-back assumption was that artifacts found close to a dated sample were more likely to be associated with that sample than artifacts found at a distance from that sample. In other words, the associations were stochastic rather than deterministic; trends could be viewed as true even if the association between any given artifact and any given date might prove to be false. The research design also hoped to base temporal series on absolute dates alone, so that trends in diagnostic artifacts could also be examined, but the actual data obtained by the project were too limited to allow such fine distinctions. Instead, diagnostic artifacts were combined with dates to provide the temporal dimension for the analysis.

As a result, the analysis will focus on characterizing the flaked stone assemblage from each feature, then on ordering the features through time, then on characterizing each site as a whole. The final discussion of flaked and ground stone artifacts will then focus on identifying trends through time, based on data from all of the sites.

LA 2713

LA 2713 contained features dating to the Late Archaic period and the Late 18 Mile and Mesita Negra phases. During data recovery, 161 lithic artifacts were recovered; as is evident from Table 8.1, 92 percent of the assemblage consists of chert, chalcedony, and fine-grained quartzite flakes. An irregular core, a biface fragment, and two retouched flakes were also found. Table 8.2 summarizes the artifact assemblage from each feature.

Table 8.1. LA 2713: Lithic Artifacts

Raw Material	Artifact Class			Total
	Cores	Flakes	Tool	
Chert	1	66	3	70
Chalcedony		24		24
Fine Grained Quartzite		58		58
Limestone		6		6
Obsidian		1		1
Sandstone		1		1
Total	1	156	3	160

Table 8.2. Lithic Artifacts from Features from LA 2713

Feature	Raw Material	Artifact Class			Total
		Cores	**Flakes**	**Tools**	
Surface and General Fill	Chert		16		16
	Chalcedony		5		5
	Fine Grained Quartzite		29		29
	Total		50		50
100	Chert		6		6
	Chalcedony		4		4
	Fine Grained Quartzite		7		7
	Total		17		17
104	Chert		12	1	13
	Chalcedony		4		4
	Fine Grained Quartzite		6		6
	Sandstone		1		1
	Total		23	1	24
105	Chert		3		3
	Chalcedony		3		3
	Fine Grained Quartzite		1		1
	Limestone		1		1
	Total		8		8
106	Chert	1	20	1	22
	Chalcedony		7		7
	Fine Grained Quartzite		13		13
	Limestone		5		5
	Obsidian		1		1
	Total	1	46	1	48
114	Chert		9	1	10
	Chalcedony		1		1
	Fine Grained Quartzite		2		2
	Total		12	1	13

The following analysis is divided into two sections. The first section presents an analysis of reduction technology. The second focuses on identifying trends in the materials by inferred temporal affiliation, so changes in lithic technology can be identified.

Reduction Techniques

Although the assemblage contained numerous flakes, only three tools and a single core were recovered (Table 8.1). As a result the analysis will focus on using multiple lines of evidence to determine the technology of flaked stone reduction. The small samples from several features limit the possibility of detecting differences between features, however.

As was previously mentioned, most of the assemblage was chert, chalcedony, and fine-grained quartzite. An obsidian flake was the only piece of raw material that was clearly not locally available. Differences are apparent between the features in terms of relative frequencies of raw materials (Table 8.3). A Fisher's Exact Probability Test (Everitt 1992) was used to determine whether these differences are statistically significant. The null hypothesis for the test is that each raw material type was represented in the same relative frequency in the assemblages from each feature and the general site fill. Obsidian and sandstone were eliminated from the analysis because only a single flake of each was found. The level of rejection (alpha) was set at 0.05. The probability resulting from the Fisher's Exact Probability Test is 0.021, which is less than 0.05. The null hypothesis is consequently rejected, and I conclude that the various raw materials do occur in different proportions at each feature and in the site fill.

Table 8.3. LA 2713: Lithic Artifacts By Raw Material and Provenience

Raw Material	Feature						Total
	Surface and General Site Fill	100	104	105	106	114	
Chert	16	6	13	3	22	10	70
Chalcedony	5	4	4	3	7	1	24
Fine-Grained Quartzite	29	7	6	1	13	2	58
Limestone				1	5		6
Obsidian					1		1
Sandstone			1				1
Total	50	17	24	8	48	13	160

I used an analysis of adjusted residuals from a Chi-square Test to evaluate the sources of the variation. I excluded Feature 105 and limestone, obsidian, and sandstone from the analysis due to small sample sizes. The analysis of adjusted residuals indicates that the general site fill produced fewer chert artifacts but more fine-grained quartzite artifacts than expected by chance. Feature 114, a Late 18 Mile or Mesita Negra Phase hearth, produced more chert artifacts than expected by chance.

The only cores from the site were a chert irregular core and a biface fragment, from Feature 106, an undated ash stain. The core had cortex on less than 25 percent of its surface and had a maximum dimension of slightly less than 6 cm. The biface fragment was slightly less than 2 cm long and did not have any cortex. The presence of the irregular core and the biface demonstrate the use of generalized and bifacial core reduction technology at the feature.

The striking platforms of flakes sorted were primarily single-faceted, though collapsed and cortical flakes were also common (Table 8.5). Multi-faceted platforms were almost completely absent; the only such platforms were from Feature 106, the ash stain that also contained the biface fragment. The flake and platform morphology is indicative of generalized core reduction. The relatively high frequency of crushed platforms suggests the use of hard hammer reduction. A Fisher's Exact Probability

Table 8.4. Chi-Square Test of Raw Materials by Provenience

Raw Material	Feature	Observed	Expected	Chi-Square	Adj. Residuals
Chert	General Site Fill	16	23	2.18	-2.49
	100	6	8	0.44	-0.96
	104	13	11	0.53	1.08
	106	22	19	0.35	0.95
	114	10	6	2.65	2.33
Chalcedony	General Site Fill	5	7	0.69	-1.11
	100	4	2	0.96	1.13
	104	4	3	0.13	0.43
	106	7	6	0.14	0.48
	114	1	2	0.41	-0.73
Fine Grained Quartzite	General Site Fill	29	20	4.44	3.34
	100	7	7	0.02	0.17
	104	6	9	1.02	-1.42
	106	13	17	0.75	-1.32
	114	2	5	1.89	-1.85
		Chi-Square Value=		16.61	
		Critical Value (.05,8)=		15.51	

Note: An adjusted residual equal to or greater than 1.96 or equal to or less than –1.96 indicates a statistically significant difference at an alpha level of 0.05. Positive values indicate more observed than expected whereas negative values indicate fewer observed than expected. Bolded adjusted residuals indicate a statistically significant difference.

test was used to evaluate whether any of the features or the general site fill differed in the relative proportions of the various platforms. The null hypothesis was that each platform type occurs in the same relative frequency. The level of rejection (alpha) was set at 0.05. The p-value resulting from the analysis was 0.006, which is less than the critical value. As a result, I reject the null hypothesis and conclude that the various platform types do occur in different frequencies. Analysis of adjusted residuals from a Chi-square Test (Table 8.6) indicate that the site surface and general site contained fewer cortical flakes than expected. Feature 100 (a Mesita Negra phase hearth) contained more collapsed platforms than expected, while Features 104 (a Late Archaic period hearth) and 114 (a Late 18 Mile or Mesita Negra phase hearth) contained fewer than expected. Feature 104 produced more cortical flakes than expected.

Most of the flakes did not have any cortex on the dorsal surface, indicating that some cores were heavily reduced (Table 8.7). However, about one-fifth of the flakes had more than 25 percent dorsal cortex, indicating that initial reduction of locally available materials took place at LA 2713. Unfortunately, the small numbers in each cortex and raw material class, when sorted by feature, preclude effective statistical evaluation of the relative frequencies.

Table 8.5. Platform Morphology for Flakes from LA 2713

Feature	Raw Material	Platform Type				Total
		Cortical	Single-facetted	Multi-facetted	Collapsed	
Surface and General Fill	Chert		5		4	9
	Chalcedony	1	3			4
	Fine Grained Quartzite	1	7		5	13
	Total	2	15		9	26
100	Chert		1		2	3
	Chalcedony	2			2	4
	Fine Grained Quartzite		3		3	6
	Total	2	4		7	13
104	Chert	4	4			8
	Chalcedony		1			1
	Fine Grained Quartzite	3	2			5
	Total	7	7			14
105	Chert	2	1			3
	Chalcedony				1	1
	Fine Grained Quartzite		1			1
	Limestone	1				1
	Total	3	2		1	6
106	Chert		4	2	8	14
	Chalcedony	1	3			4
	Fine Grained Quartzite	3	5		1	9
	Limestone	1	1			2
	Obsidian		1			1
	Total	5	14	2	9	30
114	Chert	2	5			7
	Chalcedony		1			1
	Fine Grained Quartzite		2			2
	Total	2	8			10

However, a Fisher's Exact Probability Test can be used to compare the amount of cortex on flakes of different raw materials across the entire site (Table 8.8). The null hypothesis was that flakes of each raw material have the same proportions of cortex covering their dorsal surfaces. Obsidian and limestone were eliminated from the analysis because they were each represented by a single item. The level of rejection (alpha) was set at 0.05, and the resulting p-value of the test was 0.78, which is greater than 0.05. As a result, I cannot reject the null hypothesis. Instead, I conclude that the distributions of flakes by the amount of dorsal cortex were similar for each raw material. I further conclude that cores of each raw material were reduced to roughly the same degree.

Table 8.6 LA 2713: Chi-square Test of Common Platform Types by Provenience

Platform Type	Feature	Observed	Expected	Chi-Square	Adj. Residual
Cortical	Surface and General Fill	2	6	2.34	-2.02
	100	2	3	0.24	-0.59
	104	7	3	5.20	2.78
	105	3	1	2.23	1.74
	106	5	6	0.19	-0.58
	114	2	2	0.01	-0.13
Single-facetted	Surface and General Fill	15	13	0.19	0.73
	100	4	7	1.09	-1.61
	104	7	7	0.01	-0.13
	105	2	3	0.39	-0.92
	106	14	14	0.01	-0.19
	114	8	5	1.57	1.90
Collapsed	Surface and General Fill	9	7	0.59	1.05
	100	7	3	3.55	2.37
	104	0	4	3.75	-2.45
	105	1	2	0.23	-0.58
	106	9	8	0.30	0.76
	114	0	3	2.68	-2.02
	Chi-Square =			24.55	
	Critical Value (.05,10) =			18.31	

Table 8.7. Amount of Cortex on the Surface of Flakes, Including Retouched Flakes, Sorted by Excavation Provenience

Feature	Raw Material	Cortex				Total
		None	1% to 24%	25% to 89%	90% to 100%	
Surface and General Site Fill	Chert	13	2	1		16
	Chalcedony	4			1	5
	Fine Grained Quartzite	26	2		1	29
	Total	43	4	1	2	50
100	Chert	3	3			6
	Chalcedony	2	1		1	4
	Fine Grained Quartzite	5	1		1	7
	Total	10	5		2	17
104	Chert	1	6	5	1	13
	Chalcedony		2	2		4
	Fine Grained Quartzite		1	1	4	6
	Sandstone	1				1
	Total	2	9	8	5	24
105	Chert	1	2			3
	Chalcedony	2	1			3
	Fine Grained Quartzite		1			1
	Limestone				1	1
	Total	3	4		1	8
106	Chert	13	5	2	1	22
	Chalcedony	3	3		1	7
	Fine Grained Quartzite	2	6	3	2	13
	Limestone	2	1	1	1	5
	Obsidian	1				1
	Total	21	15	6	5	47
114	Chert	4	3	1	2	10
	Chalcedony	1				1
	Fine Grained Quartzite	1	1			2
	Total	6	4	1	2	13

Table 8.8. LA 2713 Dorsal Cortex by Raw Material

Raw Material	Cortex				Total
	None	**1% to 24%**	**25% to 89%**	**90% to 100%**	
Chert	36	21	9	4	70
Chalcedony	12	7	2	3	24
Fine Grained Quartzite	34	12	4	8	58
Limestone	2	1	1	2	6
Obsidian	1				1
Sandstone	1				1
Total	86	41	16	17	160

The frequencies of flakes classified using Sullivan and Rozen's (1985) typology are reported in Table 8.9. The most common flake classes are complete flakes and angular debris, which compose 73 percent of the entire assemblage.

Based on Sullivan and Rozen's (1985:763) analysis, the general site assemblage reflects an emphasis on generalized reduction, with only limited reliance on bifacial reduction. The evaluation of flake maximum dimension further strengthens this interpretation. Table 8.10 presents the frequencies of flakes sorted by size. Although small flakes (maximum dimension less than or equal to 2.0 cm) are the most common size, a pattern found in both bifacial and generalized reduction, nearly half of the flakes are larger than 2.0 cm.

Table 8.9. LA 2713: Sullivan and Rozen's Flake Classes by Provenience

Feature	Flake Class				Total
	Complete	**Distal**	**Proximal**	**Angular Debris**	
Surface and General Site Fill	18	9	8	15	50
100	10	1	3	3	17
104	12	3	3	6	24
105	5	0	2	1	8
106	18	3	10	15	46
114	9	0	1	3	13
Total	72	16	27	43	158

As is further illustrated in Table 8.11, these larger flakes tend to be either complete or angular debris, which is typical of generalized core reduction according to Prentiss (2001). It is also consistent with the use of hard hammer percussion (Prentiss 2001).

The possibility that there are differences in the proportions of Sullivan and Rozen's categories between proveniences can be evaluated using Fisher's Exact Probability Test. The null hypothesis was that each of the flake classes is present in the same proportions at each of the proveniences. The level of rejection (alpha) was set at 0.05. The p-value resulting from the test is 0.50, which is greater than 0.05. The null hypothesis cannot be rejected, and I conclude that the proveniences have similar proportions of flake categories. This in turn suggests that strategies focused on generalized core reduction were used at each location.

The lines of evidence presented above indicate that the dominant reduction technique at LA 2713 was generalized core reduction, though some bifacial reduction also took place. Hard hammer percussion was used, as indicated by the number of crushed

Table 8.10. LA 2713: Flake Length by Provenience

Feature	Raw Material	Size Grade							Total
		1 cm or less	1.1 to 2.0 cm	2.1 to 3.0 cm	3.1 to 4.0 cm	4.1 to 5.0 cm	5.1 to 6.0 cm	6.1 to 7.0 cm	
Surface and General Fill	Chert	5	9	1	1				16
	Chalcedony		3	2					5
	Fine-Grained Quartzite	3	19	5	1	1			29
	Total	8	31	8	2	1			50
100	Chert		6						6
	Chalcedony		3		1				4
	Fine-Grained Quartzite	2	3	1	1				7
	Total	2	12	1	2				17
104	Chert		2	5	4	1	1		13
	Chalcedony		3	1					4
	Fine-Grained Quartzite			3	2	1			6
	Sandstone			1					1
	Total		5	10	6	2	1		24
105	Chert			2		1			3
	Chalcedony		2	1					3
	Fine-Grained Quartzite					1			1
	Limestone			1					1
	Total		2	4		2			8
106	Chert	3	12	2	4		1		22
	Chalcedony	1	1	3	2				7
	Fine-Grained Quartzite		2	8	1	2			13
	Limestone		2	2	1				5
	Obsidian			1					1
	Total	4	17	16	8	2	1		48
114	Chert		3	6				1	10
	Chalcedony			1					1
	Fine-Grained Quartzite		2						2
	Total		5	7				1	13

platforms. The high frequency of flakes with 25 percent or more dorsal cortex indicates that initial core reduction took place on the site, in turn suggesting that much if not all of the raw material used was locally available. However, obsidian from outside the area was also present. Although the reduction strategy was similar across the excavated portion of the site, minor differences were presentand will be discussed in more detail in the following section.

Table 8.11. LA 2713: Flake Classes by Maximum Dimension

Size Grade	Flake Class				Total
	Complete	Distal	Proximal	Angular Debris	
1 cm or less	4	3	2	5	14
1.1 to 2.0 cm	27	10	9	25	71
2.1 to 3.0 cm	23	2	9	12	46
3.1 to 4.0 cm	12		5	1	18
4.1 to 5.0 cm	4	1	2		7
5.1 to 6.0 cm	1				1
6.1 to 7.0 cm	1				1
Total	72	16	27	43	158

Cultural and Temporal Patterns

At LA 2713, four features could be dated using radiocarbon dating and diagnostic artifacts: Features 100, 104, 113, and 114 (Table 8.12). All of the features were hearths. These features likely do represent isolated (relative to each other) behavioral events that can be ordered in time, as sought by the research design.

No lithic artifacts were recovered from Feature 113, but 54 artifacts were recovered from the other features. Although previous analysis showed no differences in the proportions of flakes grouped using Sullivan and Rozen's framework, there could have been differences among the three features that were obscured when all of the other features are considered. As a result, Fisher's Exact Probability Test was used to determine whether there were differences among Features 100, 104, and 114. The null hypothesis was that the three features share the same relative proportions of flakes classes. The level of rejection (alpha) was set at 0.05, and the p-value of the test was 0.780. The null hypothesis cannot be rejected; I conclude that the flaked stone assemblages from the Late Archaic and Jornada Mogollon occupations reflect the same basic reduction strategy, focused largely on generalized core reduction.

Table 8.12. LA 2713: Temporal Affiliation of Features

Feature Number	Basis for Affiliation	Temporal Affiliation
100	Rio Grande B/w	Mesita Negra phase (A.D. 1000–1200)
104	Radiocarbon date: cal A.D. 400–640	Late Archaic period
113	Radiocarbon date: cal A.D. 690–890	Late Archaic period
114	Radiocarbon date: cal A.D. 1000–1170	Late 18 Mile or Mesita Negra phase (A.D. 900–1200)

I also compared the proportions of raw material types among the three features. The null hypothesis was that the raw materials occurred in the same proportions at each feature. The level of rejection(alpha) was set at 0.05, and the p-value resultingfrom the test was 0.378. The null hypothesis cannot be rejected. As a result, I conclude that raw material choice did not change through time.

Differences are apparent in the maximum dimensions of the flakes, however. Table 8.13, which presents the number of flakes from each size group by provenience, suggests that Feature 100 contains more flakes with maximum dimensions of 2.0 cm or less than the other two features. A Fisher's Exact Probability Test was used to evaluate whether this difference is statistically significant. The null hypothesis was that flake sizes did not vary significantly from feature to feature. The level of rejection (alpha) was set at 0.05. The

Table 8.13. LA 2713: Sizes of Flakes from Features 100, 104 and 114

Feature	Size Grade							Total
	1 cm or less	1.1 to 2.0 cm	2.1 to 3.0 cm	3.1 to 4.0 cm	4.1 to 5.0 cm	5.1 to 6.0 cm	6.1 to 7.0 cm	
100	2	12	1	2				17
104		5	10	6	2	1		24
114		5	7				1	13
Total	2	22	18	8	2	1	1	54

Table 8.14. LA 2713: Small and Large Flakes from Features 100, 104, and 114

Size Grade	Feature	Observed	Expected	Chi-square	Adj. Residuals
Small (2.0 cm or less)	100	14	8	5.50	3.80
	104	5	11	3.01	-3.12
	114	5	6	0.10	-0.50
Large (Greater than 2.0 cm)	100	3	9	4.40	-3.80
	104	19	13	2.41	3.12
	114	8	7	0.08	0.50
		Chi-square =		15.50	
		Critical Value (.05,2) =		5.99	

p-value resulting from the test was 0.008, which is less than 0.05. I reject the null hypothesis and conclude that sizes of flakes (based on maximum dimensions) are different among the features. Given that the fill from all three features was screened using eighth-inch mesh, it is likely that the results reflect behavioral differences rather than excavation methods.

To more clearly evaluate the trends, I collapsed the size categories into “small flakes” (2.0 cm or less) and “large flakes” (larger than 2.0 cm). The numbers of small and large flakes from each feature are reported in Table 8.14. A Chi-Square Test was used to determine whether the differences are statistically significant. The null hypothesis was that the relative frequencies of small and large flakes are the same for the three features. The level of rejection (alpha) was set at 0.05.

As shown in Table 8.14, the Chi-Square value is 15.50, which is greater than the critical value of 5.99. I reject the null hypothesis and conclude that the three features do have different proportions of small and large flakes. An analysis of the adjusted Chi-square residuals indicates that Feature 100, the Mesita Negra phase hearth, had more small flakes and fewer large flakes than expected, while Feature 104, the Late Archaic period hearth, had more large flakes and fewer smaller flakes than expected.

As Alher (1989) and Prentiss (2001) discuss, differences in flake size relate to both the technique and intensity of reduction, with bifacial reduction and more intensive reduction producing more small flakes. The lack of difference in the proportions of Sullivan and Rozen’s classes suggest that the differences in flake size are largely due to the intensity of reduction, instead of being from differences in technique. One way to evaluate this possibility is a comparison of platform frequencies and cortex among the three features. These variables also reflect the intensity of reduction.

The frequencies of cortical, collapsed, and single-faceted platforms are presented in Table 8.15. Fisher's Exact Test can be used to evaluate the null hypothesis that the three features contain the same proportions of platform types. The level of rejection (alpha) was set at 0.05, and the resulting p-value is 0.001. The null hypothesis is therefore rejected; the three features contain different relative frequencies of each platform type.

A Chi-square can be used to help determine the source of this variation. The result of the Chi-square Test, which is consistent with the Fisher's Exact Probability Test, is presented in Table 8.16.

Analysis of the adjusted residual indicates that Feature 104 (the Late Archaic period hearth) contained more flakes with cortical platforms and fewer collapsed platforms than expected, Feature 114 (the Late 18 Mile or Mesita Negra phase hearth) contained more single-faceted platforms than expected, and Feature 100 (the Mesita Negra phase hearth) contained more collapsed platforms than expected.

Table 8.15. LA 2713: Frequencies of Platform Types from Features 100, 104 and 114

Feature	Platform Type			Totals
	Cortical	Single-faceted	Collapsed	
100	2	4	7	13
104	7	7		14
114	2	8		10
Totals	11	19	7	37

Table 8.16. LA 2713: Chi-square Test of Flake Platform Types by Features

Platform Type	Feature	Observed	Expected	Chi-Square	Adj. Residuals
Cortical	100	2	4	0.90	-1.41
	104	7	4	1.93	2.10
	114	2	3	0.32	-0.79
Single-faceted	100	4	7	1.07	-1.84
	104	7	7	0.00	-0.13
	114	8	5	1.60	2.12
Collapsed	100	7	2	8.38	3.99
	104	0	3	2.65	-2.29
	114	0	2	1.89	-1.79
		Chi-square =		18.75	
		Critical Value (.05,4) =		9.49	

Frequencies of flakes by the amount of cortex on their dorsal surfaces are presented in Table 8.17. Fisher's Exact Probability Test was used to test the null hypothesis that the distributions of cortex-bearing flakes are similar among the features. The level of rejection (alpha) was set at 0.05. The result of the test is 0.011. I consequently reject the null hypothesis.

A Chi-square Test was used to explore the differences. In order to strengthen the Chi-square Test, I collapsed flakes with 25–89 percent and 90–100 percent dorsal cortex into a single category (Table 8.18). Analysis of the adjusted residuals indicates that Feature 100 contained more flakes without cortex and fewer decortication flakes (25 to 100 percent coverage) than the other features, while Feature 104 contained fewer flakes without cortex and more decortication flakes than expected.

Table 8.17. LA 2713: Frequencies of Flakes by Dorsal Cortex and Features

Feature	% of cortex covering the dorsal surface				Total
	None	1% to 24%	25% to 89%	90% to 100%	
100	10	5	0	2	17
104	2	9	8	5	24
114	6	4	1	2	13
Total	18	18	9	9	54

Table 8.18. LA 2713: Chi-square Test of Dorsal Cortex Versus Features

Amount of Cortex	Feature	Observed	Expected	Chi-Square	Adj. Residuals
None	100	10	6	3.31	2.69
	104	2	8	4.50	-3.49
	114	6	4	0.64	1.13
1 to 24%	100	5	6	0.08	-0.41
	104	17	8	0.13	0.58
	114	5	4	0.03	-0.23
25 to 100%	100	2	6	2.37	-2.28
	104	5	8	3.13	2.90
	114	2	4	0.41	-0.90
		Chi-Square =		14.59	
		Critical Value (.05,4) =		9.49	

The observed differences in cortex, platform types, and flake size uniformly reflect variation in the intensity of generalized core reduction. Analysis of flake morphology and raw material has already demonstrated that similar materials and reduction methods were used at Features 100, 104, and 114. The high number of flakes without cortex at

Feature 100 (the Mesita Negra phase hearth) suggests that core reduction at the feature was more intensive than at the other two features. Furthermore, collapsed platforms are more likely when removing smaller flakes with correspondingly smaller and weaker platforms. In contrast, the larger flakes and high preponderance of cortical flakes and cortical platforms at Feature 104 (the Late Archaic period hearth) is indicative of less intensive reduction. The intensity of reduction at Feature 114 (a Late 18 Mile or Mesita Negra phase hearth) is likely intermediate between that at Feature 100 and 104, as indicated by the numerous single-faceted platforms and intermediate frequencies of cortical flakes and small flakes.

Summary

The flaked stone assemblage from LA 2713 demonstrates a mixed flaked stone reduction strategy focused on generalized core reduction with limited bifacial reduction. The raw materials are likely all locally available, with the exception of a single obsidian flake. Raw material selection does not vary between features, and the reduction techniques appear to be uniform.

However, differences are present in the intensity of flaked stone reduction among features with known temporal affiliations. Three features that produced flaked stone artifacts could be dated using diagnostic artifacts or radiocarbon dating. Feature 100, a Mesita Negra phase hearth, was associated with more flakes without cortex, more flakes with collapsed platforms, and more small flakes than the other two dated features. Feature 104, a Late Archaic period hearth, was associated with larger flakes, more decortication flakes (25+% dorsal cortex), and more cortical platforms. Flakes from Feature 114, a Late 18 Mile or Mesita Negra phase hearth, had more single-faceted platforms than

expected. Given that raw material selection does not differ among the features and that the proportions of broken flakes are similar, the differences between the features are most likely from differing intensities of generalized core reduction: cores were more heavily reduced at Feature 100 and less heavily reduced at Feature 104, with the cores at Feature 114 falling somewhere in between.

LA 75159

LA 75159 contained features and deposits dating from the Middle Archaic period to the McKenzie Phase. Data recovery yielded 670 artifacts including eight ground stone tools. As is evident from Table 8.19, the assemblage is dominated by chert, chalcedony, and fine-grained quartzite flakes, which comprise 85 percent of the assemblage. Table 8.20 provides a summary of the artifact assemblage from each feature and the units excavated into the pond deposits.

Table 8.19. LA 75159: Lithic Artifacts by Material and Type

Raw Material	Artifact Class				Totals
	Cores	Flakes	Hammer-stones	Tools	
Chert	9	291	1	21	322
Chert - Edwards Plateau		7		5	12
Chalcedony		67		3	70
Petrified Wood		3		2	5
Fine-Grained Quartzite	11	207	1	9	228
Medium-Grained Quartzite		4			4
Limestone		8			8
Silicified Limestone		2			2
Obsidian		5		2	7
Basalt		1			1
Rhyolite		1			1
Sandstone	1	1			2
Totals	21	597	2	42	662

Analysis of Formal Tools

Forty-four tools (including two hammerstones) were recovered (Tables 8.19 and 8.20). Most of the tools were utilized flakes and retouched flakes that demonstrated use damage. Additional tools include bifaces (n=7), knives/point preforms (n=3), scrappers (n=6), and projectile points (n=3). The projectile points include an indeterminate arrow point and a Scallorn point (A.D. 700–1200) (Turner and Hester 1993) , and a dart point similar to an Armijo B stemmed point (1900 B.C.–A.D. 400) (Turnbow 1997).

Eight ground stone tools, all made of quartzite, were recovered. Two of these were fragments of slab metates, both of which were recovered from Trench 4. Hard et al. (1996) found that in the Southwest, slab metates are indicative of wild food resource processing. A performance analysis by Adams (1999:485–486) indicated that slab metates are useful for grinding soaked seeds, or naturally oily such as sunflower seeds. In addition, Adams (1999:485) provided experimental and ethnographic evidence that slab metates were often used with one-hand manos. Consistent with this evidence, the manos from LA 75159 include two complete one-hand manos, found in Trenches 2 and 4, and one one-hand mano fragment, found in Trench 5. These manos may have been used with slab metates similar to those from Trench 4. Two fragments of indeterminate manos were also found.

Analysis of Reduction Techniques

Multiple lines of evidence were again applied to determine the technology of flaked stone reduction.

Table 8.20. LA 75159: Lithic Artifacts by Provenience, continued

Excavation Provenience	Raw Material	Artifact Class				Total
		Cores	Flakes	Hammerstones	Tool	
Unit 101 - Pond Deposits	Chert	1	39		1	41
	Chert - Edwards Plateau				1	1
	Chalcedony		5		2	7
	Petrified Wood		1			1
	Fine-Grained Quartzite	3	30		3	36
	Medium-Grained Quartzite		1			1
	Limestone		2			2
	Silicified Limestone		1			1
	Obsidian		1			1
	Basalt		1			1
	Total	4	81		7	92
Unit 102 - Pond Deposits	Chert		8		4	12
	Chert - Edwards Plateau		2		1	3
	Chalcedony		3			3
	Petrified Wood		1			1
	Fine-Grained Quartzite		2			2
	Limestone		1			1
	Obsidian				1	1
	Total		17		6	23
Feature 100	Chert	2	91		3	96
	Chert - Edwards Plateau		1			1
	Chalcedony		28			28
	Fine-Grained Quartzite		39		1	40
	Medium-Grained Quartzite		2			2
	Obsidian		3			3
	Total	2	164		4	170
Feature 101	Chert		3			3
	Chert - Edwards Plateau				1	1
	Fine-Grained Quartzite		6			6
	Limestone		1			1
	Total		10		1	11
Feature 102	Chert	2	34			36
	Chert - Edwards Plateau		2			2
	Chalcedony		11			11
	Petrified Wood				1	1
	Fine-Grained Quartzite		19			19
	Medium-Grained Quartzite		1			1
	Total	2	67		1	70
Feature 107	Chert		2			2
	Total		2			2

Most of the assemblage was chert (50 percent), chalcedony (11 percent), and fine-grained quartzite (34 percent). Non-locally available material included 12 pieces of Edwards Plateau chert and seven pieces of obsidian (Table 8.20). Differences between the various provenience units will be addressed in more detail below.

Most of the cores (15 out of 21) from LA 75159 were irregular (Table 8.21). One bifacial core, three tested rocks, and two unifacial cores were also found. The mix of cores reflects the use of both generalized and bifacial reduction strategies.

The three tested rocks are cobbles of chert and fine-grained quartzite that are indistinguishable from materials used in most of the lithic assemblage—indicating that most of the materials used at the site were collected from nearby sources. The chert tested cobble is much smaller than the two tested quartzite cobbles (Table 8.21). Furthermore, the quartzite irregular cores appear to be larger than the chert irregular cores. A Mann-Whitley U Test, a nonparametric equivalent to the T-test, was used to determine whether these apparent differences are statistically significant. The null hypothesis was that the sizes of chert and quartzite irregular cores and tested rocks are similar. The level of rejection (alpha) was set at 0.05, and the p-value associated with the test is 0.02. The null hypothesis was therefore rejected, and I conclude that the fine-grained quartzite irregular cores and tested rocks are in fact larger than their chert counterparts. This difference in size almost certainly reflects differences in size for the original nodules. Still, all three tested cores had maximum dimensions of 9.0 cm or less, which is quite small compared to the initial core sizes of materials from many lithic sources (Banks 1990).

Oddly, an irregular core of sandstone was also found. Huckell (1986) demonstrates that ground stone can be initially reduced by flaking, which removes material more quickly. It is therefore possible that the sandstone "irregular core" is actually a fragment of a ground stone preform.

Most of the cores (20 out of 21) retain some cortex (Table 8.22). Over half of the cores (12 out of 21) have cortex on 25 percent or more of their surfaces. The prevalence of cortex suggests that cores were not reduced heavily enough to remove their outer surfaces, probably in part because of the small size of the nodules.

Cortical, single-faceted, and collapsed platforms are the most common platform types (Tables 8.23 and 8.24). Multi-faceted and stepped platforms were almost completely absent. The general flake morphology, along with the predominance of cortical and single-faceted platforms, is typical of generalized core reduction, as is the high percentage of irregular cores. The high frequency of crushed platforms suggests the use of hard hammer reduction.

Table 8.25 presents the frequencies of the three most common platform types, for each provenience with more than 15 flakes. A Chi-square Test was used to evaluate whether proportion of the various platforms vary by provenience. The null hypothesis for the analysis was that each platform type occurs in the same relative frequency among the provenience units. The level of rejection (alpha) was set at 0.05. The resulting Chi-square value is 34.50, which exceeds the critical value of 15.51 for 8 degrees of freedom. As a result, I reject the null hypothesis and conclude that different provenience units contained different proportions of platform types. Analysis of the adjusted residuals indicates that Unit 100 contained fewer flakes with collapsed platforms, Unit 101 contained more flakes with cortical platforms, and Feature 100 contained more flakes with collapsed platforms but fewer flakes with cortical platforms or single-faceted platforms than expected by chance. These differences will be explored in more detail below, but as an initial interpretation, the patterns suggested that the remains from Unit 100, (which are dominated by Middle to Late Archaic period materials) represent different reduction strategies than indicated at the other locations. Furthermore, the materials from Unit 101 were probably less heavily reduced than at other areas, whereas those from Feature 100 were probably more heavily reduced.

Table 8.21. LA 75159: Cores by Type, Raw Material and size

Core Type	Raw Material	Maximum Dimension						Totals
		3.1 to 4.0 cm	4.1 to 5.0 cm	5.1 to 6.0 cm	6.1 to 7.0 cm	7.1 to 8.0 cm	8.1 to 9.0 cm	
Bifacial Core	Fine-grained Quartzite				1			1
	Totals				1			1
Irregular Core	Chert	3	2	1	1			7
	Fine-grained Quartzite	1		4	1	1		7
	Sandstone			1				1
	Totals	4	2	6	2	1		15
Tested Rock	Chert	1						1
	Fine-grained Quartzite						2	2
	Totals	1					2	3
Unidirectional Core	Chert			1				1
	Fine-grained Quartzite					1		1
	Totals			1		1		2

Table 8.22. LA 75159: Cores by Material and Cortex

Raw Material	Cortex				Totals
	None	1% to 24%	25% to 89%	90% to 100%	
Chert		4	4	1	9
Fine-Grained Quartzite	1	3	5	2	11
Sandstone		1			1
Totals	1	8	9	3	21

Table 8.23. LA 75159: Flake Platforms by Type and Material

Platform Type	Raw Material									
	Chert	Chert – Edwards Plateau	Chalce-dony	Petrified Wood	Fine-grained Quartzite	Medium-grained Quartzite	Limestone	Obsidian	Rhyolite	Totals
Cortical	29	1	4		40		3			77
Single-faceted	63	1	8	1	53	2			1	129
Multi-faceted	4				1			1		6
Collapsed	75	4	23	1	26	1		2		132
Stepped	6									6
Totals	177	6	35	2	120	3	3	3	1	350

Table 8.24. LA 75159: Flake Platforms by Type and Provenience

Platform Type	Feature								Totals
	General Site Fill	Unit 100 - Pond Deposits	Unit 101 - Pond Deposits	Unit 102 - Pond Deposits	Featur e 100	Feature 101	Feature 102	Feature 107	
Cortical	8	33	16	3	11	1	5		77
Single-faceted	12	48	15	3	28	4	19		129
Collapsed	9	33	12	5	59	1	12	1	132
Totals	29	114	43	11	98	6	36	1	338

Table 8.25. LA 75159: Chi-square Test of Flake Platform Types Versus Proveniences

Platform	Provenience	Observed	Expected	Chi-square	Adj. Residuals
Cortical	General Site Fill	8	7	0.29	0.64
	Unit 100 – Pond Deposits	33	26	1.88	1.95
	Unit 101 – Pond Deposits	16	10	3.91	2.42
	Feature 100	11	22	5.77	-3.28
	Feature 102	5	8	1.26	-1.35
Single-faceted	General Site Fill	12	11	0.08	0.38
	Unit 100 – Pond Deposits	48	43	0.47	1.09
	Unit 101 – Pond Deposits	15	16	0.12	-0.47
	Feature 100	28	37	2.35	-2.34
	Feature 102	19	14	2.03	1.92
Collapsed	General Site Fill	9	11	0.48	-0.93
	Unit 100 – Pond Deposits	33	45	2.99	-2.76
	Unit 101 – Pond Deposits	12	17	1.37	-1.61
	Feature 100	59	38	11.21	5.15
	Feature 102	12	14	0.30	-0.75
		Chi-square =		34.50	
		Critical Value (.05,8) =		15.51	

Differences in the frequencies of platform types for common raw materials, as presented in Table 8.23, were also evaluated using a Chi-square Test. For this test, only raw material types represented by at least 10 flakes with platforms are considered. The null hypothesis for the test was that the proportions of flakes with each type of platform are similar. The level of rejection (alpha) was set at 0.05, and the results of the analysis are presented in Table 8.26. The resulting Chi-square value is 32.59, which exceeds the critical value of 12.59. I reject the null hypothesis, and conclude that the more common raw materials do correlate with different frequencies of platform types. Analysis of the adjusted residuals indicates that chert flakes have fewer cortical platforms but more collapsed platforms, chalcedony flakes have fewer single-faceted platforms and more collapsed platforms, and fine-grained quartzite flakes have more cortical platforms but fewer collapsed platforms than expected by chance. These results suggest that chert and chalcedony cores may have been more heavily reduced than the fine-grained quartzite cores.

Most flakes from LA 75159 do not have any dorsal cortex and only 16 percent of the flakes have 25+ percent dorsal cortex, indicating that most of the flakes were from heavily reduced cores (Table 8.27). This was especially true for flakes of raw materials such as obsidian and Edwards Plateau chert that are not locally available, and that had no flake with cortex covering more than 24 percent of their surfaces. However, eleven percent of the non-Edwards Plateau chert, fine-grained quartzite, and chalcedony flakes had cortex covering 90 to 100 percent of their dorsal surfaces, indicating that initial reduction of cores was completed on site, which in turn suggests that these materials were locally available.

A Chi-square Test was used to examine cortex on flakes of locally available raw materials across the site; the fact that non-local raw materials were heavily reduced is demonstrated by the lack of decortication flakes (flakes 25+ percent dorsal cortex). The analysis was limited to chert, chalcedony, and fine-grained quartzite because the other material types occur infrequently. The null hypothesis for the test was that flakes of each raw material have the same proportions of dorsal

Table 8.26. LA 75159: Chi-square Test of Flake Platform Types Versus Raw Materials

Raw Material	Platform Type	Observed	Expected	Chi-Square	Adj. Residuals
Chert	Cortical	29	38	2.25	-2.47
	Single-faceted	63	65	0.06	-0.47
	Multi-faceted	4	3	0.72	1.24
	Collapsed	75	65	1.52	2.27
Chalcedony	Cortical	4	8	1.88	-1.65
	Single-faceted	8	13	2.12	-1.96
	Multi-faceted		1	0.54	-0.78
	Collapsed	23	13	7.05	3.57
Fine-Grained Quartzite	Cortical	40	27	6.41	3.62
	Single-faceted	53	46	1.19	1.74
	Multi-faceted	1	2	0.38	-0.79
	Collapsed	26	46	8.45	-4.65
		Chi-Square Value =		32.59	
		Critical Value (.05,6) =		12.59	

cortex. The level of rejection (alpha) was set at 0.05. The resulting Chi-Square value is 13.03, which is greater than the critical value of 12.59 (Table 8.28). I reject the null hypothesis and conclude that chert, chalcedony, and fine grained quartzite flakes do differ in the amount of dorsal cortex.

Analysis of the adjusted residuals indicates that more chert flakes have no dorsal cortex and that more fine-grained quartzite flakes have 25 to 89 percent dorsal cortex than expected by chance. Also, there are fewer fine-grained quartzite flakes without cortex than expected. Because the amount of dorsal cortex correlates with the intensity of reduction, these differences suggest that chert cores were more heavily reduced and fine-grained quartzite cores were less heavily reduced, compared to the assemblage as a whole. This is consistent with the conclusions derived from analysis of platform types (see Table 8.26).

The frequencies of flakes classified using Sullivan and Rozen's (1985) typology are reported in Table 8.29. The most common flake classes are complete flakes and angular debris, which comprise 63 percent of the assemblage. Based on Sullivan and Rozen's (1985:763) analysis, the general site assemblage most likely reflects a focus on intensive generalized reduction but also bifacial reduction. The evaluation of flake maximum dimensions further strengthens this interpretation. Table 8.30 presents the frequencies of flakes sorted by size. Large flakes (maximum dimension larger than 2.0 cm) are the most common, as is often the case with generalized reduction. As further illustrated in Table 8.30, the large flakes tend to be either complete or angular debris, which is typical of generalized core reduction and hard hammer percussion (Prentiss 2001). Table 8.31 shows frequencies of Sullivan and Rozen's flake types by provenience. The null hypothesis, that the types are present in the same proportions among the proveniences, was evaluated using Fisher's Exact Probability Test. The level of rejection (alpha) was set at 0.05. The resulting p-value is 0.23. I cannot reject the null hypothesis, therefore each category of flake occurs in the same proportions across proveniences, which suggests that similar reduction strategies (generalized reduction plus limited bifacial reduction) were used at each location.

Table 8.27. 75159: Flakes by Dorsal Cortex and Raw Material

	Raw Material												
Cortex	**Chert**	**Chert - Edwards Plateau**	**Chalce-dony**	**Petrified Wood**	**Fine-grained Quartzite**	**Medium-grained Quartzite**	**Lime-stone**	**Silicified Lime-stone**	**Obsidian**	**Basalt**	**Rhyolite**	**Sand-stone**	**Totals**
None	200	4	48	1	116	0	1	2	4	1	1	1	379
1% to 24%	53	3	13	1	46	3	2	0	1	0	0	0	122
25% to 89%	12	0	2	0	17	1	1	0	0	0	0	0	33
90% to 100%	26	0	4	1	28	0	4	0	0	0	0	0	63
Totals	291	7	67	3	207	4	8	2	5	1	1	1	597

Table 8.28. LA 75159: Chi-square Test of Dorsal Cortex Versus Raw Material

Raw Material	Percent of Cortex	Observed	Expected	Chi-square	Adj. Residuals
Chert	None	200	187	0.84	2.20
	1% to 24%	53	58	0.38	-0.99
	25% to 89%	12	16	0.99	-1.47
	90% to 100%	26	30	0.50	-1.07
Chalcedony	None	48	43	0.54	1.31
	1% to 24%	13	13	0.01	-0.09
	25% to 89%	2	4	0.76	-0.96
	90% to 100%	4	7	1.20	-1.23
Fine-Grained Quartzite	None	116	133	2.26	-3.17
	1% to 24%	46	41	0.60	1.09
	25% to 89%	17	11	2.80	2.16
	90% to 100%	28	21	2.14	1.94
	Chi-square =			13.03	
	Critical Value (.05,6) =			12.59	

In summary, chalcedony, and fine-grained quartzite are the dominant raw materials used at LA 75159. Various lines of evidence indicate that the dominant reduction technique was generalized core reduction, but that considerable bifacial reduction also took place. Hard hammer percussion was common, as indicated by the number of crushed platforms. The frequency of flakes with 5+ percent dorsal cortex indicates that initial core reduction took place on the site. Chert and chalcedony cores were more heavily reduced than were fine-grained quartzite cores. Although the general reduction strategy was similar across the excavated portion of the site, minor differences were present. These will be discussed in more detail in the following section.

Cultural and Temporal Patterns

The deeply stratified and well-dated pond deposits at LA 75159 provides an almost unique opportunity to examine changes in local lithic technology through time. In addition, the temporal affiliation of several features could be determined. Again, these features reflect isolated behavioral episodes, and can also be useful for considering temporal and behavioral variation in lithic reduction.

The following analysis is based on sampled strata from Units 100 and 101, and on the fill of Features 100 and 102 (Table 8.32). The proveniences yielded 558 lithic artifacts (Table 8.33).

Table 8.34 shows the frequencies of Sullivan and Rozen's flake types by dated provenience. Although previous analysis showed no differences in the proportions of flakes grouped according to Sullivan and Rozen's classes, there might be differences among dated proveniences that were obscured by considering the other proveniences. A Chi-square Test to therefore used to assess the null hypothesis that there are no differences in the proportions of flake classes among dated proveniences. Flakes from Stratum 4 of Unit 100 and Level 5 of Unit 101 were excluded due to small sample sized. The level of rejection (alpha) was set at 0.05. The p-value resulting from the test is 0.18, which is larger than 0.05. I consequently cannot reject the null hypothesis, and I conclude that reduction technique was similar for all of the dated proveniences. At LA 75159, flaked stone assemblages from the Middle Archaic, Late Archaic, and Jornada Mogollon occupations reflect the same basic reduction strategy, namely generalized core reduction.

Table 8.29. LA 75159: Sullivan and Rozen Flake Classes by Raw Material

Flake Class	Raw Material											
	Chert	Chert - Edwards Plateau	Chalce-dony	Petrified Wood	Fine-grained Quartzite	Medium-grained Quartzite	Lime-stone	Silicified Limestone	Obsidian	Rhyolite	Sandstone	Totals
Complete	136	4	26	1	85	1	3		3	1		260
Distal	45	1	15		40	1	1	2				105
Proximal	51	2	16	1	40	2						112
Angular Debris	56		10	1	40		4		2		1	114
Totals	288	7	67	3	205	4	8	2	5	1	1	591

Table 8.30. LA 75159: Flake Types by Size

Size Grade	Flake Class				Total
	Complete	Distal	Proximal	Angular Debris	
1 cm or less	22	17	11	9	59
1.1 to 2.0 cm	88	40	51	40	219
2.1 to 3.0 cm	64	25	26	45	160
3.1 to 4.0 cm	53	17	14	18	102
4.1 to 5.0 cm	16	4	6	1	27
5.1 to 6.0 cm	12	1	4	0	17
6.1 to 7.0 cm	5	1	0	1	7
Total	260	105	112	114	591

Table 8.31. LA 75159: Flake Types by Provenience

Feature	Flake Class				Total
	Complete	Distal	Proximal	Angular Debris	
General Site Fill	23	7	9	3	42
Unit 100 - Pond Deposits	100	32	29	50	211
Unit 101 - Pond Deposits	26	17	18	17	78
Unit 102 - Pond Deposits	10	1	4	2	17
Feature 100	71	34	33	26	164
Feature 101	2	2	4	2	10
Feature 102	27	12	15	13	67
Feature 107	1	0	0	1	2
Total	260	105	112	114	591

Table 8.32. LA 75159: Dated Proveniences Used for Analysis

Provenience	Age
Unit 100	
Stratum 3	McKenzie phase (A.D. 1200 to 1350)
Stratum 4	Late Archaic period (1800 B.C. to A.D. 750) Early 18 Mile phase (A.D. 750 to 850) Late 18 Mile phase (A.D. 850 to 1000) Mesita Negra phase (A.D. 1000 to 1200)
Stratum 5	Late Archaic period (1800 B.C. to A.D. 750)
Stratum 6	Late Archaic period (1800 B.C. to A.D. 750)
Stratum 7	Middle to Late Archaic period (3200 B.C. to 1800 B.C.)
Unit 101	
Levels 1 and 2	Mesita Negra phase (A.D. 1000 to 1200) McKenzie phase (A.D. 1200 to 1350)
Level 5	Late Archaic period (1800 B.C. to A.D. 750)
Feature 100	Mesita Negra phase (A.D. 1000 to 1200)
Feature 102	Early 18 Mile phase (A.D. 750 to 850) Late 18 Mile phase (A.D. 850 to 1000) Mesita Negra Phase (A.D. 1000 to 1200)

Table 8.33. LA 75159: Flaked Stone Artifacts from Dated Proveniences

Provenience	Artifact Class				Totals
	Cores	Flakes	Hammer-stones	Tools	
Unit 100 - Stratum 3	1	44		3	48
Unit 100 - Stratum 4	1	4			5
Unit 100 - Stratum 5	1	20	1	5	27
Unit 100 - Stratum 6	3	82		7	92
Unit 100 - Stratum 7	1	61		2	64
Unit 101 - Levels 1 & 2	3	70		7	80
Unit 101 - Level 5		2			2
Feature 100	2	164		4	170
Feature 102	2	67		1	70
Totals	14	514	1	29	558

Table 8.34. LA 75159: Flakes Classes by Dated Provenience

Provenience	Flake Class				Totals
	Complete	Distal	Proximal	Angular Debris	
Unit 100 – Stratum 3	16	7	8	10	41
Unit 100 – Stratum 4	2	1	1	0	4
Unit 100 - Stratum 5	8	3	3	6	20
Unit 100 - Stratum 6	49	12	4	17	82
Unit 100 - Stratum 7	25	9	12	15	61
Unit 101 - Levels 1 & 2	22	16	14	15	67
Unit 101 - Level 5	0	0	1	1	2
Feature 100	71	34	33	26	164
Feature 102	27	12	15	13	67
Totals	218	93	89	102	502

However, differences in raw material selection were intuitively evident among the proveniences (Table 8.35). These differences were most evident in the proportions of chert, chalcedony, and fine-grained quartzite, which account for most of the assemblage. A Chi-square Test was used to evaluate the apparent differences (Table 8.36). The null hypothesis for the test was that each raw material occurs in the same proportions at each dated provenience. The level of rejection (alpha) was set at 0.05. The resulting Chi-square value is 30.84, which exceeds the critical value of 21.03. I reject the null hypothesis and conclude that raw materials do in fact occur in different proportions at the various proveniences.

Analysis of the adjusted residuals indicates that Feature 100 (a Mesita Negra phase hearth) contains more chert and chalcedony but less fine-grained quartzite than expected. Strata 5 (Late Archaic period) and 6 (Middle to Late Archaic periods) of Unit 100 contained more fine-grained quartzite than expected, but Stratum 7 contains less chalcedony than expected by chance alone. The similarities between the Middle/Late Archaic strata, and their differences with the Jornada Mogollon hearth could reflect changes in raw material selection, with an increasing preference for chert through time.

However, these differences are not evident at Feature 102 (a Jornada Mogollon hearth) and the remains from more recent strata in Units 100 and 101 probably indicate that the differences reflect more limited behavioral differences associated with the use of Feature 100, the Mesita Negra hearth, rather than a general pattern.

Additional differences among proveniences are apparent in maximum dimensions of flakes (Table 8.37). For example, flakes from Unit 100 appear to be larger than the flakes from many other proveniences. This is at least partly due to differences in excavation techniques; the fill of Unit 100 was screened using quarter-inch mesh while the fill of Features 100 and 102 was screened using eighth-inch mesh. As a result, it is not possible to compare frequencies of flakes sorted by size among those proveniences. The differences in excavation strategy are also at least partly responsible for differences in raw material frequencies between the Unit 100 strata and Feature 100, given that many of the chert flakes from Feature 100 have maximum dimensions of 1.0 cm or less (Table 8.38), and are less likely to be recovered using quarter-inch screen.

Table 8.35. LA 75159: Flaked Stone Raw Materials by Dated Provenience

Provenience	Raw Material												Totals
	Chert	Chert – Edwards Plateau	Chalce-dony	Petrified Wood	Fine-grained Quartz-ite	Med.-grained Quartz-ite	Lime-stone	Silici-fied Lime-stone	Obsi-dian	Basalt	Rhyolite	Sand-stone	
Unit 100 - Stratum III	23	1	4	0	19	0	1	0	0	0	0	0	48
Unit 100 - Stratum IV	2	0	0	0	3	0	0	0	0	0	0	0	5
Unit 100 - Stratum V	9	3	1	0	13	0	1	0	0	0	0	0	27
Unit 100 - Stratum VI	40	0	10	1	39	0	0	0	1	0	0	1	92
Unit 100 - Stratum VII	26	0	2	0	32	0	1	1	1	0	1	0	64
Unit 101 - Levels 1 & 2	37	1	7	1	29	1	1	1	1	1	0	0	80
Unit 101 - Level 5	0	0	0	0	1	0	1	0	0	0	0	0	2
Feature 100	96	1	28	0	40	2	0	0	3	0	0	0	170
Feature 102	36	2	11	1	19	1	0	0	0	0	0	0	70
Totals	269	8	63	3	195	4	5	2	6	1	1	1	558

Table 8.36. LA 75159: Chi-square Test of Lithic Raw Materials Versus Proveniences

Raw Material	Provenience	Observed	Expected	Chi-square	Adj. Residuals
Chert	Unit 100 - Stratum 3	23	24	0.01	-0.18
	Unit 100 - Stratum 5	9	12	0.66	-1.19
	Unit 100 - Stratum 6	40	46	0.69	-1.31
	Unit 100 - Stratum 7	26	31	0.73	-1.30
	Unit 101 – Levels 1 & 2	37	37	0.00	-0.10
	Feature 100	96	84	1.70	2.26
	Feature 102	36	34	0.14	0.57
Chalcedony	Unit 100 - Stratum 3	4	6	0.44	-0.74
	Unit 100 - Stratum 5	1	3	1.14	-1.17
	Unit 100 - Stratum 6	10	11	0.05	-0.27
	Unit 100 - Stratum 7	2	7	3.81	-2.21
	Unit 101 – Levels 1 & 2	7	9	0.38	-0.71
	Feature 100	28	20	3.36	2.36
	Feature 102	11	8	1.14	1.22
Fine-Grained Quartzite	Unit 100 - Stratum 3	19	17	0.27	0.68
	Unit 100 - Stratum 5	13	8	2.47	2.02
	Unit 100 - Stratum 6	39	33	1.24	1.54
	Unit 100 - Stratum 7	32	22	4.55	2.85
	Unit 101 - Levels 1 & 2	29	27	0.19	0.59
	Feature 100	40	60	6.74	-3.94
	Feature 102	19	24	1.12	-1.42
		Chi-square Value =		30.84	
		Critical Value (.05,12) =		21.03	

Table 8.37. LA 75159: Flakes by Dated Provenience and size

Provenience	Size Grade							Total
	1 cm or less	1.1 to 2.0 cm	2.1 to 3.0 cm	3.1 to 4.0 cm	4.1 to 5.0 cm	5.1 to 6.0 cm	6.1 to 7.0 cm	
Unit 100 - Stratum 3	0	14	18	6	5	1	1	45
Unit 100 - Stratum 4	0	0	3	1	0	0	0	4
Unit 100 - Stratum 5	0	5	10	7	0	1	0	23
Unit 100 - Stratum 6	1	4	32	34	7	5	2	85
Unit 100 - Stratum 7	5	16	15	16	7	3	1	63
Unit 101 – Levels 1 and 2	0	34	26	11	3	0	1	75
Unit 101 – Level 5	0	0	1	0	1	0	0	2
Feature 100	42	94	21	7	1	2	0	167
Feature 102	11	29	17	10	0	1	0	68
Total	59	196	143	92	24	13	5	532

Table 8.38. LA 75159, Feature 100: Flakes by Size and Raw Material

Raw Material	Size Grade						Total
	1 cm or less	1.1 to 2.0 cm	2.1 to 3.0 cm	3.1 to 4.0 cm	4.1 to 5.0 cm	5.1 to 6.0 cm	
Chert	23	56	11	2	0	1	93
Chert - Edwards Plateau	1	0	0	0	0	0	1
Chalcedony	8	15	3	1	1		28
Fine-grained Quartzite	9	21	6	3	0	1	40
Medium-grained Quartzite	0	0	1	1	0	0	2
Obsidian	1	2	0	0	0	0	3
Total	42	94	21	7	1	2	167

However, the dated remains from Units 100 and 101 can be compared because they were all screened through quarter-inch mesh. A Chi-square Test was again used to determine if significant differences are present (Table 8.39). The division between flakes measuring 2.0 cm or less and those measuring 2.0+ cm, previously applied to materials from LA 2713, was again used. The null hypothesis was that small and large flakes occurred in the same proportions among proveniences. Level 5 of Unit 101 and Stratum 4 of Unit 100 were excluded from the analysis due to sample size. The level of rejection (alpha) was set at 0.05. The Chi-Square value is 33.89, which is greater than the critical value of 9.49 for 4 degrees of freedom. The null hypothesis is rejected, and I conclude that the sizes of flakes are different for the various proveniences.

Table 8.39. LA 75159 Units 100 and 101: Chi-square Test of Flake Size

Flake Maximum Dimension	Provenience	Observed	Expected	Chi-square	Adj. Residuals
2.0 cm or less	Unit 100 - Stratum 3	14	12	0.26	0.65
	Unit 100 - Stratum 5	5	6	0.25	-0.61
	Unit 100 - Stratum 6	5	23	14.16	-5.24
	Unit 100 - Stratum 7	21	17	0.89	1.25
	Unit 101 - Levels 1 & 2	34	20	9.14	4.11
Greater than 2 cm	Unit 100 - Stratum 3	31	33	0.10	-0.65
	Unit 100 - Stratum 5	18	17	0.09	0.61
	Unit 100 – Stratum 6	80	62	5.28	5.24
	Unit 100 - Stratum 7	42	46	0.33	-1.25
	Unit 101 - Levels 1 & 2	41	55	3.40	-4.11
		Chi-square Value =		33.89	
		Critical Value (.05,4) =		9.49	

Analysis of the adjusted residuals indicates that Stratum 7 of Unit 100, which dates to the Middle and Late Archaic periods, contained more large flakes, while Levels 1 and 2 of Unit 101, which date to the Mesita Negra and McKenzie phases, contained more small flakes. This difference parallels the differences found for the LA 2713 assemblage, suggesting that the differences are related to changes in the intensity of flaked stone reduction through time.

As was done before, one way to explore the source of the variation is comparing platform types and amount of cortex among dated proveniences. The frequency of cortical, collapsed, and single-faceted platforms is presented in Table 8.40. A Chi-square Test was used to evaluate the null hypothesis that the various dated proveniences yielded same proportions of platform types. To avoid bias introduced by different screen sizes, the test was limited to the strata and levels from Units 100 and 101 that were screened using quarter-inch mesh. In addition, multi-faceted and stepped platforms were excluded, as were Stratum 4 of Unit 100 and Level 5 of Unit 101, due to small sample size. The level of rejection (alpha) was set at 0.05. The Chi-square value is 8.68, which is less than the critical value of 15.51 for 8 degrees of freedom (Table 8.41). The null hypothesis cannot be rejected, and I conclude that there are no differences in the proportions of cortical, single-faceted, and collapsed platforms from the various proveniences.

Table 8.40. LA 75159: Flake Platform Types by Dated Proveniences

Provenience	Platform Type					Totals
	Cortical	Single-faceted	Multi-faceted	Collapsed	Stepped	
Unit 100 - Stratum 3	6	5	0	8	3	22
Unit 100 - Stratum 4	0	1	0	2	0	3
Unit 100 - Stratum 5	3	4	0	6	0	13
Unit 100 - Stratum 6	15	22	2	13	1	53
Unit 100 - Stratum 7	9	19	0	5	0	33
Unit 101 - Levels 1 and 2	12	15	1	11	1	40
Unit 101 - Level 5	1	0	0	0	0	1
Feature 100	14	28	1	59	0	102
Feature 102	5	19	1	12	0	37
Totals	65	113	5	116	5	304

Table 8.41. LA 75159, Units 100 and 101: Chi-Square Test of PlatformTypes

Platform Type	Provenience	Observed	Expected	Chi-square
Cortical	Unit 100 - Stratum 3	6	6	0.03
	Unit 100 - Stratum 5	3	4	0.18
	Unit 100 - Stratum 6	15	15	0.01
	Unit 100 - Stratum 7	9	10	0.05
	Unit 101 - Levels 1 & 2	12	11	0.06
Single-faceted	Unit 100 – Stratum 3	5	8	1.17
	Unit 100 – Stratum 5	4	6	0.42
	Unit 100 – Stratum 6	22	21	0.03
	Unit 100 - Stratum 7	19	14	1.77
	Unit 101 - Levels 1 & 2	15	16	0.08
Collapsed	Unit 100 - Stratum 3	8	5	1.33
	Unit 100 - Stratum 5	6	4	1.51
	Unit 100 - Stratum 6	13	14	0.08
	Unit 100 - Stratum 7	5	9	1.97
	Unit 101 - Levels 1 & 2	11	11	0.01
		Chi-square Value =		8.68
		Critical Value (.05,8) =		15.51

Similarly, no differences are apparent among the strata and levels of Units 100 and 101 in regards to the distribution of cortex on their surfaces. Table 8.42 presents a Chi-square Test evaluating the null hypothesis that the Unit 100 and 101 dated contexts have similar distributions of dorsal cortex. Again, Stratum 4 and Level 5 of Units 100 and 101 are excluded due to small sample size. The level of rejection (alpha) was set at 0.05.

The resulting Chi-square value is 10.22, which is less than the critical value of 21.03 for 12 degrees of freedom. I cannot reject the null hypothesis; there are no statistically significant differences in the amount of dorsal cortex through time. However, differences in flake maximum dimension are present that parallel those found during the analysis of LA 2713. To wit, the flakes from the Archaic period tend to be longer than the flakes from the Jornada Mogollon occupation, which may reflect differences in the intensity of reduction.

Summary

The assemblage from LA 75159 demonstrates a reduction strategy focused on generalized core reduction, with limited bifacial reduction. The raw materials appear to be locally available, with the exception of seven obsidian flakes and 12 Edwards Plateau chert artifacts. Feature 100, a Mesita Negra phase hearth, contains a higher proportion of chert than the other proveniences, but this is probably partly due to differences in excavation methods: Feature 100 was screened using eighth-inch mesh and Units 100 and 101 were screened using quarter-inch mesh.

More significant differences are present within the assemblages from Units 100 and 101. These units provide a deeply stratified record of remains from the Middle Archaic period through the end of the Jornada Mogollon occupation. As a result, they provide an ideal sample with which to study technological changes through time. Based on the relative frequencies of flake classes based on Sullivan and Rozen’s research, reduction techniques remained effectively the same during the entire sequence: an emphasis of generalized reduction, with lesser amounts of bifacial reduction. However, the intensity of reduction increased through time, as reflected by changes in

Table 8.42. LA 75159: Chi-square Test of Dorsal Cortex Versus Dated Proveniences

Dorsal Cortex	Provenience	Observed	Expected	Chi-square
None	Unit 100 – Stratum 3	28	23	0.99
	Unit 100 - Stratum 5	10	12	0.29
	Unit 100 - Stratum 6	38	44	0.77
	Unit 100 - Stratum 7	33	32	0.01
	Unit 101 - Levels 1 & 2	41	39	0.14
1% to 24%	Unit 100 - Stratum 3	7	12	2.02
	Unit 100 - Stratum 5	9	6	1.40
	Unit 100 - Stratum 6	24	22	0.10
	Unit 100 - Stratum 7	19	17	0.33
	Unit 101 - Levels 1 & 2	18	20	0.17
25% to 89%	Unit 100 - Stratum 3	4	4	0.02
	Unit 100 - Stratum 5	2	2	0.01
	Unit 100 - Stratum 6	7	7	0.00
	Unit 100 - Stratum 7	6	5	0.12
	Unit 101 - Levels 1 & 2	5	6	0.23
90% to 100%	Unit 100 - Stratum 3	6	6	0.01
	Unit 100 - Stratum 5	2	3	0.43
	Unit 100 - Stratum 6	16	12	1.59
	Unit 100 - Stratum 7	5	9	1.55
	Unit 101 - Levels 1 & 2	11	10	0.05
		Chi-square Value =		10.22
	Critical Value (.05,12) =			21.03

the maximum dimensions of flakes. This change parallels the patterns inferred at LA 2713.

LA 75163

Data recovery at LA 75163, a Late Archaic and Jornada Mogollon site, yielded 591 lithic artifacts, including three ground stone tools. Most of the flaked stone items (91 percent) were chert, chalcedony, and fine-grained quartzite flakes (Table 8.43). Table 8.44 provides a summary of the artifact assemblage from each feature.

Analysis of Formal Tools

Ten formal flaked stone tools were found (Table 8.45). These tools were primarily flakes with or without formal retouch that were used as expedient tools. The edge damage indicates that they were used for some cutting task. A biface preform and a formal scraper were also found.

Three quartzite ground stone tools were recovered. A slab metate and a fragment of an indeterminate metate were recovered from Trench 2 and Feature 123, a hearth of unknown age. A pestle was also recovered from Trench 2.

Analysis of Reduction Techniques

Multiple lines of evidence were applied to investigate flaked stone reduction,. The small samples from several features limited the ability to detect differences among features.

Almost all of the assemblage was chert, chalcedony, and fine-grained quartzite (Table 8.43). Seven obsidian flakes were the only artifacts made of a material that was clearly not locally available. No Edwards Plateau chert was recovered.

Table 8.43. LA 75163: Flaked Stone Artifacts by Material

Raw Material	Artifact Category			Totals
	Cores	Flakes	Tools	
Chert	2	311	6	319
Chalcedony		132	1	133
Petrified Wood		3		3
Fine-Grained Quartzite	2	95	1	98
Medium-Grained Quartzite	1	2		3
Limestone		20	1	21
Silicified Limestone			1	1
Obsidian		7		7
Basalt		3		3
Totals	5	573	10	588

Table 8.44. LA 75163: Flaked Stone Artifacts by Provenience

Feature	Artifact Category			Totals
	Cores	Flakes	Tools	
General Site Fill		74	2	76
Feature 107	1	41		42
Feature 109		18		18
Feature 110		91		91
Feature 112		49	1	50
Feature 114		18	2	20
Feature 119		10		10
Feature 123		1		1
Feature 129	2	57	1	60
Feature 137		13		13
Feature 138	2	65	1	68
Feature 139		32		32
Feature 141		6	1	7
Feature 144		98	2	100
Totals	5	573	10	588

Table 8.46 shows the frequencies of raw materials by provenience; those materials seem to occur in the same general proportions across the site. This conclusion was evaluated using Fisher's Exact Probability Test. The null hypothesis was that each raw material was present in the same proportion at each provenience unit. The level of reject (alpha) was set at 0.05. Samples of fewer than 15 artifacts were eliminated to avoid small sample sizes. The resulting p-value is 0.89, which is greater than 0.05. I conclude that the most common raw materials are present in the same general proportions across the site.

Three irregular cores, two unifacially flaked cores, and a biface were the only cores found on the site (Table 8.47). The presence of the irregular/ unidirectional cores and the bifacial core indicate that the inhabitants of the site used both reduction techniques. Four of the six cores have some cortex on their surface (Table 8.48), indicating that core reduction was not highly intensive. The maximum dimensions of the cores ranged in size from 3.1 to 7.0 cm (Table 8.49).

Table 8.45 LA 75163: Formal Flaked Stone Tools by Provenience

Artifact Type	Provenience	Raw Material					Totals
		Chert	Chalcedony	Fine-grained Quartzite	Limestone	Silicified Limestone	
Use-Damaged Flake w/o Intentional Retouch	General Site Fill	1					1
	Feature 112	1					1
	Feature 114				1		1
	Feature 138		1				1
	Feature 144	1					1
	Total	3	1		1		5
Edge-Modified Flake	Feature 114	1					1
	Feature 129			1			1
	Feature 144					1	1
	Total	1		1		1	3
Middle Stage Biface	Feature 141	1					1
	Total	1					1
Formal Scraper	General Site Fill	1					1
	Totals	1					1

Table 8.46. LA 75163: Flaked Stone by Raw Material and Provenience

Raw Material	Provenience														Totals
	General Site Fill	Feature 107	Feature 109	Feature 110	Feature 112	Feature 114	Feature 119	Feature 123	Feature 129	Feature 137	Feature 138	Feature 139	Feature 141	Feature 144	
Chert	39	24	8	51	25	11	7		30	6	34	18	5	61	319
Chalcedony	20	6	2	21	9	6	1		14	4	19	9	2	20	133
Petrified Wood		2									1				3
Fine Grained Quartzite	14	7	6	12	12	1	2	1	14	3	11	5		10	98
Medium Grained Quartzite	1								1		1				3
Limestone	2	2	2	5	2	1			1					6	21
Silicified Limestone														1	1
Obsidian		1		1	1						2			2	7
Basalt				1	1	1									3
Totals	76	42	18	91	50	20	10	1	60	13	68	32	7	100	588

The most common flake platform type is collapsed platforms; cortical and single-faceted platforms are common as well (Table 8.50). Multi-faceted and stepped platforms are almost completely absent from the assemblage. The flake and platform morphology is indicative of generalized core reduction, and the high frequency of crushed platforms suggests the use of hard hammer reduction.

There intuitively appears to be differences in the frequencies of platform types by raw materials. This is especially true for collapsed platforms, which are present on more than half of the chert flakes with platforms, but are far less frequent for several other raw material types. A Chi-square Test was can used to determine whether the differences are statistically significant. The null hypothesis was that platform types are present in the same frequencies for each raw material. Multi-faceted and stepped platforms were eliminated from the analysis, as were all raw materials with fewer than 15 items. The level of rejection (alpha) was set at 0.05. The resulting Chi-square Value is 20.88, which is greater than the critical value of 9.49 for 4 degrees of freedom (Table 8.51).

I reject the null hypothesis and conclude that common raw materials are associated with different proportions of platform types. Analysis of the adjusted residuals indicates that chert flakes have more collapsed platforms and fewer cortical and single-faceted platforms, and that fine-grained quartzite flakes have more cortical and single-faceted platforms than expected by chance alone. These differences, especially the differences in cortical platforms, suggest that chert cores were reduced more intensively than other raw materials, while fine-grained quartzite was reduced less intensively than other materials. Previous analysis of frequencies of common raw materials indicates that they do not occur disproportionately in any of the features. It is possible, however, that there are differences in reduction intensity that are reflected in flake platforms from each feature, independently of raw material. I used a Fisher's Exact Probability Test to evaluate the null hypothesis that the platform types are present in the same proportions at each feature (Table 8.52). The level of rejection (alpha) was 0.05. The resulting p-value is 0.44. The null hypothesis cannot be rejected, and I conclude that there are not substantial differences in the distribution of platforms among the features.

Table 8.47. LA 75163: Cores by type and Raw Material

Artifact Type	Feature	Raw Material			Totals
		Chert	Fine-grained Quartzite	Medium-grained Quartzite	
Irregular Core	Feature 107		1		1
	Feature 129		1		1
	Feature 138	1			1
	Totals	1	2		3
Unidirectional Core	Feature 129	1			1
	Feature 138			1	1
	Total	1		1	2
Middle Stage Biface	Feature 141	1			1
	Totals	1			1

Table 8.48. LA 75163: Cortex on Cores

Core Morphology	Raw Material	Cortex %		Totals
		None	1% to 24%	
Irregular Core	Chert		1	1
	Fine-grained Quartzite	1	1	2
Unidirectional Core	Chert		1	1
	Medium-grained Quartzite		1	1
Middle Stage Biface	Chert	1		1
Totals		2	4	6

Table 8.49. LA 75163: Maximum Dimensions of Cores

Artifact Type	Raw Material	Size Grade				Totals
		3.1 to 4.0 cm	4.1 to 5.0 cm	5.1 to 6.0 cm	6.1 to 7.0 cm	
Irregular Core	Chert	1				1
	Fine-grained Quartzite			1	1	2
Unidirectional Core	Chert				1	1
	Medium-grained Quartzite		1			1
Middle Stage Biface	Chert			1		1
Totals		1	1	2	2	6

Table 8.50. LA 75163: Flake Platforms by Raw Material

Raw Material	Platform Type					Totals
	Cortical	Single-faceted	Multi-faceted	Collapsed	Stepped	
Chert	14	64	3	102	4	187
Chalcedony	9	30		31	2	72
Petrified Wood		1		1		2
Fine-Grained Quartzite	11	27	2	11		51
Medium-Grained Quartzite		2				2
Limestone	6	4		3		13
Silicified Limestone		1				1
Obsidian		1		4		5
Basalt	1	1				2
Totals	41	131	5	152	6	335

Table 8.51. LA 75163: Chi-Square Test of Flake Platform Types Versus Common Raw Materials

Platform Morphology	Raw Material	Observed	Expected	Chi-Square	Adj. Residual
Cortical	Chert	14	20	2.04	-2.41
	Chalcedony	9	8	0.14	0.45
	Fine-Grained Quartzite	11	6	5.29	2.67
Single-faceted	Chert	64	73	1.07	-2.13
	Chalcedony	30	28	0.10	0.47
	Fine-Grained Quartzite	27	20	2.59	2.28
Collapsed	Chert	102	87	2.70	3.62
	Chalcedony	31	34	0.22	-0.74
	Fine-Grained Quartzite	11	24	6.73	-3.94
		Chi-Square Value =		20.88	
		Critical Value (.05,4) =		9.49	

Table 8.52. LA 75163: Flake Platform Types by Provenience

Platform Type	Provenience													Totals
	General Site Fill	Feature 107	Feature 109	Feature 110	Feature 112	Feature 114	Feature 119	Feature 129	Feature 137	Feature 138	Feature 139	Feature 141	Feature 144	
Cortical	8	4	2	5	4	2		4	1	2	4	1	4	41
Single-faceted	18	7	6	18	9	5	5	13	3	12	5	3	27	131
Multi-faceted		1						1	1	1			1	5
Collapsed	19	12	2	22	16	6	4	14	2	22	11	1	21	152
Stepped		2							1	2	1			6
Totals	45	26	10	45	29	13	9	32	8	39	21	5	53	335

Most of the flaked stone from LA 75163 lacks dorsal cortex, indicating that most cores were heavily reduced (Table 8.53). Some items of chert, chalcedony, fine-grained quartzite, limestone, and silicified limestone have 25+ percent dorsal cortex, however, indicating that they were locally available raw materials and that initial reduction of those local materials took place at the site. A Chi-Square Test was used to evaluate the null hypothesis that dorsal cortex does not vary by raw material. Materials represented fewer than 15 items were eliminated from the sample. The level of rejection (alpha) was set at 0.05. The results of the analysis are presented in Table 8.54.

The resulting Chi-Square value is 52.49, which exceeds the critical value of 16.92 for 9 degrees of freedom. The null hypothesis is therefore rejected, and I conclude that the amount of dorsal cortex varies by raw material. Analysis of the adjusted residuals indicates that there are more chert flakes without dorsal cortex, more chalcedony flakes with 1–24 percent dorsal cortex, more fine-grained quartzite flakes with 25+ percent dorsal cortex, and more limestone with 1–24 percent and 90+ percent dorsal cortex than expected by chance alone. There are also fewer fine-grained quartzite and limestone flakes without cortex than expected. Taken together, these results indicate that chert was more heavily reduced than the other raw materials; chalcedony, fine-grained quartzite, and limestone were less heavily reduced, in that order. This result is consistent with the conclusions derived from analysis of platform morphology.

Table 8.55 presents frequencies of flakes by dorsal cortex and provenience. Fisher’s Exact Probably Test was used to evaluate the null hypothesis that the distribution of dorsal cortex was the same at each provenience. Features with fewer than 15 flakes were excluded from the analysis. The level of rejection (alpha) was set at 0.05. The resulting p-value is 0.43. The null hypothesis cannot be rejected, indicating that flakes do not vary significantly by dorsal cortex from one provenience to the next.

The data in Table 8.54 indicate that different raw material types correlate with differences in intensity of reduction. However, the lack of differences in amount of dorsal cortex among features suggests that reduction intensity did not differ among the various features. This in turn suggests that within the site, similar strategies were used during the various instances of flaked stone reduction. Table 8.56 shows frequencies of flakes classified using Sullivan and Rozen’s (1985) typology. The most common classes are complete flakes and angular debris, which make up 79 percent of the assemblage. Based on Sullivan and Rozen's (1985:763) analysis, the site assemblage primarily reflects generalized reduction strategies, with limited reliance on bifacial reduction.

However, small flakes (maximum dimension of 3.0 cm or less) are very common (82 percent; Table 8.57) relative to the other sites excavated during the project, and could indicate greater reliance of bifacial reduction (Prentiss 2001). In my opinion the small flakes instead indicate that the intensity of reduction was greater here than at other sites. I will return to this issue presently.

Potential differences in the proportions of flake categories among proveniences was evaluated using Fisher’s Exact Probability Test. The null hypothesis was Sullivan and Rozen’s flake classes are present in the same proportions for each provenience. The level of rejection (alpha) was set at 0.05. The p-value resulting from the test is 0.92. The null hypothesis cannot be rejected; I conclude that each category of flake is present in similar proportions across the site. This in turn suggests that similar strategies (focused on generalized core reduction) were used at each location within the site.

In summary, various lines of evidence indicate that the dominant reduction technique at LA 75159 was generalized core reduction, but that bifacial reduction also took place. Hard hammer percussion was common, as indicated by the large number of crushed platforms. The presence of flakes with 25+ percent dorsal cortex indicates that initial core reduction took place on the site; the analysis further suggests that chert, chalcedony, fine-grained quartzite, limestone, and silicified limestone were locally available. (Obsidian from outside the area was also present.) Differences in

Table 8.53. LA 75163: Dorsal Cortex by Raw Material

Raw Material	Cortex %				Totals
	None	1% to 24%	25% to 89%	90% to 100%	
Chert	256	37	8	14	315
Chalcedony	93	32	4	4	133
Petrified Wood	3	0	0	0	3
Fine-grained Quartzite	58	16	9	13	96
Medium-grained Quartzite	0	2	0	0	2
Limestone	8	7	1	5	21
Silicified Limestone	0	0	0	1	1
Obsidian	6	1	0	0	7
Basalt	1	1	1	0	3
Totals	425	96	23	37	581

Table 8.54. LA 75163: Chi-square Test of Dorsal cortex by Raw Material

Cortex %	Raw Material	Observed	Expected	Chi-Square	Adj. Residuals
None	Chert	256	231	2.62	4.72
	Chalcedony	93	98	0.23	-1.05
	Fine-grained Quartzite	58	71	2.22	-3.17
	Limestone	8	15	3.57	-3.74
1% to 24%	Chert	37	51	3.98	-3.28
	Chalcedony	32	22	4.94	2.78
	Fine-grained Quartzite	16	16	0.01	0.11
	Limestone	7	3	3.75	2.16
25% to 89%	Chert	8	12	1.48	-1.87
	Chalcedony	4	5	0.27	-0.60
	Fine-grained Quartzite	9	4	7.41	3.05
	Limestone	1	1	0.04	0.21
90% to 100%	Chert	14	20	1.84	-2.11
	Chalcedony	4	8	2.36	-1.82
	Fine-grained Quartzite	13	6	7.75	3.16
	Limestone	5	1	10.02	3.33
		Chi-Square Value =		52.49	
		Critical Value (.05,9) =		16.92	

Table 8.55. LA 75159 Flakes by Provenience and Dorsal Cortex

Feature	Dorsal Cortex				Total
	None	1% to 24%	25% to 89%	90% to 100%	
General Site Fill	50	13	3	9	75
Feature 107	33	4	1	3	41
Feature 109	13	3	1	1	18
Feature 110	69	16	3	3	91
Feature 112	40	5	2	3	50
Feature 114	10	7	3	0	20
Feature 119	10	0	0	0	10
Feature 123	0	0	1	0	1
Feature 129	40	11	1	6	58
Feature 137	9	2	1	1	13
Feature 138	47	14	2	3	66
Feature 139	26	4	1	1	32
Feature 141	4	1	0	1	6
Feature 144	74	16	4	6	100
Total	425	96	23	37	581

Table 8.56. LA 75163: Flakes Classes by Raw Material

Raw Material	Complete	Distal	Proximal	Angular Debris	Total
Chert	177	52	19	69	317
Chalcedony	74	19	13	27	133
Petrified Wood	1	1	1	0	3
Fine-grained Quartzite	51	7	3	35	96
Medium-grained Quartzite	0	1	1	0	2
Limestone	10	3	3	5	21
Silicified Limestone	1	0	0	0	1
Obsidian	5	1	0	1	7
Basalt	2	1	0	0	3
Total	321	85	40	137	583

Table 8.57 LA 75163: Flakes Sorted by Size and Morphology

Size Grade	Sullivan and Rozen classes				Total
	Complete	Distal	Proximal	Angular Debris	
1 cm or less	68	21	9	37	135
1.1 to 2.0 cm	177	56	21	90	344
2.1 to 3.0 cm	43	5	10	9	67
3.1 to 4.0 cm	19	3		1	23
4.1 to 5.0 cm	10				10
5.1 to 6.0 cm	4				4
Total	321	85	40	137	583

dorsal cortex and platform morphology indicate that chert was more heavily reduced the other locally available materials.

Cultural and Temporal Affiliations

Six features could be dated using radiocarbon dating and diagnostic artifacts (Table 8.58). All of the features were hearths or roasting pits. Five of the features date to the Jornada Mogollon occupation; one contained Late Archaic materials, but only seven flaked stone artifacts. Given the lack of obvious temporal differences among most of the features, the assemblage is most useful for defining behavioral patterns attributable to the Jornada Mogollon occupation of the area.

Table 8.58. LA 75163: Features With Inferred Ages

Feature	Temporal Affiliation
Feature 112/113	Early 18 Mile phase (A.D. 750–850) Late 18 Mile phase (A.D. 850–1000) Mesita Negra phase (A.D. 1000–1200)
Feature 137	Early 18 Mile phase (A.D. 750–850) Late 18 Mile phase (A.D. 850–1000) Mesita Negra phase (A.D. 1000-1200)
Feature 138	Early 18 Mile phase (A.D. 750-850) Late 18 Mile phase (A.D. 850-950)
Feature 139	Early 18 Mile phase (A.D. 750-850) Late 18 Mile phase (A.D. 850-1000) Mesita Negra Phase (A.D. 1000-1200)
Feature 141	Late Archaic period (1800 B.C.–A.D. 750)
Feature 144	Early 18 Mile phase (A.D. 750–850) Late 18 Mile phase (A.D. 850–1000) Mesita Negra Phase (A.D. 1000–1200)

Previous analysis indicated that there are no differences in the proportions of raw materials among proveniences. The null hypothesis that this would hold true among features of known ages was evaluated using Fisher's Exact Probability Test. The level of rejection (alpha) was set at 0.05. The p-value resulting from the test is 0.62. The null hypothesis cannot be rejected. I conclude that raw material choice did not vary significantly among the dated features.

Differences in flake size evident in the assemblages from the other sites are not evident in the LA 75159 assemblage (Table 8.59). As with the other sites, I collapsed the size categories into "small flakes" (maximum dimensions of 2.0 cm or less) and "large flakes" (maximum dimensions greater than 2.0 cm). Fisher's Exact Probability Test was used to determine whether differences in the frequencies are statistically significant. The null hypothesis for the test is that the relative frequencies of small and large flakes are equal within the six features. The level of rejection (alpha) is set at 0.05, and the resulting p-value is 0.112, which is greater than 0.05. I cannot reject the null hypothesis and conclude that the six features do not have statistically different proportions of small and large flakes.

This conclusion is at odds with the analyses of the previous site, for which size differences were evident. As was previously discussed, however, the differences were time-sensitive, with Archaic period remains characterized by flakes with longer maximum dimensions than Jornada Mogollon flakes. The current analysis involves only seven Archaic period flakes versus 248 Jornada Mogollon flakes. Nor are differences apparent in the relative frequencies of flake classes as defined by Sullivan and Rozen (Table 8.60). Fisher's Exact Probability Test was used to evaluate the null hypothesis that there are no such differences. The level of rejection (alpha) was 0.05. The p-value resulting from the test is 0.848. I cannot reject the null hypothesis. Taken together, the lack of variation in flake morphology, length, and raw material indicates consistency in material selection and reduction for the Jornada component of LA 75163.

Table 8.59. LA 75163: Small and Large Flakes by Dated Feature

Feature	Flake Size		Total
	2.0 cm or less	Greater than 2 cm	
Feature 112	44	6	50
Feature 138	57	9	66
Feature 139	22	10	32
Feature 141	5	2	7
Feature 144	86	14	100
Total	214	41	255

Table 8.60. LA 75163: Flake Classes by Dated Proveniences

Feature	Sullivan and Rozen's classes				Total
	Complete	Distal	Proximal	Angular Debris	
Feature 112	28	8	3	11	50
Feature 138	37	10	5	14	66
Feature 139	22	3	2	5	32
Feature 141	5	1	1		7
Feature 144	49	16	7	28	100
Total	141	38	18	58	255

Summary

The assemblage from LA 75163 reflects a strategy focused on intensive but generalized core reduction, with limited bifacial core reduction. Except for seven obsidian flakes, the raw materials were locally available, and reduction most likely began on the site. Raw material selection did not differ among features. Chert was more intensively reduced than other local materials, as shown by the near-lack of platform and dorsal cortex as well as by the small size of most chert flakes. Fine-grained quartzite and limestone were the least reduced materials. Examination of raw material choice and the technique and the intensity of reduction did not demonstrate any differences within the assemblage.

Lithic Reduction in the Pecos River Valley Northeast of Roswell

The preceding analysis bears on three issues raised in the research design: (1) exchange and trade; (2) subsistence and resource exploitation; and (3) chronology.

Exchange and Trade

Most of the lithic raw material used at LA 2713, LA 75159, and LA 75163 appears to be local. The exceptions include obsidian from an unknown source or sources and Edwards Plateau chert (Table 8.61). These exotic materials are present in both Archaic and Jornada Mogollon contexts (Table 8.62). The exotic materials could have been obtained directly during rather large seasonal rounds; if so, seasonal rounds during the Jornada Mogollon occupation possibly remained comparable to those of the Archaic period. The materials could also have been obtained through trade, however, during the Archaic period as well as during the Jornada Mogollon occupation.

Table 8.61. Frequencies of Lithic Raw Materials, LA 2713, LA 75159, and LA 75163

Raw Material	Site			Total
	2713	**75159**	**75163**	
Chert	70	322	317	709
Chert - Edwards Plateau	0	12	0	12
Chalcedony	24	70	133	227
Petrified Wood	0	5	3	8
Fine-grained Quartzite	58	228	96	382
Medium-grained Quartzite	0	4	2	6
Limestone	6	8	21	35
Silicified Limestone	0	2	1	3
Obsidian	1	7	7	15
Basalt	0	1	3	4
Rhyolite	0	1	0	1
Sandstone	1	2	0	3
Total	160	662	583	1405

Table 8.62. Raw Material Selection Through Time

Raw Material	Period			Total
	Middle to Late Archaic	**Late Archaic**	**Jornada Mogollon**	
Chert	26	67	347	440
Chert - Edwards Plateau	0	3	5	8
Chalcedony	2	17	116	135
Petrified Wood	0	1	3	4
Fine-grained Quartzite	32	59	154	245
Medium-grained Quartzite	0	0	4	4
Limestone	1	2	9	12
Silicified Limestone	1	0	2	3
Obsidian	1	1	9	11
Basalt	0	0	2	2
Rhyolite	1	0	0	1
Sandstone	0	2	0	2
Total	64	152	651	867

Subsistence and Resource Exploitation

The flaked stone artifacts provide little insight into subsistence. The projectile points indicate that animals were hunted using atlatls and, later, bows, which is consistent with the animal bones with evidence for butchering. Tools such as scrapers reflect hide processing.

Better subsistence information can be gained from the ground stone assemblages from LA 75159 and LA 75163. Slab metates and one-handed manos were recovered from these sites. Hard et al. (1996) and Adams (1999) suggest that such tools were most frequently used to grind small amounts of seeds and kernels, especially from wild plants. In contrast, trough and basin metates used with two-hand manos were better at grinding large amounts of flour from domesticates such as maize. The morphology of the recovered ground stone suggests that its occupants used only locally available wild plant foods.

The combined flaked stone and ground stone data therefore indicate a generalized foraging strategy focusing on wild foods, rather than a specialized strategy (focused on domesticates, for example, or on a single species of game).

Flaked stone reduction strategies and exploitation of raw materials do not appear to differ significantly among the sites or through time. Table 8.63 presents the frequencies of Sullivan and Rozen's flake types by dated proveniences. The null hypothesis, that percentages of the flake types were similar through time, was subjected to a Chi-square Test. The level of rejection (alpha) for the test was 0.05. The resulting p-value was 0.58, which is greater than 0.05. I cannot reject the null hypothesis and I conclude that similar proportions of each flake class are present in the combined Archaic period assemblages versus the combined Jornada Mogollon assemblages.

Table 8.63. Flake Classes by Occupation

Flake Class	Occupation		Total
	Archaic	Mogollon	
Complete	110	310	420
Distal	30	110	140
Proximal	25	88	113
Angular Debris	46	128	174
Total	211	636	847

I further conclude that similar reduction techniques were used through time. Comparison of the proportions of flake classes to experimentally derived assemblages reported by Sullivan and Rozen (1985) and Prentiss (2001) indicates that the dominant reduction technique was generalized core reduction (though limited bifacial reduction also occurred).

Table 8.64 presents the frequencies of flake classes sorted by time and site. Using these data, I evaluated the null hypothesis that by period, reduction was uniform at each site. The level of rejection (alpha) was 0.05. For the Archaic period assemblages, the resulting p-value is 0.89, which is greater than 0.05. As a result, I cannot reject the null hypothesis for the Archaic period. I conclude that similar reduction strategies were used at all three sites during the Archaic period.

A Chi-square Test was used to examine the same frequencies for the Jornada Mogollon occupation (Table 8.65). The resulting Chi-square value is 38.66, which greatly exceeds the critical value of 12.59 for 6 degrees of freedom ($p<.001$). As a result, I reject the null hypothesis and conclude that there is variation within Jornada Mogollon period reduction at the three sites. Analysis of the adjusted residuals indicates that LA 2713 and 75163 produced more complete flakes and LA 75159 more proximal flakes than expected by chance. LA 2713 produced fewer distal flakes, LA 75159 produced fewer complete flakes, and LA 75163 produced fewer proximal flakes than expected.

Based on frequencies of complete flakes, more bifacial reduction probably took place at LA 75159 than at the other two sites. For all three Jornada Mogollon components, however, reduction strategies were a mix of generalized and bifacial reduction.

It is possible that the variation in the Jornada Mogollon assemblage is tied to changing reduction strategies during the Ceramic period. Table 8.66 presents the frequencies of flake classes by phase for the Mogollon period occupation. A Chi-Square Test was used to evaluate the null hypothesis that the proportions of flake classes were the same for features dated to various phases of the Jornada Mogollon occupation. Flakes from indeterminate Mogollon occupations are excluded from the analysis. In addition, the nine flakes dated to the Late 18 Mile phase/Mesita Negra phase were excluded due to small sample size. The level of rejection (alpha) was set at 0.05. The resulting p-value is 0.23. I cannot reject the null hypothesis, and I conclude that the differences in Table 8.65

Table 8.64. Flake Classes by Occupation and Site

Occupation	Flake Class	LA #			Total
		2713	**75159**	**75163**	
Archaic	Complete	12	93	5	110
	Distal	3	26	1	30
	Proximal	3	21	1	25
	Angular Debris	6	40		46
	Total	24	180	7	211
Jornada Mogollon	Complete	21	144	145	310
	Distal	1	69	40	110
	Proximal	1	70	17	88
	Angular Debris	6	63	59	128
	Total	29	346	261	636

Table 8.65. Chi-square Test of Jornada Mogollon Flake Classes by Site

Site	Flake Class	Observed	Expected	Chi-square	Adj. Residuals
LA 2713	Complete	21	14	3.33	2.61
	Distal	1	5	3.22	-2.02
	Proximal	1	4	2.26	-1.66
	Angular Debris	6	6	0.00	0.08
LA 75159	Complete	144	169	3.60	-3.93
	Distal	69	60	1.40	1.93
	Proximal	70	48	10.23	5.10
	Angular Debris	63	70	0.63	-1.32
LA 75163	Complete	145	127	2.49	2.87
	Distal	40	45	0.59	-1.10
	Proximal	17	36	10.12	-4.46
	Angular Debris	59	53	0.80	1.30
		Chi-square Value =		38.66	
		Critical Value (.05,6) =		12.59	

Table 8.66. Ceramic Period Flake Classes by Phase

Phase	Flake Class				Total
	Complete	Distal	Proximal	Angular Debris	
Indeterminate Jornada Mogollon	138	43	28	58	267
Early 18 Mile phase (A.D. 750–900)	37	10	5	14	66
Late 18 Mile/Mesita Negra phases (A.D. 900–1200)	9			3	12
Mesita Negra phase (A.D. 1000–1200)	87	35	34	29	185
Mesita Negra/McKenzie phases (A.D. 1000–1350)	27	17	15	15	74
McKenzie phase (A.D. 1200–1350)	12	5	6	9	32
Total	310	110	88	128	636

are not differences related to technological changes during the Jornada Mogollon occupation of the area. The cause of the differences is unclear, but the heavier emphasis on bifacial reduction at LA 75159 may reflect a greater emphasis on hunting than at other sites; due to game attracted to the spring and pond.

What is clear is that the common conclusion that Archaic period flaked stone was based on curated technology, while Ceramic period flaked stone was based on expedient technology (e.g., Parry and Kelley 1987) does not apply to the study area. Through time, the observed data reflect a focus on generalized core reduction, which is associated with expedient technology. Both Archaic and Ceramic period users of the area were probably highly mobile, so the observed pattern probably has to do with the ubiquity of raw material across the study area and more generally across eastern New Mexico.

Curated technologies were most useful when high-quality raw materials were not readily available, and therefore had be carried from place to place by a mobile population (Binford 1979; Kelley 1988). However, the inhabitants of eastern New Mexico had access to high-quality materials almost anywhere they camped. As a result, there was no real advantage to using a curated reduction strategy when an expedient strategy was just as effective. In other words, even if the local residents were as mobile as supposed during both the Archaic period and the Ceramic period, it was possible to rely on expedient reduction except when formal tools (such as projectile points) were specifically needed or desired.

Despite the similarities in reduction through time, differences in the intensity of reduction could have been present, as reflected in the amount of dorsal cortex on flakes. Tables 8.67 and 8.68 examine this possibility. The null hypothesis (that dorsal cortex did not change through time) was evaluated using a Chi-square Test. The level of rejection (alpha) was set at 0.05. The resulting Chi-square value is 67.44, which exceeds the critical value of 7.81. I reject the null hypothesis and conclude that amount of dorsal cortex on flakes does differ between the Archaic period and the Jornada Mogollon occupation. The adjusted residuals indicate that the Archaic period remains include more flakes with cortex than expected by chance alone; the opposite is true for the Jornada Mogollon occupation. I conclude that the intensity of reduction was less during the Archaic period than during the Jornada Mogollon occupation.

A similar trend is evident in the maximum dimensions of flakes. As was noted during analysis of materials from LA 2713 and LA 75159, Archaic period flakes tend to be longer than Jornada Mogollon flakes. The applicability of this trend across the entire assemblage was evaluated using a Chi-square Test. The null hypothesis was that the maximum dimensions of flakes were similar for the Archaic and the Jornada Mogollon occupations. A distinction between "large"

Table 8.67. Frequencies of Flakes by Occupation and Presence of Dorsal Cortex

Cortex	Occupation		Total
	Archaic	Jornada Mogollon	
None	91	472	563
1% to 24%	69	107	176
25% to 89%	26	27	53
90% to 100%	30	46	76
Total	216	652	868

Table 8.68. Chi-Square Test of Dorsal Cortex Versus Occupation

Period	Cortex	Observed	Expected	Chi-square	Adj. Residuals
Archaic	None	91	140	17.21	-8.07
	1% to 24%	69	44	14.50	4.92
	25% to 89%	26	13	12.44	4.20
	90% to 100%	30	19	6.50	3.08
Jornada Mogollon	None	472	423	5.70	8.07
	1% to 24%	107	132	4.80	-4.92
	25% to 89%	27	40	4.12	-4.20
	90% to 100%	46	57	2.15	-3.08
		Chi-square Value =		67.44	
		Critical Value (.05,3) =		7.81	

(maximum dimension greater than 2.0 cm) and "small" (maximum dimension equal to or less than 2.0 cm) was again used. Units 100 and 101 at LA 75159 were excluded from the analysis because they were screened using quarter-inch mesh, versus the eighth-inch mesh used for the features. The resulting Chi-Square value is 31.74, which exceeds the critical value of 3.84 for 1 degree of freedom (Table 8.69). I reject the null hypothesis and conclude that the Archaic period flakes do tend to be larger than those from the Jornada Mogollon occupation.This conclusion parallels the one based on analysis of the stratified deposits of Units 100 and 101 at LA 75159 (see Table 8.39), as well as the results of the analysis of dorsal cortex. Thus, multiple lines of evidence indicate that along the US 70 study corridor, Jornada Mogollon lithic reduction was more intensive that Archaic period reduction. The reason for this differences is not obvious, however. One potential explanation may be differences in the length individual occupations of a site. Archaic period people may have been more mobile than their Jornada Mogollon counterparts (even if both were highly mobile compared to Ceramic period occupants of other parts of the Southwest), and therefore did not inhabit the sites as long, thus having less time to intensively reduce cores of locally available materials. Another possibility is that the tasks completed by the Jornada Mogollon people required different types of flaked stone tools (formal or otherwise), which resulted in the differences in reduction intensity.

Table 8.69. Chi-Square Test of Flake Size Versus Occupation

Period	Flake Maximum Dimension	Observed	Expected	Chi-Square	Adj. Residuals
Archaic	2.0 cm or less	10	23	7.19	-5.63
	Greater than 2 cm	20	7	22.83	5.63
Jornada Mogollon	2.0 cm or less	412	399	0.41	5.63
	Greater than 2 cm	113	126	1.30	-5.63
		Chi-Square Value =		31.74	
	Critical Value (.05,1) =			3.84	

Chronology

Analysis of lithic materials from three sites can be applied to one of the most difficult problems facing archaeologists working in eastern New Mexico: how can one date apparently non-diagnostic lithic artifact scatters that are ubiquitous to the region? First, differences in flake maximum dimension are striking. For all of the features with known temporal affiliations, screened using eighth-inch mesh (except for Feature 114 at LA 2713), Jornada Mogollon remains contain more small flakes than large flakes (using 2.0 cm as the cutoff; Table 8.70). In contrast, most of the flakes from Feature 104 of LA 2713, a Late Archaic period hearth, are larger that 2.0 cm. (Most of the flakes from Feature 141 of LA 75163, an Archaic period hearth, are 2.0 cm or smaller, but this may be due to a small sample size [n=7]). Based on this empirical pattern, it is possible to hypothesize that assemblages dominated by small flakes are probably from the Jornada Mogollon period, while those dominated by large flakes are from the Archaic period. The pattern does not hold for materials screened using quarter-inch mesh, because many of the small flakes are not trapped in the screen. In fact, most Jornada Mogollon flakes recovered using quarter-inch mesh are large flakes (Table 8.71). Still, the Archaic period remains tend to contain a much greater proportion of large flakes—often more than four times as many large flakes as small ones—while the Jornada Mogollon deposits yielded only about twice as many (Table 8.71). Based on the differences in size, therefore, the ratio of small to large flakes may be temporally diagnostic regardless of the size of the screen (Table 8.72). Assemblages screened with eighth-inch or quarter-inch mesh that contain more than three times as many large flakes as small flakes probably date to the Archaic period; all of the assemblages in the current sample that fit this criterion are from that period. Assemblages that contain more small flakes than large flakes probably date to the Jornada Mogollon occupation; eight of nine such assemblages within the current sample date to that occupation. Assemblages that are more than half large flakes but fewer than three times the number could date to either occupation; in the current sample, three of the proveniences are from the Jornada Mogollon occupation and two are from the Archaic period.

The indicators presented here and summarized in Table 8.72 are, of course, based on a statistical argument. There will undoubtedly be assemblages (such as Feature 141from LA 75163) that do not follow the pattern, but the differences in flake maximum dimension provides a means of determining a probable date when other avenues are not available. However, this approach will only be useful when dealing with materials that are screened, and hence recovered during excavation. A flaked stone analysis conducted as part of a general pedestrian survey will necessarily be biased towards large flakes because of their increased visibility. Furthermore, the patterns outlined above will likely be most applicable to materials screened through eighth-inch mesh, because of the increased likelihood that small flakes will be recovered instead of falling through the screen.

Table 8.70. Flake Size by Dated Provenience (Fill Screened Through Eight-Inch Mesh)

Occupation	Provenience	Flake Maximum Dimension	
		2.0 cm or less	Greater than 2 cm
Late Archaic	LA 2713, Feature 104	5	19
	LA 75163, Feature 141	5	2
	Total	10	21
Jornada Mogollon	LA 2713, Feature 100	14	3
	LA 2713, Feature 114	5	7
	LA 75159, Feature 100	136	34
	LA 75159, Feature 102	40	30
	LA 75163, Features 112/123	44	6
	LA 75163, Feature 137	8	5
	LA 75163, Feature 138	57	9
	LA 75163, Feature 139	22	10
	LA 75163, Feature 144	86	14
	Total	412	118

Table 8.71. Flake Size by Dated Provenience (Fill Screened Through Quarter-Inch Mesh)

Indicator	Number of Jornada Period Assemblages	Number of Archaic Period Assemblages
Number of large flakes more than three times the number of small flakes	0	3
Small flakes outnumber large flakes	8	1
Large flakes are more than half of assemblage but not more than three times the number of small flakes	3	2

Table 8.72. Possible Chronological Indicators for Flake Assemblages

Indicator	Number of Jornada Period Assemblages	Number of Archaic Period Assemblages
Number of large flakes more than three times the number of small flakes	0	3
Small flakes outnumber large flakes	8	1
Large flakes are more than half of assemblage but not more than three times the number of small flakes	3	2

An additional avenue for determining an assemblage's chronological affiliation is through the amount of dorsal cortex on flakes. As is shown in Table 8.73, the project's Jornada Mogollon assemblages tend to contain more flakes without cortex, while those from the Archaic period tend to contain more flakes with some cortex. In fact, 73 percent of the flakes assigned to the Jornada Mogollon occupation were free of cortex, compared to 42 percent of the Archaic period flakes. It may thus be possible to differentiate between Archaic and Jornada Mogollon period materials using the generalization that less than half of Jornada Mogollon flakes will lack dorsal cortex, while more than half of Archaic period flakes will have some dorsal cortex.

Table 8.73. Flake Dorsal Cortex by Occupation

Occupation	Cortex				Total
	None	1% to 24%	25% to 89%	90% to 100%	
Archaic	91	69	26	30	216
Jornada Mogollon	472	107	27	45	651
Total	563	176	53	75	867

The hypothesis that the percentage of dorsal cortex reflects an assemblage's age was evaluated in Table 8.74. Applying the rule that Jornada Mogollon assemblages contain more than half non-cortical flakes, while Archaic period assemblages contain more than half cortical flakes, 16 of the 18 assemblages would have been assigned to the correct occupation. Two of the Archaic period assemblages would have been incorrectly dated to the Jornada Mogollon occupation, however. While not perfect, this approach does provide a second line of evidence on the age of otherwise non-diagnostic materials. This rule further appears to be applicable regardless of whether eighth-inch or quarter-inch mesh is used.

During survey, the use of dorsal cortex for dating sites or concentrations is likely to be more problematic, because the amount of cortex on a flake's surface correlates to some degree with the size of the flake. For example, initial reduction flakes will tend to be large, because the core itself is large, and will have a large amount of cortex. Flakes from the same core but without cortex will be smaller, because the core must be partly reduced to eliminate cortex. A Chi-square Test was therefore used to determine whether cortex is associated with larger flakes. The null hypothesis was that the same proportions of large and small flakes have some cortex on their dorsal surfaces.

The level of rejection (alpha) was set at 0.05. The resulting Chi-Square Value is 264.59, which exceeds the critical value of 3.84 (Table 8.75). Small flakes do in fact tend to have no dorsal cortex, while larger flakes tend to have some cortex on their dorsal surfaces.

Given that larger flakes will be more visible during site recording, it is likely that cortical flakes will also be more readily visible, and therefore over-represented in any tally. As a result, dating assemblages based on in-field tallies may be misleading. One way to address this problem would to increase the percentage of cortical flakes used to distinguish Jornada Mogollon and Archaic period assemblages, to 60 percent (i.e., assemblages with 60 percent or more cortical flakes date to the Archaic period, while those with fewer than 60 percent cortical flakes are from the Jornada Mogollon occupation). The potential utility of this "fudge factor" can be evaluated using the assemblages from dated contexts. In Table 8.76, the exclusion of small flakes parallels the bias toward large flakes during in-field analysis. Twelve of the 18 assemblages were assigned to the correct occupation; two Archaic period and four Jornada Mogollon assemblages were classified improperly. Although "two out of three" is less than ideal, it is better than would be obtained by chance alone, and therefore does provide a clue to evaluate the age of an assemblage—not the only clue used, I hope.

Table 8.74. Flake Dorsal Cortex by Dated Context, as a Predictor of Assemblage Age

Occupation	Provenience	Cortex				Correct?
		None		Some		
		Count	%	Count	%	
Archaic	LA 2713, Feature 104	2	8	22	92	yes
	LA 75159, Unit 100, Stratum 5	11	41	16	59	yes
	LA 75159, Unit 100, Stratum 6	40	43	52	57	yes
	LA 75159, Unit 100, Stratum 7	33	52	31	48	no
	LA 75159, Unit 101, Level 5	0	0	2	100	yes
	LA 75163, Feature 141	5	71	2	29	no
	Total	91	42	125	58	
Jornada Mogollon	LA 2713, Feature 100	10	59	7	41	yes
	LA 2713, Feature 114	6	50	6	50	yes
	LA 75157, Unit 100, Stratum 3	22	59	15	41	yes
	LA 75159, Unit 100, Stratum 4	3	75	1	25	yes
	LA 75159, Unit 101, Levels 1 & 2	42	53	38	48	yes
	LA 75159, Feature 100	142	84	28	16	yes
	LA 75159, Feature 102	51	73	19	27	yes
	LA 75163, Features 112/123	40	80	10	20	yes
	LA 75163, Feature 137	9	69	4	31	yes
	LA 75163, Feature 138	47	71	19	29	yes
	LA 75163, Feature 139	26	81	6	19	yes
	LA 75163, Feature 144	74	74	26	26	yes
	Total	472	73	179	27	

Table 8.75. Chi-Square Test of Cortex Versus Flake Size

Size	Cortex	Observed	Expected	Chi-square	Adj. Residuals
Small	None	695	553	36.52	16.27
	Some	154	296	68.19	-16.27
Large	None	220	362	55.76	-16.27
	Some	336	194	104.12	16.27
		Chi-square Value =		264.59	
		Critical Value (.05,1) =		3.84	

The time-sensitive differences discussed above are related to differences in the intensity of core reduction. Using attributes such as flake size and percent of dorsal cortex, differences in reduction can be tied to the appropriate period of occupation. However, this approach has the same weakness as all inductively derived patterns: it applies to the samples considered in this analysis but may be less applicable to assemblages from other areas. As a result, future workers will need to further evaluate these generalizations with dated materials from other sites. As a final comment, the rules can be applied to screened materials with greater confidence, so they may be useful during testing even when problematic during survey.

Dating Non-diagnostic Assemblages from LA 2713, LA 75159, and LA 75163

The two rules outlined above can be used to tentatively date proveniences with non-diagnostic assemblages. The frequencies of small and large flakes and of cortical and non-cortical flakes from these proveniences are shown in Tables 8.77 and 8.78, along with the likely occupation. The conclusions based on each approach are in agreement for 13 out of 15 of the undated proveniences represented by more than a couple of flakes. Only two of the proveniences (Strata 1 and 2 of Unit 100 at LA 75159, probably highly disturbed; Feature 114 at LA 75163) produced inconsistent results and therefore cannot be assigned to either occupation. Given the high degree of consistency achieved, future projects may be able to provide tentative cultural and chronological assignments to proveniences for which direct dating or artifact cross-dating is not possible.

Table 8.76. Test of the "60 Percent" Rule for Dorsal Cortex

Period	Provenience	Cortex				Correct?
		None		Some		
		Count	%	Count	%	
Archaic	LA 2713, Feature 104	1	5	18	95	yes
	LA 75159, Unit 100, Stratum 5	7	32	15	68	yes
	LA 75159, Unit 100, Stratum 6	36	41	51	59	no
	LA 75159, Unit 100, Stratum 7	17	40	26	60	yes
	LA 75159, Unit 101, Level 5	0	0	2	100	yes
	LA 75163, Feature 141	1	50	1	50	no
Jornada Mogollon	LA 2713, Feature 100	1	33	2	67	no
	LA 2713, Feature 114	3	43	4	57	yes
	LA 75157, Unit 100, Stratum 3	12	48	13	52	yes
	LA 75159, Unit 100, Stratum 4	3	75	1	25	yes
	LA 75159, Unit 101, Levels 1 & 2	19	41	27	59	yes
	LA 75159, Feature 100	18	53	16	47	yes
	LA 75159, Feature 102	15	50	15	50	yes
	LA 75163, Features 112/123	3	50	3	50	yes
	LA 75163, Feature 137	2	40	3	60	no
	LA 75163, Feature 138	3	33	6	67	no
	LA 75163, Feature 139	6	60	4	40	yes
	LA 75163, Feature 144	5	36	9	64	no

Table 8.77. Tentative Affiliations of Undated Proveniences, Based on Dorsal Cortex

LA No.	Provenience	Cortex				Affiliation
		None		Some		
		Count	%	Count	%	
2713	General Site Fill	43	86	7	14	Mogollon
	Feature 105	3	37	5	63	Archaic
	Feature 106	22	46	26	54	Archaic
75159	General Site Fill	26	49	27	51	Archaic
	Unit 100 - Strata 1 and 2	12	71	5	29	Mogollon
	Unit 101 - Strata 3 and 4	3	30	7	70	Archaic
	Unit 102 - Pond Deposits	10	43	13	57	Archaic
	Feature 101	5	45	6	55	Archaic
	Feature 107	2	100	0	0	?
75163	General Site Fill	51	67	25	33	Mogollon
	Feature 107	33	80	8	20	Mogollon
	Feature 109	13	72	5	28	Mogollon
	Feature 110	69	76	22	24	Mogollon
	Feature 114	10	50	10	50	Archaic
	Feature 119	10	100	0	0	Mogollon
	Feature 123	0	0	1	100	?
	Feature 129	40	69	18	31	Mogollon

Table 8.78. Tentative Affiliations of Undated Proveniences, Based on Flake Size

LA No.	Provenience	Size				Mesh Size	Occupation
		Small		Large			
		Count	%	Count	%		
2713	General Site Fill	39	78	11	22	Various	Mogollon
	Feature 105	2	25	6	75	1/8 inch	Archaic
	Feature 106	21	44	27	56	1/8 inch	Archaic
75159	General Site Fill	13	25	40	75	Various	Archaic
	Unit 100 – Strata 1 and 2	5	29	12	71	1/4 inch	Archaic
	Unit 101 – Strata 3 and 4	2	20	8	80	1/4 inch	Archaic
	Unit 102 - Pond Deposits	9	39	14	61	1/4 inch	Archaic
	Feature 101	0	0	11	100	1/8 inch	Archaic
	Feature 107	2	100	0	0	1/8 inch	?
75163	General Site Fill	48	63	28	37	Various	Mogollon
	Feature 107	39	95	2	5	1/8 inch	Mogollon
	Feature 109	16	89	2	11	1/8 inch	Mogollon
	Feature 110	82	90	9	10	1/8 inch	Mogollon
	Feature 114	17	85	3	15	1/8 inch	Mogollon
	Feature 119	8	80	2	20	1/8 inch	Mogollon
	Feature 123	1	100	0	0	1/8 inch	?
	Feature 129	46	79	12	21	1/8 inch	Mogollon

ANALYSIS OF POTTERY

Based on the issues identified in Chapter 2, ceramic analysis focused on three questions:

- What differences, if any, are present in pottery production and use between components/isolated episodes within each site?
- What are the differences in pottery consumption and production between the sites?
- Is the pottery acquired through trade or is it produced by the inhabitants of each site?

Methods and Definitions

Only sherds larger than a quarter were analyzed, because smaller sherds are difficult to type and probably do not reflect variation in paste and surface treatment. Analysis was therefore restricted to 46 sherds from the three sites that yielded pottery (Table 8.79).

Each sherd was analyzed separately and given an individual identification number, which was recorded along with the sherd's provenience information. The sherds were assigned to defined cultural-historical types when possible, and a binocular microscope (20x) was used to examine paste, slip, temper, and paint attributes. The specific attributes measures were:

- Temper type; included fine-grained quartzite, medium-grained quartzite, and ground sherds (grog).
- Presence and color of slip (white was the only slip color present).
- Presence and type of surface treatment. Five were identified: corrugated, painted, polished, smoothed, and both painted and polished.
- Type of paint, when present (only mineral paints were observed).
- Vessel shape (bowls and jars were the only vessel shapes identified).
- Vessel portion (body, neck, and rim sherds were identified).

Table 8.79. Frequencies of Ceramic Types From Each Site

LA No.	Type						Total
	El Paso Brown Ware	Jornada Brown Ware	Cord-marked Plainware	Chupadero B/w	Lincoln B/w	Pueblo Polychrome	
2713			2	2	2		6
75159	5	14	2	7		1	29
75163	1	11					12
Total	6	25	4	9	2	1	46

Cultural-historical types were identified using the attributes in Mills (1988:163–168), McKenna and Miles (1989), and the Human Systems Research Technical Manual for the Tularosa Basin (HSR 1973). Three cultural-historical types dominated the assemblage: Jornada Brown Ware, El Paso Brown Ware, and Chupadero Black-on-white. A sherd of an unidentified Pueblo polychrome was also found.

El Paso Brown Ware is common in a region bounded to the north by Kenna, New Mexico; to the south by Villa Ahumada, Chihuahua; to the east by the New Mexico-Texas border; and to the west by the Arizona-New Mexico border. El Paso Brown Ware often has crushed limestone and quartz temper and soft, friable paste. The temper is frequently exposed on the pottery’s surface, which is unslipped. Surfaces are generally not polished, though they are smoothed to obliterate the coils used to form the vessels. El Paso Brown Ware was produced from A.D. 200 to as late as A.D. 1350.

Jornada Brown Ware is distributed across much the same area as El Paso Brown Ware. It is distinguished from El Paso Brown Ware by greater

surface treatment. Both the interior and exterior surfaces are generally partly polished to highly polished, and temper is rarely visible on the vessel surfaces.

Chupadero Black-on-white is common from Torrance County and Socorro County to the north into Chihuahua, Mexico to the south. It is also found as a trade ware in much of the Rio Grande Valley and eastern New Mexico. Its paste is generally well-fired and gray, and tempered using crushed sherds and igneous stone. The decorated surface is generally polished, slipped with a white slip, and decorated with black, mineral-based paint. Unpainted surfaces can be polished or scored. It is generally considered to have been made between A.D. 1150 and 1550.

Lincoln Black-on-red was made around Nogal and Hondo, New Mexico, and across the Tularosa Basin. It is found as a trade ware south to El Paso and across southeastern New Mexico. Lincoln Black-on-red is typically well-fired with a red to terra cotta paste. The surface is highly polished, but slips are uncommon. Temper varies but is often medium-grained sand. Lincoln Black-on-red was made from A.D. 1300 to 1350.

Results of Pottery Analysis

The assemblage from LA 2713 is quite small, but includes Chupadero Black-on-white and Lincoln Black-on-white, as well as a cord-marked plainware sherd. The Chupadero Black-on-white sherds were recovered from the general fill but two sherds of Lincoln Black-on-red were recovered from hearths (Features 100 and 113; Table 8.80), indicating that the hearths date to the McKenzie Phase. The Chupadero Black-on-white sherds and the Lincoln Black-on-red sherd from Feature 100 were from jars; the Lincoln Black-on-red sherd from Feature 113 was from a bowl (Table 8.81).

The assemblage from LA 75159 is much larger than the other assemblages. It is dominated by Jornada Brown Ware but also contains El Paso Brown Wares and Chupadero Black-on-white, as well as a few cord-marked plainware sherds. The Chupadero Black-on-white was found with Jornada Brown Ware (Feature 100) and with El Paso Brown Ware (Unit 101), suggesting that the associated materials date between A.D. 1050 and 1200 or 1300 (the Mesita Negra and McKenzie phases).

The Jornada Brown Ware is tempered with fine quartzite grains, the El Paso Brown Ware with medium-sized quartzite grains, and the Chupadero Black-on-white with ground sherds (Table 8.80). The vessel morphology of most sherds could not be determined, but at least nine sherds are from jars and four are from bowls (Table 8.81).

The assemblage from LA 75163 contains 11 Jornada Brown Ware sherds and one El Paso Brown Ware sherd. This assemblage may be from the early portion of the Ceramic period, given the lack of decorated wares. All of the sherds from the site have fine quartzite temper (Table 8.80). Both bowls and jars are represented (Table 8.81).

Ten sherds were submitted for petrographic analysis: the two cord-marked sherds from LA 2713, four Chupadero Black-on-white sherds from LA 75159, and four Chupadero Black-on-white sherds collected from the surface of LA 127511 during testing (Appendix A). Unfortunately, the petrographic analysis did not provide any firm conclusions concerning the origin of the pottery.

Pottery Use in the Middle Pecos River Valley

The limited ceramic assemblage precludes a detailed analysis of differences in pottery use and consumption among the sites. It also prevents the use of techniques such as seriation to develop a better understanding of temporal distributions of various pottery types in eastern New Mexico. Instead, what is clear from the analysis is that the inhabitants of LA 2713, LA 75159, and LA 75163 did not leave much pottery at the excavated features. Crown and Wills (1995) have argued that Southwestern pottery was made and used in contexts where semi-sedentary or fully sedentary people were storing significant quantities of seeds and kernels of plants such as maize. The apparently limited use of pottery by the inhabitants of the US

Table 8.80. Provenience, Type, and Temper of Analyzed Sherds

LA Number	Provenience	Temper	Type						Total
			El Paso Brown Ware	Jornada Brown Ware	Cord-marked plainware	Chupadero B/w	Lincoln B/w	Pueblo polychrome	
2713	General Site Fill	Sherd and Sand			1				1
		Sherd				2			2
	Feature 100	Sherd and Sand					1		1
	Feature 106	Sherd and Sand			1				1
	Feature 113	Sherd and Sand					1		1
75159	General Site Fill	Fine Quartzite Grains		3					3
		Sherd and Sand						1	1
	Feature 100	Fine Quartzite Grains		8					8
		Sherd				2			2
	Unit 100	Fine Quartzite Grains		1					1
		Medium Quartzite Grains	1						1
	Unit 101	Medium Quartzite Grains	4						4
		Sherd and Sand			1				1
		Sherd				5			5
	Feature 102	Fine Quartzite Grains		2					2
		Sherd and Sand			1				1
75163	General Site Fill	Fine Quartzite Grains		3					3
	Feature 137	Fine Quartzite Grains		1					1
	Feature 138	Fine Quartzite Grains	1	6					7
	Feature 144	Fine Quartzite Grains		1					1

Table 8.81. Provenience, Type, and Temper of Analyzed Sherds

LA No.	Feature	Type	Shape			Total
			Bowl	Jar	Unknown	
2713	General Site Fill	Cord marked plainware			1	1
		Chupadero B/w		2		2
	Feature 100	Lincoln B/w		1		1
	Feature 106	cord-marked plainware			1	1
	Feature 113	Lincoln B/w	1			1
	Total		1	3	2	6
75159	General Site Fill	Jornada Brown Ware	1		2	3
		Pueblo polychrome	1			1
	Feature 100	Jornada Brown Ware		2	6	8
		Chupadero B/w			2	2
	Unit 100	El Paso Brown Ware		1		1
		Jornada Brown Ware			1	1
	Unit 101	El Paso Brown Ware	1	2	1	4
		Cord-marked plainware			1	1
		Chupadero B/w	1	4		5
	Feature 102	Jornada Brown Ware			2	2
		cord-marked plainware			1	1
	Total		4	9	16	29
75163	General Site Fill	Jornada Brown Ware		1	2	3
	Feature 137	Jornada Brown Ware	1			1
	Feature 138	El Paso Brown Ware	1			1
		Jornada Brown Ware	3	2	1	6
	Feature 144	Jornada Brown Ware	1			1
	Total		6	3	3	12

70 sites suggests that those inhabitants were fairly mobile and did not rely on stored domesticates, at least when staying at these sites. It is of course possible that the sites are special use locations that do not reflect the full range of activities by the sites' inhabitants, and thus may not reflect the full extent of their use of pottery.

No firm evidence was found regarding where the pottery was made, but it is probable that the Lincoln Black-on-red and the Chupadero Black-on-white were produced elsewhere (perhaps in the Sacramento Mountains), because the sites lie outside of the known region of production. Their presence may thus reflect contact between the people living in the study area and those living in the mountains to the west.

The analysis also identified a few examples of cord-marked sherds, which in eastern New Mexico are assumed to be Plains Woodland pottery rather than Southwestern pottery. This pottery indicates that the US 70 project area also ties to the Plains as well as to areas to the west; whether these inter-regional ties involved trade, travel by local groups, or both, remains unclear, but is an important topic for future research.

Chapter 9

LA 75159 ARCHAEOFAUNAL ANALYSIS

Marie E. Brown

Vertebrate faunal remains, consisting of 956 specimens, were recovered from two sites during the US 70 data recovery project. The assemblage from LA 75159 (n=931) is the larger of the two (Table 9.1). Most of this assemblage is associated with the Late Archaic and Formative components. The assemblage from Boaz (LA 127502) (n=25) is associated with the early 1900s occupation of the town, and is described in the second volume of this report.

Table 9.1. Archaeofaunal Assemblages From LA 75159

Taxon	NISP
Terrapene ornata (Western Box Turtle)	97
Colubridae (Colubrid Snakes)	1
Sylvilagus audubonii (Desert Cottontail)	8
Lepus californicus (Black-tailed Jackrabbit)	8
Rodentia (Rodents)	1
Cynomys ludovicianus (Black-tailed Prairie Dog)	3
Carnivora (Carnivores)	1
Canis sp. (Dog, Coyote, Wolf)	3
Artiodactyla (Even-toed Ungulates)	10
Antilocapra americana (Pronghorn)	6
Odocoileus/Antilocapra americana (Deer/Pronghorn)	1
Bison bison (Bison)	64
Bos taurus (Cattle)	1
Bison/Bos (Bison/Cattle)	16
Indeterminate very small mammal (rat-size or smaller)	10
Indeterminate small mammal (rabbit-size)	60
Indeterminate medium mammal (coyote-size)	12
Indeterminate large mammal (pronghorn-size)	98
Indeterminate very large mammal (bison-size)	531
Total	931

METHODS

All of the recovered vertebrate faunal remains were examined for the analysis. In order to improve identifications and processing information, refits were determined and fresh breaks were noted and occasionally mended. In addition, all freshly broken fragments from the same bone in a single provenience (FS) were counted as one specimen—a complete bone or tooth or a fragment thereof. These procedures reduced the initial size of the assemblage. The method of recording was number of individual specimens (NISP) rather than minimum number of individuals (MNI). Basic attributes recorded for each specimen were taxon, element, laterality, fragmentation and portion, weathering, burning, gnawing, and butchery evidence. Identifications of taxon, element, laterality, and portion were determined primarily with the aid of comparative specimens in the possession of the faunal analyst. Occasionally, published osteological references, such as Balkwill and Cumbaa (1992) and Olsen (1964), were consulted.

Taxonomic identifications were made to the lowest level of specificity (e.g., order, family, genus, species) warranted by each specimen. Many specimens were identified only to a size category (e.g., small mammal, large mammal). For mammals, very small mammals are rat-size or smaller, small are rabbit-size, medium are coyote-size, large are pronghorn-size, and very large are bison/cattle-size. The placement of a specimen into an animal size category was somewhat subjective, based pri-

marily on the thickness of the compact (cortical) bone, the size of the specimen, and the possible element represented. In several instances, the taxonomic identification—genus or species—was uncertain due to the former presence of two or more osteologically similar species (e.g., deer versus pronghorn, cattle versus bison) in or near the project area. In some cases, only the listing of alternatives (e.g., bison/cattle, deer/pronghorn) was possible. After the variables were recorded, the number of identified specimens (NISP) for each taxon was computed (Table 9.1).

NATURAL HISTORY

Reptilia (Reptiles)

Family Emydidae (Box and Water Turtles)

Terrapene ornata (Western Box Turtle)

Western box turtle (*Terrapene ornata*) (n=97) was recovered from LA 75159. The western box turtle is native to the project area. This turtle, which attains a length of 10 to 15 cm, is a terrestrial species that can enclose itself in its shell. It prefers dry, open grasslands, seldom entering wooded areas. Although the box turtle is not dependent on free water, it may enter shallow pools during hot weather. The box turtle hibernates in the ground during the winter. Burrows can reach depths of 61 cm in open grasslands but are shallower in woodlands. This species has a population density of more than one individual per acre. A clutch of two to eight eggs is laid in late spring to early summer. The box turtle is omnivorous; its diet consists of insects, earthworms, vegetation, and carrion (Collins 1974:95–98; Degenhardt and Christiansen 1974:30–33; Degenhardt et al. 1996:104–107; Ernst and Barbour 1972:96–102; Williamson et al. 1994:134). Although the box turtle is sometimes eaten, it is believed to be a source of illness (Ernst and Barbour 1972:265).

Mammalia (Mammals)

Family Leporidae (Rabbits, Hares)

Sylvilagus audubonii (Desert Cottontail)

Desert cottontail (*Sylvilagus* sp.) remains (n=8) were recovered from LA 75159. Of the three cottontail species known in New Mexico, the desert cottontail is the most widespread, occurring throughout the state (Bailey 1931:54; Cockrum 1982:133; Findley et al. 1975:89). This leporid is found primarily at elevations below the coniferous forests, in the Lower and Upper Sonoran zones. It inhabits deserts, grasslands, brushy areas, piñon-juniper woodlands, and riparian zones. The desert cottontail also frequents cultivated fields and the dense vegetation adjoining such fields. Brush or shrubs are necessary for resting and hiding (Bailey 1931:54–60; Chapman and Willner 1978:2–3; Clark and Stromberg 1987:80; Findley 1987:57; Zeveloff 1988:92). This cottontail subsists mainly on grasses, forbs, cacti, and shrubs (Bailey 1931:55–56; Chapman et al. 1982:102; Chapman and Willner 1978:3). Cultivated plants, including corn, are also eaten (Bailey 1931:55–56; Chapman et al. 1982:101). Much of the cottontail's water requirements are provided by its food (Bailey 1923:71–72; Chapman et al. 1982:102; Findley 1987:57; Zeveloff 1988:92).

Predation by a variety of animals—bobcats, coyotes, foxes, raccoons, skunks, raptors, snakes—is the major cause of cottontail deaths and it is the primary regulator of cottontail abundance (Chapman et al. 1982:106–107; Clark and Stromberg 1987:78–79; Ingles 1941:236; Zeveloff 1988:88, 92). The cottontail, however, is an r-selected mammal. Its high mortality rate is offset by a high reproductive rate. Breeding generally occurs from mid- or late winter through late summer. A single female may have as many as six litters per year (Chapman et al. 1982:94; Clark and Stromberg 1987:78, 81; Findley 1987:57–58; Hoffmeister 1986:131, 137; Zeveloff 1988:93).

Lepus californicus (Black-tailed Jackrabbit)

The black-tailed jackrabbit (*Lepus californicus*), identified in the archaeofaunal assemblage from LA 75159, is the most common jackrabbit in New Mexico. It occurs throughout the state below the ponderosa forest zone (Findley 1987:55; Findley et al. 1975:93–94). This leporid is usually found at elevations below 1800 m (6000 ft), in the Lower and Upper Sonoran zones (Bailey 1913:18, 33, 1931:48). It inhabits deserts and open shortgrass prairies with scattered shrubs. In addition, the jack-

rabbit is very adaptable to agricultural conditions. Areas of heavy brush or woods are avoided (Dunn et al. 1982:133; Findley 1987:54–55; Findley et al. 1975:93–94; Hoffmeister 1986:140–141, Zeveloff 1988:98). "They are found in mesquite, sagebrush, desertscrub, into open pinyon-juniper" (Hoffmeister 1986:141). The black-tailed jackrabbit is most common, however, in open, treeless habitats (Findley 1987:55).

The jackrabbit usually feeds at night on grasses, mesquite, and herbs. Cultivated crops are also consumed. This leporid, like the cottontail, depends on succulent or green vegetation for water. Surface water is drunk when available. The breeding season extends from mid- or late winter to late summer. A single female may have as many as seven litters per year. Because the black-tailed jackrabbit is an r-selected species, the yearly number and size of litters per breeding female help to offset the high mortality rates. Jackrabbit predators include snakes, eagles, hawks, owls, coyotes, foxes, bobcats, and skunks (Clark and Stromberg 1987:87; Dunn et al. 1982; Findley 1987:56; Hoffmeister 1986:141–142; Zeveloff 1988:99–100).

Family Sciuridae (Squirrels and Allies)

Cynomys ludovicianus (Black-tailed Prairie Dog)

Remains of the black-tailed prairie dog (*Cynomys ludovicianus*) (n=3) were recovered from LA 75159. Today the species is found in the eastern half of New Mexico, but its range formerly extended into the southwestern portion of the state (Bailey 1931:120; Findley 1987:67; Findley et al. 1975:130–131). The black-tailed prairie dog is primarily an Upper Sonoran species (Bailey 1913:32; 1931:120, 123) that inhabits semi-arid shortgrass prairies, avoiding stands of tall grass. It is a highly social animal that lives in very large colonies that can extend over large expanses of plains. Family groups retain some cohesion and independence within the well-organized colonies. Communication among colony members is both vocal and visual. A dome- or doughnut-shaped mound surrounds the burrow entrance which may extend almost vertically to a depth of 5 m before leveling off. The entrance mound prevents water from entering the burrow. The burrow system is extensive and permanent. The nest is in the deeper portions of the burrow. Much of the winter is spent in the burrow. Breeding occurs in late winter and a single litter of about four young is born in late March or early April. This prairie dog consumes the stems, leaves, and seeds of a variety of grasses, weeds, and shrubs. The black-footed ferret (*Mustela nigripes*), an endangered species, was the most specialized predator of the black-tailed prairie dog. Formerly, both species had nearly identical distributions. Other predators include hawks, coyotes, foxes, bobcats, badgers, and snakes (Findley 1987:67–68; Hoffmeister 1986:194–196; Zeveloff 1988:145, 147). The burrowing activities of prairie dogs can severely impact buried cultural deposits if their colonies are established in a buried site.

Prairie dogs are considered food competitors of domestic livestock, so much effort has been devoted to eradicating them from rangeland. Such programs have primarily used poisons. As a result, prairie dogs are extinct within many areas of their former range (Findley 1987:68).

Family Canidae (Dogs, Coyotes, Wolves, Foxes)

Canis sp. (Dog, Coyote, Wolf)

Remains of a large dog (*Canis familiaris*) or wolf (*C. lupus*) (n=3) were recovered from LA 75159. The dog is closely associated with humans. Based on a radiocarbon date of ca. 8400 B.C., the earliest known domestic dog remains in North America are from Jaguar Cave, Lemhi County, Idaho (Lawrence 1967:44; 1968:43). "Since dogs were domesticated from an Old World, not a New World stock, and since the remains discussed are of a small animal with typical dog characters, domestication must have taken place at a considerably earlier date" (Lawrence 1967:44). When humans entered North America by way of the Bering Strait, therefore, they were accompanied by dogs which were probably the first domesticated animals. The domestic dog probably descended from the wolf (*C. lupus*).

> The wolf has perfected hunting habits that would not have been lost on early hunters who observed their game-getting practices. Both wolves and humans were pack, or team, hunters early on, and it is likely that these similar

> tactics for obtaining prey were influential in bringing about the initial stages of association between the two species. This hunting association and the fact that both hominids and large canids have mutually compatible social organizations eventually led to taming and, ultimately, to domestication [Olsen 1985:xi].

When Spanish explorers first entered the American Southwest, they brought Spanish greyhounds, in part to control local peoples. These dogs were larger than coyotes or large Pueblo dogs but smaller than the local wolf (Olsen 1978:19; Winship 1990:34). On several occasions, the greyhounds of Coronado's expedition (1540–1542) were used in dog-baiting episodes (Bolton 1990:200, 203, 228). During De Soto's expedition into what is now the southeastern United States, Spanish dogs served similar functions. Bloodhounds were used "in tracking down Indians, retrieving those who tried to escape and tearing in pieces guides who misled" (Swanton 1939:92). Later, as settlers moved into New Mexico, so did various breeds of domestic dog.

The gray wolf, the largest wild canid, formerly ranged throughout New Mexico and was abundant here in the 1800s. Programs to eliminate the wolf from western rangelands in the early 1900s resulted in its extirpation in New Mexico and the other western states (Findley 1987:118; Findley et al. 1975:283–284). Rocky areas on bluffs or slopes (e.g., rockshelters), holes dug in sandy hillsides or ridges, and enlarged badger holes are used as dens (Bee et al. 1981:167; Hoffmeister 1986:467; Zeveloff 1988:251). "Dens are located sufficiently high to provide a good view of the surrounding country, and they usually have small entrance ways that enlarge within the den. Some are several feet in length" (Hoffmeister 1986:467). Wolves mate for life. A single litter of usually six or seven pups is born in the spring. The gray wolf preys on large mammals such as deer, elk (wapiti), moose, and bison. The beaver, however, is also eaten. Hunting is done by packs of typically four to eight individuals (Bee et al. 1981:167–168; Hoffmeister 1986:467; Zeveloff 1988:250–251). Historically, thousands of gray wolves were killed every winter for their pelts (Carbyn 1987:372). The major non-human predator of the wolf is the grizzly bear (*Ursus arctos*) (Zeveloff 1988:251).

Family Antilocapridae (Pronghorn)

Antilocapra americana (Pronghorn)

Pronghorn (*Antilocapra americana*) remains (n=6) were identified in the assemblage from LA 75159. Although pronghorn formerly occurred throughout the Southwest, intensive hunting greatly reduced their numbers by the early 1900s. Since that time, however, they have been expanding within their former range. Pronghorn, which were once almost as numerous as bison, inhabit arid and semi-arid grasslands, subsisting on browse such as sagebrush, buckbrush, and rabbitbrush. Prickly pear cacti, forbs, grasses, and cultivated crops are also eaten. Most, or all, of the pronghorn's water requirements are supplied by the consumed plants. Horns are present in both sexes and the sheaths are shed and replaced annually. Pronghorn congregate in large herds (e.g., 100 individuals) during the winter but disperse into smaller groups in the spring. Breeding occurs in the fall. Females give birth, usually to twins, in mid-June. The pronghorn uses its great speed (up to 60 miles per hour) to elude predators such as bobcats and coyotes (Findley 1987:144–145; Findley et al. 1975:333–334; Hoffmeister 1986:549, 551–552; Jones et al. 1985:318; Zeveloff 1988:334–336).

Family Bovidae (Cattle, Sheep, and Relatives)

Bison bison (Bison)

Bison bison remains (n=64) are present in the assemblage from LA 75159. In addition, this assemblage also contains numerous bison-size specimens (n=531). Most, if not all, of the latter specimens are probably bison.

The bison, the largest extant terrestrial mammal in North America, was formerly the dominant mammal of the prairies. This grazer of open grasslands once numbered in the millions, but has been extirpated throughout most of its range. By 1890, fewer than 1,000 bison were left in North America. In 1884, the last recorded killing of free-ranging bison in New Mexico occurred (Findley 1987:146). "Extermination of the bison was part of

a United States government policy to suppress the Indian tribes that depended on them for food, clothing, and shelter. At the turn of the century, efforts were finally made to save them [bison] from extinction" (Zeveloff 1988:345). Today, almost 100,000 bison survive in public and private herds in western North America.

Although the bison is primarily a grassland species, it also inhabits forest edges and the prairie-forest transition zone. This bovid is very gregarious, living in large herds. Core herds consist of females, calves, yearlings, and two-year-olds. Older males are solitary or form small groups on the peripheries of the main herds. During the breeding season, from mid- to late summer, the males join the female-subadult herds. The bison is a K-selected species. After a gestation period of 9.5 months, a single precocial calf per breeding female is usually born in the spring. Occasionally, a female may have twins. Although sexual maturity is attained by the age of three for both sexes, males generally do not breed much until the age of six (Bee et al. 1981:229–230; Findley 1987:146; Zeveloff 1988:346–347).

Bison are efficient grazers. They are "capable of growing and maintaining good condition on less nutritious fare than domestic cattle require" (Findley 1987:146). Although grasses are preferred, sedges and brushy plants are consumed when grass is unavailable. Bison seek water each day. During droughts, however, they can go several days without water. Besides humans, major predators include wolves and grizzly bears (Bailey 1931:16; Bee et al. 1981:230; Findley 1987:146; Zeveloff 1988:346).

Bos taurus (Cattle)

Cattle (*Bos taurus*) remains were found at both LA 75159 (n=1) and LA 127502 (n=7). The history of cattle is discussed in detail in the historical volume of this report.

ARCHAEOFAUNAL ASSEMBLAGES BY PROVENIENCE

The archaeofaunal assemblage from LA 75159 was recovered from five trenches and five excavation units. Of the latter, three units were associated with trenches. The assemblage will be discussed by trench and associated excavation unit. Faunal data for the non-associated units (101 and 102) will be presented last.

Trench 1

The vertebrate faunal component of Trench 1 is very small, consisting of five bison/cattle specimens (Table 9.2). The only identified elements are a right first phalange and a left second phalange. Both exhibit rodent gnawing and both are very eroded, prohibiting identification to species. Because Trench 1 was in a pasture, the faunal remains may be those of cattle. None of the specimens is burned or displays butchering marks.

Trench 2

The faunal component of Trench 2 contains few specimens (n=16) (Table 9.2). Most of the remains (n=13) represent fragments of a box turtle carapace (upper shell). The bison/cattle specimens include a rib fragment and the distal portion of a left second phalange. As for Trench 1, the eroded condition of the phalange prevented identification to species. Trench 2 was in the same pasture as Trench 1. None of the remains is burned, gnawed, or modified. All are weathered.

Feature 100, Unit 103

Feature 100, a dark stain, was exposed during the excavation of Trench 2. The second largest faunal component (n=145) from the site was recovered from Unit 103, which was placed over the stain. Three levels were excavated. Unit 103 contained the most taxonomic variety of any provenience (Table 9.3).

The box turtle specimens (n=9) consist of carapace and plastron (lower shell) fragments. Identified desert cottontail elements include the maxilla (n=3), auditory bulla, a tooth, the humerus, radius, and tibia. Based on maxilla fragments, at least two individuals are represented. The jackrabbit specimen is an astragalus fragment. The indeterminate rodent specimen is a very eroded proximal femur shaft. The prairie dog specimens (n=3) consist of a

Table 9.2. LA 75159: Faunal Components by Trench

Taxon	T1	T2	T3	T4	T5
Terrapene ornata (Western Box Turtle)		13			
Odocoileus/Antilocapra americana (Deer/Pronghorn)					1
Bison bison (Bison)					7
Bos taurus (Cattle)			1		
Bison/Bos (Bison/Cattle)	5	3	1		
Indeterminate large mammal (pronghorn-size)					3
Indeterminate very large mammal (bison-size)				9	6
Total	5	16	2	9	17

Table 9.3. LA 75159, Feature 100, Unit 103: Faunal Components by Level

Taxon				
	L.1	L.2	L.3	Total
Terrapene ornata (Western Box Turtle)	3	6		9
Sylvilagus audubonii (Desert Cottontail)	2	6		8
Lepus californicus (Black-tailed Jackrabbit)		1		1
Rodentia (Rodents)		1		1
Cynomys ludovicianus (Black-tailed Prairie Dog)		1	2	3
Artiodactyla (Even-toed Ungulates)	2	4	1	7
Antilocapra americana (Pronghorn)		2		2
Bison/Bos (Bison/Cattle)		3		3
Indeterminate very small mammal (rat-size or smaller)	4	6		10
Indeterminate small mammal (rabbit-size)	19	18	9	46
Indeterminate medium mammal (coyote-size)		6		6
Indeterminate large mammal (pronghorn-size)	20	21	6	47
Indeterminate very large mammal (bison-size)		2		2
Total	50	77	18	145

skull fragment, a proximal left ulna, and the distal portion of a right scapula. The indeterminate artiodactyl specimens (n=7) are tooth fragments. Pronghorn is represented by a parietal fragment and a nearly complete ulnar carpal. The bison/cattle specimens (n=3) are tooth fragments. No specific elements were noted among the various indeterminate animal remains.

None of the specimens exhibits gnawing and no butchering marks were noted. The remains, however, are very weathered (e.g., eroded). The incidence of burning is low (n=24, 16.6 percent). The burned specimens include Artiodactyla (n=1) and rabbit-size (n=14, 3 calcined), coyote-size (n=1, calcined), and pronghorn-size (n=8, 2 calcined) mammals.

The presence of calcined specimens suggests that the Unit 103 faunal component is cultural. Although natural fires can carbonize bones, they rarely calcine bones (David 1990:75). As stated by Lyman (1994:388–389), calcination requires "longer heating times, higher temperatures, or both, relative to carbonization." The burned specimens, therefore, were originally discarded into a fire, probably as food refuse. Feature 100, therefore, probably represents hearth cleaning debris and a food refuse disposal area.

Feature 102, Unit 105

Feature 102, a dark stain, was exposed during the excavation of Trench 2. A small faunal component (n=21) was recovered from Unit 105 which was placed over the stain. Three levels were dug. Very

little taxonomic variability is represented (Table 9.4). The colubrid snake specimen, a vertebra, is considered intrusive. The jackrabbit specimens (n=2) consist of a mandible fragment and the tip of the right lower incisor. The bison/cattle specimens (n=3) are a nearly complete lower left incisor and indeterminate tooth fragments. No bison-size remains are present. Except for a rabbit-size long bone shaft fragment, none of the specimens is burned and none is gnawed. The remains are very eroded. The presence of a burned specimen suggests that hearth cleaning debris was occasionally deposited in Feature 102. The feature was also used for the discard of food refuse.

Table 9.4. LA 75159, Feature 102, Unit 105: Faunal components by level

Taxon				
	L.1	**L.2**	**L.3**	**Total**
Colubridae (Colubrid Snakes)		1		1
Lepus californicus (Black-tailed Jackrabbit)		2		2
Bison/Bos (Bison/Cattle)	1	2	1	4
Indeterminate small mammal (rabbit-size)		6		6
Indeterminate medium mammal (coyote-size)	1			1
Indeterminate large mammal (pronghorn-size)	1	6		7
Total	3	17	1	21

Trench 3

Only two specimens were found in the fill of Trench 3 (Table 9.2). The cattle specimen is a nearly complete left second phalange that exhibits rodent and carnivore gnawing. Neither specimen is burned or displays butchering marks. Both specimens are weathered. Trench 3 was in the same pasture as Trenches 1 and 2.

Trench 4

The faunal component of Trench 4 consists of bison-size remains (n=9) (Table 9.2). No specific elements were identified. None is burned or gnawed or has butchering marks. All are weathered. Trench 4 was in the same pasture as the previous trenches.

Trench 5

Trench 5 was placed in old pond deposits in the current north right-of-way of US 70. Faunal remains (n=17), which extended from near the surface to at least 30 cm below (auger hole) the bottom of the trench (1.55 m below surface), include bison remains (Table 9.2). Identified bison elements (n=7) include a horn core, a tooth , two very fragmented thoracic vertebrae, a humerus, a femur, and a tibia. The dorsal spine of one thoracic vertebra exhibits probable filleting cutmarks. The deer/ pronghorn specimen is a scapula fragment. Although no specific elements were identified among the pronghorn- and bison-size remains, long bone shaft fragments—three pronghorn-size, one bison-size—were noted. Rodent gnawing is present on the bison-size long bone shaft fragment. None of the remains is burned but all are weathered.

Unit 100

Unit 100 was placed along the north edge of Trench 5. Almost all of the LA 75159 archaeofaunal assemblage was recovered from Unit 100 (n=613, 65.8 percent). Most are bison and bison-size remains (n=498, 81.2 percent). Because faunal remains extend below 1.85 m and because several thousand years of deposition are represented—based on radiocarbon dates obtained from the Unit 100 column—the faunal component from Unit 100 will be discussed by level (Table 9.5).

Level 2 (date rejected)

Few faunal remains (n=3) were recovered from Level 2. The bison specimen is the shaft portion of a right ulna. None of the remains is burned or gnawed or exhibits butchering marks, but all are weathered.

Table 9.5. LA 75159, Unit 100: Faunal Components by Level

Taxon	Level								
	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Total**
Terrapene ornata (Western Box Turtle)			2			3	8	60	73
Lepus californicus (Black-tailed Jackrabbit)							2	3	5
Carnivora (Carnivores)							1		1
Canis sp. (Dog, Coyote, Wolf)							1	2	3
Antilocapra americana (Pronghorn)		1			1			1	3
Bison bison (Bison)	1	2		2	1	24	16	7	53
Indeterminate small mammal (rabbit-size)						1	2	5	8
Indeterminate medium mammal (coyote-size)							2	3	5
Indeterminate large mammal (pronghorn-size)	2	3	1		4			7	17
Indeterminate very large mammal (bison-size)		23	5	1	8	118	111	179	445
Total	3	29	8	3	14	146	143	267	613

Level 3 (ca. A.D. 1330)

The faunal component of Level 3 is small (n=29). The pronghorn specimen is the proximal shaft portion of a left tibia. The bison remains consist of a nearly complete lumbar vertebra and a proximal fragment of a left humerus. Most of the remains are bison-size (n=23, 79.3 percent), suggesting that hunters were attracted to the pond by the presence of large game. None of the remains is burned or gnawed or exhibits butchering marks, but all are weathered.

Level 4 (ca. A.D. 645)

Few faunal remains were found in Level 4 (n=8). Box turtle, the only specifically identified taxon, is represented by a carapace and a plastron fragment. As with Level 3, most of the remains are bison-size (n=5, 62.5 percent). None of the remains is burned or gnawed or exhibits butchering marks, but all are weathered.

Level 5 (ca. A.D. 240)

The faunal component of Level 5 is very small (n=3). The bison remains consist of a lower left molar fragment and a nearly complete left lateral malleolus. The latter and the bison-size specimen are covered with a heavy coat of calcium carbonate. The tooth has less calcium carbonate. None of the remains is burned or gnawed or exhibits butchering marks, but all are weathered.

Level 6 (ca. 875 B.C.)

Few faunal remains were recovered from Level 6 (n=14). The pronghorn specimen is a tooth fragment. The bison specimen consists of a fragment of a trapezoid-magnum (a carpal). Two of the pronghorn-size specimens are skull fragments. None of the remains is burned or gnawed or exhibits butchering marks. All, however, are weathered.

Level 7 (ca. 1340 B.C.)

Level 7 yielded the second largest faunal component from Unit 100 (n=146, 23.8 percent). Little taxonomic variability is represented, however (Table 9.5). The box turtle remains (n=3) are carapace fragments. The bison specimens (n=24) consist of the remains of a poorly preserved and very fragmented left maxilla with molars (n=3) that are also fragmented and very weathered. Additional bison remains include tooth fragments (n=18), the dorsal spine of a thoracic vertebra, and part of the distal shaft of a metacarpal. Most of the faunal

component consists of bison-size remains (n=118, 80.8%). Among the bison-size specimens, two have chopmarks. None of the remains is burned or gnawed, but all are weathered.

Level 8 (ca. 1490 B.C.)

Although the faunal component of Level 8 (n=143, 23.3 percent) is slightly smaller than that of Level 7, Level 8 has greater taxonomic variability (Table 9.5). The box turtle specimens (n=8) are carapace fragments. The jackrabbit is represented by the distal end of a right humerus and by the proximal portion of a right second metatarsal. The indeterminate carnivore specimen is the odontoid process of the axis vertebra. The canid specimen is a complete first phalange of a large dog or wolf. The bison specimens (n=16) consist of a complete, but fragmented, right mandible with a full set of premolars (n=3) and molars (n=3) in varying stages of completeness. The incisors are missing. Based on wear, the bison was at least 4.5 years old at the time of death. Other bison remains include tooth fragments (n=4), rib fragments (n=2), a portion of the proximal shaft of the right tibia, a metapodial shaft fragment, and a fragment of a left third phalange. As with Level 7, most of the component consists of bison-size remains (n=111, 77.6 percent). The incidence of burning is very low (n=2, 1.4 percent). A box turtle carapace fragment and a bison-size fragment are charred. None of the remains is gnawed or exhibits butchering marks. All of the specimens are weathered.

Level 9 (ca. 1905 B.C.)

Level 9 contained the largest faunal component from Unit 100 (n=267, 43.6 percent). Along with Level 8, Level 9 contains more taxonomic variability than the unit's upper levels. The box turtle remains are numerous (n=60), consisting of carapace and plastron fragments of a single individual. The jackrabbit remains (n=3) consist of two left scapula fragments and the femoral head of a left femur. Two individuals, one of which is very young, are represented. The identified canid (large dog or wolf) specimens (n=2) include a complete right first metacarpal and a third phalange fragment. The pronghorn specimen is a metapodial shaft fragment. The bison specimens (n=7) consist of tooth fragments (n=3), tooth sockets (n=2), a rib shaft fragment, and a mid-shaft fragment of a left tibia. Bison-size remains (n=179, 67 percent) comprise most of the faunal component. Burning is exhibited by seven specimens—box turtle plastron (n=1) and carapace (n=3) fragments and pronghorn-size (n=1) and bison-size (n=2) remains. One of the bison-size remains is calcined. None of the remains is gnawed or exhibits butchering marks. Except for six box turtle specimens, the Level 9 faunal component is weathered.

Unit 101

Unit 101 was southwest of Trench 5 and Unit 100. Few faunal remains (n=32) were recovered from five levels (Table 9.6). Little taxonomic variability is represented. The bison remains from Level 2 consist of tooth fragments (n=2) and a fragment of the proximal shaft of a left femur. The bison specimen from Level 3 is a tooth fragment. None of the remains is burned or gnawed or exhibits butchering marks. All are weathered.

Unit 102

Unit 102 was southeast of Trench 5 and Unit 100. Faunal remains (n=71) were recovered from Levels 2 and 3 (Table 9.7). The box turtle remains (n=2) are carapace fragments. The indeterminate artiodactyl remains (n=3) are tooth fragments. The pronghorn specimen is a distal fragment of a metatarsal. None of the remains is burned or gnawed or exhibits butchering marks. All are weathered.

DISCUSSION

Examination of Tables 9.2 through 9.7 indicates that bison and bison-size remains are primarily associated with Trench 5 and Units 100 through 102. These units and the trench were either in or near the old pond deposits. Undoubtedly, prehistoric hunters were attracted to the pond by the presence of bison and possibly other bison-size mammals. Although most, or all, of the bison-size remains are probably bison, it is possible that wapiti (elk, *Cervus elaphus*) remains may also be present. Even though wapiti are currently associated with semi-open forests and forest edges, their range formerly included the Great Plains (Fitzgerald et al 1994:383).

Table 9.6. LA 75159, Unit 101: Faunal Components by Level

Taxon	Levels					
	L.1	L.2	L.3	L.4	L.5	Total
Bison bison (Bison)		3	1			4
Indeterminate large mammal (pronghorn-size)	4	1		3	3	11
Indeterminate very large mammal (bison-size)	3	14				17
Total	7	18	1	3	3	32

Table 9.7. LA 75159, Unit 102: Faunal Components by Level

Taxon	Level		
	L.2	L.3	Total
Terrapene ornata (Western Box Turtle)	1	1	2
Artiodactyla (Even-toed Ungulates)		3	3
Antilocapra americana (Pronghorn)		1	1
Indeterminate large mammal (pronghorn-size)	2	11	13
Indeterminate very large mammal (bison-size)	24	28	52
Total	27	44	71

In describing western Kansas in the 1800s, Phillips (1890:351) stated, "then came the buffalo and the buffalo grass, and the beautiful herds of antelope, and the majestic herds of elk. I have, as late as 1866, seen several thousand of these latter magnificent creatures in a herd."

As was stated earlier, bison seek water daily. Consequently, they would have been attracted to the spring. Knowing the movements of bison herds, prehistoric hunters could have waited in ambush for the herd or could have followed the herd to the spring. In any case, the abundance of bison and bison-size remains indicates procurement of bison was the primary intention of the hunters. The presence of pronghorn, pronghorn-size, jackrabbit, and box turtle remains suggests the killing of these animals was incidental to the obtaining of bison meat.

The presence of low meat value (e.g., horn core, mandible, teeth, carpals, metapodials) and high meat value (e.g., thoracic vertebrae, ribs, humerus, femur) elements indicates the basic processing—skinning, dismembering, defleshing—of the bison carcasses occurred at the pond, the locus of procurement. The butchered remains were discarded in the pond or along its edge. No articulated bones were found. Although long bones appear to have been broken for the extraction of marrow, there is no evidence for bone grease processing.

The generally weathered condition—exfoliation, cracking, erosion—of the remains probably resulted from both initial exposure on the surface and periodic dry and wet cycles within the clayey spring deposits. The expansion and shrinkage of the clayey deposits also resulted in fragmentation of the bones. The observed fragmentation of bones did not result from bone grease processing.

Although the incidence of burning associated with Unit 100 is very low (n=9, 1.5 percent), the presence of nearby hearths for processing the bison or for preparing food during the butchering process is indicated. The data are limited but the presence of burned box turtle remains (n=5) suggests processing techniques similar to ethnographic accounts. After first killing the turtles by putting their heads in a fire, the Cheyenne eviscerated them while they were still in their shells. "Then a large fire was built, and the turtle were placed about it, standing up on the edge of their shells and thus roasted" (Grinnell 1923:I:308). The Florida Seminole "merely cut off the plastron and butcher the animal alive and kicking, when it is set up before the fire and roasted in its own oven" (Skinner 1913:76–77). The recovered charred turtle shell fragments,

especially the peripherals (n=2), indicate turtles were probably roasted in their shells by placing them on edge before a fire. The charring was incidental to roasting.

The faunal components of Trenches 1 through 4 and Units 103 (Feature 100) and 105 (Feature 102), which were on the south side of US 70 (away from the old spring) stand in sharp contrast to those of Trench 5 and Units 100 through 102. There is a paucity of bison-size remains and an absence of definite bison remains. Because the portion of the site south of US 70 is in a pasture, it is likely that the bison/cattle and bison-size specimens are actually those of cattle. The faunal remains are primarily rabbit-size and pronghorn-size. Burned specimens were noted among both size categories, indicating procurement as food resources.

The southern portion of the site may represent the encampment area of the site. This may explain the paucity or lack of bison-size remains in this portion of the site. Although very conjectural, several scenarios are possible. While the killing and processing of bison occurred at the spring, the hunters camped a short distance from the spring. Bison meat, therefore, was cooked and consumed in the camp after removal from the bones at the spring. An alternative explanation suggests Features 100 and 102 may represent camping episodes during which hunters came to the site in anticipation of the arrival of a bison herd. While waiting, the hunters caught whatever was available—box turtles, cottontails, jackrabbits, prairie dogs, pronghorn. A calibrated intercept date of A.D. 220 for Feature 100 suggests it may be associated with Level 5 of Unit 100.

The small size of the excavation units and their scattered placement preclude more meaningful interpretations. The faunal data hint at the importance of LA 75159 for hunting groups.

CONCLUSIONS

Most of the 931 archaeofaunal specimens from LA 75159 are from bison and bison-size animals and are associated with a former pond. For several thousand years, prehistoric hunters were attracted to the pond by the periodic presence of bison. Although the bison was the primary prey species, box turtles, leporids, prairie dogs, and pronghorn were secondary meat resources.

Chapter 10

BOTANICAL ANALYSIS

Jim Hasbargen

INTRODUCTION

Fourteen microbotanical samples were analyzed for pollen remains: one from LA 2713, 10 from LA 75159, and three from LA 75163. Twenty-seven macrobotanical sediment samples from cultural contexts were analyzed: four from LA 2713, 17 from LA 75159, and four from LA 75163, and two from LA 130557.

POLLEN ANALYSIS

Methods

Sediment samples for pollen analysis were processed at the Palynology Laboratory of Texas A&M University. Each sediment sample was thoroughly mixed and a 15 cc subsample was extracted. Exceptions were for sample number 372 (Unit 100, Level 9, Stratum VII) from LA 75159, which contained only enough material for a 10 cc subsample, and sample numbers 224 (Unit 10, Level 2, Stratum II) and 285 (Unit 20, Level 3, Stratum III) from LA 75163 which were pollen washes. A known quantity (27,000 grains) of exotic spores (*Lycopodium* sp.) was added to each sample to quantify pollen concentration. Samples were treated with hydrochloric acid to remove carbonates and screened through 0.15 mm mesh to remove the coarse fraction. Samples were then treated with concentrated hydrofluoric acid (50 percent) to dissolve silicates, washed in 1 percent potassium hydroxide (KOH), and subjected to acetolysis to reduce the organic contaminants. Next, samples were floated in zinc bromide (specific gravity 2.0) to isolate the pollen/organic fraction. The remaining light fractions were stained with safranin and suspended in glycerol.

The processed pollen samples were analyzed at the SWCA laboratory in Flagstaff. Pollen samples were counted under a Leica binocular microscope at 400x magnification. Pollen grains were counted along parallel transects to a minimum of 200. Martin (1963) determined that, with regard to common environmental pollen types, a pollen count of 200 is statistically the same as a pollen count encompassing 2000 grains. The transect in which the pollen total reached 200 was followed to the end of the transect, so reported counts will almost always exceed 200. Aggregates (clumps of pollen grains, all of the same taxon) were counted as a single grain with the taxon and quantity recorded elsewhere on the tally sheet. Next the entire slide was scanned at 100x to look for rare but significant pollen types not included in the initial count. Parallel transects were counted until 25 tracer pollen grains had been identified, and the final transect was then followed to the end. If fewer than five pollen grains had been counted in the area including 25 tracers, that sample was considered sterile, so for this report "sterile" means fewer than 360 pollen grains per cubic centimeter of sediment. High-spine composite pollen was differentiated from low-spine composite pollen based on spine height of >2 micrometers, as proposed by Hevly et al. (1965).

Standard palynological categories are used in this report. Whenever possible, pollen is identified to genus or species, though in some cases identification is only possible to family. A category called Deteriorated is used in this report whenever a pollen grain could be recognized as pollen, but was too crumpled or the exine (the outer coat of the pollen grain) was too degraded for accurate typing. If the pollen grain was in good condition but could not be identified using standard reference texts like Moore et al. (1991) or Kapp (1969), and it could not be matched with any pollen types in the SWCA reference collection, a category of Unknown was applied. The Cheno-am category encompasses several genera from the Chenopodiaceae and Amaranthaceae families. It includes saltbush, goosefoot, pigweed, and related species, many of which were both important prehistoric subsistence resources, and "weedy" plants that rapidly colonize disturbed ground. Palynologists divide the sunflower family (Asteraceae) into four groups, two of which are

present in this assemblage: high-spine composites and low-spine composites. Significant members of the high-spine composites include aster, sunflower, and seepwillow. The low-spine composites include bursage and ragweed.

Limitations of Pollen Analysis

The pollen assemblage in any sediment sample results from a complex combination of environmental and cultural factors. In general, wind pollinated plants such as pine, bursage, or ragweed produce more pollen, and disperse that pollen over a wider area, than insect pollinated plants such as cholla or cotton. For example, one male pine cone may produce almost 6×10^5 pollen grains ($>10^9$ grains from just one tree), while some species of *Plantago* spp. produce as few as 30 pollen grains per anther (Faegri and Iversen 1989:12). Consequently, wind-pollinated plants are better represented in the pollen record. In addition, thickness of the exine, or outer shell of the pollen grain will affect preservation. For example, robust pine pollen grains preserve better than fragile juniper pollen grains, so the pollen signature of a piñon-juniper woodland is dominated by piñon pine pollen while juniper pollen is less abundant.

Human behavior will also influence the pollen record. Non-local plants carried into an archaeological site may appear in the pollen record, while field cultivation and changes to natural drainage patterns may encourage the growth of "weed" species not normally found in the area. Finally, it is important to remember that absence of a pollen taxon in the pollen record does not necessarily mean absence of that plant species at the site. Beans, squash, and cotton are all insect-pollinated, and do not produce large quantities of pollen. Cultigen pollen in extramural contexts can easily be overwhelmed by the background pollen signal produced by native wind pollinated plants.

Pollen Analysis Results

Pollen counts are presented in Table 10.1. Ethnobotanical uses of identified plants are presented in Table 10.2. Site-bysite discussions are provided below.

LA 2713

One pollen sample was collected from LA 2713. Bag number 147 was recovered from Unit 106, Level 4, Feature 114. The sample is dominated by deteriorated pollen (47.6 percent), high-spine composite pollen (26.7 percent), Cheno-am pollen (12.4 percent), and grass pollen (9.4 percent). The Cheno-am pollen level is significantly lower and grass pollen level is much higher than in the pollen profiles from sites LA 75159 and LA 75163. This suggests that grassland vegetation dominated this site in the past. No cultigen pollen was noted in the sample from LA 2713, and all pollen types in this sample could represent normal environmental pollen rain. However, pollen levels from Cheno-am, high-spine composite, grass, *Ephedra*, and Onagraceae plants could also be enhanced by agricultural activity.

LA 75159

Ten pollen samples were collected from LA 75159. Bag number 293 (Stratum 4, Level 5) was collected from Unit 101 near the west edge of the pond deposits. Bag numbers 342 (Stratum 2, Level 2), 345 (Stratum 3, Level 2), 348 (Stratum 4, Level 3), 357 (Stratum 5, Level 5), 363 (Stratum 5, Level 6), 366 (Stratum 6, Level 7), 369 (Stratum 6, Level 8), 372 (Stratum 7, Level 8), and 375 (Stratum 7, Level 9) were collected from Unit 100, a column of samples from pond sediments. Only bag numbers 342, 345, 348, 357, and 375 from Unit 100 contained enough pollen to count. The other five samples from this site were sterile and the sediment appeared to be heavily oxidized.

Radiocarbon dating of the sediment column in Unit 100 indicates that some turbation and sediment mixing may have occurred in the past. Although the five pollen profiles from Unit 100 do not necessarily, represent sequential steps along a timeline they do indicate a general trend over time and they contain useful information regarding changes in the pollen rain and the changing environment at LA 75159. No cultigen pollen was noted in samples from Unit 100, and all pollen types in these samples could represent normal environmental pollen rain. However, pollen levels from Cheno-am, high-spine composite, grass, *Sphaeralcea*,

Table 10.1. Pollen Counts for US 70 Sites

Site No.	LA 2713	LA 75159					LA 75163
Sample No.	147	342	345	348	357	375	214
Sample Location	Unit 106 Level 4 Feature 114	Unit 100 Level 2 Stratum II	Unit 100 Level 2 Stratum III	Unit 100 Level 3, Stratum IV	Unit 100 Level 5 Stratum V	Unit 100 Level 9 Stratum VII	Unit 12 Level 2 Feature 141
Pollen Type							
Total pollen count	202	202	211	246	218	207	206
Tracer	131	46	83	29	51	142	83
Pollen conc. (grains/cc)	2776	7904	4576	15269	7694	2624	4467
Taxonomic richness	7	7	13	7	5	6	7
Deteriorated	96 47.6[1]	72 35.6	59 28.0	75 30.5	82 37.6	63 30.4	52 25.2
Unknown	0	0	2 0.9	0	0	0	0
Fir	0	0	1 0.5	0	0	0	0
Ponderosa-type pine	0	1 0.5	1 0.5	1 0.4	0	0	1 0.5
Piñon	4 2.0	4 2.0	5 2.4	5 2.0	3 1.4	6 2.9	3 1.5
Oak	0	0	1 0.5	0	0	0	2 1.0
cf. Cottonwood	0	0	1 0.5	0	0	0	0
Juniper	0	1 0.5	0	0	0	0	0
Cheno-am	25 12.4	81 40.1	74 35.1	76 30.9	49 22.5	39 18.8	101 49.0
High-spine Composite	54 26.7	39 19.3	52 24.6	83 33.7	79 36.2	81 39.1	40 19.4
Low-spine Composite	2 1.0	2 1.0	1 0.5	3 1.2	3 1.4	8 3.9	0
Grass	19 9.4	3 1.5	9 4.3	2 0.8	2 0.9	9 4.3	3 1.5
Globemallow	0	0	2 0.9	1 0.4	0	0	0
Mormon Tea	1 0.5	0	2 0.9	0	0	0	0
Evening Primrose Family	1 0.5	0	0	0	0	0	0

Table 10.1 Pollen Counts for US 70 Sites (Ccontinued)

Pollen Type	Site No.	LA 2713	LA 75159					LA 75163
	Sample No.	147	342	345	348	357	375	214
	Sample Location	Unit 106 Level 4 Feature 114	Unit 100 Level 2 Stratum II	Unit 100 Level 2 Stratum III	Unit 100 Level 3, Stratum IV	Unit 100 Level 5 Stratum V	Unit 100 Level 9 Stratum VII	Unit 12 Level 2 Feature 141
Caltrop		0	0	1 0.5	0	0	0	0
Aggregates[2]		Hi-Spine 2 Grass 3	Cheno-am 2 Hi-Spine 2	Cheno-am 4 Hi-Spine 4	Cheno-am 2 Hi-Spine 2	Cheno-am 2 Hi-Spine 3	Cheno-am 5 Hi-Spine 6 grass 4	Cheno-am 4

1 Column percent

2 Number of grains in largest aggregate

Table 10.2. Ethnobotanical uses of identified plants

Pollen Taxon	Common Name	Ethnobotanical Uses
Pinus, piñon-type	piñon	food, fuel, building, medicinal, ceremonial, other
Ephedra	Mormon tea	food, fuel, medicinal
Cheno-am	saltbush, goosefoot, pigweed, and others	food, fuel, medicinal, ceremonial, other
High-spine Composite	sunflower, aster, seepwillow, and others	food, fuel, medicinal, ceremonial, other
Low-spine Composite	bursage, ragweed	food, fuel
Gramineae	grass family	food, ceremonial, other
Onagraceae	evening primrose family	food, medicinal, ceremonial

Note: Ethnobotanical uses are based on Bohrer (1991), Castetter and Bell (1942), Castetter and Underhill (1935), Curtin (1984), Elmore (1943), Gallagher (1972), Gasser and Kwiatkowski (1991), Stevenson (1915), and Whiting (1939).

Ephedra, and *Kallstroemia* plants could also be enhanced by agricultural activity.

The sample dating from the Archaic period (Level 9) contains lower levels of Cheno-am pollen and higher levels of high-spine composite, low-spine composite, grass, and piñon pine pollen than is present in more recent samples (Levels 2, 3, and 5). Composite and Cheno-am pollen are components of a normal pollen rain, and can also be enhanced by environmental conditions that favor disturbance plants. The rise in Cheno-am pollen (four-wing saltbush) at the expense of composite (sunflower, bursage, ragweed) and grass pollen could result from environmental change favoring the more opportunistic Cheno-am plants. Conversely, the change in pollen rain could have resulted from culturally induced vegetation changes, such as agricultural activity that favors weedy plants like the Cheno-am group. The decreased level of piñon pine pollen over time could indicate a long-term decrease in regional piñon pine cover, either through environmental change or wood cutting activity.

LA 75163

Three pollen samples were collected from ashy features containing fire-altered rocks at LA 75163. Sample 224 (Unit 10, Stratum 2, Level 2) was obtained from a pollen wash from ground stone in Feature 138. Sample 214 (Unit 12, Stratum 2, Level 2) was obtained from Feature 141, a hearth. Sample 285 (Unit 20, Stratum 3, Level 3), a pollen wash from ground stone, was obtained from Feature 129. The pollen wash samples, Bags 224 and 285, were sterile. Only the sediment sample in Bag 214 contained sufficient pollen for analysis.

The pollen profile from Bag 214 was dominated by Cheno-am (49.0 percent), deteriorated (25.2 percent), and high-spine composite (19.4 percent) pollens. Tree pollen included piñon pine (1.5 percent), oak (1.0 percent), and ponderosa pine (0.5 percent). The only other pollen type in this sample was grass (1.5 percent). No cultigen pollen was noted, and all pollen types in this profile could represent normal environmental pollen rain, although some of the Cheno-am pollen component may also have been contributed by cultural modification of the environment. It is unfortunate that only one sample from this site contained enough pollen for a full count, with no other sample to indicate background pollen levels.

MACROBOTANICAL ANALYSIS

Methods

Macrobotanical analysis examines carbonized plant remains in sediment samples. It is especially useful for identifying seeds, seed pods, nut shells, flower stalks, and wood that may have been introduced into the site and partially burned during normal household activities. Analysis is limited to carbonized plant material in order to exclude modern plant remains that are also in the sediment sample.

During processing, a 2-liter sediment sample (about the volume of a two pound coffee can) is introduced into a tank of water and agitated, so that the organic matter separates from the soil and floats to the top. The organic fraction is then skimmed off and allowed to dry. Carbonized plant remains are removed from the float sample, and identified under a 20x binocular microscope by comparing them with a plant reference collection. Processing was conducted by laboratory personnel in SWCA's Albuquerque office. Macrofossil identification was performed by Richard Holloway at Quaternary Services in Flagstaff.

MACROBOTANICAL ANALYSIS RESULTS

LA 2713

Four sediment samples collected from charcoal stains at LA 2713 were analyzed. Bag 105 was obtained from Feature 113 in Unit 100, Level 2. Bag 135 was collected from Feature 104 in Unit 104, Levels 1-3, Stratum IV. Bag 141 was collected from Feature 106 in Unit 102, Stratum 2/3, Level 5. Bag 148 was obtained from Feature 114 in Unit 106, Level 3. All four samples contained charcoal fragments that could be identified as *Prosopis* (mesquite) wood. In addition, Bag 141 contained charred seeds of *Mollugo* a member of the Carpetweed family that commonly grows in sandy habitat. Uncharred *Mollugo* seeds were recovered

from Bags 105, 141, and 148. Uncharred *Portulaca* (purslane) seeds were present in Bag 148.

LA 130557

Two sediment samples from LA 130557 were analyzed. Bag 100 was collected from Stratum 2, Level 2, in Unit 10. Bag 105 was collected from Stratum 3, Level 5 of Feature 100 in Unit 11. Bag 105 contained fragments of *Prosopis* charcoal. Both samples contained uncharred *Mollugo* seeds and Bag 100 also contained uncharred Caryophyllaceae (Pink family) seeds.

LA 75159

Seventeen sediment samples from LA 75159 were analyzed for macrobotanical remains. Bag 303 was collected from Stratum 4, Level 5 of Unit 101, on the margin of an ancient pond. Bag 386 was collected from Stratum 2 of Feature 101, in Level 2 of Unit 104. Bags 340 (Stratum 2, Level 2), 343 (Stratum 3, Level 2), 346 (Stratum 4 [top], Level 3), 349 (Stratum 4 [middle], Level 3), 352 (Stratum 4 [bottom], Level 3), 355 (Stratum 5 [top], Level 5), 358 (Stratum 5 [middle], Level 5), 364 (Stratum 6 [top], Level 7), 367 (Stratum 6 [bottom], Level 8), 289 (Stratum 6, Level 8, under bison mandible), 370 (Level 7 [top], Level 8), 373 (Stratum 7 [middle], Level 9), 324 (Level 10), 325 (Level 11), and 326 (Level 12) were collected from Unit 100 within the former pond. Very small fragments of unidentified charcoal were present in bags 303, 324, 325, 340, 343, 346, 349, 355, 373, and 386. A few charred *Chenopodium* seeds were noted in Bag 340.

LA 75163

Four sediment samples from ash stains at LA 75163 were analyzed for macrobotanical remains. Bag 213 was collected from Feature 141 in Stratum 2, Level 2 of Unit 12. Bag 236 was collected from Feature 138 in Stratum 2, Level 3 of Unit 10. Bag 240 was recovered from Feature 144 of Stratum 2, Level 2 of Unit 15. Bag 271 was collected from Feature 129 in Stratum 3, Level 3 of Unit 20. Very small fragments of charcoal were recovered from Bags 213, 236, and 240. Only the fragments in Bag 236 were large enough for a tentative identification as *Prosopis* charcoal. A few charred *Portulaca* and *Mollugo* seeds were also noted in Bag 240.

SUMMARY AND CONCLUSIONS

Botanical analysis did not provide a clear indication of cultural activities related to the samples that were analyzed. Several of the sediment samples submitted for pollen analysis were heavily oxidized and contained insufficient quantities of pollen. Only one sediment sample from LA 2713, five samples from LA 75159, and one sample from LA 75163 contained enough pollen for analysis. Pollen profiles from these samples were dominated by common taxa normally found in the nearby environment. However many of those pollen types are also opportunistic plants that serve as indicators of cultural modification to the environment (such as agriculture). The strongest indication of environmental change that may have been culturally induced came from LA 75159, where the Archaic period sediment sample contained more piñon pine pollen and fewer indications of disturbance plants than were present in later sediment samples. No cultigen pollen was noted in any of the sediment samples analyzed as part of this project.

Charred mesquite wood was present in samples from Sites LA 2713, LA 75163, and LA 130557. However, mesquite currently grows at all three sites and the charcoal recovered from the flotation samples could be attributed to natural sources as well as to cultural introduction. Most of the plant seeds identified through macrobotanical analysis were uncharred and therefore must be regarded as modern specimens. A small number of charred seeds were present; all were derived from plants that currently grow in the area. The presence of these few charred seeds could be attributed to natural wildfires more easily than to cultural activity.

Chapter 11

SUMMARY AND CONCLUSIONS

The results of data recovery at LA 2713, LA 75159, LA 75163, LA 127518, and LA 130557 indicate that all of the sites were used repeatedly as short-term campsites during the Native American occupation of Eastern New Mexico. The assemblages included materials dating from the end of the Middle Archaic Period to the end of the Jornada Mogollon occupation, and perhaps slightly beyond.

SITES INVESTIGATED

LA 2713

Data recovery at LA 2713 included five mechanically excavated trenches and nine hand-excavated units. Fourteen potential features were exposed, six of which appeared to be cultural (Features 100, 101, 104, 105, 113, and 114) and nine of which were probably natural (Features 102, 103, and 106–112).

Features 100, 104, 113, and 114 appeared to be the remains of hearths. All four features contained mesquite, a common fuel wood; Features 113 and 114 yielded *Mollugo* seeds. The function of the remaining two cultural features is less certain. Feature 105 could have been a pit house, but was too badly disturbed to allow a positive identification. Feature 101 may have been an additional hearth, but was too damaged during trench excavation to allow a positive identification. In addition, previous research identified the remnants of hearths elsewhere in the site (Crawford et al. 1999:52–54; Polk et al. 2000:3.1–3.19).

Data recovery collections included 160 pieces of flaked stone and seven sherds. The few sherds collected during the excavation and previous surface collections indicate use of the site during the Late 18 Mile, Mesita Negra, and McKenzie Phases (A.D. 900–1350). In addition, radiocarbon dates from Features 104 and 113 indicate repeated use of the site during the Late Archaic period. Analysis of a pollen sample from Feature 114, a Jornada Mogollon hearth, reflects grassland vegetation similar to modern flora. The ubiquity of mesquite in macrobotanical samples indicates the preferred fuel wood. The *Mollugo* seeds may indicate one wild food used at the site, but lack of seed charring is an issue here. The lack of maize macrobotanical remains and pollen, and of other domesticates, suggests that domesticated foods were not used at LA 2713.

The possible pit house may reflect extended use of the site, but that evidence is highly suspect. The site's occupants had access to resources through trade or travel; petrographic analysis of two sherds (Appendix A) suggests that some or all of the pottery on the site was manufactured in mountain areas to the west.

LA 75159

Data recovery at LA 75159 included five backhoe trenches and six hand-excavated units. Nine features were identified, as well as a dark, organically stained deposit from a spring-fed pond. The features included five soil stains and four small clusters of burned caliche (one with associated artifacts).

One of the burned caliche clusters (Feature 100) and two stains (Features 101 and 102) were excavated by hand. Feature 100 yielded Jornada Brown Ware and Chupadero Black-on-white sherds, and a charcoal sample from the feature yielded a radiocarbon date of cal A.D. 690 to 890. The hearth dates to the Jornada Mogollon occupation and, based on the sherds and radiocarbon date, was most likely used during the Late 18 Mile phase. The hearth also yielded 145 bones (24 of them burned) from various animals, indicating that the hearth was used to cook food including meat.

Feature 101 did not yield temporally diagnostic materials; Feature 102 yielded sherds of Jornada Brown Ware. These features were most likely hearths; they contained bones from bison, pronghorn, rabbit, turtle, and other mammals.

Twenty-nine sherds were recovered from Units 100, 101, 103, and 105 and Trenches 3 and 4. Jornada Brown Ware was the most common pottery but, unfortunately, has a wide time range. Chupadero Black-on-white (A.D. 1050–1550) and El Paso Brown Ware may indicate a late Jornada Mogollon occupation. Of the identified vessel forms, sherds from jars outnumber sherds from bowls nearly two to one.

Data recovery at LA 75159 yielded 663 pieces of flaked stone. Most (n=586) are flakes or shatter; they reflect generalized core reduction but also bifacial reduction. Most of the lithic debitage represents late stage reduction or tool manufacturing. Chert dominated the assemblage; fine-grained quartzite was the second most common material. Non-local materials such as obsidian were present in small quantities.

Seven pieces of ground stone were recovered. One mano came from Feature 100, which dates to the Late 18 Mile phase. The other mano and metate fragments were recovered from back dirt and are undated.

Trench 5 exposed deposits created by the filling of a spring-fed pond. Such deposits are unusual in the region, at least during the period of human occupation, and were therefore a focus of work at the site. In addition to the trench, work included three hand-excavated units (100–102). A second trench (Trench 1) encountered either the south edge of the pond deposits or disturbed soil from highway construction. A column of radiocarbon, pollen, macrobotanical, and bulk soil samples were taken from Unit 100. This column reflects the time between at least 3,500 years ago and today. Excavation stopped before the bottom of the pond deposits, so even earlier cultural and natural remains could be present at LA 75159.

The pollen samples from the pond deposits suggest that the plant community changed slightly through the observed time span. The relative frequency of Cheno-Am pollen increased through time (from 18.8 percent to 40.1 percent), while the frequency of high-spine composites decreased (from 39.1 percent to 19.3 percent).

The geographic setting of the site (at a spring/pond, next to a pass between the Pecos Valley and the Llano Estacado) made it attractive to animals and humans alike. The human visitors also made use of hunting opportunities provided by the pond, as indicated by the hearths and bone. Radiocarbon results indicate a human presence at the pond since at least the end of the Middle Archaic period, though the intensity of occupation may have varied. The terminal Middle Archaic period and late Jornada Mogollon occupations may have been relatively more intensive, as indicated by frequencies of artifacts and bone. The Archaic period occupation may have focused on larger game such as bison and pronghorn. Human activity at the spring seems to have reached a nadir prior to about A.D. 600, before rebounding to some degree. By that time, the hunting focus had shifted toward antelope and smaller species, particularly rabbits.

Based on the evidence gleaned from the limited portion of the site that was excavated, the site’s occupants were probably highly mobile, or at least well-connected. Alibates and Edwards Plateau cherts from Texas, along with sherds probably from west of the Pecos River and from Plains Woodland groups, support this notion. The site's occupants also made use of local lithic resources such as purplish fine-grained quartzites and cherts, which could be found on nearby hills and a short distance eastward, at the edge of the Llano Estacado.

Even though the sampled pond deposits were within the US 70 right-of-way, they proved to be outside the construction zone for highway widening (which is why they were not fully excavated). More extensive—and deeper—excavation of the pond deposits is likely to yield important cultural and paleoecological information on the Holocene of eastern New Mexico. The imperatives of CRM led us to discover and sample the pond deposits; we hope that in some future year, a research-oriented project will be able to excavate those deposits more fully.

LA 75163

LA 75163 is a large, multi-component site next to permanent seep springs in a box canyon. Part of the right-of-way had previously been excavated by Regge Wiseman (2000), and the remaining deposits within the right-of-way were less substantial than Wiseman's excavations found. Substantial deposits can be seen outside the right-of-way, however, especially overlooking the seep springs.

SWCA's work at the site included three backhoe and 17 hand-excavated units. Forty-five features, most of which were probably hearths, were exposed in the trenches. Twenty-one of the features were further investigated in hand-excavated units. The studies yielded 589 pieces of flaked stone, 13 sherds, and three ground stone fragments. No bone was recovered from the site. Almost all of the lithic materials reflects tool manufacturing. Chert and chalcedony were the most common raw materials. The sherds were all Jornada Brown Ware, except for one El Paso Brown Ware. The ground stone included two metate fragments and a pestle.

Pollen samples from Features 129, 138, and 141 were analyzed but only the sample from Feature 141 yielded identifiable remains. The pollen from Feature 141 included no cultigens and was similar to what might be expected in a modern sample. Macrobotanical samples were recovered from Features 129, 138, 141, and 144. The samples from Features 138, 141, and 144 yielded very small fragments of charcoal, but only the sample from Feature 138 contained identifiable remains, which were a few charred *Portulaca* and *Mollugo* seeds.

Most of the features at the site were probably hearths; most were in comparable stratigraphic settings, reflecting the fact that the landscape was stable during most of the prehistoric occupation.

When combined with Wiseman’s (2002) efforts, the current data recovery effort demonstrates that LA 75163 was extensively used since at least the Middle Archaic period. LA 75163 is unusual for the area in that it is a permanent source of water, which undoubtedly attracted prehistoric people as well as game. The topographic setting—seep springs at the head of a small box canyon would have been useful to hunters, who could have trapped herd animals in the canyon. However, no projectile points or faunal remains were recovered on the site itself. Wiseman saw LA 75163 as a point on the interface between Plains and Pecos Valley adaptations in southeastern New Mexico; unfortunately, the data obtained by SWCA did not allow us to further evaluate his highly intriguing model.

LA 127518

Despite the excavation of a backhoe trench and three hand excavation units, LA 127518 yielded only a small quantity of non-diagnostic artifacts: five pieces of flaked stone including one core. ACA reported ground stone at the site during their survey, but none was encountered during testing or data recovery. At least two and perhaps all three of the features excavated during this project were not the remains of human activity.

The artifacts collected during data recovery added little to the information obtained during the survey and testing phases of this project. The assessment that the Native American component of the site dates to the Archaic period has therefore not changed. The presence of at least 17 burned caliche and fire-cracked rock features elsewhere on the site suggests repeated uses of the site. One reason for site use may have been the abundant stone eroding from an adjacent hillside. Other features that may encouraged site use are a playa 0.7 km to the northeast and a natural pass 1.0 km to the southwest. The two features may have funneled game through the area.

LA 130557

LA 130557 is a site with limited amounts of flaked stone and Jornada Mogollon pottery. Data recovery was concentrated in the 4 percent of the site within the US 70 right-of-way, and included a backhoe trench and two hand-excavated units. The recovered artifacts included four flakes, even though previous surface collection had yielded more than 100 flaked stone artifacts.

A single feature, Feature 100, was identified as charcoal stain exposed in the trench wall. The

feature produced a calibrated radiocarbon date of 2550–2540 and 2490–2300 B.C, which indicates a previously unidentified Middle Archaic period component. The feature may have been a hearth. The botanical studies indicated that the hearth fuel was mesquite. However, a rodent burrow and a more recent root burn had disturbed the feature.

The site yielded the earliest date for the entire project. The paucity of subsurface artifacts and features suggests that LA 130557 may have been a short-term campsite. However, a much more dense scatter of artifacts outside the right-of-way, particularly along the route of a buried fiber optic cable, suggests that additional subsurface features are present in the 96 percent of the site outside the highway right-of-way. Further investigations may yield additional important data about this site, and may link it to LA 2713, which is a short distance to the west.

DISCUSSION OF PROBLEM DOMAINS

I: Defining Context

Problem Domain I focused on identifying the natural context of the prehistoric occupation, especially with regard to the geoarchaeological contexts of archaeological remains. The stratigraphic positions of archaeological materials and the project's geomorphogical analysis (Appendix B) both support the sequence presented by Hall (2002) and outlined in Chapter 1. Specifically, most of the archaeological materials are not stratified, despite being from an occupation spanning several thousand years, nor are they associated with strong soil formation. It appears, instead, that the associated ground surface was "semi-stable" during much of the prehistoric occupation of the area. Hall's results, combined with those of this project, further indicate that the GBFEL-TIE Model developed for the southern Tularosa Basin and discussed in Chapter 2 is not generally applicable to the research area.

Stratified pond deposits were encountered at LA 75159. Pollen analysis from these deposits indicates some changes in vegetation at the site and perhaps more generally in the area. The percentage of Cheno-Am pollen more than doubles from the lowest (terminal Middle Archaic) stratum to the uppermost stratum that is not heavily disturbed. The percentage of high-spine composites declines accordingly. This pattern may reflect increased precipitation or a raised water table. However, it could also be due to increased ground disturbance around the pond by humans, grazing animals, or both.

II: Paleoindian Use of the Study Area

Unfortunately, no new information was gleaned about the Paleoindian Period occupation of the area; the oldest materials found dated to the Middle Archaic period. The greatest likelihood of Paleoindian remains is in the pond deposits at LA 75159, but determining the age of the deepest pond deposits would require a separate study.

III: Deciphering Southwest New Mexico Pre-history

Most of the actual analysis focused on issues related to Problem Domain III. These included subsistence, technology, trade, and chronology. The analytic approach proposed in the Research Design (Chapter 2) and Wiseman (2000) was effective for addressing these issues. Our analysis suggests that even in the absence of stratigraphically sealed behavioral episodes, features and their associated remains can be statistically grouped as behavioral packets that can often be placed in chronological order.

Nineteen features or stratigraphic units were dated using a combination of radiocarbon dates and diagnostic artifacts (Table 11.1). When both types of dating approaches could be applied, diagnostic artifacts and radiocarbon dates provided compatible results. The analysis of the materials from these and other features allow the following conclusions.

Subsistence

No evidence for domesticates was found at any of the sites. Macrobotanical and pollen remains from economically important species include piñon, Mormon tea, saltbush, goosefoot, pigweed,

Table 11.1. Dated Proveniences from US 70 Sites

Provenience	**Date**	**Temporal Affiliation**
	LA 2713	
Feature 100	Rio Grande B/w	Mesita Negra phase (A.D. 1000–1200)
Feature 104	Radiocarbon date: cal A.D. 400-640	Late Archaic period
Feature 113	Radiocarbon date: cal A.D. 690–890	Late Archaic period
Feature 114	Radiocarbon date: cal A.D. 1000–1170	Late 18 mile or Mesite Negra phases (A.D. 900–1200)
	LA 75159	
Unit 100		
Stratum 3	Radiocarbon date: cal A.D. 1200– 1290 & cal A.D. 1220–1410	McKenzie phase (A.D. 1200–1350)
Stratum 4	Jornada Brown Ware (A.D. 200–1200) Scallorn projectile point (A.D. 700–1200) Radiocarbon date: cal A.D. 600–680	Late Archaic period (1800 B.C.–A.D. 750) Early 18 Mile phase (A.D. 750–850) Late 18 Mile phase (A.D. 850–1000) Mesita Negra phase (A.D. 1000–1200)
Stratum 5	Radiocarbon dates: cal A.D. 130–350 & 990–820 cal BC	Late Archaic period (1800 B.C.–A.D. 750)
Stratum 6	Radiocarbon dates: 1430–1200 cal B.C. & 1610–1420 cal B.C.	Late Archaic period (1800 B.C.–A.D. 750)
Stratum 7	Radiocarbon date: 1970–1760 cal B.C.	Middle to Late Archaic period (3200 B.C.–1800 BC)
Unit 101		
Levels 1 and 2	Chupadero B/w (A.D. 1050–1550) Jornada Brown Ware (A.D. 200–1200)	Mesita Negra phase (A.D. 1000–1200) McKenzie phase (A.D. 1200–1350)
Level 5	Radiocarbon date: 820–700 cal B.C.	Late Archaic period (1800 B.C.–A.D. 750)
Feature 100	Chupadero B/w (A.D. 1050–1550) Radiocarbon date: cal A.D. 690–890	Mesita Negra phase (A.D. 1000–1200)
Feature 102	Jornada Brown Ware (A.D. 200–1200)	Early 18 Mile phase (A.D. 750–850) Late 18 Mile phase (A.D. 850–1000) Mesita Negra phase (A.D. 1000–1200)
	LA 75163	
Feature 112/ 113	Jornada Brown Ware (A.D. 200–1200)	Early 18 Mile phase (A.D. 750–850) Late 18 Mile phase (A.D. 850–1000) Mesita Negra phase (A.D. 1000–1200)
Feature 137	Jornada Brown Ware (A.D. 200–1200)	Early 18 Mile phase (A.D. 750–850) Late 18 Mile phase (A.D. 850–1000) Mesita Negra phase (A.D. 1000–1200)
Feature 138	Jornada Brown Ware (A.D. 200–1200) El Paso Brown Ware Radiocarbon date: cal A.D. 680–890	Early 18 Mile phase (A.D. 750–850) Late 18 Mile phase (A.D. 850–950)
Feature 139	Jornada Brown Ware (A.D. 200–1200)	Early 18 Mile phase (A.D. 750–850) Late 18 Mile phase (A.D. 850–1000) Mesita Negra Phase (A.D. 1000–1200)
Feature 141	Radiocarbon date: 790–410 cal B.C.	Late Archaic period (1800 B.C.–A.D. 750)
Feature 144	Jornada Brown Ware (A.D. 200–1200)	Early 18 Mile phase (A.D. 750–850) Late 18 Mile phase (A.D. 850–1000) Mesita Negra Phase (A.D. 1000–1200)

sunflower, aster, seepwillow, bursage, ragweed, and various grasses (Appendix D). The slab metates and one-hand manos found at the sites are consistent with the use of such wild resources, and are inconsistent with the regular processing of large amounts of domestics such as maize (Hard et al. 1996). Furthermore, animals such as rabbits, hares, bison, box turtles, and pronghorn were hunted (Appendix C). Bones from bison (and bison-sized mammals) are most common in Archaic Period deposits and features, especially at LA 75159, which is consistent with environmental changes thought to have forced bison from the region by the end of the Late Archaic period. After the Late Archaic, pronghorn and pronghorn-sized animals as well as the smaller animals increased in importance.

As is discussed in Chapter 1, archaeologists have proposed that two groups inhabited eastern New Mexico during the Ceramic period (A.D. 750–1350): a Neo-Archaic group focused on broad-spectrum hunting and gathering, and a Jornada Mogollon group that was more sedentary and that used domesticates (see Sebastian and Larralde 1989:83). The sites do not reflect occupation by two distinct groups, as reflected in differences in faunal, botanical, ceramic, and lithic remains. Instead, the subsistence practices within and between sites are fairly uniform.

Two possibilities may account for the lack of variation in the Ceramic period remains. First, the Neo-Archaic and Jornada Mogollon "groups" may have been members of a single group that used different subsistence strategies at different times of the year or in different years, depending on conditions. Second, the US 70 sites may have been occupied by only one of the groups, because their settings made the sites unattractive to members of the other group. Given that there is little evidence of shelters and the use of domesticates, under this hypothesis the sites' inhabitants would have been members of the Neo-Archaic group. Regardless of which of these possibilities is true, it is clear that the sites' Ceramic period occupants participated in a Neo-Archaic subsistence strategy, not a Formative subsistence strategy.

Technology

Almost all of the artifacts from the five sites are flaked stone; most of that assemblage reflects intensive generalized core reduction, with limited bifacial reduction. In the Southwest, the shift from mobile to sedentary populations is associated with a shift from curated to expedient technology, but the latter shift is not evident at the US 70 sites. Instead, the sites' inhabitants did not use curated technology extensively at any time, including during the later Archaic Period. The heavy reliance on expedient tools is most likely related to the availability of lithic raw materials along the project corridor. A curated flaked stone technology would have had little advantage in such an environment, because tool stone could be collected as needed. The only curated tools were thus be specialized items such as projectile points.

While the reduction techniques were similar for Archaic and Ceramic period materials, the intensity of reduction appears to have differed. Archaic period materials are less heavily reduced than Ceramic period materials. The difference may reflect differences in the length of each occupation, or it differences in types of expedient tools (and thus in the activities during which the tools were used).

Petrographic and typological analysis of the pottery indicates that most of the assemblage is El Paso Brown Ware or Jornada Brown Ware. Decorated types included Lincoln Black-on-red, which was found only at LA 2713, and Chupadero Black-on-white. Jar and bowl forms were both present, indicating both food storage and food service. Regardless, the sites' occupants did not use pottery extensively.

Trade

The Chupadero Black-on-white and Lincoln Black-on-red pottery found during this project was most likely produced elsewhere, possibly by people living in the mountains to the west (Appendix A). Indeed, it remains unclear how much eastern New Mexico brownware was produced locally, and how much of it was obtained from other locations; conceivably all of the pottery found during the project is imported material.

Obsidian and Edward's Plateau chert were also found, but in small quantities. The project was unable to determine whether the exotic pottery and tool stone was obtained through trade, or as part of seasonal rounds, or both. In either case, the local "connections" with the outside world were extensive even if they were not intensive.

Chronology

The remains from dated proveniences, as listed in Table 11.1, conform to the cultural historical sequence outlined in Chapter 1. One of the biggest difficulties facing archaeologists in eastern New Mexico is their inability to date lithic artifact scatters that lack diagnostic artifacts such as projectile points (Sebastian and Larralde 1989). And, as this project shows, Archaic and Ceramic period flaked stone assemblages may be generally similar despite the differences in their ages. One possible means of dealing with this problem is measuring attributes that reflect the intensity of flaked stone reduction. In the US 70 sample, at least, Archaic period flakes tend to have larger maximum dimensions and more cortex than Ceramic period remains. These differences have led to the inductively derived rules in Table 11.2, which also lists the accuracy of each rule. These rules do not allow an age determination for every assemblage within the current population. For example, the rules do not work for assemblages with between 50 and 75 percent "large" flakes. Likewise, differences in flake length cannot be applied to unscreened materials because of the bias towards recovery of large flakes. However, application of these rules does provide a way to derive testable propositions about site age, where dating the site is otherwise impossible. As a final caution, the rules outlined in Table 11.2 are inductively derived from a small number of sites, and will need to be tested with data from other sites in order to evaluate their regional applicability.

Another goal of the research was to determine temporal relationships between the excavated sites and those excavated during previous data recovery projects. A literature search and a call for information sent via the NMAC-L listserv yielded 53 radiocarbon dates from 17 nearby sites (Table 11.3). Most of these dates are from Late Archaic period features (Figure 11.1). Most of the remaining dates correspond with the Jornada Mogollon occupation; a few dates are from the Protohistoric and Historic periods.

The pattern from the 17 other sites is paralleled by that from the five sites excavated as part of the current project. Using non-calibrated dates, 11 of the 19 dates from secure contexts correspond with the Late Archaic period; one with the Middle Archaic period; three with the Late Archaic period or Early 18 Mile phase; three with the Early 18 Mile, Late 18 Mile, or Mesita Negra phases; and one with the McKenzie phase. Thus, the changing intensity of occupation along US 70 corresponds with that for the area as a whole. Given that the excavated portions of the five sites reflect short occupations by mobile hunters and gatherers, the sites' occupants must have been using other portions of the landscape, so such consistency would be expected—but only if the US 70 sample was representative of regional activity. At some level, it seems to be. When the US 70 samples andother reported samples are combined, only 21 of the 53 non-calibrated radiocarbon dates predate A.D. 1. This supports Sebastian and Larralde's (1989:54) conclusion that the intensity of the occupation of eastern New Mexico increased in the final portion of the Late Archaic period, between A.D. 1 and A.D. 750.

Table 11.2. Inductively Derived Rules for Dating Otherwise Nondiagnostic Flaked Stone Scatters

Archaic	Jornada Mogollon
3 x the number of flakes with maximum dimensions larger than 2 cm when compared with the number of flakes 2.0 cm or smaller (100 percent accurate).	Flakes with maximum dimensions of 2.0 cm or smaller (88 percent accurate).
More than 50 percent of flakes screened through 1/4 inch or smaller mesh have cortex (66 percent accurate).	50 percent or fewer flakes screened through 1/4 inch or smaller mesh have cortex (100 percent accurate).
When dealing with unscreened materials, 60 percent of more flakes have some cortex (66 percent accurate).	When dealing with unscreened materials, less than 60 percent of flakes have some cortex (66 percent accurate).

Table 11.3. Uncalibrated Radiocarbon Dates from Nearby Sites

LA Number	Beta-Analytic Num	Uncalibrated Age (BP)	Cultural Affiliation	County	Citation
6825	82889r	270+/-50	Protohistoric	Eddy	An Under-Appreciated Phenomenon: Small Non-Rock Thermal Features in Southeastern New Mexico by R. Wiseman
8053	122660a	880+/-40	Late 18 Mile Phase/Mesita Negra Phase	Eddy	
8083	122655a	1000+/-50	Early 18 Mile Phase/Late 18 Mile Phase	Eddy	
8083	122656a	930+/-50	Late 18 Mile Phase/Mesita Negra Phase	Eddy	
22107	88654	1680+/-80	Late Archaic	Eddy	Archaeological Investigations Along the Potash Junction to Cunningham Station Transmission Line Eddy & Lea Counties, New Mexico by D. Staley, K. Adams, T. Dolan, J. Evaskovich, D. Hill, R. Holloway, W. Hudspeth, R. Roxlau; 1996
22107	88655	1110+/-90	Early 18 Mile Phase/Late 18 Mile Phase	Eddy	
22107	88656	1100+/-80	Early 18 Mile Phase/Late 18 Mile Phase	Eddy	
22107	88657	700+/-90	McKenzie Phase	Eddy	
38264	118869	2820+/-60	Late Archaic	Eddy	The Dating of Annular Middens from Surface Artifacts: A Problem from the Northern Trans-Pecos Region in New Mexico by R. Wiseman
38264	118870	2910+/-50	Late Archaic	Eddy	
38264	118871	2880+/-60	Late Archaic	Eddy	
38264	118872	2930+/-50	Late Archaic	Eddy	
38264	118873	2800+/-80	Late Archaic	Eddy	
38264	118876a	110+/-50	Historic	Eddy	An Under-Appreciated Phenomenon: Small Non-Rock Thermal Features in Southeastern New Mexico by R. Wiseman
38264	122663a	920+/-50	Late 18 Mile Phase/Mesita Negra Phase	Eddy	
38264	122664a	2790+/-50	Late Archaic	Eddy	
38264	122665a	1870+/-70	Late Archaic	Eddy	
38264	126922	2730+/-170	Late Archaic	Eddy	The Dating of Annular Middens from Surface Artifacts: A Problem from the Northern Trans-Pecos Region in New Mexico by R. Wiseman
38264	126923	2890+/-60	Late Archaic	Eddy	
38264	126924	2930+/-60	Late Archaic	Eddy	
38264	126925	2900+/-90	Late Archaic	Eddy	
44565	118880a	140+/-60	Historic	Eddy	An Under-Appreciated Phenomenon: Small Non-Rock Thermal Features in Southeastern New Mexico by R. Wiseman
75160	44923	1900+/-50	Late Archaic	Roosevelt	Data Recovery at Site LA 75160 Near Kenna Draw, & at Site LA 75163, Near Bob Crosby Draw, Curry County, along the US West Right-of-Way, New Mexico by M. Sechrist & K. Laumbach
75163	44988	5890+/-50	Early Archaic	Curry	
83680	n/a	1360+/-90	Late Archaic	Eddy	An Update of LA 83680 for the Proposed Pipeline to Service the Rocky Road Federa. No. 1 Well by S. Simpson

Table 11.3. Uncalibrated Radiocarbon Dates from Nearby Sites, continued

LA Number	Beta-Analytic Num	Uncalibrated Age (BP)	Cultural Affiliation	County	Citation
98820	139022	1480+/-60	Late Archaic	Eddy	Testing & Data Recovery at Five Sites Near Carlsbad, Eddy County, New Mexico edited by J. Acklen & J. Railey, 2001
98820	139023	1550+/-60	Late Archaic	Eddy	
98820	139024	1440+/-40	Late Archaic	Eddy	
98820	139026	1430+/-100	Late Archaic	Eddy	
98820	139027	1800+/-60	Late Archaic	Eddy	
98820	139028	470+/-70	Protohistoric	Eddy	
98820	139029	2040+/-80	Late Archaic	Eddy	
98820	139030	1860+/-60	Late Archaic	Eddy	
98820	139031	1850+/-60	Late Archaic	Eddy	
98820	139032	1940+/-70	Late Archaic	Eddy	
106730	88636	1210+/-80	Late Archaic/Early 18 Mile Phase	Eddy	Archaeological Investigations Along the Potash Junction to Cunningham Station Transmission Line Eddy & Lea Counties, New Mexico by D. Staley, K. Adams, T. Dolan, J. Evaskovich, D. Hill, R. Holloway, W. Hudspeth, R. Roxlau; 1996
106730	88637	1440+/-60	Late Archaic	Eddy	
109291	88645	2710+/-80	Late Archaic	Eddy	Archaeological Testing at LA 109291, LA 109292, & LA 109294; Sites Along the Potash Junction to I.M.C. #1 Transmission Line Corridor Eddy County, New Mexico by D. Staley, J. Abbott, K. Adams, D. Hill, R. Holloway, W. Hudspeth, R. Roxlau; 1996
109291	88646	1240+/-60	Late Archaic/Early 18 Mile Phase	Eddy	
109292	88647	1200+/-60	Late Archaic/Early 18 Mile Phase	Eddy	
109292	88648	1220+/-90	Late Archaic/Early 18 Mile Phase	Eddy	
109294	88649	1150+/-60	Early 18 Mile Phase/Late 18 Mile Phase	Eddy	
109294	88650	1270+/-70	Late Archaic	Eddy	
109294	88651	1350+/-60	Late Archaic	Eddy	
109920	88639	1360+/-70	Late Archaic	Eddy	Archaeological Investigations Along the Potash Junction to Cunningham Station Transmission Line Eddy & Lea Counties, New Mexico by D. Staley, K. Adams, T. Dolan, J. Evaskovich, D. Hill, R. Holloway, W. Hudspeth, R. Roxlau; 1996
109927	88641	1270+/-80	Late Archaic	Eddy	
109927	88642	1160+/-70	Late Archaic/Early 18 Mile Phase	Eddy	
109927	88643	1160+/-70	Late Archaic/Early 18 Mile Phase	Eddy	
109930	88644	960+/-110	Late 18 Mile Phase/Mesita Negra Phase	Eddy	
116467	118881r	420+/-70	Protohistoric	Eddy	An Under-Appreciated Phenomenon: Small Non-Rock Thermal Features in Southeastern New Mexico by R. Wiseman
116469	118884a	960+/-50	Late 18 Mile Phase/Mesita Negra Phase	Eddy	
116469	118885a	960+/-60	Late 18 Mile Phase/Mesita Negra Phase	Eddy	
116469	118887a	950+/-50	Late 18 Mile Phase/Mesita Negra Phase	Eddy	

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APPENDIX A

PETROGRAPHIC ANALYSIS

Andrea J. Carpenter

Appendix A

PETROGRAPHIC ANALYSIS

Andrea J. Carpenter

INTRODUCTION

Ten sherds from sites LA 2713, LA 75159, and LA 127511 along the US 70 corridor between Roswell and Portales, New Mexico were submitted for petrographic analysis. Two sherds from LA 2713 are corrugated; the remaining sherds are Chupadero Black-on-white.

TEST PROCEDURE

A thin section was cut from each sherd. All 10 sherds were stained for potassium feldspar and petrographically examined using the Glagolev-Chayes point-counting method. The intersection of the cross hairs was taken as the point and the grain beneath it was identified, and one count was recorded for that particular grain type. When possible, a minimum of 500 points was recorded for each thin section. For this study, the point-counting stage was set to cover the horizontal and vertical transects in increments of 1.0 mm. Sand-sized grains were divided into monomineralic fragments and lithic fragments. The monomineralic fragments were counted as the mineral phase to which they belonged (e.g., quartz, biotite), while the lithic fragments were classified based on composition and texture (e.g., andesite, granite). Sherd temper was recorded as grains with discrete boundaries, different paste color, and often different inclusions than the surrounding clay paste. Sand-sized grains were measured as very coarse (VC = >1.0 mm), coarse (C = 0.5–1.0 mm), medium (M = 0.25–0.5 mm), fine (F = 0.125–0.25 mm), and very fine (VF = 0.06–0.125 mm) using a micrometer fitted to the eyepiece of the petrographic microscope. A fineness modulus (FM = cumulative percentage of VF, F, M, C, and VC sized grains/100), or coarseness value, was computed for each sample. Values range from 0 (finest) to 5 (coarsest).

PETROGRAPHIC RESULTS

Tables A.1 and A.2 summarize the results of petrographic analysis, while Figures A.1–A.4 provide selected photographs from thin sections.

Table A.1. Petrographic Attributes of the Corrugated Sherds

Component	***117-1***	***132-1***
Clay	157	97
Silt-Sized Grains	39	28
Sand-Sized Grains	125	122
Quartz	54	36
Polycrystalline Quartz	2	3
Plagioclase	8	14
Plagioclase-Altered	2	1
Microcline	26	18
Opaque	1	1
Hornblende	observed	1
Biotite	---	1
Granite	32	44
Grog (?)	---	3
Percent Silt	**12**	**11**
Percent Sand	**39**	**49**
Fineness Modulus	**2.68**	**2.73**
Total Points	***321***	***247***

Table A.2. Petrographic Attributes of the Chupadero Sherds

Component	***225-1***	***242-1***	***242-2***	***242-3***	***48-1***	***48-2***	***57-1***	***64-1***
Clay	120	291	249	306	375	220	182	166
Silt-Sized Grains	23	72	32	49	43	36	20	19
Sand-Sized Grains	59	74	91	115	69	53	52	38
Quartz	5	21	10	5	9	4	3	4
Polycrystalline Quartz	4	3	1	3	---	2	---	1
Plagioclase	---	---	4	6	1	3	3	---
Plagioclase-Altered	---	---	1	3	3	1	1	2
Potassium Feldspar	7	7	4	7	11	13	9	1
Opaque	---	---	2	2	2	---	---	1
Hornblende	---	---	observed	observed	---	---	observed	1
Biotite	observed	---	observed	1	---	---	observed	---
Clinopyroxene	---	---	2	4	1	1	observed	observed
Pyroxene/Amphibole	---	---	---	1	---	---	1	---
Granitic	---	3	7	8	4	2	2	3
Felsite (Porphyry)	2	---	25	17	6	3	1	1
Microcrystalline Calcite	1	9	6	6	observed	observed	2	1
Sandstone	1	1	---	---	---	---	---	---
Siltstone	---	2	---	---	---	---	---	---
Argillite	4	11	---	---	observed	---	1	1
Brown Grog	4	8	19	24	17	11	29	16
Opaque Grog	**30**	9	10	27	1	---	---	---
Red Grog (?)	---	---	---	---	14	13	---	7
Unknown	---	---	---	1	1	---	---	---
Percent Silt	**11**	**17**	**9**	**10**	**9**	**12**	**8**	**9**
Percent Sand	**29**	**17**	**25**	**25**	**14**	**17**	**21**	**17**
Fineness Modulus	**2.61**	**2.68**	**2.41**	**2.44**	**2.59**	**2.16**	**2.57**	**2.59**
Total Points Counted	***202***	***437***	***372***	***470***	***487***	***309***	***254***	***223***

Corrugated Sherds

Two sherds (2713-117-1 and 2713-132-1) were recovered from site LA 2713, in Unit respectively. Both sherds contain sand-sized grains of monomineralic quartz, microcline, and plagioclase and lithic fragments of granite. The granite is composed of equigranular quartz, plagioclase, and microcline and rare biotite, muscovite, and hornblende minerals (Figure A.1). Granophyric texture was also observed in few granite grains. Since many of the sand-sized grains are individual crystals (e.g. monomineralic quartz), it is unlikely that the tempering material is a crushed granite rock. Sand and weathering granite are more likely sources for the inclusions. Granitic rocks are found west of the project area in Lincoln County. The Capitan Mountains, the Sierra Blanca Peak, and the Gran Quivira area are all sources of granitic material. Intrusive rocks are also reported along US 70 southwest of Kenna in Railroad Mountain (New Mexico Geological Society 1982) but is a medium-grained olivine gabbro and hence not likely a source material (Steve Hall, personal communication, 2002).

Chupadero Black-on-white Sherds

All eight Chupadero Black-on-white sherds are tempered with crushed sherd (grog) and contain varying amounts of quartz, plagioclase, potassium feldspar, felsite (quartz monzonite porphyry or quartz monzodiorite porphyry), equigranular gra-

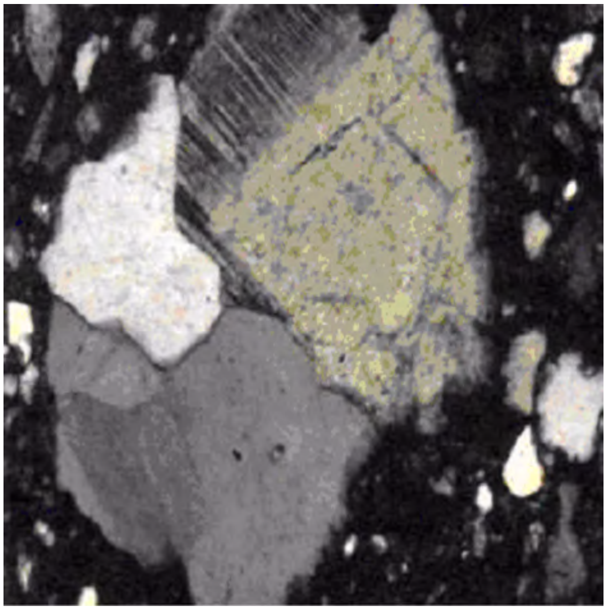

Figure A.1. Granite grain in sherd.

nitics, and mafic minerals. Many of these mineral inclusions are likely derived from the sherd temper. Microcrystalline calcite is present as sand sized grains and relict voids in the paste body of each sherd. These calcareous grains are lacking in the two corrugated samples.

Warren (1981) reports that Chupadero sherds from Gran Quivira were made with calcareous clays that also contained sand-sized grains of calcite and felsite. However, her felsite temper contains distinct bronze colored biotite that is lacking in the felsite grains in the US 70 sherds. Stewart et al. (1990) reports that Chupadero sherds from the Robinson site near the Capitan Mountains lack calcite inclusions but contain quartz monzonite, a type of felsite rock that may be present in the US 70 sherds. Potential sources of felsite rock are Sierra Blanca Peak, the Capitan Mountains, the Gran Quivira region, and Railroad Mountain along US 70. A comparative analysis of Warren's Gran Quivira sherds, Garrett's Robinson sherds, and the US 70 sherds would help us to determine if the US 70 sherds were produced locally or imported from the west.

The sherds recovered from LA 75159, Unit 101, Stratum 2, Level 2 (75159-242-2 and 75159-242-3) both contain grog and sand-sized grains of felsite and minor amounts of monomineralic quartz, plagioclase, and potassium feldspar. The felsite grains are porphyritic with phenocrysts of slightly altered plagioclase in a seriate groundmass of microgranular plagioclase, potassium feldspar, and minor quartz (Figure A.2). Trace amounts of clinopyroxene, hornblende, biotite, opaque minerals, and equigranular quartz monzonite/quartz monzodiorite were also observed in the paste. The grog contains inclusions of quartz, potassium feldspar, plagioclase, felsite, hornblende, biotite, clinopyroxene, and microcrystalline calcite. The clay

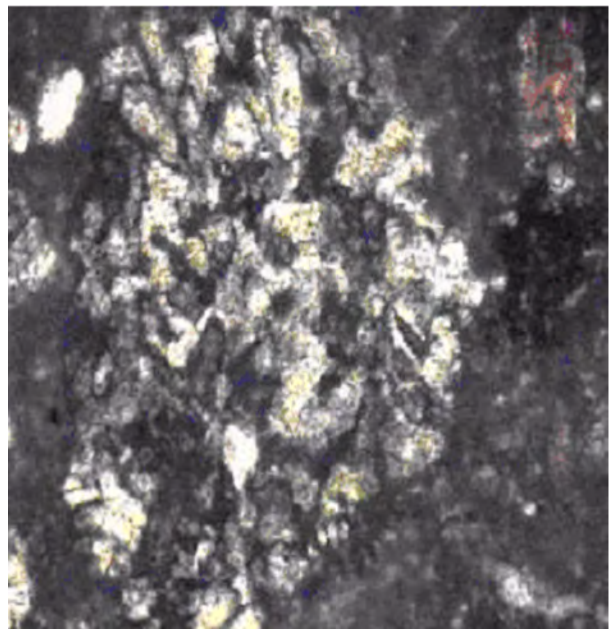

Figure A.2. Microgranular ground mass.

appears calcareous; it contains common silt-sized particles of calcium carbonate and rare sand-sized grains of microcrystalline calcite (bioclasts?) (Figure A.3). Voids, where microcrystalline calcite grains once were, are also observed.

Two sherds (75159-225-1 and 75159-242-1) were recovered from LA 75159, Unit 101, Stratum 1/2, Level 1 and Stratum 2, Level 2, respectively. Both sherds contain grog and sand-sized grains of monomineralic quartz and potassium feldspar and rounded, cryptocrystalline argillite or indurated clay pellets with rare silt-sized quartz inclusions. Trace amounts of sandstone, siltstone, hornblende, biotite, felsite, and equigranular granophyric gra-

nitic material were also observed. The grog contains inclusions of quartz, potassium feldspar, biotite, sphene, and equigranular granitics with quartz and potassium feldspar. These sherds have less mafic minerals relative to the two previous Chupadero samples. The paste contains silt-sized particles of calcium carbonate and rare sand-sized grains of microcrystalline calcite and relict voids.

Four sherds (127511-48-1, 127511-48-2, 127511-57-1, and 127511-64-1) were recovered from the site surface during the testing phase at LA 127511. The sherds were found in the expanded right-of-way on the south side of US 70. All the sherds contain grog and sand-sized grains of monomineralic potassium feldspar with lesser amounts of monomineralic quartz and plagioclase, felsite, and equigranular granitics. Trace amounts of clinopyroxene, hornblende, biotite, and opaque minerals were also observed. The grog contains inclusions of potassium feldspar, quartz, plagioclase, felsite, clinopyroxene, hornblende, biotite, equigranular granitics, and opaque minerals. Samples 125711-48-1, 127511-48-2, and 127511-64-1 contain distinct red grog (?) temper (redware?) (Figure A.4). All four sherds contain microcrystalline calcite grains and relict voids. Samples 127511-48-1 and 127511-48-2 contain common silt-sized calcium carbonate particles in a brown colored paste, whereas samples 127511-57-1 and 127511-64-1 have a more glittery paste appearance.

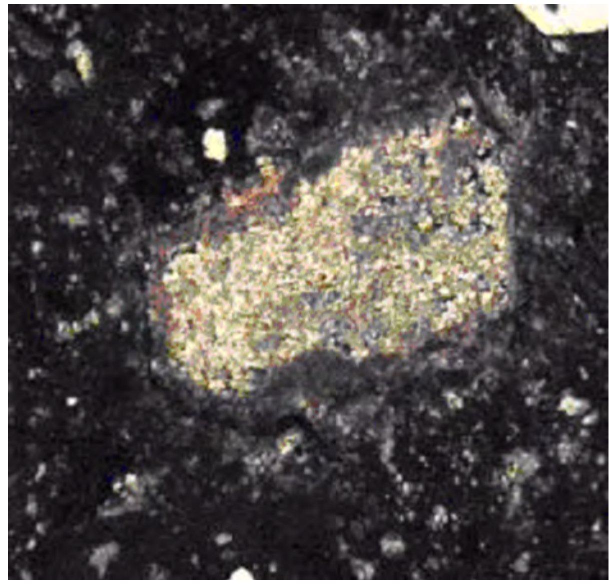

Figure A.3. Microcrystalline.

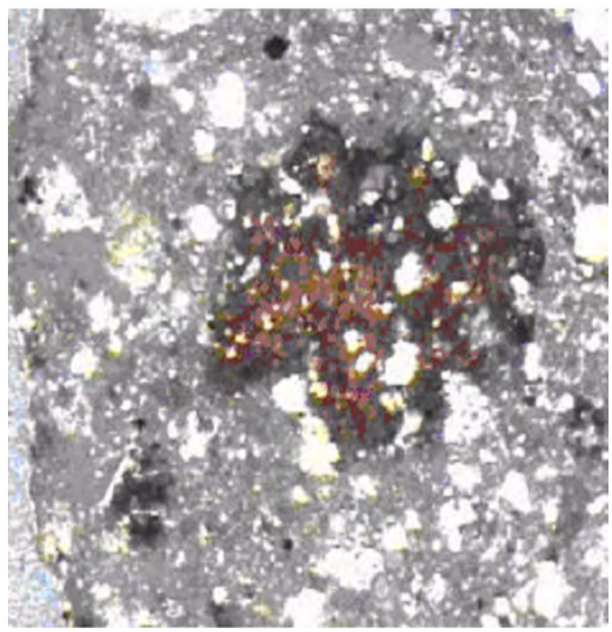

Figure A.4. Red grog.

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APPENDIX B

GEOMORPHOLOGY AND SOIL STRATIGRAPHY

Nicole Bailey

Appendix B

GEOMORPHOLOGY AND SOIL STRATIGRAPHY

Nicole Bailey

Of the eight archaeological sites selected for data recovery studies along US 70, six were chosen for detailed examination of geomorphology and soil stratigraphy. This report provides the results of field studies at LA 2713, LA 75159, LA 75163, LA 127511, LA 127518, and LA 130557 and addresses several questions relating to the geomorphology and soil stratigraphy, namely:

1. What are the dominant geomorphic processes responsible for shaping the landscape on which the sites are located?

2. What are the key soil-forming properties for interpreting the geomorphic history of each site, and why?

3. What is the nature of the deposits in which artifacts are found at each site?

GEOLOGIC AND GEOMORPHIC BACKGROUND

Five of the sites (LA 2713, LA 75159, LA 75163, LA 127511, and LA 130557) are in the Lower Pecos Valley. LA 127518 is on the Llano Estacado. Both areas are encompassed by the Great Plains physiographic province (Hawley et al. 1976).

The Lower Pecos Valley is characterized by karst topography from dissolution of evaporites (including gypsum, anhydrite, salt, and potash) of the underlying Permian Artesia Group (Hawley et al. 1976; Kelley 1971). During much of late Pliocene time, there is little or no record of deposition. This period coincides with the soil-forming interval of the Ogallala caprock caliche, a thick, highly resistant, stage IV–VI accumulation of pedogenic carbonate that caps the upper Ogallala Formation.

Until middle to late Pleistocene time,[1] the upper Pecos River was still part of the Brazos River drainage system; drainage in the lower Pecos River headed in the Sacramento range west of Roswell (Hawley et al. 1976).

Early and middle Pleistocene time was marked by deposition of the Gatuna Formation (Robinson and Lang, 1938, in Hawley et al. 1976). The Gatuna deposits are derived from reworked Ogallala gravels, uplift in the Sacramento range area, and Tertiary porphyries in the Sierra Blanca (Hawley et al. 1976). The dominant geomorphic processes during this time were salt/gypsum dissolution and dynamic alluvial processes, indicated by collapsed sink deposits and channel gravels.

The Mescalero Plain is a surface on the east side of the Pecos River that corresponds to the early Pleistocene Diamond A Plain on the west side of the river. Development of the Mescalero Plain indicates the onset of a period of stability (minimal erosion or deposition) in the Lower Pecos region, when strong calcic soils formed (Thornbury 1967; Hawley et al. 1976:Figure 1). Grading westward at a slope of 1 to 5 percent, the Mescalero Plain lies between the Pecos River terraces and the Llano Estacado escarpment and extends from Ft. Sumner to just beyond the Texas state line (Sebastian and Larralde 1989) (Figure B.1).

The Mescalero dune belt, which covers much of the Pecos Valley, extends north-south along the western escarpment of the Llano Estacado, or High Plains (Figure B.2). Deposited during the late Holocene, the dune belt is character

1. Quaternary age designations are as described in Machette et al. (1999): Holocene, < 10 ka; latest Pleistocene, 10-15 ka; late Pleistocene, 10-130 ka; middle Pleistocene, 130-175 ka; early Pleistocene, 750-1600 ka; late Quaternary, < 130 ka; late and middle Quaternary, < 750 ka.

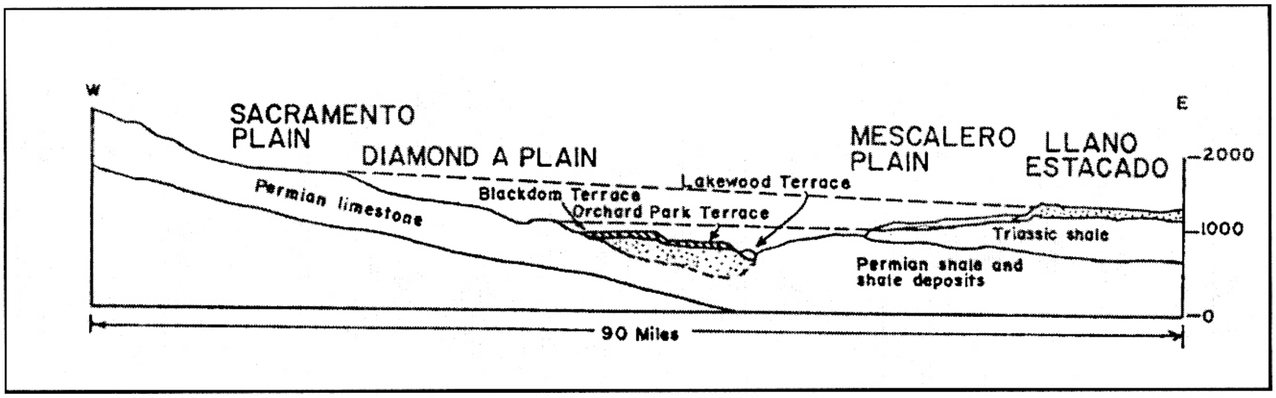

Figure B.1. Geologic cross-section of the Pecos Valley. From Sebastian and Larralde (1989).

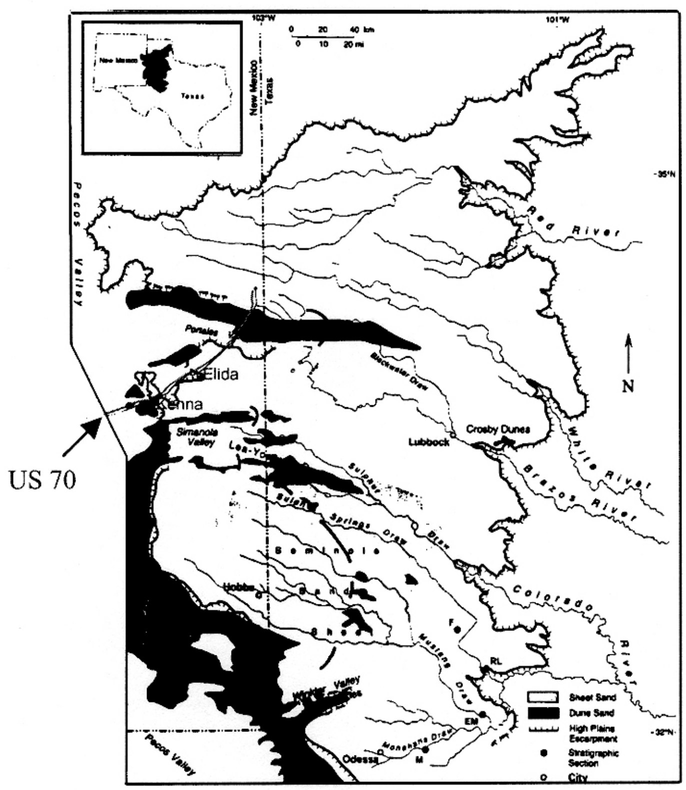

Figure B.2. Location map of dune fields and sand sheets on Southern High Plains. The local segment of US 70 has been added.

ized by sand sheets and low coppice dunes. The Southern High Plains, once part of the vast piedmont alluvial plain extending from the eastern Rocky Mountains, now exists as a broad plateau in eastern New Mexico and West Texas. Much of the Southern High Plains boundary is delineated by an erosional escarpment topped by the Ogallala caprock caliche. The Ogallala Formation, a dominantly fluvial gravel deposit with substantial eolian input, was deposited during Pliocene-Miocene time (Reeves 1976). Most of the exposed sections

and surficial deposits on the Llano Estacado are composed of Ogallala Formation deposits.

Deposited above the Ogallala Formation between 500–65 ka, the Blackwater Draw Formation is an extensive sheet-like eolian deposit (Hawley et al. 1976). The multiple paleosols imply episodic deposition (Gustavson 1996; Hawley et al. 1976).

PROCEDURES

Soils were described using methods and terminology outlined in Soil Survey Staff (1975) and Birkeland (1984). For more detailed information regarding taxonomy of soils at each site, please refer to Lenfesty (1980).

Examination of the soils at the six major sites revealed that four sites (LA 2713, LA 75163, LA 130557, and LA 127511) share a common sequence of buried soils. These buried soils will be referred to as:

1. Stage I gypsic paleosol;
2. Stage II calcic/gypsic paleosol; and
3. Late Stage III gypsic or Stage I–II gypsic paleosol.

Representative bulk soil samples were collected from each identified horizon in the following four profiles, for laboratory analysis: 1-1-a (LA 75163), 2-1-a (LA 2713), 5-5-a (75159), 6-1-a (LA127518). Horizons thicker than 20 cm were sampled every 10–15 cm. Samples were oven-dried, split, and sieved to <2 mm fraction in preparation for analyses performed by the New Mexico Tech soils lab. For carbonate and Fe-extraction procedures, samples were crushed to pass a 100 mesh sieve (0.0058 mm). Standard laboratory procedures (as described in Singer and Janitzky 1986) were employed for the following analyses: particle size, calcium carbonate content, conductivity, and pH. Particle size was analyzed using sodium pyrophosphate as a dispersing agent, sieve separation of the sand sized fraction, and pipette extraction in settling tubes. Calcium carbonate content was derived by digesting each sample with 6N hydrochloric acid in a Chittick apparatus. A soil-water extract was prepared in order to measure conductivity on a Fisher Scientific Accumet Research AR50 conductivity meter. Soil pH was measured in 0.01M $CaCl_2$ on a Fisher Scientific Accumet Research AR50 pH meter. Organic matter content was determined with the loss by ignition method.

RESULTS OF SITE INVESTIGATIONS

LA 75163

Located about 3 km east of the Pecos River (US 70 mile marker 350.5), at an elevation of about 1,110 m, LA 75163 sits on the west edge of the Mescalero Plain. The site extends to the south bank of Bob Crosby Draw, where the draw coincides with a sinkhole (Figure B.3), creating a small box canyon. Thick beds of gypsum with thinly interbedded red mudstone of the Seven Rivers Formation (Artesia Group) are exposed along the walls of the sinkhole (Kelley 1971). The surficial deposits consist of gypsiferous and sandy residuum (Hunt 1977). LA 75163 was originally investigated in 1994 by Regge Wiseman of the Museum of New Mexico, who scraped the upper 20–30 cm (but went as deep as 90 cm) and found cultural artifacts, including hearths, pits, burned rocks, flaked stone, and pottery (Wiseman 2000).

For this project, three trenches were excavated in the site, two on the north side (Trenches 2 and 3) and one on the south side of US 70 (Trench 1), all of which were oriented parallel to the highway. Trench 1 abuts the west edge of the Wiseman scrape area.

Profile 1-1-a

Profile 1-1-a is shown in Figure B.4.

Cumulic soil in coppice dune (0-73 cm)

0–2 cm: AC nongravelly dark brown (7.5YR 4/6 dry; 3/4 wet) strongly effervescent loamy sand; weak fine subangular blocky; loose; nonsticky and nonplastic; many very fine and common fine roots; abrupt and wavy boundary.

2–15 cm: Bw_b nongravelly strong brown (7.5YR 4/6 dry; 4/4 wet) sandy loam; strongly effervescent;

Figure B.3. Bob Crosby Draw near LA 75163. Note the exposed gypsum bedrock along the walls of the draw.

moderate fine subangular blocky; soft; nonsticky and nonplastic; many very fine, many fine, and few medium roots; clear and smooth boundary. * FCRs[1] (10 cm bgs).

15–40 cm: Bw_by nongravelly strong brown (7.5YR 4/6 dry; 4/6 wet) sandy loam; strongly effervescent; moderate fine-medium subangular blocky; slightly hard; nonsticky and nonplastic; many very fine, common fine, common medium, and few very coarse roots; clear and smooth boundary.

Stage I gypsic soil

40–55 cm: Bw_{b2}y nongravelly strong brown (7.5 YR 4/6 dry; 4/6 wet) sandy loam; strongly effervescent; moderate medium subangular blocky; slightly hard; nonsticky and nonplastic; many very fine, common fine, common medium, and few very coarse roots; clear and smooth boundary.

55–73 cm: C_by largely nongravelly strong brown (7.5YR 5/6 dry; 4/6 wet) sandy loam; strongly effervescent; weak fine subangular blocky; slightly hard; nonsticky and nonplastic; many very fine, common fine, common medium, and few very coarse roots; abrupt and wavy boundary.

Stage II calcic soil

73–101 cm: Btk_b nongravelly brown (7.5YR 5/4 dry; 4/4 wet) sandy loam; violently effervescent; moderate medium subangular blocky; slightly hard to hard; slightly sticky and nonplastic; very few fine clay coatings; many very fine, few fine, few medium, few coarse roots; clear and smooth boundary. ** ash pocket (80 cm bgs).

101–138 cm: Btk_{2b} nongravelly brown (7.5YR 5/3 dry; 5/4 wet) clay loam; violently effervescent; strong coarse angular blocky; hard; sticky and plastic; common distinct clay coatings/bridges; common very fine, common fine, few medium, few coarse roots; clear and wavy boundary.

Stage III gypsic soil

138–160 cm: $2By_b$ nongravelly light brown (7.5YR 6/4 dry; 5/4 wet) clay loam; strongly effervescent; moderate medium to coarse angular blocky; friable; sticky and plastic; common very

1. * precedes list of cultural artifacts found in that horizon. FCR = fire-cracked rock. ** indicates that some or all of listed artifacts were not personally observed near the described profile, but are correlated to that profile and horizon using archaeologists' field notes.

Figure B.4. Profile 1-1-a as site LA 75163.

fine and common fine roots; abrupt and smooth boundary.

160–bottom: $2By_{2b}$ nongravelly light brown (7.5YR 6/4 dry; 5/4 wet) loam; strongly effervescent; moderate fine to medium platy; friable; slightly sticky and nonplastic.

Profile 1-1-c

Profile 1-1-c is shown in Figure B.5.

0–1cm: AC nongravelly brown to reddish brown (5–7.5YR 4/4 dry; 4/4 wet) loamy sand; violently effervescent; single grain very fine granular; loose; nonsticky and nonplastic; many very fine and many fine roots; abrupt and wavy boundary.

1–7 cm: Bw_b nongravelly brown to reddish brown (7.5YR 4/4 dry; 5–7.5YR 4/4 wet) sandy loam; violently effervescent; weak fine subangular blocky; slightly hard; nonsticky and nonplastic; common very fine, common fine, and few medium roots; clear and smooth boundary.

Stage I gypsic soil

7–31 cm: BCy_b largely nongravelly brown (7.5YR 5/4 dry; 4/6wet) sandy loam; strongly effervescent; weak fine subangular blocky; slightly hard; nonsticky and nonplastic; many very fine, many fine, and few medium roots; abrupt and wavy boundary. ** FCR (550 ± 40 ^{14}C yrs BP at 15 cm bgs), charcoal pocket with associated chalcedony and chert flakes (30 cm bgs, probably overlaps into Btk_by_1).

Stage II calcic/gypsic soil

31–80 cm: Btk_by_1 nongravelly brown (7.5YR 5/4 dry; 4/4 wet) sandy loam; violently effervescent; few medium concretions (carbonate? But gypsum filaments present); moderate fine to medium subangular blocky; slightly hard; nonsticky and nonplastic; few fine clay coatings; common very fine, common fine, few medium, and few coarse roots; clear and smooth boundary. **chert scraper (60 cm bgs, may not be in situ).

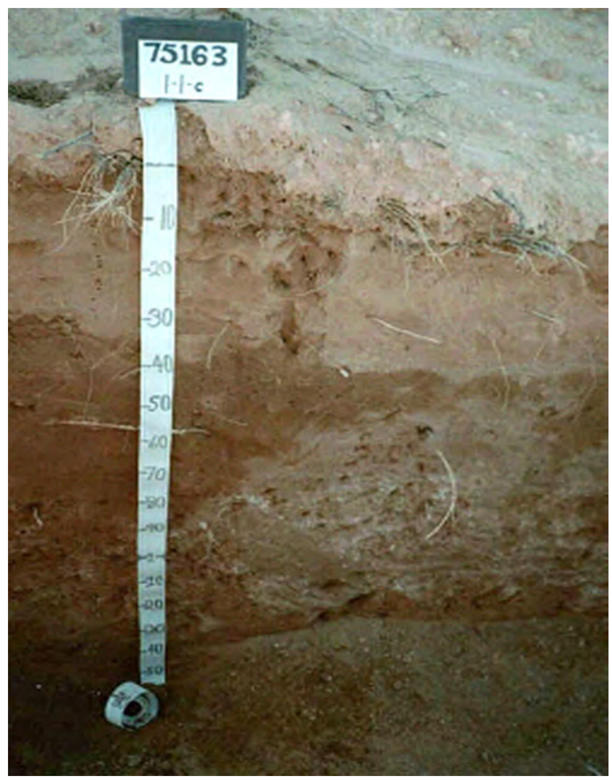

Figure B.5. Soil profile 1-1-c at site LA 75163.

80–89 cm: Btk_by_2 largely nongravelly brown to reddish brown (5–7.5YR 5/4 dry; 4/6 wet) clay loam; violently effervescent; common medium concretions (carbonate, but some could be gypsum?); moderate medium subangular blocky; slightly hard; slightly sticky and plastic; few fine clay coatings/bridges; many very fine and common fine roots; clear and wavy boundary.

Stage III gypsic soil

89–113 cm: By_{1b} nongravelly reddish brown (5YR 5/4 dry; 4/6 wet) clay loam; violently effervescent; few fine filaments and common fine to medium soft masses (carbonate/gypsum?); moderate fine angular blocky; friable; slightly sticky and plastic; common very fine and common fine roots; clear and wavy boundary.

113–bottom: By_{2b} nongravelly light reddish brown (5YR 6/4 dry; 5/6 wet) clay loam; violently effervescent; many fine to medium concretions and filaments (gypsum); moderate medium subangular blocky; friable; sticky and plastic; common very fine and common fine roots.

Profile 1-2-a

Profile 1-2-1 is shown in Figure B.6.

0–3 cm: AC largely nongravelly brown (7.5YR 5/4 dry; 3/4 wet) sandy loam; violently effervescent; single grain very fine granular; loose; nonsticky and nonplastic; many very fine and common fine roots; abrupt and wavy boundary.

3–10 cm: Bw_b largely nongravelly brown (7.5YR 5/4 dry; 3/4 wet) sandy loam; violently effervescent; moderate fine subangular blocky; slightly hard; nonsticky and nonplastic; many very fine and many fine roots; abrupt and smooth boundary. ** Ash stains (10 cm bgs), FCRs (2480 ± 40 ^{14}C yrs BP at 10 cm bgs, may actually be in Bwy_{b1}).

Stage I gypsic soil

10–28 cm: Bwy_{b1} nongravelly brown (7.5YR 5/4 dry; 4/4 wet) loam; violently effervescent; few fine filaments (gypsum?); moderate fine subangular blocky; friable; slightly sticky and nonplastic; many very fine, many fine, few medium, and few coarse roots; gradual and smooth boundary. ** Ash stain with charcoal (114.3 ± 0.6 ^{14}C yrs BP at 20 cm bgs, appears to be erroneous date, sampled from burrow), ash stain with metate (20 cm bgs), FCRs with ash stain, flakes, sherds (1240 ± 40 ^{14}C yrs BP at 20 cm bgs), FCRs (230 ± 40 ^{14}C yrs BP at 30 cm bgs).

Figure B.6. Soil profile 1-2-a at site LA 75163.

28–40 cm: Bwy_{b2} largely nongravelly reddish brown (5YR 5/4 dry; 4/6 wet) clay loam; violently effervescent; few fine filaments (gypsum?); moderate medium subangular blocky; friable; sticky and plastic; common very fine, common fine, few medium, and few coarse roots; clear and wavy boundary.

Stage II calcic/gypsic soil

40–61 cm: Btk_by nongravelly yellowish red (5YR 5/6 dry; 5/8 wet) clay loam; violently effervescent; few fine soft masses (carbonate?); moderate fine subangular blocky; friable; sticky and plastic; few distinct clay coatings/bridges; common very fine, common fine, and few medium roots; clear and smooth boundary.

61–82 cm: $Bk_{b1}y$ nongravelly reddish yellow (5YR 6/6 dry; 5/6 wet) clay loam; violently effervescent; common fine to medium soft masses (carbonate?); moderate medium to coarse angular blocky; slightly hard; sticky and plastic; common very fine, common fine, and few medium roots; clear and wavy boundary.

82–100 cm: $Bk_{b2}y$ nongravelly reddish yellow (5YR 6/6 dry; 5/6 wet) clay loam; violently effervescent; common medium concretions (carbonate?); moderate medium angular blocky; hard; sticky and plastic; common fine roots; clear and wavy boundary.

Stage III gypsic soil

100–bottom: By_b nongravelly yellowish red (5YR 5/6 dry; 5/8 wet) clay loam; violently effervescent; common medium concretions (gypsum, but also filaments present could be carbonate); moderate medium to coarse angular blocky; friable; sticky and plastic.

Trench 3

Due to similarities to Trench 2, soils in Trench 3 were not described. Trench 3: Ash stain at 35 cm bgs.

Discussion

Within the coppice dunes, the uppermost soil is a cumulic Stage I gypsic soil, while the interdunal areas consist of a thin AC horizon atop of the Stage I gypsic soil. Throughout the site, most of the cultural material was found within the upper two buried soils and on or just beneath the surface (historic eolian deposits). All of the dated material was extracted from the upper gypsic soil.

Since both of the upper two soils consist of eolian parent material, an overall generalization that eolian processes were dominant at this location during the formation of both the Stage I gypsic soil and the underlying Stage II calcic soil is reasonable. However, two important distinctions can be made. First: if a cultural artifact is adjacent to (either above or below) the boundary between these two soils, it was likely either left behind as a lag deposit during erosion, or eroded from another location and redeposited. The reasoning behind this distinction concerns the nature of the boundary itself, which represents a period of landscape instability, in which erosion, deposition, or both were occurring. Second: pedogenic carbonate and gypsum accumulations reflect climatic conditions during the time of soil formation, so a distinction can be made between "dry" and "drier" conditions. Thus, conditions were much drier during the time of Stage I gypsic soil formation than when the Stage II calcic soil formed. Unfortunately, there is a potential complication. In both soils, even though one soil property is dominant, there is evidence of overprinting. In other words, the gypsic horizons are overprinted by smaller amounts of carbonate, and the calcic horizons are overprinted by lesser amounts of gypsum. This means that "dry" and "drier" conditions cannot be assumed uncritically for the respective soils; the region has undergone multiple wetter/drier periods during the Quaternary. This is true for all of the site profiles. Instead, the designations "dominantly dry" and "dominantly very dry" should suffice.

Particle size analyses for Profile 1-1-a indicate that LA 75163 contains the highest sand content of all the sites (Table B.1). As expected, carbonate content dramatically increases downward at the boundary between the Stage I gypsic paleosol and the Stage II calcic/gypsic paleosol. Though conductivity values show a notable increase at the upper boundary of the Late Stage III gypsic paleosol, gypsum content does not show the same change. These results do not agree with the field observations. One would expect the gypsum content to spike upward along with the conductivity values, especially given that By horizons were noted.

LA 2713

LA 2713 and LA 130557 are within 350 meters of each other and are both on a small hill (with respective elevations of 1,233 m and 1,230 m), ca. 9.5 km east of Bob Crosby Draw. A total of six trenches were excavated, five at LA 2713 (three on north side and two on south side of highway) and one at LA 130557 (south side of US 70).

Table B.1. Data Summary for Soil Analyses.

		Top Depth		Partical Size (< 2mm)			Conductivity	Gypsum	pH	% Org.
Location	Horizon	(cm)	CaCO3 %	% sand	% silt	% clay	(us/cm)	(us/cm)	in CaCl	Matter
LA 75163										
Trench 1-1-a	AC	0-2	< 0.05	86	8	7	389	349	7.29	2.82
Trench 1-1-a	Bw	2-15	1.46	84	10	6	389	357	7.50	1.32
Trench 1-1-a	Bw2	15-40	2.17	83	11	6	383	360	7.54	0.92
Trench 1-1-a	Bwy	40-55	0.48	90	4	6	438	360	7.48	0.61
Trench 1-1-a	Cy	55-73	0.43	90	5	5	379	361	7.51	0.27
Trench 1-1-a	Btkb	73-101	3.14	80	10	9	374	363	7.46	0.80
Trench 1-1-a	Btkb2	101-138	9.45	63	20	16	775	423	7.21	0.95
Trench 1-1-a	2Byb	138-160	17.86	55	26	19	1170	525	7.54	0.92
Trench 1-1-a	2By2b	160-162	6.34	27	67	5	2150	587	7.38	0.71
LA 2713										
Trench 2-1-a	A	0-2	< 0.05	87	5	8	450	1140	7.74	0.37
Trench 2-1-a	Bw	2-9	< 0.05	89	3	7	454	8910	7.60	0.52
Trench 2-1-a	Bw2	9-29	< 0.05	78	7	15	449	1180	7.59	0.73
Trench 2-1-a	Btyb	29-44	< 0.05	76	12	12	452	1250	7.53	0.89
Trench 2-1-a	Btyb2	44-73	1.17	77	10	13	453	9910	7.61	0.31
Trench 2-1-a	Btkby	73-94	< 0.05	88	5	7	434	1050	7.65	0.29
Trench 2-1-a	Ckby	94-129	< 0.05	82	7	11	451	9740	7.59	0.67
LA 75159										
Trench 5-5-a	AB2	3-14	9.71	48	30	21	580	390	8.57	3.49
Trench 5-5-a	Bwy	14-30	10.82	43	32	25	1090	537	8.15	2.98
Trench 5-5-a	Bwkby	30-52	9.32	30	43	27	1570	595	8.09	2.94
Trench 5-5-a	Btkby	52-84	22.86	30	36	34	2230	583	7.94	2.92
Trench 5-5-a	Btkby2	84-105	30.20	34	30	36	931	400	8.09	1.66
Trench 5-5-a	Btb	105-146	< 0.05	41	31	28	693	394	8.08	2.02
LA 127518										
Trench 6-1-a	AB1	0-3	1.33	54	26	20	453	9990	7.29	3.40
Trench 6-1-a	Bt	3-18	2.26	39	27	34	443	1190	7.44	2.49
Trench 6-1-a	Btk	30-41	1.65	34	29	37	447	9640	7.55	0.74
Trench 6-1-a	Btk3	52-77	7.90	36	27	36	450	9600	7.71	0.71
Trench 6-1-a	K	89-121	28.44	38	26	35	501	9270	7.86	0.67

Profile 2-1-a

Profile 2-1-1 is shown in Figure B.7.

0–2 cm: A nongravelly yellowish red (5YR 5/6 dry; 4/6 wet); noneffervescent; single grain very fine granular; loose; nonsticky and nonplastic; many very fine and many fine roots; abrupt and smooth boundary.

2-9 cm: Bw largely nongravelly yellowish red (5YR 5/6 dry; 4/6 wet); noneffervescent; weak medium subangular blocky; soft; nonsticky and nonplastic; many very fine, many fine, and few medium roots; abrupt and smooth boundary.

Figure B.7. Soil profile 2-1-a at site LA 2713.

9-29 cm: Bw_2 nongravelly strong brown (7.5YR 4/6 dry; 4/4 wet); noneffervescent; weak fine subangular blocky; soft; nonsticky and nonplastic; many very fine, common fine, and few medium roots; clear and smooth boundary. ** Ash stain (between 20-35 cm).

Stage 1 gypsic soil

29–44 cm: Bty_b nongravelly yellowish red (5YR 4/6 dry; 5/6 wet); noneffervescent; moderate fine angular blocky; hard; slightly sticky and slightly plastic; many very fine, common fine, few medium, and few coarse roots; clear and smooth boundary. ** Burned caliche (40 cm bgs). 44–73 cm: Bty_{b2} nongravelly yellowish red (5YR 5/6 dry; 5/8 wet); noneffervescent; moderate medium subangular blocky; hard; sticky and plastic; many very fine, common fine, few medium, and few coarse roots; clear and smooth boundary.

Stage II calcic/gypsic soil

73–94 cm: Btk_by nongravelly yellowish red (5YR 5/6 dry; 5/8 wet); strongly effervescent; many fine filaments (gypsum?); moderate medium to coarse subangular blocky; soft; slightly sticky and slightly plastic; common distinct clay coatings; common very fine, few fine, and few medium roots; clear and smooth boundary.

94–129 cm: Bk_by nongravelly yellowish red (5YR 5/6 dry; 5/8 wet); strongly effervescent; many fine filaments and few fine concretions (gypsum and carbonate respectively?); moderate fine angular blocky; slightly hard; nonplastic and nonsticky; few fine and few medium roots; abrupt and wavy boundary.

Stage III gypsic soil

129–bottom: By_b nongravelly yellowish red (5YR 5/8 dry; 5/8 wet); slightly effervescent; weak medium subangular blocky; slightly hard to hard; slightly sticky and nonplastic.

Trench 4

Due to similarities to Trench 2, soils in Trench 4 were not described. However, several cultural features were noted, one of which was ^{14}C dated. Cultural material found in Trench 4: FCRs (20–25 cm bgs); Charcoal stain (850 ± 40 ^{14}C yrs BP at 40 cm bgs); four other charcoal stains (50–60 cm bgs).

Profile 2-2-a

Profile 2-2-a is shown in Figure B.8.

0–4 cm: AB largely nongravelly dark brown (7.5YR 3/4 dry; 3/3 wet) sandy loam; weakly effervescent; moderate fine to medium subangular blocky; hard; nonsticky and nonplastic; many ver

Figure B.8. Soil profile 2-2-a at site LA 2713.

fine and many fine roots; abrupt and wavy boundary. * charcoal stain with 1 burned caliche (1510 ± 40 ^{14}C yrs BP between 0-30 cm bgs).

4–24 cm: AB_2 largely nongravelly dark brown (7.5YR 3/4 dry; 3/3 wet) sandy loam; weakly effervescent; moderate fine angular blocky; hard; nonsticky and nonplastic; many very fine, many fine, few medium, and few coarse roots; abrupt and wavy boundary.

Stage I gypsic soil

24-36 cm: Bt_by nongravelly yellowish red (5YR 4/6 dry; 4/6 wet) clay loam; noneffervescent; moderate fine subangular blocky; very hard; sticky and plastic; common distinct clay coatings/bridges; common very fine, many fine, and few very coarse roots; abrupt and irregular boundary.

Stage II calcic soil

36–50 cm: Btk_by nongravelly yellowish red (5YR 5/6 dry; 5/8 wet) loam; violently effervescent; many fine filaments and common fine to medium irregularly-shaped concretions (carbonate); moderate fine angular blocky; very hard; slightly sticky and nonplastic; few distinct clay coatings/bridges; common very fine, many fine, few medium, and few very coarse roots; clear and smooth boundary.

50–82 cm: Cky_b nongravelly yellowish red (5YR 5/6 dry; 4/6 wet) sandy loam; violently effervescent; weak fine to medium subangular blocky; slightly hard; nonsticky and nonplastic; common very fine and common fine roots; gradual and smooth boundary.

82–133 cm: Cy_b nongravelly yellowish red (5YR 5/6 dry; 4/6 wet) sandy loam; noneffervescent; weak fine subangular blocky; slightly hard; nonsticky and nonplastic; few very fine and few fine roots.

Trench 5

Due to similarities to Trench 1, soils in Trench 5 were not described. Cultural material found in Trench 5: charcoal stain with FCRs and hearth, sherd nearby (1230 ± 40 ^{14}C yrs BP at 25 cm bgs); charred material with associated flaked stone and ground stone (970 ± 40 ^{14}C yrs BP at ? cm bgs).

Trench 3

All of the trenches were parallel to the highway with the exception of Trench 3, which bisected Trench 2 at right angles in order to expose a disturbed section thought to be a possible pit structure. Upon closer examination of the stratigraphy, two separate disturbances were identified in Trench 3, one in the south end (Disturbed 1) and one in the northern end (Disturbed 2) (Figure B.9). Disturbed 1 lies closest to the highway berm and appears to be part of the highway construction zone. The lower boundary slopes toward the highway, crosscutting the AB_2 horizon, and is lined with a traver-

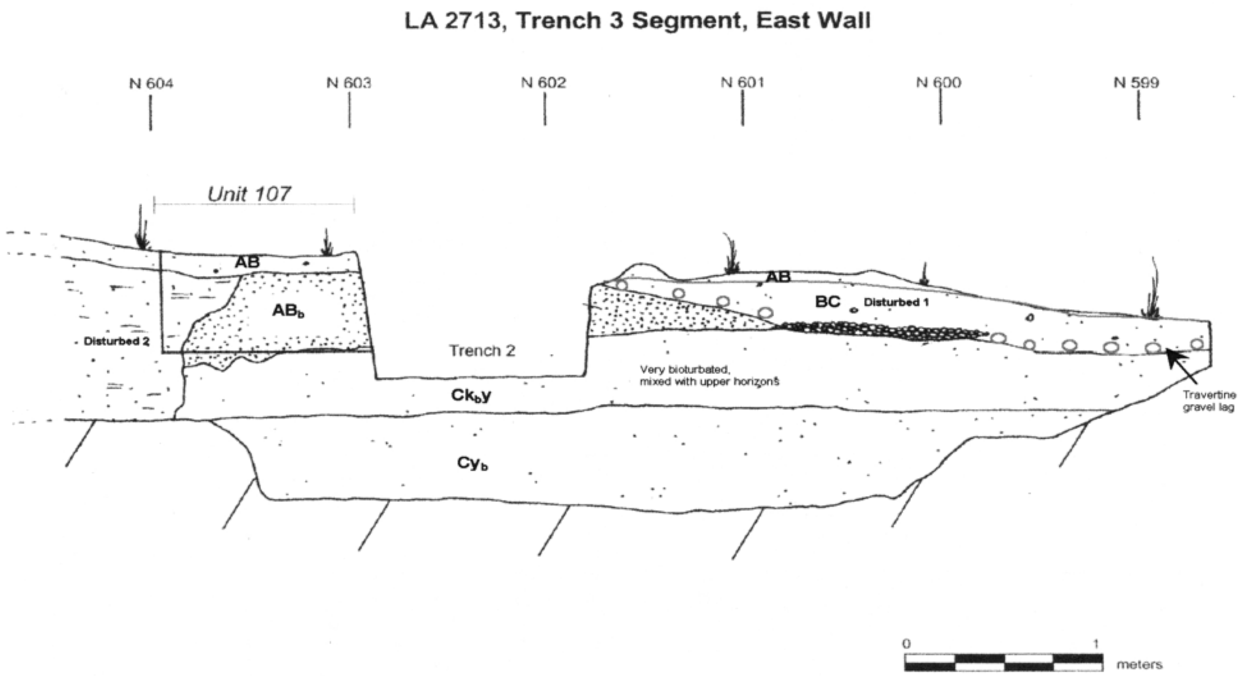

Figure B.9. Cross-section of Trench 3, LA 2713, showing Disturbed 1 and 2.

tine gravel lag. Disturbed 2 is only partly exposed and crosscuts the AB_2 and Ck_by horizons. Filled with a random mixture of gravels and chunks of the AB_2 and Ck_by horizons, it appears very mottled. Both disturbed areas are overlain by the uppermost horizon, AB_1 , and in comparison to the rest of Trench 2, are highly bioturbated. Given the stratigraphic relationships described, both disturbances were deemed modern events (i.e., within the last 50–100 yrs).

Discussion

Even though both Cky_b and Cy_b contain no observable primary sedimentary structures, they were designated as C horizons because they appear massive with little or no pedogenesis.

Wind direction is from the southwest and these sites are directly downwind of LA 75163, where gypsum is exposed, so it would make sense that gypsum is accumulating in such high concentrations at this site.

Given that all three soils of the sequence are present at this site, there are a few important differences to note between these profiles and those described at LA 75163.

First, the upper gypsic soil is 30–40 cm thicker. Recall Profile 1-1-a at LA 75163, in which the upper gypsic soil was 30+ cm thicker than in the other profiles, due to the presence of a coppice dune. Though this upper soil has a similar cumulic nature, the thickened profile cannot be attributed to the presence of coppice dunes and is relatively constant throughout sites LA 2713 and LA 130557.

Second, there is one exception to the previous statement, which can most likely be attributed to anthropogenic activities. Trenches 2, 3, and 4, which are on the north side of the highway and on either side of a worn dirt road, are missing the upper portion of the thickened gypsic soil. The dirt road bisects the site on both sides of the highway. However, while the southern road leads to a private property, the northern road leads to a gravel pit and appears to be well used. The upper 30 cm has been removed by either highway construction or by quarry-related activity. The presence of travertine clasts both on and just below the surface of the northern profiles also supports this idea, as the

clasts are clustered around the entrance to the dirt road.

Third, based on gypsum and carbonate accumulations, the degree of soil development is less than at LA 75163, yet the sediments are significantly more indurated and rubified. This issue will be addressed in the general discussion section of this appendix.
Overall, lab analyses for Profile 2-1-a support the field observations (Table B.1). Carbonate content was barely traceable (< 0.05%) in all but one of the horizons. Soluble salt content remained consistently low throughout the profile, while gypsum content was highly variable. Field observations indicated that this site had the highest gypsum content, so it is not surprising that gypsum values were more than an order of magnitude higher than at LA 75163. The high variability suggests that much of the gypsum accumulation is not pedogenic, as the higher values are randomly distributed in the profile in relation to the buried soils.

LA 130557

Due to differences in the lower profile, both the north and south walls of Profile 3-1-a were described.

Profile 3-1-a (South Wall of Trench)

0–4 cm: A nongravelly strong brown (7.5YR 4/6 dry; 4/4 wet) sandy loam; noneffervescent; single grain very fine granular; loose; nonsticky and nonplastic; many very fine and many fine roots; abrupt wavy boundary.

4–15 cm: Bw nongravelly strong brown (7.5YR 4/6 dry; 4/4 wet) sandy loam; noneffervescent; weak fine subangular blocky; slightly hard; nonsticky and nonplastic; many very fine and many fine roots; clear and smooth boundary.

15–29 cm: Bw_2 nongravelly strong brown (7.5YR 4/6 dry; 5-7.5YR 4/6 wet) sandy loam; noneffervescent; moderate very fine to fine subangular blocky; slightly hard; nonsticky and nonplastic; many very fine, many fine, and few medium roots; clear and smooth boundary.

Stage I gypsic soil

29–50 cm: Bty_b nongravelly yellowish red (5YR 4/6 dry; 4/6 wet) loam; noneffervescent; few very fine filaments (gypsum); moderate medium angular blocky; hard; slightly sticky and slightly plastic; common distinct clay coatings/bridges; many very fine, common fine, and few medium roots; clear and wavy boundary.

50–64 cm: Bty_{b2} largely nongravelly yellowish red (5YR 5/8 dry; 5/8 wet) sandy loam; noneffervescent; few very fine filaments (gypsum); moderate medium subangular blocky; hard; slightly sticky and nonplastic; common distinct clay coatings/bridges; common very fine, common fine, and few medium roots; clear and smooth boundary.

Gypsic soil

64–90 cm: Bwy_b nongravelly yellowish red (5YR 5/8 dry; 5/8 wet) sandy loam; noneffervescent; few very fine filaments (gypsum); weak fine to medium subangular blocky; slightly hard; nonsticky and nonplastic; common very fine and common fine roots; clear and smooth boundary.

90–bottom: Cy_b nongravelly yellowish red (5YR 5/8 dry; 4/6wet) sandy loam; noneffervescent; weak fine subangular blocky; slightly hard; nonsticky and nonplastic; few very fine and few fine roots.
Profile 3-1-a (North Wall of Trench)

0–4 cm: A noneffervescent

4–18 cm: Bw noneffervescent

18–33 cm: Bw_2 noneffervescent

Stage I gypsic soil

33–50 cm: Bty_b noneffervescent

50–64 cm: Bty_{b2} noneffervescent; clear and wavy boundary

Stage II calcic soil

64–100 cm: Btk_by violently effervescent; gradual and smooth/broken boundary

100–bottom: Ck_by nongravelly; violently effervescent

On the north wall, the Btk_by horizon appears to be a remnant calcic paleosol, which would correlate to the calcic paleosol observed at the first two sites. Interpreting the remnant was tricky for several reasons. First, it existed as an isolated chunk (~80 cm long) bounded on both sides by the Bwy_b horizon seen elsewhere at that depth. Second, it was not in the south wall profile. Third, the calcic paleosol was absent throughout most of the trench, except at the east end, where again it was observed only on the north wall. Instead of finding a large chunk like that in Profile 3-1-a, I was only able to find localized whitened areas (~20 cm diameter). Nevertheless, designating the calcic chunk and whitened areas as krotovinas was not possible, as neither location showed any evidence of burrowing. Further evidence that these were indeed part of an in situ calcic paleosol were the HCl test results. While no other horizon in the profile reacted to hydrochloric acid, including the Bwy_b surrounding the remnants, both the large chunk at the west end and the whitened areas at the east end of the trench violently effervesced.

If, in fact, there was a calcic soil present at one time it is unclear why it does not appear in the south wall of the trench. In the interests of safety, however, the trench was not consistently excavated to a suitable depth for viewing the entire soil profile throughout the length of the trench. Due to the uneven excavation pattern, it may be possible that other remnants exist. One explanation for the discontinuous nature of the calcic paleosol is that the overlying sediments were eroded at one time, thereby exposing the calcic horizon to the effects of leaching and subsequent degradation.

Discussion

In terms of carbonate and gypsum accumulation, LA 2713 and LA 130557 are the most unusual sites of those examined. As the only sites to contain horizons with little or no carbonate, they may ultimately serve an important role when evaluating soil development at all six locations. Though all three buried soils were present, the upper and lower gypsic soils contain no carbonate. Some possible implications are: (1) assuming that parent material (eolian sand) contains some carbonate, this site must have a different source than first two sites; (2) assuming that parent material contains no carbonate and that all carbonate accumulation is pedogenic, other sites had a constant source of carbonate, while these sites has not; or (3) within upper and lower gypsic soils, all of the carbonate has been flushed out of the profile. This last possibility does not seem likely at first, since both have gypsum accumulations, but gypsum filaments are forming on top of clay films, so perhaps they are recent accumulations.

As LA 2713 and LA 130557 are within 350 m of one another, they are essentially the same location. Sediments of the upper gypsic soil at this location are eolian-derived, with some additional sheetwash component included, especially at LA 130557. Unlike at LA 75163, carbonate is not present in the Stage I gypsic soil. The absence of carbonate indicates that this location remained arid during the soil-forming period, with no record of wetter conditions like that of LA 75163.

LA 127511

LA 127511 is situated on a hill 58 km east of Bob Crosby Draw and 6.4 km west of the Llano Estacado scarp (US 70 mile marker 386.7). The hill was once part of the Llano but is now an isolated remnant. The highway cuts through the hill, exposing conglomerates and cross-bedded coarse sand layers with gravels, all part of the Ogallala Group.

Profile 4-1-a

Profile 4-1-a is shown in Figure B.10.

0–10 cm: AB 10% gravels; strong brown (7.5YR 4/6 wet) loam; violently effervescent; weak fine subangular blocky; very friable; slightly sticky and slightly plastic; many very fine and many fine roots; clear and wavy boundary.

10–25 cm: Bwk 10-25% gravels; brown (7.5YR 5/4 dry; 4/6 wet) loam; violently effervescent; carbonate coatings on bottoms of gravels; weak fine angular blocky; friable; slightly sticky and slightly

Figure B.10. Soil profile 4-1-a at site LA 127511.

plastic; many very fine, many fine, and few medium roots; clear and wavy boundary.

25–55 cm: Bwk$_2$ 25% gravels; brown (7.5YR 5/4 dry; 4/6 wet) loam; violently effervescent; carbonate coatings on bottoms of gravels; weak fine subangular blocky; friable; slightly sticky and slightly plastic; many very fine, many fine, and few medium roots; clear and wavy boundary.

Stage I calcic overprinting Stage II or III gypsic soil

55–65 cm: Bty$_b$k 25% gravels; brown (7.5YR 5/4 dry; 4/6 wet) sandy loam; violently effervescent; reworked gravels coated with gypsum either on bottom or all over, then overprinted with carbonate coatings; weak fine subangular blocky; friable; slightly sticky and nonplastic; few fine to distinct clay coatings; many very fine and many fine roots; clear and wavy boundary.

65–82 cm: Bty$_b$k$_2$ mostly gravels (25–50%); brown (7.5YR 5/4 dry; 4/6 wet) sandy loam; violently effervescent; reworked gravels from lower horizons partly or completely coated with gypsum, then overprinted with carbonate coatings; weak very fine to fine subangular blocky; slightly hard; slightly sticky and nonplastic; few fine to distinct clay coatings/bridges; common very fine and common fine roots; abrupt and wavy boundary.

82–110 cm: Cy$_b$k mostly gravels (75%); brown (7.5YR 5/4 dry; 4/6 wet); violently effervescent; carbonate is disseminated as quasi-laminar, gravels in this horizon and one below are partly or completely coated with gypsum; moderate medium angular blocky; extremely hard to locally loose; slightly sticky and nonplastic; common very fine and many fine roots; abrupt and wavy boundary. Carbonate present as continuous pebble coatings with some inter-pebble coatings in lower horizon; very hard.

110–bottom: Cy$_b$k$_2$ mostly gravels (75%); (5YR 6/3 wet); strongly efferevescent; loose to locally very hard.

Discussion

There is a noticeable texture change at the boundary between Bty$_b$k$_2$ and Cy$_b$k; eolian material with sheetwash gravels changes to mostly gravels with some sand. Water is impeded by the higher clay content in Bty$_b$k$_2$, thus carbonate is concentrated just beneath this texture boundary in a quasi-laminar fashion. The lower portion of this gravelly horizon (Cy$_b$k$_2$) is loose in many areas. Thus, Cy$_b$k is acting as a Stage III calcic soil in the upper portion and more like a Stage I or II in the lower portion.

Profile 4-1-a is on a northeast-facing slope, while the western part of the trench is on the hilltop. The thicknesses of the uppermost soil differ by 35 cm (20 cm thick on the hilltop, 55 cm thick on the slope), indicating that sheetwash has moved downslope and thickened the soil profile.

The gravels in the lower two horizons are imbricated, which suggests that they are stream deposits of the Ogallala Formation. Interestingly, the pebbles/cobbles (most noticeably, granite clasts) are very weathered and friable with only biotite and quartz still recognizable.

The upper horizons contain reworked gravels that are partly or completely coated with gypsum, then partly coated with carbonate.

LA 75159

LA 75159 is situated along the main stem of Kenna Draw, a valley that connects to a natural pass onto the Llano Estacado (at US 70 mile marker 387.3). Until the late 1800s, a natural spring emerged in the northern portion of the site, creating a small pond that has since dried up and filled with sediment.

Five trenches were excavated, one on the north side of US 70 and four on the south side (Figure B.11). Unfortunately, much of this site is anthropogenically altered, as it coincides with a working cattle ranch. On the north side of the highway, for example, just north of the US 70 right-of-way, an earthen stock tank was built. Much of the surrounding ground surface was probably scraped in order to create the tank. In addition, US 70 was constructed at a higher level than the adjacent ground surface, most likely to accommodate a culvert. On the south side of the highway, a cow path abuts the west end of Trench 2 before it veers toward an artificial drainage that issues from the culvert (Figure B.11). Overburden from the excavation of the drainage was observed in the upper 20 cm of Trench 1.

Profile 5-1-a

Profile 5-1-1 is shown in Figure B.12.

0–5 cm: A 10% gravels; dark yellowish brown (10YR 4/4 dry; 4/3 wet) sandy loam; violently effervescent; moderate medium subangular blocky; slightly hard; slightly sticky and slightly plastic; many very fine and common fine roots; abrupt and wavy boundary.

Figure B.11. Trench 2 at site LA 75159, looking eastward. Note the cow path to the left of the trench that bears left toward the culvert

5-23 cm: C 10-25% gravels; dark yellowish brown (10YR 4/4 dry; 4/3 wet) clay loam; violently effervescent; moderate medium subangular blocky; slightly hard; sticky and plastic; many very fine and common fine roots; abrupt and smooth boundary.

23–29 cm: ABw_b 10% gravels; dark yellowish brown (10YR 4/4 dry; 3/3 wet) sandy loam; violently effervescent; weak fine subangular blocky; slightly hard; slightly sticky and slightly plastic; many very fine, many fine, and few medium roots; abrupt and wavy boundary.

29–40 cm: AB_b 10% gravels; dark brown (10YR 4/3 dry; 3/3 wet) clay loam; violently effervescent; moderate fine angular blocky; very hard; sticky and plastic; many very fine, many fine, and few medium roots; abrupt and irregular boundary.

40–66 cm: Btk_by 10% gravels; yellowish brown (10YR 5/4 dry; 4/4 wet) clay loam; violently effervescent; weak fine subangular blocky; slightly hard; sticky and plastic; few distinct clay coatings/bridges; many very fine, common fine, and few medium roots; clear and irregular boundary.

66–87 cm: $Btky_b$ 10% gravels; pink (7.5YR 7/3 dry; 6/4 wet) clay loam; strongly effervescent;

Figure B.12. Soil profile 5-1-a at site LA 75159.

many medium filaments (gypsum?); moderate fine subangular blocky; hard; sticky and plastic; common distinct clay coatings/bridges; few very fine and common fine roots; clear and smooth boundary. * dark strata with bone and artifacts (60-80 cm bgs), probably not in situ due to burrowing.

87–99 cm: Bky_b 10% gravels; pink (7.5YR 7/3 dry; 6/4 wet) clay loam; strongly effervescent; moderate fine to medium subangular blocky; hard to very hard; sticky and plastic; few very fine and common fine roots; clear and smooth boundary.

99–110 cm: Bky_{b2} 10% gravels; pinkish white (7.5YR 8/2 dry; 6/4 wet) clay loam; weakly to strongly effervescent; moderate fine to medium angular blocky; hard to very hard; sticky and plastic; abrupt and smooth boundary.

110–142 cm: $2Bky_b$ 10% gravels; pink (7.5YR 7.3 dry; 5/4 dry) clay loam; violently effervescent; moderate fine subangular blocky; slightly hard; sticky and plastic; few very fine, common fine, and few medium roots; gradual and wavy boundary.

142–bottom: $2Bky_{b2}$ 10% gravels; light brown (7.5YR 6/4 dry; 6/4 wet) sandy loam; strongly effervescent; moderate medium subangular blocky; hard; slightly sticky and nonplastic.

One artifact was found in AB_b horizon, but some were found as deep as 80 cm in the preliminary survey (especially in upper 0.5 m).

AB_b and Bky_b may be two separate soils, because both lower boundaries are very irregular.

The C horizon is recently disturbed material, probably due to excavation of the culvert. Composed of a random mixture of gravels and chunks of older gypsic soils, the C horizon is unusually well indurated for material so recently disturbed. This can probably be attributed to the high gypsum content in the gypsic soil chunks.

ABw_b still has what is left of surface organics, lots of very fine to fine roots, in the upper portion of the horizon. It appears that this was recently buried.

$Bkyb_2$ is completely indurated with gypsum, appearing somewhat laminar. This accumulation is not typical of a Stage III gypsic soil. Instead, one would expect to see the laminations in a late Stage III or early Stage IV. Similar to the carbonate laminations in Profile 4-1-a, this accumulation can be attributed to an abrupt change in sediment texture. The horizon below ($2Bky_b$) is finer-grained and consequently, impedes the flow of water. Thus, the gypsum concentrates at the texture boundary.

Profile 5-2-a

Profile 5-2-a is shown in Figure 13.

0–10 cm: AB largely nongravelly brown (10YR 4/3 dry; 3/4 wet) loam; strongly effervescent; moderate fine subangular blocky; slightly hard; slightly sticky and slightly plastic; many very fine, many fine, and common medium roots; clear and wavy boundary.

10–45 cm: ABk largely nongravelly dark brown (10YR 3/3 dry; 3/3/ wet) silty clay loam; weakly effervescent; common fine filaments and discontinuous coatings on pebbles (carbonate?); moderate very fine to fine subangular blocky; hard; sticky and plastic; many very fine, many fine, and common medium roots; clear and wavy boundary.

Figure B.13. Soil profile 5-2-a at site LA 75159.

Stage I calcic soil

45–70 cm: Btk largely nongravelly dark yellowish brown (10YR4/4 dry; 7.5–10YR 3/3 wet) silty clay; strongly effervescent; common fine carbonate filaments and discontinuous coatings, moderate medium angular blocky; extremely hard; very sticky and very plastic; common distinct clay coatings/bridges; many very fine, many fine, common medium, and few coarse roots; clear and wavy boundary.

Stage II gypsic soil

70–100 cm: Btky largely nongravelly brown (7.5YR 5/4 dry; 4/6 wet) silty clay; strongly effervescent; common fine carbonate filaments developing atop of clay films; many medium gypsum nodules; moderate medium angular blocky; very sticky and very plastic; common distinct clay coatings/bridges; many very fine, common fine, and few medium roots; clear and smooth boundary.

100–bottom: Bky_b largely nongravelly brown (7.5YR 5/4 dry; 4/6 wet) clay loam; violently effervescent; common fine filaments (carbonate or gypsum?); moderate fine to medium angular blocky; extremely hard; sticky and very plastic; common distinct clay linings in pores and coatings on grains; common very fine and common fine roots.

This is a cumulic soil profile in which translocated clays in the Bt horizons have been subsequently overprinted by carbonate filaments.

Filaments and pebble coatings in ABk are believed to be carbonate given their reaction to HCl.

The bottom horizon (Bkyb) was labeled as a buried soil even though the label seems to follow the sequence from above. However, it is much more friable than Btky and, though filaments are present, no gypsum nodules were observed as in Btky.

Profile 5-2-b

Profile 5-2-b is shown in Figure 14.

0–2 cm: AB violently effervescent; abrupt and wavy boundary.

2–20 cm: $C_{disturbed}$ violently effervescent; abrupt and smooth boundary.

20–41 cm: Ek_b violently effervescent; moderate medium angular blocky; clear and wavy boundary. * burned caliche, ground stone, flaked stone (30 cm bgs).

41–75 cm: Bt_b noneffervescent; moderate fine to medium angular blocky; many prominent clay coatings/bridges; many very fine and many fine roots; clear and wavy boundary.

75–93 cm: Btk_b violently effervescent; very hard; gradual and wavy boundary.

93–bottom: Bky_b violently effervescent; many medium to large (up to 4cm diam.) gypsum filaments and nodules, however some of the filaments are most likely carbonate; extremely hard.

The “E” horizon is important, because it is not present at the east end of the trench, where artifacts are found. If it is part of the same soil as Btb (and Abk at east end), it must have been eroded from the east end of the trench, which implies that any artifacts are not in situ (because it is an erosional boundary). Another possible explanation is that this horizon is actually an older disturbed layer.

Figure B.14. Soil profile 5-2-a at site LA 75159.

The lower boundary is not abrupt like that of $C_{disturbed}$, but is more gradational.

Profiles 5-2-m₁ and 5-2-m₂

Profiles 5-2-m_1 and 5-2-m_2 were described between Profiles 5-2-a and 5-2-b, but not in great detail. In both profiles, a highly indurated, whitened By horizon (Stage III gypsic) was noted at the bottom, below a Bky horizon that is analogous to that of Profile 5-2-b. These lower horizons (Bky and By) are bioturbated, but more so in 5-2-m_1. It seems likely that neither 5-2-a or 5-2-b had been excavated deep enough to expose this gypsic horizon.

Profile 5-4-a

0–2 cm: AB violently effervescent.

2–35 cm: AB_2 violently effervescent.

35–51 cm: AB_3 or Bw violently effervescent * dark stain (40 cm bgs-base).

51–65 cm: Btk violently effervescent.

65–99 cm: Btk_2 violently effervescent.

Stage III calcic soil

99–137 cm: Btk_3 violently effervescent.

137–bottom: Bky_b violently effervescent.

Profile 5-5-a (pond deposits)

Profile 5-5-a is shown in Figure B.15.

0–3 cm: AB largely nongravelly dark grayish brown (10YR 4/2 dry; 4/3 wet); violently effervescent; moderate very fine to fine subangular blocky; very hard; many very fine and many fine roots; abrupt and wavy boundary.

3–14 cm: ABy largely nongravelly dark brown (10YR 3/3 dry; 4/3 wet); violently effervescent; few very fine gypsum filaments; few fine to common reworked carbonate nodules; strong medium to coarse angular blocky; very hard to extremely hard; many very fine and common fine roots; abrupt and wavy boundary.

14–30 cm: Bwy largely nongravelly grayish brown (10YR 5/2 dry; 4/2 wet); violently effervescent; common medium gypsum filaments (some carbonate?); moderate fine angular blocky; hard to very hard; common very fine, common fine, and common medium roots; abrupt and smooth boundary. * sherds, flakes (1900 ± 60 ^{14}C yrs BP at 25 cm bgs).

30–52 cm: Bwk_by largely nongravelly dark grayish brown (10YR 4/2 dry; 3/3 wet); violently effervescent; few fine filaments (carbonate and gypsum); moderate medium subangular blocky; hard; many very fine, many fine, and few medium roots; abrupt and wavy boundary, contains bone (46 cm). * projectile pt., sherds, flakes, bone fragments (770 ± 40 ^{14}C yrs BP at 35 cm and 690 ± 70 ^{14}C yrs BP at 48 cm bgs).

52–84 cm: Btk_by largely nongravelly dark gray (10YR 4/1 dry; 3/2 wet); violently effervescent ++; many medium gypsum filaments on top of clay films (can see crystals) and thin discontinuous

Figure B.15. Soil profile 5-5-a at site LA 75159.

coatings on pebbles (do not react with HCl as much as matrix); moderate fine to medium subangular blocky; moderate distinct clay coatings/bridges; slightly hard; many very fine, common fine, few medium, and few coarse roots; abrupt and smooth boundary. * sherd (1400 ± 40 ^{14}C yrs BP at 71 cm bgs), artifact? (1790 ± 40 ^{14}C yrs BP at 78 cm bgs).

84–105 cm: Btk_by_2 25% gravels; light brownish gray (10YR 6/2 dry; 3/2 wet); violently effervescent ++; many medium filaments and nodules (seem to be gypsum, react weakly with HCl); moderate fine angular blocky; moderate distinct clay coatings/bridges; extremely hard; common very fine, few fine, and few medium roots; abrupt and smooth boundary.

105–bottom: Bt_b largely nongravelly grayish brown (10YR 5/2 dry; 3/3 wet); weakly effervescent; strong medium to very coarse prismatic; moderate distinct clay coatings/bridges; extremely hard; common very fine, few fine, and common medium roots; contains travertine clasts, bones (132 cm), Fe nodules and stains. * artifact? (2750 ± 40 ^{14}C yrs BP at 112cm bgs, 3070 ± 50 ^{14}C yrs BP at 134cm bgs), bison mandible and ribs, teeth and other bones, scraper, flakes, ground stone? (143-162 cm bgs).

Below recorded bottom: * box turtle shell fragments, bison tibia fragments, rib bones, quartzite and chert flakes, quartzite scraper (3550 ± 40 ^{14}C yrs BP at 163 cm bgs, 2980 ± 40 ^{14}C yrs BP at 175 cm bgs).

The upper 20–30 cm may have been disturbed. These deposits appear to be well mixed, though horizonation is evident, an indication that this disturbance is older than that in Trenches 1 and 2 (perhaps the pond was filled in a land owner sometime in the past).

Two distinct carbonate accumulations not associated with soil horizons were noted, one at 52–66 cm and the other at 88–105 cm (Figure B.15). Lab analyses also show a spike in carbonate content at these two locations in the profile, though carbonate content is high throughout the profile. The two zones of carbonate accumulation do not appear to be the result of illuvial transport through the soil horizon because they are not accumulating as coatings on peds/clasts or as filaments. Rather, they seem to be the result of evaporation of a capillary fringe above what was once the water table. Thus, the two carbonate zones are recording two different water table levels.

According to lab results, gypsum content remains consistently low throughout the profile, but soluble salt content is considerably higher and more variable. As expected, the pond site is more clay-rich and organic-rich than at other locations.

Samples collected throughout the pond profile provide a relatively complete ^{14}C dating record. The samples have a strong linear relationship and if the highest and lowest samples are discarded, they indicate that the pond sedimentation rate was a relatively constant 3.5 cm/100yrs.

With no other ^{14}C dates obtained from the other four trenches, it is difficult to assess what geomorphic processes were active at the calculated time

intervals in Trench 5. Since the trench location overlaps with a paleopond, the dates only provide ages for various times during pond sedimentation. However, active sedimentation itself is indicative of upslope erosional processes, in this case either by alluvial or sheetwash processes. Additionally, LA 75159 is less than 8 km from the western edge of the High Plains, for which there are numerous climatological and/or geomorphological studies (Holliday 2001; Muhs and Holliday 2001). It is therefore reasonable to extrapolate general climate trends from these studies to LA 75159 and even to the other sites. The regional Quaternary climate trends will be addressed further in the general discussion section of this appendix.

LA 127518

The only site on the Llano Estacado, LA 127518 is 4.5 km east of LA 75159 (at US 70 mile marker 390.2).

Profile 6-1-a

Profile 6-1-a is shown in Figure B.16.

Figure B.16. Soil profile 6-1-a at site LA 127518.

0–3 cm: AB largely nongravelly brown (7.5YR 4/4 dry; 3/4wet) silty clay loam; violently effervescent; weak fine to medium subangular blocky; sticky and plastic; hard; many very fine and many fine roots; clear and smooth boundary.

3–18 cm: Bt largely nongravelly strong brown (7.5YR 4/6 dry; 5–7.5YR 4/6 wet) silty clay loam; strongly effervescent; moderate fine to medium subangular blocky; sticky and plastic; common fine clay coatings/bridges; hard; many very fine, many fine, and few medium roots; gradual and smooth boundary.

18–30 cm: Bt_2 largely nongravelly yellowish red to strong brown (5–7.5YR 4/6 dry; 3/4 wet) silty clay loam; violently effervescent; moderate fine to medium angular blocky; sticky and very plastic; common distinct clay coatings/bridges; hard; many very fine, many fine, and few medium roots; clear and smooth boundary.

30–41 cm: Btk largely nongravelly yellowish red (5YR 4/6 dry; 4/6 wet) silty clay; violently effervescent +; few fine carbonate filaments; strong fine angular blocky; very sticky and very plastic; common distinct clay coatings/bridges; very hard; many very fine, many fine, and few medium roots; clear and smooth boundary.

41–52 cm: Btk_2 largely nongravelly yellowish red (5YR 5/6 dry; 4/6 wet) silty clay; violently effervescent +; common medium carbonate concretions; strong fine angular blocky; very sticky and very plastic; common distinct clay coatings/bridges; very hard; common very fine and many fine roots; clear and smooth boundary.

52–77 cm: Btk_3 largely nongravelly yellowish red (5YR 4/6 dry; 4/6 wet) silty clay; violently effervescent +; common to many large carbonate seams; strong fine angular blocky; very sticky and very plastic; common distinct clay coatings/bridges; extremely hard; common very fine and many fine roots; clear and smooth boundary.

77–89 cm: Btk_4 largely nongravelly yellowish red (5YR 4/6 dry; 4/6 wet) silty clay; violently effervescent +; many large carbonate seams and concretions; strong fine to medium angular blocky; very

sticky and very plastic; many prominent clay coatings/bridges; extremely hard; few very fine and common fine roots; abrupt and smooth boundary.

89–129 cm: K largely nongravelly light reddish brown (5YR 6/4 dry; 5/6 wet) silty clay; violently effervescent +; moderate fine to medium angular blocky; very sticky and very plastic; extremely hard; few very fine and few fine roots.

Profile 6-1-b

Profile 6-1-b is shown in Figure 17.

0–3 cm: AB.

3–18 cm: Bt *dark stain (10 cm bgs)

18–30 cm: Btk common medium carbonate concretions. * med-dark stain (30-120 cm bgs).

30–40 cm: Btk_2 common medium to large carbonate concretions.

40–62 cm: Btk_3 common medium to large carbonate seams and concretions; abrupt and irregular boundary.

62–bottom: K 75% gravels (subrounded, poorly sorted, coarser-upward).

The entire profile is cumulic. No gypsum was observed at this site, which has the finest-grained sediments of all six sites. No datable cultural features were found more than 10 cm below the surface.

Particle size analyses for Profile 6-1-a reveal that LA 127518 does indeed have the highest clay and silt content of any of the sites (Table B.1). Notably, and as expected, carbonate content increases 8 percent in the lower Btk horizons and increases even more dramatically in the K horizon, to 28 percent. Similar to what was found at LA 2713, soluble salt content is consistently low throughout the profile, while gypsum content is very high and more variable. The high gypsum content does not agree with the field observations. Since this profile contains more fine-grained sediments, the gypsum probably imparted a sandier feel to the sediment as noted by Reheis (1987) and thus was not recognized.

Figure B.17. Profile 6-1-b at site LA 127518.

GENERAL DISCUSSION

Soils and Soil Formation in the Project Area

All three of the buried soils (Stage I gypsic, Stage II calcic, and Late Stage III gypsic) are present at LA 75163, LA 2713, and LA 130557, while only the lower two buried soils were observed at LA 127511. One factor that may account for this variability is geomorphic setting. LA 75163, LA 2713, and LA 130557 all lie on the Mescalero Plain and are within or adjacent to localized dune fields. In contrast, LA 127511 is on top of a pediment, a remnant of the nearby Llano Estacado. Gravels of the Ogallala Formation are easily observable in the road cut and are overlain by a Stage I calcic soil formed in sheetwash and eolian sediments. It is unlikely that this uppermost soil is analogous to the uppermost eolian sediments at the other three sites for two reasons. First, numerous other studies (e.g., Hall 2001; Holliday 2001; Muhs and Holliday 2001) have concluded that the surficial eolian deposits in nearby dune fields are historic in age,

probably formed within the last 100+ years. Second, the soil morphology indicates that the uppermost soil at LA 127511 is much older than that at the other sites, on the order of 1 ka.

The fundamental geomorphic processes responsible for creating the modern landscape are eolian, alluvial, and karst in origin, with subsequent sheetwash and rilling. The west edge of the Llano Estacado, where LA 127518 is situated, is characterized by widespread eolian deposits and appears to be a degrading landscape, as shown by the eroded soil profile.

The principal indicators of soil formation in this region are carbonate and gypsum accumulation, both of which are time-dependent soil properties that can be used as proxies for age-dating soils. Pedogenic carbonate-rich horizons commonly form in arid and semi-arid regions with several recognizable stages of accumulation (Stages I-VI). While some of the $CaCO_3$ may originate from parent material weathering, studies like the Desert Project in southern New Mexico have indicated that atmospheric dust is a more likely origin (Gile et al. 1981). Annual Pleistocene rates of carbonate accumulation were calculated for the Roswell–Carlsbad area; the rate of 5.1×10^{-4} g/cm^2 was 2 to 5 times higher than rates calculated for other Southwestern regions, including the Desert Project study area in Las Cruces (Machette 1985). Still, a Stage III carbonate horizon is the highest stage of carbonate accumulation recorded in this study, while soils at Las Cruces have Stages IV, V, and even VI (Gile et al. 1981). There are two possible explanations: (1) the soils along the US 70 corridor are younger, implying that the surfaces of the region were more unstable throughout the late Pliocene, Pleistocene, and Holocene than in the Las Cruces region; or (2) some other factor is inhibiting soil development.

Reheis (1987) found this same pattern in the Kane alluvial fans in Wyoming, and suggests that gypsum is responsible. With Permian evaporites exposed in sinkholes and drainages at various locations in the study area, an obvious source of gypsum is provided. There are several mechanisms by which the gypsum can enter the soil: (1) dust, (2) surface water runoff, (3) groundwater, (4) local springs, and (5) in situ weathering of gypsum parent material. High concentrations of gypsum in the soil will inhibit carbonate movement through the soil profile due to the common ion effect. Before either gypsum or carbonate even gets into the soil profile, the higher solubility of gypsum gives it a distinct advantage over carbonate for entering the profile. Perhaps much of the carbonate is blown away even before it can dissolve and percolate below the surface (Reheis 1987). Once in the soil profile, when the carbonate encounters a significant amount of gypsum, its solubility can be lowered further by a factor of 64 (Reheis 1987).

Other effects of gypsum on soil morphology include alteration of texture, rubification, induration, suppression of clay movement, and physical disintegration of clasts (Reheis 1987). Although Reheis reports a sandy feel to gypsic laden soils, I found that in a parent material that was already sandy, gypsum imparted a claylike feel to the moistened soil. Upon comparing horizons of similar original texture, some with little or no gypsum and others with Stage II or above, plasticity was not affected, but stickiness was notably greater.

Soil reddening and induration also seemed to be directly related to the presence of gypsum. Gypsic soils retain water due to the hygroscopic nature of salts, and subsequently augment the weathering process. In addition, Reheis (1987) suggests that through increased physical weathering, more surface area of the clasts are exposed to the air for oxidation, which is another possible source of rubification. Assuming that oxidized iron is also concentrating in the soils, it is reasonable to presume that iron is responsible for cementing the grains and increasing induration. The reddest and most indurated soils were recorded along US 70 at LA 2713 and LA 130557. Recall that my initial assessment of this site was that the soils were younger than those at LA 75163 and LA 127511 to which I was correlating them. The trench walls were massive and structure was less pronounced, especially in the lower portion of the profile. The reddening and induration also increased downward in the profile. Reheis (1987) mentions that gypsum inhibits clay translocation. With its high solubility and hygroscopic nature, gypsum induces clay floc-

culation, even more so than carbonate. It is therefore possible that gypsum concentrations are so high at this particular site that clay movement was impeded, giving a false impression of younger age.

Unusually friable gravels were noted at LA 127511. They were partly or completely coated with gypsum and then overprinted with a partial coating of carbonate. Other studies have shown that gypsum induces rapid physical weathering of clasts through pressures of hydration and crystallization along cracks and grain boundaries (Dan et al. 1982, Reheis 1987).

Thus it seems clear that, with the exception of LA 127518, soils within this study area have undergone a complicated history of development, reflected by carbonate and gypsum accumulation. Carbonate accumulates during times of semi-arid to arid climate conditions, while gypsum records periods of extreme aridity.

Comparison to Other Regional Studies in Southern New Mexico

In the past 20 years, numerous geochronological studies of Quaternary deposits have been conducted in the surrounding region. In a recent study of the Mescalero Sands in Eddy County, NM just 48 km south of the US 70 study area, Hall (2001) found a seemingly good correlation of soil sequence stratigraphy and geochronology between his area and the GBFEL-TIE project in the southern Tularosa basin (Blair 1990) (Figure B.18). He matched his Bk unit, Unit 1, Unit 2, and Unit 3 to the Q1, Q2, Q3, and Q4 units of the Tularosa Basin based on pedogenic clay and carbonate morphology, locations of unconformities, and occurrences of prehistoric archaeology.

Attempts were made to correlate the US 70 soil sequences to these two regions using the same criteria. It was assumed that since the Mescalero Sands area shares a similar eolian and pedological history with the Tularosa Basin, even though the two locations are separated by a distance of 140 km and have had different climate regimes (Tularosa drier, Mescalero wetter), at least some or all of the soil/stratigraphic sequences should be observed in the US 70 region. Certainly, the Mescalero Sands and the US 70 region have shared similar eolian histories for at least part of the Holocene, since some of the US 70 sites lie on the northern edge of the Mescalero Sand sheet. The three buried soils (Late Stage III gypsic, Stage II calcic, and Stage I gypsic) noted at the four westernmost US 70 sites may be the equivalent of Hall's Units 1, 2, and 3 respectively. There are several reasons why the degree of confidence in these correlations does not approach that in Hall's report. First, the study area was confined to a narrow corridor along US 70, so few natural or road-cut exposures were encountered to supplement the trench observations. Second, the trenches were excavated to a maximum of 1–1.5 m, so that in most cases, the lowest buried soil encountered was not fully exposed. Third, the large amounts of gypsum in the soil profiles has created complex overprinting effects with carbonate, such that extrapolating age estimates from carbonate accumulation was very difficult. Nevertheless, the similarities are indicative of a direct correlation.

Soils

Late Stage III Gypsic Paleosol and Bk, Q1 Paleosols

Blair et al. (1990) defined the Q1 paleosol as a stage III–IV calcic soil formed in Pleistocene basin fill sediments and assigned it an age of 50,000 to 250,000 years. Hall's Bk paleosol formed on Triassic bedrock and is not as strongly developed, thus a younger age of 20,000 to 50,000+ years was designated. The contrasts in carbonate morphology most likely reflect differences in parent material and climate between the two study areas. In the US 70 region, the analogous buried soil contains more gypsum than carbonate accumulation and was observed only at site LA 75163 as a late stage III gypsic soil. The overwhelming gypsum concentration is probably a function of both the soil forming on the Permian Seven Rivers Formation and of the adjacent gypsum bedrock exposure in Bob Crosby Draw.

Stage I-II Gypsic Paleosol

Though this paleosol is stratigraphically analogous to the Bk and Q1 paleosols, it developed in eolian sand at LA 2713/130557. One of the criteria for the

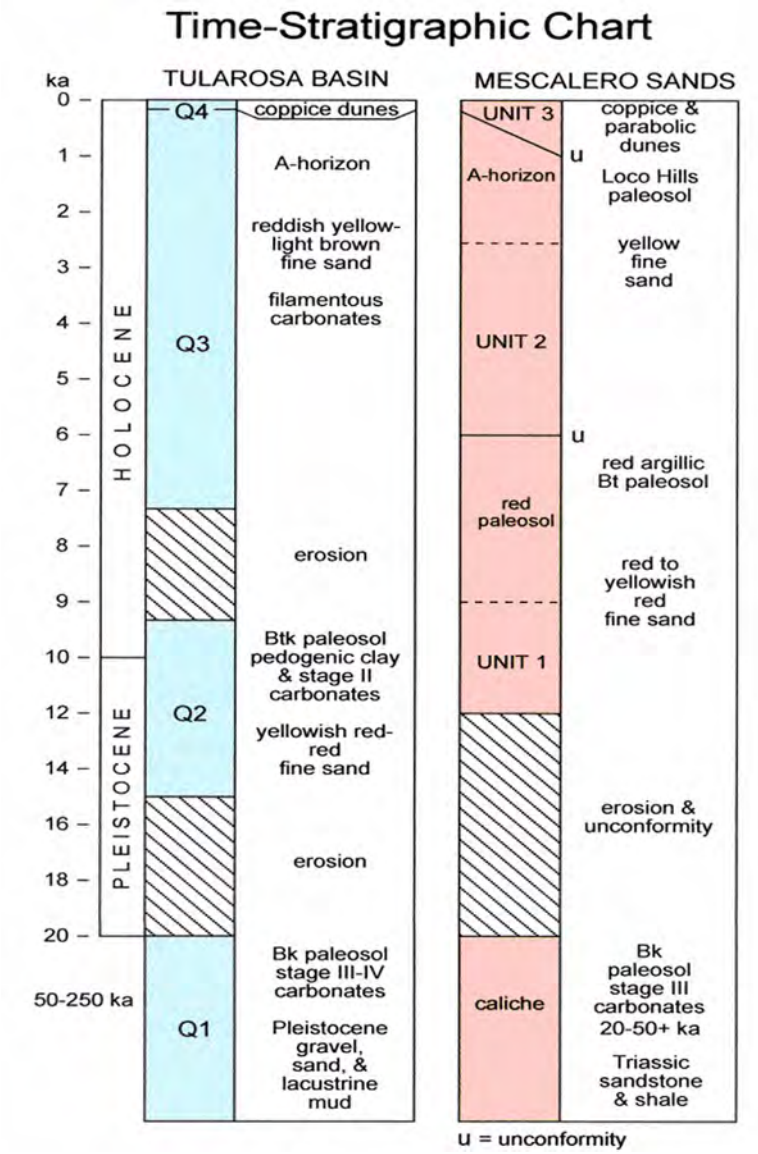

Figure B.18. Time-stratigraphic chart of Tularosa Basin (GBFEL-TIE) and Mescalero Sands, southern southeastern New Mexico. After Hall (2001).

Bk and Q1 paleosols is that it underlies all of the eolian sequences. This eolian sand layer is massive, with little or no carbonate.

Stage II Gypsic/Calcic Paleosol and Unit 1, Q2 Paleosols

As in the Hall (2001) and Blair et al. (1990) studies, there is an unconformity above the oldest buried soil, or above the Stage III gypsic paleosol at LA 75163. Only the indurated By horizons survived the period of erosion that stripped off the upper Bt and A horizons. Since the Stage I–II gypsic paleosol is absent from LA 75163, that site was undergoing a period of instability (e.g. erosion) during which time it formed at a more stable LA 2713/130557. A Stage II calcic/gypsic paleosol lies above the Stage III gypsic paleosol at LA 75163 and above the Stage I–II paleosol at LA 2713/130557. This paleosol is 30 to 70 cm thick, with strong clay accumulation. The presence of Bt horizons is consistent with the other two studies. The soil morphology with respect to gypsum and carbonate accumulation varies across sites. Overall,

this paleosol records a complex history of carbonate and gypsum accumulation, in which it is impossible to discern which one is overprinting the other. The shifts in carbonate and gypsum accumulation in the soil profile could be in response to either availability of carbonate and gypsum from nearby bedrock exposures and windblown sediments or to minor climate fluctuations. Holliday (2001) notes that much of the late Holocene eolian sand on the Southern High Plains was deposited in response to very minor shifts in climate.

Stage I Gypsic Paleosol and Unit 2, Q3 Paleosols

This paleosol strongly correlates with the late Holocene Unit 2 and Q3 paleosols based on the presence of an A horizon at the upper boundary. Most importantly, like the other two studies, all of the prehistoric archaeology was found within or at the lower boundary of this eolian deposit. The thickness of the paleosol in the US 70 area is consistent with the noted thickness of Unit 2 at the margins of the Mescalero Sand sheet. Like the older Stage I–II gypsic paleosol present at LA 2713/130557, this eolian deposit contains no carbonate at these two sites and almost no carbonate at LA 75163.

Historic Eolian Deposits and Unit 3, Q4 deposits

The surficial deposits are mesquite coppice dunes in the US 70 region with very weak soil development (i.e., AC horizons). These eolian deposits are most likely historic in age and are correlated to historic dune deposits in the other two study areas.

LA 75159

Although there is evidence that the soil sequence/stratigraphy at LA 75159 correlates to the sequence discussed above, several factors interfere with the interpretation. First, the land was heavily modified by human activity associated with cattle ranching. Second, as late as the 1800s (or possibly the early 1900s), an active spring and associated pond were present at this site. The ^{14}C dates and artifacts from the pond indicate that the pond existed in that location for at least several thousand years.

The other four trenches were excavated on the south side of US 70 away from the paleopond, but some of them may still have been influenced by the spring as indicated by darkened A and B horizons. These horizons are much richer in organic matter than those at any of the other five sites, evidence that more moisture was available even at the other four trench locations. Trenches 2 and 4 contain cumulic soil profiles, in which B horizons have overprinted former A horizons. In Trench 2, a Stage III gypsic horizon was observed in the lowest part of the profile. Because of the cumulic nature of this profile, it is difficult to correlate this paleosol with the Late Stage III gypsic paleosol at LA 75163.

The only location at this site at which a sequence of paleosols was observed was Trench 1. A Stage II gypsic paleosol is buried by a Stage II-III calcic/gypsic paleosol, which lies below a Stage I calcic paleosol. However, both the upper and middle buried soil are overprinted by gypsum and carbonate accumulation. Though the soil sequence appears to be similar to the sequence discussed above, correlation is hampered by differences in depositional environment. The deposits at this site may have an eolian component but, overall, are very clay-rich, consistent with a spring/pond environment.

LA 127518

Holliday (2001) recently studied the eolian stratigraphy of the Southern High Plains, thus providing a geochronological context for LA 127518, the only site on the Llano Estacado. The Btk indicates early to late Pleistocene Blackwater Draw Formation (Holliday 2001) and also looks like Hall's (2001) late Pleistocene red Bt paleosol. The degree of soil development correlates to that of the Isaack's Ranch soils (9–70ka) (Gile et al. 1981, Machette 1985). Due to the cumulic nature of the soil profile, it is impossible to delineate younger soils like those described by Holliday (2001) in the nearby Mescalero Dunes and Lea-Yoakum Dunes. This edge of the High Plains appears to be currently degrading, which may explain why the upper Bt horizon is so close to the surface and why carbonate is overprinting the Bt lower in profile.

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GLOSSARY

A horizon: mineral horizon formed at the surface or below an O horizon that exhibits obliteration of all or much of the original rock structure; is characterized by an accumulation of humified organic matter intimately mixed with the mineral fraction; not dominated by properties of E or B horizons.

Alluvial: pertaining to processes or materials associated with transportation or deposition by running water.

B horizon: horizon that formed below an A, E, or O horizon and is dominated by obliteration of all or much of the original rock structure and showsone or more of the following:
i.Illuvial concentration of silicate clay, iron, aluminum, humus, carbonates, gypsum, or silica, alone or in combination;
ii.Evidence of removal of carbonates;
iii.residual concentration of sesquioxides;
iv.coatings of sesquioxides that make the horizon conspicuously lower in value, higher in chroma, or redder in hue than overlying and underlying horizons without apparent illuviation of iron;
v.alteration that forms silicate clay or liberates oxides or both and that forms granular, blocky, or prismatic structure if volume changes accompany changes in moisture content;
vi.brittleness.

Buried soil: soil covered by alluvial, eolian, or other surface mantle of more recent depositional material, usually to a depth greater than 50 cm.
Calcic soil: a subsurface diagnostic horizon at least 15 cm thick that has a secondary accumulation of carbonates, usually of calcium or magnesium, in excess of 15 percent calcium carbonate equivalent, and contains at least 5 percent more than an underlying horizon.

Carbonate: translocated secondary calcium carbonate precipitated as masses, nodules, concretions, or coatings on ped faces or pore surfaces.

C horizon: horizons or layers, excluding hard bedrock, that are little affected by pedogenic processes and lack properties of O, A, E, or B horizons. The material of C horizons may be either like or unlike that from which the solum presumably formed. The C horizon may have been modified even if there is no evidence of pedogenesis.

Clay films: coatings or oriented clay on the surfaces of peds and mineral grains and lining pores.

Cumulic (accretionary) soil: accumulation of mineral material by wind orwater on the surface of the soil. These soils often lack any easilyrecognizable features because they accumulate slowly and are easilyassimilated into the soil.

Effervescent: bubbles and hisses as gas escapes (e.g., adding HCl to soil that contains $CaCO_3$ will produce a chemical reaction, during which CO_2 effervesces).

Escarpment: a fairly continuous cliff or fairly steep slope, produced by erosion or faulting, breaking the general continuity of more gently sloping land surfaces.

Eolian: pertaining to earth material transported and deposited by the wind (e.g., dunes).

Evaporites: residue of salts (e.g., gypsum and more soluble species) precipitated by evaporation.

Friable: a consistency term pertaining to the ease of crumbling of soils.

Gypsic soil: a soil common near playa margins, where salts are concentrated at ornear the soil surface by upward flux from a water table by evaporation.Less commonly, such soils occur in association with parent materials that are saline, or where gypsum is added with eolian material.

Horizon: a layer of soil or soil material approximately parallel to the land surface and differing from adjacent, genetically related layers in physical, chemical, and biological properties such as color, structure, texture, consistency, kinds and numbers of organisms present, degree ofacidity or alkalinity, etc.

Hygroscopic: readily taking up and retaining moisture.

Illuvial material: material carried from an overlying layer that has been precipitated from solution or deposited from suspension.

Indurated: very strongly cemented soil horizon.
Karst: topography with sinkholes, caves, and underground drainage formed in limestone, gypsum, or other rocks by dissolution.

Parent material: the unconsolidated and more or less chemically weathered mineral or organic matter from which a soil profile is developed by pedogenic processes.

Paleosol: a soil that formed on a landscape in the past with distinctive morphological features resulting from a soil-forming environment that no longer exists at the site. The former pedogenic process was either altered because of external environmental change or interrupted by burial.

Ped: a unit of soil structure such as a block, column, granule, plate, or prism, formed by natural processes. Ped structures are identified by cutting out a chunk of soil from a particular horizon and breaking it apart in your hand. The natural ped structures will break out of the soil chunk.

Residuum: unconsolidated, weathered, or partly weathered mineral material that accumulates by disintegration of bedrock in place.

Rilling: an erosion process on slopes in which numerous and randomly occurring small channels of only several centimeters in depth are formed.

Rubification: development of reddish to reddish-brown soil color throughprogressive oxidation of iron. Probably related to conditions that determine goethite/hematite ratio in soils and to the interaction with soil organic matter.

Sheetwash: the removal of a fairly uniform, thin layer of soil from the surface by rainfall and largely unchanneled surface runoff.

Soil: the unconsolidated mineral or organic material on the immediate surface of the earth that has been subjected to and shows effects of genetic and environmental factors of: climate (including water and temperature effects) and macro- and microorganisms, conditioned by relief, actingon parent material over time. A product soil differs from the parent material from which it is derived in many physical, chemical, biological, and morphological properties and characteristics.

Soil horizon (e.g. Bt, Bk, C): one of a set of layers that results from effects of soil-forming processes and are approximately parallel to the soil surface.

Translocation: the removal of soil material (e.g., clay) and/or soluble materials (e.g., salts) from one soil zone to another, via water movement in the profile.

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APPENDIX C

RADIOCARBON ASSAYS

BETA

BETA ANALYTIC INC.

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REPORT OF RADIOCARBON DATING ANALYSES

Dr. Steven Carothers/Ken Carothers — Report Date: 7/12/01

SWCA, Incorporated — Material Received: 6/6/01

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 156277 SAMPLE : 2713-106 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 690 to 890 (Cal BP 1260 to 1060)	1220 +/- 40 BP	-24.6 o/oo	1230 +/- 40 BP
Beta - 156278 SAMPLE : 2713-163 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (peat): acid/alkali/acid	112.6 +/- 0.6 pMC	-23.9 o/oo	12.4 +/- 0.6 pMC
Beta - 156279 SAMPLE : 75159-298 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (organic sediment): acid washes 2 SIGMA CALIBRATION : Cal BC 820 to 770 (Cal BP 2770 to 2720)	2440 +/- 40 BP	-15.3 o/oo	2600 +/- 40 BP
Beta - 156280 SAMPLE : 75159-347 ANALYSIS : Radiometric-Standard delivery MATERIAL/PRETREATMENT : (organic sediment): acid washes 2 SIGMA CALIBRATION : Cal AD 1220 to 1410 (Cal BP 730 to 540)	690 +/- 70 BP	-25.0* o/oo	690 +/- 70* BP
Beta - 156281 SAMPLE : 75159-362 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (organic sediment): acid washes 2 SIGMA CALIBRATION : Cal BC 990 to 820 (Cal BP 2940 to 2770)	2660 +/- 40 BP	19.4 o/oo	2750 +/- 40 BP

Dates are reported as RCYBP (radiocarbon years before present, "present" = 1950A.D.). By International convention, the modern reference standard was 95% of the C14 content of the National Bureau of Standards' Oxalic Acid & calculated using the Libby C14 half life (5568 years). Quoted errors represent 1 standard deviation statistics (68% probability) & are based on combined measurements of the sample, background, and modern reference standards.

Measured C13/C12 ratios were calculated relative to the PDB-1 international standard and the RCYBP ages were normalized to -25 per mil. If the ratio and age are accompanied by an (*), then the C13/C12 value was estimated, based on values typical of the material type. The quoted results are NOT calibrated to calendar years. Calibration to calendar years should be calculated using the Conventional C14 age.

BETA

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REPORT OF RADIOCARBON DATING ANALYSES

Dr. Steven Carothers

Report Date: 7/12/01

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 156282	3450 +/- 40 BP	-19.0 o/oo	3550 +/- 40 BP

SAMPLE : 75159-371
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic sediment): acid washes
2 SIGMA CALIBRATION : Cal BC 1970 to 1760 (Cal BP 3920 to 3710)

Beta - 156283	2480 +/- 40 BP	-24.9 o/oo	2480 +/- 40 BP

SAMPLE : 75163-227
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 790 to 410 (Cal BP 2740 to 2360)

Beta - 156284	1250 +/- 40 BP	-25.4 o/oo	1240 +/- 40 BP

SAMPLE : 75163-228
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 680 to 890 (Cal BP 1270 to 1060)

Beta - 156285	114.9 +/- 0.6 pMC	-22.3 o/oo	14.3 +/- 0.6 pMC

SAMPLE : 75163-243
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (peat): acid washes

Beta - 156286	3930 +/- 40 BP	-25.3 o/oo	3930 +/- 40 BP

SAMPLE : 130557-104
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 2550 to 2540 (Cal BP 4500 to 4480) AND Cal BC 2490 to 2300 (Cal BP 4440 to 4250)

Dates are reported as RCYBP (radiocarbon years before present, "present" = 1950A.D.). By International convention, the modern reference standard was 95% of the C14 content of the National Bureau of Standards' Oxalic Acid & calculated using the Libby C14 half life (5568 years). Quoted errors represent 1 standard deviation statistics (68% probability) & are based on combined measurements of the sample, background, and modern reference standards.

Measured C13/C12 ratios were calculated relative to the PDB-1 international standard and the RCYBP ages were normalized to -25 per mil. If the ratio and age are accompanied by an (*), then the C13/C12 value was estimated, based on values typical of the material type. The quoted results are NOT calibrated to calendar years. Calibration to calendar years should be calculated using the Conventional C14 age.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.6:lab. mult=1)

Laboratory number: **Beta-156277**

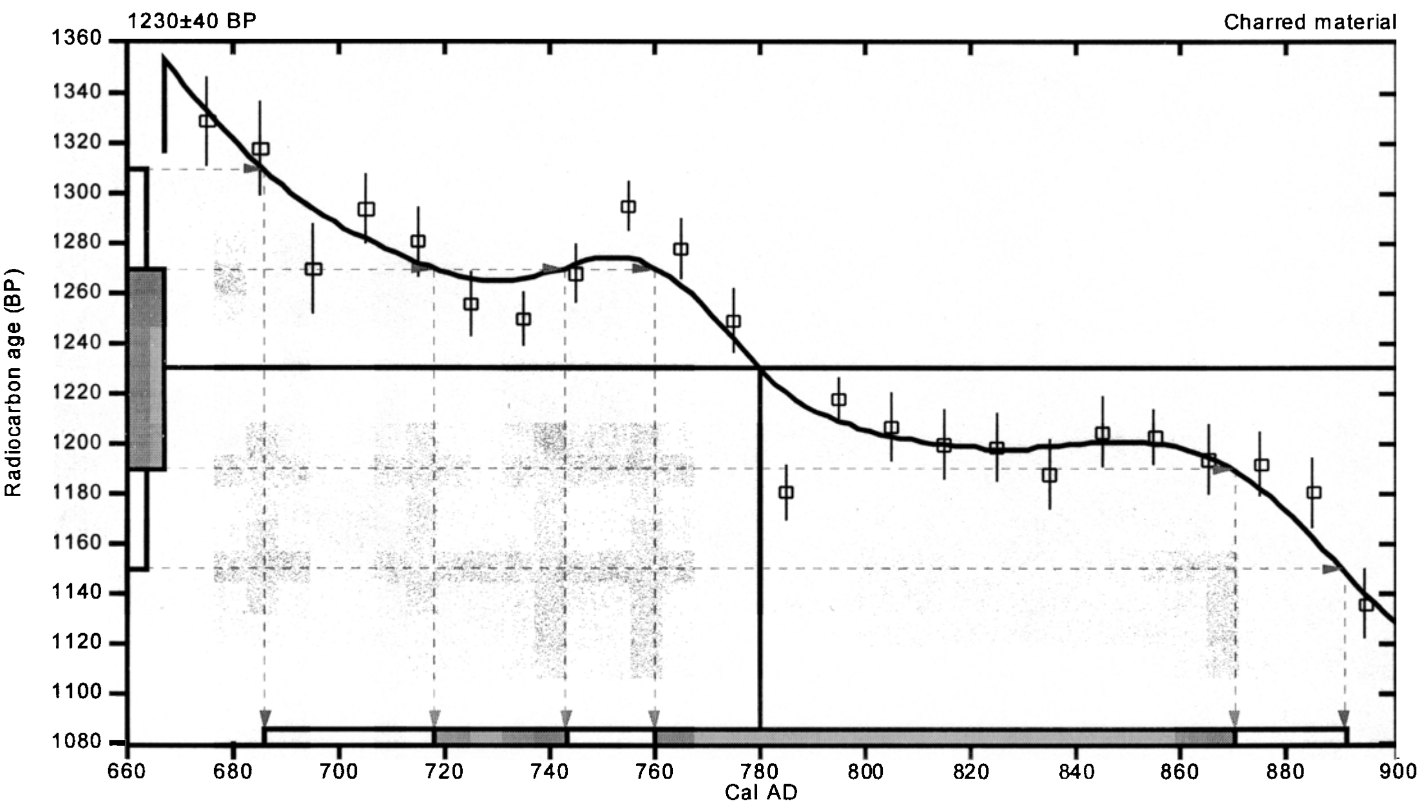
Conventional radiocarbon age: **1230±40 BP**

2 Sigma calibrated result: **Cal AD 690 to 890 (Cal BP 1260 to 1060)**
(95% probability)

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal AD 780 (Cal BP 1170)

1 Sigma calibrated results: Cal AD 720 to 740 (Cal BP 230 to 1210) and
(68% probability) Cal AD 760 to 870 (Cal BP 190 to 1080)



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Calibration Database
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Mathematics
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Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-15.3:lab. mult=1)

Laboratory number: **Beta-156279**

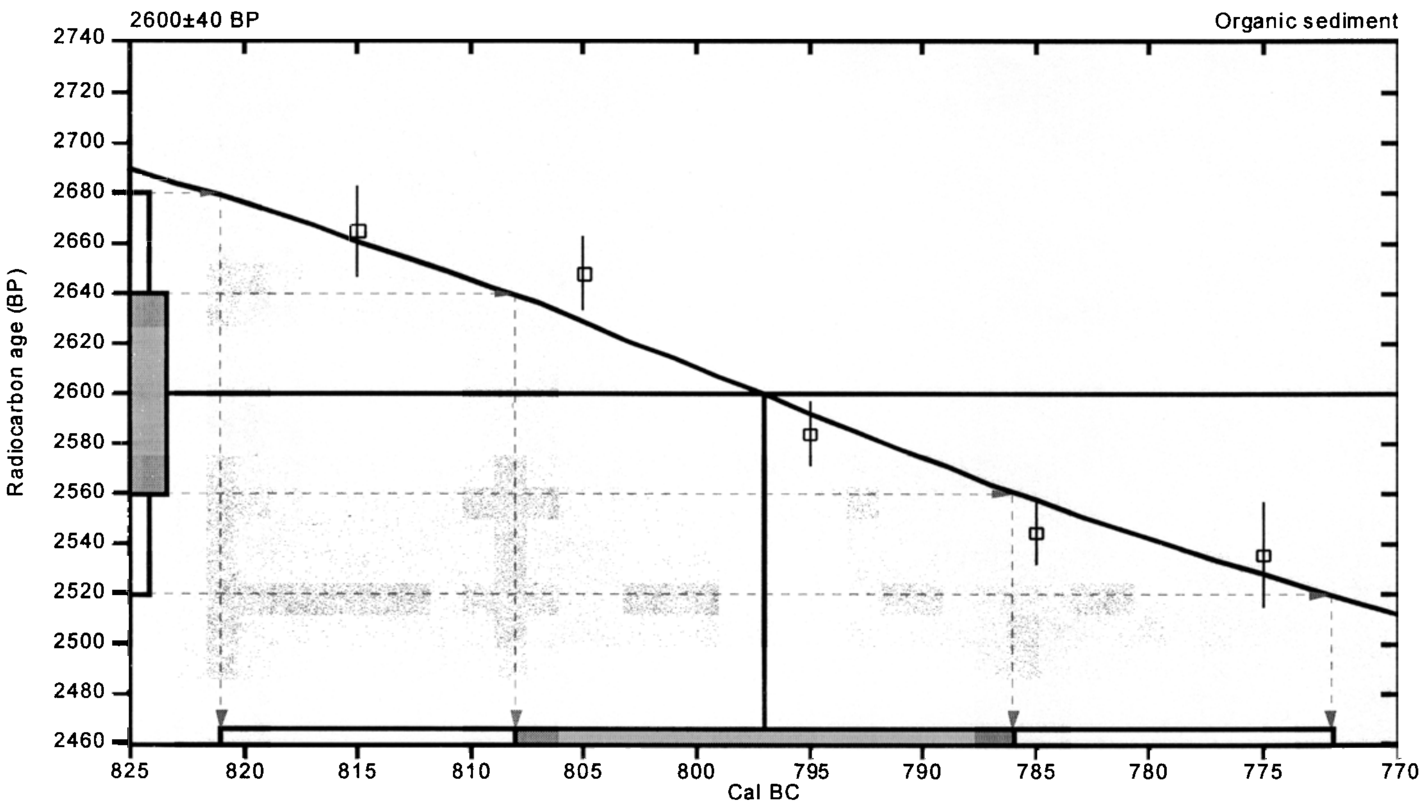
Conventional radiocarbon age: **2600±40 BP**

2 Sigma calibrated result: **Cal BC 820 to 770 (Cal BP 2770 to 2720)**
(95% probability)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 800 (Cal BP 2750)

1 Sigma calibrated result: Cal BC 810 to 790 (Cal BP 2760 to 2740)
(68% probability)



References:

Database used

Calibration Database

Editorial Comment

Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii

INTCAL98 Radiocarbon Age Calibration

Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083

Mathematics

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25:lab. mult=1)

Laboratory number: **Beta-156280**

Conventional radiocarbon age[1]: **690±70 BP**

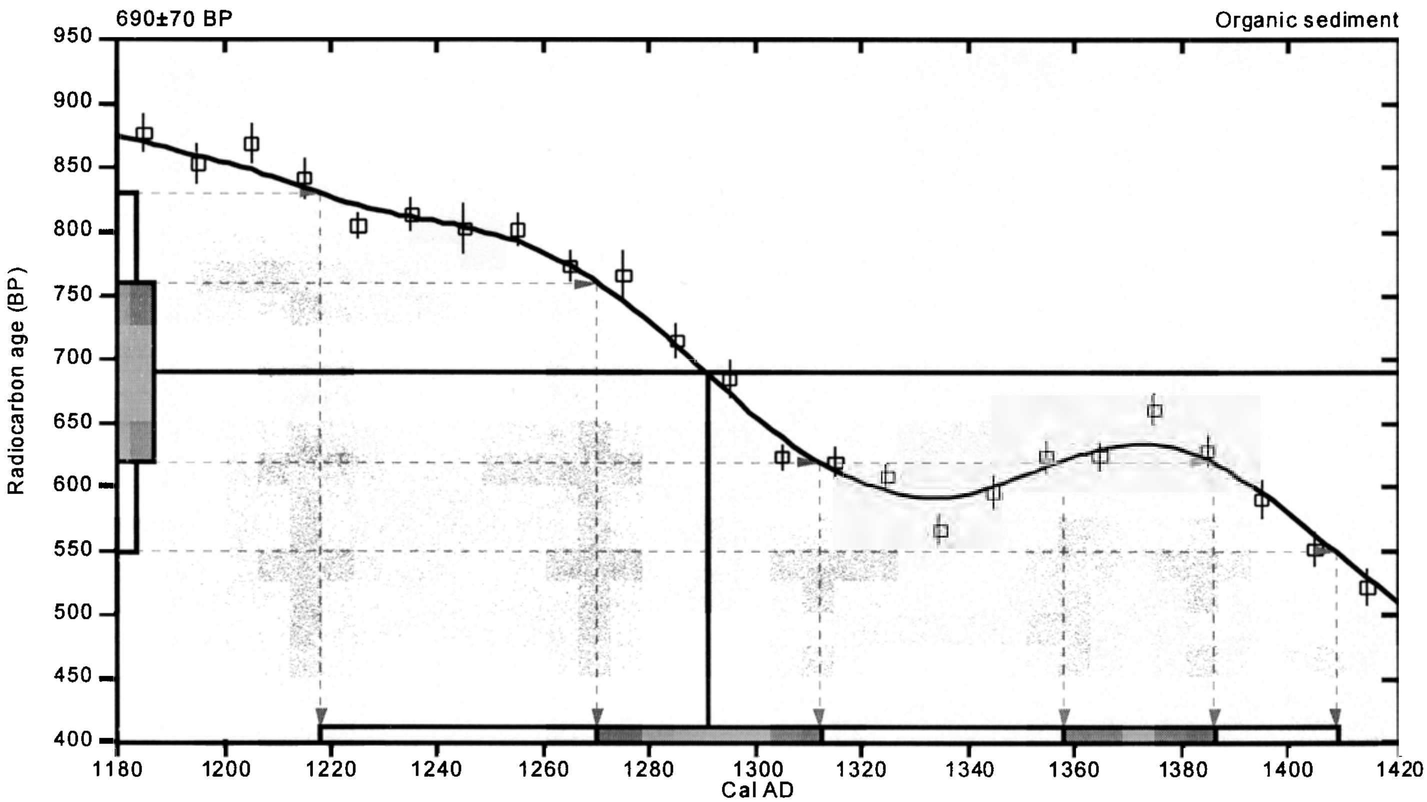
2 Sigma calibrated result: (95% probability) **Cal AD 1220 to 1410 (Cal BP 730 to 540)**

[1] C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 1290 (Cal BP 660)

1 Sigma calibrated results: (68% probability) Cal AD 1270 to 1310 (Cal BP 680 to 640) and Cal AD 1360 to 1390 (Cal BP 590 to 560)



References:

Database used

Calibration Database

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INTCAL98 Radiocarbon Age Calibration

Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083

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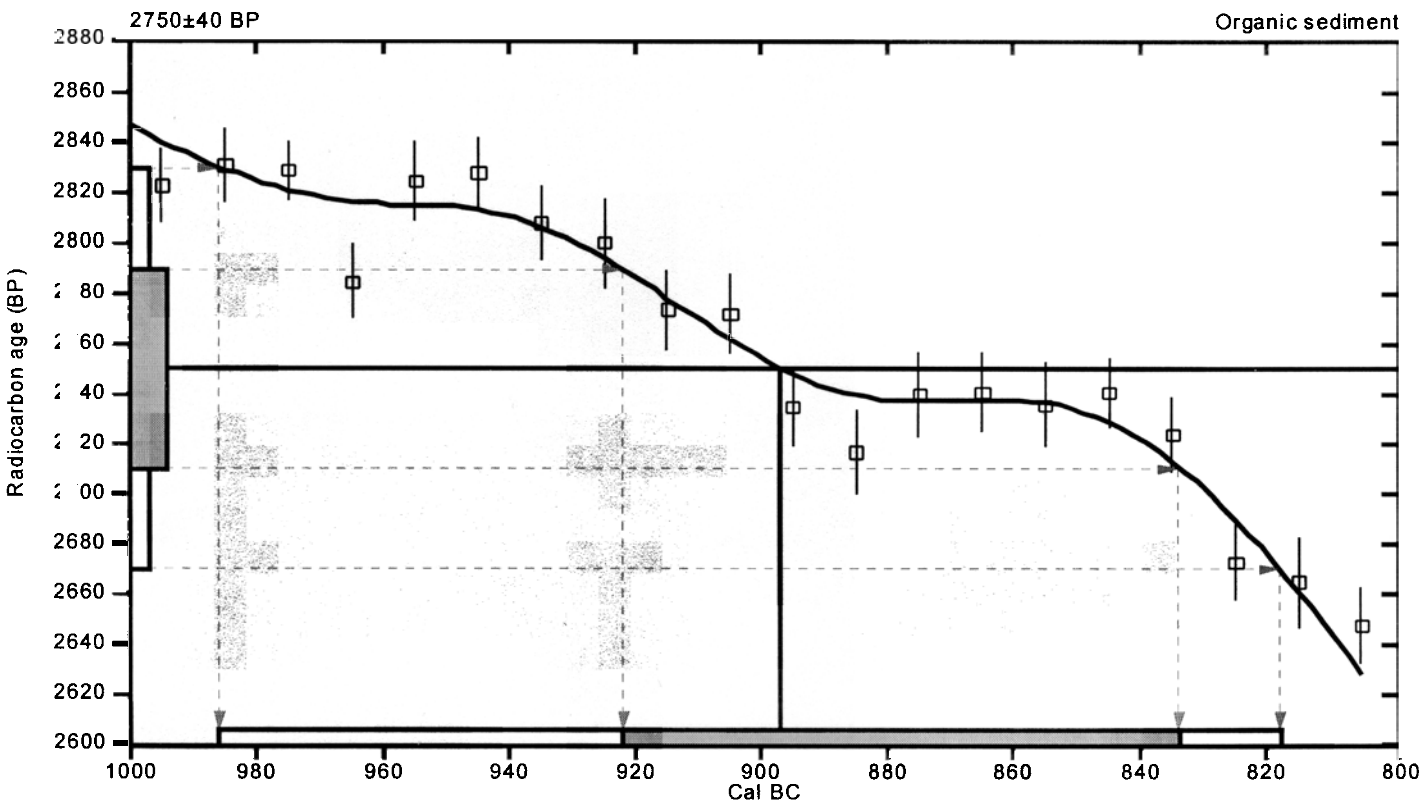
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-19.4:lab. mult=1)

Laboratory number:	**Beta-156281**
Conventional radiocarbon age:	**2750±40 BP**
2 Sigma calibrated result: (95% probability)	**Cal BC 990 to 820 (Cal BP 2940 to 2770)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 900 (Cal BP 2850)
1 Sigma calibrated result: (68% probability)	Cal BC 920 to 830 (Cal BP 2870 to 2780)



References:

Database used

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INTCAL98 Radiocarbon Age Calibration

Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083

Mathematics

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-19:lab. mult=1)

Laboratory number: **Beta-156282**

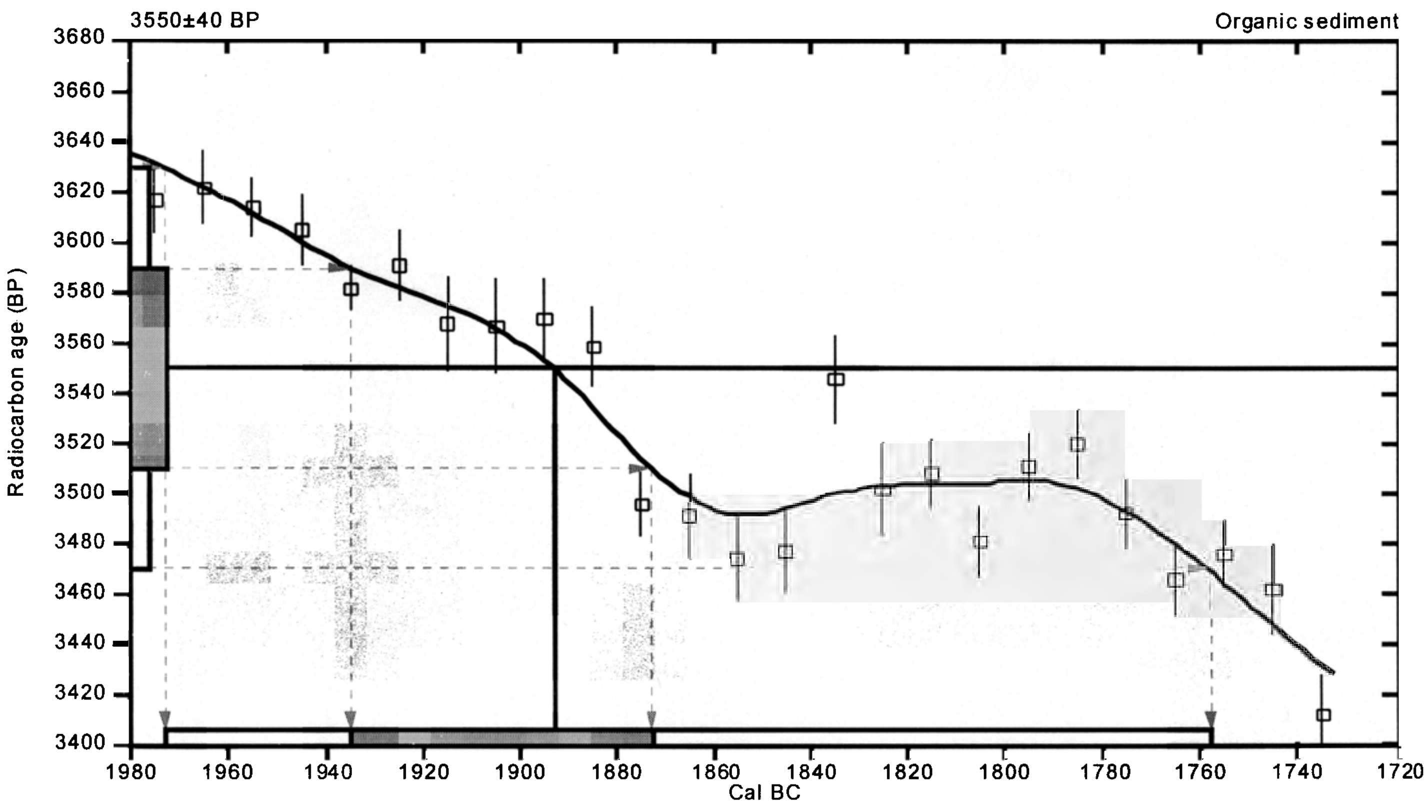
Conventional radiocarbon age: **3550±40 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 1970 to 1760 (Cal BP 3920 to 3710)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 1890 (Cal BP 3840)

1 Sigma calibrated result: (68% probability) Cal BC 1940 to 1870 (Cal BP 3880 to 3820)



References:

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Mathematics
A Simplified Approach to Calibrating C14 Dates
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.9:lab. mult=1)

Laboratory number: **Beta-156283**

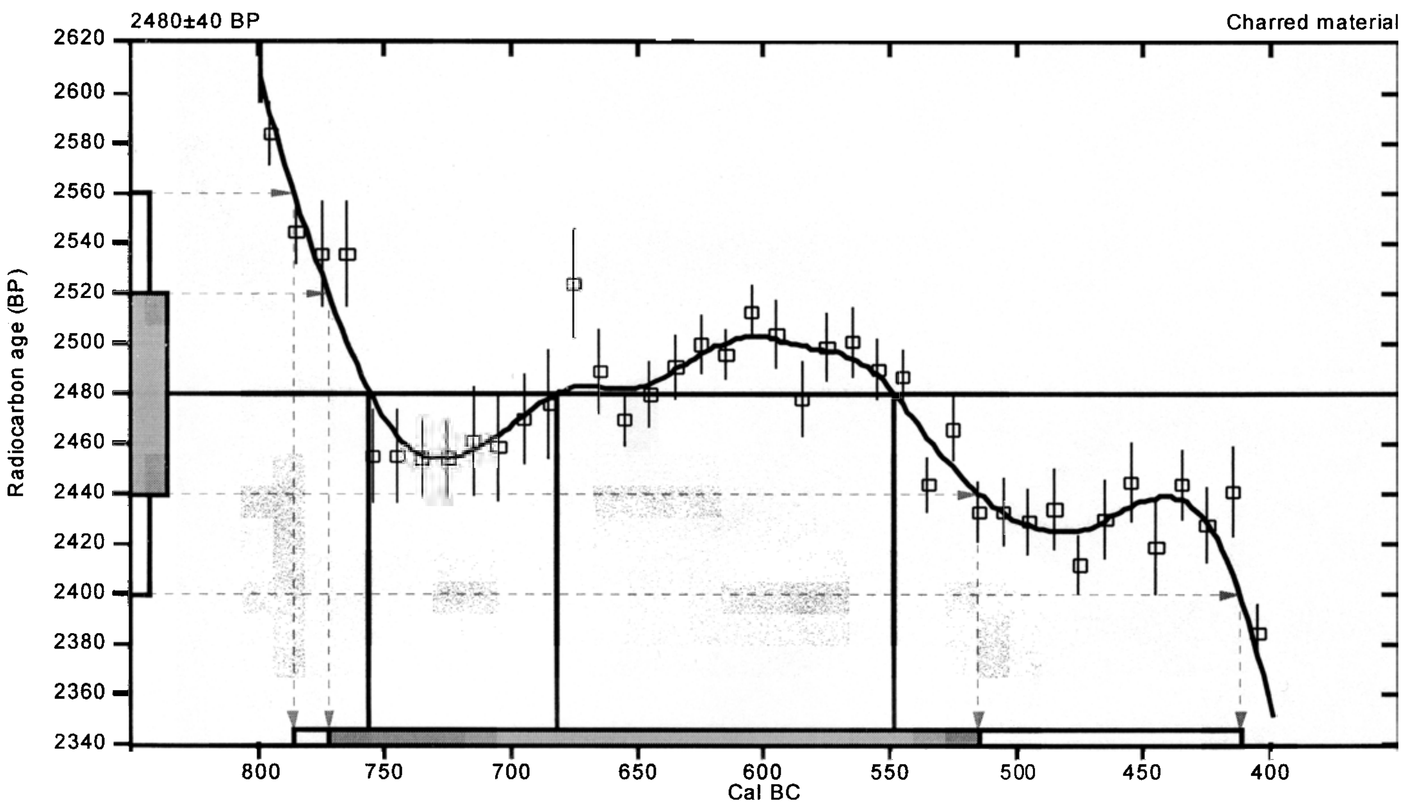
Conventional radiocarbon age: **2480±40 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 790 to 410 (Cal BP 2740 to 2360)**

Intercept data

Intercepts of radiocarbon age with calibration curve: Cal BC 760 (Cal BP 2710) and
Cal BC 680 (Cal BP 2630) and
Cal BC 550 (Cal BP 2500)

1 Sigma calibrated result: (68% probability) Cal BC 770 to 520 (Cal BP 2720 to 2460)



References:

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INTCAL98 Radiocarbon Age Calibration

Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083

Mathematics

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.4:lab. mult=1)

Laboratory number: **Beta-156284**

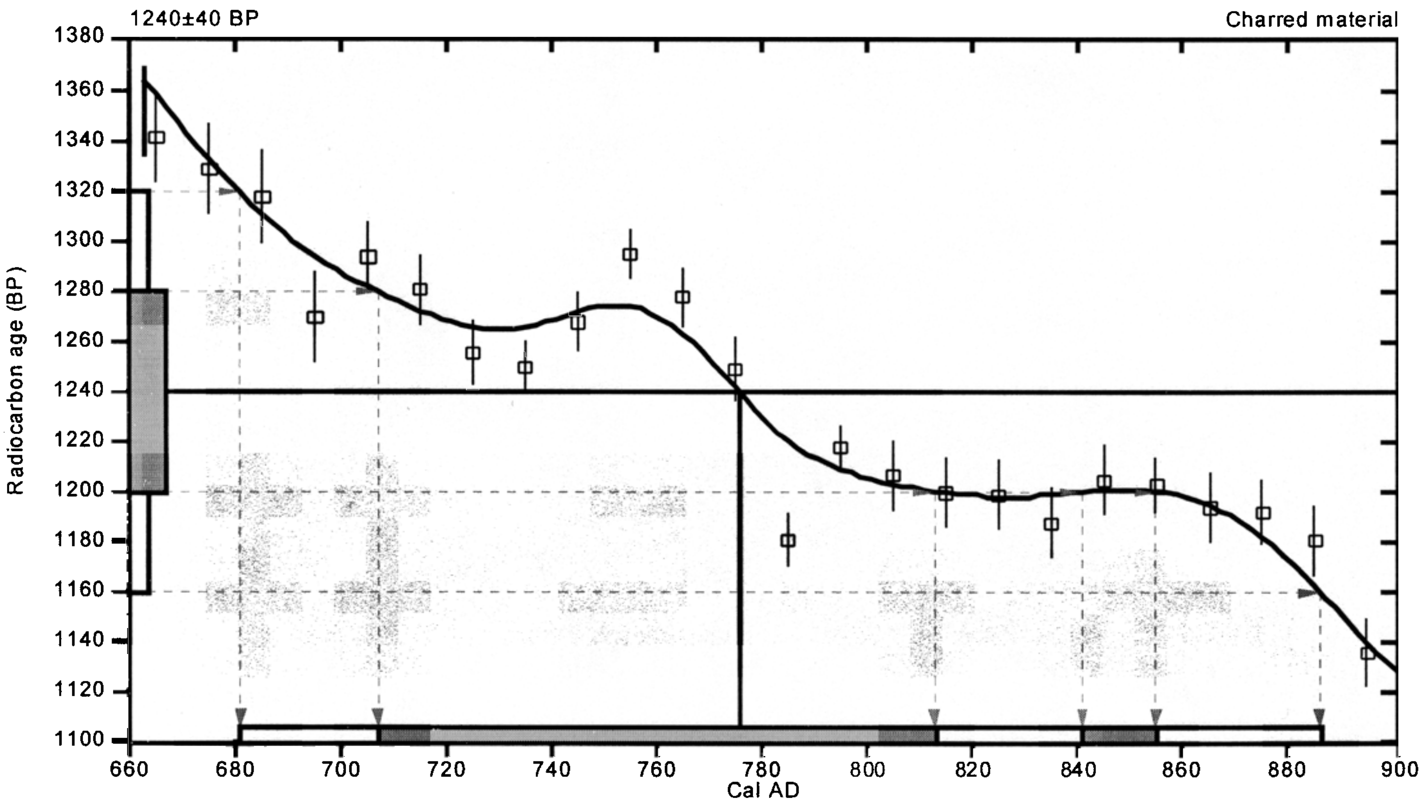
Conventional radiocarbon age: **1240±40 BP**

2 Sigma calibrated result: **Cal AD 680 to 890 (Cal BP 1270 to 1060)**
(95% probability)

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal AD 780 (Cal BP 1170)

1 Sigma calibrated results: Cal AD 710 to 810 (Cal BP 240 to 40) and
(68% probability) Cal AD 840 to 860 (Cal BP 110 to 00)



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Mathematics
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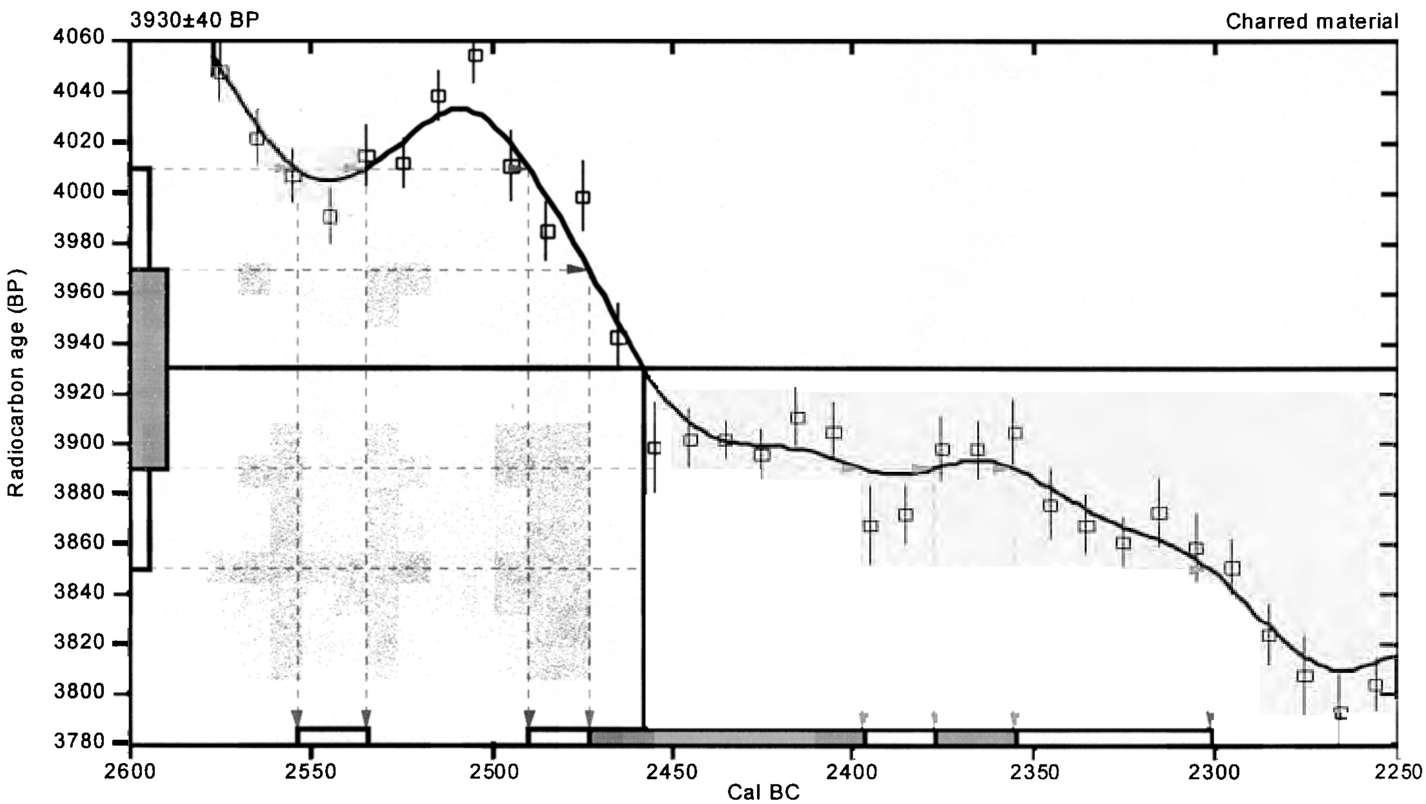
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.3:lab. mult=1)

Laboratory number:	**Beta-156286**
Conventional radiocarbon age:	**3930±40 BP**
2 Sigma calibrated results: (95% probability)	**Cal BC 2550 to 2540 (Cal BP 4500 to 4480) and Cal BC 2490 to 2300 (Cal BP 4440 to 4250)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 2460 (Cal BP 4410)
1 Sigma calibrated results: (68% probability)	Cal BC 2470 to 2400 (Cal BP 4420 to 4350) and Cal BC 2380 to 2360 (Cal BP 4330 to 4300)



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Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083
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REPORT OF RADIOCARBON DATING ANALYSES

Dr. Kathryn Donoho — Report Date: 10/5/01

SWCA, Incorporated — Material Received: 8/24/01

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 158832	1510 +/- 40 BP	-25.3 o/oo	1510 +/- 40 BP

SAMPLE : 2713-138
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 440 to 640 (Cal BP 1510 to 1310)

Beta - 158833	840 +/- 40 BP	-24.4 o/oo	850 +/- 40 BP

SAMPLE : 2713-140
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1050 to 1100 (Cal BP 900 to 850)AND Cal AD 1140 to 1270 (Cal BP 810 to 680)

Beta - 158834	970 +/- 40 BP	-25.3 o/oo	970 +,

SAMPLE : 2713-146
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1000 to 1170 (Cal BP 950 to 780)

Beta - 158835	1820 +/- 40 BP	-25.2 o/oo	1820 +/- 40 B

SAMPLE : 75159-323
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 100 to 260 (Cal BP 1860 to 1690) AND Cal AD 290 to 320 (Cal BP 1660 to 1630)

Beta - 158836	1680 +/- 60 BP	-11.6 o/oo	1900 +/- 60 BP

SAMPLE : 75159-341
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic sediment): acid washes
2 SIGMA CALIBRATION : Cal BC 30 to Cal AD 240 (Cal BP 1980 to 1710)

Dates are reported as RCYBP (radiocarbon years before present, "present" = 1950A.D.). By International convention, the modern reference standard was 95% of the C14 content of the National Bureau of Standards' Oxalic Acid & calculated using the Libby C14 half life (5568 years). Quoted errors represent 1 standard deviation statistics (68% probability) & are based on combined measurements of the sample, background, and modern reference standards.

Measured C13/C12 ratios were calculated relative to the PDB-1 international standard and the RCYBP ages were normalized to -25 per mil. If the ratio and age are accompanied by an (*), then the C13/C12 value was estimated, based on values typical of the material type. The quoted results are NOT calibrated to calendar years. Calibration to calendar years should be calculated using the Conventional C14 age.

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REPORT OF RADIOCARBON DATING ANALYSES

Dr. Kathryn Donoho

Report Date: 10/5/01

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 158837 SAMPLE : 75159-344 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (organic sediment): acid washes 2 SIGMA CALIBRATION : Cal AD 1200 to 1290 (Cal BP 750 to 660)	650 +/- 40 BP	-17.9 o/oo	770 +/- 40 BP
Beta - 158838 SAMPLE : 75159-353 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (organic sediment): acid washes 2 SIGMA CALIBRATION : Cal AD 600 to 680 (Cal BP 1350 to 1270)	1280 +/- 40 BP	-17.8 o/oo	1400 +/- 40 BP
Beta - 158839 SAMPLE : 75159-356 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (organic sediment): acid washes 2 SIGMA CALIBRATION : Cal AD 130 to 350 (Cal BP 1820 to 1600)	1680 +/- 40 BP	-18.2 o/oo	.790 +/- 40 BP
Beta - 158840 SAMPLE : 75159-365 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (organic sediment): acid washes 2 SIGMA CALIBRATION : Cal BC 1430 to 1200 (Cal BP 3380 to 3150)	2960 +/- 50 BP	-18.2 o/oo	3070 +/- 50 BP
Beta - 158841 SAMPLE : 75159-368 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (organic sediment): acid washes 2 SIGMA CALIBRATION : Cal BC 1610 to 1420 (Cal BP 3560 to 3380)	3130 +/- 40 BP	-18.1 o/oo	3240 +/- 40 BP

Dates are reported as RCYBP (radiocarbon years before present, "present" = 1950A.D.). By International convention, the modern reference standard was 95% of the C14 content of the National Bureau of Standards' Oxalic Acid & calculated using the Libby C14 half life (5568 years). Quoted errors represent 1 standard deviation statistics (68% probability) & are based on combined measurements of the sample, background, and modern reference standards.

Measured C13/C12 ratios were calculated relative to the PDB-1 international standard and the RCYBP ages were normalized to -25 per mil. If the ratio and age are accompanied by an (*), then the C13/C12 value was estimated, based on values typical of the material type. The quoted results are NOT calibrated to calendar years. Calibration to calendar years should be calculated using the Conventional C14 age.

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REPORT OF RADIOCARBON DATING ANALYSES

Dr. Kathryn Donoho

Report Date: 10/5/01

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 158842	2760 +/- 40 BP	-11.4 o/oo	2980 +/- 40 BP
Beta - 158843	240 +/- 40 BP	-25.8 o/oo	230 +/- 40 BP
Beta - 158844	440 +/- 40 BP	-18.2 o/oo	550 +/- 40 BP

Beta - 158842
SAMPLE : 75159-374
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 1360 to 1360 (Cal BP 3310 to 3300) AND Cal BC 1320 to 1060 (Cal BP 3260 to 3000

Beta - 158843
SAMPLE : 75163-241
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1530 to 1550 (Cal BP 420 to 400) AND Cal AD 1630 to 1680 (Cal BP 320 to 270)
Cal AD 1740 to 1810 (Cal BP 210 to 140) AND Cal AD 1930 to 1950 (Cal BP 20 to 0)

Beta - 158844
SAMPLE : 75163-272
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic sediment): acid washes
2 SIGMA CALIBRATION : Cal AD 1310 to 1370 (Cal BP 640 to 580) AND Cal AD 1380 to 1430 (Cal BP 570 to 520)

Dates are reported as RCYBP (radiocarbon years before present, "present" = 1950A.D.). By International convention, the modern reference standard was 95% of the C14 content of the National Bureau of Standards' Oxalic Acid & calculated using the Libby C14 half life (5568 years). Quoted errors represent 1 standard deviation statistics (68% probability) & are based on combined measurements of the sample, background, and modern reference standards.

Measured C13/C12 ratios were calculated relative to the PDB-1 international standard and the RCYBP ages were normalized to -25 per mil. If the ratio and age are accompanied by an (*), then the C13/C12 value was estimated, based on values typical of the material type. The quoted results are NOT calibrated to calendar years. Calibration to calendar years should be calculated using the Conventional C14 age.

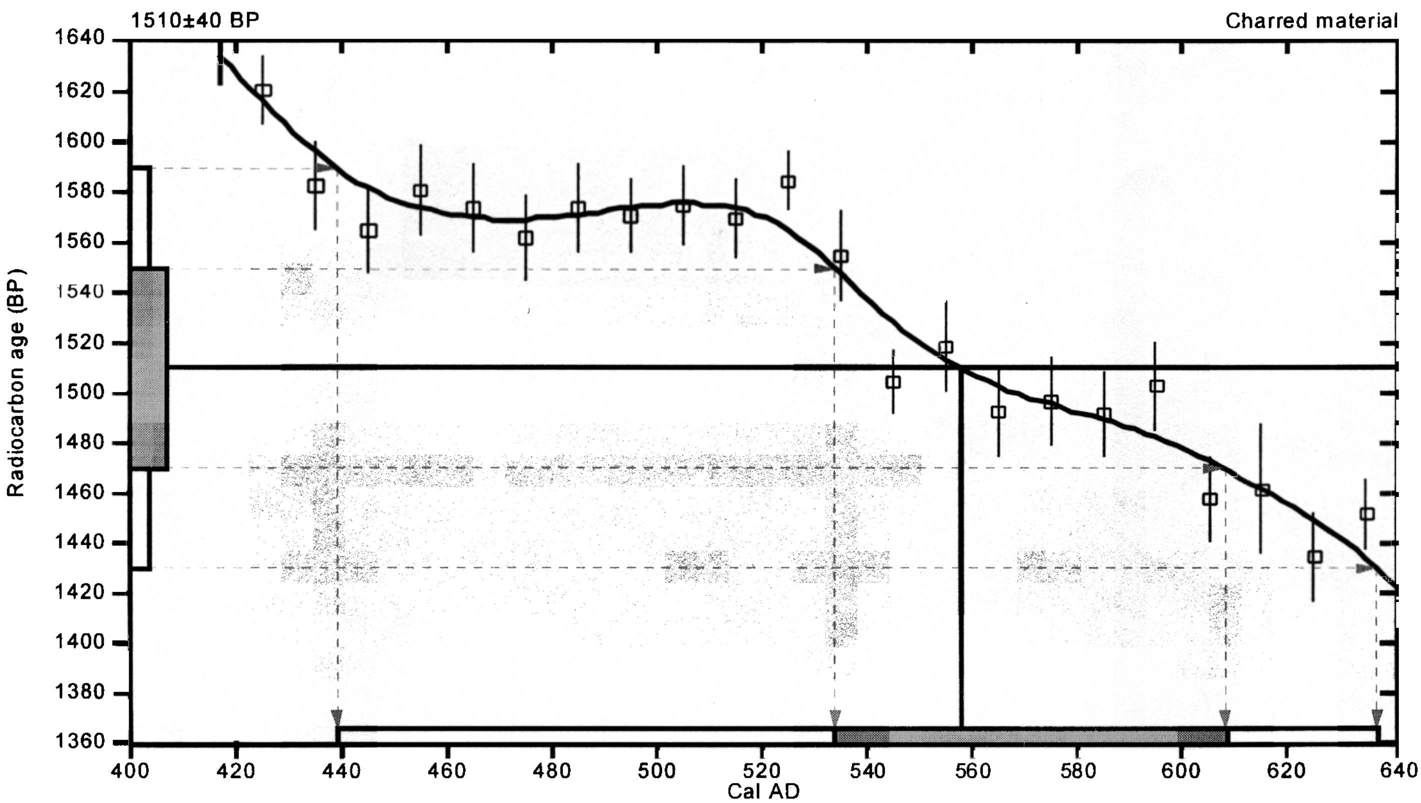
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.3:lab. mult=1)

Laboratory number:	**Beta-158832**
Conventional radiocarbon age:	**1510±40 BP**
2 Sigma calibrated result: (95% probability)	**Cal AD 440 to 640 (Cal BP 1510 to 1310)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal AD 560 (Cal BP 1390)
1 Sigma calibrated result: (68% probability)	Cal AD 530 to 610 (Cal BP 420 to 340)



References:

Database used

Calibration Database

Editorial Comment

Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii

INTCAL98 Radiocarbon Age Calibration

Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.4:lab. mult=1)

Laboratory number: **Beta-158833**

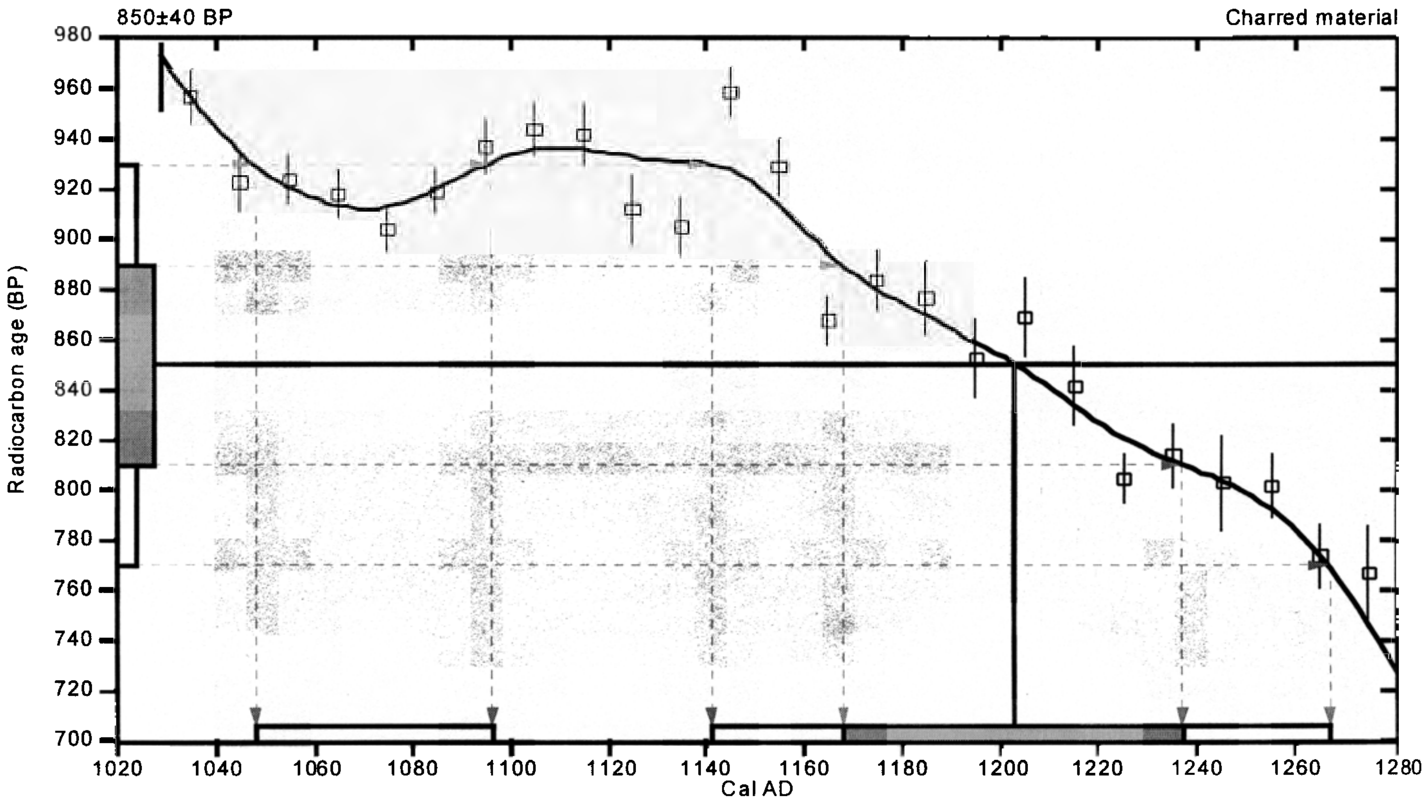
Conventional radiocarbon age: **850±40 BP**

2 Sigma calibrated results: **Cal AD 1050 to 1100 (Cal BP 900 to 850) and**
(95% probability) **Cal AD 1140 to 1270 (Cal BP 810 to 680)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 1200 (Cal BP 750)

1 Sigma calibrated result: Cal AD 1170 to 1240 (Cal BP 780 to 710)
(68% probability)



References:
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.3:lab. mult=1)

Laboratory number: **Beta-158834**

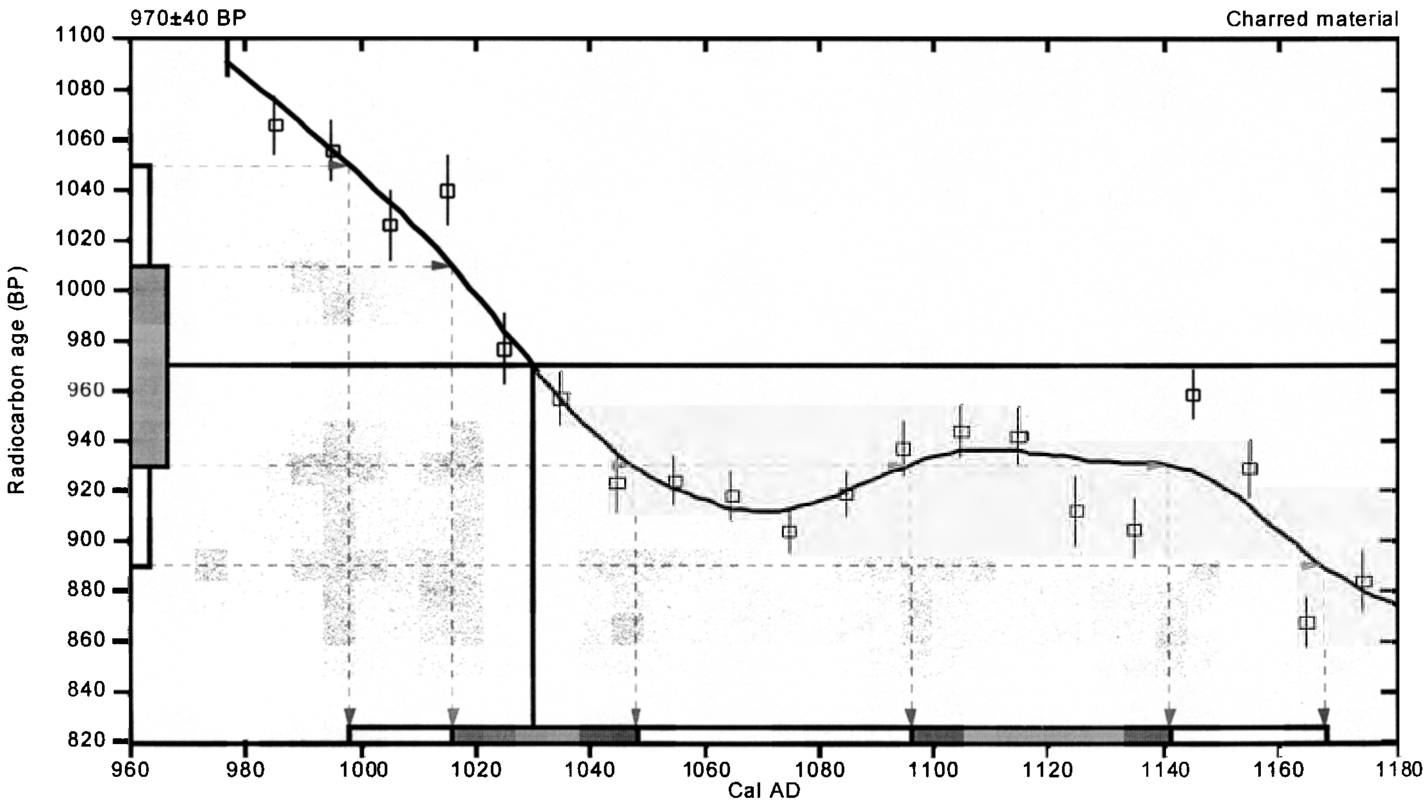
Conventional radiocarbon age: **970±40 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 1000 to 1170 (Cal BP 950 to 780)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 1030 (Cal BP 920)

1 Sigma calibrated results: (68% probability) Cal AD 1020 to 1050 (Cal BP 930 to 900) and Cal AD 1100 to 1140 (Cal BP 850 to 810)



References:

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Mathematics
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.2:lab. mult=1)

Laboratory number: **Beta-158835**

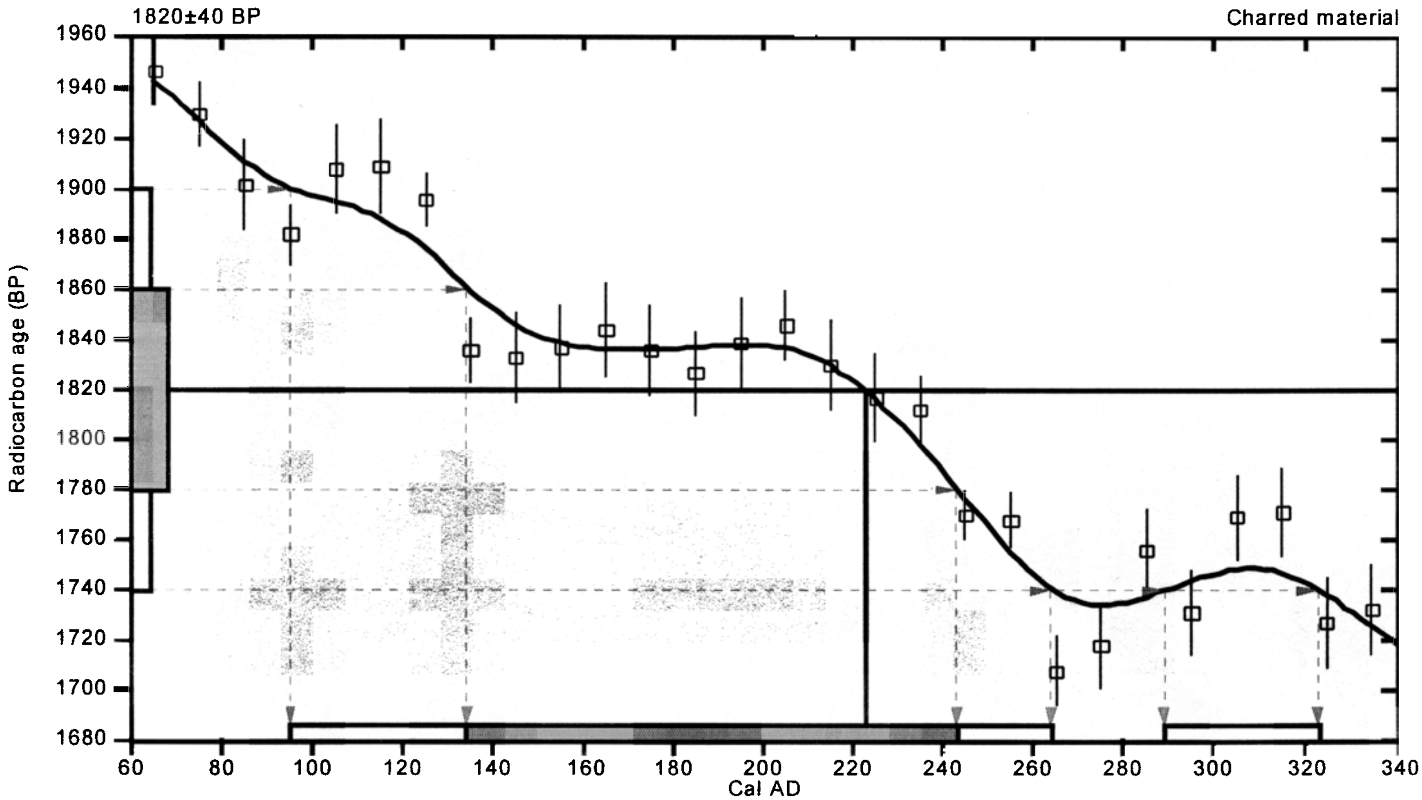
Conventional radiocarbon age: **1820±40 BP**

2 Sigma calibrated results: **Cal AD 100 to 260 (Cal BP 1860 to 1690) and**
(95% probability) **Cal AD 290 to 320 (Cal BP 1660 to 1630)**

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal AD 220 (Cal BP 1730)

1 Sigma calibrated result: Cal AD 130 to 240 (Cal BP 820 to 710)
(68% probability)



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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-11.6:lab. mult=1)

Laboratory number: **Beta-158836**

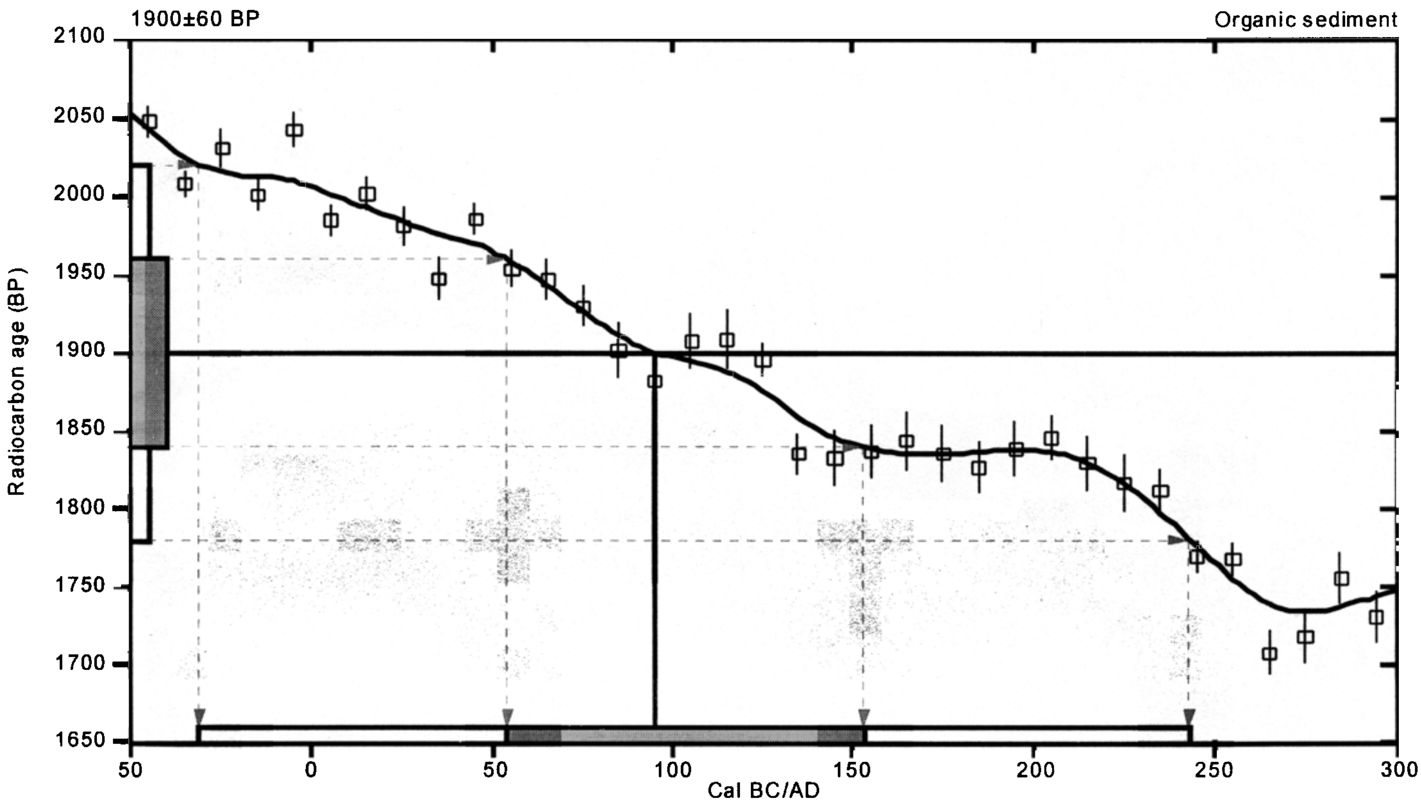
Conventional radiocarbon age: **1900±60 BP**

2 Sigma calibrated result: **Cal BC 30 to Cal AD 240 (Cal BP 1980 to 1710)**
(95% probability)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 100 (Cal BP 1860)

1 Sigma calibrated result: Cal AD 50 to 150 (Cal BP 1900 to 800)
(68% probability)



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Mathematics
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-17.9:lab. mult=1)

Laboratory number: **Beta-158837**

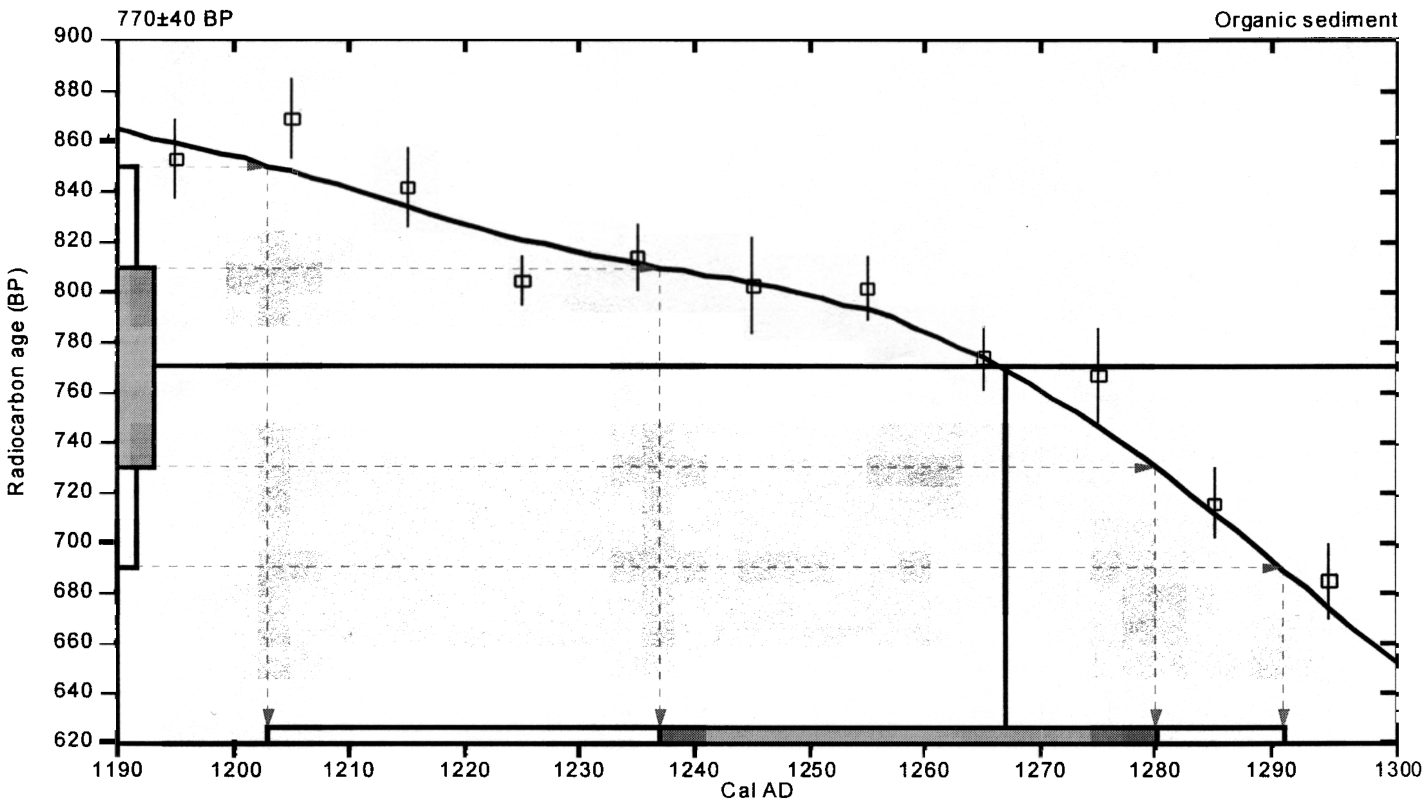
Conventional radiocarbon age: **770±40 BP**

2 Sigma calibrated result: **Cal AD 1200 to 1290 (Cal BP 750 to 660)**
(95% probability)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 1270 (Cal BP 680)

1 Sigma calibrated result: Cal AD 1240 to 1280 (Cal BP 710 to 670)
(68% probability)



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Mathematics
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Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-17.8:lab. mult=1)

Laboratory number: **Beta-158838**

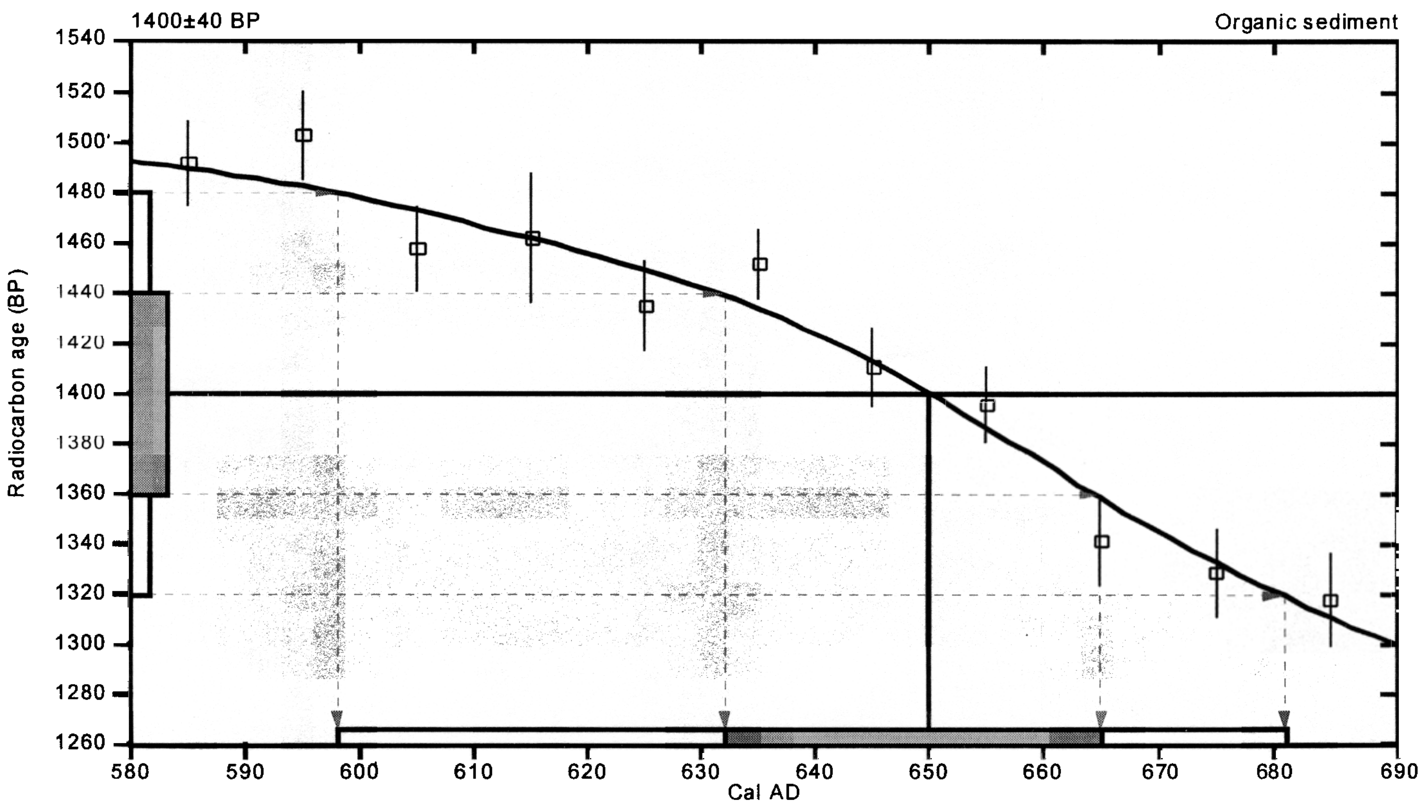
Conventional radiocarbon age: **1400±40 BP**

2 Sigma calibrated result: **Cal AD 600 to 680 (Cal BP 1350 to 1270)**
(95% probability)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 650 (Cal BP 1300)

1 Sigma calibrated result: Cal AD 630 to 660 (Cal BP 320 to 1280)
(68% probability)



References:

Database used

Calibration Database
Editorial Comment
Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii
INTCAL98 Radiocarbon Age Calibration
Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083
Mathematics
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-18.2:lab. mult=1)

Laboratory number: **Beta-158839**

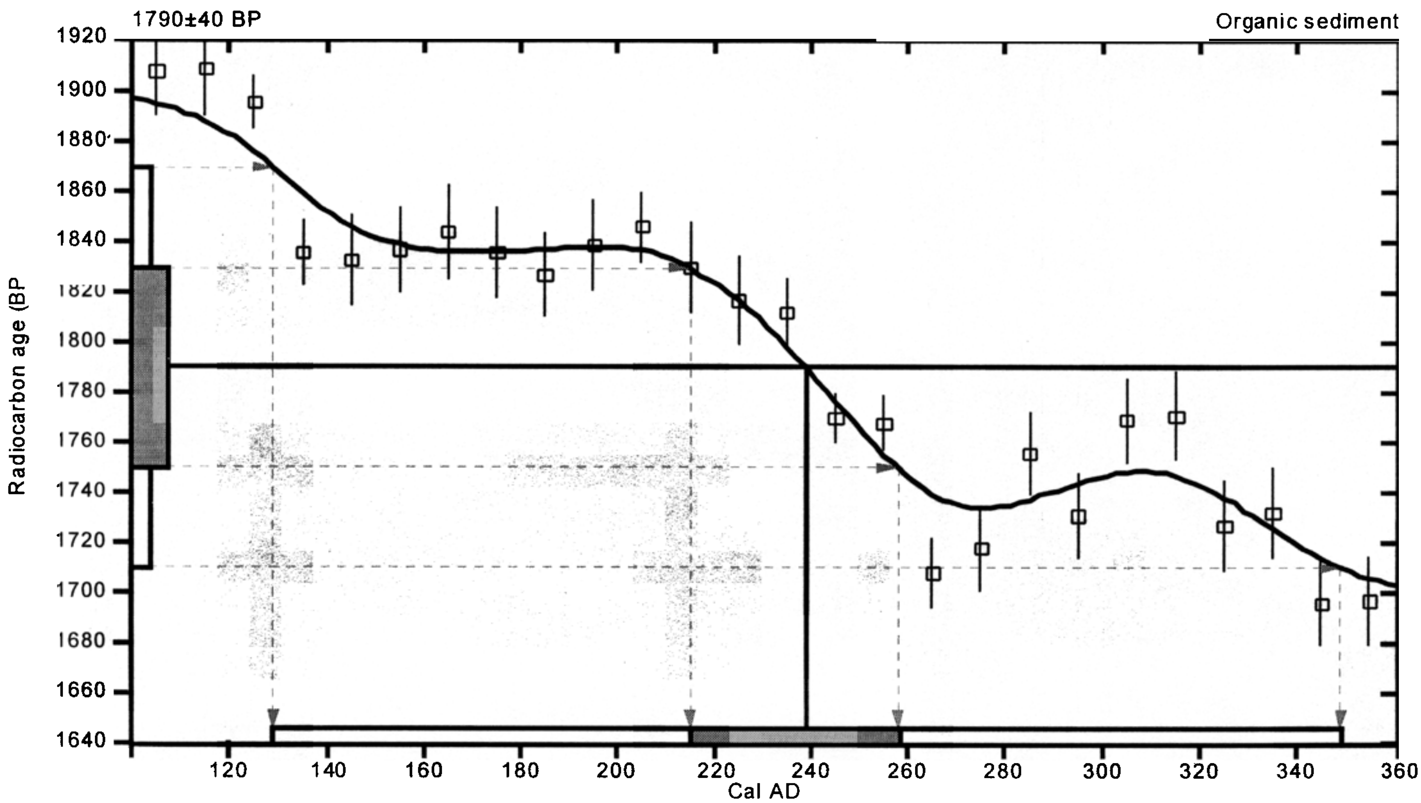
Conventional radiocarbon age: **1790±40 BP**

2 Sigma calibrated result: **Cal AD 130 to 350 (Cal BP 1820 to 1600)**
(95% probability)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 240 (Cal BP 1710)

1 Sigma calibrated result: Cal AD 220 to 260 (Cal BP 1740 to 1690)
(68% probability)



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Mathematics
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-18.2:lab. mult=1)

Laboratory number: **Beta-158840**

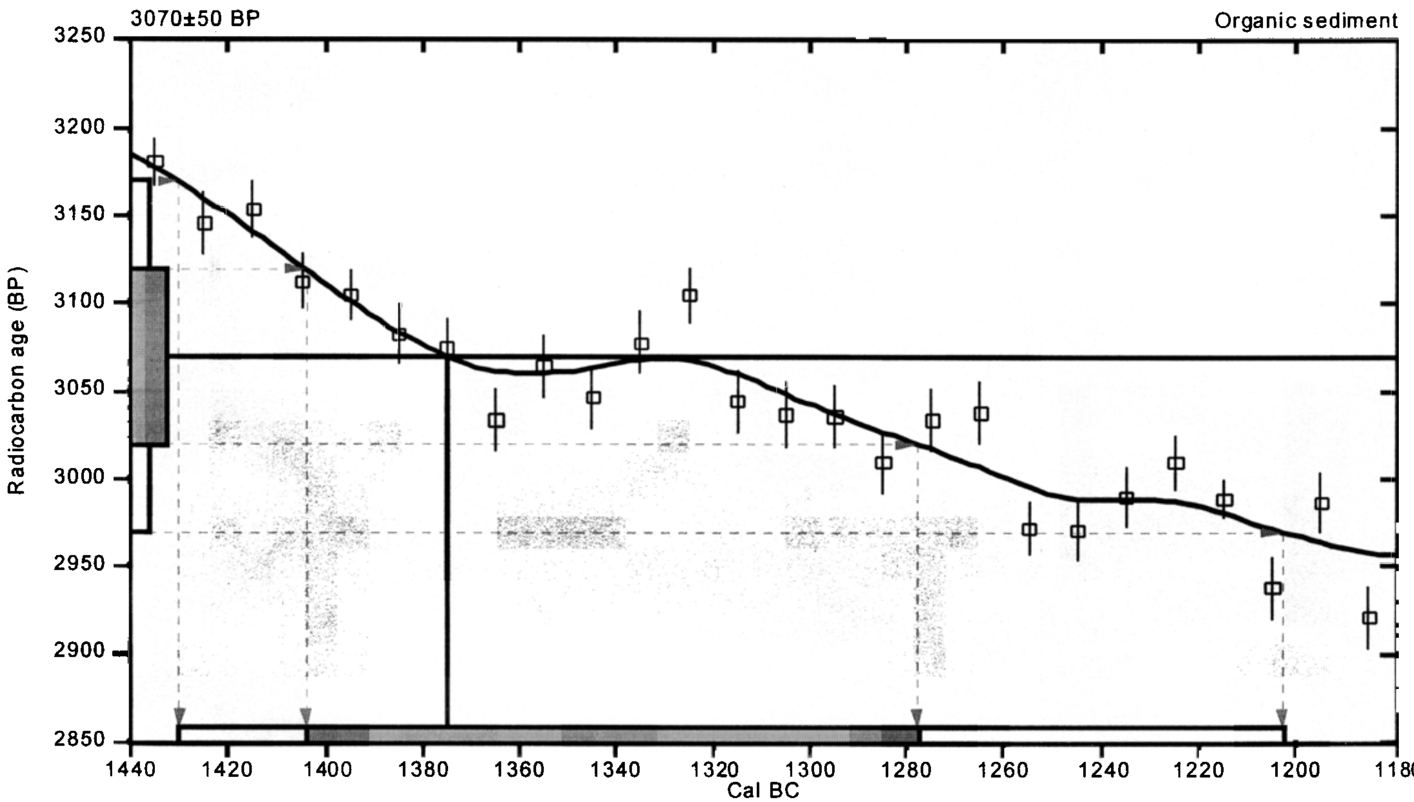
Conventional radiocarbon age: **3070±50 BP**

2 Sigma calibrated result: **Cal BC 1430 to 1200 (Cal BP 3380 to 3150)**
(95% probability)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 1380 (Cal BP 3320)

1 Sigma calibrated result: Cal BC 1400 to 1280 (Cal BP 3350 to 3230)
(68% probability)



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Mathematics
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-18.1:lab. mult=1)

Laboratory number: **Beta-158841**

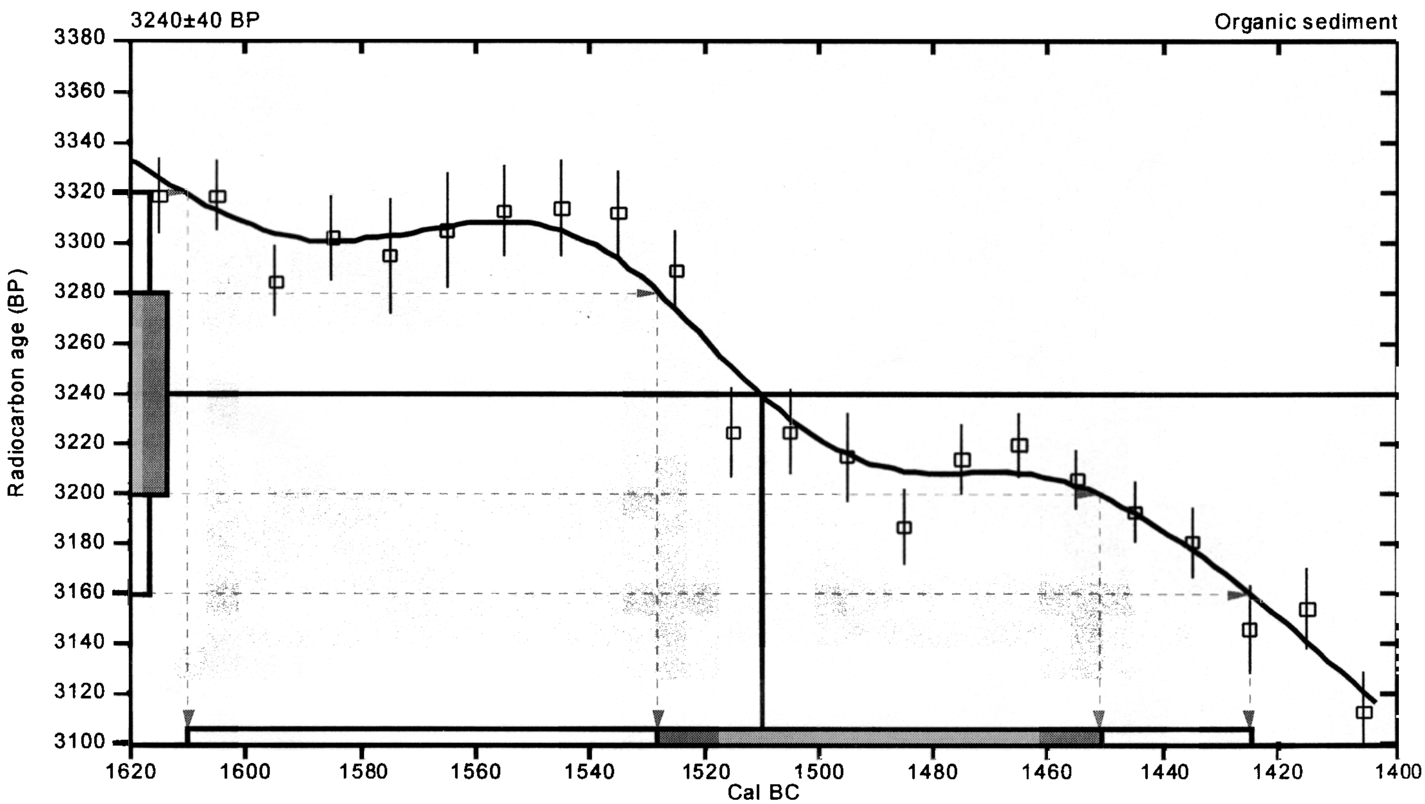
Conventional radiocarbon age: **3240±40 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 1610 to 1420 (Cal BP 3560 to 3380)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 510 (Cal BP 3460)

1 Sigma calibrated result: (68% probability) Cal BC 530 to 1450 (Cal BP 3480 to 3400)



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Mathematics

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-11.4:lab. mult=1)

Laboratory number: **Beta-158842**

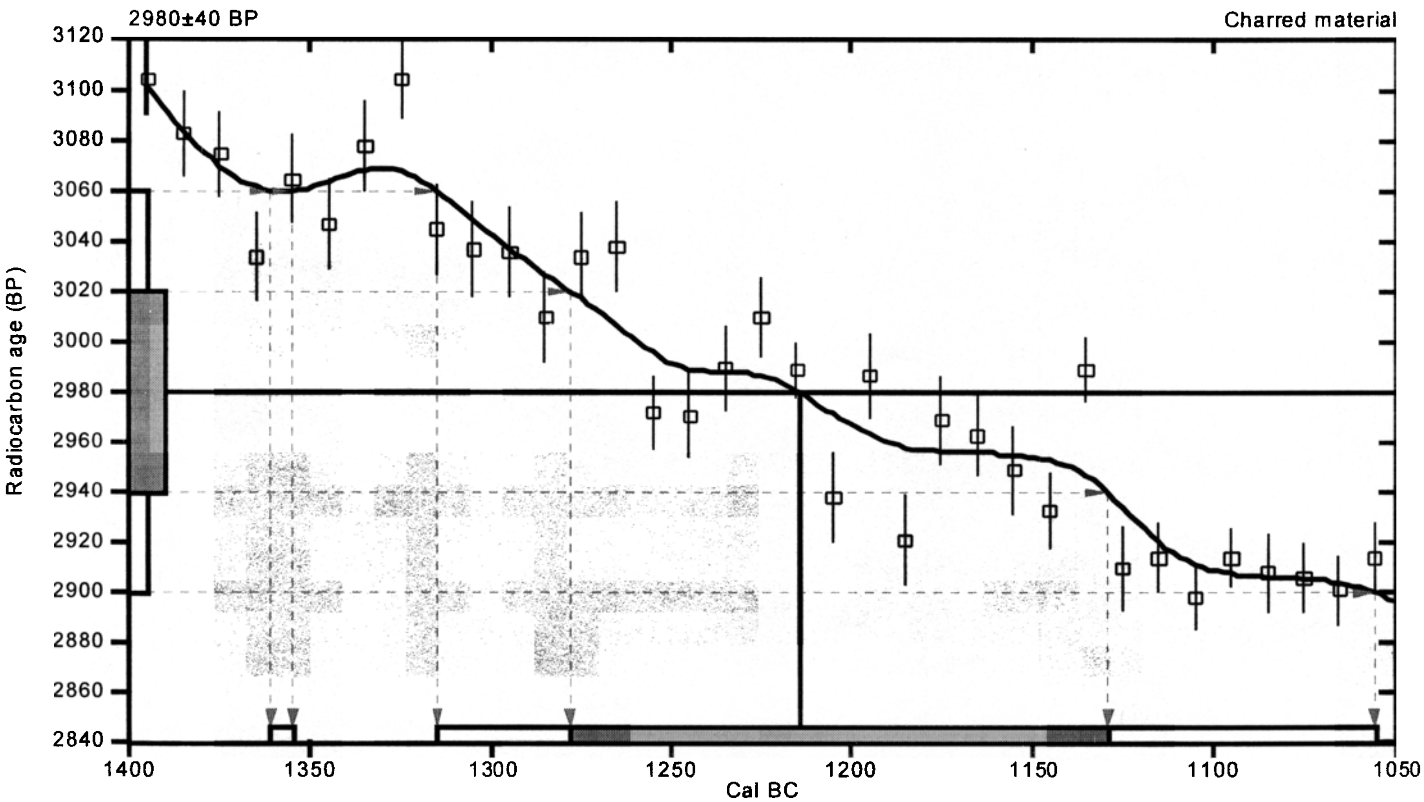
Conventional radiocarbon age: **2980±40 BP**

2 Sigma calibrated results: (95% probability) **Cal BC 1360 to 1360 (Cal BP 3310 to 3300) and Cal BC 1320 to 1060 (Cal BP 3260 to 3000)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 210 (Cal BP 3160)

1 Sigma calibrated result: (68% probability) Cal BC 280 to 1130 (Cal BP 3230 to 3080)



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Mathematics

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.8:lab. mult=1)

Laboratory number: **Beta-158843**

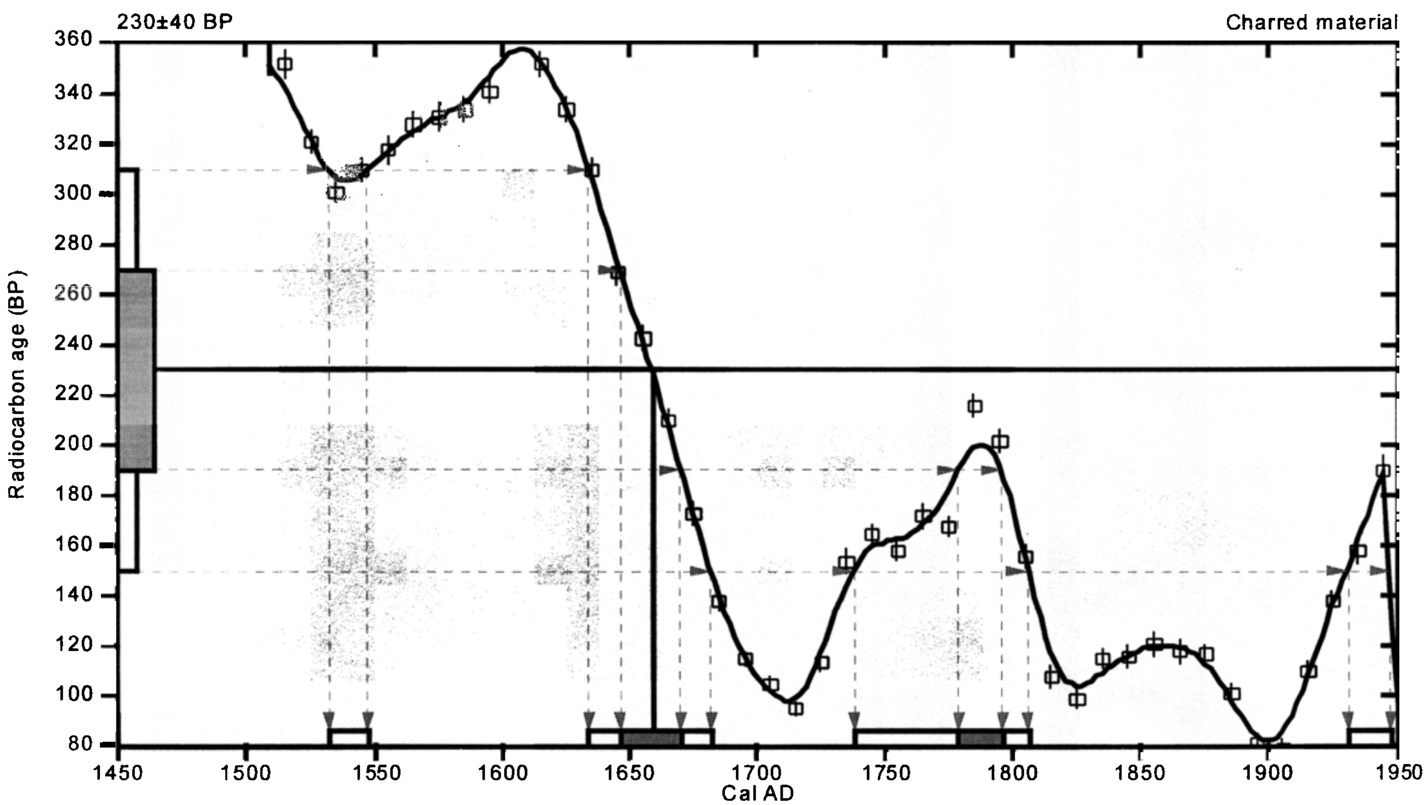
Conventional radiocarbon age: **230±40 BP**

2 Sigma calibrated results: (95% probability)
Cal AD 1530 to 1550 (Cal BP 420 to 400) and
Cal AD 1630 to 1680 (Cal BP 320 to 270) and
Cal AD 1740 to 1810 (Cal BP 210 to 140) and
Cal AD 1930 to 1950 (Cal BP 20 to 0)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 1660 (Cal BP 290)

1 Sigma calibrated results: (68% probability)
Cal AD 1650 to 1670 (Cal BP 300 to 280) and
Cal AD 1780 to 1800 (Cal BP 170 to 150)



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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-18.2:lab. mult=1)

Laboratory number: **Beta-158844**

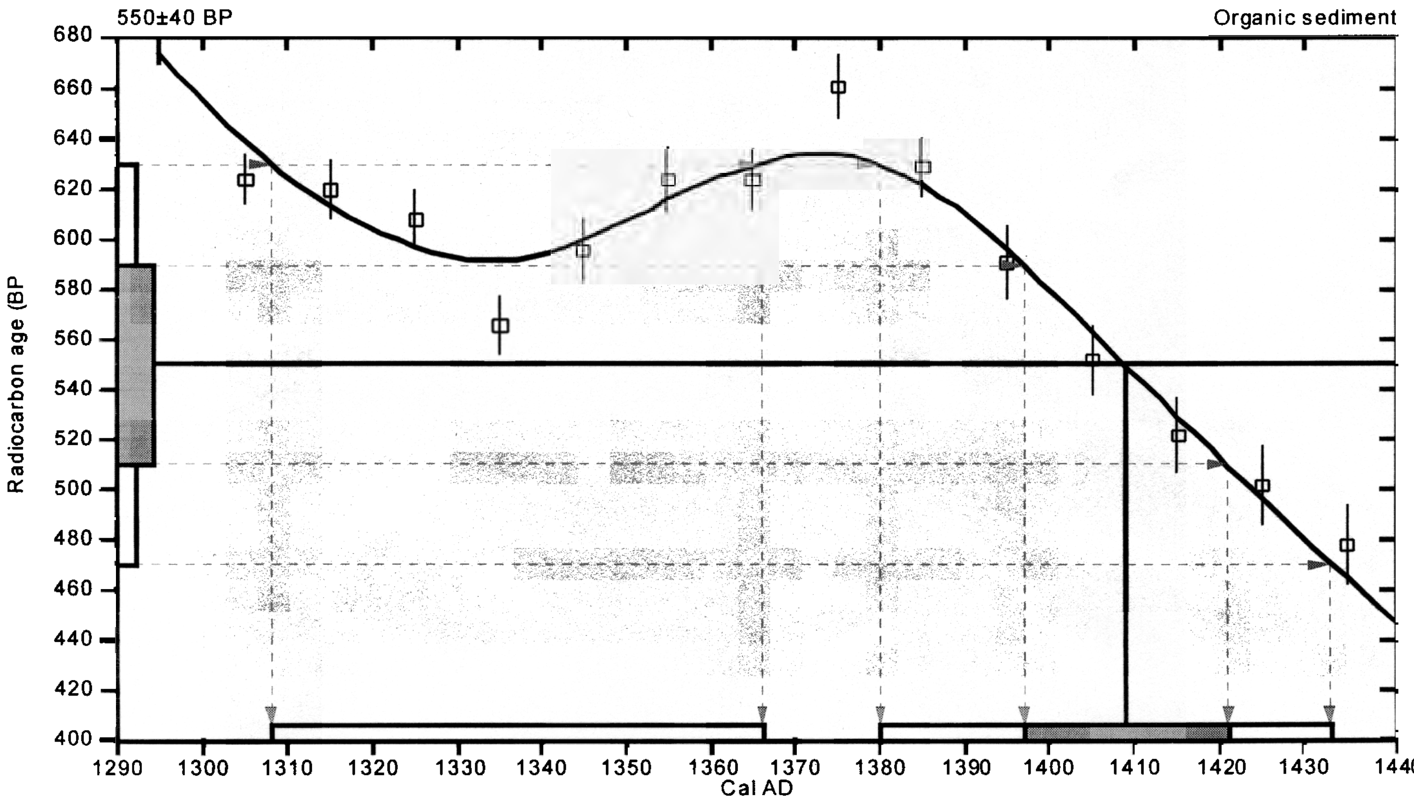
Conventional radiocarbon age: **550±40 BP**

2 Sigma calibrated results: **Cal AD 1310 to 1370 (Cal BP 640 to 580) and**
(95% probability) **Cal AD 1380 to 1430 (Cal BP 570 to 520)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 410 (Cal BP 540)

1 Sigma calibrated result: (68% probability) Cal AD 400 to 1420 (Cal BP 550 to 530



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