NMCRIS Activity No. 127085

10,000 Years of Transient Occupation in the Jornada del Muerto:
Excavations at Eight Sites at the Spaceport America Facility, Sierra County, New Mexico

Volume I

James L. Moore and Nancy J. Akins

Office of Archaeological Studies · Museum of New Mexico

Archaeology Notes 453

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10,000 Years of Transient Occupation in the Jornada Del Muerto:

Excavations at Eight Sites at the Spaceport America Facility, Sierra County, New Mexico

James L. Moore and Nancy J. Akins

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Prepared for the Federal Aviation Administration and
the New Mexico Spaceport Authority
Project-Specific Permit for State Trust Land No. SE-302
ARPA Permit No. 21-8152-11-19
NMCRIS No. 127085

ARCHAEOLOGY NOTES 453
SANTA FE 2014 NEW MEXICO

NMCRIS INVESTIGATION ABSTRACT FORM (NIAF)

1. NMCRIS Activity No.:	2a. Lead (Sponsoring) Agency:	2b. Other Permitting Agency(ies):	3. Lead Agency Report No.:
127085	Federal Aviation Administration (FAA), Office of Commercial Space Transportation	NM Historic Preservation Division; New Mexico State Land Office (NMSLO)	

4. Title of Report: 10,000 Years of Transient Occupation in the Jornada del Muerto: Excavations at Eight Sites at the Spaceport America Facility, Sierra County, New Mexico

Author(s) James L. Moore and Nancy J. Akins

5. Type of Report
- ☐ **Negative**
- ☒ **Positive**

6. Investigation Type

☐ Research Design ☐ Survey/Inventory ☐ Test Excavation ☒ Excavation ☐ Collections/Non-Field Study
☐ Overview/Lit Review ☐ Monitoring ☐ Ethnographic study ☐ Site specific visit ☐ Other

7. Description of Undertaking (what does the project entail?): Research excavations were conducted at eight sites at Spaceport America including LA 111422, LA 111429, LA 111435, LA 155963, LA 155964, LA 155968, LA 155969, LA 156877.

8. Dates of Investigation: 8-May-2011 to 15-Sep-2011

9. Report Date: 28-Feb-2014

10. Performing Agency/Consultant: Office of Archaeological Studies, MNM/DCA
Principal Investigator: R. Dello-Russo
Field Supervisor: James L. Moore and Nancy J. Akins
Field Personnel Names: Nancy Akins, James Moore, Guadalupe Martinez, Virgina Phiroda, Patricia Rodgers, Lynette Etsitty, Vernon Foster, Karen Wening, P. J. McBride/ethnobot; S. A. Hall/geomorphology.

11. Performing Agency/Consultant Report No.: Archaeology Notes No. 453

12. Applicable Cultural Resource Permit No.: Project-Specific Permit for State Trust Land No. SE-302, ARPA permit No. 21-8152-11-19

13. Client/Customer (project proponent): New Mexico Spaceport Authority
Contact: Elizabeth Oster, Cultural Resources Specialist for NMSA
Address: P.O. Box 4759, Santa Fe, New Mexico, 87502
Phone: (505) 603-8527

14. Client/Customer Project No.:

15. Land Ownership Status *(<u>Must</u> be indicated on project map)*:

Land Owner	Acres Surveyed	Acres in APE
TOTALS		

16 Records Search(es):

Date(s) of ARMS File Review	Name of Reviewer(s)	
Date(s) of NR/SR File	Name of Reviewer(s)	
Date(s) of Other Agency File Review	Name of Reviewer(s)	Agency

17. Survey Data:

a. Source Graphics ☐ **NAD 27** ☐ **NAD 83** **Note: NAD 83 is the NMCRIS standard**

☐ **USGS 7.5' (1:24,000) topo map** ☐ **Other topo map, Scale:**

☐ **GPS Unit** **Accuracy** ☐ **<1.0m** ☐ **1-10m** ☐ **10-100m** ☐ **>100m**

b. USGS 7.5' Topographic Map Name	**USGS Quad Code**

c. County(ies): Doña Ana County, NM

17. Survey Data (continued):

d. Nearest City or Town: Rincon, NM

e. Legal Description:

Township (N/S)	Range (E/W)	Section	¼ ¼ ¼
			, , .
			, , .
			, , .
			, , .
			, , .
			, , .
			, , .
			, , .
			, , .

Projected legal description? ☐ **Yes** ☒ **No** ☐ **Unplatted**

f. Other Description (e.g. well pad footages, mile markers, plats, land grant name, etc.):

18. Survey Field Methods:

Intensity: ☐ 100% coverage ☐ <100% coverage

Configuration: ☐ block survey units ☐ linear survey units (l x w): ☐ other survey units (specify): Linear with appended small blocks

Scope: ☐ non-selective (all sites recorded) ☐ selective/thematic (selected sites recorded)

Coverage Method: ☐ systematic pedestrian coverage ☐ other method (describe)

Survey Interval (m): **Crew Size:** **Fieldwork Dates:**

Survey Person Hours: **Recording Person Hours:** **Additional Narrative:**

19. Environmental Setting (NRCS soil designation; vegetative community; elevation; etc.):

20. aa. Percent Ground Visibility:	**b. Condition of Survey Area (grazed, bladed, undisturbed, etc.):**
21. CULTURAL RESOURCE FINDINGS ☒ **Yes, see next report section** ☐ **No, Discuss Why:**	
22. Required Attachments (check all appropriate boxes): All of the information below is included in the attached report. ☒ **USGS 7.5 Topographic Map with sites, isolates, and survey area clearly drawn** ☐ **Copy of NMCRIS Mapserver Map Check** ☐ **LA Site Forms - new sites (*with sketch map & topographic map*)** ☒ **LA Site Forms (update) - previously recorded & un-relocated sites (*first 2 pages minimum*)** ☐ **Historic Cultural Property Inventory Forms** ☐ **List and Description of isolates, if applicable** ☐ **List and Description of Collections, if applicable**	**23. Other Attachments:** ☐ **Photographs and Log** ☐ **Other Attachments** ***(Describe)*:**
24. I certify the information provided above is correct and accurate and meets all applicable agency standards. **Principal Investigator/Responsible Archaeologist:** Robert Dello-Russo **Signature** ______________________ **Date** 11/27/2013 **Title (if not PI):**	
25. Reviewing Agency: **Reviewer's Name/Date** **Accepted ( ) Rejected ( )** **Tribal Consultation (if applicable):** ☐ **Yes** ☐ **No**	**26. SHPO** **Reviewer's Name/Date:** **HPD Log #:** **SHPO File Location:** **Date sent to ARMS:**

CULTURAL RESOURCE FINDINGS

[fill in appropriate section(s)]

1. NMCRIS Activity No.:	**2. Lead (Sponsoring) Agency:**	**3. Lead Agency Report No.:**
127085	US Federal Aviation Administration NM/OK Airport Development Office	

SURVEY RESULTS:
Sites discovered and registered:
Sites discovered and NOT registered:
Previously recorded sites revisited (*site update form required*):
Previously recorded sites not relocated *(site update form required):*
TOTAL SITES VISITED:
Total isolates recorded: **Non-selective isolate recording?** ☐
HCPI properties discovered and registered:
HCPI properties discovered and NOT registered:
Previously recorded HCPI properties revisited:
Previously recorded HCPI properties not relocated:
TOTAL HCPI PROPERTIES (visited & recorded, including acequias):

MANAGEMENT SUMMARY:

IF REPORT IS NEGATIVE YOU ARE DONE AT THIS POINT.

SURVEY LA NUMBER LOG
Sites Discovered:

LA No.	Field/Agency No.	Eligible? (Y/N, applicable criteria)

Previously recorded revisited sites:

LA No.	Field/Agency No.	Eligible? (Y/N, applicable criteria)

MONITORING LA NUMBER LOG *(site form required)*

Sites Discovered (*site form required*) **:** **Previously recorded sites *(Site update form required):***

LA No.	Field/Agency No.	LA No.	Field/Agency No.

Areas outside known nearby site boundaries monitored? Yes ☐**, No** ☐ **If no explain why:**

TESTING & EXCAVATION LA NUMBER LOG (*site form required*)

Tested LA number(s)	Excavated LA number(s)
	LA 111422
	LA 111429
	LA 111435
	LA 155963
	LA 155964
	LA 155968
	LA 155969
	LA 156877

Administrative Summary

At the request of the New Mexico Spaceport Authority (NMSA) of the Economic Development Department, the Office of Archaeological Studies (OAS), New Mexico Department of Cultural Affairs, completed research-oriented excavations at eight archaeological sites at Spaceport America in Sierra County, New Mexico. The sites are on New Mexico State Land Office trust land and Bureau of Land Management land. All excavation took place on State Trust Land managed by the New Mexico State Land Office (NMSO).

Excavations at LA 111422, LA 111429, LA 111435, LA 155963, LA 155964, LA 155968, LA 155969, and LA 156877 were aimed at collecting data to aid in the examination of a of a series of themes and questions posed in the research design for this project (Post and Dello-Russo 2010), as well as to assess the ability of these sites to provide further information on the prehistory or history of the Jornada del Muerto after research-oriented investigations were complete. All eight sites had previously been recommended as eligible to the *National Register of Historic Places*.

Analysis of data collected by this study demonstrates a long series of Prehistoric- through Historic-period occupations at these sites, beginning at least as early as the Folsom period (LA 111429, LA 155963, and LA 155968), and including the Archaic period (LA 111435, LA 155963, and possibly LA 156877), the Late Archaic/Mesilla-phase transition (LA 111429 and LA 155963), the Mesilla phase (LA 111422, LA 111429, LA 111435, LA 155963, LA 155968, and possibly LA 155969), the Doña Ana/ El Paso phase transition (LA 155963), and the Protohistoric to early Historic periods (LA 111429, LA 155963, LA 155964, and LA 155968). With the exception of LA 155969, these sites still have the ability to provide information besides what was recovered during this study. LA 155969 is badly deflated and contains no evidence for subsurface cultural deposits or features, and is felt to have little or no further research potential.

MNM Project No. 41.917
Project-Specific Permit, State Trust land, No. SE-302
ARPA Permit, Bureau of Land Management land, No. 21-8152-11-19
NMCRIS No. 127085

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1 | Introduction to the Project

Introduction to the Research-Oriented Study

James L. Moore

Between May 8 and August 12, and from September 6 through 15, 2011, the Office of Archaeological Studies (OAS) conducted research-oriented investigations at eight sites within the Spaceport America facility in Sierra County, New Mexico (Fig. 1.1). The investigated sites included LA 111422, LA 111429, LA 111435, LA 155963, LA 155964, LA 155968, LA 155969, and LA 156877 (Table 1.1). These investigations were completed at the request of the New Mexico Space Authority (NMSA) under a Memorandum of Agreement between NMSA and OAS. As described in more detail below, two of the sites where research-oriented investigations were later conducted and six additional sites were examined during an initial testing phase (Table 1.2). These six additional sites included LA 111420, LA 111421, LA 111432, LA 112370, LA 112371, and LA 112374.

The project was directed by James L. Moore and Nancy J. Akins, who were assisted in the field by Lynette Etsitty, Vernon Foster, Guadalupe Martinez, Virginia Prihoda, Patricia Rogers, and Karen Wening. Stephen S. Post and Robert Dello-Russo were the principal investigators for this project until the retirement of Mr. Post, at which time Dr. Dello-Russo became the sole principal investigator. The field methods used were specified in: *A Research Design for the Archaeological Investigation of 14 Sites at Spaceport America, Sierra County, New Mexico*, by James L. Moore, Nancy J. Akins, Robert Dello-Russo, and Stephen S. Post (Archaeology Notes 430, Office of Archaeological Studies, Museum of New Mexico), as amended by letter.

LA 111422, LA 111435, LA 155963, LA 155964, LA 155968, LA 155969, and LA 156877 are entirely situated on New Mexico State Trust land. Most of LA 111429 is on New Mexico State Trust land, but a small portion extends onto land administered by the Bureau of Land Management. Investigations conducted during this project were restricted to New Mexico State Trust land. Archaeological studies on New Mexico State Trust land were conducted under Project-Specific Permit No. SE-302. Anticipating the possibility of extending investigations onto Bureau of Land Management land, ARPA Permit No. 21-8152-11-19 was obtained. Site locational information is presented in Appendix 7. All notes and artifacts recovered during the course of this study and the testing phase are curated at the Archaeological Records Collection of the Museum of New Mexico in Santa Fe.

Geomorphological studies were conducted by Dr. Stephen A. Hall of Red Rock Geological Enterprises; his results are reported in Chapter 21. Mechanical excavation of soil pits was conducted by CMC Construction, Inc. Analysis of OSL samples was completed by the Optically Stimulated Luminescence Laboratory, Department of Earth and Atmospheric Sciences at the University of Nebraska—Lincoln. Sediment samples were analyzed by the Milwaukee Soil Laboratory, LLC, and the Pedology Laboratory, Department of Geography, University of Kansas–Lawrence.

Most artifact analyses were conducted at OAS, with a few specialized analyses being sent to qualified laboratories. The artifact categories examined by OAS personnel included fauna, chipped stone, ceramics, ground stone, and ethnobotanical samples. Analysis of faunal materials was conducted by Nancy J. Akins. Chipped stone artifact analysis was conducted by James L. Moore assisted by Mary

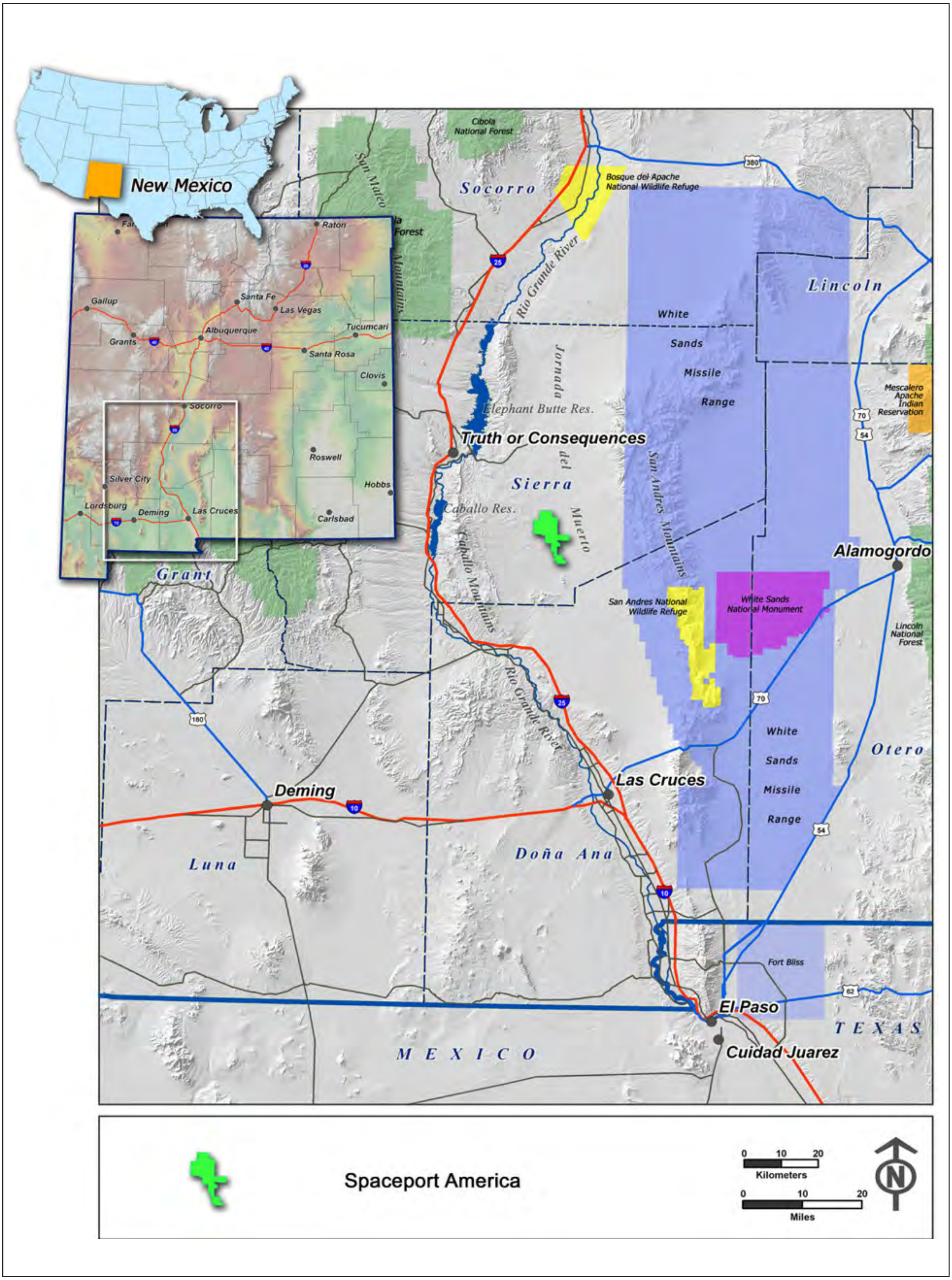

Figure 1.1. Location of Spaceport America with respect to surrounding areas.

Table 1.1. *Information on sites investigated during this study.*

Site	Land Status	Description	Size	Work Performed	Comments
LA 111422	NMSLO State Trust Land	Mesilla phase camp site with possible Archaic component; 6 features	0.45 ha, 1.114 acres	excavated 51 sq m and 3 features, recorded 3 new features	–
LA 111429	NMSLO State Trust Land, BLM land	Large multicomponent site containing Paleoindian, Archaic, Formative, and Protohistoric components, 24 features	18.07 ha, 44.65 acres	excavated 133 sq m and 6 features, surface collected 119 sq m	all work performed on NMSLO State Trust Land
LA 111435	NMSLO State Trust Land	Mesilla phase site with Middle and Late Archaic components, 15 features	2.36 ha, 5.83 acres	excavated 76.5 sq m and 9 features, recorded 6 new features	work only performed in western half of site by amendment to plan
LA 155963	NMSLO State Trust Land	Large multicomponent site containing Paleoindian, Archaic, Formative, Protohistoric, and Historic components, 160 features	53.32 ha, 131.75 acres	excavated 153 sq m. and 12 features, surface collected 602 sq m, recorded 29 additional features	–
LA 155964	NMSLO State Trust Land	Historic Native American site with possible earlier component, multiple features	0.53 ha, 1.30 acres	excavated 16 sq m and 3 features, recorded 5 additional features	–
LA 155968	NMSLO State Trust Land	Multicomponent Paleoindian, Mesilla phase, with a Historic component, 8 features	1.19 ha, 2.95 acres	excavated 18 sq m and 1 feature, recorded 5 additional features, collected all visible artifacts	–
LA 155969	NMSLO State Trust Land	Post-Archaic artifact scatter with 1 deflated feature	0.77 ha, 1.91 acres	excavated 16 sq m and 1 feature, collected all visible artifacts	–
LA 156877	NMSLO State Trust Land	Multicomponent site with Archaic and Formative components, 5 features	0.39 ha, 0.95 acres	excavated 16 sq m and 1 feature, collected all visible artifacts	–

Table 1.2. List of the sites at Spaceport America that were examined during the testing and data recovery phases.

Site	Testing Phase	Data Recovery Phase
LA 111420	x	–
LA 111421	x	–
LA 111422	–	x
LA 111429	x	x
LA 111432	x	–
LA 111435	–	x
LA 112370	x	–
LA 112371	x	–
LA 112374	x	–
LA 155963	x	x
LA 155964	–	x
LA 155968	–	x
LA 155969	–	x
LA 156877	–	x

Weahkee. C. Dean Wilson supervised analysis of ceramic artifacts, and was assisted by Richard Montoya. Karen Wening analyzed the ground stone assemblage, and Pamela McBride examined the ethnobotanical samples. Jeffrey L. Boyer analyzed the radiocarbon data.

Four analyses were conducted by qualified laboratories other than those at OAS. Beta Analytic, Inc., analyzed the radiocarbon samples. Protein residue analysis of selected chipped stone artifacts was completed by Dr. Robert M. Yohe II of the Laboratory of Archaeological Science at the University of California at Bakersfield, with the assistance of Summer Gibbons (Appendix 1). The PaleoResearch Institute analyzed phytoliths and starch residues on fire-cracked rock samples removed from thermal features (Appendix 2). Dr. M. Steven Shackley of the Archaeological XRF Laboratory sourced obsidian samples from our sites (Appendix 3).

The rationale behind this study was twofold—to collect data applicable to the questions posed in the research design for this project (Chapter 4) and to assess the potential of these sites to provide information useful to future studies. The research phase of this project was preceded by a testing phase at eight sites including LA 111420, LA 111421, LA 111429, LA 111432, LA 112370, LA 112371, LA 112374, and LA 155963 (reported in Akins and Moore 2011a). The testing phase had three goals. The first was assessment of *National Register* eligibility for LA 111421, LA 112370, LA 112371, and LA 112374. The second goal was to assess corridors of potential future construction-related disturbance at LA 111420, LA 111429, and LA 111432, all three of which had already been determined to be "eligible." The final goal was to examine LA 111429 and LA 155963, the largest and most complicated "eligible" sites within the area encompassed by Spaceport America, to aid in selecting features and artifact concentrations for research-oriented investigations.

Testing determined that three of the four sites assessed for *National Register* eligibility—LA 111421, LA 112470, and LA 112474—were sparse distributions of surface artifacts with no evidence for subsurface cultural deposits or features, and they were recommended as "not eligible" for the *National Register*. LA 112471 was found to contain more surface and subsurface artifacts than the other three sites in this category, and was recommended as "eligible." Assessment at LA 111420 and LA 111432 found additional evidence that supports the standing determination of "eligible" based on their potential to contain further information, but no further work was recommended unless they could not be avoided during future construction. Testing at LA 111429 and LA 155963 identified several features and artifact concentrations at each that were targeted for more detailed investigation during research-oriented investigations because of their research potential. The geomorphological analysis of the tested sites is presented in the current study (Chapter 21), and their chipped stone artifacts assemblages are discussed in more detail in Chapter 14.

The six other sites were not examined during testing, necessitating the development of investigative plans that utilized information provided by earlier studies, primarily surveys conducted by Human Systems Research (HSR 1995) and Zia Engineering & Environmental Consultants (Zia; Quaranta and Gibbs 2008). Because site conditions changed during the intervening years and assessing the potential of features to provide necessary information is difficult to accomplish using survey data, some changes to the plans formulated prior to initiation of fieldwork were made after that work began, as detailed in the site reports.

No definite evidence of structures was noted at any of these sites during survey and testing, although a few potential structural remains were noted. All eight sites reflect short-term residential occupations. In several cases multiple occupations were suggested, often reflecting different cultural periods (Akins and Moore 2011a; HSR 1997; Quaranta and Gibbs 2008). Two of these sites—LA 111422 and LA 111435—were considered to reflect Mesilla-phase occupations, and each contains evidence of thermal features. LA 111429 and LA 155963 are both very large sites, with Paleoindian, Archaic, and Formative period uses being defined for both during survey and testing. In addition, LA 155963 was thought to contain a Protohistoric component as well as a fairly extensive Historic component. LA 155964 was considered to contain Middle Archaic and Formative period features including a possible structure. LA 155968 and LA 156877 were described as scatters of prehistoric artifacts with features. LA 155969 was essentially described in the same way, although a possible structure was also noted.

The data recovery plan for this study specified the examination of several general themes, as detailed in Chapter 4. In general, limited excavations at these sites were successful in recovering data useful in exploring the themes and questions posed in the research design, and in providing a better idea of how human populations used the central Jornada del Muerto from the Paleoindian period to the Historic period. In only one case was the research potential of a site considered to have been exhausted by this study. That site is LA 155969, which proved to be badly deflated and which contained no subsurface cultural deposits or features. The other seven sites retain at least some potential to provide further information concerning the prehistoric to historic use of the region.

Paleoindian components were identified at LA 111429, LA 155963, and LA 155968, and in each case the diagnostic projectile points recovered from these sites, by this and previous studies, suggest that the main Paleoindian use of these sites occurred during the Folsom period, though additional earlier and later Paleoindian occupations cannot be ruled out. While Archaic remains were found at several sites, none appeared to have been primarily occupied by Archaic hunter-gatherers. Archaic components were found at LA 111435 (Middle and Late Archaic features) and possibly LA 156877, while features at LA 111429 and LA 155963 yielded dates representing the Late Archaic/Mesilla-phase transition. Jornada Mogollon remains were among the most common identified and mainly had a Mesilla-phase affiliation. Mesilla-phase remains were identified at LA 111422, LA 111429, LA 111435, LA 155963, LA 155968, and possibly LA 155969. One feature that dates from the Doña Ana- to El Paso-phase transition was also identified at LA 155963, providing some evidence for later Jornada Mogollon use of the region. Analysis of the ceramic assemblage appears to confirm this possibility, and also suggests some El Paso-phase use of the area. A surprising number of radiocarbon samples were dated to the Protohistoric and Historic periods, and were obtained from features at LA 111429, LA 155963, and LA 155964, while a single historic period chipped stone tool was found at LA 155968.

This report is structured in four parts. Part I contains background material for the study including overviews of the physical (Chapter 2) and cultural environments (Chapter 3), the research orientation for this study (Chapter 4), and the field methods that were used (Chapter 5). The sites are described and our investigations discussed in Part II (Chapters 6–13). Discussions of laboratory analyses are included in Part III, including chipped stone (Chapter 14), ground stone and ornaments (Chapter 15), fauna (Chapter 16), ethnobotanical materials (Chapter 17), ceramics (Chapter 18), and chronology (Chapter 19). Part IV presents project syntheses and supporting studies, including a survey of the modern vegetation (Chapter 20), a geomorphological study (Chapter 21), a synthesis of geomorphological and archaeological information (Chapter 22), a survey of potential chipped stone material sources (Chapter 23), a study of some of the feature types examined (Chapter 24), and discussion of the research orientation (Chapter 25) and research questions (Chapter 26).

Spaceport America Regulatory Background

Elizabeth A. Oster

In December 2008, the Federal Aviation Administration Office of Commercial Space Transportation issued a Launch Site Operator License to the NMSA to develop and operate a commercial space launch site, to be called Spaceport America. The issuance of a Launch Site Operator License by the FAA is considered a federal undertaking subject to review as required by the National Environmental Policy Act (NEPA) and Section 106 of NHPA. In December 2008 the FAA issued a Record of Decision stating that the FAA had selected the Preferred Alternative, as analyzed in the November 2008 *Final Environmental Impact Statement for the Spaceport America Commercial Launch Site, Sierra County, New Mexico.* The undertaking is subject to review and concurrence by the New Mexico State Historic Preservation Office, Historic Preservation Division (SHPO-HPD) as well as the "Section 106 Consulting Parties" (see below for description of this group).

The FAA is responsible for analyzing the environmental impacts associated with issuing a launch-site operator license, and is thus the lead federal agency responsible for the proposed Spaceport America cultural (and natural) resources compliance review. Cooperating agencies include the

Bureau of Land Management (BLM), the National Park Service (NPS), the U.S. Army White Sands Missile Range (WSMR), and the National Aeronautics and Space Administration (NASA). The Areas of Potential Effects (APE)* identified for the proposed undertaking are located primarily on lands managed by the New Mexico State Land Office (NMSLO) and the U.S. Department of Interior—BLM. Some private land will also be affected.

A Programmatic Agreement (PA), finalized in December of 2008, guides the completion of the responsibilities for the undertaking per Section 106: *Programmatic Agreement among the Federal Aviation Administration, Bureau of Land Management, New Mexico State Land Office, New Mexico Spaceport Authority, New Mexico State Historic Preservation Officer, and Advisory Council on Historic Preservation Regarding the Spaceport America Project, Sierra County, New Mexico* (Section 106 PA). The FAA, in consultation with the SHPO-HPD, identified the following nine tribes as potentially having religious or cultural affiliation with the project area and provided each of them with information about opportunities for site visits to the project area and for participation in the Section 106 process: the Comanche Indian tribe; Fort Sill Apache tribe of Oklahoma; Hopi tribe; Isleta Pueblo; Kiowa tribe of Oklahoma; Mescalero Apache tribe; Navajo Nation; White Mountain Apache tribe; Ysleta del Sur Pueblo.

The Section 106 PA document was signed by the following agencies and groups:

Federal Aviation Administration
Advisory Council on Historic Preservation
Bureau of Land Management (New Mexico State Office)
New Mexico State Historic Preservation Office
New Mexico Spaceport Authority
New Mexico State Land Office

The Consulting Parties in the Section 106 process listed below were also asked to participate in development of the Section 106 PA, and were asked to review and sign the Section 106 PA as Concurring Parties:

National Aeronautics and Space Administration (NASA)
U.S. Army White Sands Missile Range (WSMR)
National Park Service (NPS)
New Mexico Department of Transportation (NMDOT)
Sierra County
National Trust for Historic Preservation (NTHP)
New Mexico Heritage Preservation Alliance (NMHPA)
El Camino Real de Tierra Adentro Trail Association (CARTA)
Ysleta del Sur Pueblo
Comanche Indian tribe
Hopi tribe
Mr. Dennis Wallin (representative for the private property owners)

Together, the Section 106 PA Signatories and Concurring Parties and the nine Native American tribes identified as culturally affiliated with resources in the Spaceport America project area comprise the "Section 106 Consulting Parties" for Spaceport America compliance review. As consultation regarding the Spaceport undertaking has gone forward, three tribes have continued to participate as Section 106 Consulting Parties: Ysleta del Sur Pueblo; the Comanche Indian tribe; and the Hopi tribe of Arizona. Under the terms of the Section 106 PA, the NMSA is responsible for developing plans and submitting them to the FAA for approval, including mitigation plans for known historic properties as well as any properties that may be identified as a result of survey and evaluation or monitoring. The FAA, in turn, will submit mitiga-

* In an effort to avoid confusion, the term "Areas of Potential Effect" (APE) is used in this document only to refer to the regulatory context within which the consultation for the Spaceport America undertaking has taken place, rather than as a general referent to physical locations within which planned disturbances have occurred, and/or within which the field investigations described herein have been conducted. This is in part because the authors of the report do not wish to detract from the research focus that guided the design and implementation of the field studies, as well as the preparation of the report. In addition, as the information provided in this section specifies, two APEs ("Physical" and "Setting") have been identified for the Spaceport America undertaking, and while they have areas of overlap they are defined very differently. Therefore, in the interests of clarity, the land surfaces within which archaeological sites have been identified and investigated are generally referenced as "previously surveyed."

tion plans to the Section 106 Consulting Parties for comment, prior to accepting them. Per Stipulation I(a) of the Section 106 PA, in addition to the qualifications required for the issuance of a permit to conduct archaeological investigations in New Mexico (4.10.8.11 NMAC and 4.10.11.9 NMAC), project supervisory staff are required to meet the professional qualifications for archaeology outlined in the Secretary of the Interior's Standards (36 CFR part 61, Appendix A). The State of New Mexico requires that a research design shall be prepared guiding archaeological data recovery excavations according to the specifications of 4.10.16 NMAC, implementing regulations for the "Cultural Properties Act" (§§18-6-1 through 18-6-27, NMSA 1978).

The research design was submitted for Section 106 review in conformance to Stipulation V(c) i of the Section 106 PA, and for review and issuance of a permit to the Cultural Properties Review Committee (CPRC) in conformance to Stipulation V(d). The document was approved by the CPRC on March 17, 2011, and was approved and accepted by the FAA (following review and consultation with the Section 106 Consulting Parties) on April 11, 2011. While the fieldwork was in progress, the field directors requested a small amendment to the plan of investigation for LA 111435. The amendment was reviewed and accepted by the FAA on July 8, 2011, in consultation with the SHPO.

Status of Information about Cultural Resources in the Areas of Potential Effects

As defined in the Section 106 PA, the APE for the Spaceport undertaking consist of: "the Physical APE, comprised of the areas that may be directly affected by physical ground disturbance and construction of the commercial space launch site, and the Setting APE, comprised of the area within five miles of the facility wherein potential visual and audible effects to the historic properties may occur…" (FAA 2008). The *Final Environmental Impact Statement for the Spaceport America Commercial Launch Site, Sierra County, New Mexico,* provides additional detail regarding the definition of the APE as well as the nature of the potential effects, as follows:

> The proposed Project has the potential to affect cultural resources in two ways: through physical impacts to resources, and through changes to the visual and auditory character of the rural setting of resources. For physical impacts, the APE is defined as the areas within which construction or operations activities would occur, hereafter referred to as the Physical APE. Because the Physical APE boundaries include more area (the Project boundary plus a buffer area) than would be specified for construction of the Spaceport America facilities, not all of the resources identified within this APE would necessarily be impacted by the Project. The Physical APE was developed to allow for possible minor shifting of facility locations during Project design and construction to avoid resource impacts and to allow ample area for construction activities. Due to the nature of the undertaking, the potential effects of the Project could also extend to areas outside of, but in proximity to, the limits of disturbance of the proposed Spaceport America facilities. These are areas that may contain resources that could be impacted through the introduction of visible or audible intrusions into the setting by the proposed Project. This area has been defined by the FAA, in consultation with the New Mexico State Historic Preservation Officer (NMSHPO), the BLM, the NPS, and the National Trust for Historic Preservation, as a 5-mile radius surrounding any proposed aboveground infrastructure or facilities, and is hereafter referred to as the Setting APE (FAA 2008).

The project area is located in the Yost Draw portion of the Jornada del Muerto, a north–south trending basin. Cultural resources in the general project area and vicinity identified during archaeological survey (including recent work conducted in advance of/as mitigation for the proposed undertaking) date from the Paleoindian period up to the twentieth century. The majority of the cultural properties in the APE are prehistoric Native American sites, but the project area also includes segments of El Camino Real de Tierra Adentro National Historic Trail (El Camino Real NHT; El Camino Real) identified as portions of the Yost Draw Study Area (Marshall 1991) as well as the historic Aleman Ranch complex. The Aleman Ranch complex has been determined as "eligible" for the *National Register,* and encompasses standing structures as well as archaeological components.

As described above, the FAA (in partnership with the NMSA) conducted three intensive cultural resource inventories of the APEs to identify and provide the basis for evaluating the eligibility of historic properties (as well as assessing the effects of the proposed undertaking). These include: (1) an inventory of all construction areas located on the Spaceport site, encompassing the vertical (VLA) and horizontal (HLA) launch areas, access roads, wastewater treatment plan, and utility corridors (referred to as the "onsite inventory"); (2) an inventory of all offsite construction areas, including the location of the substation and electrical distribution line, as well as fiber-optic cables (the "offsite inventory"); and (3) an inventory of the water-well field and associated pipeline corridors. The inventory efforts resulted in the identification of 80 cultural properties, primarily archaeological sites, and 622 isolated occurrences. The following archaeological survey reports capture the results of the field investigations:

> *Cultural Resources Survey of 2,720 Acres for the Proposed Spaceport America Sierra County, New Mexico* (NMCRIS 104538). Zia Engineering & Environmental Consultants, Las Cruces (Quaranta and Gibbs 2008).
>
> *Cultural Resources Survey of 463 Acres of Offsite Fiber Optics and Transmission Lines for Proposed Spaceport America Sierra County, New Mexico* (NMCRIS 106719). Zia Engineering & Environmental Consultants, Las Cruces (Gibbs 2008).
>
> *Cultural Resource Survey of 181 Acres of Water Well Field and Pipeline and Transmission Line Corridors for Proposed Spaceport America, Sierra County, New Mexico.* Zia Engineering & Environmental Consultants, Las Cruces (Gibbs 2008).

With respect to the 80 cultural properties (consisting of archaeological, architectural, and other cultural resources) in the Physical and Setting APE identified as a result of the cultural resources surveys outlined above, 61 have been determined "eligible" for listing on the *National Register*, 14 are "undetermined" and considered potentially "eligible," and the remaining five have been determined as "not eligible." Some of the Setting APE eligible/undetermined resources coincide with those identified within the Physical APE. In addition, a collection of four historic properties—including archaeological deposits, architectural buildings and structures and a water control feature—have been grouped together to form the Aleman Draw historic district, which lies partially within the Physical APE and entirely within the Setting APE. None of the isolated occurrences, however, have been determined "eligible" for listing on the *National Register*. As such they need not be formally considered further, although they comprise a dataset that may prove to be of value during spatial analyses of the distribution of cultural resources on the landscape.

The identification, evaluation, and assessment activities conducted by the FAA in advance of the Spaceport undertaking also included extensive research of El Camino Real and its setting within the APEs established through Section 106 consultation. These investigations encompassed information derived from previous studies of El Camino Real and aerial photography with data provided by new and previously conducted ground surveys (FAA 2008). The Spaceport America project encompasses approximately 26 square miles, including segments of El Camino Real and associated cultural resources that have been recognized as among the most important extant manifestations of the storied trail (FAA 2008; NPS 1996). The congressional addition of El Camino Real de Tierra Adentro to the National Trails System in 2000 has recognized the entire length of the trail in the United States as a significant historic resource, regardless of land ownership/management status. El Camino Real de Tierra Adentro in Mexico has been inscribed as a serial nomination on the UNESCO World Heritage List (Criteria ii and iv), and in February of 2012, formal notification was received that portions of El Camino Real in New Mexico had been listed on the *National Register of Historic Places*.

The investigative efforts of the FAA in the APEs identified for the Spaceport America undertaking have resulted in a significant increase in the information available regarding cultural resources in the general region of the Jornada del Muerto. Archaeologists involved in the Spaceport identification surveys were able to draw upon the results of some earlier work, including archaeological fieldwork conducted by Duran (1982, 1985, 1986), Hilley

(1981), Human Systems Research (HSR 1997), and Kirkpatrick and Hart (1995). The latter two survey projects had been conducted by HSR for earlier proposed locations for a Spaceport, then referred to as the Southwest Regional Spaceport. An innovative study of El Camino Real conducted from 1989 to 1991 by Marshall resulted in the identification of 16 road segment study areas, from Galisteo and La Bajada in the north to the Robledo Paraje near Fort Selden in the south, including the Yost Draw Study Area described above (1991). Many of the segments that Marshall identified formed the basis for the additional research required to compile a Multiple Property Documentation Form for the *National Register* listing, as well as the creation of the listings for 11 individually listed segments (Merlan et al. 2010a). Listed segments within the Jornada del Muerto and in the general area of the Spaceport Project include Jornada Lakes, Yost Draw, Point of Rocks, and Rincon Arroyo-Perillo (Merlan et al. 2010b, 2010c, 2010d, 2010e).

Data recovery (including remote sensing and archival analyses) has already been conducted at four archaeological sites (LA 8871, LA 51205, LA 80070, and LA 155962) that are located along the Spaceport entrance road; two of these sites were also examined by means of geophysical survey (Vaughan et al. 2013). The results of these investigations will be provided in the report now in preparation by Zia Engineering & Environmental Consultants, LLC (Zia). Archaeological testing has been conducted by OAS at eight sites and was previously reported (Akins and Moore 2011a).

Previous Consultation Documents

In addition to the Section 106 PA, a number of other documents have been created to guide cultural resources compliance and mitigation conducted for the Spaceport undertaking. These include protocols for discoveries of human remains and other culturally sensitive materials, an initial version of a cultural resources management plan, and an overarching plan or protocol for archaeology. These documents have already been subject to Section 106 consultation and review, and (along with the Section 106 PA) must be accounted for and adhered to in all subsequent mitigation planning. They are as follows:

(1) *Mitigation Plan for Archaeology Spaceport America 2010*

(2) *Plan and Procedures for Unanticipated Discoveries of Cultural Resources (Including Human Remains) During Construction and Operation of the Spaceport America, Sierra County, New Mexico: Specific Procedures to Follow for Discoveries of Human Remains and/or Funerary Objects, Sacred Objects, and Objects of Cultural Patrimony during Intentional Archaeological Excavations, Spaceport America Project*

(3) *Cultural Resources Protection, Preservation, and Mitigation Plan for Spaceport America*

The archaeological mitigation plan outlines an investigative framework for all aspects of archaeological fieldwork at the Spaceport, from excavation to site protection and construction monitoring, and includes fieldwork protocols that conform to state and federal regulations. This plan, which has been reviewed by the Section 106 Consulting Parties, identifies a rationale for research-based investigations that is exemplified by the research reported here**.** The "Unanticipated Discoveries" and "Specific Procedures" documents outline the protection and follow-up consultation and investigation requirements for discoveries of human remains and other culturally sensitive materials during planned excavations and/or construction. The *Cultural Resources Protection, Preservation, and Mitigation Plan for Spaceport America* (CRPPMP) serves as the overall guiding document for cultural resources management, protection, and preservation until such time as a formal cultural resources management plan can be created.

2 | The Physical Environment

Physical Environment

James L. Moore

Geology

South-central New Mexico and adjacent parts of Texas and Mexico are in the Mexican highlands section of the Basin and Range province. Most mountains in this region were formed by uplift and trend from north to south. The East and West Potrillo Mountains, formed by volcanism, are exceptions. The San Andres-Organ-Franklin chain, which flanks the east side of the Rio Grande Valley, and the Doña Ana and Caballo Mountains have intrusive granitic to porphyritic cores formed during Precambrian and Tertiary times (King et al. 1971).

The project area is in the Jornada del Muerto, one of a series of down-warped basins that formed along the continental rift now occupied by the Rio Grande (Chapin and Seager 1975). Episodes of deformation contributed to development of the Rio Grande depression (Chapin and Seager 1975:299). The first of these was during the late Paleozoic (Fig. 2.1) as the ancestral Rocky Mountains were formed, and the second was during the Laramide uplifts of late Cretaceous to middle Eocene times. These events created a north-trending tectonic belt. Chapin and Seager (1975:299) note, "The Rio Grande rift is essentially a "pull-apart" structure caused by tensional fragmentation of western North America. Obviously, a plate subjected to strong tensional forces will begin to fragment along major existing zones of weakness and the developing "rifts" will reflect the geometry of the earlier structure." Thus, the early deformations weakened the continental plate, causing it to split along the Rio Grande depression. Down-warped basins formed as the plate pulled apart. The basins in south-central New Mexico were internally drained until early to mid-Quaternary times (Hawley and Kottlowski 1969).

The geologic history of the Rio Grande Valley is summarized by Hawley and Kottlowski (1969). Major basins in south-central New Mexico include the Palomas and Jornada del Muerto, and the Mesilla and Hueco Bolsons. Materials eroded from surrounding highlands began filling these basins during Tertiary times and continued until the mid-Quaternary. These sources were supplemented by the ancestral upper Rio Grande during the later stages of basin filling. The Rio Grande extended from Colorado to northern Chihuahua by Kansan times, entering the Hueco Bolson through a gap between the Franklin and Organ Mountains during the early Quaternary. It was apparently diverted from the Hueco Bolson to the Mesilla Bolson during the mid-Pleistocene. Until its integration with the lower part of the system, the upper Rio Grande fed a series of lakes in west Texas, Chihuahua, and south-central New Mexico. Several mechanisms for integration of the two river systems have been proposed, including headward erosion and capture by the lower stream, spillover of the upper system, and tectonic uplift and subsidence. Whatever the cause, entrenchment of the river seems to have halted deposition in the basins soon after the systems were integrated.

The Jornada del Muerto is a broad valley flanked by the San Andres Mountains on the east and the Caballo and Fra Cristobal ranges on the west. An internally drained basin, the Jornada del Muerto is about 100 km long by 30 km wide, and is filled with a mixture of fluvial, alluvial, and colluvial sediments derived from the ancestral Rio Grande

Era	Period	Epoch	End Date[1]
Cenozoic	Quaternary	*Holocene*	Modern
		Pleistocene	0.012
	Tertiary	*Pliocene*	1
		Miocene	12
		Oligocene	25.7
		Eocene	34
		Paleocene	55
Mesozoic	Cretaceous	*Late Cretaceous*	78
		Early Cretaceous	
	Jurassic		130
	Triassic		180
Paleozoic	Permian		230
	Pennsylvanian		270
	Mississippian		310
	Devonian		350
	Silurian		400
	Ordovician		430
	Cambrian		490
Precambrian			600

[1]Million Years Ago

Figure 2.1. Geologic periods and time scale.

and the bordering mountain ranges (Wondzell et al. 1996). While the fluvial sedimentation ended when the Rio Grande incised its current valley to the west of the Jornada del Muerto ca. 300,000 to 400,000 years ago, alluvial and colluvial sedimentation is ongoing.

Soils

This discussion of soils is summarized from Quaranta and Gibbs (2008:20–22) and from the USDA Natural Resources Conservation Service webpage (http://ortho.ftw.nrcs.usda.gov [accessed 8-25-10]). There are six soils defined within the study area, including: the Stellar-Continental soil association, the Berino-Doña Ana soil association, the Reakor-Doña Ana soil association, the Wink-Doña Ana soil association, Armijo clay, and the Largo series. However, the Stellar-Continental soil association dominates the study area.

The Stellar-Continental soil association occurs on gentle slopes of less than 9 percent, and typically consists of 45 percent Stellar loam and 25 percent Continental fine sandy loam. Stellar loam is a deep and well-drained soil forming in mixed sediments derived from rhyolite, andesite, shale, and monzonite and tends to occur on basin floors and at the toes of alluvial fans at elevations of 792–1,768 m (2,600–5,800) ft. These are well-drained soils, on which runoff and permeability are both slow. Continental soils are gravelly, deep and well-drained, and formed in mixed alluvium from various sources on slopes of 0–15 percent. These soils occur on fan terraces at elevations of 305–1,524 m (1,000-5,000 ft), and have slow permeability and low to moderate runoff potential.

Berino soils occur in combination with Doña Ana soils to form the Berino-Doña Ana soil association. Berino soils are very deep and well-drained, and are forming in mixed alluvium whose surface is often reworked by wind. These soils occur on sandy plains, fan piedmonts, piedmont slopes, and valley floors with slopes of 0 to 7 percent at elevations of 1,219–1,676 m (4,000–5,500 ft). Besides being well-drained, runoff is very slow, and Berino soils have a moderate permeability. Doña Ana soils are also very deep and well-drained, and are forming in alluvial sediments derived from sedimentary rocks. These soils occur on alluvial fans and fan terraces at elevations ranging from 1,097–1,676 m (3,600–5,500 ft). The runoff rate is moderate, and permeability is moderately slow.

Reakor soils occur with Doña Ana soils to form the Reakor-Doña Ana soil association. Reakor soils are very deep and well-drained, and are forming in alluvium that is mostly derived from limestone, with small amounts of eolian sediments. These soils occur on broad plains and alluvial fans with slopes of 1 to 5 percent at elevations ranging from 914–1,676 m (3,000–5,000 ft). The runoff rate is moderately slow to slow, and permeability is moderate to moderately slow. Wink soils also occur with Doña Ana soils, forming the Wink-Doña Ana soil association. Wink soils are very deep and well-drained, and are forming in calcareous unconsolidated sediments of eolian or alluvial origin. These soils occur on level to moderately sloping uplands at elevations of 823–1,219 m (2,700–4,000 ft). The runoff rate ranges from negligible to low, depending on slope, and permeability is relatively rapid. Quaranta and Gibbs (2008:22) note that sites that seem to occur on these soils are all in the southeastern part of the Spaceport America facility.

The Armijo clay is deep and well-drained, and is forming in mixed alluvium on slopes of 0 to 2 percent. This soil occurs on broad floodplains, usually channelized, and on terraces around playas at elevations of 1,250–1,372 m (4,100–4,500 ft). Permeability and runoff rate are both very slow. Largo soils are very deep and well-formed in loamy calcareous alluvium derived from red bed formations. These soils occur on valley bottoms, terraces, alluvial fans, and piedmont slopes with slopes of 0 to 5 percent at elevations ranging from 1,219–1,676 m (4,000–5,500 ft) The rate of runoff is moderate, and permeability is moderate to moderately slow.

Vegetation

The Jornada del Muerto falls within the Chihuahuan Desert zone, and is generally classified as a semi-desert grassland, though the vegetation ranges from nearly pure stands of grass, to savannah mixtures of grass and shrubs, to nearly pure stands of shrubs. Most agree that the modern vegetation does not accurately reflect that of the past. Territorial survey records indicate that the mesas of southern New Mexico were dominated by grasslands until at least the 1880s (Dick-Peddie 1975; York and Dick-Peddie 1969). What is now Chihuahuan Desert with occasional pockets of grama grass was once a mosaic of grassland-desert scrub (Dick-Peddie 1975:81). This change has most often been blamed on large-scale cattle ranching. The former grasslands were dominated by black grama, blue grama, and side-oats grama. Other common plants included soaptree yucca, tobosa grass, bush muhly, mesquite, four-winged saltbush, creosote, Mormon tea, sacahuista, prickly pear, and cholla cacti (Dick-Peddie 1975:83).

In contrast, Frederickson et al. (2006) feel that mesquite expansion is due to a series of cause and effect relationships occurring over millennia, which might have otherwise occurred in the absence of livestock grazing. Mesquite has been present since at least the Pleistocene, and its dispersion across the landscape during that period may have been partly related to its consumption by megafauna and their patterns of movement (Frederickson et al. 2006:286). The combination of the megafauna extinction and increasing aridity at the end of the Pleistocene may have led to a spread of mesquite during the Paleoindian period. Archaic and Formative period exploitation of mesquite may also have extended its range. Dick-Peddie (1965) notes that Territorial survey notes from the 1840s and 1850s indicate that most pockets of mesquite in southern New Mexico occurred in areas containing prehistoric settlements. Thus, humans have had an affect on the distribution of what is often considered to have been an invader species for millennia.

Information on the modern vegetation of the project area is adapted from Quaranta and Gibbs (2008:18–19), who obtained their information on the structure and extent of vegetative communities from Brown (1994) and Dick-Peddie (1993). Three vegetative communities are defined for the study area: Chihuahuan Desert Grassland, Chihuahuan Desert Scrub, and Arroyo Riparian. Most of the project area is dominated by a mixture of Chihuahuan Desert Grassland and Chihuahuan Desert Scrub. The Arroyo-Riparian community tends to occur along the three major drainages and some of the minor arroyos.

Chihuahuan Desert Grassland

Most of the project area contains vegetation belonging to this community. The Chihuahuan Desert Scrub land is dominated by a variety of grasses, intermixed with abundant shrubs, forbs, and cacti. The grasses include tobosa (*Pleuraphis mutica*), black grama (*Bouteloua eriopoda*) and burrograss (*Scleropogon brevifolius*). Common shrubs include soaptree yucca (*Yucca elata*) and honey mesquite (*Prosopis glandulosa*), while cane cholla (*Cylindropuntia imbricata*) is a common variety of cactus.

Chihuahuan Desert Scrub

This vegetative community tends to be inter-fingered with the Chihuahuan Desert Grassland community throughout the project area, and includes areas of mesquite-stabilized coppice dunes, scattered areas dominated by tabosa and burrograss, four-wing saltbush (*Atriplex canescens*) and soaptree yucca. Low lying areas in which water can accumulate often supports stands of little-leaf sumac (*Rhus microphyllum*) mixed with tarbush (*Flourensia cernua*) and honey mesquite. Areas between stands of shrubs often contain erosional rills, especially in the coppice dunes, and archaeological features and artifacts tend to be more visible in these areas because of the erosion. Rill eroded areas are common in the central and southeast parts of the Spaceport America facility.

Arroyo Riparian Vegetation

This vegetative association occurs throughout the project area along arroyos and in playa basins. In the southeastern part of the Spaceport America facility, Jornada Draw is a major area of Arroyo Riparian Vegetation. The types of plants that dominate this community include honey mesquite, desert willow (*Chilopsis linearis*), and little-leaf sumac. There are also dense stands of tarbush that often inter-finger with the Chihuahuan Desert Grassland community.

Fauna

Fitzsimmons (1955) provides a brief summary of fauna for the region, and Quaranta and Gibbs (2008) provide lists of expected fauna that were used to construct Table 2.1, as well as a short but useful discussion. Table 2.1 contains lists of bird, reptile, and mammal species that are either known to occur or are expected to occur within the study area, but does not extend to adjacent montane and riverine environments.

The most common types of birds found in this region are the desert sparrow, ash-throated fly-catcher, mourning dove, and quail. Migratory waterfowl often winter along the Rio Grande, and include various types of geese and sandhill cranes, as well as various other species. Most of the birds occurring within the study area that are shown in Table 2.1 are not restricted to any specific vegetative community. Exceptions to this include horned lark, vesper sparrow, and meadow lark, which mostly occur in grassland areas that they prefer as nesting grounds. Chihuahuan ravens and Swainson's hawks usually nest in areas dominated by mesquite, but use the entire area for feeding. Of the reptile species included in Table 2.1, western diamondbacks are most common in arroyo systems, while whiptail and horned lizards tend to be found in upland areas containing Chihuahuan Desert Scrub vegetation. Pronghorn are found within the Jornada del Muerto, while deer are most common in adjacent mountain ranges but also occur within the study area. Mule deer and oryx, the latter a recently introduced species, mostly occupy areas dominated by mesquite and little-leaf sumac, while pronghorn tend to live in grasslands. Rabbits and coyotes are found in all vegetative communities throughout the study area. Black bears and mountain sheep occur in the mountain ranges that border the Jornada del Muerto. Beaver and muskrat live along the Rio Grande, while skunks are ubiquitous to the region. Gray foxes are also sometimes found in this region. Fish are available in the Rio Grande, especially in the modern reservoirs, and include bass, catfish, carp, crappie, and sucker.

Table 2.1. Faunal species known to occur in the project area, or that are expected to occur there (from Quaranta and Gibbs 2008:19–20).

Birds	**Reptiles**
canyon towhee (*Pipilo fuscus*)	greater earless lizard (*Cophosaurus texanus*)
ruby-crowned kinglet (*Regulus calendula*)	Texas horned lizard (*Phrynosoma cornutum*)
ash-throated flycatcher (*Myiarchus cinerascens*)	collared lizard (*Crotaphytus collaris*)
sage sparrow (*Amphispiza bellii*)	roundtailed horned lizard (*Phrynosoma modestum*)
Cassin's sparrow (*Amphispiza cassinii*)	side-blotched lizard (*Uta stansburiana*)
vesper sparrow (*Pooecetes gramineus*)	checkered whiptail (*Aspidoscelis tesselatus*)
house finch (*Carpodacus mexicanus*)	western diamondback rattlesnake (*Crotalus atrox*)
thrasher (*Toxostoma* spp.)	New Mexico whiptail (*Aspidoscelis neomexicanus*)
horned lark (*Eremophila alpestris*)	
western meadowlark (*Sturnella neglecta*)	**Mammals**
Chihuahuan raven (*Corvus cryptoleucus*)	black-tailed jackrabbit (*Lepus californicus*)
ladder-backed woodpecker (*Picoides scalaris*)	desert cottontail rabbit (*Sylvilagus audubonii*)
black-throated sparrow (*Amphispiza bilineata*)	pronghorn (*Antilocapra americana*)
white-crown sparrow (*Zonotrichia leucophrys*)	mule deer (*Odocoileus hemionus*)
chipping sparrow (*Spizella passerina*)	oryx (*Oryx gazella*)
loggerhead shrike (*Lanius ludovicianus*)	coyote (*Canis latrans*)
scaled quail (*Callipepla gambelii*)	American badger (*Taxidea taxus berlandieri*)
greater roadrunner (*Geococcyx californianus*)	pocket mouse (*Perognathus* spp. and *Chaetodipus* spp.)
red-tailed hawk (*Buteo jamaicensis*)	kangaroo rat (*Dipodomys* spp.)
northern harrier (*Circus cyaneus*)	mountain lion (*Felis concolor*)
mourning dove (*Zenaida macroura*)	spotted ground squirrel (*Spermophilus spilosoma*)
turkey vulture (*Cathartes aura*)	
Gambel's quail (*Callipepla gambelii*)	
Scott's oriole (*Icterus parisorum*)	
northern mockingbird (*Mimus polyglottos*)	
brown-headed cowbird (*Molothrus ater*)	
lesser nighthawk (*Chordeiles acutipennis*)	
Swainson's hawk (*Buteo swainsoni*)	
prairie falcon (*Falco mexicanus*)	
western kingbird (*Tyrannus verticalis*)	

Physical Environment of the Rio Grande Rift Province, Mexican Highlands Area: Paleoclimates

Donald E. Tatum

Overview of Regional Studies in Paleoclimate Processes and Events

The Jornada del Muerto (Jornada Basin) is a north–south trending, elongated, closed structural basin that lies on a plain east of the Rio Grande, 100 m (328 ft) above the river (Havstad and Beck 1995). It is bordered to the east by the Organ, San Andres, and Oscura Mountains, to the northeast by Chupadera Mesa, and partially separated from the Rio Grande by the Fra Cristobal, Caballo, and Dona Ana Mountains. To the north it is bounded by the Loma de las Canas hills and an extensive series of arroyos draining west to the river (DeLorme 1998; USGS Loma de las Canas and San Antonio Quadrangles). The down-faulted basin (graben) is an eastern extension of the Rio Grande Rift geologic province of the Mexican Highland section, which, in turn, occupies parts of southeastern Arizona, southern and central New Mexico, western Trans-Pecos Texas, and northern Chihuahua. The basin areas of the Mexican highlands comprise most of the northern Chihuahuan Desert (Hawley 1993). Now mantled by thick fluvial, alluvial, and eolian deposits derived from sediment transported by ancestral Rio Grande distributaries, from erosion of the tectonically uplifted valley walls, and from deflated, re-worked valley-floor deposits, the basin represents one of the easternmost extensional faults of the Rio Grande Rift (Hawley 1993).

Numerous paleoclimate-related studies have been undertaken in the Mexican Highland section and surrounding environs; from these investigations the paleoclimate history of the area can be inferred. Regionally and temporally specific paleoclimate data have been derived from packrat midden palynology and plant macrofossil studies conducted in the Sacramento, San Andres, and Hueco Mountain ranges of New Mexico and Texas, in the Jornada Basin, and on Otero Mesa, New Mexico (Betancourt, Van Devender, and Martin 1990; Holmgren et al. 2003; Van Devender and Martin 1979). Speciation studies of fossil insects extracted from packrat middens in the northern Chihuahua desert have provided additional insight into climate during the transition from early-to-late Holocene (MacKay and Elias 1992). Studies of Holocene alluvial fan deposits in the Organ and Sacramento Mountains (Frechette and Meyer 2009; Gile 1987; Hawley 2003) and deflation/lag deposit studies at Fort Bliss (Monger 1993) have also contributed correlatable data to the body of paleoclimate knowledge of the region. Other geochronologic evidence for climate change through time includes sedimentation studies of pluvial and perennial lake basins in southern and central New Mexico and in northern Mexico (Allen et al. 2009; Allen 1994; Castiglia and Fawcett 2006; Gile 2002; Hall 2001; Hawley 2003). Stable carbon isotope and soil geomorphology, as paleovegetation indicators have been used to identify and date major climate shifts in the northern Chihuahuan Desert (Buck and Monger 1999; Monger et al. 1993).

The most time-specific, chronologically detailed studies with implications for the recent Holocene in the Mexican Highland area include dendroclimatology data obtained from living old-growth wood samples in El Malpais National Monument, the San Andres, Organ, Oscura, Sierra del Nido, and Gallinas Mountains (Dean and Robinson 1977; Grissino-Mayer 1996; Parks et al. 2006; Stahle et al. 2009). Speleochronology studies also contribute correlatable, high-resolution climate data from the late Pleistocene through the late Holocene (Polyak et al. 2007). Finally, Poore et al. (2005) have used comparisons of sedimentation rates and relative abundance of the planktic foraminifer *Globigerinoides sacculifer* in cores from the Gulf of Mexico with dendroclimatology records as corroborative proxy indicators for the southwest monsoon (Mann et al. 1999).

Regional Paleoclimate Overview

Some of the more extensively documented climate events with implications for the Tularosa and Jornada Basins and eastern Mexican highlands are the major climate shifts of the Late Pleistocene and early- to mid-Holocene that had geographically wide-ranging effects across much of North America. Many climate processes that contributed to more recent paleoenvironmental conditions of these regions are rooted in the Wisconsin Glacial Episode, the most recent glacial maximum in North America. Based on studies of Pleistocene lake expansion as indicated by relict shorelines and sedimentary facies changes in Lake Otero and Lake Estancia, the Wisconsinan ended between about 18,000 and 16,300 calendar years ago (18–16.3 kya) (Allen 2005; Allen et al. 2009).

Studies of packrat midden pollen and fossil insect assemblages (Coleoptera and Hymenoptera) from the northern Chihuahuan Desert indicate that from about 42,000 years ago until about 12,875 years ago, the climate was more mesic than it is today. During the late Pleistocene, average summer temperatures for the region have been estimated to be about 1 to 4 degrees Celsius lower than present-day temperatures (Brackenridge 1978; Hawley 1993; Mackay and Elias 1992; Mehringer and Haynes 1965; Phillips et al. 1986; Sebastian and Larralde 1989; Wendorf and Hester 1975). Fossil pollen studies conducted in the region indicate that piñon-juniper-oak woodlands were the dominant vegetation on upland slopes; shrubs (including sage), steppe grass, and sparsely scattered non-coniferous trees grew on the lowland landscapes (Betancourt et al. 1990; Hall 2001; Holliday 1987; Mackay and Elias 1992).

The presence of cienega and spring deposits dating to the late Pleistocene indicates that there was more surface water during this time than at present (Hall 2001). Perennial and pluvial lakes occupied closed playa basins in the southern High Plains and the ancestral Rio Grande valley of southern New Mexico. Wetlands and shallow lakes developed in the valley floor of the Tularosa Basin beginning ca. 49 kya. By about 35,400 calendar years ago the wetland and lake systems hosted dense stands of emergent aquatic vegetation, attracting Pleistocene mammals, as indicated by fossiliferous plant fragments and mammalian skeletal remains and footprints preserved in extensive fine-grained gypsum deposits (Allen et al. 2005, 2009; Allen 1994; Gile 2002; Holliday et al. 2008; Hawley et al. 1976, Lucas et al. 2002, 2007; Morgan and Lucas 2002, 2005).

Geochronology studies of depositional facies in three lakes in the region indicate lake freshening occurring repeatedly, beginning about 29.3 kya for Lake Otero (Tularosa Basin), at about 28.7 kya for Lake Estancia (just north of the Tularosa Basin), and about 27.6 kya for Lake King in the Salt Basin (just southeast of the Tularosa Basin) (Allen and Anderson 2000; Allen et al. 2005; Allen 1994, 2009; Gile 2002; Hawley et al. 1976). This time frame is consistent with playa high stands recorded across the western United States during the late Wisconsinan (Smith and Street-Perrott 1983). Sedimentation records also indicate periods of drought and minimization of lake pooling. For Lake Estancia, a severe desiccative period occurred between about 18,100 and 16,340 calendar years ago, when the lake shrank to its minimum pool. Lake Otero may have completely dried up during the drought. Consequently, wind deflation and erosion obliterated or obscured the sediment record, and any subsequent mesic-period deposition would probably have been inset into the eroded areas. On the Llano Estacado, too, sedimentation rates based on C^{14} date extrapolation at White Lake indicate lake desiccation by 16,400 years BP (Hall 2001). The lake sediment record of drought between 18,100–16,340 calendar years ago is loosely corroborated by groundwater isotope studies in northwestern New Mexico which infer that between 20,000 and 17,000 calendar years ago, a short period of higher temperatures (3 degrees Celsius higher than the rest of the late Wisconsinan) and decreased precipitation occurred (Phillips et al. 1986). Two more periods of pluvial expansion between about 16,340 and 14,480 calendar years BP, are indicated by Lake Estancia's sediment record. Magnetic susceptibility measurements recorded in sediments from Hall's Cave on the Edwards Plateau in Texas also indicate a brief time of milder climate and increasing rainfall for the same time period. This mesic interval temporally correlates with a major influx of fresh water derived from melting northern hemisphere ice shelves (Heinrich event H1). The reduced salinity of seawater resulted in changes to oceanic current circulation and atmospheric temperature and weather patterns (Maslin et al. 2001). Event H1 has been geochronologically dated to between 16.5 and 17.5 kya, indicating a climatic event of global proportion (Ellwood and Gose 2006).

The termination of the ~17 kya cooling period signaled the transition from the mesic Wisconsinan period into a more xeric, post-glacial late Pleistocene–early Holocene. In the eastern Mexican highlands and Basin and Range areas, fossil insect, plant, and pollen evidence from packrat middens indicates that the full-glacial Wisconsinan interval was followed by successively warmer and drier intervals alternating with multi-decadal periods of greater effective moisture, cooler temperatures, and diminished evaporation (Betancourt et al. 1990; Hawley

1993, Holmgren et al. 2003; Van Devender and Spaulding 1979). Such short-term, cool, wet weather cycles have been linked to Pacific Decadal Oscillation and El Nino–Southern Oscillation (ENSO) climate cycles and related southward shifts of winter storm tracks—processes still recurrent in modern times (Asmerom et al. 2007; Castiglia and Fawcett 2006; Collier and Webb 2002; Rasmussen et al. 2006).

About 14.5 kya, the first xeric-adapted ant species began appearing on the Mexican highlands (MacKay and Elias 1992). Sedimentation rates in the drainages leading into the playas began increasing shortly thereafter, indicating more sediment from drying playa basins being re-deposited into the drainage channels and eolian sediments deposited in the playa basins (Hall 2001; Holliday et al. 2008). Piñon pine began disappearing from lower elevation woodland assemblages, retreating to the highlands and leaving oak, juniper, and desert-adapted grasslands as the dominant species in areas that formerly also supported piñon (Van Devender 1990; Van Devender and Spaulding 1978).

Younger Dryas

In the final millennia of the late Pleistocene, during the Clovis and Folsom periods, the warming, drying climate abruptly returned to near-glacial conditions in the northern hemisphere (Haynes 2008). This dramatic climate shift, known as the Younger Dryas, lasted from about 12.9 ka to 11.2 ka. From the Lake Estancia basin, the sediment record indicates renewed lake freshening between about 12.9 kya and 11.5 kya. The cooling episode has been theorized to have occurred as a result of a glacial meltwater pulse originating from a thawing Antarctic Ice Sheet that caused sea level to rise ~20m. Consequently, the influx of fresh water altered the flow of salinity currents in the North Atlantic Deep Water (NADW) formation, warming the North Atlantic region and triggering the Bolling-Allerod interstadial (~14.6 kya), which initiated the end of the Wisconsinan glacial stade and contributed to the melting of the northern hemisphere Fennoscandian and Laurentide ice sheets. As a consequence of freshwater forcing in the North Atlantic, the response by the NADW initiated the Younger Dryas cooling event in the northern hemisphere (Weaver et al. 2003).

The Younger Dryas was punctuated by about a 900-year period of climatological vacillation during the Clovis/Folsom transition. The Folsom drought saw fluctuating water levels in playas and marshes and the beginning of sand sheet deposition in upland areas (Holliday 2000). The cooling episodes were accompanied by a resurgence of higher precipitation levels and the recharging of aquifers. Favorable rainfall conditions led to the re-emergence of wetlands and cienegas, environments that were conducive to riparian plant growth.

Wetland and cienega deposits are dark, organically enhanced, sometimes peaty deposits that have been recorded across North America. They can be associated with the Younger Dryas period, or may be Holocene-related. Younger Dryas-aged deposits of this type are referred to as black mat deposits (Haynes 2008). They are sometimes immediately underlain and overlain by eolian silt or fine sand facies that are indicative of warmer, drier depositional environments. The stratigraphic sequence represents the more xeric climate conditions that prevailed after the Wisconsinan glacial terminus, the sudden onset of Younger Dryas cooling, followed by an abrupt shift back to more xeric climate conditions. The black mat deposit, when present in Clovis-period deposits, may be an indication of the apparent termination of Clovis culture and the sudden demise of many Rancholabrean faunal species (Firestone et al. 2007; Haynes 2008; Polyak et al. 2004; Stuiver et al. 1995; Taylor et al. 1997). In the Mexican highlands area and adjacent environs, some of the extinct paleofauna are represented by the faunal assemblage recovered from Pendejo Cave, in the Sacramento Mountain western foothills, and examined by Harris (1995). The assemblage included *Equus* spp. (horse), *Capromeryx* (midget goat), *Stockoceros* (Stock's pronghorn), *Coragyps occidentalis* (Western vulture), *Hemauchenia* (lamine camelid), *Camelops* (camel), and *Aztlanolagus agilis* (hare) (Harris 1995).

Scharbauer interval

Post-Younger Dryas, the climate in the southern High Plains/northern Chihuahuan Desert continued warming and drying between 11.2 kya and 10.2 kya during a period known as the Scharbauer interval (Sebastian and Larralde 1989; Wendorf and Krieger 1959). Piñon and juniper woodlands disappeared from lowland areas (Holmgren et al. 2003) and moved upslope into the highlands (Sebastian and Larralde 1989). As a result of increased eolian movement of sediment, soil deflation occurred, creating localized accretions of coarse-grained particles known as lag deposits, which have been dated to this drying period (Monger 1993).

Beginning around 10.9 kya, the region experienced increasing rainfall and slightly cooler temperatures during the Scharbauer Interval, a period that would become known as the Lubbock subpluvial. Pollen preserved in packrat middens indicates a brief re-advance of piñon-juniper forest into lowland areas (Betancourt et al. 1990; Sebastian and Larralde 1989). Also evidence for the Lubbock Subpluvial, climate researchers working in caves in the Guadalupe Mountains conducted geochemical and geochronological studies gauging oxygen-stable isotope concentrations and speleothem growth over time. Asmerom and Polyak et al. (2004, 2007) recorded a resurgence of speleothem growth occurring between about 11.1 and 10.8 kya.

Altithermal period

During the middle Holocene, the southern High Plains/Llano Estacado experienced long-term, overall drying and warming conditions during a time known as the Altithermal (Antevs 1948; Holliday 1988; Meltzer 1991). Eolian reworking of playa basin sediments continued as lake replenishment rates slowed (Allen et al. 2005, 2009; Holliday et al. 2008). Drought-related accretionary lag deposits and erosional alluvial fans dating to this time period have been recorded on Fort Bliss and in the Organ Mountains (Monger et al. 1993). During the Altithermal, more xeric-adapted plant and animal species began arriving on the southern High Plains and northern Chihuahuan Desert in the time period leading up to the establishment of the modern climate regime about 4,000 years ago (Holmgren et al. 2003). Pollen records infer the final demise of the late Wisconsinan winter rainfall regime during this time period (Betancourt et al. 1990). Desert grass species continued to gain inroads into territory previously dominated by piñon-juniper-oak species, followed by the arrival of Chihuahuan Desert Scrub vegetation into the region (Buck and Monger 1999). Xeric-adapted ant species began replacing mesic-adapted species (Mackay and Elias 1992). Perhaps for the first time on the southern High Plains, people began excavating water wells to replace former surface water sources. Altithermal-period wells have been recorded near former playas, springs, and valley floor stream-beds at Blackwater Draw, New Mexico, and at Mustang Springs, Texas (Meltzer 1991; Meltzer et al. 1987). Charcoal-rich alluvial fans in the Sacramento Mountains dating between 5.8 and 4.2 kya indicate episodic forest fires and slope failure during the Altithermal period (Frechette and Meyer 2009).

Evidently, this period was punctuated by more mesic climate intervals. For example, Castiglia and Fawcett have recorded the mid-Holocene (~7 kya–7.6 kya) development of constructional beach ridges for Laguna El Fresnal and Laguna Santa Maria closed playa basins of the northern Mexico Chihuahuan Desert borderlands (located southwest of the Jornada Basin; Castiglia and Fawcett 2006) Poore et al. (2005) have used relative abundance of the planktic foraminifer *Globigerinoides sacculifer* in sediment cores from the Gulf of Mexico and comparisons to relative abundance of packrat middens as indicators for the summer monsoon in the southwestern United States. *G. sacculifer* increased in abundance in Gulf sediments during an enhanced monsoon. Conversely, packrat middens decrease in abundance during enhanced monsoon because they are unstable and susceptible to damage by insects (Spaulding et al. 1990). Their research indicates enhanced monsoonal activity during the time of pluvial lake enhancement recorded for Laguna El Fresnal and Laguna Santa Maria sub-basins (located southwest of the Jornada Basin).

Speleoclimatology data from caves in the Guadalupe Mountains provide correlative proxies of increased effective rainfall during the mid-Holocene. Asmerom and Polyak et al. (2004, 2007) recorded a resurgence of speleothem growth occurring ~7.27 kya.

Neoglacial and post-neoglacial periods

For the Mid- to Late Holocene, several data sources provide a somewhat correlative to proximally correlative, chronologically specific, subdecadal record of climate including: stalagmite growth and stable oxygen isotope records from speleothems in Guadalupe Mountain caves; dendroclimatology records from the Sacramento, Organ, and San Andres mountains, the Sierra del Nido in north-central Mexico, the El Malpais National Monument on the southwestern Colorado plateau, the Sevilleta National Wildlife Refuge near Socorro, the Gallinas Mountains, and Chupadera Mesa; and sediment cores from the Gulf of Mexico. The marine sediment cores provide data from the early-Holocene onward, and show an overall drying trend with lower effective precipitation after ca. 7,000 calendar years before present, with multi-decadal and multi-century periods of increased precipitation. The El Malpais chronology begins about 136 BC. The other dendro records begin in the late sixteenth century (AD 1569 and 1597; Sierra del Nido and Organ mountains) and the mid- to late seventeenth century (AD 1644 and 1687; Oscura and San Andres mountains; (Betancourt et al. 1990; Grissino-Mayer et al. 1990, 1996; Naylor et al. 1971; Polyak and Asmerom 2001; Poore et al. 2005; Stahle et al. 2009). Some climate researchers have placed the final establishment of the modern climate regime in the Mexican highlands area as occurring about 3000–4000 years before present. Beginning about 4,000 calendar years ago another cycle of slightly moister, cooler climate took hold. Researchers have recorded magnetic susceptibility variations occurring ~4.4 kya in Hall's Cave sediments (Edwards Plateau), linking them to a North American climate event termed the Neoglacial period (Ellwood and Gose 2006). During the Neoglacial, a resurgence of alpine glacial activity occurred in the North American Cordillera (Pielou 1991; Wood and Smith 2004).

Again, the contemporaneous formation of constructional playa beach ridges ca. 4.2–4.8 kya coinciding with playa lake-level highstands in the northern Chihuahuan Desert provides corroborative evidence for a mesic interval, this time during the Neoglacial (Castiglia and Fawcett 2006). Goodfriend and Ellis (2000) in a study of stable carbon isotopes from shells of gastropods recovered from Hinds Cave, on the southern High Plains, have recorded a period of progressively moister conditions dating to the onset of the Neoglacial. Geomorphology and geochemistry studies conducted in the Tularosa Basin (Fort Bliss) identified stable geomorphic surfaces with stable pedogenic carbon isotopes dating to the Neoglacial, between 4 kya and 2.2 kya (Buck and Monger 1999).

Asmerom et al. (2007) have recorded low, stable oxygen isotope signatures, indicative of Neoglacial pluvial conditions and corresponding to increased speleothem development during moist climate conditions. These pluvial conditions, based on more recent speleothem growth data, were generally similar to the climate during the recent Holocene; that is, lengthy intervals of somewhat more mesic, then less mesic conditions, with intervals of true drought. The middle Holocene pluvial, beginning ~7 kya, continued until ~4.6 kya. This period was followed by a 1,300-syear period of decreased effective annual precipitation. By about 3.3 kya somewhat more pluvial conditions returned to the Guadalupe Mountains vicinity, lasting for another 200 years. Decreased moisture and more arid conditions prevailed again for about 300 years. Pluviality returned about 2.8 kya for half a millennium, followed by the onset of aridity beginning about 340 BC. This drier, less mesic interval, according to speleothem data, lasted until about 10 BC (Asmerom et al. 2007); the final decades of it are revealed in the dendrochronology record from the El Malpais Long Chronology, where its effects seem to persist for several more decades (Grissino-Mayer 1996). Another pluvial record appears in the speleothem growth data during the first decade AD and persisting until ~AD 265. This period is also reflected in the El Malpais chronology, as is the xeric period, which follows; the stalactite record shows it continuing until about AD 470. The tree-ring chronology indicates a period of near-perfect drought lasting between ~AD 250 until ~AD 500 that was punctuated by brief pluvial intervals several years in duration, with most decades being sere. This dry period is also apparent in the sediment core record from the Gulf of Mexico (Poore et al. 2005).

There are notable periods of reduced tree-ring growth apparent in El Malpais records but not reflected in stalactite records, either because of small-scale regional climate variations or because the events affecting tree-ring growth did not affect speleothems. The years between AD 536–543, AD 560–570, and AD 577–585 show tree growth as being markedly reduced at El Malpais. Tree-ring chronologies from three old-tree sites in Colorado (Almagre Mountain 1 and 2; Mt. Goliath) also indicate a period of greatly reduced growth spanning three to four decades during the same period (Graybill 1983; Lamarche and Harlan 1968). Historic accounts and dendroclimatic evidence from Europe also indicate a major climate event ca. AD 536 that inhibited vegetative growth. Baillie (1994) has referred to the event as a "dust veil," thought to have been the result of a major volcanic eruption or the collision of a cosmic object with Earth.

The so-called Anasazi Drought may be evident in the stalagmite record as a period of reduced speleothem development occurring ~AD 1047 to ~AD 1180. This somewhat xeric interval also shows up in the Long Chronology from El Malpais, although intermittently punctuated by several multi-year pluvial periods. Another lengthy xeric period with pluvial intermissions occurred ca early- to mid-fifteenth century, according to El Malpais dendrochronology records, Gulf sediment cores, and stalagmite annular growth data (Grissino-Mayer 1997; Polyak et al. 2007; Poore et al. 2005). Also evident in the Gulf sediment cores and in at least several dendroclimatology records (the El Malpais tree-ring record, the Sierra del Nido record, the Gallinas Mountains record, and the Organ Mountains record) is the ca. AD 1660–1670 drought, which contributed to abandonment of the Salinas Pueblos and other cultural upheavals (Grissino-Mayer 1997; Grissino-Mayer and Swetnam 1981; Naylor 1971; Parks, Dean, and Betancourt 2006; Poore et al. 2005; Stahle et al. 2009; Stokes et al. 1970). Parks, Dean, and Betancourt (2006) have contributed additional dendroclimate data from tree-ring samples collected in Sevilleta National Wildlife Refuge near Socorro, from Chupadero Mesa, and from Mountainair. The evidence from these samples also indicates a xeric interval spanning about a decade beginning ~1660. However, this dry period is not quite as apparent in the speleothem data, although a xeric blip occurs in the record ca. AD 1680. This could be because the middle to late seventeenth century drought lasted only about 10 years and the sampling interval for the speleothem was 32 years (Polyak et al. 2007).

Major historic-period xeric climate episodes that are visible in all of the previously cited dendroclimatology records and in the Gulf of Mexico sediment core records include mid-eighteenth century episodic drought and a mid-twentieth century interval of significant drought that have also been documented in dendroclimate studies conducted in northern Mexico by Cleaveland et al. (2003) and Villanueva et al. (2006). The eighteenth-century drought episodes were implicated in mass livestock die-offs, river desiccation, and cultural abandonment events that were recorded in northern Mexico and what is now Texas by Spanish Colonial settlers and religious officials. The AD 1950–1960 drought had disastrous effects in the trans-Pecos and borderlands regions (Cleaveland 2006; Holden 1928; Villanueva et al. 2006).

Major pluvial periods with implications for human occupation and adaptation in the Mexican highlands are also documented through dendroclimatology research and may be correlated with the Gulf of Mexico sediment cores, and, to a lesser extent, with the speleothem-stable isotope research. However, some period of lag between the appearance of a pluvial period in annular tree rings and its appearance in the annular rings of stalactites is apparent, possibly because of the time lag between the onset of the pluvial event, the rainfall absorption in the ground, its dissolution of calcium carbonate and the occurrence of mineral deposition and resolution on the speleothems.

Based on Gulf sediment cores and abundance of *G. sacculifer* forms, relative absence of packrat middens, and annular tree-ring growth, major pluvial events of multi-decadal duration occurred during the late second to mid-third century AD, the late sixth century to the mid-seventh century AD, the early to middle eleventh century AD, and from AD 1825–1900. This latter pluvial event may have reached its maximum peak around the turn of the nineteenth–twentieth centuries. The monsoonal indicators from the Gulf of Mexico sediment core records suggest that it was the strongest pluvial period since the late fifteenth century (Poore et al. 2005). Scurlock (1998) has compiled documentation of 13 major- to moderate floods (flow 10,000 cubic feet per second or more) between 1890 and 1911. Tree-ring records from El Malpais, and the Oscura, Sierra del Nido, Gallinas, and San Andres mountains all indicate a pluvial period beginning ~1890 and continuing through the first decade of the twentieth century (Grissino-Mayer et al. 2004; Grissino-Mayer and Swetnam 1991; Stockton 1982, 1991; Stokes et al. 1970).

Implications of Geochronometrics and Climate for Human Occupation and Adaptation in the Mexican Highlands Area, Rio Grande Rift Province, and Beyond: Research Questions and Possibilities

Geochronometrically dated cultural occupations at archaeological sites in the Tularosa and Jornada Basins may reveal correlations between proxy-observable climate regimes and events and cultural activities. For example, pre-ceramic occupations that can be dated to a specific cultural period (e.g., Clovis or Folsom) may have taken advantage of pluvial conditions during late Pleistocene or early Holocene times to utilize the terraces, lowlands, or other environs around Jornada Draw for the entrapment of game animals. Early Archaic inhabitants, during the Altithermal, may have been motivated away from the midlands to areas closer to the Rio Grande River or to more mesic highland areas in the pursuit of game, mast, or grain. Similarly, early agriculturists, such as Late Archaic forager-farmers and Jornada-Mogollon or other formative groups, may have sought out wet meadows, cienegas or playas to grow domesticates during xeric times or may have taken advantage of mesic conditions ca. 950 BP to pursue dry-land agriculture on lowland or midland terraces, or to gather piñon on upland areas. Detailed studies about paleoclimates and human adaptations have been previously conducted in and around areas of the southern Rio Grande Rift and Mexican highlands. That information is readily available for comparison to future discoveries in these regions and will reveal more about the continual evolution of ecological dynamics between humans and the environment.

3 | Overview of the Culture History of the Jornada Mogollon Region

James L. Moore

The first synthesis of archaeological data was completed for south-central New Mexico in 1948. Through survey, excavation, and reevaluation of previous work in the region, Lehmer (1948) defined the Jornada Branch of the Mogollon in a region extending from north of Carrizozo to south of Villa Ahumada, Chihuahua, and from 120 km west to 240 km east of El Paso. This was not only the first comprehensive examination of the region, it was virtually the only such study until large-scale cultural resource investigations began in the 1970s.

Large areas of federally controlled land in south-central New Mexico and the western Trans-Pecos region of Texas have been examined since this time, and many of the sites recorded by these studies have been tested or excavated. The most extensive investigations have been conducted on land administered by the Department of Defense in south-central New Mexico and adjacent parts of Texas. Thus, a considerable amount of information has become available over the last 30 years, and literally tens of thousands of new sites have been recorded in this area. This has provided us with a considerable amount of data concerning the entire span of human occupation in the region. Following other studies, culture history is divided into five broad periods: Paleoindian, Archaic, Formative, Protohistoric, and Historic. The chronological scheme presented here is summarized in Figure 3.1.

Paleoindian Period (10,000–6,000 BC)

The earliest agreed upon occupation of the Southwest was during the Paleoindian period, which is divided by researchers into two broad temporal divisions: Llano, which includes both Clovis (10,000–9,000 BC) and Folsom (9,000–8,500 BC), and Plano (8,500–6,000/5,500 BC). These dates are by no means exact and fluctuate by several hundred years among researchers (Agogino 1968; Irwin-Williams 1965, 1973; Irwin-Williams and Haynes 1970; Neuman 1967). While Clovis and Folsom are considered to represent distinct cultures, the Plano encompasses a number of individual traditions. At one time all Paleoindians were classified as big-game hunters. Many now consider Clovis to have been more generalized hunter-gatherers, while Folsom and some later groups turned increasingly toward the specialized hunting of migratory game, particularly bison (Stuart and Gauthier 1981). Other Plano groups may have been hunter-gatherers whose lifestyle resembled that of the Archaic. However, even these groups probably placed more emphasis on large-game hunting and less on collecting plant foods that required extensive processing and that were to become staples during the Archaic period.

Some view the break between Paleoindian and Archaic periods as an actual dislocation of populations. This view entails the migration of Late Paleoindian peoples onto the Plains in response to the movement of bison out of the desert Southwest (Irwin-Williams and Haynes 1970). While some groups, particularly those that specialized in big-game hunting, probably did follow the retreating bison, it is unlikely that everyone left and the ensuing demographic vacuum was occupied by a new group of people. Instead, later inhabitants of the Jornada region were probably Paleoindian descendants who exploited a more general array of resources. Thus, the Paleoindian period ends with the slow demise of specialized big-game hunting and the movement of most of those specialists out of the Southwest.

Although Paleoindian remains are relatively rare in the Jornada region, they do occur and indi-

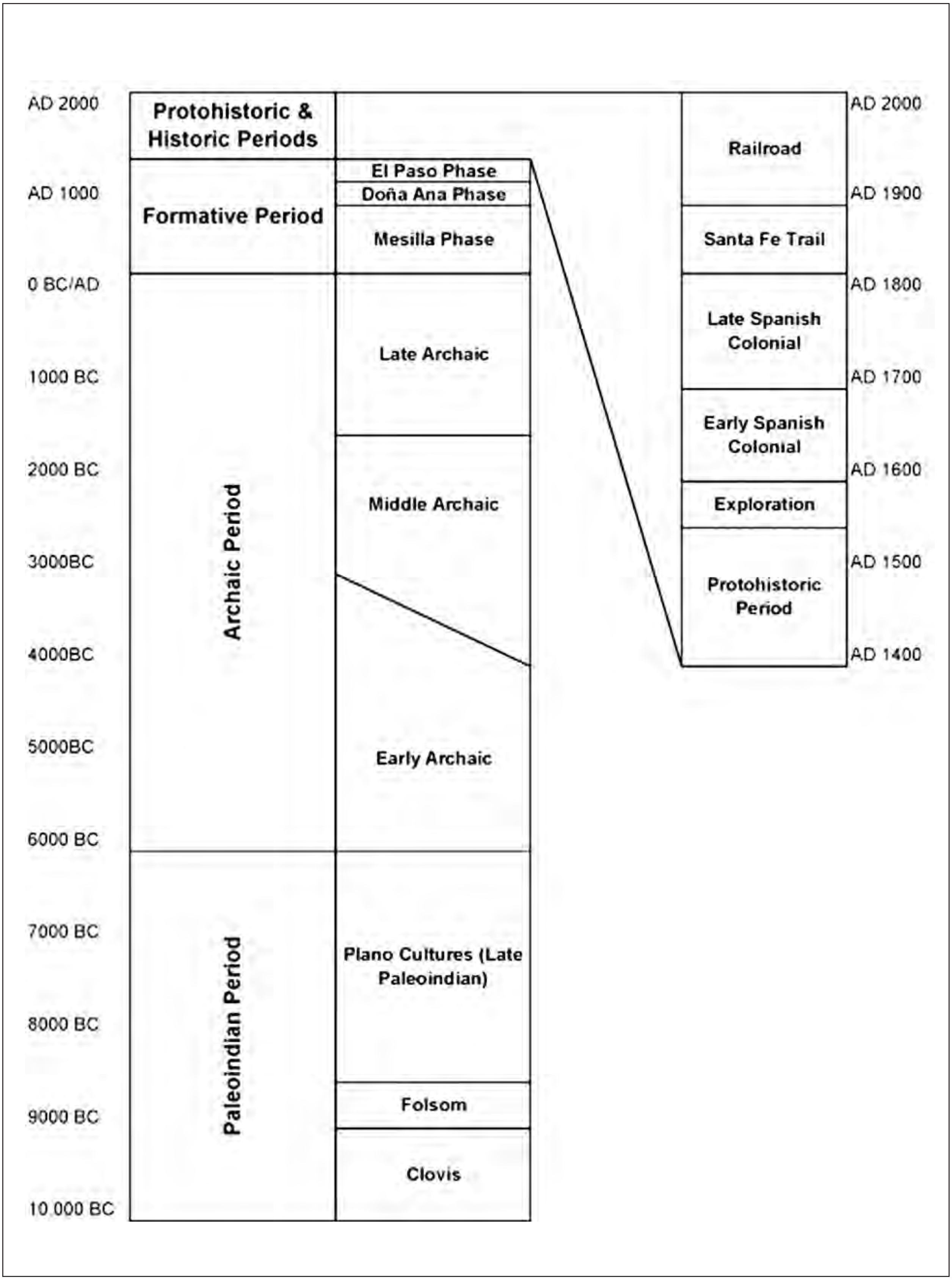

Figure 3.1. Chronological timeline for the project area.

cate that south-central New Mexico and western Trans-Pecos Texas were occupied by humans by at least 10,000 BC. However, there are some who feel that the occupation of this region can be pushed back to a much earlier date. From data collected during excavations at Pendejo Cave, MacNeish et al. (1993) propose three distinct pre-Clovis complexes dating back to ca. 53,000 BC. As Riley (1995:37) notes, these early dates have been met with some skepticism. Miller and Kenmotsu (2004:211–212) summarize data from the initial study of Pendejo Cave and various re-evaluations of both those data and the site's stratigraphy, and conclude that the precision used during the initial excavation was insufficient to accurately define the stratigraphy and support the argument for pre-Clovis occupations. Lacking a firm resolution to this controversy, we simply note that possible pre-Clovis remains have been found in the region.

Clovis materials are rare in this region. Sechrist (1994:47) indicates that only three Clovis sites or localities have been found, including the Mockingbird Gap site, the Rhodes Canyon Locality, and the North Mesa site. Other Clovis remains generally consist of isolated points found in southern New Mexico, the western Trans-Pecos region of Texas, and northern Chihuahua (DiPeso 1974; Krone 1976; Miller and Kenmotsu 2004). Evidence of a Folsom occupation is more common. Seaman and Doleman (1988:15) found two Folsom points and many possible spurred scrapers during a survey in the Jornada del Muerto. The only evidence of Paleoindian occupation found by Whalen (1978:14) during surveys in the Hueco Bolson was two isolated Folsom-point fragments. Other isolated Folsom points have been found east of El Paso in the Hueco Bolson (Brook 1968a) and north of El Paso in Otero and Doña Ana Counties (Davis 1975; Krone 1975). Ravesloot's (1988a, 1988b) survey of the Santa Teresa area located a single site containing a Folsom component. Quimby and Brook (1967) found a site containing a Folsom point and a tentatively associated hearth along the New Mexico-Texas border. Russell (1968) recorded three Folsom campsites around a dry Pleistocene lake near Orogrande. Stuart (1997) reports a cluster of Folsom sites north of El Paso. A sample survey near the Mockingbird Gap site by Elyea (2004) discussed six other Paleoindian components within 20 km of the study area, and documented five newly discovered Paleoindian (Folsom and Cody) sites. Perhaps more significantly, Amick (1994) reported 526 Folsom artifacts (mostly from private collections) in the northern Jornada del Muerto.

Miller and Kenmotsu (2004:216) note that Folsom assemblages characteristically contain large percentages of high-quality, fine-grained materials, some of which were obtained from sources located up to 450 km from where they were found, including the Texas Panhandle (Alibates and Edwards Plateau cherts), northwestern New Mexico (Chuska chert), the Jemez Mountains (obsidian), and eastern Arizona (Cow Canyon obsidian). In contrast, Elyea (2004) suggests that the majority of Folsom lithic materials in the Jornada Basin originate in the Rio Grande valley, followed by more local materials from the Jornada Basin itself. This pattern, to Elyea, suggests cultural ties between the Rio Grande and the Jornada region during the Folsom period. Miller and Kenmotsu (2004) note that Amick (1994, 1996) suggests that the Folsom occupations in the Hueco and Tularosa basins used residential sites oriented toward hunting game animals other than bison as part of a settlement system that exploited a very wide area, including the Southern Plains (Miller and Kenmotsu 2004:217).

Plano materials also occur in the region. During a survey near Santa Teresa, Elyea (1989:18) found a Cody Complex projectile point and a spurred end scraper. The Cody Complex is comprised of Scottsbluff and Eden projectile point types and associated formal tools dating to near the end of the Plano period. These artifacts occurred on different sites and were associated with no other Paleoindian materials, suggesting they were curated by later peoples. Elyea (2004) also noted the presence of Cody Complex artifacts in the northern Jornada Basin. Hart (1994:39) recorded a Late Paleoindian site in the southern Tularosa Basin that contained an Agate Basin point fragment. A probable Cody Complex site was located during the Border Star 85 survey in the southern Tularosa Basin (Elyea 1988). Brook (1968b) found an isolated Scottsbluff point in a roadbed north of El Paso. Russell (1968) recorded a large Plainview site on the edge of a dry Pleistocene lake near Orogrande, and recovered later Paleoindian points from two of the three Folsom sites he recorded in that area.

A few studies have found large numbers of Paleoindian sites. Carmichael (1986a:107) recorded

50 Paleoindian components in the southern Tularosa Basin. Relative dates were established for 29 components, including 14 Folsom and 15 Plano. Nearly all seemed to be short-term camps and contained similar tool assemblages (Carmichael 1983:151). Anschuetz et al. (1990:87) found four Paleoindian components during another survey in the southern Tularosa Basin. Other than a Plainview point on one component, the only temporally diagnostic artifacts were an unidentified point and spurred scrapers. Miller and Kenmotsu (2004:217) note that most finds of Plano materials have been in basins near major playas or along the margins of the Rio Grande Valley, and indicate that this essentially replicates a pattern noted by Carmichael (1986a) in the Tularosa Basin. This pattern may reflect an adaptation to the hunting of large animals that tended to stay close to these water sources (Miller and Kenmotsu 2004:217). A survey of much of the area encompassing Spaceport America by Human Systems Research (1997) identified Paleoindian components on 9 sites, and included both Folsom and Plano locales.

Unfortunately, the relative rarity of Paleoindian sites in the region precludes a more detailed discussion of settlement or subsistence patterns. Whether this rarity is real or related to patterns of soil deposition, later occupation, or survey location is unresolved. However, it is interesting that most recorded sites from this period are parts of multicomponent locales or occur in badly eroded areas. This suggests that many Paleoindian remains may have been revealed by soils eroded after their occupation or are mixed with the remains of later peoples who either mined their sites for useable materials or chose to occupy the same locations.

Archaic Period (6,000 BC–AD 200)

A tradition based on the use of a broader range of plant and animal foods emerged at the end of the Paleoindian period. These subsistence changes probably occurred because of environmental change coincident with the end of the Pleistocene that involved a long-term pattern of drying that resulted in the extinction of large game animals, the expansion of plant communities adapted to drier conditions, and a reduction in perennial water sources (Miller and Kenmotsu 2004:218). As Miller and Kenmotsu (2004:218) note: "These changes undoubtedly contributed to large-scale changes in subsistence strategies, requiring a diversification of the Paleoindian subsistence base with a greater focus on exploitation of plant foods. Such changes and accompanying shifts in settlement and technology, mark the onset of the Archaic period at ca. 6000 B.C."

Groups utilizing this new adaptation exploited a different range of foods—plant foods in particular—than appear to have been used during the Paleoindian period. Rather than being tied to the migratory patterns of large game, Archaic peoples focused on seasonally available plant foods occurring in a wide variety of environmental zones, supplemented by the hunting of small-to-large game. The project area is within the zone assigned to the Chihuahua Tradition by MacNeish and Beckett (1987) and MacNeish (1993). This tradition extends north from Chihuahua into southeastern and south-central New Mexico and the western Trans-Pecos region of Texas (Miller and Kenmotsu 2004). Many consider the Chihuahua Tradition to be separate and distinct from other Archaic traditions defined to the north (Oshara Tradition) and west (Cochise Tradition) of the project area, though many characteristics are shared between all three of these groups.

Archaic Phases

MacNeish and Beckett (1987) divide the Archaic into five phases. However, the Archaic can also be more simply divided into Early, Middle, and Late subperiods, based on projectile point typologies, which also correspond to paleoenvironmental and paleoclimatic intervals (Miller and Kenmotsu 2004:218). A correlation between these systems is provided by Miller and Kenmotsu (2004:218), allowing both systems to be used in this discussion.

The Gardner Springs phase is the first in the Chihuahua Tradition sequence, and corresponds to the Early Archaic (6,000–4,000/3,000 BC). Most sites from this phase are small, and a pattern of seasonal scheduling may be indicated. The Gardner Springs population probably exploited a wide range of floral and faunal resources. The chipped stone assemblage includes projectile points, flake and core-choppers, denticulates, planes, and scrapers, while the ground stone assemblage contains basin milling stones, anvil mortars, slab mullers, and pebble hammers or pestles.

The Keystone phase corresponds to the Middle

Archaic (4,000/3,000–1,200 BC), and is considered a period of efficient foragers. MacNeish (1993) feels there was a further deterioration of the climate during this period and rainfall became less reliable. Dependence on plant foods may have increased, but this is tentative. Most Keystone phase sites are small, and there are some indications that the use of resources was seasonally scheduled, focusing on the processing and consumption of seeds. The associated assemblage includes small half-moon bifacial side blades, large pointed unifaces, planes, and projectile points. Milling stones and mullers continued to be used, along with manos and metates.

Significant changes occurred during the Fresnal phase, which corresponds to the early part of the Late Archaic (1,200 BC–AD 200) and is better defined than earlier phases. There is definite evidence for the use of domesticated plants during this phase, and as a consequence there seems to have been significant changes in the settlement system. Of equal importance is evidence suggesting that surplus foods were stored in pits. The associated assemblage includes planes, gouges, choppers, projectile points, and bone beads. Though milling stones and mullers continue to occur in the ground stone assemblage, they are now outnumbered by manos and metates.

The Hueco phase represents the late part of the Late Archaic. MacNeish (1993:403) suggests that the population grew rather rapidly during this phase. More sites are recorded that date to this phase than any earlier period. Base camps were larger, suggesting they were either occupied for longer periods or by larger groups. Distinctive scrapers and small disk choppers occur in addition to projectile points. Wedge manos and trough metates dominate the ground stone assemblage, which also includes bedrock mortars. There is also evidence that baskets and sandals were being woven by this time. Importantly, the number and types of storage features appear to increase during this phase.

Miller and Kenmotsu (2004:218–236) provide a detailed overview of the Archaic in the Jornada region, and many of their observations are important to this discussion. As noted earlier, few Early Archaic sites have been found in this region. Early Archaic projectile points are often found on the surface, but are only slightly more common than Paleoindian points. This period is not well dated, and its temporal placement is mainly based on the cross-dating of projectile points with other regions. The rarity of Early Archaic sites may be due to environmental factors, with much of this period's landscape currently buried beneath sediments, eroded away, or in the lower strata of rock shelters and therefore invisible during archaeological survey. One characteristic of the Early Archaic is the first evidence for the use of rock or caliche as cooking stones or heating elements, suggesting that an important change occurred in the subsistence system involving increased emphasis on plant processing. Ground stone artifacts also seem to appear at this time, supporting the increased value of plant processing to the subsistence system. Projectile points changed from the lanceolate styles of the Paleoindian period to stemmed forms. Accompanying this change was the use of coarser-grained materials for projectile point manufacture. These characteristics may indicate a shift in the types of animals being hunted as well as in hunting practices. Differences between the Early Archaic and Paleoindian periods suggest the development of "a seasonally mobile settlement system of small bands, although possibly more restricted than during earlier periods" (Miller and Kenmotsu 2004:223).

The changes in subsistence, settlement, and technology that began in the Early Archaic seem to have continued through the Middle Archaic, perhaps becoming intensified in the second half of the period (Miller and Kenmotsu 2004:223). Population growth is also likely. Continued drying may have caused a more restricted timing and distribution of plant resources, resulting in the development of a seasonal land use pattern focused on the exploitation of specific plants. Some characteristics of excavated sites suggest greater levels of occupational intensity and perhaps the presence of larger groups. Evidence of houses, or huts, has been found for this period at several sites, and this is the first occurrence of definite structures in this region, and predates the arrival of domesticated plants. Few technological changes are visible in chipped and ground stone assemblages, and the same types of thermal features seen in the Early Archaic continued in use. Perhaps the most visible change is in the diversification of projectile point styles. Miller and Kenmotsu (2004:225) suggest that patterns of beveling and serration on point blades that are most common during the Middle Archaic may be indicative of a behavioral change:

> Such patterns may indicate an increased emphasis on the conservation of raw materials, blade modification related to multiple uses of the tools, or an aspect of increased efficiency in felling prey. These possibilities suggest that the design and use of projectile points among Middle Archaic groups reflects different patterns of technological and settlement organization than was the case among earlier and later intervals of the Archaic period. (Miller and Kenmotsu 2004:225)

The argument for general continuity of Middle Archaic settlement, subsistence, and technology with those of the Early Archaic may be incorrect, and may simply be a function of the paucity of basic comparative data from both periods.

In contrast, many important changes occurred during the Late Archaic, especially in the second half of the period. The number of recorded sites represents a dramatic increase over earlier periods, and characterizes the peak of residential use in several environmental zones. Indeed, nearly every major environmental zone was exploited during the Late Archaic, indicating an apparent expansion of the resource base beyond the central basins that formerly were the focus of occupation. This expansion may have been the result of a wet period that ended ca. 500 BC. Population growth seems likely, as represented by the vast increase in number of sites. Cultigens, including corn and beans, were introduced during this period (Miller and Kenmotsu 2004:227), but were most likely a supplement to the diet rather than a focus, as shown by stable isotope analysis of human remains that do not indicate a high level of corn in the diet (MacNeish and Marino 1993). Cultigens were merely one facet of a diet that was primarily based on hunting and gathering. Burned rock features appear to be more common during the Late Archaic, and ring-middens occur in areas outside the Hueco Bolson. Changes in projectile point technology are evident, and include a shift to corner- and side-notched types. A probable reduction in territorial range is suggested both by the large jump in the number of sites from this period and an increased use of local raw materials for the manufacture of projectile points.

Some general observations made by Miller and Kenmotsu (2004:230–236) for the Late Archaic are of particular interest. They note a general correspondence between the introduction of cultigens and an increase in dated features, and suggest that these trends are closely linked. Rather than indicating dramatic growth, these trends could suggest that population levels actually remained stable while land use was intensified because of an increasing restriction of territorial range. Competing groups may have cut off access to resources that were formerly exploited outside the general region, requiring the population to focus on increasingly smaller areas. Late Archaic projectile point types reflect less intensive maintenance and reduced durability and versatility when compared to earlier types. Coupled with evidence for increased numbers of dated features and structures, these patterns suggest more intensive land use, constrained territorial ranges and decreases in mobility, as reflected either in a reduction in the number of residential moves, or an increase in the duration of moves, or both.

Diagnostic Archaic Artifacts

In general, only projectile points are considered temporally diagnostic for the Archaic period. Styles commonly associated with the Early Archaic include Bat Cave, Abasolo, Jay, and Bajada. Miller and Kenmotsu (2004) note that Uvalde points also occasionally occur in the region, but are much more common further to the east in Texas. A different array of projectile points is associated with the Middle Archaic, including Pelona, Amargosa, Todsen, Almagre, Langtry, Shumla, Trinity, and Bat Cave styles. Projectile point styles commonly associated with the early Late Archaic include Chiricahua, Nogales, Augustin, Todsen, La Cueva, San José, Fresnal, Maljamar, and possibly Pedernales. Styles associated with the later Late Archaic include San Pedro, Hatch, Hueco, and Fresnal. As characterized in the Chihuahua Tradition, this array of projectile points reflects a mixture of diagnostics from several different regions. This suggests that, not only was the Jornada Basin area stylistically connected to the general Southwestern Archaic communication system, but it also had ties further to the east and southeast in Texas.

Archaic House Forms and Feature Types

Data on structures and features are available from several excavations. Roney and Simons (1988) excavated Late Archaic pit structures near Santa Teresa that were circular (n = 4) or oval (n = 1) in shape, and were dish-shaped in profile except for one that was flat-bottomed. All were under 3 m in diameter, three were less than 2 m in diameter, and none were deeper than 30 cm. Interior features included postholes, a basin hearth in one structure, and an informal hearth on the floor of a second. Three similar pit structures were excavated in the same area by O'Leary (1987). These examples were circular (n = 2) or oval (n = 1) in shape, less than 3 m in diameter, and no deeper than 25 cm. In profile they were dish-shaped and contained no internal features. All three were radiocarbon dated to the Hueco phase.

A similar Middle or Late Archaic structure was excavated on White Sands Missile Range (Swift and Harper 1991). It was shallow (18 cm deep) and less than 2 m in diameter, with no internal features other than a possible posthole (Swift and Harper 1991:115). Gerow (1994) excavated two pit structures near Chaparral that appeared to be Archaic in date, and each was associated with a different cluster of features. They were roughly circular, and while one was dish-shaped the second was incompletely excavated so its profile shape is unknown. Both structures were less than 3 m in diameter and 30 cm deep. One floor was use-compacted, though there was no formal preparation evident, and an informal hearth was found on its surface.

O'Laughlin (1980) excavated twelve pit structures at the Keystone Dam site and found at least eleven more in auger tests. In general, they were small (ca. 3 m diameter), shallow (ca. 10 to 20 cm deep), and circular, with nearly level or dish-shaped floors. Most contained informal hearths. Evidence for a clay or adobe coating on the outside of superstructures was found in at least 12 cases (O'Laughlin 1980:144). This is the only known example in the region of an Archaic site that contains a large number of structures, and is interpreted as a winter village. Several clusters of huts in groups of 2 to 5 were identified, suggesting the presence of multiple nuclear families. Rather than indicating a single large macroband occupation structured in discrete clusters, the site was probably occupied on several occasions by groups of 2 to 5 families.

In general, Middle and Late Archaic pit structures were shallow with basin-shaped or flat-bottomed, scooped-out, unplastered floors. Posts usually occur in irregular patterns and were placed around and within floor areas, often occupying both positions in the same structure. Interior hearths are often absent and when present are usually informal concentrations of ash and charcoal on floor surfaces, though at least one shallow basin hearth has been found. Posts formed the base of the superstructure, which was covered with grass stems, yucca stalks, and reeds. Mesquite branches were most commonly used for posts, though other woods were undoubtedly also used when available. A thin layer of clay or adobe may have been applied to the exterior surface, but evidence for this has been found at only one site. Most exterior features are thermal features, both with and without associated fire-cracked rock (Gerow 1994; Hard 1983a; O'Laughlin 1980; O'Leary 1987; Roney and Simons 1988). Between one and four extramural pits were probably used for storage at the Keystone Dam site, and two were reused for trash disposal at a later time (O'Laughlin 1980).

Archaic Ideology and Ceremonialism

Little information concerning Archaic religious beliefs is available. Panels of abstract rock art in the region may have been created by Archaic peoples (Schaafsma 1992), but while this art is probably related to ideology, its nature precludes any interpretation of meaning at this time. However, variation between this style of rock art and later forms suggests that there were great differences between the ideological systems of local hunter-gatherers and farmers.

Archaic Ties to Other Regions

When dealing with a highly mobile population, determining whether the presence of an exotic artifact or material represents the size of the territory exploited or exchange ties with distant groups is difficult. Considering the large distances between the Jornada region and the sources of some of the exotic materials found there, the latter is more likely. Projectile point styles are often used to indicate ties between groups, and in this light the Jornada region seems like a crossroads between the Oshara and Cochise traditions, as well as groups living to the east and southeast in Texas. Evidence from geochemical sourcing suggests acquisition of some obsidian directly from sources in the Jemez Mountains, as well as from sources in Chihuahua (Miller and Kenmotsu 2004:235). A textile analysis by Beckes and Adovasio (1982) concluded that similarities in basketry and weaving techniques between the Jornada region and northern Mexico indicate a close relationship or cultural continuum between those regions. In contrast, Formative period textiles have predominantly Mogollon characteristics (Miller and Kenmotsu 2004:235). These data, combined with obsidian sourcing, suggest that the primarily north-south ties in effect during the Archaic shifted to a westerly focus during the Formative period (Miller and Kenmotsu 2004:236).

Archaic Subsistence

The few subsistence data that are available suggest the use of a broad range of plant and animal foods during the Archaic. Deer and antelope bones are common in Early Archaic deposits, implying heavy dependence on medium-to-large game. The appearance of ground stone tools and burned rock features during the Early Archaic implies that wild seeds, and possibly succulents, were processed and consumed. A shift to the use of coarser-grained materials for projectile point manufacture along with a change in point design may signify the hunting of a different array of animals than was exploited by Paleoindians as well as a change in hunting techniques (Miller and Kenmotsu 2004). Little subsistence information is available for the Middle Archaic, but the continued use of ground stone tools and the association of projectile points from this period with burned rock features suggests a continuity in wild plant exploitation, including four-wing saltbush, chenopodium, purslane, mesquite, rushes and grasses, and cacti (Miller and Kenmotsu 2004:224). Limited evidence for the hunting of rabbits and other small-to-medium mammals has been recovered from Middle Archaic contexts.

Domesticates were certainly available by the Late Archaic, and there is good evidence for the storage of food in pits. The range of domesticated plants increased during the late part of this period and included at least four varieties of corn, cucurbits, and possibly beans and amaranth. The number and types of storage features appear to increase during this phase, suggesting careful planning and storage of surpluses for consumption during the winter rather than any degree of true sedentism. Most of the meat consumed seems to have come from small game, particularly rabbits, with little evidence for reliance on large animals.

The use of several wild plant species has been documented, particularly in Late Archaic contexts. Camilli et al. (1988) found evidence for the use of vetch seeds and flower stalks or pods of a plant from the Liliaceae family. Other economic plants identified during that study include purslane and amaranth seeds, and a probable yucca pod. Gerow (1994) recovered evidence for the Archaic use of chenopodium and purslane. Mesquite seems to have been the main source of fuel wood, but there is also evidence for the use of other shrubs like saltbush (Camilli et al. 1988; Hard 1983a).

A wider variety of woods and economic plants was identified at the Keystone Dam site than at other open air sites. Mesquite wood was recovered from thermal features. Other woods were identified in samples from structures and probably represent construction materials, though use as fuels cannot be ruled out. They include desert willow, Apache plume, creosote, wolfberry, reed, cottonwood, and possible tornillo (O'Laughlin 1980:82). Burned grass stems and yucca stalks were also identified, as were fragments of Turk's cap cactus. The array of charred seeds included saltbush, cheno-ams, tansy mustard, Turk's cap, various grasses, creosote, prickly pear, purslane, smartweed, mesquite or tornillo, possible acacia, dock, bulrush, and a plant from the poppy family (O'Laughlin 1980:88).

Excavations at High Rolls Cave near Fresnal Shelter in the Sacramento Mountains, recovered extensive and detailed information concerning Late Archaic subsistence. Three main periods of occupation were defined, beginning with a very late Middle or early Late Archaic occupation, followed by two periods of Late Archaic use (Lentz 2005). Bohrer (2005) identified a suite of wild plants used as food as well as domesticates including corn, a variety of amaranth (*Amaranthus cruentus*), and possibly tobacco. The main wild plants used included cheno-ams, chenopodium, drop seed grass, false tarragon seeds, juniper, mesquite, piñon, prickly pear, and banana yucca fruit (Bohrer 2005:218–219). The use of a wide range of small-to-medium animals was also evident, suggesting a long-term Late

Archaic trend toward increased use of rabbit and small mammal, concomitant with an increase in the use of deer versus pronghorn and bighorn sheep (Akins 2005:143). However, deer bones consistently dominate the identified taxa, indicating they were probably taken nearby and brought to the cave as intact or nearly intact carcasses (Akins 2005:143).

Some evidence from Fresnal Shelter has been used to suggests a specialized highland Archaic hunting pattern by Wimberly and Eidenbach (1981). Most of the identified bone from this site was mule deer, though some antelope, bighorn sheep, and bison bones were also found. The butchering pattern suggested that meat packages including major long bones and attached muscle were removed and transported elsewhere, while parts that contained less meat were processed and consumed on-site (Wimberly and Eidenbach 1981:27). This would have major implications for low altitude sites, especially since radiocarbon dates suggest the shelter was used throughout the Archaic. If a pattern of this sort was common, there might be little evidence for large game consumption in lowland sites, and when such evidence occurs, only long bones may be present. Thus, the predominance of small mammal remains in lowland Archaic sites might not preclude the consumption of meat from large mammals obtained in the highlands. However, Akins (2005:140) has reexamined these data, and suggests that a large percentage of unidentified long bone fragments and cancellous tissue represent the missing elements, which simply could not be precisely identified during analysis. Akins attributes the fragmented condition of these bones to the extraction of bone grease and marrow, which has important implications for some of the earlier conclusions drawn from this assemblage. Occupations in Fresnal Shelter appear to have been of longer duration than some archaeologists have suggested (e.g., Cameron 1972), and all of the bone grease and marrow produced were probably not consumed during residence at the shelter, as Wimberly and Eidenbach (1981) proposed. Thus, the possibility that highland hunters were transporting parts of carcasses to lowland sites may be unlikely, though this does not rule out the transport of dried meat, marrow, and bone grease.

Formative Period (AD 200/400–1450)

The Jornada Mogollon occupation is collectively labeled the Formative period (O'Laughlin 1980; Ravesloot 1988a; Stuart 1990). Lehmer (1948) defined three phases for this period, which originally spanned the years between AD 900 and 1400. This framework remained mostly unchanged until the 1970s, when large-scale studies were begun in the Hueco Bolson of southwest Texas (Whalen 1977, 1978). Through these and other studies, the temporal framework and settlement and subsistence model developed by Lehmer has been modified and refined.

Mesilla Phase (AD 200/400–1000)

Lehmer (1948) considered the Mesilla phase an outgrowth of the Archaic and dated it between AD 900 and 1100. It was characterized as the "first pottery-making, village-dwelling horizon in south-central New Mexico" (Lehmer 1948:78). Farming was assumed to be of primary importance, despite the lack of cultigens in the sites he investigated (Lehmer 1948:76). These assumptions have been questioned by other researchers.

Dating the phase

Whalen (1977, 1978) initially pushed the beginning of the Mesilla phase back to ca. AD 400, and proposed a generalized settlement-subsistence system. Other beginning dates have been suggested by various researchers, illustrating a continuing uncertainty about when it started. While some (O'Laughlin 1980; Whalen 1980a, 1981) have placed its beginning around 0 BC/AD, others feel it began ca. AD 200 (Batcho et al. 1985; Ravesloot 1988a). O'Laughlin (1985:54) notes that the best evidence for early ceramics in the Hueco Bolson comes from a site radiocarbon dated to the sixth or seventh centuries AD; earlier dates are single samples from limited activity sites. This suggests that an AD 200 or earlier date for the beginning of the phase is questionable, and the beginning of the phase is currently thought to have been sometime between AD 200 and 500. Whalen (1994:23) simply suggests that the Mesilla phase began in the early centuries AD, sidestepping the issue. In contrast, most authors have agreed with Lehmer's ending date of AD 1100. However, Miller and Kenmotsu (2004:238) provide an updated temporal range for the Formative Period, based on analysis of many additional radiocarbon samples from Fort Bliss and a re-analysis of early archaeomagnetic samples obtained from the region. They date the Mesilla phase between AD 200/400 to 1000, though they note it would also be plausible to consider the period between AD 1000 and 1150 as a late extension of the phase. The actual dating of phases can be confusing, and the use of phases tends to emphasize the importance of certain trends that more realistically represent a long-term trajectory (Miller and Kenmotsu 2004:238). Ultimately, examining the development and direction of cultural patterns is more important than dividing a particular time period into phases. However, we use the dates for phases assigned by Miller and Kenmotsu (2004) in this discussion, since they represent one of the most recent evaluations. Since research suggests there were significant differences in settlement and subsistence between the early and late parts of the phase, most researchers now break the Mesilla phase into early and late periods with dating based on ceramic types present.

Mesilla phase pottery

While undecorated El Paso Brown wares dominate throughout the phase, early sites contain intrusive ceramics such as Alma Plain and San Francisco Red, while Mimbres white wares occur in later assemblages. The appearance of the latter provides a good demarcation point, and the late Mesilla phase is considered to have begun ca. AD 750 (Hard 1983b:41; Hard 1986:266; Whalen 1993:481).

The extremely long period during which El Paso Brown was made has led many to search for temporally sensitive variation in vessel form, manufacturing techniques, and stylistic attributes. Whalen (1980b:31–32) suggested that early El Paso Brown vessels tend to have pinched rims, coarse temper, and a coarse, bumpy surface finish. Late El Paso Brown was thought to be dominated by rims that were everted and tapered or direct, with finer temper and a smoother surface finish (Whalen 1980b:31–32). Some of these ideas have been verified and amplified by further research. A regional comparison showed that ceramic densities increase on Mesilla phase sites over time, so there tends to be more pottery on late Mesilla sites than on early Mesilla sites (Whalen 1994:75). Two long-term trends in temper were also identified. Through time, vessels tend to contain more temper, and temper tends to be more finely ground (Whalen 1994:79). While vessel forms were dominated by neckless and short-necked jars throughout the life of this type, changes in vessel shape, volume, and orifice diameters indicate that storage in large containers became increasingly important in the late Mesilla phase (Seaman and Mills 1988a, 1988b; Whalen 1994:86, 89).

Another significant variation identified by Whalen (1994:83) was a change in firing temperatures around AD 700. After that date, vessels seem to have been fired at higher temperatures or for longer periods, producing differences in surface hardness and core characteristics that are distinguishable from earlier brown wares. However, Whalen (1994:83) does not believe this represents a reorganization of ceramic technology. Rather, something as simple as the use of more wood and less grass during firing may have been involved.

House forms and feature types

Pithouses were the only type of structure used during the Mesilla phase. Some differences have been noted between structures in different environmental zones, but there seems to have been little variation in form between the early and late parts of the period. Whalen (1994:46) found that the largest, deepest, and most heavily roofed structures are in the Rio Grande Valley, while those in the desert basins are smaller, shallower, and less heavily roofed. In general, pit structures from the Jornada region are smaller than their contemporaries elsewhere in the Southwest and tend to contain few internal features. Heavily used extramural activity areas are often found in association.

The most detailed information on Mesilla phase structures comes from Whalen's (1994) excavations at Turquoise Ridge, a winter village occupied during both the early and late parts of the phase. While likely that the late Mesilla population was larger and remained at the village for longer periods, the only apparent difference between early and late structures was their depth (Whalen 1994:47). Late structures were somewhat deeper, though it was uncertain whether this was caused by deeper initial excavation or more wear during longer occupations. Some structures were occupied long enough to require remodeling or were used more than once. House abandonments were apparently planned, and abandoned structures were used for trash disposal (Whalen 1994:50). Internal features include postholes, hearths, storage pits, warming pits, and pits of unknown function. Postholes occur both on and around the edge of floors, often in combination. Hearths include formal basins excavated into floors and informal deposits of ash and charcoal or areas of oxidation on floor surfaces. Both large and small storage pits sometimes occur inside structures. Warming pits are found but are rare, and consist of irregular unburned pits that contain burned or heated rock. There was a shift from round to rectangular pithouses between AD 700 and 1000, with round pithouses being almost entirely replaced by rectangular houses by 1000 (Miller and Kenmotsu 2004:240).

Smaller, more ephemeral huts are found at sites occupied for short periods, and are similar in form to those used during the Archaic (Miller and Kenmotsu 2005:239). Huts are represented by small diameter (average 2.5 m), shallow (15–30 cm), circular dish-shaped basins with sloping walls that lack prepared floors (Miller and Kenmotsu 2005:239). The insubstantial nature of these structures in addition to evidence for short occupations suggest that they represent the summer component of a settlement system that mixed a sedentary cold-season residence based on stored foods with a mobile warm season exploitation of seasonally productive ecological zones.

Many types of extramural features also occur at Mesilla phase sites. While storage and midden features can be common at winter villages like Turquoise Ridge (Whalen 1994), they are rare at sites occupied during other seasons. Middens are usually shallow and diffuse, with imprecise boundaries (Whalen 1994:61). Burials are rare and usually unaccompanied by grave goods. Thermal features are usually common and take several forms including simple hearths and small and large fire-cracked rock features with and without fire pits. In general, the presence or absence of a pit within fire-cracked rock features probably reflect different degrees of erosion rather than functional differences. Size may reflect functional differentiation with small roasting features potentially more related to household use, while larger features were probably used communally (Whalen 1994). Variety in the types of thermal features peaks by AD 650, either declining or occurring in similar frequencies after that date (Miller and Kenmotsu 2004:250–251).

Ideology and ceremonialism

Little information is available concerning Mesilla phase ceremonialism. Larger than normal pithouses that may reflect a ritual use have been found at only three sites, including Turquoise Ridge (Whalen 1994), Los Tules (Lehmer 1948), and the Rincon site (Hammack 1962). These sites were all occupied late in the phase, leading Whalen (1994) to conclude that this type of structure originated after AD 750. The appearance of such features suggests an accompanying change in social organization. Traditionally, southwestern communal structures are associated with ritual societies that crosscut community and bind them together. Thus, the appearance of communal structures in the late Mesilla phase suggests that the loose social organization characteristic of the Archaic and early Mesilla phase was giving way to a more cohesive pattern of group identity and membership. However, there is no evidence for any ceremonial organization larger than individual villages.

Ties to other regions

Certain types of artifacts are indicative of ties to other regions, but what form those ties took cannot be determined with certainty. Most imported pottery at Mesilla phase sites is from the Mimbres area to the west. Mimbres pottery occurs on both early and late Mesilla phase sites, suggesting that the Jornada region was tied into an exchange system that centered on the Mimbres area, particularly during the late part of the phase. Marine shell represents another relatively common import, and includes *Olivella* sp. beads and fragments of *Glycymeris* sp. bracelets (Lehmer 1948; O'Laughlin 1977, 1985; O'Laughlin and Greiser 1973; Whalen 1994). Other types of marine shell are rare and include fragments of *Haliotus* sp. and *Pyrene* sp. (O'Laughlin 1985; Whalen 1994). Turquoise also occurs in Mesilla phase contexts and is best reported from Turquoise Ridge (Whalen 1994), where 11 fragments were found. One piece of turquoise was also found at Los Tules (Lehmer 1948). However, without chemical analysis it is impossible to determine whether this material was obtained from local sources, such as those in the Orogrande area, or was imported.

Subsistence

Both wild and domestic foods were consumed during the Mesilla phase, presumably continuing the Archaic pattern of exploiting a broad spectrum of resources. In general, domesticates are rarer than wild foods, and this probably reflects a heavier use of wild species with domesticated plants acting as supplements rather than staples. Corn and beans have been recovered from Mesilla phase sites, but cucurbits have not been found. However, since cucurbits occur at Archaic sites, they were probably used but are poorly preserved. In the most detailed study yet conducted, Whalen (1994) found a differential distribution of corn remains in samples from early and late Mesilla contexts at Turquoise Ridge. Corn occurred in 7.3 percent of early samples and 27 percent of late samples, suggesting increased use after AD 750. One bean was also found in early deposits at this site. However, agriculture most likely played a somewhat more important role in the subsistence system of the Mesilla phase than it did during the Archaic, as evidenced by more intensive occupation at Mesilla phase sites and the appearance of winter villages like Turquoise Ridge.

A wide spectrum of wild plants occurs at both early and late Mesilla phase sites, representing use as food, fuel, and construction materials. Wild plants are mostly represented by seeds including purslane, chenopodium, amaranth, sunflower, acorn, mesquite, tornillo, mallow, yucca, sumac, bugseed, mustard, and various cacti and grasses (Camilli et al. 1988; Dean 1994; Ford 1977; Hard 1983a; O'Laughlin 1979, 1981, 1985; Wetterstrom 1978; Whalen 1980b, 1994). Some evidence for the use of leaf succulents also exists. Scott (1985) found agave fibers in a large roasting pit, and Camilli et al. (1988) recovered yucca leaves from a late Mesilla pit structure; both examples probably represent foods. Fuels were mostly shrubs, mesquite in particular (Camilli et al. 1988; Hard 1983a; Minnis and Toll 1991; O'Laughlin 1979), though there is limited evidence for the use of small trees like oak and juniper (Kirkpatrick et al. 1994; Minnis and Toll 1991). Other fuels include saltbush, Mormon tea, creosote, desert hackberry, and desert willow (Brethauer 1979; O'Laughlin 1979). Mesquite branches are usually assumed to have been the main elements in pithouse superstructures, though there is little direct evidence of this. Materials used to cover superstructures include grass stems and yucca stalks (Gerow 1994; Hard 1983a; Roney and Simons 1988).

Hard and Roney (2005) compare levels of agricultural dependence between the Jornada region and Cerro Juanaqueña, a Late Archaic trincheras site in northern Chihuahua. While there was a heavy investment in the cultivation and consumption of domesticates, especially corn, at Cerro Juanaqueña by 1250 BC, similar levels of agricultural dependency do not occur in the Jornada region until ca. AD 1000. Using optimal foraging theory to examine the data, environmental factors are suggested as the cause of these differences. Before AD 1000, farming in the Jornada region was a risky, low-return proposition. In contrast, shrubs represented high-density, high-return resources, supplemented by the use of succulents and forbs. "The relatively high return of shrub resources and the mobility required to exploit them were favored relative to the lower return and higher risk of farming" (Hard and Roney 2005:173). Thus, this mix of heavy reliance on wild plants supplemented by domesticates continued until conditions were such that the risk and yield associated with the cultivation of domesticates were reduced to levels that made their use economically feasible.

Evidence for the range of animals exploited is more limited. Rabbits, both cottontails and jackrabbits, are the most commonly identified faunal remains (Brethauer 1979; Brown 1994; Foster 1988; Hard 1983a; O'Laughlin 1977, 1979, 1981, 1985; Whalen 1980b, 1994). Other types of animals for which evidence of consumption exists include box turtle, spiny soft-shell turtle, quail, owl, muskrat, deer, possibly antelope, fresh water mollusks, and various rodents and birds (O'Laughlin 1977, 1979, 1981, 1985; Whalen 1994).

Trends in the manufacture of ceramic vessels also provide some information on changing subsistence patterns. Changes in the amount and size of temper in the late Mesilla phase suggests an attempt to produce pottery more resistant to thermal shock (Whalen 1994:11). This implies that vessels were required to withstand longer periods of heating, which could indicate changes in food processing techniques. Changes in firing techniques may have resulted in harder and more durable vessels. This may have been required by new patterns of pottery use or could reflect variation in the types of materials used in firing, possibly as a consequence of environmental change. Finally, the larger average size of late Mesilla vessels may indicate an increase in their use for storage (Seaman and Mills 1988a, 1988b; Whalen 1994). All of these changes in pottery suggest important behavioral differences between the early and late parts of the Mesilla phase.

The behavioral differences visible between the early and late parts of the Mesilla phase probably involved a continuing adaptation to population growth and a concomitant constriction of the area available for economic exploitation, a process that began during the Archaic period. Mesilla phase settlements tend to be scattered across the interior basins, and some villages are located along the margins of the Rio Grande Valley (Miller and Kenmotsu 2004:244-245). Cold-season villages seem to have been occupied more intensively during the late Mesilla phase, suggesting the growing importance of stored foods to support longer periods of village occupations, perhaps by larger groups of people. This possibility is supported by the increased size of ceramic vessels seen in the late Mesilla phase. The appearance of probable ritual structures in late Mesilla phase villages may be indicative of population growth, with new elements of social structure being developed to help organize larger populations. Though cold-season villages seem to have been occupied more intensively, the warm season pattern of dispersal of part of the village population to basin interiors to exploit food resources in that zone did not disappear, indicating that wild plant foods continued to be an important part of the subsistence economy at the same time that farming assumed increased importance.

Doña Ana Phase (ca. AD 1000–1250/1300)

While the Doña Ana phase was initially defined by Lehmer (1948), it is the most poorly known period of occupation. Lehmer (1948) considered this phase to be transitional between the Mesilla and El Paso phases and dated it from AD 1100 to 1200. No attempt was made to distinguish Doña Ana components in Whalen's (1977, 1978) early studies in the Hueco Bolson because of difficulties involved in distinguishing those remains from survey data alone. Thus, Doña Ana components were combined with the later El Paso phase into the Pueblo period. Whalen (1980a) has also referred to the Doña Ana phase as the Transitional period, again combining it with the El Paso phase in a regional synthesis.

Lehmer (1948:88) used pottery recovered during excavations at La Cueva, which lacked structural remains, to date the Doña Ana phase. The initial definition of this phase was mostly based on guesswork using remains excavated in 15 cm levels from the talus in front of a cave in which the fill was described as "hideously disturbed" (Lehmer 1948:35–37). It is no wonder that there has been so much confusion and speculation about this phase! Nevertheless, Carmichael has proposed a locally extensive Doña Ana occupation in the Tularosa Basin. Unfortunately, his arguments are based on survey data, and some have criticized his logic. Carmichael (1983, 1984, 1985a, 1985b, 1986b) presents a series of attributes he considers diagnostic of a Doña Ana occupation, and integrates these data into a model of nonlinear culture change for the region. First is a mixture of pottery, combining types from the Mesilla and El Paso phases. Initially, sites were only assigned to the Doña Ana phase when this ceramic association occurred in discrete features thought to represent eroded middens (Carmichael 1986a:72). However, once the association was considered valid it was extended to all sites at which it occurred, whether found in discrete features or not. The latter class of sites comprised over two-thirds of his sample. Though no surface evidence of structures were found, they were inferred by the presence of features interpreted as eroded trash-filled borrow pits (Carmichael 1986a:72). The associated adobe pueblos are thought to have eroded away, leaving behind little visible evidence of their existence.

From these data, Carmichael inferred a locally extensive, short-term occupation during the Doña Ana phase for the southern Tularosa Basin. Many large habitation sites were identified in environmental settings similar to, though slightly different from, those occupied during the El Paso phase. These were alluvial fans, with El Paso phase sites tending to occur at slightly lower elevations. This suggested a climax of population and complexity at an earlier date than was previously thought, and led to construction of a model of development entailing oscillations in the relative intensity of local occupations (Carmichael 1985b). Simply put, Carmichael feels there were peaks in occupation size and intensity during both the Doña Ana and El Paso phases. In his study area, the larger peak is thought to have been during the earlier phase.

While this is an interesting model and certainly deserves consideration, many of its assumptions have been criticized. Anschuetz (1990:24) notes that the framework on which Carmichael builds his definition of the Doña Ana phase is based on excavations at La Cueva and Indian Wells Village (Lehmer 1948; Marshall 1973)—sites that are disturbed or incompletely described. The ceramic association used to define the phase may be more indicative of mixed Mesilla and El Paso phase occupations (Anschuetz 1990:24). While Carmichael originally considered this possibility, he later disregarded it. His logic in concluding that trash deposits represent the remains of eroded trash-filled borrow pits rather than surface middens is also criticized. Anschuetz and Seaman (1987:5) conclude there is no definitive or consistent way to define Doña Ana remains during survey. One of the main problems they point out is the lack of pottery types exclusive to this phase, leading to serious difficulties in discriminating remains from this period from those of earlier or later occupations. Thus, they feel that survey data should not be used to define Doña Ana occupations.

During a survey on Fort Bliss, Mauldin (1993) recognized and addressed these difficulties. Sites containing pottery types that Carmichael considered diagnostic of the Doña Ana phase were defined as multi-component (Mauldin 1993:24). However, one such site was subjected to a more rigorous examination to test Carmichael's assumptions. While this did not include excavation, it did entail detailed mapping and recording of surface feature and artifact type and distribution. Though several middens on the site contained pottery diagnostic of both the Mesilla and El Paso phases, Mauldin (1993:41) concluded that, "[t]he spatial patterning of components…suggests that the apparent Doña Ana assemblage actually may represent the overlap of the Mesilla and El Paso phase occupations." Mauldin's (1993) results suggest that Carmichael may indeed be in error, and that his sites represent a mixture of Mesilla and El Paso phase occupations in an area that was eminently suitable for use during both periods. So, where does this leave the Doña Ana phase? Should it be abandoned, or merely reconsidered yet again? Fortunately, a few sites from this phase have been excavated and provide some data (Bilbo 1972; Kegley 1982; Scarborough 1986). Thus, a basic outline of the Doña Ana phase can be sketched.

Dating the phase

Mauldin (1993:41) suggests that this phase should be dated between AD 1100 and 1150 and may have spanned an even shorter period. This is based on Kegley's (1982) work at Hueco Tanks and Scarborough's (1986) excavations at Meyers Pithouse Village, which suggest that the overlap between Mimbres Black-on-white and Chupadero Black-on-white that were originally used to define the phase lasted only 50 years or less. In fact, Mimbres Black-on-white is absent from Meyers Pithouse Village, which has been securely dated to the late Doña Ana phase by radiocarbon and archaeomagnetic samples (Mauldin 1993:41). If the traditional date of AD 1100 to 1200 were to continue in use, then what Lehmer and Carmichael both considered a characteristic ceramic assemblage may only occur at sites occupied early in the phase. Miller and Kenmotsu (2004:237–238) note that recent revisions to the Jornada sequence now place this phase between AD 1000 and 1250/1300. Several changes occurred around AD 1000 that point to the beginning of the transition from residence in pithouses to pueblos, along with an intensification of the agricultural base. This period of transition is now considered to represent the Doña Ana phase.

Changes in architecture mark both the beginning and end of this period. By AD 1000, the transition from round to rectangular pithouses was virtually complete, and the first isolated rooms appeared. These consist of square rooms in shallow pits with prepared floors, central collared hearths, and occasional storage pits and entry steps (Miller and Kenmotsu 2004:239). Roof support was supplied by two main posts along a central axis, supplemented by both interior and exterior post. These structures may be precursors to pueblo rooms, differing mainly in that they are isolated rather than joined together as is common in the later form, and tend to have smaller floor areas (Miller and Kenmotsu 2004:239). After AD 1250/1300 pit structures essentially disappear, and pueblos containing contiguous roomblocks were built. Changes in village location occur coincident with these shifts in structural types. Doña Ana and El Paso phase sites tend to cluster on alluvial fans, with sites of the latter phase occurring at somewhat lower elevations (Miller and Kenmotsu 2004:245).

Because the Doña Ana phase represents a period of transition, there are differences between the early and late parts of the phase (as discussed by Miller and Kenmotsu 2004:246-251). Around AD 1000, use of the central basins declined markedly, and there was an increased use of alluvial fans. This shift also corresponds to the changeover from round to rectangular pit structures. This pattern held until ca. AD 1150, when settlement on alluvial fans reached its apex, and settlement near playas became common. Construction of the more formal isolated rooms was greatly increased, and a major change in the structure of settlements also occurred. Rock-lined thermal features become increasingly common after 1000, and their use peaks after 1150. There is a significant increase in the construction of formal trash pits and storage facilities after 1150, and reliance on agriculture appears to have begun to intensify, as signified by a marked increase in mano size and grinding area (Hard et al. 1996).

Pottery

Traditionally, this phase was defined by the occurrence of El Paso Brown, El Paso Polychrome, Chupadero Black-on-white, St. Johns Polychrome, Three Rivers Red-on-terra cotta, and Mimbres Classic Black-on-white (Lehmer 1948:37). Marshall (1973:53) added El Paso Bichrome to the list. Carmichael (1986a:72) indicates that Playas Red Incised also occurs on Doña Ana phase sites and notes that the variety of El Paso Brown on his sites was late and had thickened rims. An unidentified black smudged ware was found in a probable Doña Ana phase pithouse near El Paso (Bilbo 1972:75).

Mauldin (1993:41) notes that the Hueco Tanks site (Kegley 1982) contained a ceramic assemblage similar to that defined by Lehmer. However, Mimbres Black-on-white comprised only a very small percentage of imported wares, while 90 percent was Chupadero Black-on-white. This type also comprises most of the nonlocal pottery from Meyers Pithouse Village (Mauldin 1993:41). Other intrusive pottery at that site included Three Rivers Red-on-terra cotta, Playas Red, and undifferentiated Chihuahuan wares (Mauldin 1993:41). Again, no Mimbres Black-on-white was found in this assemblage of over 13,000 sherds (Mauldin 1993:41).

Significant changes occur in brown ware assemblages after AD 1000, as discussed by Miller and Kenmotsu (2004:252–253). The manufacture of El Paso Bichrome and Polychrome vessels began around this time, and these types represent increasingly large portions of assemblages until around AD 1275, when the bichrome and early polychrome varieties were replaced by classic El Paso Polychrome. In the plain wares, the predominantly neckless jars of the Mesilla phase were augmented by short-necked jars. These types were replaced by necked jars with everted rims by 1250/1300, and a smaller variety of vessel forms overall were made.

House forms and feature types

This topic was partly addressed in the section on dating the phase, when temporal architectural trends were presented. Marshall (1973:53) indicates that Indian Wells Village contained a mixture of pithouses and surface structures. Round pithouses were common, but square pithouses also occurred. Surface structures had jacal or coursed adobe walls, and rooms often contained hearths. Surface rooms are common late in the period at this site, with small pit rooms being used for storage (Marshall 1973:53). Unfortunately, Indian Wells Village is incompletely described, and little detail is available. Even more unfortunate is that it was assigned to the Doña Ana phase because it contained a mixture of surface and pit rooms, even though the ceramic assemblage is similar to that of the El Paso phase (Marshall 1973:13). The presence of both round and rectangular pithouses is also suspicious, because this is a characteristic of the late Mesilla phase rather than the Doña Ana or El Paso phases. Thus, this site may represent a locale that was occupied from the Mesilla phase to the El Paso phase rather than a Doña Ana phase village.

At Meyers Pithouse Village, Scarborough (1986) found no surface structures, only four rectangular pithouses. One was substantially larger than the others and may have been a communal structure or work area (Scarborough 1986:283). Internal features include irregularly placed postholes and well-defined hearths in at least three structures. Extramural hearths were also found, and storage pits occurred both within and outside pithouses.

Six pithouses were excavated at the Hueco Tanks site, all similar in construction style (Kegley 1982). These pithouses were rectangular, 2.3–5.5 m long by 2.3–4.5 m wide and 0.24–0.95 m deep. Floors were plastered with adobe and had two postholes oriented on a north–south axis and a formal hearth, usually collared. An adobe step was sometimes adjacent to the south wall and may have been related to a wall or roof entrance in that area. Walls appear to have been plastered but were usually so deteriorated that this was not certain. Little evidence of roof construction remained, but in at least one case the roof was covered with a layer of adobe.

A probable pithouse from this phase was excavated at the Castner Annex Range Dam site (Bilbo 1972). It was shallow (10 cm deep) and rectangular, with both interior and exterior postholes (Bilbo 1972:75). Building materials had collapsed into the structure when it was partially burned and showed that walls were made of jacal and slanted inward, and that roof vigas were covered with a similar material (Bilbo 1972:75). A formal hearth may have existed, but the condition of the structure made this difficult to verify.

Ideology and ceremonialism

The late Mesilla ceremonial pattern at least partly continued into this phase. This is suggested by a probable communal structure at Meyers Pithouse Village (Scarborough 1986), which resembles similar structures from late Mesilla phase sites. However, at the beginning of this phase there was a significant change in rock art style that may reflect initial participation in a widespread ideological system with its roots in Mesoamerica. Jornada style rock art seems to appear around AD 1000, and Schaafsma (1992) suggests it began in the Mimbres area and spread to the Jornada. Common motifs include masks and faces, which occur as both carvings and paintings (Schaafsma 1992:67). Schaafsma (1972:122) notes that: "As the art represents a significant break with the past, so, too, must the associated ritual have represented a cleavage with the earlier tradition." This new ritual system appears to have been introduced at the beginning of the Transitional period, and was probably closely linked to the changes in Jornada society that began occurring around that time.

Ties to other regions

Significant changes in extraregional ties occurred during this phase, as suggested by pottery imports. Mimbres pottery disappears from assemblages by around AD 1150 (Mauldin 1993), and this closely corresponds to the date of the Mimbres systemic collapse (Stuart and Gauthier 1981). Subsequent pottery imports were dominated by types from the north (Chupadero Black-on-white, Three Rivers Red-on-terra cotta, and St. Johns Polychrome) or the south (Playas Red and various Chihuahuan wares). This indicates a geographical change in interaction from an east–west axis to a north–south axis, similar to the pattern defined for the Archaic and differing significantly from that of the Mesilla phase.

Turquoise was found at Meyers Pithouse Village (Scarborough 1986:283), though whether it was from sources in the Jornada region or elsewhere is uncertain. Turquoise and a *Glycymeris* sp. shell bracelet fragment were found at the Castner Annex Range Dam site and may have been from Doña Ana phase deposits (Bilbo 1972). A small fragment of cloth was recovered from the pithouse at this site (Bilbo 1972:75), which may be a piece of imported cotton cloth. *Olivella* sp. shell beads were recovered from the Hueco Tanks site (Kegley 1982).

Subsistence

Flotation analysis suggests that domesticates continued to comprise only a small part of the diet during the early Doña Ana phase, increasing in use after AD 1150 (Miller and Kenmotsu 2004:248). Wild plant foods were the focus of subsistence activities in the early part of the phase, and were also very important in the late part of the phase. However, the more common occurrences of two-hand manos in addition to increased mano size and grinding area after AD 1000 indicate that corn had assumed a more important role than ever before. This is supported by studies of plant ubiquity conducted by Hard and others (1996) and Miller (1990, 1997) on flotation samples from all phases of the Formative period. This study showed increasing agricultural dependence during the Doña Ana phase, with a pronounced increase after AD 1150 (Miller and Kenmotsu 2004:249). The use of various cacti and succulents may have also intensified during the late Doña Ana phase, peaking by the end of the phase.

Excavation at Meyers Pithouse Village recovered at least one bean, several kernels of corn, and a large amount of rabbit bone (Scarborough 1986). Heavy lagomorph use is evident in three Transitional assemblages for which detailed analysis results are available (Miller and Kenmotsu 2004:250). While bone from medium and large artiodactyls including deer, antelope, and bison, also occur, their numbers are small in comparison to that of rabbits.

El Paso Phase (AD 1250/1300–1450)

Lehmer noted few differences between the El Paso and Doña Ana phases. Rather, he felt that the "difference between the two phases is primarily one of time and of formalization of already existing patterns" (Lehmer 1948:82). Residence was generally in adobe pueblos, with roomblocks grouped around plazas or in east-west oriented rows. Pithouses were thought to have been phased out by this time. However, Miller and Kenmotsu (2004) suggest that the differences between these phases are much more apparent than was initially thought. In addition to shifts in the areas that were occupied around AD 1200, there was a much heavier reliance on farming, and a significantly decreased use of the central basins. Major changes also occurred in ceramic assemblages, house types, village layout, and other aspects of material culture.

Dating the phase

Lehmer (1948) found it difficult to find a break between the Doña Ana and El Paso phases. He considered the occurrence of Mimbres pottery in the former and its absence in the latter to be significant and from this suggested that the transition occurred between AD 1150 and 1250 (Lehmer 1948:87–88). The end of the phase was linked to dates for early Rio Grande glaze wares that were occasionally found in local assemblages and suggested that the El Paso phase ended sometime between AD 1375 and 1400.

Since they were first proposed, these dates have come under scrutiny and are questioned by many. Traditionally, the El Paso phase has been considered to extend from around AD 1200 to 1400, as proposed by Lehmer. As Mauldin (1993:41) notes, if the presence of both Mimbres Black-on-white and Chupadero Black-on-white defines the Doña Ana phase, evidence from the few well-dated sites suggest that phase ended around AD 1150. However, if the construction of adobe roomblocks is also used as a defining characteristic, the El Paso phase probably didn't begin until around AD 1200, as tradition suggests.

However, recent research has added a considerable amount of information concerning the end of this phase. Cordell and Earls (1984) reevaluated manufacture dates for Glaze A in the Piro district and concluded that it was produced or continued in use until at least AD 1500 in that area. This is a hundred years later than the traditional end date for this type (Habicht-Mauche 1993). If most of the Glaze A in the Jornada region was obtained from the Piro district, Cordell and Earls (1984:96–97) suggest that a later ending date for this phase must be considered.

Miller and Kenmotsu (2004:238) have reassessed data for the Formative sequence, and place the beginning of the El Paso phase at AD 1250/1300. This date is based on information that suggests the population became agricultural specialists by this time, rather than simply using cultigens to supplement a diet focused on the exploitation of a variety of wild plant foods. This is viewed as the culmination of a long-term trend beginning in the Mesilla phase, representing a continuum of increasing agricultural dependence and social integration and decreasing mobility (Miller and Kenmotsu 2004:238). The El Paso phase ended sometime after AD 1450, based on a lack of later radiocarbon dates from structures of this phase. Miller and Kenmotsu (2004:258) link the abandonment of the Jornada region by farmers to similar abandonments occurring throughout the southern Southwest in the fifteenth century. Several reasons for this abandonment are proposed including drought leading to the failure of an overspecialized farming economy, or fallout from the demise of the regional system centered on Páquime in northern Chihuahua. Considering the range of data that were examined and evaluated by Miller and Kenmotsu's (2004) study, their dates are used in this discussion.

Pottery

The beginning of the El Paso phase has often been assumed to coincide with the almost exclusive use of polychromes and the virtual abandonment of plain wares. However, Seaman and Mills (1988a:181) suggest that use of El Paso Brown continued into the early El Paso phase and was not replaced by decorated wares as rapidly as many believe. Thus, one cannot assume that an assemblage containing both El Paso Brown and El Paso Polychrome dates to the late Mesilla or Doña Ana phases, as has often been the case in the past.

El Paso Polychrome sherds, both from decorated and undecorated parts of vessels, usually comprise a very high percentage of El Paso phase ceramic assemblages. For example, this type makes up 94 percent of the assemblage from La Cabrana Pueblo, 95 percent from Pickup Pueblo, 90 to 95 percent from the Sgt. Doyle site, 95 percent from the Condron Field site, 94.4 percent from the Bradfield site, 83.3 percent from the Alamogordo sites, and 90 percent from Twelve Room House (Bradley 1983; Gerald 1988; Green 1969; Hammack 1961; Lehmer 1948; Moore 1947). Trace amounts of El Paso Brown were found at the McGregor and Sgt. Doyle sites (Brook 1966a; Green 1969). A few textured El Paso Brown sherds were also noted at the Alamogordo sites (Lehmer 1948).

As noted earlier, El Paso Bichrome and early versions of El Paso Polychrome disappeared by the beginning of this phase, and were replaced by a late or classic variety of El Paso Polychrome (Miller and Kenmotsu 2004:252–253). Trends in these wares include an increasing elaboration of designs, the addition of secondary design elements, and complex multiple band layouts (Miller and Kenmotsu 2004:253). The neckless and short-necked jars that dominated during the Doña Ana phase were replaced by necked jars with everted rims, and this may be related to a desire for greater containment security for processing corn (Hard et al. 1994; Seaman and Mills 1988a, 1988b; Miller and Kenmotsu 2004:253). There is a greater uniformity in vessel form and less variety in assemblages from this phase, which may be related to reduced mobility or a more uniform vessel function (Miller and Kenmotsu 2004:253).

Imported wares from several regions occur in small percentages at sites from this phase; Chupadero Black-on-white is often the most common import. Small amounts of Mimbres Black-on-white occur at a few sites and probably represent an earlier occupation or heirloom pieces (Brook 1966a; Hunter 1988; Lehmer 1948). Other types made in the Mogollon region are Lincoln Black-on-red and Three Rivers Red-on-terra cotta. Pottery from the White Mountain and Zuñi areas include St. Johns Polychrome and Heshotauthla Polychrome (Bradley 1983; Brook 1966a; Gerald 1988; Green 1969; Hammack 1961; Hunter 1988; Lehmer 1948). Rio Grande Glaze A wares occasionally occur and include Agua Fria Glaze-on-red and Arenal Glaze Polychrome (Green 1969; Lehmer 1948). Galisteo Black-on-white has also been reported from a few sites (Brook 1966a; Green 1969).

Wares imported from northern Mexico include Ramos Polychrome, Ramos Black, Playas Red Incised and Corrugated, Casas Grandes Incised, Carretas Polychrome, Villa Ahumada Polychrome, Madera Black-on-red, Babicora Polychrome, and unidentified brown wares (Bradley 1983; Brook 1967; Foster and Bradley 1984; Green 1969; Hammack 1961; Hunter 1988; Kirkpatrick et al. 1994; Lehmer 1948). Since Wiseman (1981) has identified local copies of Playas Incised produced in the Sierra Blanca region, this type cannot always be assumed to be imported. Salado types include Tucson Polychrome and Gila Polychrome (Bradley 1983; Green 1969; Hammack 1961; Kirkpatrick et al. 1994; Lehmer 1948).

Unidentified smudged wares are sometimes recovered and include a polished brown ware from Pickup Pueblo (Gerald 1988) and corrugated wares from La Cabrana Pueblo, the Sgt. Doyle site, the Condron Field site, the Alamogordo sites, and Twelve Room House (Foster and Bradley 1984; Green 1969; Hammack 1961; Lehmer 1948; Moore 1947). Unidentified black and brown incised wares are reported from the McGregor site (Brook 1966a), and a red punctate ware was found at the Tony Colon I site (Hunter 1988).

Thus, while imported wares usually comprise less than 10 percent of El Paso phase assemblages, they occur at many sites, especially those containing adobe structures. Various types were imported from regions to the north, west, southwest, and south and represent a number of groups including the Rio Grande Pueblos, Zuñi, western Mogollon, Salado, and Casas Grandes of northern Mexico.

House forms and feature types

Lehmer (1948:80) claimed that El Paso houses were always adobe-walled surface structures and defined two basic forms: linear roomblocks and rooms grouped around plazas. While his first assertion is not upheld by more recent data, the second is basically confirmed. An example of the first basic form is Hot Well Pueblo, which contains 150 to 200 rooms arranged in a number of discrete linear units (Brook 1966b). Plaza arrangements are rare and include Indian Tank in the San Andres Mountains, House 2 at Alamogordo Site 1, and Alamogordo Site 2 (Lehmer 1948; Miller and Kenmotsu 2004).

In addition to Hot Well Pueblo and House 2 at Alamogordo Site 1, Hubbard (1992) indicates that Escondida and Indian Tank Pueblos contain more than 100 rooms apiece, and Cottonwood Springs

Pueblo has over 200. Of these large villages, only Indian Tank is thought to contain more than one story (Hubbard 1992). Foster (1993:11) notes that pueblos containing 8 to 10 single-story rooms are more common than these large villages. Smaller villages were usually built as linear roomblocks, though a few L-shaped structures also occur. Roomblocks are usually 1 to 2 rooms wide, and multiple roomblocks often occur at the same site. Descriptions are available for several small linear sites and can probably be considered representative. La Cabrana Pueblo contains 9 rooms, 8 in a double-row roomblock with a single large room at the northeast end (Bradley 1983; Foster and Bradley 1984). Pickup Pueblo contains 6 linear rooms (Gerald 1988). A total of 17 rooms in several blocks of 1 to 4 rooms was defined at the Sgt. Doyle site (Green 1969). Most roomblocks were a single room wide, but one was 2 rooms wide, and another was L-shaped. The Condron Field site contained 7 rooms in blocks of 3 and 4, each a single room wide (Hammack 1961). Sixteen rooms arranged in a block 1 to 2 rooms wide were found at the Bradfield site (Lehmer 1948). House 1 at Alamogordo Site 1 contained 15 rooms in a linear block that was 1 to 2 rooms wide, with an isolated block of 2 rooms (Lehmer 1948). Twelve Room House was built along similar lines, containing 12 rooms in a block that was mostly 1 to 2 rooms wide, ranging up to 3 rooms wide in one area (Moore 1947). Finally, Anapra Pueblo contained 8 linear rooms (Scarborough 1985). Miller and Kenmotsu (2004:242) note that most El Paso phase room blocks are oriented along an east–west axis, unless they are in riverine settings or are situated along major drainages, in which case they tend to parallel stream orientation. Isolated rooms, similar to those used during the Doña Ana phase, continue to occur during the El Paso phase (Miller and Kenmotsu 2004:244).

Villages probably grew by accretion rather than being built as planned communities. Pueblo walls were usually coursed or puddled adobe; they were commonly set in foundation trenches and often extend below floor levels. Wall heights are impossible to determine, since erosion has usually reduced them to mere stubs. Floors are sometimes slightly sunken, and steps commonly occur, usually just within the presumed locations of doors. Floors are usually adobe, and interior wall and floor surfaces tend to be plastered. A few examples of multiple plaster layers on floors and walls have been noted, indicating that some structures were refurbished (Brook 1966a; Hammack 1961; Lehmer 1948). Little evidence of roof construction is normally either preserved or described in reports. However, data concerning roof construction techniques is available from La Cabrana Pueblo (Foster and Bradley 1984). There, roofs consisted of wooden vigas overlain by mesquite and tornillo limb latillas. This framework was covered with layers of grass and reeds, which were coated with a layer of adobe in at least some rooms. Besides the refurbishing of walls and floors, there is evidence of more extensive remodeling at some sites. Parts of rooms at the Bradfield site and Twelve Room House were partitioned into long narrow bins or rooms (Lehmer 1948; Moore 1947). Remodelings like these could have been done to create secure storage spaces for important objects or supplies, and may be an indication of seasonal residence rather than year-round use. This was almost certainly the case at Twelve Room House, where a cache of ritual objects was discovered in one of the bins/narrow rooms.

Nearly every El Paso phase village contains at least one room that is much larger than other rooms at the site (Hammack 1961; Marshall 1973). Caches of ritual materials are often found beneath the floors of these rooms, and they seem to have served a communal function. At Twelve Room House, Moore (1947:99) notes that the largest room did not show much evidence of use. The hearth was not fired to the extent of similar features in other rooms, and the floor was rough and unpolished. However, another room that was remodeled into four compartments was as large or larger than this chamber before it was subdivided. Thus, the original communal room may have been replaced by a new one and converted to storage chambers for ritual materials.

Postholes and hearths are the most common features in El Paso phase pueblos. Pits for roof support posts are often, but not always, found inside rooms. Support posts were set into walls in at least one case (Brook 1979:27). Interior hearths are normally plastered and often collared and are usually circular in shape, though rectangular examples occur. Storage pits were often built within rooms; their walls are sometimes plastered. Other pits with undefined purposes sometimes occur, as do caches. A possible above-ground storage cist was identified in one room at the Sgt. Doyle site (Green 1969).

Few types of extramural features are recorded for pueblos because most excavation has concentrated on rooms. Extramural hearths containing fire-cracked rock were noted at the Sgt. Doyle site (Green 1969). Middens have been recorded at several sites, as have trash-filled borrow pits. Extramural storage pits occur at a few villages, and small plazas or work areas have been defined at several sites. An exception to the lack of extramural excavation is Firecracker Pueblo, where dozens of extramural features were found including trash and storage pits, hearths, and several types with undefined functions (Miller and Kenmotsu 2004:244). Perhaps the most interesting features are those associated with water conservation and control. At least nine reservoirs are recorded for the area, and all are either associated with El Paso villages or contain materials indicative of use during that phase (Bentley 1993; Hubbard 1987; Leach et al. 1993). Hubbard (1992) has located a possible canal, which he dates ca. AD 900 to 1000 on the basis of nearby sites. However, this date may be too early, and if this feature is real it was probably built during the El Paso phase.

Some variation has been noted between villages along the Rio Grande and those built away from the river, including differences in size, construction techniques, and degree of refurbishing. Foster and Bradley (1984:199) note that riverine sites tend to lack internal floor features, while non-riverine villages often contain a variety of them. Riverine pueblos usually lack internal support posts and do not exhibit evidence of extensive refurbishing. This may reflect variation in the duration of occupation, with little major refurbishing required at riverine villages because of constant attention to maintenance needs (Foster and Bradley 1984:211). The largest villages tend to occur in non-riverine settings.

While adobe villages are considered the main residences of the El Paso population, short-term habitation or task-specific sites also occur. While most seem to be open camps containing ephemeral shelters at best, there are a few examples of more substantial structures. Batcho et al. (1985:54-55) excavated an El Paso phase pithouse at the Santa Teresa Airport. This structure was square, measured 2 by 2 m, and was at least 40 cm deep. At least five large extramural pits were probably used for storage. This site is thought to be a fieldhouse. Moore (1996) excavated a multi-occupational camp at the Santa Teresa Port-of-Entry with some features that may date to the early part of the El Paso phase, including a shallow pit structure, similar in size and form to huts built during the Archaic and Mesilla phase.

Carmichael (1985a, 1985c) excavated numerous pit structures dating to the Pueblo period (Doña Ana and El Paso phases) at Site 37 at Keystone Dam. Between 16 and 23 pit structures were located, generally small and circular with sloping walls, irregular floors, informal internal hearths, and postholes around their peripheries as well as on floor surfaces. Several structures overlap, suggesting that multiple occupational episodes were represented. These structures seem to have been unburned ephemeral brush shelters (Miller et al. 1985:182). Extramural features included large and small hearths containing fire-cracked rock. Carmichael (1986b) feels that these remains represent short-term hunting and gathering occupations. However, it is also possible that they were farming structures.

Other researchers also suggest the existence of farming structures or fieldhouses in this region. Hubbard (1992) feels that many ceramic scatters and smaller pueblos may be fieldhouses. During a survey in the southern San Andres Mountains, Browning (1991:31) identified numerous single-room structures represented by upright slab foundations that are thought to have been fieldhouses. These structures are often surrounded by activity areas containing extramural hearths and middens, and are probably contemporaneous with large El Paso phase villages in the area.

Ideology and ceremonialism

The ideological and ritual system that originated during the late Mesilla phase became more pronounced and elaborate during this phase. The rock art style depicting masks, human faces, and animal forms continued in use, and the two former elements figured predominantly in the art of the Rio Grande Valley and Tularosa Basin (Schaafsma 1972, 1992). Foster (1993:12) feels that the abundant and complex rock art is evidence for increased ceremonialism. This ritual system was probably much different from that of Archaic and early Mesilla times and seems to have been particularly concerned with farming and rainmaking.

Foster (1993) feels that Jornada society became more complex during the El Paso phase, with greater population concentrations and densities resulting in reorganization. The largest villages were built during this phase and were probably at least partly integrated by ritual societies whose activities were centered in the large communal rooms, which Thompson (1988:61) suggests were focal points for activities related to group needs. Further evidence for the increased importance and elaboration of ritual was found at Hot Well Pueblo. There, analysis of features in one room suggests that it functioned as an astronomical observatory (Brook 1979:38). Another room contained a polychrome wall mural of probable ritual significance (Brook 1975:19).

The discovery of ritual caches and objects of religious importance buried beneath the floors of El Paso phase sites is further evidence of the religious system. Ritual caches are documented for several sites and known anecdotally for others. Thompson (1988:61) notes that they are usually found beneath the floors of large communal rooms and often contain ornaments, pigments, and ceramic vessels. Brook (1975:19) indicates that there were jewelry caches under the floors of two rooms at Hot Well Pueblo. Hammack (1961) found a cache in the center of the largest room at the Condron Field site, which contained 99 shell beads in a pit covered with a removable adobe plug and filled with sand that was not native to the area. Lehmer (1948) documents a cache from one of the Alamogordo sites that contained five polished turquoise blanks, several olivella shells, and a quartz crystal buried in a small jar under a floor. More extensive caches are also reported. A subfloor cache at La Cabrana Pueblo contained limonite and kaolin pigments, a large projectile point, three turquoise pendants, and smoothing stones (Bradley 1983:48). Numerous fossils were recovered from the floor of an adjacent room in association with pieces of shaped and unshaped calcite, gypsum crystals, shell beads and pendant, turquoise, pyrite, carved stone shells, a copper ore pendant, a piece of pyrite embedded in a basalt nodule, many olivella shell beads, a fragment of a *Conus* sp. shell, and pieces of kaolin, hematite, malachite, limonite, and copper ore (Bradley 1983:72, 74). There was also a necklace containing an etched fluorite pendant and olivella shell beads, crinoids, turquoise, and sandstone concretions.

Perhaps the most extensive cache was found at Twelve Room House (Moore 1947). Room 2 at that site was partitioned into several bins, one of which contained 3 large jars, 2 "jug form" vessels, 3 El Paso Polychrome bowls with terraced rims, a polished black ware bowl, a small trough metate with yellow ocher stains, 2 round stone balls, a round stone object, 6 pieces of yellow ocher, 2 pieces of travertine, 62 olivella shell beads, 34 shell disk beads, 4 turquoise beads, 15 *Alectrion* sp. beads, 1 tubular shell bead, 1 small charred corn cob, a section of hollow reed containing a soft light green material, a basket fragment, and many burned gourds. The shell beads were stored in one or two of the broken jars. The material in the section of reed was similar to a lump of iron potassium found cached in a shallow pit in another room. Hammack (1961) recovered a similar El Paso Polychrome bowl with stepped rim at the Condron Field site.

Several unique or very rare objects of probable religious function have also been found. Lehmer (1948:53) reports seeing several stone and clay animal effigies in private collections from the Alamogordo area, which were reputedly found in El Paso phase sites. Four stone effigies were found at the Alamogordo sites; three resembled bears and one a mountain sheep (Lehmer 1948). In addition, an elaborate white stone cloud terrace set in a cylindrical base was buried beneath the floor of one room (Lehmer 1948:70). Traces of green, brown, black, and blue paint were all that remained of its decoration. Lehmer (1948) notes that it was similar to another specimen seen in a private collection in Las Cruces.

Thus, an elaboration of the ritual system is visible in the array of objects and materials left behind, usually hidden in caches. They include objects depicting animal forms and cloud terraces, as well as ceramic vessels, especially bowls with cloud terrace rims. Various pigments, numerous species of marine shell, turquoise, and perhaps projectile points also seem to have had ritual significance. These types of objects and caches have not been found in earlier sites and may have assumed a special significance during this phase.

Ties to other regions

There is much evidence for extra-regional contact during this phase, and pottery is one of the best indicators of its areal extent. Though imported types usually comprise only 5–10 percent of ceramic assemblages, they consistently indicate some level of interaction with distant regions. In particular, there was a great deal of interaction with other Mogollon peoples in central New Mexico and east-central Arizona. Pottery types from the Pueblo area indicate contact with the glaze ware producing region in the central Rio Grande, and the Chupadero Black-on-white producing area in central New Mexico. Considering the rarity of most Pueblo pottery, it is likely that there were no direct contacts with the far northern segments of that group. However, the common occurrence of Chupadero Black-on-white suggests a rather high degree of contact with intermediate groups. Some contact with the Salado peoples to the west and southwest are suggested by finds of Tucson Polychrome and Gila Polychrome, but these types are rarely common. Conversely, the array of Mexican pottery types suggests a considerable amount of contact with northern Chihuahua. Numerous polychromes and textured ceramics were imported from that region and are fairly common at sites of this phase, particularly the large adobe-walled villages.

Turquoise is often found at El Paso phase sites, though much of it may have been mined in the Jornada area. Bentley (1993) suggests that at least some of the turquoise from Hot Well Pueblo was mined in the Jarilla Mountains. Similarly, some of the turquoise at La Cabrana Pueblo was from the Jarillas, though other specimens were from undetermined sources. Turquoise fragments or ornaments are reported from other sites but are not sourced (Brook 1966a; Green 1969; Hammack 1961; Hunter 1988; Kirkpatrick et al. 1994; Lehmer 1948; Moore 1947). Thus, it is difficult to determine whether most of the turquoise from this area was imported or mined locally. Preliminary evidence suggests that both possibilities are likely. Finds of copper bells are reported for the region but are rare (Lehmer 1948).

Marine shell, primarily from the Gulf of California, occurs with regularity in El Paso assemblages and suggests the existence of an extensive exchange network. *Olivella* sp. shells were often processed into beads, but unworked specimens also occur. Fragments of *Glycymeris* sp. shell bracelets have been recovered from many sites, though they are never common, and were probably obtained from the Hohokam. *Conus* sp. shells were often used for tinklers and probably dangled from clothing or jewelry. Other types of shell include a mother-of-pearl pendant from La Cabrana Pueblo and a possible abalone shell fragment from the Tony Colon I site (Foster and Bradley 1984; Hunter 1988). Lehmer (1948) reports beads made from marine worm casings and pendants cut from bivalve shells at the Alamogordo sites. Unfortunately, he does not mention whether the bivalves were marine or freshwater. *Alectrion* sp. beads were found at Twelve Room House (Moore 1947). Finally, Southward (1979) reports freshwater mussel shells in an assemblage from Three Rivers, as well as specimens of *Vermitus* sp. and *Spondylus princeps*. The freshwater mussel was either obtained from the Rio Grande (100 km away) or the Rio Pecos (160 km away).

Goods from a large region were moving into the area during the El Paso phase. While there was a degree of contact with other areas during earlier phases, there appears to have been an intensification of exchange ties with distant areas during this period that is represented by a proliferation in the amounts and types of exotic goods at many sites. In particular, there seems to have been quite a bit of contact with northern Mexico and central New Mexico. While direct contact is possible for these areas, indirect contact is probably responsible for the occurrence of raw and processed marine shells, some turquoise, and pottery from the northern Pueblo region.

Subsistence

Though wild plant foods continued to be consumed in this phase, the variety and amounts of domesticates in addition to evidence for the construction of water and soil control systems suggest that cultigens had a vastly increased dietary importance. This is partly suggested by large finds of corn. For example, Scarborough (1985) recovered corn cached in storage pits at Anapra Pueblo, and Brook (1966b:4) notes that a village excavated in 1939 about 64 km north of Hot Well Pueblo yielded 200 bushels of charred corn. The array of cultigens includes corn, beans, and cucurbits. In addition to common beans, tepary and lima beans are reported from a few sites (Bradley 1983; Ford 1977). Cucurbit remains are rare and are often not identified to species. However, Ford (1977) identified warty squash at an El Paso phase site in the Hueco Bolson, and gourds are mentioned as possible cultigens (Bentley 1993).

Many wild plants were used for food, fuel, building materials, and other purposes. Mesquite and tornillo were probably very important supplements to the diet. Beans, pods, seed coats, and stems from these plants have been recovered from many sites (Bentley 1993; Brook 1966b; Bradley 1983; Ford 1977; Scarborough 1985; Southward 1979). Chenopodium and amaranth were also important food sources, and there was some use of grass seeds, though they are not commonly reported. Other wild plants that were consumed include large petal onion, mariola, acorn, at least two species of yucca, spurge, two species of acacia, purslane, buffalo gourd, a member of the pink family, bugseed, Mexican buckeye, and several species of cactus including prickly pear, Turk's cap, cholla, and pitaya (Bentley 1993; Brook 1966b; Bradley 1983; Ford 1977; Kirkpatrick et al. 1994; Southward 1979).

Woody plants were used for fuel and construction. Types of fuel woods reported for El Paso phase sites include mesquite, saltbush, and oak (Kirkpatrick et al. 1994; Southward 1979). Mesquite and tornillo limbs were used in construction, as were ponderosa pine, juniper, reeds, and grass stems (Bentley 1993; Bradley 1983; Foster et al. 1981; Southward 1979). Some plants may have been used for different purposes. Sand Mormon tea stems were found at Hot Well Pueblo (Bentley 1993) and may have been used as medicine. Hoary pea was found at La Cabrana Pueblo. This plant is used to stupefy fish by the Tarahumara and may have served a similar purpose at La Cabrana (Bradley 1983:109). Fish remains are only reported from this site, but they comprise a large percentage of the faunal assemblage and probably represent an important, but often unrecognized, food source. Over 5,000 fish bones and scales were found in trash deposits, including members of the catfish, gar, and sucker families.

Many animal species were eaten, though rabbits remained the dominant source of animal protein. This is true even of La Cabrana Pueblo, where large amounts of fish were consumed (Bradley 1983; Foster et al. 1981). It is possible that turkeys were kept in El Paso phase villages, but direct evidence for this is not good. Turkey bone was recovered at La Cabrana Pueblo, but an overlying historic component also contained turkey remains, suggesting that the turkey bone from prehistoric deposits could have originated in historic levels (Foster and Bradley 1984). Eggshells have been found at some sites and are probably turkey (Brook 1966b; Green 1969). Other mammals used for food include antelope, mule deer, kangaroo rat, white-throated woodrat, and possibly long-tailed weasel (Brook 1966b; Bradley 1983).

Protohistoric Period (AD 1450–1600)

Many assume that the Jornada region was mostly abandoned at the end of the El Paso phase. While few sites from this area are actually assigned a Protohistoric date, Spanish documents show that it was occupied in the sixteenth century, and a reevaluation of dates suggests a continual occupation from the El Paso phase into the Protohistoric period, though residence in adobe-walled villages did not continue past around AD 1450. Upham (1984, 1988) feels that a realignment of subsistence strategies occurred, rather than replacement of the indigenous population. He suggests that the Jornada people adapted to changing environmental conditions by switching to a more generalized settlement and subsistence system. Thus, the Protohistoric economic and settlement systems are thought to have been similar to those of the Archaic or Early Formative periods. This is echoed by Carmichael (1986a), who also suggests that the indigenous people reverted to a hunting-gathering adaptation at the end of the El Paso phase, similar to the subsistence system documented in the early Historic period by the Spanish.

While evidence for this transition is visible further south in the part of the Jornada region around modern El Paso, it is not yet documented for the middle Jornada del Muerto region. Thus, we currently do not know whether the residents of the latter also returned to a hunting and gathering lifestyle when they abandoned their villages, continuing to exploit the same region, or if they moved elsewhere, including to the south to join related groups in the El Paso area or north to join Pueblo groups in the Rio Grande Valley or Salinas district. If the former is correct, then by at least the late sixteenth century they had been pushed out of the region and replaced by Athabaskan hunter-gatherers. Whether or not the middle and southern portions of the Jornada del Muerto was also used by Piros during the Protohistoric period is also unknown, but possible. Some evidence of possible Piro occupations is suggested at the Mockingbird Gap site in the northern Jornada del Muerto (Weber and Agogino 1997).

Several different peoples occupied south-central New Mexico and adjacent parts of Trans-Pecos Texas and Chihuahua during the Protohistoric period, including the Manso, Suma, Jumano, Jocome, Patarabuye, and various Athabaskan groups. Of these, only the Athabaskans are of interest to this study because none of the others are thought to have lived as far north as the project area. The Manso are considered descendants of the Jornada Mogollon, and lived in the area between El Paso and Las Cruces (Baugh and Sechrist 2001; Beckett 1984; Beckett and Corbett 1992). The Patarabuye and Jumanos lived in the La Junta region to the east and south of the Manso. The Mansos were not the only descendants of the Jornada Mogollon in this region. Beckett (1994:163) has suggested that the Jano and Jocome spoke similar dialects of the Sonoran branch of the Uto-Aztecan language family, while the Suma and Jumanos were latecomers to the region and probably spoke languages that were related to one another but not to those of the other groups. Athabaskans considered ancestral to the modern Mescalero Apaches occupied a region between the Mansos on the south and the Piros on the west and northwest (Baugh and Sechrist 2001:36). This area encompasses the Jornada del Muerto, where Athabaskans were first encountered by the Spanish during Oñate's colonizing expedition in 1598, and were initially named the Apache del Perrillo (Baugh and Sechrist 2001:35). This same group may have later been known as the Sierra Blanca and Faraon Apaches, and eventually became the Mescalero Apache (Baugh and Sechrist 2001:35-36). The modern Mescalero tribe contains three different groups: the Mescalero, Chiricahua, and Lipan peoples (www.mescaleroapache.com/area/history_and_cul.htm [accessed 8/23/10]). The project area is within the region encompassed by the sacred mountains of the Mescalero including Sierra Blanca, the Guadalupes, Three Sisters Mountain, and Oscura Peak.

Seymour (2002:393) places the Apache arrival in the area now occupied by the Fort Bliss military reservation between AD 1450 and 1645. A firmer arrival date cannot yet be defined, and this range, which spans the years between the presumed end of the El Paso phase and the earliest Spanish entry into the region, is the best compromise. Apaches became more prominent in the Tularosa and Hueco basins in the 1650s (Baugh and Sechrist 2001:36), and this may indicate an expansion of their traditional range. Raids against the Spanish and Pueblo Indians intensified after the Pueblo Revolt, as the Spanish hold on the region was weakened. Finally, under pressure from Spanish and Comanches, who were encroaching on the plains by the early-to-middle 1700s, the Mescaleros were pushed toward the El Paso area (Baugh and Sechrist 2001:36).

Using primarily survey information and a reexamination of suspected sites on Fort Bliss, Baugh and Sechrist (2001:290) concluded that very little evidence for an Apache occupation of that area was indicated, and considered their conclusions upheld by Miller's (1996, 2001) survey of radiocarbon dates from the area, which found few dates suggesting occupation during the Protohistoric period. They considered the normal indicators of probable Apache occupation applied in the region—the presence of rock rings, enclosures, and alignments—to be weak evidence, noting that "the association of grouped rock features with Apache activity is an overworked assumption that has a long, deeply ingrained history among archaeologists" (Baugh and Sechrist 2001:273). However, they do note that Protohistoric sites are often components on sites that mainly belong to different cultures and different time periods, and are often discounted as evidence of occupation during that period (Baugh and Sechrist 2002:272).

Seymour (2002), using more detailed information from excavation and material culture analysis, identified a range of probable Protohistoric-period sites in the same region, often displaying distinctive characteristics thought to be diagnostic of different ethnic groups. As Seymour (2002:395) notes: "It was Baugh and Sechrist's (2001:278) conclusion that the Protohistoric period 'appears to be underrepresented on the Fort Bliss reservation.' It is my position that the Protohistoric period is under-recorded in the region owing to the fact that it has not been recognized. This same factor likely accounts for the low frequency of Paleoindian and Early and Middle Archaic sites on the base."

Archaeologically, Seymour (2002; Church 2007) identified two complexes at Fort Bliss and elsewhere in south-central New Mexico and the western Trans-Pecos of Texas that are thought to represent the remains of various Protohistoric and early historic groups known to have occupied the region. The Canutillo complex is considered a Plains adaptation related to bison hunting, and is related to several similar complexes in Texas (Seymour and Church 2007:99). This complex probably represents sites occupied by groups such as the Jano, Jocome, Suma, and/or Manso, and its chipped stone assemblage is biface-oriented with a distinct range of projectile points and other tools. The Cerro Rojo complex is representative of the early Apache occupants of the region, and has an expedient chipped stone reduction strategy with retouched tools and distinct side-notched and tri-notched projectile points. Since the Canutillo complex is unlikely to extend north into the study area, we focus on the Cerro Rojo complex.

Characteristics of the Cerro Rojo complex include the presence of rock-ringed huts, tipi rings, structural clearings, lean-tos, and sleeping platforms in rock shelters. Throughout the region, a number of pottery types are considered diagnostic of Protohistoric- and early Historic-period occupations. They include seven types of Apache wares and several Pueblo wares. The currently defined Apache wares are Soledad Plain, Otero Plain, Llano Plain, Sierra Plain, Cerro Plain, Cornudas Plain, and Rustler Plain (Seymour 2002). Except for Soledad Plain and Cornudas Plain these types are brown wares, and the latter is thought to be intrusive from further to the northwest. Pueblo wares include Valle Bajo Red-on-brown from the El Paso region, Piro utility wares and Pueblo glaze wares from the Middle Rio Grande, Tewa Polychrome and Ogapoge Polychrome from the northern Rio Grande, and Tabira gray ware from the Salinas District. Most of the Pueblo types are historic rather than Protohistoric, though some types were also made during the Protohistoric period. Apache summer camps and those occupied by large groups of people were mostly located in high-altitude settings in the mountains, while winter camps were in low altitude settings along rivers and in the foothills (Seymour and Church 2007:100). The latter are thought to account for some of the sites in the Santa Teresa area along the Rio Grande and around playas (Seymour and Church 2002:100).

Historic Period (1539–World War II)

The Historic period in New Mexico began with the entrance of the first Spanish expedition into the region in 1540. Several methods have been used to divide the European occupation into shorter periods. One of the most common is to divide this period into politically based sub-periods including Spanish Exploration and Colonization (1540–1692), Spanish Colonial (1692–1821), Mexican (1821–1848), and American (1848–World War II). This is the approach taken in this chapter.

Spanish Exploration and Colonization Period (1539–1692)

Based on information gathered by Cabeza de Vaca and his companions following the Narváez expedition to Florida (Covey 1990), the Spanish Empire became interested in lands north of Mexico in the 1530s. Fray Marcos de Niza was dispatched on a scouting mission into the Southwest in 1539, and a major expedition under Francisco Vázquez de Coronado explored the region between 1540 and 1542. No other contact between New Spain and New Mexico occurred until 1581, when Father Agustín Rodríguez and Captain Francisco Sánchez Chamuscado led an expedition up the Rio Grande (Hammond and Rey 1966). Ostensibly to rescue two priests left by the Rodríguez-Chamuscado expedition, Antonio de Espejo led a party into New Mexico in 1582. Gaspar Castaño de Sosa attempted to illegally found a colony in 1590-1591, but was arrested and returned to Mexico (Simmons 1979). A second attempt at colonization was made by Francisco de Leyva Bonilla and Antonio Gutiérrez de Humaña in 1593, but their party was devastated by conflict with Indians (Hammond and Rey 1966).

Juan de Oñate established the first successful colony in New Mexico at San Juan Pueblo (Ohkay Owingeh) in 1598. The route Oñate's party traveled to reach New Mexico became El Camino Real de Tierra Adentro, and remained the main line of contact between New Mexico and the rest of the world until the Santa Fe Trail was opened in 1821. Oñate was replaced as governor in 1607 by Pedro de Peralta, who moved the capital to the new town of Santa Fe around 1610 (Simmons 1979). The first Spanish settlement in southern New Mexico was at El Paso del Norte, now the city of Juárez in Mexico, where the mission of Nuestra Señora del Guadalupe de los Mansos del Paso del Norte was established in 1659 to serve the Manso and Suma Indians (Baugh and Sechrist 2001:38). The settlement that grew up around the mission was El Paso del Norte, which became a *villa* in 1680 (Baugh and Sechrist 2001:38).

During this period, the colony was poorly and sporadically supplied with goods carried up the Camino Real. The missions were supplied by an inefficient caravan system (Ivey 1993; Moorhead

1958; Scholes 1930), while the secular population was mainly supplied by a few independent traders (Hendricks and Mandell 2002). Trade with the Plains Apaches was an important source of income. Slaves were a particularly important commodity, and were often bought from the Apaches for resale to the mines of northern Mexico. The Spanish often supplemented this source of slaves by raiding Apache villages during the seventeenth century. This antagonized both the Apaches and their Pueblo trading partners, and caused the former to unleash a series of raids against the Spanish and some Pueblos in the 1660s and 1670s (Forbes 1960). This, in turn, exacerbated Pueblo resentment of the Spanish, contributing to several rebellions that finally culminated in the general revolt of 1680.

A combination of religious intolerance, forced labor, the extortion of tribute, and Apache raids led the Pueblo Indians to revolt in 1680, driving the Spanish from New Mexico (Forbes 1960; Hackett and Shelby 1942; Simmons 1979). The surviving colonists retreated to El Paso del Norte, accompanied by the Pueblo Indians who remained loyal to them. Because El Paso del Norte could not accommodate all the refugees, new villages were founded to house them. Difficult living conditions caused by war, drought, and disease caused a population decline that led to the abandonment of several of these villages, until by 1700 only five settlements remained in the area (Baugh and Sechrist 2001:39).

Attempts at reconquest were made by Otermín in 1681 and Cruzate in 1689, but both failed (Ellis 1971). Diego de Vargas eventually negotiated the Spanish return in 1692, exploiting the factionalism that had developed among the Pueblos (Ellis 1971:64; Simmons 1979:186). Vargas returned to Santa Fe in 1693, staging his expedition out of El Paso del Norte, but had to fight several pitched battles. After displacing the Tanos from Santa Fe and pacifying the other Pueblos, Vargas reestablished the New Mexican colony.

Spanish Colonial Period (1692–1821)

Hostilities with the Pueblos continued until around 1700, but by the early years of the eighteenth century the Spanish were again in control of New Mexico. Though failing in its attempt to throw off the Spanish yoke, the Pueblo Revolt caused many significant changes. The system of tribute and forced labor was never reestablished, and the missions were scaled back (Simmons 1979). With the reconquest of New Mexico, much of the earlier economic system was abandoned. The dominance of the church and mission supply caravans eventually ended. The new economic power was the families who prospered by dealing in sheep. By the middle of the eighteenth century a considerable trade developed over the Camino Real between New Mexico and Chihuahua (Athearn 1974), mostly to the benefit of the Chihuahuan merchants. Most trade goods were transported on mule back in annual caravans, carrying raw materials and items produced by cottage industries south and manufactured and luxury goods north.

New Mexico suffered from hostile Indian activity virtually from its founding (Forbes 1960), though certain periods were worse than others. Attacks by Utes and Comanches began as early as 1716, as the Comanches sought to drive the Apaches from the Plains and cut their economic ties to the French colony in Louisiana (Noyes 1993). Having been pushed off the Plains by 1740, various Apache groups were attempting to establish new territories and support themselves in any way possible. Governor Anza concluded a peace treaty with the Comanches in 1786, which included an alliance against the Apaches (Noyes 1993:80; Thomas 1932:75). Later the same year, Anza broke up an alliance between the Gila Apaches and Navajos, and concluded a peace with the Navajos (Thomas 1932:52). This brought New Mexico into a period of relative peace and improved economic conditions (Frank 1992:95). Caravans still followed an irregular schedule, but by the middle of the eighteenth century they operated almost annually (Connor and Skaggs 1977:21). Unfortunately, nationalistic unrest in Mexico cut this period of economic prosperity short, and interfered with the movement of goods throughout Mexico. The war for independence from Spain began in 1810, and continued until 1821.

Mexican Period (1821–1848)

Under the Treaty of Cordova, Mexico gained its independence in 1821, and New Mexico became part of the Mexican nation. Trade between Missouri and New Mexico began that same year, and dominated the New Mexican economy for the next quarter century (Connor and Skaggs 1977). Trade with the

United States brought ample inexpensive goods to New Mexico and broke the Chihuahuan monopoly. Trade over the Santa Fe Trail soon expanded to Chihuahua, with most of the goods carried by the Santa Fe traders being transported south over the Camino Real until the Mexican War of 1846–1847. The importance of the Camino Real as a transportation corridor increased during this period with this link to the United States via the Santa Fe Trail providing a new source of manufactured goods and other imports. The Mexican War resulted in the annexation of New Mexico by the United States. The years immediately following the war were characterized by a growing interest in commerce and a market economy that demanded more dependable means of transportation (Pratt and Snow 1988).

American Period (1848–World War II)

After a disruption of trade by the Civil War, a resurgence of trade over the Santa Fe Trail and the Camino Real that occurred after the war ended actually helped doom them. Railroad promoters saw the possibilities of overland routes to the west and began developing their finances (Connor and Skaggs 1977:204). The railroad reached Santa Fe by 1880 (Glover and McCall 1988), effectively bringing commercial use of the Santa Fe Trail to an end. By 1881, the railroad was extended south to El Paso, and by 1882 El Paso was connected by rail to Juarez (Myrick 1990). These developments ended use of the Camino Real as a major commercial route. Thus, both trails were superseded by more efficient transportation systems in the late nineteenth century, bringing to a close their dominance as transportation corridors.

The arrival of the railroad significantly altered supply patterns in New Mexico. With this link to the eastern United States, New Mexico entered a period of economic growth and development, especially in the larger urban areas (Pratt and Snow 1988:441). This link began the process of ending New Mexico's position as a frontier territory by better tying it to a national economy. In addition to increasing ease and volume of supply to the region, New Mexico became more accessible to tourists, who soon became an important part of the local economy. With the availability of rapid and inexpensive transport, several industries boomed in New Mexico. Sheep and wool production expanded, and the cattle business began its climb toward becoming the dominant ranching industry. Mining expanded into the early 1900s, with coal becoming an important export. The transformation of the New Mexican economy into its modern form was well under way by the time it became the 47th state in 1912.

A Brief Survey of Archaeological Sites in the Study Area

According to a search of the records conducted by Quaranta and Gibbs (2008), seven archaeological studies were previously conducted in or near the study area, four of which located sites now within the Spaceport America study area (Duran 1986; Marshall 1991; Human Systems Research 1997, unpublished survey data), and three that did not intersect with the study area (Hester 1977; Hilley 1983; Duran 1985). Additional surveys were conducted by Zia Engineering & Environmental Consultants for Spaceport America (Gibbs 2008; Lawrence et al. 2010; Quaranta and Gibbs 2008). Table 3.1 provides basic information on these studies as obtained from NMCRIS, and contains a total of 317 sites (see Post and Dello-Russo 2010:Appendix 1 for details), ranging from the Paleoindian period through the recent Historical period. The number of sites in Post and Dello-Russo (2010:Appendix 1) differs from the totals shown in Table 3.1 because of various revisits to sites that were sometimes examined by other projects on that list, as well as some that were not. Without going into great detail, we can summarize this array of sites and showcase one survey—a sample of the northern Jornada del Muerto reported by Hester (1977)—to provide a partial picture of what types of sites have been recorded in and around the project area. It should be noted that not all of the sites recorded by Marshall's (1991) survey of the Camino Real are actually located in the vicinity of Spaceport America, but those that are in different areas are not culled from Post and Dello-Russo (2010:Appendix 1). For example, LA 7—La Bajada Pueblo—is included in the list, but is located just south of La Bajada Mesa in the northern Rio Grande Valley. Of the 37 new sites recorded by Marshall's survey, only four are definitely within the study area, and they were re-inventoried during a survey conducted by Human Systems Research (1997). Thus, this list is subject to revision.

Table 3.1. Previous cultural resource activities within the general vicinity of the current project area.

NMCRIS No.	Year	Performing Agency	Acres	Activity	New	No. of Sites Revisited	**Total**
636	1983	New Mexico State University (NMSU) Cultural Resource Management Division	469	Linear Survey	13	0	13
7023	1985	Human Systems Research	57	Block and Linear Survey	4	1	5
26132	1977	University of Texas-San Antonio Department of Anthropology	960	Block Survey	96	0	96
39797	1991	Cibola Research Consultants	1,601	Linear Survey	37	3	40
46610	1986	Human Systems Research	0	Monitoring	0	9	9
49589	1997	Human Systems Research	4,096	Block and Linear Survey	113	13	126
98713	2006	Human Systems Research	41	Unspecified Survey	0	3	3
104538	2007	Zia Engineering & Environmental Cons.	2,710	Block and Linear Survey	18	25	43
106719	2007	Zia Engineering & Environmental Cons.	455	Block and Linear Survey	20	2	22
118255	2010	Zia Engineering & Environmental Cons.	88	Block Survey and Monitoring	0	0	0
Total			10,477		301	56	357

Only one prehistoric to Historic-period Pueblo site—the aforementioned LA 7—is included in Post and Dello-Russo (2010:Appendix 1) and can be ignored because it far north of the project area. Most of the sites (n = 263; 87.37 percent) are single component, while the remaining 54 sites contain 116 different components. Paleoindian use is represented by four single-component sites and 12 components on other sites, for a total of 16 components. These include three Folsom locales, four Plano locales, and nine locales that were assigned general Paleoindian dates. While the number of Paleoindian components seems low, this is actually a fairly large number for such a comparatively small region. Unfortunately, from survey data alone it is impossible to determine how many actually represent Paleoindian occupations and how many are simply Paleoindian tools that were salvaged and redeposited on later sites.

Archaic occupations are represented by 29 single-component locales and 32 components on other sites, for a total of 61 components. Sites from this long period are much more common than were those of the Paleoindian period, and Archaic components are third most common overall for the project area. Only two components were dated to the Early Archaic period, with 10 assigned to the Middle Archaic and 15 to the Late Archaic. The remaining 34 components are generally dated to the period.

Formative-period occupations are represented by 76 single-component locales and 24 components on other sites, for a total of 100 components. Formative-period components are the most common of those that can be assigned dates, and this is the second most common category overall. Twenty-one components are assigned to the Mesilla phase, three to the Doña Ana phase, 13 to the El Paso phase, and the remaining 65 were assigned a general Jornada Mogollon affinity.

Definite Protohistoric components were rare, and are represented by only one single-component locale and two components on other sites. All three components are considered representative of Apache occupations. Combining Hispanic and Anglo locales, a total of 69 historic components are represented in the area, consisting of 42 single-component locales and 27 components on other sites. Most of the remaining sites and components could not be assigned to any specific occupational period, and this is overall the most common category. Unknown sites include 109 single-component sites and 15 components on other sites. The four remaining components are late Pueblo manifestations (two single-component sites and two components on other sites), and are probably outside the area of interest.

The study that will be discussed in somewhat greater detail was a sample survey of land administered by the Bureau of Land Management in the northern Jornada del Muerto (Hester 1977). A total of 96 sites was recorded by this study, and included (using their terminology) a felsite quarry, a petroglyph site, one historic cemetery, two bead caches, two ceramic scatters, five hearths lacking associated artifacts, five ceramic-period villages, eight lithic scatters, 33 lithic campsites, and 38 ceramic period campsites.

Of these sites, the five ceramic-period villages probably deserve the greatest amount of attention. Three of these villages were damaged by illicit excavation at the time of the survey. One is a large pithouse village located on an alluvial fan a few miles west of the San Andres Mountains (Hester 1977:35). This site has suffered considerably from illegal excavations, and reportedly contained intact roof beams and human remains. Dating to the late Mesilla and Doña Ana phases, this site probably contains multiple pit structures. A second village was located in the Rio Grande Valley, and had also suffered form illicit excavation. Pithouses are present at this site, which may represent a Mimbres rather than Jornada Mogollon occupation. The third site is a very large Mimbres village located along an arroyo draining the San Andres Mountains.

Two possible village sites did not appear to have suffered from illicit excavation at the time of the survey. The first of these is located in the middle of the Jornada del Muerto basin. While no evidence of structures was noted at this site, the density of the artifact scatter and the number of features exposed by deflation suggested that houses might be present. This site was thought to date to the Doña Ana phase or later. The second site may represent a Mesilla-phase occupation, and is located on an alluvial fan of the Caballo Mountains. Again, this site was considered to be a village because of the density of associated artifacts, and the presence of structures is suspected.

The 33 lithic campsites were categorized as such by the presence of chipped stone artifacts and features, and the absence of ceramics. These sites were assigned dates ranging from the Paleoindian through Archaic periods, and may also contain some Apache components. In contrast, no features were seen at the eight sites categorized as simple lithic scatters. The 38 ceramic campsites were similar to the lithic campsites with the addition of pottery to their assemblages. While some of the larger sites in this category could represent villages, they contained no visible evidence of structures or artifact densities similar to those seen at the five village sites. The two sites categorized as ceramic scatters contained no visible features or chipped stone artifacts. The remaining categories are represented by only a few examples apiece, and except for the historic cemetery, could not be accurately dated.

The results of Hester's (1977) survey provide a microcosm of the types of sites that occur in the region. Most of these sites appear to be campsites, perhaps repeatedly used, dating to the Archaic and Jornada Mogollon periods. However, the presence of several villages in the region, mostly located on alluvial fans near the mountains, suggests a settlement pattern similar to the models proposed by Hard (1983b) and Whalen (1994), with cold-season villages located near permanent water sources and arable land and warm season camps situated in basin interiors. Interestingly, both Jornada and Mimbres villages occur in the region, suggesting a frontier situation. The two possible villages situated in the basin interior may actually represent prime locations for repeated uses through time rather than villages, though this possibility cannot be ruled out without further study.

The sites proposed for further investigation during the present study easily fit the pattern, both temporally and in terms of site classification, that was seen during Hester's (1977) survey. The only types that do not occur among the 14 sites that will be studied in more detail are the ceramic villages and several of the rarer categories. Both the lithic and ceramic campsite categories are represented, though the former is much more common in the current project area.

4 | A Plan for Data Recovery and Research-Oriented Investigations at Spaceport America

James L. Moore and Robert Dello-Russo

The Federal Aviation Administration and New Mexico Spaceport Authority (FAA and NMSA 2010a) developed four general research themes during Section 106 consultations for the Spaceport undertaking that will be used to guide further archaeological investigations at Spaceport America. These themes were used as a basis for the development of research questions that guided the planning and execution of this research (Moore et al. 2010a), though additional questions were posed and examined, as discussed below. While we discuss all four themes in this chapter, as predicted in the data recovery plan for this project (Moore et al. 2010a), only three were applicable to the array of sites that the OAS examined, as described in Chapter 26 of this report. These research themes represent broad questions that were addressed by the results of testing and research-based investigations. Following the discussion of each research theme in this chapter is a set of more specific research questions that were addressed with information derived from these studies. The research themes were not considered to be exhaustive and were considered as guides to research that were elaborated upon to generate the more specific questions. Data from sites examined during each investigative phase were applicable to one or more research questions, depending on the level of temporal control and the types and amount of information available. All available data were considered, thus information from sites determined as "not eligible" for the state or national registers, as well as from "eligible" sites that contained no potentially significant remains within construction/buffer corridors during testing and were not further examined during the research phase were also used to address the research questions.

Theoretical Research Orientation

Following statements in the *Mitigation Plan for Archaeology at the Spaceport America* (FAA and NMSA 2010b) and the *Cultural Resources Protection, Preservation, and Mitigation Plan* (CRPPMP; FAA and NMSA 2010a), the specific research themes and questions outlined in this chapter were informed by a theoretical research orientation favored by the OAS. This research orientation can best be described as an Ecological Landscape approach to the investigation of settlement and subsistence behaviors by human groups. More specifically, we are interested in understanding how human groups utilized different strategies and tactics—such as changes in mobility, changes in technology, or the intensification of subsistence pursuits—to address changes in the various ecological parameters of the landscape in which they existed. In the current project area, this approach was applied, through archaeological research, to remains produced by foragers (hunter-gatherers) and forager-farmers in the Prehistoric time periods of the Jornada del Muerto region, but was extended to include groups with similar, and market-related, adaptations during the Historic period, when warranted.

Foragers and Forager-Farmers: Changes in Subsistence and Settlement Behaviors

Of enduring interest to anthropologists throughout the world are the nature of foraging, or hunting-gathering, economies and the apparent relationships that exist between such foraging-based economies and their natural environments. In particular, it is often suggested that the spatial, temporal, and biological variability of resource productivity can influence subsistence-related behaviors and can drive changes in mobility tactics (Kelly 1983), labor organization (Binford 1991, 2001), technology (Kelly 1988; Nelson 1991; Parry and Kelly 1987, Railey 2010, Reed 2008), procurement and processing techniques (Hard 1986; Nelson and Lippmeier 1993), storage practices, and planning depth (Binford 1990, 2001). Put more simply, these adaptations are "about improving accessibility (to subsistence resources) . . . or making returns more predictable" (Bender 1978:205).

Changes in the accessibility to, or availability of, subsistence resources are often viewed from an ecological perspective, wherein shifts in climatic regimes drive changes in resource productivity which, in turn, affect the nature of human subsistence behavior. Certainly, the observations made in ethnographic and ecological studies have demonstrated the variability of human behaviors in dynamic environmental contexts, but descriptions of variation are insufficient to the goal of explanation in anthropology. In addition, the direct application of historical ethnographic patterns to archaeological data is problematic in that it "merely substitute(s) a description from one point in history for one from another point in history" (Simms 1987:12). As a consequence of the inadequacies of the direct historical approach, it has now become apparent that the study of hunter-gatherer prehistory must "go beyond broad typological categories, such as generalized versus specialized, simple versus complex, storing versus non-storing, or immediate versus delayed return" (Kelly 1995:343) and utilize a framework of interpretation and understanding that addresses why and how changing ecological conditions affect human behavior. If paleoenvironmental information is a powerful predictor of human subsistence decisions (cf. Dean et al. 1994:85) then a local, ecologically driven approach should avoid the assertion of normative descriptions as explanations for change (Plog et al. 1988; Winterhalder and Goland 1997).

Regional Background

Archaeologists working in the southwestern United States have also believed that environmental factors underlie changes in the prehistoric subsistence behaviors of forager groups (Berry and Berry 1986; Hunter-Anderson 1986; Irwin-Williams and Haynes 1970; Jennings 1978; Vierra 1994), although the actual mechanisms by which such environmental factors encouraged changes in behavior have often been left unspecified (but see Dello-Russo 2008). Because many of the "interpretations of the prehistoric events in the Southwest rely on climatic and other environmental changes" (Cordell 1984:21), it is important that researchers provide explicit reconstructions of past environments, sufficient explanations of the means by which environmental changes are discerned, and systematic links between these changes and human behavioral responses.

In New Mexico and the surrounding region, archaeologists have often explicitly or implicitly acknowledged a relationship between climatic variables and the settlement and subsistence behaviors of pre-ceramic (Archaic) foragers (cf. Cully and Toll 1983:48). Irwin-Williams, in the Arroyo Cuervo region, proposed that the development of sedentary, agricultural groups in north-central New Mexico from a foraging-based economy was "the result of cultural adjustment to a number of complex and interacting elements, including principally, climatic change, population increase and the introduction and development of new subsistence and processing technologies" (1973:18). Reinhart's study of Archaic cultures on the Ceja Mesa in the Middle Rio Grande valley posited that the subsistence patterns of . . . late archaic cultures appear(ed) to show a direct relationship to prevailing environmental conditions" (1968:214). Cordell (1978:23–33), in a review of Archaic cultural manifestations in the Middle Rio Grande valley, suggested that two productive avenues of research should include the definition of the subsistence base both prior to and after the adoption of cultigens, and the monitoring of climatic conditions under which these cultural adaptations occurred. Both Reher and Witter (1977) and Chapman (1980) implied that foragers were responding to the natural constraints of climate and plant productivity when they argued that Archaic foragers in New Mexico had positioned themselves on the landscape in areas where they had access to subsistence resources (although they differed over which suite of resources was involved). Building on this foundation, Hogan (1986:57) proposed that Archaic groups had followed a serial foraging strategy wherein their settlement strategies were constrained by the availability of a "relatively small number of seasonally abundant resources," such as rice grass, dropseed, or goosefoot seeds. As previously, the implicit argument here was that the seasonal abundance of such annual plant seeds would have depended on the effects of climatic variables, such as precipitation.

Thus, while researchers in the Southwest have continually sought to place changes in forager subsistence behaviors into environmentally driven contexts, the potential for successful research from this perspective has historically suffered from two deficiencies. First, the systemic ecological connections among the variations in climate, plant productivity, and human economic decision-making have been left largely unspecified (but see Dello-Russo 2008); and second, the absence of precise temporal resolution between archaeological and climatic data has precluded all but the most general of assessments (cf. Hogan 1986:114–115; Cordell 1978:29).

Behavioral Ecology

Behavioral ecology represents a subset of evolutionary ecology which, as defined by Winterhalder and Smith (1992:5), is "the application of natural selection theory to the study of adaptation and biological design in an ecological setting." Appropriately, behavioral ecology directs our attention "to the role and characterization of the environment" (Winterhalder and Smith 1992:8) and to the behavioral responses made by individuals in that environment. Consequently, this theoretical perspective must also incorporate an historical perspective, particularly as it pertains to the natural and social contexts in which the individual's behaviors are undertaken. Such a perspective allows not only for the assessment of changes in the distribution and abundance of subsistence resources but also for an understanding of the set of strategic behaviors available to the forager when confronted with such environmental changes.

Optimal Foraging Models

Human subsistence behaviors, which are undertaken in response to variations in natural parameters, can be evaluated through economic measurements of these behaviors. Models of optimal foraging are economic in scope and are utilized to specify theoretical behavioral optimums for certain identified currencies. The prediction of behavioral optimums does not imply that foragers are expected to reach such optimums or to forage at optimum levels. Rather, these optimums are used in a referential capacity to evaluate the constraints and trade-offs involved in reaching a behavioral decision. Neither are optimality models merely descriptions of foraging behavior. Optimal foraging models have the potential to take researchers beyond description toward the discovery of explanations of cultural forms of behavior. The approach to optimality modeling is a cumulative one in that elementary models, incorporating basic currencies such as time, energy, or nutrients, can be modified to address problems with model fit and can be broadened to encompass other currencies, such as the storability of resources. This framework is an asset of the approach in that it provides a method to examine complex behaviors in a way that contributes to general theory.

The diet breadth model

In the diet breadth model the forager chooses from a set of available resources on the basis of their abundance and efficiency rank. Efficiency rank represents a quantitative comparison between handling costs (generally measured in terms of time) and the yield (measured in terms of energy) of an encountered resource. In a fine-grained environment where resources are encountered at random, the model predicts that a forager will take a resource only if the returns from that resource are greater than the returns of other resources. Thus, the model predicts the order in which resources are added to or deleted from the diet.

Following Simms (1987:15–16, 40–43), our definitions of costs are briefly summarized as follows:

(1) Search time is the time required to travel to and locate a resource patch or a resource within a patch containing more than one resource. Search time is dependent on the general environmental abundance of the resource.

(2) Pursuit time is the time required to pursue or collect a resource after it has been encountered. With immobile plant resources, pursuit time represents gathering time and the efficiency of it is affected by technology and technique.

(3) Processing time is the time required to process a resource into a useable form which is, in turn, entirely dependent on the efficiency of processing.

(4) Handling time is the sum of pursuit and processing time and is generally used in conjunction with search time to bring about predictions

concerning the relative contributions of different resources to a subsistence diet.

The issue of efficiency ranking for subsistence resources implies two important points: (1) higher-ranked resources will always be taken when they are encountered; and (2) the inclusion of lower-ranked resources in the diet will depend on the abundance of higher ranked resources. The latter statement implies that as the abundance of higher-ranked resources decreases, lower-ranked resources will be included in the diet, or, as the abundance of higher-ranked items increases, lower-ranked items will be eliminated from the diet, regardless of their abundance (Charnov and Orians 1973; MacArthur and Pianka 1966).

An important distinction exists between search time and pursuit time. While both measures vary with resource abundance, search time abundance refers primarily to the frequency of resource patches on the landscape and pursuit time abundance specifies density within the resource patch once it is encountered. Procurement time for plants, however, is primarily governed by gathering efficiency, with density playing a secondary role. In contrast, individual density within a patch is more important for assessing the procurement costs of mobile animals.

In effect, foraging decisions represent contrasting assessments of search time relative to handling time. That is to say, as resources with a high rank (high energy yield per handling time) are utilized, their abundances decrease, their search times increases, and their overall procurement costs increase. By expanding the diet to include lower rank items (low energy yield/handling time), handling time per unit of energy increases and search time decreases. Thus, the theoretically optimal diet is reached where decreasing search times equals increasing handling times. This is an important point because it implies that the overall abundance of a given resource on the landscape does not, in and of itself, predict its inclusion in the forager's diet (cf. Winterhalder and Goland in 1997). As an example, this is reflected in a forager's decision to collect storable seeds, even though they are costly to harvest and may not be less abundant than other, less storable, resources. Their value, in terms of delayed consumption, controls the decision to harvest. These concepts may have implications for the current project in terms of the adoption of cultigens (from Archaic to Formative), the level of storage technology employed by human groups, the changes in processing technology, the suite of subsistence resources sought by foragers, and changes in the location of sites on the landscape (settlement patterning).

The central place foraging model

By adding a spatial dimension to the analysis, foraging can be modeled as a trip with a given point of departure and return. This central place foraging model (Orians and Pearson 1979) characterizes the expected energy return from a given prey item and the expected foraging time for that prey item in terms of travel time to and from a hypothetical central place. An increase in the central place-to-patch round-trip time requires increases in patch foraging time, minimal required prey size, and expected energy intake. In contrast, given a constant round-trip travel time, an increase in prey abundance generates an increase in the minimum prey size and a decrease in the patch foraging time. The implication here is that the ranking of dietary items will vary with the distance from central place to patch, such that low-ranked items in nearby patches may rank quite highly in distant patches. This approach may have implications for the current project in terms of changes in hunting-related technology over time, the body size of the animals that were targeted by hunters, and possibly the locations of different site types on the landscape. For example, this could enable an investigation of the shift from the Paleoindian lifeway to the Archaic that transpired across the Pleistocene–Holocene climatic transition.

Optimization Approaches and Archaeology

Winterhalder and Smith (1992:22) have suggested that evolutionary ecology models in general, and optimal foraging theory in particular, are useful because they open the way for a synthesis between cultural and biological concepts. Consequently, our attention has been directed to the relationships between a localized and varied environment, on the one hand, and the suite of flexible human behaviors, on the other. In his summary of optimality models and archaeological applications, Simms (1987:21–25) argues strongly for models that are matched to their respective test data in terms of complexity. As such, diet breadth models, which predict the order in which particular subsistence resources are added or removed from the diet, provide an excellent match for the changes in archaeological subsistence data observed for a single location or region over a period of time. In addition, central place foraging models can be used effectively when examining archaeological data at a regional scale.

In an interesting example, Jochim (1976) constructed an economic behavior model for hunter-gatherers that incorporated decision-making processes. His model, which was based on a ranking of subsistence resources, assumed that settlement decisions were based primarily on the proximity of economic resources and the availability of shelter. Consequently, Jochim (1976:53–56) argued that an index of resource diversity should provide a useful measure for the subsistence value of a given area. This use of a diversity index to predict foraging behavior was subsequently refuted by Chapman (1980) in a study of Archaic adaptations in the Middle Rio Grande valley, and was qualified by Cully and Toll (1983:390–391). The latter researchers suggested that resource diversity may be useful as a guide in understanding forager mobility and settlement on a regional scale but, for more localized situations, the evidence suggests that foragers responded to the presence of a relatively narrow spectrum of subsistence resources.

In order to address issues about diet variations during the Holocene, Simms (1984, 1987) used archaeological and ethnographic data from the Great Basin, experimental data on handling times and encounter rates for plant resources, and estimates from ethnographic and current hunting descriptions for animal resources. His investigations sought to examine the roles of plant and small mammal resources in both men's and women's foraging strategies, and the conditions under which large game species would have comprised most of the diet. As great variability in seed-harvesting return rates was implied by this pattern, Simms stressed the importance of in-patch characteristics, such as intra-patch density, harvest timing, and variations in annual seed production. The unpredicted presence of low-ranked seeds in ethnographic diets also underscored those seed attributes that might favor delayed consumption or storage. The diet model assumes that energy is maximized on a daily basis but, with the issue of storage, behavioral decisions must also consider subsistence requirements beyond the daily time frame.

More recent work by Christopher Raven and Robert Elston (Raven and Elston 1989; Raven 1990) at the Stillwater Wildlife Management Area tested a suite of predictions about prehistoric human settlement behavior with data retrieved through archaeological reconnaissance. Their predictive model, which was based on assumptions from optimal foraging theory, attempted to "relate variation in the spatial and temporal distribution of subsistence resources . . . to a theoretically effective subsistence strategy" (Raven and Elston 1989:i). They assumed that the differential use of the landscape by prehistoric foragers was primarily conditioned by the spatial and temporal distribution of subsistence resources. In concordance with foraging theory, they also assumed that foragers made behavioral decisions based on efficiency (most energy per unit of effort). Finally, using the patch choice model, data collected by Simms (1984, 1985, 1987) on the caloric returns of many Great Basin resources, and some information on regional environmental change, Raven and Elston were able to rank resource patches at Stillwater and develop expectations about the locations of prehistoric subsistence-related activities and the content of archaeological assemblages. While it was concluded that prehistoric subsistence patterns covered an area larger than the Stillwater Marsh, Raven and Elston's expectations were largely upheld.

The Ecological Landscape approach underscores the idea that different landscapes would have presented foragers with different subsistence resource constraints at different spatial and temporal scales. Thus, the archaeological research proposed for Spaceport America can apply this idea to examine: (1) the climatic mechanisms that controlled changes in the prehistoric botanical communities, faunal communities, and hydrological regimes of the Jornada del Muerto region; and (2) how such ecological changes affected the economic behaviors of human foragers during the Paleoindian, Archaic, Formative, Protohistoric, and Historic occupations of the regions containing the project area. Importantly, the Ecological Landscape approach corresponds well with the basic Research Themes outlined in the Mitigation Plan and the CRPPMP (FAA and NMSA 2010a:13–22) and, by extension, points to the Research Questions expressed in the body of the Research Design. Together, this concordance will allow the Research Design, and results of the current study, to serve as a foundation for future archaeological research in the region.

Theme 1: *Development of Prehistoric and Historic Chronologies, Cultural Histories, and Historic Contexts for All Time Periods of Occupation/ Use in the Region*

Currently, discussions of chronology and culture history for the project area are mainly based on survey data, and the local sequence is often conflated with that of the Mimbres region to the west (FAA and NMSA 2010a:14). As the overview of culture history in Chapter 3 made clear, we fit our project area into the general Jornada Mogollon region, homeland to a culture that probably developed out of an Archaic base. However, most of the chronological and culture historical information available for the Jornada Mogollon has been generated by studies in the El Paso region and in the Tularosa Basin. More detailed information that may be recovered by the investigations outlined in this plan can be used to amplify the survey data, and help begin the process of determining how cultural developments in this area compare with those elsewhere in the Jornada region and general Jornada Mogollon culture history, or with frameworks that cover wider spatial areas for the Paleoindian and Archaic occupations. In addition, the derivation of Protohistoric and Historic period dates for several features provides important preliminary data for these periods that is absent from survey level studies, which usually fail to recognize remains from these periods unless they are accompanied by temporally diagnostic artifacts. Thus, the sites in this study are also useful in examining questions of chronology and culture history for those periods of adaptation, and can again be compared with the results of intensive investigations elsewhere in the region.

This general understanding of how people used and adapted to a certain region through time can be developed with a variety of data generated during this study. Constructing solid chronologies and outlining cultural histories are perhaps the most important building blocks in this process. This, in turn, will allow us to see how this region fits into the more general Jornada Mogollon framework.

Research Question 1: What Are the Chronologies of Occupation/Use for the Various Cultural Components within the Project Area?

More specifically stated, how do the sites examined by this project fit the chronological frame developed in the overview of cultural history in Chapter 3? Are they, for example, synchronized with similar developments elsewhere in south-central New Mexico, or are there potentially important differences? Our expectations are that these sites fit well into the chronological scheme presented in the overview of culture history. If so, this research both confirms and strengthens conclusions made by other researchers for the region. If not, this might mean that developments in the middle Jornada del Muerto region did not exactly parallel those elsewhere in the region. In this case, we could perhaps look to other adjoining regions for a closer fit.

Thus, strong chronological controls were needed for this study, and are provided by a number of different analyses. Chronological data were collected using ceramic assemblages, projectile point assemblages, radiocarbon samples, and optically stimulated luminescence (OSL) samples. Each of these potential dating methods is applied in different ways.

The analysis of ceramic assemblages from Formative and later period sites should provide critical information concerning where those assemblages fit temporally. As discussed in the culture history overview, studies completed elsewhere in the Jornada Mogollon region have developed seriations of pottery types and, in some cases, the forms and other characteristics of vessels and sherds allow a relatively precise placement of an assemblage into a particular period. In many cases, this may be a more desirable way of dating Formative-period components than the use of radiocarbon samples, because of problems inherent in the latter with the use of old wood and the likelihood that many decades of growth are being averaged in some samples of tree wood, thereby reducing the precision of the date (Browman 1981; Taylor 1987). These problems can be nullified by dating materials from annuals and shrubs with much shorter lives than trees, but these types of materials are not always available. Conversely, when dealing with Archaic- or Paleoindian-period components, radiocarbon dates can be quite useful, even with the problems discussed above.

This is because the occupational periods defined for these periods tend to be much longer than those of the Formative and later periods and, thus, can more successfully utilize dates with lower degrees of precision.

Despite the potential problem mentioned above, the analysis of radiocarbon samples can be useful for all periods of occupation. Miller (1996, 1997) provides a detailed analysis of radiocarbon dates for much of the Jornada region, and those data were used by Miller and Kenmotsu (2004) to provide more accurate date ranges for Formative-period occupations. Radiocarbon dates are currently uncommon for the middle Jornada del Muerto region and could, therefore, provide critical information concerning the timing of events and trends in comparison with other parts of the region. Radiocarbon samples are often the only way to determine dates for components lacking temporally diagnostic artifacts. In some instances, the availability of radiocarbon dates may allow the relationship between certain types of diagnostic artifacts and other cultural materials to be explored. For example, does the presence of a few Paleoindian artifacts on a site indicate an occupation during that period, or were those artifacts salvaged and curated by a later group?

OSL samples were obtained from geological trenches to aid in the dating of soil formation events and to help identify the time periods during which certain sediments were deposited. This will aid in understanding site formation issues and in developing a more detailed paleoenvironmental reconstruction for the project area.

Identification of diagnostic projectile points can provide broad temporal information, but the level of precision is very low. While projectile points are used to date general periods of occupation for Archaic and Paleoindian components in the absence of other materials amenable to temporal analysis, the possibility that prehistoric people salvaged and reused this type of artifact is very high. Since this also leads to the inaccurate or low precision dating of occupational components, other approaches to dating are much more desirable.

Research Question 2: How Does the Chronology of Site Occupation in the Project Area Fit the Regional Culture History Framework?

This question is closely tied to Research Question 1, because the first step in seeing how these sites fit into the regional culture historical framework is to provide them with accurate dates. Without accurate chronological controls, it will be very difficult to address this question in detail. As discussed in Chapter 3, a detailed culture history is available for the Jornada region, but it is primarily based on research conducted in the region around El Paso and in the Tularosa Basin. Using data from the sites in this study, how does the chronology of landscape use and cultural developments over time compare with trends in these other parts of the region? Do we see similar events and transitions occurring at about the same time in all parts of the region, or are there potentially important differences?

The examination of chronology represents one of the main focal points of this study. In essence, this question links nearly all of the other research questions posed in this chapter, and provides a way in which to summarize the results of this study. Defining culture history is important to regional studies because it provides a framework in which to examine cultural changes and adaptations through time. For instance, detailed information on the Formative period is available from the El Paso region and the Tularosa Basin and somewhat less detailed but similar data on the Paleoindian, Archaic, and Protohistoric occupations are also available from those areas. By examining cultural historical developments in the project area we may be able to determine whether they parallel those in other parts of the region, or sometimes deviate from them. Deviations, if definable, can be important because they are indicators of variation within a broadly linked cultural area that could be evidence for differing constraints, such as environmental conditions, resource availability, or the presence of unique outside influences. These possibilities can be examined by data recovered from ancillary investigations, such as paleoenvironmental studies, or from the presence of exotic materials or objects in assemblages that point toward ties with specific regions, including imported tool stone, pottery, or materials used for ornaments like turquoise and shell.

Theme 2:
Interaction of Settlement, Land Use, Access to Scarce/Desired Resources, and Subsistence Practices in the Region for All Time Periods and All Cultures

As the Federal Aviation Administration and New Mexico Spaceport Authority (FAA and NMSA 2010a) note, water has been the most critical resource in the Jornada del Muerto throughout the entire period of human occupation. Water availability conditioned the movement of Pleistocene megafauna and, hence, the movement and settlement patterns of the human cultures that preyed upon them. Similarly, the availability of water during the Archaic and Protohistoric periods helped determine where camps would be placed, and where the plants and animals that were targeted for exploitation would be located. While the subsistence needs of the Formative-period population were somewhat different from those of the earlier and later occupants of the region, they too depended on water availability to determine where to establish a settlement or temporary camp, and where to farm. Water sources were critical to the Spanish travelers who crossed the Jornada del Muerto on the Camino Real, and were equally critical to the Anglo ranchers who represent some of the latest occupants of the region, though the latter are also able to supplement naturally occurring water with wells.

The seasonal availability of water, climatic fluctuations that affected the availability of water and the distribution of locations where water was available, would all have affected patterns of land use over time. But, while water was obviously a critical resource, it was not the only resource that would have conditioned land-use patterns. During prehistory, access to tool stone was also an important consideration, for the manufacture of both chipped stone tools and ground stone tools. During the Historic period, access to manufactured goods would have varied according to the transportation system in use and changing governmental controls through time (Moore 2001, 2004, n.d.).

Thus, access to critical resources would have been an important aspect of the settlement systems or patterns of landscape use, and must be taken into account. For all time periods, water sources including springs, erosional cuts, and playas could have been the basis for the creation of residential areas. While residential sites may not have been established solely to exploit tool stone sources, those areas would have been exploited as quarries and, if a water source was located nearby, may have increased the attractiveness of a specific location for settlement. For part-time forager-farmers, or full-time agriculturalists, the location of potentially arable soil with sufficient water for farming could have constituted a major settlement inducement in all time periods after the late part of the Middle Archaic.

So, how did the distribution of critical resources condition settlement systems and patterns of land use in the project area? How did these patterns vary among time periods, and do those variations fit the patterns seen elsewhere in the Jornada Mogollon region? These are the main questions that can be explored in the more specific research questions posed below.

Research Question 3: How Do Site Locations/Types and the Availability of Water Vary Through Time?

The settlement patterns proposed for the Jornada region, as discussed in Chapter 3, varied considerably through time in accordance with changes in both the physical and cultural environments. The former began with the transition from wet, cooler terminal Pleistocene conditions to the warmer and drier Holocene, and continued with variations in temperature and rainfall regimes through the later periods of human occupation and up to the present. Variations in the cultural environment coincided with those in the physical environmental, and were linked to them in part. The people who lived in this region had to change their ways in order to adapt to the new environmental conditions. A successful adaptation or improving environmental conditions often resulted in population growth, and that type of increase often caused changes to occur in the cultural environment that required adjustments or adaptations. As there were more and more people living on the landscape, the size of areas available for exploitation decreased, requiring the development of ways in which to intensify food production. Often, those ways were tenuous in the desert Southwest, and only proved to be workable as long as environmental conditions did not change for the worse.

While very few sites from the Paleoindian period have been found and investigated in the Jornada region, it is possible that different patterns of landscape use may be discerned for the human groups from those times than for subsequent hunter-gatherer populations during the Early, Middle, and Late Archaic periods. Permanent or semi-permanent water sources would have attracted the megafaunal prey of Paleoindians, and hunting may have been easier where animals could have been incapacitated in bogs or driven into streams or ponds. Thus, the archaeological remains of camps and kill sites from that era may be located in areas that would have contained active streams, ponds, or marshy ground. However, in the case of kill sites, it may have been the presence of faunal resources that were the main attraction rather than the presence of water itself.

Early Archaic sites are expected to fit a general pattern of land use and adaptation similar to that seen during later Archaic periods, although this assumption may be incorrect because population densities were likely much lower than in later Archaic periods. This uncertainty is because the Early Archaic is not well-represented by excavated sites, so the settlement and subsistence systems in use during that period remain mostly unclear. The appearance of thermal features containing rock, which are absent from Paleoindian sites before 10,500 BP (Thoms 2009), may indicate a major change in the subsistence system for the Early Archaic period, with floral resources assuming an increased dietary role as was the case in later Archaic periods. Changes in projectile point technology, such as the materials used to manufacture these tools, also point to a major change in the subsistence system, perhaps corresponding to the disappearance of the megafauna that was hunted during earlier times. Miller and Kenmotsu (2004:223) suggest that a seasonal settlement system based on small bands developed during this period, with the level of mobility perhaps more restricted than that of the Paleoindian period. These changes continued into the Middle Archaic, when seasonal timing apparently became more restricted and focused on the availability of certain plants, and the first structures occurred. Despite the current state of the archaeological record, which suggests that few changes occurred between Early and Middle Archaic, major differences may become apparent with further research because most evidence for those changes are currently obscured by a paucity of data.

In many ways, the Middle and Late Archaic patterns of settlement and land use are expected to mirror that of the Formative Mesilla phase, which has been modeled by Hard (1983) and Whalen (1994a, 1994b). In Hard's model, cold-season settlements are expected to be situated on alluvial fans and piedmonts at the base of mountains as well as in riverine settings. These are the locations where reliable supplies of water and firewood were both available, and where cold-air drainage could be avoided. These are also areas in which arable land is most available, and where some farming could have been accomplished. The latter is important because part of the population is thought to have remained in the cold-season camps through the warm season (probably the elderly, very young, and infirm), tending nearby fields. During the warm season, the rest of the population would disperse across the landscape to exploit seasonal resources. Foraging camps would be established where there were suitable supplies of food, water, and firewood. The onset of the monsoon season would provide water in seasonal playas, and make parts of the interior basins accessible that could not be used at other times due to a lack of water. Surplus foods collected during this season would be transported back to cold-season camps for storage, thereby augmenting any crops that were grown.

Whalen's (1994a, 1994b) model is not as detailed as Hard's, but it incorporates some of Hard's ideas and takes both the early and late parts of the Mesilla phase into account. Whalen believes that the early Mesilla people maintained a basically Archaic settlement and subsistence system, with one major difference: a more intensive use of cold-season camps. This pattern was sustained by large-scale food storage. While there is some evidence for food storage at Archaic cold-season camps, it was at a much smaller scale. The storage facilities at both Mesilla phase and Archaic cold-season camps were probably filled with cultigens and wild foods gathered at warm-season camps, although the proportional mix of each type of food probably varied with precipitation. The remainder of the Archaic settlement system probably resembled that of the Mesilla phase and included small camps and resource extractive locales (Whalen 1994a:142).

This pattern apparently continued into the late Mesilla phase with little change, though there is evidence for increased storage capacity at cold-season camps. Subsistence throughout the period relied on wild resources supplemented by domesticates. However, there is some evidence for an increase in the use of cultigens during the late Mesilla phase (Whalen 1994a:119; Whalen 1994b:634). Other changes suggest a slight reorganization of society late in the phase that included larger groups using cold-season camps and construction of communal structures.

By the Doña Ana and El Paso phases, there were major changes in how the landscape was used. Villages from these periods were more permanent and tended to cluster on alluvial fans or around playas, and those of the El Paso phase occurred at slightly lower elevations than those of the Doña Ana phase (Miller and Kenmotsu 2004:245). While Mesilla-phase structures are found across most environmental zones, the isolated houses of the Doña Ana and El Paso phases are generally only found around playas or in the riverine zone (Miller and Kenmotsu 2004:245). This suggests that interior basins may have been used differently in the late part of the Formative period.

The location of our project area in a basin interior suggests that we can expect to see mainly evidence of warm season use during those periods when water and seasonal foods were available. The most intensive use of the interior basin is expected to have occurred during the Middle and Late Archaic and the Mesilla phase, with sites expected to demonstrate a similar pattern of transient use, though specific locations may evidence repeated occupations through time because critical resources are conveniently located nearby. Temporary structures may occur at these sites, but would be of insubstantial construction and might only be found if they were burned. Middle and Late Formative (Doña Ana and El Paso) sites may occur in this zone, but are not expected to exhibit the kind of intensive use seen at the earlier sites. In all cases, sites should be situated near a water source. Foraging camps may mostly be located at playa margins and along intermittent streams. Any more substantial or permanent settlements are not expected, but if they occur they should be located adjacent to a permanent water source in an area where arable land was also available.

Protohistoric Apache sites are expected to follow a settlement pattern similar to that of the Archaic, because a similar hunting and gathering lifestyle is represented. However, the acquisition of the horse sometime after AD 1600 and conflict with Spanish, Mexican, and American governments almost certainly affected the earlier Protohistoric pattern.

Other than the chronological data mentioned earlier, information on site type and function, subsistence, and seasonality will also be used to address this question. Site type can be defined using such data as the presence or absence of structures, the types of features present, evidence for single or multiple uses, and evidence for the types of activities that occurred there. Site structure can be examined using the spatial distribution of various material classes and tool types across a site in relation to the locations of any related structures and features.

Site function can be defined from a similar suite of information, especially the types of chipped and ground stone tools, ceramic vessels, and structures and features that are present. Subsistence information will be derived from data obtained through analysis of faunal bone, blood residue, and paleobotanical materials. The results of the faunal and botanical analyses can also help define the season(s) of use for sites, and are important adjuncts to the characteristics of any structures that might be present, as well as the types of features identified

Research Question 4: How Do Site Locations and the Access to Other Critical Resources Vary through Time?

Other critical resources include outcrops of tool stone, habitats for the animals that were hunted, and areas containing useable floral and seed resources. Did the location of suitable outcrops of tool stone affect choice of site location? If so, what types of sites are located near tool stone outcrops? Is there evidence for the use of these sites as residential locales, or did they simply function as resource extractive locations? This question will be addressed by an examination of areas that may contain tool stone deposits, including outcrops and gravel beds. Pertinent information will also be gleaned from survey reports, in which likely sources are noted, and from the geomorphological study. In addition, the sites and the areas surrounding them were examined for raw material sources that could be used for the manufacture of either chipped or ground stone tools. These data are used to assess the likelihood that the presence of these resources affected the site selection choice, using information on occupational type, site structure, and structure of the chipped and ground stone assemblages. If a source of raw materials suitable for chipped stone reduction is located near a site, we expect to see evidence of extraction and preliminary reduction including a high percentage of primary cortical flakes, discarded tested cobbles, discarded hammer stones, and a comparative lack of extensively reduced cores. If a source of raw materials suitable for ground stone tool manufacture is located nearby, we would also expect to see evidence of extraction and perhaps preliminary shaping. This may be indicated by a large percentage of flakes from materials that do not break conchoidally, like sandstone, and which were therefore used for ground stone rather than chipped stone tools.

Did the availability of animal and plant resources also factor into site location selection? This possibility has already been proposed for Paleoindian sites. Examination of available data suggests that greater densities of animals in certain plant communities and near water sources may have affected site location choice during the Archaic and early Formative periods. Some of those plant resources are likely to have been the same that were desired for exploitation by the human population including grasslands and mesquite thickets, where edible seeds from various grasses and mesquite beans were available. Some of the attractive plant communities would have been located where there was sufficient moisture available to support them. Thus, once again we are probably looking at the juxtaposition of sites and water sources. These factors may have been of somewhat less importance when selecting site locations during the later parts of the Formative period, when there was presumably a higher reliance on dry land farming. However, if exploitation of the inner basins actually continued during the late Formative, counter to the current state of knowledge, the archaeological presence of small resource extractive camps from the Doña Ana and El Paso phases would demonstrate that a similar set of locational selection criteria were in operation and would indicate a continued reliance on hunted and gathered foods in basin interiors.

Research Question 5: What Evidence Is There for Either Continuity or Changes in Land-Use Patterns through Time and between Regions?

Why are some sites or general areas that contain many sites reoccupied repeatedly while others are not? Is the presence of critical resources an important attraction for site occupation through time? Are there differences in occupational areas through time that might point to variation in the types of resources considered critical to the settlement system? Do sites that are more isolated appear to function differently in the settlement and subsistence system than do those that demonstrate repeated occupations? These questions are closely related to Research Questions 1, 2, and 4. Good chronological controls, information on site structure, and the nature and seasonality of resource exploitation are data needed to address these inquiries. At least some of these data should be available from stratigraphic assessments during site excavations, analyses of the chipped and ground stone assemblages, and floral and faunal analyses.

A persistent drying trend that began in Clovis times eventually led to the disappearance of perennial water sources including the lakes and marshes that occupied many of the large basins, the replacement of woodland communities by Chihuahuan desert, and the demise of large game animals (Miller and Kenmotsu 2004). These trends caused major changes in human settlement and subsistence patterns that marked the beginning of the Early Archaic period. At this time, we should see a shift to a focus on a diverse suite of plant foods from a reliance on the hunting of large game that is thought to have characterized the Paleoindian period. Changes in the settlement system should be visible, and were necessitated by the spotty distribution of reliable water sources that would have restricted access to much of the interior basins during the dry season. A seasonal pattern of resource exploitation should become visible during this period. Continuity in these adaptations should continue through the Middle Archaic period, perhaps intensifying during the latter part of the period (Miller and Kenmotsu 2004:223). This intensification may have involved a need to adapt to continued drying conditions and to an increasingly fluctuating climatic pattern that, in turn, resulted in both a more restricted level of resource access and a greater variation in the spatial distribution of food resources (Miller and Kenmotsu 2004:223). We expect to see, for this time period, a more intensive pattern of seasonality that focused on areas with critical plant food resources that were adjacent to seasonal sources of water.

In addition, our expectations are that environmental changes between the late Middle Archaic and the Mesilla phase of the Formative period were not extreme enough to cause major variations in the locations of water sources and floral and faunal resource distributions that would have resulted in archaeologically visible changes in the settlement system. This should be evidenced by repeated occupations of the same or similar locales through time, creating palimpsests at many sites composed of debris from multiple overlapping occupations and potentially including components from the late Middle Archaic through the early Formative period. Considering the regional culture history summarized in Chapter 3, major changes in settlement patterns may be visible after the Mesilla phase, because of an increased dependence on farming and a reduction in the use of basin interior areas as resource extractive zones. During the Protohistoric period, we would expect to see a return to the Archaic and Mesilla phase patterns, suggesting that components from this period might also overlap with those from earlier periods of occupation.

Research Question 6: What Can Site Structure Analyses Tell Us about Occupational Patterns through Time?

Knowledge of how sites are physically structured is critical to this investigation and was one of the focuses of research-oriented excavation. The targeted investigation of areas thought to contain the discrete remains of occupational events on sites can provide good information on how an area was used at various times. Considering the multi-component nature of several of the sites investigated by this study, evidence of palimpsest distributions indicative of repeated overlapping occupations may be the rule rather than the exception. Attempting to unravel those data and to determine whether discrete occupations can be defined and interpreted will be the focus of site structure analysis. Since none of the larger sites was fully investigated, certain areas that appeared to contain the best potential for providing site structural information were targeted. Excavation concentrated on visible, preferably intact, features; clusters of artifacts presumably indicative of activity or discard zones; and areas that had the potential to contain structural remains. Portions of sites exhibiting characteristics or artifacts diagnostic of different time periods were examined in this way. Of particular importance were areas suspected of containing Paleoindian, Early Archaic, or Protohistoric remains, because these periods are under-represented in the archaeological record for the region.

As with most of the other research questions discussed to this point, addressing this question requires data from a variety of sources. Provenience information from excavations is used to establish the vertical and horizontal relationships between features (especially those that have been dated) and artifact distributions. Those relationships, when recognized or defined, can, in turn, aid in assessing (1) the spatial organization (site structure) of the various occupations; (2) evidence for potential mixing with materials from other occupations; and (3) geomorphological processes that might have affected the distribution and associations of recovered materials. Analysis of the chipped stone, ground stone, and ceramic assemblages can provide information on site function and the presence of potential activity zones. Floral and faunal analyses will amplify the results of these studies by providing data on subsistence and seasonality. Chronometric data for features, related artifact scatters, and activity areas will also be critical to an adequate exploration of overlapping occupations, as well as determining where a given component fit in the culture history of the region.

Theme 3: *Military History, Encompassing Native American Military Activities as Well as Spanish, Mexican, and American Military Actions and Settlements Including Historic Forts and Camps*

An almost total lack of significant historic components on any of the sites proposed for examination in this plan will make this research theme difficult, if not impossible, to examine using data provided by this study. This difficulty was recognized by FAA and NMSA (2010a) when proposing this research theme, and it was noted that both archaeological surveys and archival research have provided no indications of known forts, major military encampments, or battle sites within the Spaceport America facility. Most military activities for this area, including those of the Spanish, Mexican, and American governments are expected to have been in the vicinity of the Aleman Ranch, an archaeological site that is not included in this study. Thus, we expect to find no direct evidence for military activities in our study area, though isolated military artifacts might be found, reflecting transient military use of the project area while bivouacked elsewhere. However, the presence of potential Historic Apache components on some of the sites may provide some pertinent information.

Research Question 7: Is There Evidence of an Apache Presence in the Project Area that Can Be Tied to Concurrent Military Activities?

Though no evidence for this type of occupation was recognized during survey, the recovery of a single possible Apache sherd and several dates from features in the Protohistoric and Historic periods may help to address this question. Considering the evidence for Apache occupation identified in the Fort Bliss area (Seymour 2002; Seymour and Church 2007), and the fact that evidence for Apache occupations in that study area was thought to be low before actual field studies began (Baugh and Seychrist 2001), the presence of potential Apache occupations on some of our sites is important.

Protohistoric Apache sites are expected to reflect a very similar settlement and subsistence system to those of the late Middle Archaic through early Mesilla phases, when subsistence is thought to have mainly been based on hunting and gathering, and supplemented by some farming. Those Historic Apache sites occupied after the acquisition of the horse and when the Apache economy was based partly on raiding, are expected to reflect quite different settlement and subsistence systems. Using absolute dates indicative of a Protohistoric- or Historic-period occupation, the presence of diagnostic pottery or chipped stone tools (as defined by Seymour [2002] and Seymour and Church [2007]), or the presence of metal tools and other Euroamerican artifacts to define Apache components, we can begin examining questions of site structure, settlement type, and similarities in landscape use with prehistoric periods. The identification of Historic Apache components may also allow for the evaluation of their relationship to known or theoretical military operations.

Theme 4: *Dynamics of Trade, Interaction, and Economy throughout All Time Periods, Including a Focus on El Camino Real as a Transportation Corridor, Exploration of the Development of Railroads in the Region, and the Development of Aerospace Exploration in New Mexico*

This study may be able to examine the dynamics of trade, interaction, and economy through the prehistoric period and perhaps into the Protohistoric and early Historic period, but examination of the Camino Real, and the development of railroads and the aerospace industry cannot be addressed because we do not expect to recover any data that would be pertinent to these areas of inquiry. The presence of materials that are not native to the project area can provide information on the extent of ties that the inhabitants of this region had with other peoples, and might also give us an idea of where people were living during other parts of the year. Such materials not only provide an idea of what types of exotic goods were considered important to acquire, but also the direction of trade and exchange ties. For instance, pottery from the Mimbres area commonly occurs on sites in the Jornada Mogollon region throughout the Mesilla phase, disappearing after about AD 1150, a date consistent with the collapse of the Mimbres regional system. After that approximate date, new trade links seem to have been established with two regions. One of these was the Casas Grandes regional system to the south, as indicated by the occurrence of pottery, as well as a few copper bells (Lehmer 1948), from that region on El Paso phase sites. The second was the region in central New Mexico where Chupadero Black-on-white was manufactured. These changes represent adaptations to the changing social and cultural scene, and might also be represented in middle Jornada del Muerto sites. Only very small amounts of pottery from the Pueblo area seem to occur in the Jornada region, though rare Glaze A and Galisteo Black-on-white sherds have been recovered from a few sites. Rather than direct acquisition, the Pueblo sherds probably represent down-the-line exchange. Was this exchange facilitated by human groups further north in the Jornada region, or were these exotic ceramics acquired from somewhere else?

Other types of trade goods can include raw materials used in the manufacture of chipped and ground stone tools. For example, the presence on middle Jornada del Muerto area sites of rock types that could only have been acquired from Rio Grande gravels or in the highlands surrounding the Jornada del Muerto basin may be more indicative of seasonal movement patterns by indigenous peoples than of exchange and trade. Similarly, bone from animal species that had not been native to the study area could also be regarded as evidence of seasonal movement rather than exchange. In contrast, marine shell or shell from non-native freshwater mollusks is good evidence for trade and exchange. As noted in Chapter 3, several species of imported shells have been found at numerous sites elsewhere in the Jornada region. The presence of plants found only in other ecological zones would also most likely be considered indicative of seasonal movement, as would the presence of cultigens. The occurrence of exotic lithic materials on sites can also have different implications for different occupational periods. For example, the presence of rocks that outcrop in the Texas Panhandle, like Alibates and Edwards Plateau cherts, might be considered indicative of movement patterns for a Paleoindian period component, but it could also be evidence of trade among hunting parties. Thus, as with other research themes, information on chronological placement and context are important in examining this theme.

Research Question 8: With What Areas Did the Residents of the Study Area Interact during Various Periods of Occupation?

Were exchange and trade ties in the project area similar to those seen elsewhere in the Jornada Mogollon region, or were they different? Can we see any evidence of interaction with other regions during the Archaic or Protohistoric period? Miller and Kenmotsu (2004) suggest that exchange ties in the Jornada region were aligned along a north-south axis during the Archaic, shifting to an east-west alignment during the Mesilla phase, and back to a north–south alignment during the Doña Ana and El Paso phases. Exotic obsidians imported from the Jemez region to the north and from Chihuahua to the south occur in some assemblages. Is a similar pattern of interaction reflected in our sites, or might there be subtle differences conditioned by a greater distance from the Chihuahua sources and a smaller distance to those in north-central New Mexico than is the case for sites further to the south in the El Paso region? Obsidian sourcing can be used to help determine where obsidian found on sites in the project area originated, but in the case of the Jemez sources, must be augmented with information on cortex type and nodule size, since Jemez obsidian nodules are common in Rio Grande gravels.

As noted earlier, Jornada interaction patterns seem to have shifted to an east–west axis during the Mesilla phase, and exchange seems to have been primarily with the Mimbres regional system to the west. Analysis of ceramic assemblages from the project area sites in the middle Jornada del Muerto may provide the information needed to determine the direction of interaction in which site occupants were engaged. The presence of small percentages of Mimbres wares in local assemblages would be indicative of the east–west tie, while the presence of pottery from a range of other regions may suggest that trade and exchange ties were more widespread than those elsewhere in the region. A total lack of Mimbres pottery on sites of this time period, coupled with the occurrence of exotic types from elsewhere, would suggest that trade and exchange ties in the middle Jornada del Muerto differed from those in other parts of the region.

With the collapse of the Mimbres system around AD 1150, exchange ties shifted back to a pattern similar to that of the Archaic, with a north–south alignment. This is indicated by the occurrence of pottery from the Casas Grandes regional system as well as Chupadero Black-on-white from central New Mexico. Similar trends in our data would indicate an equivalent regional interaction.

Questions Unrelated to the Research Themes

A single question is proposed for examination that does not directly intersect with the four research themes, yet can contribute greatly to our knowledge of the human use, and the effects of that use, on the project area, as well as to our understanding of how physical forces shaped the formation of archaeological sites.

Research Question 9: What Is the History of Geomorphic Changes in the Middle Jornada del Muerto, and How Do Those Changes Relate to the Archaeological Record?

This question is mainly aimed at defining prehistoric landscapes by examining the relationship between the overall geologic stratigraphy of the project area and the locations of archaeological remains from various periods of occupation. By examining stratigraphic profiles for each site in relation to the dates for any archaeological remains that occur within them, along with luminescence (OSL) dates for the sediment deposits themselves, an idea of how the landscape of this region has changed through time can be derived. These data can be used to develop a model for predicting which sediment strata might contain intact archaeological remains from various time periods, as well as to evaluate how intact those remains might be. For example, the presence of Mesilla-phase artifacts with no associated intact features on a surface layer comprising a Pleistocene age B soil horizon would imply that erosional processes had impacted the vertical and, possibly, horizontal distributional relationships among those artifacts and severely reduced their utility in a site structural analysis. These data can also provide important information on soil formation processes occurring through time, which in turn can provide data on the paleoenvironment.

Chronological controls are critical to this investigation, and are provided by chronometric and relative dates obtained for archaeological features, as well as OSL dates for the sediments and soils within which they occur. A range of other data needed for this evaluation include the stratigraphic details for each site, the texture and chemistry of sediments, and the nature of soils and paleosols observed at archaeological sites and during the geomorphological studies conducted at each of the sites.

5 | Field Methods

This chapter provides a general overview of the field methods used during research-oriented investigations at Spaceport America. This phase focused on the examination of parts of sites expected to yield data useful in addressing specific research questions. The field methods were generally the same for each site, though there were differences in specific applications. Those differences, which mainly involved the use of surface collection (and later laboratory analysis) versus in-field analysis of artifacts, are detailed in the individual site reports in Part II of this report.

General Excavation Procedures

Horizontal Proveniencing: The Grid System

A Cartesian grid system was established that tied spatial measurements for all sites into the NAD 83 UTM projection, allowing precise spatial plotting of excavation areas, features, site boundaries, and other mapped aspects of archaeological sites. The survey monuments used as main site datums and backsights were established by professional surveyors before field investigations began, and were precisely plotted and tied to the NAD 83 UTM projection. Using those survey monuments and a total station, artifacts and investigation units could be precisely located within a 1 by 1 m grid system within the UTM system. Individual grid units were referenced by the grid lines that crossed at their southwest corners, and grid lines were labeled according to the last three or four digits of their UTM designation.

Vertical Proveniencing: Strata and Levels

Just as the grid system for each site was tied to a main datum linked to its UTM location, so were all elevations, with the main site datum also being used to reference all vertical measurements. While elevation above sea level was recorded for the main datum at each site, that point was also assigned an arbitrary elevation sufficient to embrace the elevational range of the site. The arbitrary elevation was used as the main vertical reference point during excavation but could be converted to precise elevations if desired. Thus, vertical measurements were made in meters or parts of meters. Since topographical variations at a given site often made it difficult to use one datum to provide vertical control for an entire site, subdatums were established when needed and their elevations and horizontal coordinates were determined relative to that of the main site datum.

Two methods were used to track vertical provenience within excavation units: strata and levels. Sediment strata at each site were assigned unique numeric designations as they were encountered, and descriptions of each were recorded. Each vertical level within an excavation unit was assigned an arbitrary level number, beginning with the surface. The surface was considered an arbitrary level with no thickness; it was designated Level 0. The first vertical excavation unit dug was labeled Level 1, the second Level 2, and so on. Since stratum and level numbers represent two completely different series, stratum numbers were not necessarily in sequence as excavation proceeded downward, but level numbers were always in sequence.

Site Mapping and Surface Collection

A total station was used at each site to record the locations of associated features, artifact clusters, modern cultural features such as roads and fence lines, all excavation areas and associated subdatums, and all collected and field analyzed artifacts. In order to prevent data loss, these measurements were also entered on a paper record.

Temporally diagnostic artifacts encountered during surface examination were collected and point provenienced. These mainly included projectile points and ceramic sherds, though other types of artifacts (cans, cartridge cases, etc.) were also occasionally collected if they could provide temporal data. In a few cases, when called for by the research plan (Moore et al. 2010), all visible surface artifacts were collected at a site. At small sites, for which the research plan did not call for total collection, nondiagnostic artifacts were analyzed in the field and their locations were point provenienced. The types of artifacts included in this category were debitage, cores, ground stone tools, and fragments of fire-cracked rock that were not directly associated with features. Artifact data collected during field analysis were standardized and formatted to allow their inclusion in databases that also include collected materials.

Recording Excavation Units

Grid unit excavation began by completion of a form for the surface that provided initial elevations and coordinates of the unit corners and described the type of sediment present, the amount of vegetation, the presence or absence of fire-cracked rock, and the field specimen number for any collected artifacts. Forms, which were also completed for each level of excavation, included descriptions of sediments, an inventory of any cultural materials recovered, and a listing of other relevant observations including ending depths, stratum number, and level number. Other types of information included the presence of cultural and non-cultural inclusions, evidence of disturbance, and how artifacts and other materials, such as gravel, were distributed. Sketch plans were drawn when needed to illustrate field observations.

Recovery of Cultural Materials

Artifacts were identified by the visual inspection of levels and were recovered as they were excavated, either as point-located artifacts or by the screening of excavated sediments though hardware cloth with variably sized mesh. Collected materials were assigned a field specimen (FS) number, which was listed in a catalog and noted on all related excavation forms and artifact bags. This allowed the relationship between recovered materials and their location to be maintained. All materials collected from a unit of excavation received the same FS number. Samples that were not associated with specific units of excavation received unique FS numbers.

Most artifacts were recovered by the systematic screening of soil strata. All sediments removed during the hand-excavation of grid units were passed through two sizes of screen. Most fill was passed through 1/4-inch mesh hardware cloth, but 1/8-inch mesh hardware cloth was used for feature excavation. Other cultural materials, primarily botanical in nature, were recovered in the laboratory from bulk soil samples using flotation analysis. Sediments for flotation analysis were collected from features as volumes of at least 2 liters of soil, when possible. Macrobotanical materials were also collected as individual samples when available. Charcoal for radiocarbon analysis was usually collected separately during feature excavation, targeting larger fragments of brush and other short-lived plants.

Mechanical Excavation

Mechanical equipment was used to excavate soil pits at most sites, as discussed in the site reports. All mechanical excavation was supervised and monitored by project staff to ensure that areas containing cultural features or deposits were not disturbed during the processes of accessing the chosen locations, excavating the pits, and removing equipment from the site. Soil pits were then examined by the project geomorphologist, who described sediments and took samples for analysis of their physical characteristics and for OSL dating. Following this, the soil pits were backfilled using mechanical equipment, again with all aspects of the process being supervised by project staff to ensure that cultural deposits and features were not damaged. Mechanical equipment was not used to excavate any archaeological remains at these sites.

Feature Recording

All features on the investigated sites—whether they were excavated or not—were assigned a feature number, point provenienced, described on standardized forms, and photographed. The following types of data, when applicable, were recorded for these features, including:

- Feature type
- Feature size (north–south maximum extent and core, east–west maximum extent and core)
- Estimated number of fire-cracked rocks
- Maximum fire-cracked rock density in a 50 by 50 cm area
- Fragmentation of the fire-cracked rock (large, cobble, highly fragmented, mixed)
- Rock types and proportions (caliche, igneous, quartzite, limestone, sandstone, other)
- Whether there were ceramics, ground stone, or chipped stone in association with the feature
- Whether any chipped stone artifacts were heat treated
- Information on the general locale (dune, interdunal, washed area, etc.)
- Whether the feature had potential for artifact association information, for subsurface deposits, for chronometric samples, or for subsistence remains.

Specific Excavation Methods

Excavations within various parts of the sites were approached in somewhat different ways, even though the mechanics of excavation were usually the same. All archaeological excavations were accomplished using hand tools. Specific methods varied depending on whether a structure, another type of feature, or extramural deposits were being examined.

Structures

While a detailed excavation methodology was developed for structures in the overall research design for the project (Moore et al. 2010), the only possible structure encountered during research-oriented investigations was small and ephemeral. Excavation within structural limits was carried out by natural strata in 1 by 1 m grid units, dividing the structure into quadrants. All sediments removed from above and around the structure and within its interior were screened through 1/8-inch mesh. No prepared floor was encountered and the east half of the structure was left unexcavated. Ethnobotanical and radiocarbon samples were taken from just above the unprepared floor. Plans and profiles of the structure were drawn, and photographs were taken during and following excavation. Additional grid units around the structure were excavated to examine potential extramural use areas.

Features

Features, including structures, were assigned unique numbers unless they had been numbered by earlier studies and the location identified during the current study matched that identified during those previous studies. Small features (less than 2 m in diameter) were usually excavated differently than large features (greater than 2 m in diameter). If the horizontal extent of a small feature could be defined it was divided in half. One half was excavated in arbitrary levels to define internal strata, and a profile of the exposed fill was drawn. The second half was then removed by strata. Excavation data were recorded on the appropriate forms. Samples were taken for botanical analysis (flotation, phytolith/starch), and charcoal was collected for radiocarbon analysis, if available. All remaining soil removed from small features was screened through 1/8-inch mesh hardware cloth to recover associated artifacts. Plans showing locations and sizes of excavation units were drawn for each feature. A second cross-section illustrating the vertical form of the feature perpendicular to the profile was also drawn. A summary form was completed for each excavated feature that described its shape, contents, and construction details. In some instances, a feature could not be defined because it was so deflated or disturbed that it no longer existed or the excavation unit missed the feature entirely. In these cases the same procedure was followed, with soil profiles being drawn, photographs taken, and a feature form completed. In situations where field observations determined that the initial excavation unit missed the feature, additional units were completed to adequately excavate the previously missed feature.

Large features that could be defined were usually excavated by grid unit, and were sampled rather than being completely excavated. The number of exploratory grids was kept to a minimum, and as much of the feature as possible was excavated by natural strata. Standard excavation forms were completed for each excavated unit. At least two perpendicular profiles were drawn, when possible, and summary forms and plans that described and detailed feature shape and contents were completed. All features were photographed before and after excavation. Other photographs showing construction or excavation details were taken at the discretion of the excavator.

Extramural Excavation Areas

Two types of excavation units were used to examine extramural areas. The most common was the surface strip, where the loose upper sediments were removed down to the harder-packed sediments that lay beneath them. Less common was the exploratory grid unit, which consisted of grid units used to examine areas of interest. Surface strips were used to investigate artifact clusters and potential activity areas around and between features. Deeper sediments in surface strips were sometimes sampled within one of the included grid units to determine whether cultural materials occurred below the loose upper sediments. Exploratory grid units were used to assess parts of sites that were outside the zones examined by surface strips.

Surface strips were excavated in 2 by 2 m units. However, each of the four grids in a 2 by 2 m unit was excavated separately, and the form used to summarize excavation was structured to allow the separate recording of elevations, artifact content, and field specimen numbers for each 1 by 1 m grid unit. This recording method cut down on the amount of time and paperwork required to record excavation data, but it retained the level of precision associated with excavation and recording in 1 by 1 m grid units. Sediments removed during excavation were screened through 1/4-inch mesh hardware cloth to recover associated artifacts. Plans of each extramural area were drawn, showing their configuration and the grid units included in each.

Botanical Sampling

The collection of samples for botanical analysis focused on contexts that could provide the best information on plant use and foodways or that contained materials amenable to absolute dating. Three types of botanical samples were collected—flotation, radiocarbon, and macrobotanical. No wood samples suitable for dendrochronological analysis were found at any of the sites. The collection of flotation samples was standardized to recover consistent data from similar contexts. Soil samples suitable for pollen, phytolith, or starch analysis were removed from each flotation sample, though no samples were submitted for pollen analysis because all were obtained from burned features and fire destroys pollen. Flotation samples were obtained from features that were large enough to produce sufficient material for sampling and that actually contained cultural deposits. At least one sample was obtained from small features. Multiple samples were obtained from larger features, with at least one sample being collected from each stratum defined. When multiple grid units were excavated into a large feature, cultural strata in each grid unit were often sampled.

Macrobotanical samples were collected, when observed, to aid in defining prehistoric or historic foodways and botanical resource use. Burned seeds and other plant parts were collected when encountered during excavation or screening if they had potential to provide information on botanical resource use. Unburned materials were not retained for analysis. While macrobotanical specimens do not represent a statistically valid sample, they can provide important subsidiary information on how plants were used at an archaeological site.

When available, samples of charcoal for radiocarbon analysis were taken from thermal features and the small structures, focusing on the recovery of fragments of brush and other short-lived species. Samples of charcoal were also taken for geomorphological and stratigraphic studies, when available. Besides providing temporal data, the species composition of radiocarbon samples provided information on fuel-wood use patterns and could also provide stable carbon isotope data for environmental/paleoclimatic reconstruction.

Metal Detector Surveys

Metal detector surveys were conducted in two different situations. Areas around excavated features on larger sites and the entirety of smaller sites were examined using transects spaced 3–5 m apart in order to search for buried metal objects during the initial phase of research investigations. After the radiocarbon dates were obtained, in May 2012, we returned to the three sites that had features dating to the Protohistoric or Historic periods. These features, together with other undated features near the Protohistoric- or Historic-period features at LA 155963, and some of the presumably historic red rock features, were examined through more intense and concentrated metal detection efforts. Transects were a meter or less apart and the sizes of the areas investigated varied (Table 5.1). The only metal artifact found was a modern aluminum arrow tip recovered near one of the red rock features (Feature 147). Pieces of molten rock associated with the red rock features generally did not register as metallic but two were slightly "hot."

6 | Investigations at LA 111422

Introduction

This small Mesilla-phase Jornada Mogollon artifact scatter with associated features and a possible Late Archaic component is located on NMSLO trust land. BLM public land lies about 13 m to the east of the site boundary. LA 111422 was determined "eligible" to the NRHP under Criterion "d" because it has integrity (51–75 percent), features and temporally diagnostic artifacts, and the potential to yield subsistence remains and dating materials. Under the current plans, a proposed utility corridor will bisect the site and impact just over half of the eastern portion of the site including two features. A fence marks the boundary between NMSLO and BLM land and, according to Quaranta and Gibbs (2008:206, 209, 395), an abandoned two-track road parallels the fence on the BLM side. At present, the two-track road is no longer visible. Research-oriented investigations were initiated to examine a sample of features in order to see if cultural deposits are preserved and to collect dateable materials to provide a more accurate idea of when LA 111422 was occupied. Other reasons for this study include obtaining information on subsistence practices, season of occupation, mobility patterns, and whether multiple occupations are represented.

Previous Work

In 1995, HSR recorded the site as a small, diffuse, chipped stone scatter with ceramics and fire-cracked rock but no fire-cracked rock features. An estimated 100 surface artifacts were noted and a random sample of 19 artifacts was analyzed (FAA and NMSA 2010b:31).

Zia revisited the site in 2007. Only 16 artifacts were located during that study, including a sherd and a piece of ground stone. However, they found a possible Late Archaic projectile point and three fire-cracked rock features; they analyzed 14 of the chipped stone artifacts (Quaranta and Gibbs 2008:206–211). OAS revisited the site in September of 2010 to assess current conditions at the site.

Site Setting

The site is in a fairly flat area covered with low undulating dunes that are stabilized by mesquite, soaptree yucca, broom snakeweed, bush muhly, and range grasses. Jornada Draw is approximately 800 m to the east (FAA and NMSA 2010b:31).

Preliminary Site Description

HSR archaeologists originally estimated the site size as 7,850 sq m (0.76 hectares, 1.9 acres). They described the site as a small, diffuse, chipped stone artifact scatter with eight El Paso Brown sherds. Surface artifacts also included nine pieces of ground stone (four basin and one slab metate fragment), three cores, and 19 pieces of debitage including flakes and angular debris, four pieces of which were unifacially utilized. Scattered pieces of fire-cracked rock were observed but no fire-cracked rock features were defined. HSR proposed that the site dates to the Mesilla phase of the Jornada Mogollon culture based on the ceramics and they suggested that it may have been a temporary campsite or short-term processing area. (Site form; FAA and NMSA 2010b:31).

Zia archaeologists shifted the site boundary 31 m to the south and farther west of the fence (FAA and NMSA 2010b:31, 62) resulting in a site measuring 50 by 60 m (2,274 sq m, 0.23 hectares, 0.56 acres) in size (Fig. 6.1). They were unable to locate most of the chipped stone artifacts observed by HSR and they described the site as a sparse scatter of chipped stone artifacts with a single brown ware sherd, a Late Archaic-like projectile point that is not described, and a boulder metate fragment in an area with three fire-cracked rock features. The fire-cracked rock features ranged from 0.50 to 2.0 m in diameter with a fairly low degree of fragmentation from thermal alteration. Two of these features were within the stabilized dunes and had the potential to contain subsurface cultural deposits. Analyzed chipped stone artifacts included three pieces of angular debris, eight flakes, two cores, and a tested cobble. Zia felt the features and artifacts, including the wear on the boulder metate fragment, suggest a somewhat extended duration or repeated occupations (FAA and NMSA 2010b:21; Quaranta and Gibbs 2008:207).

Research-Oriented Investigations

OAS investigations at LA 111422 began with mapping, using a total station to record the locations of all visible features and surface artifacts, and to lay out excavation and surface strip areas (Fig. 6.1). The redefinition of site boundaries was based on the distribution of artifacts and features observed during this investigative phase, and were substantially expanded to the west and north (Fig. 6.1). As currently defined, LA 111422 covers 4,507.44 sq m (0.45 ha, 1.114 acres). All visible surface artifacts within this area were point provenienced and recorded. Only artifacts within excavation areas or that were temporally diagnostic were collected. A considerable amount of erosion is evident at this site. Most features are badly deflated, with associated fire-cracked rock scattered over areas that were larger than the original limits of the features. Many of the artifacts occur in deflated areas and have potentially been moved both horizontally and vertically by erosion.

Research-oriented investigations resulted in the identification of six fire-cracked rock features. More than 400 artifacts were collected or recorded in the field, representing a substantial increase in artifact frequency as compared to that documented by earlier recording efforts. Table 6.1 lists the grids excavated and the number of grid units excavated.

Two of the three previously identified features and one of the newly discovered features were investigated during this phase. Since the research design called for excavating three features, the three that were considered to have the most potential for containing intact subsurface deposits were excavated. Four surface-strip areas covering a total of 32 sq m were also excavated. A single geomorphological soil pit (BHT 17) was placed near the center of this site (Fig. 6.1).

Surface Strip and Collection Areas

As specified in the research design, between 20 and 80 sq m were to be hand excavated to the base of cultural deposits or to the base of potential artifact-bearing soils as determined by the project geomorphologist (Moore et al. 2010:111). Soils considered capable of containing artifacts are those that were deposited on top of the Pleistocene-age piedmont alluvium that forms the substrate in the study area (see Chapter 21). Excavation was conducted in 4 surface strip areas of variable size using 2 by 2 m excavation units in each. Surface strip areas were placed within artifact clusters or in areas containing temporally diagnostic artifacts in order to collect the maximum amount of data available at this level of examination. All visible surface artifacts were point provenienced and field analyzed, and then, unless they fell within excavation areas or were temporally diagnostic, were left in place.

Surface Strip 1. This excavation area was used to examine a scatter of artifacts defined during site mapping and to determine whether the scatter represented the surface expression of a larger deposit of cultural materials. Four 2 by 2 m excavation units were included in this surface strip, and all 16 grid units were excavated (grid units 906–909N/647–650E). As shown in Figure 6.1, Surface Strip 1 was in the central part of LA 111422, just east of the mechanically excavated soil pit (BHT 17). The loose sediment mantle was stripped from all 16 grid units, stopping when more compact caliche-flecked sediments were encountered. Plants were very sparse in this area, covering up to 5 percent of the surface, and primarily consisted of grasses and snakeweed. Fire-cracked rock fragments (n = 8) occurred on the surface of 6 grid units and—within the entire 16 excavation units—averaged only 0.50 pieces per grid unit. Six chipped stone artifacts and 8 sherds were collected from the surface of this 16-unit excavation area, yielding averages per grid unit of 0.38 and 0.50, respectively.

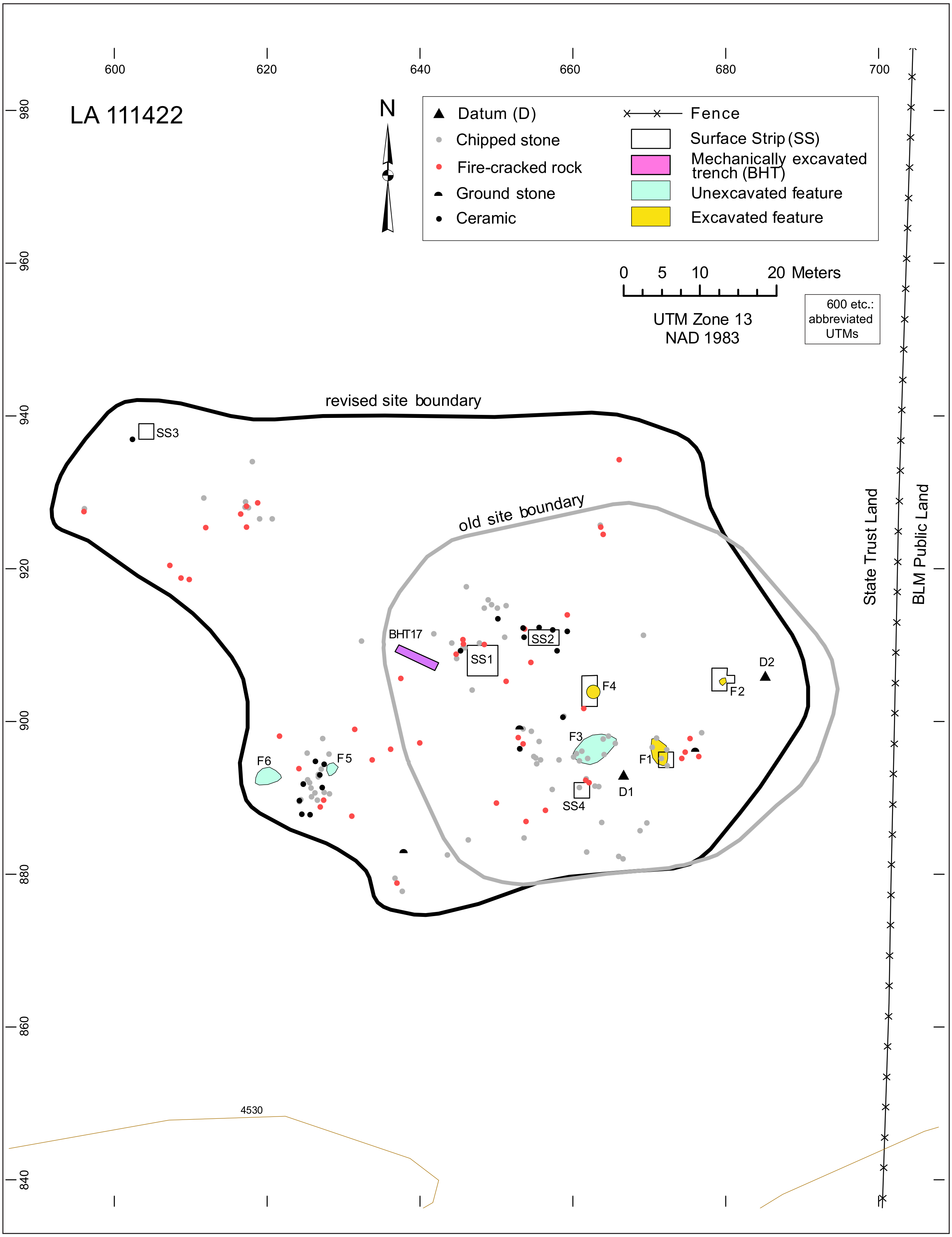

Figure 6.1. LA 111422, site plan.

Table 6.1. LA 111422, summary of excavation areas.

Excavation Area	Included Grids	No. of Surface Stripped and Excavated Grids	Excavated Artifacts
Surface Collection	n/a	n/a	22 ceramic
Feature 1	894-895N/672-673E	4	2 flot. samples
Feature 2	904N/679-680E, 905N/679-681E, 904N/679-680E	7	1 flot. Sample
Feature 4	902-905N/662-663E	8	6 ceramics 8 chipped stone 4 bone 2 flot. samples
Surface Strip Area 1	906-909N/647-650E	16	50 ceramics 30 chipped stone
Surface Strip Area 2	910-911N/655-658E	8	148 ceramics 14 chipped stone 1 bone
Surface Strip Area 3	937-938N/604-605E	4	none
Surface Strip Area 4	890-891N/661-662E	4	1 ceramic 1 chipped stone

Two strata were encountered during excavation. Stratum 1 covered the surface and was a light brown loamy sand that contained less than 1 percent small gravel inclusions. This sediment unit averaged 5.83 cm thick in this area and varied in depth across the excavation unit, ranging from 2 to 11 cm. A moderate amount of bioturbation was caused by plant roots, an ant hill, and rodent burrows. Fire-cracked rock was much more common in this subsurface context, with 100 fragments occurring for an average of 6.25 pieces per grid unit. Artifacts were also much more common in this stratum than surface indications suggested, with 42 sherds and 34 chipped stone artifacts being recovered from Stratum 1. Thus, there was an average of 2.63 sherds and 2.13 pieces of chipped stone per grid unit in Stratum 1.

The second layer of sediment, which was not numbered because it was not excavated, was essentially the same as Stratum 6 at LA 111435, consisting of a compact brown silty loam that contained flecks of caliche. The occurrence of the caliche indicated that this stratum was the pre-occupational substrate, so excavation ended when it was encountered.

<u>Assessment of Surface Strip 1</u>

While numerous artifacts were recovered from Stratum 1, this layer of sediments does not appear to represent an intact cultural deposit. Rather, the artifacts were probably deposited on the surface in this area and have become mixed in with Stratum 1 through bioturbation and perhaps by deflation. This conclusion was supported by the lack of soil staining, charcoal, and ash in Stratum 1. However, the fact that all 50 sherds were the same type of pottery and were tempered with the same material (crystalline igneous) suggests that a single Jornada Brown jar may be represented. If this is correct, then these materials retain some spatial integrity, though the sherds were scattered across at least 13 grid units.

Surface Strip 2. This excavation area was to the east–northeast of Surface Strip 1 and was used to investigate a scatter of sherds to determine whether they represented a pot drop (Fig. 6.1). Two 2 by 2 m excavation units were included in this area, and all 8 grid units were excavated (910–911N/655–658E). The loose sediment mantle was stripped from all units, stopping when more compact caliche-flecked sediments were encountered. Vegetation was sparse, with only about 2 percent of the surface covered by grasses and snakeweed. Fire-cracked rock fragments were noted on the surface of 3 grid units, but were not counted. Four chipped stone artifacts and 16 sherds were collected from the surface, yielding respective averages of 0.50 and 2.00 per grid unit.

Two strata were encountered during excavation. Stratum 1 covered the surface and was a light brown loamy sand that contained less than 1 percent pea gravel inclusions. This layer averaged 4.61 cm thick and varied in depth across the excavation area, ranging from 2 to 7 cm deep. A moderate amount of bioturbation was noted; it was caused by plant roots and surface traffic. Fire-cracked rock was somewhat more common in subsurface contexts, with 16 fragments being noted for an average of 2.00 pieces per grid unit. Artifacts were much more common than surface indications suggested, with 132 sherds, an indeterminate piece of ground stone, and 11 pieces of chipped stone occurring in Stratum 1. The average numbers of sherds and chipped stone artifacts per grid unit were 16.50 and 1.38, respectively. The second layer of sediments encountered was again the same as Stratum 6 at LA 111435, consisting of a compact brown silty loam that contained flecks of caliche. Excavation again ended when these materials were encountered.

<u>Assessment of Surface Strip 2</u>

Considering the number of sherds recovered from this area, at least one pot drop appears to be represented. However, when the ceramic assemblage is examined more closely, the presence of multiple vessels becomes evident. Three ceramic types are represented, including: El Paso Polychrome (n = 1); El Paso Brown Ware (n = 1); and Jornada Brown Ware (n = 146). Since the El Paso Polychrome and Brown Ware sherds are both tempered with granite and represent, respectively, sherds from a jar rim and a jar body, the likelihood that they derive from the same vessel is high. Two tempers are represented in the array of Jornada Brown sherds (crystalline igneous = 145, Mogollon volcanics = 1), indicating the presence of at least two vessels. The crystalline igneous-tempered Jornada Brown body sherds exhibit three different surface treatments (polished interior and exterior = 1, unpolished = 35, and polished exterior = 94). This suggests that these sherds could represent at least three different vessels, though this is uncertain since a single vessel can exhibit different surface treatments in different areas. Thus, sherds from at least three and perhaps as many as five different vessels were recovered from this surface strip. This suggests a discard zone rather than a single pot drop. The widely scattered nature of these sherds throughout the excavation area suggests considerable movement due to bioturbation and erosion/aggradation.

Surface Strip 3. This excavation area was in the far northwest part of LA 111422 and was used to investigate an area near where two atypical brown ware sherds were collected during the surface inventory (Fig. 6.1). This was done in order to try to find related specimens, if any were present. Surface Strip 3 consisted of a single 2 by 2 m excavation area, and all four grid units were excavated (937–938N/604–605E). The loose sediment mantle was stripped from these grid units, stopping when more compact carbonate-indurated sediments were encountered. Surface vegetation was sparse, with about 3–5 percent of the surface covered by snakeweed. No fire-cracked rock was noted on the surface, and no artifacts besides the two sherds collected during the surface inventory were found. Since the sherds actually were recovered from grid unit 936N/603E, there were no surface artifacts within the area covered by Surface Strip 3.

Two strata were encountered during excavation. Stratum 1covered the surface and was a light brown loamy sand that contained only two pieces of gravel and no artifacts or fire-cracked rock. Stratum 1 averaged 3.44 cm thick in this area, and varied in depth across the excavation area, ranging from 1 to 13 cm deep. The only evidence noted for bioturbation was plant roots. The second layer of sediments was again the same as Stratum 6 at LA 111435, consisting of a compact brown silty loam that contained flecks of caliche. Excavation ended when these sediments were encountered.

<u>Assessment of Surface Strip 3</u>

The lack of any artifacts other than the two sherds recovered from the surface of an adjacent grid unit suggests that no intact cultural deposits occur in this part of the site. Analysis showed that these sherds were not actually atypical, but represented fragments of a Jornada Brown bowl.

Surface Strip 4. This excavation area was just south of Feature 3 in the southeast part of LA 111422, and was used to investigate a part of the site where a projectile point was collected during the surface inventory and to determine whether associated materials were present (Fig. 6.1). One 2 by 2 m excavation area was included in Surface Strip 4, and all four grid units were excavated (890–891N/661–662E). The loose sediment mantle was stripped from these grid units, stopping when more compact caliche-flecked sediments were encountered. Surface vegetation was sparse, and less than 1 percent of the surface was covered by small grasses and a single mesquite plant. No fire-cracked rock fragments were noted on the surface and no additional artifacts were found.

Two strata were encountered during excavation. Stratum 1 covered the surface and was a light brown loamy sand that contained less than 1 percent pea gravels, only one fragment of fire-cracked rock, and two artifacts. Disturbances were common, consisting of roots and rodent burrows. This stratum averaged 4.78 cm thick, and was of a fairly even depth across the excavation unit, ranging from 4 to 7 cm. A single sherd from a Jornada Brown bowl, the aforementioned projectile point, and a chert core flake were the only artifacts recovered in addition to the piece of fire-cracked rock, with sherds averaging 0.25 specimens per grid unit and chipped stone artifacts 0.50 per grid unit. Analysis indicated that the projectile point was actually a medium-sized corner-notched arrow point preform that was abandoned during manufacture, probably because the tip broke off at a flaw. The second layer of sediments encountered was again the same as Stratum 6 at LA 111435, and consisted of a compact brown silty loam that contained flecks of caliche. Excavation ended when these materials were encountered.

<u>Assessment of Surface Strip 4</u>

The presence of a sherd in addition to the projectile point preform suggested that these artifacts were probably associated with the general scatter of Mesilla-phase materials in this part of the site. The identification of the preform as such is important because initial field examination identified this specimen as a possible Archaic point, in which case it could have been evidence for multiple components. No significant deposits of cultural materials or evidence of an earlier component were found in this area, and the artifacts that were found were probably displaced from their original locations by bioturbation and by deflation.

Feature Descriptions

Zia recorded three fire-cracked rock features at LA 111422. Features 1 and 2 were believed to have good potential for subsurface deposits based on their location within a mesquite-stabilized dune (Quaranta and Gibbs 2008:206, 211). OAS proposed to investigate the three features described by Zia (Moore et al. 2010a:111). Three additional features—4, 5, and 6—were identified during research-oriented investigations; Feature 4 was excavated in place of Feature 3 as it (Feature 4) appeared to have more potential to yield useful information. The other features were inventoried and described.

Feature 1 (stain)

Feature 1 was initially identified as a 2.1 by 1.6 m scatter of about 16 fire-cracked rocks located within a dune (Quaranta and Gibbs 2008: 211). OAS observed 15 to 20 pieces of fire-cracked rock and an area of charcoal-stained soil (Fig. 6.2) and placed a 1 by 1 m grid unit over the stained sediment. The upper 2 cm of fine-grained yellow brown sand (7.5 YR 6/4 dry) were removed from the grid unit, exposing a stain measuring about 15 by 15 cm. The stain was fairly diffuse and a trench somewhat larger than the stain was excavated up to the center of the feature to observe it in profile (Figs. 6.3, 6.4). The profile suggested that the stain was fill preserved in a rodent burrow or other natural feature and the actual cultural feature may have deflated entirely. The charcoal-stained fill was loose eolian sand with charcoal flecks. A single chipped stone artifact, a metaquartzite core flake fragment, was collected from the fill above the feature and much of the dark fill was collected as flotation samples. Two flotation samples from the fill contained only burned yucca caudex and saltbush. A saltbush wood radiocarbon sample produced a Mesilla-phase date of cal AD 541–642 (Boyer, Chapter 19, this report).

The three grid units to the north, northeast, and east of Feature 1 were surface stripped to determine whether associated artifacts were present. All had small numbers of fire-cracked rock on the surface but contained no charcoal-stained soil. The grid unit just east of the feature had core flakes of limestone, metaquartzite, and chert (n = 1 apiece).

Feature 2 (small rock-filled fire pit)

Zia described Feature 2 as scatter of 12 pieces of fire-cracked rock measuring 0.8 by 0.6 m and located in a dune (Quaranta and Gibbs 2008:211). OAS placed a 1 by 2 m excavation unit over and to the south of the densest concentration of rocks (Fig. 6.5). Up to six cm of loose dune sand was removed, exposing a circular arrangement of fire-cracked rock that was probably the base of a small fire pit (Figs. 6.6, 6.7) excavated into a more compact matrix of sandy loam. The shallowly excavated pit was disturbed by rodent and insect burrows. It measured 34 by 30 cm by 6 cm deep, and was filled with loose light brown (7.5 YR 5/4 dry) sandy loam that contained no charcoal but had 32 pieces of fire-cracked rock. A flotation sample was collected.

Five additional grid units were surface stripped around Feature 2 in an effort to better define the feature and to recover potentially associated artifacts (Fig. 6.7). Stratum 1, the loose upper fill, was eolian silty sand (7.5 YR 6/4) containing some gravel and sparse fire-cracked rock. No artifacts were found in this feature or in the grid units around the feature, and no burned plant material was recovered in the flotation sample.

Feature 3 (fire-cracked rock scatter)

Zia described Feature 3 as a small (0.6 by 0.3 m) scatter of 8 pieces of fire-cracked rock (Quaranta and Gibbs 2008:211). OAS observed a 6.7 m north–south by 9.0 m east–west scatter of 40 to 50 pieces of fire-cracked rock surrounding a sand hummock stabilized by mesquite (Fig. 6.8). It has a maximum density of 4 rocks in a 50 by 50 cm area and the rocks are primarily limestone and igneous cobbles, with some of sandstone and quartzite. A projectile point preform was found within a few meters of the feature. No ash was visible in the vicinity but the fire-cracked rock scatter extends under the dune so the feature may have some potential for subsurface deposits.

Feature 4 (deflated fire pit)

Although Feature 4 was not noted by Zia, it is located at the center of the area they defined as the site. When found, it was a sparse scatter of five pieces of fire-cracked rock within a meter of an area of carbon-stained sediment at the edge of a mesquite-stabilized dune (Fig. 6.9). A 1 by 2 m excavation unit was placed over the stained soil. Removal of up to 5 cm of loose mesquite stabilized dune sand (7.5 YR 4/4) containing no gravel or

Figure 6.2. LA 111422, Feature 1, before excavation.

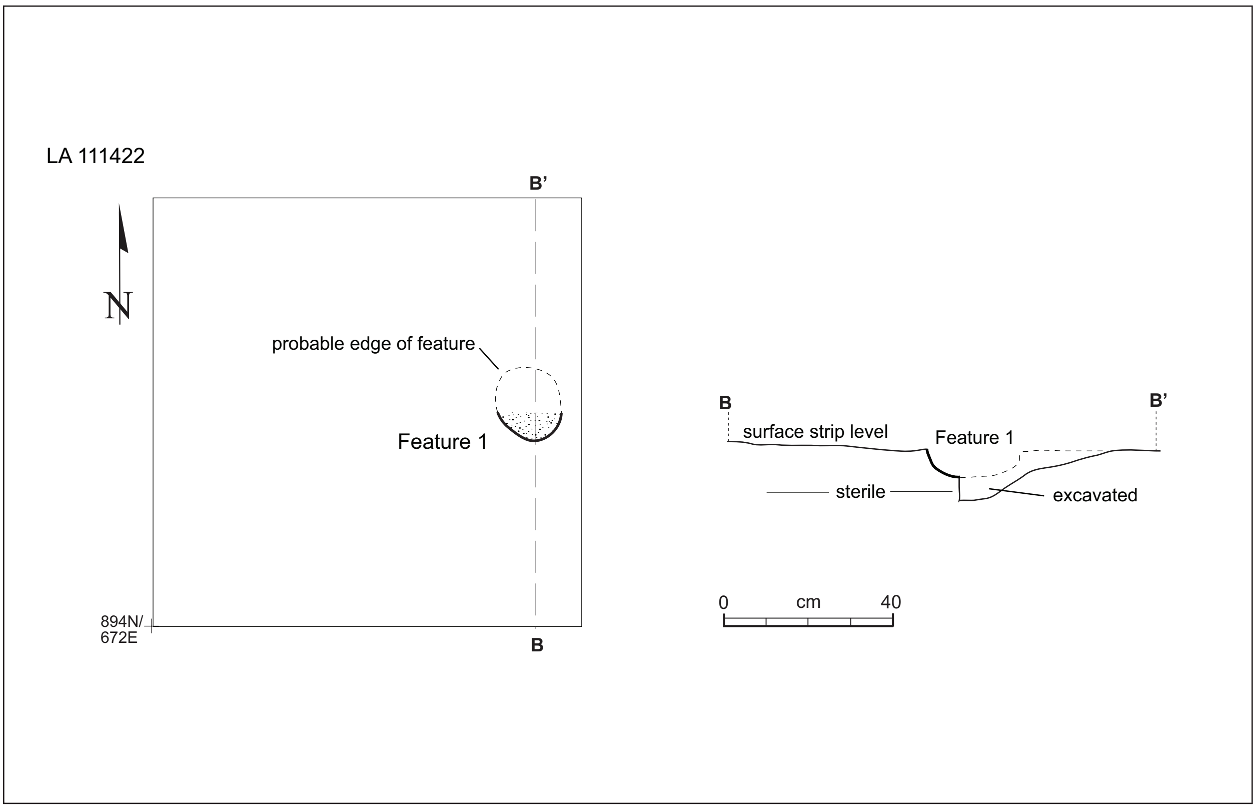

Figure 6.3. LA 111422, Feature 1, plan and profile.

Figure 6.4. LA 111422, Feature 1 profile.

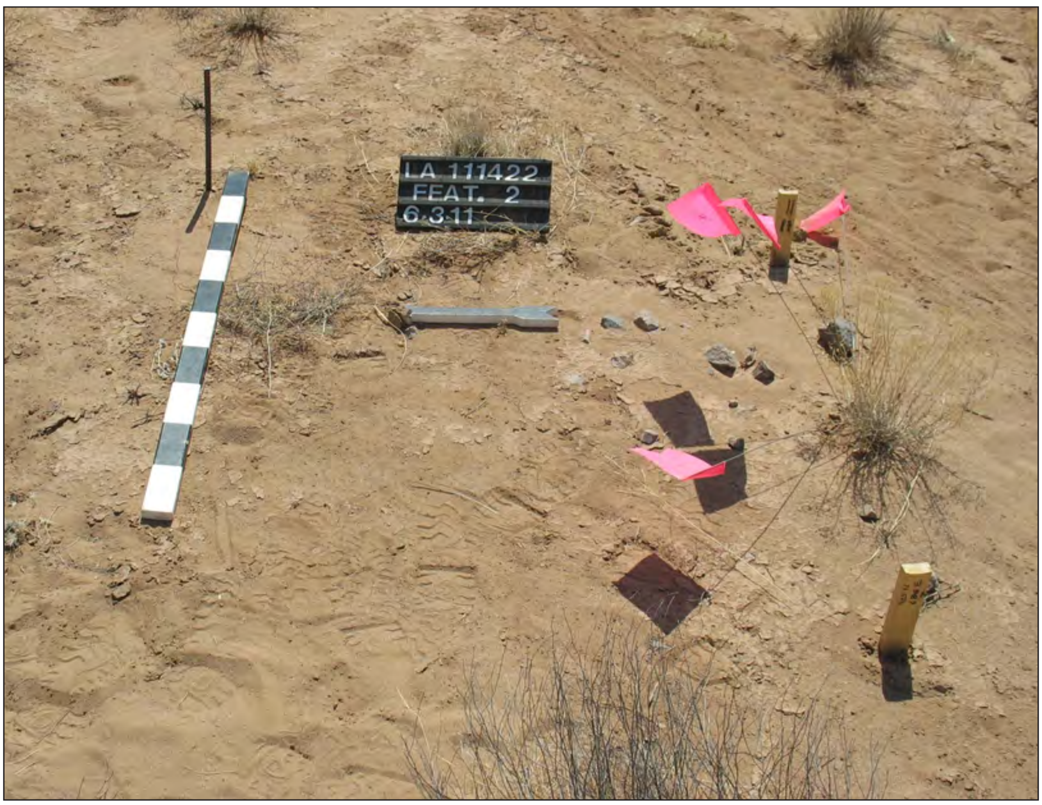

Figure 6.5. LA 111422, Feature 2, before excavation.

Figure 6.6. LA 111422, Feature 2, with fire-cracked rock exposed.

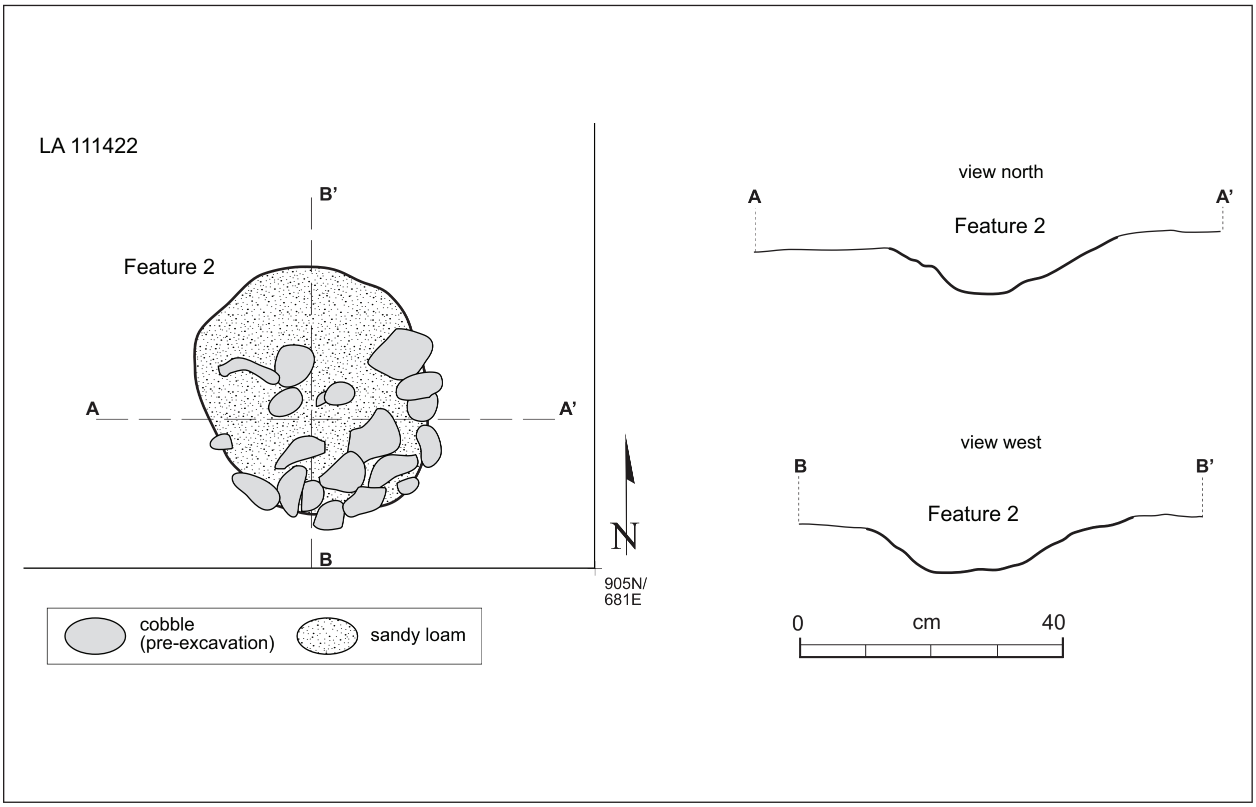

Figure 6.7. LA 111422, Feature 2, plan and profiles.

charcoal (Stratum 1) revealed an amorphous area of darkly stained soil occupying much of the north half of grid unit 903N/663E and the southern part of 904N/663E, which also had a second stain in the northern portion of the grid unit (Fig. 6.10). The stain was bisected and the west half of the pit fill (Stratum 2) was removed to obtain a profile of the feature (Fig. 6.11). Stratum 2 was darkly stained (7.5 YR 3/3 dry) and contained a few charcoal flecks, fire-cracked rock fragments (n = 5), and two limestone core flakes. The feature was within the dune and was damaged by a mesquite root and both rodent and insect burrows, leaving the pit walls indistinct (Fig. 6.12). The stained fill covered a 90 cm east–west by 60 cm north–south area with a maximum depth of 8 cm.

A total of eight grid units were surface stripped over and around Feature 4 in an effort to define the feature and recover potentially associated artifacts. This resulted in the recovery of 16 pieces of fire-cracked rock, 6 ceramics, 14 chipped stone artifacts, and 4 bones. The ceramics are all Jornada Brown body sherds with igneous temper. Chert was the dominant lithic material and included 4 core flakes, 1 biface flake, and 5 pieces of angular debris. The four remaining chipped stone artifacts are all core flakes, 2 of limestone and 2 of metaquartzite. None of the chipped stone artifacts are utilized but cortex covers the entire dorsal surface on one chert core flake, possibly suggesting some initial core-reduction activities around this feature. All of the bones are from cottontail rabbits. Three are unburned and one is burned. Two flotation samples produced burned yucca caudex and cheno-ams as well as saltbush fuel wood. A radiocarbon date on yucca caudex produced a date of cal AD 568–654 (Boyer, Chapter 19).

Feature 5 (fire-cracked rock scatter)

Features 5 and 6 are to the west of Zia's original site boundary, in an area of sparse fire-cracked rocks, chipped stone artifacts, and ceramics. Feature 5 is a dispersed fire-cracked rock scatter with a concentration bordered by mesquite stabilized dunes and large tufts of grass (Fig. 6.13). The overall scatter measures 9.0 m north–south by 14.0 m east–west and the more concentrated area is 1.0 m north–south by 1.5 m east–west. It is composed of about 30 fire-cracked rocks with a maximum density of eight rocks in a 50 by 50 cm area. The rock in this feature consists mainly of igneous and limestone cobbles with fewer pieces of sandstone and quartzite. Sparse chipped stone artifacts are present in the area but no evidence of ash or buried fire-cracked rock is visible. It does not appear to extend beneath the coppice dune, so that the potential for buried deposits associated with this feature is low.

Feature 6 (fire-cracked rock scatter)

Feature 6 lies at the west margin of the newly defined site boundary. It is a small concentration of about 20 fire-cracked rocks measuring 2.7 m north–south by 1.4 m east–west. It is at the edge of a mesquite-stabilized dune (Fig. 6.14), has a maximum density of eight rocks in a 50 by 50 cm area, and mainly includes igneous cobbles with some limestone and sandstone. No artifacts were observed in the immediate vicinity and no ash was visible.

Artifact Assemblages

Information from two levels of artifact analysis is available for LA 111422. All artifacts recovered from excavation areas were subjected to a full laboratory analysis. Surface artifacts that did not occur in excavated areas were point provenienced and analyzed in the field unless they were temporally diagnostic. Artifacts with the potential to provide information on the date of occupation, like sherds and projectile points, were point provenienced and collected for more detailed analysis. In-field analysis of ground stone artifacts was limited to defining the type and portion of artifact represented, and identification of the materials from which they were made. A more rigorous in-field analysis was applied to chipped stone artifacts, with material type and quality, artifact morphology and function, cortical coverage and type, portion, platform type, presence of a platform lip, evidence for thermal alteration, and dimensions being recorded.

In-Field Analyses

In-field artifact analyses collected information on 52 chipped stone artifacts, 7 ground stone artifacts, and 49 pieces of fire-cracked rock. Two of the chipped stone artifacts—a projectile point fragment and a piece of obsidian debitage—were also collected for more detailed analysis. The chipped stone assemblage was dominated by various cherts (n = 35, 67.31 percent), and also included limestone (n =

Figure 6.8. LA 111422, Feature 3.

Figure 6.9. LA 111422, Feature 4, before excavation.

Figure 6.10. LA 111422, Feature 4, after excavation.

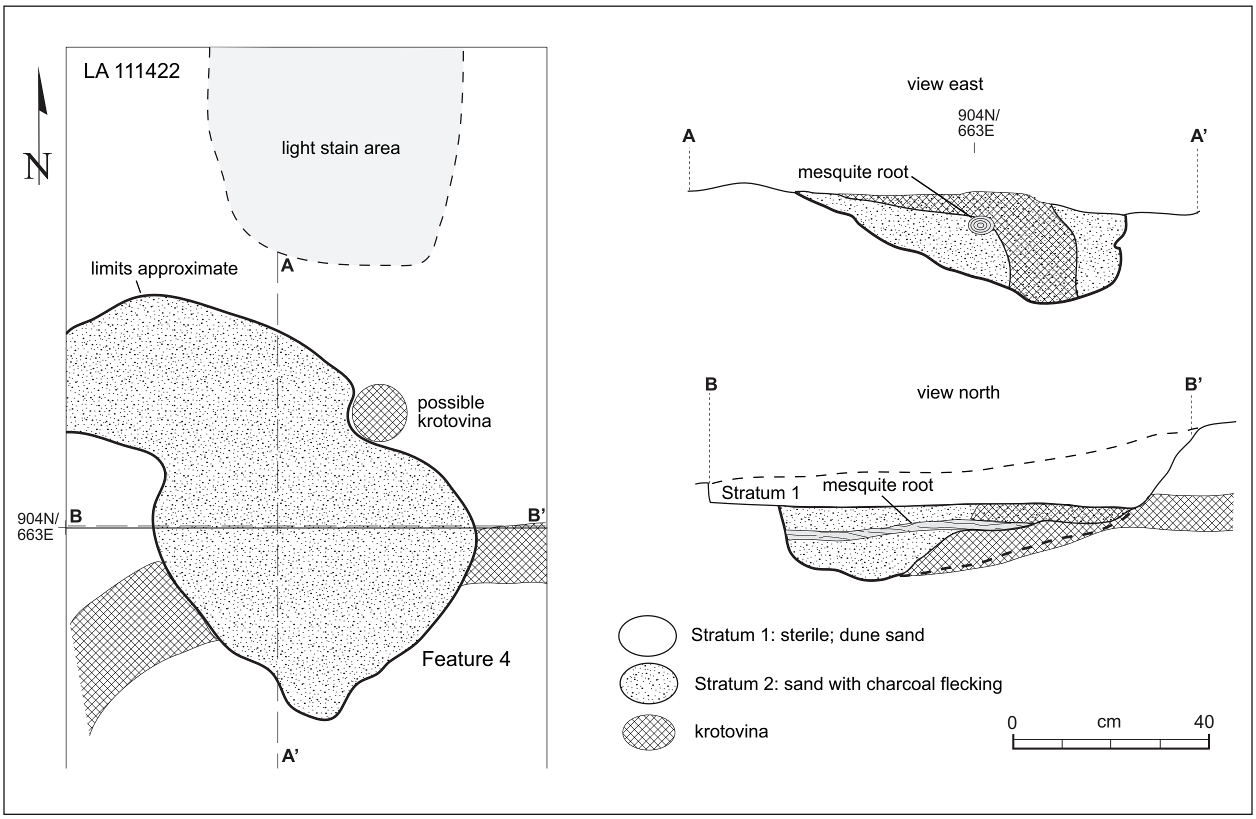

Figure 6.11. LA 111422, Feature 4, plan and profiles.

Figure 6.12. LA 111422, Feature 4, profile.

Figure 6.13. LA 111422, Feature 5.

Figure 6.14. LA 111422, Feature 6.

9, 17.31 percent), metamorphic undifferentiated (n = 5, 9.62 percent), metaquartzite (n = 2, 3.85 percent), and obsidian (n = 1, 1.92 percent).

Only 3 chipped stone tools—an early stage uniface, a projectile point tip, and a hammerstone—were analyzed in the field. A more exact function could not be defined for the uniface. From the size of the projectile point tip, it was interpreted as having been part of a dart point made from thermally altered gray chert. The remaining chipped stone artifacts were all debris generated during core reduction. Core flakes dominated these artifacts (n = 64, 77.11 percent), followed by angular debris (n = 8, 9.64 percent), cores (n = 7, 8.43 percent), and a tested cobble (n = 1, 1.20 percent).

Seven ground stone artifacts were recorded on the site surface, though only three individual tools were represented. They consisted of a sandstone metate fragment, a complete basalt slab metate, and five fragments of a sandstone basin metate. Individual pieces of fire-cracked rock that were not directly associated with thermal features were also inventoried. This assemblage of fire-cracked rock was dominated by undifferentiated igneous materials (n = 30, 61.22 percent), followed by limestone (n = 9, 18.37 percent), vesicular basalt (n = 7, 14.29 percent), sandstone (n = 2, 4.08 percent), and rhyolite (n = 1, 2.04 percent).

Laboratory Analyses

Summaries of the results of the laboratory analyses are provided here, with more detailed discussions provided in the synthetic chapters later in this volume. These assemblages include chipped stone artifacts, sherds, faunal remains, floral remains, and radiocarbon samples. No ground stone tools were recovered during excavation at LA 111422.

Chipped Stone. Seventy-nine chipped stone artifacts were recovered during investigations at LA 111422. Forty specimens (50.63 percent) were recovered from Surface Strip 1, and included core flakes (n = 30, 75.00 percent), angular debris (n = 9, 22.50 percent), and one biface flake (2.50 percent). Surface Strip 2 yielded 15 specimens (18.99 percent) consisting of 10 core flakes (66.67 percent), 4 pieces of angular debris (26.67 percent), and a corner-notched arrow point (6.67 percent). A core flake was the only specimen from Surface Strip 4 (1.23 percent). Four core flakes (5.06 percent) were recovered from the Feature 1 surface strip, and 2 core flakes were recovered during the excavation of this feature. Fourteen specimens (17.28 percent) were recovered from the surface strip around Feature 4, including: core flakes (n = 8, 57.14 percent); angular debris (n = 5, 35.71 percent); and a biface flake (7.14 percent). The three remaining specimens came from the general surface collection (n = 3; core flake, core, and a projectile point preform).

Various cherts dominated this part of the assemblage (n = 43, 54.43 percent), which also included limestone (n = 19, 24.05 percent), metaquartzite (n = 14, 17.72 percent), and siltstone (n = 3, 3.80 percent). Dorsal cortex occurred on nine specimens (7 chert and 2 metaquartzite), and in each case it was waterworn suggesting that most if not all of the materials used at this site were obtained from local gravel deposits.

Ground Stone. A single piece of ground stone was recovered in the first level of excavation in Surface Strip Area 2. It is a fire-fractured piece of a rhyolite indeterminate object.

Ceramics. A total of 227 sherds were collected from five general proveniences at LA 111422 including the general site surface (n = 22, 9.69 percent), Surface Strip 1 (n = 50, 20.03 percent), Surface Strip 2 (n = 148, 65.20 percent), Surface Strip 4 (n = 1, 0.44 percent), and the area that was surface stripped around Feature 4 (n = 6, 2.64 percent). Overall, the assemblage was dominated by Jornada Brown (n = 216, 95.15 percent), followed by El Paso Brown (n = 10, 4.41 percent), and El Paso Polychrome (n = 1, 0.44 percent). All of the El Paso Brown and Polychrome sherds are from jars. Twenty-one of the Jornada Brown sherds are also from jars (9.72 percent), while the vessel form from which the remaining 195 specimens of this type derived could not be defined. All of the El Paso Brown and Polychrome sherds are tempered with granite, but since most of the El Paso Brown sherds were scattered across the site area rather than being clustered in one or just a few areas, the number of vessels represented is impossible to determine. Similarly, there is no way to determine just how many Jornada Brown vessels are represented since sherds of this type are also scattered across most of the site area and vessel form could not be defined for most of them. However, in this case two different types of temper are represented—crystalline igneous and Mogollon volcanics. This indicates that at least two and possibly more Jornada Brown vessels are represented in this assemblage.

Modifications related to use were noted on a number of sherds. A total of 73 sherds (32.16 percent) exhibit interior wear indicative of use as cooking vessels, and one sherd has a beveled edge from an unidentified type of use. Most of the use-modified sherds (n = 58, 78.38 percent) were recovered from Surface Strip 2 (57 were modified from cooking, 1 had a beveled edge). The rest of the cooking modified sherds came from Surface Strip 1 (n = 9, 12.16 percent) and the general surface collection (n = 7, 9.46 percent). Thus, modified sherds represent 38.51 percent of the specimens recovered from Surface Strip 2, 18.00 percent of those from Surface Strip 1, and 31.82 percent of the surface-collected sample.

Fauna. Five pieces of animal bone were recovered during excavation, all from mature cottontails. A single specimen was found in Surface Strip 2, while four pieces were recovered from the area around Feature 4 that was surface stripped. Only the piece from Surface Strip 2 and one of the fragments from the Feature 4 surface strip were burned and therefore probably of cultural derivation. Two of the unburned specimens from the Feature 4 surface strip may have gone through the digestive system of a carnivore, so it is possible that these specimens as well as the other two unburned fragments are non-cultural.

Flotation. Five flotation samples were collected and analyzed from Features 1, 2, and 4. Charred plant parts were uncommon, and included fragments of yucca caudex and cheno-am seeds. Since these specimens were charred and came from cultural features, they are probably indicative of prehistoric use. While the cheno-am seeds undoubtedly represent food use, the yucca caudex could either be indicative of use of yucca as food or fuel. A wide range of other plants were also represented in the samples from these features, but all were unburned and therefore probably non-cultural. Saltbush wood was the only type of fuel wood identified. The presence of unburned plants that presumably were deposited in these features at a time much later than the period of use suggests a degree of disturbance, probably the result of bioturbation.

Radiocarbon. Two radiocarbon samples were obtained from Features 1 and 4, consisting of saltbush wood and yucca caudex. Both of these materials are from perennials that are not as long-lived as most trees, so the old-wood problem associated with tree wood probably does not pertain. The two standard deviation date ranges of both suggest an early Mesilla-phase occupation at this site, and probably represent a single component.

LA 111422 Summary and Recommendations

For LA 111422, OAS proposed to excavate between 20 and 80 sq m in areas near tools and within artifact concentrations, to excavate all three of the features identified by Zia archaeologists, and to mechanically excavate a trench to examine the geomorphology at the site (Moore et. al 2010a). A geomorphological trench was placed west of Surface Strip 1 (Fig. 6.1) and a total of 32 sq m of fill was removed from four areas of the site. Excavation locations were determined by the surface presence of ceramics (Surface Strips 2 and 3), ceramic and chipped stone artifacts (Surface Strip 1), and a projectile point (Surface Strip 4). None of the excavations found intact deposits, only artifacts that were probably displaced by bioturbation and deflation.

Three additional features were recorded during the research phase. All six features at LA 111422 are fairly sparse fire-cracked rock scatters, none of which appear to have great potential for producing subsistence, dating, or artifact association data. Two of the features identified by Zia were excavated and Feature 4 was substituted for the third Zia feature (Feature 3) because it appeared to have more potential for providing information pertinent to the research questions. None of the excavated features were completely intact with cultural fill. Features 1 and 4 contained carbon-stained soil and scant fire-cracked rocks, while the more intact and rock-filled Feature 2 lacked burned material. The fuel wood remains that were found in the stained soil associated with two of these features were saltbush and yucca caudex, and Feature 4 also had cheno-am remains. Both contained enough burned fuel wood to date the features to the early part of the Mesilla phase. The excavation of grids surrounding the features recovered small artifact samples, mostly chipped stone. Feature 4, and the area around it, also contained ceramics and bone.

Both Jornada Brown Ware and El Paso Brown Ware ceramics were recovered. Two (at Surface Strips 1 and 2) of the three main sherd concentrations are not associated with features (Fig. 6.1). The third is adjacent to Feature 5, which was not excavated, and the ceramics in that area are distinctive in that all are El Paso Brown jar sherds with granite temper, probably from the same vessel. Those from Surface Strip 2 are the most diverse, including mainly Jornada Brown sherds, but El Paso Brown and El Paso Polychrome sherds were also present. Surface Strip 1 mainly produced Jornada Brown sherds with a few El Paso Brown sherds. The single sherd from Surface Strip 4 is the only one with Mogollon volcanic temper, while the two specimens from Surface Strip 3 are typical of the other Jornada Brown ceramics found elsewhere at the site.

Surface chipped stone (Fig. 6.1) is spread throughout the site area with clusters between Features 5 and 6, around Features 1 and 3, and in the areas investigated by Surface Strips 1 and 2. None of the tools (projectile points, unifaces, hammerstone) were directly associated with features. The same is true for the ground stone. No tools were recovered from the excavation of features or surface strip areas. The flake to angular debris ratio is moderate (4.69:1), biface flakes comprise only 1.64 percent of the flake population, and thermal alteration of cherts was not very common (10.34 percent), especially since nearly half of the thermally altered specimens (four of nine) represent discard burns. Since three of five examples of successful thermal treatment are formal tools (a preform and two projectile points), little if any thermal alteration probably occurred at this site. The only chipped stone tools recovered were a hammerstone, a piece of utilized debitage, a uniface of undetermined function, an arrow point preform, the medial portion of a large arrow or small dart point, and a corner-notched arrow point. These types of tools suggest a limited range of activities, including hunting and general manufacture/maintenance. These characteristics are all consistent with a short-term Formative-period occupation with no good evidence for an earlier component.

The only subsistence remains from this site are burned cottontail bones and the cheno-am seeds found in the Feature 4 flotation sample. The radiocarbon dates, ceramics, and lithic assemblage are all consistent with a relatively narrow range of use during the early Mesilla phase.

LA 111422 is significant because it is relatively small and may contain only a single component since the two features with radiocarbon dates (Features 1 and 4) have dates that are statistically the same. Feature 2 is a different type of thermal feature (rock-lined) and has no associated ceramic or chipped stone artifacts. While this feature could represent a different period of occupation, this is uncertain because the feature lacked charcoal and could not be dated. The Feature 5 and 6 area has most of the El Paso Brown Ware ceramics and could also indicate a different group or occupation. The unexcavated features at this site have the potential to provide additional information on occupation of the area. This is particularly true of the Feature 3 and Feature 5 areas and the scatter of fire-cracked rock and chipped stone in the northwest part of the site.

7 | Investigations at LA 111429

Introduction

LA 111429 is a very large artifact scatter containing numerous features. Temporally diagnostic artifacts indicate the site contains components from multiple periods of occupation including Paleoindian, Archaic, and Jornada Mogollon. The site is located on NMSLO trust land, and under Criterion "d" it is determined "eligible" to the NRHP because it has integrity (51–75 percent), a large number and diverse array of features, temporally diagnostic artifacts, and the potential for providing subsistence and dating materials that can be used to address research questions concerning the prehistoric use of the area from the Paleoindian through the Jornada Mogollon periods. County Road A020, along with a series of bar ditches, passes through the eastern part of the site and may eventually require improvements (FAA and NMSA 2010b:34; Quaranta and Gibbs 2008:236, 396).

Research-oriented investigations were initiated in order to examine a selection of features at LA 111429 to collect subsistence samples, diagnostic artifacts, and dateable materials to provide a more accurate idea of when this site was occupied and how many periods of occupation might be represented by its features. Extensive surface stripping was initiated to determine whether artifacts are primarily surficial or if intact cultural deposits are present, especially in areas containing artifacts diagnostic of Paleoindian occupation. Other reasons for this study include obtaining information on subsistence practices, season of occupation, mobility patterns, and whether multiple occupations are represented (Moore et al. 2010a:119).

Previous Work

HSR first recorded this site in 1995. They estimated that about 5,000 chipped stone artifacts are present on the surface along with a few sherds. They observed an array of artifacts that includes specimens dating to the Paleoindian, Middle Archaic, Late Archaic/Early Formative, and Jornada Mogollon periods, as well as the modern era. Chipped stone debitage samples from five areas and about half of the visible tools were analyzed and many of the latter were collected. Of the eight fire-cracked rock features that were described, two had charcoal stains in association (FAA and NMSA 2010b:33; Quaranta and Gibbs 2008:236).

In 2007, Zia adjusted the site boundaries based on the surface artifact distribution observed at that time. Zia archaeologists reported temporally diagnostic artifacts dating to the Archaic and Jornada Mogollon periods and analyzed a sample of 127 artifacts. In all, 21 fire-cracked rock features were located and described during that examination (Quaranta and Gibbs 2008:239–241). Testing was conducted within a buffer zone along CR A020 by the OAS in 2010 following an approved testing plan (Moore et al. 2010). That study found no intact cultural deposits or features within the buffer, but did find a buried A soil horizon in one test pit from which bulk soil samples were obtained. Those samples were submitted for analysis during the current phase of study, and the results are presented later in this chapter. OAS defined several artifact clusters that potentially represent a variety of occupational periods, and that were examined in more detail during the current study.

Site Setting

LA 111429 lies on a flat plain that slopes gently towards Jornada Draw, a wide arroyo that lies 200 m west of the site. The north end of the site has about a 5 percent slope containing rocky, caliche, and sandy soils, which support a combination of grasses and occasional saltbush, yucca, cholla, and mesquite. The central part of the site has flat, gravelly, grass-covered hardpan on the west and mesquite-stabilized dunes on the east. The south and southeastern areas are gravelly and flat, and low mesquite-stabilized dunes are present along the east side. Plants observed include mesquite, various grasses, yucca, Mormon tea, and cholla (McBride, Chapter 20, this report; Quaranta and Gibbs 2008:236, 243).

Preliminary Site Description

LA 111429 was previously described as a large artifact scatter containing a diverse artifact assemblage and numerous features. When first recorded, HSR estimated that the site covered an area of 151,190 sq m (15.12 hectares, 37.4 acres). Artifacts recorded or collected by HSR include a Clovis point base, 6 Folsom point fragments, 11 Paleoindian and other scrapers, a Middle Archaic-like point, a Late Archaic/Early Formative projectile point, a biface midsection, a core tool, a uniface, tabular choppers, knives, core tools, a hammerstone, fragments of nine manos, five metates, and other ground stone tools, Jornada Mogollon corrugated ceramics, and modern metal artifacts (two movie film-reel cans and a sanitary-seal metal food can). Eight fire-cracked rock features were described, two of which had associated charcoal stains. Because some of the chipped stone artifacts appeared to exhibit evidence of heat treatment, HSR archaeologists speculated that some of the fire-cracked rock features could have been used to heat-treat raw materials (FAA and NMSA 2010b:33–34).

Zia archaeologists adjusted the borders of LA 111429 and slightly increased the estimated size to 730 by 290 m (159,801 sq m, 15.98 hectares or 39.48 acres) (FAA and NMSA 2010b:32). They observed Formative, Archaic, and Middle Archaic-period projectile points, a knife blade, and a variety of scrapers (n = 9), but no sherds. A sample of 155 pieces of chipped stone debris was analyzed in the field, including: 8 cores, 8 pieces of angular debris, and 139 flakes. Fifteen pieces of ground stone were described, including: complete and partial one-hand manos; fragments of slab and basin metates; and a hammerstone. They also documented 21 fire-cracked rock features scattered throughout the area. The features ranged between 1.75 and 7.0 m in diameter and consisted of as few as 10 to as many as thousands of pieces of fire-cracked rock. Most of these rocks were highly fragmented igneous cobbles or pieces of caliche, and four or five of the features could constitute ring middens. The largest midden (7.5 by 5.0 m) has thousands of pieces of fire-cracked rock in association and is mounded 60 cm above the ground, with stained soil and chunks of charcoal also occurring. Several of the fire-cracked rock features are partly buried. Zia archaeologists ascribe a communal food-processing function to some of the thermal features. In addition to the described features, there are a small number of anomalous depressions. These, and others on the east side of the Jornada Draw are postulated as kill and/or meat processing locations for Paleoindian hunters and favorable locations for Archaic and Formative groups (FAA and NMSA 2010b:33–35; Quaranta and Gibbs 2008:239–240). OAS found that artifacts extended beyond the revised boundaries of the site and that the HSR delineation of the site area may be more accurate in the northeastern part of the site.

OAS testing at LA 111429 began with relocating, assessing, and renumbering the features identified by Zia, locating additional features and artifact clusters, and estimating site boundaries (Akins and Moore 2011a). A sample of 76 artifacts was field analyzed, and four diagnostic artifacts were collected. Site size was re-estimated at this time as 821.75 m north–south by 308.81 m east–west, which is larger than the estimates provided by either of the earlier studies. Test excavations were restricted to a buffer zone within 15 m of each side of the existing bed of County Road A020 to determine whether intact cultural deposits existed in that zone. Eight test pits and 32 auger tests were used to examine this part of the site, finding no evidence for intact cultural deposits or features. Twenty-four features were identified and described, and 20 by 20 cm hand-excavated units were used to examine and assess the potential of 10 features to contain intact cultural deposits. Five of these tested features were found to have the potential to provide temporal and/or subsistence information.

Research-Oriented Investigations

The original recording of LA 111429 placed it entirely on New Mexico State Trust Land. However, modification of the boundaries based on artifact distribution during the OAS testing phase moved the boundary several meters to the north onto Bureau of Land Management property. All of the research phase investigations took place on New Mexico State Trust Land. As currently defined, LA 111429 covers 180,675.48 sq m (18.07 ha, 44.65 acres). Diagnostic artifacts noted during the initial recording and the testing phases (Akins and Moore 2011a) suggest that LA 111429 is a multicomponent locale that was used during at least the Paleoindian, Archaic, and Formative periods. Spanish Colonial-era use is also indicated by the results of the research-oriented investigations. Since much of the mapping of LA 111429 was accomplished during testing, a total station was only used during the research-oriented investigations to lay out excavation, surface strip, and surface collection areas, and to point-provenience diagnostic surface artifacts that were collected outside those areas (Figs. 7.1–7.3). A considerable amount of erosion was evident at this site, especially along the west edge. Most visible features are deflated, with associated fire-cracked rock scattered over zones that are larger than the original feature limits. Most artifacts occur in deflated areas and were potentially moved both vertically and horizontally by erosion. Six of the 24 features defined at LA 111429 were investigated during this phase; 11 surface strip areas were excavated and artifacts were recovered from three surface collection areas. Table 7.1 lists excavated and surface-collected features, grids, and number of grids contained by each excavation area. In addition, four geomorphological trenches (BHTs 13–16) were placed throughout the site area (Figs. 7.2–7.3).

Surface Strip and Collection Areas

Eleven surface strip areas of variable size were used to investigate LA 111429. As specified in the research plan (Moore et. al 2010a:93), the five main artifact clusters identified during testing were selected for more detailed examination during this phase. These clusters included the three Paleoindian areas, the ground stone area, and an area containing the densest cluster of thermal features directly adjacent to, and to the northeast of, Paleoindian Area 1 (Fig. 7.1), as defined during testing (Akins and Moore 2011a). Besides collecting a sample of surface artifacts from each cluster, the research plan specified that 10 to 40 sq m would be excavated in each cluster. Though the plan also stated that in-field analysis of artifacts from selected areas would be conducted, this procedure was not implemented because it was felt that sufficient data for site interpretation was provided by the artifacts collected from surface and subsurface contexts in the clusters. In-field analysis, while expanding the database, would have provided redundant data that were considered unnecessary at this level of examination.

Paleoindian Area 1

Paleoindian Area 1 is in the west-central section of the site and was examined using three excavation areas and two surface collection areas (Fig. 7.2). Because evidence for biface manufacture and the thermal alteration of cherts was seen in this area during testing, it was assumed to reflect a Paleoindian or Archaic period occupation. The surface in this part of the site consists of two zones. The eastern quarter to third was covered by a mantle of loosely consolidated sediments. Those sediments were eroded away from most of the western two-thirds to three-quarters of the area, leaving a hardpan with a few islands of sediment remaining. Since most of the visible artifacts were on the hardpan and very few were visible on the surface in areas that are still covered by the sediment mantle, the artifacts appeared to be eroding out of those materials. As discussed in more detail in Chapters 21 and 22, OSL dates obtained for these sediments, and their extension under later sand layers to the northeast of Paleoindian Area 1, indicate a Paleoindian to Early Archaic date for the deposition of these materials. Two excavation areas (Surface Strips 1 and 2) were placed on sediment islands that were surrounded by hardpan containing moderate to abundant surface artifact densities. Surface Strip 1 was in the west-central part of Paleoindian Area 1, while Surface Strip 2 was in the south-central section. Both of these areas measured 4 by 4 m. The third excavation area (Surface Strip 3) was placed at the northeast edge of Paleoindian Area 1 where the sediment mantle appeared to be intact and no surface artifacts were visible. This excavation area measured 4 by 2

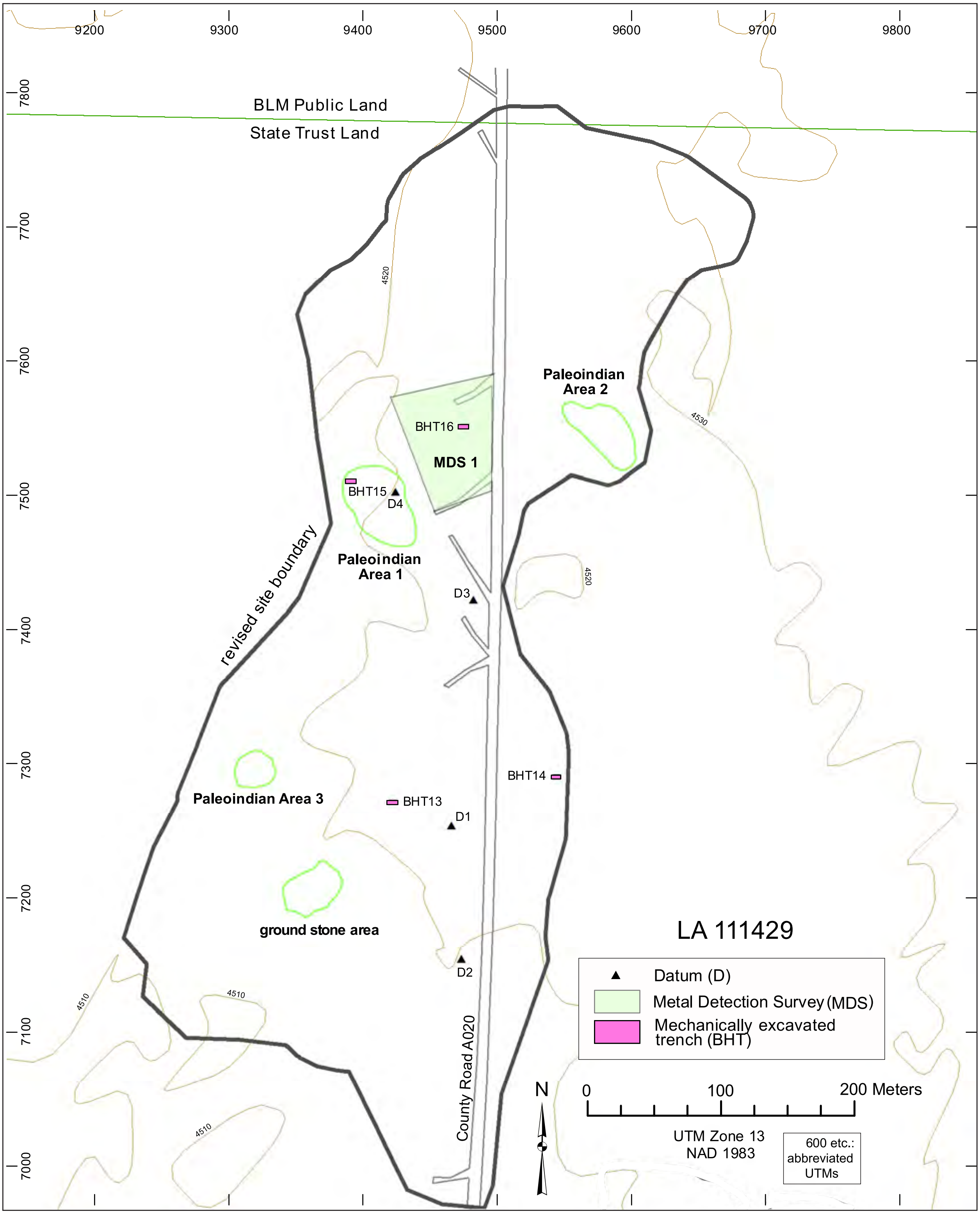

Figure 7.1. LA 111429, plan of entire site showing excavation areas and artifact clusters.

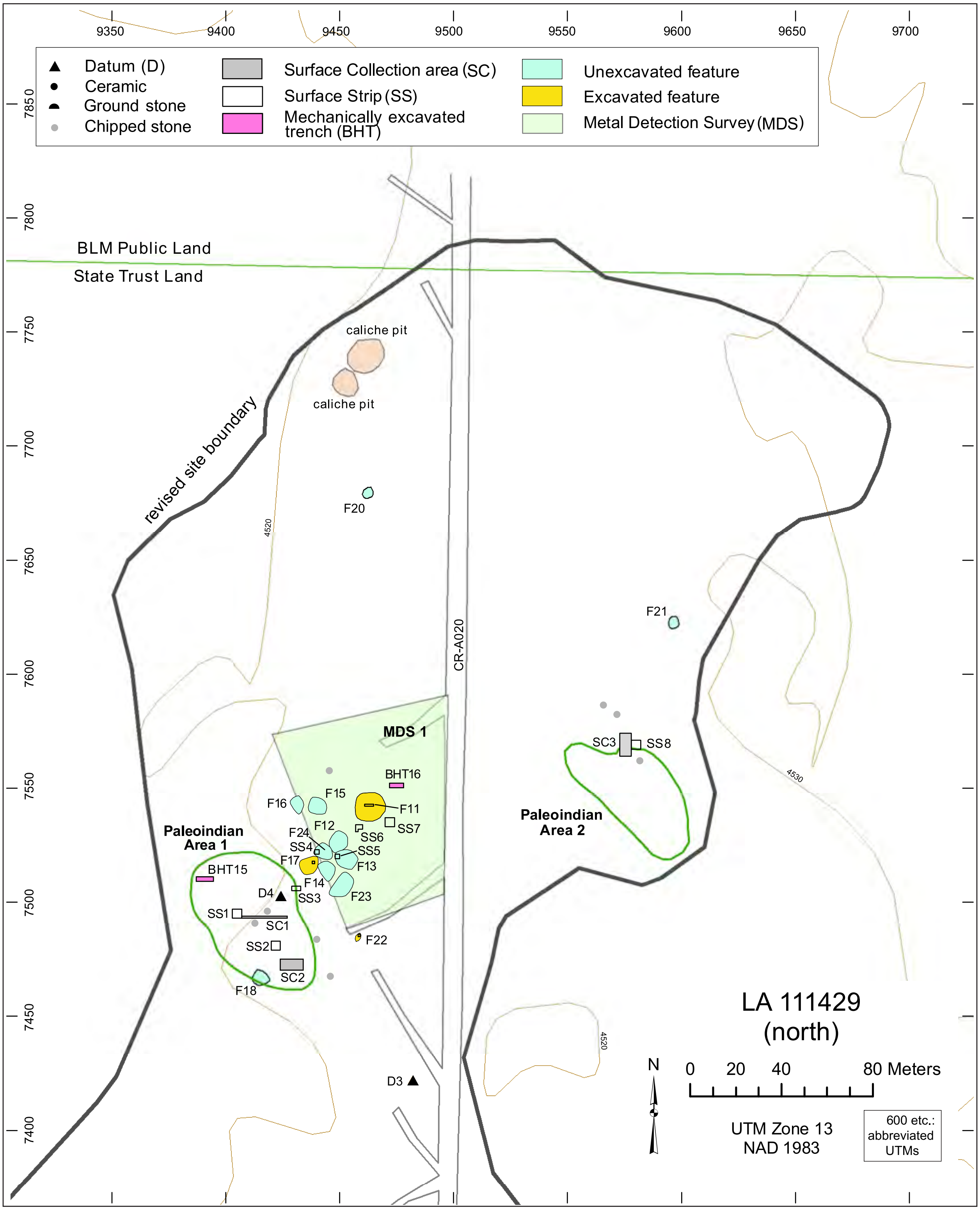

Figure 7.2. LA 111429, plan of the north section of site showing excavation areas, artifact clusters, and features.

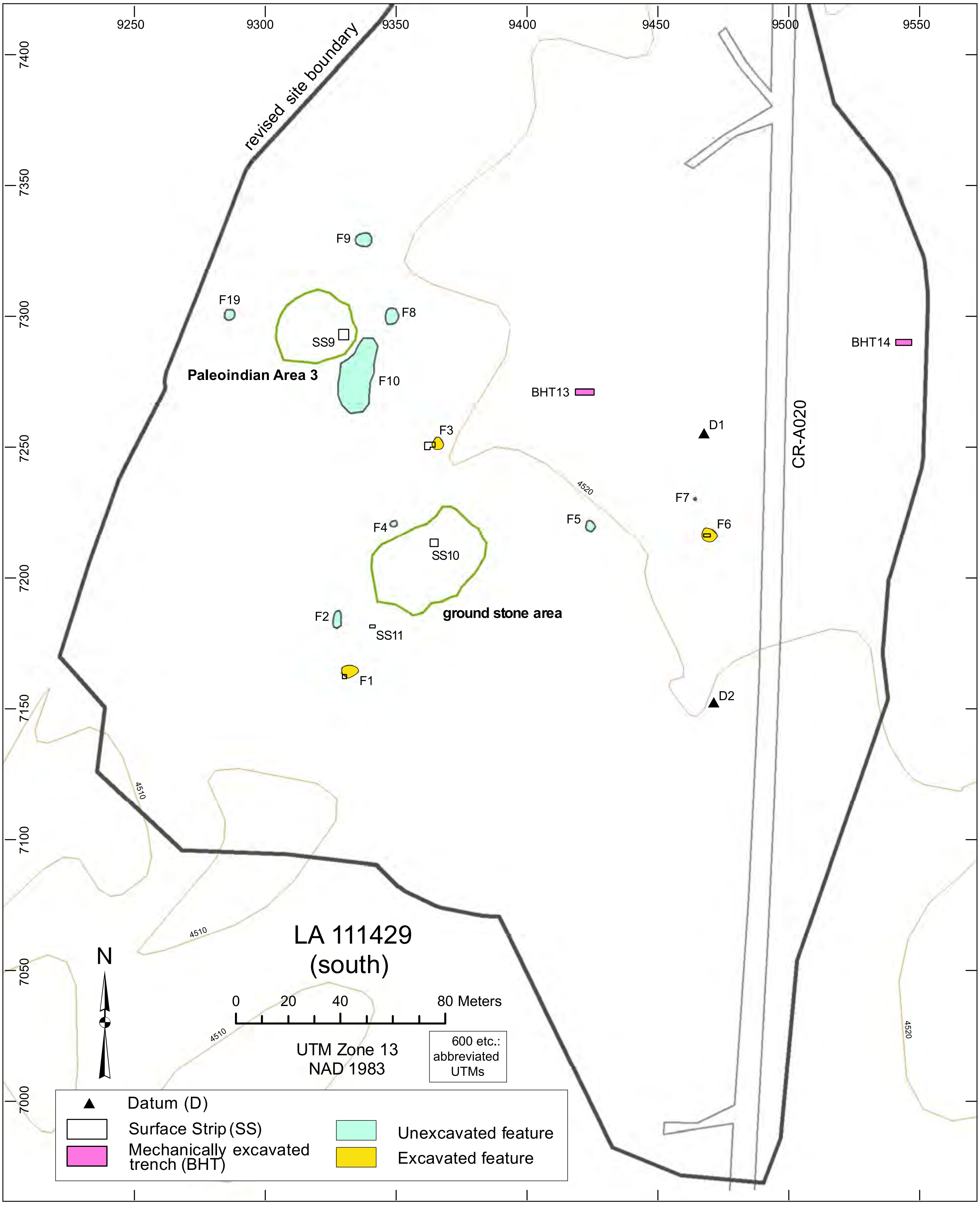

Figure 7.3. LA 111429, plan of the south section of site showing excavation areas, artifact clusters, and features.

Table 7.1. LA 111429, summary of excavation areas.

Excavation Area	Included Grids	No. of Surface Collected, Surface Stripped, and Excavated Grids
Feature 1	7162N/9330E	1
Feature 3	7250-7251N/9361-9364E 7249N/9361-9362E	10
Feature 6	7216N/9468-9469E	2
Feature 11	7542N/9461-9464E	4
Feature 17	7517N/9438E	1
Feature 22	7485N/9458E	1
Surface Collection Area	7493N/9407-9425E	19
Surface Collection Area	7470-7474N/9424-9433E	50
Surface Collection Area	7564-7573N/9573-9577E	50
Surface Strip Area 1	7493-7496N/9403-9406E	16
Surface Strip Area 2	7479-7482N/9420-9423E	16
Surface Strip Area 3	7505-7506N/9429-9432E	8
Surface Strip Area 4	7521-7522N/9439-9440E	4
Surface Strip Area 5	7519-7520N/9448-9449E	4
Surface Strip Area 6	7532-7533N/9457-9459E 7531N/9457E	7
Surface Strip Area 7	7533-7536N/9470-9473E	16
Surface Strip Area 8	7567-7570N/9578-9581E	16
Surface Strip Area 9	7291-7294N/9328-9331E	16
Surface Strip Area 10	7212-7214N/9363-9365E	9
Surface Strip Area 11	7181N/9340-9341E	2

m. A total of 40 sq m—the maximum allowed by the research plan—was thus excavated in Paleoindian Area 1.

In order to augment artifact data recovered from the excavation areas, two surface collection areas were used to recover samples of the artifacts visible on the hardpan (Fig. 7.2). Surface Collection Area 1 covered 19 sq m (1 by 19 m) and extended east from the southeast corner of Surface Strip 1. Surface Collection Area 2 covered 50 sq m (5 by 10 m) and was placed to the south-southeast of Surface Strip 2. Since Surface Strip 3 was well onto the sediment mantle, no hardpan was exposed adjacent to it and surface artifacts were not visible, so no surface collection area was placed next to it.

Surface Strip 1. This 4 by 4 m excavation area included grid units 7493–7496N/9403–9406E (Fig. 7.2). The loose sediment mantle was stripped from all 16 grid units in a single level, and a second level was excavated into the underlying hardpan in the four grid units that made up the northeast quadrant (7495–7496N/9405–9406E). Two strata were encountered during excavation. The upper unit (Stratum 1) was a light brown, sandy silty clay containing 8–10 percent gravels, the bulk of which were caliche fragments. This stratum averaged 6.53 cm thick, with the average depth ranging from 10.3 cm in the southwest quadrant, to 4.44 cm in the southeast quadrant, and 5.56 and 5.78 cm in the northeast and northwest quadrants, respectively. Fire-cracked rock was quite common in Stratum 1 and consisted mostly of small fragments of caliche. Fire-cracked rock was found in all but one grid unit and ranged in number from nine to 47, averaging just under 22 fragments per grid unit. Stratum 1 was semi-stabilized by vegetation, primarily grasses.

A second level was excavated into the caliche-flecked hardpan (Stratum 2) in four grids (7495–7496N/9405–9406E) because a few chipped stone artifacts were embedded in the top of Stratum 2, and another level was needed to determine whether that layer contained artifacts in numbers similar to those found in Stratum 1. A level that averaged 6.22 cm thick was excavated into Stratum 2, with depths ranging from 2–16 cm across the four grid units. This layer of hard-packed silty clay was light brown and contained numerous flecks of caliche. Excavation found that the few artifacts recovered from Stratum 2 all came from the upper 1–2 cm near its contact with the upper stratum, suggesting that they originated in the upper stratum and reached the top of the lower stratum through natural processes. Ninety-six chipped stone artifacts were recovered from Surface Strip 1, including 10 from the surface, 79 from Stratum 1, and 7 from Stratum 2. There was an average of six artifacts per grid unit, ranging from a low of three to a high of 12. A single ground stone artifact was recovered from Stratum 1, but its function could not be identified.

Surface Strip 2. This 4 by 4 m excavation area covered grid units 7479–7482N/9420–9423E (Fig. 7.2). Besides containing an island of sediment above the hardpan, this area was selected for examination because of the presence of a concentration of fire-cracked rock on the surface of grid unit 7479N/9423E, which potentially represented the location of a thermal feature. The loose sediment mantle was stripped from all 16 grids in a single level and excavation did not continue down into the hardpan. Closer examination showed that the concentration of fire-cracked rock did not represent an intact thermal feature, and no evidence of oxidized soil, charcoal, or ash was found. No definite function could be assigned to the concentration of fire-cracked rock, so it is possible that it represented a deflated thermal feature or discard zone.

Two strata were encountered in Surface Strip 2. Stratum 1 comprised the modern surface and contained two layers that were differentiated by degree of consolidation rather than variation in color or texture. The upper layer was a thin (1–2 cm thick) deposit of light brown, fine-grained silty sand that was semi-consolidated into a crust wherever the surface was undisturbed by foot traffic. The lower layer was a looser, light brown, fine-grained silty sand. A small amount of gravel (1–2 percent) occurred in Stratum 1, primarily small, rounded limestone pebbles. Bioturbation was common and occurred to and beyond the bottom of the stratum. Stratum 1 was semi-stabilized in this area by vegetation, mainly grasses, that covered about 25 percent of the surface. The caliche-flecked hardpan (Stratum 2) under Stratum 1 was not investigated. The lowermost centimeter or so of Stratum 1 was transitional to Stratum 2, and contained a higher clay content and a few caliche flecks. Stratum 1 averaged 5.53 cm thick, ranging from 4.77 cm in the northeast quadrant to 6.22 cm in the northwest quadrant, and 5.56 cm in the northeast and northwest quadrants.

Fire-cracked rock was quite common and

mostly occurred as small fragments, mainly caliche. Fire-cracked rock was found in all grids and ranged in number from 13–44, averaging 27.5 fragments per grid. A total of 164 chipped stone artifacts was recovered from Surface Strip 2, including 14 from the surface and 150 from Stratum 1. There was an average of 10.25 artifacts per grid unit, ranging from a low of 5 to a high of 16.

Surface Strip 3. This 2 by 4 m excavation area included grid units7505–7506N/9429–9432E (Fig. 7.2). As noted above, this area was selected for examination because it was well within the zone where the sediment mantle was not eroded, and was used to help determine whether the artifact-bearing layer of sediment continued to the north and east of Surface Strips 1 and 2. The loose sediment mantle was removed from all eight grids in a single level, and excavation did not continue down into the hardpan.

Two strata were encountered in Surface Strip 3. Stratum 1 was a light brown, fine-grained sandy silty clay that was loose at the surface and grew more compact with depth until it transitioned into caliche-flecked sediments at its base. Excavation ended at the top of the caliche-flecked sediments (Stratum 2). Stratum 1 contained about 2 percent gravels and pea gravels, with larger gravels occurring at the bottom just above the top of Stratum 2. Bioturbation was common and occurred to the bottom of the stratum. These sediments were semi-stabilized by vegetation, mainly grasses, which covered about 30 percent of the surface. Stratum 1 averaged 16.61 cm thick, ranging from 16.11 cm in the eastern half to 17.11 cm in the western half. Excavation in this surface strip showed that the artifact-bearing sediments were at least three times as thick as they were in the remnant islands examined further to the south and west, suggesting that quite a bit of material has been eroded from the islands.

Fire-cracked rock was uncommon and occurred as small fragments, mostly caliche. No fire-cracked rock was recovered from the surface, and one grid unit did not produce any fire-cracked rock. An average of 2.38 pieces of fire-cracked rock was recovered per grid unit, and ranged in number from 0–7. In contrast, chipped stone artifacts were abundant, with 251 being recovered from subsurface contexts. The number of artifacts per grid unit averaged 31.38, and ranged from a low of 21 to a high of 43.

Surface Collection Areas. As noted earlier, Surface Collection Area 1 covered 19 sq m and extended east from the southwest corner of Surface Strip 1 (Fig. 7.2). All visible artifacts on the hardpan were collected from grid units 7493N/9408–9425E. Five grid units contained no artifacts and included 7493N/9408–9409E, 7493N/9415E, 7493N/9417E, and 7493N/9425E. Thirty-eight chipped specimens were collected from the remaining grid units, of which 37 were artifacts and one was eliminated as a natural rock during analysis.

Surface Collection Area 2 covered 50 sq m, and was southeast of Surface Strip 2 at 7470–7474N/9424–9433E (Fig. 7.2). All visible artifacts on the hardpan were collected. Two grid units—7470N/9429E and 7471N/9429E—contained no artifacts. A total of 154 specimens were collected from this area, of which 147 were chipped stone artifacts and seven were eliminated as natural rock during analysis.

Assessment of Excavations in Paleoindian Area 1

Several factors suggest that the sediment mantle labeled Stratum 1 in Paleoindian Area 1 represents the remains of an occupational zone dating to the late Paleoindian or Early Archaic period. The most important of these is the OSL date derived from these sediments, which places the formation of Stratum 1 at the approximate transition between these periods. Second is the number of artifacts that occur in Stratum 1 or that are exposed on the hardpan in areas where Stratum 1 has been removed by erosion. Third is the character of the artifacts, where a large number exhibit a degree of thermal alteration and occasional tools, such as spurred end scrapers, suggest a Paleoindian affiliation. However, the lack of charcoal and ash in the three surface strips and the apparent absence of definable thermal features suggest that Stratum 1 has undergone a great deal of bioturbation over time. The artifacts recovered from Stratum 1 were deposited either as that layer of sediments was forming or before it formed, and have been moved both upward and downward through bioturbation. Thus, some spatial integrity may be preserved.

Paleoindian Area 2

Paleoindian Area 2 is near the east-central boundary of the site and was examined using a single excavation area (Fig. 7.2). A Paleoindian affinity was tentatively assigned to this area because observations made during testing indicated that it contains an extensive amount of debris derived from biface manufacture, considerable evidence for thermal alteration, and at least one spurred end scraper. As was the case in Paleoindian Area 1, the surface in Paleoindian Area 2 was also divided into two zones. Hardpan was exposed on the surface through most of this part of the site, but was broken in places by islands covered by a thin mantle of sediments similar to those in Paleoindian Area 1. The sediment mantle covered the hardpan at the north and east edges of Paleoindian Area 2, and to the east the mantle extended up to the base of a sand dune that rims the eastern edge of LA 111429. Since most visible surface artifacts were on the hardpan and very few occurred in areas that are still covered by the sediment mantle, the artifacts in this part of the site also appeared to be eroding out of those upper sediments. A single excavation area was placed in a sediment-mantled zone at the north edge of Paleoindian Area 2, and a surface collection area was placed adjacent and to the west of the surface strip.

Surface Strip 8. This 4 by 4 m excavation area covered grid units 7567–7570N/9578–9581E (Fig. 7.2). This area was selected for examination because it was at the north edge of Paleoindian Area 2 in a zone from which the sediment mantle had not yet eroded. This area was also used to determine whether the artifact-bearing layer of sediment continued further to the north of the artifact cluster as defined by surface observations. The loose sediment mantle was stripped from all 16 grids in a single level, and excavation did not continue down into the hardpan.

Two strata were encountered in Surface Strip 8. Stratum 1 was a loose, light brown, fine-grained loamy sand that ended on top of hard-packed sediments (Stratum 2) containing some flecks of caliche. Excavation ended at the top of Stratum 2. Stratum 1 contained 8–10 percent gravels and pea gravels. Bioturbation was common and consisted of rodent and insect burrows as well as roots, all of which appeared to end beyond the bottom of the stratum. These sediments were semi-stabilized by vegetation, mainly grasses and snakeweed, that covered about 10 percent of the surface. Stratum 1 averaged 6.47 cm thick, ranging from 5.56–5.78 cm in the southern quadrants to 7.11–7.44 cm in the northern quadrants.

No charcoal, ash, or fire-cracked rock was found on the surface or during excavation. In contrast, chipped stone artifacts were fairly common. A total of 97 chipped stone artifacts were recovered from Surface Strip 8, with 9 found on the surface and 88 from subsurface contexts. There was an average of 6.06 artifacts per grid unit, ranging from a low of three to a high of 12.

Surface Collection Area. Surface Collection Area 3 covered 50 sq m and was adjacent to the west edge of Surface Strip 8 (Fig. 7.2). All visible artifacts on the surface were collected from grid units 7564–7573N/9573–9577E. Only 18 of the 50 grid units yielded artifacts, including 7564–7565N/9573E, 7564N/9577E, 7565N/9576E, 7566N/9575E, 7567N/9577E, 7568N/9574E, 7568–7569N/9575E, 7569N/9577E, 7570N/9575–9577E, 7571N/9574E, 7571N/9576E, 7572N/9573E, and 7573N/9579–9576E. Twenty-six specimens were collected from this area, of which 24 were chipped stone artifacts and two were eliminated as natural rock during analysis.

Assessment of Excavations in Paleoindian Area 2

Considering the number of artifacts recovered from Stratum 1 in this area and their general visual similarity to those recovered from the surface strips in Paleoindian Area 1, Stratum 1 in this part of the site may either represent the same sediment as, or a deposit similar to, Stratum 1 in Paleoindian Area 1. A high degree of thermal alteration in the chipped stone assemblage, in addition to the presence of tools potentially diagnostic of a Paleoindian occupation (spurred end scrapers), strengthens this conclusion.

The Feature Area

The Feature Area, in the north-central part of LA 111429, immediately northeast of Paleoindian Area 1, contained numerous fire-cracked rock features; it was examined using four surface-strip areas (Fig. 7.2). This area contained the densest concentration of features at LA 111429, leading to the label assigned to it. Its surface is covered by a sand sheet, and one of the reasons for excavating several surface strips was to determine whether the artifact-bearing sediment mantle in Paleoindian Area 1 continued under the sand sheet. The other reason for excavating these surface strips was to collect artifacts associated with the use of some of the features. Surface artifacts occurred throughout the Feature Area, but were mostly in the more eroded areas. Surface Strip 4 was placed at the west edge adjacent to Feature 24 in order to determine whether there were in situ deposits associated with the use of that feature. Surface Strip 5 was at the west edge and adjacent to Feature 13 for a similar reason. Surface Strip 6 was placed between the scatters of fire-cracked rock associated with Features 11 and 12 in order to determine whether that zone contained evidence of cultural activities. Surface Strip 7 was placed southeast of Feature 11, again to determine if that zone contained evidence of activities related to the nearby feature. Surface Strips 4 and 5 each covered 4 sq m; Surface Strip 6 encompassed 7 sq m; and Surface Strip 7 covered 16 sq m. A total of 31 sq m were thus excavated into the Feature Area. To remain consistent in excavation-area designation, these excavation areas were referred to as surface strips; however, to better investigate the possibility that Stratum 1 in Paleoindian Area 1 continued under the sand sheet, some went significantly deeper than a simple stripping away of the loose surface sediment.

Surface Strip 4. This 2 by 2 m excavation area covered grid units 7521–7522N/9439–9440E (Fig. 7.2). The loose sediment mantle was stripped from all four grid units in a single level and excavation did not extend down into the underlying sediment.

Two strata were encountered in Surface Strip 4. The loose sediments covering the surface were initially labeled Stratum 1, but were different in color (darker) and texture (coarser grained) from Stratum 1 as encountered in Paleoindian Areas 1 and 2; to provide the necessary distinction it was renumbered as Stratum 20. The upper 3 cm of Stratum 20 was a brown, sandy silty clay that contained a few chipped stone artifacts, a few pieces of gravel, and most of the fire-cracked rock recovered from this excavation area. The remainder of the fill consisted of similar sediments that contained 20–25 percent gravels and pea gravels as well as most of the chipped stone artifacts, but no fire-cracked rock. In retrospect, the lower gravelly sediments probably correspond to Stratum 5, as defined elsewhere in the Feature Area and discussed below. Bioturbation was common, and the sediments in this area were semi-stabilized by a small amount of vegetation. Excavation ended at the top of a layer of light brown sediments. Stratum 20 averaged 16.33 cm thick, ranging from 10.33 cm in the northwest corner to 20.6 cm along the south and east sides.

Fire-cracked rock was fairly common on the surface, but was not counted. With the exception of 7521N/9440E, fire-cracked rock was found in subsurface contexts and consisted of small fragments of caliche. The number of fragments averaged 28.5 per grid unit, ranging from a low of 0 to a high of 42. A total of 111 chipped stone artifacts were recovered, including one from the surface and 110 from Strata 20/5. There was an average of 27.75 chipped stone artifacts per grid unit, ranging from a low of 23 to a high of 35.

Surface Strip 5. This 2 by 2 m excavation area covered grid units 7519–7520N/9448–9449E. After the loose surface sediments were stripped and screened, excavation continued downward in the two southern grid units to determine if the sediment mantle examined in Paleoindian Area 1 continued this far to the northeast.

Three strata were encountered in Surface Strip 5. Stratum 20 comprised the upper loose sediments, and was a layer of brown sandy silt that averaged 7.67 cm thick and ranged from 6 to 9 cm thick. Nine pieces of fire-cracked rock were noted on the surface of Stratum 20, and a single ground stone artifact (a sandstone metate fragment) was recovered from that context. Cultural materials were more common in subsurface contexts, with 39 pieces of fire-cracked rock (9.75 per grid unit), 32 chipped stone artifacts (8 per grid unit), a bone fragment, and a shell of uncertain derivation being recovered during excavation of Stratum 20. Since the bone fragment was unburned and the shell exhibited no evidence of cultural manipulation, both were considered to be non-cultural.

As noted above, excavation continued downward in only the two southern grids (7519N/9448–9449E). Stratum 5 was below Stratum 20, and was a 20 cm thick layer of strong brown, loose, sandy loam with about a 20 percent gravel/pea gravel content. Artifacts occurred, but were less common than in Stratum 20, and included 13 chipped stone artifacts (3.25 per grid unit) and three pieces of unburned bone (0.75 per grid unit). Small fragments of fire-cracked rock were more common, and numbered 38 for an average of 19 per grid unit. The deepest layer of sediment encountered was Stratum 6, which lay just below Stratum 5 and was distinguished by a textural change. A single 10 cm level was excavated into Stratum 6 and did not reach the bottom of this layer, so its total thickness was undetermined.

Stratum 6 consisted of a light brown, blocky silt clay containing only about 1 percent gravel inclusions; flecks of caliche were common. Cultural materials were less common in this stratum, totaling only five chipped stone artifacts and nine pieces of fire-cracked rock (1.25 and 2.25 per grid unit, respectively). Considering the presence of caliche flecks indicative of a very old layer of sediment, the cultural materials in Stratum 6 were most likely carried down from Stratum 5. Rodent and root disturbances were seen in all levels of excavation.

Because Stratum 5 seemed similar to Stratum 1 in Paleoindian Area 1 in artifact content, in the presence of pea gravels, and in location just above Pleistocene era caliche-flecked sediment, we feel that Stratum 5 may represent a continuation of Stratum 1 below the thicker layer of later sediments that mantles the surface of the Feature Area. If correct, this indicates that the potential late Paleoindian/Early Archaic occupation represented in Paleoindian Area 1 is more extensive than surface representations suggest.

Surface Strip 6. This excavation area covered 7 sq m and included grid units 7532–7533N/9457–9459E and 7531N/9457E (Fig. 7.2). Surface Strip 6 initially consisted of a 2 by 2 m area covering grid units 7532–7533N/9457–9458E. However, in order to better examine the area near Feature 11, it was expanded by three grid units (7531N/9457E and 7532–7534N/9459E). Excavation continued down beyond the stripping of loose sediments from the surface in only the original 2 by 2 m grid unit area.

Four strata were encountered in Surface Strip 6. Stratum 20 was uppermost and consisted of light brown sand that contained less than 1 percent small gravel inclusions and was 2–4 cm thick. A single fragment of fire-cracked rock was the only cultural specimen seen on the surface. Chipped stone artifacts were common in Stratum 20, with 26 specimens occurring for an average of 3.71 per grid unit. At least 15 pieces of fire-cracked rock were also found in Stratum 20, for an average of 2.14 pieces per grid unit. As noted above, excavation continued down in only the original 2 by 2 m surface strip area and encountered Stratum 3, a 14 cm thick layer of compact sand. Artifacts were less common in Stratum 3, with only eight chipped stone artifacts (2.00 per grid unit) and no fire-cracked rock occurring.

Excavation continued below Stratum 3 in grid units 7532–7533N/9458E (Fig. 7.4) and encountered Stratum 5, a layer of strong brown, loose sandy loam containing a considerable amount of gravel. Stratum 5 averaged 12.33 cm thick, ranging between 10 and 15 cm. While no fire-cracked rock was found in Stratum 5, nine chipped stone artifacts were recovered, with an average of 4.5 artifacts per grid unit. Several of the chipped stone artifacts recovered from Stratum 3 probably also originated in Stratum 5, since the field notes for this excavation area indicate that most of the chipped stone artifacts recovered from Stratum 3 popped out of the top of the gravelly layer that constituted Stratum 5. Excavation ended when the top of Stratum 6 was encountered. Rodent and root disturbances were common throughout the strata encountered in this excavation unit.

Surface Strip 7. This excavation area covered 16 sq m and included grid units 7567–7570N/9478–9481E (Fig. 7.2). The loose sediments were stripped from this excavation area, and a single grid unit (7533N/9470E) was excavated deeper to examine the contents of the stratum underlying the loose sediments.

Three strata were encountered in Surface Strip 7. Stratum 3 was uppermost and consisted of light brown, silty sand reflecting coppice dune activity. Stratum 3 contained only about 1 percent or less gravel inclusions, mostly very small rounded pebbles of chert and limestone. Bioturbation was common and included rodent and insect burrows as well as roots, all of which occurred to and beyond the bottom of the stratum. These sediments were mostly unstabilized, though some sparse grasses covered less than 1 percent of the surface. Stratum 3 averaged 3.97 cm thick, ranging from 3.22 cm in the southwest quadrant to 4.22 cm in the southeast quadrant and 3.56 cm in the northeast quadrant to 4.89 cm in the northwest quadrant.

Excavation continued down into Stratum 5 in only grid unit 7533N/9470E. Stratum 5 was much more compact than Stratum 3, and contained caliche flecks and less than 1 percent gravels, in contrast to elsewhere in the Feature Area. Caliche coated the surface of gravels at the bottom of this stratum, probably reflecting the presence of an old erosional surface just below Stratum 5. Stratum 5 averaged 10.25 cm thick in this grid unit and exhibited evidence of bioturbation, mainly roots that continued past the bottom of the stratum. Excavation ended at the top of Stratum 6.

Figure 7.4. LA 111429, Surface Strip 6 stratigraphy showing Strata 3 and 5.

No charcoal or ash was found on the surface or during excavation. Fire-cracked rocks were common, with 17 fragments on the surface, 133 fragments in Stratum 3, and none in Stratum 5. Fire-cracked rock occurred on the surface of three-quarters of the grid units in this excavation area and in all but one grid unit in subsurface contexts, with an average of 9.38 fragments per grid unit, ranged from a low of 0 to a high of 34. Formal artifacts were somewhat less common. A total of 51 chipped stone and four ground stone artifacts was recovered from Surface Strip 7, with three pieces of ground stone found on the surface, 50 chipped stone artifacts and one piece of ground stone in Stratum 3, and a single chipped stone artifact in Stratum 5. There was an average of 3.38 artifacts per grid unit, ranging from a low of 0 to a high of 13. Stratum 3 contained the only diagnostic artifacts found in this surface strip area, consisting of two fragments of the same Folsom Point base recovered from two different grid units.

Assessment of Excavations in the Feature Area

Three strata were examined by surface strips in this area. Stratum 20 was uppermost, and contained numerous artifacts as well as fragments of fire-cracked rock. This stratum is probably related to one or more of the more recent occupational periods during which the features were built and used. Stratum 3 occurred below Stratum 20 in places and contained numerous chipped stone artifacts and fragments of fire-cracked rock. Besides containing numerous artifacts, two fragments of the same Folsom point were found in Stratum 3, suggesting a possible Paleoindian affiliation. Geomorphological data presented in Chapter 21 suggest that Stratum 3 is probably too young to contain an in situ Paleoindian component. OSL dates obtained from BHT 16 suggest that at least the upper 20 cm of sediment in the north part of LA 111429 may only be about 500 years old, consistent with a Protohistoric occupation. An OSL sample at 60 cm below the surface returned a date of 5400 ± 270 (UNL-3223). While impossible to match these dates to the archaeological strata that were defined, they suggest that sediments as shallow as Strata 20 and 3 are fairly recent. Stratum 5 was the deepest of the artifact-bearing strata and may represent part of the deposit that was OSL dated to 5400 ± 270. It contained variable numbers of artifacts and little fire-cracked rock, and could represent a continuation of Stratum 1 from Paleoindian Area 1 under the dunes that cover the Feature Area, though considering the date obtained for that stratum, this is tentative. A longer profile would be needed in this area to ascertain the actual relationship between these two strata. If a Paleoindian occupation is indicated, as was the case in Paleoindian Areas 1 and 2 these materials probably retain a degree of spatial integrity, but they have been moved and perhaps mixed by bioturbation. Thus, none of these strata are intact, and the artifacts they contain are probably related to several different periods of occupation.

Paleoindian Area 3

Paleoindian Area 3 was an artifact cluster in the southwest part of the site, and was assumed to reflect a very early occupation because a Folsom point was recovered from nearby during testing. This artifact cluster was examined using a single excavation area (Fig. 7.3). As was the case in the other Paleoindian areas, part of Paleoindian Area 3 is covered by a thin layer of loose sediment while the rest was a hardpan surface that contains small to moderate numbers of chipped stone artifacts. Most of the artifacts lying on the hardpan probably eroded out of the thin layer of sediment. Unfortunately, it was not possible to determine whether the loose sediment dates to the same period as those in Paleoindian Area 1. A single excavation area (Surface Strip 9) was placed on a sediment island surrounded by hardpan that contained small to moderate surface artifact densities.

Surface Strip 9. Surface Strip 9 was in the southeast part of Paleoindian Area 3 and measured 4 by 4 m, covering grid units 7291–7294N/9328–9331E (Fig. 7.3). This area was selected for examination because it was in a zone from which the sediment mantle had not yet been eroded, and was used to help determine whether the artifacts on the hardpan had eroded from the sediment mantle as was the case in Paleoindian Areas 1 and 2. The loose sediment was stripped from all 16 grids in a single level, and excavation did not continue down into the hardpan.Two strata were encountered in Surface Strip 9. Stratum 10 was a loose, light brown, sandy clay that ended on top of hard-packed sediments that, in turn, contained some flecks of caliche. Stratum 10 contained 3–5 percent pea gravels; the upper 4–5 cm of sediment was loosely compacted, becoming slightly compact and platy below that. Bioturbation was common and consisted of rodent burrows and roots that occurred to and beyond the bottom of the stratum. These sediments were semi-stabilized by vegetation that covered about a third of the surface and mainly consisted of grasses and a few small mesquite bushes. Stratum 10 averaged 7.27 cm thick, ranging from 5.89–6.89 cm on the eastern side to 8.11–8.22 cm on the western side.

No charcoal or ash was noted on the surface or during excavation. While fire-cracked rock occurred on the surface, it was not separately counted but was inventoried with the fire-cracked rock recovered from subsurface contexts. A total of 512 fragments of fire-cracked rock was found, averaging 32 fragments per grid unit with a range from 11 to 52. Most of the fire-cracked rock was caliche, and fire-cracked rock was found in every grid unit. Artifacts were more sparsely distributed through Stratum 10. One chipped stone artifact was recovered from the surface while 43 chipped stone artifacts and one piece of ground stone were found in Stratum 10. There was with an average of 2.75 artifacts per grid unit, ranging from 0 to 6. The distribution of artifacts was fairly even across this area; only one grid unit (7291N/9328E) contained no artifacts. This was also the grid unit that contained the fewest pieces of fire-cracked rock.

Assessment of Excavations in Paleoindian Area 3

Despite referring to this part of the site as Paleoindian Area 3, nothing recovered by excavation ties the associated materials to that period, though this is further evaluated during a later, more detailed discussion of the chipped stone assemblages. As was the case in the other excavation areas, while the materials in Surface Strip 9 probably retained some spatial integrity, they have been moved by bioturbation and possibly erosion and aggradation, so their actual relationship to one another has most likely been obscured.

Ground Stone Area

The Ground Stone Area is in the southwest part of the site and contained the greatest concentration of ground stone tools observed but not quantified at LA 111429 during the testing phase. No potential date was assigned to this area. This artifact cluster was examined using two excavation areas (Fig. 7.3). Most of the surface was covered by a layer of eolian sand with a harder underlying stratum exposed in eroded areas. Chipped and ground stone artifacts were sparse through most of this area, but were often clustered in eroded zones. Both excavation areas were placed where multiple pieces of ground stone were visible on the surface. Surface Strip 10 was a 3 by 3 m excavation area in the north-central part of the Ground Stone Area where at least one fragment of a ground stone tool as well as several chipped stone artifacts were visible on the surface. Surface Strip 11 was a 2 by 1 m excavation area in the southern part of the Ground Stone Area, again, where at least one ground stone tool fragment and several chipped stone artifacts were visible on the surface. A total of 11 sq m was excavated into the Ground Stone Area, just above the minimum recommended in research plan. No additional surface collection was conducted.

Surface Strip 10. This excavation area covered 9 grid units including 7212–7214N/9363–9365E (Fig. 7.3). Excavation began with a 2 by 2 m surface strip at 7212–7213N/9363–9364E and was expanded by five grid units to better examine deposits in this area. The loose surface mantle of sediment was stripped in one level, with excavation extending down another level in two grid units.

Three strata were encountered in this surface strip. Stratum 7 constituted the loose surface sediments and was a brown, sandy silty clay that contained less than 1 percent gravel. Bioturbation was common and included rodent burrows, roots, and cattle tracks impressed into the underlying harder stratum. These sediments were semi-stabilized by vegetation that covered about 40 percent of the surface and mainly consisted of grasses. Stratum 7 averaged 4.49 cm thick, ranging from 5.67 cm in the southwest to 6.75 cm in the southeast to 4.00–4.75 cm on the north edge.

The main reason for expanding the original 2 by 2 m excavation area was the discovery of a stain in the northwest corner that measured 80 by 30 cm. Four other stains were subsequently found, with the total of five stains occurring in five different grid units (Fig. 7.5). A partial grid unit was excavated into one stain, and consisted of a triangular-shaped area in grid unit 7213N/9363E that measured 27 cm east–west by 27 cm north–south by 34 cm along the diagonal. This small excavation unit encountered Stratum 8, consisting of a strong brown, sandy silty clay that contained ash and a few burned roots, 1 percent gravel inclusions, and no artifacts. The occurrence of ash and burned roots indicated that this stain represented a natural burn, and it was concluded that the stains in this area probably reflect a non-cultural burning event. A 10 cm thick level was excavated into a second grid unit (7214N/9363E) to further investigate the nature of Stratum 8, which underlay the loose surface sediment. Again, no gravels or cultural materials were encountered and, 6 cm into this stratum, flecks of caliche began appearing and the soil color changed from strong brown to brown, indicating a stratigraphic change. Excavation ended at this point.

While fire-cracked rock occurred on the surface of Surface Strip 10, it was not separately counted but was included with the specimens recovered from subsurface contexts. A total of 95 fragments of fire-cracked rock were found on the surface and in Stratum 7, yielding an average of 9.5 fragments per grid unit with a range of 2–21. Most of the fire-cracked rock was caliche. Artifacts were less common with three artifacts—two chipped stone and one ground stone—coming from the surface, and 21 chipped stone artifacts and one piece of ground stone coming from Stratum 7. Thus, the artifact assemblage included 23 pieces of chipped stone and 2 fragments of ground stone, with an average of 2.78 artifacts per grid unit, ranging from a low of 0 to a high of 5. The distribution of artifacts was fairly even across this area, with only one grid unit (7213N/9363E) containing no artifacts.

Surface Strip 11. This 1 by 2 m excavation area covered grid units 7181N/9340-9341E (Fig. 7.3). This area was selected for examination because it was outside but near the southwest edge of the Ground Stone Area near Features 1 and 2, and had a few artifacts on the surface. The loose sediment mantle was stripped from both grid units in a single level, and excavation ended at that point and did not continue down into the harder underlying sediments.

Two strata were encountered. Stratum 7 was the loose surface sediment and consisted of a brown, sandy silty clay that contained less than 1 percent gravel inclusions. Bioturbation was common and included rodent burrows, roots, and cattle tracks impressed into the underlying harder stratum. This sediment was semi-stabilized by vegetation that covered about 10–15 percent of the surface and mainly consisted of grasses. Stratum 7 averaged 4.63 cm thick, ranging from 4.50 cm on the west side of the excavation area to 6.50 cm on the east side. Excavation ended at the top of Stratum 8.

No fire-cracked rock was found on the surface of this excavation area, and it occurred in subsurface contexts in only one grid unit—7181N/9340E. Stratum 7 in 7181N/9340E yielded 13 pieces of fire-cracked rock that was about half caliche and was otherwise unidentifiable. An average of 6.5 pieces of fire-cracked rock occurred per grid unit in Surface Strip 11. Artifacts were even less common, with a piece of ground stone and a piece of chipped stone occurring on the surface and 7 pieces of chipped stone being recovered from Stratum 7. Thus, there was an average of 4.5 artifacts per grid unit in Surface Strip 11, with most occurring in 7181N/9341E. Neither charcoal nor ash were noted in either grid unit.

Assessment of Excavations in the Ground Stone Area

Neither of the surface strip areas placed in this part of the site encountered cultural features or deposits, and few artifacts were recovered from either one. This suggests that, at least in the areas selected for excavation, there is little potential for finding intact or even partly intact cultural deposits. However, this is unlikely to be the case for the southern part of the site as a whole because artifact clusters that appeared to in the process of eroding out were seen elsewhere, outside the Ground Stone Area.

Assessment of All Excavation Areas

Most of the excavation conducted at LA 111429 was concentrated in the northern half of the site, which testing suggested would have the greatest potential

Figure 7.5. LA 111429, Surface Strip 10 showing stains uncovered by excavation.

for containing intact subsurface cultural deposits. This was especially true for the zones defined as Paleoindian Areas 1 and 2 and for the Feature Area. Excavation demonstrated that these areas contain deposits that may retain a degree of spatial integrity, though in each case there is evidence of disturbance from bioturbation. Thus, the patterning of cultural materials is preserved at a coarse-grained level. The only dated feature in the northern part of the site was Feature 11, which represents Spanish Colonial–era use. While Feature 11 is within the cluster of thermal features for which the Feature Area was designated, its late date cannot be automatically extended to the other features in this area, though a similar date is of course possible for some or all of them.

One of the more interesting aspects of the northern part of the site is the potential extent of Stratum 1, which appears to date to the late Paleoindian or Early Archaic period, at least in Paleoindian Area 1. This layer of sediment may extend under later dune deposits in the Feature Area, and possibly as far as Paleoindian Area 2. The later strata in the Feature Area were not dated, but Stratum 3 may represent an early Mesilla-phase occupation, concurrent with dates for features in the southern part of the site. Stratum 20 is most likely associated with the period between the Protohistoric period and the Spanish Colonial occupation represented by Feature 1. The paleosol encountered during testing underlies Stratum 20 and, as discussed below, was dated to the Protohistoric period, which could suggest that the dune mantle in the northern portion of the site accumulated in less than 200 years.

Results for the southern part of the site were less conclusive. Numerous chipped stone artifacts were recovered from Surface Strip 9 in Paleoindian Area 3, but it was not possible to determine whether Stratum 10 was related to Stratum 1 in Paleoindian Area 1 or whether it represents an entirely different layer of sediment. Further investigation would be necessary to determine which is the case. No cultural deposits or features and few artifacts were recovered from the surface strips in the Ground Stone Area, but this situation may not be representative of the southern part of the site as a whole. As noted earlier, a few eroded areas in this part of the site contain numerous artifacts and in some cases the materials appear to be in the process of eroding out. This suggests that the results of excavation in the Ground Stone Area may not be typical of this part of LA 111429.

The topographic configuration of LA 111429 is interesting and suggests that buried cultural deposits, some perhaps dating as early as the Paleoindian period, may be more extensive than surface indications suggest. Erosion is common at the northern and southern ends of the site and along its west flank, but there appears to have been a great deal of aggradation in the east-central part of the site where surface indications of features and other cultural materials are uncommon. Two bulk soil radiocarbon dates were obtained from an A soil horizon buried under more recent coppice dune sands in Test Pit 3 during testing, but were not submitted for analysis until field work for the research-oriented investigations were complete. The most accurate and most precise dates for these samples are both cal AD 1405–1470 (Boyer, Chapter 19) indicating the horizon dates to the Protohistoric period. It also indicates that the upper sand sheet (including Stratum 20) that occupies the east-central part of LA 111429 and into which Feature 11 is excavated accumulated in about 200 years.

The presence of numerous chipped stone artifacts eroding out along the west edge of the site in addition to a greater age for the sediment sheet that lies directly above the hardpan suggests that fairly intact cultural deposits may continue under the more recent sand sheet for an undetermined distance. This possibility was also suggested by the results of excavation in the Feature Area, which seemed to show that Stratum 1 continues under more recent sediments for a good distance to the north and east. Thus, the potential for LA 111429 to contain fairly intact buried deposits is quite high. In addition to potential Paleoindian remains, there is also a chance that similarly intact Archaic- and perhaps Formative-period deposits are present.

Feature Descriptions

Zia identified 21 thermal features at LA 111429, ranging from small to large, which they felt reflect the difference between single domestic units and communal food processing and distribution areas. These pits were described as measuring from 1.75 to 7.0 m in diameter and most contained highly fragmented rocks. Four were considered to be ring-midden features. They also noted that the rock in some features was mainly caliche, others were mainly of igneous cobbles, and the rest had a mix of rock types (Quaranta and Gibbs 2008:239).

OAS was unable to locate some of Zia's features based on their coordinates and descriptions (Quaranta and Gibbs 2008:240) so the decision was made to renumber the features. These were all inventoried during the testing phase (see Moore et al. 2010a). The research plan for this site included the excavation of Features 1, 3, 6, 11, and 17 and up to five additional features (Moore et al. 2010:117). Ultimately, only one additional feature was excavated due to the complexity of two of those investigated. Investigated features are described below in detail followed by brief descriptions of those that were inventoried.

Feature 1 (fire-cracked rock scatter or deflated feature)

Located in the southern portion of LA 111429, Feature 1 is Zia Feature 16, which they described as a 2.0 m diameter scatter of about 30 pieces of lightly fragmented fire-cracked igneous rocks (Quaranta and Gibbs 2008:240). OAS determined that the feature was a dispersed scatter covering an area over 13.0 by 21.0 m with a greater concentration that was 4.0 by 3.0 m in size. No charcoal-stained soil was observed within the surface of the feature area. However, during the testing phase a 20 by 20 cm test within the feature found charcoal-stained soil at 2 cm below the ground surface suggesting it had the potential to contain dating and subsistence samples.

The feature is located in an eroded inter-dunal area with dense bunch grass bordered by small mesquite bushes and yucca. Investigation of this feature consisted of placing a 1 by 1 m grid unit within the more concentrated portion of the feature (Fig. 7.6). Rock in that and adjacent grids was mapped. Eight pieces of fire-cracked rock were present on the surface and included vesicular basalt, burned caliche, and igneous rocks. Two levels of fill were removed from the grid unit. The upper 5 to 10 cm (Stratum 13) was loose eolian sandy silty clay (7.5 YR 5/4) with a small amount of gravel and no charcoal. About 50 pieces of fire-cracked rock were recovered from this root and insect disturbed stratum (Fig. 7.7), as was a complete chert core flake. Most of the fire-cracked rock was burned caliche with small numbers of vesicular basalt and igneous rocks. Excavation of a second level encountered similar but more compact soil (Stratum 14) with a small amount of gravel (Figs. 7.8, 7.9). A single chert core flake fragment was recovered from this level. No flotation samples were taken.

Excavation in this grid unit suggested that Feature 1 is deflated and scattered. Extensive surface stripping in the general area may have revealed the remnants of an *in situ* feature or nothing more than rodent burrows filled with stained soil. The lack of stained soil in the grid unit suggests it was completely deflated and excavations were terminated.

Feature 3 (large roasting pit)

Located in the southern half of LA 111429, OAS Feature 3 may be Zia Feature 13 or they may designate two separate, but closely spaced, features. As plotted, the two features are about 15 m apart but no other features are present in the vicinity. Zia described Feature 13 as a 3 m diameter scatter of over 50 pieces of fire-cracked rocks, mainly burned caliche with moderate to high fragmentation and chipped stone on the south edge (Quaranta and Gibbs 2008:240). OAS's initial description of this feature noted a scatter of about 100 pieces of fire-cracked rock—comprised of igneous rocks, vesicular basalt, sandstone, quartzite, burned caliche, and limestone—with charcoal-stained soil about two m southwest of the scatter. Grass and low brush are fairly dense in and around the feature area (Fig. 7.10). During the testing phase, a 20 by 20 cm test was placed in the fire-cracked rock portion of the feature and excavated to a depth of 16 cm. It encountered a compact surface at 10 cm below the surface on which the fire-cracked rock—but no charcoal-stained soil —appeared to be resting.

Research investigations began with the placement of a 3 by 2 m grid over the stained soil. Up to 10 cm of loose fill was removed revealing a large stain (Fig. 7.11). The stain was bisected along the north–south axis and fill was removed from the east half in four levels. A profile was drawn and the west face was photographed (Figs. 7.12, 7.13). Fill from the west half was also removed in four levels as there were no distinct breaks in the stratigraphy. Excavation in this half of the pit encountered a cluster of four large igneous cobbles (Fig. 7.14) placed in the upper fill and suggesting something like a pot rest. These rocks measured: 17 by 12 by 8 cm; 20 by 12 by 8 cm, 15 by 12 by 12 cm, and 15 by 13 by 8 cm.

The loose eolian fill overlying the pit was sandy

Figure 7.6. LA 111429, Feature 1 prior to excavation.

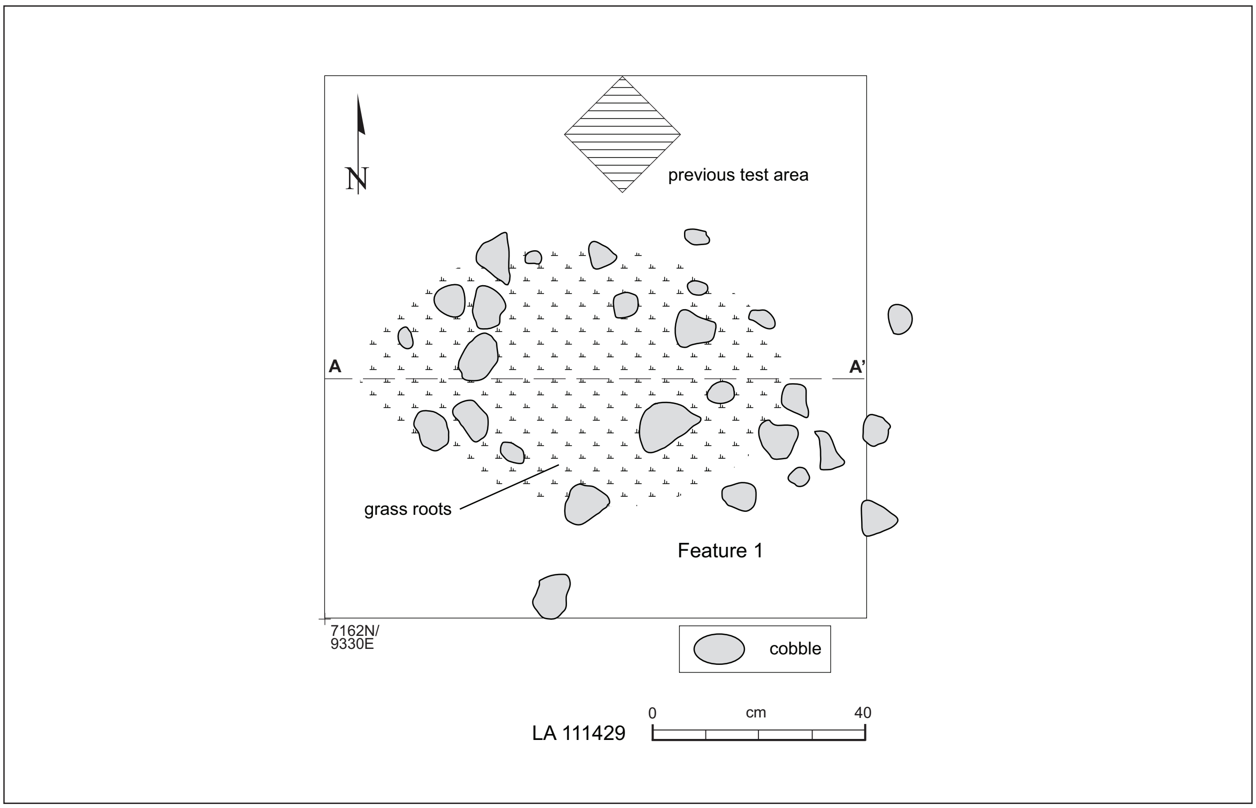

Figure 7.7. LA 111429, Feature 1, plan after Level 1.

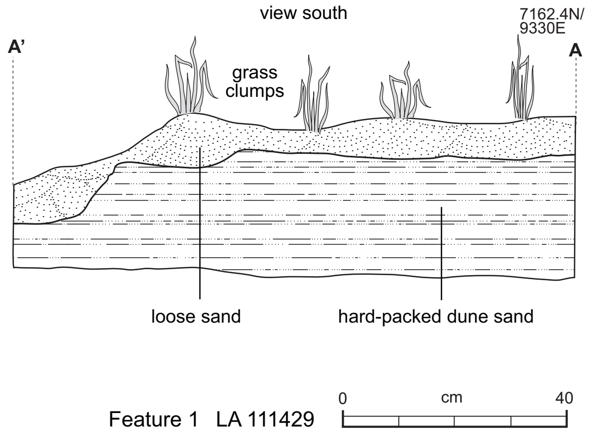

Figure 7.8. LA 111429, Feature 1, profile.

Figure 7.9. LA 111429, Feature 1, grid profile after excavation.

silt with varying amounts of charcoal flecking covered with a thin crust of water laminated silt. Rodent and insect burrows were present, with an extensive rodent burrow present in the southwest quadrant. Eight pieces of fire-cracked rock were noted on the surface of the 6 grid units and another 53 were recovered from the loose fill that constituted the surface strip. Fill within the pit (Stratum 9) was darkly stained silty sand nearly devoid of gravel and containing no fire-cracked rock. Color ranged from 7.5 YR 4/2 (brown) in the upper fill to 7.5 YR 2.5/1 (black) near the base. The amount of compaction varied but was never hard. Insect and rodent bioturbation was present throughout with a major rodent tunnel at the center of the feature. The density and size of charcoal pieces increased with depth. Seven pieces of chipped stone were recovered from the fill (four in Level 1, one in Level 2, two in Level 3). They include three chert core flakes, two chert angular debris, a limestone core flake, and a piece of limestone angular debris.

This large roasting feature was an ovoid and steep-walled pit measuring 1.7 m north–south and 1.9 m east–west with a depth of 0.52 m (Fig. 7.12). It was excavated into the underlying Pleistocene B soil horizon. Walls were unfinished and charcoal stained and baked (Fig. 7.16).

Wood in radiocarbon and flotation samples and collected, in turn, from the feature fill, was all saltbush. Samples of saltbush and yucca caudex produced radiocarbon dates falling within the Late Archaic or early Mesilla phase, 2 cal BC–AD (Boyer, Chapter 19). Four of the six flotation samples contained burned yucca caudex and one also had an unknown plant part.

The fire-cracked rock scatter just east of the pit consisted of about 70 pieces of rock that were mainly igneous and burned caliche. To investigate the relationship between the roasting pit and adjacent fire-cracked rock scatter, the grid was extended east in a 2 by 2 m area that slightly overlapped the main fire-cracked rock concentration. Surface rock was mapped (Fig. 7.17) and the loose upper eolian fill removed. The fill was loose sandy silty loam (7.5 YR 5/4). Fire-cracked rock was fairly sparse on the surface of the four grid units (12 pieces) but abundant in the eolian fill (91 in the northwest grid unit, 46 in the northeast grid unit, 40 in the southwest grid unit, and 33 in the southeast grid unit). Thirty-two chipped stone artifacts were recovered, mainly chert (n = 21) but including eight metaquartzite, two limestone, and one obsidian. Most are core flakes (n = 23), with some angular debris (n = 8), and a biface flake. At least two pieces of ground stone were observed in the main scatter.

Feature 6 (fire-cracked rock scatter)

Feature 6 at LA 111429 is probably the same feature identified as Feature 21 by Zia. It was described as a 4 m diameter scatter of about 80 pieces of fire-cracked rock, mainly caliche with low fragmentation, and was mounded 30 cm above the surrounding ground surface with the deposits forming a small dune (Quaranta and Gibbs 2008:240). During the testing phase, OAS documented this same feature as a scatter of about 100 pieces of fire-cracked rock on a small stable dune with a maximum dispersion of about 5.0 m north–south and 4.3 m east–west and a denser area 2.0 m in diameter. Densities were estimated at about 25 rocks in the densest area and less than 10 elsewhere. This feature was chosen for excavation because a 20 by 20 cm test excavated during testing revealed the presence of subsurface fire-cracked rocks at least 20 cm deep.

Located just west of County Road A20, Feature 6 was at the base of a gentle dune slope in an area with abundant grass and scattered yucca and mesquite (Fig. 7.19). More intense observations indicated that the scatter measured 8.0 m north–south by 6.2 m east–west and the more concentrated portion was 1.0 m north–south by 2.5 m east–west. Investigations began by placing a 1 by 1 m grid unit in the densest part of the concentration. A total of 34 pieces of burned caliche were counted on the surface as well as substantial numbers of naturally occurring gravel (Fig. 7.20). From four to eight centimeters of loose fill (called Stratum 11) were removed as the first level. A sandstone one-hand mano fragment and a metaquartzite core flake were recovered and about 23 pieces of fire-cracked rock were observed. Two additional levels (Strata 12 and 15) were excavated for a total of 29–31 cm of fill removed. Fire-cracked rock was less abundant, 26 in Stratum 12 and 3 in Stratum 15. Since fire-cracked rock continued into the lowest level excavated, a second 1 by 1 grid unit was placed to the east of the original grid unit. Surface rock (about 12) was mapped and the loose eolian Stratum 11 removed. The upper fill was thicker in this grid unit (3 to 9 cm) because it was at the base of a yucca that had

Figure 7.10. LA 111429, Feature 3, fire-cracked rock taken during testing.

Figure 7.11. LA 111429, Feature 3, stain.

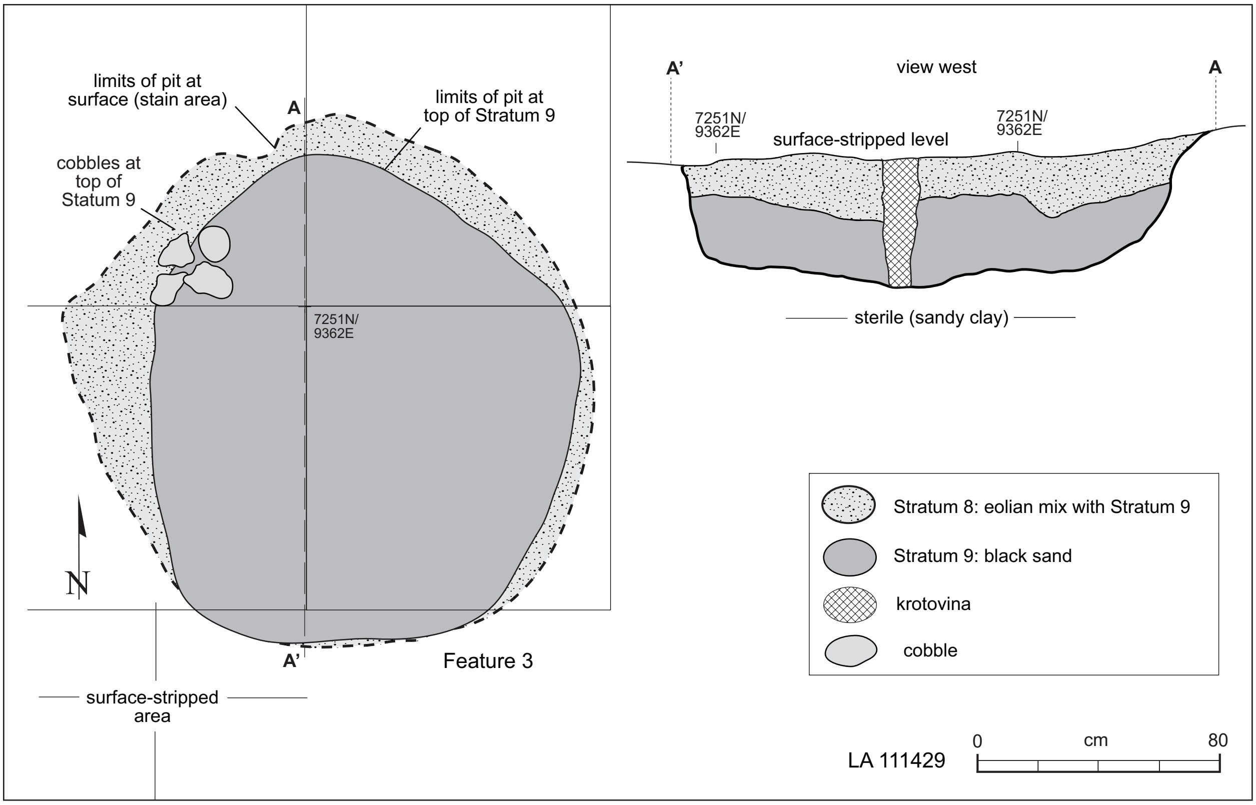

Figure 7.12. LA 111429, Feature 3, plan and profile of west face.

Figure 7.13. LA 111429, Feature 3, profile.

Figure 7.14. LA 111429, Feature 3, cobbles in west half of fill.

Figure 7.16. LA 111429, Feature 3, after excavation.

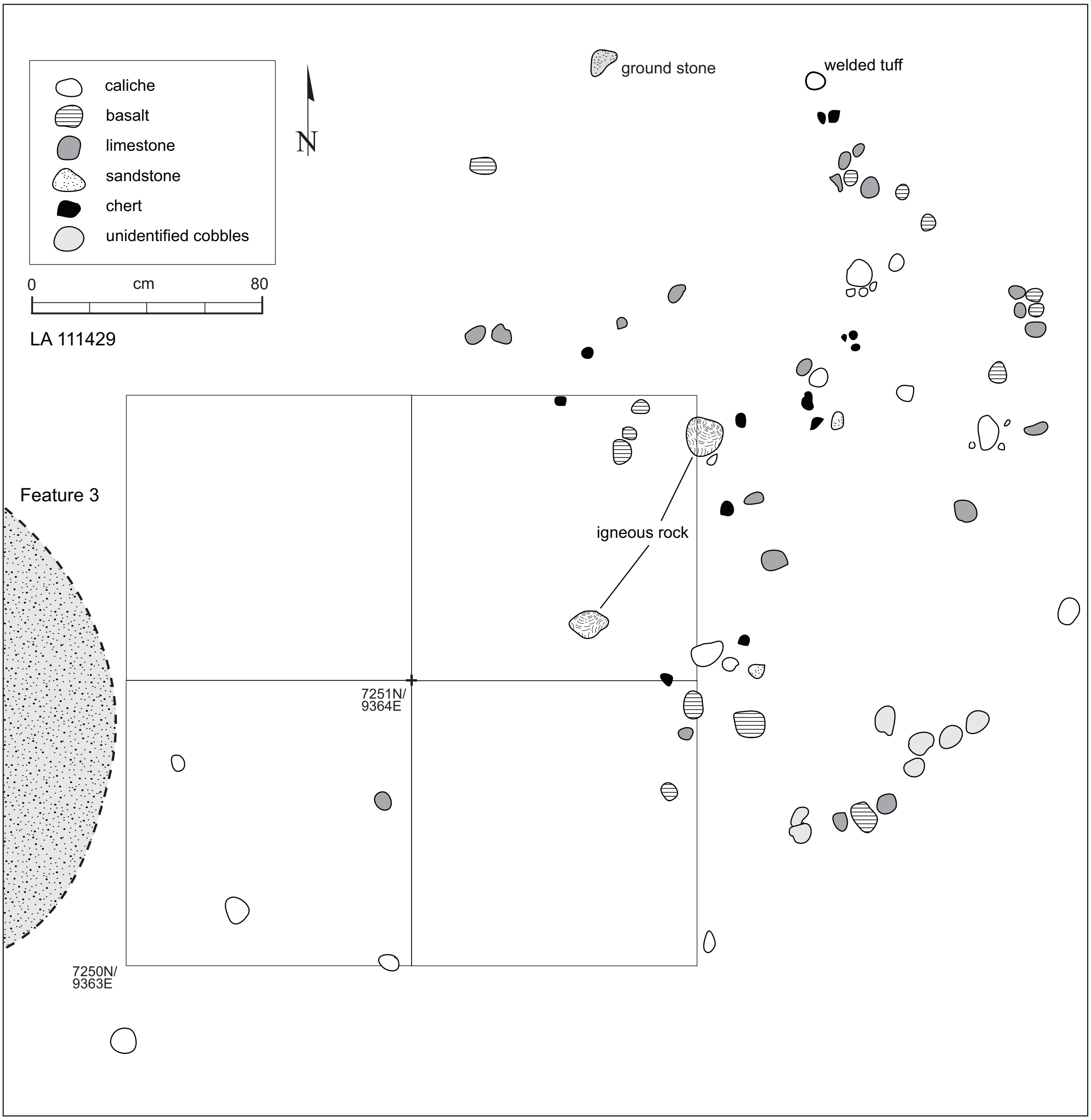

Figure 7.17. LA 111429, plan of surface rock in grids east of Feature 3.

accumulated wind-blown deposits. No artifacts were found, but 48 pieces of fire-cracked rock (42 burned caliche and 6 igneous) were encountered in that level. Two additional levels (20 cm) of fill were removed without finding evidence of an intact feature. Again, fire-cracked rock was less abundant in the lower levels (about 20 in Level 2 and 5 in Level 3). Pieces of a quartzite and a sandstone metate were found in the second level. No flotation sample was collected because of the lack of an intact feature or associated stained fill.

The upper fill (Stratum 11 or 3) was loose eolian silty sand (7.5 YR 5/4 or 6/4 depending on the observer) that contained fire-cracked rock and small gravel. Beneath this was Stratum 12, a more compact sandy silty loam (7.5 YR 5/4 or 6/3 depending on the observer) with scattered caliche nodules. Stratum 15 (the equivalent of site Stratum 2) was compact (7.5 YR 6/4) silty sandy loam with some gravel inclusions (Figs. 7.21). No charcoal was observed in any of the strata and all strata had insect and rodent disturbance.

Excavations in these two grid units suggested that Feature 6 is highly deflated and scattered. However, since much of the fire-cracked rock occurred beneath the surface, it is possible that a more intact thermal feature is present in the area.

Feature 11 (large rock-filled roasting pit)

LA 111429, Feature 11, is Zia Feature 7, a 7.5 by 5 m ring midden composed of thousands of pieces of fire-cracked rock mounded to 60 cm above ground surface (Quaranta and Gibbs 2008:240). OAS inventoried the feature as a 7.0 by 7.8 m scatter of fire-cracked rock on the surface of a stabilized dune (Fig. 7.22a,). Hundreds of fire-cracked rocks were observed on the surface, as was charcoal-stained soil. Much of the rock was in an area 5.2 m in diameter.

Feature 11 is located in the northern part of the site on the southern edge of a southwest to northeast–trending dune ridge. Grass covers much of the dune upslope and around the main concentration of fire-cracked rock, with mesquite growing to the south and west and yucca to the east. The feature's location at the edge of the dune suggests it was a large mound of rock that trapped eolian sand; however excavation indicates that the roasting pit was intentionally cut into the dune. Rock in the pit has stabilized part of the dune, and discarded and eroding fire-cracked rock covers the downslope sides of the dune.

OAS investigations began by mapping the surface rocks between 7538–7546N and 9460.5–9466E and recording elevations at grid corners and midway along the north–south grid lines for much of that area (Fig. 7.22b). Then, an east–west row of grid units (7542N/9461–9464E) was established through the portion of the feature where surface indications suggested the presence of a pit (Fig. 7.23). Surface rocks in the grid units chosen for excavation were photographed. No other grids were excavated.

Excavation soon revealed a pit filled with tightly packed pieces of rock, nearly all of which is burned caliche. Fill was removed from each 1 by 1 m grid unit a layer of rock at a time. Soil from between the rocks in a layer was removed, the rocks were mapped and photographed, then the rocks were removed. This process was repeated for 9 of the 11 layers of rocks. Rocks in the last two layers, found only in the deepest part of the pit, were only photographed. Charcoal specimens for radiocarbon dating and flotation samples were collected from most levels of each grid.

Above the pit was a layer of 2 to 10 cm of recently deposited loose eolian sand with a minor silt content (7.5 YR 6/2 dry). Just below this was a layer of slightly gray, grainy textured dune sand (7.5 YR 5/3 dry) that ranged from 2 to 24 cm thick in areas along the east side (Figs. 7.24, 7.25). The pit soil (Stratum 4) was charcoal-stained dune sand with a slight loam content (7.5 YR 3/2 wet, 4/2 dry), a grainy texture, and abundant charcoal in some areas. Pockets of clean sand (Stratum 4) appear under rocks and along the sides, where it probably represents slumped pit walls (7.5 YR 5/3 dry), and in rodent burrows where it was laminated. The bottom of the pit is covered with a layer of 2 to 20 cm of powdery white ash with a minor sand content and disintegrating pieces of burned caliche (7.5 YR 6/2 dry). The soil underlying the pit is a sandy loam (7.5 YR 6/4 dry), some with a reddish tinge from the heat.

The Feature 11 pit was scooped out of the coppice dune then lined and filled with tightly packed pieces of caliche and wood. Larger pieces of rock characterized some layers (Fig. 7.26), and smaller ones other layers (Fig. 7.27). Almost all of the rock is caliche that ranges in size from about 40 cm to less than 10 cm with numerous small heat-fractured

Figure 7.19. LA 111429, Feature 6, prior to excavation.

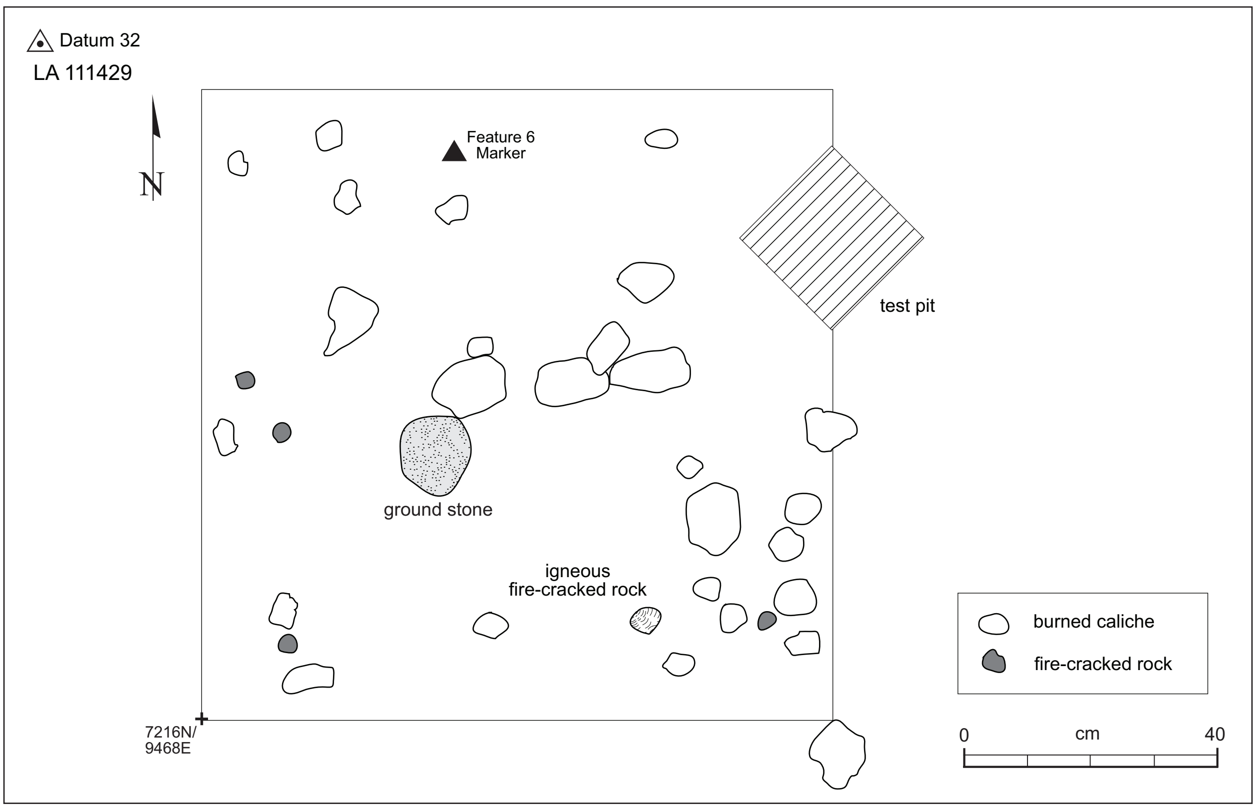

Figure 7.20. LA 111429, Feature 6, plan of surface fire-cracked rock.

Figure 7.21. LA 111429, Feature 6, profile.

Figure 7.22a. LA 111429, Feature 11.

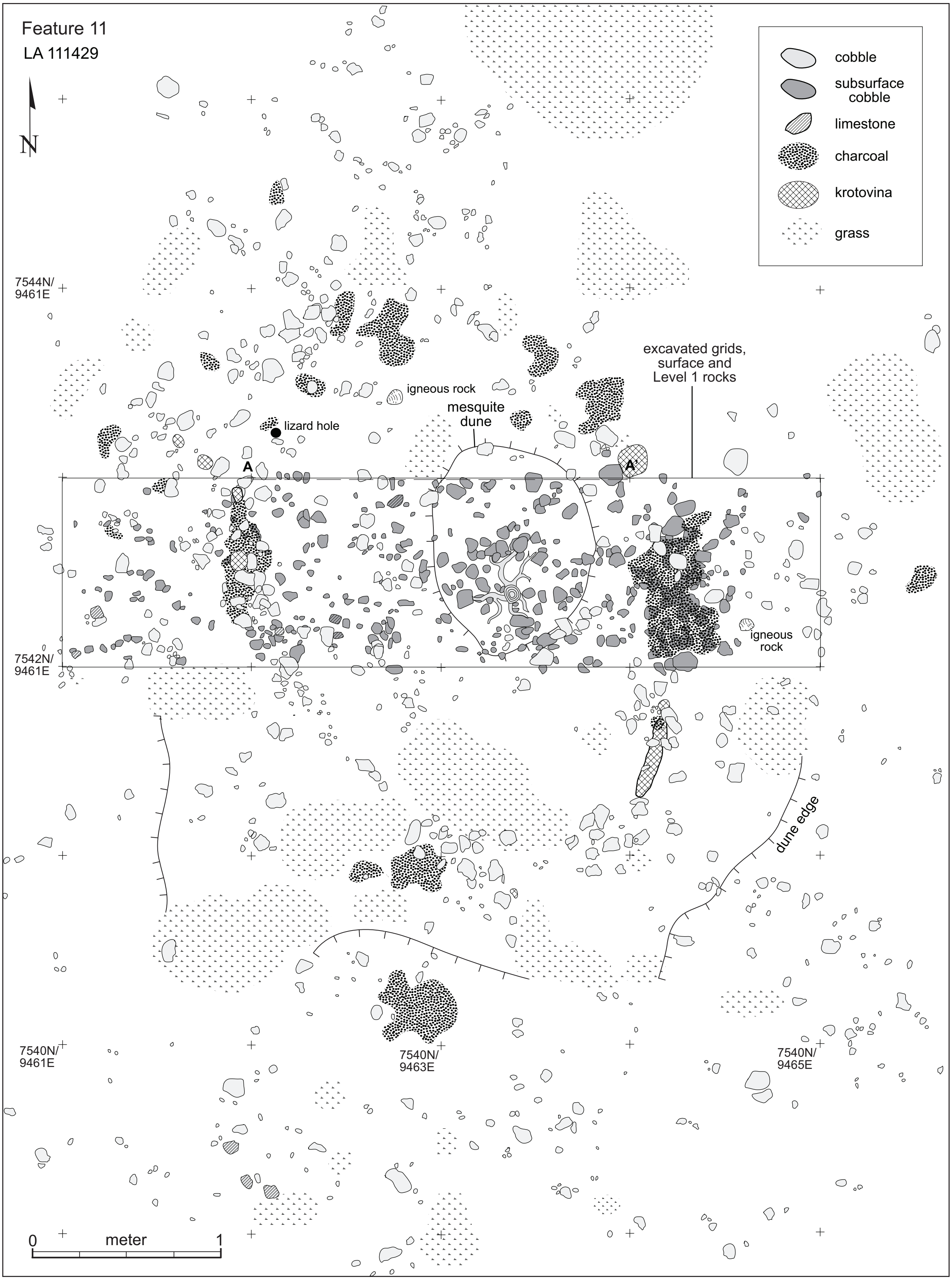

Figure 7.22b. LA 111429, Feature 11, plan.

Figure 7.23. LA 111429, Feature 11, grids in densest area of fire-cracked rock.

spalls. Some of the caliche nodules are more cobble-like while others are slabs that could had been harvested from caliche beds like those exposed at the western edge of the site area. Igneous, limestone, and sandstone rocks as well as several pieces of ground stone were also used to fill the pit. The rocks were not uniformly placed in flat planes. Some were laid flat and others were laid in a vertical or diagonal orientation. The amount of rock was equal to, or exceeded that, of the fill dirt. Burning fractured the rock, completely burned the wood, and reddened the surrounding dune soil. Rodent burrows impacted the eastern and western margins of the pit leaving collapsed areas filled with laminated sand. Insect burrows and hardened lumps from their secretions were common. Also present were lizard burrows, a red ant tunnel, and a mesquite bush growing in one of central grid units.

The excavated pit measured about 2.16 m east–west, but both edges were impacted by rodent burrowing and it could have been slightly larger or smaller. The north–south diameter is unknown. The pit has gently sloping walls forming a basin shape and was at least 0.63 m deep. Soil at the base of the pit was burned to varying degrees (Fig. 7.28). Deflation may have impacted the upper layer of pit fill, but probably by less than 10 cm. The rock in the grids surrounding the feature could suggest it was used then cleaned and reused at least once. However, the profile shows that the rocks were not removed from the pit after its last use, suggesting that whatever was cooked was roasted or baked on top of the pit. Rocks placed over the processed material could also have been the source of the fire-cracked rock and cobble spread.

A sample of the 313.95 grams of charcoal collected for radiocarbon samples was identified. Of this, 64 percent was identified as mesquite, 18 percent as saltbush, just over 3 percent as cholla wood or bark, and 14 percent as yucca caudex, leaf, or stem parts. The 21 flotation samples collected from this feature contained burned prickly pear fruit and pads along with yucca caudex, stem, and leaf fragments, cheno-am, spurge, dropseed, and other grasses. Samples of mesquite, saltbush, and yucca stem were submitted for radiocarbon analysis. Both the most accurate (cal AD 1620–1685) and most precise (cal AD 1630–1675) dates for this feature (Boyer, Chapter 19) place it in the Spanish Colonial era.

Artifacts were sparse. A limestone core flake was recovered from the first level of 7542N/9464E. Ground stone (two sandstone one-hand mano fragments, two sandstone slab metate fragments, and a quartzitic sandstone metate fragment) was found in three of the four grids; all are fire-fractured. Most of what was recovered was the charcoal, macrobotanical material, and flotation samples. Three pieces of bone were found in flotation samples. Two are from lizards and one is a fragment of a cottontail metatarsal. None are burned, suggesting they are post-occupational additions to the pit fill.

Two surface strip areas (Surface Strip 6 and 7) were placed in flat areas just south of this feature. It is unlikely that activities would have occurred much closer while the pit was in use. The mesquite fuel would have produced a hot fire and these areas were selected to locate possible activity areas that could have been associated with the feature.

Feature 17 (fire-cracked rock scatter)

Feature 17 is part of a cluster of six fire-cracked rock features located southeast of Feature 11. It was not given a number by Zia, who show only five features in an area where OAS identified nine features (Quaranta and Gibbs 2008:237). During testing, this feature was recorded as a 5.6 by 5.0 m diameter scatter of about 75 fire-cracked rocks with a more concentrated area 1.6 m in diameter. It was chosen for excavation because a 20 by 20 cm test revealed the presence of buried rock and of a small mesquite could have been obscuring a more intact section of the feature.

Investigation began by placing a 1 by 1 m grid unit within the scatter (Fig. 7.29). About 22 pieces of fire-cracked rock, including burned caliche, limestone, and igneous rocks, were on the surface along with small naturally occurring gravel. Between 6 and 10 cm of loose eolian sandy silt loam was removed down to a more compact soil (Fig. 7.30).

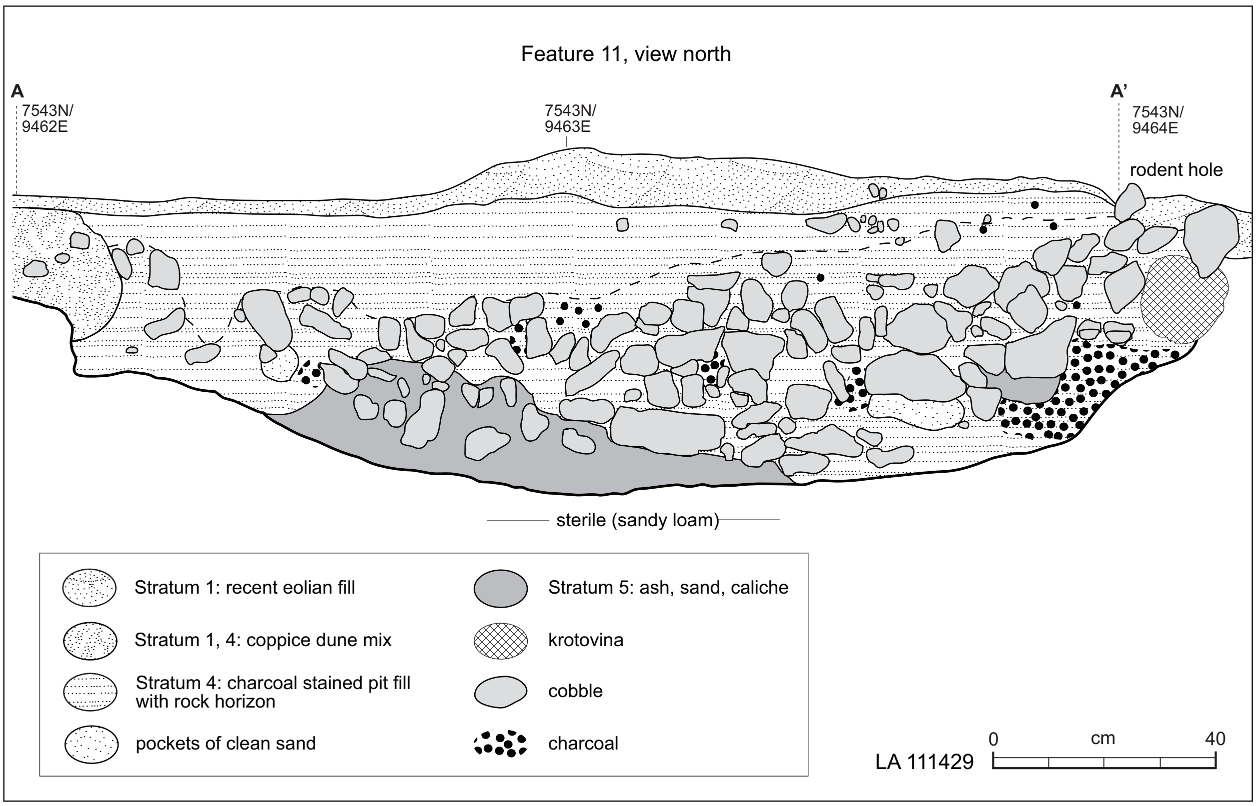

Figure 7.24. LA 111429, Feature 11, profile.

Figure 7.25. LA 111429, Feature 11, profile.

Figure 7.26. LA 111429, Feature 11, smaller rock in Level 3/7.

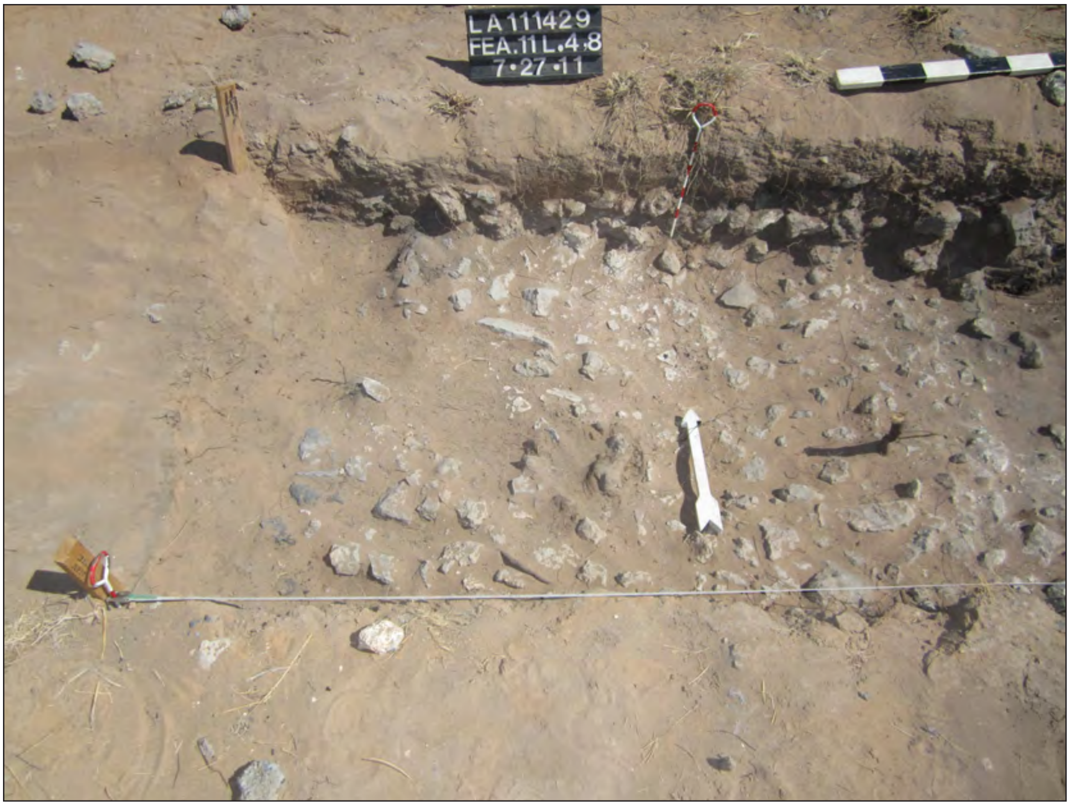

Figure 7.27. LA 111429, Feature 11, larger rock in Level 4/8.

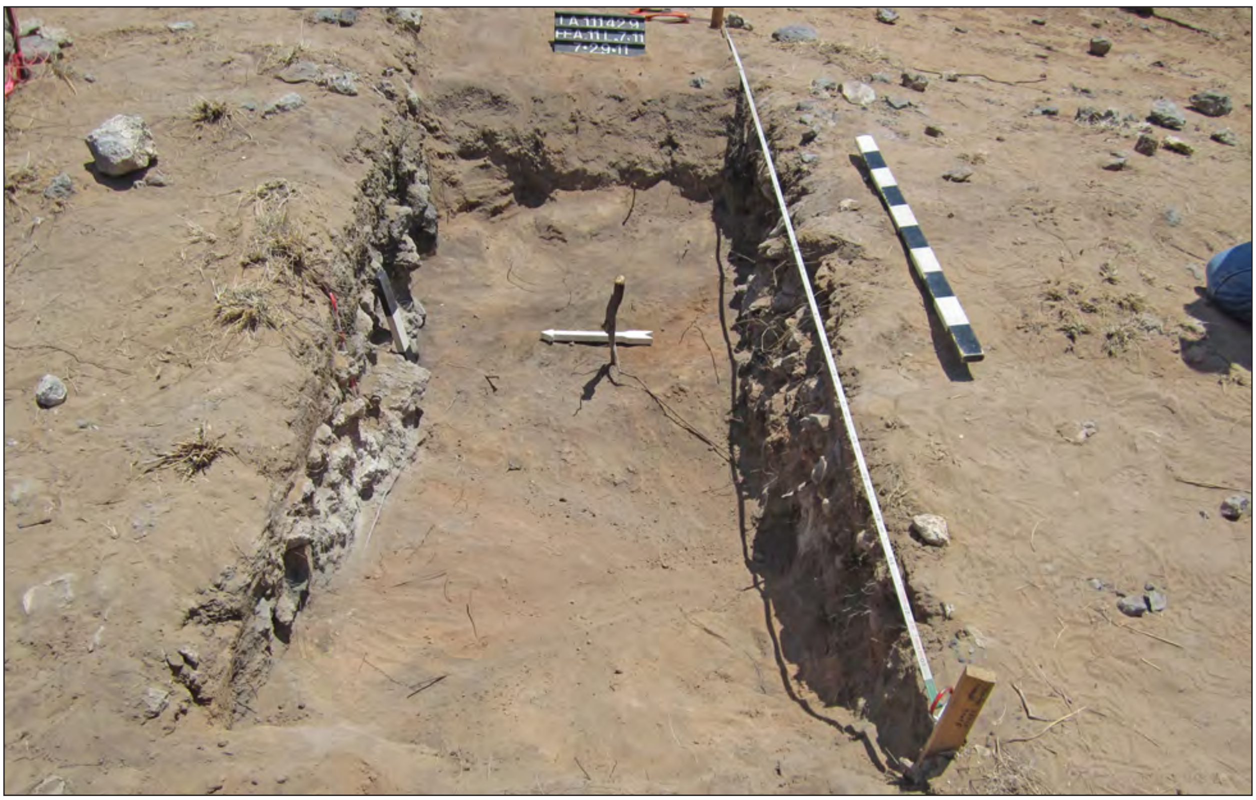

Figure 7.28. LA 111429, Feature 11, base of pit with rock removed.

About 15 pieces of fire-cracked rock were found in the fill but no ash or charcoal was observed, no artifacts were recovered, and a flotation sample was not taken.

Excavation in this grid unit did not encounter evidence of an intact feature. The lack of charcoal or charcoal-stained soil suggests that this feature was highly deflated. It could have originally been built on the surface or in a shallow pit, after which the fill and rock could have dispersed over time. Alternatively, the remains of an intact feature could have been buried under the mesquite or nearby. Extensive foot traffic around the feature did not reveal any charcoal-stained soil that would have suggested the presence of a still buried feature, so it is likely that little or nothing other than the scatter of rocks remains.

Feature 22 (fire-cracked rock scatter)

Feature 22 at LA 11429 was not recorded by Zia (Quaranta and Gibbs 2008:237). During testing, OAS recorded it as a small scatter of about 20 fire-cracked rocks in an area measuring 3.3 m north–south by 3.1 m east–west. The rocks were mainly cobbles of igneous rock, limestone, chert, and sandstone with a maximum density of 8 in a 50 by 50 cm area. A 20 by 20 cm test in the feature suggested a potential depth of about 10 cm. The feature was chosen for excavation because of its location; a county-road drainage cut lies just north of the scatter and ongoing maintenance could eventually destroy the feature. More intense scrutiny of the area suggested the scatter was more like 6.0 by 5.0 m in size. Some of the fire-cracked rocks exhibited a calcium carbonate deposit and some cobbles lacked or had only slight fire spalling.

Located on a relatively flat area covered by small clumps of grass, a 1 by 1 m grid unit was placed in the densest area of rock less than a meter from the county road disturbance (Figs. 7.31, 7.32). Between 3 and 7 cm of loose eolian sandy silt loam (7.5 YR 6/3) was removed from the grid unit as Level 1. This fill was alternating silt and sand lenses from wet and dry episodes and contained small pieces of gravel. About 10 pieces of fire-cracked rock were found in this level (Fig. 7.33) as well as a chert-core hammer-

Figure 7.29. LA 111429, Feature 17, prior to excavation.

Figure 7.30. LA 111429, Feature 17, after excavation.

stone, two chert biface flakes, and a partial sandstone one-hand mano. No indication of an intact feature was found and excavation in the area was discontinued.

Inventoried Features

Feature 2 (fire-cracked rock scatter)

Located in the south area north of Feature 1, OAS Feature 2 is Zia Feature 15. Quaranta and Gibbs (2008:240) described this feature as a 3 m diameter scatter of over 50 pieces of fire-cracked rock, and the rocks as mostly caliche, highly fragmented, and buried. The OAS inventory of the feature has it measuring 8.0 m north–south by 5.5 m east–west with a more concentrated area that is 2.5 m north–south by 1.8 m east–west. It is located in a relatively flat interdunal area with a dense patch of grass at the center (Fig. 7.34). It was estimated to contain about 100 pieces of fire-cracked rock that was largely vesicular basalt and burned caliche with smaller amounts of limestone and igneous rocks, and at least one ground stone fragment. Even the more concentrated area had relatively few rocks, about 5 in a 50 by 50 cm area. A 20 by 20 cm test adjacent to the grass stabilized area found four centimeters of dune sand overlying compact clayey sand and no indications of subsurface deposits.

Feature 4 (fire-cracked rock scatter)

Located at the north edge of the Ground Stone Area in LA 111429, OAS Feature 4 is Zia Feature 14. It was described as a 3 m diameter fire-cracked rock scatter comprised mainly of highly fragmented caliche with some igneous rocks. Chipped stone, shale objects, and grinding slabs were noted in the vicinity (Quaranta and Gibbs 2008:240). OAS described the feature as measuring 5.8 m north–south by 8.5 m east–west with a more concentrated area that is 2.4 m north–south by 1.4 m east–west. The rocks are mainly burned caliche with some limestone and quartzite (Fig. 7.35). The maximum density in a 50 by 50 cm area is 10. This feature is located in a deflated area between dunes that appears to have little soil depth and little potential for subsurface deposits, chronometric samples, or subsistence remains.

Feature 5 (fire-cracked rock scatter)

Also in the southern area between Features 6 and 7 and the Ground Stone Area, Feature 5 is Zia Feature 19. They described it as a 3 m diameter scatter of 75 pieces of fire-cracked caliche (Quaranta and Gibbs 2008:240). OAS estimated that the scatter comprises less than 50 rocks with maximum dimensions of 3.8 m north–south by 7.0 m east–west and a more concentrated area of 2.2 m north–south by 2.8 m east–west. Most of the rocks are small pieces of burned caliche with densest area having about 7 rocks in a 50 by 50 cm area (Fig. 7.36). It is in an area of stabilized dunes with a potential for 20 cm of fill in some of the dune areas.

Feature 7 (fire-cracked rock scatter)

Feature 7 is Zia Feature 20. As described, it was comprised a large fire-split igneous cobble, other smaller igneous rocks, and two pieces of caliche, all mostly buried (Quaranta and Gibbs 2008:240). Located east of the Ground Stone Area, OAS was able to locate 12 pieces of fire-cracked rock in an area measuring 1.0 m north–south by 1.1 m east–west. The large basalt rock was possibly ground (Fig.7.37). The greatest density in a 50 by 50 cm area is seven rocks. A 20 by 20 cm test found just over 10 cm of dune sand that became more compact with depth and contained small pieces of carbonates at the base. At 10 to 11 cm below the surface, lenses of clay were observed in the dune sand and these lenses increased with depth. Excavation stopped at 20 cm after encountering a redder soil with a slight silt content. No evidence of subsurface deposits that could provide subsistence or dating samples was found.

Feature 8 (fire-cracked rock scatter)

Feature 8 is located on a grass-stabilized dune slope. It is Zia Feature 11, which was described as a 2 m scatter of caliche and igneous rock with additional rock extending downslope from the original

Figure 7.31. LA 111429, Feature 22, prior to excavation.

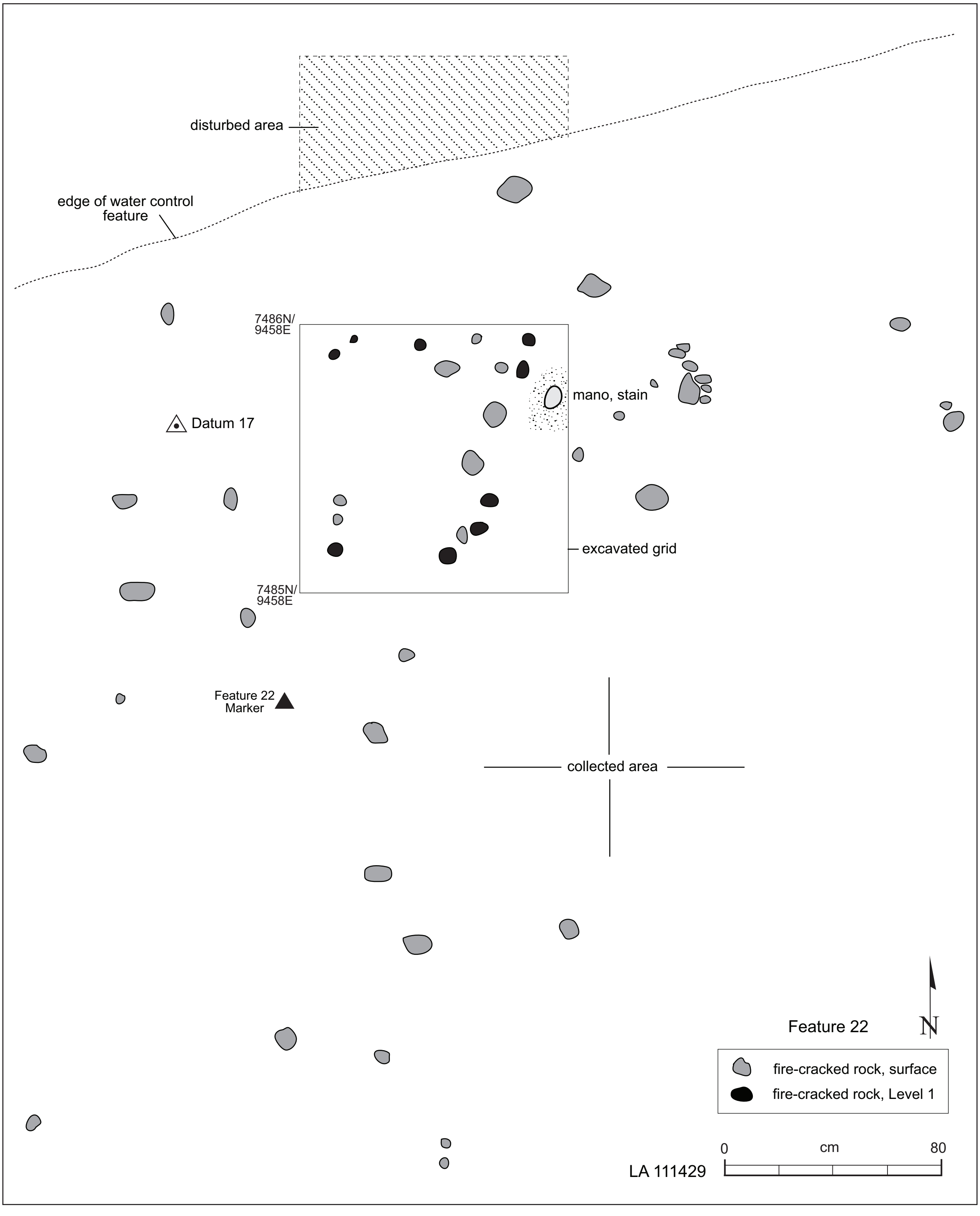

Figure 7.32. LA 111429, Feature 22, plan of fire-cracked rock.

Figure 7.33. LA 111429, Feature 22, after excavation.

Figure 7.34. LA 111429, Feature 2.

Figure 7.35. LA 111429, Feature 4.

Figure 7.36. LA 111429, Feature 5.

feature (Quaranta and Gibbs 2008:240). OAS found that the scatter was large, 12 m north–south by 7.8 m east–west, with a more concentrated area measuring 1.6 m north–south by 1.3 m east–west (Fig. 7.38). This enlarged scatter has about 300 rocks that are mainly burned caliche with small numbers that are quartzite, limestone, and unburned caliche. These are in an area of dunes and deflated zones, and the rocks are eroding and scattered to the southwest. In some areas the fire-cracked rocks are fairly dense, a maximum of 26 in a 50 by 50 cm area. Artifacts are present on periphery of the scatter.

A 20 by 20 cm test in one of the grass stabilized areas found 5 to 6 cm of loose fine silty sand overlying another 5 to 6 cm of more compact silty clay with some sand, then very compact silty clay. No subsurface fire-cracked rock or other evidence of buried deposits was found. However, fire-cracked rock is present on the surface of some of the grass-stabilized areas and the burned caliche lacks the heavy carbonate coating found in some scatters. This may suggest the scatter is younger and post-dates the sand sheet in this area.

Feature 9 (fire-cracked rock scatter)

This feature is the one Zia called Feature 10 and described as a 5.0 by 2.5 m scatter of hundreds of moderately fragmented caliche and igneous fire-cracked rocks (Quaranta and Gibbs 2008:240). Located in an inter-dunal area with small grass-stabilized dunes inside and west of the feature, the rocks were mainly in the deflated areas (Fig. 7.39). These are widely scattered, covering 23.2 m north–south by 10 m east–west with a denser area that is 5.5 m north–south by 3.0 m east–west. The number of fire-cracked rocks was estimated at 200 to 300 with a maximum density of 24 in a 50 by 50 cm area. These rocks are mainly caliche with small amounts of basalt, chert, limestone, and sandstone. Chipped stone is present to the east, with some being some heat-treated. The paucity of soil in the areas with fire-cracked rock suggests the only potential for subsurface deposits would be in the grassy areas, and even in those areas the potential is low.

Feature 10 (fire-cracked rock scatter)

The feature OAS labeled Feature 10 is Zia Fea-

Figure 7.37. LA 111429, Feature 7.

tures 12 and 18. Their map shows a large scatter with Feature 12 in the northeast portion. Feature 12 was described as distinct from other features in the size of the rock, about 75 pieces of mostly igneous rocks with low fragmentation. A basin metate fragment was observed at the northern edge and flakes were noted in association with the scatter. Feature 18 was about 4 m in diameter and comprised low to moderately fragmented igneous and caliche rocks eroding downslope into a fire-cracked rock concentration (Quaranta and Gibbs 2008:240).

OAS considered Feature 10 to be one large scatter with two loci, both in an eroded inter-dunal area. The north locus (Zia Feature 12) comprised 100 to 200 pieces of fire-cracked rock scattered over a 17 m north–south (includes both loci) by 23 m east–west area, with a concentration 2.0 m in diameter and a maximum density of five pieces in a 50 by 50 cm area. The rock is mainly burned and unburned caliche (about 80 percent) with small, widely dispersed pieces of igneous, limestone, and sandstone rocks. The southern locus (Zia Feature 18) had about 100 pieces of fire-cracked rock in a 15 m east–west area and a concentration that was 2.3 m north–south by 2.8 m east–west. Rocks were almost all burned caliche with a few pieces of limestone and igneous rock. Again, most of the rock was small fragments. Little soil was present in either area (Fig. 7.40), and the potential for datable and subsistence samples is low.

Feature 12 (fire-cracked rock scatter)

One of the northern area cluster of features at LA 111429, this is Zia Feature 5, described as a mostly discrete 4 m diameter fire-cracked rock scatter and possible ring midden composed of caliche with some igneous rocks (Quaranta and Gibbs 2008:240). Feature 12 is located in an area of small, stabilized dunes and inter-dunal spaces. It was composed of 100 to 200 pieces of widely scattered fire-cracked rock, mainly carbonate-coated burned caliche with small fragments of limestone and sandstone eroding from a mesquite-stabilized dune (Fig. 7.41). The maximum extent of the scatter was 7.0 m north–south by 7.5 m east–west, with a more concentrated area that was 2.8 m north–south by 2.2 m east–west. Rock was fairly dense in places, with a maximum of 27 in a 50 by 50 cm area. A 20 by 20 cm test excavated into the denser area found fine dune sand containing numerous pieces of burned (n = 21) and unburned (n = 18) caliche and a small biface flake that was not collected. At 28 cm below ground surface, the fill was a more compact sand with some silt content and burned (n = 4) and unburned (n = 1) caliche. Excavation stopped at 36 cm. No obvious A horizon or charcoal was observed in the test, which may suggest that the potential for an intact feature and feature deposits is low, but could also mean it is present in another portion of the scatter.

Feature 13 (fire-cracked rock; deflated fire pit)

Another of the cluster of features in the northern area of LA 111429, this is probably the same feature as Zia Feature 6. It was described as a 3 m diameter possible ring midden that is disarticulated and composed of caliche and igneous rocks (Quaranta and Gibbs 2008:240). Feature 13 was composed of approximately 100 pieces of fire-cracked rock in a 5 m north–south by 2 m east–west area. The central portion of the feature is in a stabilized dune. It is fairly intact (Fig. 7.42) and is less dispersed than Feature 12. The rock is mainly caliche with some sedimentary rocks and a maximum density of 25 rocks in a 50 by 50 cm area. A 20 by 20 cm test found loose dune sand and fire-cracked rocks down to 5 cm below ground surface where the soil became a slightly darker-colored compact sand that could represent an A horizon a few centimeters thick. Beneath this are alternating layers of looser and more compact fill. At 20 cm below ground surface, carbonate flecks appear and the soil becomes siltier. No evidence of charcoal or ash was observed, and the fire-cracked rock (n = 12) was almost all in the upper few centimeters of fill. It was unlikely to have been a ring-midden and appeared to have little potential for having the kinds of subsurface deposits that could produce dating and subsistence samples.

Feature 14 (fire-cracked rock scatter)

OAS Feature 14 is Zia Feature 4. Feature 4 was described as a scatter about 15 m in diameter with a 3 m diameter concentration. Rock was described as mostly caliche of variable fragmentation and patterned as a possible ring midden (Quaranta and Gibbs 2008:240). Feature 14 is a scatter of 200 to 300 pieces of fire-cracked rock, mainly caliche with some limestone, sandstone, and silicified wood. It was scattered over a 7 m north–south by 8 m east–west area, with a more concentrated area that was 0.90 north–south by 0.70 m east–west. Most of the

Figure 7.38. LA 111429, Feature 8.

Figure 7.39. LA 111429, Feature 9.

Figure 7.40. LA 111429, Feature 10.

Figure 7.41. LA 111429, Feature 12.

rocks were small fragments with a maximum density of 16 rocks in a 50 by 50 cm area. It was in an inter-dunal area with considerable vegetation but little (less than 10 cm) soil deposition (Fig. 7.43), and was unlikely to produce samples for dating or subsistence studies.

Feature 15 (fire-cracked rock scatter)

Feature 15 is Zia Feature 8, which was described as 10 fire-cracked igneous cobbles in a 1.25 m area with a metate fragment in association (Quaranta and Gibbs 2008:240). OAS estimated at least 11 pieces of fire-cracked rock in a 1.9 m north–south by 1.5 m east–west area and observed no ground stone. The rock was igneous, limestone, and unburned caliche with a maximum density of 4 in a 50 by 50 cm area (Fig. 7.44). Located in a deflated area surrounded by small dunes at the northern edge of the north feature cluster, the fill in Feature 15 was deeper in some areas but the feature appeared to be mostly deflated and unlikely to have remaining subsurface deposits.

Feature 16 (fire-cracked rock scatter)

Feature 16 at LA 111429 does not have a Zia equivalent. Just west of Feature 15, it is in a deflated area and is composed of between 50 and 75 small pieces of fire-cracked rock in a 4.0 m north–south by 2.6 m east–west area with a denser concentration measuring 2.0 m north–south by 1.0 east–west. A maximum density of 16 rocks was observed in a 50 by 50 cm area but most of the feature area has no more than one rock in that amount of space. The rocks are largely burned caliche with considerable amounts of sandstone and limestone (Fig. 7.45). The feature is located among several grass-stabilized dunes and the scatter extends down slope. Up to 30 cm of fill were suggested by a 20 by 20 cm test. At the surface was a thin crust of wind- and water-deposited soil that is mainly sand with some silt. Between 4 to 5 cm and 13 cm below ground surface the fill became compact with clay lenses and some softer areas. The only burned rocks were in the upper fill and no charcoal was found, suggesting this feature has low potential for retaining material for dating or subsistence samples.

Figure 7.42. LA 111429, Feature 13.

Figure 7.43. LA 111429, Feature 14.

Feature 18 (fire-cracked rock scatter)

Zia Feature 9 is the same as OAS Feature 18. Feature 9 was described as a 7.0 m diameter ring of fire-cracked rock with flakes in association (Quaranta and Gibbs 2008:240). OAS observed a scatter of less than 100 fire-cracked rocks around a small mesquite-stabilized dune (Fig. 7.46) located at the south margin of Paleoindian Area 1. It measures 9 m north–south by 8.5 m east–west with a denser area that is 2 m north–south by 1.5 m east–west. Less than 100 rocks make up the feature and only about 12 of those are in the more concentrated area. Most of the rock is burned caliche, especially at the periphery with igneous rock at the center. A possible mano fragment was observed near the center and a biface was located just west of the feature. Given the location and proximity to tools, this feature may have some potential for augmenting surface collection information but appeared to lack sufficient soil deposition to preserve subsistence and dating samples.

Feature 19 (fire-cracked rock scatter)

Located in the southern part of the site near the western boundary, this is Zia Feature 17, a 3.0 m diameter low-density scatter of small pieces of caliche (Quaranta and Gibbs 2008:240). It was in a flat inter-dunal area with grass (Fig. 7.47), and measured 13.5 m north–south by 9.0 m east–west with a denser area that was 2.5 m north–south by 1.7 m east–west. The rock was mainly small pieces of burned caliche with small amounts of sandstone and a maximum density of 10 rocks in a 50 by 50 cm area. There was some soil accumulation in the area as well as several pieces of chipped stone, some possibly heat-treated; however, the potential for subsurface deposits that could provide dating and subsistence samples is thought to be low.

Feature 20 (fire-cracked rock scatter, deflated fire pit)

The northern-most of the features at this site, Feature 20 is the same as Zia Feature 2. It was briefly described as a 2.5 m scatter of moderately to highly

Figure 7.44. LA 111429, Feature 15.

Figure 7.45. LA 111429, Feature 16.

fragmented caliche (Quaranta and Gibbs 2008:240). OAS found a scatter of 200 to 300 pieces of fire-cracked rock in a 4.0 m north–south by 3.5 m east–west area and a denser concentration measuring 1.5 m north–south by 1.3 m east–west. The rock was burned and unburned caliche and limestone with a maximum density of 50 in a 50 by 50 cm area. It was located in an inter-dunal area (Fig. 7.48) with little soil accumulation and little potential for subsurface deposits.

Feature 21 (fire-cracked rock scatter)

The only feature at LA 111429 found east of the county road, Zia Feature 1 was described as a 2.5 m area of fire-cracked rocks, with some more dispersed elements. The rocks were caliche, some pieces large but many small (Quaranta and Gibbs 2008:240). OAS labeled the feature as Feature 21 and measured the dispersion at 7.3 m north–south by 9 m east–west and the concentration as 1.9 m in diameter with a maximum density of 20 rocks in a 50 by 50 cm area. The feature contained about 100 pieces of fire-cracked rock, mostly burned caliche but also some limestone (Fig. 7.49). Located in a flat grass-covered area at the eastern edge of the site, the soil was relatively shallow and suggests little potential for buried deposits.

Feature 23 (fire-cracked rock scatter)

Feature 23 is a sparse fire-cracked rock scatter located at the periphery of the northern feature cluster and was not recorded by Zia. It consisted of less than 20 pieces of fire-cracked rock in a 7.0 m in diameter area and a denser area that was 2.5 m north–south by 1.7 m east–west. The feature was at the edge of an area of grass-stabilized dune but has little soil accumulation (Fig. 7.50). Most of the rocks are caliche with small amounts of sandstone and limestone. The lack of soil depth suggests this feature has little potential to produce dating or subsistence samples.

Feature 24 (fire-cracked rock scatter)

Feature 24 was not recorded by Zia. It was in the north-central section of the northern feature cluster and comprised between 100 and 200 pieces

Figure 7.46. LA 111429, Feature 18.

Figure 7.47. LA 111429, Feature 19.

Figure 7.48. LA 111429, Feature 20.

of fire-cracked rock. It occupied a 5.5 m north–south by 8.5 m east–west area with a denser area that was 2.3 m north–south by 1.5 m east–west and had a maximum density of 20 rocks in a 50 by 50 cm area. The rock was largely small pieces of burned caliche (Fig. 7.51) with some limestone and sandstone. The feature was at the edge of small mesquite-stabilized dune that could obscure evidence of intact deposits.

Artifact Assemblages

Information from two phases of investigation are available for LA 111429—the research-oriented investigations and test excavations. The latter have already been discussed in Akins and Moore (2011a), but are reconsidered here because they can be used to augment data collected during the present study. All artifacts recovered during research-oriented investigations came from excavation and surface collection areas, or were collected as temporally diagnostic artifacts and point provenienced. These, and the temporally diagnostic artifacts collected during testing, were subjected to full laboratory analysis. However, the bulk of the artifacts examined during testing were field analyzed and returned to their original locations. In-field analysis of ground stone artifacts was limited to defining the type and portion of artifact represented and identification of the materials from which they were made. A more rigorous analysis was applied to chipped stone artifacts with material type, quality, artifact morphology and function, cortical coverage and type, portion, platform type, presence of a platform lip, evidence of thermal alteration, and dimensions being recorded.

In-Field Analyses

Seventy-six artifacts were field analyzed during testing at LA 111429, two were recovered during excavation, and four were both field analyzed and collected for further analysis. This provided a sample of 78 artifacts for this investigative phase. Two of the collected artifacts date to the recent Historic period and are not considered any further because the research-oriented investigations focused on the prehistoric occupations of the

Figure 7.49. LA 111429, Feature 21.

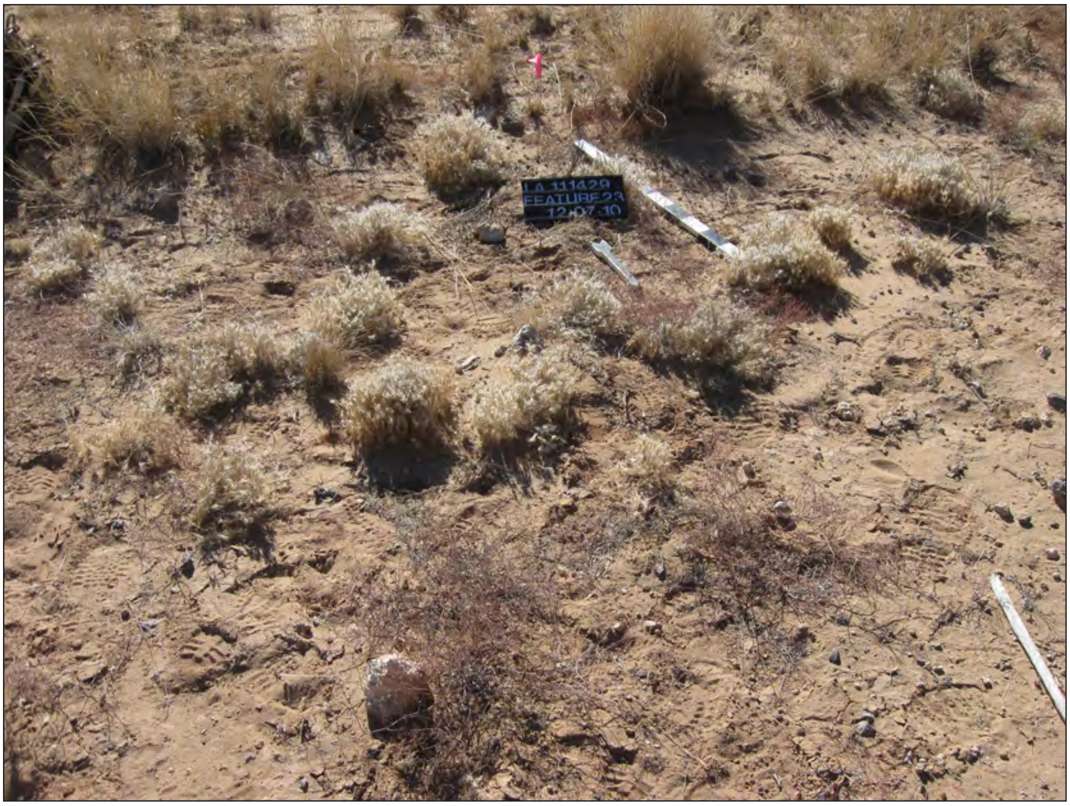

Figure 7.50. LA 111429, Feature 23.

Figure 7.51. LA 111429, Feature 24.

site. The assemblage of prehistoric artifacts that was collected or examined during testing included 25 ground stone tools and 50 chipped stone specimens. The ground stone assemblage consisted of 9 one-hand manos (6 complete), 1 metate fragment, 10 undifferentiated mano fragments, and 5 fragments of unidentifiable ground stone tools. Igneous material, including basalt, was the dominant material type used for the manufacture of ground stone tools in this sample, with 4 one-hand manos, 7 mano fragments, and 1 unidentified tool fragment being made of this material. Sandstone was the second most common material and was represented by 2 one-hand manos, 1 mano fragment, the metate, and two unidentifiable tool fragments. Two one-hand manos, a mano fragment, and an unidentifiable tool fragment were made from metaquartzite. The last three specimens include a one-hand mano fragment made from an unidentified material, a rhyolite mano, and an unidentified orthoquartzite ground stone tool.

This chipped stone assemblage was dominated by chert (n = 36; 72.00 percent), followed by limestone (n = 5; 10.00 percent), rhyolite (n = 4; 8.00 percent), metaquartzite (n = 2; 4.00 percent), undifferentiated metamorphic material (n = 2; 4.00 percent), and basalt (n = 1; 2.00 percent). The only non-tool artifacts that were field analyzed were four core flakes (two chert, two undifferentiated metamorphic) found in the buffer along County Road A020 and a chert overshot flake found elsewhere on the site. The latter was recorded because it could either be an example of a mistake made during biface manufacture or a purposeful aspect of tool manufacture during the Clovis period. The two specimens recovered during excavation are a core flake and a biface flake, both made of chert. Otherwise, only tools and the occasional core were field analyzed and included bifaces (n = 17), unifaces (n = 13), cobble tools (n = 7), and cores (n = 6).

None of the six middle-stage bifaces could be assigned a specific function. Four of these specimens exhibited lateral snaps indicative of manufacturing breakage, while two exhibit nondiagnostic breaks. No more specific function could be assigned to 8 of the 11 late-stage bifaces either. Four of these specimens exhibited lateral snaps and 1 had a reverse fracture, all of which were indicative of manufacturing breakage. The last three specimens exhibited nondiagnostic breaks. Thus, most of the bifaces (8 of 14; 57.14 percent) that could not be assigned to a specific function represented unfinished tools that were broken during manufacture. The three other late-stage bifaces were finished tools and included the medial portion of a Folsom point, a proximal fragment of an unidentified Paleoindian point, and the midsection of a large unidentified point.

Thirteen chert unifaces represented four basic tool types, including a denticulate made on a late-stage uniface, an early-stage uniface that could not be assigned a more specific function, a scraper-spokeshave made on a middle-stage uniface, and 10 end scrapers. The latter included eight specimens made on early (n = 7) and middle (n = 1) stage unifaces; the others are spurred end scrapers, with one apiece made on early and late stage unifaces. It should also be noted that many, if not most, of the other eight end scrapers were also spurred end scrapers, but were not initially differentiated during field analysis. All seven cobble tools were choppers; five were made of durable materials including basalt, rhyolite, and limestone, and two were made of nondurable cherts. Six cores were also recorded, one because it appeared to have been made from Alibates silicified dolomite. The other cores were recorded early in the examination of this site and served to help define the boundaries of the scatter before it became apparent just how many artifacts there were at LA 111429.

Laboratory Analyses

Summaries of the results of the LA 111429 laboratory analyses are provided here, with more detailed discussions provided in the synthetic chapters later in this volume. These assemblages include chipped stone artifacts, ground stone tools, sherds, faunal remains, floral remains, and radiocarbon samples.

Chipped Stone. A total of 1,207 chipped stone artifacts were recovered from LA 111429 during research-oriented investigations. Artifact totals by material category for the various contexts of recovery are shown in Table 7.2. Most of this assemblage was recovered from surface strip and surface collection areas, with comparatively few artifacts found during feature excavation. The array of materials identified at LA 111429 was dominated by cherts, which comprised nearly 94 percent of the total assemblage and were dominant in every recovery context; the smallest percentages of this material category came from the Feature 3 surface strip and feature excavations. While metaquartzite was the second most common material, this category comprised less than 2 percent of the total assemblage and was most common in contexts thought to represent Archaic or later occupations. Basalt and andesite were the rarest materials in this assemblage. Obsidian was also rare and occured in only four contexts, two of which are thought to represent Paleoindian occupations.

Table 7.3 shows the distribution of artifact morphology categories by collection context. All assemblages are dominated by reduction-related debris including flakes, angular debris, and cores. Formal tools are comparatively rare, and over a third were recovered by the general surface collection of temporally diagnostic artifacts. These tools were unassociated with the excavation and formal surface collection areas. Biface flakes were most common in Surface Strips 6 and 8 and are fairly common in Surface Strips 1–5 and 7, all of which potentially contain some Paleoindian materials. While Surface Strip 9 was at first also thought to represent an occupational area dating to that period, the rather small percentages of biface flakes in comparison with the other areas that had tentatively been assigned a Paleoindian date suggest that a different occupational period may be represented in Surface Strip 9.

Formal tool types found in this assemblage included a burin, a uniface of undetermined function, 5 end scrapers, 3 end/side scrapers, a spurred end scraper, 8 bifaces of undetermined function, 2 unidentified projectile points, 3 large Archaic projectile points, 2 side-notched Formative-period projectile points, an unidentified Paleoindian point, and 2 fragments of the same Folsom Point. Of the 29 formal tools recovered in excavation or surface collection areas, fewer than a quarter (n = 7; 24.14 percent) were from areas thought to reflect Paleoindian occupations. Three projectile points (2 unidentified and 2 large Archaic points) as well as the spurred end scraper, an end/side scraper, 5 bifaces, and the unidentified Paleoindian point were recovered during the collection of temporally diagnostic artifacts and were difficult to link to a specific excavation area. A few informal tools were also identified, including 14 pieces of utilized debitage. Most of the informal tools (n = 10, 71.43 percent) came from probable Paleoindian contexts.

Ground Stone. Thirty pieces of ground stone were recovered from LA 111429 during the research phase. Eight were collected from the surface (5 one-hand manos [4 complete], a mano fragment, a basin metate fragment, and a metate fragment). Surface Strips 1, 5, 6, 7, 9, 10, and 11 produced between 1 and 5 ground tools each, mainly mano fragments (3 one-hand, 1 unknown type) and metate fragments (3 slab, 4 metate), an indeterminate object, and a complete chopper. The rest were fragments recovered during the excavation of Features 6 and 11 (3 one-hand manos, 2 slab metates, 3 metate fragments, and a chopper). The most commonly used material is sandstone (n = 19) followed by quartzite (n = 4), trachyte (n = 3), quartzitic sandstone (n = 2), then limestone and rhyolite (n = 1 each). One-hand manos are mainly sandstone (n = 6) with some made of trachyte (n = 3) and quartzite (n = 2). Undifferentiated fragments are either sandstone or orthoquartzite (n = 1 each). Except for single examples of quartzite and orthoquartzite indeterminate metate fragments, the metates are made of sandstone (n = 10). The indeterminate object is rhyolite, and the choppers are limestone and quartzite.

Ceramics. A single Jornada Brown body sherd was recovered from LA 111429 as a point-provenienced temporally diagnostic artifact. This specimen, which was found to the northeast of Paleoindian Area 3, was tempered with a crystalline igneous material, and was polished on the exterior but not on the interior. The interior of the sherd evidenced signs of wear from cooking use. While an exact identification of the vessel form represented by this sherd could not be made, it probably came from a jar.

Fauna. Seven animal bones were recovered during research-oriented investigations at LA 111429, all of which are unburned. Three specimens were recovered from Feature 11, including two lizard bones and one from a cottontail; four came from Surface Strip 5, including three from small mammals and one from a snake. All seven specimens originated through non-cultural processes and are, thus, probably intrusive.

Flotation. Six flotation samples were collected and analyzed from Feature 3, and 22 were collected and analyzed from Feature 11; these materials are discussed in the feature descriptions and Chapter

Table 7.2. LA 111429, chipped stone material type by collection context; counts and row percentages.

Collection Context		Chert	Silicified wood	Obsidian	Basalt	Rhyolite	Welded ash-flow tuff	Lime-stone	Silt-stone	Meta-morphic	Meta-quartzite	**Total**
Surface Collection	Count	13	–	–	–	1	–	–	–	–	1	15
	Row %	86.67%	–	–	–	6.67%	–	–	–	–	6.67%	1.24%
Surface Collection Area 1	Count	36	–	–	–	–	–	–	–	1	–	37
	Row %	97.30%	–	–	–	–	–	–	–	2.70%	–	3.07%
Surface Collection Area 2	Count	137	4	–	–	2	–	2	1	1	–	147
	Row %	93.20%	2.72%	–	–	1.36%	–	1.36%	0.68%	0.68%	–	12.18%
Surface Collection Area 3	Count	23	–	–	–	–	–	–	–	–	1	24
	Row %	95.83%	–	–	–	–	–	–	–	–	4.17%	1.99%
Surface Strip Area 1	Count	94	2	–	–	–	–	–	–	–	–	96
	Row %	97.92%	2.08%	–	–	–	–	–	–	–	–	7.95%
Surface Strip Area 2	Count	145	6	1	–	1	–	8	2	–	1	164
	Row %	88.41%	3.66%	0.61%	–	0.61%	–	4.88%	1.22%	–	0.61%	13.59%
Surface Strip Area 3	Count	244	–	2	–	–	–	2	–	2	1	251
	Row %	97.21%	–	0.80%	–	–	–	0.80%	–	0.80%	0.40%	20.80%
Surface Strip Area 4	Count	108	–	–	–	–	–	–	–	–	3	111
	Row %	97.30%	–	–	–	–	–	–	–	–	2.70%	9.20%
Surface Strip Area 5	Count	48	–	–	–	–	1	–	–	–	1	50
	Row %	96.00%	–	–	–	–	2.00%	–	–	–	2.00%	4.14%
Surface Strip Area 6	Count	40	–	–	1	–	–	2	–	–	–	43
	Row %	93.02%	–	–	2.33%	–	–	4.65%	–	–	–	3.56%
Surface Strip Area 7	Count	50	–	–	–	–	–	–	–	–	1	51
	Row %	98.04%	–	–	–	–	–	–	–	–	1.96%	4.23%
Surface Strip Area 8	Count	97	–	–	–	–	–	–	–	–	–	97
	Row %	100.00%	–	–	–	–	–	–	–	–	–	8.04%
Surface Strip Area 9	Count	40	–	–	–	–	–	–	–	–	4	44
	Row %	90.91%	–	–	–	–	–	–	–	–	9.09%	3.65%
Surface Strip Area 10	Count	20	–	1	–	1	–	–	–	–	1	23
	Row %	86.96%	–	4.35%	–	4.35%	–	–	–	–	4.35%	1.91%
Surface Strip Area 11	Count	8	–	–	–	–	–	–	–	–	–	8
	Row %	100.00%	–	–	–	–	–	–	–	–	–	0.66%
Feature 3 Surface Strip	Count	21	–	1	–	–	–	2	–	–	8	32
	Row %	65.63%	–	3.13%	–	–	–	6.25%	–	–	25.00%	2.65%
Feature Excavation	Count	10	–	–	–	–	–	3	–	–	1	14
	Row %	71.43%	–	–	–	–	–	21.43%	–	–	7.14%	1.16%
Total	Count	1,134	12	5	1	5	1	19	3	4	23	1,207
	Row %	93.95%	0.99%	0.41%	0.08%	0.41%	0.08%	1.57%	0.25%	0.33%	1.91%	100.00%

Table 7.3. LA 111429, general artifact morphology by recovery context for chipped stone artifacts; count and row percentages.

Collection Context		Angular Debris	Core Flake	Biface Flake	Notching Flake	Bipolar Flake	Potlid	Core	Uniface	Biface	**Total**
Surface Collection	Count	–	3	–	–	–	–	1	2	9	15
	Row %	–	20.00%	–	–	–	–	6.67%	13.33%	60.00%	1.24%
Surface Collection Area 1	Count	9	25	2	–	–	–	–	1	–	37
	Row %	24.32%	67.57%	5.41%	–	–	–	–	2.70%	–	3.07%
Surface Collection Area 2	Count	23	98	20	1	2	1	–	1	1	147
	Row %	15.65%	66.67%	13.61%	0.68%	1.36%	0.68%	–	0.68%	0.68%	12.18%
Surface Collection Area 3	Count	2	21	1	–	–	–	–	–	–	24
	Row %	8.33%	87.50%	4.17%	–	–	–	–	–	–	1.99%
Surface Strip Area 1	Count	14	69	7	–	–	1	2	2	1	96
	Row %	14.58%	71.88%	7.29%	–	–	1.04%	2.08%	2.08%	1.04%	7.95%
Surface Strip Area 2	Count	35	115	12	–	–	1	–	–	1	164
	Row %	21.34%	70.12%	7.32%	–	–	0.61%	–	–	0.61%	13.59%
Surface Strip Area 3	Count	30	197	22	1	–	–	1	–	–	251
	Row %	11.95%	78.49%	8.76%	0.40%	–	–	0.40%	–	–	20.80%
Surface Strip Area 4	Count	23	76	10	–	–	–	–	2	–	111
	Row %	20.72%	68.47%	9.01%	–	–	–	–	1.80%	–	9.20%
Surface Strip Area 5	Count	14	30	4	–	–	–	–	1	1	50
	Row %	28.00%	60.00%	8.00%	–	–	–	–	2.00%	2.00%	4.14%
Surface Strip Area 6	Count	16	17	10	–	–	–	–	–	–	43
	Row %	37.21%	39.53%	23.26%	–	–	–	–	–	–	3.56%
Surface Strip Area 7	Count	19	22	4	–	–	–	1	–	5	51
	Row %	37.25%	43.14%	7.84%	–	–	–	1.96%	–	9.80%	4.23%
Surface Strip Area 8	Count	12	73	10	–	–	–	–	2	–	97
	Row %	12.37%	75.26%	10.31%	–	–	–	–	2.06%	–	8.04%
Surface Strip Area 9	Count	14	28	1	–	–	–	1	–	–	44
	Row %	31.82%	63.64%	2.27%	–	–	–	2.27%	–	–	3.65%
Surface Strip Area 10	Count	5	16	1	–	–	–	1	–	–	23
	Row %	21.74%	69.57%	4.35%	–	–	–	4.35%	–	–	1.91%
Surface Strip Area 11	Count	3	4	–	–	–	–	1	–	–	8
	Row %	37.50%	50.00%	–	–	–	–	12.50%	–	–	0.66%
Feature 3 Surface Strip	Count	8	23	1	–	–	–	–	–	–	32
	Row %	25.00%	71.88%	3.13%	–	–	–	–	–	–	2.65%
Feature Excavation	Count	3	8	2	–	–	–	1	–	–	14
	Row %	21.43%	57.14%	14.29%	–	–	–	7.14%	–	–	1.16%
Total	Count	230	825	107	2	2	3	9	11	18	1,207
	Row %	19.06%	68.35%	8.86%	0.17%	0.17%	0.25%	0.75%	0.91%	1.49%	100.00%

17. Charred plant remains occurred but were rarer than unburned plant remains. Burned plant parts from features were considered to represent evidence of cultural use. The range of identified seeds that might have been used as food include yucca from Feature 3, and cheno-am, spurge, dropseed and other grasses, cactus, prickly pear, yucca, and possibly caltrop from Feature 11. A much wider range of unburned plant seeds represents intrusive materials indicative of bioturbation. The types of charcoal present suggest that shrubs and yucca were the main types of fuels used in both features. Besides yucca, the shrubs represented in flotation and charcoal samples included saltbush from Feature 3 and cholla, mesquite, and saltbush from Feature 11.

Radiocarbon. Five radiocarbon samples were obtained from LA 111429's Features 3 and 11, consisting of yucca, saltbush, and mesquite. In addition, two bulk soil samples were taken from an A soil horizon encountered during testing. The two standard deviation date ranges for two samples obtained from Feature 3 both suggested a Late Archaic or very early Mesilla-phase use for that roasting pit, while three samples from Feature 11 all suggested a Protohistoric- to early Historic-period use for that roasting pit. The dates for Feature 11 corresponded with the Protohistoric period dates for the A soil horizon, suggesting that features as well as part of the Protohistoric landscape are preserved at this site.

LA 111429 Summary and Recommendations

Considerable work was done at this site during the testing phase. Diagnostic artifacts were located and analyzed in the field or collected, features were located and described, artifact clusters were identified and mapped, and test units placed along the road corridor. The plan for the research phase was to investigate areas that could have had deep deposits that would produce subsistence or dating material or areas of abundant artifact concentrations. Artifacts from five artifact clusters identified during the testing phase were to be sampled through surface collection and through 10 to 40 sq m of hand excavation. Five features identified during testing and up to five additional features were to be excavated in part or completely along with a small buffer area. Up to five geomorphology trenches were to be excavated at this site (Moore et al. 2010a:119).

Eleven surface strip areas were placed in artifact clusters. Paleoindian Area 1 was investigated through three surface strip areas (4 by 4 m, 4 by 4 m, and 2 by 4 m) and two surface collections areas (19 and 50 sq m). An OSL date from Stratum 1 suggests that this occupational zone dates to the late Paleoindian or Early Archaic period, as does the presence of spurred end scrapers. Paleoindian Area 2 was examined by a 4 by 4 m surface strip area and a 50 sq m surface collection area adjacent to the strip area. Few artifacts were recovered, but the presence of spurred end scrapers and the degree of thermal alteration of cherts suggest a Paleoindian association. In the Feature Area, four surface strip areas (2 by 2 m, 2 by 2 m, 7 sq m, and 4 by 4 m) were excavated with no additional surface collections. Cultural material in this area appears to represent at least two occupations. A single (4 by 4 m) surface strip area placed in Paleoindian Area 3 recovered no diagnostic material. Two surface strip areas (9 sq m and 1 by 2 m) in the Ground Stone Area located no intact cultural deposits and few artifacts.

OAS investigated the five features identified in the research plan but only excavated one additional feature due to the complexity of Features 3 and 11. Feature 3, a large Late Archaic/Mesilla-phase roasting pit, was completely excavated along with a 3 by 2 m area over and around the feature and a 2 by 2 m area in the adjacent fire-cracked rock scatter. Feature 11, a large roasting pit packed with caliche and dating to the early Historic period, was sampled by a line of four grid units and the associated surface rocks were mapped. No surface stripping was done in the feature scatter due to its location at the edge of a dune and the presence of two surface strip areas to the southwestern and the southeastern portions of the feature. The other four features that were investigated are fire-cracked rock scatters. One (Features 1, 17, and 22) or two (Feature 6) grid units were placed in the scatters and none encountered charcoal-stained soil or other indications of an intact feature. It is possible that intact features are present outside the sampled grid units, especially for Features 1 and 6, but no additional excavation was undertaken.

Artifacts recovered during testing and research-oriented investigations in the features included a single Jornada Brown sherd, seven pieces of bone that were probably post-occupational, a small number of ground stone tools, and a good sample of chipped stone debitage and tools. A total of eight pieces of ground stone (six manos and two metates) were collected from the general site surface for full analysis, while another 22 fragments were recovered during excavation. Almost all of the ground stone collected from the site was fragmentary (25 of 30) and many pieces appear to have been used as heating elements (18 fractured, crazed, or reddened and three indeterminate), accounting for the fragmentary condition of the assemblage. Most ground stone tools were found in the surface strip areas (n = 13) or the Feature 6 surface strip (n = 5) and are mainly manos (n = 5) and metates (n = 10) but also included two choppers and an indeterminate fragment. The rest are from feature excavations. Among the Feature 11 fill fire-cracked rocks were fragments of two one-hand manos and three metate fragments. A fragment of a one-hand mano was recovered from Feature 22.

Analysis of the chipped stone assemblage suggests that these artifacts were generated during multiple periods of occupation at LA 111429, with materials from Surface Strips 1–3 and 8 and Surface Collection Areas 1–3 primarily representing Paleoindian (probably Folsom) period occupations. Artifacts recovered from Surface Strips 4–7 represented multiple periods of occupation, with assemblages recovered from Strata 20 and 3 potentially having a Protohistoric or Spanish Colonial affiliation. Stratum 5 may represent a continuation of Stratum 1 from Paleoindian Area 1 under later deposits in the Feature Area, and therefore the materials recovered from that layer of sediment as well as those from the upper part of Stratum 6 possibly also represent Paleoindian materials, though this remains uncertain. Surface Strip Area 9 was initially assigned a Paleoindian affiliation, but preliminary examination of the materials from this excavation area suggests that they differ enough in composition from other Paleoindian assemblages at the site that a different occupational period may be indicated. This is tested in detail in Chapter 17. Insufficient chipped stone artifacts were recovered from Surface Strips 8–11 to provide any idea of temporal or cultural affiliation.

Flotation samples taken from Features 3 and 11 contained a range of possible food plants including yucca, cheno-am, dropseed, and cactus. The main fuel woods were saltbush for the earlier feature and mesquite for the later one, reflecting the types of fuel available during the different time periods. Starch and phytolith remains suggest that warm season grasses may have been used in a buffering or steam-retaining layer in Feature 11 (Appendix 2, this report).

Only two of the features had sufficient material for radiocarbon analysis. Feature 3 dates to the Late Archaic or early Mesilla phase, and Feature 11 dates to the Spanish Colonial period. Two bulk soil samples taken from an A horizon in a dune during testing both date to the Protohistoric period. Diagnostic projectile points recovered during testing and research-oriented investigations push site use back until at least the Folsom era and the Archaic, and the recovery of a Clovis Point fragment during initial recording (HSR 1995) could suggest an even earlier occupation.

While not all of the features or artifact cluster excavations were productive, this site contributes significant information that can be used to address the project research questions. Dates or artifacts ranging from the Paleoindian to the Spanish Colonial period indicate the site was a favorable occupational location for a range of periods and lifestyles. Much of what was found fits well within the regional framework, however, the large Spanish Colonial-era roasting feature is fairly unique and was completely unexpected, especially considering the lack of any Euroamerican artifacts. Since this feature is similar in structure to Feature 1 at LA 155964, there is strong evidence for early Historic period use of the Spaceport area, probably by Apacheans. Since there may be little difference between the assemblages produced by these late occupations and ceramic assemblages dating to the Late Archaic and Formative periods, features and associated materials from the Historic period can currently only be recognized when absolute dates are available. This means that Historic period use of the Spaceport area could easily have been more intense than surface indications suggest.

This large and diverse site retains considerable research potential. Expanding the excavations areas around Features 3 and 11 could provide additional information and clarification as to the groups who constructed and used the features. Other features could contain cultural deposits with material suitable for dating and for examining subsistence practices at this site. Further OSL dating of surface and shallowly buried sediment strata could help trace the potential Paleoindian occupation areas into sections of the site where those materials remain buried. This is especially true for Stratum 5 in the Feature Area and the surface sediment sheet in Paleoindian Area 2. Excavation of other thermal features in the Feature Area could help determine whether there is evidence for a more extensive Spanish Colonial-period use of the site than is currently thought, or if the features in that part of the site reflect multiple periods of occupation. The structure of LA 111429, with numerous artifacts eroding out along the western edge of the site, suggests that cultural deposits may extend under the deeper, younger, sediment sheets that occupy much of the eastern part of the site, especially in the central area where evidence of part of the Protohistoric-period landscape is preserved as a paleosol. In short, LA 111429 retains considerable potential to provide information on the occupation of the project area, which conceivably extends from the early Paleoindian period into the early Historic period.

8 | Investigations at LA 111435

Introduction

LA 111435 is a Mesilla-phase Jornada Mogollon artifact scatter with associated features. It is located on NMSLO trust land and, under Criterion "d," is determined "eligible" to the NRHP because it has integrity (76 to 99 percent), has a number and diversity of features and tool types, and has the potential to contain datable materials that could be used to address research questions concerning regional prehistory. A proposed utility corridor passes through the west central part of the site, which, in turn, contains several features. A fence and an abandoned two-track road ran through the center of the site when it was recorded by Zia in 2007 (Quaranta and Gibbs 2008:217, 396), but the road was no longer discernible during our fieldwork. Research-oriented investigations were initiated to examine a sample of features in order to determine if there are intact cultural deposits as well as to collect dateable materials to provide a more accurate idea of when LA 111435 was occupied. Other reasons for this study include obtaining information on subsistence practices, season of occupation, mobility patterns, and whether multiple occupations are represented.

Previous Work

In 1995, HSR archaeologists recorded the site as a moderately dense artifact scatter containing 400 to 600 surface artifacts, five fire-cracked rock features, and two ash-stain features. Random samples of the chipped stone artifacts, most of the tools and ground stone, and the ceramics were analyzed. Based on the artifact assemblage HSR archaeologists suggested that the site functioned as a late Mesilla-phase food preparation and processing area, a seasonal base camp, or a habitation site (FAA and NMSA 2010b:36).

Zia archaeologists revisited the site in 2007. They were unable to locate two of the features recorded by HSR but found two that they felt could represent the remains of shallow burned basin or pit brush structures. The Zia archaeologists felt the site was used for plant processing and was probably a wet-season residential base camp (Quaranta and Gibbs 2008:217–223).

Site Setting

The site is on a low ridge of mesquite-stabilized hummock dunes. A variety of grasses, prickly pear, cholla, and a wide range of annuals and perennials grow on the site (McBride, Chapter 20, this report); areas of dense mesquite thickets occupy much of its eastern half. Jornada Draw is at the eastern edge of the site.

Preliminary Site Description

The site area was estimated as 30,233 sq m (3.02 hectares, 4.47 acres) by HSR and was reduced to 14,778 sq m (248 by 80 m; 1.48 hectares, 3.65 acres) by Zia. HSR archaeologists described the site as a scatter of artifacts and seven distinct features on the south face of a low dune. Ceramic types included El Paso Brown (n = 1), Mimbres Red washed (n = 2), and Alma Plain or Western Mogollon corrugated (n = 2). HSR analyzed a 10 percent random sample of chipped stone debitage and most (80 percent) of the tools (a scraper and a piece of an agave knife or retouched tabular piece of limestone) and ground stone (n = 14 manos, slab, and basin metates, anvil). Their map shows the features clustering on the southern slope near a ridge top with fire-cracked rock scatters, tools, and ground stone scattered in an east–west direction along the ridge. They noted that at least the ash stains indicate the presence of subsurface materials and could yield significant amounts of charcoal for radiocarbon dating (FAA and NMSA 2010b:36–38, Quaranta and Gibbs 2008:217).

Zia archaeologists considered this site to be a large artifact scatter and described nine features, which included small thermal features, ring middens, and charcoal stains. They proposed that the small thermal features were probably for domestic use (n = 5) and ranged from 1.0 to 4.0 m in diameter with the scattering of the associated stones influencing the recorded sizes. Both stains were about 1.0 m in diameter and lacked fire-cracked rock; Zia suggested that they could represent burned shallow brush structures. The ring middens, which they suggested could represent communal use, were 7.0 and 8.0 m in diameter and mounded 30 cm high. An agave knife fragment, 5 slab metate fragments, a cobble pestle, an anvil, a core, 2 tested cobbles, and 11 flakes were analyzed. They also noted that El Paso Brown and Jornada Brown sherds were sparsely scattered over the site area. To the Zia archaeologists, the artifact assemblage and feature morphology suggested extended occupations and multiple use episodes, and they, too, felt that the site could contain dating and subsistence-related materials (Quaranta and Gibbs 2008:217–222).

Research-Oriented Investigations

Investigations at LA 111435 began with mapping, using a total station to record the locations of all visible features and to lay out excavation and surface strip areas (Fig. 8.1). A continuous but uneven scatter of cultural materials indicates that the site boundary extends a considerable distance to the east and southeast. The relationship between these materials and the more concentrated scatter of artifacts and related features in the western third of the site where most of our investigations occurred remains uncertain. As currently defined, LA 111435 covers 23,611.28 sq m (2.36 hectares, 5.83 acres) A sample of visible surface artifacts in the western third of the site was point-provenienced, analyzed, and left in place unless artifacts fell within excavation areas (Fig. 8.2). The sample concentrated on the western third of the site because that area contained the best preserved cluster of features. A considerable amount of erosion was evident, especially in the eastern two-thirds, where fire-cracked rock features were scattered by erosion and were difficult to define. Two such areas, containing scattered fire-cracked rock and possibly including more than one deflated feature, were identified (Areas 1 and 2; Fig. 8.1). Rather than treating these areas as features, the rocks and artifacts were briefly described (see details below), and their boundaries were indicated on the map (as reported in the preliminary report for this phase [Akins and Moore 2011b]). Nine of the 15 features defined at LA 111435 were investigated during this phase, and three surface strip areas were excavated. The areas excavated, the number of excavated grid units, and the locations of grid units are shown in Table 8.1. In addition, a single geomorphological soil pit (BHT 18) was excavated near the northeast edge of this site (Figs. 8.1, 8.2).

Area 1 was defined by a scatter of fire-cracked rock. A somewhat heavier scatter of fire- cracked rock at the southern end of Area 1 might represent a deflated and scattered thermal feature. An area of potentially stained soil was noted at the northern end of Area 1, but since no charcoal was seen in the stain its nature could not be conclusively defined from surface observations alone. Several material types were noted among the fire-cracked rock, with limestone and welded ash-flow tuff being the most common. Other materials include sandstone, vesicular basalt, and undifferentiated igneous and metamorphic rocks. Fewer than 50 or so chipped stone artifacts were observed on the surface of this area and included debitage of chert, limestone, and welded tuff, with at least one chert biface flake and one chert core in association. No ground stone or ceramic artifacts were seen in this area.

Area 2 is larger than Area 1 and is located to its southeast. Badly deflated, most cultural materials in Area 2 appear to have been dropped onto the Pleistocene B soil horizon that occurs on or just below the surface throughout much of the project area. Like Area 1, the surface distribution of fire-cracked rock was used to define the extent of Area 2. The fire-cracked rock assemblage is dominated by limestone, with lesser amounts of undifferentiated igneous materials, sandstone, vesicular basalt, andesite, and welded ash-flow tuff also occurring. While fire-cracked rock is lightly scattered across the entire area, it is denser at Area 2's southern end, where between three and six highly deflated

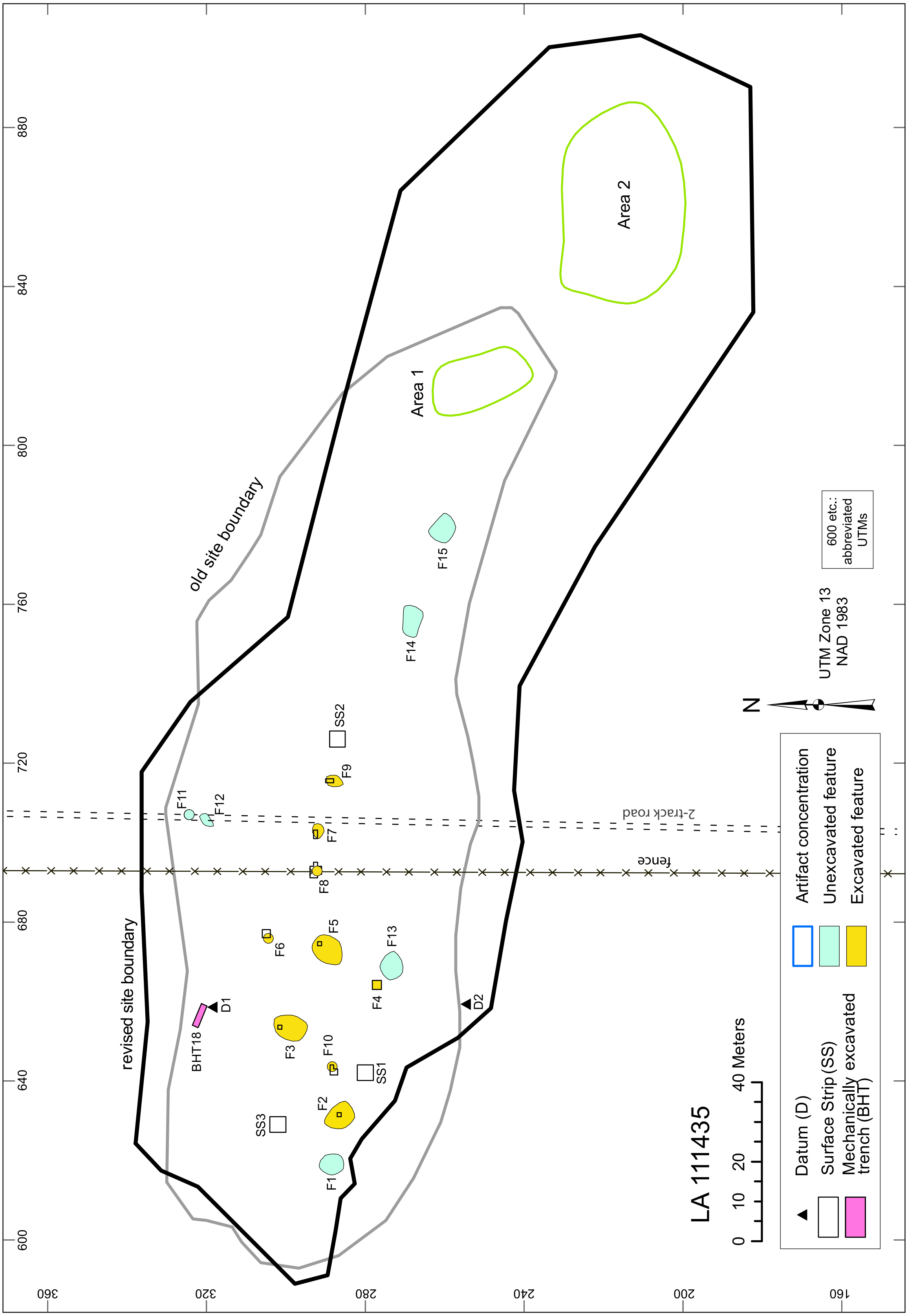

Figure 8.1. LA 111435, plan of the site showing the locations of point provenienced artifacts, features, and excavations areas.

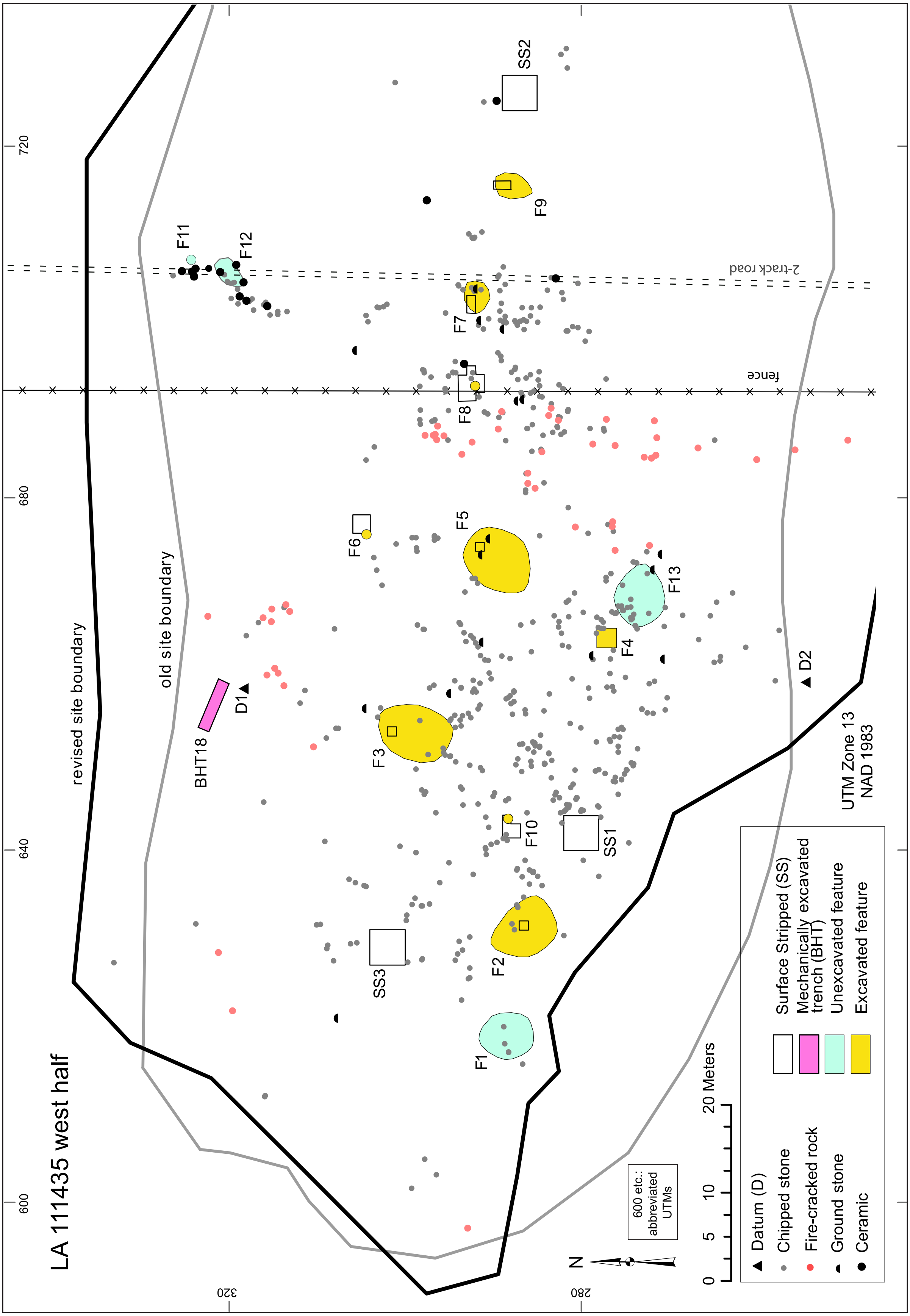

Figure 8.2. LA 111435, plan of the more intensively investigated western third of the site showing the locations of artifacts, features, and excavations areas.

Table 8.1. LA 111435, summary of excavation areas.

Excavation Area	Included Grids	No. of Surface Stripped and Excavated Grids
Surface Collection	n/a	n/a
Feature 2	286N/631E	1
Feature 3	301N/653E	1
Feature 4	276–277N/662–663E	4
Feature 5	290N/674E	1
Feature 6	304–305N/676–677E	4
Feature 7	292N/701–702E	2
Feature 8	291–293N/692–693E	9
Feature 9	288–289N/715E	2
Feature 10	287N/642–643E	4.5
Surface Strip Area 1	278–281N/640–643E	16
Surface Strip Area 2	285–288N/724–727E	16
Surface Strip Area 3	300–303N/627–630E	16

and dispersed thermal features may be represented. However, these possible features are so badly disarticulated that they blend into one another and cannot be separated. Artifacts are more common than in Area 1, though they are not dense. An estimated 100–200 chipped stone artifacts occur in Area 2; they primarily consist of debitage and cores, and a few tools including a biface and a chopper. Ground stone tools also occur in this area, with fragments of at least two metates noted.

Surface Strip and Collection Areas

As specified in the research design for this investigation, between 20 and 80 sq m were to be hand excavated to the base of potential cultural deposits as determined by the project geomorphologist (Moore et al. 2010:124; amended by letter as reported in Akins and Moore 2011b). Excavations were conducted in three surface strips of variable size. To collect the maximum amount of data available from this limited level of examination and to determine whether intact cultural deposits are present, surface strips were placed in artifact clusters or areas containing temporally diagnostic artifacts. A sample of surface artifacts was also point provenienced and field analyzed, then left in place unless they fell within excavation areas. The area sampled consisted of the western third of the site (Akins and Moore 2011b), where features were better preserved and not as much erosion was evident (as was the case in the eastern two-thirds of the site).

Surface Strip 1. This excavation area was in the southwestern part of the site and was used to investigate an area that contained an Archaic projectile point (point provenienced and collected separately) as well as a surface scatter of chipped stone artifacts. It encompassed 16 grid units including 278–281N/640–643E (Fig. 8.2). The loose sediment mantle was stripped from all 16 grid units and the stripping stopped when more compact sediments were encountered. Surface plants were sparse, ranging from 0 to about 2 percent vegetative cover, mainly grasses and snakeweed. While fire-cracked rock was noted on the surface of 4 grid units, it was not counted. Four chipped stone artifacts were collected from the surface, and the average number of surface artifacts per grid unit was 0.25.

Two strata were encountered. Stratum 1 covered the surface and was a reddish-brown sand containing a few pieces of gravel per grid unit. This stratum averaged 5.75 cm thick and was somewhat variable in depth, ranging from 3 to 10 cm. Considerable evidence for bioturbation was noted, including insect burrows and roots from nearby mesquite hummocks, as well as the evidence of cattle grazing that was found across the site. No fire-cracked rock was noted during excavation, and only 30 chipped stone artifacts were recovered from Stratum 1, averaging 1.88 artifacts per grid unit. Below the loose sediments that constituted Stratum 1 was Stratum 6, a compact layer of brown silty loam that exhibited occasional caliche flecks. According to the project geomorphologist, the latter indicates that Stratum 6 was probably deposited prior to human occupation of the New World, so excavation halted when it was encountered.

Assessment of Surface Strip 1

While it is possible that the chipped stone artifacts recovered from this area were associated with the Archaic projectile point found during site mapping and collection, these materials did not appear to derive from intact cultural deposits. The lack of staining, charcoal, and ash in Stratum 1 suggest that the chipped stone artifacts deposited on the prehistoric surface were subsequently moved around and buried through bioturbation and erosion/aggradation. Although the original spatial orientation of these materials may no longer be well preserved and artifacts may have been moved around some, they represent the remains of a locus of human activity that retains some ability to provide further information on how and when LA 111435 was used.

Surface Strip 2. This excavation area was used to investigate a surface scatter of sherds in the far eastern section of the western third of LA 111435, and contained 16 grid units, including 285–288N/724–727E (Fig. 8.2). The loose sediment mantle was stripped from these grid units, stopping when more compact sediments were encountered. Surface vegetation was very sparse and ranged from 0 to about 2 percent vegetative cover, mainly grasses and snakeweed. No fire-cracked rock and only 2 chipped stone and 6 ceramic artifacts were found on the surface of this area, yielding averages of 0.13 and 0.38 per grid unit, respectively.

Two strata were encountered. Stratum 1 was a loose, reddish-brown sand that contained only 1–5 pieces of gravel per grid unit. This stratum averaged 3.21 cm thick and was variable in depth, ranging from 1 to 12 cm. Considerable evidence for disturbance was noted including rodent and insect burrows, roots, rodent pellets, and unburned plant parts, as well as evidence of cattle grazing. No charcoal or ash was noted in Stratum 1. Fourteen pieces of fire-cracked rock were found during excavation, yielding an average of 0.88 pieces per grid unit. Only one chipped stone artifact and 18 sherds were recovered during excavation, averaging 0.06 and 1.13 per grid unit, respectively. Below Stratum 1 was Stratum 6, a compact layer of brown silty loam that exhibited occasional caliche flecks. Excavation ended when Stratum 6 was encountered.

Assessment of Surface Strip 2

The artifacts recovered from this area do not appear to have derived from intact cultural deposits. The lack of staining, charcoal, and ash in Stratum 1 suggests that the artifacts were deposited on a prehistoric surface and were subsequently moved and buried through bioturbation and erosion/aggradation. Although the original spatial orientation of these materials may no longer be well preserved and artifacts may have been moved around some, they represent a locus of human activity that retains some ability to provide information on how and when LA 111435 was used. Only two vessels appear to be represented in the small ceramic assemblage—an El Paso Brown jar and a Jornada Brown vessel of indeterminate type with an unpolished interior and a polished exterior. This argues for a degree of spatial integrity, but the fact that sherds from the El Paso Brown vessel were found in six grid units and sherds from the Jornada Brown vessel were found in 10 grid units demonstrates the amount of movement resulting from biological and geological processes.

Surface Strip 3. This excavation area, which was used to investigate a surface scatter of sherds in the far western part of the site, contained 16 grid units, including 300–303N/627–630E (Fig. 8.2). The loose sediment mantle was stripped from all 16 grid units, stopping when more compact sediments were encountered. Surface vegetation was sparse and consisted of a single yucca plant. Only seven pieces of fire-cracked rock were found on the surface, averaging 0.44 fragments per grid unit. Artifacts were more common, with eight pieces of chipped stone and 19 sherds found; they averaged 0.50 and 1.19 per grid unit, respectively.

Two strata were encountered. Stratum 1 was a loose, light reddish-brown, silty sandy loam that contained less than 1 percent gravels and pea gravels. This stratum averaged 2.97 cm thick and was variable in depth, ranging from 1 to 8 cm. Considerable evidence for disturbance was noted, and included rodent and insect burrows, roots, rodent pellets, and unburned plant parts, as well as signs of the cattle grazing observed across the site. No charcoal or ash was noted in Stratum 1. Sixteen pieces of fire-cracked rock were found during excavation, yielding an average of 0.88 pieces per grid unit. Only two chipped stone artifacts and 10 sherds were recovered during excavation, averaging between 0.13 and 0.63 specimens per grid unit, respectively. Below Stratum 1 was Stratum 6, a compact layer of brown, silty loam that exhibited occasional caliche flecks. Excavation ended when Stratum 6 was encountered.

Assessment of Surface Strip 3

The artifacts recovered from this area do not appear to have derived from intact cultural deposits. The lack of staining, charcoal, and ash in Stratum 1 suggests that the artifacts were deposited during a prehistoric occupation and subsequently moved and buried through bioturbation and erosion/aggradation. The possibility that some spatial integrity remains is suggested by the recovery of 29 El Paso Brown body sherds, all tempered with granite, probably representing a single vessel, and all centered on 300N/628E where 72.41 percent (n = 21) of the sherds were found. The balance was spread through at least five other grid units.

Feature Descriptions

Zia identified and described nine features at this site. Two of the features were 1.0 m diameter stains believed to represent habitation structures, five were small fire-cracked rock features that ranged from 1.0 to 4.0 m in size, and two were ring middens measuring 7.0 to 8.0 m in diameter (Quaranta and Gibbs 2008:217–218).

OAS proposed to investigate nine features at this site. Only those with the potential to provide chronometric samples or subsistence remains were to be excavated beyond what was necessary to assess the potential of the feature (Moore et al. 2008:124). In addition to the original nine features, six more were located and some of those are included in the sample of excavated features. The others were inventoried.

Feature 1 (fire-cracked rock scatter)

Zia described Feature 1 as a fire-cracked rock scatter 4.0 m in diameter and comprising moderately fragmented cobbles of igneous, limestone, and rhyolite (Quaranta and Gibbs 2008:218). OAS chose not to excavate this feature because it is at the western edge of the site and is unlikely to be impacted by future construction activities. The scatter measures 15.3 m north–south by 11.0 m east–west with a concentration that is 4.5 m north–south by 4.0 m east–west. It has between 70 and 80 rocks, including cobbles and tabular sandstone. The fire-cracked rock consists of almost equal amounts of igneous rocks and caliche with slightly fewer pieces of limestone, and some of sandstone, quartzite, and other rock types (Fig. 8.3). It is on a gentle slope with mesquite shrubs at the center and in the surrounding area. A scatter of artifacts lies at the edge and downslope of the feature, but the eolian soils are shallow and unlikely to obscure buried cultural deposits. The potential for finding charcoal for radiocarbon dating and subsistence remains in this feature is low.

Feature 2 (fire-cracked rock scatter, deflated fire pit)

Also in the western part of the site, Feature 2 was described as a multi-core (12 and 8 m diameter) fire-cracked rock scatter that washed downslope (Quaranta and Gibbs 2008:218). OAS observed a large scatter of fire-cracked rock measuring 15 m north–south by 11 m east–west with a less dispersed core concentration at the northern end that measured 4 m north–south by 5 m east–west (Fig. 8.4). An estimated 150 cobbles form the core with an additional 200 rocks scattered downslope. These are mainly igneous, with fewer pieces of limestone, metamorphic rock, sandstone, and caliche.

A single 1 by 1 m grid unit was excavated into the most concentrated area of this feature. Three to four cm of loose eolian sandy silty loam (7.5 YR 6/4) were removed, and 104 pieces of fire-cracked rock were recovered on the surface and in the first level of fill. This overlaid similar but more compact soil (7.5 YR 5/4) with rodent and bug burrows and increasing numbers of carbonate nodules (Fig. 8.5). No cultural deposits, charcoal, or ash were observed, suggesting that Feature 2 is a badly eroded and dispersed thermal feature that likely retains little or no integrity. No artifacts were recovered in the excavated grid unit, and no samples were collected from this feature. No further excavation was undertaken at this feature.

Feature 3 (rock-filled fire pit)

Zia described Feature 3 as a 7 m diameter ring midden with a central depression and rock mounded 30 cm above ground surface (Quaranta and Gibbs 2008:218). OAS observed a scatter of fire-cracked rock measuring 10.3 m north–south by at least 8.1 m east–west (Fig. 8.6) on a slope at the edge of a mesquite-stabilized dune ridge. The more concentrated portion measures 4.4 m north–south by 5.3 m east–west.

A single grid unit was placed over a concentration of rocks and stained soil that looked like it could have been part of an intact pit (Fig. 8.7a). One to five centimeters of fill (Stratum 2) was removed from this grid unit, leaving the larger rocks in place. Stratum 2 consisted of loose coppice dune sand (7.5 YR 6/6 dry) that became more compact with depth and had carbonate streaks at the base of the rocks in the cluster. Fill from between the rocks in the concentration (Stratum 4) was removed in two levels. The upper fill was charcoal-stained dune sand (7.5 YR 5/3 dry) containing abundant fire-cracked rock fragments (n = 30 loose in the fill) and including, in turn, small split cobbles and large (38 by 25 by 20 cm) upright cobbles. Most were igneous (n = 48; basalt, rhyolite, vesicular basalt) cobbles with some limestone (n = 4) and caliche (n = 12). Excavation stopped when the loose fill was removed from between the rocks (Fig. 8.7b), and the rock was mapped and cross-section profiles were drawn (Fig. 8.8). Two additional layers of fire-cracked rocks were mapped and removed and a final profile drawn (Fig. 8.8). A true stratigraphic profile was not possible because of the small size of the pit, lack of fill, and the tightly packed rocks. The original pit measured 42 by 38 cm and was 31 cm deep. It was constructed by scooping out soil from the coppice dune and lining the pit with rock, then following that with a layer of fuel wood, brush, and more rock. The dune sand did not exhibit evidence of burning. The small sample of fuel wood collected from the fill was all saltbush and tarbush. A radiocarbon date on tarbush places the feature in the Late Archaic, (1213–1008 cal BC, Boyer, Chapter 19, this report). Two flotation samples produced burned yucca basal

Figure 8.3. LA 111435, Feature 1, fire-cracked rock scatter.

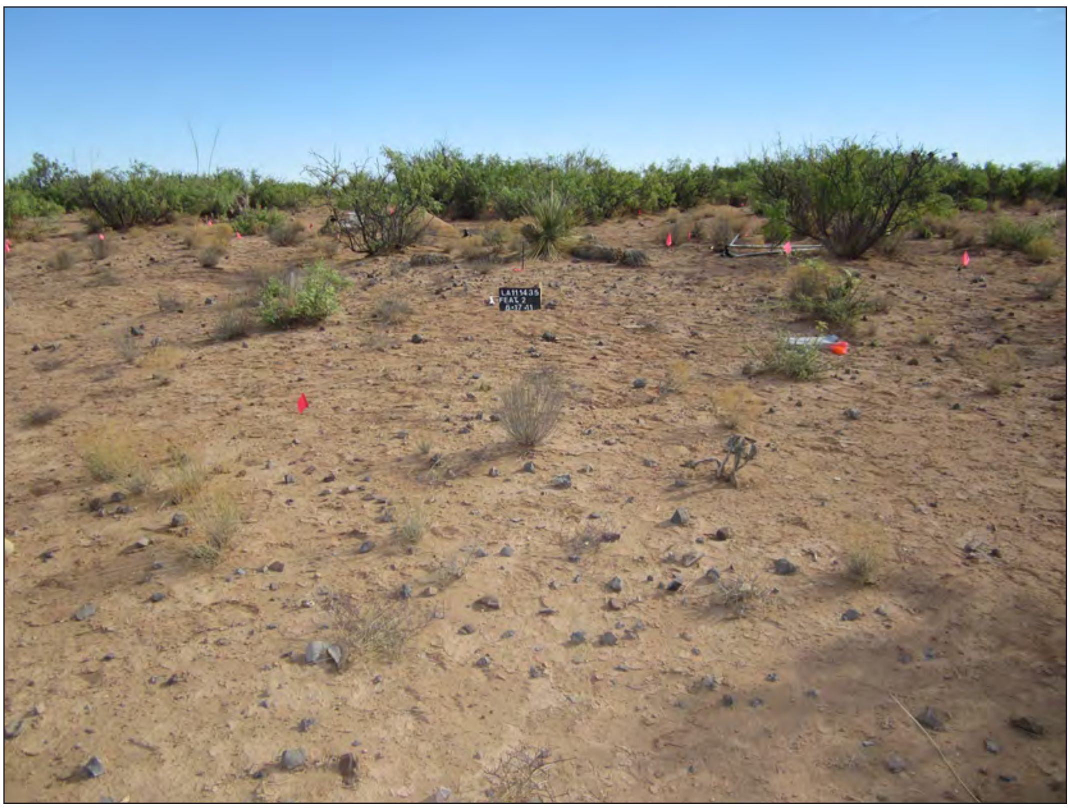
Figure 8.4. LA 111435, Feature 2, fire-cracked rock scatter before excavation.

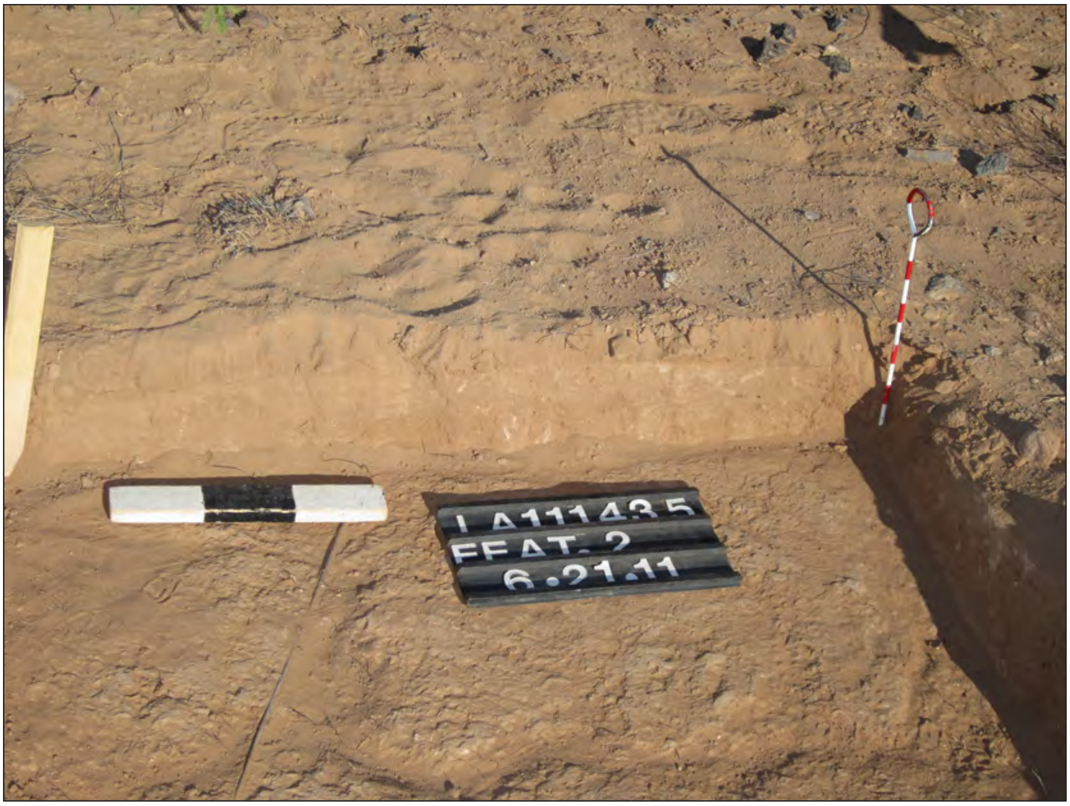

Figure 8.5. LA 111435, Feature 2, west face of grid unit.

Figure 8.6. LA 111435, Feature 3, before excavation.

Figure 8.7a. LA 111435, Feature 3, detail of intact portion of fire pit before excavation.

Figure 8.7b. LA 111435, Feature 3, detail of intact portion of feature after removal of loose sediment.

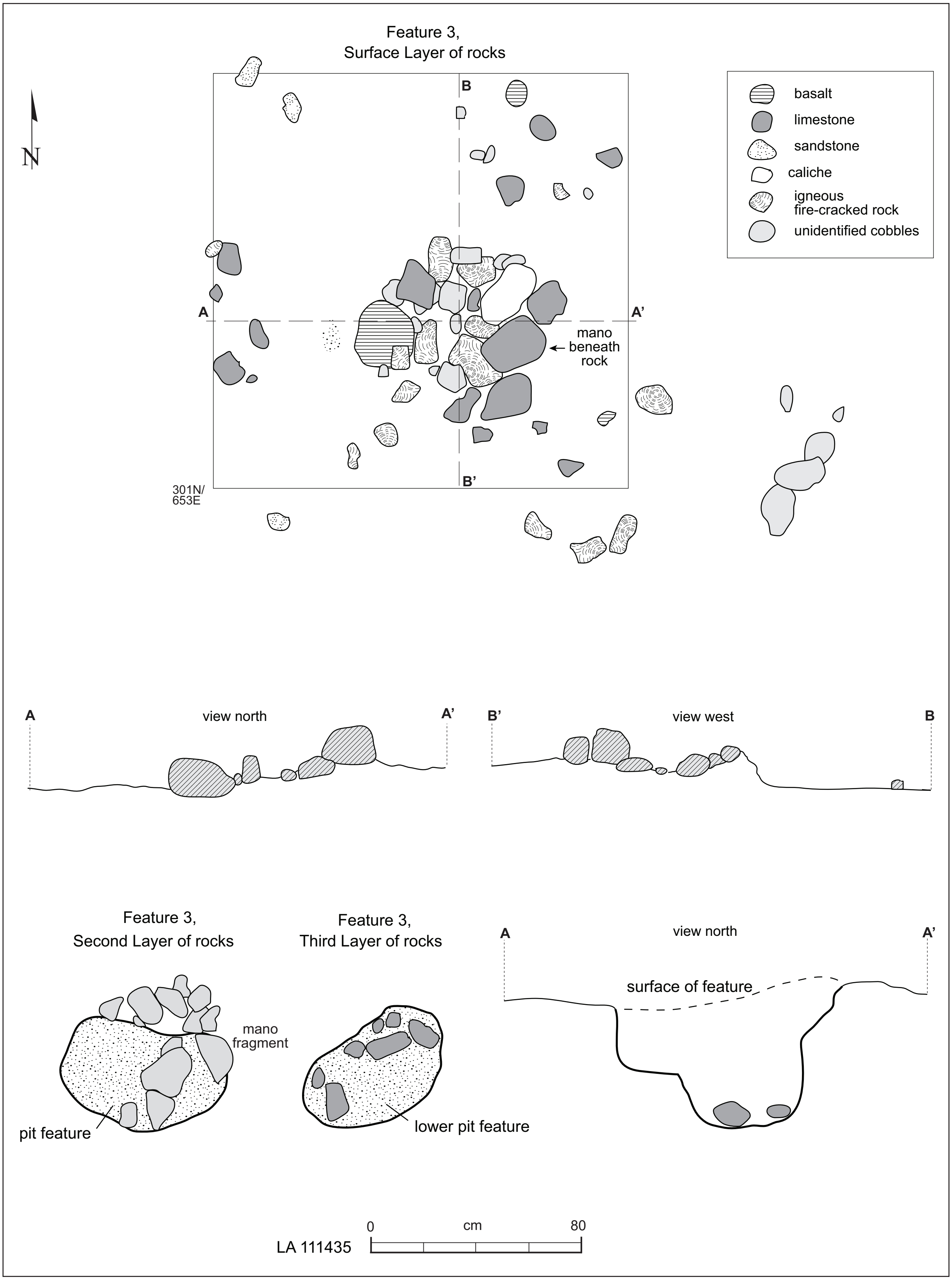

Figure 8.8. LA 111435, Feature 3, plans and profiles at bases of Levels 1–3.

caudex and modern seeds and mesquite leaves. Two pieces of angular debris were recovered from the first level of fill in the grid unit, and a sandstone one-hand mano fragment was incorporated into the pit lining.

A relatively clear area around the intact portion of the pit gives this feature the appearance of a ring midden but this is unlikely to have been such a feature. Rather, the fire-cracked rock surrounding the pit suggests that either the pit represents the remaining portion of a larger, deeper thermal feature that was deflated and dispersed by erosion or, more likely, it was a fairly small pit that was repeatedly cleaned, and the fractured cobbles were removed and dispersed over a short distance from the pit. No further excavation was done. Future excavation of a larger area might resolve any questions as to whether this one small pit produced all of the fire-cracked rocks centered on this pit or whether it is one of a series of similar features occurring in the vicinity.

Feature 4 (small fire pit)

Feature 4 was described as a sparse scatter of small cobbles with a light stain about a meter a diameter (Quaranta and Gibbs 2008:218). OAS observed a sparse scatter of fire-cracked rock measuring 4.4 m north–south by 4.0 m east–west, with a more concentrated area and an associated carbon stain (Fig. 8.10). The fire-cracked rock in this scatter was mainly caliche (about 80 percent), with small amounts of sandstone, limestone, igneous, and metamorphic rocks.

A 1 by 1 m grid unit was placed over the most concentrated portion of the feature where about 12 fire-cracked rocks were spread over an area just over 1.0 m in diameter. The upper fill was removed as Stratum 2 (the unstained coppice dune soil outside of the feature area) and Stratum 4 (the stained soil). Stratum 2 was 6 cm of loose silty sand (5 YR 5/3 dry) containing some gravel and fire-cracked rock. Stratum 4 was up to 8 cm of darkly stained sandy clay loam (5 YR 3/1) containing no charcoal flecks or gravel but with sparse, large and small fire-cracked rocks that extended well beyond the actual pit. The profile (Fig. 8.11) shows a thin crust of laminated silty clay overlying a rodent and insect disturbed Stratum 4. Cleaner fill at the pit bottom may be rodent burrow fill (Fig. 8.12).

The pit was excavated into the compact paleosol (general site Stratum 6) underlying the eolian deposits. It was roughly bowl shaped and measured 40 cm north–south by 44 cm east–west and was 7 cm deep, with much of the east wall removed by a rodent burrow. Surface stripping the grid unit resulted in the recovery of one rhyolite core flake from the surface and a chert core flake from Level 1. No chipped stone artifacts were found in the actual feature fill. Only uncharred seeds and mesquite duff were found in two flotation samples. No wood or charcoal was present in these samples.

The grid units to the north, northwest, and west of the feature were surface stripped. Fill was 2 to 6 cm of Stratum 2, with 5 to 7 pieces of fire-cracked rock noted in each of the three grid units. A small piece of a fire-fractured basalt ground stone object was found in one grid and a chert core flake was found in another grid unit.

Feature 5 (fire-cracked rock scatter, probable thermal feature)

Zia's Feature 5 is described as an 8 m diameter ring midden mounded 30 cm high with fairly dense rock (Quaranta and Gibbs 2008:218). OAS observed a large scatter of fire-cracked rock measuring 13 m north–south by 9 m east–west and a more concentrated area measuring 5 m north–south by 4 m east–west and centered on a mesquite thicket and stabilized dune (Fig. 8.13).

A single grid unit was excavated north of the center of the concentration and downslope from where an actual pit was most likely to be. The central area was overgrown with mesquite that could have impacted the feature and would have required considerable removal of vegetation. Three levels (between 27 and 32 cm total due to the slope) of fill were removed. Fill was essentially Stratum 1 (7.5 YR 5/4 to 6/4 sandy, silty loam), with patches of charcoal-stained soil and fire-cracked rock but no evidence of an intact feature (Fig. 8.14). Areas of Stratum 6 (cleaner fill with small caliche nodules) occurred within the Stratum 2 matrix and at the base of the excavation unit and were probably the result of rodent disturbance. Chipped stone artifacts were recovered from the first and third levels of fill. Those near the surface were all chert angular debris (n = 3); a chert core flake was found in the lower level. The flotation sample taken from Level 2 contained yucca basal caudex and unburned floral material and no wood.

Figure 8.10. LA 111435, Feature 4, before excavation.

Figure 8.11. LA 111435, Feature 4, eastern half excavated.

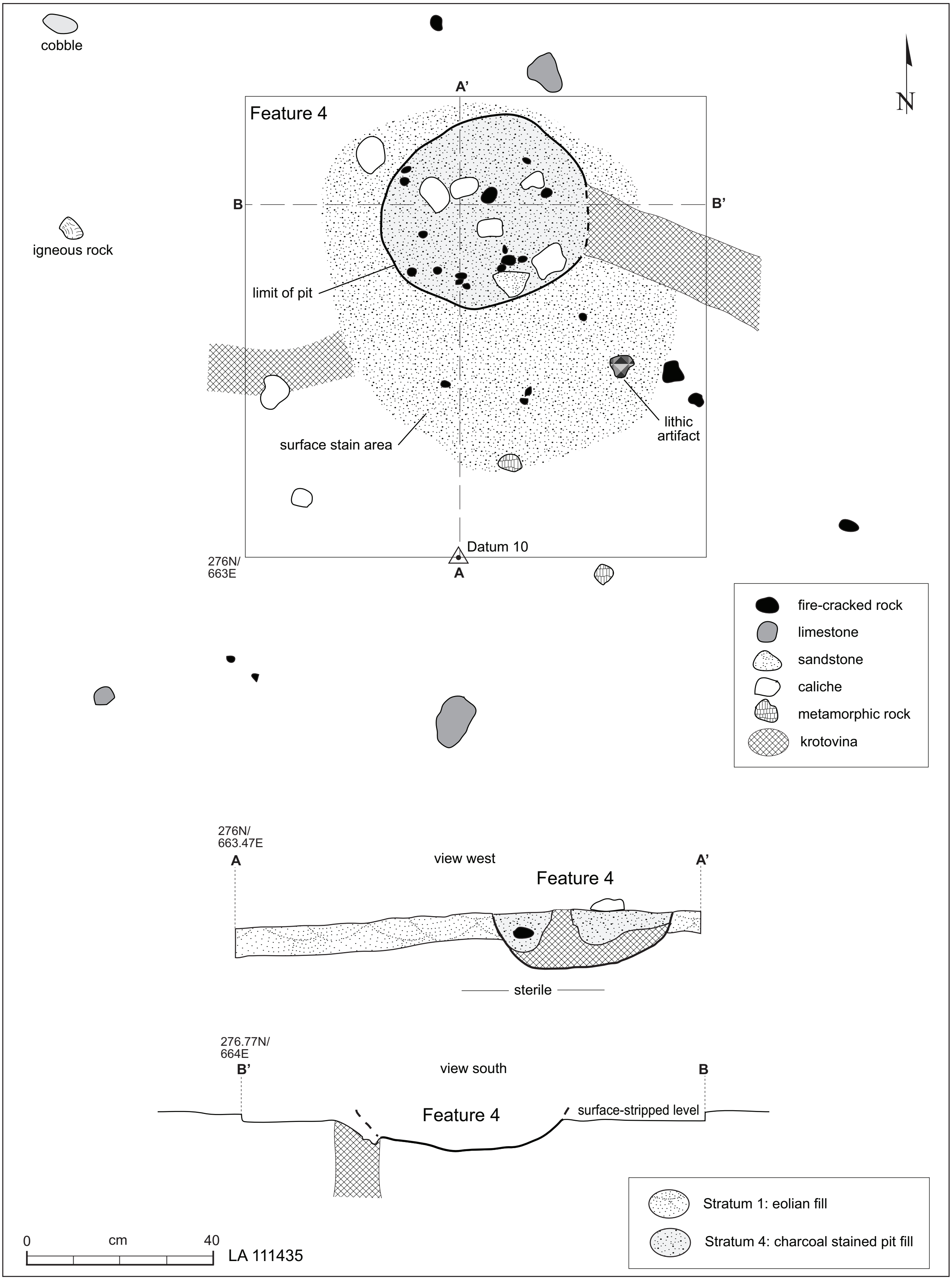

Figure 8.12. LA 111435, Feature 4, plan and profiles.

Figure 8.13. LA 111435, Feature 5, fire-cracked rock.

Figure 8.14. LA 111435, Feature 5, south wall of grid unit.

Excavation associated with this feature showed that fire-cracked rock, and possibly stained pit fill, may have been removed from this feature, as it was in Feature 3. This suggests that it was the repeated use of the feature that resulted in the "ring-like" configuration.

Feature 6 (large roasting pit)

Feature 6 was initially defined as a one-meter area of charcoal-and-ash-stained soil (Quaranta and Gibbs 2008:218). OAS began by excavating a 1 by 1 m grid unit over the eastern portion of the stain. Removing the loose upper 1 to 6 cm of soil revealed that stained earth occupied the southwest third of the grid unit, coppice dune sand (Stratum 2) the north and east portions of the grid unit, and large-grained eolian sand the southwest corner. The lower or pit fill (Stratum 5) was up to 43 cm of charcoal-stained eolian sand ranging from 7.5 YR 3/2 to 7.5 YR 4/4 in color with abundant powdered to small chunks of charcoal (Figs. 8.15, 8.16). The only fire-cracked rocks recovered were five very small heat fractured spalls.

This large roasting pit was excavated into the slope of a coppice dune. Excavation was limited to the part that lay within the original 1 by 1 m grid unit and did not completely expose the pit in either dimension. The portion excavated indicates that the pit had a flat bottom that curved up slightly into fairly vertical walls. It is estimated to measure 1.06 m north–south and at least 1.10 m east–west, with a maximum depth of 39 cm. The fill contained active termite tunnels and several dormant nests of cicadas. Insect burrows riddled the pit walls as did a rodent burrow along the north wall. The dune sand matrix apparently contains little iron but there was a slight reddish tinge to the east wall that could be evidence of a previous burn.

Fuel wood recovered from the upper and lower pit fill was saltbush and yucca caudex with a piece of mesquite wood present in a flotation sample. The three radiocarbon dates (two on yucca caudex and one on saltbush) all fall within the Mesilla phase with a most accurate and precise date of cal AD 378–540, Boyer, Chapter 19, this report). What little burned plant material was found in the two flota-

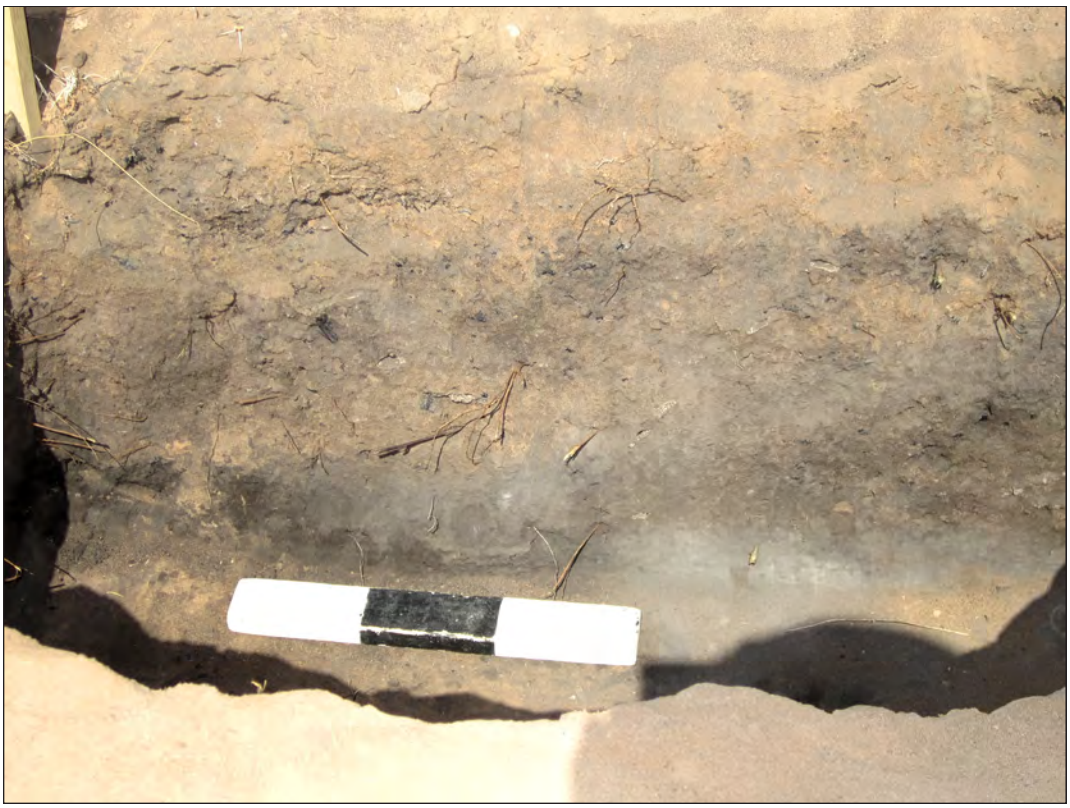

Figure 8.15. LA 111435, Feature 6, fill.

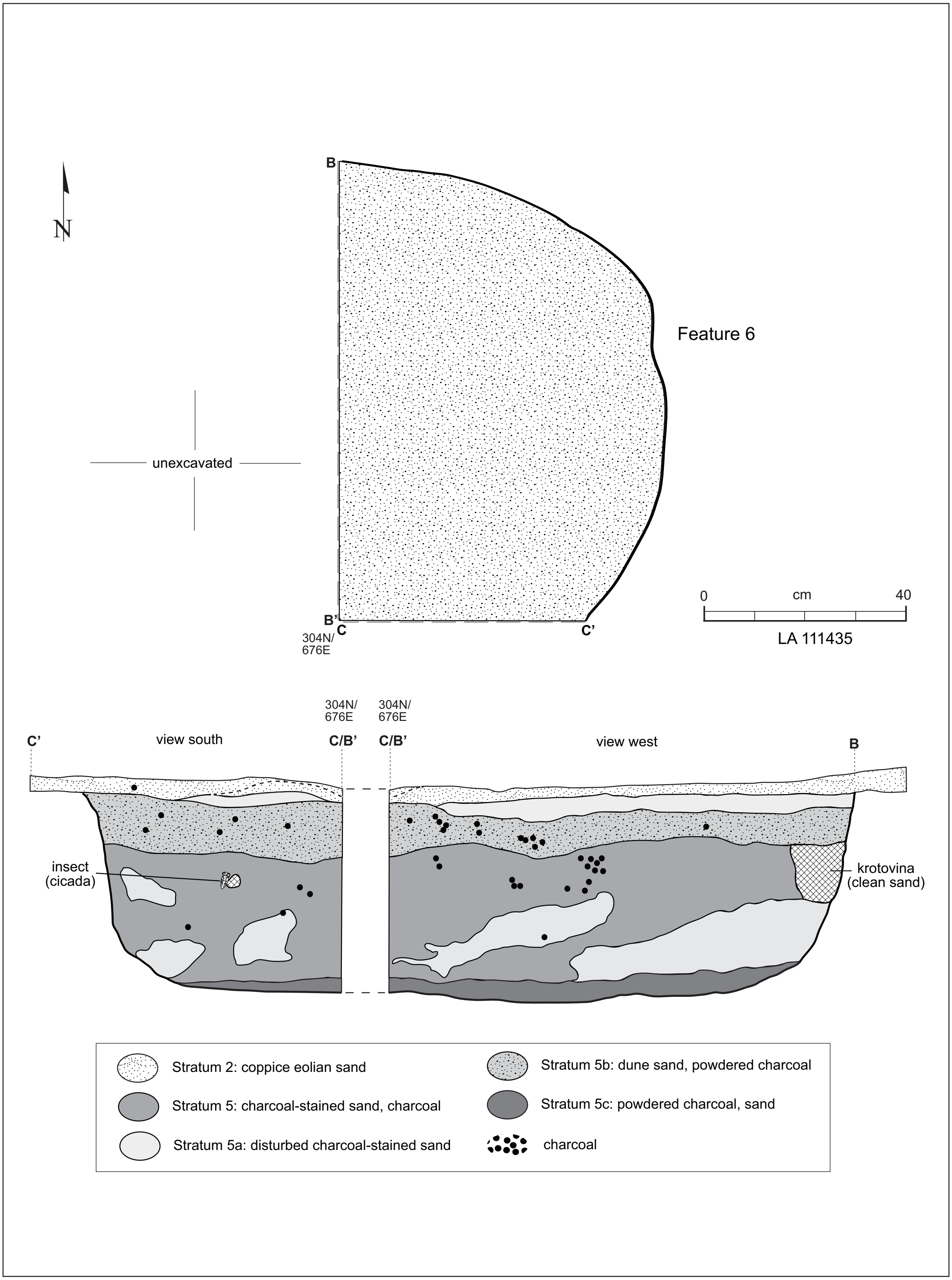

Figure 8.16. LA 111435, Feature 6, plan and profiles.

tion samples consisted of basal caudex, leaf fragments, and fiber from yucca and an unidentified plant part. Two chipped stone artifacts were found in the second level of fill and included a limestone core flake and a chert pot lid, with the latter being evidence of discard into the feature while or before the feature was burned.

Once the pit excavations were completed, three additional grid units located north, northeast, and east of the feature were stripped of between 3 and 10 cm of Stratum 2 coppice dune sand. Excavation stopped at a slightly more compact soil beneath the dune that could be the remains of a surface associated with the large roasting pit. Three small fire-cracked rock spalls were found in the grid to north, one in the grid to the northeast, and five that are probably parts of the same rock in the grid to the east. The eastern grid unit also contained a small charcoal stained area that was probably soil transported by rodents but could also have been from a completely buried feature upslope from the grid unit. No artifacts were found in the surrounding grids.

Feature 7 (stain/rodent burrow)

Zia described Feature 7 as an area of charcoal-stained soil 1.0 m in diameter with ceramics and flakes in association (Quaranta and Gibbs 2008:218). OAS observed an area of charcoal-stained soil within a widely dispersed fire-cracked rock scatter, which measured 9 m north–south by 8 m east–west. This feature is on the southwest-facing slope of a coppice dune with the stained soil at the upper edge of the fire-cracked rock scatter.

Two 1 by 1 m grid units were placed over the area of stained soil. A complete limestone two-hand mano was collected from the surface of one of the grid units. A single level of fill (11 cm) was excavated from the western grid unit, exposing a network of rodent burrows that were the source of the charcoal-stained soil. The adjacent grid was excavated to a depth of 8 cm, revealing a continuation of the rodent tunnel network and a circular area that was probably the nest (Figs. 8.17, 8.18). The upper fill (Stratum 2) consisted of a crust of water-laminated soil overlying loose eolian sand that became more compact with depth (5 YR 5/4 dry). Fill in the rodent burrows (Stratum 8) was sand with a slight loam content and was charcoal stained with charcoal flecks (5 YR 4/3). It is possible that an intact but rodent riddled thermal pit remains in the area, however, this was deemed sufficiently unlikely to justify continuing explorations.

A total of 12 chipped stone artifacts were found in Stratum 1 of the two grid units. These include pieces of chert (n = 2) and limestone (n = 3) angular debris, and 7 core flakes of chert. No flotation samples were taken from the rodent burrows, but a sample of the charcoal from Stratum 8 was all saltbush wood that resulted in a Late Archaic date of 592–403 cal BC (Boyer, Chapter 19, this report).

Feature 8 (possible structure)

Feature 8 was described as "3.5 m diameter; sparse density; low-moderate fragmentation; stain on west end," with two ground stone artifacts in the vicinity (Quaranta and Gibbs 2008:218). OAS observed a slight stain and few fire-cracked rocks in a coppice dune just east of the barbed-wire fence. A single grid unit was established and the upper 5 cm of loose eolian fill (Stratum 2) was removed, revealing the southwest corner of a large circular stain with oxidized sand at its south margin. The excavation area was extended to cover the estimated extent of the feature as well as five additional grid units around the feature. Adjacent grids were excavated to the extent necessary to reveal the stain (3 to 4 cm). This upper fill was loose coppice dune sand with some charcoal and very sparse fire-cracked rock (7.5 YR 5/4). The extent of the stain was mapped and photographed (Fig. 8.19) before the stained fill (Stratum 9) was removed in the two western quadrants (Fig. 8.20). The lower fill was a more compact sand containing a small amount of silt and enough charcoal to give it a gray color (7.5 YR 4/3). Stratum 9 contained few inclusions but had considerable rodent scarring marked by pockets of clean dune sand. Areas of pure powdered gray ash with some sand content were observed in the western half (Figs. 8.21, 8.22). The lower fill in the eastern half of the feature was not excavated.

Feature 8 was a roughly circular and basin-shaped possible structure with a relatively flat bottom. Evidence of burning was observed on and near the southern margin. It measured 1.5 m north–south by an estimated 1.6 m east–west, and was about 10 cm deep. A considerable amount of bioturbation distorted the northeastern extent of the feature. Since it was built in the dune sand, there was only a relatively soft and fragile "crust" to indicate

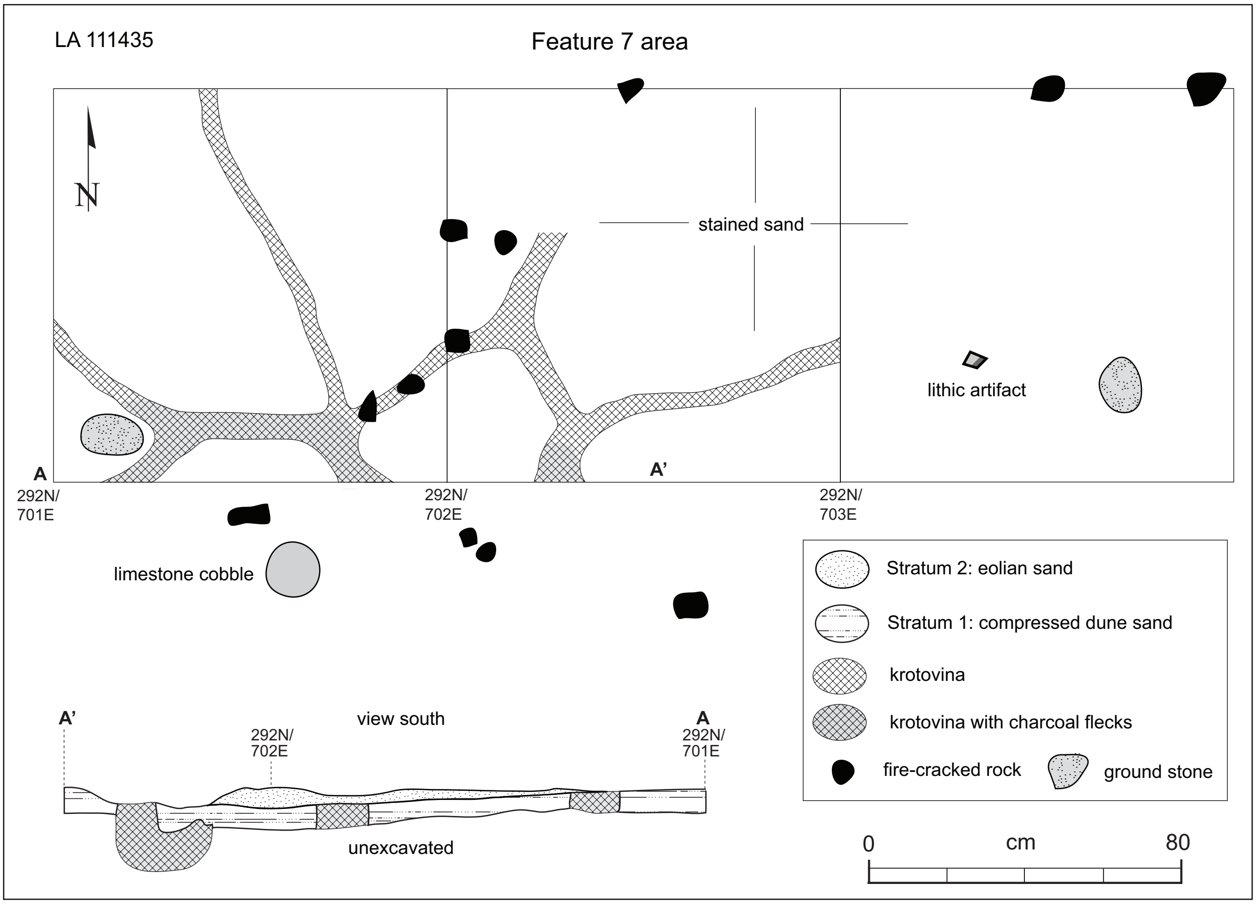

Figure 8.17. LA 111435, Feature 7, excavation grid plan and profile.

Figure 8.18. LA 111435, Feature 7, excavated grids.

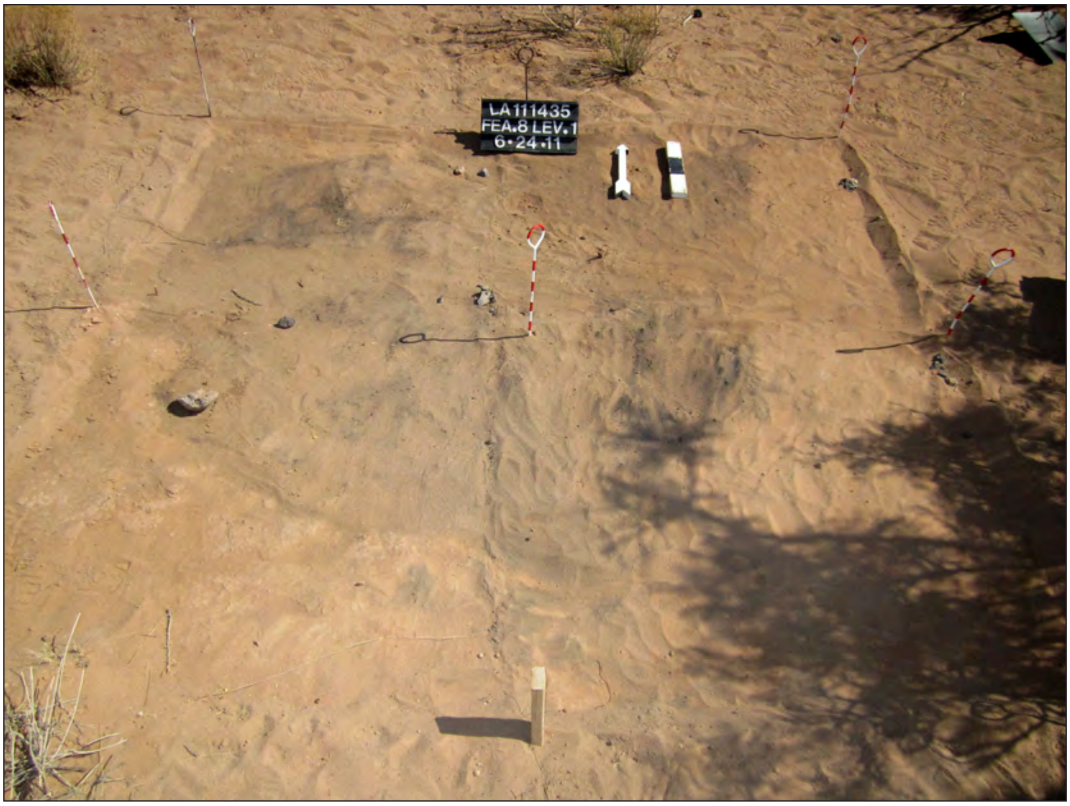

Figure 8.19. LA 111435, Feature 8 showing extent of stain beneath Stratum 1.

the use surface. Within the structure, charcoal was embedded in the interior surface, while the corresponding surface on the exterior was cleaner, but had some carbonate staining (Fig. 8.22).

Carbonized grass stems, false purslane and hedgehog cactus seeds, and yucca basal caudex and leaf fragments were recovered in two flotation samples. The wood was all saltbush. Radiocarbon samples composed of yucca caudex and saltbush date to the Mesilla phase (a most accurate date of cal AD 771–1014 and a more precise date of cal AD 807–976, Boyer, Chapter 19, this report).

Three core flakes of chert, rhyolite, and limestone were found in the fill of Feature 8, and 24 chipped stone artifacts were found in the grid units above and around the feature. Most were core flakes (n = 16) of chert (n = 10), limestone (n = 3), and metaquartzite (n = 3) along with 5 pieces of angular debris (4 chert and 1 silicified wood), 2 chert cores, and a chert pot lid. A Jornada Brown sherd was found on the surface outside the feature and 4 bone fragments came from the lower fill of the feature. Only one bone, a small mammal long bone shaft fragment, was burned. A second small mammal long bong shaft fragment was unburned. These last two specimens were complete and nearly complete elements from a kangaroo rat and were probably post-occupational.

This feature may represent the remains of a small ephemeral shelter lacking internal features. It would have had a brush (saltbush and yucca) superstructure that burned. Similar features have been identified as structures at Fort Bliss (Church and Sale 2003; Condon et al. 2008, Morgan 2009:1464–1467). Alternatively, it could have been the remains of a large but shallow thermal feature.

Feature 9 (fire-cracked rock scatter)

Zia described Feature 9 as a 4-m diameter scatter of igneous and limestone fire-cracked rocks (Quaranta and Gibbs 2008:218). OAS observed a scatter of fire-cracked rock that measured at least 6.4 m north–south by 5.0 m east–west, with no obvious concentration. Two grid units placed within the

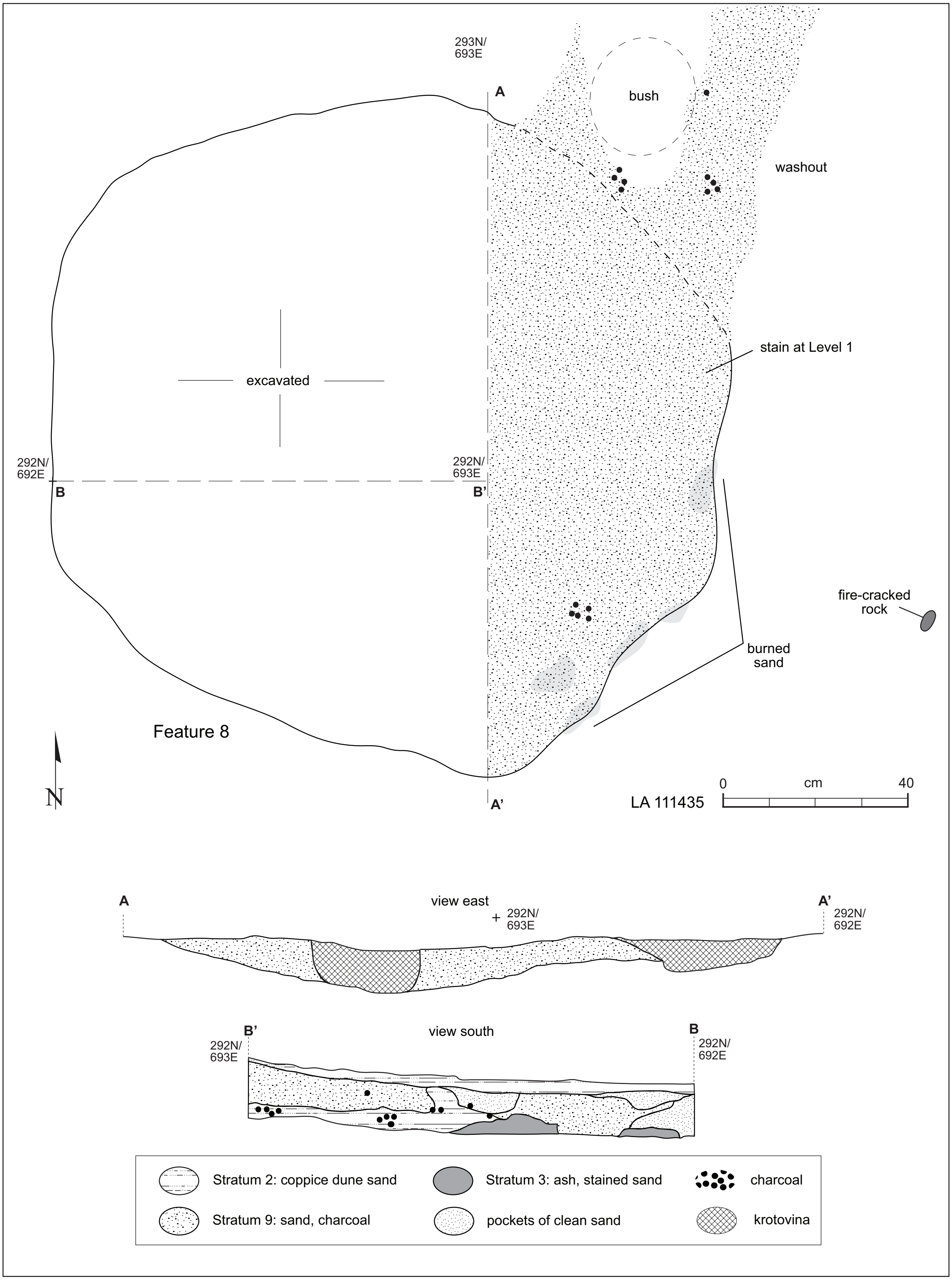

Figure 8.20. LA 111435, Feature 8, plan and profiles.

Figure 8.21. LA 111435, Feature 8, fill.

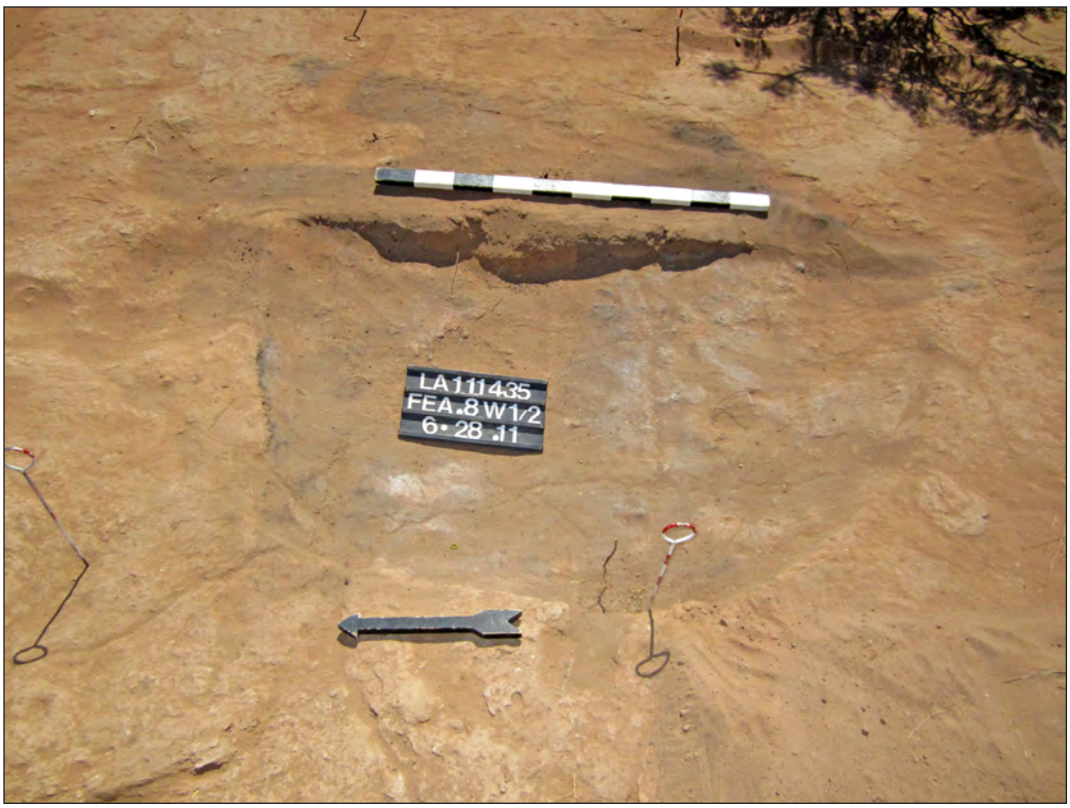

Figure 8.22. LA 111435, Feature 8, western half excavated.

concentration were used to examine this feature. Located on a slope, a single level of fill ranging from 6 to 20 cm thick in the southern grid unit and 3 to 8 cm thick in the northern grid unit was removed. The upper fill (Stratum 2) was coppice dune sand with a slight silt content, especially on the surface where it was consolidated into a moisture laminated crust (7.5 YR 6/4). There was extensive evidence of rodent burrowing, no charcoal flecking, and some fire-cracked rock (about 35 in the southern grid unit and 20 to 30 in the northern grid unit) in this stratum. The fill became harder with depth and excavation in the northern grid stopped while the southern grid was excavated another 10 cm (Fig. 8.23). While the excavator states that no charcoal or staining was observed, the photo shows a small ephemeral area of charcoal-stained sediment at the base of the first level in the northern grid unit. Regardless, excavation suggests that Feature 9 lacks evidence of integrity in the area with the greatest density of fire-cracked rock. The general lack of charcoal-stained soil suggests that the feature is deflated and has little potential to provide additional information. A piece of limestone angular debris was found in the upper level of fill, and no flotation samples were taken.

Feature 10 (fire-cracked rock with stain)

Feature 10 is a small area of carbon-stained sediment within a scatter of fire-cracked rock that measures 12.7 m north–south by 8.7 m east–west and is located between Features 2 and 3. Investigation began with a 1 by 1 m grid unit placed over the stain (Fig. 8.24), which also had four fragments of fire-cracked rock on the surface. The surface was a thin crust of water-laminated soil, and the stain was revealed in a slightly disturbed area. This crust was removed and the feature and non-feature fill were removed as Stratum 1 (non-feature) and Stratum 3 (feature fill), respectively. Stratum 1 is described as 1 to 6 cm of loose silty sand (7.5 YR 5/3) with minimal charcoal flecking, and was removed to where the more compact Stratum 6 was encountered. The darkened feature fill sediment was up to 20 cm of loose silty loam with enough charcoal to give it a stained appearance (7.5 YR 2.5/2). As shown in the

Figure 8.23. LA 111435, Feature 9, grids after excavation.

profile photo (Fig. 8.25), both strata were heavily disturbed by rodent and insect burrowing where excavation went beyond the stained fill. Only the portion of the pit within this excavation unit was excavated (Fig. 8.26). Loose fill was removed from above the eastern half to expose the stained soil. The pit may have been as large as 1.15 m north–south by at least 80 cm east–west. Bioturbation removed any evidence of construction and, aside from the charcoal, there were no other indications of burning.

Two flotation samples produced a diverse array of taxa. Charred goosefoot, dropseed grass, aster family, and bean family seeds were identified along with a prickly pear cactus embryo. The small amount of charcoal that was collected as a wood sample was all saltbush and produced the earliest radiocarbon date for the project, 2940–2877 cal BC, which falls in the Middle Archaic period (Boyer, Chapter 19, this report).

Two pieces of bone were recovered in the flotation samples. One is a small fragment of a burned small mammal long bone. The second is an element from a small reptile or amphibian and was probably post-occupational.

Three and a half additional grid units were used to examine the rest of the feature and surrounding area. These grid units were placed to the south, southwest, and west of the feature. As mentioned earlier, the upper fill was removed from the grid unit containing the eastern portion of the pit to help determine its size. Three pieces of ground stone were found in the grid unit southwest of the feature. All are fire-fractured basalt mano fragments that, given the early date, may or may not have been associated with the feature. Eleven core flakes (six chert, two limestone, two metaquartzite, and one rhyolite) were found in the feature and another five chert core flakes—three on the surface and two in Level 1—were found while stripping the adjacent grid units.

Feature 11 (stain)

Features 11 and 12 are in a wind-scoured area at the northern edge of the site east of the fence. The amount of eolian sand accumulated in the vicinity of these features changed daily depending on the wind. Feature 11 (Fig. 8.27) consisted of several spots of charcoal-stained soil in a 0.5 by 0.5 m area on the scoured surface. A single ceramic artifact and several chipped stone artifacts are present in the area. This and Feature 12 could represent living surfaces where cultural materials were discarded and worked into the soil by later activities. Two Jornada Brown sherds were collected from near these features; neither feature was excavated.

Feature 12 (stain)

Feature 12 is larger than Feature 11, and consists of a diffuse gray stain measuring 6.0 m north–south by 3.4 m east–west. It also has a few pieces of fire-cracked rock (n = 10, igneous, sandstone, and limestone), and a more diverse assemblage of cultural materials, including chipped stone and burned bone fragments.

Feature 13 (fire-cracked rock scatter)

Feature 13 is a fire-cracked scatter located southeast of Feature 4. Fewer than 40 pieces of fire-cracked rock (largely igneous with small numbers of caliche, limestone, and chert) were present and had a maximum density of eight pieces in a 0.50 by 0.50 m area. The rocks radiated out from a small mesquite shrub and occupied an area that measured 11.0 m north–south by 14 m east–west (Fig. 8.28). Sherds, ground stone (fragments of a basalt one-hand mano and a sandstone slab metate), and chipped stone artifacts were observed within and just beyond the scatter. No staining was visible and, unless a more intact section lies under the mesquite, this feature is probably highly deflated. Feature 13 was not excavated.

Feature 14 (fire-cracked rock scatter)

Located in the eastern part of the site just beyond the main coppice dunes, Feature 14 is a scatter of 40 to 50 pieces of fire-cracked rock in an area measuring 15.0 m north–south by 9.7 m east–west (Fig. 8.29). The rock was nearly all igneous with a few pieces of sandstone and chert. Sparse chipped stone artifacts were the only cultural materials observed in the area. A lack of accumulated soil suggests that this feature has little potential for producing subsurface cultural material. Accordingly, Feature 14 was not excavated.

Feature 15 (fire-cracked rock scatter)

Also located in the eastern portion of the site, Feature 15 is on a gentle slope surrounded by mesquite and other brush (Fig. 8.30). It is a widely dispersed scatter of about 60 fire-cracked rocks mea-

Figure 8.24. LA 111435, Feature 10, stain prior to excavation.

Figure 8.25. LA 111435, Feature 10, fill.

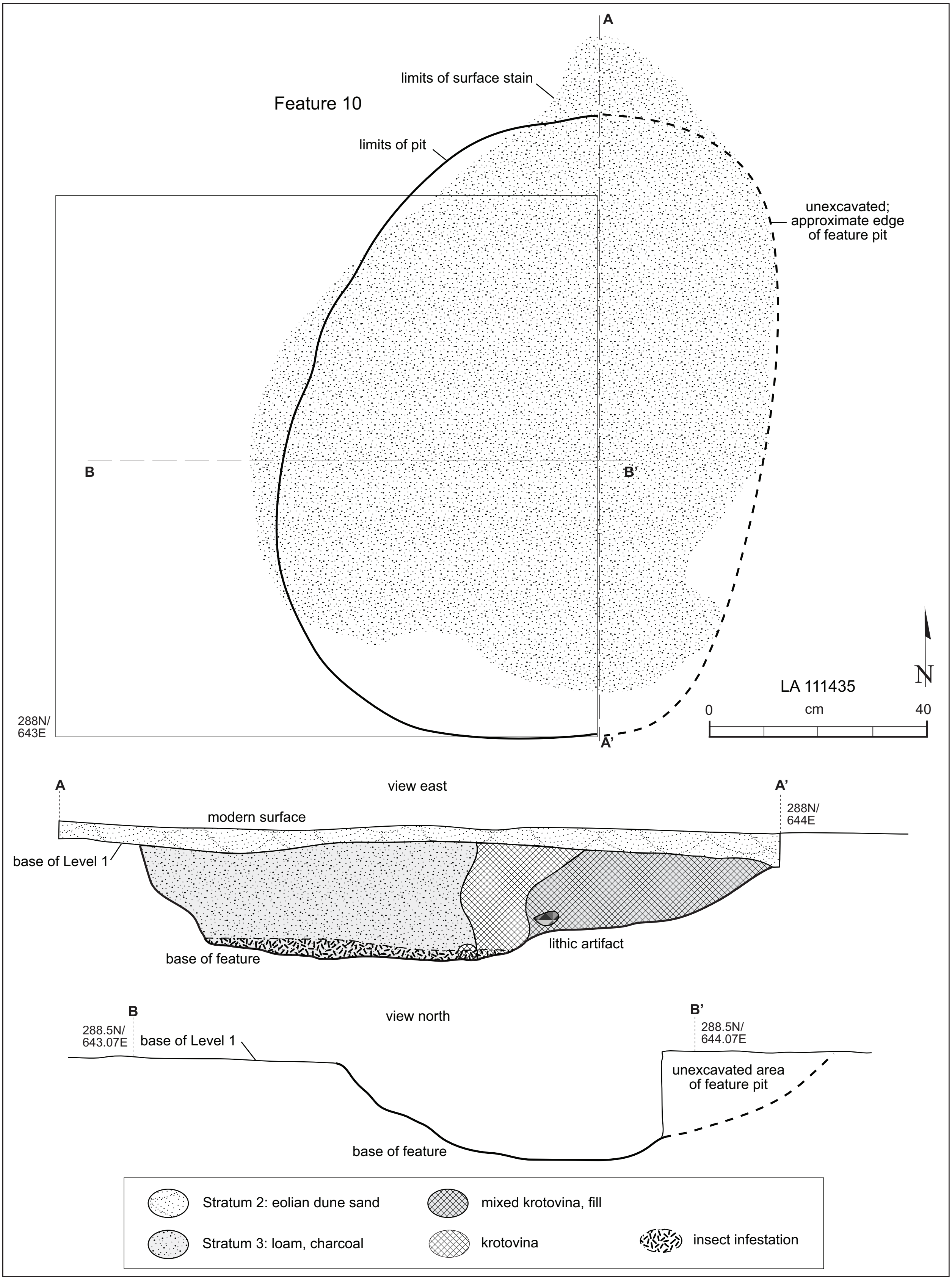

Figure 8.26. LA 111435, Feature 10, plan and profiles.

Figure 8.27. LA 111435, Feature 11, stain.

Figure 8.28. LA 111435, Feature 13, fire-cracked rock scatter (sign board shows wrong feature number).

Figure 8.29. LA 111435, Feature 14, fire-cracked rock scatter.

Figure 8.30. LA 111435, Feature 15, fire-cracked rock scatter.

suring 22 m north–south by 15 m east–west, with a small concentration area (2.3 m north–south by 2.2 m east–west). The rock is almost all igneous with small amounts of quartzite, limestone, and other materials. A chopper and sparse chipped stone artifacts are present in the vicinity. Again, a lack of accumulated soil suggests that there is little potential for this feature to provide subsistence or dating samples. Accordingly, Feature 15 was not excavated.

Artifact Assemblages

Information from two levels of analysis is available for LA 111435. All artifacts recovered during excavation were subjected to a full laboratory analysis. Surface artifacts in the western third of the site that were not in excavation areas were point provenienced and field analyzed unless they were temporally diagnostic. Artifacts with the potential to provide information on the date of occupation, such as sherds and projectile points, were point provenienced and collected for more detailed analysis. In-field analysis of ground stone artifacts was limited to identifying the type and portion of artifact represented, and the materials from which they were made. A more rigorous analysis was applied to chipped stone artifacts, with material type and quality, artifact morphology and function, cortical coverage and type, portion, platform type, presence of a platform lip, evidence for thermal alteration, and dimensions recorded.

In-Field Analyses

In-field artifact analyses collected information on 509 chipped stone artifacts, 17 pieces of ground stone, 16 sherds, and 52 fragments of fire-cracked rock. Some temporally diagnostic surface artifacts were point provenienced and collected in addition to being analyzed in the field. These artifacts, which were all found outside the excavation areas, included 11 chipped stone artifacts, 16 sherds, and 1 piece of ground stone. These collected artifacts are included in the above totals because they were also field-analyzed.

The chipped stone assemblage was dominated by various cherts (n = 299, 58.74 percent), and also included limestone (n = 78, 15.32 percent), several varieties of rhyolite (n = 78, 15.32 percent), metaquartzite (n = 23, 4.52 percent), metamorphic undifferentiated (n = 11, 2.16 percent), basalt (n = 7, 1.38 percent), orthoquartzite (n = 6, 1.18 percent), igneous undifferentiated (n = 2, 0.39 percent), quartz (n = 2, 0.39 percent), chalcedony (n = 1, 0.20 percent), silicified wood (n = 1, 0.20 percent), and siltstone (n = 1, 0.20 percent).

Nineteen formal and informal tools were identified in this assemblage and analyzed in the field. The three informal tools were pieces of debitage that were used, but showed no evidence that their shapes or edge angles were purposely altered. These tools included a utilized core flake and a utilized resharpening flake. The final informal tool was a core flake with one edge used as a scraper. Three of the formal tools were made on cobbles and included two cores that were reused as choppers and a cobble chopper. Six tools were early stage unifaces and included three specimens (for which a more specific function could not be defined): an end scraper, a side-scraper, and a plane. The seven remaining tools were bifaces and included four specimens (for which a more specific function could not be defined), a fragment of an Archaic projectile point (which was collected), and an edge bite that represents a mistake made during tool manufacture.

The remaining field-analyzed chipped stone artifacts were all debris produced during the core reduction or tool manufacturing process. Core flakes dominated these artifacts (n = 371, 72.89 percent), followed by angular debris (n = 82, 16.11 percent), biface flakes (n = 4, 0.79 percent), resharpening flakes (1, 0.20 percent), cores (n = 36, 7.07 percent), and a tested cobble (n = 1, 0.20 percent). These counts and percentages also included the informal tools listed above. While most of the debitage were indicative of core reduction, tool manufacture and refurbishing were also indicated based on the presence of biface flakes, a resharpening flake, and an edge bite.

Seventeen ground stone tools were recorded, and each probably represents a separate tool. Only one specimen—a basalt lapstone—was complete. There were seven one-hand mano fragments in this assemblage (six basalt, one sandstone), three of which exhibit two ground facets (two basalt, one sandstone), while the other four each only have one ground facet. Five slab metate fragments were also found (four sandstone, one rhyolite), and a single basin metate fragment (sandstone) was identified. Three other metate fragments occur (one apiece of sandstone, vesicular basalt, welded tuff), but a more accurate morphological determination was not possible for any of them.

Fifty-two pieces of fire-cracked rock that were not directly associated with thermal features were point plotted and recorded. Limestone is the most common material (n = 20, 38.46 percent), followed by igneous undifferentiated (n = 16, 30.77 percent), nonvesicular basalt (n = 9, 17.31 percent), metaquartzite (n = 4, 7.69 percent), sandstone (n = 1, 1.92 percent), vesicular basalt (n = 1, 1.92 percent), and caliche (n = 1, 1.92 percent).

Laboratory Analyses

Summaries of the results of the laboratory analyses are provided here, with more detailed discussions of each major artifact type in the synthetic chapters later in this volume. These assemblages include chipped stone artifacts, sherds, animal bone, ground stone tools, botanical remains, and radiocarbon samples.

Chipped Stone. A total of 125 chipped stone artifacts were recovered from various contexts at LA 111435. Ten specimens were collected from the area within a proposed utility corridor in the eastern part of the sampled area, as specified in the treatment plan (Moore et al. 2010a). Chipped stone artifacts were also recovered from the main surface strip areas, features, and several surface strips associated with features. Surface Strip 1 produced 34 specimens, Surface Strip 2 yielded 3, and 10 were recovered from Surface Strip 3. Two specimens were found during the excavation of Feature 3, and Feature 4 produced 2 specimens while its associated surface strip yielded 1 other. Feature 5 contained four chipped stone artifacts. Features 6 and 7 contained 2 and 12 specimens, respectively. Feature 8 produced only 3 chipped stone artifacts, but the associated surface strip yielded 24. A single piece of chipped stone was found in Feature 9. Eleven specimens were found in Feature 10, and its associated surface strip yielded another 5. Finally, a single Archaic projectile point was collected from the surface, and did not fall into any of the excavated areas.

Overall, cherts dominate this assemblage (n = 98, 78.40 percent). Other materials occur in far smaller numbers and include limestone (n = 14, 11.20 percent), metaquartzite (n = 7, 5.60 percent), rhyolite (n = 4, 3.20 percent), and 1 examples each of silicified wood and welded ash-flow tuff (0.80 percent apiece). Morphologically, this assemblage contains mostly materials produced during the reduction process, including core flakes (n = 97, 77.60 percent), angular debris (n = 22, 17.60 percent), and cores (n = 3, 2.40 percent). There are also two pot lids (1.60 percent) and a single biface (0.80 percent), which is the base of an Archaic-period Martindale point.

Tables 8.2 and 8.3 show the distribution of material and morphological categories for each context of recovery. As might be expected, cherts dominate in each case. Similarly, core flakes dominate in each context. One formal tool—the Martindale point—and no informal chipped stone tools were recovered from this site.

Ground Stone. Seven ground stone artifacts were recovered from a variety of contexts. An end fragment of an unburned sandstone one-hand mano was recovered during the excavation of Feature 3, and was used to line the pit. A complete limestone two-hand mano was found on the surface of one of the grid units stripped during the examination of Feature 7. Three specimens were recovered from the Feature 10 surface strip. These artifacts may be fragments of the same vesicular basalt mano, and all three were fractured by heat suggesting reuse of this tool as a heating element in a thermal feature after it was no longer suitable for use as a grinding tool. Another fragment of a heat-fractured vesicular basalt ground stone tool was found in the Feature 4 surface strip, and probably represents a different tool than the mano fragments from the Feature 10 surface strip. This specimen also appears to have been used as a heating element when it was no longer suitable for its original use. The last ground stone tool was recovered during surface collection and is a corner fragment of a nonvesicular basalt basin metate that was also used as a lapidary stone.

Ceramics. Sixty-nine sherds were collected from three proveniences including the general site surface (n = 16, 23.19 percent), Surface Strip 2 (n = 24, 34.78 percent), and Surface Strip 3 (n = 29, 42.03 percent). Overall, this assemblage is dominated by El Paso Brown (n = 44, 63.77 percent), but Jornada Brown is also common (n = 25, 36.23 percent). All of the El Paso Brown sherds are from jars, while only two of the Jornada Brown sherds (8.00 percent) are definitely derived from this vessel form. The vessel form for the 23 remaining Jornada Brown sherds (92.00 percent) cannot be determined. All of the El Paso Brown sherds are tempered with granite, while

Table 8.2. LA 111435, distribution of material types by context of recovery; counts and column percentages.

Material Type		Surface Collection	Surface Strip 1	Surface Strip 2	Surface Strip 3	Feature 4 Surface Strip	Feature 5 Surface Strip	Feature 8 Surface Strip	Feature 9 Surface Strip	Feature 10 Surface Strip	Feature Excavation	**Total**
Chert	Count	8	32	2	9	2	3	17	–	5	20	98
	Col. %	72.73%	94.12%	66.67%	90.00%	66.67%	100.00%	70.83%	–	100.00%	64.52%	78.40%
Silicified wood	Count	–	–	–	–	–	–	1	–	–	–	1
	Col. %	–	–	–	–	–	–	4.17%	–	–	–	0.80%
Rhyolite	Count	–	–	1	–	1	–	–	–	–	2	4
	Col. %	–	–	33.33%	–	33.33%	–	–	–	–	6.45%	3.20%
Fine welded ash-flow tuff	Count	–	–	–	1	–	–	–	–	–	–	1
	Col. %	–	–	–	10.00%	–	–	–	–	–	–	0.80%
Limestone	Count	2	1	–	–	–	–	3	1	–	7	14
	Col. %	18.18%	2.94%	–	–	–	–	12.50%	100.00%	–	22.58%	11.20%
Meta-quartzite	Count	1	1	–	–	–	–	3	–	–	2	7
	Col. %	9.09%	2.94%	–	–	–	–	12.50%	–	–	6.45%	5.60%
Total	Count	11	34	3	10	3	3	24	1	5	31	125
	Col. %	8.80%	27.20%	2.40%	8.00%	2.40%	2.40%	19.20%	0.80%	4.00%	24.80%	100.00%

Table 8.3. LA 111435, artifact morphology for all excavational contexts; counts and column percentages.

Artifact Morphology		Surface Collection	Surface Strip 1	Surface Strip 2	Surface Strip 3	Feature 4 Surface Strip	Feature 5 Surface Strip	Feature 8 Surface Strip	Feature 9 Surface Strip	Feature 10 Surface Strip	Feature Excavation	**Total**
Angular debris	Count	2	4	–	–	–	3	5	1	–	7	22
	Col. %	18.18%	11.76%	–	–	–	100.00%	20.83%	100.00%	–	22.58%	17.60%
Core flake	Count	7	30	3	10	3	–	16	–	5	23	97
	Col. %	63.64%	88.24%	100.00%	100.00%	100.00%	–	66.67%	–	100.00%	74.19%	77.60%
Pot lid	Count	–	–	–	–	–	–	1	–	–	1	2
	Col. %	–	–	–	–	–	–	4.17%	–	–	3.23%	1.60%
Cores	Count	1	–	–	–	–	–	2	–	–	–	3
	Col. %	9.09%	–	–	–	–	–	8.33%	–	–	–	2.40%
Projectile point	Count	1	–	–	–	–	–	–	–	–	–	1
	Col. %	9.09%	–	–	–	–	–	–	–	–	–	0.80%
Total	Count	11	34	3	10	3	3	24	1	5	31	125
	Col. %	8.80%	27.20%	2.40%	8.00%	2.40%	2.40%	19.20%	0.80%	4.00%	24.80%	100.00%

all of the Jornada Brown sherds are tempered with a different crystalline igneous material. The array of sherds recovered from the two surface strips suggest a minimum of three different vessels including an El Paso Brown jar and a Jornada Brown vessel in Surface Strip 2, and a second El Paso Brown jar in Surface Strip 3. While the El Paso Brown sherds collected on the surface are scattered across the site and represent an uncertain number of vessels, there was a cluster of five Jornada Brown sherds centered at around 705N/322E that may represent a second vessel of that type. Thus, we can suggest that at least four and probably more vessels are represented in this assemblage.

Twenty sherds (28.99 percent) exhibit wear related to use as cooking vessels. Most of these sherds were found in Surface Strip 2 (n = 17, 85.00 percent), with wear from this type of use occurring on four El Paso Brown jar sherds and 13 Jornada Brown sherds. The rest of the cooking modified sherds were recovered in the surface collection, with this type of wear occurring on one El Paso Brown jar sherd and two Jornada Brown sherds. Thus, sherds exhibiting cooking wear represent 18.75 percent of the surface collected sample, 70.83 percent of the specimens from Surface Strip 2, and none were identified in Surface Strip 3.

Fauna. Six pieces of animal bone were recovered during excavation, including four (66.67 percent) from Feature 8 and two (33.33 percent) from Feature 10. Two species are represented in the specimens from Feature 8 including banner-tailed kangaroo rat (n = 2) and unidentified small mammal (n = 2). All four specimens are from mature individuals. Only one specimen—a long bone shaft fragment from an unidentified small mammal—is burned, which suggests cultural use and discard. The other three specimens are unburned, and are probably non-cultural. Both specimens from Feature 10 were found in a flotation sample. One of these specimens is from an unidentified reptile or amphibian and is unburned, so it probably is non-cultural. The second specimen is a long bone fragment from an unidentified juvenile small mammal and is burned, suggesting cultural use and discard.

Flotation. Twelve flotation samples were collected and analyzed from LA 111435 including two each from Features 3, 4, 6, 8, and 10, and one from Feature 5. Charred plant parts were moderately common. Fragments of yucca basal caudex were the most ubiquitous of these specimens, and fragments were recovered from Features 3, 5, 6, and 8 and may have been used as fuel rather than representing food remains. Charred yucca leaf fragments were also found in Features 6 and 8, and Feature 6 contained fragments of yucca fiber. Other types of charred plant parts occurred in three features and were most common in Feature 10, which contained goosefoot, dropseed grass, aster family, bean family, and unidentifiable seeds as well as unidentifiable plant parts. Feature 8 contained charred seeds of false purslane and hedgehog cactus as well as grass stems and prickly pear caudex. Besides the yucca specimens, Feature 6 contained spines from an undetermined plant. Since these specimens were charred and came from cultural features, they are considered indicative of prehistoric use. While the goosefoot, dropseed, aster family, bean family, and unidentifiable seeds probably represent food use, the yucca basal caudex, leaf fragments, and fiber are probably indicative of use as fuel. A wide range of other plants also occurred in these features, but all were unburned and therefore considered non-cultural. Fuel wood was identified in seven charcoal sample and one flotation sample. Three types of wood were identified; saltbush wood was found in Features 3, 6, 7, 8, and 10, while probable tarbush occurred only in Feature 3 and mesquite only in Feature 6. Other types of burned materials include yucca basal caudex from Features 6 and 8, and yucca leaf and stem from Feature 8. The presence of unburned plant parts suggests a degree of disturbance in all three of the sampled features, probably the result of bioturbation.

Radiocarbon. Nine radiocarbon samples from five features were analyzed, providing potential occupational dates for LA 111435. Materials from plants with comparatively short lives were used in these analyses. Feature 3 yielded a Middle Archaic date, Feature 10 a much earlier Middle Archaic period date, Feature 7 a Late Archaic period date, Feature 6 an early Mesilla phase date, and Feature 8 a Late Mesilla phase date. Thus, each of the five features yielded different dates representing five distinct occupations that do not appear to overlap (Boyer, Chapter 19, this report).

LA 111435 Summary and Recommendations

The research plan for LA 111435 proposed to field analyze surface artifacts, to examine all nine of the features observed by Zia to see if intact deposits were present, to excavate between 20 and 80 sq m to examine artifact distributions, to search for cultural deposits, and to excavate up to two geomorphological trenches (Moore et al. 2010a:124, amended by letter as reported in Akins and Moore 2011b). A single geomorphological trench was excavated in the north portion of the site west of the fence that bisects the site (Fig. 8.2). Surface stripping in three 16 sq m areas resulted in the excavation of 48 grid units. These were placed in locations with the Archaic projectile point (Surface Strip 1) and scatters of ceramics (Surface Strip 2 and Surface Strip 3). None of the surface stripped areas contained intact cultural deposits; rather most artifacts appear to have been moved by biological and geological processes.

OAS identified an additional six features at this site and investigated nine of the 15 features, including all but one of those identified by Zia. Newly recorded Feature 10, an area of carbon-stained soil, was substituted for Zia Feature 1, a fire-cracked rock scatter, because Feature 10 appeared to have better potential for providing useful data. Of the nine features investigated, only four were relatively intact: Feature 3—the base of Middle Archaic fire pit; Feature 4—a small fire pit; Feature 6—a large early Mesilla-phase roasting pit without fire-cracked rock; and Feature 8—a probable brush structure dating to the Mesilla phase. Test units were placed in Feature 2—a fire-cracked rock scatter that is probably a deflated fire pit; Feature 5—a large fire-cracked rock scatter that could be associated with an intact feature outside of the tested area; Feature 7—a stain that dates to the Late Archaic; Feature 9—a fire-cracked rock scatter with little potential for intact deposits; and Feature 10—a stain and possible pit that dates to the Middle Archaic.

Most of the ceramics were found in two of the surface strip areas (78.6 percent) and around Features 11 and 12—stains that could represent activity or living surfaces. Surface Strip 3 had all El Paso Brown ceramics that could be from a single vessel. The others had a mix of Jornada Brown and El Paso Brown sherds. A single Jornada Brown sherd was found on the surface just outside of the surface strip area for Feature 8, the possible structure.

Most of the ground stone artifacts recovered by excavation were heat fractured. Even the four pieces from Middle Archaic contexts (Features 3 and 10) were fire-cracked, indicating they were used as heating elements. The only two-hand mano that was collected came from Feature 7, which had a Late Archaic date, suggesting the mano may not have been associated with the feature. Surface ground stone artifacts inventoried and left in place and are mainly one-hand manos (n = 7) and slab (n = 5), basin (n = 1), and undifferentiated (n = 3) metate fragments. Some were scattered throughout the site area (Fig. 8.2) with others occurring in the vicinity of features. Two one-hand basalt manos were found just outside the Feature 3 scatter and two sandstone slab metate fragments were within the Feature 3 scatter. A sandstone basin metate and a sandstone slab metate fragment and two basalt one-hand manos were noted in the area surrounding Feature 13. Just south of the possible structure (Feature 8) were a vesicular basalt trough metate fragment and a sandstone slab metate fragment. To the southeast were another sandstone metate fragment and a sandstone one-hand mano. A sandstone metate fragment was found in the Feature 7 scatter.

The in-field chipped stone analysis found evidence of core reduction throughout the site area. Tools, however, were rarely associated with features. An early stage biface was found near Feature 13 and a plane was found just a few meters north of Feature 8. A side scraper was just to the northwest of Feature 10, but the other tools were more scattered. Surface chipped stone artifacts were spread across the section of site that was sampled, but were most heavily clustered between Features 1 and 15 on the east and west and Feature 13 and BHT 18 on the north and south, with a smaller cluster around Features 12 and 13 (Fig. 8.2). The flake to angular debris ratio is 4.46:1, biface flakes comprise only 0.85 percent of the flake population, and thermal alteration of cherts was not common (7.00 percent). This was especially true since 28.57 percent (eight of 28) of the thermally altered specimens represent artifacts damaged from discard into a thermal feature, including specimens recovered from Features 6 and 8. Two examples of successful thermal alteration are formal tools and two others are biface flakes, with the remainder composed of core flakes (n = 14) and angular debris (n = 2). Many of the specimens that were successfully heat-treated could have been associated with one or more of the Archaic occupations, though this is tentative. The chipped stone tools that were recovered or recorded during field analysis included four pieces of utilized debitage, a chopper, a plane, two core-choppers, three unifaces, an end scraper, two side scrapers, five bifaces, and an Archaic Martindale point. These tools suggest that a wide range of activities occurred at the site including hunting-related tasks, leather preparation, wood-working, vegetal material processing, and general manufacture/maintenance. Since multiple occupations are indicated for the site, assigning any activities to specific occupations is difficult and is not attempted here.Little fauna was recovered from the site. All faunal specimens were either post-occupational or could not be identified beyond the size of the animal. Flotation samples were more productive. Fuel woods in the radiocarbon and flotation samples indicated that saltbush was the primary fuel along with yucca, tarbush, and—beginning in the early Mesilla phase—mesquite. Archaic Feature 10 produced the most varied assemblage of plants that could have been used for food (goosefoot, dropseed, aster, bean family, and prickly pear cactus). The two Mesilla-phase features (Features 6 and 8) held a variety of yucca parts, a grass stem, hedgehog cactus, and false purslane.

LA 111435 produced three of the earliest radiocarbon dates for the project. Dates ranged from the Middle Archaic to about the middle or late portion of the Mesilla phase. Ceramic types and the chipped stone artifacts were consistent with use of this site during these periods.

Located directly across Jornada Draw from the southern portion of LA 111429, this site contributes considerable information on the Archaic and Mesilla-phase occupation of the Spaceport area. Both groups probably spent relatively brief periods gathering, processing, and consuming a variety of plant foods. The quantity and range of stone tool types demonstrate considerable core reduction as well as other activities involving plant or hide processing and biface manufacture. LA 111435 also retains potential for further research. Though most artifacts have probably been displaced, the distribution of sherds in the surface stripped areas suggests that the assemblage may retain some coherence, enough that activity areas might be defined and associated with the various periods of occupation. Large strip areas around features like Feature 5 and Feature 7, as well as Features 11 and 12, could locate other intact features. Feature 13 had a number of ground stone objects, sherds, and considerable chipped stone artifacts in association that could provide additional information on subsistence and spatial relationships. In addition, the eastern features and artifact assemblage have not been investigated and could hold additional potential for dating and use of that portion of the site area.

9 | Investigations at LA 155963

Introduction

LA 155963 is a large prehistoric artifact scatter containing artifacts and features that date to the Paleoindian period, Late Archaic, or Early Mesilla through the Doña Ana phases of the Jornada Mogollon, Protohistoric period, and Early Historic period. It is located on NMSLO trust land and has been determined "eligible" under Criterion "d" for the NRHP based on the assessment that it has integrity (between 76 and 99 percent) the potential to contain subsurface deposits including potential dating materials and possible habitation features, and has a significant artifact assemblage. For these reasons, it has the potential to address research domains within regional prehistory (Quaranta and Gibbs 2008:133, 393, 402).

This site lies just west of the entrance road to Spaceport America. A power line runs along the southern boundary of the site and County Road A-021 lies less than 100 m to the south, paralleling the southern site boundary. A recent north–south trending waterline passes through the eastern portion of the site. Research-oriented investigations were initiated to examine a selection of features at LA 155963 and to collect dateable materials to provide a more accurate idea of when this site was occupied and how many periods of occupation might be represented by the features. Extensive surface stripping was performed to help determine whether artifacts are primarily surficial or intact cultural deposits are present, especially in areas containing artifacts diagnostic of Paleoindian and Jornada Mogollon occupations. Other goals of this phase were to examine an area thought to contain Protohistoric period remains in the southwest part of the site, and to obtain information on subsistence practices, season of occupation, mobility patterns, and whether multiple occupations are represented.

Previous Work

The site was originally recorded by Zia in 2007 and at that time was described as a large prehistoric artifact scatter with features dating from the Late Archaic and Mesilla phase of the Jornada Mogollon (Quaranta and Gibbs 2008:132–133). Features were located and described and a sample of 37 pieces of chipped stone debitage was analyzed (Quaranta and Gibbs 2008:132). Additional visits to locate site boundaries and mark a protective buffer occurred in 2009 and 2010. The area within a proposed waterline corridor along the east edge of the site was checked for undocumented features, and the documented features within that corridor were examined to determine if any would be affected by the proposed construction. The corridor was staked and the integrity of features within the corridor assessed. The features were determined to lack integrity and the section of the site within the corridor was found to be unlikely to exhibit subsurface cultural manifestations. Monitoring of waterline construction found no intact subsurface features. A second construction corridor along the south edge of the site was assessed and found to be unlikely to contain subsurface cultural manifestations. Monitoring of construction along that corridor also found no evidence of intact cultural features (FAA and NMSA 2010b:19).

OAS visited the site in September 2010 to evaluate its current condition. We observed additional diagnostic artifacts and unrecorded features and were unable to locate middens seen during Zia's recording of the site. Following an approved plan (Moore et al. 2010), testing took place in 2010. At that time five soil pits (BHT 7–11) were excavated for the geomorphological study and the site was examined again, resulting in the definition and point proveniencing of a large number of additional features. Diagnostic artifacts were collected when seen, including a Folsom point that provided the first archaeological evidence for a Paleoindian occupation at LA 155963.

Site Setting

LA 155963 is located on the southern and southeastern slopes of a low, gently sloping hill. Soils are of mixed depths with exposed caliche nodules associated with shallow deposits. In the northern part of the site the eastern slope is actively eroding with minor drainage channels running into a more major arroyo along the eastern site boundary. A shallow southeast-trending drainage bisects the central part of the site. Just outside of the site boundary to the west and along this drainage is a cattle pond that supports lush vegetation. Moisture in the pond may be from a natural seep that lies at the base of the caliche hill. The subsurface sediment there is the dense, hard silty clayey fine sand of the piedmont alluvium coming off of the Caballo Mountains. The piedmont alluvium probably has a low permeability, thus would serve as a good pond base, holding water and not letting it seep away underground (Stephen Hall, personal communication March 2013). This could have been the site of a prehistoric water source. Vegetation is mainly creosote in the northern section and mesquite to the south with saltbush and yucca throughout (McBride, Chapter 20, this report; Quaranta and Gibbs 2008:132–133). LA 155963 is about 800 m east of the Aleman Ranch. Southeast-trending Aleman Draw lies 200 m southeast of the site.

Preliminary Site Description

Zia initially described LA 155963 as large, covering an area measuring approximately 1,075 by 498 m (501,654 sq m, 50 ha, 124 acres) with two core areas and over 35 fire-cracked rock features (Figs. 9.1–9.4). The fire-cracked rock features were said to range from 0.5 to 4.0 m in diameter. Core Area 1 was recorded as an approximately 100 sq m area containing about 20 fire-cracked rock features and chipped and ground stone artifacts. Most of the features were eroded and their elements scattered. Core Area 2 was considered to be the same size but with only one defined feature: a burned caliche and fire-cracked rock feature. It also appeared to contain dense concentrations of fire-cracked rock as well as charcoal stains, midden deposits, numerous small brown ware ceramics, two gray ware ceramics, 10 pieces of ground stone, abundant chipped stone artifacts, a San Pedro point, and the potential for buried pit structures. The surface artifact assemblage was estimated to exceed 10,000 chipped stone artifacts, with up to 40 cm of cultural deposits visible in erosion channels. A sample of the ground stone (5 manos, 4 or 5 metate fragments, a boulder with grinding, and 2 hammerstones), chipped stone tools (the projectile point, 3 flake tools, 3 scrapers, a graver, a chopper, and a drill), and chipped stone debitage (2 pieces of angular debris and 35 flakes) were analyzed in the field (FAA and NMSA 2010b:18, Quaranta and Gibbs 2008:139–142).

During its initial examination of the site in 2010, OAS observed a number of additional tools, including two Formative-period projectile points in the ceramic concentration, Archaic projectile points, a biface, and a drill in the northern area. Few artifacts appeared to occur in the intervening area between the core areas and a northern cluster of artifacts and features. The 40 cm deep midden described on the site form during initial recording as exposed in an arroyo could not be found. A possible slab-lined fire pit was observed in an area noted for several tools, and other unrecorded features were observed, including a dark stain outside of the core areas.

Investigations at LA 155963 by the OAS during testing were mainly focused on providing a more detailed description of the site, defining additional features, and clarifying the distribution of artifact clusters in relation to temporally diagnostic artifacts (Akins and Moore 2011a). Site boundaries were expanded a bit and the site was then thought to cover 533,139 sq m (53.32 ha, 131.75 acres), measuring 1,084.74 m north–south by 787.50 m east–west; about 6 percent larger than the dimensions originally defined by Zia. During this examination, 141 features were located and defined, including some of those that were originally described by Zia. Of those, 55 features were recorded in detail at that time, and these represented a more diverse assemblage than was found during the initial recording. Tests were conducted in four features to assess their

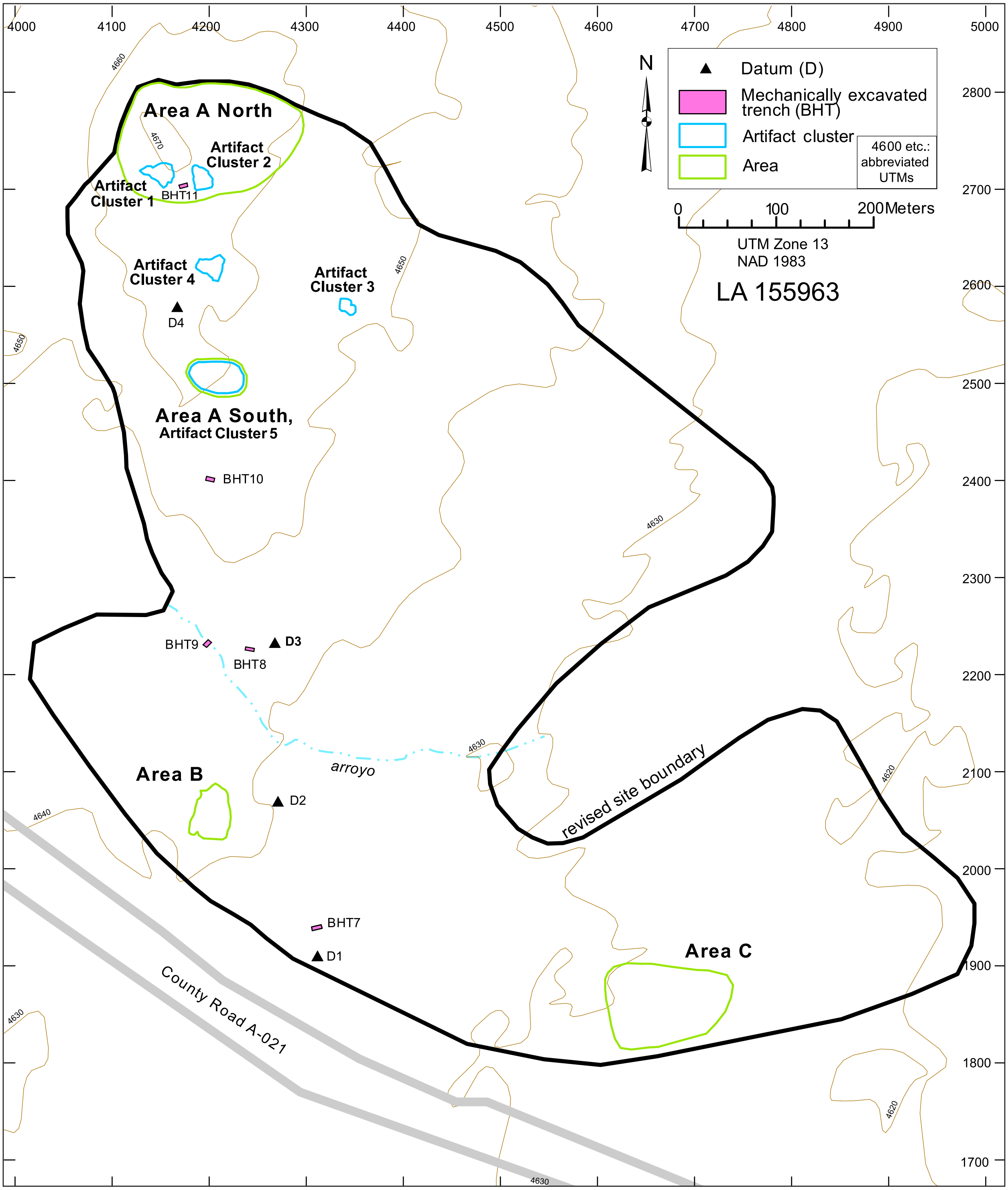

Figure 9.1. LA 155963, plan of the site showing the locations of artifact clusters, examination areas, and sections of site.

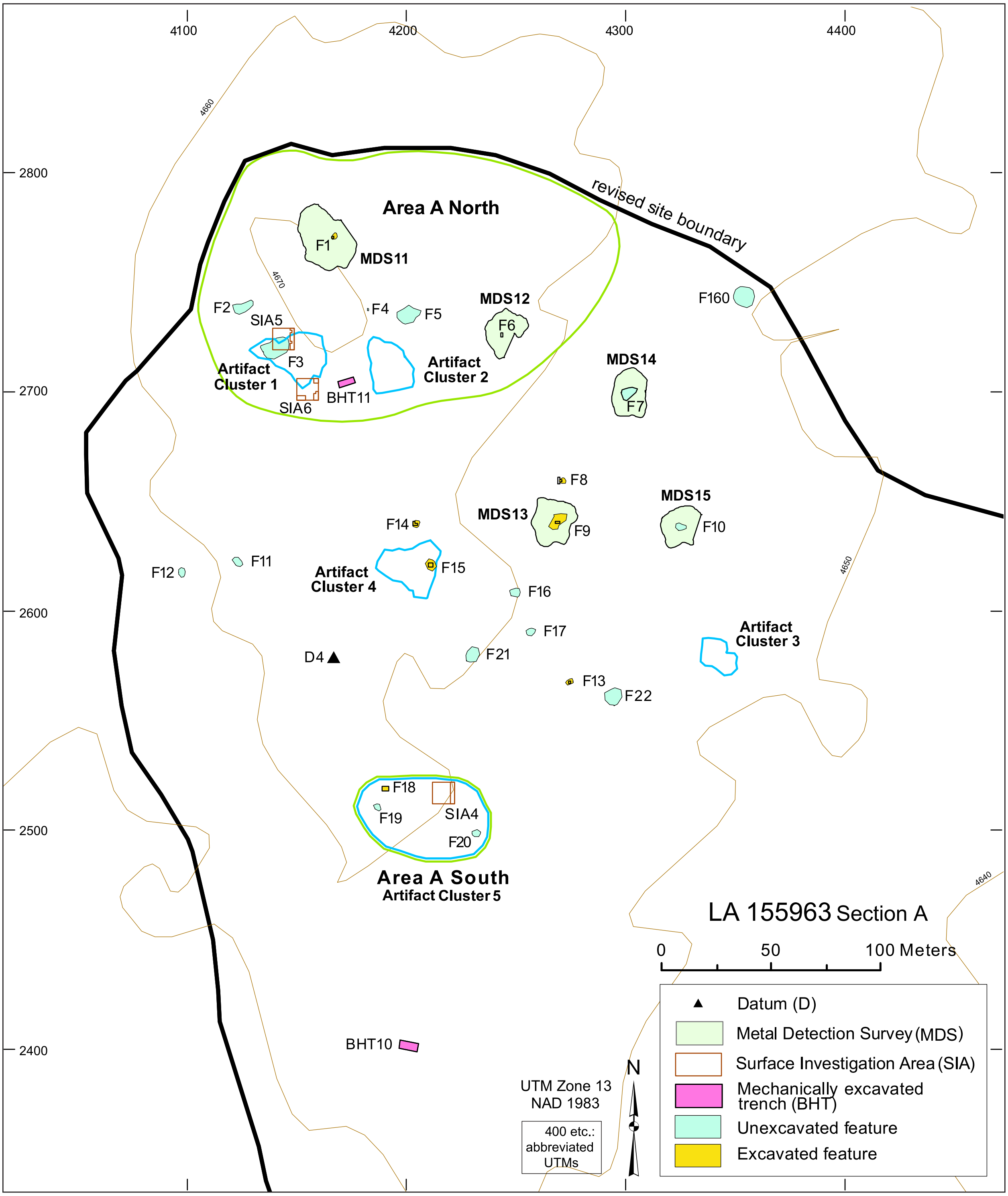

Figure 9.2. LA 155963, Section A, plan of the northern section of site showing the locations of artifact clusters, excavation areas, and features.

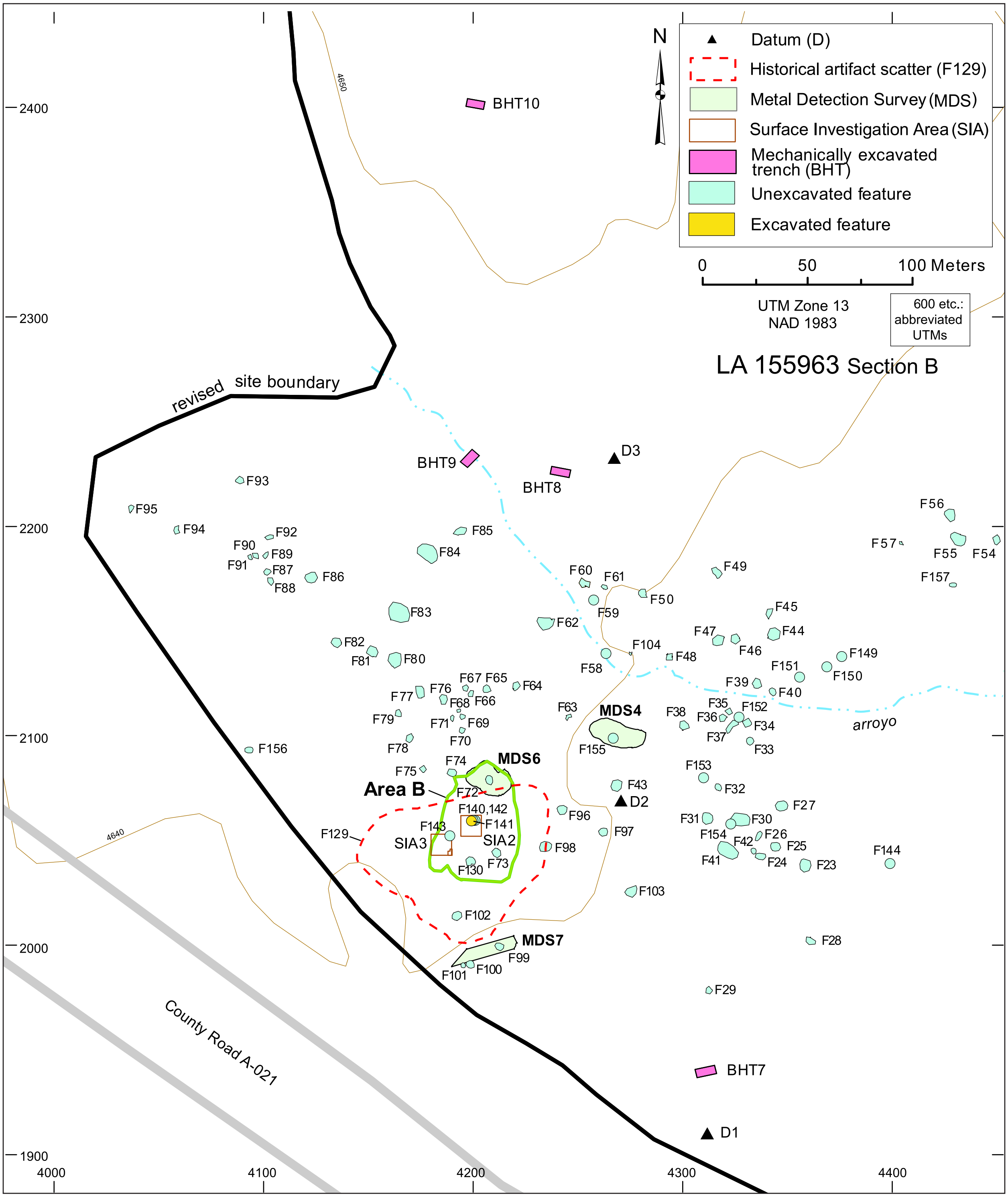

Figure 9.3. LA 155963, Section B, plan of the southwestern section of site showing the locations of artifact clusters, excavation areas, and features.

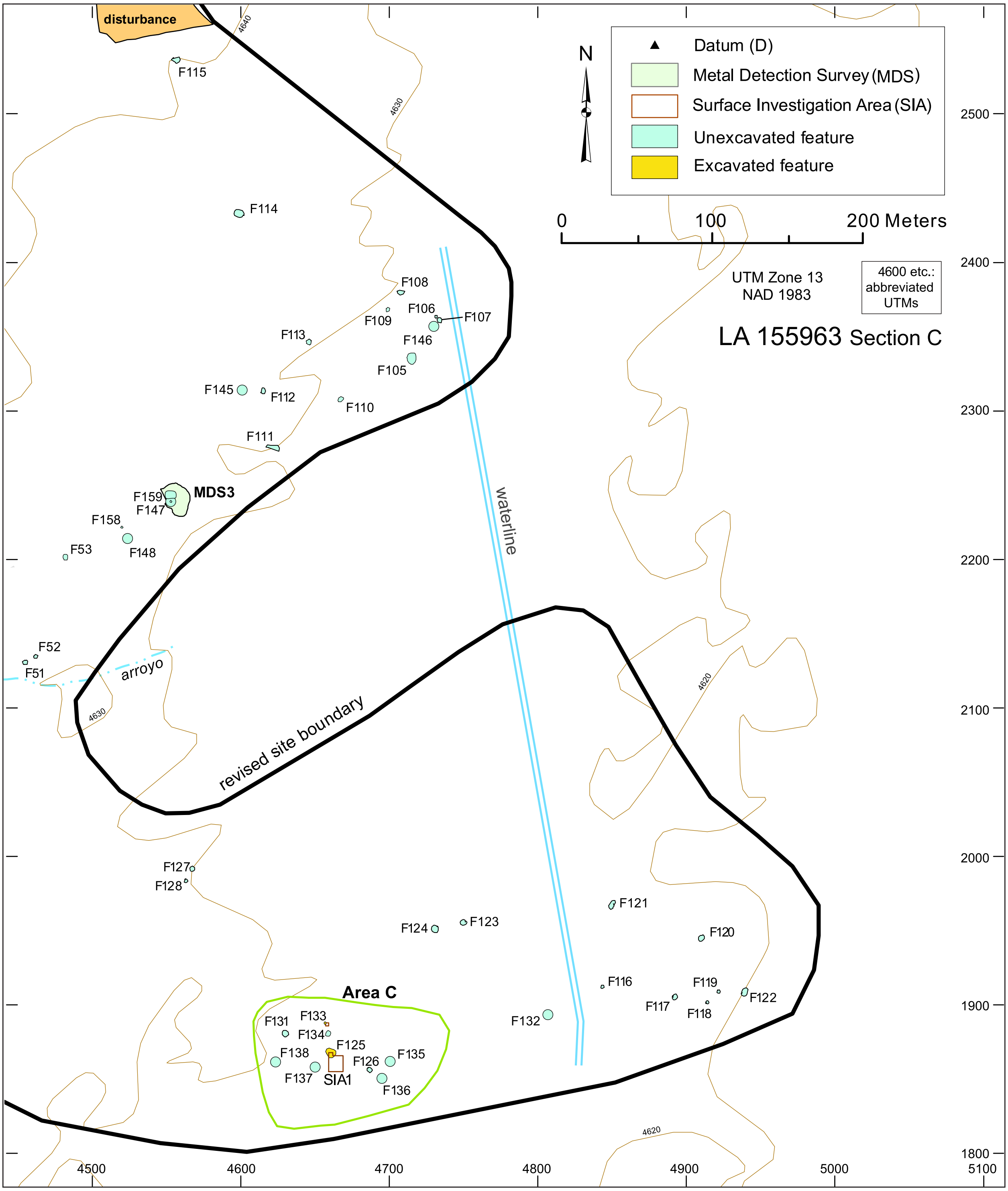

Figure 9.4. LA 155963, Section C, plan of the eastern section of site showing the locations of artifact clusters, excavation areas, and features.

integrity and their potential to contain dateable materials. At least 14 features were thought to be sufficiently well-preserved to provide temporal and subsistence data. A sample of 202 artifacts was analyzed in the field during testing, and information on this assemblage is provided later in the chapter.

Five artifact clusters were defined in the northwestern part of the site, representing concentrations in a general scatter of chipped and ground stone artifacts (Figs. 9.1–9.2). These clusters were mapped and briefly described but no detailed analysis of individual artifacts was completed. Artifact Cluster 1 near the northern edge of the site contains a spurred end scraper and, in combination with the nearby discovery of two Folsom point fragments, indicates the presence of a previously undefined Paleoindian component. Artifact Cluster 2 is a concentration of chipped stone artifacts near Cluster 1, and is possibly associated with it. Artifact Cluster 3 is also nearby and contains a concentration of chipped and ground stone artifacts thought to possibly represent an Archaic component. Artifact Cluster 4 contains a mixture of Paleoindian and Archaic chipped and ground stone artifacts, suggesting overlapping components in that area. Artifact Cluster 5 is a dense scatter of chipped and ground stone artifacts thought to primarily represent an Archaic component, though the presence of some Formative period materials suggests another area of overlapping occupations.

A section of the southwestern part of LA 155963 was referred to as the "Sherd Area," (now Area B) and contains hundreds of brown ware sherds as well as at least one Chupadero Black-on-white sherd. This part of the site appears to have been the focus of Formative period occupation, though no evidence of the middens noted by Zia was found, and there were no signs of associated habitation structures. The discovery and collection of three possible Protohistoric projectile points associated with thermal features in the southeast part of the site led to the preliminary definition of a "Protohistoric Area" (now Area C). A scatter of late nineteenth-century artifacts as well as several features that appear to date to the same time period are indicative of activities associated with the Aleman Ranch (Feature 129). Thus, a record of at least 10,000 years of sporadic use can be suggested for LA 155963.

The artifact assemblage and features identified at LA 155963 during initial recording, re-examination of the site, and testing indicated multiple use episodes. Components span the Paleoindian (Folsom and possibly late Paleoindian), Archaic (primarily Late Archaic), and some of the earliest Formative-period use of the area (Mesilla phase), as well as historic period use of the site, perhaps by ranch personnel.

Research-Oriented Investigations

Since much of the mapping of LA 155963 was accomplished during the testing phase, a total station was only used to lay out excavation and surface investigation areas, and to point provenience diagnostic surface artifacts that were collected outside feature and excavation areas (Figs. 9.1–9.4). LA 155963 was divided into three sections for the convenience of description in this report. Each section corresponds to the portions of the site shown in Figures 9.2–9.4, and are labeled according to the study area that occurs on each of those plans. Thus, Section A is the northern part of the site and contains Areas A North and A South (Fig. 9.2); Section B is the southwestern part of the site and contains Area B (Fig. 9.3); and Section C is the southeastern part of the site and contains Area C (Fig. 9.4). A considerable amount of erosion was evident, especially in the southern three-quarters of the site where most features were badly deflated and their associated fire-cracked rocks were scattered well beyond the original limits of the features. Many artifacts occurred in deflated areas and were potentially moved both vertically and horizontally by erosion. In addition to the features identified during testing, 29 more were located during research-oriented investigations and subsequent visits to the site, bringing the current total up to 157 (160 features were initially defined but 3 were eliminated as non-cultural manifestations). Features that had not been recorded in detail during the testing phase were examined and recorded during the research-oriented study.

During initial examination of LA 155963 and continuing through the testing phase, the assignment of specific labels to three areas was based on artifact content and assumed occupational dates. These were originally labeled as the Paleoindian, Sherd, and Protohistoric Areas (Akins and Moore 2011a; Moore et al. 2010a). However, during research-oriented investigations it quickly became apparent that these labels were overly simplistic because each of these areas exhibited evidence of multiple occupations during different temporal periods. Because of this, the original labels are no longer used in this study. These areas are now designated Areas A, B, and C, respectively, to coincide with the mapping divisions used to break LA 155963 into manageable sections for presentation. Area A North (Fig. 9.1) was originally designated the Paleoindian Area. A second area in the north part of the site, labeled Area A South, was selected for examination during research-oriented investigations because it contained a dense cluster of chipped stone artifacts. Area C was formerly the Protohistoric Area, and Area B was formerly the Sherd Area. By instituting these less specific labels, we avoid incorrect or inaccurate temporal associations. These areas are discussed below in the order in which they were examined during fieldwork rather than in alphabetic order.

Thirteen features were examined during this phase, and six surface investigation areas were excavated in several of the artifact clusters defined during testing. While the research design for this study (Moore et al. 2010) specified excavation of between 14 and 30 features, due to the complexity of the large roasting pits investigated at other sites there was insufficient time to excavate more than 13 features at LA 155963, one of which was determined to be non-cultural, as reported in the preliminary report for this phase (Akins and Moore 2011b). Most of the features chosen for excavation were selected because they had the potential to provide datable materials and subsistence samples. Others were unique and had potential to provide information on site structure and use. The excavated features and grid units, together with the number of excavated grid units, are shown in Table 9.1. The surface investigation areas were excavated in four different artifact clusters. Each surface investigation area measured 10 sq m, and all visible artifacts within those areas were collected by grid unit as representative samples of the types and ranges of cultural materials present. Subsurface deposits were sampled in each surface investigation area, with the number of excavated grid units ranging from 9 to 68. Areas were selected for surface stripping for a variety of reasons. Surface Investigation Area 1 was used to examine part of Area C that was originally thought to represent a Protohistoric period occupation in the southeastern part of the site (Figs. 9.3–9.4). Surface Investigation Areas 2 and 3 were placed in Area B in the southwest quadrant of the site in order to recover artifacts and to examine the nature of Formative period deposits in that area (Fig. 9.3). Surface Investigation Area 2 was placed in a fairly dense concentration of surface artifacts, while Surface Investigation Area 3 was placed nearby where those deposits were partly covered by a thin sheet of eolian sand to determine whether cultural deposits extended further under the sand sheet. Surface Investigation Area 4 was placed in a dense cluster of chipped and ground stone artifacts adjacent to an area of carbon-stained sediment in Area A South in the northwest part of the site that was originally defined as Feature 139 (Fig. 9.2). Surface Investigation Areas 5 and 6 were used to recover subsurface materials in Area A North in the northwest quadrant of the site (Fig. 9.2). Surface Investigation Area 5 was placed in Artifact Cluster 1, while Surface Investigation Area 6 was in an area where a Folsom point fragment and a section of an Archaic projectile point were found on the surface in order to determine whether there were associated materials present.

Surface Investigation Areas

Six surface investigation areas were used to examine various parts of LA 155963. As specified in the research plan (Moore et al. 2010), three areas were targeted to provide information for addressing research questions. An additional area was investigated in a part of the site thought to contain primarily Archaic-period materials. Each surface investigation area measured 10 by 10 m. The surface of each area was collected by 1 by 1 m grid units, and the plan specified that a minimum of 10 grid units should be excavated in each surface investigation area. While this procedure was carried out in most cases, only 9 grid units were excavated in Surface Investigation Area 3 because of time constraints.

Area C

Area C was in the southeast part of the site, and was examined by a single surface investigation area (Figs. 9.4–9.5). Three un-notched projectile points noted in this area during testing were thought to potentially date to the Protohistoric period. How-

Table 9.1. LA 155963, summary of excavation areas.

Excavation Area	Included Grids	No. of Surface Stripped and Excavated Grids
Area C Surface Collection	n/a	n/a
Feature 1	2770N/4166E	1
Feature 6	2725-2726N/4243E	0
Feature 8	2658-2660N/4269E	4
Feature 9	2640N/4268-4269E	2
Feature 13	2567N/4274E	1
Feature 14	2639N/4203-4204E	3
Feature 15	2620-2621N/4210-4211E	4
Feature 18	2518-2519N/4189-4191E	6
Feature 125	1865-1866N/4659-4661E	6
Feature 133	1886-1887N/4657-4658E	4
Feature 139	in Surface Strip Area 4	–
Feature 141	in surface Strip Area 2	–
Surface Investigation Area 1	1855-1864N/4659-4668E	68 including 1861-1864N/4659-4668E, 1859-1860N/4659-4661E, 1860N/4662E, 1859-1860N/4965-4668E, 1857-1858N/4664-4668E, 1857N/4663E, 1857-1858N/4668E, 1855-1856N/4667-4668E
Surface Investigation Area 2	2052-2061N/4194-4203E	20 including 2058-2059N/4194-4203E
Surface Investigation Area 3	2043-2052N/4180-4189E	9 including 2053-2054N/4188-4189E, 2055N/4189E, 2051-2052N/4188-4189E
Surface Investigation Area 4	2512-2521N/4212-4221E	20 including 2512-2521N/4220-4221E
Surface Investigation Area 5	2719-2728N/4139-4148E	18 including 2719-2728N/4147-4148E except for 2722N/4147E and 4147N/4147E
Surface Investigation Area 6	2596-2705N/4150-4159E	19 including 2696-2697N/4150-4153E, 2696-2698N/4158-4159E, 2699N/4159E, 2704-2705N/4158-4159E

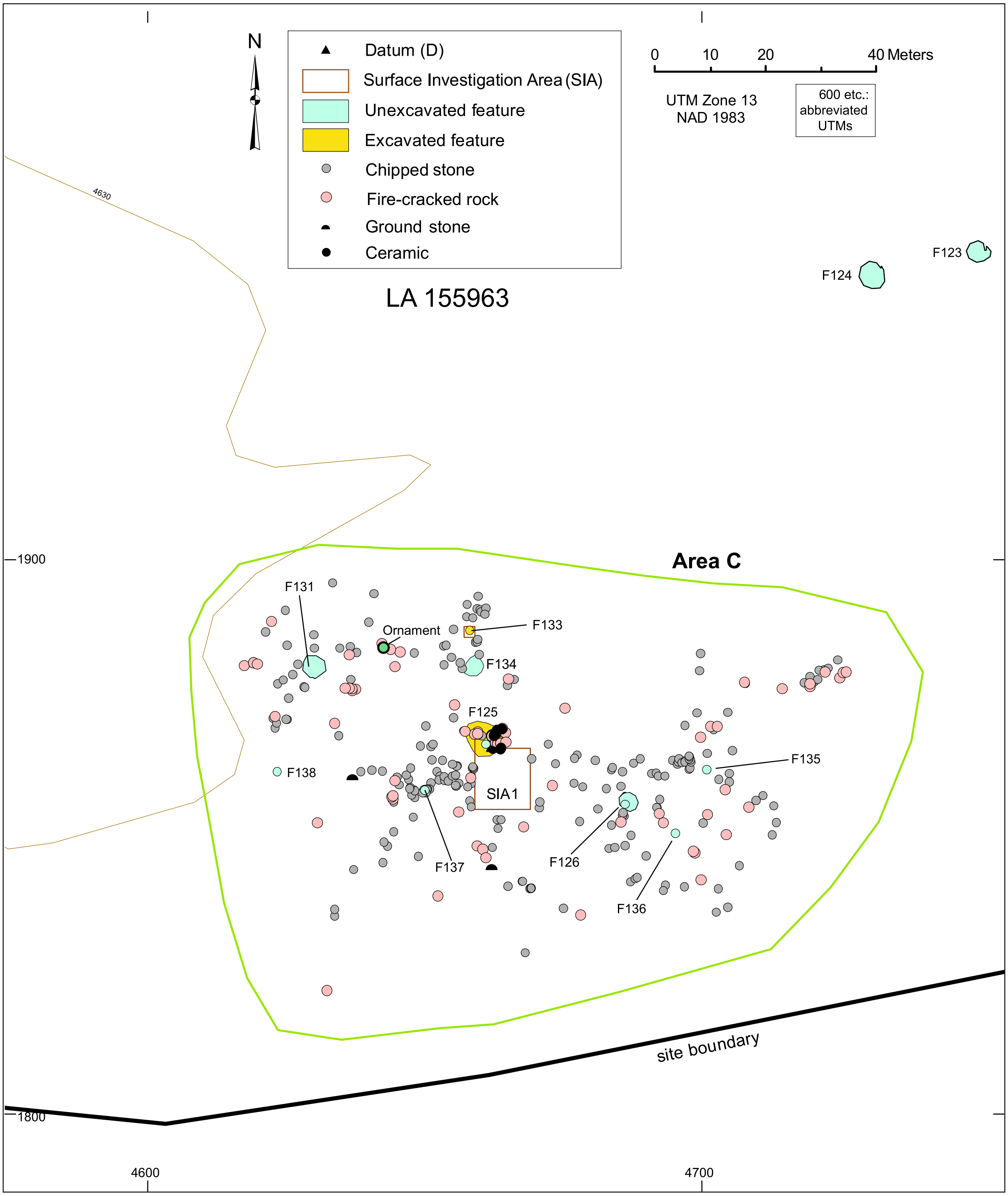

Figure 9.5. LA 155963, Area C, showing Surface Investigation Area 1 and locations of point-provenienced artifacts and features.

ever, during research-oriented investigations, the recovery of numerous brown ware sherds dating to the prehistoric Jornada Mogollon occupation of the region in addition to a few Archaic projectile points led to the re-dating of this area as entirely prehistoric.

Surface Investigation Area 1. This area was just south of and adjacent to the Feature 125 surface strip and included grid units 1855–1864N/4659–4668E (Figs. 9.4–9.5). A total of 67 sq m in 68 grid units were excavated in this area, as shown in Figure 9.6. This was the largest number of grid units excavated in any of the surface investigation areas at LA 155963. Two strata were encountered, with excavation removing the upper loose sediments and generally stopping when harder packed sediments were encountered. The loose upper layer of sediment was Stratum 1, which was a light brown silty sand containing an average of 7.56 percent gravel, ranging from 1 to 20 percent per grid unit. The overall average thickness of this stratum was 4.08 cm, with the average thickness of this stratum in other grid units varying considerably across the area, ranging between 1 and 12 cm. Disturbances were common and included insect burrows, roots, and livestock footprints. Fire-cracked rock was comparatively uncommon in Stratum 1 and mostly occurred as small fragments. Over half of the grid units contained fire-cracked rock, averaging 4.65 pieces per grid unit. The surface in this area was stabilized in places by vegetation, primarily mesquite bushes and a few grasses. Indeed, most of the grid units that were not excavated were avoided because they contained mesquite hummocks.

A second level was excavated into a single grid unit to determine whether cultural materials continued into the harder packed sediments that underlay Stratum 1. Stratum 2 was examined by a single level in 1861N/4663E that averaged 8 cm thick, ranging from 6 to 9 cm. This layer was a strong brown, sandy clay containing about 10 percent gravels, no fire-cracked rock, and no artifacts. It was compact and was penetrated by insect burrows. Stratum 2 contained an 8 cm diameter cobble that was coated with caliche, suggesting that the deposition of this unit occurred far earlier than the

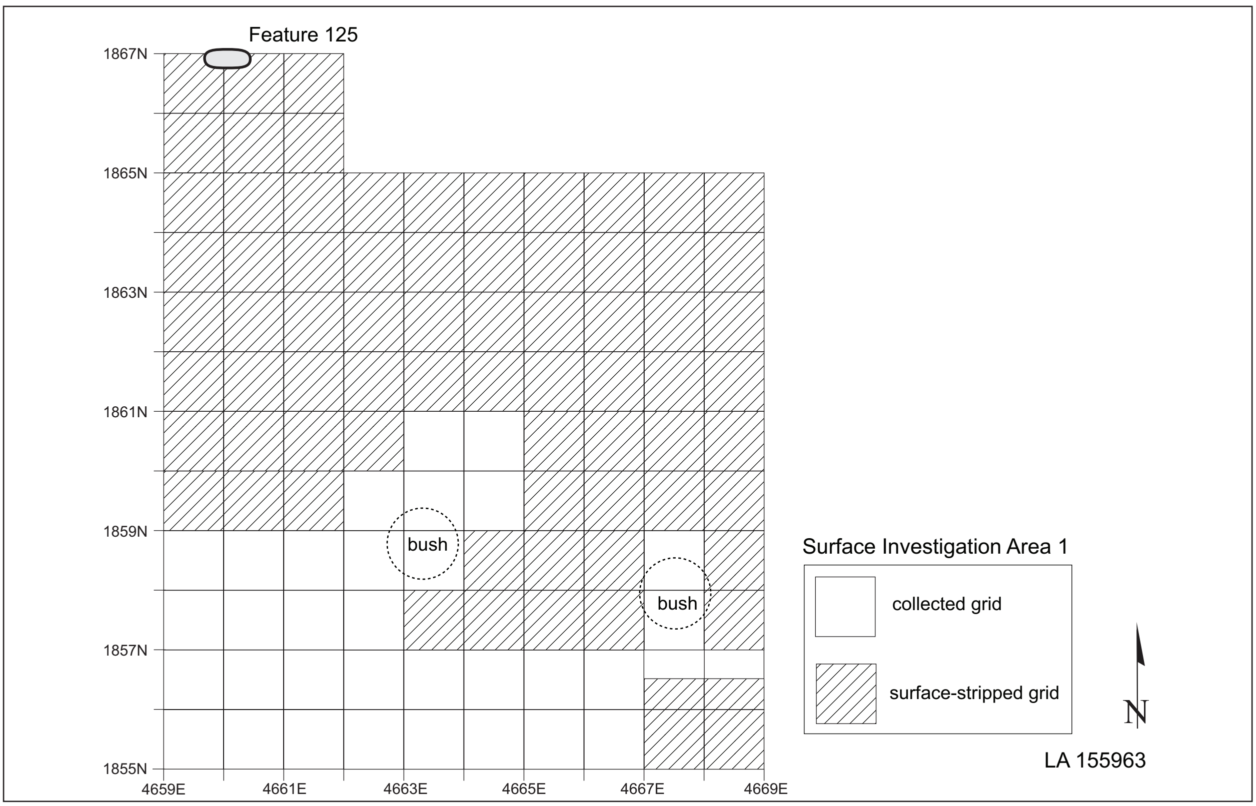

Figure 9.6. LA 155963, Surface Investigation Area 1, plan, showing Feature 125 and all excavated grid units.

human occupation of this region began, so excavation ended at the top of Stratum 2 in all other grid units.

A total of 108 artifacts were recovered from the excavated portion of Surface Investigation Area 1, including 104 chipped stone artifacts and 4 sherds. Twenty-seven of the chipped stone artifacts were collected from the surface, while the rest came from Stratum 1. An average of only 1.62 artifacts was recovered per grid unit in Surface Investigation Area 1, which included 1.55 chipped stone artifacts and .06 sherds per grid unit.

Area B

Area B was in the southwest part of LA 155963 in the only section of the site that exhibited large numbers of sherds on the surface (Fig. 9.3). Because of the large number of sherds in this part of the site, it appeared to have been the main locus of Formative-period occupation. The surface in this area was eroded and pebbly, interrupted by small to large mesquite hummocks and occasional eolian sand sheets. Two 10 by 10 m surface investigation areas were examined in Area B. Surface Investigation Area 2 was placed in an area that was mostly composed of the pebbly eroded surface, with mesquite hummocks at some of its edges. Surface Investigation Area 3 was southwest of Surface Investigation Area 2 near the southwest edge of Area B where the pebbly eroded surface was mostly but not entirely covered by a sand sheet. Surface Area 3 was used to determine whether the artifact-bearing sediments continued under the mantle of sand. Before subsurface investigations began all visible surface artifacts were collected by grid unit.

Surface Investigation Area 2. The grid units included in this area were 2052–2061N/4194–4203E (Fig. 9.3). All visible surface artifacts were collected before excavation began, with materials from two grid units adjacent to the west side of Surface Investigation Area 2 also being collected (2057N/4193E and 2060N/4193E). Thus, the total number of grid units that were surface collected was 102, but artifacts were only recovered from 93 including the two additional grid units. A total of 964 artifacts were collected from the surface, including 267 sherds, 563 chipped stone artifacts, and 134 fragments of bone. There was an average of 9.45 surface artifacts per grid unit in this area.

Twenty grid units were excavated in Surface Investigation Area 2 including 2058–2059N/4194-4203E. Two strata were encountered, with excavation removing the upper loose sediment and stopping when harder-packed sediment containing caliche flecks was encountered. The upper layer of sediment was originally labeled Stratum 1, but it contained more gravel than Stratum 1 in Surface Investigation Area 1 and was sufficiently distant from Surface Investigation Area 1 that it could not be directly linked to those deposits. Thus, its designation was changed to Stratum 17. Stratum 17 was a light brown, silty sand containing about 20 percent gravel and pea gravel inclusions. This layer averaged 5.71 cm thick, ranging from 2 to 10 cm, though the average thickness was fairly even from east to west across the excavation area.

As the hard-packed sediments under Stratum 17 were exposed, three fire pits (Features 140–142) were identified (Fig. 9.7). There were no surface indications of these features, which were excavated into the underlying preoccupational stratum. Feature 141 was excavated to recover dateable materials in order to help determine whether the fire pits were contemporaneous with the artifacts in Stratum 17 or represented an earlier occupation of the area. A radiocarbon sample of saltbush wood from Feature 141 returned a date of cal AD 662–882 (Boyer, Chapter 19, this report). These results suggest that the three subsurface fire pits were indeed contemporaneous with the cultural materials recovered from Stratum 17, and that the occupation of this area occurred during the Mesilla phase. Other than within the thermal features, no charcoal or ash were noted in Stratum 17.

Fire-cracked rock was found in every excavated grid unit, averaging 7.2 pieces per grid unit and ranging between 2 and 17. Less than 1 percent of this area was stabilized by vegetation, primarily snakeweed and grasses. The subsurface assemblage totaled 1,293 artifacts including 759 pieces of chipped stone, 272 sherds, 261 bones, and one piece of ground stone. There was an average of 643.65 artifacts per grid unit, and the average artifact count for each grid unit was 37.95 chipped stone artifacts, 13.6 sherds, 13.05 bone fragments, and 0.05 pieces of ground stone.

Surface Investigation Area 3. Grid units included in this area were 2043–2052N/4180–4189E (Fig. 9.3). Prior to excavation of a sample of grid

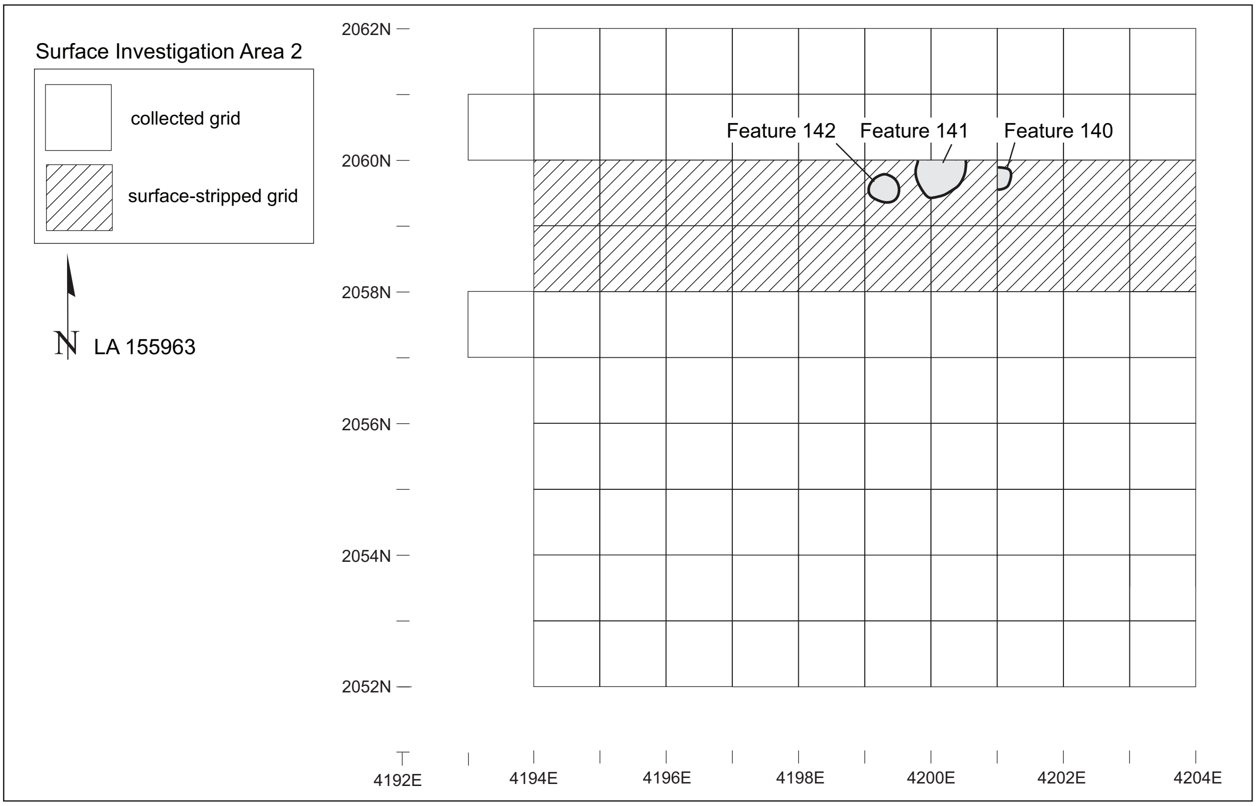

Figure 9.7. LA 155963, Surface Investigation Area 2, plan, showing collected and excavated grid units, and the three thermal features discovered during excavation.

units, all visible surface artifacts were collected. In contrast with Surface Investigation Area 2, artifacts were recovered from the surface of only 16 grid units in Surface Investigation Area 3, with a total of only 36 surface artifacts being recovered, including 5 sherds, 24 chipped stone artifacts, and 7 pieces of bone. Thus, there was an average of only 0.36 surface artifacts per grid unit in this area.

Nine grid units were excavated including 2043–2044N/4188–4189E, 2045N/4189E, and 2051–2052N/4188–4189E (Fig. 9.8). Three strata were encountered, with excavation removing two layers of loose sediment and stopping when harder-packed sediment containing caliche flecks was encountered. Stratum 16 was a sheet of eolian sand that covered most of Surface Investigation Area 3, and was a light brown, sandy silty loam that contained less than 1 percent gravel inclusions until the interface with the underlying stratum was reached, at which point the amount of gravel increased to about 2–3 percent. This layer averaged 9.87 cm thick, and ranged in thickness between 0 and 17 cm.

As was the case in Surface Investigation Area 2, the next layer was originally labeled Stratum 1 but its designation was changed to Stratum 17 for the same reason. This stratum consisted of a light brown, silty sand with a platy structure that contained about 10 percent gravel and pea gravel inclusions. Stratum 17 averaged 5.57 cm thick, and ranged in thickness from 0 to 14 cm, with the thinnest deposits occurring in the northeast corner of this area.

No fire-cracked rock was recovered from the surface of this area. Fragments of fire-cracked rock occurred in only 4 grid units in Stratum 16 and in 7 grid units in Stratum 17. There were averages of 6.67 pieces of fire-cracked rock per grid unit in Stratum 16 and 12.22 pieces in Stratum 17. Only 3–5 percent of the surface of this area was stabilized by vegetation, consisting mainly of grasses and snakeweed. In all, 316 artifacts were recovered from sub-

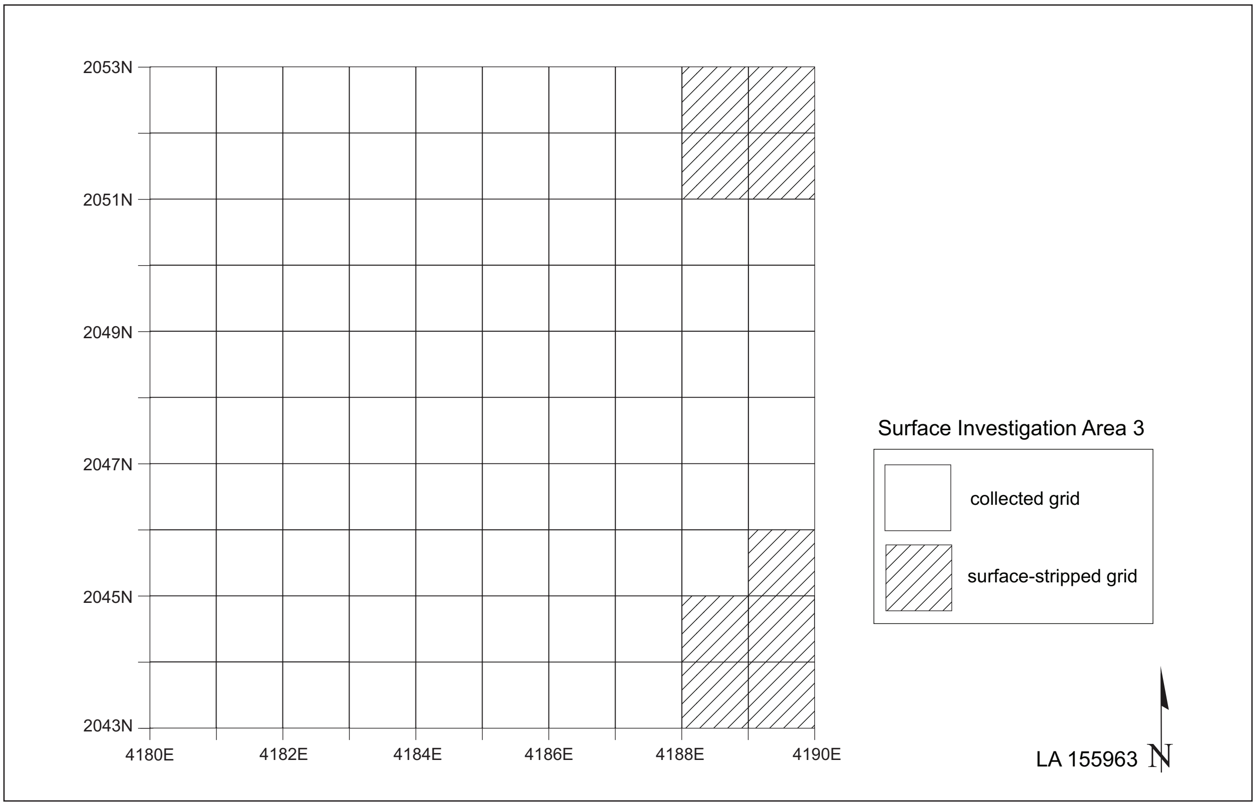

Figure 9.8. LA 155963, Surface Investigation Area 3, plan, showing collected and excavated grid units.

surface contexts. Only 39 artifacts were found in Stratum 16 and probably represent materials that were moved upward from Stratum 17 by bioturbation. They included 26 chipped stone artifacts, 10 sherds, 1 bone fragment, 1 travertine bead, and 1 piece of metal. The latter reflects the historic use of this general area and may not have been moved up from the underlying stratum. Most of the artifacts from Surface Investigation Area 3—a total of 265—were recovered from Stratum 17. This assemblage included 153 chipped stone artifacts, 52 sherds, and 60 pieces of bone. There were averages of 19.88 chipped stone artifacts, 6.89 sherds, 6.78 pieces of bone, and 0.11 ornaments recovered per grid unit from subsurface contexts in this area. Artifact and fire-cracked rock counts were much higher in the northern grid units than they were in the southern units. This suggests that, while cultural deposits do indeed continue under the sheet of eolian sand that covers much of Stratum 17 in that area, they begin to thin to the south. Thus, Surface Investigation Area 3 probably straddles the edge of the main cultural deposition zone in Area B.

Area A South

While relocating features for excavation in the north part of LA 155963, an artifact concentration was noted near Features 18–20 that was thought to represent a potential Archaic occupation zone. This preliminary temporal designation was applied because the assemblage consisted of only chipped and ground stone artifacts, and there seemed to be less evidence for thermal alteration of the chipped stone artifacts than was the case in Area A North. In addition, a previously unrecorded stain was found in this area and designated Feature 139. With the juxtaposition of a possible thermal feature and a purely chipped stone assemblage, it was decided that a surface investigation area should be placed in this location.

This part of the site contains mesquite hummocks separated by shallow erosional basins and slopes, and is drained by a small intermittent gully. Surface Investigation Area 4 was placed in a zone between mesquite hummocks that contain loose surface sediment. It was situated so that Feature 139 was in the southwest corner of the investigation area, and the small intermittent gully was directly to the west. Investigation of Feature 139 quickly established that, rather than being a thermal feature as was first thought, it was simply a patch of darker sediment that did not contain cultural materials, and it was eliminated as a cultural feature. Before subsurface investigations began, all visible surface artifacts were collected by grid unit.

Surface Investigation Area 4. The grid units included in this area were 2512–2521N/4212–4221E (Fig. 9.2). Prior to excavating a sample of grid units, all visible surface artifacts were collected, with cultural materials being recovered from the surface of 85 grid units. A total of 426 artifacts were collected including 418 chipped stone artifacts and 8 ground stone tools. Twenty grid units were excavated along the west edge of this area including 2512–2521N/4220–4221E (Fig. 9.9). Two strata were encountered, with excavation removing the upper layer of loose sediment and stopping when harder packed sediment was encountered. Stratum 1 was a sheet of eolian brown silty sand that contained 5 to 8 percent gravels composed mainly of caliche, limestone, and quartzite. Excavation ended when the underlying harder-packed stratum was exposed, which consisted of a dark yellowish-brown, fine silty sand. Stratum 1 averaged 12.13 cm thick, ranging from 5 to 36 cm thick, deepening from south to north across the excavated area.

No fire-cracked rock was recovered from the surface and it was not common in subsurface contexts. There was an average of only 3.4 pieces of fire-cracked rock per grid unit, ranging from 0 to 11 pieces. Only 3–5 percent of the surface was stabilized by vegetation including small mesquite bushes and grasses. A total of 586 artifacts were recovered during excavation in this area including 584 chipped stone artifacts and 2 pieces of ground stone. Thus, there was an average of 29.30 artifacts per excavated grid unit. The distribution of artifacts followed no discernible pattern.

Area A North

Area A North in LA 155963 was originally designated "the Paleoindian Area" because two Folsom point fragments were found along the western edge of the site in this area during testing, ceramic artifacts were very sparse, and the surface assemblage appeared to contain a large percentage of thermally altered chipped stone artifacts. However, considering the large amount of evidence for reoccupation seen across this site, some mixture of materials from multiple periods was considered likely and the area was relabeled, as discussed earlier.

The northern and western edges of LA 155963 coincide with the edge of the promontory that this part of the site occupies, and those areas are heavily eroded with numerous small cobbles and gravels exposed. Mesquite hummocks are less common through this area, and creosote bushes are common. As Area A North was being examined to select locations for surface investigation areas, another Folsom point and an Archaic point were found in Artifact Cluster 1. Since three Folsom point fragments had now been found in this general area, the decision was made to place two surface investigation areas in Artifact Cluster 1. Surface Investigation Area 5 was at the northern edge of Artifact Cluster 1, overlapping the scatter of fire-cracked rock defined as Feature 3. Surface Investigation Area 6 was at the southern edge of Artifact Cluster 1. Before subsurface investigations began, all visible surface artifacts in these areas were collected by grid unit.

Surface Investigation Area 5. The grid units included in this area were 2719–2728N/4139–4148E (Fig. 9.2). Prior to excavating a sample of grid units, all visible surface artifacts were collected and, thus, 42 chipped stone artifacts and one ground stone artifact were recovered from 40 grid units. Eighteen grid units were excavated along the east edge of this area including 2719–2728N/4147–4148E except for 2722N/4147E and 2727N/4147E (Fig. 9.10). Two strata were encountered, with excavation removing the upper layer of loose sediment and stopping when more compact sediment of a different color was encountered. Stratum 1 in this part of the site was a brown, sandy silty clay containing 10–15 percent gravels, mostly caliche and limestone. About 5–10 percent of the surface of Stratum 1 was covered by gravel, and 5–15 percent of the surface was covered and semi-stabilized by vegetation, mostly

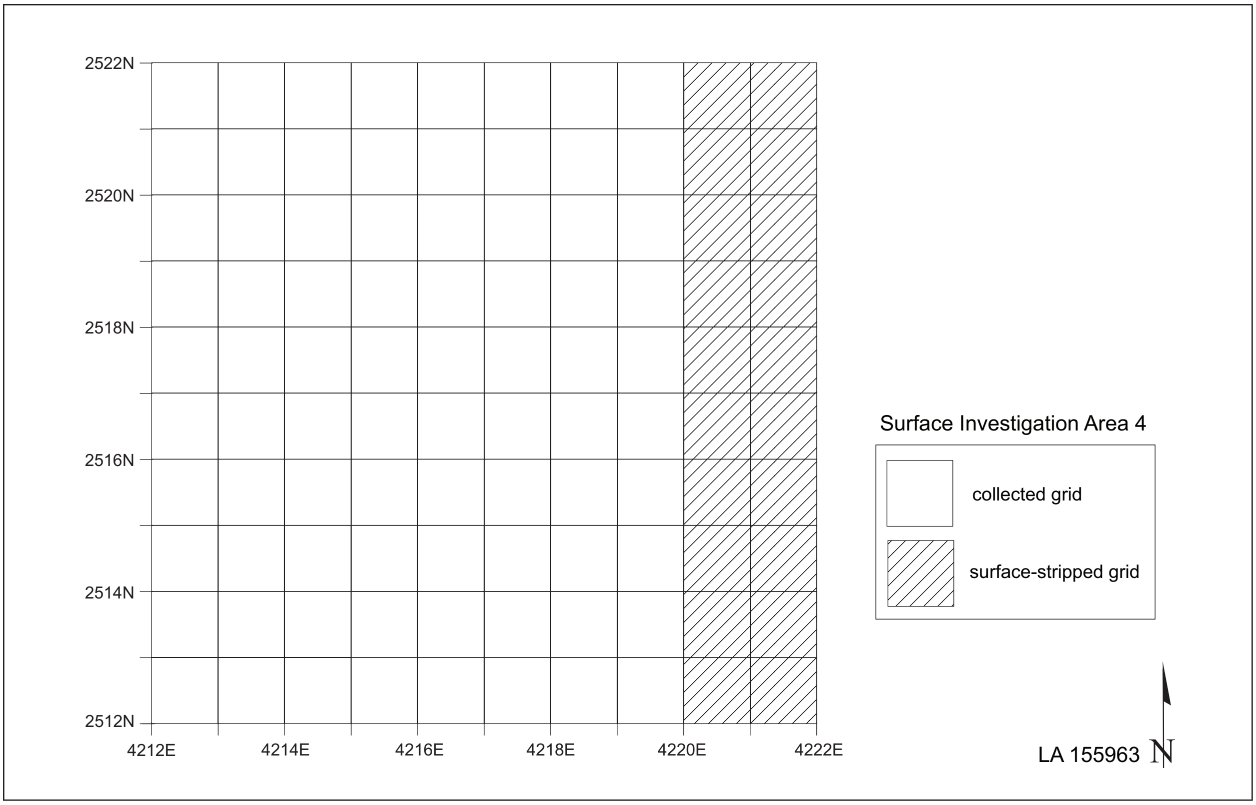

Figure 9.9. LA 155963, Surface Investigation Area 4, plan, showing collected and excavated grid units.

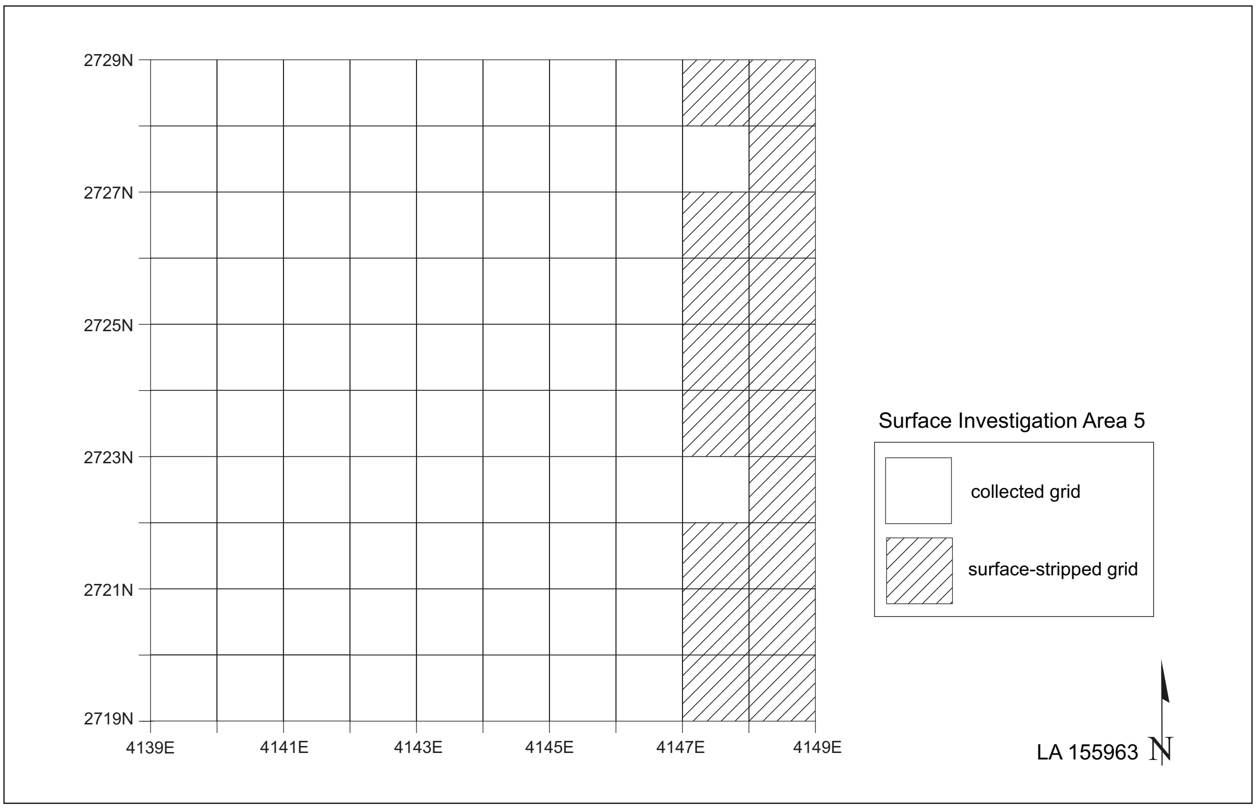

Figure 9.10. LA 155963, Surface Investigation Area 5, plan, showing collected and excavated grid units.

creosote and a small unidentified shrub. Excavation ended when the underlying stratum of more compact redder sediment was encountered. Quite a bit of root disturbance was noted. Stratum 1 averaged 10.84 cm thick, ranging from 6.55 to 12.88 cm. It was thinnest in the four southernmost grid units, which exhibited the most evidence for erosion.

No fire-cracked rock was recovered from the surface, and it was also uncommon in subsurface contexts—only 16 fragments were found. There was an average of 0.89 pieces of fire-cracked rock per grid unit, with a range of 0–3 fragments occurring per grid unit. Chipped stone artifacts were far more common, with 369 specimens being recovered for an average of 20.50 per grid unit, ranging from 6 to 43. The density of chipped stone artifacts increased from south to north, with an average of 25.00 recovered per grid in the southern part of the surface stripped area and 51.40 per grid in the northern part.

Surface Investigation Area 6. The grid units included in this area were 2696–2705N/4150–4159E (Fig. 9.2). Prior to excavating a sample of grid units, all visible surface artifacts were collected. Twelve chipped stone artifacts were recovered from the surface of 12 different grid units. Nineteen grid units were then excavated in various parts of this area as shown in Figure 9.11. This sampling strategy was used to examine different parts of the area and because much of the surface was covered by small hummocks created by sand building up around creosote bushes. While excavation generally ended after the first level was removed, a second level was excavated in one grid unit in the northeast corner of the area.

The grid units excavated in Surface Investigation Area 6 included 2696–2697N/4150–4153E, 2696-2698N/4158–4159E, 2699N/4159E, and 2704-2705N/4158–4159E. Two strata were encountered, with excavation mostly removing the loose upper sediment, ending at the top of more highly compacted sediment. Stratum 1 in this area was a brown to strong brown sandy silt that contained 10 to 20 percent caliche and limestone gravel, with a few quartzite and chert gravels also occurring. About 10–20 percent of the surface was covered by gravel, and 5–15 percent was covered and semi-

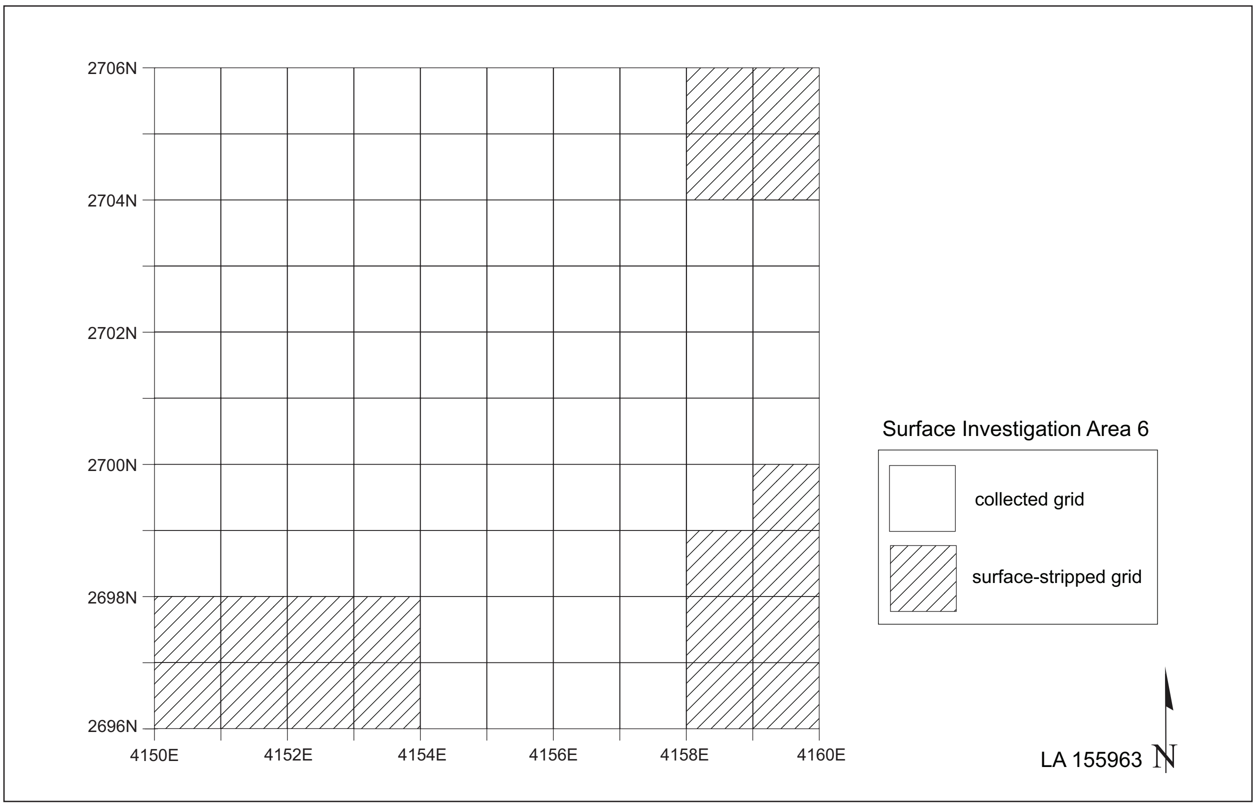

Figure 9.11. LA 155963, Surface Investigation Area 6, plan, showing collected and excavated grid units.

stabilized by vegetation including creosote bushes, grasses, and snakeweed. Excavation ended in all but one grid unit when the more compact sediment was encountered. Stratum 1 averaged 6.49 cm thick, ranging from 3.89 to 10 cm. It was thickest in the northeast corner of the area and in the northernmost of the seven grid units excavated in the southeast corner. It was thinnest in the grid units in the southeast corner, which was the most eroded section.

No fire-cracked rock was recovered from the surface, but it was more common in subsurface contexts than were chipped stone artifacts. There was an average of 5.06 pieces of fire-cracked rock per grid unit, with a range of 1 to 16 fragments. As noted, chipped stone artifacts were less common, with only 31 occurring in Stratum 1 for an average of 1.63 per grid unit and with a range from 0 to 5. Chipped stone artifacts were least common in the northeast corner of Surface Investigation Area 6, and tended to occur in the highest densities in the southeast corner of the area.

A single 10 cm level was excavated into Stratum 2 in 2705N/4159E to determine whether cultural materials occurred below the loose surface sediment. Stratum 2 was a brown silty sand containing about 10 percent gravel inclusions which, in turn, consisted mainly of caliche but also occasional pebbles of chert and limestone. Four fragments of fire-cracked rock were recovered near the top of this level. Since cultural deposits did not appear to extend into this stratum, excavation was ended.

Assessment of Surface Investigation Area Excavations

Six surface investigation areas were excavated in four different parts of LA 155963 to determine whether intact cultural deposits might be present and to provide more detailed information for use in site interpretation. In all cases, the spatial integrity of artifacts in excavated areas has been compromised by movement caused by bioturbation as well as by sediment erosion/aggradation. Nonetheless, in many cases excavation showed that the surface expression of cultural materials in these areas is not always an accurate reflection of what is below the surface.

Erosion was extreme in Surface Investigation Area 1 in Area C and most artifacts were lying on or just below the surface. There was an almost continual scatter in this part of the site, with Archaic and Formative period occupations represented but difficult to separate into discrete components. Further excavation could be useful in this area, especially to examine thermal features for temporal and subsistence data, but the palimpsest distribution of materials will make it difficult to define breaks between occupation areas as well as to accurately assign chipped and ground stone artifacts to a specific period of use.

This problem is less of a concern in Area B, where excavation demonstrated evidence of an intense Formative period occupation that deposited large amounts of debris. However, the mixing of cultural materials through an upper sediment zone was shown by the occurrence of three thermal features that could only be defined after Stratum 17 was removed. Since there was no surface expression of these fire pits, the upper 10 cm or so of sediment in this area could have been intensely bioturbated, concealing the presence of these features. Similarly, there is also a possibility that multiple Formative-period occupations occurred over a period of many years, with deposits building up through both natural and cultural processes and concealing earlier features. In both scenarios, in addition to thermal features Stratum 17 could also conceal evidence of temporary structures, though none was found during our limited excavations. While Stratum 17 may have been bioturbated, it contains large numbers of artifacts that probably retain some spatial integrity related to general discard zones.

Surface Investigation Area 4 in Area A South exhibited a heavy concentration of chipped stone artifacts, tailing off at the perimeter of the concentration to the very sparse scatter that characterizes much of this part of the site. This suggests a degree of spatial integrity to these materials in relation to a zone of occupation, though certainly not between artifacts. Bioturbation and erosional/aggradation processes have undoubtedly caused a great deal of localized movement of these materials, spreading them throughout the loose surface sediment layer. Repeated episodes of aggradation and erosion are possible in this area, with materials being dropped onto the surface of the more consolidated layer of sediments below Stratum 1, then being covered with more eolian sediments and mixed upward (and perhaps downward to a lesser degree) by bioturbation, beginning the process again.

This may also have been the case with materials recovered from Surface Investigation Areas 5 and 6 in Artifact Cluster 1 in Area A North. While there has obviously been quite a bit of internal movement of materials in this artifact cluster, the general occupation areas probably retain some integrity, with the relationship between artifacts being obscured. While it is likely that some or even all of the artifacts in this part of the site represent one or more Folsom occupations, no dates were obtained from associated features, so this is impossible to say for certain. However, the occurrence of an Archaic projectile point in addition to the three Folsom points may be a good indicator of multiple occupations which, in turn, created a palimpsest distribution similar to that seen in Area C. This question can be addressed by detailed examination of the associated chipped stone assemblage.

Excavated Features

Zia specifically identified and briefly described 41 features and defined two core areas at LA 155963. The first core area was described as 20+ eroded fire-cracked rock features and the second as a large area with fire-cracked rocks and stains, including one that could have been a habitation area (Quaranta and Gibbs 2008:139 and 140). OAS located 131 features during the testing phase and proposed to excavate between 14 and 30. Those chosen for excavation were believed to have the potential to provide subsistence or dating samples or were located within artifact clusters where they could provide information on site structure. In addition, any features that had not already been inventoried were to be located and inventoried (Moore et al. 2010:89–93).

The goal of investigating at least 14 features was not met as this was the last site excavated and there was no time left for further excavation. However, Features 132 to 155 were located and described and Features 156 through 160 were located and described (though 160 feature numbers were assigned, three features were determined to be non-cultural and were eliminated). Additional features are present within site boundaries, especially in the western area but time was not sufficient enough to locate and inventory all of the features at this very large site.

Feature 1 (large fire pit with rock)

Feature 1 is the farthest north of the features at this site and is in Area A North (Fig. 9.2). It was recorded by Zia as Feature 20, a discrete fire-cracked rock feature consisting of about 15 pieces of burned caliche and limestone at the edge of a dune (Quaranta and Gibbs 2008:140). It was described by OAS during the testing phase as a 9.0 north–south by 2.6 m east–west scatter of fire-cracked rocks located at the edge of a dune. The feature encompasses a more concentrated area measuring 6.2 m north–south by 1.3 m east–west. Less than 50 pieces of fire-cracked rock were observed, almost all caliche with a small amount of limestone. A 20 by 20 cm test in the most concentrated section found that the fire-cracked rock extended to at least 16 cm below the ground surface.

A 1 by 1 m grid unit was placed within the fire-cracked rock scatter. No charcoal-staining was observed on the surface of the unit, which had a scattering of burned caliche and a large number of small unburned pieces. The upper fill, consisting of 3 to 7 cm of loose sandy loam (7.5 YR 5/4) with small caliche nodules, was removed and a mottled, circular stain was exposed. Excavation outside the pit was stopped and the feature became the focus of excavation. The east half was excavated to the base of the pit, and the numerous fire-cracked rocks were mapped and removed. The exposed profile was drawn and photographed (Fig. 9.12) and the remaining fill was removed after mapping the fire-cracked rock. The pit fill (Stratum 5) was charcoal-stained sandy loam (7.5 YR 3/2) containing pieces of charcoal and small gravel. About 90 pieces of fire-cracked rock were found in the pit. The rocks were at a fairly uniform level and were tightly packed in places (Fig. 9.13). Almost all were caliche ranging in size from 2 to 15 cm. The rest were small sharp-edged spalls of a different material, suggesting that a different type of rock had been heated and removed.

Feature 1 was a roughly bowl-shaped pit that measured 76 cm north–south by 74 cm east–west by 9 to 10 cm deep, except for an area of possible rodent disturbance where it was 15 cm deep (Fig. 9.14). It was excavated into soil containing abundant pieces of caliche. Pit walls were fairly well defined but irregular due to the surrounding soil. A large mesquite root bisected the pit at its base. The only other disturbance noted was the rodent burrow in the southwest corner.

None of the three flotation samples contained

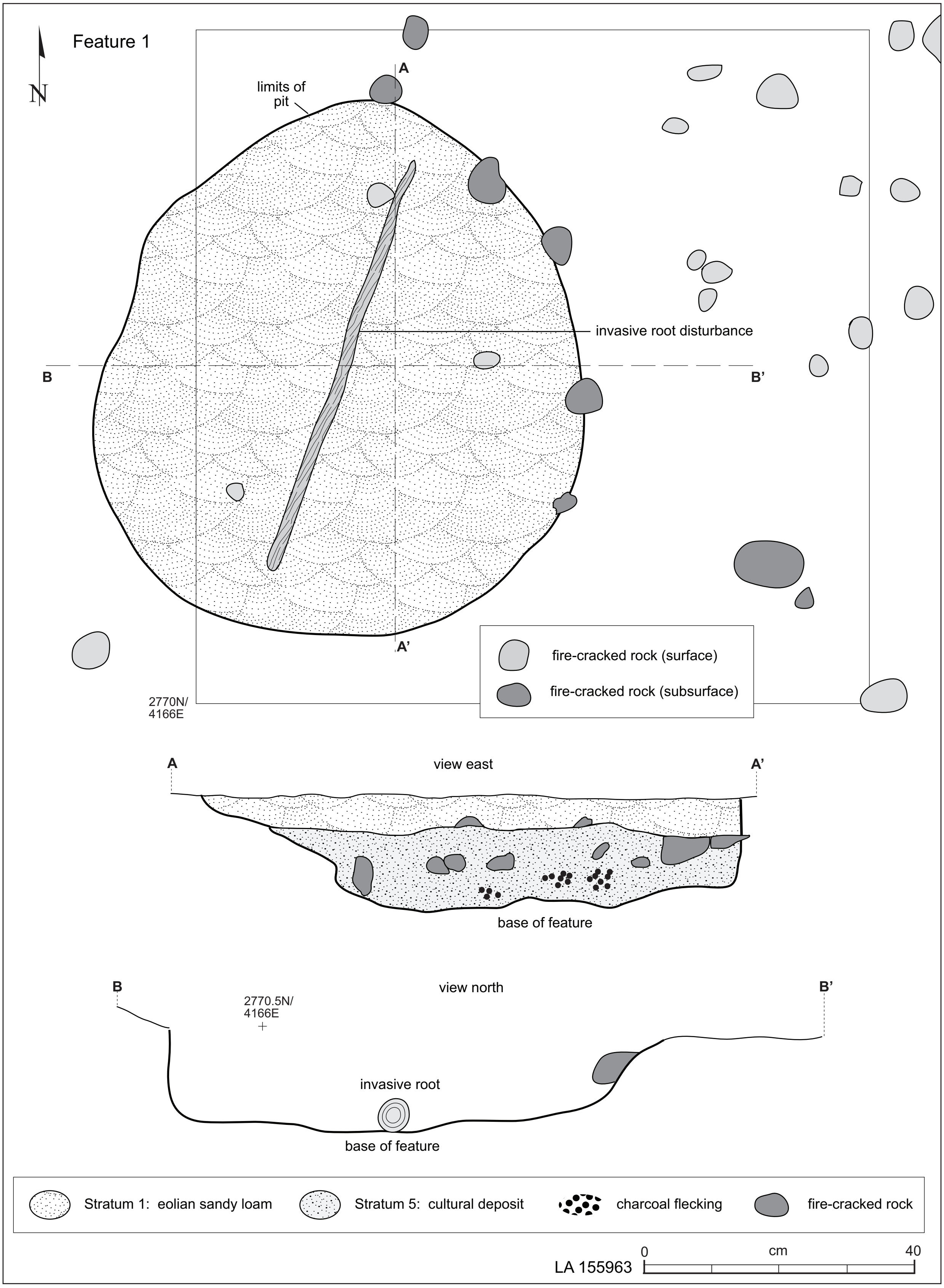

Figure 9.12. LA 155963, Feature 1, plan and profiles.

Figure 9.13. LA 155963, Feature 1, partially excavated.

Figure 9.14. LA 155963, Feature 1, with rock removed.

burned plant material. Fuel wood in the radiocarbon samples was mesquite (7.83 g) and saltbush (3.82 g). Samples of each were submitted for radiocarbon analysis and produced dates in the Protohistoric period (cal AD 1470–1640, Boyer Chapter 19). The only associated artifacts were chipped stone recovered from the feature. All are unutilized chert debitage including two core flakes, a piece of angular debris, and a pot lid. An intensive metal detection survey around this feature (545 sq m) did not locate any metal artifacts.

Feature 6 (disturbed fire pit with rocks)

Located near the east edge of Area A North, Feature 6 is Zia Feature 32, described as partially buried and composed of about 50 pieces of fire-cracked rock—including some ground stone—in a 1.0 by 1.0 m area (Quaranta and Gibbs 2008:140). During the testing phase, OAS recorded it as a 60 cm diameter concentration of fire-cracked rock within a scatter as large as 2.0 m north–south and 16.5 m east–west. About 30 to 50 rocks were included in the scatter, which had charcoal-stained soil near the center. Its appearance in December of 2010 (Fig. 9.15) was considerably different from that in August of 2011 (Fig. 9.16) when it was excavated. At that time, it was a well-defined circle of fire-cracked rocks with associated fire-cracked rock extending over an area at least 5.0 by 3.0 m. Because of its appearance, only the feature itself was excavated and not the surrounding grid units. Fill was removed from the eastern half of the circle of rocks, a stratigraphic profile was drawn, and the western-half fill was removed (an area 45 by 39 cm and 8 cm deep). The excavators noted that the upper fill appeared to be intermixed eolian sandy loam (7.5 YR 6/6) and carbon-stained pit fill (5 YR 3/2), and they observed a large rodent hole filled with seeds. The walls and bottom of the pit in the southern half were described as poorly defined to virtually nonexistent but the bottom in the northern half was described as blackened and well defined, and the circle of rock was described as remarkably undisturbed (Fig. 9.17).

Contents of the flotation and bulk-soil samples from this feature confirm that massive disturbance had occurred between the time it was inventoried in December and excavated eight months later. Rabbit pellets were found throughout and suggest that during the spring breeding season a rabbit dug a shallow pit, scattered the rock in a circular form, and built a nest at the center of the feature. While the feature itself retained no integrity, the flotation sample and radiocarbon dates provide evidence of a thermal feature at this location. Burned monocot stems were found in the flotation sample and submitted as a radiocarbon sample that returned a date in the Historic era (cal AD 1811–1920; Boyer, Chapter 19, this report). A chert core flake from an adjoining grid unit was the only artifact collected. The flotation sample contained an unburned vertebra from a lizard. Intensive metal detection around this feature (259 sq m) did not locate any metal artifacts.

Feature 8 (small fire pit with fire-cracked rock)

Located in the northern part of LA 155963 between Area A North and Area A South, OAS Feature 8 is the same as Zia Feature 33. Quaranta and Gibbs described it as 30 pieces of fire-cracked rock in a 2.0 m diameter area with an intact buried stain (2008:140). During the testing phase, OAS described it as a fire-cracked rock scatter measuring 6.0 m north–south by 5.2 m east–west with a more concentrated area measuring 2.3 m north–south by 1.5 m east–west. Charcoal-stained soil was noted as well as ceramic and chipped stone artifacts (Fig. 9.18).

The scatter was in a washed area at the edge of a shallow drainage with creosote and mesquite bushes at its north and northwest edges. It was selected for excavation because it was the only northern feature with associated surface ceramics. A 4 by 4 m grid was established over the feature and 4 El Paso Brown jar body sherds and 8 chipped stone artifacts (4 chert core flakes, 1 chert angular debris, and 3 metaquartzite core flakes) were point-plotted and collected. Fire-cracked rock was plotted in an approximately 2 by 2 m area, not including those in the active portions of the drainage. Surface fill was removed from the two grid units that contained the feature and from one grid unit to the east. The drainage cut bisected the feature so two kinds of fill overlaid it. The fill in the drainage was coarse-grained sand (Stratum 13) with pockets of small caliche nodules. Outside the drainage was coppice dune sand (Stratum 10) that consisted of large-grained sand with abundant small caliche nodules and occasional pieces of fire-cracked rock. Both overlaid compact red sand (Stratum 11) (5 YR 2.5/1) that was mostly fine-grained but contained pockets of dune sand. This stratum contained sparse rock and spots of organic material but no charcoal. Two additional El Paso Brown jar body sherds and

Figure 9.15. LA 155963, Feature 6, during testing.

Figure 9.16. LA 155963, Feature 6, prior to excavation.

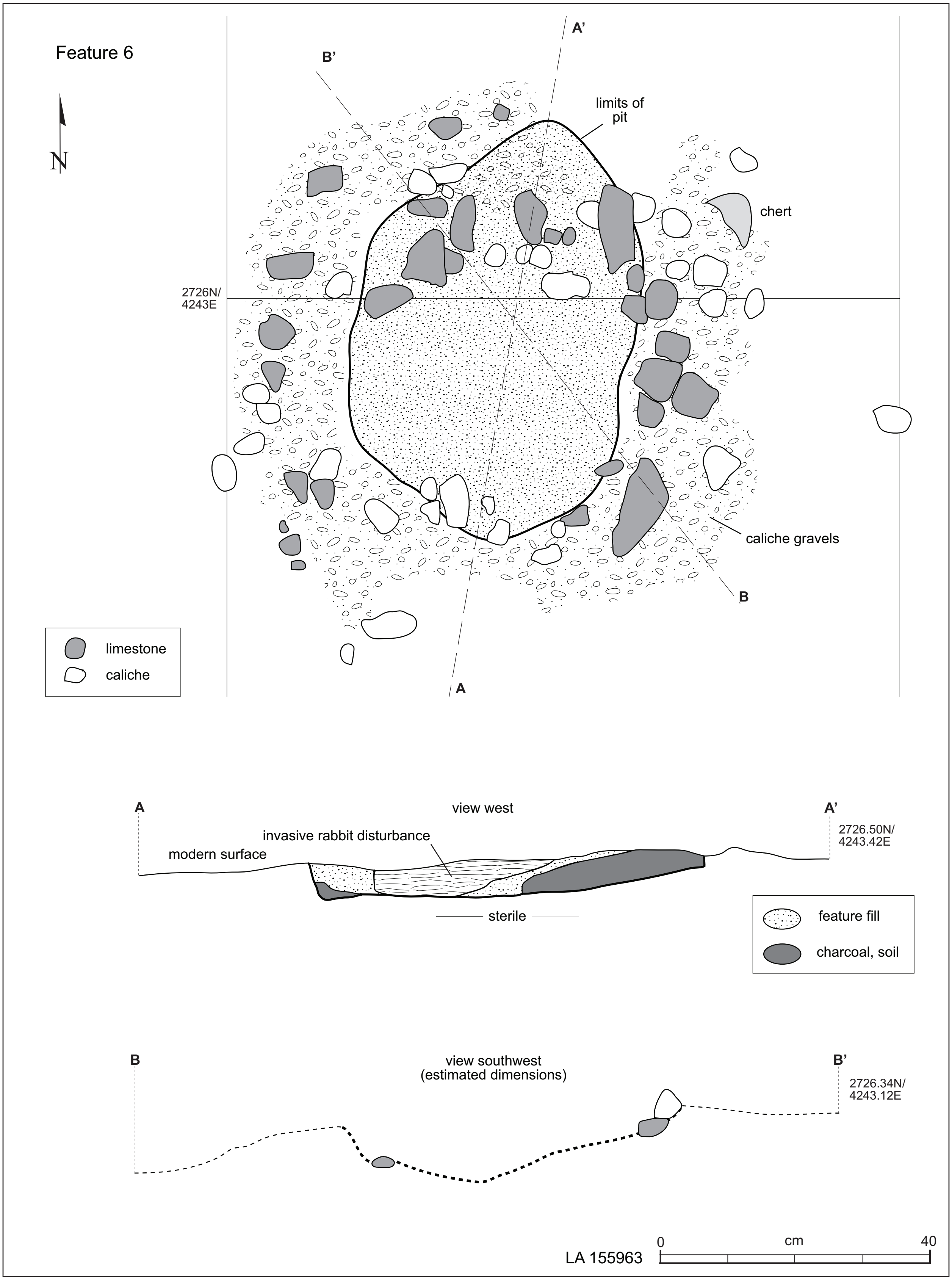

Figure 9.17. LA 155963, Feature 6, plan and profiles as excavated.

Figure 9.18. LA 155963, Feature 8 prior to excavation.

5 chert core flakes (2 utilized) were recovered from Stratum 10 (n = 3), Stratum 11 (n = 1), and Stratum 13 (n = 1).

Once the extent of the stain was exposed, fill was removed from the southern portion of the pit, avoiding obvious disturbance in the northern portion. Fill (Stratum 12) was darkly stained fine loamy sand (7.5 YR 4/3) with a few small spalls and larger pieces of fire-cracked rock. The base was riddled with insect and lizard or rodent burrows leaving irregular undulating sides and bottom (Figs. 9.19–9.20) with small patches that appeared to have been oxidized. The shallow scooped-out area that comprised the remains of Feature 8 measured 60 by 40 cm by 8 cm deep. The entire content was collected as flotation and bulk carbon samples.

A flotation sample contained carbonized goosefoot seeds and yucca basal caudex. The caudex and a bulk soil sample produced radiocarbon dates that fall within the Doña Ana or El Paso Phases (cal AD 1224–1302; Boyer, Chapter 19, this report). No artifacts were recovered from feature fill.

Feature 8, along with at least Features 9, 14, and 15 represent a series of thermal features on the eastern slope of Area A. The slope has many small and generally shallow drainages, with mesquite and creosote stabilized dunes throughout. Additional features probably underlie the dunes or have been completely destroyed by the drainages, leaving widely scattered fire-cracked rock and pockets of washed charcoal in many drainages. The distribution of artifacts and small thermal features and the radiocarbon dates from this area suggest repeated use as short-term camps or for lesser processing activities. Ground stone fragments are incorporated into some of the features, again suggesting repeated use of this portion of the site.

Feature 9 (stain)

Feature 9 at LA 155963 is just south of Feature 8 and is Zia Feature 34, which was described as a 50 cm diameter stain at the edge of a drainage (Quaranta and Gibbs 2008:140). During the testing phase, OAS recorded a fire-cracked rock scatter measuring

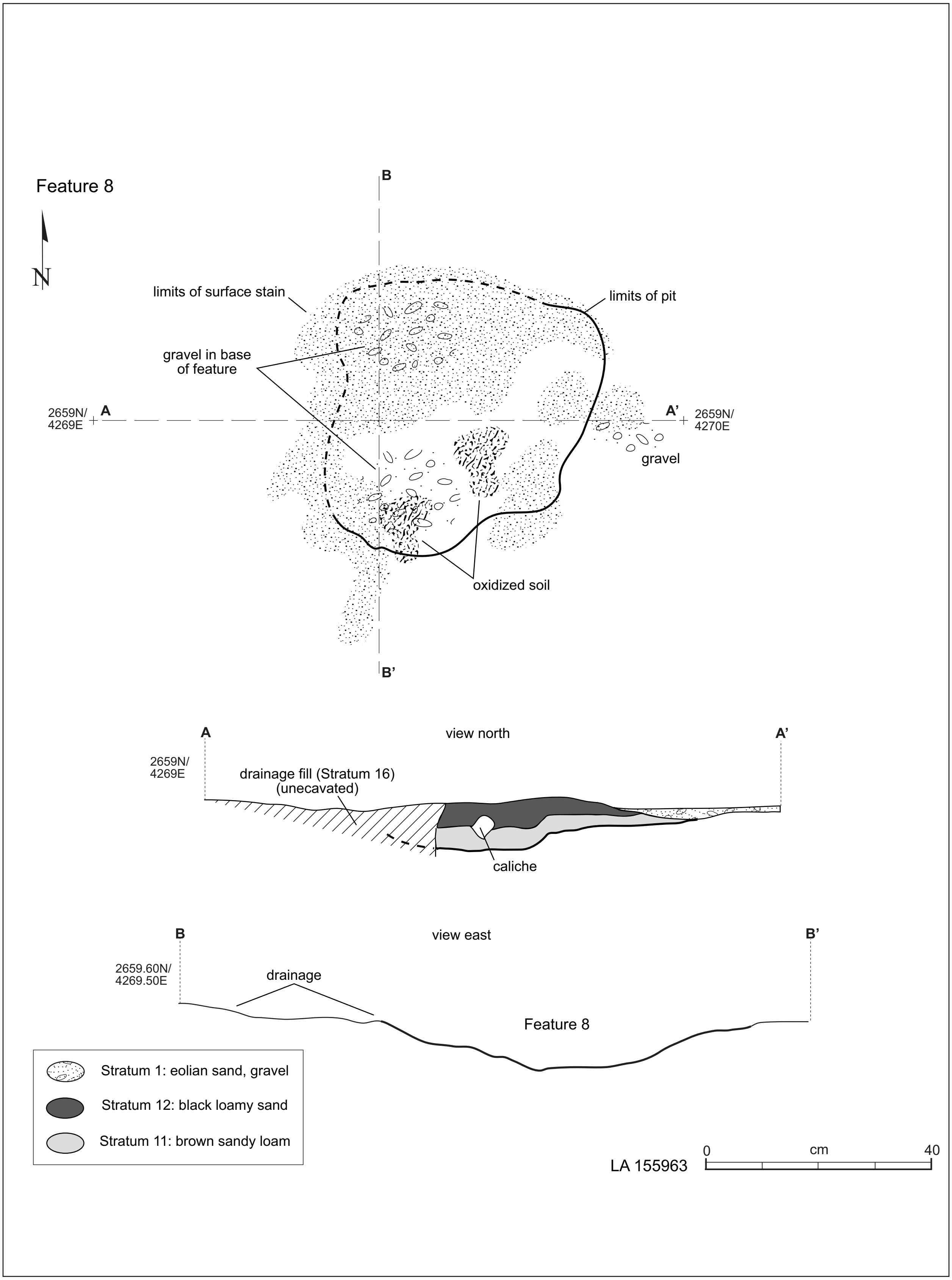

Figure 9.19. LA 155963, Feature 8, plan and profiles.

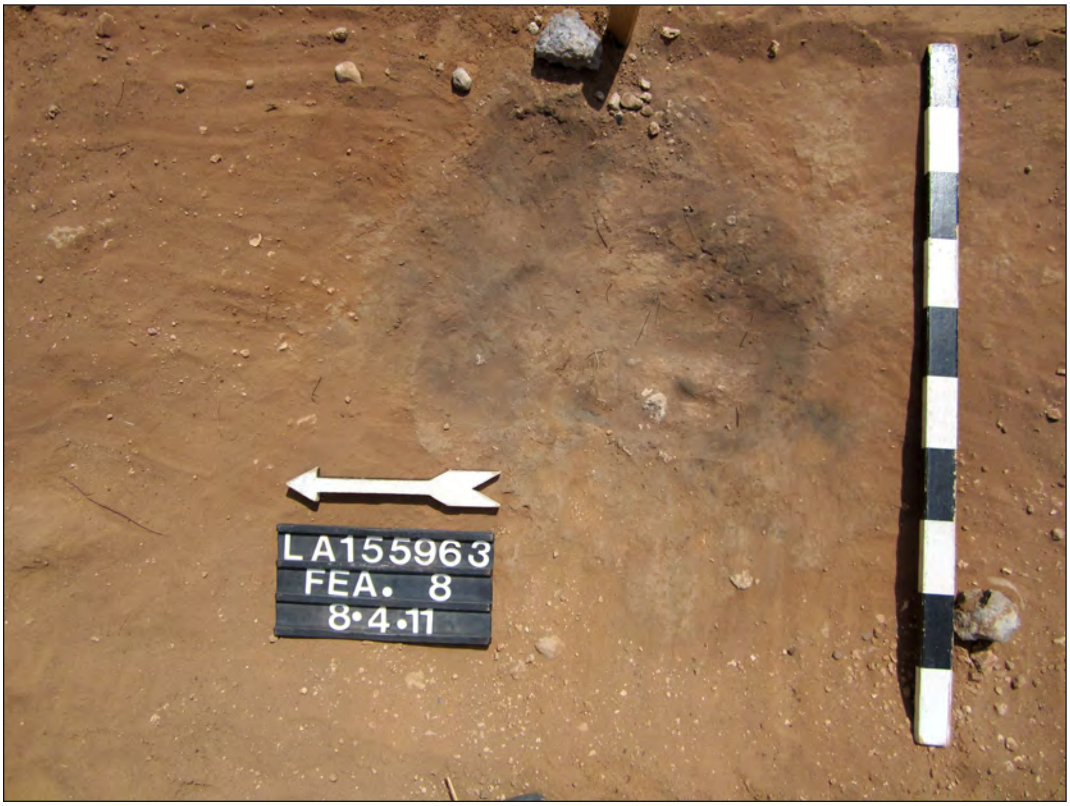

Figure 9.20. LA 155963, Feature 8, after excavation.

11.5 m north–south by 7.5 m east–west containing a denser area measuring 2.0 m north–south by 3.5 m east–west. Rock was fairly dispersed and an ash stain was present. A number of ground stone artifacts and sparse chipped stone artifacts were noted. A 20 by 20 cm test found subsurface rocks and abundant charcoal in soft dune sand. Based on this test, Feature 9 was selected for excavation.

A 5 by 5 m grid was placed over the charcoal-stained area, the grid units were photographed, and surface artifacts (core flakes of chert [n = 2] and silicified wood [n = 1] [elsewhere in the text, a piece of chert angular debris, and a chert biface) were collected. Two adjacent grid units at the center of the collection grid were selected for excavation. Stratum 10, soft loose sand (7.5 YR 5/4) mixed with darkly stained and charcoal-flecked soil, was removed from the surface (5 to 10 cm). The darker soil, called Stratum 15 where it was mixed (7.5 YR 4/3) and Stratum 19 where it was darker (7.5 YR 4/2), was patchy. A few pieces of fire-cracked rock, mainly caliche, and small nodules of unburned caliche were found throughout. A circular 30 cm diameter spot (Fig. 9.21) was treated as the primary feature but was determined to be a rodent burrow and excavation in this area stopped. In retrospect, excavation should have extended another level to ensure there was no buried feature. Alternatively, a scatter of artifacts and fire-cracked rock just upslope from the stain may have been the source of the fire-cracked rock and carbon-stained soil.

Wood collected for a radiocarbon sample was mesquite from Stratum 10 and mesquite with a small amount of saltbush from Stratum 19. Charred goosefoot and an array of unburned plant parts were found in the flotation sample. A radiocarbon sample composed of mesquite dates to the Spanish Colonial/Early Historic period cal AD 1626–1680 (Boyer, Chapter 19, this report). A chert core flake was collected from the grid excavations and an unburned long bone end fragment from a small animal was found in a flotation sample. An intensive metal detection survey around this feature (337 sq m) did not locate any metal artifacts.

Feature 13 (isolated metate)

Feature 13 was identified during the testing phase. Located between Area A North and Area A south (Fig. 9.2) on the eastern slope, it consisted of several sandstone slabs representing either a shattered ground stone object or the sides of a slab-lined bin (Fig. 9.22) in an area with widely scattered fire-cracked rock. A single grid unit was placed over the stones to examine this feature. Between one and four cm of loose colluvial sand containing abundant caliche nodules was removed from around the slabs. The slabs and fire-cracked rock in the grid were mapped (Figs. 9.23–9.24), the slabs removed, and the area brushed. No evidence of a pit was found, indicating it was a broken sandstone basin metate rather than a slab-lined pit. Two pieces of chert angular debris, three chert core flakes, and seven fragments of the same metate were recovered during excavation. No samples were collected

Feature 14 (rock-filled roasting pit)

Also between Area A North and Area A South, Feature 14 was first recorded during the testing phase as a scatter of fire-cracked rock with a concentration and numerous associated chipped stone and ground stone artifacts. A 20 by 20 cm test encountered a lens of powdered charcoal near the surface. Feature 14 was selected for excavation because it was eroding into an adjacent shallow drainage (Fig. 9.25) and because carbon-stained soil was present.

The associated scatter of artifacts and fire-cracked rock measured 8.0 by 6.5 m. A more concentrated area of fire-cracked rock was adjacent to two creosote bushes in a broad washed area, with a deeper drainage cut impacting the eastern portion of the scatter. As much as 40 percent of the feature was intact with the rest scattered by colluvial action. Investigations began by placing a 5 by 5 m grid around the feature, photographing each grid unit, and point plotting and collecting the surface artifacts (29 pieces of chipped stone, a fire-fractured mano, and two metate fragments). Most of the chipped stone artifacts are core flakes (18 chert, 1 silicified wood, and 2 metaquartzite), with the rest of the assemblage consisting of 3 pieces of chert angular debris, 2 biface flakes (chert and obsidian), 2 cores (chert and rhyolite), and a silicified wood biface. The two grid units over the main concentration and the grid unit to the north of the concentration that had charcoal-stained soil were excavated to define the extent of Feature 14.

The upper 1 to 6 cm of loose sandy loam with small caliche nodules (Stratum 13) was removed from among the rocks as were the obviously displaced rocks. This fill was a combination of eolian and colluvial soil, eolian in the western grid unit where it was stabilized by a creosote bush and colluvial or mixed elsewhere. Adjacent to the north edge of the rock concentration were areas of charcoal-stained loose loamy sand (Stratum 18) with charcoal flecks (10 YR 3/6) that probably originated in the feature (Fig. 9.26). This fill was collected as a flotation sample. Excavation in the grid units stopped at Stratum 16, a more compact and laminated but otherwise similar (5 YR 5/6) stratum. A dark spot in the southeast corner of the eastern grid unit was excavated 5 to 6 cm into Stratum 16 to investigate a pocket of ashy fill that turned out to be a rodent burrow. After feature excavation was completed, the rest of the eastern grid unit was excavated to the same level, thus confirming that the fill beneath the feature was sterile.

Once the rocks comprising what appeared to be the bottom of a rock-filled thermal feature were exposed (Fig. 9.27) the feature became the focus of excavation. Fill and rocks were removed from the south half of the pit to expose a profile. The fill (Stratum 17) was similar to the upper colluvial fill and to the underlying Stratum 16, a reddish, sandy loam (5 YR 5/6) with caliche nodules. It was fairly compact with carbonate streaks, decayed roots, rodent disturbance, and no charcoal. The decayed roots, and probably some powdered charcoal gave the fill a darker color. The bottom was not distinct, but was only slightly harder with more caliche and a small burned area on the west side indicating there was some depth to the feature (Fig. 9.28). The circular concentration of fire-cracked rocks measured 70 cm in diameter with a depth of 10 cm. The shallow depression beneath these rocks was about 30 cm north–south by 44 cm east–west. Rocks comprising the feature (about 160) were largely limestone, igneous, and caliche with one of quartzite. Most were larger rocks and were not heavily fractured.

Alluvial action appears to have removed any intact feature fill from among the rocks. Yet, a stained soil (Stratum 18) occurred upwind (northwest) of the feature and in nearby rodent burrows. This, and

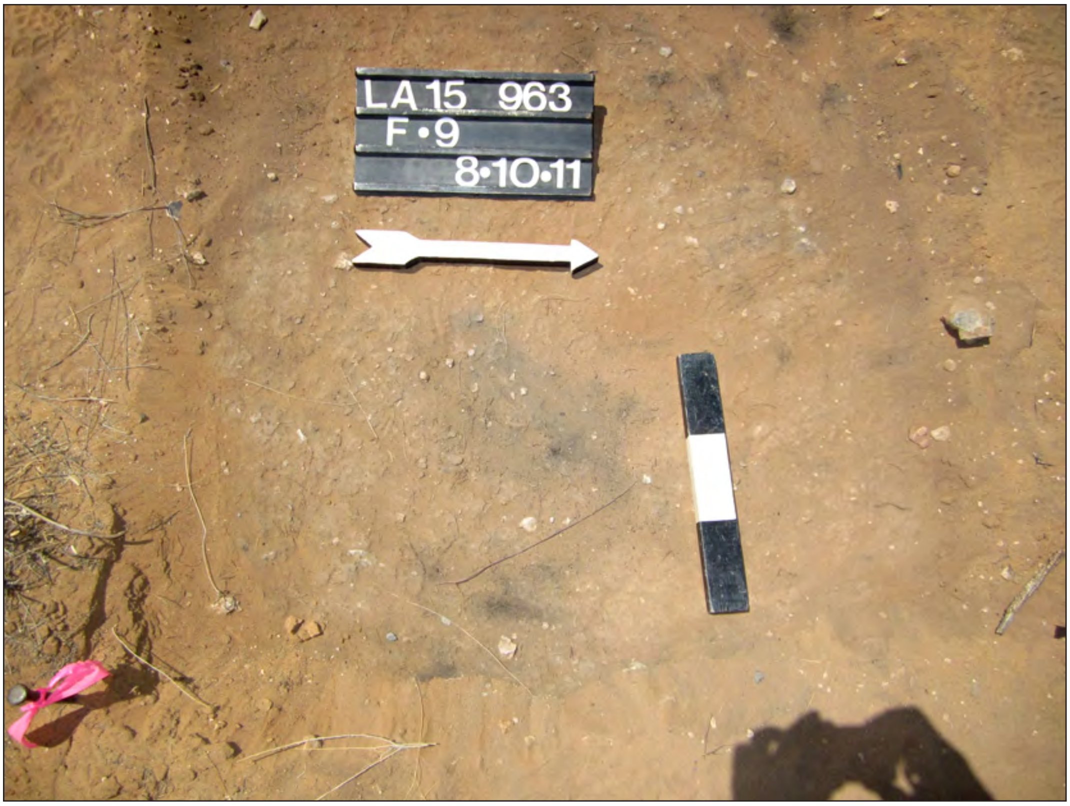

Figure 9.21. LA 155963, Feature 9, stain in grid unit.

Figure 9.22. LA 155963, Feature 13, sandstone.

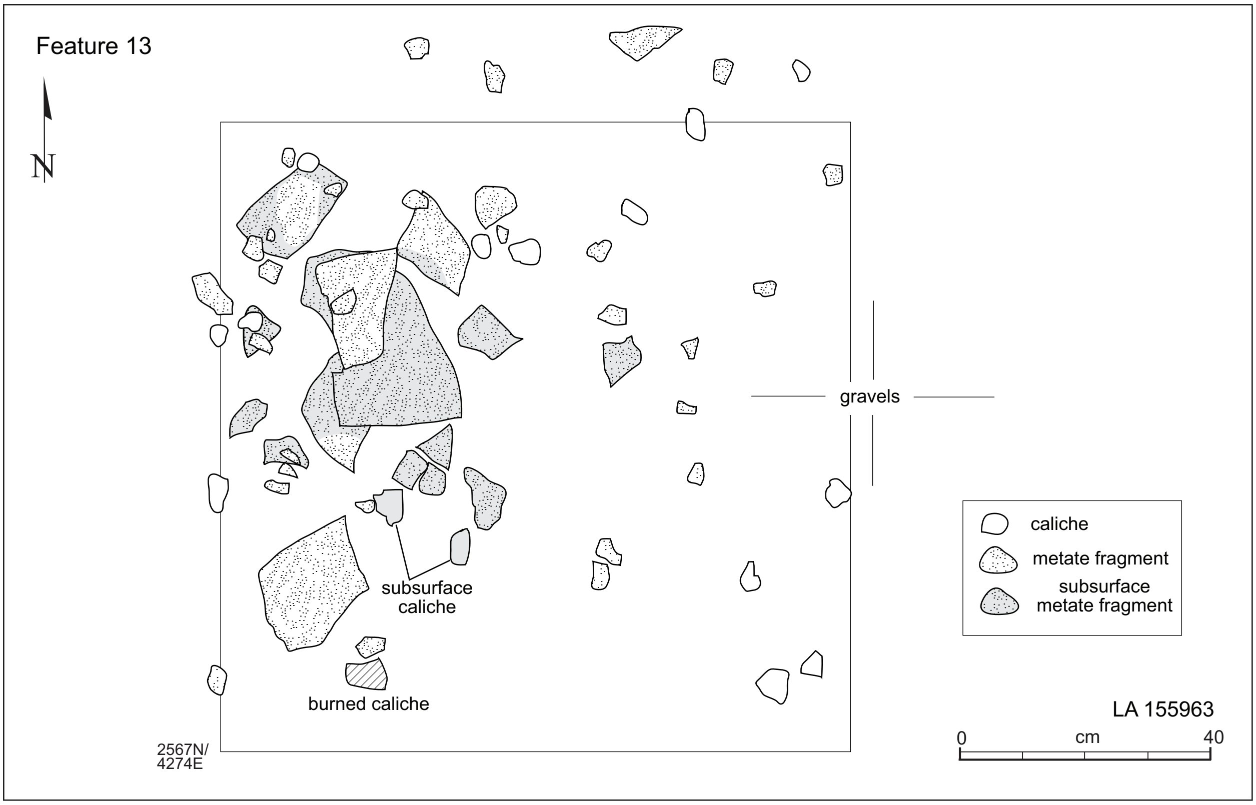

Figure 9.23. LA 155963, Feature 13, plan of metate fragments comprising the feature.

Figure 9.24. LA 155963, Feature 13 with metate fragments exposed.

Figure 9.25. LA 155963, Feature 14.

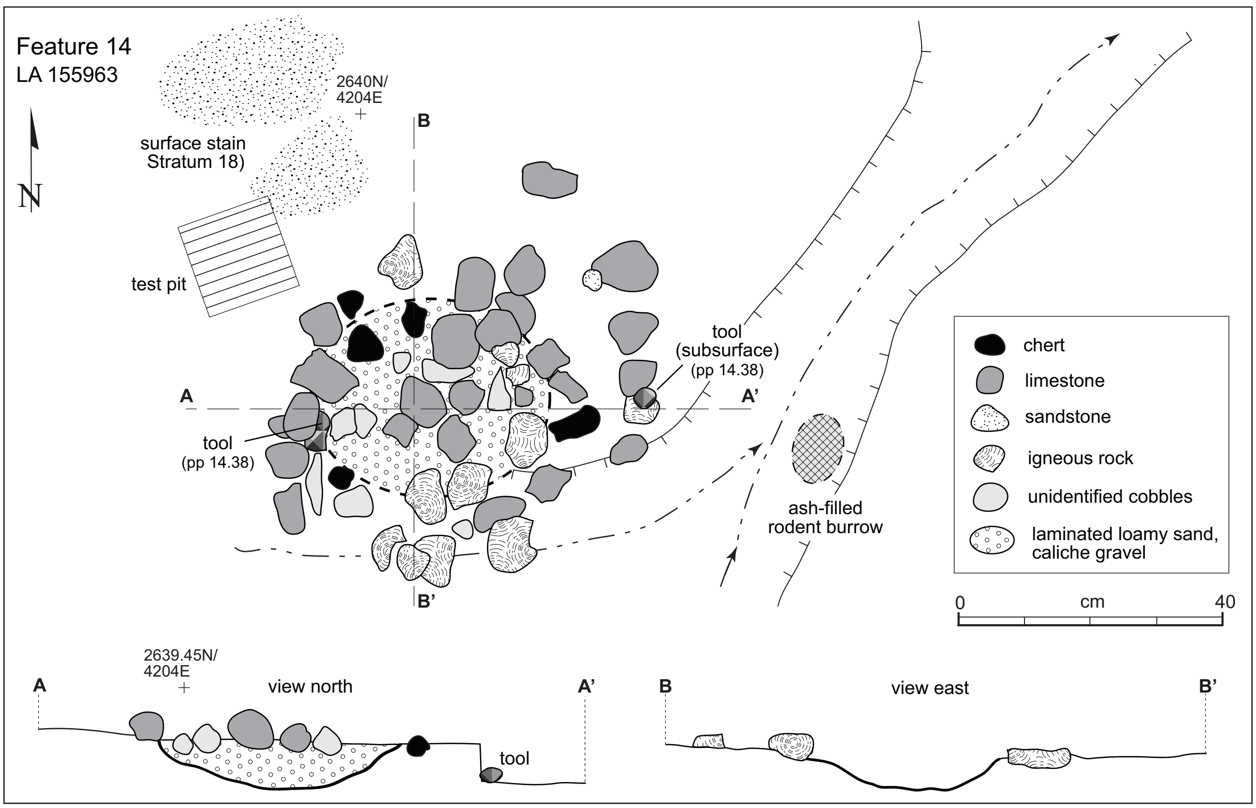

Figure 9.26. LA 155963, Feature 14, plan and profile.

Figure 9.27. LA 155963, Feature 14, with base rock in place.

Figure 9.28. LA 155963, Feature 14, with some rocks removed.

the number of scattered cobbles around the fire pit, could suggest multiple uses and cleaning of the feature.

Fill within the feature (Stratum 17) contained three chert core flakes. Excavation in the grids produced an additional 26 pieces of chipped stone (8 from Stratum 10, 13 from Stratum 13, and 6 from Stratum 16. Most are core flakes (15 chert, 1 silicified wood, 1 metaquartzite) with fewer pieces of angular debris (4 chert), biface flakes (3 chert), pot lids (1 chert), and cores (1 chert, 1 metaquartzite). A radiocarbon sample from the grids surrounding the feature contained a small amount of saltbush that produced a Mesilla phase date of cal AD 430 to 591 (Boyer, Chapter 19, this report). None of the three flotation samples from within the feature contained burned plant material.

Feature 15 (stain or small fire pit)

Feature 15 is south-southeast of Feature 14 and within Artifact Cluster 4 (Fig. 9.2). During the testing phase, it was described as a fire-cracked rock scatter with charcoal-stained soil and a scatter of chipped stone artifacts. Fewer than 50 pieces of fire-cracked rock, mainly caliche (80 percent) with some igneous rocks and sandstone, were observed in a 6.0 m north–south by 10.0 m east–west area with a more concentrated zone measuring 1.8 m north–south by 1.5 m east–west. The feature is located on a gentle southeastern slope with small mesquite and creosote bushes and a shallow drainage at the south edge (Fig. 9.29). A more intense search of the area during the research phase suggests the extent of the fire-cracked rock was as large as 9.5 m north–south by 12.80 m east–west.

Investigations on the last day of fieldwork began with establishing a 5 by 5 m grid over the stain and central portion of the scatter, photographing each grid and collecting the surface artifacts (161 pieces of chipped stone [Table 9.2] and a sandstone metate fragment). Four grid units were initially placed over two small areas of charcoal-stained soil, and two additional grid units were later placed adjacent to their southern edge (Fig. 9.30). The surface was covered with a thin veneer of eolian sand overlying what appeared to be the same Stratum 16 that was found in Feature 14, a reddish-brown sandy loam with gravel and small nodules of caliche. Stratum 16 also contained fire-cracked rock and artifacts. The looser soil (1 to 6 cm) was removed to better define the stains (Fig. 9.31), and the stains were mapped before excavating the two western grid units another 3 to 7 cm (Fig. 9.32). The large stain in the northern grid became less distinct and was probably the result of rodent disturbance. The most well-defined stain, which at Level 1 was no more than an amorphous smear, was investigated (Fig. 9.33) but only to the extent of collecting the fill as flotation and bulk carbon samples. The stain measured about 20 cm north–south by 30 cm east–west with a depth of 10 cm. Fill was a darkly charcoal-stained loamy sand with no fire-cracked rock. Three other areas of charcoal-stained soil also occurred within the excavated grid units but none were as dark or concentrated as this one.

A flotation sample produced burned yucca caudex and a small amount of saltbush wood. A bulk soil sample was submitted for radiocarbon analysis and it produced a date at the Late Archaic–Mesilla phase transition (2 cal BC–AD 125, Boyer, Chapter 19, this report). Artifacts recovered during grid unit excavation included 51 pieces of chipped stone from the first level of fill and 13 from the second level (Table 9.2).

Feature 18 (modern?)

Feature 18 was on the ridge top in Area A South, just north of Feature 19 and west of Surface Investigation Area 4 (Fig. 9.2). It was identified during the testing phase as a small (46 by 39 cm) slab-lined feature with an associated "collector's" pile of chipped stone and a complete sandstone slab metate.

Investigations began by establishing a 2 by 3 m grid over and around the feature (Fig. 9.34). Surface rocks, except for the abundant naturally occurring gravels, were mapped and artifacts were point plotted and collected (Fig. 9.35). The upper 4 to 11 cm of fill from the surrounding grid units were removed as a single level. This fill was a recent veneer of large-grained eolian sand overlying a laminated darker sandy loam (7.5 YR 5/6) containing small nodules of caliche (Stratum 1). The feature then became the focus of excavation, and fill was removed from the south half to provide a stratigraphic profile (Fig. 9.36). Most of the fill was the same laminated sandy loam with caliche nodules (Stratum 1) as was found in the surrounding grids. Beneath this was a coarser textured sandy loam of the same color and with small pieces of caliche gravel. It also contained spalls of rock from

Table 9.2. LA 155963, Feature 15, chipped stone artifact type and material.

Material Type	Artifact Morphology	Surface Collection	Surface Stripping	Level 2	**Total**
Chert	angular debris	16	5	2	23
	core flake	65	34	9	108
	biface flake	3	5	–	8
	bipolar flake	1	–	–	1
	middle stage biface	1	–	1	2
	late stage	1	1	–	2
	edge bite	1	1	–	2
Silicified wood	angular debris	1	–	–	1
	core flake	3	–	–	3
	biface flake	–	1	–	1
Limestone	angular debris	–	1	–	1
	core flake	–	1	–	1
Siltstone	core flake	2	–	–	2
Meta-quartzite	angular debris	–	1	–	1
	core flake	3	1	1	5
Total		97	51	13	161

the upright slabs, a desiccated prickly pear cactus and deteriorated aster spines. Fill beneath this and beneath the feature was a smooth textured sandy loam (10 YR 5/4) with a more uniform distribution of caliche gravel. Fill was then removed to the same level from the north half of the pit, from around the outside of the slabs (Fig. 9.37) and from the remainder of the grid unit.

The stones used to construct the feature were a combination of limestone cobbles and gray sandstone or ortho-sandstone slabs that were eroded and deteriorating. These were shallowly set in the native soil, forming a discontinuous circle with no evidence they were placed in a pit (Fig. 9.35). Rather, the stones were nestled in the loose and soft fill. The desiccated remains of a cactus were found at the center of the fill. Interior dimensions were 42 cm north–south by 34 cm east–west by 6 cm deep, with an exterior that was 50 cm in diameter.

A total of 160 pieces of chipped stone were recovered by surface collection and by surface stripping the grid units; one piece of chipped stone was found in the fill of the feature (Table 9.3). Most were part of a collector's pile that was centered around the metate. A flotation sample from within the feature contained no burned plant material, only hundreds of aster family achenes or seeds, along with nine other unburned seed taxa, creosotebush and globemallow fruit, and mesquite leaves. No function other than a collector's pile can be suggested for this modern feature.

Feature 125 (small fire pit with fire-cracked rock)

Feature 125 at LA 155963 was chosen for excavation because it was located within what was initially thought to be a possible Protohistoric occupation area at the northern edge of Surface Investigation Area 1 (Fig. 9.4). It consisted of a relatively compact scatter of about 50 pieces of fire-cracked rock in an area that measured about 5.0 m in diameter and extended south of and around a small mesquite-stabilized dune (Fig. 9.38). The rocks ranged from small fragments to cobbles in the 10 cm size range; most were limestone, igneous, and caliche, with some sandstone and quartzite. No charcoal-stained soil was visible. This feature had not been recorded by Zia.

Two 1 by 1 m grid units were placed over the densest part of the scatter just south of the mesquite bush. Surface rocks and artifacts (one Northern Jornada incised body sherd, one piece of chert angular debris, and a fragment of a basalt basin metate) were mapped (Fig. 9.39) and 2 to 4 cm of recent loose eolian loamy sand with small gravel (7.5 YR 6/6) were removed as Stratum 1. This overlays both an eolian silty loam (Stratum 2) that is reddish in color (7.5 YR 5/6) as well as the charcoal-stained feature fill (Stratum 4). Once the edges of the feature were exposed, the pit became the focus of excavation.

The feature was bisected by a grid line and fill was removed from the east half to obtain a stratigraphic profile (Fig. 9.40). Fill was a mix of the reddish eolian (Stratum 2) sediment and charcoal-stained sandy loam (7.5 YR 4/6) with powdered charcoal, chunks of charcoal, fire-cracked rock, and small pieces of burned and fire-hardened soil. The remaining fill was removed, leaving rocks in place for mapping (Figs. 9.41–9.42). The pit had been scooped into loose Stratum 2 soil, which resulted in irregular walls and bottom. It measured 59 by 50 cm and was 6 cm deep and appeared to be fairly intact, with only a small amount of bioturbation from insects. The rocks on the bottom of the pit did not form a distinct pattern but a clear spot near the center could suggest that the larger rocks were placed to support a cooking pot. Evidence in the profile photo (Fig. 9.40) may also suggest that something was removed from this area as the soil is cleaner than that outside the ring of rock. This feature was probably used only a few times as there was no accumulation of charcoal-stained soil in adjacent grids. Four additional grid units to the east and south were surface stripped of up to 13 cm of Stratum 1 fill to recover associated cultural materials. The grid to the west had a small oval (24 by 19 cm) veneer of charcoal-stained silty loam that was hard packed and could be all that remains of a use surface associated with Feature 125.

Surface stripping the grids around the feature facilitated the recovery of a small number of core flakes (5 chert, 1 limestone) and 8 El Paso Brown jar sherds. An El Paso Polychrome jar sherd, three Southern Jornada Plain slipped red bowl sherds, and an El Paso Brown jar sherd were found during the stripping of the same grid unit. A single chert core flake was found in feature fill. Flotation samples taken from each half of the feature produced only burned yucca caudex, mesquite, and saltbush. Saltbush submitted for radiocarbon analysis produced a Mesilla-phase date of cal AD 769–898 (Boyer Chapter 19, this report).

Figure 9.29. LA 155963, Feature 15, before excavation; Feature 14 in background.

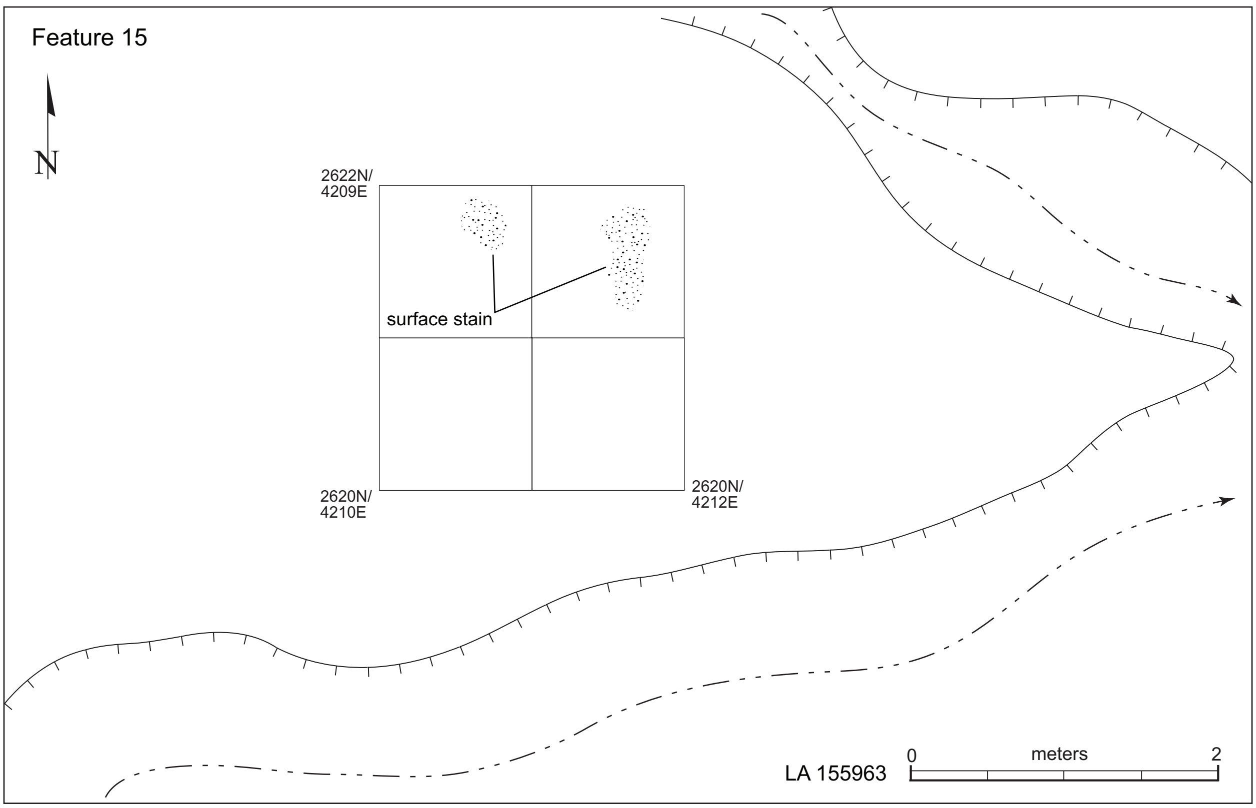

Figure 9.30. LA 155963, Feature 15, plan of area.

Figure 9.31. LA 155963, Feature 15, at base of Level 1, showing stains.

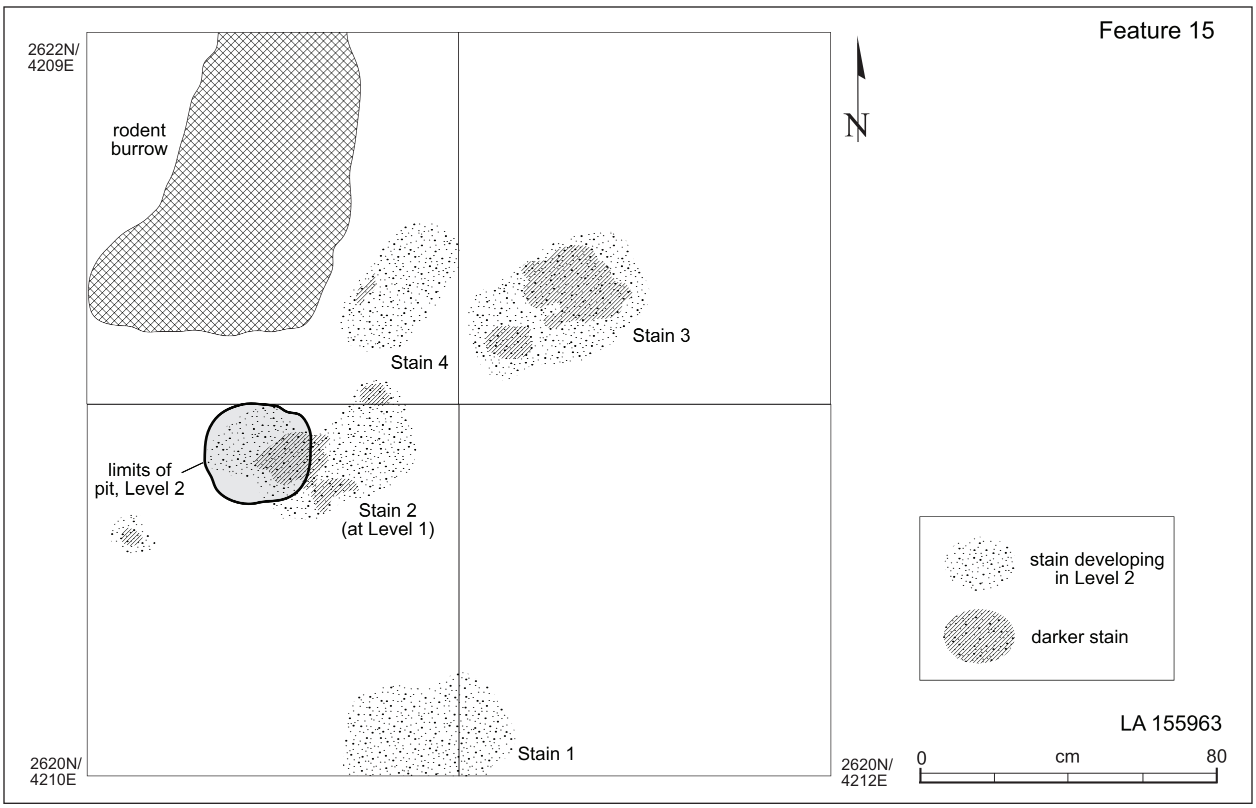

Figure 9.32. LA 155963, Feature 15, plan of stains at Level 1.

Figure 9.33. LA 155963, Feature 15, with flotation sample removed.

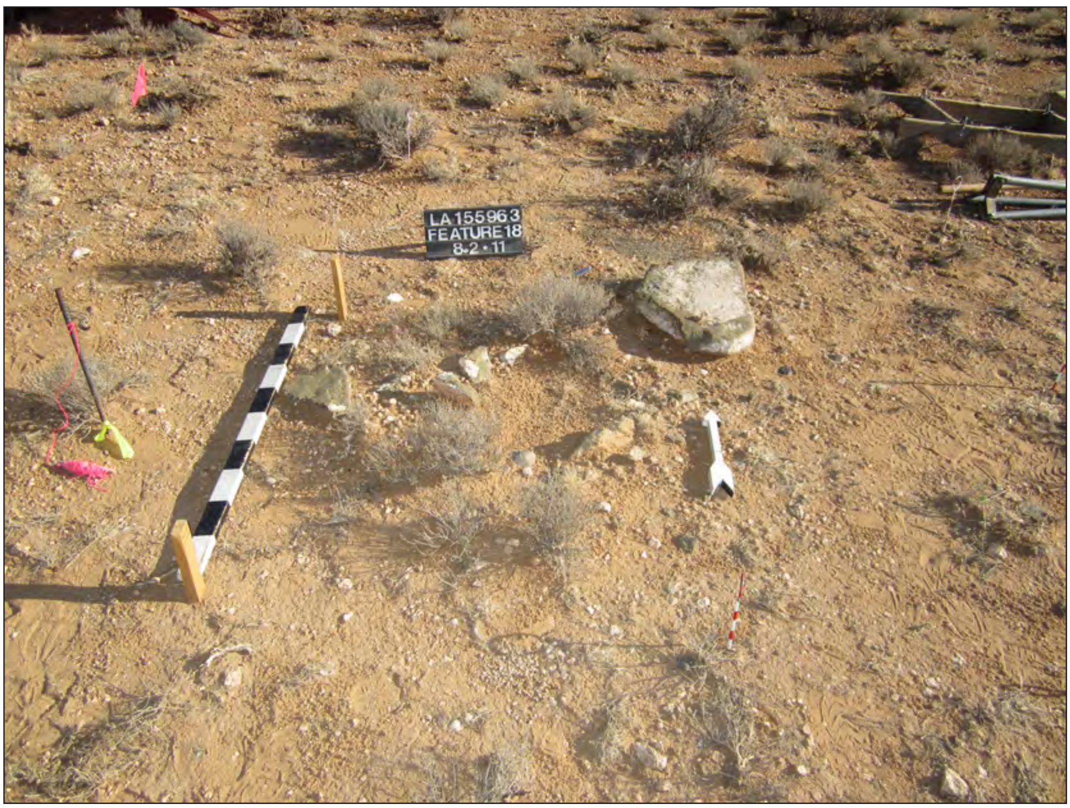

Figure 9.34. LA 155963, Feature 18, prior to excavation.

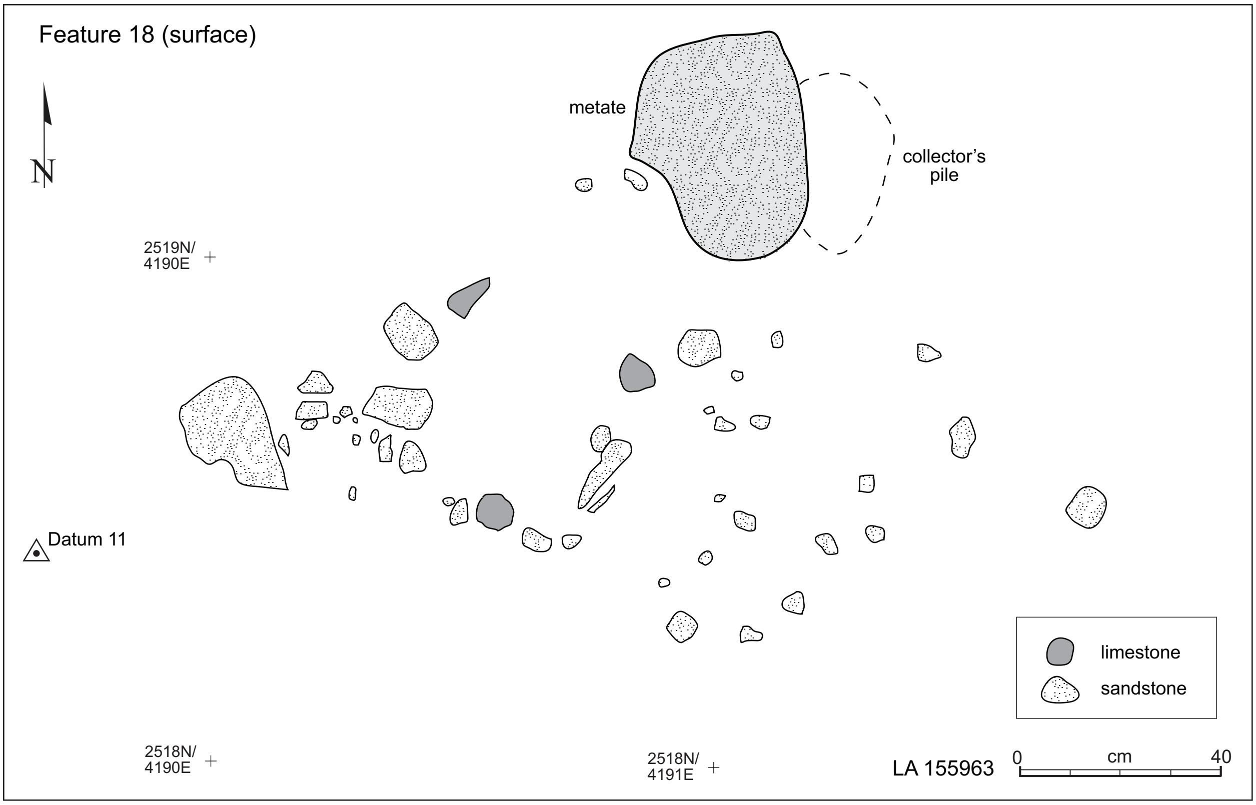

Figure 9.35. LA 155963, Feature 18, plan at surface level.

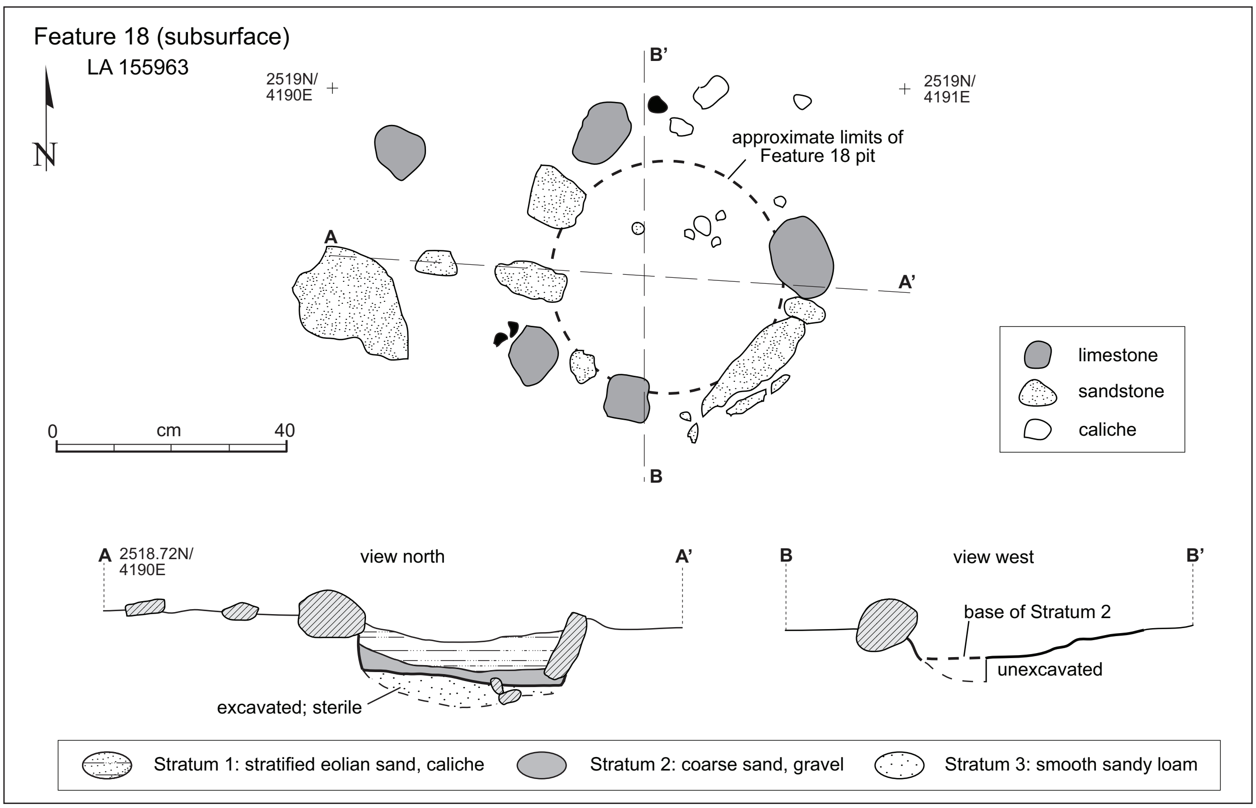

Figure 9.36. LA 155963, Feature 18, plan and profiles.

Table 9.3. LA 155963, Feature 18, summary of collected chipped stone artifacts.

Material Type	Artifact Morphology	Feature 18 Surface		Feature	**Total**
		Surface Collection	Surface Stripping 1	Level 2	
Chert	angular debris	1	12	–	13
	core flake	16	87	–	103
	biface flake	2	3	–	5
	pot lid	–	1	–	1
	unidirectional	–	1	–	1
	multidirectional	–	1	–	1
	biface	–	–	1	1
	early stage biface	3	–	–	3
	middle stage	1	–	–	1
	late stage biface	–	1	–	1
Silicified wood	angular debris	–	4	–	4
	core flake	3	13	–	16
	biface flake	1	–	–	1
Obsidian	core flake	–	1	–	1
Meta-quartzite	angular debris	–	2	–	2
	core flake	2	5	–	7
Total		29	131	1	161

Figure 9.37. LA 155963, Feature 18, rock exposed.

Figure 9.38. LA 155963, Feature 125, prior to excavation.

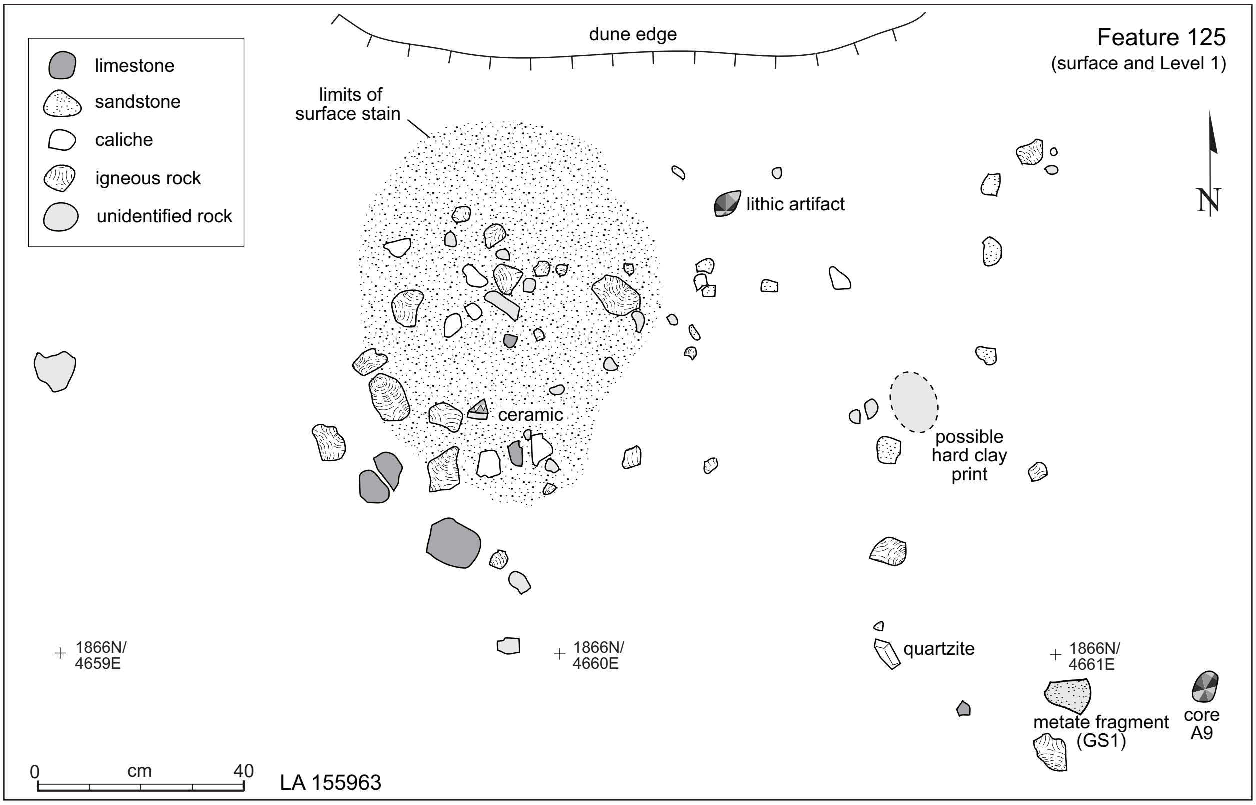

Figure 9.39. LA 155963, Feature 125, plan of surface rock.

Figure 9.40. LA 155963, Feature 125, profile.

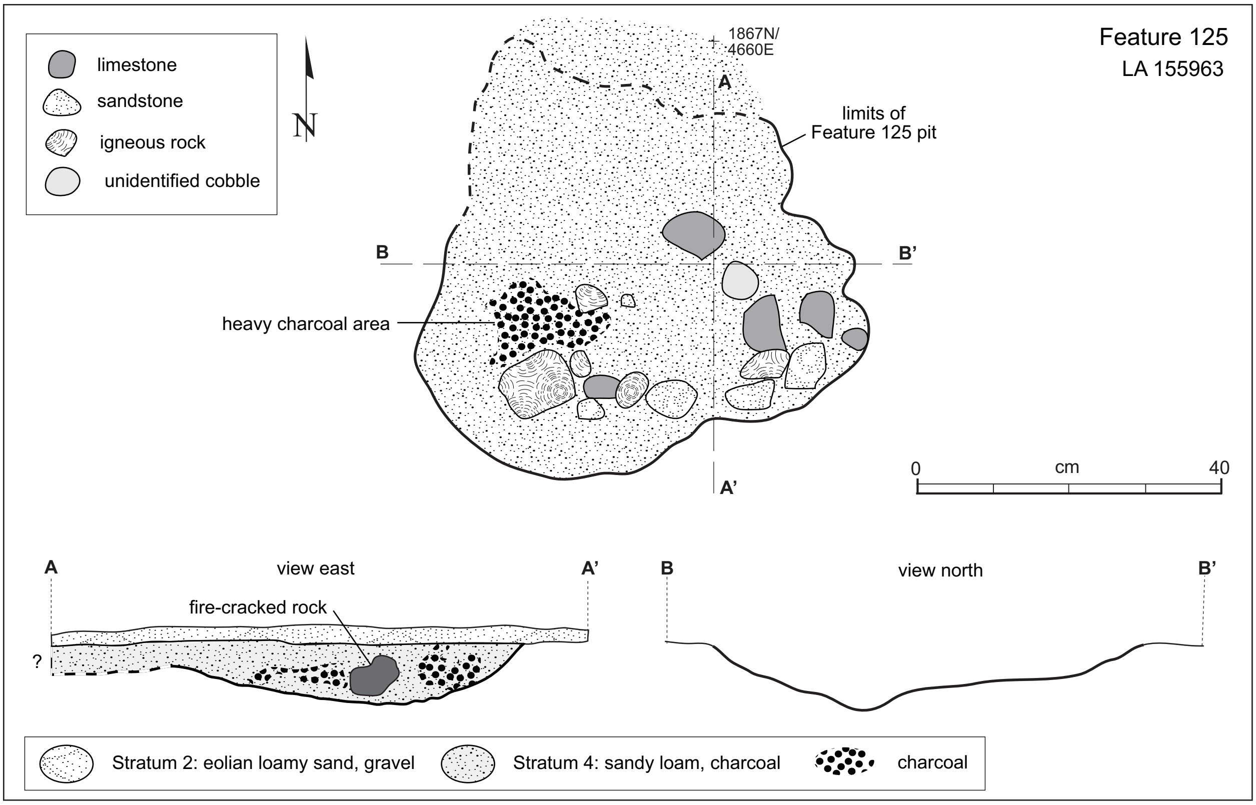

Figure 9.41. LA 155963, Feature 125, plan and profile.

Figure 9.42. LA 155963, Feature 125, excavated.

Feature 133 (stain)

Feature 133 was a small area of charcoal-stained soil in Area C (Fig. 9.43) that had not been recorded by Zia. The immediate area around the feature is wind-scoured with little vegetation. Four grid units were placed over and around the stain and 1 to 2 cm of loose fill were removed. The surface fill (Stratum 1) was a thin deposit of eolian sandy loam (7.5 YR 5/4) containing small pieces of gravel and a single piece of fire-cracked rock. Beneath Stratum 1 was compact reddish sandy clay (5 YR 5/4) with numerous insect burrows (Stratum 2). Three of the grid units had areas of charcoal-stained soil. A stain in the southeast grid was a very thin lens of grayish soil that was 18 by 23 cm while a stain in the northwest grid was about 10 cm in diameter and about 4 cm deep. The fill in the latter stain was loamy sand (7.5 YR 4/3) with small flecks of charcoal and evidence of insect disturbance. The stain in the northeast grid had diffuse charcoal-stained fill as well as two rodent burrows. Most, if not all, of what remained of this feature (Fig. 9.44) was probably the result of rodent activity with a small amount of stained soil preserved in one of the burrows. If there had been a feature in this location, most of it appeared to have been removed by erosion. Two chert core flakes were found on the surface and during surface stripping. A flotation sample contained a variety of burned material, including unidentifiable seeds, flame flower, prickly pear cactus embryos, and yucca basal caudex and leaf fragments.

Feature 139 (not a feature)

Feature 139 was a diffuse area of dark sediment in an area with scattered fire-cracked rocks in the northern portion of LA 155963. Surface Investigation Area 4 was placed over and adjacent to the northern edge of the dark sediment to aid in defining its size and shape (Fig. 9.2). However, as surface stripping proceeded it became apparent that the area of dark sediment labeled Feature 139 was actually a darker-colored layer of sediment (Fig. 9.45) rather than a cultural feature. The upper fill, eolian silty sand (7.5 YR 5/4), contained a few pieces of caliche gravel. Fifteen fire-cracked rocks and 159 (32 surface, 127 surface stripping) pieces of chipped stone were recovered from the 2 by 2 m grid unit originally thought to contain the feature (2512–2513N/4220–4221E). The 2 by 2 m unit just to the north held 18 pieces of fire-cracked rock, a basalt slab metate with anvil wear, a hammerstone (Fig. 9.46), a sandstone metate fragment, and 72 pieces of chipped stone (25 surface, 47 surface stripping). The amount of cultural material, including the in situ artifacts, suggests at least an activity area in this locale. Human activity may have altered the soil color so that it resembled a stain.

Feature 141 (fire pit with fire-cracked rock)

Feature 141 was an area of darkly stained sediment found in Surface Investigation Area 2, within Area B (Zia Core Area 2 [Fig. 9.47]). The upper fill (Stratum 1) was eolian silty sand (7.5 YR 6/4) with light surface gravel. Once the upper fill was removed and the outline of the pit exposed, fill was removed from the southern half and a stratigraphic profile was drawn (Fig. 9.48). At this point it became obvious that the pit extended into the two unexcavated grid units to the north. The upper fill (5 cm) was removed from the southern halves of those grid units to allow fill from the north half of the pit to be removed. The pit fill (Stratum 30) was charcoal-stained soft silty sand (7.5 YR 3/3) with little fire-cracked rock except at the base. Fire-cracked rocks in the fill (n = 34) were small sharply fractured pieces. Insect burrows riddled the edges of the pit and a rodent hole impacted the northwest portion of the wall.

The pit was excavated into compact fill. It was well-defined, measuring 82 cm north–south by 67 cm east–west with a depth of 19 cm. The overall shape was that of a shallow basin with a fairly flat bottom and walls ranging from nearly vertical to sloped (Fig. 9.48). Resting about 2 cm from the bottom at the center were several minimally fractured large rocks, primarily igneous and limestone (Fig. 9.49). No burning was noted on the walls or floor but the feature appears to have been a fire pit. It lacked evidence of repeated use, such as accumulations of ash and rock outside of the pit, and thus appears to have been used briefly and abandoned. Two smaller stains on either side (Features 140, 142) were not excavated.

Wood samples from this feature were mesquite (2.72 g) and saltbush (1.39 g) (see Table 17.7). Radiocarbon dates on saltbush, mesquite wood, and mesquite seeds all date to the Mesilla phase, cal AD 662–882 (Boyer, Chapter 19, this report). Such a large proportion of mesquite is unusual for this time

Figure 9.43. LA 155963, Feature 133, prior to excavation.

Figure 9.44. LA 155963, Feature 133, area after excavation.

Figure 9.45. LA 155963, Surface Investigation Area 4; Feature 139 would have been in the southern four grid units.

Figure 9.46. LA 155963, hammerstone and metate in grid to north of where Feature 139 would have been.

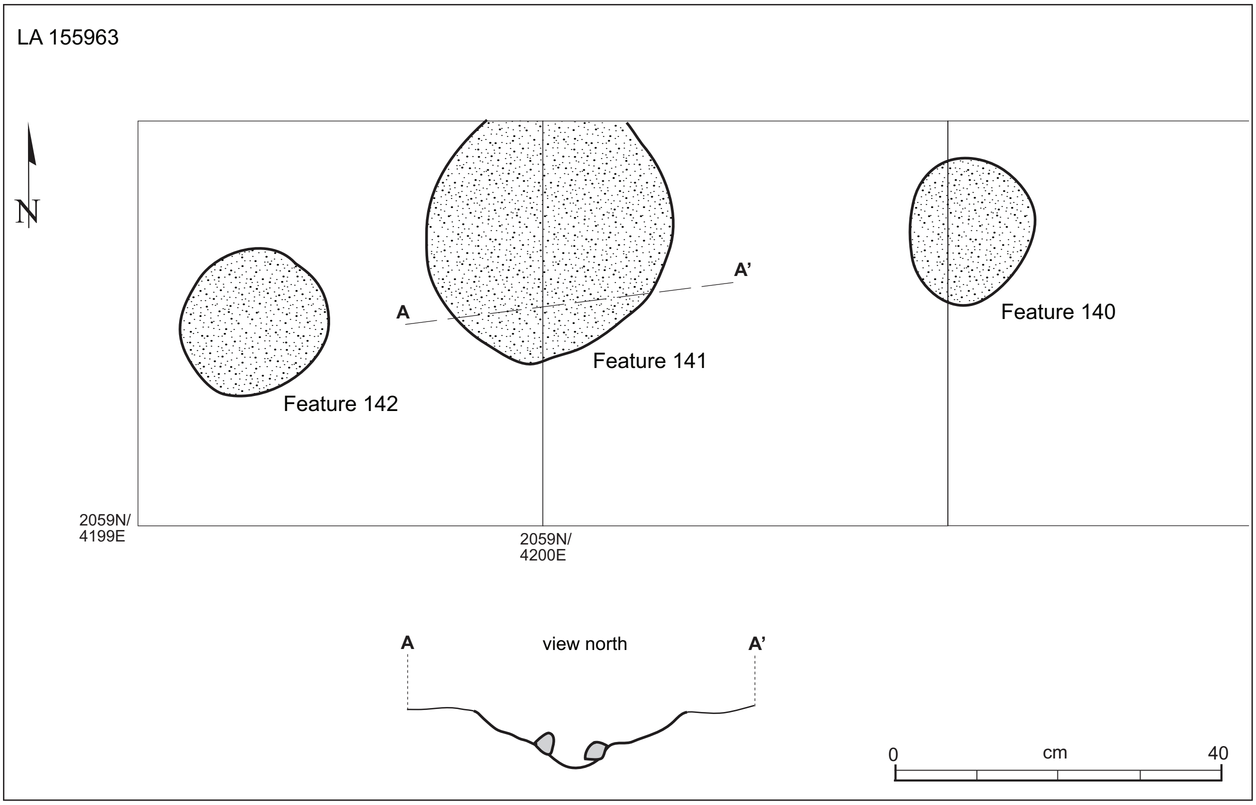

Figure 9.47. LA 155963, Surface Investigation Area 1, showing Feature 140–142 stains.

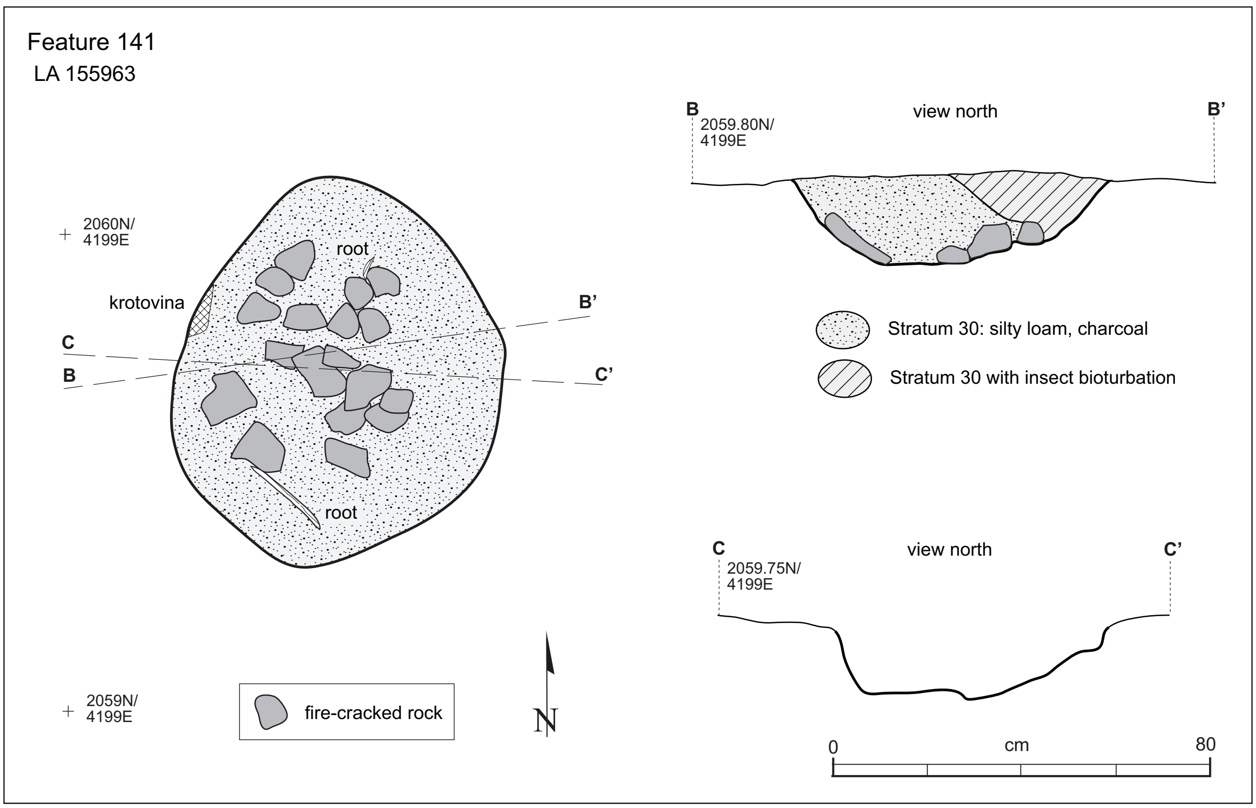

Figure 9.48. LA 155963, Feature 141, plan and profiles.

Figure 9.49. LA 155963, Feature 141, excavated with rock in place.

period. Most features with similar amounts date to the Protohistoric period or later. Burned mesquite and sumac seeds were collected as macrobotanical samples and two flotation samples contained burned seeds of amaranth, cheno-am, hedgehog cactus, purslane, and mesquite, along with grass stems.

Fill in the pit contained an El Paso Brown jar sherd and a Jornada Brown bowl sherd, a piece of chert angular debris, and a considerable amount of bone. The fauna (n = 51, 37 recovered from flotation) was mostly small burned fragments (70.6 percent) and the only identifiable taxa were cottontail and jackrabbit.

Unexcavated Features

Of the 160 features initially identified at this site, 12 were fully or partially excavated, one was eliminated as a feature during excavation, two were eliminated as features during detailed examination, and 145 were recorded at the inventory level. Rather than describing each feature, feature data are used to characterize the different portions of the site, with some distinctive feature types treated separately (Feature 129 and the red rock features). Information in the feature database includes:

- Feature number
- Phase in which it was recorded (testing or research) and whether it was excavated or sampled
- Northing
- Easting
- Feature type
- Feature size (north–south maximum extent and core, east–west maximum extent and core)
- Estimated number of fire-cracked rocks
- Maximum fire-cracked rock density (in a 50 by 50 cm area)
- Fragmentation of the fire-cracked rock
- Fire-cracked rock types and proportions (caliche, igneous, quartzite, limestone, sandstone, other)
- Whether there were ceramics in association
- Whether there was ground stone in association

- Whether there was chipped stone in association
- Whether any of the chipped stone was heat treated
- Whether the feature was tested
- Locale and soil association
- Potential for artifact association information
- Potential for subsurface deposits
- Potential for chronometric samples
- Potential for subsistence remains

Digital photographs were taken of each feature. Most of the features are collections of fire-cracked rock that form more of a continuum than absolute types and could therefore be assigned to different types by other observers. The fire-cracked rock features were recorded as: dispersed fire-cracked rock scatter without a concentration to suggest a single origin; dispersed fire-cracked rock scatter with a core or concentration suggesting an origin; a distinct fire-cracked rock core or concentration; or a fire-cracked rock core or concentration with dispersed scatter. The main criteria used were whether there was a concentration and, if so, how dense and concentrated the rock was and whether the scatter extended well beyond the concentration.

Section A Features

For this discussion, Section A (Fig. 9.1) includes all features with a NAD 83 northing of 3652495 or greater, which includes Section C Features 10 and 115 (Table 9.4). These 24 features lie at the north end of the site along with Artifact Clusters 1 through 5 and Surface Investigation Areas 3 through 5. Diagnostic point types from this area include: three partial Folsom points; one unidentified Paleoindian point; one San Pedro point; one Shumla point; two large side-notched Archaic points; and one large corner-notched Archaic point. Only two (8.3 percent) of the Section A features have ceramics in association (Features 8, 160), while ground stone was observed at 16 (66.7 percent), and small numbers of chipped stone were seen in most (21 or 87.5 percent). A few had substantial numbers (n = 3, 12.5 percent) of chipped stone artifacts. The types of artifacts, the viewshed from this area, the types of features, and radiocarbon dates suggest that Section A was primarily used by Paleoindian, Archaic, and Protohistoric groups. Eight of the Section A features were investigated, more than in any other part of the site. This was due in part to initial impressions that this area has the oldest features, to the variability in the types of features, and because a number appeared to be intact or had charcoal-stained soil. Features that were not excavated included all of those that were mainly fire-cracked rock scatters, with (n = 9) or without (n = 4) concentrations, two fire-cracked rock concentrations with scatters, and a lithic reduction area with an associated collector's pile. For the most part, these features were estimated to have very little potential for subsurface remains. Feature 20 has good potential for subsurface deposits while Features 4 and 10 have low to fair potential. More features are in areas with artifacts and could provide spatial activity information. These include Features 4 and 160 (low to fair potential), Feature 16 (fair to good potential), Feature 19 (fair to good potential), Feature 20 (good potential), and Features 21 and 22 (fair potential).

Section A is at the highest elevation for the site. From the north end hunters would have been able to watch for large game animals to the north (Fig. 9.50) and the west (Fig. 9.51). Others could have kept watch over a large area. Based on location and viewshed, Features 1, 2, 3, 4, 6, 7, 11, 12, 19, and 20 have this broad vista, yet both of the investigated features (Features 1 and 6) are Protohistoric or Historic in date.

Features on the eastern slope (Fig. 9.52) tend to be scatters of fire-cracked rock, some with stains (Features 8, 9, 10, 14, 15, 16, 17, 115) and lack the kinds of vistas available from the ridge top and western slope. These features cover the time span between the Late Archaic and Protohistoric to Modern periods.

Section B Features

Section B includes those features south of Section A that have a NAD 83 easting of 314400 or less (Fig. 9.1) except for the historic artifact scatter (Feature 129) and the red rock features. Spatially, it is the smallest area but contains 80 of the OAS recorded features (plus the historic artifact scatter and several of the red rock features). Zia recorded a number of features and two "core" areas comprised of multiple features in this area (Quaranta and Gibbs 2008:135, 137). A portion of Core Area 1 roughly corresponds to the OAS sherd area, which has few features visible on the surface. Table 9.5 lists the features in Section B, except for those identified as red-rock features and the historic artifact scatter (Feature 129). Zia feature numbers are noted when possible, as is

Table 9.4. LA 155963, Section A, summary of features as inventoried.

Feature No.	Feature Type	Phase and Treatment	Maximum Size (m) of Feature or Fire-cracked Rock Scatter		Size of Fire-cracked Rock Concentration or Core Area		Estimated Fire-cracked Rock	% Burned Caliche	Zia Feature No.
			north–south	east–west	north–south	east–west			
1	Small thermal pit	excavation - excavated	9.0	6.2	2.6	1.3	<50	90.0%	20
2	Dispersed FCR with concentration	testing - recorded	3.6	8.2	1.0	1.0	50–100	82.0%	23
3	Dispersed FCR scatter	testing - recorded	2.0	11.0	0.0	0.0	<10	90.0%	24
4	FCR concentration and dispersed scatter	testing - recorded	2.7	2.2	1.1	1.0	<50	55.0%	19
5	Dispersed FCR with concentration	testing - recorded	8.0	18.0	1.4	2.2	50–100	90.0%	21
6	Stain and FCR	excavation - excavated	2.0	16.5	0.6	0.6	<50	50.0%	32
7	Dispersed FCR with concentration	testing - recorded	5.5	7.5	2.5	1.5	50–100	90.0%	36
8	Small thermal pit	excavation - excavated	6.0	5.2	2.3	1.5	20	60.0%	33
9	Stain and FCR	excavation - tested/partial	11.5	7.5	2.0	3.5	50–100	50.0%	34
10	Dispersed FCR with concentration	testing - recorded	8.0	12.5	1.5	1.5	50–100	90.0%	35
11	Dispersed FCR with concentration	testing - recorded	6.5	4.0	1.0	1.2	<50	50.0%	18
12	Collector's pile/quarry & testing - recorded area	testing - recorded	0.0	0.0	0.5	0.3	absent	0.0%	31
13	Broken metate/not a feature	excavation - excavated	0.0	0.0	1.2	0.6	<50	90.0%	–
14	Small thermal pit	excavation - excavated	15.0	12.5	2.0	2.0	>200	50.0%	–
15	Stain and FCR	excavation - tested/partial	6.0	10.0	1.8	1.5	<50	80.0%	–
16	Dispersed FCR scatter	testing - recorded	8.0	14.0	1.5	1.3	50–100	85.0%	–
17	Dispersed FCR with concentration	testing - recorded	7.5	16.5	2.0	1.5	<50	70.0%	–
18	Slab-lined feature	excavation - excavated	1.2	1.3	0.5	0.4	absent	0.0%	–
19	Dispersed FCR with concentration	testing - recorded	20.0	20.0	1.4	1.3	100–200	70.0%	–
20	FCR concentration and dispersed scatter	testing - recorded	11.0	15.0	2.1	1.5	100–200	40.0%	–
21	Dispersed FCR with concentration	testing - recorded	15.0	14.5	1.2	1.5	100–200	85.0%	–
22	Dispersed FCR scatter	testing - recorded	2.5	4.0	0.0	0.0	20	40.0%	–
115	Dispersed FCR scatter	excavation - recorded	17.0	18.0	0.0	0.0	<50	90.0%	–
160	Dispersed FCR with concentration	post excavation - recorded	6.0	8.0	1.2	1.0	<50	95.0%	–

FCR = fire-cracked rock

Figure 9.50. LA 155963, Section A, view to north.

Figure 9.51. LA 155963, Section A, view to west.

Figure 9.52. LA 155963, Section A, view to east from east side.

whether the feature falls within one of the Zia core areas. Less than half of the features fall within the core areas or were specifically identified by Zia. No feature is visible in the area Zia designated as Feature 26. A few features are in dense clusters of features where it was not possible to determine which one was the OAS equivalent (those are listed with a "?" mark).

Features in this area are largely dispersed fire-cracked rock features, some without concentrations (n = 12, 15.0 percent), some with concentrations (n = 12, 15.0 percent), and a few with multiple concentrations (n = 6, 7.5 percent). Others are concentrations (n = 12, 15.0 percent) or concentrations with dispersed scatters (n = 33, 41.3 percent). Three are charcoal stains (3.8 percent) uncovered in surface investigation areas, one is a possible stain (1.3 percent), and the excavated feature is a small thermal pit (1.3 percent).

Only one Section B feature was excavated (Feature 141) and it, along with Features 140 and 142, was discovered in Surface Investigation Area 2. Feature 143 was discovered in Surface Investigation Area 3 but was not investigated. None of these features had any surface indications. The other features were recorded during the testing (n = 27), research (n = 48), or post-research (n = 1) phases. Of the 79 that were not excavated, Features 30, 38, 42, 98, 130, 140, 142, 143, 144, 150, and 156 were estimated to have fair or good potential to provide spatial or activity information. Those with fair or good potential for subsurface deposits, including charcoal for radiocarbon samples or burned subsistence remains, include Feature 98, Feature 130, and possibly the stains found during surface stripping (Features 140, 142, 143).

The most prominent topographic feature of Section B is the deep arroyo (Fig. 9.53) with numerous deflated features along either side. Soils range from dark red and wind- and water-scoured (Fig. 9.54) in the west, where features show no evidence of subsurface remains (Fig. 9.55), to areas just east of the arroyo where the soil is a buff color and the ground is covered by gravel of various sizes (Figs. 9.56–9.57).

Table 9.5. LA 155963, Section B, summary of features as inventoried.

Feature No.	Feature Type	Phase and Treatment	Maximum Size (m) of Feature or Fire-cracked Rock Scatter		Size of Fire-cracked Rock Concentration or Core Area (m)		Estimated Fire-cracked Rock	% Burned Caliche	Ceramics Present?	Zia Feature No. or Core Area
			north–south	east–west	north–south	east–west				
23	FCR concentration and dispersed scatter	testing	10.0	14.0	1.5	1.3	50–100	10	absent	1
24	FCR concentration	excavation - recorded	0.0	0.0	2.0	2.0	<50	0	absent	2
25	FCR concentration	excavation - recorded	0.0	0.0	3.2	4.5	50–100	30	absent	–
26	FCR concentration and dispersed scatter	testing	4.7	3.5	3.0	1.7	50–100	20	absent	CA1
27	dispersed FCR with	testing	3.7	9.0	1.5	1.5	100–200	60	present	CA1
28	FCR concentration and dispersed scatter	excavation - recorded	7.5	9.5	2.0	2.5	<50	60	absent	–
29	FCR concentration and dispersed scatter	excavation - recorded	12.5	12.0	1.5	2.6	50–100	50	absent	17
30	dispersed FCR with concentration	excavation - recorded	10.5	12.5	2.0	2.0	100–200	20	absent	CA1
31	dispersed FCR scatter	excavation - recorded	8.5	8.0	0.0	0.0	100–200	10	absent	CA1
32	dispersed FCR scatter	excavation - recorded	3.8	3.8	0.0	0.0	50–100	40	absent	CA1
33	dispersed FCR with	testing	6.5	5.0	2.0	1.8	<50	20	absent	CA1
34	dispersed FCR with	testing	7.5	5.3	2.5	2.5	50–100	50	absent	CA1
35	dispersed FCR with concentration	excavation - recorded	8.0	11.0	2.0	2.0	50–100	40	absent	CA1
36	dispersed FCR with concentration	excavation - recorded	5.0	6.5	1.6	1.8	50–100	70	absent	CA1
37	dispersed FCR with multiple deflated cores	excavation - recorded	7.0	6.0	0.0	0.0	100–200	60	absent	–
38	FCR concentration and dispersed scatter	excavation - recorded	15.0	12.0	2.5	2.2	100–200	60	present	CA1
39	FCR concentration and dispersed scatter	excavation - recorded	16.0	12.0	1.5	1.3	>200	40	absent	–
40	dispersed FCR with	testing	6.5	4.5	1.8	2.0	50–100	70	absent	5
41	dispersed FCR scatter	excavation - recorded	19.5	11.5	0.0	0.0	100–200	10	absent	CA1
42	dispersed FCR scatter	testing	17.5	12.5	3.0	3.0	100–200	45	absent	–
44	dispersed FCR scatter	testing	7.3	7.0	1.0	2.0	50–100	70	absent	6

(Table 9.5, continued)

Feature No.	Feature Type	Phase and Treatment	Maximum Size (m) of Feature or Fire-cracked Rock Scatter		Size of Fire-cracked Rock Concentration or Core Area (m)		Estimated Fire-cracked Rock	% Burned Caliche	Ceramics Present?	Zia Feature No. or Core Area
			north–south	east–west	north–south	east–west				
45	FCR concentration and dispersed scatter	excavation - recorded	13.0	7.5	1.3	1.3	50–100	30	absent	–
46	FCR concentration and dispersed scatter	excavation - recorded	15.0	12.5	2.0	1.7	100–200	70	absent	–
47	dispersed FCR with multiple deflated cores	excavation - recorded	13.5	12.0	0.0	0.0	100–200	50	absent	4
48	FCR concentration and dispersed scatter	testing	5.8	5.6	1.8	2.0	100–200	50	absent	3
49	dispersed FCR with	testing	5.0	8.0	1.3	1.4	50–100	30	absent	–
50	charcoal stain	testing	0.0	0.0	1.6	1.8	20	50	absent	–
58	FCR concentration	testing	0.0	0.0	0.7	0.8	<50	0	absent	–
59	FCR concentration and dispersed scatter	testing	5.4	6.4	1.3	1.9	50–100	30	absent	–
60	dispersed FCR scatter	excavation - recorded	11.5	12.5	0.0	0.0	50–100	75	absent	–
61	FCR concentration and dispersed scatter	excavation - recorded	16.5	12.0	1.3	1.8	50–100	80	absent	–
62	dispersed FCR scatter	excavation - recorded	14.4	18.0	0.0	0.0	100–200	10	absent	–
63	FCR concentration and dispersed scatter	excavation - recorded	12.0	12.0	1.0	1.3	50–100	20	absent	CA2
64	FCR concentration and dispersed scatter	excavation - recorded	18.5	12.0	1.7	1.5	100–200	60	absent	–
65	FCR concentration and dispersed scatter	excavation - recorded	6.5	7.5	2.0	1.5	50–100	70	absent	–
66	FCR concentration	testing	0.0	0.0	1.2	1.0	30	45	absent	8?
67	FCR concentration and dispersed scatter	testing	4.5	4.0	1.4	1.2	50–100	5	absent	–
68	FCR concentration	testing	0.0	0.0	1.0	0.8	20	40	absent	11?
69	FCR concentration and dispersed scatter	testing	3.8	4.5	1.5	1.3	<50	5	absent	–
70	FCR concentration and dispersed scatter	testing	4.5	4.5	2.0	2.0	50–100	15	absent	–
71	FCR concentration	testing	0.0	0.0	1.4	1.0	40	25	absent	–
72	FCR concentration and dispersed scatter	testing	6.0	6.0	1.8	1.6	<50	15	absent	CA2
74	dispersed FCR scatter	testing	5.0	7.0	1.5	2.0	>200	30	present	CA2
75	dispersed FCR with	testing	3.0	4.0	1.3	1.2	<50	60	absent	CA2

(Table 9.5, continued)

Feature No.	Feature Type	Phase and Treatment	Maximum Size (m) of Feature or Fire-cracked Rock Scatter		Size of Fire-cracked Rock Concentration or Core Area (m)		Estimated Fire-cracked Rock	% Burned Caliche	Ceramics Present?	Zia Feature No. or Core Area
			north–south	east–west	north–south	east–west				
76	FCR concentration and dispersed scatter	excavation - recorded	12.5	8.0	1.5	2.6	50–100	20	absent	–
77	dispersed FCR with	testing	4.0	5.5	1.5	1.4	<50	10	absent	14
78	FCR concentration and dispersed scatter	excavation - recorded	12.5	12.5	1.9	2.0	100–200	20	absent	–
79	FCR concentration and dispersed scatter	excavation - recorded	11.0	10.5	1.9	1.2	50–100	10	absent	–
80	FCR concentration and dispersed scatter	excavation - recorded	15.5	15.5	1.3	0.9	>200	40	absent	15
81	dispersed FCR scatter	excavation - recorded	11.8	11.8	0.0	0.0	>200	20	absent	–
82	FCR concentration and dispersed scatter	excavation - recorded	11.7	13.6	2.7	3.2	50–100	20	absent	–
83	dispersed FCR scatter	excavation - recorded	9.4	14.0	0.0	0.0	100–200	20	absent	–
84	FCR concentration and dispersed scatter	testing	15.0	14.0	1.2	1.1	100–200	10	absent	16
85	FCR concentration and dispersed scatter	testing	3.5	3.5	1.1	1.3	<50	20	absent	–
86	FCR concentration and dispersed scatter	excavation - recorded	9.3	12.2	2.0	2.0	100–200	10	absent	–
87	FCR concentration and dispersed scatter	excavation - recorded	1.8	2.5	0.8	0.7	50–100	0	absent	–
88	FCR concentration	excavation - recorded	0.0	0.0	3.3	3.7	50–100	0	absent	–
89	FCR concentration	excavation - recorded	0.0	0.0	2.4	2.6	<50	10	absent	29
90	FCR concentration	excavation - recorded	0.0	0.0	2.8	3.4	100–200	40	absent	27
91	FCR concentration	excavation - recorded	0.0	0.0	1.1	1.8	50–100	60	absent	28
92	FCR concentration	excavation - recorded	0.0	0.0	1.9	2.3	50–100	40	absent	–
93.1	FCR concentration and dispersed scatter	excavation - recorded	5.0	9.7	2.0	1.5	50–100	80	absent	–
93.2	FCR concentration and dispersed scatter	excavation - recorded	8.2	12.0	1.6	1.3	50–100	10	absent	–
94	FCR concentration and dispersed scatter	excavation - recorded	14.5	9.5	1.8	1.2	50–100	30	absent	–

(Table 9.5, continued)

Feature No.	Feature Type	Phase and Treatment	Maximum Size (m) of Feature or Fire-cracked Rock Scatter		Size of Fire-cracked Rock Concentration or Core Area (m)		Estimated Fire-cracked Rock	% Burned Caliche	Ceramics Present?	Zia Feature No. or Core Area
			north–south	east–west	north–south	east–west				
95	FCR concentration and dispersed scatter	excavation - recorded	5.5	7.5	2.2	2.0	50–100	15	absent	–
97	dispersed FCR with concentration	excavation - recorded	14.5	10.5	1.7	2.8	50–100	10	absent	–
98	dispersed FCR scatter	testing	6.3	7.5	0.3	0.5	<50	70	present	CA2
103	dispersed FCR scatter	excavation - recorded	10.0	9.6	0.0	0.0	100–200	0	absent	–
104	stain?	testing	0.0	0.0	1.8	1.5	<10	100	absent	–
130	FCR concentration and dispersed scatter	excavation - recorded	13.0	9.5	2.0	2.3	<50	10	present	–
140	dispersed FCR with multiple deflated cores	excavation - recorded	0.0	0.0	0.3	0.3	absent	0	present	CA2
141	small thermal pit	excavation -	0.0	0.0	0.8	0.7	<50	0	present	CA2
142	charcoal stain	excavation - recorded	0.0	0.0	0.4	0.4	absent	0	present	CA2
143	charcoal stain	excavation - recorded	0.0	0.0	0.3	0.4	absent	0	present	CA2
144	dispersed FCR scatter	excavation - recorded	11.0	19.5	0.0	0.0	<50	60	absent	–
150	dispersed FCR with multiple deflated cores	excavation - recorded	17.0	29.0	0.0	0.0	50–100	70	absent	–
151	dispersed FCR with multiple deflated cores	excavation - recorded	20.0	13.0	0.0	0.0	50–100	50	absent	–
153	dispersed FCR with multiple deflated cores	excavation - recorded	26.0	15.0	0.0	0.0	>500	50	absent	CA1
154	FCR concentration and dispersed scatter	excavation - recorded	16.0	1435.0	1.4	1.3	100–200	30	absent	–
156	FCR concentration	–	0.0	0.0	1.2	1.2	<50	0	absent	–

FCR = fire-cracked rock

Section C Features

Section C includes those features south of Section A that have a NAD 83 easting greater than 314400 (Fig. 9.1). Thirty-seven features were recorded by OAS in this area; Zia had recorded only 13 here (Table 9.6). Feature 109 was originally identified in this area but was determined to be a natural accumulation of rocks. Two features, Feature 125 (a small thermal pit) and Feature 133 (a stain), were excavated in this area. Most of the features in Section C are fire-cracked rock concentrations with (n = 22, 59.5 percent) or without dispersed scatters (n = 1, 2.7 percent), with fewer dispersed fire-cracked rock scatters with (n = 3, 8.1 percent) or without (n = 7, 18.9 percent) concentrations also occurring. Other feature types include the Feature 125 small thermal pit, an artifact concentration, and two charcoal stains (one of which was excavated). Ceramics were observed near most Section C features (89.2 percent) and ground stone was observed at fewer (27.0 percent). Only four (10.5 percent) have no associated chipped stone artifacts, while most had small numbers (78.4 percent) and a few have substantial numbers (10.5 percent).

Potential for spatial information and subsurface remains is generally low in this area. Soils tend to be shallow and windswept or with gravel pavement (Fig. 9.58).

Red Rock Features

Several burned rock features (Table 9.7) are distinctive in several respects and probably represent some type of historic activity on the site. Other features have similar rock but it is either widely scattered and/or occurs with fire-cracked rock and chipped stone artifacts that suggest an earlier occupation. It is the number and density of the red and black igneous rocks that make the features discussed in this section distinctive.

These features generally lack rock that is obviously fire-fractured, other than an occasional stray piece from a nearby thermal feature. The rock is mainly small rounded igneous pebbles but also includes some larger and rounded pieces as well as some larger and angular pieces (Fig. 9.59). They range in form from relatively small and compact (2.5 by 1.9 m diameter) to large and widely scattered (17 by 16 m), and consist of between 50 and 100 to at least 300 rocks. The 17 red rock features have a fairly linear distribution that originates within the historic artifact scatter (Feature 129) and trends in a northeastern direction (Fig. 9.60). In the south, they are in a more open washed area (Fig. 9.61) with a slight gravel pavement. Further north, soils are red and there is denser vegetation and a slight caliche pavement (Fig. 9.62).

The rocks appear to have been burned at a high temperature, which altered the color. Several also contain pieces of coal, lignite, or pieces of melted rocks. Only one feature had rock that measured "hot" with a metal detector. Another unusual aspect is the presence of core tools at several features, and these are often red rocks (Figs. 9.63–9.64).

Feature 129

During the testing phase at LA 155963, a large area that contained a number of late nineteenth- and early twentieth-century artifacts was designated Feature 129 (Fig. 9.3); it may represent activities associated with the nearby Aleman Ranch. The area has a large quantity of iron and galvanized steel hardware that suggests construction debris. Two discrete artifact clusters are present in the feature. One is a 2 m diameter cluster of cement fragments that appears to represent a discard area for bags of cement that became wet and solidified. The other is a scatter of about 50 machine-cut square nails in a 3 m diameter area. The nails are of various pennyweights, which suggests a large wood object such as a trough or wagon. Other household objects such as fruit or vegetable cans (about 10), lard buckets (n = 2), .45 caliber casings (n = 2), aqua glass (n = 10, soda bottle?), barrel hoops (n = 5), pipe couplings (n = 1), and iron-stone pottery (n = 1) are also present. As noted, several of the red rock features are included in Feature 129 (Features 73, 99–102) and one of the bags of cement appears to contain similar red rocks (Fig. 9.65).

Artifact Assemblages

Three types of artifact assemblages are available for LA 155963. They include the artifacts that were point provenienced and collected or analyzed in the field during the testing phase, and which have already been discussed in Akins and Moore (2011a), and artifacts collected during the research phase. Artifacts from all three assemblage types are used in the artifact syntheses presented in later chapters. In

Figure 9.53. LA 155963, Section B, view of arroyo looking northwest.

Figure 9.54. LA 155963, Section B, Feature 84 in wind-scoured area.

Figure 9.55. LA 155963, Section B, area where features have no evidence of subsurface deposits.

Figure 9.56. LA 155963, Section B, Features 65–67 in area with gravel pavement.

Figure 9.57. LA 155963, Section B, area with gravel pavement north of the arroyo; Feature 61 is in foreground.

Figure 9.58. LA 155963, Section C, soils with and without gravel.

Table 9.6. LA 155963, Section C, summary of features as inventoried.

Feature No.	Feature Type	Phase and Treatment	Maximum Size (m) of Feature or Fire-cracked Rock Scatter		Size of Fire-cracked Rock Concentration or Core Area		Estimated Fire-cracked Rock	% Burned Caliche	Ceramics Present?	Zia Feature No.
			north–south	east–west	north–south	east–west				
51	FCR concentration and dispersed scatter	excavation - recorded	11.2	11.2	1.1	1	50–100	50	absent	40
52	FCR concentration and dispersed scatter	excavation - recorded	11.6	11	1	0.8	50–100	70	absent	39
54	FCR concentration and dispersed scatter	excavation - recorded	14	14	1.5	2.4	50–100	70	absent	–
55	Dispersed FCR with concentration	testing - recorded	15	10.5	1.5	1.3	50–100	40	absent	38
56	Dispersed FCR scatter	testing - recorded	10	10	0	0	50–100	60	absent	38
57	FCR concentration and dispersed scatter	excavation - recorded	26	24.5	1.3	0.9	< 50	50	absent	37
106	FCR concentration and dispersed scatter	excavation - recorded	6	7.5	1.5	1.4	< 50	20	absent	–
107	FCR concentration and dispersed scatter	excavation - recorded	70	3	1.5	1.2	100–200	80	absent	–
108	FCR concentration and dispersed scatter	excavation - recorded	7	7	1.5	1.5	< 50	60	absent	–
111	Dispersed FCR scatter	excavation - recorded	12.5	17	0	0	50–100	85	absent	–
112	Dispersed FCR scatter	excavation - recorded	18	21	0	0	20	70	absent	–
113	FCR concentration and dispersed scatter	excavation - recorded	12	11	1.5	1.2	50–100	90	absent	–
114	FCR concentration and dispersed scatter	excavation - recorded	22	25.5	2.7	3.6	100–200	70	absent	–
116	FCR concentration	excavation - recorded	0	0	0.5	0.6	< 10	0	absent	49
117	Artifact concentration	excavation - recorded	11	13.5	2.4	2.6	< 10	33	absent	46
118	FCR concentration and dispersed scatter	excavation - recorded	8.5	12.5	0.8	0.7	< 50	20	absent	47
119	FCR concentration and dispersed scatter	excavation - recorded	13.5	15	1.4	1.5	50–100	20	absent	48
120	Dispersed FCR scatter	excavation - recorded	16	12.6	0	0	50–100	90	absent	–
121	Dispersed FCR scatter	excavation - recorded	8	9	0	0	< 50	90	absent	–
122	FCR concentration and dispersed scatter	excavation - recorded	2.3	3.7	0.6	1.2	< 50	20	absent	48?
123	FCR concentration and dispersed scatter	excavation - recorded	6.7	5	1.4	1.4	50–100	10	absent	44-45?
124	FCR concentration and dispersed scatter	excavation - recorded	4.5	5.8	1	1.7	50–100	10	absent	–
125	Small thermal pit	excavation - excavated	0	0	0.59	0.5	50–100	10	present	–
126	FCR concentration and dispersed scatter	excavation - recorded	8.5	9.7	0.7	0.7	< 50	0	absent	–
127	FCR concentration and dispersed scatter	excavation - recorded	7.6	6	2.3	2.1	50–100	30	absent	41
128	FCR concentration and dispersed scatter	excavation - recorded	7.7	6.8	2.7	2	50–100	60	absent	–
131	FCR concentration and dispersed scatter	excavation - recorded	8.7	9.5	1.3	1.5	50–100	80	absent	–
134	Dispersed FCR scatter	excavation - recorded	4	3.4	0	0	< 50	5	absent	–
135	Dispersed FCR with concentration	excavation - recorded	17.5	10.2	0.5	0.5	50–100	30	absent	–
136	Dispersed FCR with concentration	excavation - recorded	12	9.8	2	2	50–100	10	absent	–
137	Dispersed FCR scatter	excavation - recorded	9	9.5	0	0	< 50	0	absent	–
138	FCR concentration and dispersed scatter	excavation - recorded	6.2	5.5	1.7	1.7	< 50	0	absent	–
145	FCR concentration and dispersed scatter	excavation - recorded	16	12	0.6	0.7	< 50	80	absent	–
146	FCR concentration and dispersed scatter	excavation - recorded	5.5	8.5	2	2	50–100	90	absent	–
148	FCR concentration and dispersed scatter	excavation - recorded	10	19.5	0.7	1	50–100	90	present	–

FCR = fire-cracked rock

Table 9.7. LA 155963, summary of red rock features.

Feature No.	Phase and Treatment	Maximum Size (m)		Estimated Rocks	Rock Size	Rock Type	Tools Present
		north–south	east–west				
43	testing - recorded	8.0	8.0	300	small pebbles	coal	–
53	excavation - recorded	5.7	3.7	100–200	pebbles and cobbles	coal	–
73	testing - recorded	3.5	3.3	100–200	small pebbles	coal or slag	–
96	testing - recorded	5.5	6.5	100–200	pebbles and cobbles	lignite	–
99	excavation - recorded	6.6	7.0	>200	pebbles and cobbles	–	yes
100	excavation - recorded	2.5	1.9	>200	pebbles and cobbles	molten rock	yes
101	excavation - recorded	3.0	4.0	>200	pebbles and cobbles	coal or slag	–
102	excavation - recorded	9.5	8.5	>200	small to larger pebbles	–	–
105	excavation - recorded	7.0	8.5	100–200	small pebbles	coal or slag	yes
110	excavation - recorded	3.0	7.5	>200	pebbles and cobbles	–	–
147	excavation - recorded	13.0	6.0	>200	pebbles and cobbles	coal or slag	yes
149	excavation - recorded	9.5	19.0	>200	small pebbles	coal or slag	yes
152	excavation - recorded	12.5	14.0	>200	pebbles and cobbles	coal or slag	yes
155	excavation - recorded	17.0	16.0	50–100	pebbles and cobbles	–	yes
157	post excavation-recorded	5.4	2.3	50–100	small pebbles	coal or slag	yes
158	post excavation-recorded	5.8	2.4	50–100	small pebbles	coal or slag	–
159	post excavation-recorded	5.8	7.3	100–200	small to large pebbles	coal or slag	–

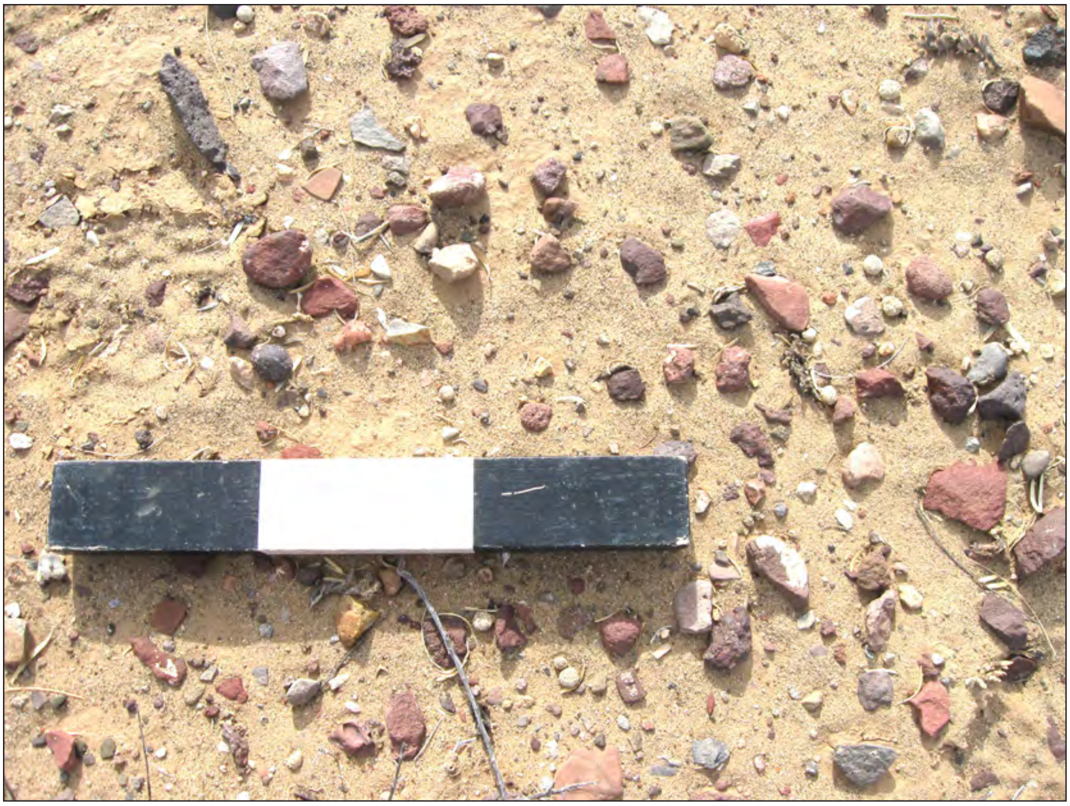

Figure 9.59. LA 155963, Feature 73, red rock feature rock.

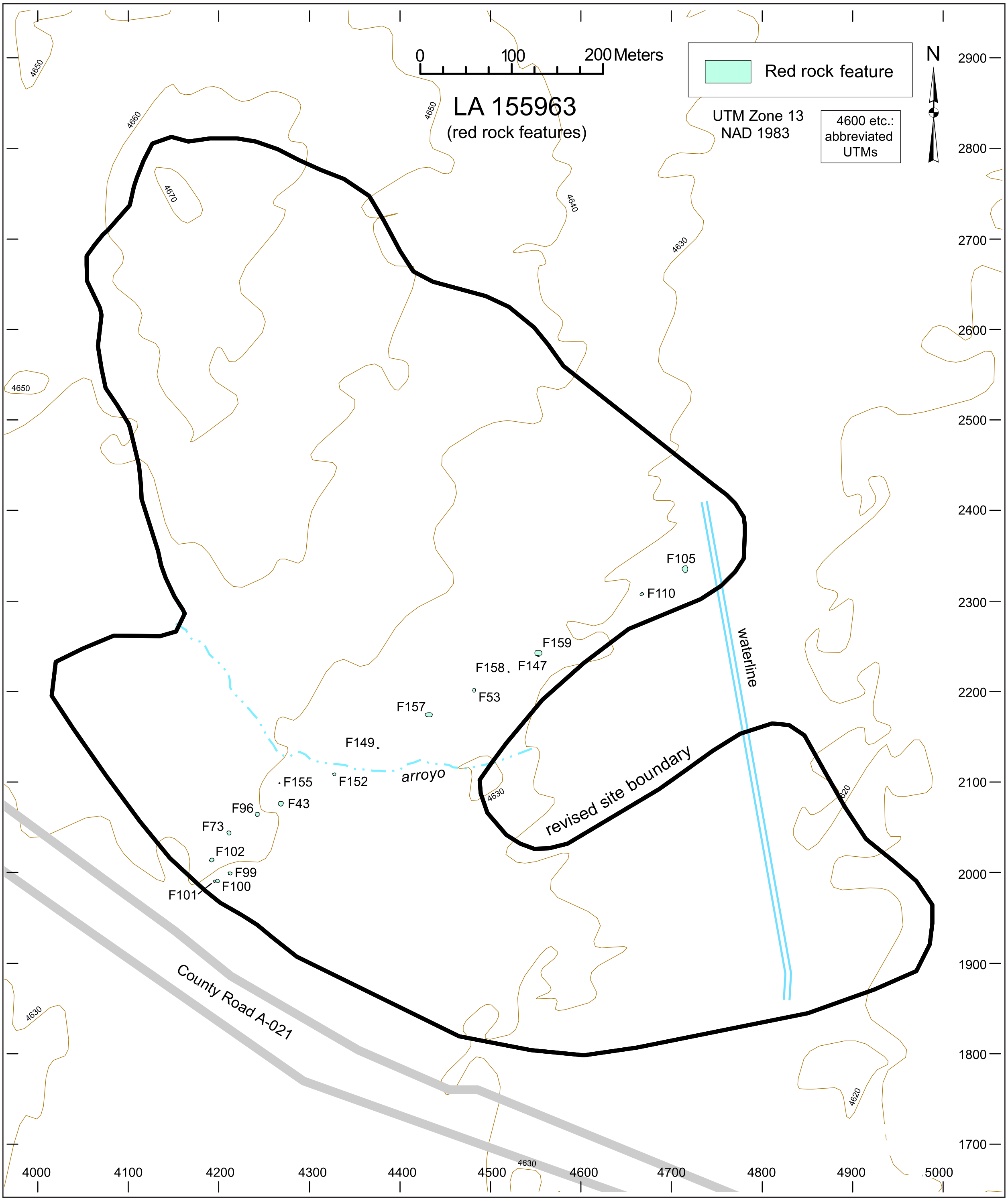

Figure 9.60. LA 155963, distribution of red rock features.

Figure 9.61. LA 155963, Feature 102, southern red rock feature.

Figure 9.62. LA 155963, Feature 110, more northern red rock feature.

Figure 9.63. LA 155963, Feature 147, tool from feature.

Figure 9.64. LA 155963, Feature 152, tool from feature.

Figure 9.65. LA 155963, Feature 129, cement with red rocks.

this section the various types of artifacts from these assemblages are summarized, but are not discussed in any great detail.

Testing Assemblage

Artifact collection during testing focused on the recovery of temporally diagnostic artifacts that could be used to help determine when the various parts of this massive site were used. A total of 202 artifacts are included in this sample including 29 historic artifacts, 86 ground stone tools, 7 sherds, 2 ornaments, and 79 chipped stone artifacts. Of these, 31 chipped stone artifacts, 8 historic artifacts, 2 ornaments, and 2 sherds were collected for more detailed examination. The field-analyzed ground stone assemblage included 15 one-hand manos (9 whole, 6 fragments), 21 metates (3 whole, 18 fragments), 4 undifferentiated mano fragments, a complete lapidary stone, and 45 unidentified ground stone tools (all fragments). Sandstone was the dominant material used in the manufacture of these tools, accounting for 76.4 percent of the assemblage (n = 68). The remainder of the ground stone assemblage was made from basalt (n = 6, 6.7 percent), metaquartzite (n = 4, 4.5 percent), undifferentiated igneous materials (n = 4, 4.5 percent), rhyolite (n = 2, 2.2 percent), and unidentified materials (n = 2, 2.2 percent).

The array of historic artifacts are discussed in Chapter 7 of the testing report (Akins and Moore 2011a), and are not further considered here since the focus during the research-oriented phase was on earlier proveniences. The small ceramic assemblage includes two Chupadero Black-on-white sherds that were collected and five brown ware sherds that were recorded in the field but not collected. The two ornaments were analyzed during the current study and consist of a sandstone concretion that was slightly modified to create a phallic shape and a small quartz crystal.

The chipped stone assemblage includes a single piece of debitage and 78 formal tools. The piece of debitage is an overshot flake, which represents an error made during tool manufacture. Of the 63 bifaces that were collected, nine are early stage tools to which no more specific function could be assigned. Similarly, no more specific function could be assigned to 24 of the 25 middle-stage bifaces that were collected. The exception is a chert projectile point preform. In contrast, only one of the 29 late stage bifaces could not be assigned a more specific function. The remainder of this tool category consists of 26 projectile points, a drill, and a knife. The projectile points include three Folsom point fragments, two Paleoindian points, two stemmed and two side-notched Archaic points, two San Pedro points, and four Archaic point fragments. The remainder of the projectile points date to the Formative period and included six corner-notched, two stemmed, and three unnotched specimens. Unifacial tools include a spokeshave, a denticulate, four scrapers, and two spurred end scrapers. The small array of cobble tools are all choppers (n = 6); a single core reused as a hammerstone was also recorded.

In-Field Analyses

In-field artifact analysis at LA 155963 during the research phase was conducted in Area C and collected information on 219 chipped stone artifacts, 3 pieces of ground stone, 1 ornament, and 69 fragments of fire-cracked rock (Fig. 9.47). The chipped stone assemblage was dominated by cherts (n = 178, 81.28 percent); it also included rhyolite (n = 15, 6.85 percent), limestone (n = 6, 2.74 percent), obsidian (n = 5, 2.28 percent), metaquartzite (n = 4, 1.83 percent), metamorphic undifferentiated (n = 4, 1.83 percent), silicified wood (n = 2, 0.91 percent), siltstone (n = 2, 1.83 percent), and single specimens of basalt, orthoquartzite, and quartz (0.46 percent, apiece).

Seven tools—a hammerstone, a projectile point preform, a San Jose point, and three bifaces—were analyzed in the field, and the San Jose point was also collected. Two of the bifaces were broken and discarded during manufacture, and the other two specimens exhibited nondiagnostic breaks. The remaining chipped stone artifacts were all debris created during core reduction. Core flakes dominated these artifacts (n = 142, 64.84 percent), followed by biface flakes (n = 30, 13.70 percent), angular debris (n = 29, 13.24 percent), and cores (n = 11, 5.02 percent).

Three ground stone artifacts were recorded in Area C; they consisted of a basin metate fragment made from an unidentified igneous material, a fragment of an unidentified ground stone tool made from sandstone, and a small piece of unworked micaceous sandstone that may have served as a pot lid, or it simply represents a manuport. A single hematite concretion in the form of a ball was also recorded and collected. Further examination in the laboratory could identify no evidence of cultural modification, but since this type of rock did not appear to be native to the area in which it was found, the possibility exists that it was collected elsewhere and discarded or lost at this location. If this assumption is correct, then the hematite concretion could have been used as a ritual object, though this was impossible to establish.

A total of 71 pieces of fire-cracked rock that were not directly associated with thermal features were recorded in Area C. Unidentified igneous materials dominated this small assemblage (n = 39, 54.93 percent). Limestone was the second most common material used for this purpose (n = 22, 30.99 percent), followed by sandstone (n = 8, 11.27 percent), and metaquartzite (n = 2, 2.82 percent).

Laboratory Analyses

Summaries of the results of the laboratory analyses are provided here, with more detailed discussions provided in the synthetic chapters presented for each major artifact type later in this volume.

Chipped Stone. Of the 3,565 chipped stone artifacts recovered during research-oriented investigations at LA 155963, 454 (12.73 percent) are from Area A North and may represent a Paleoindian occupation, 1,002 (28.11 percent) are from Area A South and probably represent an Archaic occupation, 1,525 (42.78 percent) are from Area B and represent a Mesilla-phase occupation, 104 (2.92 percent) are from Area C and probably also represent a Mesilla-phase occupation, 47 (1.32 percent) were collected from the surface outside features and surface investigation areas, and 433 (12.15 percent) were recovered during feature excavation and associated surface stripping.

Table 9.8 shows the distribution of material categories by excavation area. The surface collection is not considered in this discussion because it represents a very small and biased sample. Chert (including chalcedony) is the most common material category in all cases, but is most dominant in Area A North, which is thought to represent a Paleoindian component, and Area C, a Mesilla-phase component. The percentage of chert for Area C could be a result of sample error, since this is the smallest assemblage examined at LA 155963. Fortunately, other surface-chipped stone artifacts outside Surface Investigation Area 1 in Area C were analyzed in the field and will provide additional data for examining the material-type distribution for this part of the site. Area B contains the smallest percentage of chert, which is surprising since this area also dates to the Mesilla phase, and could be an indication that sample error is indeed the cause for the large percentage of chert for Area C. Metaquartzite is the second most common material type, and is found in all contexts. Silicified wood is also fairly common and occurs in all contexts. Since this material is essentially a chert, it was probably not distinguished from chert prehistorically. Other materials were much less common and no other material type occurred in all contexts, though obsidian was found everywhere but Area C.

Table 9.9 shows the distribution of artifact morphologies for all excavation areas. The surface collection is again not considered for the reason listed above. Considering only the debitage, Area A North again stands out from the rest of the assemblages. That area contains the lowest percentage of angular debris and highest percentage of biface flakes. Interestingly, Area A South, which is thought to represent an Archaic component, also stands out from the Mesilla-phase components in Areas B and C, again with a lower percentage of angular debris and a higher percentage of biface flakes. This may demonstrate a long-term change in reduction strategy, from one that focused on the manufacture of large bifaces to one in which small bifaces predominated. This possibility is explored in more detail in a later chapter.

Ceramics. The distribution of pottery types by excavation area is shown in Table 9.10 for LA 155963. Southern Jornada Mogollon wares comprise the bulk of this assemblage in all three areas (Area A North: n = 7, 100 percent; Area B: n = 485, 76.1 percent; Area C: n = 90, 98.8 percent), followed by Northern Jornada Mogollon wares (Area B: n = 140, 22.0 percent; Area C: n = 1, 1.1 percent). Imported wares include the white wares and mineral-painted wares (Cibola region; Area B: n = 6, 0.9 percent) and the Mimbres wares (Mogollon Highlands; Area B: n = 6, 0.9 percent). Area B produced the largest number of specimens and contained most of the imported wares as well as those from the Northern Jornada Mogollon region.

Jars were the most common vessel form (n = 595, 80.95 percent), with very few bowl sherds (n =

Table 9.8. LA 155963, material type categories by excavation areas; counts and column percentages.

Material Type		Surface Collection	Feature Excavation	Area A North	Area A South	Area B	Area C	**Total**
Chert	Count	34	367	431	842	1,133	100	2,907
	Col. %	72.34%	84.76%	94.93%	84.03%	74.30%	96.15%	81.54%
Silicified wood	Count	1	31	7	88	20	2	149
	Col. %	2.13%	7.16%	1.54%	8.78%	1.31%	1.92%	4.18%
Obsidian	Count	10	2	1	4	5	–	22
	Col. %	21.28%	0.46%	0.22%	0.40%	0.33%	–	0.62%
Igneous	Count	–	–	1	–	2	–	3
	Col. %	–	–	0.22%	–	0.13%	–	0.08%
Basalt	Count	1	–	–	1	1	–	3
	Col. %	2.13%	–	–	0.10%	0.07%	–	0.08%
Rhyolite	Count	–	2	–	9	30	–	41
	Col. %	–	0.46%	–	0.90%	1.97%	–	1.15%
Fine welded ash-flow tuff	Count	–	–	1	–	–	–	1
	Col. %	–	–	0.22%	–	–	–	0.03%
Limestone	Count	–	4	5	1	110	–	120
	Col. %	–	0.92%	1.10%	0.10%	7.21%	–	3.37%
Sandstone	Count	–	–	–	3	–	–	3
	Col. %	–	–	–	0.30%	–	–	0.08%
Siltstone	Count	–	3	1	1	19	–	24
	Col. %	–	0.69%	0.22%	0.10%	1.25%	–	0.67%
Metamorphic	Count	–	–	1	–	1	–	2
	Col. %	–	–	0.22%	–	0.07%	–	0.06%
Metaquartzite	Count	1	24	5	51	200	2	283
	Col. %	2.13%	5.54%	1.10%	5.09%	13.11%	1.92%	7.94%
Orthoquartzite	Count	–	–	1	–	4	–	5
	Col. %	–	–	0.22%	–	0.26%	–	0.14%
Quartz	Count	–	–	–	2	–	–	2
	Col. %	–	–	–	0.20%	–	–	0.06%
Total	Count	47	433	454	1,002	1,525	104	3,565
	Col. %	1.32%	12.15%	12.73%	28.11%	42.78%	2.92%	100.00%

Table 9.9. LA 155963, artifact morphology by excavation area; counts and column percentages.

Artifact Morphology		Surface Collection	Feature Excavation	Area A North	Area A South	Area B	Area C	**Total**
Angular debris	Count	3	59	45	148	410	18	683
	Col. %	6.38%	13.63%	9.91%	14.77%	26.89%	17.31%	19.16%
Core flake	Count	12	334	321	789	1,061	84	2,601
	Col. %	25.53%	77.14%	70.70%	78.74%	69.57%	80.77%	72.96%
Biface flake	Count	1	20	77	30	7	–	135
	Col. %	2.13%	4.62%	16.96%	2.99%	0.46%	–	3.79%
Cores	Count	3	6	2	31	39	2	83
	Col. %	6.38%	1.39%	0.44%	3.09%	2.56%	1.92%	2.33%
Uniface	Count	4	–	3	–	1	–	8
	Col. %	8.51%	–	0.66%	–	0.07%	–	0.22%
Biface	Count	24	14	6	4	7	–	55
	Col. %	51.06%	3.23%	1.32%	0.40%	0.46%	–	1.54%
Total	Count	47	433	454	1,002	1,525	104	3,565
	Col. %	1.32%	12.15%	12.73%	28.11%	42.78%	2.92%	100.00%

Table 9.10. LA 155963, pottery type by excavation area; counts and column percentages.

Pottery Type		Area B	Area C	Surface Collection	Feature Excavation	**Total**
Unpainted polished white ware	Count	4	–	–	–	4
	Col. %	0.66%	–	–	–	0.54%
Mineral paint undifferentiated	Count	2	–	–	–	2
	Col. %	0.33%	–	–	–	0.27%
Plain slipped red	Count	–	–	–	3	3
	Col. %	–	–	–	10.00%	0.41%
El Paso Brown Rim	Count	7	5	–	–	12
	Col. %	1.16%	6.57%	–	–	1.63%
El Paso Brown Body	Count	461	71	1	23	556
	Col. %	76.07%	93.42%	4.35%	76.67%	75.65%
Indeterminate brown ware with large sand	Count	8	–	–	–	8
	Col. %	1.27%	–	–	–	1.09%
El Paso Polychrome	Count	–	–	–	1	1
	Col. %	–	–	–	3.33%	0.14%
Plain slipped red	Count	2	–	–	–	2
	Col. %	0.33%	–	–	–	0.27%
Jornada Brown Body	Count	60	–	–	2	62
	Col. %	9.90%	–	–	6.67%	8.44%
Jornada Incised	Count	1	–	–	1	2
	Col. %	0.17%	–	–	3.33%	0.27%
South Pecos Brown Body	Count	60	–	–	17	77
	Col. %	9.88%	–	–	33.33%	10.48%
Mimbres White Ware unpainted	Count	2	–	–	–	2
	Col. %	0.33%	–	–	–	0.27%
Mimbres Black-on-white undifferentiated	Count	–	–	–	4	4
	Col. %	–	–	–	7.84%	0.54%
Total	Count	607	76	1	51	735
	Col. %	82.59%	10.34%	0.14%	6.94%	100.00%

10, 1.4 percent). The remainder of the assemblage (n = 130, 17.68 percent) were unidentifiable body sherds, though most of these specimens probably also came from jars. Temper in the Southern Jornada or El Paso Brown wares is mainly granite (n = 569); a small number have crystalline igneous temper (n = 2, 0.3 percent). Northern Jornada Mogollon or Jornada Brown wares are tempered with crystalline igneous (n = 64, 45.4 percent), indeterminate feldspar (n = 72, 51.1 percent), and dark feldspar (n = 5, 3.5 percent). The Cibola wares have sand (n = 1, 16.7 percent) or sherd and sand temper (n = 5, 83.3 percent). The Mimbres sherds are all tempered with Mogollon volcanic rocks.

Ground Stone. Twenty ground stone tools were collected from LA 155963: 15 metate fragments (3 basin, 2 slab, 1 basin or slab, and 9 indeterminate), 3 manos (2 one-hand, 1 two-hand), 1 indeterminate fragment, and 1 chopper. A variety of materials were used for the manufacture of these tools, including sandstone (n = 15) basalt (n = 3), orthoquartzite (n = 1), and metaquartzite (n = 1). The only complete specimens were a two-hand mano, a slab metate, a slab metate reused as an anvil, and the chopper; all other ground stone tools were represented by fragments.

Fauna. A total of 522 pieces of animal bone were recovered during excavation, with 88.70 percent recovered during surface stripping in Area B. Most of the assemblage is comprised of small bone fragments that cannot be attributed to a specific species, with 88.89 percent being classified as small mammal, with the unknown small animal, small mammal or medium to large bird, small to medium mammal, and medium to large mammal bone categories each comprising less than 1 percent of the assemblage. Identifiable species include cottontail (4.21 percent), jackrabbit (3.83 percent), medium bird (0.38 percent), ornate box turtle (0.38 percent), lizard (0.19 percent), and bobcat (0.19 percent). Only 4.60 percent of the bone was unburned (n = 24), with the majority exhibiting evidence of burning, both through discard (n = 494, 94.64 percent) and possible roasting (n = 4, 0.77 percent). These proportions indicate that most of the bone from LA 155963 represents cultural use. The few intrusives include the lizard bone and 23 pieces from small animals. Small mammals, probably mostly rabbits, may have provided most of the meat consumed at this site. However, there is also some evidence for the consumption of medium to large mammals, birds, and turtles. Whether the bobcat bone is evidence of consumption or some other use remains an open question.

Flotation. Flotation samples were collected and analyzed for Features 1, 6, 8, 9, 14, 15, 125, and 141. Most of these samples were from Formative-period contexts, with Features 14, 125, and 141 yielding Mesilla-phase dates and Feature 8 dating to the Doña Ana or El Paso phase. Feature 15 dates to the Late Archaic period. The only burned species recovered from the Late Archaic context was yucca caudex that probably represents fuel use rather than consumption. Burned plant remains from Mesilla-phase contexts include yucca caudex, grass stems and seeds of amaranth, cheno-am, goosefoot, purslane, hedgehog cactus, and mesquite. While the yucca caudex and grass stems are probably indicative of use as fuel rather than consumption, the others probably represent foods. The Doña Ana- or El Paso-phase context contained burned goosefoot seeds and yucca caudex. Again, the yucca caudex probably represents fuel use, while the goosefoot seeds were probably used as food. Fuel use in the later features is mainly mesquite with smaller amounts of saltbush. The Protohistoric feature contained no burned plant remains other than mesquite and saltbush fuel remains, while one feature dating to the Spanish Colonial period had burned goosefoot and grasses with mesquite and saltbush wood. Burned monocot stems are all that was found in Historic feature fill.

Radiocarbon. Twelve samples from eight features were submitted for analysis to provide radiocarbon dates for various parts of LA 155963. Multiple samples of different types of materials were submitted for Features 1, 8, and 141 in order to assess correspondences between different types of burned plant material. The samples from Feature 1 were mesquite and saltbush wood, and both samples suggest that this feature dates to the Protohistoric period. A bulk soil sample and a sample of yucca caudex were submitted for Feature 8, and both indicate a Doña Ana- to El Paso-phase date. Samples of saltbush and mesquite wood as well as mesquite seeds were submitted for Feature 141; all three samples indicate a Mesilla-phase date.

Despite the apparent correspondence for the results from the various materials analyzed for these features, the mesquite wood samples seem to date slightly earlier than the other materials (Boyer, Chapter 19, this report), though they still provide fairly accurate dates in these cases. For instance, the mesquite wood from Feature 1 provides a date of AD 1416–1491 while the saltbush wood provides a longer date range of AD 1470–1640 (both calibrated with CALIB; 2 sigma). The mesquite wood from Feature 141 provides a date range of AD 608–688, while the range for the saltbush wood is AD 761–882 and the mesquite seed range is AD 662–779 (all calibrated with CALIB; 2 sigma). In both cases the mesquite wood yielded earlier dates than the other materials, but the differences were not so great as to render those results invalid. This suggests that in instances where only mesquite wood is available, the radiocarbon date derived may suggest a somewhat earlier use than was actually the case, but the date can still be relatively close. In any event, dates derived from mesquite wood should be considered tentative unless verified by dates on other materials. In contrast, the yucca caudex sample and bulk soil sample from Feature 8 provide nearly identical date ranges of AD 1224–1296 and AD 1250–1301 (both calibrated with CALIB; 2 sigma) respectively, indicating that bulk soil samples can provide accurate dates for features.

A bulk soil sample from Feature 15 dates to the Late Archaic period, and in light of the results for Feature 8 this date is probably accurate. Two features date to the Mesilla phase (Features 14, 125). Since saltbush wood was submitted for both of these features, the dates probably accurately place their period of use. The last two features both yielded fairly late dates. A sample of monocot stems from Feature 6 places its use during the Historic period, while mesquite wood from Feature 9 provided multiple intercepts that suggest a use date in the seventeenth century (Boyer, Chapter 19, this report).

LA 155963 Summary and Recommendations

The research plan for LA 155963 was to record the remaining features located during testing, excavate or sample between 14 and 30 of the features, and excavate blocks of grid units up to 10 by 10 m in up to seven artifact clusters. However, due to the amount of time spent at other sites (Akins and Moore 2011a:16), only 13 of the features that were identified at the site were investigated and 154 sq m were excavated in six areas within artifact clusters (Akins and Moore 2011b).

In addition to recording the remaining 97 features located during testing, Features 132–155 were found and recorded during the research phase and Features 156–160 during subsequent visits to the site. Thirteen features were investigated, although Feature 139 was found to be an area of darker sediment rather than a cultural feature. All but four of the investigated features were in Section A (Figs. 9.2–9.5) and the features with radiocarbon dates represent the Late Archaic-Mesilla–phase transition (Feature 15), the Mesilla phase (Features 14, 141, 125), the Dona Ana-El Paso–phase transition (Feature 8), the Protohistoric period (Feature 1), and the Historic period (Features 6, 9). Most were either fire pits (n = 5) or stains (n = 3), but also included a small roasting pit, what was probably an isolated and now broken metate, and a modern rock feature. Surface investigation areas were placed in the Paleoindian area in Area A North (n = 2), Area A South in the vicinity of Features 18–20, the Area B Sherd Area (n = 2), and in Area C just south of Feature 125.

Features 1 and 6 are in the Paleoindian part of Area A North but date to the Protohistoric (Feature 1) and Historic (Feature 6) periods. One was a fire pit and the other was disturbed but probably was also a fire pit or at least a substantial stain. Both had fire-cracked rocks and the fuel wood in Feature 1 was saltbush and mesquite. No fuel wood was recovered from Feature 6. Nothing associated with these features confirms the late dates and no metal was located in intensive metal detection surveys around these features. However, both Surface Investigation Areas 5 and 6 were placed in areas where large proportions of thermally altered chipped stone was observed and near where Folsom point fragments had been collected. Initial observations on the chipped stone assemblages from these surface investigation areas suggests that they are not associated with occupations represented by the dated features, and may in fact represent a Folsom period occupation that currently lacks any dated features.

Features 14 and 15 are south of the Paleoindian Area, in and near Artifact Cluster 4 (Fig. 9.2). These are a small roasting pit and a pocket of charcoal-stained fill or a small fire pit that date to the Late Archaic-Mesilla Phase transition (Feature 15) and the Mesilla Phase (Feature 14). Both had saltbush fuel wood and surface stripping (3 and 4 sq m) and collecting in the surrounding areas (5 by 5 m each) produced good samples of chipped stone artifacts but no ceramics. Features 8 and 9 are also just south of Paleoindian Area 1 and east of Features 14 and 15. Feature 8 was a small fire pit dating to the Mesilla Phase while Feature 9 was an early Historic-period stain that could be associated with a nearby feature. El Paso Brown ceramics and several pieces of chipped stone were associated with Feature 8 while Feature 9 had a few pieces of debitage and a biface. The only fuel found in Feature 8 is yucca while Feature 15 had pieces of mesquite and saltbush. Both had charred goosefoot. Feature 13 is south of Feature 9 and Feature 18 is on the ridge south of Features 14 and 15. Feature 13 consists of pieces of a slab metate that resembled a collapsed bin that had no associated pit or use surface. Feature 18 was an apparently modern ring of rocks placed around a now desiccated cactus and decorated with asters.

Investigations in Area B focused on two areas of surface collection and stripping (Surface Investigation Areas 2 and 3) where large numbers of artifacts were collected from the surface of 10 by 10 m areas and a sample of grid units was excavated (20 and 9, respectively). Only one feature was investigated in Area B and it was revealed during surface stripping. Feature 141 was a small fire pit with fire-cracked rock dating to the Mesilla phase. It is only one of two Mesilla-phase features to have mesquite fuel wood as well as burned mesquite seeds, and a wide array of potential food plants, rabbit bones, and a ceramic were recovered from the pit.

Area C was investigated through Surface Investigation Area 1 (67 sq m excavated) and Features 125 and 133. Feature 125, a small fire pit with fire-cracked rock, dates to the Mesilla phase while Feature 133 was a pocket of charcoal-stained fill preserved in a rodent burrow that was not dated but had burned yucca and prickly pear parts. Fuel wood in Feature 125 was yucca caudex, saltbush, and mesquite and surface stripping the surrounding area recovered small numbers of sherds and chipped stone artifacts. The surface investigation area was adjacent to the six grid units used to investigate Feature 125. Most of the artifacts are chipped stone but also include a small number of sherds.

Artifacts recovered during the research investigations are mainly chipped stone. As summarized earlier, an initial examination of these materials suggests that there may be distinct differences between the assemblages from Area A North, Area A South, and Areas B and C that represent temporal distinctions. Preliminary dates can be assigned using diagnostic chipped stone artifacts and assemblage characteristics for the chipped stone artifacts from Areas A North and South, while the presence of ceramics and a few absolute dates are used in assigning preliminary dates to the chipped stone artifacts from Areas B and C. Area A North is believed to represent a Folsom-period occupation, the Area A South assemblage is thought to represent an Archaic occupation, and good evidence indicates that the Areas B and C assemblages date to the Mesilla phase. However, based on the recovery of a San Jose point in association with numerous chipped stone artifacts that were recorded in the field, Area C may also contain an Archaic component. Thus, Area C may contain both Mesilla phase and Archaic components.

Examining the diagnostic projectile points from LA 155963 that were mostly collected during nonintensive surface examination shows that all parts of the site contain materials from multiple time periods, though there are some potentially important differences. Sixteen identifiable projectile points were recovered from Section A (north of the NAD 83 N3652495 line), 15 came from Section B (south of NAD 83 N3652495 and west of E314400), and 8 were found in Section C (south of NAD 83 N3652495 and east of E314400).

The sample from Section A contains seven Paleoindian points (including four Folsom point fragments), eight Archaic points (all probably Late Archaic), and one Formative-period point. These specimens suggest that the main periods of occupation for this part of the site were during the Folsom and Late Archaic periods, though there may have also been some use during the terminal part of the Paleoindian period as well as during the Formative period.

Section B contained only a single Paleoindian point (Folsom), eight Archaic points (Early and Late Archaic periods), and six Formative-period points. The Folsom point was found in the northern part of this section of site and was the only Paleoindian point recovered outside Section A. This suggests that most, if not all, Paleoindian use of LA 155963 was confined to the higher north end of the site. The presence of Early and Late Archaic points in this part of the site probably indicates that there was fairly intensive Archaic use in addition to the well-documented Formative-period use. Unfortunately, this section of the site is heavily eroded and most visible features are deflated and scattered, so we currently have no dates to substantiate this possibility. However, since most features outside the Area B Sherd Area were aceramic, they potentially mostly date to the Archaic period, and this would account for the several Archaic points recovered from this part of the site.

Section C contained four points each from the Archaic and Formative periods. The Archaic points date to the Middle and Late Archaic periods, though three can be placed in the latter and only one in the former. This suggests the likelihood that this part of the site contains multiple overlapping occupations dating to these periods. Indeed, when recording Area C, most sherds clustered around Feature 125 suggesting that this area was the focus of the Formative period occupation in Area C. Pottery was rare elsewhere in Area C, perhaps indicating that most of this area represents one or more Archaic occupations.

When dated features for these sections of the site are considered, we can suggest that Paleoindian use of LA 155963 was probably mostly confined to the north part, primarily in Section A. Archaic occupations occur in all parts of the site. Formative period use of LA 155963 seems to have focused on the southern part of the site (Sections B and C), though there is also good evidence of some use of the northern part (Section A) as well. The only evidence for Protohistoric and early Historic use was dated features in Section A, though considering that visually distinguishing Protohistoric and early Historic features from those of earlier periods is impossible as seen at LA 111429 and LA 155964. Use during this period could easily have been more widespread across the site. Evidence of later Historic period use in the form of undated and dated features and artifacts was found in all parts of the site but concentrated in the south (Feature 29).

In addition to data from excavation and intensive surface collection areas, diagnostic projectile points were opportunistically collected to provide a wider base for temporal associations at LA 155963. A fairly wide range of Archaic types were recovered in this way, including: Bajada (n = 1), San Jose (n = 1), Armijo (n = 1), San Pedro (n = 2), Shumla (n = 1), and Perdiz (n = 1) points. These projectile points indicate that LA 155963 was used from the Early to the Late Archaic periods, potentially adding credence to our tentative assignment of an Archaic association to Area A South. Thus, LA 155963 was sporadically used, probably for short-term residential camps, between the Paleoindian and Historic periods.

The ground stone recorded in the field during testing and research investigations (n = 89) and recovered during research investigations (n = 20) are largely fire-fractured and include indeterminate objects (n = 47), metates (n = 37), one-hand manos (n = 17), manos (n = 5), a lapidary stone, and a chopper. Most of those recovered from excavations and in surface investigation areas are fire-fractured and provide no contextual information. Of the complete or near complete artifacts analyzed in the laboratory, one complete metate was part of a collector's pile and the Feature 13 broken metate was isolated so neither of these can be used for inferring activities in a particular location. The other complete metate was found in Surface Investigation Area 4. Complete metates recorded in the field include a basin metate found within a few meters of Feature 125; two complete metates and two complete one-hand manos in the vicinity of Features 72, 74, and 141; and an isolated metate west of Features 112 and 145 and north of Feature 53. Other one-hand manos are near Features 50, 60, 61, and 85. One of the manos, a large two-handed specimen, is from Surface Investigation Area 2 near Feature 141, which suggests a Mesilla-phase use for this tool. Similarly, the chopper was found on the surface at Feature 9. It is limestone and given that the surface limestone at this site tends to dissolve somewhat, it may well agree with the Early Historic radiocarbon date for this feature. Overall, the distribution of complete one-hand manos suggests a Mesilla-phase association for this tool type, unless they were scavenged and reused.

Ceramics were recovered from all three of the areas where surface stripping was focused, but the bulk of the sample came from Surface Investigation Area 2 in Area B (n = 539, 73.3 percent). Only a few sherds occur in Section A and those that were found were all associated with Feature 8. In Area B, excavated Feature 141 (in Surface Investigation Area 2) and Feature 38 had associated sherds. Others were found in Surface Investigation Areas 1 and 3 as well as during the general surface collection of diagnostic materials. In Area C, all of the sherds came from in and around Feature 125. Southern Jornada Mogollon wares (El Paso) are the most common tradition in all three areas (100.00, 76.1, and 98.9 percent respectively). Area B, with its much larger sample, has a good amount of Northern Mogollon (Jornada) wares as well as all of the Cibola and Mogollon Highland sherds. Sherds from these traditions co-occur in Surface Investigation Area 2 and do not suggest any spatial or great temporal differences.

While this site yielded most of the fauna recovered from the project, almost all specimens were found in Area B Surface Investigation Areas 2 and 3, which date to the Mesilla Phase. Burned bone in these areas indicates that rabbits were the primary animals consumed, but the burned assemblage also includes bobcat, turtle, and a medium-sized bird. Feature 141 is the only feature with burned bone, and both cottontail and jackrabbit were recovered from it.

Features with quantifiable amounts of fuel woods had mesquite and saltbush, with the proportion of mesquite tending to increase through time (McBride, Chapter 17, this report; Figs. 17.10–17.11). The presence of mesquite in Features 141 and 125 suggest that this species was becoming fairly common by the middle of the Mesilla phase. Other than yucca caudex, which probably was used as fuel, flotation and macrobotanical samples provide little evidence of subsistence remains. One Mesilla-phase fire pit (Feature 141) had burned remains of amaranth, cheno-am, purslane, grass stems, hedgehog cactus, and mesquite seed. Early Historic-period Feature 9 had burned goosefoot.

Eight features had sufficient burned material for radiocarbon dates. These include one of two dating from the Late Archaic-Mesilla–phase transition, three of the six Mesilla-phase features, the only feature with a Dona Ana-El Paso–phase date, one of two with Protohistoric-period dates, and two of four with Historic-period dates. Of the latter, one has an Early Spanish Colonial date and the other dates to the Santa Fe Trail or Early Railroad Period. These were all stains or thermal features, none of which are of diagnostic types that would allow temporal assignment without an absolute date. No metal was recovered in metal-detection surveys around those with historic dates and, other than brown ware ceramics, none of the artifacts were particularly diagnostic.

With diagnostic artifacts and radiocarbon dates demonstrating use of the site from at least Folsom into the nineteenth century, LA 155963 was undoubtedly a location that attracted a wide range of groups. Residue analysis on diagnostic projectile points and a soil sample suggest that rabbits were hunted from Folsom occupation into the Mesilla phase. As discussed by Moore in Chapter 22, raw materials for chipped stone reduction are also available along the northwestern edge of the promontory that LA 155963 sits upon, perhaps also contributing to the attraction of this location for a wide variety of groups. It is also a site that retains great potential for further research. Additional excavation in the vicinity of Surface Investigation Areas 2 and 3 could locate more buried features and possibly the remains of structures that could clarify how Mesilla-phase groups used this area. Investigation of additional features in the northern area of the site could provide more information on the Paleoindian, Archaic, Protohistoric, and Spanish Colonial-era use of the site area. More aerially extensive excavations in the vicinity of Surface Investigation Areas 5 and 6 in Area A North might recover additional information on the potential Paleoindian occupation of that part of the site.

10 | Investigations at LA 155964

Introduction

Located less than 200 m southeast of LA 155963, this site is a small artifact scatter with features that were initially thought to date to the Middle Archaic and Formative periods. It is on NMSLO trust land and has been determined as "eligible" under Criterion "d" for NRHP. The site has integrity (51 to 75 percent); it has the potential to contain dating and subsistence-related materials; it has thermal features; and it was thought to have a possible habitation structure. This gives it the potential to produce important information on settlement and subsistence and to contribute to our knowledge of regional prehistory (FAA and NMSA 2010b:21, Quaranta and Gibbs 2008:144, 402).

LA 155964 is near the entrance road, the runway, and an area used as a staging area for construction trailers (FAA and NMSA 2010b:20–21). Fencing and a utility corridor described in earlier construction plans are not currently being contemplated. Research-oriented investigations were initiated to examine known features at LA 155964 in order to determine their nature and to collect dateable materials to provide a more accurate idea of when this site was occupied. Other reasons for this study include obtaining information on subsistence practices, season of occupation, mobility patterns, and whether multiple occupations are represented.

Previous Work

LA 155964 was recorded by Zia in April 2007. Features were described and three chipped stone tools, 14 pieces of debitage, and two ground stone tools were analyzed in the field (Quaranta and Gibbs 2008:144–145). In 2009 a 50-foot protective buffer was identified by Zia archaeologist Victor Gibbs and marked with metal stakes by a fencing crew. Orange mesh fencing was draped around the fence posts to protect the site (FAA and NMSA 2010b:10). The protective fence was present when research-oriented investigations were conducted at the site, but has since been removed.

Site Setting

LA 155964 is on a nearly flat area southeast of the extensive dune and gravel-topped ridge on which LA 155963 sits. Active eolian deposition has occurred in the area, with mesquite-stabilized dunes forming and creosote and grass growing between the dunes.

Preliminary Site Description

LA 155964 as originally described covered an area of approximately 52 by 80 m (3,300 sq m, 0.33 ha, or 0.81 acres) (Fig. 10.1). It was originally described as a sparse and dispersed scatter of stone artifacts with two visible fire-cracked rock features and a depression that could indicate the presence of a small structure. The fire-cracked rock features were 1.0 and 5.0 m in diameter, and the larger one was thought to be a ring midden. The evidence for a possible structure consisted of 10 rocks around the edge of a very shallow depression. Artifacts described for the site included a complete Archaic projectile point, a projectile point fragment, a unifacial scraper, 11 pieces of chipped stone (seven with retouch or use wear), a core, two tested cobbles, a basin metate fragment, and a mano. Few surface artifacts were observed and analyzed, but those that were indicated a range of activities (Quaranta and Gibbs 2008:144–145).

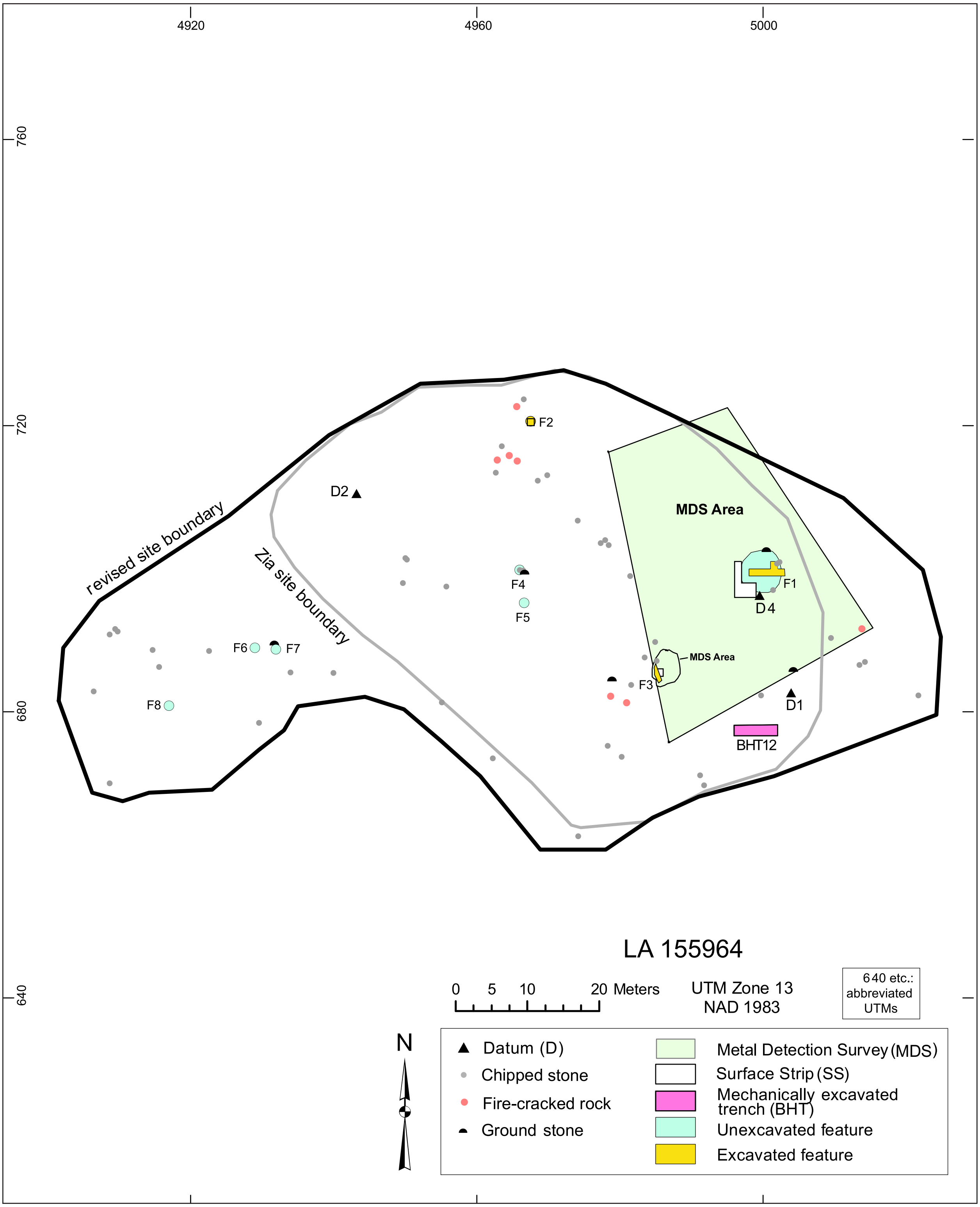

Figure 10.1. LA 155964, plan of site showing locations of features, artifacts, and excavation areas.

Research-Oriented Investigations

OAS investigations began at LA 155964 by locating surface artifacts within both the fenced area and within a buffer around the fence. This distribution was used to determine new site boundaries, which extend the site considerably to the west and east. As currently defined, LA 155964 covers 5,248.07 sq m (0.53 ha, 1.30 acres). The extent of surface artifacts and the locations of features were mapped using a total station (Fig. 10.1). All visible chipped and ground stone artifacts were analyzed in the field, and two pieces of debitage were collected for material identification. All three previously identified features were examined by excavation and five additional features were identified and described. Table 10.1 lists the features excavated, grid units associated with those features, and number of 1 by 1 m units excavated. A single geomorphological soil pit (BHT 12) was excavated near the southeastern edge of this site (Fig. 10.1).

Surface Strip Areas

A single surface strip area was excavated adjacent to Feature 1 to recover information on activities associated with the use of that large thermal feature. As proposed in the research plan (Moore et al. 2010:94), up to 13 sq m were to be excavated adjacent to features or the possible structure at this site, should the partial excavation of any of the features or structure demonstrate that they contained intact cultural deposits. Since Feature 1 appeared to be the most extensive and only comparatively intact feature, surface-stripping activities concentrated on an area adjacent to it.

Surface Strip 1. This L-shaped excavation area was adjacent to the west edge of Feature 1 and contained nine grid units including 696–700N/4996E and 696–697N/4997-4998E (Fig. 10.1). The loose sediment mantle was stripped from all nine grid units, stopping when the underlying compact Pleistocene B soil horizon was encountered. Only 1–2 percent of the surface area was stabilized by vegetation, and this consisted primarily of small tufts of grass. No artifacts were collected from the surface and fire-cracked rock was only noted on the surface of one grid unit (two fragments in 697N/4997E).

Other than the Pleistocene B soil horizon, a single stratum was encountered in this area. Stratum 1 was a brown sandy loam containing an average of 8.5 percent gravels and pea gravels. This stratum averaged 3.92 cm thick, ranging from 1.5 to 6.5 cm, with its thickness increasing from south to north. Several types of disturbance were noted including insect and rodent burrows and plant roots. Charcoal flecks and staining were common and mainly occurred in the grids closest to Feature 1, disappearing in the southwest corner of the surface strip. Most of the charcoal flecks and charcoal-stained sediments were in the lowermost 1–2 cm of fill, just above the Pleistocene B soil horizon. This suggests that the use surface at the time of occupation was the top of the Pleistocene B soil horizon. The loose sediments that now cover that horizon were deposited by eolian processes, and artifacts, fire-cracked rock, and gravel appear to have been moved upward into Stratum 1 from the surface of the Pleistocene B soil horizon by bioturbation.

Fire-cracked rock was common in Stratum 1 and occurred in all nine excavated grids. There was an average of 51.11 pieces of fire-cracked rock per grid unit, ranging from 2 to 119 pieces. The large amount of fire-cracked rock can probably be attributed to materials cleaned out of Feature 1, directly to the east. The fire-cracked rock was dominated by undifferentiated igneous materials (94.87 percent), with other materials occurring in much smaller proportions including limestone (1.79 percent), sandstone (1.79 percent), chert (1.34 percent), and metaquartzite (0.22 percent).

Chipped stone artifacts were less common than was fire-cracked rock, with 270 specimens being recovered from Surface Strip 1. There was an average of 30 chipped stone artifacts per grid unit, ranging from 9 to 55. Artifact density appeared to increase from west to east in the six southern grids (696–697N/4996–4998E) and to decrease from south to north in the five grids that ran along the west side of the excavation area (696–700N/4996E). Because Surface Strip 1 was directly adjacent to the west edge of Feature 1, we assume that the cultural materials recovered from that area were associated with the use of that thermal feature. Thus, these materials constitute the only sizeable Historic era assemblage recovered during our examination of Spaceport America sites.

<u>Assessment of Excavation Area</u>

As suggested by the configuration of deposits in Surface Strip 1, the occupational surface associated

Table 10.1. LA 155964, summary of excavation areas.

Excavation Area	Included Grids	No. of Surface-stripped and Excavated Grids
Surface Collection	n/a	n/a
Feature 1	696-697N/4996-4998E 698-700N/4996E 699N/4998-5001E 700N/5000E	14
Feature 2	720N/4967E	1
Feature 3	685N/4985E	1

with the Historic period use of Feature 1 appears to have been the top of the Pleistocene B soil horizon. Charcoal, ash, and fire-cracked rock were removed from Feature 1 and discarded around the feature, eventually being covered by a thin layer of eolian sediments (Stratum 1). The area examined by Surface Strip 1 was part of an activity or discard zone around the large thermal feature. Though some movement of cultural materials through bioturbation and erosional/aggradational processes is likely, the structure of this activity zone seems to be fairly intact and further excavation could add information on Historic period use of the region.

Features

Zia identified two fire-cracked rock features and one small structure at LA 155964. The fire-cracked rock features are described as a darkly stained possible ring midden 5 m in diameter and a smaller burned rock feature with light staining, while the structure is described as 10 cobbles surrounding a depression (Quaranta and Gibbs 2008:144).

OAS proposed the partial excavation of all three of the features identified by Zia, concentrating on any that proved to have the potential for providing samples for dating and subsistence information. An additional five features were located during the current study and inventoried. All are fire-cracked rock scatters that, from their scattered and deflated appearance, have little potential for subsurface deposits. Similarly, Feature 1 proved to have the most potential while Feature 3, the possible structure, did not provide convincing evidence that it was a structure.

Feature 1 (large rock-filled roasting pit)

Most of the effort at this site was directed toward Feature 1, the large fire-cracked rock scatter with charcoal-stained soil (Fig. 10.2). After a grid and subdatum were established, the grid units with stained soil (25 1 by 1 m grid units) were each photographed to provide a record of the surface fire-cracked rocks. Excavation began with a transect of four 1 by 1 m grid units placed in an east–west direction through the center of the stain (Fig. 10.3). Removing the upper few centimeters of loose fill demonstrated that the easternmost of these grid units was outside the feature and excavation was terminated in that grid unit. A single grid unit to the north of the transect was added to provide a north–south profile.

The feature was packed with rocks. Rather than excavating in arbitrary 10 cm levels, a layer of rocks was exposed, drawn, photographed, and removed and this sequence repeated in each grid for each layer of rock until the base was reached (Fig. 10.4). Flotation and charcoal samples were collected from each layer and grid unit. Seven layers were excavated and around 9,300 rocks were removed from the four grid units. The rocks were mainly cobbles fractured into a range of sizes from small spalls to cobbles over 10 cm in size. These were mainly igneous (60 to 70 percent) and limestone (20 to 30 percent) with small amounts of quartzite, granite, sandstone, chert, and petrified wood. Many had been fractured in place.

The pit, which measured 2.76 m east–west and at least 2.0 m north–south, in the excavated grids was excavated at least 46 cm into the compact Pleistocene B soil horizon. It was bowl-shaped with a flat bottom and walls that sloped up to the ground surface. The pit sides and bottom were unfinished, fire reddened and blackened, and scarred by rodent burrows. Resting on the flat bottom of the pit was a probable oval-shaped ring of very large cobbles (Fig. 10.5) that extends into the unexcavated grids to the north and was filled with large pieces of charcoal. The cobbles are 10 to 30 cm in size, and the area formed by the cobbles was excavated separately as Feature 1.1. Interior measurements of Feature 1.1 are just under a meter east–west and at least 30 cm north–south.

Fill within Feature 1 was a thin (2 cm) layer of loose eolian sandy loam (7.5 YR 5/6 dry) capping the darkly stained pit fill (Stratum 2 [Fig. 10.6]). This layer was a more or less homogenous (Fig. 10.7) combination of loosely packed and darkly stained sandy loam (7.5 YR 4/2) and fire-cracked rock. Charcoal was denser near the base (Fig. 10.8) and consisted of burned logs stacked in alternating directions. Abundant insect and rodent activity gave the soil a coarse-textured appearance. Fill within the Feature 1.1 portion was darker (7.5 YR 3/3 dry), with abundant charcoal and fewer pieces of fire-cracked rock.

Unlike all of the other features examined, this one produced a large number of chipped stone artifacts (n = 212) as well as small numbers of bones and ground stone artifacts. This contrasts markedly with the Spanish Colonial-era roasting pit (Feature

Figure 10.2. LA 155964, Feature 1 before excavation.

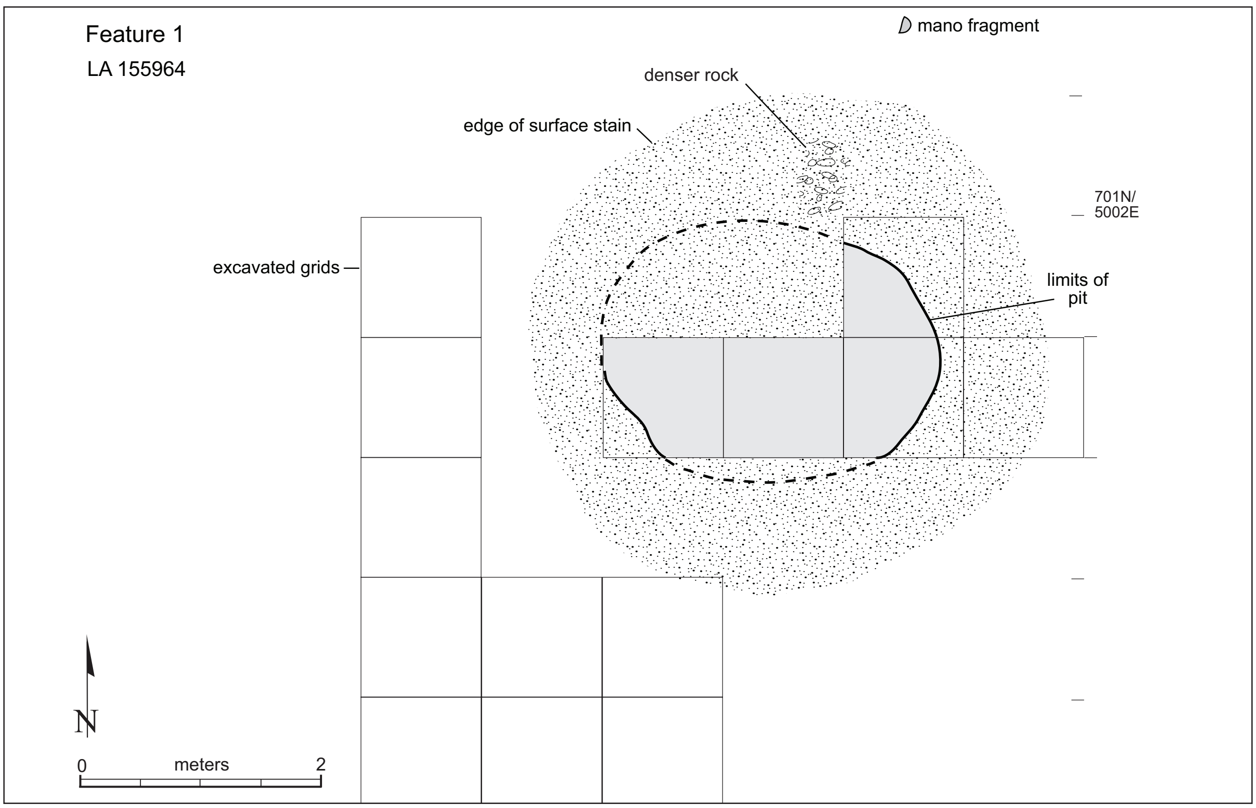

Figure 10.3. LA 155964, Feature 1, plan.

Figure 10.4. LA 155964, Feature 1 at the base of Level 6.

Figure 10.5. LA 155964, Feature 1, rock at base of pit.

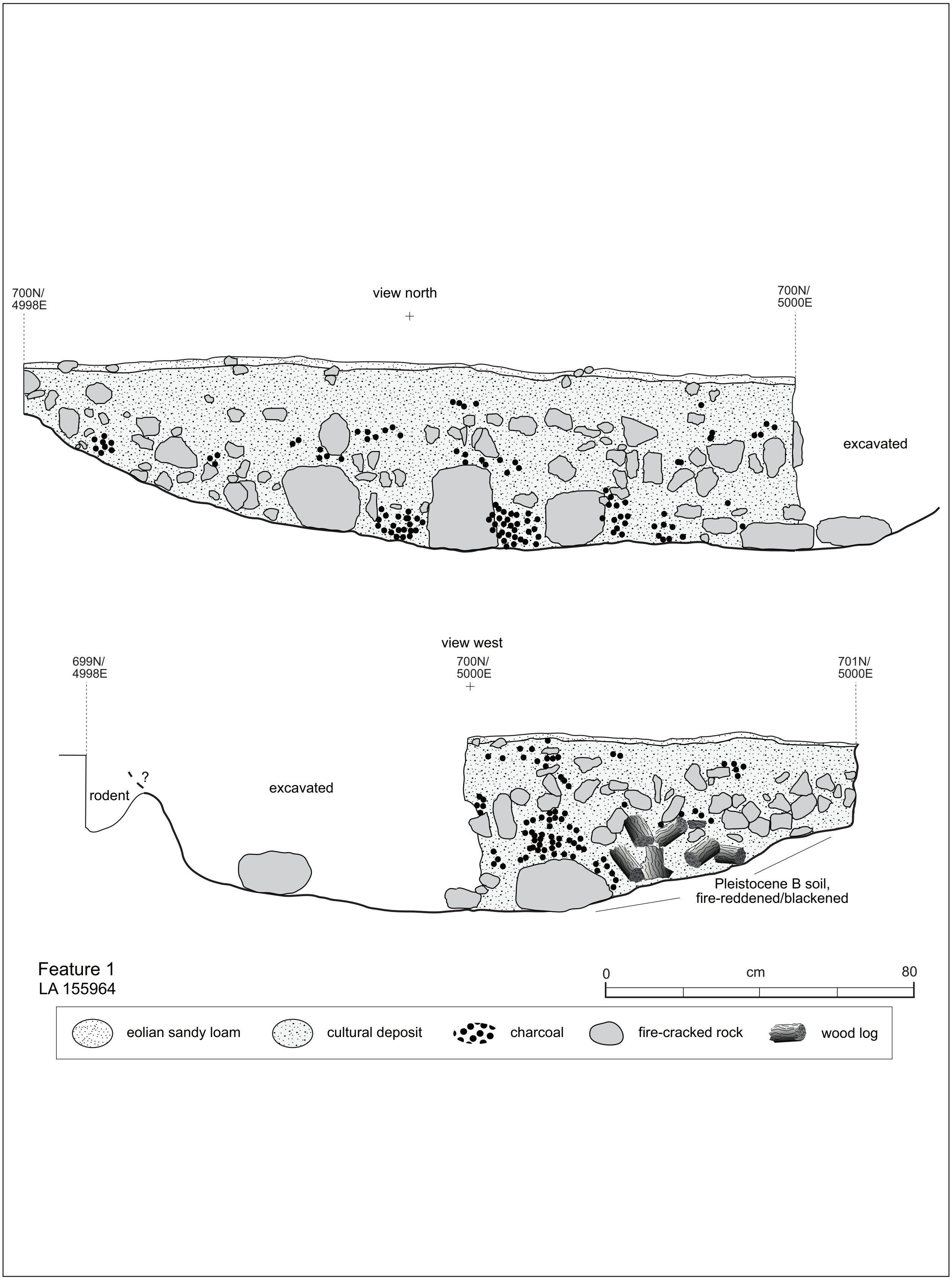

Figure 10.6. LA 155964, Feature 1, profile.

Figure 10.7. LA 155964, Feature 1, fill in east–west profile.

Figure 10.8. LA 155964, Feature 1, fill in north-south profile.

11 at LA 111429) that contained only two pieces of chipped stone from the first level of fill. Because of the sloping walls of the Feature 1 pit, fill was removed from some grid units in seven layers while others had only two levels of rock. Table 10.2 gives chipped stone artifact counts by grid unit and level, indicating that they were distributed throughout the fill rather than clustering in any particular level. It also shows that fairly large proportions in some levels were angular debris along with a scattering of cores and pot lids. Nearly half of the chipped stone artifacts (47.3 percent) were thermally altered, and in 89.7 percent of cases that alteration came from discard into a thermal feature. Thermally altered chipped stone artifacts were recovered from all levels in most of the grids, suggesting that they were part of the rock material placed in the pit as heating elements. The heat-crazed artifacts were all mostly fine-grained chert (with one limestone pot lid) and comprised half of the angular debris and a quarter of the core flakes. Overall, the assemblage from within the pit was similar to that recovered by surface stripping to its west and south. Angular debris were much more common in the surface strip (65.8 percent versus 48.1 percent) and core flakes were less common (28.9 versus 33.5 percent). Whole artifacts were also more common in the surface strip (77.0 versus 75.5 percent) and fewer of these were thermally altered (33.0 versus 48.1 percent).

Ground stone artifacts were found in three grid units. A limestone fire-fractured mano fragment was found in the first level of fill. The other two were from deep in the pit (Level 6) and include a fragment of a basalt metate and a complete limestone edged abrader, both fire-fractured.

Much of the fauna (n = 78) recovered from this feature was from flotation samples (74.4 percent). None are burned and all are from small mammals including lizards and snakes (21.8 percent), rodents (20.5 percent), and rabbits (19.2 percent). The rest are small unidentifiable fragments. Specimens tend to be fairly complete (41 percent) and most, if not all, are probably post-occupational.

The 23 flotation samples from Feature 1 contained charred amaranth and bugseed seeds, yucca basal caudex, some with leaf and fiber fragments, grass stems, and cactus areoles, epidermis, and stem tissue. A macrobotanical sample from deep in the pit was a flat-stemmed cactus pad fragment. Fuel wood from the pit is largely mesquite with very small amounts of saltbush, tarbush, and yucca caudex and stem. Burned aster family seeds, grass stems, and yucca basal caudex and fiber were found in the two samples from Feature 1.1. Samples of yucca stem, yucca caudex, mesquite, tarbush, and cactus pads were submitted for radiocarbon analysis and the most accurate and most precise date is AD 1800–1940 (Boyer, Chapter 19, this report). Given the absence of metal artifacts, shown by a subsequent intensive metal detector survey around (294 sq m) Feature 1, and the number of associated chipped stone artifacts, it was probably built and used at the early end of that range of dates.

The amount of cultural material associated with this feature suggests that early Historic period groups either spent an extended amount of time at the site or it was occupied a number of times, probably during the warm season. Yucca, mesquite, and tarbush wood were gathered, as well as just about every cobble in the vicinity, and used to prepare the pit for roasting.

Feature 2 (small fire pit)

Feature 2 is a scatter of about 25 fire-cracked rocks (Fig. 10.9) in a slight depression (Fig. 10.10). Excavation began by removing the loose fill from the grid containing the rock, determining the extent of the feature, then removing the charcoal-stained fill from among the rocks. Fill within the pit was eolian sandy silt (7.5 YR 6/4) with a small amount of charcoal. A total of 66 pieces of fire-cracked rock was removed from the grid (Fig. 10.11), 62 of which were considered part of the feature. No artifacts were recovered.

At best, Feature 2 was a small fire pit measuring 0.80 by 0.66 m and up to 0.10 m deep. The pit was shallow with no distinct form. Use was apparently brief but the deflated nature of the fire pit may have removed evidence of a more substantial feature. No artifacts were recovered from the feature or grid excavation. The flotation sample taken from beneath the rocks contained burned monocot stems, unknown plant parts that could be cactus pad tissue, and a few very small pieces that could be fragments of yucca fruit. Flotation wood consisted of five pieces of mesquite and fifteen of saltbush.

Feature 3 (possible activity area)

The possible structure was examined by excavating a 1 by 1 m grid unit that contained one of

Table 10.2. LA 155964, Feature 1, chipped stone artifacts.

North	East	Level	Elevation		Angular Debris		Core Flake		Pot Lid		Tested Cobble		Uni-directional Core		Bidirectional Core		Multi-directional Core		**Total**	
			Start	End	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %
699	4998	1	9.86	9.88	1	14.3	3	42.9	2	28.6	–	–	1	14.3	–	–	–	–	7	100.0
		2	9.88	9.90	6	54.5	2	18.2	1	9.1	–	–	1	9.1	1	9.1	–	–	11	100.0
		3	9.90	9.96	6	35.3	8	47.1	3	17.6	–	–	–	–	–	–	–	–	17	100.0
		4	9.26	10.05	1	25.0	2	50.0	1	25.0	–	–	–	–	–	–	–	–	4	100.0
		5	10.05	10.14	1	50.0	1	50.0	–	–	–	–	–	–	–	–	–	–	2	100.0
		6	10.14	10.16	8	80.0	1	10.0	1	10.0	–	–	–	–	–	–	–	–	10	100.0
699	4999	1	9.84	9.93	8	72.7	1	9.1	2	18.2	–	–	–	–	–	–	–	–	11	100.0
		2	9.93	9.95	1	50.0	1	50.0	–	–	–	–	–	–	–	–	–	–	2	100.0
		3	9.95	10.00	2	66.7	–		1	33.3	–	–	–	–	–	–	–	–	3	100.0
		4	10.00	10.01	4	28.6	5	35.7	3	21.4	–	–	1	7.1	–	–	1	7.1	14	100.0
		5	10.01	10.04	5	45.5	4	36.4	2	18.2	–	–	–	–	–	–	–	–	11	100.0
		7	10.10	10.14	7	43.8	7	43.8	1	6.3	1	6.3	–	–	–	–	–	–	16	100.0
		8	10.14	10.30	4	57.1	2	28.6	1	14.3	–	–	–	–	–	–	–	–	7	100.0
699	5000	1	9.85	9.91	12	52.2	7	30.4	4	17.4	–	–	–	–	–	–	–	–	23	100.0
		2	9.91	9.93	3	75.0	–	–	1	25.0	–	–	–	–	–	–	–	–	4	100.0
		3	9.96	9.91	4	57.1	2	28.6	1	14.3	–	–	–	–	–	–	–	–	7	100.0
		4	9.96	10.02	–	–	1	100.0	–	–	–	–	–	–	–	–	–	–	1	100.0
		5	10.02	10.05	2	28.6	5	71.4	–	–	–	–	–	–	–	–	–	–	7	100.0
		6	10.05	10.06	4	66.7	1	16.7	1	16.7	–	–	–	–	–	–	–	–	6	100.0
		7	10.06	10.22	8	57.1	4	28.6	2	14.3	–	–	–	–	–	–	–	–	14	100.0
699	5001	1	9.89	9.90	3	25.0	5	41.7	2	16.7	–	–	–	–	–	–	2	16.7	12	100.0
		2	9.90	9.93	–	–	1	100.0	–	–	–	–	–	–	–	–	–	–	1	100.0
700	5000	1	9.81	9.91	2	40.0	2	40.0	1	20.0	–	–	–	–	–	–	–	–	5	100.0
		2	9.91	9.92	4	44.4	4	44.4	1	11.1	–	–	–	–	–	–	–	–	9	100.0
		3	9.92	10.02	5	83.3	1	16.7	–	–	–	–	–	–	–	–	–	–	6	100.0
		4	10.02	10.05	1	50.0	1	50.0	–	–	–	–	–	–	–	–	–	–	2	100.0
Total					102	48.1	71	33.5	31	14.6	1	0.5	3	1.4	1	0.5	3	1.4	212	100.0

Figure 10.9. LA 155964, Feature 2 before excavation.

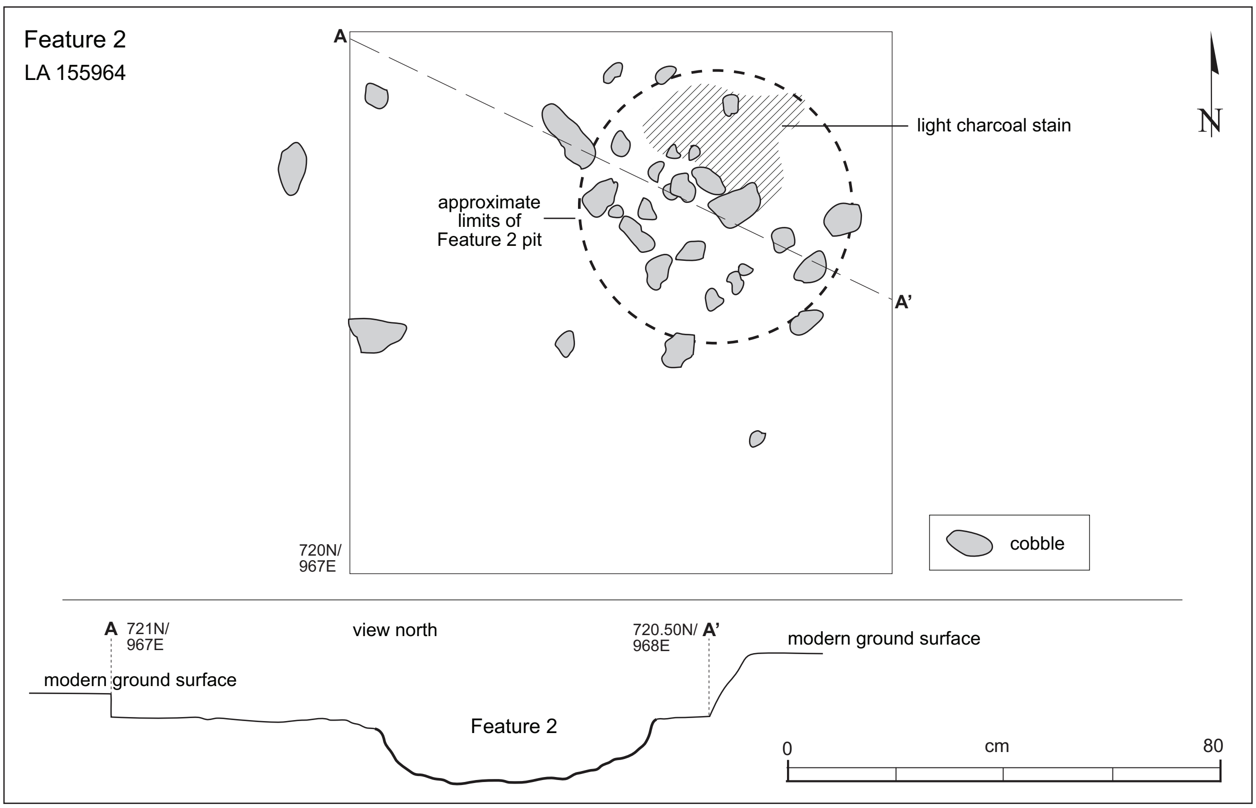

Figure 10.10. LA 155964, Feature 2, plan and profile.

Figure 10.11. LA 155964, Feature 2, pit after rocks were removed.

the large cobbles that Zia described as rimming the structure (Quaranta and Gibbs 2008:144). The surface was fine eolian sandy loam containing small pieces of gravel, mesquite, and grass. Three levels of fill (30 cm) were removed. The uppermost fill was loose eolian sandy loam, which was heavily disturbed by rodent burrows and contained a single fire-cracked rock. Soil became more compact in the second level and produced more fire-cracked rock (about 20 pieces) but no artifacts. The final level was even more compact with no fire-cracked rock, a small amount of gravel, and some carbonate deposits. The excavators concluded that the fill was naturally deposited into what may be a slight, depression in the harder Pleistocene soils. No further investigations were done, no photos were taken, and no profile was drawn.

After the radiocarbon dates identified Feature 1 as Early Historic, more intensive metal detecting was conducted at the features dating to that period. While no metal was detected in the 16 sq m around Feature 3, it was photographed (Fig. 10.12) and the remaining rocks were mapped (Fig. 10.13). The mapping revealed the presence of two hammerstones, a core, and three pieces of chipped stone. While it did not meet expectations for a prehistoric feature, the associated artifacts could represent the remains of a more ephemeral occupation by later groups. Further excavation would be needed to determine if it is cultural or non-cultural.

Feature 4 (fire-cracked rock scatter)

Features 4 and 5 are located about 3 m apart near the center of the site. Feature 4 is a fairly small concentration of fire-cracked rock located just east of a low mesquite shrub in an area containing at least one chipped stone tool, one chert core, and a one-hand mano. The 30 or so rocks in this feature covered an area measuring 4.6 m north–south by 2.2 m east–west, with a denser concentration measuring 1.7 m north–south by 1.5 m east–west (Fig. 10.14). A maximum density of seven fire-cracked rocks was observed in a 50 by 50 cm area. The rocks were mainly igneous and limestone cobbles with a

Figure 10.12. LA 155964, Feature 3, rock.

considerable amount of burned caliche and some sandstone. No ash was visible and there was little soil depth, suggesting that the potential for subsurface deposits is low. A complete limestone one-hand mano was associated with this feature. No excavations were undertaken at Feature 4.

Feature 5 (fire-cracked rock scatter)

Feature 5 is a small fire-cracked rock scatter measuring 2.5 m north–south by 2.1 m east–west (Fig. 10.15). It was made up of about 20 fire-cracked cobbles that were mainly igneous with some limestone and quartzite. The maximum density in a 50 by 50 cm area is only two pieces of fire-cracked rock. No artifacts were observed in the immediate vicinity of the feature, and there appeared to be little soil deposition. Absent any evidence of charcoal-stained soil, this feature has a low potential for containing subsurface deposits that could provide chronometric samples or subsistence remains. No excavations were undertaken at Feature 5.

Feature 6 (fire-cracked rock scatter)

Features 6, 7, and 8 are all on the west side of the site and outside the originally defined site boundaries. Feature 6 is a loose concentration and scatter of fire-cracked rock (Fig. 10.16) composed of about 50 rocks. These were mainly lightly fractured igneous cobbles with some limestone and sandstone. It measured at least 3.0 m north–south by 9.0 m east–west, with a denser concentration that was 1.0 m north–south by 2.0 m east–west. The maximum density of rocks is 13 in a 50 by 50 cm area. No artifacts were noted in or around the feature but its location at the southern edge of, and possibly under, an area of grass-stabilized soil could possibly obscure evidence of cultural deposits. No excavations were undertaken at Feature 6.

Feature 7 (fire-cracked rock scatter)

Located at the northwestern edge of the same stabilized grassy area as Feature 6, Feature 7 may be part of the same fire-cracked rock scatter as Feature 6 with the center located under the grass. Feature 7

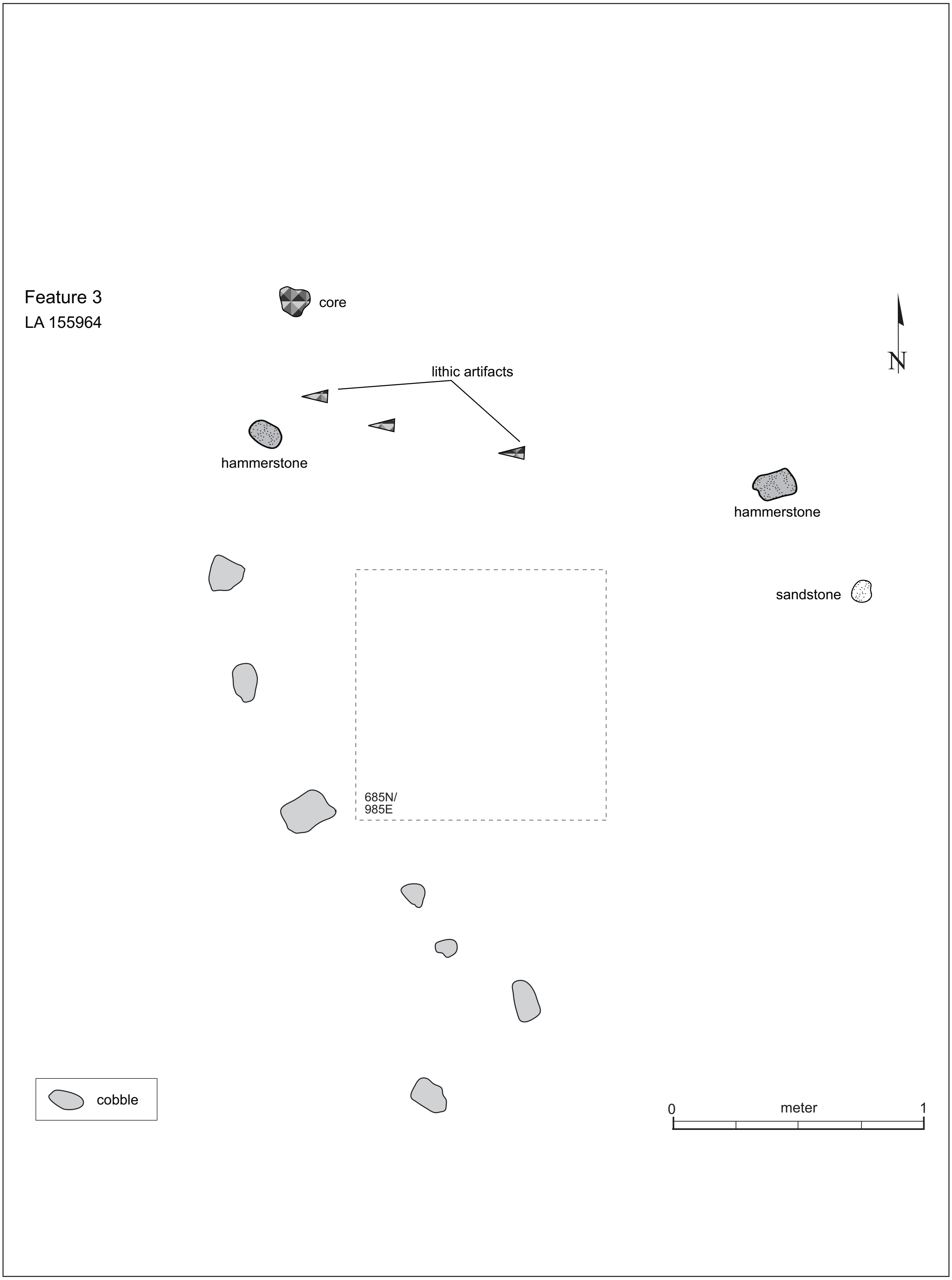

Figure 10.13. LA 155964, Feature 3, plan of rock comprising feature.

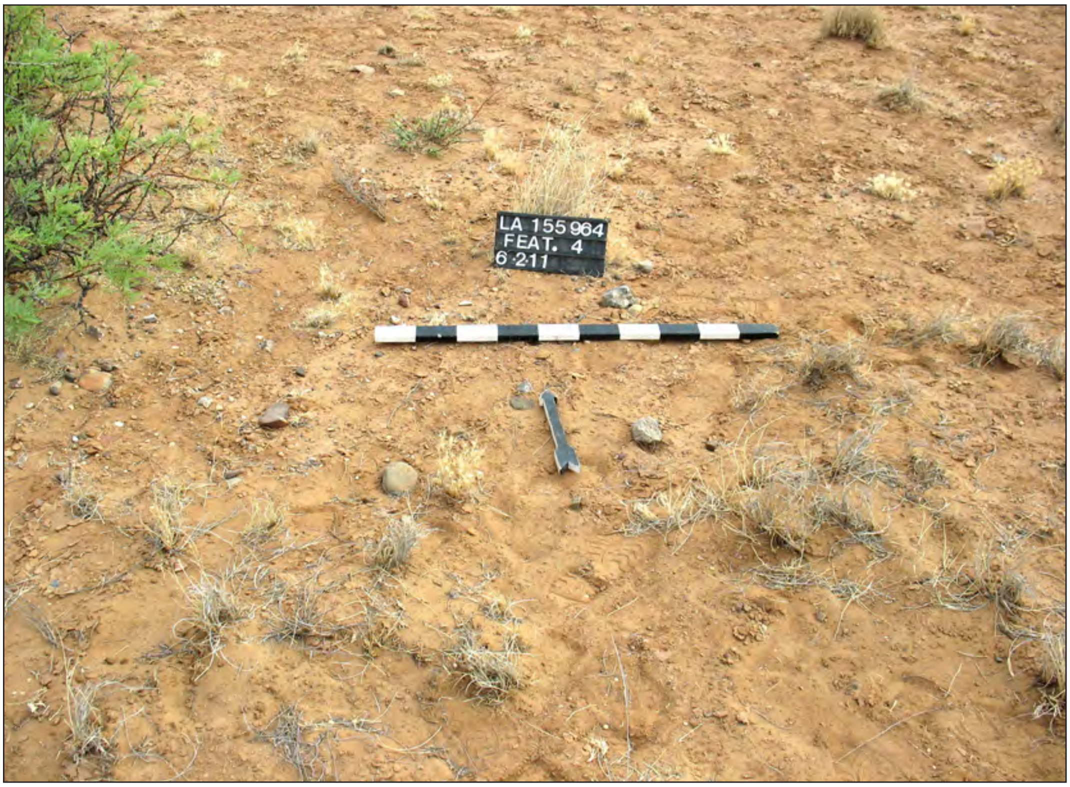

Figure 10.14. LA 155964, Feature 4.

Figure 10.15. LA 155964, Feature 5.

Figure 10.16. LA 155964, Feature 6.

is a scatter of about 40 rocks with no apparent concentration covering an area of at least 1.0 m north–south by 3.2 m east–west (Fig. 10.17). The maximum density is 12 pieces of fire-cracked rock in a 50 by 50 cm area. The rocks are highly fragmented and mainly igneous with a few pieces of limestone and sandstone. As with Feature 6, no artifacts were observed nearby and the potential for subsurface deposits depends on whether there are more intact portions of the feature beneath the grass-stabilized soil. No excavations were undertaken at Feature 7.

Feature 8 (fire-cracked rock scatter)

This scatter of 60 to 70 pieces of fire-cracked rock measured 8.5 m north–south by at least 4.5 m east–west, with a more concentrated area that was 1.8 m north–south by 1.5 m east–west (Fig. 10.18). It extended out of and around a small grass-stabilized dune with mesquite shrubs on three sides. Rocks are again mainly igneous with smaller amounts of limestone, quartzite, and sandstone. Rocks are minimally to moderately fractured and a maximum density of 8 was observed in a 50 by 50 cm area. Few artifacts were observed in the general vicinity of the feature, and the potential for subsurface deposits is low unless it extends beneath the dune. No excavations were undertaken at Feature 8.

Artifact Assemblages

Information from two levels of analysis is available for LA 155964—in-field analysis and laboratory analysis. In-field analyses recorded fewer attributes than were used in the laboratory analyses. However, consistency was maintained in the codes used in both levels of analysis to allow all artifacts from certain categories to be used together. The artifacts included in both levels of analysis are discussed separately.

In-Field Analyses

In-field analyses collected information on 83 chipped stone artifacts, five pieces of ground stone, and 31 fragments of fire-cracked rock. The chipped stone assemblage is dominated by cherts (n = 43, 51.81 percent), and also includes limestone (n = 20,

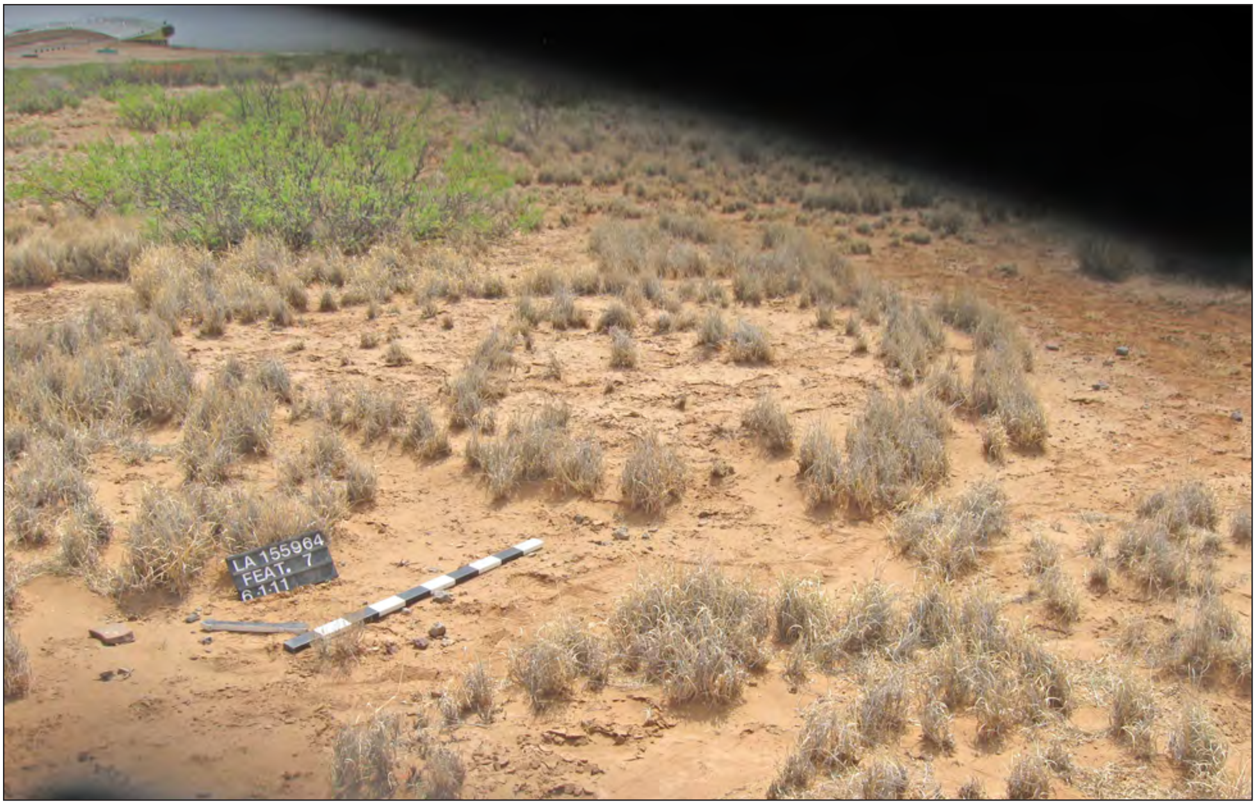

Figure 10.17. LA 155964, Feature 7.

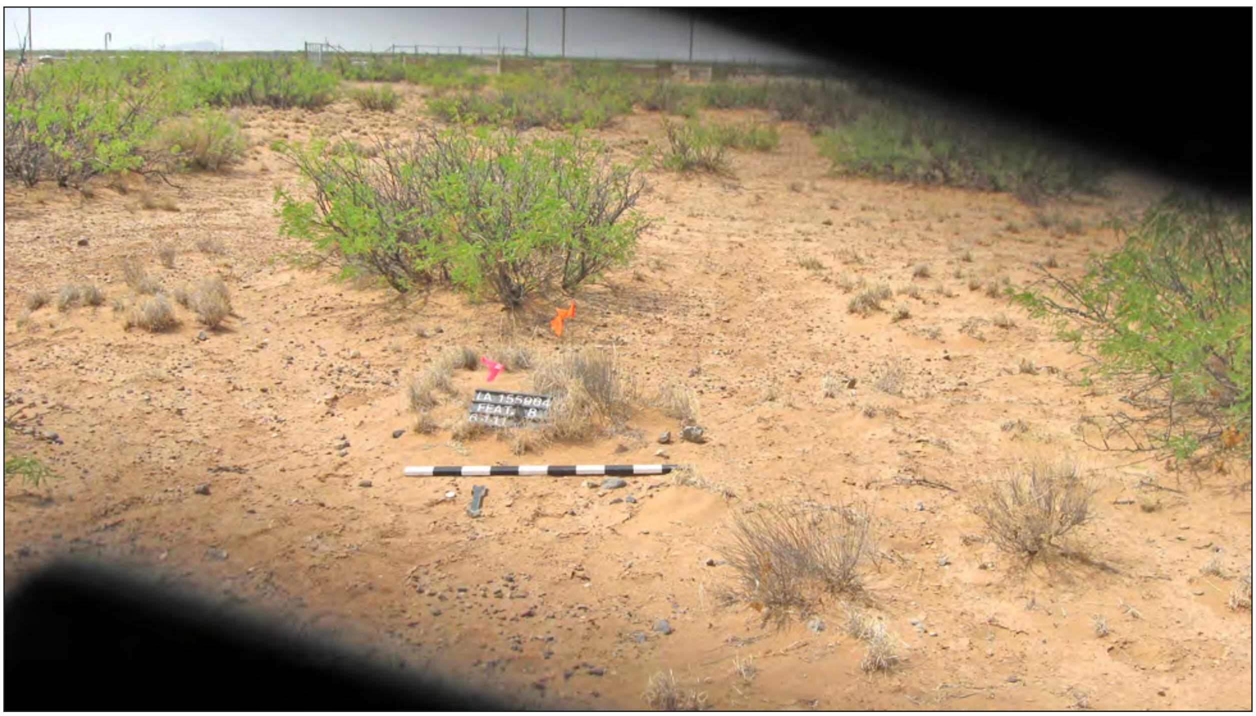
Figure 10.18. LA 155964, Feature 8.

24.10 percent), metamorphic undifferentiated (n = 6, 7.23 percent), metaquartzites (n = 6, 7.23 percent), rhyolite (n = 5, 6.02 percent), silicified wood (n = 1, 1.20 percent), basalt (n = 1, 1.20 percent), and siltstone (n = 1, 1.20 percent).

Seven tools—a chopper, two side-scrapers, three bifaces, and a projectile point fragment—were analyzed in the field. Although two of the bifaces were complete, no exact functions can be defined for them. Since the projectile point is represented by a medial fragment, its type also cannot be defined. However, from the size of this fragment it was probably part of an Archaic dart point. The remaining chipped stone artifacts are debris created during reduction. Core flakes dominate (n = 35, 67.31 percent), followed by angular debris (n = 5, 9.62 percent), cores (n = 4, 7.69 percent), and a biface flake (n = 1, 1.92 percent).

Five ground stone tools were recorded on the surface, three of which are fragmentary but represent different tools. They include a basalt basin metate fragment, a sandstone slab metate fragment, a sandstone one-hand mano reused as a hammerstone, a complete limestone one-hand mano, and an orthoquartzite one-hand mano fragment. Individual pieces of fire-cracked rock that were not directly associated with thermal features were also plotted and described, and include two fragments of limestone and one each of undifferentiated igneous, undifferentiated metamorphic, chert, and rhyolite.

Laboratory Analyses

Summaries of the results of the laboratory analyses are provided here, with more detailed discussions provided in the synthetic chapters later in this volume.

Chipped Stone. A total of 485 chipped stone artifacts were recovered during excavation from three contexts: surface collection (n = 3, 0.62 percent), the Feature 1 surface strip (n = 270, 55.67 percent), and Feature 1 excavation (n = 212, 43.71 percent). The surface collected artifacts include an obsidian core flake, a chert end/side scraper, and the large projectile fragment that was also discussed in the in-field analysis section.

Overall, the assemblage is dominated by cherts (n = 462, 95.26 percent), distantly followed by limestone (n = 12, 2.47 percent), igneous undifferentiated (n = 4, 0.82 percent). metaquartzite (n = 3, 0.62 percent), silicified wood (n = 3, 0.62 percent), and obsidian (n = 1, 0.21 percent). Various types of debitage dominates the assemblage, including angular debris (n = 287, 59.18 percent), core flakes (n = 150, 30.93 percent), and pot lids (n = 38, 7.84 percent). Eight cores (16.50 percent) were also recovered. The only formal tools were the end scraper and projectile point fragment that were mentioned above (0.21 percent apiece).

The assemblage recovered from the Feature 1 surface strip is very similar in character to the overall assemblage. This assemblage is also dominated by various cherts (n = 261, 96.67 percent), followed distantly by limestone (n = 5, 1.85 percent), igneous undifferentiated (n = 2, 0.74 percent), silicified wood (n = 1, 0.37 percent), and metaquartzite (n = 1, 0.37 percent). Only debitage were found in this area including angular debris (n = 185, 68.52 percent), core flakes (n = 78, 28.89 percent), and pot lids (n = 7, 2.59 percent). The large percentage of angular debris is probably due to thermal fragmentation, with either artifacts or unflaked nodules exploding in the fire, resulting in numerous pieces that do not exhibit the characteristics of intentionally removed flakes.

The somewhat smaller assemblage from Feature 1 is also dominated by cherts (n = 199, 93.87 percent), followed by limestone (n = 7, 3.30 percent), silicified wood (n = 2, 0.94 percent), igneous undifferentiated (n = 2, 0.94 percent), and metaquartzite (n = 2, 0.94 percent). This assemblage is mostly composed entirely of debitage including angular debris (n = 102, 48.11 percent), core flakes (n = 71, 33.49 percent), and pot lids (n = 31, 14.62 percent), but also includes cores (n = 8, 3.77 percent).

Ground Stone. Three ground stone tools were collected from Feature 1 at LA 155964. All are heat fractured, indicating reuse as a thermal elements. These are an edge fragment of a limestone mano, a complete but fire-fractured limestone edge abrader, and an internal fragment of a sandstone metate. Because of their fragmentary nature, more exact determinations of tool type cannot be made.

Fauna. Seventy-eight pieces of bone were recovered from LA 155964, all of which came from Feature 1. Numerous taxa are represented including unknown small animal (n = 27), jackrabbit (n = 12), lizards (n = 10), small rodent (n = 9), medium to large rodent (n = 7), small mammal (n = 3), cottontail (n = 3), snakes (n = 3), reptile or amphibian (n = 3), and whiptail (n = 1). None of these specimens are burned, though one bone from a jackrabbit may have been cut through, suggesting cultural use. Most of these specimens, with the exception of the specimen exhibiting cut marks, are probably intrusive to Feature 1 rather than representing consumed animals.

Flotation. Twenty-one flotation samples were collected from Feature 1 and one was taken from Feature 2. Charred plant seeds were common in the main part of Feature 1 and included amaranth, bugseed, goosefoot, grass, aster, monocot, mesquite, and unknown seeds as well as various parts of cactus and yucca. Only aster and monocot seeds were identified in Feature 1. The yucca consisted primarily of caudex fragments, though some seeds and fragments of fruit were also recovered. Cactus was represented by several parts including stem fragments, probable aureoles, and epidermis fragments. Feature 2 produced specimens of a monocot and an unknown taxon. While most of the seeds, fruit, pad, and other cactus fragments probably represent food use, the yucca caudex more likely served as fuel. A wide range of other plants were also identified in these samples, but are unburned and probably of non-cultural derivation, suggesting a degree of disturbance in both features, probably the result of bioturbation.

Mesquite wood is ubiquitous in the charcoal recovered from flotation samples as well as the charcoal samples from Features 1 and 2, comprising well over 90 percent of the wood in each sample (see Chapter 17, this report). Saltbush is the second most common type of fuel, but occurs in comparatively small percentages when present. Other types of fuels include wood from probable tarbush, yucca caudex, and yucca stem.

Radiocarbon. Five radiocarbon samples from Feature 1 were analyzed; they provided potential use dates. When possible, materials from plants with comparatively short lives that would not have survived long on the surface after the demise of the plant were used in this analysis, though some wood samples were also submitted. All five samples provide multiple intercepts, but the most accurate and most precise dates place it in the Historic era between 1800 and 1940. Considering the prevalence of chipped stone artifacts in the assemblage and the complete lack of metal artifacts, an early eighteenth century date is more likely. The proximity of the Aleman Ranch, which had a military presence for a period after its establishment in 1867 (Quaranta and Gibbs 2008:37) suggests that any dates later than the mid-1800s probably postdate the use of this feature.

LA 155964 Summary and Recommendations

The research investigation plan for LA 155964 included locating diagnostic artifacts, artifact clusters, and features and investigating the three features identified by Zia. If subsurface cultural materials were encountered, the plan was to excavate up to 13 sq m adjacent to features that contained intact cultural deposits. A single mechanical geomorphological trench was to be excavated and OSL samples were to be collected (Moore et al. 2010a:94).

OAS located and field analyzed 83 chipped stone artifacts, 5 pieces of ground stone, and 31 pieces of fire-cracked rock that were not specifically associated with a feature. In addition, fire-cracked rock Features 4–8 were identified and described. Most of the excavation at this site focused on Feature 1, a large fire-cracked cobble-filled roasting pit. The pit was partially excavated by placing a row of grid units bisecting the pit from east to west and a single grid adjacent and to the north of the row of grid units to provide a profile in the other direction. In addition to the feature excavation, nine grids to the west and southwest of Feature 1 were surface stripped to obtain associated artifacts. Feature 2, a small indistinct fire-pit, was investigated using a single grid unit. No artifacts were recovered. The third feature was problematic. A single grid unit was placed in a slight depression that was bordered by several large cobbles. Zia felt that Feature 3 was a structure, but nothing in the fill of the grid unit or its profile supported the Zia inference and it was not investigated further. In retrospect, given the late radiocarbon dates for Feature 1, it is possible that Feature 3 is a use area associated with that occupation, but nothing beyond the presence of a line of larger rocks and a small assemblage of chipped stone artifacts remain.

The surface assemblage from the site contained several chipped stone (end/side scraper and a projectile point fragment) and ground stone (metate and mano fragments) tools. Some were near, and possibly associated with, features. Excavation recovered a large sample of chipped stone artifacts from Feature 1 and the surrounding area. Three pieces of ground stone were among the fire-cracked rocks and were probably recycled and used as heating elements. Feature 1 flotation samples (n = 21) and wood samples (n = 24) collected for dating indicate that mesquite was the primary fuel wood with small amounts of yucca caudex, saltbush, and tarbush also used. Burned yucca stems and fiber, grass stems, aster seeds, and cactus pads were also recovered. A single sample from Feature 2 had mesquite and saltbush wood and an array of mostly unknown plant parts. A fair amount of fauna (n = 78) was found in Feature 1, mainly in the flotation samples. All are from small animals, none are burned and most are probably post-occupational additions to the feature fill.

A large percentage of the assemblage recovered from Feature 1 and the associated surface strip has attributes that suggest improper thermal alteration and, thus, probably represents a combination of artifacts that were discarded into the feature before or during use. In addition, some heat fractured debris may be fragments of unreduced chert cobbles that were likely used as heating elements and were broken during that use. Most, if not all, of the artifacts recovered in the surface strip were probably discarded materials cleaned out of Feature 1.

Feature 1 has one of the latest radiocarbon dates for the project, between 1800 and 1940. Intensive metal detecting around it and Feature 3 recovered no metal, suggesting the occupational date probably falls at the early end of this span. No ceramics were recovered from this site and the projectile point was a medial fragment of a probable dart point that could not be further identified.

The presence of a large complex roasting feature dating to the nineteenth or early twentieth century was not anticipated. In this respect, Feature 1 and the Protohistoric and Historic features documented by this project provide interesting information on the use of the Spaceport area during this period of time. Evidence for use during the nineteenth or twentieth centuries was expected to display a different character, especially a reduced importance for chipped stone tools and an increased importance for metal tools and Euroamerican materials. This clearly is not the case for Feature 1 and Feature 3, if associated. Other than the better-preserved nature of Feature 1, this roasting pit and its associated artifacts closely resemble those left behind by prehistoric occupations. Indeed, lacking the late radiocarbon dates, Feature 1 would have been (and was) assumed to represent a prehistoric occupation, perhaps during the Late Archaic based on the presence of a probable dart point fragment in the surface assemblage. Given the sheer number of thermal features recorded by this project as a whole and the six Protohistoric and early Historic period features that were identified by their dates only, there may be a significant presence of late occupations in the study area that are otherwise impossible to define.

With remaining features and artifacts, as well as the unexcavated portion of Feature 1 and the surrounding area, this site retains considerable potential for future research. None of the smaller features have the same potential as Feature 1, and their relationship to that roasting pit is uncertain and certainly undemonstrated. Additional excavation in and around Feature 1 could add further information to our knowledge of this late occupation.

11 | Investigations at LA 155968

Introduction

LA 155968 was originally described by Zia as a prehistoric chipped-stone artifact scatter with features. It is located on NMSLO trust land and has been determined as "eligible" under Criterion "d" for NRHP. The site has integrity (between 51 and 75 percent); there are subsurface deposits, including features with dating potential; and there is a significant artifact assemblage. For these reasons, it has the potential to address research questions concerning regional prehistory. The site lies within a proposed utility corridor (Quaranta and Gibbs 2008:183, 404) and has been impacted by improvements to a county road that passes along its southern edge. Research-oriented investigations were initiated to examine a large stain; to determine the stain's nature and state of preservation; and, from collected subsistence and dateable samples, to gain a more accurate idea of how the feature was used and when the site was occupied. Additional excavation was conducted to help determine whether the artifacts at this site are primarily on the surface, or whether buried cultural deposits exist. Other reasons for this study include obtaining information on subsistence practices, season of occupation, mobility patterns, and whether multiple occupations are represented.

Previous Work

LA 155968 was first recorded by Zia in 2007. One feature was described and the tools and a sample of debitage were analyzed. The site was revisited by Victor Gibbs of Zia in 2009 to locate the site boundaries and mark a 50-foot protective buffer. The buffer was delineated with metal stakes and orange-mesh fence was draped around the stakes (FAA and NMSA 2010b:22). The protective fence was removed after OAS work was completed at the site in 2011.

After the protective fence was installed in 2009 the site was revisited by Elizabeth Oster and Victor Gibbs and the map revised. Boundaries of a proposed road-construction disturbance corridor were staked by professional surveyors within the site area. The staking was monitored by NMSA's cultural resources contractor Elizabeth Oster and Zia archaeologist Victor Gibbs. Re-examination of both the site surface in the southern third of the site and the buffer resulted in the discovery of a fragment of a Folsom point made of gray chert, which was collected. A series of auger holes were excavated in the southern area, three each adjacent to two fire-cracked rock scatters and at 10 m intervals just within the northern edge of the proposed construction disturbance corridor and the proposed fence location. The auger tests indicated that the unconsolidated fire-cracked rock scatters lack subsurface context and it is unlikely that subsurface cultural materials are associated with them.

After consultation with the NMSLO and NMSHPO in November of 2009, Elizabeth Oster monitored the construction of a wastewater line within the 50-foot buffer area just outside the southern site boundary. No features or artifacts were exposed and no deposits with staining, charcoal flecks, or other indications of cultural deposition were observed (FAA and NMSA 2010b:23).The FAA determined, and the Section 106 consulting parties agreed, that construction of the road would not adversely affect the site as long as the site was fenced and the construction monitored. Surface artifacts in the area were collected and construction monitoring conducted in March of 2010 did not expose intact subsurface features (FAA and NMSA 2010b:22–23).

Site Setting

Situated on near-level ground with a slight slope to the southeast, the site is in an area of mesquite-stabilized sand hummocks and grass. The ground is covered by naturally occurring gravel and is somewhat deflated and eroded. It is surrounded by a tobosa grassland (Quaranta and Gibbs 2008:183).

Preliminary Site Description

LA 155968 was initially described as a medium-sized prehistoric artifact scatter of unknown affiliation (Fig. 11.1) covering an area of approximately 100 by 175 m (8,866 sq m, 0.89 ha, 2.19 acres). Site dimensions were changed somewhat during the OAS investigation (see below). The only feature described by Zia was a 3.0 m diameter stain with a few fire-cracked rock fragments along the periphery and a mano fragment at the edge. It was interpreted as the remains of a small habitation structure (Quaranta and Gibbs 2008:183). Three unconsolidated fire-cracked rock scatters were noted to the southeast and southwest of the stain. The plotted tools (1 biface fragment, 6 scrapers, 1 utilized flake, 1 one-hand mano, and 4 metate fragments) were scattered throughout the site area. The sample of debitage included 4 pieces of angular debris, 16 flakes, and 2 cores. The surface artifact assemblage, which was estimated at about 100 artifacts, included chipped stone and ground stone artifacts (FAA and NMSA 2010b:22). The presence of a Folsom point fragment could signal the presence of a Paleoindian component.

Research-Oriented Investigations

OAS investigations began with the flagging and collecting of all visible surface artifacts within the temporary fence and a buffer area beyond the fence. A total station was used to map the distribution of surface artifacts and features (Fig. 11.1). The artifact distribution was then used to determine current site boundaries. The improved county road has eliminated what was the southern boundary of this site, so the new site boundary in that area is north of the right-of-way fence. Site boundaries were expanded along most of the perimeter other than the southern boundary. As currently defined, LA 155968 covers 11,921.93 sq m (1.19 ha, 2.95 acres). Surface collection resulted in the recovery of a considerably larger chipped stone assemblage than was predicted, and the entire surface assemblage included a few sherds and pieces of ground stone. Features 2 through 6 were identified and inventoried. Table 11.1 provides information on excavated areas, including grid units, number of grid units excavated, and associated artifacts.

As specified in the research design (Moore et al. 2010a:96), most excavation focused on Feature 1, a large stain thought to represent the remains of a structure. Eight grid units were originally proposed for excavation, with five used to bisect Feature 1. Though not explicitly specified in the research design, the three remaining grid units were to be used to examine other parts of the site to determine whether cultural deposits occurred outside Feature 1. Though the number of grid units excavated in Feature 1 exceeded the number specified because of the nature of that feature (as discussed later), three grid units were still used to assess other parts of the site.

Those 1 by 1 m exploratory grid units (EGU) were placed at various locations across the site. EGU 1 was placed in an area of loose eolian sediment to determine whether that sediment was obscuring cultural deposits. EGU 2 was in an area covered with eolian silty clay where about 15 small pieces of fire-cracked rock and scattered tufts of grass were visible on the surface. EGU 3 was in an area covered with eolian clayey silt and sparse small gravels, but no fire-cracked rock was noted on the surface.

Most of the work at this site was directed toward Feature 1, a large area of carbon-stained sediment within a sparse fire-cracked rock scatter. Surface fire-cracked rock and artifacts (a chopping tool, a chipped stone artifact, and two sherds) were mapped and 15 grid units were surface-stripped to define the extent of carbon-stained sediment and any associated features. Surface stripping also revealed a number of smaller areas of carbon-stained sediment and round spots of clayey soil. All but one of these areas proved to be no more than surface irregularities or rodent disturbance. No geomorphological soil pit was excavated at this site.

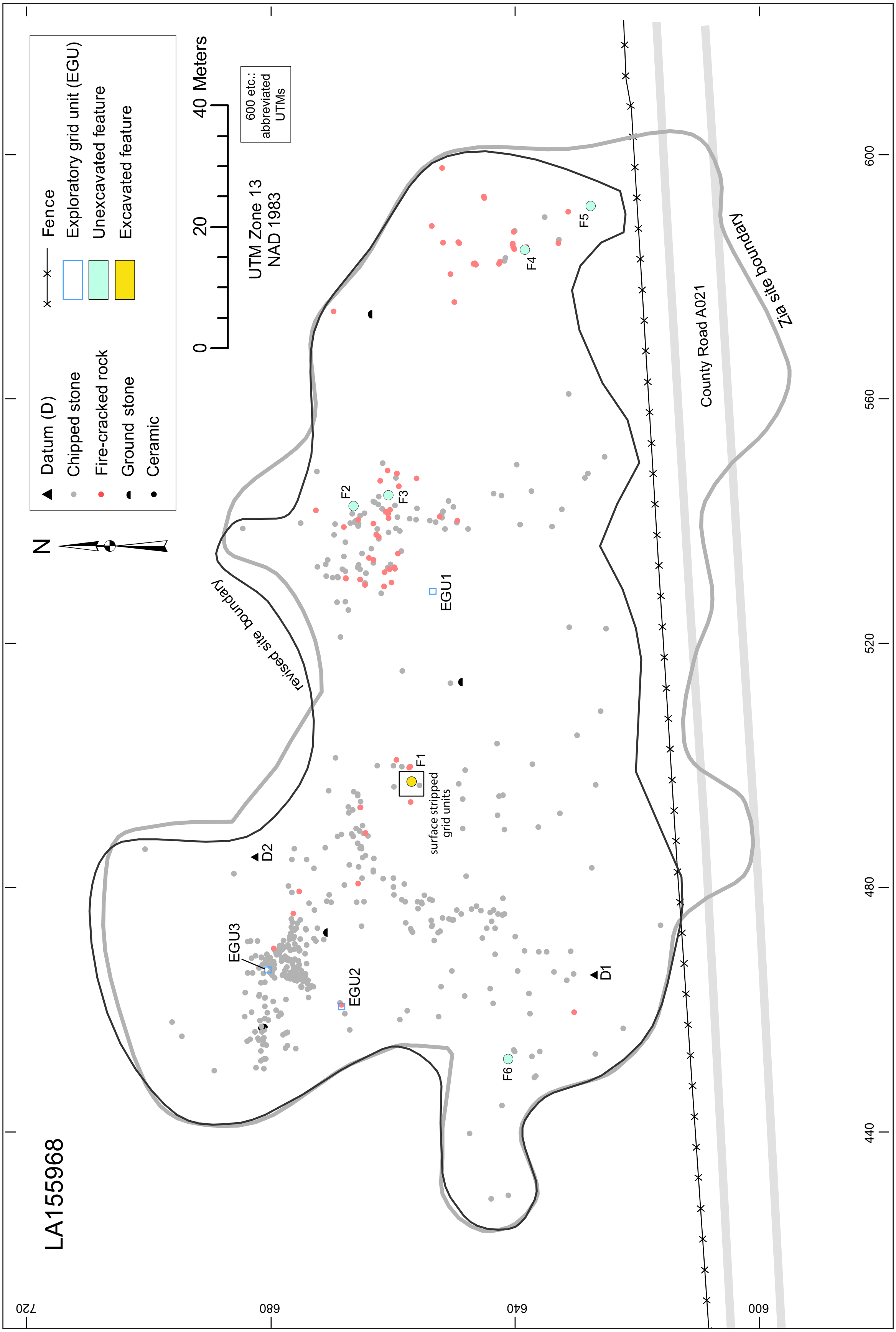

Figure 11.1. LA 155968, site plan.

Table 11.1. LA 155968, summary of excavation areas and collected artifacts.

Excavation Area	Included Grids	No. of Surface-stripped and Excavated Grids	Associated Artifacts
Surface collection	n/a	n/a	445 chipped stone 4 ceramics 3 ground stone
Test Pit 1	653N/528E	1	1 chipped stone
Test Pit 2	668N/460E	1	7 chipped stone
Test Pit 3	680N/466E	1	9 chipped stone
Feature 1	655N/496E 656-658N/495-499E 657-658N/495E	15	52 chipped stone 5 ceramics 5 C14 10 flotation 1 soil sample

Exploratory Grid Units

Three EGUs were used to examine deposits in various parts of the site to determine whether cultural deposits were present. The first exploratory grid unit was placed in the east-central part of the site at 653N/528E, where there was a concentration of surface artifacts to the east (Fig. 11.1). This location was selected to help determine whether the artifact cluster was the result of erosional patterns or represented the actual distribution of cultural materials. The presence of substantial numbers of artifacts in this excavation unit would indicate that much of the artifact cluster remains concealed beneath a mantle of uneroded sediment.

Three strata were encountered in 653N/528, and were excavated in four levels (Fig. 11.2). Stratum 1 was uppermost and was excavated in a single level. This stratum averaged 10.75 cm thick and consisted of a reddish-brown crusted clay silt that contained few gravels (less than 1 percent) and no cultural materials. A small amount of root disturbance was noted in this layer, which probably represents fairly recent eolian deposits. Stratum 2 was under Stratum 1 and consisted of a yellowish-red compact clayey silt that contained some caliche flecks and a lens of limestone pea gravels. This stratum was pitted with insect and rodent burrows, indicative of a considerable amount of bioturbation. Stratum 2 averaged 13 cm thick and contained 25 fragments of fire-cracked rock. Stratum 3 was a dense and hard reddish-brown clay silt that also exhibited a large amount of bioturbation, including insect and rodent burrows. Two levels with an average thickness of 18.25 cm overall were excavated into Stratum 3. Gravels and pea gravels were common in this stratum, comprising up to 20 percent of the matrix. Some possible fragments of fire-cracked rock were also noted, with five occurring in Level 3 and a few in Level 4. In addition to possible fire-cracked rock, a chert core-flake was also found in Level 3. Considering the amount of bioturbation noted, the cultural materials recovered from Stratum 3 were probably deposited at or near the top of this layer and carried downward. This would be consistent with the occurrence of most surface artifacts in eroded parts of the site where this stratum is exposed.

A second EGU was placed in the northwestern section of LA 155968, to the south of a dense cluster of chipped stone artifacts (Fig. 11.1). This grid unit was at 668N/460E, and was used to determine whether a dense artifact cluster located to the north continued into this area under more recently deposited sediment. The only artifact noted on the surface was a piece of fire-cracked rock. Two strata were encountered in this EGU and were excavated in three levels (Fig. 11.3). Stratum 1 was uppermost and was removed in a single level. This stratum averaged 11 cm thick and consisted of a light reddish-brown clayey silt containing a few gravels, four chert core flakes, and a chert biface flake. This sediment probably represents recent eolian deposits. Below Stratum 1 was Stratum 3, which consisted of a light reddish-brown clay silt that contained less than 10 percent caliche-coated gravels and pea gravels. While two levels were excavated into Stratum 3 with an average thickness of 20.25 cm overall, they did not reach the bottom of the stratum. Evidence of bioturbation was noted, and included insect burrows and roots. One chert core flake was recovered from the upper level excavated into this stratum. No subsurface fire-cracked rock was noted. The results of excavation in this EGU suggested that the dense surface-artifact cluster did not continue into this area under the more recent mantle of sediment.

The third EGU was also placed in the northwestern section of the site, and was north–northwest of the second EGU in a dense cluster of chipped stone artifacts (Fig. 11.1). This unit was at 680N/466E, and was used to determine whether there were subsurface cultural deposits in the artifact cluster. Three strata were encountered and were removed in three levels (Fig. 11.4). Stratum 1 was exposed at the surface and comprised the upper half of the first level. This stratum was 4–6 cm thick and consisted of a strong brown, silty clay containing less than 1 percent gravels and pea gravels. Stratum 2 was next and consisted of a 13–17 cm thick layer of yellowish-red silty clay containing some gravels and pea gravels. Stratum 3 was a reddish-brown clayey silt that was encountered only at the bottom of the east side of this EGU. Since the bottom of Stratum 3 was not reached, its thickness remains undetermined. Level 1 included all of Stratum 1 and the upper 4–6 cm of Stratum 2. Two chert core flakes, a chert biface flake, and a metaquartzite core flake were recovered from the surface, and eight chert artifacts—five core flakes, two biface flakes, and a piece of angular debris—came from Level 1 and probably were mostly derived from Stratum

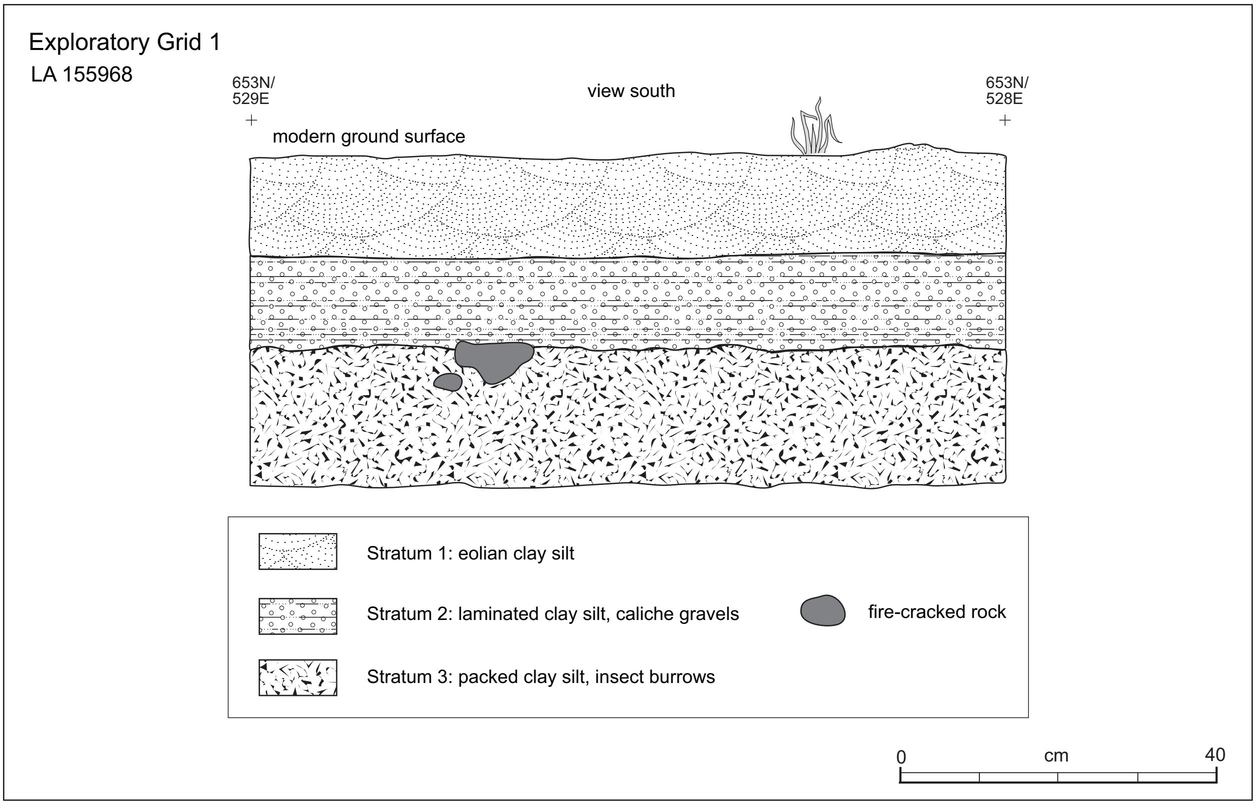

Figure 11.2. LA 155968, EGU 1, profile.

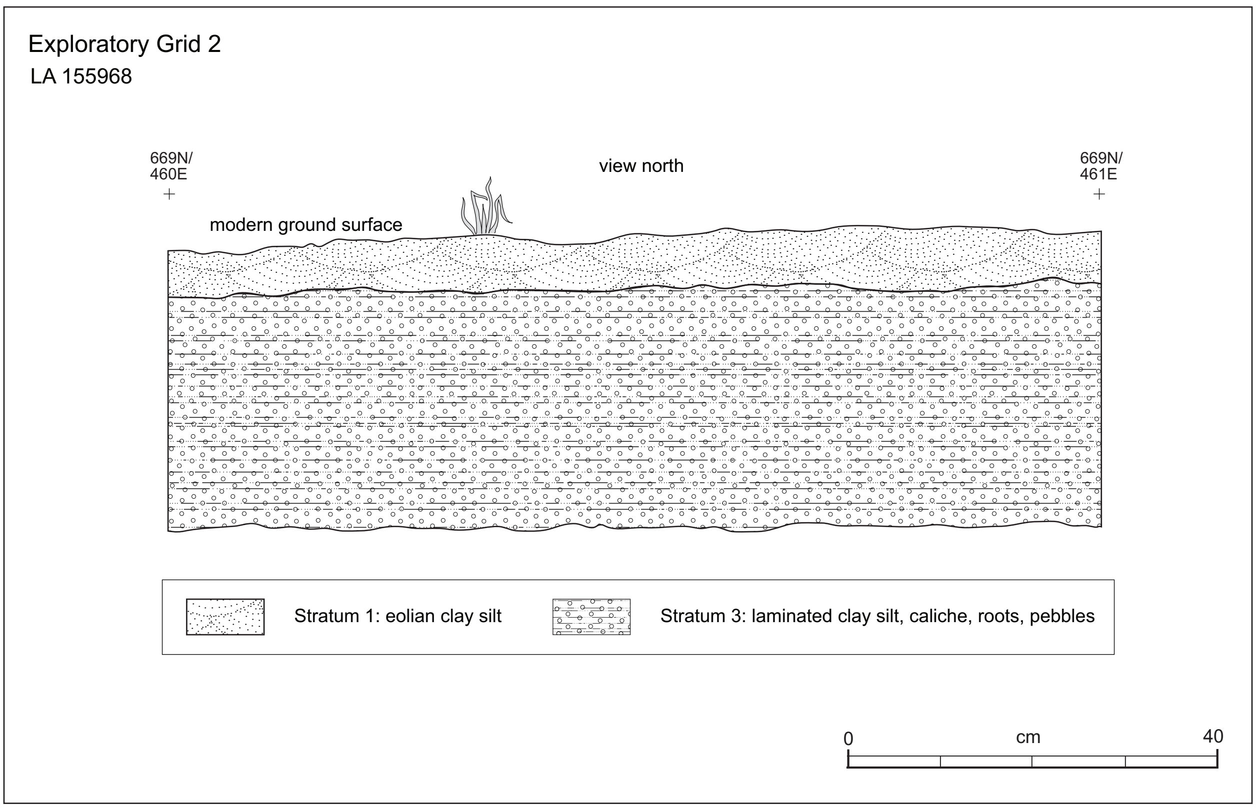

Figure 11.3. LA 155968, EGU 2, profile.

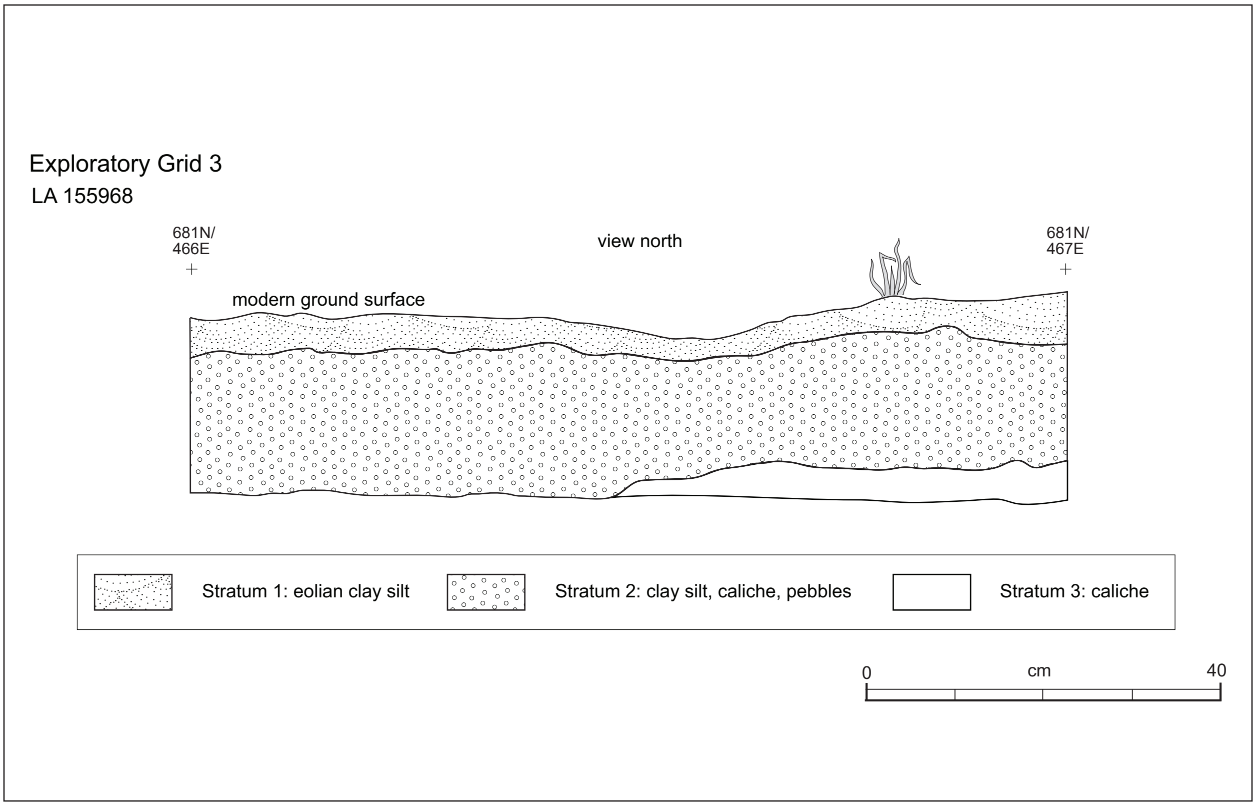

Figure 11.4. LA 155968, EGU 3, profile.

2. Levels 2 and 3 were primarily in Stratum 2, but the upper part of Stratum 3 was encountered in the eastern part of the grid as noted above. Level 2 yielded two chert core flakes, which both probably came from Stratum 2, and there were no artifacts found in Level 3.

Assessment of Exploratory Grid Unit Excavation

The results of excavations in two of the EGUs, suggest that some uneroded deposits containing cultural materials are preserved at LA 155968 and represented in Stratum 2. Most of the artifacts recovered from excavated contexts came from Strata 1 and 2, with a few pieces of fire-cracked rock and one chipped stone artifact also occurring near the top of Stratum 3. Determining just where the occupational surface was using the results of these limited excavations is difficult. The densest deposits of cultural materials were in Stratum 2, suggesting that the occupational surface coincides with that layer of sediments. If this is correct, cultural materials were moved both up into Stratum 1 and down into Stratum 3. This type of vertical artifact movement is not unusual and was not unexpected. Another, less likely, possibility is that the original occupational surface was completely eroded away, with artifacts dropping onto the surface of Stratum 3. If this second scenario is correct, then the artifacts recovered from Strata 1 and 2 were all moved upward by bioturbation. While both of these scenarios are possible, the second is considered less likely, and the occupational surface probably occurred somewhere within Stratum 2. The presence of fire-cracked rock in EGU 2 suggests that a thermal feature is or was situated near that location.

Features

When Zia archaeologists surveyed the site in 2007 they found what they described as a discrete charcoal-stained soil feature, measuring about 3 m in diameter, with small fragments of fire-cracked rock. They surmised that it was a small habitation structure based on the presence of stained soil and so few fire-cracked rocks. The only other possible feature observed was a fire-cracked rock scatter in the southwestern portion of the site (Quaranta and Gibbs 2008:183–184). In 2009, Elizabeth Oster and Victor Gibbs assessed the site, established a road-construction disturbance corridor along the southern boundary, and placed a series of auger tests just inside the disturbance corridor and adjacent to two fire-cracked rock scatters. They determined that the scatters lacked subsurface context and were unlikely to overlie cultural material. Construction in March 2010 was monitored by archaeologists; no intact deposits were observed (FAA and NMSA 2010:22–23).

OAS investigations at the site identified Features 2 through 7, none of which appeared to have the potential to produce subsurface deposits. After closer examination, the seventh feature was determined to be a dispersed scatter of natural rock and was eliminated as a feature. Since these features had not previously been identified and the research design specified a focus on Feature 1—the area of charcoal-stained soil or possible structure (Moore et al. 2010a:96)—none of the other features were investigated.

Feature 1 (large roasting pit)

Feature 1 was an area of dispersed charcoal staining (Fig. 11.5), with sparse fire-cracked rock and some larger cobbles that could have been used for various purposes but lacked specific evidence of use. OAS investigations began with establishing a sub-datum and a 4 by 4 m grid over the stain and surrounding area (southwest corner 655N/495E). Fire-cracked rock, cobbles, artifacts, and the extent of the stained soil were mapped using the 4 by 4 m grid and two grid units to the east of the original 4 by 4 m grid, which included a cluster of fire-cracked rocks.

A total of 15 1 by 1 m grid units over and around the stain were surface stripped (Fig. 11.6). The upper fill (Stratum 1) was loose eolian silty sand (7.5 YR5/4), some of which was charcoal stained. In the area adjacent to the feature the fill was alternating lenses of ash, eolian sand, and a mixture of both with indications of moisture episodes and packing

Figure 11.5. LA 155968, Feature 1, before excavation.

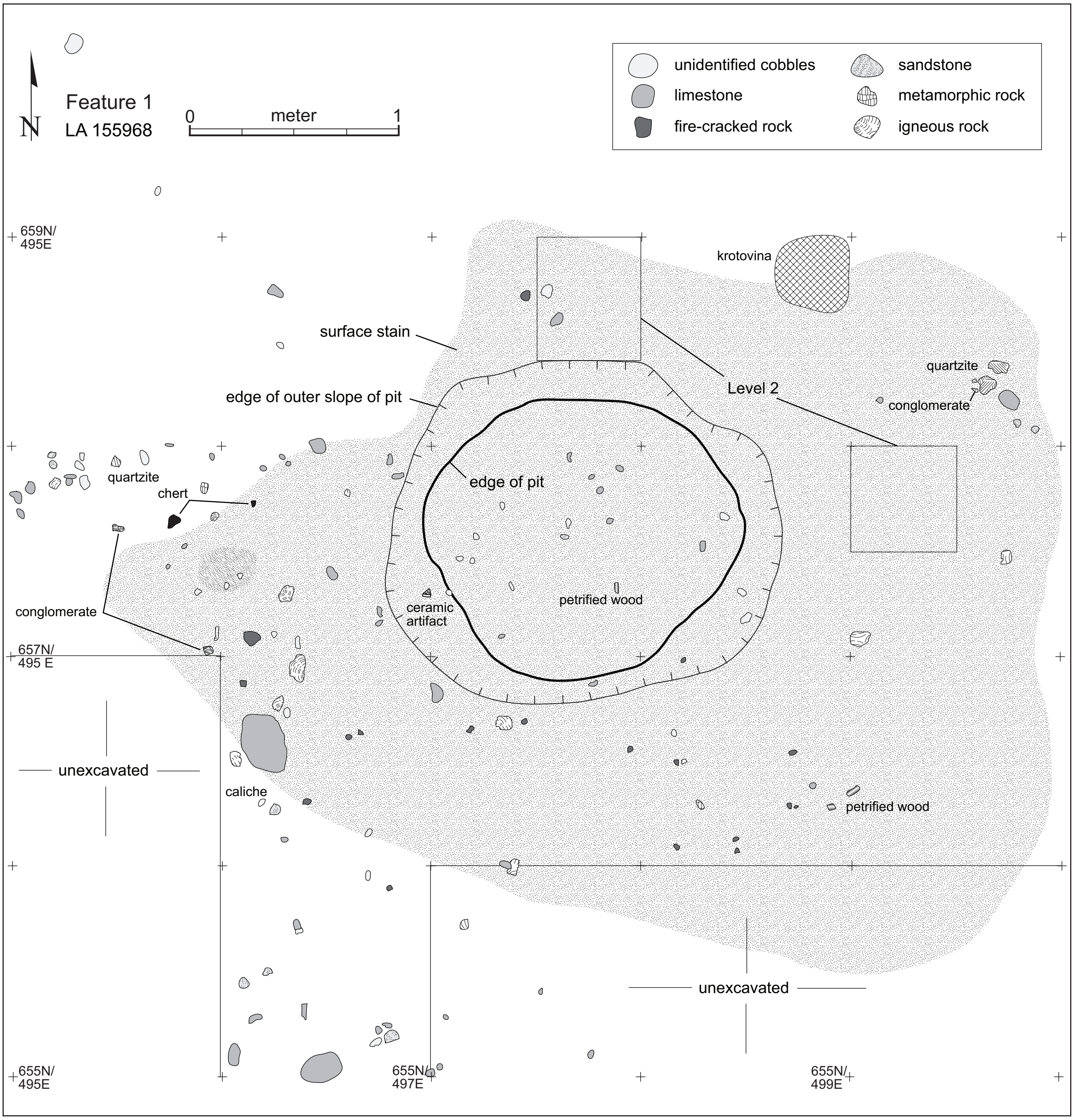

Figure 11.6. LA 155968, Feature 1, plan of stain and fire-cracked rock.

in some grid units. The surface strip removed two to six cm of sediment and revealed several small diffuse stains and a few small circular areas of dense clay around the large stain. Burrowing rodents had spread the charcoal-stained soil, creating several channels and low spots resembling features.

Once the outline of the large stain was revealed, it was excavated in 10 cm levels by grid unit, leaving the 658N grid units unexcavated until a stratigraphic profile could be drawn. Pit fill (Fig. 11.7) below Stratum 1 consisted of 30 to 32 cm of reddish-brown sandy clay (5 YR 5/3; Stratum 2) containing burned pieces of clay, small pieces of charcoal, and 131 pieces of fire-cracked rock. The base fill (Stratum 3; up to 22 cm thick) was dark reddish-brown sandy clay (5 YR 3/2) with abundant larger pieces of charcoal and considerable amounts of fire-cracked rock (n = 84).

The pit was roughly bowl-shaped (Fig. 11.6) with unprepared walls (Fig. 11.8) riddled by insect burrows, rodent burrows, and an active ant nest. It was excavated through a layer of reddish-yellow (5YR4/6 dry) compact silty clay overlying a dense layer of small chunks of caliche and sparse gravel in a silty clay matrix. The outer lip of the pit was oxidized and portions of the pit walls were sooted and burned. The pit measured 1.90 m north–south by 1.86 m east–west at the outer lip, and 1.34 m north–south by 1.47 m east–west below the lip, with a maximum depth of 0.56 m.

While Feature 1 was initially identified and excavated as if it were a structure, the shape, size, fill, and burning suggest it was a large roasting pit. The presence of considerable amounts of stained soil and a scatter of fire-cracked rock in the vicinity suggest it may have been cleaned and reused. The paucity of artifacts in the fill and in the general vicinity suggests the pit was not a center of activity, probably because of the heat generated during use.

In addition to the main feature, several areas of darker fill and round "spots" thought to have been postholes were investigated. Nearly all were determined to be the remains of rodent burrows filled with darkly stained soil or concentrations of clay lacking depth and more consistent with compressed mud layers in the shape of cattle hoof prints. The most suggestive of these was Feature 1.1, a small (0.20 by 0.28 m by 0.03 deep) shallow depression with an irregular bottom and no evidence of burning (Fig. 11.9) located about 60 cm west of Feature 1. The fill was darkly stained silty sand (5YR 4/2). No artifacts were directly associated with this feature and it may have been no more than a natural depression filled with charcoal-stained soil that originated in Feature 1. A second area, 50 cm northwest of Feature 1, called Feature 1.2, was about 80 cm in diameter, circular with an open end, and about 30 cm deep. A flotation sample was collected but further excavation revealed entry and exit rodent tunnels. Plans and profiles were completed (Fig. 11.10) but Feature 1.2 was probably no more than a burrow filled with charcoal-laden fill from Feature 1.

Artifacts recovered during the excavation of Feature 1.2 consist of five ceramics and 59 pieces of chipped stone. The ceramics are all El Paso Brown body sherds from jars and all have granite temper, suggesting a single vessel. All were found on the surface (n = 2) or during the surface stripping (n = 3) of the adjacent grids. Most of the chipped stone artifacts were found in the grids around the roasting pit (9 from the surface and 34 from surface stripping) but 16 came from pit fill. Most are undifferentiated artifacts of chert (n = 28, 47.46 percent) or limestone (n = 27, 45.76 percent) with one each (1.69 percent) of silicified wood, metaquartzite, and igneous. Most are fine-grained (93.02 percent of the surface strip and 87.50 percent of the feature fill) or fine-grained and flawed (4.65 percent surface strip and 6.25 percent pit fill), with one medium-grained and flawed artifact in pit fill. Both assemblages are dominated by core flakes (n = 23, 53.49 percent surface strip; n = 10, 62.50 percent pit fill), with biface flakes also occurring in the surface strip (n = 2, 4.65 percent). Angular debris was more common in pit fill (n = 4, 25.00 percent) than in the surface strip (n = 9, 20.93 percent), cores were fairly common in both contexts (7, 16.28 percent surface strip; n = 2, 12.50 percent pit), and two choppers (4.66 percent) were found in the surface strip. Four of the artifacts found in the pit are fire-crazed (25.0 percent), as are 10 (23.26 percent) of the surface-strip artifacts. More artifacts from the pit are complete (58.14 percent surface strip and 75.00 percent pit fill).

Five flotation samples were collected from Feature 1. All contained burned yucca caudex and three had yucca leaf fragments. A burned caltrop seed was recovered from deep in the feature. Flotation wood was predominantly saltbush with trace amounts of cholla. Wood collected for radiocarbon analysis mostly consisted of saltbush with one piece of mesquite, and small amounts of tarbush (prob-

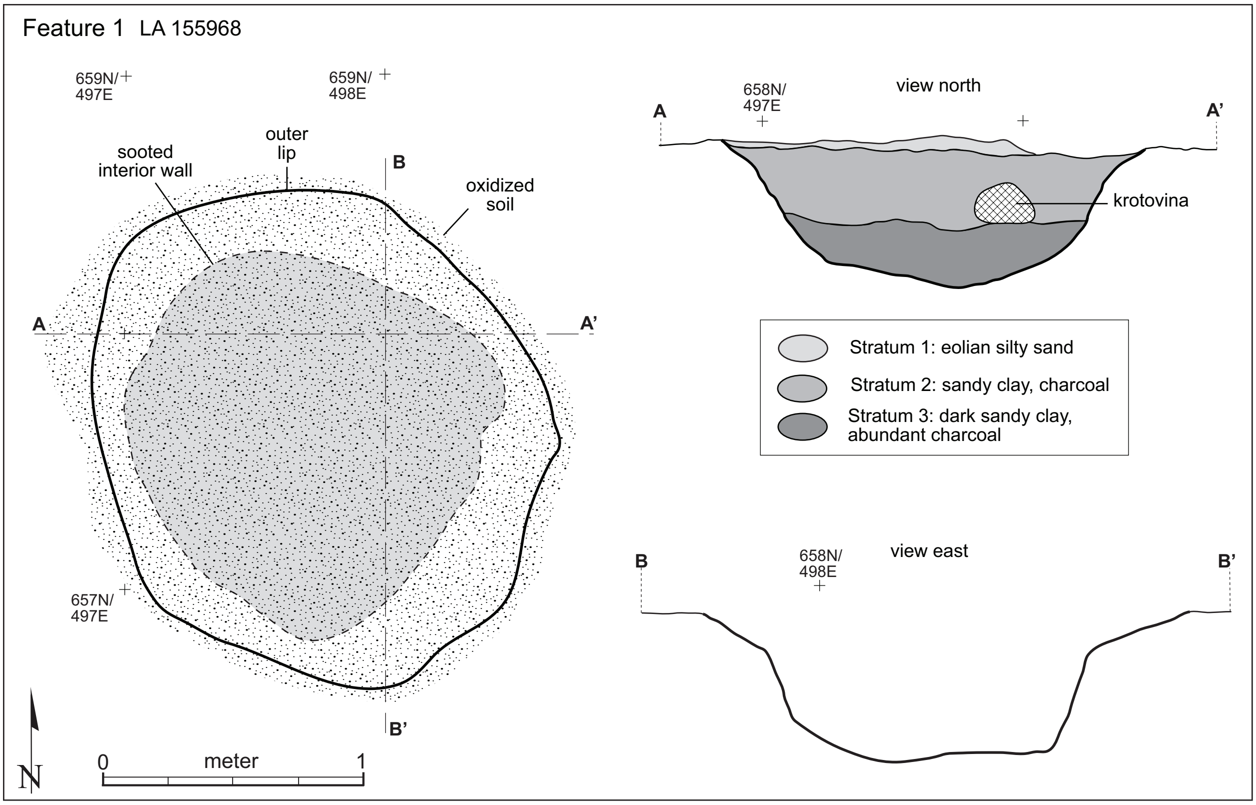

Figure 11.7. LA 155968, Feature 1, plan and profiles.

Figure 11.8. LA 155968, Feature 1 after excavation.

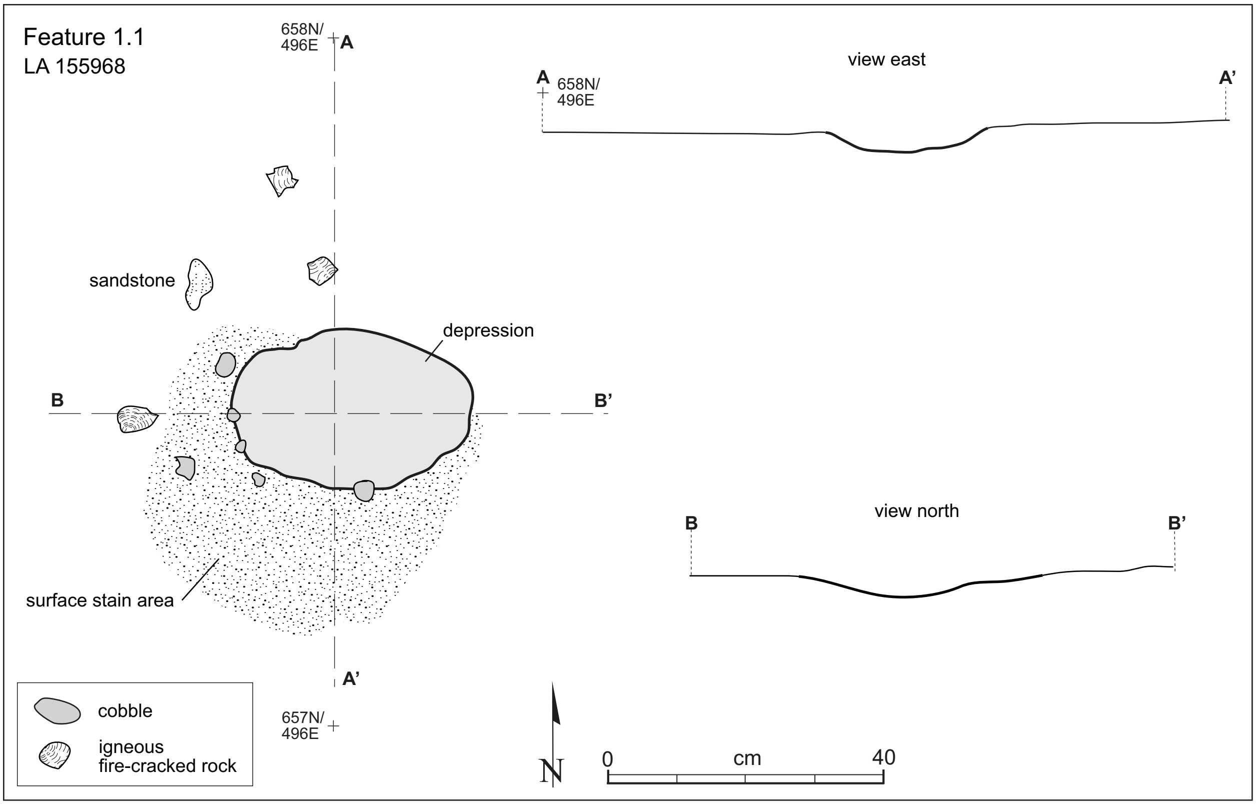

Figure 11.9. LA 155968, Feature 1.1, plan of stain and fire-cracked rock.

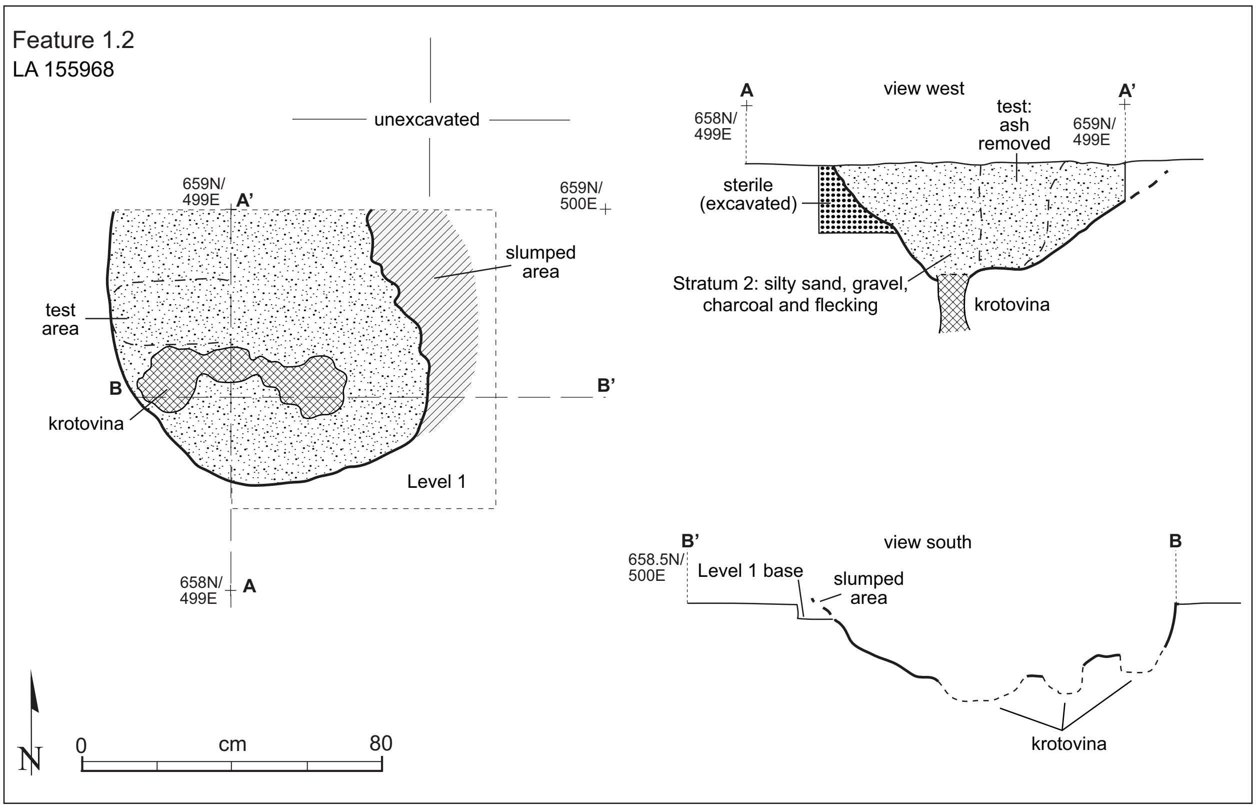

Figure 11.10. LA 155968, Feature 1.2, probable rodent burrow, plan and profiles.

able), cholla, and yucca stems and caudex. Samples from Features 1.1 and 1.2 contained yucca basal caudex and Feature 1.2 also had yucca fiber. Feature 1.1 yielded burned material from an unknown plant and unburned mesquite leaves, annual, grass, yucca, twinleaf senna, and seeds of other weedy taxa. Fuel wood was all saltbush.

Charcoal samples of tarbush (probable), yucca stem, yucca caudex, saltbush, and the unknown material were submitted for radiocarbon analysis. All five samples have calibrated radiocarbon dates that fall within the Mesilla phase, the earliest being AD 662 to 779 and the latest at AD 764 to 887 (Boyer, Chapter 19).

Feature 2 (fire-cracked rock scatter)

Features 2 and 3 are east of Feature 1, and are outside the area originally defined as the site. Feature 2 is a concentration of fire-cracked cobbles exposed around the base of a small mesquite shrub (Fig. 11.11) with a dispersed scatter of fire-cracked rock outside of the concentration. It comprises about 200 pieces of rock, mainly igneous and limestone cobbles with small amounts of quartzite and sandstone. The maximum extent is about 5.8 m north–south by 7.4 m east–west. A denser core area measured 2.3 m north–south by 2.5 m east–west, with a maximum density of 25 rocks. A fairly dense cluster of artifacts occurs to the west of the feature but the potential for subsurface deposits is probably low. Little soil is present outside of the mesquite and no staining is evident.

Feature 3 (fire-cracked rock scatter)

Located a few meters south of Feature 2, this feature is more of a scatter with a slightly denser core concentration (Fig. 11.12). Fewer than 50 cobbles make up the scatter. It measured about 4.0 m north–south by 5.8 m east–west, with a core area of 0.70 m north–south by 1.0 m east–west and a maximum density of nine rocks in a 50 by 50 cm area. Most of the rocks are igneous with a few of quartzite, limestone, and sandstone. Again, a number of artifacts were recorded around this feature, including a spurred end scraper and a multidirectional core, but there is no evidence of depth or intact fill.

Feature 4 (fire-cracked rock scatter)

Features 4 and 5 are in the far eastern portion of the site. Feature 4 is a sparse scatter of fire-cracked cobbles. Less than 30 rocks are scattered over an area covering 7.0 m north–south by 10 m east–west (Fig. 11.13), with a maximum density of only about two obviously fractured rocks in a 50 by 50 cm area. Most of the rocks are igneous with lesser amounts of quartzite, limestone, and sandstone. Little surface soil is present in the area and no stained soil was observed. This feature is, however, just south of a concentration of chipped stone artifacts, some of which were heat-treated.

Feature 5 (fire-cracked rock scatter)

Southeast of Feature 4, Feature 5 is a sparse concentration of fire-cracked rock and a small associated scatter (Fig. 11.14). Few rocks are present—only about 25; they are mainly igneous with some quartzite, limestone, and sandstone. The scatter measured 3.7 m north–south by 3.0 m east–west and the denser concentration is 0.60 m north–south by 0.80 m east–west, with a maximum concentration of 25 rocks in a 50 by 50 cm area. No artifacts occur in the scatter and the soil is shallow with no staining observed.

Feature 6 (fire-cracked rock scatter)

Located at the western edge of the site, this feature is a large scatter of about 100 fire-cracked rocks (Fig. 11.15). It measured approximately 12 m north–south by 10 m east–west, with a maximum density of five rocks in a 50 by 50 cm area. The cobbles are mainly igneous with some quartzite, limestone, and sandstone. A large chopping tool is present nearby. The feature is widely scattered, there is little soil in the area, and no charcoal staining was observed giving it a low potential for providing additional cultural material, samples for dating, or subsistence remains.

Artifact Assemblages

All visible surface artifacts were point provenienced and collected, and no materials were analyzed in the field. Each artifact category is discussed separately. No faunal specimens were recovered from this site.

Chipped Stone. A total of 497 artifacts were recovered during surface collection and excavation. The bulk of this assemblage—417 artifacts—were point provenienced and collected from the site surface. The remaining artifacts came from excavation,

Figure 11.11. LA 155968, Feature 2.

Figure 11.12. LA 155968, Feature 3.

Figure 11.13. LA 155968, Feature 4.

Figure 11.14. LA 155968, Feature 5.

Figure 11.15. LA 155968, Feature 6.

including one specimen from Grid Unit 653N/528E, six from Grid Unit 668N/460E, 14 from Grid Unit 680N/466E, 43 from the surface-strip area around Feature 1, and 16 from the excavation of Feature 1 itself. Tools were moderately common, especially in the surface collection, which included 6 bifaces, 5 spurred end scrapers, 3 other scrapers, 2 projectile points, 2 choppers, and single examples of drill, graver, utilized debitage, and strike-a-light flint. The projectile points consisted of the bases of a Midland Point and a Mogollon corner-notched point. Two choppers were also recovered from the Feature 1 surface strip. In light of the earlier recovery of a Folsom point fragment from this site during monitoring, the Midland Point, spurred end scrapers, and probably the graver suggest the presence of a major Paleoindian component. However, later use of the site, during the Mesilla phase and possibly the Historic period (as indicated by the strike-a-light flint), may have obscured the patterning of those materials to some extent; they seem to be mixed with the Paleoindian component.

Cherts dominate the surface collection (n = 381, 91.37 percent), followed distantly by silicified wood (n = 18, 4.32 percent), metaquartzite (n = 7, 1.68 percent), limestone (n = 5, 1.20 percent), siltstone (n = 3, 0.72 percent), and rhyolite (n = 3, 0.72 percent). Cherts also dominate the excavation areas (n = 47, 58.75 percent), followed by limestone (n = 27, 33.75 percent), metaquartzite (n = 2, 2.50 percent), silicified wood (n = 2, 2.50 percent), igneous undifferentiated (n = 1, 1.25 percent), and rhyolite (n = 1, 1.25 percent). The most varied assemblage is the Feature 1 surface strip, which yielded specimens in all of the listed material types and contained almost equal numbers of chert and limestone (20 and 19, respectively). The Feature 1 excavation yielded equal numbers of chert and limestone (eight apiece), suggesting that the assemblage from the Feature 1 surface strip may be related to the use of Feature 1, though a few earlier specimens could also be included in this small assemblage.

Core flakes are the most common morphological type in the overall assemblage (n = 329, 66.20

percent), followed by angular debris (n = 62, 12.47 percent), biface flakes (54, 10.87 percent), bipolar flakes (n = 2, 0.40 percent), cores (n = 28, 5.63 percent), bifaces (n = 10, 2.01 percent), unifaces (n = 8, 1.61 percent), and cobble tools (n = 4, 0.80 percent). The distributions for these morphological categories are similar to that of the overall assemblage for the surface collection because they represent the bulk of the assemblage. The surface collection includes 280 core flakes (67.15 percent), 48 pieces of angular debris (11.51 percent), 48 biface flakes (11.51 percent), 2 bipolar flakes (0.48 percent), 19 cores (4.56 percent), all 10 bifaces (2.40 percent), all 8 unifaces (1.92 percent), and 2 cobble tools (0.48 percent). The next largest sub-assemblage was from the surface strip around Feature 1, which yielded 23 core flakes (53.49 percent), 9 pieces of angular debris (20.93 percent), 2 biface flakes (4.65 percent), 7 cores (16.28 percent), and 2 cobble tools (4.65 percent). Feature 1 contained 10 core flakes (65.50 percent), 4 pieces of angular debris (25.00 percent), and 2 cores (12.50 percent). Grid Unit 653N/528E produced a single core flake (100.00 percent), Grid Unit 668N/460E yielded 5 core flakes (83.33 percent) and 1 piece of angular debris (16.67 percent), and Grid Unit 680N/466E contained 10 core flakes (71.43 percent), 3 biface flakes (21.43 percent), and 1 piece of angular debris (7.14 percent).

Thermal alteration was very common at LA 155968, with slightly over half the chipped stone assemblage exhibiting this characteristic. Overall, only 41.85 percent of the assemblage exhibited no evidence of thermal alteration, with 58.15 percent being altered. This very large percentage is considered more indicative of a Paleoindian or Archaic occupation than a Formative period use, and is consistent with the occurrence of formal tools diagnostic of a Paleoindian occupation. Thus, preliminary indications suggest that Paleoindian materials may dominate the chipped stone assemblage at this site.

Ground Stone. Three ground stone artifacts were collected from the surface. They include an internal fragment of a sandstone metate, an edge fragment of a basalt metate, and a sandstone tabular knife. The latter was made from an internal fragment of a metate that was reshaped to allow it to be used for a different purpose after the original metate was broken. These tools were widely scattered across the site.

Ceramics. Nine sherds were collected from three general proveniences at LA 155968 including the general site surface (n = 4, 44.44 percent), the Feature 1 Surface Strip (n = 4, 44.4 percent), and surface collection (n = 1, 11.11 percent). All nine sherds are from one or more El Paso Brown unpolished jars, and all are tempered with granite. At least two vessels may be represented, because these specimens were found in two clusters—one in the far northwest corner of the site about 10 m west of Grid Unit 680N/466E, and a second around Feature 1 in the west-central part of the site. No evidence of modification was noted on any of these sherds.

Flotation. Eight flotation samples were collected from Feature 1 and two smaller features. Charred plant remains were uncommon, and included yucca caudex, seeds and fiber, unidentified seeds, and caltrop seeds. The latter may represent possible cultural use of this plant.

Radiocarbon Analysis. Five radiocarbon samples were analyzed from Feature 1, providing dates for that roasting pit. Only materials from plants with relatively short lifespans were used in this analysis. Dates provided by these samples suggest that Feature 1 was used during the early Mesilla phase, sometime in the late seventh to early eighth centuries.

LA 155968 Summary and Recommendations

The research plan for LA 155968 focused on the excavation of Feature 1, identified as a possible structure by Zia. Eight grids within a 4 by 4 m area around the feature were to be hand-excavated along with the feature, and the surface artifacts point-plotted and collected. A single geomorphic trench was planned for the site (Moore et al. 2010a:96–98) but was not completed due to the difficulty of accessing the area with the backhoe.

Zia's estimate of less than 100 remaining artifacts was far too low. Ultimately 417 chipped stone, 3 ground stone, and 4 ceramic surface artifacts were point-plotted and collected (Fig. 11.1). All but one of the 16 grid units around Feature 1 was excavated. In addition, three exploratory grid units were placed throughout the site area and an additional five fire-cracked rock features were located and described.

Exploratory grid units were placed in areas with loose eolian soil to determine if the soils were obscuring cultural deposits. The results of excavation in two of the exploratory grid units suggest that there is some potential for uneroded deposits at the site (Fig. 11.1). Feature 1, a large stain with sparse fire-cracked rock was excavated and found to be a large Mesilla-phase roasting pit. The main fuel wood was saltbush but also included yucca with traces of tarbush, cholla, and a piece of mesquite. Few artifacts were found in the vicinity of Feature 1, but within a 5 to 6 m radius around the feature were eight cores, two choppers, and a side scraper, as well as El Paso Brown sherds and debitage. This array of artifacts suggests that plant processing, core reduction, and possibly cooking occurred in and around the feature.

El Paso Brown ceramics with granite temper were found in two areas of the site, around Feature 1 and in a scatter of artifacts west of EGU 680N/466E. However, as discussed in Chapter 14, the latter area represents the core of a probable Paleoindian component, indicating a degree of mixing of materials from both components in that part of the site. Ground stone artifacts were comparatively rare, with only three specimens located and collected. Metate fragments were found at the southeastern edge of the northwest artifact cluster and in the area northeast of Feature 1. A sandstone tabular knife was found at the far northeastern corner of the site. Diagnostic chipped stone tools and ceramics indicate at least three components for the site: Folsom/Midland, Mesilla, and Historic. Radiocarbon dates confirm the Mesilla-phase date for Feature 1.

Research investigations at LA 155968 provided a good sample of artifacts for at least the Paleoindian and Mesilla-phase use of the site area. Assignment of artifacts to the Paleoindian and Mogollon components is discussed in detail in Chapter 14, and was based on the structure of assemblages in various clusters, presence or absence of luster as an indication of thermal alteration, and the distribution of certain material types. Though tentative, that analysis suggests that Paleoindian artifacts comprise nearly 80 percent of the total chipped stone assemblage, with about 15 percent assigned to the Mogollon component, about 5 percent to unknown components, and a single artifact—the strike-a-light flint—to a Historic component. Thus, the Folsom/Midland Paleoindian component dominates the chipped stone assemblage, but none of the features can be assigned to that occupation and all probably represent later uses of the site. While some artifacts were undoubtedly erroneously placed in the wrong component, for the most part we believe that these assignments are accurate.

The Mesilla-phase roasting pit and associated artifacts suggest that plant resources were extracted and processed during fairly short-term occupations of the site. Associated activities probably centered on the roasting pit, but our limited excavations around the pit did not find evidence of structures or features that would indicate more than a campsite. The presence of sherds and ground stone tools in other parts of the site that are probably also associated with this occupation indicate a light overlay of Mogollon materials above and now intermixed with the Paleoindian assemblage.

This site retains considerable potential for future research. Excavation in area(s) with clusters of Paleoindian artifacts, further investigation of the area around Feature 1, and examination of the other five features could provide further information on the Paleoinidan and Mesilla-phase occupations and could help to clarify whether the lone strike-a-light represents more than a random loss by someone traversing the site or a more prolonged use of the site during the Historic period.

12 | Investigations at LA155969

Introduction

LA 155969 was originally described by Zia as a small artifact scatter containing a possible structure of undetermined date (Quaranta and Gibbs 2008). It is located on NMSLO trust land and has been determined as "eligible" under Criterion "d" for NRHP based on site integrity (originally listed as 51 to 75 percent, it is now changed to 1 to 25 percent based on the results of excavation), the possible presence of a structure, and the potential for recovering datable material. These factors suggest the site has the potential to aid in answering questions posed in the research design and to contribute to our knowledge of regional prehistory (Quaranta and Gibbs 2008:150, 404). This site is adjacent to the eastern edge of the Spaceport America runway. Research-oriented investigations were initiated to examine the only previously defined feature at LA 155969. This examination was meant to determine the nature of the feature and to collect any dateable materials that would provide a more accurate estimate of when this site was occupied. Other reasons for this study include obtaining information on subsistence practices, season of occupation, mobility patterns, and whether multiple occupations are represented.

Previous Work

Zia archaeologists recorded this site in 2007. At that time they observed a single feature with about 30 pieces of fire-cracked rock and documented all visible artifacts (Quaranta and Gibbs 2008:150, 155). The site was revisited by Zia archaeologist Victor Gibbs in 2009 to relocate the site boundaries and mark a 50-foot buffer area for protection from potential adverse effects during construction of the runway. Metal fence posts were placed at the edge of the buffer by a fencing crew and orange-mesh fencing was draped around the posts to prevent inadvertent entry during construction.

Site Setting

LA 155969 is on nearly level ground with a slight slope to the southeast. It is in an area of naturally occurring gravels dotted by mesquite-stabilized dunes and it is surrounded by wide areas of tobosa grassland. The site surface is somewhat eroded and deflated (Quaranta and Gibbs 2008:150).

Preliminary Site Description

LA 155969 (Fig. 12.1) was initially described by Zia as a small prehistoric artifact scatter and associated structural feature of unknown cultural affiliation covering an area measuring 45 by 32 m (1,065 sq m, 0.10 ha, or 0.26 acres). A single fire-cracked rock feature that was 1.25 m in diameter and composed of about 30 pieces of fire-cracked rock was noted at that time. Few artifacts were visible on the surface, and all that were visible were analyzed (two cores and two flakes). The recorders felt that the potential for the presence of buried deposits was high, though the site appeared to be substantially deflated (Quaranta and Gibbs 2008:150–151).

Research-Oriented Investigations

Investigations at this site began with the flagging of all surface artifacts within the temporarily fenced area and buffer zone beyond the fence. The distribution of artifacts and fire-cracked rock were mapped using a total station and surface artifacts were collected. The only feature recorded at this site was investigated through a surface-stripped area, which was used to examine the structure of the feature and to look for associated materials in the potential

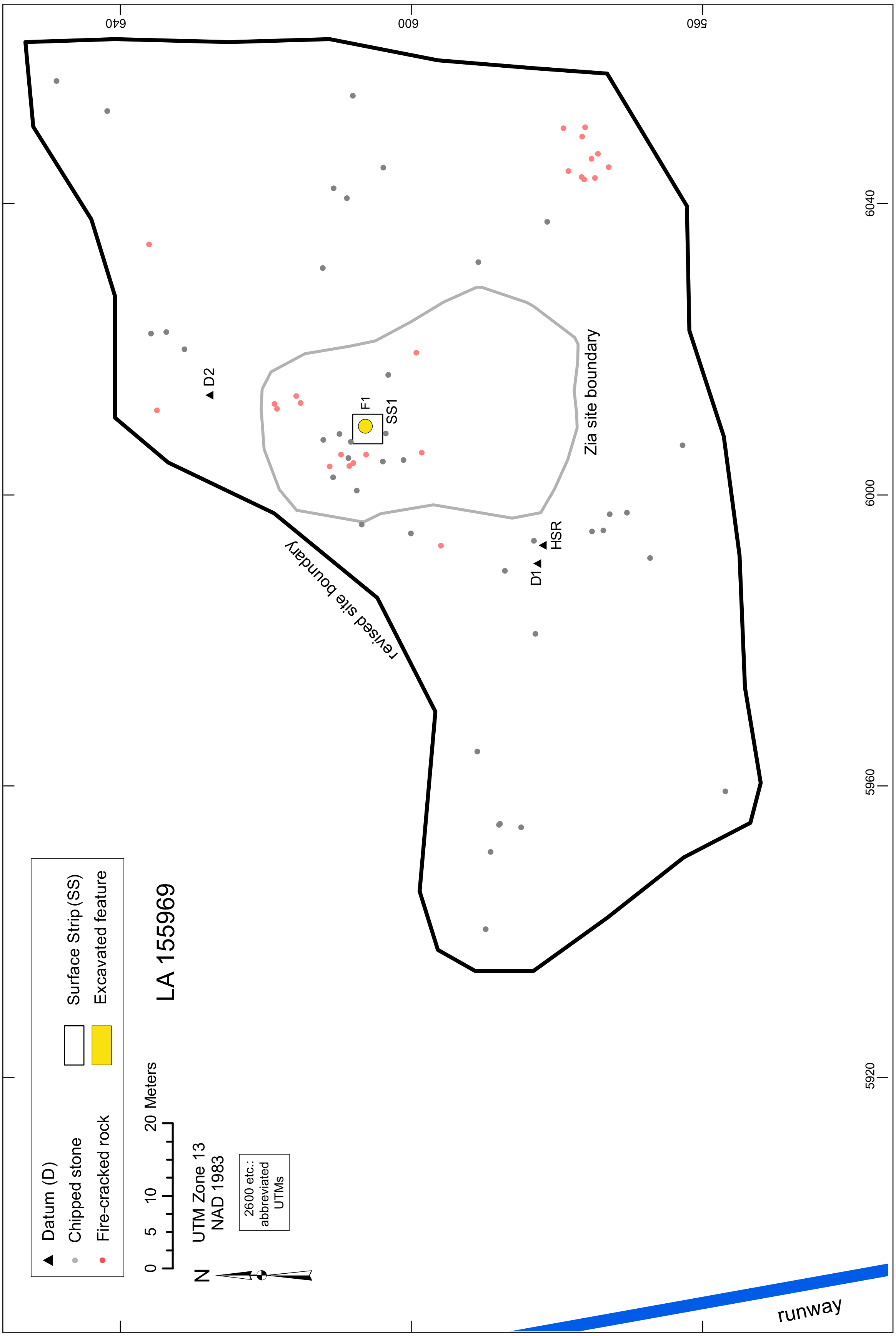

Figure 12.1. LA 155969, site plan.

work area around it. New boundaries indicate that the site is much larger than was previously recorded (Fig. 12.1). As currently defined, LA 155969 covers 7,717.53 sq m (0.77 ha, 1.91 acres). No geomorphological soil pit was excavated at this site.

Surface Strip Area

As proposed in the research plan (Moore et al. 2010:98–99), a 4 by 4 m area centered on Feature 1 was examined to help determine whether any intact cultural deposits remain. In addition, by surface stripping that area it was hoped that other features and artifacts indicative of specific activities would be found.

Surface Strip 1. This excavation unit was centered on Feature 1 and contained 16 grid units, including 604–607N/6007–6010E (Fig. 12.1). The loose sediment mantle was stripped from 14 of the 16 grid units, stopping when more compact sediments were encountered. Two grid units were not excavated because they contained a large mesquite bush, the roots of which had disrupted the deposits in those units. Only about 17 percent of the surface of this area was stabilized by grasses. Fire-cracked rock occurred on the surface of all but three grid units, with an overall average of 3.57 fragments per grid unit. One piece of chipped stone was the only artifact collected from the surface of this excavation area.

Two strata were encountered during excavation. Stratum 1 was a loose orange clayey silt that contained 5–15 percent gravels and pea gravels. This stratum averaged 3.30 cm thick, and was variable in depth, ranging from an average of 1.75 to 7.75 cm thick. Some disturbance was noted including insect burrows and roots throughout the area examined, as well as evidence of cattle grazing. No charcoal or ash was noted in Stratum 1 during excavation, and Feature 1 appeared to have been completely deflated with little spatial integrity remaining.

Below the loose sediments was Stratum 2, which was investigated using two grid units, one of which was excavated to an average depth of 11.25 cm (605N/1008E) and the second to an average depth of 10.25 cm (606N/1008E). This layer consisted of a brown silty clay. Gravels were less common than they were in Stratum 1, with pea gravels comprising only 1–2 percent of the fill. The only cultural materials encountered in Stratum 2 were two pieces of fire-cracked rock found in the upper 2 cm in 606N/6008E. Disturbances noted in this stratum were essentially the same as those in Stratum 1. Stratum 2 was concluded to be culturally sterile because no cultural materials were found below the upper 2 cm, and excavation ended.

Fire-cracked rock was common in Stratum 1, occurring in all but two grid units, with an average of 11.83 pieces per grid unit, ranging between 0 and 21. Chipped stone artifacts were considerably less common, with only four being recovered from the 14 excavated grid units, yielding an average of 0.29 artifacts per grid unit. Indeed, chipped stone artifacts were only found in four grid units: 606N/6007E, 606N/6010E, 607N/6009E, and 607N/6010E.

<u>Assessment of Excavations</u>

From the condition of Feature 1, the deposits in this area appear to have been deflated, scattering elements of the thermal feature and displacing the associated artifacts. Little if any potential remains for recovering additional cultural materials from LA 155969 through further excavation, and there appears to be no further potential for recovering information on subsistence and date of occupation.

Features

The only feature described by Zia was a fire-cracked rock feature that was 1.25 m in diameter with about 30 pieces of igneous and limestone cobbles and fragments with about 10 additional pieces spread to the northeast (Quaranta and Gibbs 2008:150). OAS proposed a complete excavation of the feature and the surrounding area. Surface collection and mapping identified a scatter of fire-cracked rock southeast of Feature 1 (Fig. 12.2) that could have been the remains of a highly deflated feature, but it was not investigated.

Feature 1 (fire-cracked rock scatter, possible deflated fire pit)

As defined by this study, Feature 1 was a 3.5 m diameter fire-cracked rock scatter (Fig. 12.3) located on relatively flat ground. Much of the visible scatter was just west of an area of grass-stabilized soil with yucca and mesquite growing around the perimeter. Investigation began by placing a 4 by 4 m grid over the concentration of rocks and digitally photographing each grid unit. Surface fire-cracked rock and visible chipped stone artifacts were mapped.

All but the two grid units in the southeast corner

Figure 12.2. LA 155969, Feature 1, scatter of fire-cracked rock southeast of feature.

Figure 12.3. LA 155969, Feature 1, before excavation.

that were covered by a large mesquite bush were excavated. Loose fill (Stratum 1) was removed from all units in depths ranging from 1 cm where the soil mantle was thin to 9 cm where the upper fill was stabilized by grass and had captured small amounts of eolian sand. This stratum had a thin crust of water-consolidated silt at the surface that overlay clayey silt laminated by previous moisture events, and tended to be chunky with loose fill in the root channels, insect burrows, and cracks. Sparse small pieces of gravel and a few fire-cracked rock spalls were the only inclusions. The grass-stabilized areas had a slightly greater sand content. Two grid units were excavated an additional 10 cm into compact silty clay (Stratum 2, 7.5 YR 6/4) that contained no fire-cracked rock or artifacts (Fig. 12.4, 12.5). This soil ranged from blocky to smooth in texture and contained small carbonate nodules.

The rock forming the feature was largely limestone cobbles, some with fossils, and igneous rocks along with smaller amounts of sandstone, sedimentary, and metamorphic rocks (Figs. 12.6, 12.7). It was probably built on an old surface with no evidence for construction of a pit to contain the rocks. When excavated it was deflated with much of the rock already exposed and contained within a 2 to 4 cm layer. Cattle trampling may have pushed some of the rock to the deeper depths. No charcoal or ash was noted beneath the rocks or in the numerous insect burrows. The rock is minimally fractured and is consistent with short-term use.

A number of artifacts were located and collected from the surface of the area excavated around Feature 1 (n = 1, chert angular debris) and from subsurface contexts (n = 4, all chert, 3 core flakes, 1 angular debris). No charcoal was observed and, since none of the fill appeared to be associated with the fire-cracked rocks, a flotation sample was not collected.

Artifact Assemblage

All visible surface artifacts were point provenienced and collected, and no materials were analyzed in the field. Only chipped stone artifacts were recovered from LA 155969.

Chipped Stone. Thirty-seven chipped stone artifacts were collected from the surface outside the excavation area at LA 155969, with five additional artifacts coming from excavated contexts in Surface Strip 1 (discussed above). Most of the artifacts in this small assemblage are pieces of debitage, including core flakes (n = 26, 70.27 percent), angular debris (n = 2, 5.41 percent), and bipolar flakes (n = 1, 2.70 percent), with a single core flake exhibiting edge damage indicative of informal tool use. In addition, five cores (13.51 percent) and single examples of a stemmed arrow point, core-chopper, plane, and uniface (2.70 percent apiece) were recovered from the surface. Chert dominated this small assemblage (n = 30, 81.08 percent), followed by metaquartzite (n = 3, 8.11 percent), limestone (n = 2, 5.41 percent), siltstone (n = 1, 2.70 percent), and metamorphic undifferentiated (n = 1, 2.70 percent). Since the cortex on 12 chert specimens, two pieces of metaquartzite, one piece of limestone, and one piece of siltstone, was waterworn, most if not all of the materials used at this site were probably obtained from nearby gravel deposits.

LA 155969 Summary and Recommendations

The excavation plan for this site included the collection of all surface artifacts, the hand excavation of a 4 by 4 m area centered on Feature 1, and the mechanical excavation of a geomorphology trench (Moore et al. 2010a:98–100). A geomorphology trench was not excavated at this site due to the difficulty of accessing it. Only 14 of the 16 grid units around Feature 1 were excavated, due to the presence of a large mesquite bush.

The surface distributions of fire-cracked rock and artifacts (Fig. 12.1) suggest that the site is a fairly sparse scatter of chipped stone artifacts with one, possibly two, deflated thermal features. The second fairly concentrated area of fire-cracked rock in the southeastern portion of the site had no associated surface artifacts and was not recorded as a feature. A variety of tools types and reduction debris were found, all to the south and southwest of Feature 1. Surface stripping around the feature produced only five artifacts, core flakes and angular debris, all of chert. The feature was completely deflated with no remaining cultural deposits and no flotation sample was collected.

The only clue to when this site may date is the small-stemmed arrow point, which suggests a Mesilla phase or later occupation. Given that there appear to be no intact deposits at this site, LA 155969 has little further potential to contribute information on the past use of the Spaceport area.

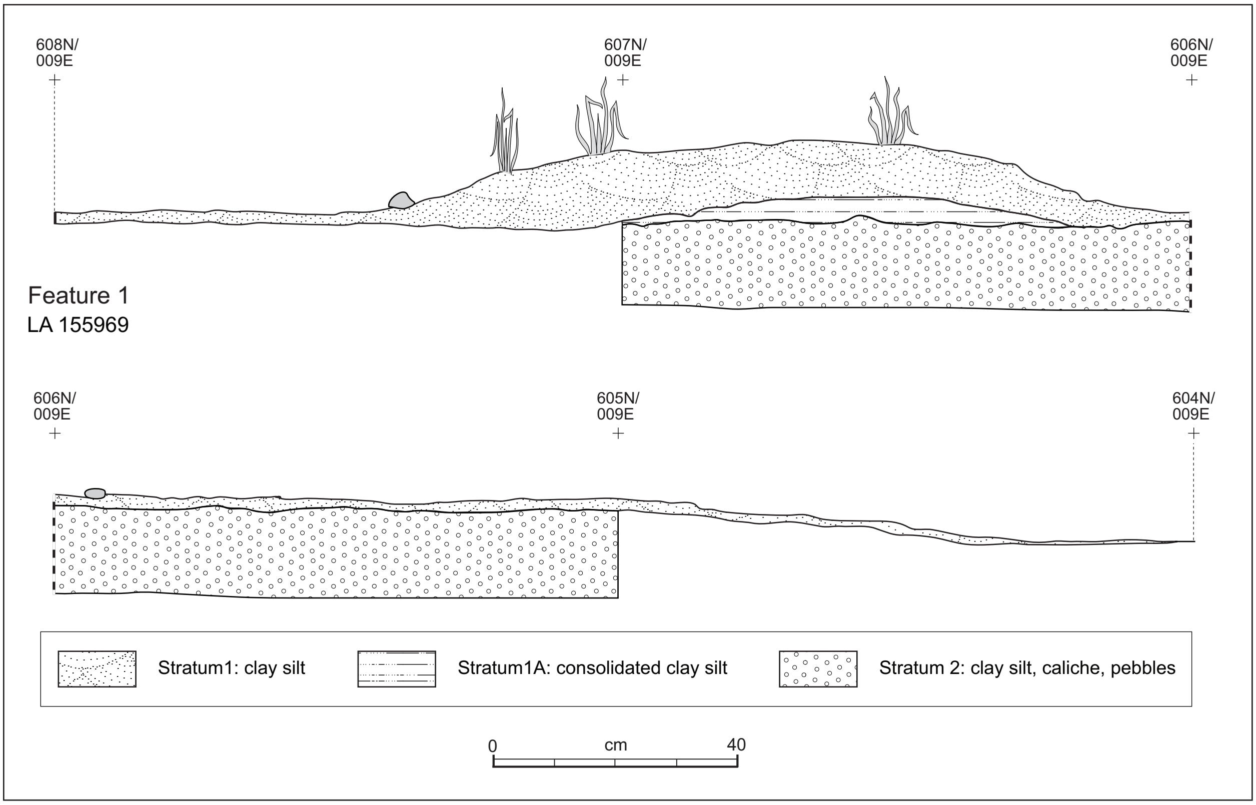

Figure 12.4. LA 155969, Feature 1, profile of east face of grid unit 605N/6009E.

Figure 12.5. LA 155969, Feature 1, after excavation, showing profile.

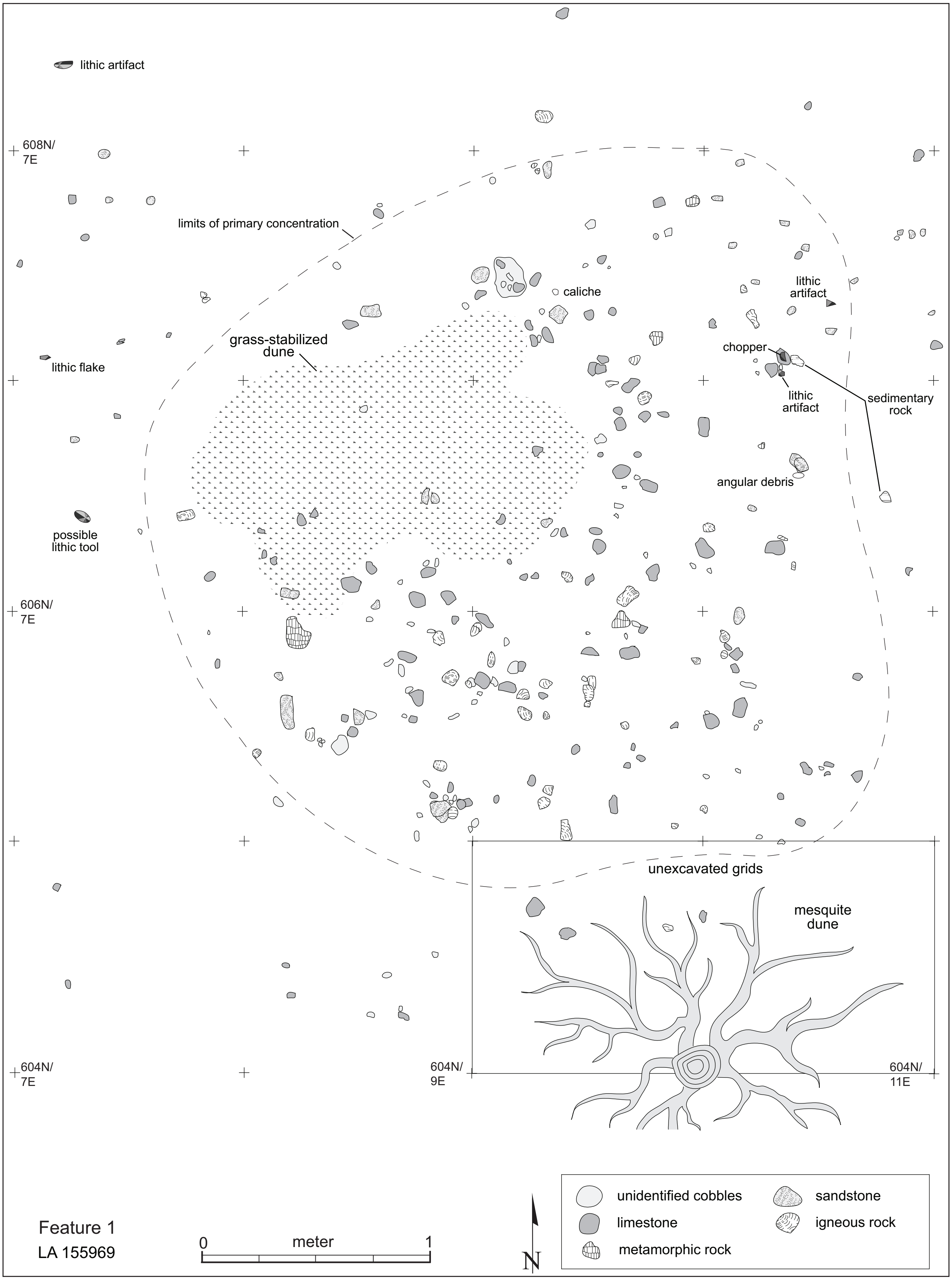

Figure 12.6. LA 155969, Feature 1, plan of fire-cracked rock.

Figure 12.7. LA 155969, Feature 1, fire-cracked rock.

13 | Investigations at LA 156877

Introduction

LA 156877 was initially described by Zia as a small artifact scatter of unknown temporal affiliation. It is located on NMSLO trust land and has been determined as "eligible" under Criterion "d" for NRHP as it appears to have integrity (51 to 75 percent) and may have subsurface deposits containing datable and subsistence-related materials that can be used to address questions posed in the research design and can contribute further information to our knowledge of the prehistory of this part of New Mexico (Quaranta and Gibbs 2008:188, 406). A county road segment crosses the southwest part of the site, and improvements have been made to this road since LA 156877 was initially recorded. A planned bar ditch will impact an additional portion of the site when it is built. Research-oriented investigations were initiated to examine one of the features defined at LA 156877 in order to determine its nature and to collect dateable materials for a more accurate idea of when this site was occupied. Other reasons for this study include obtaining information on subsistence practices, season of occupation, mobility patterns, and whether multiple occupations are represented.

Previous Work

This site was recorded by Zia in 2007 as a sparse scatter of chipped stone artifacts and a low-density fire-cracked rock scatter with a concentration that could indicate buried cultural deposits. A sample of 16 of the 30 pieces of chipped stone debitage on the surface was analyzed (Quaranta and Gibbs 2008:188–189). The site was revisited in 2009 by Zia archaeologist Victor Gibbs to relocate site boundaries and mark a 50-foot buffer to protect it from potential effects of construction. The outer edge of the buffer was marked and monitoring was conducted when metal posts were placed by a fencing crew. Orange-mesh fencing was draped around the fence posts to protect from inadvertent damage during construction. Later that year, Elizabeth Oster and Victor Gibbs revisited and assessed the site. The datum was relocated and boundaries adjusted, increasing site size. A number of artifacts and the fire-cracked rock scatter were relocated and plotted as were two additional unconsolidated fire-cracked rock scatters. A small projectile point of probable Middle Archaic age was collected at that time, and a new map showing features, artifact locations, and adjusted site boundaries was produced. In 2010, with NMSLO and NMSHPO concurrence, Zia archaeologist Victor Gibbs monitored the excavation of a waterline corridor within the protective buffer. No features or artifacts were exposed by construction activities and no cultural deposits were noted (FAA and NMSA 2010b:26).

Site Setting

LA 156877 is in a flat area with a very slight southeast slope. Low mesquite-stabilized dunes occur on and in the vicinity of the site, with yucca and sparse grasses growing between the dunes. Active eolian deposition indicates a degree of stability for the area (FAA and NMSA 2010b:25; McBride, Chapter 20).

Preliminary Site Description

Zia originally described LA 156877 as a small artifact scatter with a low-density fire-cracked rock scatter. A sample of the surface chipped stone debitage was analyzed and included 3 cores, 12 flakes, and 1 piece of angular debris (Quaranta and Gibbs 2008:188–189). A reassessment in 2009 characterized the site as a prehistoric limited-use area covering about 1,920 sq m (0.19 ha, 0.47 acres). One fire-cracked rock feature and three fire-cracked rock scatters were spread through the northeastern half of the site (Fig. 13.1). Surface artifacts included two cores, a hammerstone, a potential Middle Archaic projectile point, a piece of ground stone, angular debris, and flakes (FAA and NMSA 2010b:14, 26, 57).

Research-Oriented Investigations

OAS investigations at this site began with the flagging of visible surface artifacts and fire-cracked rock within both the fenced area and an additional 15 m buffer zone beyond the fence. An expanded distribution of artifacts and the presence of two features outside the fence marking the original buffer increased the defined site area, expanding it to the northwest and southeast. Improvements to the existing county road that runs along the southwestern edge of LA 156877 appear to have eliminated the southwestern part of the site, decreasing site area in that direction. As currently defined, LA 156877 covers 3,852.66 sq m (0.39 ha, 0.95 acres). All visible surface artifacts were point provenienced using a total station and collected.

A 4 by 4 m grid was placed over Feature 1 and the included grid units were excavated in one or two levels. All recovered artifacts came from the upper level of fill. Two of the fire-cracked rock scatters noted on the site were recorded as features. Feature 2, a dispersed fire-cracked rock scatter, is just southeast of Feature 1 at the edge of, and extending beyond, the outer edge of the original buffer. Feature 3, another dispersed fire-cracked rock scatter, is within the original site boundaries. Feature 4, also a fire-cracked rock scatter, was located outside the original site boundaries to the northwest.

After work was completed at the site, an area of carbon-stained sediment was noted in the road-cut on the southwestern edge of the site. The stain was briefly described during this investigative phase and given a designation of Feature 5. The edges of this feature were not distinct in the road cut. Feature 5 was not excavated, but a flotation sample was collected from the exposed fill. After completion of the research-oriented investigations at the site in 2011, the protective fence was removed. No geomorphological soil pit was excavated at this site.

Surface Strip Area

As proposed in the research plan (Moore et al. 2010:102), a 4 by 4 m area centered on Feature 1 was surface stripped to determine whether that thermal feature contained any intact cultural deposits. By surface stripping the area around the feature it was also hoped that information on other associated features and activities would become available.

Surface Strip 1. This 4 by 4 m excavation unit was centered on Feature 1 and contained 16 grid units, including 685-688N/902-905E (Fig. 13.1). The loose sediment mantle was stripped from all 16 grid units, stopping when more compact sediments were encountered. The only exception to this was in grid unit 686N/904E, where a second level was excavated to determine whether artifacts occurred below the loose upper sediments. Only 1–5 percent (2 percent average) of the surface was stabilized by vegetation, which consisted mostly of grass with a few small, unidentified weedy plants. Fire-cracked rocks were found on the surface of eight grid units, with an overall average of just under two fragments per grid unit. Grid unit 696N/903E, which encompassed the main surface cluster of fire-cracked rock defined as Feature 1, contained 20–30 fragments. No artifacts were noted on the surface of this excavation area.

Two strata were encountered during excavation. Stratum 1 was a brown, sandy loam that contained 5–15 percent pea gravels of basalt, limestone, chert, rhyolite, quartzite, caliche, and sandstone. This stratum averaged 4.27 cm thick, and was variable in depth, ranging from 2–4 cm on the east side of the surface strip area to 3–11.5 cm on the west side. Several types of disturbance were noted throughout the area examined, including insect burrows and roots, evidence of cattle grazing, and rodent burrows that mainly occurred within the area defined as Feature 1. No charcoal or ash was noted in Stratum 1, and Feature 1 appeared to have been completely deflated with little spatial integrity remaining.

Below the loose sediments was Stratum 2, which was investigated by an 11 cm deep level excavated in a single grid unit as noted above. This layer consisted of brown sandy clay; gravels were more common in this layer than they were in Stratum 1, with pea gravels comprising 10–15 percent of the fill. No cultural materials of any type

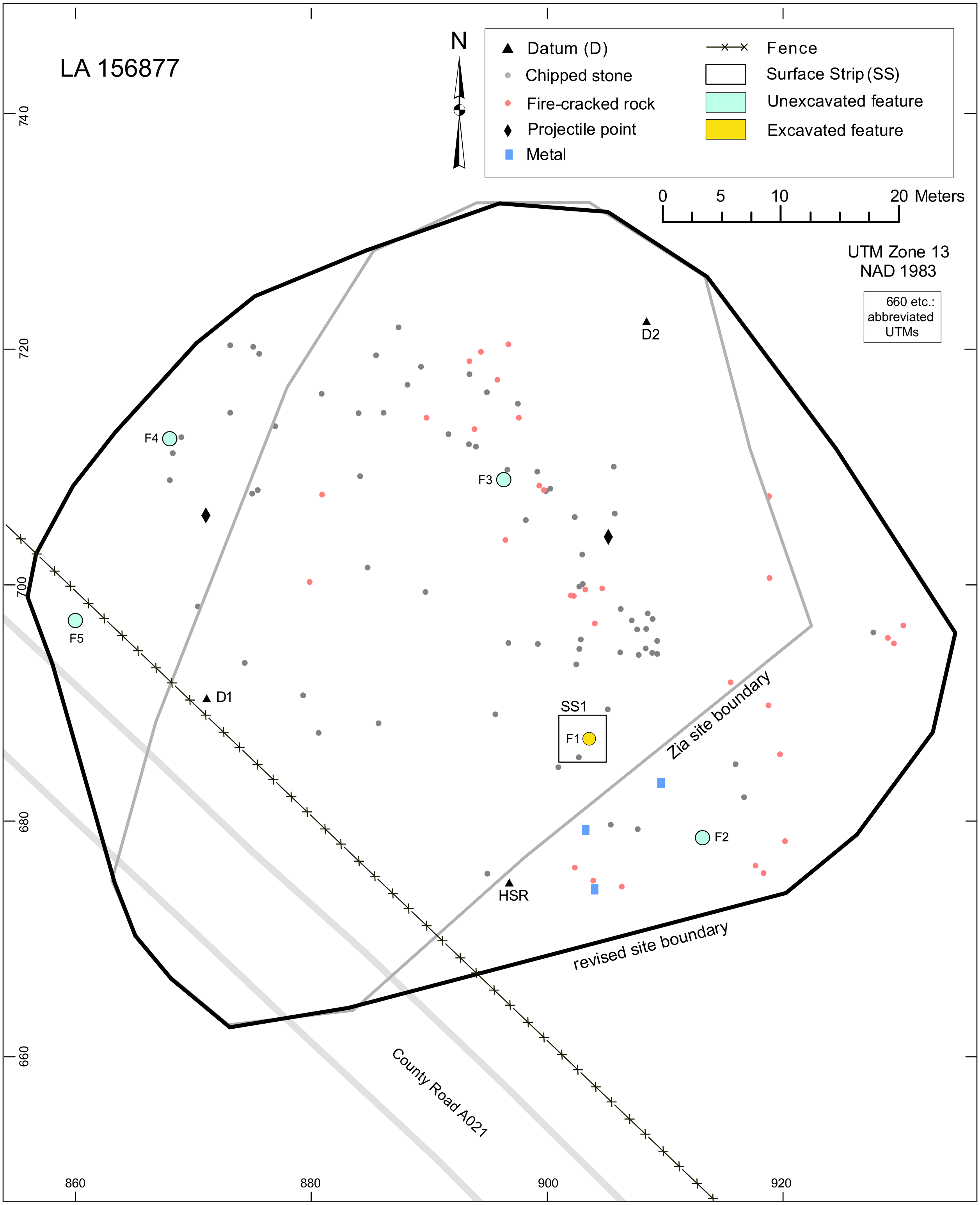

Figure 13.1. LA 156877, site plan.

were encountered in Stratum 2. Disturbances noted in this sediment layer were essentially the same as those seen in Stratum 1. Considering that 25 pieces of fire-cracked rock were found in Stratum 1 in this grid unit, Stratum 2 was determined to be culturally sterile and excavation ended.

Fire-cracked rock was common in Stratum 1, and occurred in every grid unit, with an average of 21.63 pieces per grid unit, ranging from six to 62 fragments. Chipped stone artifacts were also moderately common in Stratum 1, with 31 specimens occurring in 13 grid units. There was an average of 1.94 chipped stone artifacts per grid unit, with a range of 0–6.

Assessment of Surface Strip 1

No other cultural features were uncovered in this excavation area, but a small assemblage of chipped stone artifacts was recovered that may represent some of the activities performed around Feature 1. The lack of charcoal and ash in Feature 1, in addition to the scattered condition of elements, suggests that this area is deflated, affecting the patterning of cultural materials. However, since the fire-cracked rock making up Feature 1 retained some structure, these materials may have a degree of spatial integrity, horizontally if not vertically. The results of excavation in Surface Strip 1 suggest that limited information may still be available at this site.

Features

No features were initially identified at this site, but Zia noted a low-density fire-cracked rock scatter throughout the site area (Quaranta and Gibbs 2008:188). Reassessment of the site in October of 2009 resulted in the identification of three fire-cracked rock features, two unconsolidated scatters, and one possibly buried feature (FAA and NMSA 2010:26). OAS proposed to surface strip around the possible buried feature as formal flake tools had been noted in its vicinity. A total of five features were identified during the current study.

Feature 1 (fire-cracked rock scatter/completely deflated fire pit)

Prior to excavation, Feature 1 was a scatter of about 40 pieces of fire-cracked rock in a 4.4 by 4.6 m area. Small mesquite-stabilized dunes formed the northern boundary with small tufts of grass interspersed (Fig. 13.2). The fire-cracked rocks were in a mostly deflated area with a thin fragile crust of moisture-consolidated soil and pea gravel. The northeastern quarter of the feature contained half of the surface fire-cracked rock.

A 4 by 4 m grid was placed over Feature 1, extending into the mesquite-stabilized dunes to the north. The upper fill was removed by grid unit as Level 1. It consisted of 2 to 4 cm of loose sandy loam (7.5YR 5/4) that was basically eolian with thin colluvial clay lenses throughout. Small gravel comprised up to 10 percent of the fill. A single grid unit (688N/902E) was excavated to a depth of 21 cm, extending 18 cm into Pleistocene-era compact sandy clay of the same color as the upper fill.

Stripping within the grid units revealed about 480 fire-cracked rocks but no charcoal-stained soil and no evidence of a pit (Fig. 13.3). The rocks included a wide range of material types: basalt, rhyolite, other igneous, limestone, sandstone, chert, caliche, and granite. Three metate fragments of sandstone and vesicular basalt were point plotted. Thirty-two chipped stone artifacts were associated with this feature, and all but one of those was recovered during surface stripping (Level 1), the exception came from the surface. Nineteen chipped stone artifacts were chert (7 angular debris and 12 core flakes), five were metaquartzite (3 core flakes, 2 biface flakes), four were limestone (3 core flakes, 1 core), two core flakes were igneous undifferentiated, and one core flake apiece were orthoquartzite and metamorphic undifferentiated. Only five of the core flakes and neither of the biface flakes were complete and none were fire-fractured. No flotation samples were collected.

Feature 2 (fire-cracked rock scatter)

This scatter of 20 to 40 pieces of fire-cracked rock (Fig. 13.4) is located southeast of Feature 1 outside the boundary defined by Zia (Quaranta and Gibbs 2008:191). It covers a 15 to 16 sq m diameter area and has a maximum density of two fire-cracked rocks in a 50 by 50 cm area. Igneous rocks were most common, followed by limestone, sandstone, and quartzite. It sits on a gentle slope with small mesquite bushes and low grass, with sparse chipped stone artifacts and a chopping tool noted in the vicinity. The soil has little depth and the potential for buried deposits is low.

Feature 3 (fire-cracked rock scatter)

Feature 3 is a dispersed fire-cracked rock scatter (Fig. 13.5) located near the center of the site in a flat area with small tufts of grass. It is smaller than Feature 2, measuring about 9 m north–south by 10 m east–west. It contains fewer rocks (20 to 30) but has a greater density, with eight occurring in a 50 by 50 cm area. Most of the rocks are igneous, but some limestone, quartzite, sandstone, and chert also occur. No ash is visible and the potential for subsurface deposits is low. Four pieces of chipped stone were collected within a 5.0 m radius of the feature. Three (one piece of angular debris and two core flakes) are from the same variety of chert and the other is a rhyolite core flake.

Feature 4 (fire-cracked rock scatter)

Feature 4 is outside the original site boundary to the northwest of Feature 1 (Fig. 13.6), and is in a level area that supports some grass and small mesquite shrubs. This feature consists of a sparse scatter of 20 to 30 small fragmented rocks, most of which are limestone with fewer examples of igneous, sandstone, and other rocks also occurring. It measures 7.0 m north–south by 5.5 m east–west. Few pieces of chipped stone occur in the general area and there is little soil deposition, suggesting that the potential for artifact association information is low and the potential for buried deposits is very low.

Feature 5 (possible structure or large roasting pit)

After work was completed at the site, an area of carbon-stained sediment was noted in the road cut on the southwestern edge of the site. Construction along the road had been monitored but the stain was not noted at that time (FAA and NMSA 2010:26). The stain was briefly described during this investigative phase and given a designation of Feature 5. The area of carbon-stained sediment was mostly removed by road construction. The remaining portion is 4.04 m long in the road-cut and 63 cm deep (Fig. 13.7). It consists of gray, compact sandy clay loam containing sparse carbonate-coated small gravels, chunks of charcoal concentrated at the base of the stain, and very sparse fire-cracked rock. The sides of this feature are not distinct. Fea-

Figure 13.2. LA 156877, Feature 1, before excavation.

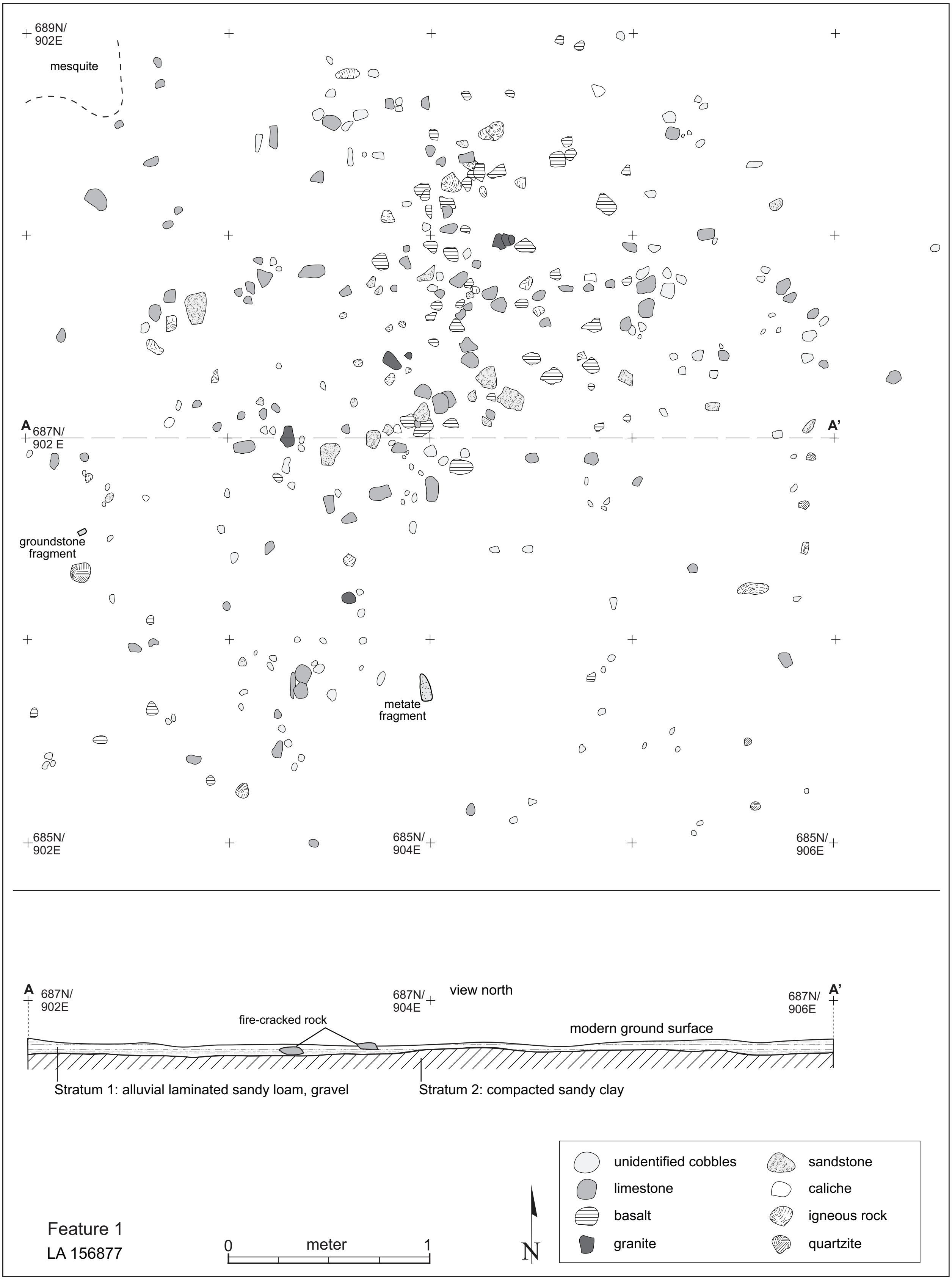

Figure 13.3. LA 156877, Feature 1, plan.

Figure 13.4. LA 156877, Feature 2.

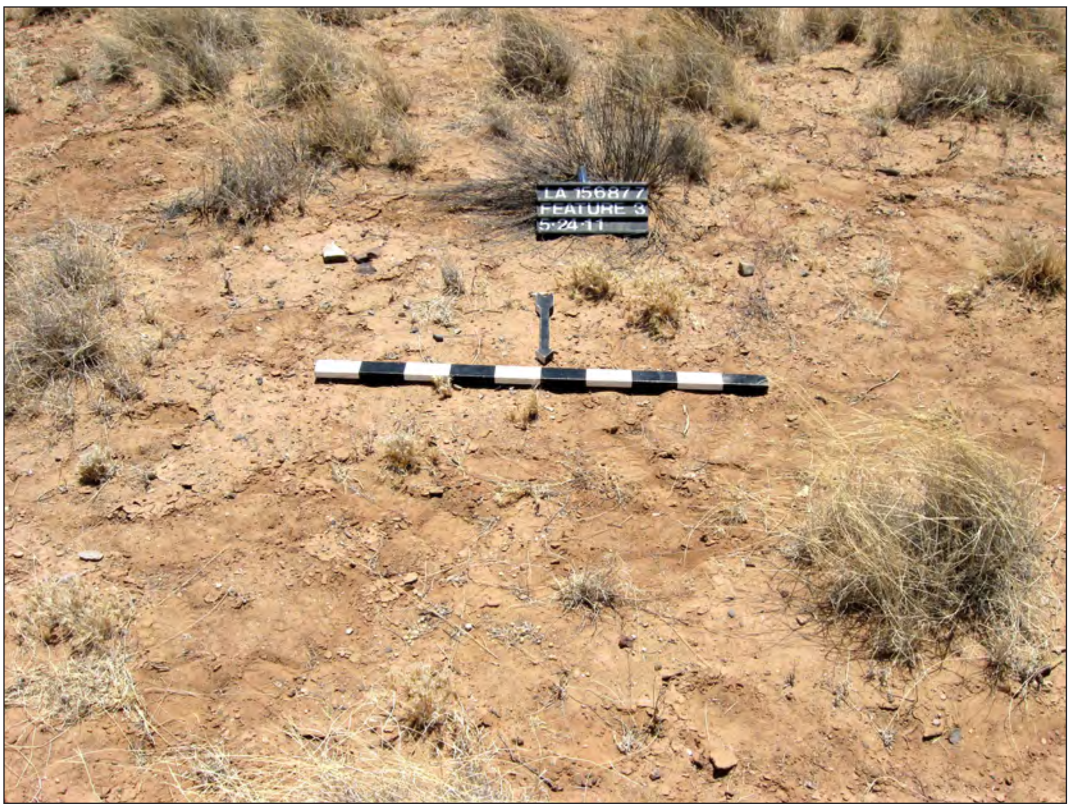

Figure 13.5. LA 156877, Feature 3.

Figure 13.6. LA 156877, Feature 4.

Figure 13.7. LA 156877, Feature 5.

ture 5 was not excavated, but a flotation sample was taken from the exposed fill. Carbonized plant material in the flotation sample consisted of yucca basal caudex, a fragment of mesquite wood, and two pieces of saltbush.

Artifact Assemblages

All visible surface artifacts were point provenienced and collected, and no materials were analyzed in the field. Each artifact category is discussed separately in this section, including chipped stone artifacts, ground stone artifacts, and flotation samples. A single sample for radiocarbon analysis was obtained from Feature 5. No sherds or bone were recovered during excavation.

Laboratory Analyses

Chipped Stone. A total of 101 chipped stone artifacts were recovered from LA 156877. Most of these—69 (68.32 percent)—were point provenienced and collected from the surface. The other 32 specimens (31.68 percent) were recovered during excavation of the Feature 1 surface strip. Chert is the dominant material type (n = 79, 78.22 percent), with a number of varieties occurring. Other materials include metaquartzite (n = 9, 8.91 percent), limestone (n = 5, 4.95 percent), silicified wood (n = 3, 2.97 percent), igneous undifferentiated (n = 2, 1.98 percent), rhyolite (n = 1, 0.99 percent), metamorphic undifferentiated (n = 1, 0.99 percent), and orthoquartzite (n = 1, 0.99 percent). Core flakes are the dominant morphological category (n = 72, 71.29 percent), followed by angular debris (n = 12, 11.88 percent), biface flakes (n = 10, 9.90 percent), a bipolar flake (0.99 percent), cores (n = 5, 4.95 percent) and a small corner-notched arrow point (0.99 percent). Other than the projectile point, the only tool identified was a piece of debitage that was used as an informal tool.

The distribution of surface-collection material types essentially follows that of the assemblage as a whole, with a few minor differences. Cherts dominate this assemblage (n = 60, 86.96 percent), followed by metaquartzite (n = 4, 5.80 percent), silicified wood (n = 3, 4.35 percent), and single specimens of limestone and rhyolite (1.45 percent apiece). The distribution of morphological categories is also very similar to that of the overall assemblage. Core flakes are dominant (n = 50, 72.46 percent), followed by biface flakes (n = 8, 11.59 percent), angular debris (n = 5, 7.25 percent), cores (n = 4, 5.80 percent), and the bipolar flake and projectile point (1.45 percent apiece).

Material type and morphological category distributions are somewhat different for the Feature 1 surface strip assemblage because that assemblage contains considerably fewer specimens. Cherts dominate this assemblage (n = 19, 59.38 percent), followed by metaquartzite (n = 5, 15.63 percent), limestone (n = 4, 12.50 percent), igneous undifferentiated (n = 2, 6.25 percent), and single specimens of orthoquartzite and metamorphic undifferentiated (3.13 percent apiece). Core flakes (n = 22, 68.75 percent) and angular debris (n = 7, 21.88 percent) dominate this part of the assemblage, followed by biface flakes (n = 2, 6.25 percent) and a core (3.13 percent).

Ground Stone. Three ground stone tools were recovered from the upper level of the Feature 1 surface strip, including two sandstone metate fragments and a vesicular basalt basin metate fragment, all of which are heat fractured.

Flotation. A single flotation sample was collected from Feature 5. Three types of charred plant remains were identified in this sample: yucca caudex, mesquite wood, and saltbush wood. The presence of unburned mesquite and amaranth seeds in this sample suggests that the contents of Feature 5 have been disturbed by bioturbation, which introduced more recent vegetative materials.

LA 156877 Summary and Recommendations

Research investigations at LA 156877 focused on surface stripping around Feature 1, a scatter of 30 to 40 pieces of fire-cracked rock observed by OAS on an earlier visit to the site. Following the research plan, artifact locations at the site were mapped with the total station, the artifacts were collected, and a 4 by 4 m area surface was stripped around the feature. The area that was surface stripped contained numerous fire-cracked rocks that were mapped and their material types noted, but no evidence of an intact feature or intact cultural deposits was found. Four additional features were also located and recorded. Three were fire-cracked rock scatters that are similar to Feature 1 in that they appeared to have little depth or potential for intact cultural deposits. Feature 5 was a large stain visible in the road cut bank. A flotation sample taken from the fill contained a variety of fuel woods (saltbush, yucca caudex, and a piece of mesquite).

Most of the surface artifacts were chipped stone, with the only temporally diagnostic artifact recovered during this study being the corner-notched arrow point that suggests a Formative-period affiliation. However, this date is in conflict with an earlier date for the site suggested by the small Middle Archaic point collected during a previous assessment. Multiple occupations may, thus, be indicated, but this is uncertain because of the limited amount of corroborative data available. The moderately high number of biface flakes (9.90 percent) in this small assemblage may support the presence of a Middle Archaic component. At least eight of the 10 biface flakes appear to have been struck during the manufacture of large bifaces and, since the two remaining specimens are both proximal fragments, they were probably removed from bifaces as well. While large biface manufacture was common during the Archaic it was much less common during the Formative period. Since the biface flakes are scattered across most of the site area and do not cluster in any particular area, materials from both periods of occupation seem to be inextricably mixed and there does not appear to be a way in which to separate materials from those occupations. Overall, core reduction and general tool manufacture or maintenance are the main activities that can be suggested from the chipped stone assemblage, again providing no mechanism for separating materials from the different occupations.The only ground stone artifacts were found in the Feature 1 surface strip. All three were from metates: two of sandstone and one of vesicular basalt. No absolute dates were obtained from this site. Feature 1 yielded no charcoal and the sample collected from Feature 5 was very small and there are no associated artifacts. Artifacts and fire-cracked rocks (Fig. 13.1) are scattered over the site area and none appear to cluster around the areas designated as features. However, since there was no surface evidence for the large Feature 5 stain, it is possible that other cultural deposits and intact features remain at this site.

Despite the lack of absolute dates for this site, and the deflated condition of visible features, LA 156877 retains the potential to provide information on the prehistory of this region. This is suggested by Feature 5, part of which remained after road construction removed a section of it. It has the potential to provide further information and perhaps shed some light on the apparent multicomponent nature of the site. In addition, the buried nature of Feature 5 suggests that other similar features might still be present and could contribute additional data if located and excavated.

14 | Chipped Stone Analysis

James L. Moore

Introduction

Information on chipped stone assemblages is available from 14 sites at Spaceport America, eight of which were examined by the current study and an additional six that were examined during the testing phase (Akins and Moore 2011a). Data from the six tested sites include those created by the full analysis of artifacts that were collected and returned to the laboratory as well as those created by the in-field analysis of uncollected artifacts. In each case, the in-field analysis samples included all visible artifacts. Testing data are also available for two of the sites examined by the research-oriented investigations—LA 111429 and LA 155963—but only data from the artifacts that were collected from those sites (both testing and research-oriented phases) are used in most of this analysis. This is because the in-field analysis at these sites focused on tools rather than all visible surface artifacts and the assemblage of tools represents a very biased sample in contrast to samples from the other tested sites. However, the field-recorded artifacts from testing at LA 111429 and LA 155963 are still useful for providing subsidiary information on periods of occupation and potential activities performed, and so are used to supplement other data in those discussions. Most information available from in-field analysis during both phases is not as detailed as the data from the analysis of artifacts that were collected and returned to the laboratory. Nevertheless, the testing data are used to augment data from the laboratory analysis and to expand the comparative database.

The full database for this project includes information on 7,514 chipped stone artifacts (including the tested artifacts from LA 111429 and LA 155963), with the testing assemblage containing 779 (10.37 percent) artifacts and the research phase assemblage containing 6,735 (89.63 percent) specimens. Analysis was completed in the field on 1,252 artifacts (16.66 percent), and includes 610 artifacts (48.72 percent) from testing and 642 artifacts (51.28 percent) from the research phase. This is potentially important, because refinements were made to the in-field analysis methods in the period between phases that resulted in the recording of a larger number of attributes in the later study. The methods used during laboratory analysis were consistent between both phases, and full analysis was applied to 169 artifacts (2.70 percent) from testing and 6,093 artifacts (97.30 percent) from the research phase.

Preliminary dates are assigned to some components based on associated radiocarbon dates and temporally diagnostic artifacts. While these assignments remain tentative in several cases, they allow many assemblages to be placed in a temporal framework; comparisons may then be made to determine potential temporal placement for assemblages that lack any associated dates

There are three goals of this analysis: (1) describe the assemblages at the site and component level and determine the reduction strategy used in each case, looking for differences that could reflect temporal variation; (2) use the data generated by assemblage descriptions and analysis to assign tentative dates to components lacking temporally diagnostic materials; and (3) define the activities reflected by chipped stone tools in each component.

Analytic Methods

Artifacts analyzed in the field were examined using a 10x hand lens and dimensions were measured with a digital caliper. No field-analyzed artifacts were weighed. Artifacts were examined under a binocular microscope at 10x–80x magnification during laboratory analysis, with higher magnification used to examine wear patterns and platform characteristics. Utilized and modified edge angles were measured with a goniometer, and artifacts in laboratory analyses were weighed on a digital scale.

Four general classes of chipped stone artifacts are recognized in this analysis: flakes, angular debris, cores, and tools. Flakes are debitage that exhibit one or more of three characteristics: definable dorsal and ventral surfaces, bulb of percussion, and striking platform. Pieces of angular debris are debitage that lack these characteristics. Cores are nodules from which debitage were struck and that exhibit three or more negative flake scars originating from one or more platforms. Tools are debitage or cores whose edges were damaged during use or modified to create specific shapes or edge angles to function in certain tasks.

Analytic Attributes

Attributes recorded for all artifacts include material type and quality, artifact morphology and function, amount of surface covered by cortex, portion, evidence of thermal alteration, and dimensions (length, width, and thickness). These were the only attributes recorded during the testing phase's in-field analysis; two attributes, flake platform type and evidence of platform lipping, were added to the in-field analysis for the research phase. In addition to the attributes already listed, several more pertaining to flakes were recorded during laboratory analysis, including dorsal scar orientation, platform angle, type of bulb of percussion, curvature, "waisting," and distal termination. In addition, all artifacts were weighed, and edge-wear patterns and utilized/modified edge angles were examined and measured on all informal and formal tools. Thus, the number of attributes varies for each level of analysis, and some assemblages and/or parts of assemblages will necessarily be omitted from discussion when certain attributes are discussed.

Material type. Materials are coded by gross category unless specific sources or distinct varieties are recognized. Codes are arranged so that major material groups fall into specific sequences of numbers, progressing from general material groups to specific varieties that can be linked to sources. Cherts, rhyolites, and metaquartzites were separated into a number of distinct varieties based on color combinations because varying colors in these materials could be important indicators of source.

Material texture and quality. This attribute provides information on the basic flaking characteristics of materials. Texture subjectively measures grain size *within* rather than *across* material types and is scaled from fine to coarse for most materials, with fine textures exhibiting the smallest grains and coarse the largest. Obsidian is classified as glassy by default, and this category is applied to no other material. Quality records the presence of flaws that could affect reduction and includes crystalline inclusions, fossils, visible cracks, and voids. Inclusions that will not affect reduction, such as specks of different colored material or dendrites, are not considered flaws. Material texture and quality are recorded together.

Artifact morphology. This is one of two attributes that provide information on artifact form and use. Artifact morphology categorizes artifacts by their general form, such as core flake or early stage biface.

Artifact function. This is the second attribute that provides information on artifact form and use, and categorizes specimens by their inferred use (or lack of use) such as end scraper or non-utilized flake.

Cortex. This is the chemically or mechanically weathered outer rind on nodules, and tends to be brittle and chalky and does not flake with the ease or predictability of unweathered material. The amount of cortical coverage is estimated and recorded in 10 percent increments for each artifact—for flakes the percentage of dorsal surface covered by cortex is estimated, while for all other artifact classes the percentage of total surface area covered by cortex is estimated, since other artifact classes lack definable dorsal surfaces.

Cortex type. The type of cortex on an artifact can be a clue to its origin. Waterworn cortex indicates that a nodule was transported by water and that its source was probably a gravel deposit. Non-waterworn cortex suggests that a material was obtained where it outcrops naturally. Cortex type was identified for artifacts on which it occurred; when identification was not possible, cortex type was coded as indeterminate.

Portion. For flakes and formal tools, the portion represented by each specimen is recorded. Angular debris and cores are considered whole by default, because it is usually impossible to determine whether these items broke during or after reduction.

Platform type. This records the shape of, and any modifications to, the striking platform on whole flakes and proximal fragments.

Platform lipping. This records the presence or absence of a lip at the ventral edge of a flake platform, and is coded as either present or absent.

Platform angle. The angle formed by the intersection of the dorsal surface of a flake and its striking platform was recorded as either greater than 45 degrees or less than 45 degrees.

Bulb of percussion. These only occur on flakes and are recorded as either pronounced or diffuse.

Flake curvature. The presence or absence of distinct curvature on the ventral surface of flakes was recorded using this attribute.

Waisted. Soft hammer percussion and pressure flaking can cause the formation of a waist between the platform and main body of a flake, and is often present on biface flakes. This attribute records the presence or absence of waisting on flakes.

Thermal alteration. When present, the type and location of evidence for thermal alteration are recorded to determine whether an artifact was purposely or incidentally heated.

Wear pattern. In cases where debitage or cores were used as informal tools, this attribute records the pattern of attrition. A second group of codes was used to record formal tool edges. Wear pattern was recorded separately for every altered edge on a tool.

Edge angle. The angles of all utilized or intentionally modified edges on informal and formal tools were recorded. Edge angle was also recorded separately for every altered edge on a tool.

Length, width, and thickness. These attributes were measured in millimeters for all artifacts. On angular debris and cores, length is the largest measurement, width is the longest dimension perpendicular to the length, and thickness is perpendicular to the width and is the smallest measurement. On flakes and formal tools, length is the distance between the proximal and distal ends, width is the distance between edges paralleling the length, and thickness is the distance between dorsal and ventral surfaces.

Weight. Weight was recorded to the nearest tenth of a gram.

Discussion

The analytic methods used during this study combine both typological and attribute approaches. In typological approaches, "individual artifacts are classified into types that have some kind of technological or functional meaning" (Andrefsky 2001:6). A benefit of this type of analysis is that behavior can be immediately inferred from the identification of a single artifact (Andrefsky 2001:6). For instance, the presence of a notching flake indicates that a notched tool was made at a site, even if no notched tools are found. However, this method can be criticized because there is often a lack of verification between artifact type and functional or technological interpretation (Andrefsky 2001:7). Attribute analysis examines the distribution of one or more characteristics through an entire population, usually of debitage (Andrefsky 2001:7). Among other things, various attributes can be used to assess the prevalence of specific reduction methods in a debitage population. However, problems can also occur when using this analytic strategy "for a variety of reasons related to the small size of attributes and the number of observations" (Andrefsky 2001:12). Typological and attribute analyses vary in scale; typological analysis is applied to individual artifacts while attribute analysis is applied to entire assemblages (Andrefsky 2001:12). Andrefsky (2001) notes that there is no "right" approach to debitage analysis, but that the approach used can vary according to the types of information desired.

The methods employed by this study assign typological interpretations to individual artifacts; in turn, attribute data that can be used to test and augment typological data is gathered. For instance, as discussed later, a rigorous set of characteristics is used to define flakes struck from bifaces versus those struck from cores. Flakes that do not fulfill the set of characteristics used to define biface flakes are, by default, considered core flakes. However, the definition used to identify biface flakes models ideal examples, and all flakes struck from bifaces (especially those struck in the early stages of manufacture) do not fit that ideal. By combining attribute analysis with a typological approach we are able to determine which flakes were definitely struck from bifaces (typological approach) as well as those that were probably struck from bifaces but do not quite fit the model (attribute analysis). The two approaches complement one another and help provide a deeper understanding of reduction technology and tool use.

The main questions this analytic scheme is designed to explore include: what types of materials were selected; what techniques were used for reduction; and what types of chipped stone tools were used. These topics can provide information about ties to other regions, mobility patterns, and site function. Material selection studies will not always reveal *how* materials were obtained, but they can usually provide information on *where* materials came from. Cortex type can be used to determine whether certain materials were obtained at outcrops or came from secondary gravel deposits. Studies of reduction technology can help show how different peoples solved the problem of producing the chipped stone tools they needed from resources at hand. Various approaches could have been used, depending on the level of residential mobility, types of stone available, and the range of other materials that could be used as tools. Examination of the tools recovered from a site can help define the range of activities that occurred there, and in many cases this will also aid in defining site function. Chipped stone tools can sometimes be used to provide temporal data, but are usually less time sensitive than other artifact classes like pottery. For this reason, the chipped stone assemblages are only used to provide temporal data at a very coarse-grained level.

Two attributes are used to record typological categories: artifact morphology and artifact function. Morphology describes the basic appearance of an artifact, especially debitage. Function describes the presumed use of an artifact based on shape and evidence of use. Information on the typological placement of debitage and cores is coded into artifact morphology, while tools are only generalized by this attribute into uniface, biface, and cobble tool categories. Conversely, the typological placement of formal tools is coded into the artifact function category and is based on shape and flaking patterns, while most debitage and cores are generalized into utilized and unutilized categories. The exceptions are pieces of debitage that were marginally modified, either by use or design, into definable tool types. This category mostly includes tools such as scrapers and spokeshaves that were made on debitage with a minimum of modification, and in most cases the source of that modification (use versus intent) is questionable. By using both artifact morphology and function, each artifact can be assigned to a specific type.

The debitage category contains flakes and angular debris. While all angular debris is assigned a single code, multiple types of flakes can occur in an assemblage, and each type can have a different origin. One of the aspirations of this analysis is to distinguish between major varieties of flakes including core flakes, biface flakes, resharpening flakes, notching flakes, bipolar flakes, blades, channel flakes, and pot lids. With the exception of core and biface flakes, these categories are usually rare or absent from most assemblages. Thus, distinguishing between core and biface flakes is a critical analytic need.

Flakes are divided into removals from cores and bifaces using a polythetic set attributes (discussed in detail later). While not all flakes removed from bifaces can be distinguished in this way, those that are can be considered definite evidence of biface reduction. Instead of rigid definitions, the polythetic set provides a flexible means of categorizing flakes and helps account for some of the variability seen in experiments. Other flake types are identified by unique characteristics. Notching flakes are produced when the hafting elements of bifaces are notched and generally exhibit a recessed, U-shaped platform and deep, semi-circular scallop at the juncture of the striking platform and dorsal surface. Bipolar flakes are produced when nodules are smashed, and sometimes exhibit evidence of having been struck at one end and crushed against an anvil at the other. Channel flakes are removed when Paleoindian dart or spear points are fluted and do not occur in later sites except as curated artifacts. Blades are defined as long, narrow removals from specially prepared cores, and are rare after the Clovis period. The traditional definition of blades in the Southwest follows that developed by Bordes (1961), which classifies as a blade any flake that is twice as long as it is wide. However, as Collins (1999) points out, the context of that definition is often overlooked by archaeologists in the New World:

> He was defining the term for use in classifying Lower and Middle Paleolithic stone tools, where blades by any definition are relatively infrequent. . . . In contrast, during the Upper Paleolithic, blades—often called

> "true blades"—are far more common and they meet more stringent definitions, even in Bordes own writings . . . where emphasis is placed on the techniques of production, not just the proportions of the piece. (Collins 1999:7)

This is important to note, because many flakes removed from large Archaic bifaces fit the proportional criteria that are often used to define blades, but result from an entirely different reduction technique. Large biface flakes often appear to be prismatic in form and are slightly curved as can be common for blades. However, blades are struck from specially prepared cores, have platform angles approaching 90 degrees, and exhibit evidence of platform preparation on the dorsal surface below its juncture with the platform (Collins 1999). Large biface flakes are struck from bifacially flaked tools or biface cores, have platform angles approaching 45 degrees, and exhibit evidence of platform preparation across the platform as well as along the edge where the platform and dorsal surface meet. Even though there is a superficial resemblance between some of the byproducts of blade and biface reduction, they represent two distinct techniques, each with its own set of attributes.

Resharpening flakes are removed from formal tool edges that become dull from use, and usually fit the polythetic set for biface flakes. They are often impossible to separate from other biface flakes, but can sometimes be distinguished by the presence of an extraordinary amount of damage on the platform and on the section of dorsal surface adjacent to the platform. Pot lids are debitage that were blown off the surface of a chipped stone artifact during thermal alteration, and are not indicative of purposeful flaking.

Cores are nodules of raw lithic material that have been modified by the removal of debitage during reduction. Some cores were efficiently reduced in a standardized fashion, while flakes were removed from others in a more haphazard manner. Core shape and size are often clues to the relative availability of materials. Materials represented by small, carefully reduced cores may have been uncommon or highly desired. Materials represented by large cores, often with haphazard or unplanned flake removals, tend to be common and not highly prized. Core analysis in the Southwest tends to be rather simplistic since evidence of specialized reduction techniques is rare after the Paleoindian period. Blade technology does not occur after the Clovis period, so prismatic (blade) cores associated with this technique rarely occur. Blade technology was replaced by the manufacture of biface cores during the Archaic period. Biface cores (or large generalized bifaces) were multifunctional in that they could be used as tools, as sources for informal debitage tools, or modified into other forms. While the manufacture of biface cores wasted a lot of material, the tools themselves were an efficient adjunct to a hunting and gathering lifestyle. However, because of their multifunctional character they tend to be categorized as formal tools rather than as cores.

Both cores and formal tools represent nuclei from which flakes were removed, but differ in the rationale behind those removals. Flakes were struck from cores for use as informal tools or to be modified into formal tools. Flakes were also removed during formal tool manufacture to create desired shapes or edge angles. Cores are classified with debitage as by-products of the reduction process. Formal tools are considered separately because they are evidence of other unrelated tasks. Since all chipped stone artifacts result from similar reductive processes, this division is in many ways artificial, because formal tools can be used to both aid in the examination of reduction processes and to provide information on the range of tasks performed. This is especially true for unfinished formal tools that were discarded during production because of breakage or problems encountered during reduction.

Material Selection

Examination of the materials reduced at a site and their physical attributes can provide information on several aspects of human behavior. The presence of materials obtained from definable sources can be indicative of movement range or exchange ties. The texture and flaking qualities of materials can be a clue to the purpose for which they were selected. Identification of materials from local sources—both primary and secondary—provides information on how the local landscape was used. The amount of cortical coverage on debitage can suggest the form in which materials arrived at a site.

Five of the attributes recorded during analysis are specifically aimed at providing information on material selection. Examining the type of cortex that occurs on materials provides information on where they were obtained. Non-waterworn cortex indicates procurement at an outcrop, while waterworn cortex indicates that a nodule was collected from a secondary gravel deposit. Since materials collected from gravel beds were often naturally transported a great distance from where they outcrop, this is an important distinction. Materials like obsidian and Pedernal chert that outcrop a long distance from the study area can be considered exotic if they possess non-waterworn cortex. However, if they exhibit waterworn cortex and are available in local gravel deposits it must be assumed that they were obtained locally. The exception to this is obsidian that originated in sources that do not drain into the Rio Grande. The amount of cortical coverage on debitage, especially flakes, provides clues concerning the level to which cores were reduced before being brought to a site. Large amounts of cortical debitage exhibiting large percentages of cortical coverage suggest that nodules were both obtained and reduced at the same location, while the opposite indicates that cores were transported in an already reduced condition.

The remaining attributes provide information on flaking characteristics, which can be critically important to the material selection process. The first of these is material type itself. Rocks vary considerably in their flaking characteristics; some flake with comparative ease and predictably, while others are more difficult to flake and do not always break in the desired way. Materials that flake easily tend to be brittle and elastic, while those that are harder to flake tend to lack elasticity and are less brittle. These characteristics are tied to what Cotterell and Kaminga (1990:129–130) refer to as <u>toughness</u>. Tough materials are durable and able to withstand impacts from pounding or chopping without splintering and coming apart. While materials from different sources vary in toughness, in general Cotterell and Kaminga's (1990:129) comparison indicates that obsidian, quartz, and chert are less tough than andesitic basalt, tuff, and rhyodacitic volcanic rock. Toughness is not equated with hardness, because hard materials also tend to be brittle and fracture easily (Cotterell and Kaminga 1990:129). Thus, materials that can be categorized as non-durable are mostly hard and brittle. Fine-grained, non-durable materials produce sharp cutting edges (Cotterell and Kaminga 1990:127) and are less tough than those that are softer and less brittle. While the former are well-suited to the production of cutting and scraping tools, the latter are best for pounding and grinding tools. Non-durable materials are less suitable for pounding or chopping because the same characteristics that allow them to produce sharp edges causes them to splinter and crack when force is applied to their edges.

This system of classification is similar to one presented by Callahan (1979:16) and modified somewhat by Whittaker (1994:66), which ranks materials by degree of toughness and the effective limits of tools used for reduction. While Callahan's (1979:16) rankings are a subjective rather than a quantitative test of toughness, they are based on many years of flintknapping experience and are probably accurate. In this scheme, obsidians and heat-treated fine-grained cherts and chalcedonies are classified as brittle and can be efficiently thinned using soft hammer percussion and pressure flaking. The finest-grained basalts and rhyolites, unheated fine-grained cherts, and other chertic materials are categorized as strong, and can be efficiently thinned using both soft hammerstone and soft-hammer percussion as well as pressure flaking. Strong cherts can be transformed into brittle materials by thermal alteration. The coarser cherts, quartzites, quartz crystal, agate, jasper, siltstone, siliceous limestone, coarser-grained quartzites and rhyolites, and most basalts are classified as tough and are best thinned using soft hammer reduction.

Luedtke (1992:80) notes that material strength (also referred to as toughness or tenacity) "is a measure of how much force must be applied to produce a fracture." Thus, strength also equates to the degree of resistance to knapping demonstrated by a material. Strong materials that require the use of hard blows to remove flakes cannot be hit as accurately as materials that require less force to initiate a fracture (Luedtke 1992:80). Some reduction techniques, like pressure flaking, are not applicable to very strong materials (Luedtke 1992:80). In discussing Callahan's (1979) material scale, Luedtke (1992:80–81) notes:

> Strength peaks in the middle of the range rather than at either end. The most workable materials, at the low end of his scale, are relatively weak. They should be worked with softer billets or flakers, and they

> require special procedures to keep platforms from collapsing. Materials at the high end of Callahan's scale, the least workable, are also somewhat less strong and prone to hinge and step fractures. Presumably, fractures start easily in materials at this end of the scale but do not propagate all the way through the stone, as desired.

Materials categorized as brittle in Callahan's scale are the most amenable to chipped stone reduction. Strong materials can be efficiently worked but require more force to remove flakes. Tough materials at the upper end of the scale generally cannot be efficiently worked because flakes struck from them often terminate in hinges or steps that make further flaking difficult to accomplish.

By combining classification systems, we can categorize materials defined as brittle and strong by Callahan (1979:16) as non-durable, and those defined as tough as durable materials. Non-durable materials are best suited to reduction because they can be efficiently flaked using a variety of methods. Durable materials are less well-suited to reduction because the techniques that can be used to efficiently work them are more limited and they cannot be flaked as efficiently. Thus, by examining the toughness of materials we may be able to determine some of the use-based parameters that factored into their selection. Three attributes are tied to an examination of durability. Material type is an important factor in determining durability, as is material texture and quality. The presence or absence of thermal alteration is also an important factor given Callahan's (1979) observation that strong cherts can be converted to a brittle state through proper heat treatment.

Material Type

The distribution of material categories by site is shown in Table 14.1. We refer to material categories rather than material types because multiple varieties occur in several cases, which have been combined into the categories shown in Table 14.1. Chert is the dominant material category overall, and comprises over 50 percent of each assemblage except for LA 111420 and LA 111421. Both of these assemblages are dominated by metaquartzite, which is the second most common material category overall but comprises only a little more than 8 percent of the composite assemblage. In contrast, metaquartzite comprises over 50 percent of both the LA 111420 and LA 111421 assemblages, giving them a character that is distinctly different from the other sites. While a variety of other material categories occur for all sites except LA 112374, most are comparatively rare overall. Exceptions to this are the material categories from LA 111422 and LA 111435, which both contain surprisingly large percentage of limestone artifacts. The LA 155963 assemblage contains the most material categories, which is not surprising since it comprises nearly half the composite assemblage. In general, the larger the assemblage the more material categories it contains: assemblages containing fewer than 100 artifacts average 3.83 material categories apiece, those with 100–250 specimens average 7.67 categories, those with 250–1000 specimens average 9.5 categories, and assemblages containing more than 1000 artifacts average 13.5 material categories. Thus, the number of material categories represented is dependent on assemblage size.

The various types comprising several of the material categories are defined using visual characteristics. For cherts, varieties are defined by color/color combination or because they match named types. Similarly, metaquartzites are distinguished by color/color combinations. In contrast, rhyolites are defined using both color and grain size. Aphanitic rhyolites are distinguished from non-aphanitic varieties and each category is further defined by color. Two varieties of obsidian are distinguished: generic obsidian and Polvadera obsidian. The latter is from the El Rechuelos formation in the Jemez Mountains, and is the only type of Jemez obsidian that can be visually distinguished with confidence.

Colors and color combinations were used to differentiate the cherts and metaquartzites because it was initially uncertain if these characteristics could be useful in determining whether certain types came from definable local sources. Table 14.2 shows artifact counts for each chert variety. Of the 56 types recorded, four are from named sources; the chert category is generic and indicates missing color information; and chalcedony refers to clear or translucent cherts. After examining the distribution of varieties in the type collection (see Chapter 23, this report), we found that multiple colors and color combinations occur in local gravel beds, potentially negating the utility of this exercise. Perhaps the most useful observation concerning chert color

Table 14.1. Material type categories by site; counts and column percentages.

Material Category		LA 111420	LA 111421	LA 111422	LA 111429	LA 111432	LA 111435	LA 112370	LA 112371	LA 112374	LA 155963	LA 155964	LA 155968	LA 155969	LA 156877	**Total**
Chert	Count	98	20	86	1172	34	397	10	57	11	2969	496	428	35	79	5892
	Col. %	30.06%	31.75%	53.09%	93.09%	77.27%	62.72%	71.43%	95.00%	100.00%	81.66%	92.54%	86.12%	83.33%	78.22%	79.79%
Silicified wood	Count	3	2	1	12	1	2	2	–	–	150	3	20	–	3	199
	Col. %	0.92%	3.17%	0.62%	0.95%	2.27%	0.32%	14.29%	–	–	4.13%	0.56%	4.02%	–	2.97%	2.70%
Obsidian	Count	1	–	–	5	–	–	–	–	–	23	2	–	–	–	31
	Col. %	0.31%	–	–	0.40%	–	–	–	–	–	0.63%	0.37%	–	–	–	0.42%
Igneous	Count	–	–	–	–	–	2	–	–	–	3	4	1	–	2	12
	Col. %	–	–	–	–	–	0.32%	–	–	–	0.08%	0.75%	0.20%	–	1.98%	0.16%
Basalt	Count	1	–	1	2	–	7	1	–	–	4	–	–	–	–	16
	Col. %	0.31%	–	0.62%	0.16%	–	1.11%	7.14%	–	–	0.11%	–	–	–	–	0.22%
Rhyolite	Count	34	5	5	9	–	82	–	–	–	44	–	4	–	1	184
	Col. %	10.43%	7.94%	3.09%	0.71%	–	12.95%	–	–	–	1.21%	–	0.80%	–	0.99%	2.49%
Fine welded ash-flow tuff	Count	–	–	–	1	–	1	–	–	–	1	–	–	–	–	3
	Col. %	–	–	–	0.08%	–	0.16%	–	–	–	0.03%	–	–	–	–	0.04%
Limestone	Count	1	–	39	24	1	92	–	–	–	121	21	32	2	5	338
	Col. %	0.31%	–	24.07%	1.91%	2.27%	14.53%	–	–	–	3.33%	3.92%	6.44%	4.76%	4.95%	4.58%
Sandstone	Count	–	–	–	–	–	–	–	–	–	3	–	–	–	–	3
	Col. %	–	–	–	–	–	–	–	–	–	0.08%	–	–	–	–	0.04%
Siltstone	Count	–	3	4	3	–	1	–	1	–	24	–	3	1	–	40
	Col. %	–	4.76%	2.47%	0.24%	–	0.16%	–	1.67%	–	0.66%	–	0.60%	2.38%	–	0.54%
Slate/ Aragonite	Count	–	–	–	–	–	–	–	–	–	1	–	–	–	–	1
	Col. %	–	–	–	–	–	–	–	–	–	0.03%	–	–	–	–	0.01%
Metamorphic	Count	4	–	6	6	–	11	–	–	–	2	5	–	1	1	36
	Col. %	1.23%	–	3.70%	0.48%	–	1.74%	–	–	–	0.06%	0.93%	–	2.38%	0.99%	0.49%
Metaquartzite	Count	183	32	20	25	8	30	1	2	–	284	5	9	3	9	611
	Col. %	56.13%	50.79%	12.35%	1.99%	18.18%	4.74%	7.14%	3.33%	–	7.81%	0.93%	1.81%	7.14%	8.91%	8.27%
Orthoquartzite	Count	–	1	–	–	–	6	–	–	–	5	–	–	–	1	13
	Col. %	–	1.59%	–	–	–	0.95%	–	–	–	0.14%	–	–	–	0.99%	0.18%
Quartz	Count	1	–	–	–	–	2	–	–	–	2	–	–	–	–	5
	Col. %	0.31%	–	–	–	–	0.32%	–	–	–	0.06%	–	–	–	–	0.07%
Total	Count	344	63	162	1259	140	633	14	75	12	3636	536	497	42	101	7514
	Col. %	4.58%	0.84%	2.16%	16.76%	1.86%	8.42%	0.19%	1.00%	0.16%	48.39%	7.13%	6.61%	0.56%	1.34%	100.00%

Table 14.2. Chert varieties recorded during analysis with counts for each type.

Chert Variety	Count	Chert Variety	Count
Chert	6	Yellow & tan chert	16
Pedernal chert	27	Red & gray chert	94
Alibates chert	4	Pink chert	108
Tecovas chert	2	Brown & black chert	29
San Andres chert	147	White & brown chert	24
Gray chert	2,130	Gray & black chert	61
Brown chert	432	Tan & gray chert	353
Tan chert	276	Gray & brown chert	112
Black chert	100	Yellow & black chert	3
Cream chert	277	Purple & gray marbled chert	11
White chert	217	Red & white chert	32
Red chert	119	Brown & tan chert	20
Yellow & purple chert	6	Black & tan chert	48
White & black chert	36	Red, black, & yellow chert	3
Tan & cream chert	33	Gray & white chert	97
Yellow chert	64	Dark gray chert	322
Green chert	9	Reddish-gray chert	3
Purple chert	25	Coarse gray chert	55
Pink & gray chert	85	Black & red chert	16
Red-brown chert	103	Mottled brown, red, & gray chert	51
Pink & tan chert	13	Yellow, gray, & pink chert	3
Yellow-brown chert	36	Mottled red, pink & yellow chert	14
Yellow-gray chert	73	Pink & yellow chert	3
Yellow-white chert	21	Mottled black, white, & red chert	17
Yellow-red chert	42	Mottled pink, red, & white chert	4
Cream & brown chert	39	Green & gray chert	2
Pink & white chert	52	Purple & cream chert	13
White & tan chert	18	Chalcedony	56

variation is that gray chert (including dark gray chert) is the most common variety. Banks (1990:79) notes that light to dark gray cherts are known to outcrop in the Caballo Mountains and, based on his brief descriptions, several samples in the type collection probably originated there. This suggests that most of the gray cherts in the assemblage could have originated in the Caballo Mountains, though they were probably obtained from gravel deposits as were the samples in the type collection. If this is correct, then at least 43.07 percent of the cherts originated in the Caballo Mountains. Whether they were also obtained there is tested in the discussion of cortex type.

While fewer colors were recorded for metaquartzites, this material is also available in local gravel deposits as detailed in Chapter 23, with all of the colors recorded during analysis occurring in those sources. Both gray and red rhyolites, with aphanitic and non-aphanitic varieties represented, occur in local gravel beds indicating that this material was also locally available. Thus, for both of these materials any distinctions made on the basis of color have little further utility because, like the cherts, they were available in and probably mostly obtained from local gravel beds rather than at outcrops.

Six material types come from named sources including Pedernal chert, Alibates chert, Tecovas chert, San Andres chert, obsidian, and Polvadera obsidian. Pedernal chert mainly outcrops in the Chama Valley of northern New Mexico and has been transported into the Rio Grande Valley via the Chama River, occurring in gravel deposits at least as far south as Truth or Consequences, since a sample was obtained from Rio Grande gravels in that area (Chapter 23, this report), and probably at least as far south as the Las Cruces/El Paso area. Alibates and Tecovas cherts outcrop in the Texas Panhandle and could only have reached the Spaceport America sites through movement or exchange. San Andres chert outcrops in several regions in which the San Andres formation occurs, including northwest New Mexico, southeast New Mexico, and south-central New Mexico in the vicinity of the project area. Thus, this type was either obtained from local gravels or from sources in nearby mountain ranges.

Examination of 27 obsidian artifacts from LA 111429 and LA 155963 using X-ray fluorescence (XRF) analysis demonstrated that these specimens came from a variety of sources in New Mexico including several in the Jemez Mountains (Cerro del Medio, Cerro Toledo, El Rechuelos, and Bear Springs Peak), as well as Mount Taylor (Horace Mesa), McDaniel Tank, Gwynn/Ewe Canyon, and Mule Creek (Appendix 3). Most obsidian varieties from the Jemez Mountains and Mount Taylor are available in gravel deposits in the Rio Grande Valley, and the former have been traced as far south as the Mexican border (Appendix 3; Banks 1990). An exception to this is Cerro del Medio obsidian, which is restricted to the interior of the Valles Caldera and does not occur in Rio Grande gravels (Arakawa et al. 2011).

Five of the obsidian artifacts submitted for XRF analysis were either from unknown sources or were too small for analysis. Of the 22 specimens for which sourcing information was obtained, 13 (59.09 percent) are from Jemez Mountain or Mount Taylor sources, from which materials can erode into the Rio Grande Valley. Four of eight specimens from Cerro Toledo exhibit waterworn cortex, as does the single example of El Rechuelos (Polvadera) obsidian. This strongly suggests that the Jemez obsidian specimens, with the exception of those from Cerro del Medio, were obtained from Rio Grande gravels. While none of the Bear Springs Peak (n = 2) or Mount Taylor (n = 2) specimens are cortical, these materials were probably also obtained from Rio Grande gravels. McDaniel Tank obsidian outcrops on the west flank of the Magdalena Mountains in an area drained by Milligan Gulch (LeTourneau et al 2010), which flows into the Rio Grande at the north end of Elephant Butte Lake. Thus, this material may also be available in Rio Grande gravels south of that confluence, but this has not yet been established. The single specimen from this source is non-cortical, so it is impossible to determine whether it was obtained at the source or from secondary gravel deposits. While the Rio Grande gravels are not a local source, they are much closer to the project area than are the original source areas for most of these materials, and most of the Jemez and Mount Taylor obsidians were probably obtained from the Rio Grande Valley as indicated by the occurrence of only waterworn cortex in this small assemblage.

The two remaining sources—Mule Creek and Gwynn/Ewe Canyon—are in southwestern New Mexico. While the single specimen of Gwynn/Ewe Canyon obsidian is non-cortical, 40 percent of those from Mule Creek (two of five) exhibit waterworn cortex, indicating procurement from secondary deposits rather than directly from the source. Shackley (1995) notes that Mule Creek obsidian erodes into the San Francisco and Gila Rivers, and those are the most likely areas from which the Spaceport America specimens were obtained. In any case, the only way in which specimens of these obsidian varieties could reach the project area is through trade or long distance travel.

Both pieces of Cerro del Medio obsidian are core flakes, with one associated with the Paleoindian component at LA 111429 and the other associated with a probable Archaic component at LA 155963. All eight pieces of Cerro Toledo obsidian are from LA 155963; 2 came from a probable Archaic component (core flake and biface flake), one from a Late Archaic component (Armijo point), and five from Formative components (four core flakes, one unnotched arrow point). One of the probable Archaic specimens and three of the Formative period specimens exhibit waterworn cortex indicative of procurement from secondary deposits. Both pieces of Bear Springs Peak obsidian and the piece of El Rechuelos obsidian are also from LA 155963. One Bear Springs Peak obsidian specimen is a Middle Archaic San José point and the other two were found in Formative-period deposits (both unnotched arrow points); none exhibit cortex. All examples of Mount Taylor (corner-notched and side-notched arrow points), Gwynn/Ewe Canyon (core flake), and McDaniel Tank obsidian (core flake) also were recovered from LA 155963. The specimen from McDaniel Tank was found in an unknown temporal context, although we know that this source was frequented by at least the Late Paleoindian period (Robert Dello-Russo, personal communication 2013); those from the other two sources came from Formative-period components, and none exhibit cortex. Two pieces of Mule Creek obsidian are from LA 111429 and the other three are from LA 155963. Both specimens from LA 111429 are core flakes. One is in a probable Archaic component and exhibits waterworn cortex while the other is in a Formative-period component. One specimen from LA 155963 is a biface flake from Formative-period deposits and the other two are a piece of angular debris and a projectile point fragment; both of unknown date.

One Alibates chert artifact is a spurred end scraper and one Tecovas specimen is an end scraper and the other is an unutilized core flake. Both scrapers came from areas thought to represent Paleoindian occupations at LA 111429 and LA 155963, respectively. The second Tecovas artifact is from a part of LA 155963 thought to represent an Archaic occupation. The other three Alibates specimens include a core from LA 111429 and core flakes from LA 111420 and LA 155964. Since the core was recovered from a site that contains evidence of a major Paleoindian component, that specimen can probably be assumed to have originated in the Paleoindian deposits, though it was apparently moved from its original location at some unknown time. LA 111420 is tentatively assigned an Archaic date, based on the types of projectile points present, and the main occupation at LA 155964 was during the Historic period. Thus, all of these specimens date to periods when residential mobility tended to be very high. The occurrence of materials obtained at great distances from the sites at which they were lost or discarded is a common pattern for Folsom-period sites, as discussed by Meltzer (2006) for the Folsom Site in northeastern New Mexico. Since the Paleoindian occupations at LA 111429 and LA 155963 both appear to have occurred primarily during the Folsom period, evidence for a similar pattern was anticipated.

The question of whether any materials other than Alibates chert, Tecovas chert, and some of the obsidians can be considered exotic or not can only be resolved by examining cortex type. Table 14.3 shows the distribution of cortex type by material for the composite assemblage. A total of 1,481 artifacts (19.70 percent) exhibit cortex, and non-waterworn cortex occurs on only 16 artifacts (1.08 percent of cortical artifacts). The only potential exotic material to exhibit non-waterworn cortex is an obsidian core flake from LA 155964 that was examined during in-field analysis and was not available for sourcing. Since cortex only occurs on the platform of this artifact and it was examined under low magnification, the identification of cortex type should be considered tentative. However, it is interesting that this artifact was found at LA 155964, which also yielded a piece of Alibates chert and had a main component dating to the Historic period. Of seven pieces of cortical Pedernal chert debitage, six exhibit waterworn cortex and the last specimen is indeterminate. This strongly suggests that the Pedernal chert all came from Rio Grande gravels.

Table 14.3. Percentages of various cortex types by material; counts and row percentages.

Material Category		Waterworn	Non-waterworn	Indeterminate
Chert	Count	1,068	9	18
	Row %	97.53%	0.82%	1.64%
Silicified wood	Count	43	–	–
	Row %	100.00%	–	–
Obsidian	Count	8	1	–
	Row %	88.89%	11.11%	–
Igneous	Count	3	–	–
	Row %	100.00%	–	–
Basalt	Count	4	–	–
	Row %	100.00%	–	–
Rhyolite	Count	48	–	1
	Row %	97.96%	–	2.04%
Limestone	Count	70	5	8
	Row %	84.34%	6.02%	9.64%
Sandstone	Count	2	–	–
	Row %	100.00%	–	–
Siltstone	Count	12	–	–
	Row %	100.00%	–	–
Metamorphic	Count	8	–	–
	Row %	100.00%	–	–
Metaquartzite	Count	134	1	1
	Row %	98.53%	0.74%	0.74%
Orthoquartzite	Count	4	–	–
	Row %	100.00%	–	–
Quartz	Count	2	–	–
	Row %	100.00%	–	–
Total	Count	1,437	16	28
	Row %	97.03%	1.08%	1.89%

Non-waterworn cortex occurs on artifacts in three other material categories including non-exotic types of chert, as shown in Table 14.3. The specimens exhibiting non-waterworn cortex occur in seven assemblages, including: LA 111420 (n = 1), LA 111421 (n = 1), LA 111429 (n = 1), LA 111435 (n = 8), LA 112371 (n = 1), LA 155963 (n = 2), and LA 155964 (n = 2). Seven varieties of chert are included in this category: gray (n = 2), tan (n = 1), black (n = 1), cream (n = 2), yellow (n = 1), gray and black (n = 1), and tan and gray (n = 1). Four of the five limestone specimens with non-waterworn cortex are from LA 111435, and the last is from LA 155963. The single metaquartzite specimen is from LA 155964. The presence of non-waterworn cortex on these few specimens indicates that chipped stone materials were sometimes obtained from outcrops and those materials were sometimes carried into the study area from elsewhere, probably in the form of partly reduced cores. The overwhelming majority of materials, however, appear to have been obtained locally. The distribution of artifacts with non-waterworn cortex is interesting, since multiple specimens occur in only three assemblages. Thus, evidence for the procurement of materials outside the study area is fairly rare and includes the specimens with waterworn cortex, the obsidian and Pedernal chert that were probably obtained in the Rio Grande Valley, and the Alibates and Tecovas cherts which outcrop in west Texas.

Two of the sites with multiple specimens—LA 111435 and LA 155964—primarily date to the Mesilla phase and Historic period, respectively, though in each case a small earlier component may also be represented. All specimens from LA 111435 and one of two from LA 155964 were examined during in-field analysis, so there is a possibility that the cortex type on at least some of these specimens was misidentified because only low magnification was used. Still, the likelihood that all of these specimens were misidentified is low. For both of these sites, materials obtained elsewhere appear to have been transported into the study area and eventually deposited there. Like the other sites on which artifacts with non-waterworn cortex occur, the main ramification is that the inhabitants of these sites had access to primary material sources.

Two artifacts with non-waterworn cortex were also identified in the LA 155963 assemblage, which is the largest of those examined during this study with dates spanning the Paleoindian to Historic periods. A limestone specimen from this site was recovered during surface stripping in Area B, and a gray and black chert specimen came from the surface strip in Area A South. This suggests that the limestone specimen dates to the Mesilla phase and the chert specimen probably dates to the Archaic period. As was the case for the other two sites containing artifacts with non-waterworn cortex, this simply means that the groups occupying these parts of LA 155963 had access to the primary sources of some materials.

The most important aspect of this study is that the overwhelming majority of cortical specimens—over 97 percent of cases—indicate procurement in gravel deposits rather than at the source. As discussed in Chapter 23, the gravels that contain most of the material types identified at the Spaceport America sites occur at Prisor Hill, on Yost Escarpment, and at LA 155963. Other potential sources include gravel beds along Yost and Aleman draws. These appear to have been the sources that were mostly used for procuring raw materials for reduction. The few artifacts with non-waterworn cortex simply indicate that people carried things with them when they traveled to these sites. Since none of the sites in our sample appear to represent long-term residential locales, this type of evidence for residential mobility is no surprise.

Material Texture and Quality

Table 14.4 presents texture and quality data for each material category. Because obsidian is the only material to which the "glassy" classification is applied, and obsidian is rare in all assemblages, the glassy category can be combined with the "fine-grained" category, representing the materials best suited to formal tool production. Overall, fine-grained materials (with the addition of glassy) appear to have been the most heavily selected for, with 80.31 percent of the assemblages falling into this category. "Medium-grained" materials account for another 18.99 percent of the overall assemblage, while "coarse-grained" materials comprise only 0.70 percent. Materials exhibiting flaws, especially if fine-grained, appear to have been considered acceptable for reduction, since this category comprises a fairly large percentage of the fine-grained materials.

Considering only the debitage assemblage, and combining the glassy and fine-grained categories, there appears to have been a tendency to select mostly unflawed fine-grained materials for tool manufacture. Of 345 flakes that were definitely removed during tool manufacture, 297 (86.09 percent) are fine-grained, 40 (11.59 percent) are fine-grained and flawed, and only 8 (2.32 percent) are medium-grained. In contrast, 63.36 percent of the 5,140 core flakes are fine-grained, 16.39 percent are fine-grained and flawed, 16.37 percent are medium-grained, 3.25 percent are medium-grained and flawed, 0.51 percent are coarse-grained, and 0.14 percent are coarse-grained and flawed. When compared to the core flakes, the combination of the much higher percentage of fine-grained materials overall in the biface flake category and the much smaller percentage of flawed materials indicates that there was a definite selection for better quality materials when choosing pieces for manufacture into formal tools.

Table 14.5 shows the distribution of material texture and quality categories for the morphological classifications of formal tools. Forty percent of the cobble tools are made from medium- and coarse-grained materials, which is not surprising since these textures tend to be tougher and therefore more durable for the pounding and chopping tasks for which this class of tool was used. None of the unifacial and bifacial tools are made from coarse-grained materials, and only 7.10 percent (n = 18) are made from medium-grained materials. Fine-grained materials (including glassy) by far dominate this part of the assemblage (n = 235, 92.89 percent). Flawed materials are much more uncommon than in the assemblage overall, comprising only 13.83 percent of the unifaces and bifaces versus 21.70 percent of the overall assemblage. Thus, fine-grained materials were heavily selected for the manufacture of formal unifacial and bifacial tools; of these, unflawed materials were preferred, although flawed materials were sometimes also considered suitable for this purpose.

While possible to examine material texture and quality data by site, doing so would be fairly useless because many of the sites contain multiple components. Thus, these attributes, as well as material type selection, are examined using the preliminary dates assigned to components within sites to provide a better idea of changes in selection parameters through time. Details of component dates and the rationale behind date assignments are presented in the individual site reports as well as in Akins and Moore (2011a) for the tested sites. Table 14.6 shows the number of artifacts assigned to each component for all 14 sites. Only three sites—LA 111420, LA 111422, and LA 156877—seem to represent single-component locales that can be assigned dates. Five sites—LA 111421, LA 112370, LA 112371, LA 111374, and LA 155969—probably represent single components but could not be dated. The six remaining sites are multicomponent as demonstrated by radiocarbon dates in most instances. Chipped stone artifacts representing Paleoindian components were identified at three sites, Archaic components at four, Formative components at six, and Historic components at four. Of these components, very few artifacts are represented for one of the four Archaic components and for three of the four Historic components.

Table 14.7 shows the distribution of material categories by temporal division. Cherts and silicified woods can be combined and were heavily selected for in each period. Percentages of cherts (including silicified wood) are 96.60 percent for the Paleoindian assemblages, 95.95 percent for the Historic assemblages, 78.15 percent for the Archaic components, and 71.80 percent for the Formative assemblages. Cherts were less heavily used in the Archaic and Formative assemblages, though they still dominated, and metaquartzites were more common in these assemblages than they were in the others. Surprisingly, obsidian use was somewhat more common in the Archaic and Formative assemblages than in the Paleoindian assemblages. This could reflect a dependence on high quality but more durable materials by the Paleoindian inhabitants of the region, with the relative fragility of obsidian of less concern to the later prehistoric inhabitants. The data in Table 14.7, in addition to others generated in this chapter, can be compared with site assemblages of unknown date to help determine whether those assemblages can be fit into a temporal category using chipped stone data alone.

Table 14.8 shows the distribution of toughness categories by temporal period. In this case, the Paleoindian components are distinctive in that they exhibit the heaviest use of brittle materials, which for the most part consist of thermally altered cherts. However, there was also heavy use of brittle materials in the Archaic and Historic assemblages, though the latter is illusory because most of the

Table 14.4. Texture and quality by material category; counts and row percentages.

Material Category		Glassy	Glassy and Flawed	Fine-grained	Fine-grained and Flawed	Medium-grained	Medium-grained and Flawed	Coarse-grained	Coarse-grained and Flawed	**Total**
Chert	Count	–	–	3552	1245	848	202	31	12	5890
	Row %	–	–	60.31%	21.14%	14.40%	3.43%	0.53%	0.20%	79.79%
Silicified wood	Count	–	–	147	47	4	1	–	–	199
	Row %	–	–	73.87%	23.62%	2.01%	0.50%	–	–	2.70%
Obsidian	Count	28	3	–	–	–	–	–	–	31
	Row %	90.32%	9.68%	–	–	–	–	–	–	0.42%
Igneous	Count	–	–	8	2	2	–	–	–	12
	Row %	–	–	66.67%	16.67%	16.67%	–	–	–	0.16%
Basalt	Count	–	–	12	1	3	–	–	–	16
	Row %	–	–	75.00%	6.25%	18.75%	–	–	–	0.22%
Rhyolite	Count	–	–	118	13	42	5	5	1	184
	Row %	–	–	64.13%	7.07%	22.83%	2.72%	2.72%	0.54%	2.49%
Fine welded ash-flow tuff	Count	–	–	2	–	1	–	–	–	3
	Row %	–	–	66.67%	–	33.33%	–	–	–	0.04%
Limestone	Count	–	–	273	11	42	11	1	–	338
	Row %	–	–	80.77%	3.25%	12.43%	3.25%	0.30%	–	4.58%
Sandstone	Count	–	–	–	–	3	–	–	–	3
	Row %	–	–	–	–	100.00%	–	–	–	0.04%
Siltstone	Count	–	–	32	1	6	1	–	–	40
	Row %	–	–	80.00%	2.50%	15.00%	2.50%	–	–	0.54%
Slate/ aragonite	Count	–	–	–	–	1	–	–	–	1
	Row %	–	–	–	–	100.00%	–	–	–	0.01%
Metamorphic	Count	–	–	29	–	7	–	–	–	36
	Row %	–	–	80.56%	–	19.44%	–	–	–	0.49%
Meta-quartzite	Count	–	–	366	3	198	44	–	–	611
	Row %	–	–	59.90%	0.49%	32.41%	7.20%	–	–	8.27%
Ortho-quartzite	Count	–	–	10	–	2	–	1	–	13
	Row %	–	–	76.92%	–	15.38%	–	7.69%	–	0.18%
Quartz	Count	–	–	2	1	–	2	–	–	5
	Row %	–	–	40.00%	20.00%	–	40.00%	–	–	0.07%
Total	Count	28	3	4653	1349	1160	266	40	13	7514
	Row %	0.37%	0.04%	61.94%	17.96%	15.44%	3.54%	0.53%	0.17%	100.00%

Table 14.5. Material quality and texture for all formal tools; counts and row percentages.

Artifact Morphology		Glassy	Fine-grained	Fine-grained and Flawed	Medium-grained	Medium-grained and Flawed	Coarse-grained	**Total**
Cobble tool	Count	–	2	–	–	–	–	2
	Row %	–	0.96%	–	–	–	–	0.73%
Unidirectional cobble tool	Count	–	3	–	2	–	–	5
	Row %	–	1.44%	–	10.00%	–	–	1.83%
Bidirectional cobble tool	Count	–	7	–	4	1	1	13
	Row %	–	3.37%	–	20.00%	20.00%	100.00%	4.76%
Early stage uniface	Count	–	37	3	4	1	–	45
	Row %	–	17.79%	9.68%	20.00%	20.00%	–	16.48%
Middle stage uniface	Count	–	9	–	–	–	–	9
	Row %	–	4.33%	–	–	–	–	3.30%
Late stage uniface	Count	–	11	–	–	1	–	12
	Row %	–	5.29%	–	–	20.00%	–	4.40%
Biface	Count	–	1	–	–	–	–	1
	Row %	–	0.48%	–	–	–	–	0.37%
Early stage biface	Count	–	22	8	3	–	–	33
	Row %	–	10.58%	25.81%	15.00%	–	–	12.09%
Middle stage biface	Count	–	40	11	4	2	–	57
	Row %	–	19.23%	35.48%	20.00%	40.00%	–	20.88%
Late stage biface	Count	8	69	7	3	–	–	87
	Row %	100.00%	33.17%	22.58%	15.00%	–	–	31.87%
Edge bite	Count	–	7	2	–	–	–	9
	Row %	–	77.78%	22.22%	–	–	–	3.30%
Total	Count	8	211	31	20	5	1	273
	Row %	2.90%	76.45%	11.23%	7.25%	1.81%	0.36%	100.00%

Table 14.6. Number of artifacts assigned to each general time period by site and percentage of assemblage represented by each temporal assignment.

Site	Unknown	Paleoindian	Archaic	Formative	Historic	**Total**
LA 111420	–	–	344	–	–	344
LA 111421	63	–	–	–	–	63
LA 111422	–	–	–	162	–	162
LA 111429	315	903	1	39	1	1,259
LA 111432	140	–	–	–	–	140
LA 111435	–	–	28	605	–	633
LA 112370	14	–	–	–	–	14
LA 112371	75	–	–	–	–	75
LA 112374	12	–	–	–	–	12
LA 155963	244	466	1,229	1,687	9	3,636
LA 155964	52	–	–	–	484	536
LA 155968	27	396	–	73	1	497
LA 155969	42	–	–	–	–	42
LA 156877	–	–	–	101	–	101
Total	984	1,765	1,602	2,667	495	7,514
	13.10%	23.49%	21.32%	35.49%	6.59%	100.00%

Table 14.7. Material category by temporal period; counts and column percentages.

Material Category		Unknown	Paleoindian	Archaic	Formative	Historic	**Total**
Chert	Count	718	1669	1120	1914	470	5891
	Col. %	82.34%	94.56%	72.82%	70.55%	95.14%	79.80%
Silicified wood	Count	29	36	96	34	4	199
	Col. %	3.33%	2.04%	6.24%	1.25%	0.81%	2.70%
Obsidian	Count	5	4	10	11	1	31
	Col. %	0.57%	0.23%	0.65%	0.41%	0.20%	0.42%
Igneous	Count	–	1	–	7	4	12
	Col. %	–	0.06%	–	0.26%	0.81%	0.16%
Basalt	Count	2	1	4	9	–	16
	Col. %	0.23%	0.06%	0.26%	0.33%	–	0.22%
Rhyolite	Count	14	4	44	122	–	184
	Col. %	1.61%	0.23%	2.86%	4.50%	–	2.49%
Fine welded ash-flow tuff	Count	1	1	–	1	–	3
	Col. %	0.11%	0.06%	–	0.04%	–	0.04%
Limestone	Count	20	17	9	279	12	337
	Col. %	2.29%	0.96%	0.59%	10.28%	2.43%	4.57%
Sandstone	Count	–	–	3	–	–	3
	Col. %	–	–	0.20%	–	–	0.04%
Siltstone	Count	5	5	3	27	–	40
	Col. %	0.57%	0.28%	0.20%	1.00%	–	0.54%
Slate/aragonite	Count	1	–	–	–	–	1
	Col. %	0.11%	–	–	–	–	0.01%
Metamorphic	Count	8	5	4	19	–	36
	Col. %	0.92%	0.28%	0.26%	0.70%	–	0.49%
Metaquartzite	Count	68	21	242	277	3	611
	Col. %	7.80%	1.19%	15.73%	10.21%	0.61%	8.28%
Orthoquartzite	Count	1	1	–	11	–	13
	Col. %	0.11%	0.06%	–	0.41%	–	0.18%
Quartz	Count	–	–	3	2	–	5
	Col. %	–	–	0.20%	0.07%	–	0.07%
Total	Count	984	1765	1556	2713	494	7512
	Col. %	13.10%	23.50%	20.71%	36.12%	6.58%	100.00%

Table 14.8. Toughness category by temporal period; counts and column percentages.

Toughness		Unknown	Paleoindian	Archaic	Formative	Protohistoric	Historic	**Total**
Brittle	Count	294	767	612	330	–	196	2199
	Col. %	29.88%	43.46%	39.33%	12.16%	–	39.68%	29.27%
Strong	Count	379	885	440	994	–	226	2925
	Col. %	38.52%	50.14%	28.28%	36.64%	–	45.75%	38.93%
Tough	Count	311	113	504	1389	1	72	2390
	Col. %	31.61%	6.40%	32.39%	51.20%	100.00%	14.57%	31.81%
Total	Count	984	1765	1556	2713	1	494	7514
	Col. %	13.10%	23.49%	20.71%	36.11%	0.01%	6.57%	100.00%

thermal alteration of cherts in the main Historic component was related to discard burn rather than intentional thermal alteration to facilitate reduction, as discussed later. The Formative components exhibit the least use of brittle materials, by far. Strong materials were most heavily used in the Paleoindian and Historic assemblages, which is not surprising considering the dominance of cherts in those assemblages as well. Materials that produce the sharpest cutting edges and are most amenable to formal tool production dominate in all but the Formative assemblages, and are somewhat less common in the Archaic assemblages than might be expected. Tough materials are comparatively rare in the Paleoindian and Historic assemblages and are much more common in the other assemblages, especially the Formative assemblage.

To sum up the temporal examination of material selection parameters, the components representing the highest level of mobility—Paleoindian, Archaic, and Historic—exhibit both the highest use of cherts and brittle/strong materials, though these characteristics can be expected to covary. The Formative assemblages, which should exhibit the lowest level of mobility, are dominated by tough and strong materials and contain the lowest percentage of brittle materials. The Archaic assemblage contains a high percentage of brittle materials as expected, but also a surprisingly large percentage of tough materials. Thus, temporal variation is visible in material selection parameters, both in material type and in material toughness.

Material Selection Viewed Through Core Assemblages

Further information on material selection parameters is available from the assemblage of cores. How cores were treated during reduction and the types and amount of cortex remaining on them can be informative about material selection locations and, potentially, about nodule size. Three core attributes are examined including cortex type, core morphology, and remaining size. As discussed earlier, cortex type is a clue to where materials were obtained. Core morphology can provide data on the intensity of reduction, especially when combined with information on cortical coverage. The remaining size of cores, especially those that were intensively reduced and retain little or no cortex, can be used to augment the other two attributes and provide a fuller understanding of reduction in relation to material source.

Logically, most core morphologies represent a reduction sequence from least to greatest amount of material removed. Tested cobbles had a few flakes struck from them to assess their suitability for further reduction, and therefore retain most of their cortical surfaces. These are very early stage cores that were rejected for further reduction, and their presence at a site suggests that they were obtained nearby and their transport was inexpensive in terms of time and energy. Thus, only local materials should be represented in the array of tested cobbles. Unidirectional cores are nodules that were considered suitable for further reduction, with flakes being struck from a single platform. When unidirectional cores are systematically reduced they eventually become pyramidal cores, which resemble blade cores in form but not in how platforms were prepared and how flakes were struck from them. While unidirectional cores should retain less cortex than tested cobbles but more than other morphological types, pyramidal cores should retain little or no cortex. Pyramidal cores are expected to be uncommon in this assemblage. Bidirectional cores logically follow unidirectional cores in the sequence, and represent acceptable nodules that were reduced from two opposing platforms and that should retain less cortex than unidirectional cores. Multidirectional cores were reduced from multiple platforms or from two non-opposed platforms and should retain less cortex than bidirectional cores. Bipolar cores are nodules or cores that were deliberatively smashed to obtain the greatest amount of edge possible. High quality materials that are only available in small nodules might be smashed as the most effective way to obtain useable debitage. Exhausted cores of high-quality material might also be smashed with the same end in mind. The former might be evidenced by the presence of significant amounts of cortex on a bipolar core, while the latter might be indicated by the absence of cortex on bipolar cores. Since this type of reduction rarely leaves a recognizable core behind, bipolar cores are expected to be rare.

Table 14.9 shows the distribution of core morphologies by component and time period. Multidirectional cores are the most abundant type, followed by unidirectional cores, tested cobbles, and bidirectional cores. No examples of pyramidal or bipolar cores were noted. When the distribution of core types is examined by temporal division, multidirectional cores are the most common type in all periods, though unidirectional cores are close seconds in all but the Paleoindian assemblage, and are tied with the multidirectional variety in the Historic assemblage. The distribution of percentages by period in Table 14.9 is interesting in that relatively few cores are associated with the Paleoindian assemblage, and that small assemblage is dominated by multidirectional cores suggesting intense reduction. The comparative rarity of cores in the Paleoindian assemblage is indicated by the proportion of the total assemblage represented by this artifact class. Cores comprise 3.96 percent of the unknown assemblage, 0.85 percent of the Paleoindian assemblage, 2.19 percent of the Archaic assemblage, 3.98 percent of the Formative assemblage, and 1.62 percent of the Historic assemblage. Initially, then, we can suggest that not only are cores least common in the Paleoindian period assemblages, they also appear to have been reduced to the greatest extent in those assemblages.

Information on mean weight and cortical coverage is shown in Table 14.10. Overall, there is a progression in percentage of cortical coverage, with tested cobbles retaining the most cortex followed in sequence by unidirectional, bidirectional, and multidirectional cores. This is the expected progression and shows that the more intensely reduced a core is, the less cortex it retains. Mean weights also mostly follow this progression, with unidirectional cores weighing considerably more than bidirectional cores, which in turn weigh a little more than multidirectional cores, on average. However, the tested cobbles do not fit the progression, weighing just slightly more than the bidirectional and multidirectional cores and considerably less than the unidirectional cores. The tested cobbles were reduced to a lesser extent than the other types, as demonstrated by the presence of considerably more cortical surface, so they had less mass removed than did the other core types. On average, the tested cobbles weigh considerably less than the unidirectional cores and only slightly more than the bidirectional and multidirectional cores. These comparisons suggest that the nodules reduced to produce tested cobbles were, on average, smaller than the nodules reduced to produce the other types of cores. Since tested cobbles were rejected as unsuitable early in the reduction sequence, then smaller nodules were more likely to be determined unsuitable for reduction, and larger nodules were more often reduced to a further extent because they contained more useable material.

Paleoindian cores tend to be both smaller and retain less cortex than cores from other time periods. This supports the earlier observation that cores were more intensely reduced in the Paleoindian assemblage than in other assemblages, and could be an indication that many were carried in from elsewhere in an already reduced state. Unfortunately, since the initial size of the nodules from which these cores were produced is unknown, this observation remains tentative. Archaic cores are quite a bit larger and retain slightly more cortex than the Paleoindian cores, and Formative cores are slightly larger and retain somewhat more cortex than the Archaic cores. While cores in the Historic assemblage tend to be much larger and retain more cortex than those in all other assemblages, this may be due to error caused by small sample size since there are only about half as many Historic cores as occur in the next smallest assemblage. Though cores from individual time periods tend to generally follow the progressions seen in the overall assemblage, there are more deviations because of small samples and large variations in sample size.

Reduction Strategy

Two basic reduction strategies have been defined for the post-Clovis occupation of the Southwest: curated and expedient. Curated reduction entails the manufacture of tools in anticipation of use, while expedient reduction involves the production of tools as needed. A curated strategy is usually associated with the manufacture of large bifaces that can be used to fulfill a variety of needs. Kelly (1988:731) defines three types of bifaces: those used as cores as well as tools, long use-life tools that can be resharpened, and those made to replace parts of existing composite tools. The last category can also be referred to as specialized bifaces, which are tools made for one or a very limited set of purposes. Bifaces with multiple functions and those with long use-lives are mostly associated with mobile lifestyles where efficiency is critical. However, these associations are not exclusive; mobile peoples also make specialized bifaces while sedentary peoples

Table 14.9. Core morphologies by site component and time period.

Site	Component	Tested Cobbles	Unidirectional Cores	Bidirectional Cores	Multidirectional Cores	**Total**
LA 111420	Archaic	1	1	–	–	2
LA 111421	Unknown	1	1	–	–	2
LA 111422	Formative	1	4	–	4	9
LA 111429	Unknown	1	4	1	4	10
	Paleoindian	–	2	–	2	4
LA 111432	Unknown	1	2	–	–	3
LA 111435	Formative	1	17	–	22	40
LA 112371	Unknown	–	1	–	2	3
LA 155963	Unknown	–	1	–	4	5
	Paleoindian	–	–	–	2	2
	Archaic	1	13	3	16	33
	Formative	–	16	4	23	43
LA 155964	Unknown	–	1	–	3	4
	Historic	1	3	1	3	8
LA 155968	Unknown	3	1	–	3	7
	Paleoindian	1	–	–	8	9
	Formative	2	4	–	6	12
LA 155969	Unknown	–	1	–	4	5
LA 156877	Formative	–	2	–	3	5
Total		14	74	9	109	206
Unknown		6	12	1	20	39
		15.38%	30.77%	2.56%	51.28%	100.00%
Paleoindian		1	2	–	12	15
		6.67%	13.33%	–	80.00%	100.00%
Archaic		2	14	3	16	35
		5.71%	40.00%	8.57%	45.71%	100.00%
Formative		4	43	4	57	108
		3.70%	39.81%	3.70%	52.78%	100.00%
Historic		1	3	1	3	8
		12.50%	37.50%	12.50%	37.50%	100.00%

Table 14.10. Mean percentage of cortex and weight of cores for time periods and summaries by time period and core type.

Period	Core Type	Mean Cortex	Mean Weight (g)
Unknown	Tested cobble	71.67%	76.08
	Unidirectional	28.33%	133.82
	Bidirectional	0.00%	none available
	Multidirectional	20.00%	187.73
Paleoindian	Tested cobble	70.00%	80.30
	Unidirectional	10.00%	23.60
	Multidirectional	16.67%	73.16
Archaic	Tested cobble	80.00%	14.90
	Unidirectional	30.71%	119.95
	Bidirectional	46.67%	149.87
	Multidirectional	3.13%	61.06
Formative	Tested cobble	82.50%	152.30
	Unidirectional	27.44%	155.17
	Bidirectional	27.50%	48.25
	Multidirectional	16.49%	60.94
Historic	Tested cobble	90.00%	122.80
	Unidirectional	63.33%	461.57
	Bidirectional	0.00%	64.70
	Multidirectional	13.33%	136.07
Unknown		30.00%	145.50
Paleoindian		19.33%	67.03
Archaic		22.29%	91.87
Formative		23.70%	96.87
Historic		40.00%	247.55
Tested cobble		77.14%	90.30
Unidirectional core		29.19%	155.73
Bidirectional core		27.78%	88.41
Multidirectional core		15.09%	84.21

manufacture general-purpose bifaces. The difference is more a matter of degree—there is less focus on specialized bifaces by mobile peoples and less focus on general-purpose bifaces by sedentary peoples. Thus, the number of bifaces, or amount of evidence for biface manufacture in an assemblage, is not necessarily indicative of reduction strategy and lifestyle; rather, it is the types of bifaces that were made and used and the types of debris discarded during their manufacture that provide clues to these aspects of prehistoric life.

The first two categories of bifaces defined by Kelly (1988) are necessarily large in size. Bifaces that function as cores, general purpose tools, and blanks for the replacement of broken or lost tools have to be large to be useful. Similarly, bifaces made with long use-lives in mind also have to be large to allow them to be resharpened. In contrast, specialized bifaces need to be no larger than the size required for the task at hand.

Projectile points are bifaces that readily illustrate these distinctions. In a curated tool kit, broken projectile points could be replaced with blanks, which could also serve as cores and general purpose tools. Large projectile points could be used as knives since they possess a fairly long edge and are usually set into detachable foreshafts. Broken points can often be reworked into a new form, so they could also serve as tools with long use-lives.

Small projectile points are evidence of a different focus. They were not as useful as cutting tools because their edges are short and awkward and inefficient to use, even when set into foreshafts. The thinness of these tools and the point of weakness formed by notching often caused them to break during use and, because of their small size and the location of most breaks, they usually could not be resharpened. Small projectile points were largely limited to a single function, and quite often could only be used once before being broken and discarded. Other small bifaces, like drills, also tended to be used for a single purpose. These are specialized tools that often had short use-lives. Thus, we differentiate between the manufacture of large and small bifaces in this analysis, as they may be indicative of different lifestyle foci.

Curated and Expedient Debitage Assemblages Modeled

Several attributes can be used to assess assemblages and determine whether they reflect a curated or expedient reduction strategy or a combination of both. Unfortunately, no single indicator can provide this information, so a range of attributes must be used. Assemblages that reflect a purely expedient strategy should contain lower percentages of non-cortical debitage than those in which a curated strategy was employed. Cortex is usually brittle and chalky and does not flake with the ease or predictability of unweathered material. This can cause problems during tool manufacture, so cortex was usually removed early in the process. Large biface manufacture is wasteful, and many flakes must be removed before the proper size and shape are achieved. These flakes are carefully struck, and are generally smaller and thinner than most flakes removed from cores. Thus, as large bifaces are manufactured, many interior flakes lacking cortical surfaces are removed and the proportion of non-cortical debitage increases. The removal of cortex is not as high a priority in expedient reduction, so the chance that a piece of debitage will possess a cortical surface is higher.

The presence of flakes struck from bifaces is usually good evidence that tools were made at a site, though the absolute number or types of bifaces that were made can rarely be defined. A polythetic set of attributes is used to distinguish biface flakes from core flakes in this analysis (Fig. 14.1). Flakes fulfilling at least 70 percent of the attributes in the polythetic set are classified as biface flakes, while those that do not are defined as core flakes by default. This method permits recognition of definite biface flakes, though it often does not identify biface flakes struck early in the tool manufacturing process. Other methods were used to try to distinguish some of those specimens, as discussed later. Biface flake length can be indicative of the size of the tool being made; lengths of 15 to 20 mm or more suggest that large bifaces were manufactured. However, when only small biface flakes occur, the reverse is not necessarily true. While the presence of small biface flakes may indicate that small, specialized bifaces were made, the possibility that they are debris produced by retouching large biface edges must also be considered. Large percentages of biface

Whole Flakes

1. Platform:
   a. has more than one facet.
   b. is modified (retouched and/or abraded).
2. Platform is lipped.
3. Platform angle is less than 45 degrees.
4. Dorsal scar orientation is:
   a. parallel.
   b. multidirectional.
   c. opposing.
5. Dorsal topography is regular.
6. Edge outline is even.
7. Flake is less than 5 mm thick.
8. Flake has a relatively even thickness from proximal to distal end.
9. Bulb of percussion is diffuse.
10. There is a pronounced ventral curvature.

Broken Flakes or Flakes with Collapsed Platforms

1. Dorsal scar orientation is:
   a. parallel.
   b. multidirectional.
   c. opposing.
2. Dorsal topography is regular.
3. Edge outline is even.
4. Flake is less than 5 mm thick.
5. Flake has a relatively even thickness from proximal to distal end.
6. Bulb of percussion is diffuse.
7. There is a pronounced ventral curvature.

Figure 14.1. Polythetic set for defining biface flakes.

flakes in an assemblage suggest that tool production was an important activity. When those flakes are long, large bifaces were probably made or used, and this suggests a curated reduction strategy. Though a lack of these characteristics is not definite proof of an expedient strategy, it does suggest that reduction was not focused on tool making.

While platform modification is used as part of the polythetic set to help assign flakes to core or biface categories, it can also be used as an independent indicator of reduction strategy. This is because the polythetic set only identifies ideal examples of biface flakes. Many flakes produced during initial tool shaping and thinning are difficult to distinguish from core flakes. However, even at this stage of manufacture platforms were usually modified to facilitate removal. While core platforms were also modified on occasion, this was not as common because the same degree of control over flake size and shape were unnecessary unless cores were being systematically reduced. Since this rarely occurred in the Southwest, a large percentage of modified platforms in an assemblage tends to be indicative of tool manufacture, while the opposite implies core reduction. When an assemblage has a high percentage of modified platforms but few definite biface flakes, an early stage of tool manufacture may be indicated.

Since tool manufacture is usually more controlled than core reduction, fewer pieces of recoverable angular debris are produced. This suggests that a high ratio of flakes to angular debris indicates tool manufacture, while a low ratio implies core reduction. Unfortunately, this is a bit simplistic because the production of angular debris also depends on the type of material being worked, the reduction technique used, and the amount of force applied. Brittle materials shatter more easily than elastic materials, and hard hammer percussion tends to produce more recoverable pieces of angular debris than soft hammer percussion or pressure flaking. The use of excessive force can also cause materials to shatter. In general, though, as reduction proceeds, the ratio of flakes to angular debris should increase, and late-stage core reduction as well as tool manufacture should produce high ratios of flakes to angular debris.

Flake breakage patterns are also indicative of reduction strategy. Experimental data suggest there are differences in fracture patterns between flakes struck from cores and tools (Moore 2003b). Though reduction techniques are more controlled during tool manufacture, flake breakage increases because debitage get thinner as reduction proceeds. Thus, there should be more broken flakes in an assemblage in which tools were made, as compared to one that simply reflects core reduction. However, trampling, erosional movement, and other post-reduction impacts can also cause breakage and must be taken into account.

Much flake breakage during reduction is caused by secondary compression, during which outward bending can result in snapped flakes (Sollberger 1986). Characteristics of the broken ends of flake fragments can be used to determine if breakage was caused by this sort of bending (Fig. 14.2). When a step or hinge fracture occurs at the proximal end of distal or medial fragments, they are classified as manufacturing breaks. Characteristics diagnostic of manufacturing breaks on proximal fragments include: "pieces à languette" (Sollberger 1986:102), negative hinge scars, positive hinges curving up into small negative step fractures on the ventral surface, and step fractures on dorsal rather than ventral surfaces. Breakage by processes other than secondary compression causes snap fractures. This pattern is common on flakes broken by trampling or erosion, but also occurs during reduction. Core reduction tends to create a high percentage of snap fractures, while biface reduction creates a high percentage of manufacturing breaks. Since snap fractures can also indicate post-reduction damage, this may be the weakest of the attributes used to examine reduction strategy.

The presence of platform lipping is indicative of reduction technology, and is marginally related to strategy. Platform lipping usually occurs during pressure flaking or soft-hammer percussion, though it sometimes also occurs on flakes removed by hard hammers (Crabtree 1972). The former techniques were usually used to make tools, so a high percentage of lipped platforms suggests a focus on tool manufacture rather than core reduction. While soft hammer percussion can also be used in core reduction, some materials are very hard and so are more efficiently reduced using hard hammers.

The pattern of scars left by earlier removals on the dorsal surface of a flake can also help define reduction strategy. Since biface reduction removes flakes from opposite edges, some scars originate beyond the distal end of a flake and run toward

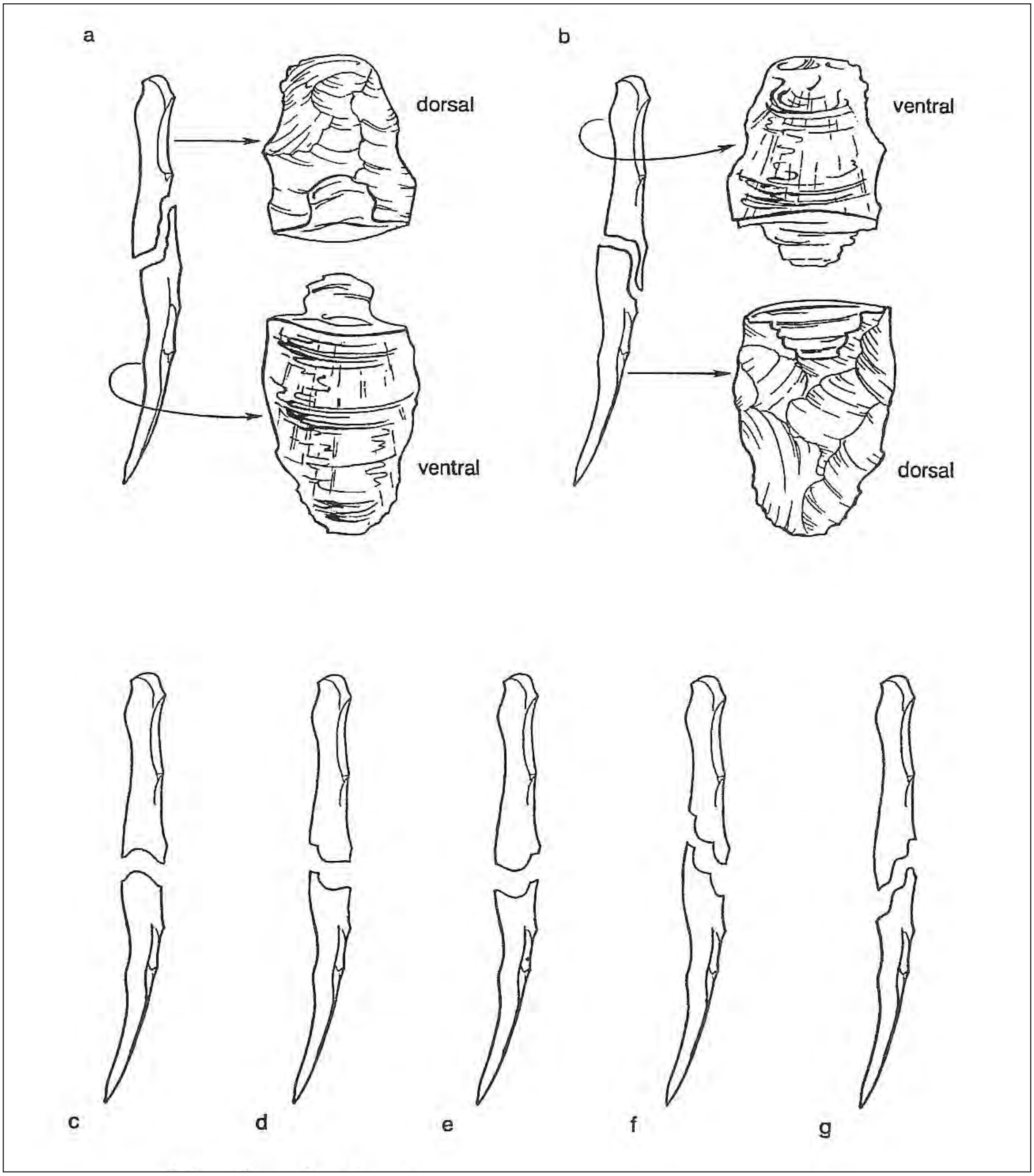

Figure 14.2. Manufacturing breakage on flakes: a–b. pieces à languette, adapted from Sollberger (1986:102); c. negative proximal hinge, positive distal hinge; d. positive proximal hinge with small step off ventral surface, negative distal hinge; e. positive proximal hinge, negative distal hinge; f. proximal step, distal step off dorsal surface; g. reverse proximal step, distal step off ventral surface. Note that proximal fragments of "e" and "f" resemble natural core terminations and would usually be defined as such.

its proximal end. These are opposing scars, and indicate reduction from opposite edges. Opposing dorsal scars are indicative of biface manufacture, but can also occur when cores were reduced bidirectionally (Laumbach 1980:858). Thus, this attribute is not directly indicative of tool production, but can help in defining the reduction strategy used.

The ratio of flakes to cores on a site is another potential indicator of reduction strategy. As the amount of tool manufacture increases, so does the ratio between flakes and cores. The opposite should be true of assemblages in which expedient core reduction dominates; in those cases the ratio between flakes and cores should be relatively low. A potential problem, of course, is that cores were often carried to another location if still useable, while debris from their reduction was left behind. This can inflate the ratio and suggest that tool manufacture rather than core reduction occurred. The systematic reduction of cores can also produce high flake to core ratios. A third ratio that might have some utility in determining reduction strategy is the ratio of core flakes to biface flakes. A high core flake to biface flake ratio indicates the prevalence of core reduction and, consequently, a higher stress on expedient reduction. A low ratio suggests that the manufacture of large bifaces was an important reduction strategy.

The final attribute that can be useful in examining reduction strategy is purposeful thermal alteration. The flaking characteristics of cherts can be altered by the proper application of heat, which makes them easier to flake and allows longer flakes to be removed more accurately. Only chert materials (including chalcedony and silicified wood) are amenable to this type of alteration. A comparatively high percentage of thermally altered cherts in an assemblage may be indicative of a stress on formal tool manufacture, which often goes hand-in-hand with a curated reduction strategy.

While few of these attributes are accurate independent indicators of reduction strategy, when combined they should allow us to fairly accurately determine how materials were reduced at a site. A curated debitage assemblage should contain high percentages of non-cortical debitage, biface flakes, modified platforms, manufacturing breaks, lipped platforms, and flakes with opposing dorsal scars, and should have high flake to angular debris, flake to core, and biface flake to core flake ratios. Purely expedient debitage assemblages should contain lower percentages of non-cortical debitage and low percentages of biface flakes, modified platforms, manufacturing breaks, lipped platforms, and flakes with opposing dorsal scars. They should also have low flake to angular debris, biface flake to core flake, and flake to core ratios. Unfortunately, "pure" assemblages are rare, and most assemblages can be expected to combine tool manufacture and core reduction.

In the following discussion, data are presented in several forms. Only composite data are presented for temporal periods in some cases. In other cases data are presented for site components as well as for temporal periods. In each case the form in which data are presented depends on whether or not component data are thought to be useful. Components that could not be dated are listed as unknown, but are not considered until the end of this discussion where the data presented in this section and some of the previous discussions are used to try to assign tentative dates to these components.

Re-examining Flake Classifications

To accurately examine site and component assemblages and suggest the type of reduction strategy that dominated, the first step is to ensure that flakes were properly classified during analysis. A problem with the polythetic set used to distinguish between biface and core flakes is that it often cannot distinguish flakes removed early in the manufacturing process before core surfaces became regularized by continued flaking. This problem can be corrected by using several of the attributes related to the polythetic set to provide weights for reclassification of some core flakes. These specimens probably represent flakes removed early in the manufacturing process, as noted earlier. Eight variables are used in reclassification, including: bulb of percussion type; evidence for platform modification; platform angle; platform lipping; ventral curvature; opposing dorsal scars; waisting between the platform and the body of the flake; and thickness. Only flakes that were subjected to full analysis are suitable for reclassification since many of these attributes were not used during the in-field analysis. In addition, only specimens that retain their platforms can be re-examined because platform data are critical to accurate type placement.

The first step in reclassification is to determine which attributes are most important in defining flakes as removals from bifaces. Whole biface flakes, proximal fragments, and lateral fragments that retain their platforms can be ranked by the number of attributes they exhibit. While overshot and notching flakes also represent removals from bifaces, they are distinguished using a different set of variables from those used to define biface flakes and are not considered in this analysis.

Percentages in which the eight attributes listed above occur in both the biface flake and core flake assemblages were examined and compared in order to rank their importance and weight them as flake type indicators. Since we are looking for misclassified biface flakes, rankings were based on the percentage of biface flakes that exhibit a particular attribute. Diffuse bulbs of percussion occur on 90.53 percent of biface flakes and 36.77 percent of core flakes, suggesting that this attribute is a fairly strong indicator of flake type, and it is assigned a weight of 7. Platforms are lipped on 71.63 percent of biface flake platforms and only 17.98 percent of core flake platforms. This is another strong indicator of flake type, and it is assigned a weight of 6. Waisting occurs on 56.52 percent of biface flakes and 2.60 percent of core flakes, making this attribute a strong indicator of flake type, so it is assigned a weight of 5. Platform angles of 45 degrees or less occur on 72.18 percent of biface flakes and on 35.67 percent of core flakes. This variable is a fair indicator of flake type, and is assigned a weight of 4. Platforms are modified on 60.20 percent of biface flakes and 9.87 percent of core flakes, making this characteristic a strong indicator of flake type; it is assigned a weight of 3. Ventral curvature occurs on 48.34 percent of biface flakes and 20.08 percent of core flakes, making it a fair indicator of flake type; it is assigned a weight of 2. The presence of opposing dorsal scars is another fair indicator of flake type that occurs on 27.30 percent of biface flakes and 4.53 percent of core flakes, and thus is assigned a weight of 1. While 94.41 percent of the biface flakes are 5 mm thick or less, this is not as strong an indicator of flake type as it might seem, since 70.52 percent of the core flakes also fall into this thickness range. This attribute is a very weak indicator of flake type and, because of this apparent lack of importance, it was dropped from further consideration.

These weights were applied to all whole flakes, proximal fragments, and lateral fragments that retained their platforms. A total of 2,658 specimens fit these parameters, of which 2,354 were categorized as core flakes during analysis and 304 as biface flakes. Since the three top-weighting categories (diffuse bulb, platform lipping, and waisted platform) appeared to be the most distinguishing characteristics in this analysis, their combined weight of 18 was used as a cut-off point, and core flakes that had a score of 18 or higher were reclassified as biface flakes. This resulted in the reclassification of 73 specimens in five site assemblages including LA 111429 (n = 26), LA 111432 (n = 1), LA 155963 (n = 42), LA 155968 (n = 3), and LA 156877 (n = 1). The reclassifications are used in the rest of this analysis.

Examining the Reduction Strategy Indicators

Each of the reduction strategy indicators listed earlier in this section can be examined separately for trends that might be important. Temporal assemblages are the main focus at this level of analysis in order to define trends indicative of changes in reduction strategy over time that tend to correspond with shifts in subsistence and residential systems.

Dorsal Cortex. While cortex type was used to examine material procurement patterns, cortex can also be used to examine reduction strategy. Several approaches can be used to examine cortical ratios, each providing a slightly different piece of the puzzle. In this discussion we only consider debitage, which is divided into two categories: flakes and angular debris. Table 14.11 shows non-cortical to cortical debitage ratios for each site component and ratios for time periods. As might be expected, there is quite a bit of variation from component to component, which is smoothed by combining the data into time periods. The latter yields an interesting temporal trend—a steady decline in non-cortical to cortical debitage ratios. This can suggest two different trends. The first is that there was a change in how materials were brought to sites through time, with the highest degree of pre-transport decortication occurring in the Paleoindian components, with progressively lower amounts of pre-transport decortication during subsequent periods. This could suggest that many of the cores and nodules in Paleoindian components were carried in from elsewhere in already reduced states. During subsequent periods there was a progressively heavier reliance on locally obtained materials, with decortication of those nodules occurring on site. A second possibility is that reduction was most intense in the Paleoindian components and grew progressively less intense during subsequent periods. This can be tested by examining the amount of cortical coverage on flakes and comparing that to artifact sizes.

Table 14.12 shows the distribution of dorsal cortex percentage categories for flakes. Percentages of non-cortical flakes steadily decrease through time while percentages for each dorsal category correspondingly increase. Figure 14.3 graphs thickness and weight data for the whole flake assemblages from each time period. Flake thicknesses are nearly identical for the Paleoindian and Archaic periods; they then increase greatly during the Formative period before dropping considerably during the Historic period. Mean weights tell a slightly different story, with flake size as determined by weight increasing steadily through the Formative period before also dropping back to Paleoindian size during the Historic period.

What cortical and dimensional trends indicate is that materials were more heavily reduced during the Paleoindian and Archaic periods, producing pieces of debitage that were both thinner and smaller in size than those of the Formative period, and also retain less cortex. The most intense reduction occured in the Paleoindian assemblages. While the Archaic assemblages also exhibit a great degree of reduction, the level is somewhat less than that of the Paleoindian assemblages. The least intensive reduction is visible in the Formative assemblages where flakes are both larger and exhibit more cortex than is the case for either of the earlier periods. The Historic assemblage appears to resemble those of the Paleoindian and Archaic periods in mean flake weight, but Historic period flakes are much thicker on average than Paleoindian and Archaic period flakes and they retain considerably more dorsal cortex. This may reflect the reduction of smaller nodules than were used during earlier periods, producing small, thick flakes with comparatively large amounts of dorsal cortex.Chipped stone analyses often divide flakes into groups determined by percentages of dorsal cortex. Traditionally, these classes

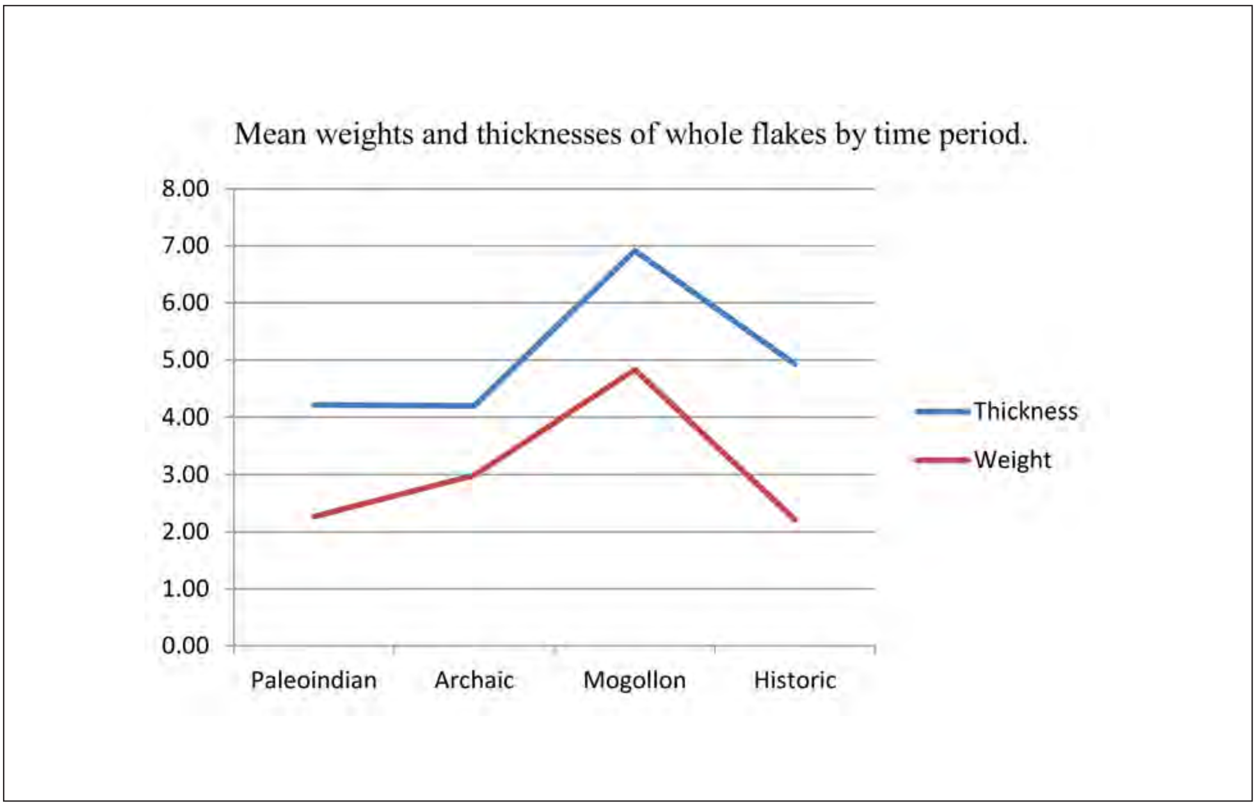

Figure 14.3. Mean weights and thicknesses of whole flakes by time period.

are termed primary, secondary, and tertiary flakes. Primary flakes are those with 50 percent or more of their dorsal surfaces covered with cortex, secondary flakes are those with less than 50 percent dorsal cortex, and tertiary flakes exhibit no dorsal cortex. Primary flakes are often considered indicative of initial core reduction when the cortical surface was removed, secondary flakes were removed as the core was further reduced, and tertiary flakes have often been considered debris from tool manufacture. Unfortunately, these classifications are based on assumptions that are simplistic and erroneous. For instance, a lack of dorsal cortex is not necessarily indicative of tool manufacture, since flakes removed from a core that has been significantly decorticated will often lack dorsal cortex. Similarly, this scheme assumes that cores are decorticated before flakes are removed for use or for shaping into formal tools, and this is also an incorrect assumption. However, stripped of their traditional meanings, these classes remain a useful way to examine flake assemblages. In this analysis, primary flakes are those with 50 percent or more of their dorsal surfaces covered by cortex, secondary flakes are those with 1–49 percent dorsal cortex, and tertiary flakes are those with no dorsal cortex. Varying percentages for these classes can be used to examine the condition of nodules or cores when they arrived at a site, and can provide information on reduction strategies.

The 50–99 percent category can be combined with the 100 percent category in Table 14.12 to provide the percentage of primary flakes for each time period. Tertiary flakes predominate in all time periods, though there are notable exceptions. While tertiary flakes represent about three-quarters or more of each temporal assemblage, percentages decrease steadily from the Paleoindian period through the Historic period, corresponding to steady increases in the secondary and primary flake categories, especially the latter. These trends suggest that the amount of primary reduction occurring in temporal components increased through time. In turn, this may be indicative of increasing reliance on local raw material sources through time, and less reliance on materials transported in to sites.

Flake Type as an Indicator of Reduction Strategy. Flakes were typologically categorized during analysis, with type designation based on a series of analytic observations using the polythetic set discussed earlier to distinguish between biface and core flakes. This was not a perfect system since many flakes removed during the early stages of tool manufacture might not fit the polythetic set and would therefore have been erroneously classified as core flakes. This was partly corrected for by the reclassification that was conducted earlier, which hopefully identified most examples of biface flakes that were not correctly classified by strict adherence to the polythetic set.

Five categories of flakes were identified. Core flakes and biface flakes were discussed earlier and represent removals from cores and tools, respectively. Bipolar flakes are evidence for the smashing of small nodules or exhausted cores in an attempt to derive the maximum amount of useable edge. This technique produces quite a bit of angular debris, and flakes created by this technique display considerable morphological variability (Andrefsky 1998:119). Notching flakes have a characteristic shape, and can be considered evidence for the later stages of notched formal tool manufacture. Pot lids are pieces of debitage that were literally blown off the surface of a chert artifact by the improper application of heat. While technically categorized as flakes because they possess definable ventral and dorsal surfaces, pot lids have no striking platform because they were removed by an entirely different process, and so are eliminated from the flake analysis. Bipolar flakes can be combined with the core flakes since they derive from the same general process, and notching flakes can be merged with biface flakes using the same rationale.

Table 14.13 shows counts and percentages of core and biface flakes for each component and by period. A comparison of percentages by period provides the most information for this attribute. Like flake size, there is a steady decrease in the percentage of biface flakes, with the highest percentage occurring in the Paleoindian assemblages and no biface flakes at all in the Historic assemblages. There is a large drop off in percentages of biface flakes between the Paleoindian and Archaic periods, and again between the Archaic and Formative periods. This suggests a declining reliance on large bifaces through time, though, in general across the Southwest, the use of large bifaces tends to remain strong throughout the Archaic period.

Table 14.14 shows percentages of all flake types by period; percentages in this table for core and biface flakes differ from those in Table 14.13

because various flake categories are not combined. Notching flakes are quite rare overall, but they are most common in the Paleoindian assemblages and the only other example is in the Archaic assemblage. This suggests that notched tools were made during both periods. Bipolar flakes occur in most temporal assemblages except for the Historic period. Observations made during fieldwork suggested that most locally available chert nodules are fairly small, so bipolar reduction may have been the most efficient means of deriving useable debitage from very small nodules. Pot lids are more indicative of incorrect thermal treatment than chipped stone reduction. Nevertheless, this type of flake occurs in small percentages in each period except for the Historic assemblage, where they comprise a significant percentage. As discussed later, the main Historic assemblage is from LA 155964 and is atypical for the amount of discard-related thermal alteration seen in it. Only one example of an overshot flake, which generally represents a mistake made during biface manufacture, was found and occurred in undated contexts.

These data suggest that expedient reduction was an important part of the reduction strategy in all temporal components, but percentages of biface flakes in the Paleoindian and Archaic assemblages indicate that curated or efficient reduction was also important. While there is some evidence for tool manufacture in the Formative assemblage, a curated reduction strategy was clearly less important during the Formative period. No evidence for tool manufacture was noted in the Historic assemblage.

Flake Platforms. What are referred to as flake platforms in this discussion only represent the small section of the original platform present on the edge of an objective piece (e.g., core) that remained attached to flakes after the flakes were removed. Another term for "platform" is "platform remnant." Platforms on objective pieces can be modified to facilitate removal, but the type of modification used will generally vary between cores and formal tools. Core platforms tend to be modified by the removal of overhangs that would collapse when struck and produce pieces of debitage that were much shorter than intended. Unless a core was prepared to strike blades, evidence for this type of modification usually occurs as scars on the dorsal surface of flakes adjacent to the back platform edge which, in turn, tend to be indistinguishable from scars left by intentional flake removal. In contrast, formal tool platforms are modified by abrasion that grinds the platform edge and/or removes small flakes from the intended platform, increasing the angle of the platform edge. This process strengthens the platform, allowing the removal of longer and more consistent flakes. Thus, platforms identified as having been modified to facilitate reduction represent removals from formal tools rather than cores. Since platform type was not recorded during in-field analysis for the testing phase, this discussion includes only the flakes that were analyzed in the laboratory or during the research phase in-field analysis.

Platform-type data are presented by temporal period for whole flakes and proximal fragments in Table 14.15. There is a definite trend toward increasing percentages of cortical platforms through time, from a very small percentage in the Paleoindian assemblage up to a quarter of the Historic assemblage. Single facet platforms are common in all assemblages, but also tend to increase in percentage through time. Single facet, abraded platforms occur in similar percentages in the Paleoindian and Archaic assemblages, but are less common in the Formative assemblage and do not occur in the Historic assemblage. Multifacet platforms are common, but do not show any particular patterning. However, multifacet, abraded platforms are very common in the Archaic assemblage and moderately common in the Paleoindian assemblage, with considerably fewer occurring in the Formative assemblage and no examples in the Historic assemblage. Retouched platforms are most common in the Paleoindian assemblage, occur in much smaller percentages in the Archaic and Formative assemblages, and are absent from the Historic assemblage. Retouched, abraded platforms follow a similar pattern, but are much less common in the Formative assemblage. Abraded platforms represent examples that were obviously abraded but are too small to determine any other characteristics. This type is uncommon and occurs only in the Paleoindian and Formative assemblages.

The other platform types in Table 14.15 represent specimens on which the platform is obscured. Collapse occurs when the platform detaches separately from the body of the flake. Excessive force can cause platforms to crush, again obscuring their original form. When platforms are categorized as obscured, it usually means they were the locus of informal tool use, again obscuring the original configuration of the platform. The Paleoindian assemblage contains the highest percentage of collapsed platforms but one of the lowest percentages of crushed platforms. This could be an indication of the increased fragility of platforms caused by thermal alteration since, as discussed later, there was more evidence of thermal alteration in the Paleoindian artifact assemblage than was evident in other assemblages.

Platform modification by abrasion is common during tool manufacture, but can also sometimes be used during core reduction. Whittaker (1994:102–104) discusses the use of an abrader to modify core platforms by rounding and dulling the platform edge or removing overhangs, though trimming edges using percussion is usually the best way to do this. Thus, *most* flakes with unmodified platforms reflect core reduction, while *most* flakes with modified platforms reflect formal tool manufacture. There are exceptions to both of these norms, and platform type cannot be used by itself to specify when during the reduction process a particular flake was struck. However, platform modification can be used as a proxy for the level of biface manufacture. Overall, large percentages of flakes in the Paleoindian and Archaic assemblages that retain their platforms exhibit evidence of platform modification—23.81 percent for the Paleoindian assemblage and 24.03 percent for the Archaic assemblage. In contrast, only 4.35 percent of flakes in the Formative assemblage have modified platforms. This is indicative of similar and relatively high levels of reliance on large bifacial tools in the Paleoindian and Archaic assemblages, and a distinct and relatively low level of reliance in the Formative assemblages, a relationship that was expected.

Flake Breakage Patterns. Flake breakage patterns can be used to examine two issues: how intact and undamaged the assemblages were and how prevalent was the evidence for core versus biface reduction. There are three ways in which flakes can break: during removal, during use, and after discard. Various factors cause flakes to fracture during removal. They can break when the force applied to remove them exceeds the tensile strength of the material, probably resulting in non-diagnostic snap fractures. Breaks can also occur when flaws are encountered during flake propagation. While this type of break can sometimes be correctly categorized, generally they are simply defined as non-diagnostic snap fractures. Flakes can also snap because of secondary compression, in which outward bending during removal causes them to buckle (Sollberger 1986). Cotterell and Kaminga (1987:700) indicate that flake breakage due to buckling can occur after a successful flake removal. Citing experiments conducted by Crabtree (1968:475) where high-speed photography captured a blade buckling in this manner *after* it was fully detached from a core, Cotterell and Kaminga (1987:700) suggest that this can only happen when a flake is very thin in relation to its length.

Both of these processes may be responsible for flake breakage during removal. The compressive forces applied when striking a flake are probably not immediately released after a flake comes off the objective piece, but instead continue to affect the flake for a very short time after removal. Elasticity allows flakes to rebound from the compressive force unless that force exceeds the elastic limits of the material, in which case a flake will buckle. The key to this type of break is that the flake must be very thin in relation to its length, as is common during tool manufacture and blade-core reduction and is less common during core reduction.

Table 14.16 shows the distribution of flake portions by temporal period. Perhaps the most interesting aspect of this table is the temporal progression seen in percentages of whole flakes for the Prehistoric components. The Paleoindian assemblage contains the smallest percentage of whole flakes and the Formative assemblage contains the largest. If this progression is accurate, it suggests that the longer flakes are left on the landscape the higher the probability that they will be broken, a logical deduction. However, the Historic assemblage does not fit this progression and contains the second smallest percentage of whole flakes. This either suggests that our correlation between time depth and breakage is erroneous or that another process was at work in the Historic assemblage.

Characteristics of the broken ends of flake fragments can be used to determine whether breaks were caused by manufacture-related bending, and those characteristics were discussed earlier. While bending fractures can often be correctly identified because of characteristics of the break, snap fractures caused by exceeding a material's tensile strength or encountering a flaw are much more difficult to distinguish. This is because snap fractures can also be caused by forces unassociated with flake removal. Flakes can snap while being used as informal tools, when they are stepped on, and when unequal pressures are applied by natural processes. These breaks are all classified as snap fractures. Thus, snap fractures are considered non-diagnostic because they can be caused by several different and unrelated processes.

The largest percentage of manufacturing breaks—32.22 percent—is in the Paleoindian assemblage. Surprisingly, only 3.80 percent of the Archaic flakes exhibit manufacturing breaks, as do 8.24 percent of those in the Formative assemblage and 12.10 percent of those in the Historic assemblage. This suggests that a combination of factors affects the percentage of whole flakes. While longevity of exposure can certainly play a role in increasing the percentage of broken flakes, breakage during removal also appears to have been common. These patterns suggest that the greatest amount of biface manufacture occurred in the Paleoindian assemblage, and this is verified by percentages of biface flakes as discussed earlier.

In any case, considerable percentages of breaks in each temporal assemblage are non-diagnostic snap fractures suggesting that post-removal processes could have been responsible for much of the breakage. However, there is no temporal progression evident for this type of breakage as was suggested earlier.

Platform Lipping and Bulb of Percussion. Platform lipping refers to the presence of a slight overhang at the intersection of the platform and ventral surface of a flake. Lipped platforms generally indicate soft hammer reduction or pressure flaking, though they sometimes occur with hard hammer percussion (Crabtree 1972). Thus, platform lipping is more indicative of tool manufacture than core reduction. Platform lipping can be used as an indicator of reduction technique, but it is not absolute and is most accurate when combined with other attributes. As Andrefsky (1998:115) notes: "Even though soft-hammer and hard-hammer flaking techniques produce detached pieces that overlap in their range of bulb morphology and amount of lipping, these characteristics may be effective discriminators in most cases." Thus, platform lipping should mostly occur on flakes that also have diffuse bulbs of percussion indicative of soft hammer reduction or pressure flaking.

Platform lipping data are available for 2,388 flakes examined during the laboratory analysis. Of the 1,360 specimens that exhibit pronounced bulbs of percussion, only 9.49 percent are lipped. In contrast, 44.46 percent of the 1,028 specimens that exhibit diffuse bulbs of percussion are lipped. These percentages are consistent with our prediction and indicate that most of the flakes with lipped platforms were removed by soft hammer percussion or pressure. However, lipping does not always occur with these removal methods so, as noted above, lipping alone is not an accurate indicator of reduction technique.

As might be expected, lipped platforms are most common in the Paleoindian (31.47 percent) and Archaic (34.23 percent) assemblages, and least common in the Formative (14.92 percent) and Historic (4.76 percent) assemblages. A similar trend is visible when the bulb of percussion is examined, with the highest percentages of diffuse bulbs occurring in the Paleoindian (51.01 percent) and Archaic (43.78 percent) assemblages and lowest in the Formative (34.39 percent) and Historic (26.98 percent) assemblages. Combined, these data suggest that soft hammer percussion/pressure flaking was more prevalent during the Paleoindian and Archaic occupations, with hard hammer percussion being more common in later periods. It should be noted, however, that these are differences in degree and that all three reduction techniques were probably used during all periods.

Opposing Dorsal Scars. When flakes removed from the surface of a biface extend past the midpoint of the tool, they leave tell-tale evidence behind. That evidence consists of opposing dorsal scars, which are negative scars at the distal end of the dorsal surface of a flake struck later from the opposing tool edge. However, opposing dorsal scars also occur when cores are reduced bidirectionally (Laumbach 1980:858), and probably during multidirectional core reduction as well. Thus, like the other attributes discussed in this section, opposing dorsal scars cannot be used by themselves to define reduction strategy; they are only meaningful when combined with other characteristics.

In general, opposing dorsal scars tend to occur most often on biface flakes. Of 2,059 core flakes on which this attribute could be examined, opposing dorsal scars occur on only 4.08 percent (n = 84), while they occur on 24.31 percent (n = 88) of the 362 biface flakes for which this attribute was recorded. Though opposing dorsal scars were noted on slightly fewer than a quarter of the biface flakes, the comparative rarity of this attribute on core flakes suggests that it might be a stronger indicator of biface reduction than was considered during the flake reclassification process, but it still remains unreliable as an independent indicator.

Overall, opposing dorsal scars are most common in the Archaic assemblage (11.01 percent), followed by the Paleoindian assemblage (3.89 percent), the Formative assemblage (2.59 percent), and the Historic assemblage (1.91 percent). Again, these percentages are indicative of a greater focus on biface manufacture in the Archaic and Paleoindian components, somewhat less in the Formative components, and the least focus in the Historic components.

Debitage Ratios. Three ratios can be used to examine relationships between various classes of debitage and cores: flakes to angular debris, flakes to cores, and core flakes to biface flakes. The flake to core ratio is probably the weakest of the three because cores can disappear from assemblages in several ways. When exhausted, cores can be smashed using the bipolar technique, turning them into multiple pieces of debitage without leaving a core behind. Cores can also be carried to another location or transformed into a tool such as a hammerstone or chopper when no longer suitable for the production of debitage, again with the potential of being moved elsewhere. Depending on whether or not any of these factors was in play, there might be considerable variation in this ratio between assemblages with attributes that otherwise suggest similar reduction strategies were used.

When objective pieces are struck, the detached pieces do not always break into recognizable flakes (Andrefsky 1998:82). These shattered pieces are classified as angular debris, and are distinguished from flakes by the lack of a striking platform and the lack of definable dorsal and ventral surfaces. Flake removal is also often accompanied by a shower of small pieces of shatter that are usually not recoverable by standard excavation techniques. This is especially true of hard hammer percussion, because the blow used to remove a flake will often cause the formation of numerous partial Hertzian crack cones; one crack will dominate and propagate to form the flake, while the others will result in the removal of small flakes that often terminate in a step or hinge (Cotterell and Kaminga 1987:687). These small flakes or pieces of shatter are most common in core reduction, which is usually accomplished using hard hammer percussion. Soft hammer percussion results in comparatively few secondary detachments of this type (Cotterell and Kaminga 1987:690).

Core reduction and tool manufacture result in the production of non-diagnostic, shattered material. The main difference is in size—core reduction produces much more angular debris that is recoverable by standard archaeological techniques than does tool manufacture. Thus, logic suggests that the ratio of flakes to angular debris should increase with the amount of tool manufacture conducted at a site. Other analyses suggest that this is indeed the case (Moore 1999b, 2001, 2003). Thus, high ratios of flakes to angular debris indicate tool manufacture, while low ratios indicate core reduction.

Table 14.17 shows flake to angular debris ratios for each component and time period, with pot lids eliminated because they are not a product of the reduction process. Considering our earlier conclusions that biface manufacture was more common in the Paleoindian and Archaic assemblages than in the Formative and Historic assemblages, the results in Table 14.17 are not surprising. In general, the highest ratios occur in the Paleoindian assemblages, though the Historic assemblage from LA 155963 and the Formative assemblage from LA 156877 are both atypically high and fall into the Paleoindian range. However, there are only eight pieces of debitage in the Historic assemblage from LA 155963 so it can be discounted because of sample error, though the same does not apply to the Mogollon assemblage from LA 156877. Archaic ratios also tend to be higher than those from later periods, again with the exception of the LA 156877 Formative assemblage. The Historic-period ratio from LA 155964 is by far the lowest, and is actually atypically low for any time period.

Besides again indicating that biface manufacture was more common in the Paleoindian and Archaic assemblages, these ratios also suggest that our assumption that the LA 156877 assemblage should be assigned to the Formative period because of the presence of a single arrow point may be erroneous. Indeed, as noted in the site report for LA 156877 (Chapter 13, this report), a Middle Archaic point was collected during an earlier examination of the site, potentially indicating a multicomponent situation. Considering other data categories, biface flakes comprise 13.25 percent of the flake assemblage from this site, though platforms are only modified on 5.56 percent of the flakes and manufacturing breaks comprise only 15.66 percent of the breaks. A multicomponent assemblage for LA 156877 begins to seem more likely, and this possibility is kept in mind during later analyses.

Flake to core ratios are provided for components and temporal periods in Table 14.18. Looking at the temporal ratios first, the Paleoindian assemblage has the highest ratio by far, followed distantly by the Archaic assemblage, while the Formative and Historic ratios are both significantly lower. However, both the Archaic and Historic ratios are inflated a bit because only a third to half of the components in each case contain cores. When examining the component ratios, these observations are essentially upheld in each case, though the assemblages that lack cores must be excluded from discussion. The three Paleoindian assemblages have some of the highest flake to core ratios. Both of the Archaic components have ratios that fit well with those of the Paleoindian assemblages. The Formative components have ratios smaller than those of the Paleoindian and Archaic components, though one Formative ratio is only slightly smaller. The single Historic assemblage that contains cores has a ratio that fits within the Formative range, suggesting a similar level of reduction intensity.

In general, the temporal ratios suggest that reduction was most intense in the Paleoindian assemblages, somewhat less intense in the Archaic assemblages, and considerably less intense in the Formative and Historic assemblages. If reduction intensity measures the amount of biface manufacture versus core reduction, then biface manufacture was most common in the Paleoindian assemblages, less common but still important in the Archaic assemblages, and least common in the Formative and Historic assemblages.

Table 14.19 shows core flake to biface flake ratios, again with pot lids dropped from consideration. Ratios for the composite assemblages from each period are as would be expected from the discussion thus far. The Paleoindian assemblage has the lowest ratio of core flakes to biface flakes, the Archaic assemblage has the second smallest, and the Formative assemblage has the largest. No biface flakes were identified in the Historic assemblage. As before, this suggests a decreasing emphasis on large biface manufacture through time, especially in the Formative period and later. Except for LA 156877, the same relationship essentially holds up for the individual components. The three Paleoindian components have the lowest ratios, except that the ratio for LA 156877 falls within their range and is lower than the ratio for the Paleoindian component from LA 111429. The ratios for the two Archaic components are higher than those of the Paleoindian components, but lower than those of the Formative assemblages, again with the exception of LA 156877 and LA 111429. The Formative assemblages have the highest ratios overall, though the Formative assemblage from LA 111429 is smaller than that of the Archaic assemblage from LA 111420. Again, however, LA 156877 is an exception. No biface flakes were identified in the Archaic assemblage from LA 111435, nor were any found in the Formative assemblage from LA 155968. Thus, in general, the site components follow the trends seen in the period assemblages. The only real exception is the Formative assemblage from LA 156877, which this analysis and the analysis of the flake-to-angular debris ratios suggest was temporally misplaced.

Thermal Alteration of Cherts. As noted earlier, cherts can be altered by the application of heat to make them more amenable to reduction. Luedtke (1992:92) notes that different cherts are variably affected by thermal treatment. Some cherts may not respond to this process and others may not change enough to make heat treatment worthwhile. Thermal alteration causes changes at several levels. Some geochemical changes can occur, but Luedtke (1992:94) indicates heat treatment generally causes few direct changes to occur in chert, though the mineralogy of some impurities can be altered. Thermal treatment can change the visual quality of chert, and thereby alter color, translucency, and luster (Luedtke 1992:94). Color changes usually result from the oxidation of iron compounds to hematite. Some cherts become darker when heat-treated, others have a reduced translucency. Luster changes in nearly all cherts when they are heat-treated, increasing their gloss (Luedtke 1992:95). However, the most important change is in flaking quality. Thermal alteration reduces the tensile strength of cherts (Luedtke 1992:96), making them easier to fracture and therefore to knap.

Correct thermal alteration produces a chert that tends to be lustrous and may have changed in color. It also produces a material that is easier to flake and that tends to be especially amenable to pressure flaking. Incorrect thermal alteration can damage chert by causing it to craze or explode, producing pot-lid fractures. While these errors do not always ruin a piece, they often create enough problems that a piece is rendered unuseable. Errors such as crazing and potlidding often happen when a piece of chert is unintentionally heat-treated, especially when discarded into an active fire. Thus, this analysis distinguishes between intentional thermal treatment and errors that might be more a reflection of discard behavior than intent.

Intentional thermal alteration is exhibited by chert artifacts that are lustrous, display luster variation, or are flawed by mistakes made during thermal alteration but still used to manufacture a tool. Inadvertent thermal alteration is exhibited by chert artifacts that were damaged by heating and were not used for tool manufacture. Distinguishing between intentional and inadvertent thermal alteration is critical in this analysis because, while the former may be an indication of the importance of tool manufacture, the latter is not.

Table 14.20 presents thermal alteration data by component and period. In most cases a large percentage of the artifacts considered to have been intentionally altered are lustrous. As discussed above, most cherts acquire a glossy luster when heat-treated (labeled “lustrous” in this study). Both lustrous and non-lustrous examples were found for many of the types of chert defined during analysis. Since a non-glossy, more matte luster appeared to be the original state for these materials, specimens that exhibit a glossy luster were concluded to have been thermally altered. Considering the temporal assemblages in Table 14.20, thermal alteration is very common in the Paleoindian and Archaic assemblages and much less common in the Formative and Historic assemblages.

In all but five cases, intentionally altered specimens dominate these assemblages. The exceptions include a case containing no thermally altered specimens (LA 111435 Archaic component), two cases with equal percentages of intentionally and inadvertently altered specimens (LA 112370 Unknown and LA 155968 Formative components), one case where only inadvertently altered specimens were found (LA 155968 Unknown component), and one case with a large percentage of unintentionally altered specimens (LA 155964 Historic component). Ten or fewer thermally altered artifacts are present in four of these cases, suggesting that their anomalous nature is due to error caused by small sample size. The last case—the LA 155964 Historic assemblage—contains a high percentage of thermally altered artifacts. Since nearly all of these artifacts were either recovered from a large thermal feature (Feature 1) or an adjacent area that contained materials cleaned out of the thermal feature, the amount of fire-related damage was due to discard practice rather than intent.

In general, individual site components follow the same trends noted for the temporal components except for the LA 111435 Archaic component, which contains no thermally altered specimens. In general, then, large percentages of intentionally heat-treated chert artifacts suggest a Paleoindian or Archaic affinity, while small percentages suggest a Formative or Historic affinity. By extension, this suggests a greater focus on biface manufacture during the Paleoindian and Archaic periods and a lesser focus during the Formative and Historic periods.

Comparison of Reduction Strategy Indicators

This discussion has repeatedly stressed the notion that none of the indicators discussed here can, by themselves, accurately identify the reduction strategy used at a site or in a temporal component. Only by using these indicators in combination and comparing the results of their combined assessment, is it possible to address the question of what reduction strategy dominated in an assemblage and how prevalent it was. By using a variety of potential indicators, it may be possible to account for some of the biases introduced into assemblages by prehistoric activities as well as by archaeological recovery methods. Many indicators overlap, but are used in somewhat different ways and should be considered interrelated.

The data presented in this section are shown in Tables 14.21 through 14.23. Table 14.21 presents numeric values for each indicator for each component. Table 14.22 shows mean, standard deviation, and first standard deviation range for each indicator by temporal division. In Table 14.23, each indicator is assessed by temporal division, a score is computed, and conclusions are made concerning the

Table 14.11. Non-cortical to cortical debitage ratios for all components on each site and each time period represented.

Site	Unknown	Paleoindian	Archaic	Formative	Historic
LA 111420	–	–	20.00	–	–
LA 111421	10.20	–	–	–	–
LA 111422	–	–	–	5.17	–
LA 111429	9.20	11.77	–	2.90	–
LA 111432	6.11	–	–	–	–
LA 111435	–	–	3.00	4.21	–
LA 112370	12.00	–	–	–	–
LA 112371	9.00	–	–	–	–
LA 112374	no cortical	–	–	–	–
LA 155963	9.12	18.26	4.98	3.06	3.00
LA 155964	2.15	–	–	–	2.99
LA 155968	2.33	5.75	–	2.44	no cortical
LA 155969	1.62	–	–	–	–
LA 156877	–	–	–	3.52	–
Period Ratios	6.62	10.53	6.02	3.36	3.00

Note: Protohistoric component on LA 111429 was eliminated because of small sample size.

Table 14.12. Dorsal cortex categories for flakes; counts and column percentages.

Cortex Category		Unknown	Paleoindian	Archaic	Formative	Historic
0%	Count	587	1345	1114	1524	117
	Col. %	88.14%	93.27%	88.13%	78.07%	74.05%
10–49 %	Count	53	60	104	237	19
	Col. %	7.96%	4.16%	8.23%	12.14%	12.03%
50–99%	Count	11	23	25	93	4
	Col. %	1.65%	1.60%	1.98%	4.76%	2.53%
100%	Count	15	14	21	98	18
	Col. %	2.25%	0.97%	1.66%	5.02%	11.39%

Table 14.13. Flake types by site component and period, counts and row percentages.

Site		Unknown		Paleoindian		Archaic		Formative		Historic	
		Core Flakes	Biface Flakes	Core Flakes	Biface Flakes	Core Flakes	Biface Flakes	Core Flakes	Biface Flakes	Core Flakes	Biface Flakes
LA 111420	Count	–	–	–	–	287	8	–	–	–	–
	Row %	–	–	–	–	97.29%	2.71%	–	–	–	–
LA 111421	Count	49	2	–	–	–	–	–	–	–	–
	Row %	96.08%	3.92%	–	–	–	–	–	–	–	–
LA 111422	Count	–	–	–	–	–	–	120	2	–	–
	Row %	–	–	–	–	–	–	98.36%	1.64%	–	–
LA 111429	Count	155	37	622	99	–	–	27	1	1	0
	Row %	80.73%	19.27%	86.27%	13.73%	–	–	96.43%	3.57%	100.00%	0.00%
LA 111432	Count	100	11	–	–	–	–	–	–	–	–
	Row %	90.09%	9.91%	–	–	–	–	–	–	–	–
LA 111435	Count	–	–	–	–	23	0	446	4	–	–
	Row %	–	–	–	–	100.00%	0.00%	99.11%	0.89%	–	–
LA 112370	Count	10	2	–	–	–	–	–	–	–	–
	Row %	83.33%	16.67%	–	–	–	–	–	–	–	–
LA 112371	Count	60	4	–	–	–	–	–	–	–	–
	Row %	93.75%	6.25%	–	–	–	–	–	–	–	–
LA 112374	Count	7	2	–	–	–	–	–	–	–	–
	Row %	77.78%	22.22%	–	–	–	–	–	–	–	–
LA 155963	Count	137	8	318	78	910	65	1173	26	7	0
	Row %	94.48%	5.52%	80.30%	19.70%	93.33%	6.67%	97.83%	2.17%	100.00%	0.00%
LA 155964	Count	35	1	–	–	–	–	–	–	150	0
	Row %	97.22%	2.78%	–	–	–	–	–	–	100.00%	0.00%
LA 155968	Count	14	2	270	55	–	–	43	0	1	0
	Row %	87.50%	12.50%	83.08%	16.92%	–	–	100.00%	0.00%	100.00%	0.00%
LA 155969	Count	30	0	–	–	–	–	–	–	–	–
	Row %	100.00%	0.00%	–	–	–	–	–	–	–	–
LA 156877	Count	–	–	–	–	–	–	30	0	–	–
	Row %	–	–	–	–	–	–	100.00%	0.00%	–	–
Period Ratios	Count	597	69	1210	232	1220	73	1881	44	159	0
	Row %	89.64%	10.36%	83.91%	16.09%	94.35%	5.65%	97.71%	2.29%	100.00%	0.00%

Table 14.14. Flake types for each temporal assemblage; counts and row percentages.

Temporal Period		Core Flake	Biface Flake	Notching Flake	Bipolar Flake	Pot Lid	Overshot Flake
Unknown	Count	596	69	–	1	2	1
	Row %	89.09%	10.31%	–	0.15%	0.30%	0.15%
Paleoindian	Count	1206	228	4	4	5	–
	Row %	83.34%	15.76%	0.28%	0.28%	0.35%	–
Archaic	Count	1219	72	1	1	3	–
	Row %	94.06%	5.56%	0.08%	0.08%	0.23%	–
Formative	Count	1877	44	–	4	6	–
	Row %	97.20%	2.28%	–	0.21%	0.31%	–
Historic	Count	158	–	–	–	38	–
	Row %	80.61%	–	–	–	19.39%	–

Table 14.15. Platform types for whole flakes and proximal fragments by period; counts and column percentages.

Platform Type		Unknown	Paleoindian	Archaic	Formative	Historic
Cortical	Count	23	32	43	169	13
	Col. %	9.06%	4.61%	9.23%	14.97%	25.00%
Single facet	Count	62	152	136	418	18
	Col. %	24.41%	21.90%	29.18%	37.02%	34.62%
Single facet and abraded	Count	16	22	15	15	–
	Col. %	6.30%	3.17%	3.22%	1.33%	–
Multifacet	Count	70	240	121	378	14
	Col. %	27.56%	34.58%	25.97%	33.48%	26.92%
Multifacet and abraded	Count	48	63	95	29	–
	Col. %	18.90%	9.08%	20.39%	2.57%	–
Retouched	Count	1	46	1	3	–
	Col. %	0.39%	6.63%	0.21%	0.27%	–
Retouched and abraded	Count	–	25	1	1	–
	Col. %	–	3.60%	0.21%	0.09%	–
Abraded	Count	1	9	–	1	–
	Col. %	0.39%	1.30%	–	0.09%	–
Collapsed	Count	25	93	39	102	6
	Col. %	9.84%	13.40%	8.37%	9.03%	11.54%
Crushed	Count	8	11	15	12	1
	Col. %	3.15%	1.59%	3.22%	1.06%	1.92%
Obscured	Count	–	1	–	1	–
	Col. %	–	0.14%	–	0.09%	–

Table 14.16. Flake portions by time period; counts and row percentages.

Period		Indeterminate Fragment	Whole	Proximal	Medial	Distal	Lateral	Collapsed Platform	**Total**
Unknown	Count	1	210	118	121	114	102	–	666
	Row %	0.15%	31.53%	17.72%	18.17%	17.12%	15.32%	–	12.14%
Paleoindian	Count	3	248	447	365	214	164	1	1442
	Row %	0.21%	17.20%	31.00%	25.31%	14.84%	11.37%	0.07%	26.29%
Archaic	Count	–	368	220	266	224	215	–	1293
	Row %	–	28.46%	17.01%	20.57%	17.32%	16.63%	–	23.57%
Formative	Count	–	797	335	170	293	329	1	1925
	Row %	–	41.40%	17.40%	8.83%	15.22%	17.09%	0.05%	35.10%
Historic	Count	–	39	14	7	69	30	–	159
	Row %	–	0.71%	8.81%	4.40%	43.40%	18.87%	–	2.90%
Total	Count	4	1662	1134	929	914	840	2	5485
	Row %	0.07%	30.30%	20.67%	16.94%	16.66%	15.31%	0.04%	100.00%

Table 14.17. Flake to angular debris ratios by component and period.

Site	Component					
	Unknown	Paleoindian	Archaic	Formative	Historic	Overall
LA 111420	–	–	7.20:1	–	–	–
LA 111421	10.20:1	–	–	–	–	–
LA 111422	–	–	–	4.69:1	–	–
LA 111429	3.05:1	4.59:1	–	2.55:1	–	–
LA 111432	4.63:1	–	–	–	–	–
LA 111435	–	–	4.60:1	4.50:1	–	–
LA 112370	12.00:1	–	–	–	–	–
LA 112371	10.67:1	–	–	–	–	–
LA 112374	3.00:1	–	–	–	–	–
LA 155963	5.80:1	8.80:1	5.13:1	2.84:1	7.00:1	–
LA 155964	7.20:1	–	–	–	0.52:1	–
LA 155968	4.00:1	7.07:1	–	3.58:1	–	–
LA 155969	7.50:1	–	–	–	–	–
LA 156877	–	–	–	6.92:1	–	–
Total	4.76:1	5.81:1	5.48:1	3.30:1	0.55:1	3.67:1

Pot lids dropped from consideration.

Table 14.18. Flake to core ratios by component and period.

Site	Component					
	Unknown	Paleoindian	Archaic	Formative	Historic	Overall
LA 111420	–	–	147.50:1	–	–	147.50:1
LA 111421	25.50:1	–	–	–	–	25.50:1
LA 111422	–	–	–	13.56:1	–	13.56:1
LA 111429	19.20:1	180.25:1	no cores	no cores	–	67.29:1
LA 111432	37.00:1	–	–	–	–	37.00:1
LA 111435	–	–	no cores	11.25:1	–	11.83:1
LA 112370	no cores	–	–	–	–	no cores
LA 112371	21.33:1	–	–	–	–	21.33:1
LA 112374	no cores	–	–	–	–	no cores
LA 155963	29.00:1	198.00:1	29.55 :1	27.88:1	no cores	32.80:1
LA 155964	9.00:1	–	–	–	18.75:1	15.50:1
LA 155968	2.29:1	36.11:1	–	3.58:1	no cores	13.75:1
LA 155969	6.00:1	–	–	–	–	6.00:1
LA 156877	–	–	–	16.60:1	–	16.60:1
Total	17.08:1	96.13:1	36.94:1	17.66:1	19.75:1	26.33:1

Potlids dropped from consideration.

Table 14.19. Core flake to biface flake ratios by component and period.

Site	Component					
	Unknown	Paleoindian	Archaic	Formative	Historic	Overall
LA 111420	–	–	35.88:1	–	–	35.88:1
LA 111421	24.50:1	–	–	–	–	24.50:1
LA 111422	–	–	–	60.00:1	–	60.00:1
LA 111429	6.11:1	7.69:1	–	27.00:1	–	7.49:1
LA 111432	10.10:1	–	–	–	–	10.10:1
LA 111435	–	–	nbf	111.50:1	–	117.25:1
LA 112370	5.00:1	–	–	–	–	5.00:1
LA 112371	15.00:1	–	–	–	–	15.00:1
LA 112374	3.50:1	–	–	–	–	3.50:1
LA 155963	19.71:1	4.14:1	23.38:1	108:01:00	nbf	19.16:1
LA 155964	35.00:1	–	–	–	nbf	185.00:1
LA 155968	7.00:1	5.25:1	–	nbf	nbf	6.13:1
LA 155969	nbf	–	–	–	–	nbf
LA 156877	–	–	–	7.30:1	–	7.30:1
Total	10.67:1	5.78:1	25.92:1	67.61:1	nbf	14.90:1

Pot lids dropped from consideration.
nbf = no biface flakes

Table 14.20. Thermal alteration data for site components and temporal periods.

Site	Component	No. Chertic Artifacts	No. Intentionally Altered	No. Inadvertently Altered	% Intentionally Altered	% Inadvertently Altered	% of Chert Assemblage Intentionally Treated	% Lustrous Specimens
LA 111420	Archaic	111	10	1	90.91%	9.09%	9.01%	70.00%
LA 111421	Unknown	22	2	1	66.67%	33.33%	9.09%	50.00%
LA 111422	Formative	87	5	3	62.50%	37.50%	5.75%	60.00%
LA 111429	Unknown	288	147	17	89.63%	10.37%	51.04%	10.20%
	Paleoindian	869	304	40	88.37%	11.63%	34.98%	76.97%
	Archaic	1	1	0	100.00%	0.00%	100.00%	0.00%
	Formative	26	10	3	76.92%	23.08%	38.46%	0.00%
LA 111432	Unknown	81	10	6	62.50%	37.50%	12.35%	20.00%
LA 111435	Archaic	20	0	0	0.00%	0.00%	0.00%	0.00%
	Formative	379	19	8	70.37%	29.63%	5.01%	94.74%
LA 112370	Unknown	12	1	1	50.00%	50.00%	8.33%	100.00%
LA 112371	Unknown	71	4	2	66.67%	33.33%	5.63%	75.00%
LA 112374	Unknown	12	1	0	100.00%	0.00%	8.33%	0.00%
LA 155963	Unknown	225	115	5	95.83%	4.17%	51.11%	94.78%
	Paleoindian	450	138	16	89.61%	10.39%	30.67%	84.06%
	Archaic	1127	631	54	92.12%	7.88%	55.99%	97.94%
	Formative	1307	217	45	82.82%	17.18%	16.60%	94.47%
	Historic	9	4	0	100.00%	0.00%	44.44%	100.00%
LA 155964	Unknown	36	6	4	60.00%	40.00%	16.67%	100.00%
	Historic	464	27	164	14.13%	85.86%	5.82%	51.85%
LA 155968	Unknown	27	0	3	0.00%	100.00%	0.00%	0.00%
	Paleoindian	386	253	22	92.00%	8.00%	65.54%	96.84%
	Formative	34	5	5	50.00%	50.00%	14.71%	80.00%
	Historic	1	1	0	100.00%	0.00%	100.00%	100.00%
LA 155969	Unknown	35	2	0	100.00%	0.00%	5.71%	100.00%
LA 156877	Formative	82	6	0	10.00%	0.00%	7.32%	83.33%
Periods	Paleoindian	1705	695	78	89.91%	11.93%	40.76%	85.61%
	Archaic	1259	642	55	89.91%	10.09%	50.99%	97.35%
	Formative	1915	262	64	80.37%	19.63%	13.68%	89.69%
	Historic	474	32	164	82.75%	17.25%	6.75%	59.38%

Table 14.21. Numeric values for each reduction strategy indicator by site component.

Site	Component	Cortical to Noncortical Flake Ratio	% Tertiary Flakes	% Biface Flakes	% Modified Platforms	% Manufacture Breaks	% Whole Flakes	% Lipped Platforms	% Diffuse Bulbs	% Opposing Dorsal Scars	Flake to Angular Debris Ratio	Flake to Core Ratio	Core Flake to Biface Flake Ratio	% of Chert Artifacts Intentionally Heated
LA 111420	Archaic	0.03	96.95	2.71	0.00	28.57	12.88	50.00	83.33	60.00	7.20	147.50	35.88	9.01
LA 111421	Unknown	0.11	90.20	3.92	0.00	0.00	17.65	nd	–	66.67	10.20	25.50	24.50	9.09
LA 111422	Formative	0.20	83.61	1.64	2.04	34.29	52.46	8.64	19.44	1.72	4.69	13.56	60.00	5.75
LA 111429	Unknown	0.11	90.10	19.27	38.39	17.89	33.85	43.04	62.64	15.51	3.05	19.20	6.11	51.04
	Paleoindian	0.07	93.62	13.73	21.87	39.90	15.95	30.56	52.43	4.72	4.59	180.25	7.69	34.98
	Formative	0.40	71.43	3.57	10.00	0.00	57.14	26.67	36.84	3.57	2.55	no cores	27.00	38.46
LA 111432	Unknown	0.13	88.29	9.91	0.00	5.88	32.43	24.00	59.38	47.95	4.63	no cores	10.10	12.35
LA 111435	Archaic	0.35	73.91	0.00	0.00	26.67	30.43	9.09	27.27	0.00	4.60	no cores	nbf	0.00
	Formative	0.20	83.56	0.89	57.00	29.51	52.67	3.19	18.52	0.00	4.50	11.25	111.50	5.01
LA 112370	Unknown	0.09	91.67	16.67	0.00	0.00	25.00	nd	nd	nd	12.00	no cores	5.00	8.33
LA 112371	Unknown	0.07	93.75	6.25	12.50	11.11	17.19	14.29	42.86	63.64	10.67	21.33	15.00	5.63
LA 112374	Unknown	0.00	100.00	22.22	0.00	0.00	11.11	nd	nd	nd	3.00	no cores	3.50	8.33
LA 155963	Unknown	0.08	92.41	5.52	27.50	2.22	33.10	20.63	40.85	8.28	5.80	29.00	19.71	51.11
	Paleoindian	0.03	97.22	19.70	23.08	33.23	19.19	31.22	52.40	3.03	8.80	198.00	4.14	30.67
	Archaic	0.18	84.79	6.67	23.18	5.46	33.13	35.98	41.87	10.66	5.13	29.55	23.38	55.99
	Formative	0.31	76.15	2.17	5.48	14.58	36.28	15.51	35.69	2.76	2.84	27.88	108.01	16.60
	Historic	0.40	71.43	0.00	0.00	50.00	42.86	0.00	16.67	0.00	7.00	no cores	nbf	44.44
LA 155964	Unknown	0.44	69.44	2.78	0.00	21.43	38.89	4.76	nd	nd	7.20	9.00	35.00	16.67
	Historic	0.35	74.00	0.00	0.00	16.04	24.00	2.38	28.26	2.01	0.52	18.75	nbf	5.82
LA 155968	Unknown	0.45	68.75	12.50	7.69	37.50	50.00	22.22	16.67	12.50	4.00	2.29	7.00	0.00
	Paleoindian	0.14	87.69	16.92	25.40	47.55	17.54	37.95	50.28	3.09	7.07	36.11	5.25	65.54
	Formative	0.34	74.42	0.00	3.13	25.00	41.86	17.86	24.14	0.00	3.58	3.58	nbf	14.71
	Historic	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	no cores	nbf	100.00
LA 155969	Unknown	0.50	66.67	0.00	4.55	45.45	0.00	11.11	11.11	0.00	7.50	6.00	nbf	5.71
LA 156877	Formative	0.24	80.72	13.25	5.56	25.49	32.53	17.39	33.33	2.41	6.92	16.60	7.30	7.32

nbf = no biface flakes
nd = no data

Table 14.22. Mean, standard deviation, and first standard deviation range for reduction strategy indicators.

Analytic Attribute		Paleoindian	Archaic	Formative	Historic
Cortical-to-noncortical flake ratio	mean	0.15	0.19	0.33	0.38
	sd	0.16	0.16	0.12	0.04
	1 σ range	0.02–0.14	0.03–0.35	0.21–0.44	0.34–0.41
% Tertiary flakes	mean	92.84	85.22	75.97	72.72
	sd	4.81	11.53	6.72	1.82
	1 σ range	88.03–97.66	73.69–96.74	69.26–82.69	70.90–74.53
% Biface flakes	mean	16.78	3.13	3.59	–
	sd	2.99	3.35	4.88	–
	1 σ range	13.80–19.77	-0.23–6.48	-1.30–8.47	–
% Modified platforms	mean	23.45	7.73	13.87	–
	sd	1.79	13.38	21.31	–
	1 σ range	21.66–25.24	-5.66–21.11	-7.44–35.18	–
% Manufacture breaks	mean	40.23	20.23	21.48	33.02
	sd	7.17	12.83	12.38	24.01
	1 σ range	33.06–47.39	7.40–33.06	9.10–33.86	9.01–57.03
% Whole flakes	mean	17.56	25.48	45.49	33.43
	sd	1.62	11	10.02	13.34
	1 σ range	15.94–19.18	14.48–36.48	35.47–55.51	20.09–46.77
% Lipped platforms	mean	33.24	31.69	14.88	1.19
	sd	4.09	20.79	8.13	1.68
	1 σ range	29.15–37.33	10.90–52.48	6.75–20.00	-0.49–2.87
% Diffuse bulbs	mean	51.70	50.82	27.99	22.47
	sd	1.23	29.08	8.29	8.2
	1 σ range	50.47–52.94	21.74–79.91	19.70–36.28	14.27–30.66
% Opposing dorsal scars	mean	3.61	23.55	1.74	1.01
	sd	0.96	32.01	1.48	1.42
	1 σ range	2.65–4.57	-8.46–55.56	0.27–3.22	-0.42–2.43
Flake-to-angular debris ratio	mean	6.82	5.64	4.18	3.76
	sd	2.12	1.37	1.59	4.58
	1 σ range	4.70–8.94	4.27–7.02	2.59–5.77	-0.82–8.34
Flake-to-core ratio	mean	138.12	88.53	14.57	–
	sd	88.79	83.4	8.86	–
	1 σ range	49.33–226.91	5.12–171.93	5.71–23.44	–
Core flake-to-biface flake ratio	mean	5.69	29.63	62.76	–
	sd	1.82	8.84	46.87	–
	1 σ range	3.88–7.51	20.79–38.47	15.90–109.63	–
% Chert artifacts intentionally heated	mean	43.73	21.67	14.64	25.13
	sd	19.01	30.06	12.62	27.31
	1 σ range	24.72–62.74	-8.40–51.73	2.02–27.26	-2.18–52.44

Table 14.23. Comparison of reduction strategy indicators by site component and temporal period.

Site	Component	Reduction Indicator													Score	Reduction Strategy
		Cortical/ Non-cortical	Percent Tertiary Flakes	Flake Type	Modified Platforms	Flake Breakage	Percent Whole Flakes	Lipping and Bulb	Diffuse Bulbs	Dorsal Scars	Flake/ Angular Debris	Flake/ Core	Core Flake/ Biface Flake	Thermally Treated Chert		
LA 111420	Archaic	C	C	E	E	E	C	C	C	C	C	C	E	E	0.615	C
LA 111421	Unknown	C	C	E	E	E	C	nd	nd	C	C	E	E	E	0.455	M
LA 111422	Formative	C	C	E	E	C	E	E	E	E	E	E	E	E	0.231	E
LA 111429	Unknown	C	C	C	C	E	E	C	C	C	E	E	C	C	0.692	C
	Paleoindian	C	C	C	C	C	C	C	C	C	E	C	C	C	0.923	C
	Formative	E	E	E	E	E	E	C	E	C	E	nd	E	C	0.250	E
LA 111432	Unknown	C	C	E	E	E	E	C	C	C	E	nd	C	E	0.500	M
LA 111435	Archaic	E	E	E	E	E	E	E	E	E	E	nd	nd	E	0.000	E
	Formative	C	C	E	C	E	E	E	E	E	E	E	E	E	0.231	E
LA 112370	Unknown	C	C	C	E	E	E	nd	nd	nd	C	nd	C	E	0.556	M
LA 112371	Unknown	C	C	E	E	E	C	E	E	C	C	E	E	E	0.385	E
LA 112374	Unknown	C	C	C	E	E	C	nd	nd	nd	E	nd	C	E	0.556	M
LA 155963	Unknown	C	C	E	C	E	E	C	E	C	C	E	E	C	0.538	M
	Paleoindian	C	C	C	C	C	C	C	C	C	C	C	C	C	1.000	C
	Archaic	C	C	E	C	E	E	C	E	C	C	E	E	C	0.538	M
	Formative	E	E	E	E	E	E	E	E	E	E	E	E	E	0.000	E
	Historic	E	E	E	E	C	E	E	E	E	C	nd	nd	C	0.273	E
LA 155964	Unknown	E	E	E	E	E	E	E	nd	nd	C	E	E	E	0.091	E
	Historic	E	E	E	E	E	E	E	E	E	E	E	nd	E	0.000	E
LA 155968	Unknown	E	E	C	E	C	E	C	E	C	E	E	C	E	0.385	E
	Paleoindian	C	C	C	C	C	C	C	C	E	C	E	C	C	0.846	C
	Formative	E	E	E	E	E	E	E	E	C	E	E	nd	E	0.083	E
LA 155969	Unknown	E	E	E	E	E	C	E	E	E	E	nd	nd	C	0.182	E
LA 156877	Formative	C	C	C	E	C	E	E	E	E	C	E	C	E	0.462	M

E = expedient; C = curated; M = mixed; nd = no data overall reduction strategy indicated by this analysis. Possible reduction strategies include curated, expedient, and a mixture of both. While it is likely that both strategies were used in most of these components, this analysis is aimed at defining the primary strategy.

We assume that emphases on both curated and expedient core reduction strategies are reflected in our data. Assemblages assigned to the Paleoindian and Archaic periods are considered more likely to reflect a curated strategy, while those from the Formative and Historic periods are considered more likely to reflect an expedient strategy. Rather than demonstrating these points for all component assemblages, this part of the analysis is aimed more at defining measures that can be used to assign relative dates to components of unknown temporal affinity. In addition, the components that have dates assigned to them can be examined for anomalies that might indicate problems in the assigned date or the presence of multiple temporal components that might otherwise be missed.

Cortical to non-cortical flake ratio. Low cortical to non-cortical debitage ratios suggest a curated reduction strategy because biface manufacture should produce a much higher percentage of non-cortical flakes than are generated during core reduction. In turn, high ratios indicate an expedient reduction strategy. There is a clear division between the means for this attribute in Table 14.22. The Paleoindian and Archaic ratios are very similar and lower than those of the Formative and Historic assemblages, which are also very similar to one another. However, there is considerable overlap in first standard deviation ranges between the Archaic and Formative assemblages. Rather than using the standard deviation ranges in this case, the difference between the Archaic and Formative means is split, and ratios below 1:0.26 are considered indicative of a curated strategy and those above it are indicative of an expedient strategy.

Percent of tertiary flakes. High percentages of tertiary flakes suggest a curated strategy because tool manufacture tends to produce larger numbers of non-cortical interior flakes than does core reduction. The opposite is indicative of an expedient reduction strategy.

As with the results for the cortical to non-cortical flake ratio there is a clear divide in means for this attribute, with the Paleoindian and Archaic assemblages grouping on one side and the Formative and Historic assemblages on the other. However, a moderately large standard deviation for the Archaic assemblages creates an overlap between the first standard deviation ranges for the Archaic and Formative assemblages. Again, we split the difference between the means for the two latter assemblages, and use 80 percent as a dividing line between curated and expedient strategies.

Flake type. Percentage of biface flakes in the flake assemblage is used to produce data for this attribute. High percentages of biface flakes are considered indicative of a curated strategy and low percentages of an expedient strategy.

Data for this attribute in Table 14.22 are mixed because the mean for the Archaic assemblages is unexpectedly low and there were no biface flakes in the Historic assemblages. Again, there is quite a bit of overlap in the first standard deviation ranges for the Archaic and Formative assemblages, but neither overlaps with the Paleoindian assemblage. Because of this, the low end of the second standard deviation range for the Paleoindian assemblage—10.80—is used as a dividing line between curated and expedient strategies.

Percent of modified platforms. Since platforms tend to be modified by grinding during tool manufacture but not during core reduction, a high percentage of modified platforms is considered indicative of a curated strategy and a low percentage indicative of an expedient strategy.

The results for this attribute are mixed in Table 14.22. The Archaic assemblage actually contains a lower percentage of modified platforms than the Formative assemblage, and large standard deviations for these two assemblages produce quite a bit of overlap with the lower portion of the first standard deviation range for the Paleoindian assemblages. Because of this, the low end of the second standard deviation range for the Paleoindian assemblage—19.87—is used as a dividing line between curated and expedient strategies.

Flake breakage patterns. Manufacturing breaks can occur during both core and biface reduction, but limited experiments suggest that they are much higher in the latter than they are in the former. Thus, higher percentages of manufacturing breaks in an assemblage suggest an emphasis on tool manufacture and therefore a curated reduction strategy.

The results for this attribute are clear for the

Paleoindian assemblages in Table 14.22, but are mixed for the other assemblages because of fairly high standard deviations. A value higher than 33 percent is clearly indicative of a curated strategy, and is used as the breaking point between curated and expedient reduction in this analysis.

Percent of whole flakes. Because flakes removed during biface reduction tend to be thinner than those removed from cores, they are more prone to buckle during removal, producing assemblages with lower percentages of whole flakes. Thus, low percentages of whole flakes suggest a curated strategy while higher percentages of whole flakes indicate an expedient strategy. However, a caveat is in order. Sites that are mainly surficial or very shallow, like those examined by this study, are also prone to having flakes broken by trampling and erosional processes. Thus, this indicator may be weak.

The results of this analysis are again clear for the Paleoindian assemblages, but not quite as clear for the other assemblages. Some overlap in first standard deviation ranges is visible in Table 14.22 for the Paleoindian and Archaic assemblages, and the range for the latter overlaps those of the other temporal categories. However, there is a clear break at 20 percent between the Paleoindian and some Archaic assemblages versus the Formative and Historic assemblages, and this value is used as the divide between curated and expedient reduction behaviors.

Percent of lipped platforms. Since platform lipping usually indicates soft hammer percussion or pressure flaking, and these are most often associated with tool manufacture rather than core reduction, high percentages of lipped platforms suggest a curated strategy while low percentages are representative of an expedient strategy.

There is a very clear pattern for this attribute in Table 14.22. Both the Paleoindian and Archaic assemblages tend to contain much higher percentages of lipped platforms than the Formative and Historic assemblages, though there is overlap between the Archaic and Formative assemblages due to a large first standard deviation range for the former. Because of this, the high end of the range for the Formative assemblages—20 percent—is used as the dividing point between curated and expedient strategies.

Percent of diffuse bulbs of percussion. Like platform lipping, diffuse bulbs of percussion usually signify that reduction was done with soft hammers or pressure, while pronounced bulbs tend to indicate hard-hammer percussion. Since soft-hammer percussion and pressure flaking are more often used in tool manufacture than in core reduction, high percentages of diffuse bulbs suggest biface manufacture while low percentages are indicative of core reduction.

As Table 14.22 shows, there are comparatively small standard deviations for all temporal divisions except for the Archaic assemblages, which have a very high standard deviation—indicating quite a bit of variability. Since there is a distinct break between the first standard deviation ranges for the Paleoindian and Formative assemblages, the break used to distinguish between curated and expedient strategies is the midpoint between the high end of the Formative first standard deviation range and the low end of the Paleoindian range. This provides a value of 43.375 percent, rounded down to 43 percent.

Percent of opposing dorsal scars. Opposing dorsal scars can occur during both biface manufacture and core reduction, but should be much more common during the former. Thus, higher percentages of opposing dorsal scars suggest a curated strategy, while small percentages reflect an expedient strategy.

Once again, as Table 14.22 shows, the Archaic assemblage has a very large standard deviation for this attribute while the other periods have much smaller standard deviations. Discounting the Archaic numbers as was done in the examination of diffuse bulbs of percussion, we see an overlap in first standard deviation ranges for the Paleoindian and Formative assemblages. Again, we take the midway point between the low end of the Paleoindian range and the high end of the Formative range as the break between curated and expedient strategies. This provides a figure of 2.93 percent, which is rounded down to 2.9 percent.

Flake to angular debris ratio. Since biface manufacture produces large numbers of waste flakes but few recoverable pieces of angular debris, a high flake to angular debris ratio suggests a curated reduction strategy. Conversely, while core reduction can also produce large numbers of flakes, it can also produce large numbers of recoverable angular debris. Thus, low flake to angular debris ratios reflect expedient reduction.

Standard deviations are small for all temporal divisions for this attribute in Table 14.22 except for the Historic assemblage. There is considerable overlap in first standard deviation ranges between the Paleoindian and Archaic assemblages, both of which overlap with the upper part of the range for the Formative assemblage. Thus, the break between curated and expedient behaviors is considered to be the midpoint between the top of the Formative range and the bottom of the Archaic range. This provides a ratio of 5.02:1 as the break point.

Flake to core ratio. As discussed earlier, this attribute is problematic because cores can be transported away from a site after they are partly reduced or they can be completely reduced and disappear from the record. With this in mind, biface manufacture produces a large number of flakes relative to cores, while core reduction produces a smaller number of flakes relative to cores. Thus, a high ratio suggests a curated strategy, while a low ratio represents expedient reduction.

Standard deviations for this attribute are quite large for the Paleoindian and Archaic assemblages in Table 14.22, and quite small for the Formative assemblage. No cores were identified in the Historic assemblage, so this period cannot be considered for this attribute. Fortunately, there is quite a bit of difference in the means for this ratio, and no overlap in the ranges for the Paleoindian and Formative assemblages. Taking the midpoint between the upper limit of the first standard deviation range for the Formative period and the lower limit of the Paleoindian range as the breaking point, we arrive at a ratio of 36.39:1. Ratios higher than this suggest a curated strategy, and those that are lower reflect an expedient strategy.

Core flake to biface flake ratio. This attribute measures the relative abundance of either biface flakes or core flakes in an assemblage, with a high percentage indicating the dominance of core flakes and therefore expedient reduction, while a low ratio indicates a large proportion of biface flakes and therefore a curated strategy.

While this attribute for the Paleoindian assemblage in Table 14.22 has a small standard deviation, the Archaic standard deviation is quite a bit higher and the Formative standard deviation is extremely high; no biface flakes were identified in the Historic assemblage. In this case the cut off between curated and expedient strategies is the midpoint between the high end of the first standard deviation range for the Paleoindian assemblage and the low end for the Archaic assemblage. This produces a ratio of 14.15:1, with higher ratios suggesting an expedient strategy and lower ratios a curated strategy.

Percent of intentionally thermally altered chert artifacts. As discussed earlier, cherts can be altered through the application of heat to improve their flaking qualities. This was often done to improve cherts used for tool manufacture. Thus, high percentages of thermally altered cherts suggest a curated strategy, while low percentages reflect an expedient strategy.

The Historic assemblage is discounted in this discussion because the bulk of it consists of artifacts that were discarded into an active thermal feature, so intentional thermal alteration is probably not indicated. While standard deviations are rather high for the other three periods, there is little overlap between the upper end of the first standard deviation range for the Paleoindian assemblage and the lower end of the range for the Formative period. The standard deviation for the Archaic assemblage is very high, causing it to severely overlap both the Paleoindian and Formative ranges. Thus, the dividing point between curated and expedient behavior is the midpoint between the upper limit of the first standard deviation range for the Formative assemblage and the lower end of the range for the Paleoindian assemblage. This produces a figure of 25.99 percent, with percentages above that representing curated behavior and those below it suggesting expedient behavior.

Examination of analytic results. The results of this analysis, using the dividing points for all variables discussed above, are shown in Table 14.23. Scores were derived by applying a value of 1 to each component variable assessed as indicative of a curated strategy, then dividing the total by the number of variables recorded for that component. Values over 0.615 (8 out of 13 variables assigned a C designation) are considered to be assemblages in which a curated reduction strategy dominated. Values of 0.385 or less (8 out of 13 variables assigned an E designation) are classified as assemblages in which an expedient reduction strategy dominated. These values were selected because they reflect a dominance of reduction strategy indicators indicative of either a curated or expedient strategy without requiring that all indicators point to a particular strategy. This was necessary, because mixed strategies are common in chipped stone assemblages, with biface reduction occurring side-by-side with expedient reduction in many cases. Thus, the values used in this analysis can reflect the dominance of a particular reduction strategy in an assemblage without suggesting that it was the only strategy used. Values falling between 0.385 and 0.615 are considered to represent more highly mixed assemblages. In the latter case, both expedient and curated strategy may have been used equally, or an unsuspected multicomponent situation may be indicated.

Thus, assigning one reduction strategy to a component does not mean that the other strategy was not used there, only that the assigned strategy dominated. While Archaic sites often demonstrate a curated reduction strategy, an expedient strategy could also have been used at the same location. For example, a study of Archaic assemblages at LA 65006 near San Ildefonso demonstrated that exotic materials (obsidian in this case) were reduced using a curated strategy, while local materials were mostly reduced using an expedient strategy (Moore 2001). The reverse may also be true in some cases. Even though an expedient reduction strategy tends to dominate on Formative period sites, some use of a curated strategy is often also indicated, and these proportional differences may relate to the types of activities undertaken at a site.

Remarkably, few Spaceport America components exhibit a curated strategy. Only five of 24 assemblages fall into this category including all three Paleoindian components (LA 111429, LA 155963, and LA 155968), the Archaic component from LA 111420, and the unknown component from LA 111429. Twelve components—half of those identified—exhibit an expedient strategy. They include five of the six Formative assemblages, one of three Archaic assemblages (LA 111435), both Historic assemblages for which there were enough data for analysis, and four of ten Unknown assemblages. The seven remaining assemblages—six unknown and one Formative—exhibit mixed reduction strategies.

The latter conclusions are no surprise in the case of the assemblages with unknown temporal affinity, since they could easily represent multicomponent situations. It was something of a surprise, however, for the Formative assemblage from LA 156877 until reports of earlier studies were reviewed, as discussed earlier. This assemblage was initially assigned a Formative period date because an arrow point was recovered during research investigations. However, during an earlier study a fragment of an Archaic point was also found at this site. In this case a multicomponent situation appears to be indicated, with a mixture of Archaic and Formative period materials comprising the assemblage.

Considering the presence of multiple temporally diagnostic artifacts in close or fairly close spatial association with the Paleoindian assemblages on LA 111429, LA 155963, and LA 155968, as well as evidence for reliance on a curated reduction strategy, the Paleoindian temporal assignment appears to be justified in these cases. Since the temporally diagnostic artifacts include several Folsom points as well as a single Midland point, all three of these assemblages probably reflect Folsom occupations, and this association is especially strong for the LA 155968 assemblage. Similarly, definition of a curated reduction strategy for LA 111420 supports the Archaic affinity assigned to that site on the basis of associated projectile points.

The Archaic assemblage from LA 111435 is another case entirely. This assemblage contains only 28 of the 633 artifacts from this site, and was assigned an Archaic affinity because of association with features dating to that period. However, none of the indicators for this assemblage suggest a curated reduction strategy, placing it with the Formative assemblage from LA 155963 and the Historic assemblage from LA 155964 as the only ones sharing this characteristic. However, five artifacts assigned to the LA 111435 Archaic component were from a surface strip area around Feature 10 and the rest were recovered from Features 7 and 10, both of which were radiocarbon dated to the Archaic period. Thus, these artifacts were closely associated with Archaic features. This shows that a curated reduction strategy may not always be evidenced by an Archaic assemblage. This is similar to patterns seen in the El Paso area, where high quality materials are often available only in small nodules, making the manufacture of large bifaces difficult and an emphasis on expedient reduction more likely. (Camilli 1988; Moore 1996). A similar situation may also exist in our study area where the highest quality materials appear to only be available in comparatively small nodules in local gravel beds.

Of the components dated to the Archaic, LA

111420 exhibits a curated reduction strategy; the component on LA 155963 exhibits a mixed strategy; and as discussed above, the component from LA 111435 exhibits an expedient strategy. These differences may be due to the dominance of cherts in the Archaic assemblages from LA 111435 and LA 155963 versus metaquartzites at LA 111420. During our survey of materials in nearby gravel beds (see Chapter 23, this report), we noted that metaquartzite nodules tended to be much larger than the chert nodules, though neither material was common. Thus, the heavy use of metaquartzites at LA 111420 may reflect the manufacture of large bifaces from locally procured nodules of this material and, if so, accounts for the curated strategy results. The use of smaller local chert nodules as well as materials transported into the area may account for the mixed reduction strategy in the LA 155963 Archaic assemblage, with some large biface manufacture occurring but much reduction focused on expedient core reduction.

Can the results of this analysis be used to assign tentative dates to assemblages of unknown temporal affinity? In most cases it may be possible, though considerable uncertainty remains because the type of reduction strategy used can vary with site function as well as by general the type of settlement/ subsistence system. Formative period assemblages reflecting a hunting focus can exhibit a curated strategy similar to that seen in Paleoindian and Archaic assemblages, while Archaic assemblages in areas lacking large nodules of knappable materials can reflect an expedient strategy similar to that seen in Formative period residential site assemblages. Thus, while the results of this analysis can provide tentative dates, in the absence of other types of data, especially knowledge of the range of activities performed, they cannot be considered reliable. The four assemblages with unknown dates that were classified as exhibiting an expedient reduction strategy (LA 112371, LA 155964, LA 155968, and LA 155969) may date to the Formative period. Assigning a date to the five assemblages exhibiting mixed reduction strategies is more difficult. Since the unknown assemblage from LA 155963 contains a mixture of materials from various undated proveniences, little weight can be applied to the analytic results for this component. The LA 111421, LA 112370, and LA 112374 assemblages are also small and demonstrate a mixed character. These assemblages may represent short-term Archaic occupations, though this is impossible to determine for certain. However, as is the case for LA 111420, the LA 111421 assemblage is dominated by metaquartzites, perhaps suggesting a bit more strongly that this component reflects an Archaic occupation.

While LA 111432 was assigned an unknown date in this analysis because no diagnostic artifacts were found during testing, the recovery of an Eden-like point during an earlier study (HSR 1995) suggests a late Paleoindian date. While this date is possible, the character of the LA 111432 assemblage is quite different from those of the other Paleoindian components. This could be due to a difference in dates since the other three Paleoindian components represent Folsom occupations. Examining the indicators in Tables 14.22 and 14.23, only the flake type attribute for LA 111432 is close to the dividing line between strategies and could potentially be reassigned to the curated category. However, even if this was done the overall strategy for this site would remain mixed. Evidence for a mixed reduction strategy could be indicative of the transition into an Archaic strategy, or it could simply be an indication that late Paleoindian groups were encountering the same reduction constraints seen in the Archaic assemblages.

Most of the artifacts in the LA 111429 Formative assemblage were recovered from surface stripping around Feature 3, which dates to the transition between the Archaic and Formative periods. This assemblage was tentatively dated to the Formative period for this analysis, which is weakly supported. The dominance of an expedient reduction strategy may indicate a very early Formative period association despite the lack of pottery, but a very late Archaic date cannot be ruled out. As suggested for Feature 3, this small chipped stone assemblage may also be transitional.

Table 14.24 shows the original dates assigned to each component, the rationale for those dates, and the dates suggested by this analysis. As already discussed, the reduction strategies defined by this analysis tend to correspond to our expectations for the occupational periods assigned to components. The main differences between our expectations and results are in the Archaic assemblages, which exhibit a much smaller degree of dependence on a curated reduction strategy than expected. This analysis also permitted the assignment of dates to components that were previously undated, though in each case these dates remain tentative due to the lack of corroborating data.

Chipped Stone Tools

Two categories of tools are included under this classification. First are formal tools, whose shapes or edge angles were significantly altered to fit the needs of a specific task. The second are debitage or cores whose edges were damaged during use. Recognizing the latter category of artifacts may be problematic because most Spaceport America artifacts were recovered from the surface or within the upper 10–15 cm of fill, locations where damage from trampling or erosional movement is common and is thus difficult to distinguish from cultural edge damage. For this reason, very conservative measures were used to define informal tools, with most artifacts with edge damage being eliminated as potential tools because the damage was inconsistent along an edge or created scoops or projections that would have been removed by the forces exerted by cultural use. At least one tool was found in each component (Table 14.25), with the exception of LA 112374, which lacked any tools. Informal tools are common in only two assemblages—the Paleoindian component from LA 111429 and the Formative component from LA 155963. Formal tools are abundant in several components, especially the unknown components from LA 111429 and LA 155963. However, since these components contain tools found across each site that were not assigned to specific components because they fell outside the limits of excavation areas, little meaning can be placed on those abundances. This is because surface tools from these sites were examined during in-field analysis to derive an idea of the range of the types of tools that occur there, but associated chipped stone assemblages in their vicinity were not analyzed. Thus, formal tools are over-represented in these two assemblages.

Tool types and numbers by component are shown in Table 14.26. Bifaces for which no function could be defined were the most common type of tool recovered, followed by projectile points and informal tools. Other types of tools are comparatively rare, but indicate a wide range of activities. This array of tools can be used to elicit two types of data. Certain types of tools have temporal implications, including projectile points, spurred end scrapers, and strike-a-light flints (Fig. 14.4–14.7). Various tool types suggest that specific activities occurred and can be used to define a range of activities for periods of occupation. Both types of data are discussed, and their implications for component date and function are explored.

Projectile Points as Temporal Indicators

Though not as temporally sensitive as pottery or radiocarbon dates derived from charcoal, projectile points can be used to define basic occupational periods based on their size and style. For instance, small projectile points suitable for tipping arrows rather than darts do not occur before the introduction of the bow around AD 400 or 600, which was essentially the beginning of the Formative period. The presence of arrow points on aceramic sites indicates occupation after AD 400–600, though we cannot always narrow the period of occupation down further. Certain projectile point styles have well-defined temporal spans and can be used to date sites or components in the absence of absolute dates or ceramics.

Unfortunately, projectile points have always been prone to salvaging and curation so dates based on these tools are not always reliable. For instance, the presence of an Archaic point on a Formative component could indicate an earlier component or it could simply have been salvaged for reuse. In such an instance other data corroborating an earlier occupation would be necessary to confirm it. The projectile points recovered from each site are discussed separately and associated with individual components when possible. How they fit with any ceramic-based or absolute dates is then discussed to determine what their presence might mean.

LA 111420. Two fragmentary projectile points were recovered from this site, including a Bajada point base and a Chiricahua point proximal fragment that includes one notch. The Bajada point is made from metaquartzite and the Chiricahua point is made from gray chert; both materials are locally available. Bajada points date to the Early Archaic while Chiricahua points are usually dated to the Middle Archaic and perhaps into the Late Archaic (Irwin-Williams 1973; Justice 2002). The dates for these points suggest two scenarios: that LA 111420 was occupied in the late part of the Early Archaic

Table 14.24. Projected dates for site components and the rationale for those assignments.

Site	Component Date	Rationale for Date	Projected Date from Chipped Stone Analysis
LA 111420	Archaic	diagnostic projectile points	Archaic
LA 111421	Unknown	no diagnostics or dates	Archaic?
LA 111422	Formative	diagnostic ceramics, radiocarbon dates	Formative
LA 111429	Unknown	no diagnostics or dates	Paleoindian or Archaic?
	Paleoindian	diagnostic artifacts	Paleoindian: Folsom period
	Formative	radiocarbon dates for associated feature	very late Archaic or very early Formative
LA 111432	Unknown	diagnostic projectile point	late Paleoindian
LA 111435	Archaic	radiocarbon dates for associated feature	Archaic
	Formative	ceramics and radiocarbon dates	Formative
LA 112370	Unknown	no diagnostics or dates	Archaic?
LA 112371	Unknown	no diagnostics or dates	Formative?
LA 112374	Unknown	no diagnostics or dates	Archaic?
LA 155963	Unknown	no diagnostics or dates	mixed proveniences, undated
	Paleoindian	diagnostic artifacts	Paleoindian: Folsom period
	Archaic	no diagnostics or dates	Archaic?
	Formative	diagnostic ceramics, radiocarbon dates	Formative
	Historic	radiocarbon dates for associated feature	Historic
LA 155964	Unknown	no diagnostics or dates	Formative?
	Historic	radiocarbon dates for associated feature	Historic
LA 155968	Unknown	no diagnostics or dates	Formative?
	Paleoindian	diagnostic artifacts	Paleoindian: Folsom period
	Formative	diagnostic ceramics, radiocarbon dates	Formative
LA 155969	Unknown	no diagnostics or dates	Formative?
LA 156877	Formative	diagnostic artifacts	mixed Archaic and Formative

Table 14.25. Numbers of formal and informal tools for each component.

Site	Component	Informal Tools	Formal Tools
LA 111420	Archaic	2	8
LA 111421	Unknown	–	5
LA 111422	Formative	1	5
LA 111429	Unknown	4	58
	Paleoindian	12	19
	Archaic	–	1
	Formative	–	1
LA 111432	Unknown	1	2
LA 111435	Archaic	1	–
	Formative	3	16
LA 112370	Unknown	–	1
LA 112371	Unknown	1	2
LA 155963	Unknown	–	68
	Paleoindian	4	21
	Archaic	5	44
	Formative	9	28
	Historic	–	1
LA 155964	Unknown	–	8
	Historic	–	1
LA 155968	Paleoindian	–	16
	Formative	1	6
	Historic	–	1
LA 155969	Unknown	1	4
LA 156877	Archaic/Formative	1	1

Table 14.26. Tool types by site component.

Site	Component	Informal Tools	Hammerstones	Choppers	Planes	Drills	Gravers	Spokeshaves	Denticulates	Burins	Gouges	Core-choppers	Scraper-gravers	Core-hammerstones	Scraper-spokeshaves	Strike-a-light flints	Unifaces	End or side scrapers	Spurred end scrapers	Spurred end scraper preforms	Bifaces	Knifes	Projectile point preforms	Large generalized bifaces	Projectile points
LA 111420	Archaic	2	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–	2	–	–	–	2
LA 111421	Unknown	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	1	–	1
LA 111422	Formative	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	1	–	2
LA 111429	Unknown	3	–	8	–	–	–	–	1	1	–	1	2	1	1	–	1	2	–	–	19	–	–	–	8
	Paleoindian	10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	3	–	3	–	–	–	6
	Archaic	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
	Formative	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
LA 111432	Unknown	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
LA 111435	Archaic	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Formative	3	–	1	1	–	–	–	–	–	–	2	–	–	–	–	3	3	–	–	5	–	–	–	1
LA 112370	Unknown	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–
LA 112371	Unknown	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–
LA 155963	Unknown	–	–	6	–	1	–	1	1	–	–	–	–	1	–	–	1	1	–	–	46	1	2	–	4
	Paleoindian	4	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	6	–	–	–	7
	Archaic	5	1	–	1	–	2	2	–	–	–	1	–	–	–	–	1	1	2	–	7	–	–	1	20
	Formative	8	–	–	–	1	–	–	–	–	–	1	–	1	–	–	1	1	–	1	5	–	–	–	13
	Historic	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–
LA 155964	Unknown	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	–
	Historic	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
LA 155968	Paleoindian	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	3	5	–	5	–	–	–	1
	Formative	1	–	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
	Historic	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
LA 155969	Unknown	1	–	–	1	–	–	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	–	1
LA 156877	Archaic/ Formative	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Total		40	2	20	3	3	3	3	2	1	1	6	2	3	2	1	10	13	10	1	107	1	4	1	70

Figure 14.4. Paleoindian projectile points: a. broken base, LA 111429, refits with Figure 14.4b; b. broken base, LA 111429, refits with 14.4a; c. Folsom point, LA 111429; d–h. Folsom point, LA 155963; i. Midland point, LA 155968; j. Paleoindian point, LA 111429; k–m. Paleoindian points, LA 155963.

Figure 14.5. Archaic projectile points: a. Martindale point, LA 111435; b. Bajada point, LA 155963; c–e. San Pedro points, LA 155963; f. Shumla point, LA 155963; g. Armijo point, LA 155963; h–i. unidentified dart points from LA 111429; j–o. unidentified dart points, LA 155963; p. unidentified dart point, LA 155964.

Figure 14.6. Formative period projectile points: a–b. LA 111429; c–i. LA 155963; j. Perdiz point from LA 155963; k. LA 155968; l. LA 156877; m. LA 156877.

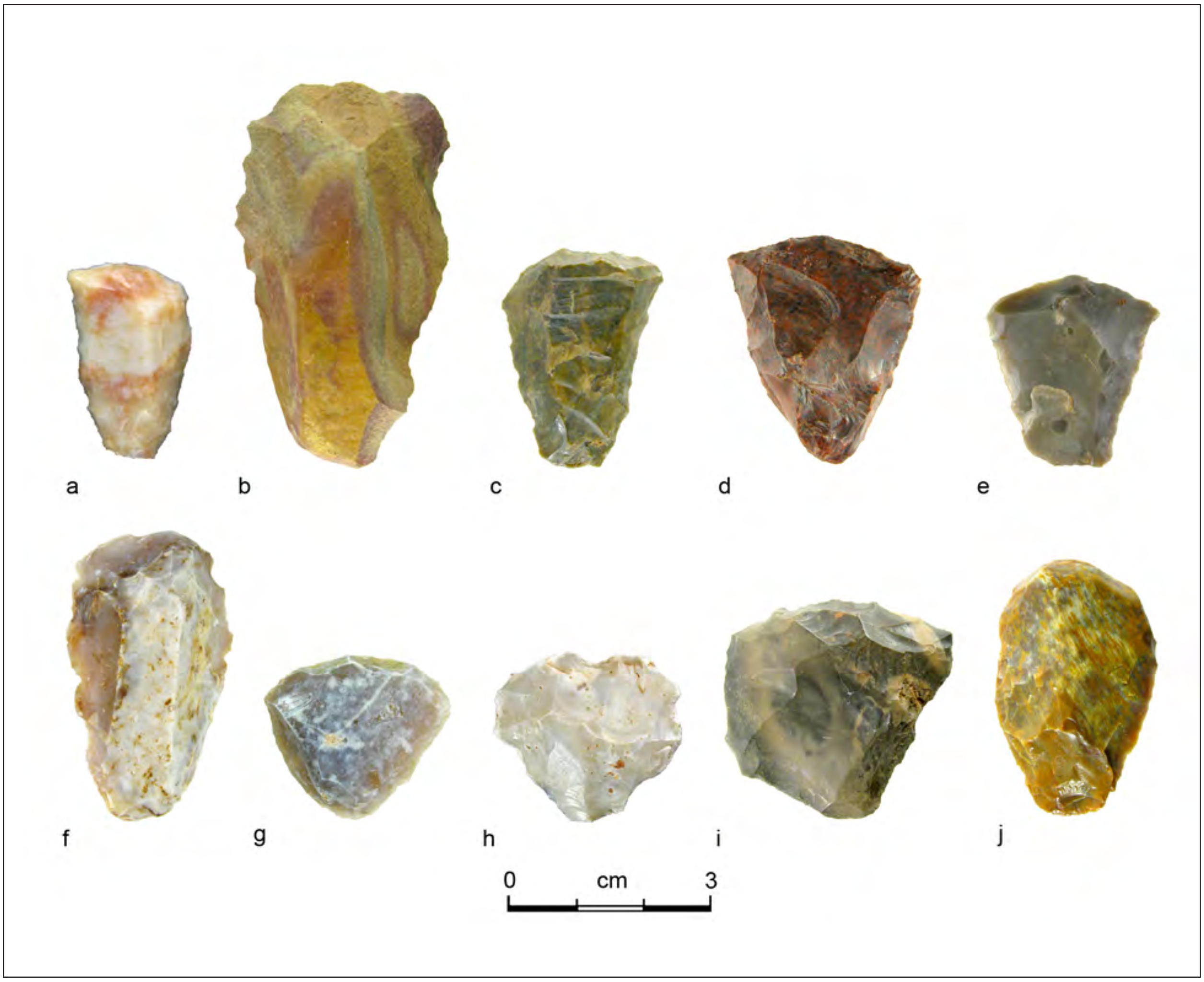

Figure 14.7. Spurred end scrapers: a. LA 111429; b. preform, LA 155963; c–e. LA 155963; f–j. LA 155968.

or early part of the Middle Archaic, or that multiple occupations are indicated, with one dating to the Early Archaic and a second to the Middle Archaic. Since these points were found in separate artifact clusters in different parts of the site, the latter scenario may be the best interpretation. The aceramic nature of LA 111420 corresponds to an Archaic date. Since this site was examined during testing, no absolute dates are available to corroborate this temporal association.

LA 111421. The tip of a large projectile point made from yellow chert was the only point recovered from this site. Since large projectile points were usually used to tip darts, only a very general Archaic affiliation can be suggested for this site based on this single artifact. The aceramic nature of LA 111421 tends to correspond to this broad Archaic date. Since this site was examined during testing, no absolute dates are available to corroborate this temporal association.

LA 111422. Two projectile point fragments were identified in this assemblage, including the medial section of a medium to large gray chert point and a complete small Formative-period corner-notched arrow point made from cream chert. While the medial section is not diagnostic because it could represent a section of blade from either a dart or large arrow point, the complete specimen dates to the Formative period. This date corresponds to the presence of pottery and the radiocarbon dates for two features.

LA 111429. Fifteen projectile point fragments were recovered from this site, including four Folsom point fragments representing three specimens, three Paleoindian point fragments that were not more accurately identified, three fragments of large projectile points, three fragments of unidentifiable projectile points, and two fragments of small side-notched arrow points. Since most of these specimens were found on the surface and were scattered across the site, they cannot be associated with specific components and can only be considered evidence of occupation during the Folsom period, the late Paleoindian period, the Archaic period, and the Formative period. The only Folsom point fragments recovered from a subsurface context were two pieces of the same base found in somewhat younger sediments in the Feature Area.

Folsom dates were assigned to materials from the two Paleoindian Areas because Folsom points were fairly common (three recovered during our work at the site and six by HSR), and because spurred end scrapers were common (three recovered during our work and several by HSR). An OSL date for the sediment out of which materials in Paleoindian Area 1 were eroding only indicated that these artifacts may date to the late Paleoindian period. Otherwise, the Folsom date assigned to these materials is tentative and based on the distinct nature of the assemblages from Paleoindian Areas 1 and 2, their similarity to probable Folsom components on LA 155963 and LA 155968, and the abundance of Folsom point fragments along the western edge of LA 111429.

The remaining projectile points simply indicate occupations at LA 111429 during the late Paleoindian period, the general Archaic period, and the Formative period. Thus, the projectile point collection from this site helps flesh out its multicomponent nature but, at the current level of analysis, most specimens cannot be associated with specific components.

LA 111432. No projectile points were recovered during our investigations at LA 111432, but a fragment of an Eden-like point was found during initial recording (HSR 1995). This is the only basis for a Paleoindian date for this component and it is not corroborated by any absolute dates. Since the chipped stone assemblage from LA 111435 varies considerably from those of other Paleoindian components, this temporal association is tentative.

LA 111435. A Martindale point was recovered from this site. This type is dated to the Early Archaic (Turner et al. 2011:132) in Texas, and probably occurs at about the same time in parts of New Mexico. A multicomponent situation is indicated by radiocarbon dates for features that fall in the Middle Archaic, Late Archaic, and Formative periods, as well as the presence of pottery. Since the Martindale point was not found in direct association with dated materials and does not seem to date beyond the Early Archaic, it could be an indication of yet another period of occupation or it could represent a curated tool. The latter is most likely.

LA 112370. No projectile points were recovered from this site and no absolute or artifact-based dates are available.

LA 112371. No projectile points were recovered from this site and no absolute or artifact-based dates are available.

LA 112374. No projectile points were recovered from this site and no absolute or artifact-based dates are available.

LA 155963. The situation at LA 155963 is similar to that at LA 111429, but there is much better association between many of the projectile points and excavation areas. Forty-five projectile points were collected from this site, representing occupations dating from the Folsom period to the Formative period. They include nine Paleoindian points, nine definite and eleven probable Archaic points, five definite and eight probable Formative points, and three unidentified points.

The assemblage of Paleoindian points comprises six Folsom points and three specimens that could not be better identified but that probably date to the late Paleoindian period. Three Folsom point fragments and a spurred end scraper were found in the Paleoindian Area in the north part of the site, indicating the presence of a definite Paleoindian component. Indeed, as discussed in Chapter 9 (this report), all but one of the Paleoindian points—a Folsom point—were found in Section A of the site, as were three of five spurred end scrapers, suggesting that was the area most preferred for use during that early period of occupation.

Of the 20 potential Archaic points, one specimen from Section C dates to the Early Archaic period (Bajada point), three specimens from Section A date to the Late Archaic (one Shumla and two San Pedro points), a Middle Archaic (San José point) and two Late Archaic specimens were found in Section C (San Pedro and Armijo points), and a Late Archaic point was found in Section B (San Pedro point). The remaining 11 specimens are too fragmentary for positive identification but include two stemmed points, one corner-notched point, four side-notched points, and four large points. The stemmed points probably date to the Early or Middle Archaic and one was in Section C and the other was in Section B near the break with Section C. All of the large side-notched and large corner-notched points as well as one of the large point fragments were found in Section A, while the other three large point fragments were found in Section B. Thus, probable Archaic projectile points occur in all parts of LA 155963, suggesting widespread use of this locality during that long cultural period.

At least 13 small specimens date to the Formative period and include a Perdiz point, three unnotched arrow points, a stemmed arrow point, six corner-notched arrow points, a side-notched arrow point, and an eccentric arrow point. Only one specimen—a corner-notched arrow point—was found in Section A. Seven specimens were found in Section B (four corner-notched, one side-notched, one stemmed, and one eccentric). The five remaining specimens were found in Section C (Perdiz point, three unnotched, and one corner-notched). The distribution of Formative period projectile points is similar to that of pottery at this site—most occur in Sections B and C, with evidence for more limited use of Section A.

The three remaining specimens were too fragmentary to be assigned to general size categories and include a corner-notched specimen and two fragments that could only be identified as parts of projectile points. The corner-notched specimen was from Section A, an unidentified fragment was from Section B, and no location was recorded for the last specimen.

LA 155964. The medial section of a large tan and gray chert projectile point was the only specimen recovered from this site, and it was in apparent association with the Historic component. Since points of this size tended to be used with darts rather than arrows, this specimen either represents a salvaged artifact, a knife, or is part of an earlier component. The latter may be the case, since several badly deflated features that were not previously identified were found during our study, perhaps signifying an earlier occupation. It might be better to suggest that this specimen belongs to a component of unknown date rather than the Historic component and this, in turn, could suggest an Archaic date for the unknown component.

LA 155968. Two projectile points were recovered during the current study, and a third specimen was collected during earlier work. A Midland point fragment was recovered during our study, and can be paired with a Folsom point fragment recovered during the earlier study. These specimens, in conjunction with five spurred end scrapers, are good evidence for a Folsom occupation and were the basis for this designation. This occupational date is not substantiated by absolute dates, but appears to be solid. The remaining projectile point is a corner-notched arrow point suggesting a Formative occupation, which is substantiated by the presence of numerous sherds as well as radiocarbon dates for Feature 1 indicating use during the early Mesilla phase.

LA 155969. A single small-stemmed arrow point was recovered from this component, suggesting a post-AD 400/600 date. While this point could indicate a Formative-period occupation, it could as easily suggest a Protohistoric- or early Historic-period affiliation. Thus, other than suggesting that this assemblage does not reflect a Paleoindian or Archaic occupation, it does not narrow the occupational date down any further than the last 1400–1600 years. No ceramic or absolute dates were obtained that would help narrow the proposed occupational date.

LA 156877. The medial section of a corner-notched arrow point was recovered from this component, suggesting a post-AD 400/600 date. While the general shape of this point is considered to indicate a Formative occupation, a Protohistoric or Historic affiliation cannot be ruled out. No ceramic or absolute dates were obtained that could narrow the date.

Summary of Projectile Point Discussion

Supplemented by data from earlier studies, the types and dates for projectile points recovered during this study were used to assess temporal associations. The results fall into six categories. In five cases projectile points were the sole bases for assigning dates to components, including LA 111420, LA 111421, LA 111432, LA 155969, and LA 156877. The projectile points found at LA 111420, and their association with different artifact clusters, may indicate a multicomponent nature for this small site, with occupations occurring during both the Early and Middle Archaic periods. An Archaic affiliation is suggested for LA 111421 and a Paleoindian affiliation is evidenced for LA 111432. Similarly, post-Archaic affiliations were suggested for LA 155969 and LA 156877.

Projectile point analysis confirmed other dates for four sites, including LA 111422, LA 155968, and the large multicomponent scatters at LA 111429 and LA 155963. In both of the latter cases, Paleoindian, Archaic, and Formative occupations were confirmed that were also suggested by other data. Projectile point types confirmed the Formative period date for LA 111422 and identified the suspected Paleoindian component at LA 155968.

In two cases, the range of recovered points either suggests the presence of an earlier occupation that was not otherwise evidenced by artifacts or absolute dates, or it indicates salvaging and curation. Curation seems the most likely explanation for the Middle Archaic point at LA 111435, while an earlier component is the more likely scenario at LA 155964. Finally, the following three assemblages yielded no projectile points: LA 112370, LA 112372, and LA 112374.

Since projectile point styles often lasted for hundreds and in some cases thousands of years, this artifact category cannot be used to assign tight dates. However, this analysis was useful in suggesting dates for several assemblages that otherwise lacked temporally diagnostic artifacts and absolute dates, and in other cases helped confirm suspected dates. While some dates derived from projectile point styles were used earlier to suggest temporal affiliations, in other cases the projectile point analysis provides new information on occupational dates. These data are combined with information from other analyses in the summary and discussion for this chapter, providing the best date estimates that can be derived from chipped stone analysis.

Using Tools to Define the Range of Activities in Site Components

Formal Tool Types. Certain tools indicate specific tasks, while others evidence a range of potential tasks, thus tools can be both specialized and generalized. Projectile points, gravers, and drills are evidence of specific activities—hunting/warfare, carving, and piercing hard materials. Hammerstones, choppers, and knives are indicative of more generalized activities—pounding, chopping, and cutting or scraping.

Functions are assigned using the overall shapes of tools or by the general shape and angle of utilized edges. Several types of formal tools were mainly used in wood-working, though they could also have been used to work other relatively hard materials, such as bone. This category includes planes, gravers, denticulates, burins, gouges, scraper-gravers, spokeshaves, and scraper-spokeshaves. Drills were used as perforators, and most likely in wood-working, bone-working, or ornament manufacture. Some tools were used for multiple activities, probably sequentially. These include the core-hammerstones that first served as a source for debitage and were then used to remove debitage from other cores, and core-choppers that were used as debitage sources and for chopping. Scrapers were primarily used to process hides, and often exhibit edges that are rounded and polished from use. Projectile points were mostly used for hunting, but sometimes also functioned as cutting tools. Two types of tools are evidence of tool manufacture—projectile point preforms and spurred end scraper preform. Strike-a-light flints were used in fire-making and only occur in Historic contexts.

Most other formal tool types were used for general manufacture and maintenance activities, and include choppers, knives, and hammerstones. Unifaces are often considered general-purpose tools, but in most cases they actually represent tools that were abandoned during manufacture because they broke or didn't flake according to plan. Similarly, bifaces and large generalized bifaces could be used as multi-function tools, but they most often actually represent failures during tool manufacture. The distribution of formal tool types by site component is shown in Table 14.26.

Informal Tools. Informal tools are more difficult to classify, because their shapes rarely provide clues as to how they were used. Since these tools were debitage or cores exhibiting use-related edge damage, information derived from experiments is used to assign them to functional categories. Conservative standards are applied when defining edge damage as evidence of use because trampling and mechanical transport often cause scarring that can be mistaken for cultural wear. Only when scar patterns are consistent along an edge and the edge margin is regular (lacking deep scoops or projections) are artifacts categorized as informal tools. This means that only specimens that exhibit extreme evidence of use are considered informal tools. Thus, the presence of informal tools in an assemblage is only the tip of an iceberg—they indicate that debitage were used as tools but do not allow quantification of the amount of use. This means that varying percentages of informal tools are not indicators of the intensity of their use; rather, it shows the amount of variation in our ability to recognize these tools.

As use-wear experiments demonstrate, several factors contribute to consistent edge scarring, the most important of which is contact with a hard material (Vaughan 1985:22). However, nearly half the edges used on hard materials and 80 percent of those used on medium-hard materials in Vaughan's (1985) experiments were not consistently scarred. These findings mirror experimental results reported by Schutt (1980), who found that consistent edge scarring only occurred when hard materials were contacted. Scarring also varies with the type of material used as a tool. Brittle materials like obsidian scar more easily than strong and tough materials like chert and basalt. Scars are easier to define on glassy and fine-grained materials than on coarse-grained rocks. Foix and Bradley (1985) conducted experiments using rhyolite and found that evidence of wear was almost invisible, with coarse-grained varieties exhibiting more resistance to wear than fine-grained types. Thus, a much higher percentage of cherts and obsidians are expected to evidence use as informal tools. These experiments also indicate that consistent scarring that was defined as cultural wear by our analysis probably only occurred when fairly hard materials were encountered by an edge. Thus, flakes used to cut soft materials like meat or vegetal matter probably were not identified unless they were cut on an anvil. Wear patterns may not be identifiable on coarse-grained materials, such as rhyolite and quartzite, even if they were extensively used.

The types of scars that occur can vary with the way in which a tool was used as well as the material on which it was used. Vaughan's (1985:20) experiments showed that cutting caused mostly bidirectional scarring (65 percent), though a significant number of specimens were scarred on only one surface (17 percent). Scraping or whittling produced bidirectional scarring in 46 percent of Vaughan's experiments and unidirectional scarring in 54 percent. Thus, it is difficult to assign a specific function to these patterns. Similarly, rounding occurred during both cutting and scraping/whittling use (Vaughan 1985:26). Robertson and Attenbrow (2008) summarized information on wear patterns from a variety of tasks, and noted that rounding (at times extreme) can also be caused by working dry hides, especially by scraping, while abrasion is often indicative of wood-working.

While retouch could represent an attempt to resharpen an edge dulled by use, this is unlikely in most cases. Most informal tools were discarded when they got dull and were replaced by a new tool because that required less effort than resharpening the dulled edge. Most retouching on informal tools was caused by use rather than intent. Retouching, as indicative of use-wear, tends to be less consistent and scars are generally shorter than those resulting from intentional retouch. Informal tools that were intentionally flaked to produce a specific edge angle or shape were assigned functions based on those attributes, and were considered along with the array of formal tools.

Schutt (1980) conducted experiments on the suitability of a range of edge angles for different tasks, and concludes that most of the edges in her experiments that measured over 40 degrees were poorly suited for cutting and were better for scraping. Thus, we assume that edge angles smaller than 40 degrees were best for cutting, while those larger than 40 degrees were better for scraping.

Having considered the parameters used in functional identification, we can now look at the array of informal tools. Edges exhibiting rounding/polish are classified as scraping tools used to work leather. Edges exhibiting scars caused by wear-related attrition (utilization and retouch) with angles measuring less than 40 degrees are classified as cutting tools; those with angles measuring over 40 degrees were classified as scraping tools. Functional definitions are only possible for utilized debitage examined during laboratory analysis, because wear patterns and edge angles were not recorded during in-field analysis.

Informal tool use was noted on only 43 chipped stone artifacts, which are distributed among components as shown in Table 14.27. Two chert informal tools were identified at LA 111420 but, since they were recorded during in-field analysis, they can only be classified as having been used in general purpose manufacture/maintenance tasks.

The LA 111429 assemblage contains the second largest number of informal tools—13 or just under a third of the total. While 10 informal tools were found in the Paleoindian component, no date could be assigned to the other three specimens. The Paleoindian assemblage contains five chert core flakes used in leather working, three chert core flakes used for cutting, and two chert core flakes used for scraping. The unknown component contains two chert core flakes and a piece of chert angular debris that were used for scraping.

A single piece of chert angular debris from LA 111432 was used for scraping. The four informal tools from LA 111435 include two chert core flakes used for scraping, a metaquartzite core flake used for cutting, and a utilized rhyolite flake recorded during in-field analysis.

The LA 155963 assemblage contains 17 informal tools from three separate components. The Paleoindian informal tools include three core flakes and a biface flake used for scraping. Five chert informal tools were found in the Archaic component and include two core flakes, two pieces of angular debris, and a unidirectional core that were all used for scraping. The Formative assemblage contains eight informal tools. Cutting tools include a piece of silicified wood angular debris and a rhyolite core flake. The six remaining tools were used for scraping and consist of three chert core flakes, two pieces of chert angular debris, and a metaquartzite multidirectional core. LA 155968, LA 155969, and LA 156877 each yielded single examples of chert core flakes used for scraping.

Defining Activities for Components Based on Tool Types

Twenty-seven components are defined for the 14 sites examined by this analysis, though some components contain too few artifacts to examine in detail and others contain materials from multiple proveniences of similar date. For example, the Archaic component at LA 111429 contains only one artifact, as does the Historic component from the same site and from LA 155968. These components cannot be discussed in detail. Two separate Paleoindian areas were combined for LA 111429, and at least two Archaic and two Formative proveniences were combined for LA 155963. Component divisions are fairly clear for most sites, only the two largest and most complicated—LA 111429 and LA 155963— have multiple proveniences that were combined in order to increase sample size.

Table 14.28 presents a summary of activities that can be defined for each component from chipped stone data. Every component probably represents a camp site that was used for varying periods of time and reflects sets of tasks performed at those locations. Thus, the lack of evidence for specific tasks does not mean that they were not performed at a location, only that no recoverable evidence for their performance was found.

In general, the number of activities represented increases with assemblage size. Thus, assemblages exhibiting only two activities average 50.17 artifacts, and those that exhibit nine activities average 965.50 artifacts. However, all assemblages do not follow this general trend; for example, the mean number of artifacts for assemblages exhibiting four activities (47.00) is actually much smaller than for those exhibiting three activities (140.20). So, while in general the more artifacts in an assemblage the more activities represented, this is not always the case. The number of tools discarded during an occupation is dependent on a number of factors including duration of stay, the number of activities performed, and whether retooling was necessary. What this analysis cannot account for are tools that were carried away because they were still serviceable.

Core reduction is ubiquitous in these components, occurring in each one. Interestingly, evidence for biface reduction occurs in all but five components, one of which is the Archaic component at LA 111435 where such a task might be expected. No evidence for biface reduction was found in either Historic component. Thus, large bifaces may have remained an important part of the tool kit well into the Formative period, though salvaging materials from earlier sites could also be responsible for this.

Projectile point preforms were recovered from only four components. They include two components with unknown dates, a Folsom component on LA 155963 and a Formative component on LA 111422. The LA 155963 unknown component can be ignored, as it is a composite of materials from across that large site. However, the preform from LA 111421 may be a clue to the date of occupation because it is a very large preform that is suitable for manufacture into a dart point. This suggests a pre-Formative date, probably Archaic.

The presence of projectile points indicates hunting, though these tools can also be used in warfare. Evidence for hunting is common, occurring in 16 assemblages. Leather working is related to hunting, since hides obtained during a hunt need to be scraped and tanned before they are suitable for use. Evidence for this activity occurs in eight assemblages, all of which also produced projectile points. Blood-residue analysis can be used to provide information on the types of animals hunted, and was applied to a sample of 16 artifacts, including one specimen from LA 111422, four from LA 111429, and 10 from LA 155963. The results of this analysis are included as Appendix 1. Unfortunately, the only animal protein identified was rabbit, occurring on a Folsom point and a spurred end scraper from LA 111429, and a San Pedro point, three arrow points, and a spurred end scraper from LA 155963. Most telling was the presence of rabbit protein in a soil sample from LA 155963, which may suggest the common nature of this protein in the area and the possibility that surface artifacts could become contaminated by proteins still residing in the surface sediments. While it is believable that the arrow points, and perhaps the San Pedro point, were used for rabbit hunting, less credence can be placed on these results for the Folsom point and the spurred end scrapers. In short, this analysis appears to be inconclusive, though it may augment our data for at least the Formative period.

Wood working was also common, with evidence for this activity being found in nine assemblages. Pounding with hammerstones is most often associated with chipped stone reduction, but can also be used in other activities, so it is considered a separate activity. Hammerstones were recovered in only four cases. Since core reduction is evidenced in every assemblage, these tools (cores) were probably mostly carried away if still serviceable. Similarly, chopping is most often associated with wood working, but since it can also occur in other activities it is considered separately here. Since only five assemblages evidence chopping activities, and include four assemblages in which wood working is otherwise suggested, chopping may not have been common, or most chopping tools were transported away from these sites. General cutting/slicing activities can be considered separately or as a subset of general manufacture/maintenance. In this analysis we chose the former, but in all but one case the general cutting/slicing activities occur in assemblages that also evidence general manufacture/ maintenance.

The list of activities using chipped stone tools shown in Table 14.28 provides an idea of some of the general tasks performed at each location. The list is certainly not complete, because we can expect that some of the tools used in them may not have been discarded at these locations. Still, the number of activities represented in many cases is large enough to suggest that each defined component represents a residential location rather than a locus in which limited activities were performed. Larger assemblages are presumed to represent longer durations of stay, while small assemblages are considered indicative of limited stays. Thus, while small assemblages such as those at LA 112370, LA 112371, and LA 112374 probably indicate short durations of stay in which few activities that used chipped stone were performed, the large number of artifacts associated with the Folsom components at LA 111429 and the Formative component in Section B of LA 155963 probably represent significantly longer stays, in which considerably more tasks that used chipped stone were performed.

Summing Up: What the Spaceport America Assemblages Tell Us

Three goals for this analysis were listed in the introduction to this chapter, and each has been fulfilled, though not always entirely satisfactorily. Important assumptions are that each component represents a camping location used for variable periods of time and by different-sized groups of people. The use of these sites as task-specific locales is unlikely because resource extraction sites other than quarries often tend to disappear from the archaeological record, as demonstrated by ethnographic studies (see Moore 1980: 360–361). The fact that the sites at Spaceport America are still visible argues for their function as residential locations of varying lengths of occupation in which resource extractive activities were probably imbedded. While some quarrying may have occurred at LA 155963, no evidence specific to this task was found and quarrying was likely imbedded in other activities. Findings for each component are summarized in Table 14.29 and discussed separately below.

LA 111420

This site was examined during testing and, while initially thought to represent a single component, further analysis suggests that two temporal components dating to the Early Archaic and Middle Archaic periods may exist. These dates are based on the presence of diagnostic projectile points from each time period, and those diagnostics were recovered from different parts of the site that contain clusters of artifacts, which suggests some separation between components. Interestingly, this is the only Archaic assemblage to exhibit a curated reduction strategy, possibly suggesting that a more mixed reduction strategy developed during the Late Archaic period, or that a different range of activities is reflected here than are evident in other Archaic sites. This was also one of the few assemblages dominated by metaquartzite rather than chert, though a heavy use of this material is not thought to be temporally diagnostic.

LA 111421

This site was examined during testing and was initially classified as having an unknown occupational date. A single component is thought to be represented, and further analysis suggests that it may date to the general Archaic period based on the occurrence of a projectile point preform that probably represents an unfinished dart point. This assemblage exhibits a mixed reduction strategy that may also be indicative of an Archaic affiliation.

LA 111422

This site was examined during the research phase and was assigned to the Mesilla phase of the Formative period based on radiocarbon dates for features and ceramic analysis. It exhibits an expedient reduction strategy and appears to represent a single occupational component.

LA 111429

This large multicomponent site was examined during both the testing and research phases, and was initially thought to contain Paleoindian, Archaic, and perhaps Formative occupations. That view changed during analysis of materials recovered during the research phase. Since excavation was targeted at only a few locations, most components at this site remain undefined.

Unknown Component. The temporally unknown assemblage from this site represents materials from multiple proveniences and exhibits a curated reduction strategy. Those proveniences include the upper artifact-bearing strata in the Feature Area, surface strips in the Ground Stone Area, artifacts recovered from test pits during that earlier phase, and materials from undated excavated features. OSL dates for strata in the Feature Area now suggest that the subsurface materials in that part of the site represent Paleoindian through Archaic occupations (see Chapter 21). Other proveniences included in this component remain undated.

Paleoindian Components. Though combined for analysis, several spatially separated probable Paleoindian components were examined. The areas assigned to this period include Paleoindian Areas 1–3 (Surface Strips 1, 2, and 9; Surface Collection Areas 1–3), as well as the lower artifact-bearing strata in the Feature Area. The assignment of dates for these assemblages was initially based on the presence of spurred end scrapers within or near them and assemblage characteristics noted in the field. In each case the latter included a large percentage of apparent biface flakes and a dominance of thermally altered cherts. A minimum late Paleoindian or Early Archaic date was furnished for Paleoindian Area 1 by an OSL date, confirming the early nature of these materials. Materials from the lower artifact-bearing strata in the Feature Area appear to occur in essentially the same stratum, and an OSL date establishes an antiquity somewhat greater than that derived for Paleoindian Area 1. Analysis confirmed the nature of these assemblages, and suggests that they match many characteristics of Paleoindian components from LA 155963 and LA 155968. In all three cases a curated reduction strategy was identified, and heat treatment of cherts was common.

Archaic Component. The presence of one or more Archaic components was indicated by a single diagnostic projectile point, but no other definite Archaic materials were identified.

Formative Component. Occupation during the Formative period is suggested by the recovery of a few sherds during the initial recording of this site (HSR 1995), but this conclusion did not receive definite confirmation during the research phase except for the recovery of a single sherd that was unassoci-

Table 14.27. Informal tools by site and component; counts.

Site	Component	Artifact Function		**Total**
		Utilized Debitage	Utilized Core	
LA 111420	Archaic	2	–	2
LA 111422	Formative	1	–	1
LA 111429	Unknown	3	–	3
	Paleoindian	10	–	10
LA 111432	Unknown	1	–	1
LA 111435	Archaic	1	–	1
	Formative	3	–	3
LA 112371	Unknown	1	–	1
LA 155963	Paleoindian	4	–	4
	Archaic	4	1	5
	Formative	7	1	8
LA 155968	Formative	1	–	1
LA 155969	Unknown	1	–	1
LA 156877	Formative	1	–	1
Total		40	2	42

Table 14.28. Reduction strategies and activities reflected in chipped stone assemblages from each component.

Site	Component	Core Reduction	Biface Reduction	Projectile Point Manufacture	Hunting	Wood Working	Leather Working	Pounding	Chopping	General Cutting/ Slicing	General Manufacture/ Maintenance	Number of General Activities
LA 111420	Archaic	x	x	–	x	x	x	–	–	–	x	6
LA 111421	Unknown	x	x	x	x	–	–	–	–	–	x	5
LA 111422	Formative	x	x	x	x	–	–	x	–	–	x	6
LA 111429	Unknown	x	x	–	x	x	x	x	–	–	x	7
	Paleoindian	x	x	–	x	–	x	–	–	x	x	6
	Formative	x	x	–	–	–	–	–	–	–	–	2
LA 111432	Unknown	x	x	–	–	–	–	–	–	–	–	2
LA 111435	Archaic	x	–	–	–	–	–	–	–	x	–	2
	Formative	x	x	–	x	x	x	–	x	–	x	7
LA 112370	Unknown	x	x	–	–	–	–	–	–	–	x	3
LA 112371	Unknown	x	x	–	–	–	–	–	–	–	x	3
LA 112374	Unknown	x	x	–	–	–	–	–	–	–	–	2
LA 155963	Unknown	x	x	x	x	x	x	x	–	x	x	9
	Paleoindian	x	x	x	x	x	–	–	–	–	x	6
	Archaic	x	x	–	x	x	x	–	x	–	x	7
	Formative	x	x	–	x	x	x	x	x	x	x	9
	Historic	x	–	–	–	–	–	–	–	–	x	2
LA 155964	Unknown	x	x	–	–	–	–	–	x	–	x	4
	Historic	x	–	–	x	–	–	–	–	–	x	3
LA 155968	Unknown	x	x	–	x	–	–	–	–	–	–	3
	Paleoindian	x	x	–	x	x	x	–	–	–	–	5
	Formative	x	–	–	x	–	–	–	–	–	–	2
LA 155969	Unknown	x	–	–	x	x	–	–	x	–	–	4
LA 156877	Archaic/ Formative	x	x	–	x	–	–	–	–	–	–	3

Table 14.29. Summary of dating and reduction strategy data for all defined components.

Site	Original Component Date	Original Date Based on:	Inferred Component Date	Inferred Date Based on:	Number of Individual Components	Reduction Strategy
LA 111420	Archaic	projectile points	same	na	2	curated
LA 111421	Unknown	no diagnostics	Archaic?	preform type	1	mixed
LA 111422	Formative	radiocarbon dates, ceramics	same	na	1	expedient
LA 111429	Unknown	no diagnostics	Paleoindian or Archaic	reduction strategy	multiple	curated
	Paleoindian	diagnostic artifacts	same	na	2+	curated
	Archaic	diagnostic artifacts	same	na	unknown	na
	Formative	radiocarbon dates, ceramics	Formative	reduction strategy	unknown	expedient
	Historic	radiocarbon dates	same	na	unknown	na
LA 111432	Unknown	no diagnostics	late Paleoindian?	projectile point	1?	mixed
LA 111435	Archaic	radiocarbon dates	same	na	2?	expedient
	Formative	radiocarbon dates, ceramics	same	na	1	expedient
LA 112370	Unknown	no diagnostics	pre-Formative?	reduction strategy	1	mixed
LA 112371	Unknown	no diagnostics	same	na	1	expedient
LA 112374	Unknown	no diagnostics	pre-Formative?	reduction strategy	1	mixed
LA 155963	Unknown	no diagnostics	same	na	multiple	mixed
	Paleoindian	diagnostic artifacts	same	na	1?	curated
	Archaic	aceramic nature, diagnostic artifacts	same	na	multiple	mixed
	Formative	radiocarbon dates, ceramics	same	na	multiple	expedient
	Historic	radiocarbon dates	same	na	multiple	expedient
LA 155964	Unknown	no diagnostics	Archaic?	projectile point	unknown	expedient
	Historic	radiocarbon dates	same	na	1	expedient
LA 155968	Unknown	no diagnostics	same	na	unknown	expedient
	Paleoindian	diagnostic artifacts	same	na	1	curated
	Formative	radiocarbon dates, ceramics	same	na	1	expedient
	Historic	diagnostic artifacts	same	na	1	na
LA 155969	Unknown	no diagnostics	post-Archaic	projectile point	1	expedient
LA 156877	Unknown	diagnostic artifacts	Archaic and Formative	projectile point	2	mixed

na = not applicable

ated with any of the excavated materials. The only other potential evidence for a Formative period occupation was Feature 3, which yielded dates indicating either a very late Archaic- or early Mesilla-phase occupation. The expedient nature of the small chipped stone assemblage associated with this feature suggests the later date, but does not confirm it.

Historic Component. Unsuspected during earlier phases, the presence of a Historic period component was indicated by radiocarbon dates from Feature 11. Since only one chipped stone artifact was directly associated with this feature, no analysis of this component in terms of a chipped stone assemblage was possible.

LA 111432

This site was examined during testing and probably represents a single component. Though no diagnostic artifacts were recovered during that study, an Eden-like point was collected from the surface during initial recording (HSR 1995). Analysis of the chipped stone assemblage failed to corroborate the late Paleoindian date suggested by this artifact. The reduction strategy is mixed, which is at odds with the other Paleoindian and Early to Middle Archaic assemblages. However, considering the small size of the sample from these periods, the type of variation shown by LA 111432 cannot be considered only indicative of a non-Paleoindian occupation. The best conclusion that can be drawn for this assemblage is that it either represents a late Paleoindian or possibly Archaic occupation; if the latter is correct then it contains a projectile point salvaged from an earlier site. While the former is more likely, the latter cannot be ruled out.

LA 111435

This site was examined during research investigations. An Archaic component was thought likely based on the presence of an Early Archaic Martindale point. A Formative-period occupation dominates, with numerous sherds having been recovered. The suite of radiocarbon dates confirms the Formative occupation, but none suggest an Early Archaic occupation. Rather, two features were dated to the Middle and Late Archaic, and each had chipped stone artifacts in close association. An expedient reduction strategy is suggested by the Archaic assemblage, which does not match our expectations for this period. An expedient reduction strategy is also indicated for the Formative assemblage. This association was expected and it was initially thought that the expedient nature of the Archaic assemblage resulted from chipped stone artifacts from the later occupation occurring near the Archaic features. However, since most artifacts in the Archaic assemblage were recovered during excavation of these features, this is unlikely. Thus, an expedient reduction strategy is not necessarily indicative of a post-Archaic occupation in all cases, especially if assemblage size is small.

LA 112370

This site was examined during testing and produced no temporally diagnostic artifacts; a single component seems indicated. The occurrence of a mixed reduction strategy reflected in the small assemblage suggests that a pre-Formative date is possible, but this cannot be confirmed.

LA 112371

This site was examined during testing and it produced no temporally diagnostic artifacts; a single component seems indicated. Evidence for an expedient reduction strategy in the small chipped stone assemblage might indicate a Formative period date, but a pre-Formative occupation cannot be ruled out. Thus, no definite temporal affiliation can be assigned to this site.

LA 112374

This site was examined during testing and it produced no temporally diagnostic artifacts; a single component seems indicated. The occurrence of a mixed reduction strategy reflected in the small assemblage suggests that a pre-Formative date is possible, but cannot be confirmed.

LA 155963

This large multicomponent site was examined during both the testing and research phases, and was initially thought to contain Paleoindian, Archaic, and perhaps Formative occupations. That view changed during analysis of materials recovered during the research phase. Since excavation during the research phase was targeted at comparatively few locations, most components remain undefined.

Unknown Component. This temporal division was assigned to 31 surface-collected artifacts, the Feature 18 surface strip, and artifacts recovered during excavation of Features 1, 13, 18, 38, 105, and 148.

Paleoindian Component. The Paleoindian component includes excavated materials from Area A North and the few scattered formal tools that can be confidently dated to this period. Though no absolute dates from this period were obtained, the occurrence of three Folsom point fragments and a spurred end scraper in this area indicates the presence of a Folsom component. Since one Folsom point fragment appears to have broken during manufacture, a camp site of some sort is indicated, and materials recovered during excavation of Surface Investigation Areas 5 and 6 are most likely associated. A curated reduction strategy is exhibited by these materials, with a large percentage of specimens having been thermally altered. These characteristics, among others, were considered indicative of a Paleoindian occupation consistent with the Folsom points found during surface examination.

Archaic Component. Only two proveniences are assigned to the Archaic period, including Surface Investigation Area 4 and Feature 15 and its associated surface strip. The latter is the only provenience assigned to this period that is radiocarbon dated. Another Archaic assemblage may be present in Area C as demonstrated by the presence of an Archaic projectile point and a large aceramic artifact scatter. Although materials from Surface Investigation Area 4 remain undated, a pre-Formative affinity is suggested by the aceramic nature of this assemblage, and an Archaic date is most likely, though by no means demonstrated.

Formative Component. Formative period dates were assigned to materials recovered from Surface Investigation Areas 1–3 and Features 8, 14, 125, 133 and their associated surface strip areas. These temporal assignments are corroborated by radiocarbon dates from the features and associated pottery in the surface investigation areas. Taken together, assemblages from these areas exhibit an expedient reduction strategy, with no indicators of a curated strategy being identified. The likelihood that these proveniences all represent Formative occupations is high, and most of the occupations dating to this long period probably occurred at the early end, though there are limited data from ceramic analysis suggesting some later use of the site during the Doña Ana and/or El Paso phases.

Historic Component. Features 6 and 9 and their associated surface collection areas are assigned to this component. Since only nine chipped stone artifacts are included in this assemblage, no detailed analysis is possible. However, Historic radiocarbon dates for two features suggest that other parts of this site could also represent Historic occupations. Unfortunately, such identifications need to be made using absolute dates, since it may be impossible to distinguish the associated chipped stone assemblages from those of earlier occupational periods.

LA 155964

This site was examined during the research phase, and was initially assumed to represent a prehistoric occupation. However, radiocarbon dates for Feature 1 demonstrate that a major occupation occurred during the early Historic period. Materials examined by the in-field analysis are mostly assumed to represent an earlier occupation of unknown date, though this is not demonstrated.

Fifty-three artifacts are assigned to the Unknown component and, as discussed above, are assumed to represent an earlier occupation, preceding the Historic period occupation by an indeterminate amount of time. The validity of this assumption may be indicated by a much smaller percentage of thermally altered specimens in the Unknown assemblage (18.87 percent versus 39.67 percent in the Historic component), but this is uncertain since most of the thermal alteration in the Historic assemblage is discard-related rather than aimed at improving flaking quality. Several deflated features were identified outside what appears to have been the Historic occupation area, suggesting that they and their associated artifacts may be older, but this is again undemonstrated. Thus, no date can be assigned to these artifacts and the possibility that LA155964 actually represents a single Historic component cannot be ruled out.

A Historic occupation is confirmed by a suite of radiocarbon dates and most artifacts in this assemblage were recovered from within or directly adjacent to Feature 1. While this is the largest Historic assemblage recovered, it is also atypical in that it represents materials that were originally discarded into a thermal feature and then cleaned out. Thus, the amount of thermal alteration seen during analysis is probably not normal for a Historic assemblage. An expedient reduction strategy is evidenced for both assemblages, and could indicate that they are related.

LA 155968

This site was examined during the research phase, and was initially thought to contain a Paleoindian component and a possible Archaic or Formative component. The former was based on the presence of a considerable amount of thermal alteration in certain areas of the site, and the latter on a large thermal feature or structure. Both components were confirmed during analysis, as was an unsuspected Historic component.

The Paleoindian component was confirmed by the recovery of a Midland point fragment and five spurred end scrapers, and the knowledge that a Folsom point fragment was found during an earlier phase of work. The assignment of most of the assemblage to this component was based on the distribution of pottery at the site as opposed to the distribution of chipped stone artifacts or temporally diagnostic formal tools. Unfortunately, no absolute dates are available to confirm the Paleoindian date. This assemblage exhibits a curated reduction strategy, and contains numerous biface flakes and many thermally altered specimens in addition to the aforementioned temporally diagnostic formal tools.

A Formative-period occupation is demonstrated by a suite of radiocarbon dates for Feature 1 and the presence of Jornada Mogollon pottery. Artifacts in this assemblage were mostly clustered around Feature 1 and exhibit an expedient reduction strategy.

One component of unknown affiliation was defined at LA 155968. However, rather than representing an additional occupation, the unknown component contains artifacts that probably belong to either the Paleoindian or Formative components, but could not be confidently assigned to either.

The final component at LA 155968 consists of a single artifact. The presence of a strike-a-light flint in this assemblage indicates an Historic-period use of this locale but it could also represent no more than casual discard of a worn-out informal tool. Unfortunately, no other materials can be assigned to this component, and so the occupation of the site could have occurred at any time after AD 1600 into the late 1800s.

LA 155969

This site was investigated during the research phase and contains a diffuse scatter of chipped stone artifacts and an eroded thermal feature. Excavation of the thermal feature determined that it was completely deflated and contained no materials for radiocarbon dating. A stemmed arrow point is the only temporally diagnostic artifact in this assemblage; it suggests a post-Archaic, probably Formative-period date. Since this assemblage also exhibits an expedient reduction strategy, this may be interpreted as a partial confirmation of this date, though this strategy is not an accurate temporal indicator in the study area.

LA 156877

This site was investigated during the research phase, and consists of a diffuse scatter of chipped stone artifacts. The recovery of a small arrow point and knowledge that a Middle Archaic point was collected during initial recording of this site suggest the presence of a mixed assemblage. Evidence for a mixed reduction strategy suggests either that the Archaic component is dominant or that materials from both assemblages are well mixed. The latter is most likely. While the arrow point is considered indicative of a Formative occupation, the lack of any corroborative temporally diagnostic materials, including pottery, renders this association tentative because the component represented by the arrow point could date any time after the Archaic period. At this level of analysis it was impossible to separate these components.

15 | Ground Stone and Ornament Analysis

Karen Wening

Ground Stone

The ground stone assemblage at Spaceport America derives from seven sites ranging in date from the Archaic to Formative to early Historic periods (LA 111422, LA 111429, LA 111435, LA 155963, LA 155964, LA 155968, and LA 156877). The variety of tools within the assemblage (n = 66) is quite limited, consisting mostly of manos (n = 22) and metates (n = 36). While most of these appear to be of generalized function, a handful of tools suggest specialized processing. These functional variations are likely linked to the vast array and differing character of wild plants gathered from the basin environs. This section addresses artifacts analyzed in the laboratory, and does not include the 137 ground stone tools analyzed in the field (see site descriptions).

Analysis Methods

The ground stone analysis consists of a standardized methodology (OAS 1994b), with some additional attributes. All artifacts were analyzed for material type, texture and induration, function, portion, preform morphology, production input, plan view outline, transverse and longitudinal cross-section shapes, shaping methods, number of uses, number of wear surfaces/edges, evidence of heating, presence of residues, artifact dimensions and weight. Utilized surfaces and edges were recorded individually, and the attributes examined included dimensions, texture, sharpening, transverse and longitudinal contour shape, and microscopic wear patterns. Microscopic wear type and location can provide a great deal about artifact function, and can often differentiate artifacts that appear to have identical functions (Adams 2010). Edge angle was measured for modified or worn edges. Wear and contour attributes together inform on the type of stroke used to manipulate the mano and the type of base companion stone used (Adams 2002:100–114).

Material Types

Spaceport ground stone tools were manufactured from a variety of material types. While sedimentary, volcanic, igneous, and metamorphic rocks were employed for these tools, fine-grained sandstones dominated the assemblage (Table 15.1). The abrasive quality of each rock type varies. Vesicular basalt and fine-grained sandstones are the most abrasive types, while igneous and metamorphic rocks such as andesitic basalt, trachyte, metaquartzite, and rhyolite are comparatively less abrasive. However, it is important to note that the abrasive quality of sandstones and vesicular basalt is minimized by the use of fine-grained materials, cortical surfaces, and a near absence of surface rejuvenation.

The project area abounds with tool stone resources, including a mix of fluvial, alluvial, and colluvial sediments derived from the ancestral Rio Grande and bordering mountain ranges (Wondzell et al. 1996). Tool stone was likely procured from several outcrops containing materials suitable for ground stone. These primary outcrop sources within the basin include Prisor Hill, Point of Rocks, Upham Hills, and the Jornada Fault zone. Secondary sources, which are more practical for ground tone tools in the project area, originate in bordering mountain ranges such as the Caballo to the west, Fra Cristobal to the north, and San Andres to the east; they erode into the basin via numerous drainages sourced in the mountains such as Jornada Draw, Aleman Draw, and Yost Draw. The Rio Grande Valley west of the

Table 15.1. Ground stone material and artifact types.

Abrasiveness (High to Low)	Material Category	Type	Manos	Metates	Choppers and Tabular Tools	Indeterminate	**Total**
High	Vesicular andesitic basalt	Vesicular andesitic basalt	–	1	–		**1**
	Sandstone	Sandstone and limestone interbedded		2			**2**
		Sandstone, green indurated	–	1	–		**1**
		Red hematitic sandstone, indurated	–	1	–		**1**
		Red sandstone, indurated	–	3	–		**3**
		Brown sandstone, indurated	–	1	–		**1**
		Gray sandstone, indurated	7	18	1		**26**
		Red hematitic sandstone, friable	1	–	–		**1**
		Red sandstone, friable	–	1	–	1	**2**
	Silicified sandstone	Silicified sandstone, gray	2	1	–		**3**
	Limestone	Limestone	2	–	3		**5**
	Nonvesicular andesitic basalt	Nonvesicular andesitic basalt	4	5	–	1	**10**
	Rhyolite	Brown ryholite	–	–	–	1	**1**
	Trachyte	Trachyte	3	–	–		**3**
	Metaquartzite	Metaquartzite, black	1	–	–		**1**
		Metaquartzite, brown	2	2	1		**4**
Low	Igneous, undifferentiated	Igneous, undifferentiated		1			**1**
Total			**22**	**37**	**5**	3	**66**

Caballo Mountains may have offered a more distant, though far less practical, source for ground stone material. Interestingly, some formations, such as the Bell Top, which outcrops at Prisor Hill and Point of Rocks, contain materials as dissimilar as sandstone and basalt (Seager 2005), perhaps offering a variety of tool stone from a single source.

Nine broad categories of material types were recognized in the Spaceport America assemblage. In descending order of abrasiveness, vesicular andesitic basalt, sandstone, silicified sandstone, limestone, non-vesicular andesitic basalt, rhyolite, trachyte, metaquartzite, and igneous undifferentiated are present (Table 15.1). Most of these categories are represented by a single type only, without variation in texture or color. Sandstone and metaquartzite are the only exceptions, with seven subtypes of sandstone, which vary in color, grain size, and induration, and two varieties of metaquartzite, which vary in color. Materials are described below according to source. However, within the artifact descriptions that follow later in this chapter, abrasive quality is considered in assessing function.

Vesicular and Non-Vesicular Andesitic Basalt (n = 11). Basalt tool stone was probably obtained from Prisor Hill, south of the project area. It outcrops as part of the Bell Top or Uvas Basaltic Andesite Formations (Seager 2005). Vesicular and andesitic basalt also outcrop at Point of Rocks and Upham Hills, south of the project area. Virtually all project basalt is andesitic, with a single vesicular basalt artifact found.

Sandstone (n = 37). Several sandstone colors are present, including gray (n = 26), red (n = 7), brown (n = 1), and green (n = 1). The last two specimens are sandstone interbedded with limestone. Some red sandstone contains hematite inclusions (n = 2). Gray sandstone may derive from Prisor Hill, Upham Hills, or Point of Rocks, outcropping in the Bell Top Formation. Bell Top sandstone contains pumice inclusions, which were observed in most project specimens. Red and tan sandstone appears to be most accessible and abundant within the Jornada Draw fault line, outcropping as the Love Ranch Formation. Yost Draw and Aleman Draw also contain sandstone from the Love Ranch Formation, although in lower quantities. Red, gray, and greenish sandstone also outcrop in the Abo Formation of the San Andres Mountains (Church et al. 1996:21). Sandstone in the basin and range province is often confined to localized or thin beds (Church et al. 1996:110).

Silicified Sandstone (n = 3). Church (1994:12) describes this material as "a sandstone cemented with silica; a hard silicified sandstone." It is denser and less abrasive than that in the non-silicified sandstone formations found in the project vicinity. It occurs both in cobble and slab form. An exact source was not found, but it may derive from the Lead Camp limestone formation of the San Andres Mountains.

Limestone (n = 5). Limestone occurs exclusively in cobble form, likely deriving from the distal parts of alluvial fans that drain the Caballo and San Andres Mountains (Seager 2005).

Rhyolite and Trachyte (n = 4). A specific source for these materials could not be found, but igneous materials are far more likely to occur in the Franklin, Organ, or Jarilla Mountains, as these ranges contain more igneous and metamorphic materials than the sedimentary-dominated San Andres, Sacramento, and Hueco Mountains (Church et al. 1996:3).Rhyolite was found in gravel deposits on Prisor Hill and LA 155963, and also occurred in samples from the Rio Grande Valley (see Chapter 23, this report). Primary sources of igneous rock also appear to outcrop in the Palm Park Formation in the southern Caballo Mountains and in the Doña Ana Formation in the Doña Ana Mountains, both considerably south of the project area (Silver 1952:153).

Metaquartzite (n = 5). Metaquartzite occurs exclusively in cobble form. Although metaquartzite appears to originate in the Caballo Mountains, it may also occur in drainages sourced there. Metaquartzite was found in samples collected from Yost Escarpment, LA 155963, and the Rio Grande Valley (see Chapter 23, this report).

Igneous Undifferentiated (n = 1). The single artifact in this category was made from a material that was obviously of igneous origin, but could not be more specifically identified.

Ground Stone Assemblage

Ground stone artifacts were recovered from seven sites (Table 15.2): LA 111422 (n = 1), LA 111429 (n = 29), LA 111435 (n = 7), LA 155963 (n = 20), LA 155964 (n = 3), LA 155968 (n = 3), and LA 156877 (n = 3). The assemblage comprises manos (n = 22), choppers and tabular tools (n = 5), metates (n = 36), and inde-

Table 15.2. Ground stone artifacts by site.

Tool Classifications				LA 111422	LA 111429	LA 111435	LA 155963	LA 155964	LA 155968	LA 156877	**Total**
Handstones	Manos	One hand	One-hand mano	–	11	1	1	–	–	–	**13**
			Mano/hammerstone	–	–	–	1	–	–	–	**1**
		Two hand	Mano, two-hand cobble	–	–	1	–	–	–	–	**1**
			Mano, two-hand cobble rocker	–	–	–	1	–	–	–	**1**
		Manos, nfs	Mano, nfs (fragmentary)	–	2	2	–	1	–	–	**6**
	Choppers and tabular tools		Chopper	–	2	–	1	–	–	–	**3**
			Tabular knife	–	–	–	–	–	1	–	**1**
			Edged abrader	–	–	–	–	1	–	–	**1**
Netherstones	Metates	Basin	Metate, basin	–	1	–	3	–	–	1	**5**
			Metate, basin/lapidary	–	–	1	–	–	–	–	**1**
		Slab	Metate, slab	–	3	–	1	–	–	–	**4**
			Metate/anvil	–	–	–	1	–	–	–	**1**
			Metate/comal	–	2	–	–	–	–	–	**2**
		Basin/slab	Metate, basin/slab	–	–	–	1	–	–	–	**1**
		Metates, nfs	Metate, nfs	–	8	–	9	1	2	2	**22**
Indeterminate	Indeterminate	Indeterminate	Fragments	1	–	1	1	–	–	–	**3**
Total				1	**29**	**7**	**20**	**3**	**3**	**3**	**66**

nfs = not further specified

terminate fragments (n = 3). The mano assemblage is dominated by one-hand forms among those for which the type can be identified. Metates, in contrast, are evenly distributed among basin and slab forms for determinate types. However, basin forms may be underrepresented. Many thin, bifacially worn fragments are probably internal portions of basin metates, but could not be definitively typed. An inventory of the project assemblage is provided in Appendix 4 (Table App4.1).

Manos (n = 22)

Manos were recovered from LA 111429 (n = 13), LA 111435 (n = 5), LA 155963 (n = 3), and LA 155964 (n = 1; Fig. 15.1). Interestingly, all of the identifiable manos from LA 111429 are one-hand types. LA 111435 and 155963, in contrast, yielded one- and two-hand manos. The majority of manos are fragmentary (n = 16, including both identified types and unidentified fragments), and all of these are one-hand types. The high percentage of mano breakage may be partially related to use of the fragments as heating elements in thermal features, as over one-third of all mano fragments have been exposed to heat (6 of 16: 37.5 percent).

One of the notable characteristics of the mano assemblage is the near-equal use of abrasive and non-abrasive materials. Sandstone and silicified sandstone make up less than half of the assemblage, while andesitic basalt, metaquartzite, rhyolite, and trachyte cobbles account for 55 percent. This choice of materials is interesting considering the nearly equal availability of sandstone and andesitic basalt in several locations within the Jornada Basin, including Yost Draw, Point of Rocks, ancestral Rio Grande gravels, and Prisor Hill (basalt only). It also contrasts with the material choices for metates, which are primarily sandstone. Differences in the abrasive quality of materials selected for the manufacture of manos and metates may be driven by several factors. Possibly, the most efficient combination for many food-processing tasks involves this mix of contrasting abrasion qualities. A similar pairing was observed at LA 159879, a Late Archaic site near Deming where starch remains indicate grass and sedge seed was processed (Wening, ms. in prep.). It may also owe to raw-material form. Sandstone slabs were probably better suited for metate manufacture, and igneous and volcanic cobbles were more readily employed as manos.

An interesting dichotomy exists in mano-shaping modification. Manos are either fully shaped into regular forms with careful pecking and grinding (n = 11), or they are completely unmodified cobbles (n = 9). Only two tools represent mid-range shaping modification. Shaped ground stone tools were examined to assess the relationship between material and shaping modification, if any. While the small sample size precludes definitive statements, some trends are apparent. Sandstone materials comprise the largest percentage of shaped manos (5 of 8; 62.5 percent). Fewer silicified sandstone and andesitic basalt artifacts are shaped (44 percent for both material groups). For comparative purposes, this shaping trend was examined for the entire assemblage as well, with similar results. When we considered only tools that could be analyzed for shaping modification (n = 22), sandstone materials are more likely to be shaped. This is true within the sandstone group (11 of 21; 52.5 percent), and within the shaped tool group (11 of 22; 50 percent). Vesicular basalt, metaquartzite, and silicified sandstone comprise the lowest percentage of shaped ground stone, each comprising less than 5 percent of the total determinate assemblage.

Manos are nearly equally distributed between one and two use surfaces (n = 12, n = 10, respectively). Most use surfaces are biaxially convex (n = 23, of 31 determinate use surfaces). Width convexity suggests the dominant use of a rocking stroke. Length convexity is linked to use in basin metates, though it also increases with wear. Ethnographic studies of Australian aboriginal seed-grinding tools note that slab metates are worn into basin metates, concluding that the two metate types represent a continuum of use rather than distinct tool types (Gorecki et al. 1997:141–142), suggesting that mano length convexity follows suit. Adams (1999:480–481) observes that width contour is a result of the stroke used to manipulate the tool, and length contour is a result of metate configuration. As slab and basin metates are nearly equally represented in the assemblage, flat and convex mano contours are expected. Biaxially flat surfaces are much less frequent, however (n = 7). This suggests that flat strokes involving constant contact with the metate surface are used less, which is possibly true of slab metate use as well.

Linear striations dominate on mano surfaces, denoting preference for a reciprocal stroke (n = 19,

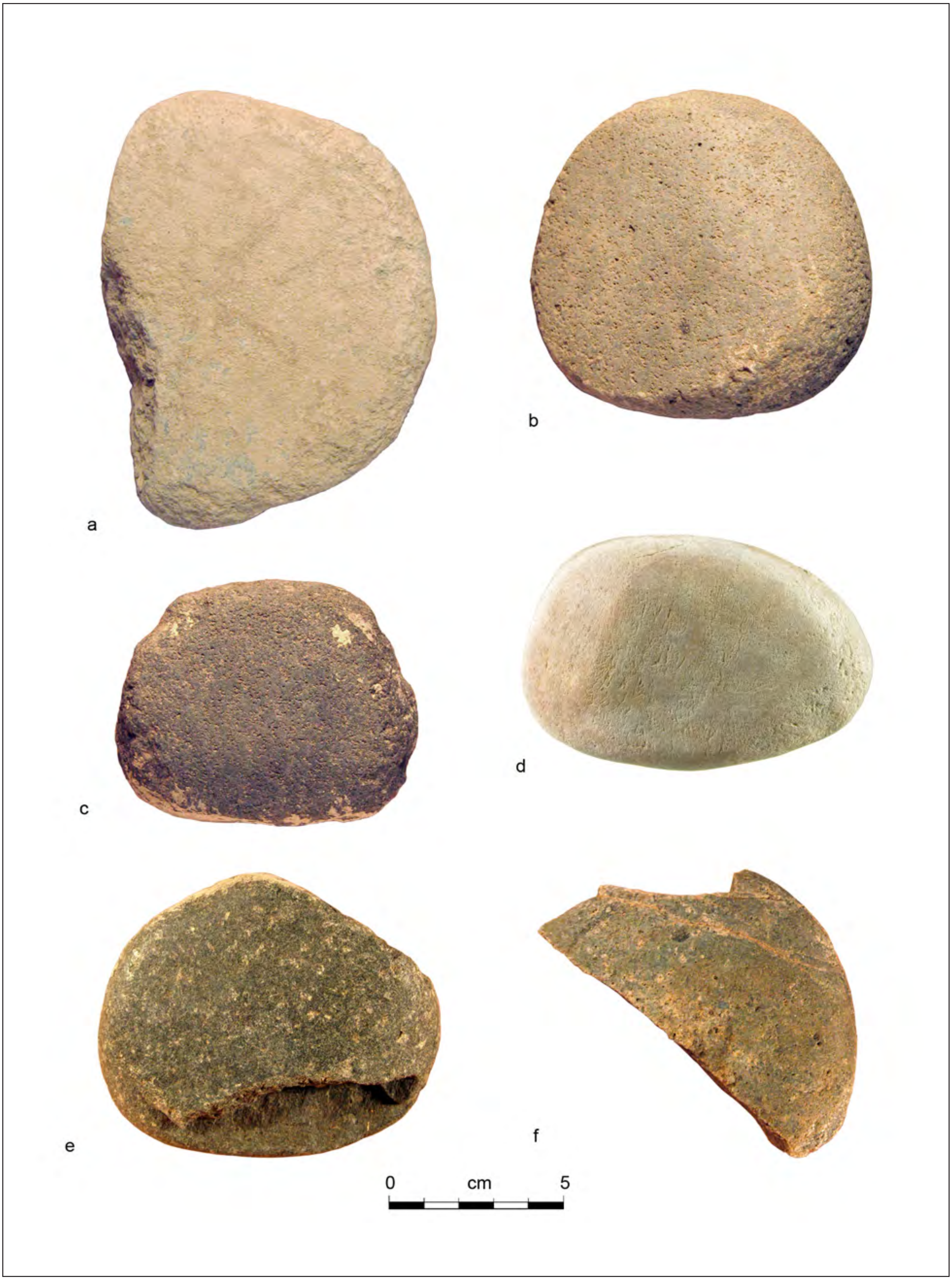

Figure 15.1. One-hand manos from LA 111429 (a–e) and LA 155963 (f).

of 23 striated surfaces). Random strokes are evident on only four surfaces. Interestingly, most of the random surfaces are paired with linear striations on the opposing surfaces, indicating use of two different strokes. This may represent functional versatility: the same tool was used with different foods, it was used to process a single food in different ways, or perhaps it was used in both manners.

Bifacial manos with linear striations are occasionally oriented at different angles, indicating that strokes differed for each side, possibly additional evidence of varied processing strategies. Heavy use predominates (n = 21 of 31 surfaces), and surface rejuvenation is rare (n = 1 surface). Secondary function is evident on only two manos (other than use as elements in fire pits), both of which display battering wear on the perimeters.

Generally, more abrasive materials, such as sandstone, are ground with reciprocal strokes, and less abrasive materials, such as metaquartzite and limestone, are ground with non-reciprocal strokes. However, neither of these material groups are restricted to a single stroke pattern. Some abrasive tools are manipulated with non-reciprocal strokes, and some low-abrasion tools are manipulated with reciprocal strokes. While the sample size is too small for generalization, this may be additional evidence of tool versatility in terms of processed materials and technique. It may also reflect the expedient nature of grinding tools. This is further addressed in the discussion below, along with mean mano dimensions and various subsistence interpretations.

One mano is quite anomalous to the assemblage and merits individual description (Fig. 15.2). It is formed from a very large, heavy silicified sandstone cobble (17.5 by 15.2 by 9.6 cm; 4900 grams). The entire surface of the tool is carefully pecked to shape. Two biaxially convex use surfaces are present, one of which is heavily used and fully rejuvenated. The reverse surface is carefully shaped, but was not used. The tool appears too large and heavy to be moved reciprocally, yet the use surface clearly displays heavy grinding and linear striations. It appears far more suitable for crushing hard seeds such as mesquite, possibly with a rocking motion. This is partially supported by the presence of mes-

Figure 15.2. LA 155963, shaped two-hand cobble mano.

quite seeds in nearby Mesilla-phase Feature 141, a fire pit with fire-cracked rock at LA 155963, the only occurrence of mesquite seeds at the site.

Tabular Tools and Choppers (n = 5)

This group comprises one tabular tool, three choppers, and one edged abrader. The larger tabular tool is formed from a sandstone metate fragment (Fig. 15.3). Three flakes were removed to create an ergonomic, triangular form. The heavily rounded edge of the tabular tool is formed by the adjoining metate surface and opposing broken surface. Small use-wear flake scars also occur sporadically along the knife edge. There is no evidence of hafting. This tool bears some morphological resemblance to tabular knives associated with agave processing in the Hohokam area (Fish et al. 1985:Fig. 2) and was classified as such. Agave does not occur in the project area, but tools of this type may have been used for yucca.

Tabular knives from the South Nash Draw project near Carlsbad may be associated with leaf succulent processing, such as yucca (Wening, ms. in prep.). At higher elevations in the project area, sotol and mescal may have been exploited as well, though these plants are not present in the basin. Interestingly, recycling of ground stone fragments into tabular knives or possible pulping planes was observed in Mesilla-phase burned rock middens thought to be associated with agave and sotol baking in the Fort Bliss area (Miller and Burt 2009:4–17).

The tabular knife was recovered from the surface of LA 155968, proximate to a dispersed fire-cracked rock scatter (Feature 4). Interestingly, yucca and saltbush remains were found in the large Mesilla-phase roasting pit at this site (Feature 1). Yucca and saltbush may have been used for fuel, but both plants had multiple additional uses, some of which involved heating. Saltbush was used for fuel, medicine, soap, and food. Saltbush seeds were parched, the tender greens were cooked, and the ashes were used for leavening and color (Cummings, ms. in prep.). Yucca stalks and their crowns, fruit, and flowers were roasted or boiled, and eaten (Rainey and Adams 2004).

The edged abrader is formed from an unmodified limestone cobble. The natural shape offers an ergonomic form and a 49-degree edge angle (Fig. 15.4). The edge is lightly rounded and polished. The natural contours of the stone appear suitable for hafting, but the artifact displays no evidence of that use. This tool was recovered from a large rock-filled roasting pit (Feature 1) at LA 155964. Interestingly, this Historic-period feature yielded yucca, cactus, and mesquite remains. This small tool appears an unlikely candidate for use in yucca or mesquite processing, but may have been useful in cactus processing, possibly being used to sever fruit from the plant.

The most formal of the three choppers is formed from a flattened, ovoid limestone cobble (Fig. 15.5). One end of the cobble is broken off and a large unifacial flake was removed for thinning; both modifications appear to have facilitated handling. There is no evidence of hafting. The utilized edge is only slightly modified by the removal of several flakes, and much of the natural cobble edge appears suitable for use (58 degrees). Use wear occurs as bifacial flaking, rounding, and polishing. It was recovered from Surface Strip 6 at LA 111429 proximate to Early Historic Feature 11 (large caliche-filled roasting pit), which yielded yucca, mesquite, and saltbush botanical remains. However, there is no direct association between the tool, the roasting pit, or the plant materials found within the feature.

The second chopper is an expediently used angular metaquartzite fragment (Fig 15.6). The 30-degree edge angle is fortuitously formed by a break. Flake scars are evident on this subtriangular tool, but do not appear to be the result of shaping, since none originate from the tool edges. Several small use-wear flakes occur on the utilized edge, suggesting light use. The tool was found near the Feature 6 fire-cracked rock scatter at LA 111429, east of the Ground Stone Area at the south end of the site.

The third chopper is made from a split ovoid limestone cobble, and is flaked unimarginally along one end to form a 74-degree edge. Light rounding and polishing is evident on the edge, dorsal, and ventral surfaces, suggesting the tool was used in scraping activity, possibly on a soft, flexible material, such as succulent leaves or hide. Two discrete areas of battering are apparent on the butt end and lateral edge, indicating possible hammerstone use as well. This tool was recovered from the surface of the Early Historic Feature 9 stain. Mesquite remains were found in the feature, though they likely represent use as fuel; the morphology of this tool does not appear suitable for mesquite processing.

Figure 15.3. LA 155963, sandstone tabular knife.

Figure 15.4. LA 155964, possible tabular tool.

Figure 15.5. LA 111429, limestone cobble chopper.

15.6. LA 155963, limestone cobble chopper.

While the mesquite and yucca remains in some of these features probably represent their use as fuel, both plants were likely exploited for other uses such as fiber and food. The tabular knife may have been used to sever yucca leaves from the stalk or to pulp the leaves for fiber similar to the process used by the Otomí community of Orizabita in Highland Central Mexico for agave leaves (Parsons et al. 1990). The Otomí use scraping tools to pulp leaves that are freshly cut or partially decomposed by heat and exposure to moisture, raising the interesting possibility that thermal features at the site may have had a role in a similar process (Parsons et al. 1990:145–146). The Parsons believe that pulping fresh-cut leaves would be difficult to impossible without iron tools, and suggest that the *penca asada* method of heating the leaves and placing them in a damp pit for several days would have been used prehistorically (1990:145–146). The cooked leaves are soaked for several days in a shallow, unlined pit (50 cm depth). Maguey leaves are also softened by cooking alone (Parsons et al. 1990:163).

The process used for yucca fiber production is very similar to agave. While ethnographically documented methods and modern experiments differ somewhat, all involve the initial step of softening the leaves. Scraping of freshly cut leaves produces a sticky residue that renders the fiber extraction virtually impossible (Haas 2001:179–180). Observing this problem during his experiments, Haas suggests that pulp softening was probably essential to fiber extraction and could be accomplished by retting, boiling, roasting, freezing, or wilting the leaves (Hass 2001:179–180 and references therein). Retting consists of soaking the leaves until the parenchyma begins to decay. Roasting entails burying the leaves in a heated pit, which would perhaps be the most available method in the Jornada basin. Wilting involves heating the leaves over hot coals. Freezing entails allowing the freshly cut leaves to sit through freeze/thaw cycles. Scraping tools are used for some modern experiments (Haas 2001; Osborne 1965) and may be present at some sites (Haas 2001:182 and references therein).

Metates (n = 36)

Basin and slab metates appear to be equally represented among determinate artifacts (n = 6 and n = 7 respectively). One is a basin/slab combination. The metate assemblage is almost entirely fragmentary, with a single whole tool present. One basin is nearly complete, refit from six fragments (Fig. 15.7). While internal fragments cannot be definitely typed, surface attributes suggest that slab metates may outnumber basins by a slightly wider margin. For example, biaxially flat use-surfaces are probably slab fragments (n = 6), while others display basin surface attributes such as marked biaxial concavity, thin cross sections, and bifacial linear striations.

A clear preference for low-abrasion materials and use surfaces is evident. Metates are produced from slightly more abrasive materials than manos, though general abrasive quality is not high and cortical surfaces are often used. Sandstone is the material of choice (n = 28), represented almost exclusively by fine-grained, well-indurated tabular stone. The choice of this material is interesting considering the availability of more abrasive vesicular basalt at several locations in the Jornada Basin, particularly at Prisor Hill, approximately 1–2 km (0.6–1.2 mi) southeast of the project area, and at Point of Rocks, about 19 km (12 mi) south (see material sources above). Smaller, water-worn basalt rocks may be more readily available from gravel deposits in the Jornada Basin, and possibly, larger materials as well. All basalt materials that can be analyzed for raw material are cobbles, suggesting that riverine gravels may indeed be the most likely source. Andesitic basalt (n = 5) and silicified sandstone (n = 1) are used as well, but these fine-grained, well-indurated materials do not appear to offer a highly abrasive surface. Vesicular basalt is virtually absent (n = 1). The preference for low abrasion is mirrored in surface use and maintenance as well. Most metates display moderate to heavy use (n = 39 of 53 use surfaces; 74 percent) with infrequent rejuvenation (n = 5 of 53 use surfaces; 9 percent), even on heavily worn surfaces. Most metates were ground with a reciprocal stroke (n = 27 surfaces), similar to manos. Random strokes were much less frequent (n = 9).

Little shaping modification occurs on metates. Shaping is difficult to determine in such a fragmentary assemblage, but artifacts with shaped edges indicate minimal flaking only. Only the refit basin metate is fully shaped. The 22 remaining metates are indeterminate fragments, most of which are internal portions (n = 17).

Four metates may have had secondary functions as comals (n = 2), lapidary stones (n = 1), or anvils (n = 1). The sandstone metate-comal is tentatively assigned, since the entire surface, including broken

Figure 15.7. LA 155963, sandstone slab (a) and basin (b) metates.

edges, is heavily sooted. Also, the fragments of this tool were recovered from roasting pit fill, possibly indicating that they were used in pit construction (LA 111429, Feature 11 Early Historic large rock-filled roasting pit). One surface is used as a metate, while the other displays wear from surface contact only. The metate-lapidary stone is lightly ground on the high spots of an uneven surface, suggesting it served as a netherstone, against which something was worked. The reverse side of this andesitic basalt tool displays a shallow ground basin. This tool was somewhat isolated from the site proper, and was located south of Feature 7 (stained fill in a rodent burrow), Feature 8 (a possible structure), and Feature 9 (a fire-cracked rock scatter) at LA 111435.

The metate-anvil appears to have an interesting use history. A large andesitic basalt cobble was used first as an anvil on a naturally concave surface (Fig. 15.8). This use shattered the rock, creating a fairly flat surface that was used as a slab metate without further modification. It was recovered near Mesilla-phase roasting pit Feature 14 at LA 155963, which contained saltbush remains.

Indeterminate Fragments (n = 3)

Rhyolite, andesitic basalt, and sandstone ground stone tool fragments each display a single, flat ground surface and cannot be further classified.

Site Assemblages and Spatial Distribution

Most of the ground stone tools were recovered from two sites: LA 111429 (n = 29) and LA 155963 (n = 20; Table 15.2). The 16 remaining ground stone tools were dispersed among five other sites: LA 111422 (n = 1), LA 111435 (n = 7), LA 155964 (n = 3), LA 155968 (n = 3), and LA 156877 (n = 3). The majority of tools at all sites were fragmentary (Fig. 15.9). Fewer than half of all ground stone tools were directly associated with features (Table 15.3). Sites are discussed below in order of ground-stone tool frequency.

LA 111422 (n = 1)

A single indeterminate brown rhyolite ground stone fragment was recovered from Surface Strip 2 in the central part of this site. The artifact is fire-cracked, and likely served as a heating element, possibly in Feature 3.

LA 111429 (n = 29)

Most ground stone tools from LA 111429 occurred in two clusters, both of which contained nearly equal numbers of ground stone tools (Fig. 15.10). The first cluster was in or near Feature 11, a large rock-filled roasting pit in the northern part of the site. Of the two remaining tools in the north, one was from a fire-cracked rock scatter (Feature 22), and one was found in Surface Strip 1 in Paleoindian Area 1. The second cluster was in the Ground Stone Area in the southern portion of the site. LA 111429 produced the largest number of ground stone tool fragments that were reused as heating elements in thermal features (n = 17; 59 percent; Fig. 15.11).

All of the ground stone from Feature 11, a roasting pit packed primarily with burned caliche (see LA 111429, Feature 11 [Chapter 7, this report]), was fragmentary and all of it was heat-fractured or burned. This feature yielded ground stone tools from both the surface and fill. Within the fill, three sooted slabs appeared to represent the same metate, which may also have been used as a comal (see metate section above). Feature 11 yielded a wide variety of botanical remains, including grass seed, saltbush, mesquite, cactus, and yucca (McBride, Chapter 17, this report). The presence of various plant remains suggests that a wide range of plant processing occurred here, though the ground stone from this feature likely served as thermal elements, since all of it is heat-fractured and fragmentary. Interestingly, the ground stone tool kit is limited, consisting only of one-hand manos and slab metates. Hard (1986:114–117, Table 10) notes the continued use of one-hand manos into historic times for the Walapai and White Mountain Apache; both groups almost exclusively depended on foraging. Ethnographic use of one-hand manos for both wild and cultivated plant processing is documented for the Walapai and Havasupai, who used multiple processing methods to reduce cereals to meal (Euler and Dobyns 1983:254). Historic processing of grass and sedge seeds with rounded or domed water-rolled pebbles and slab metates is documented for Australian Aborigines (Cane 1989:105). It is possible that one-hand manos and slab and basin metates remained in use into historic times, as they were likely the most efficient and practical tools for processing gathered resources of the basin environs.

The Ground Stone Area at LA 111429 yielded

Figure 15.8. Metate-anvil from LA 155963 (a) and metate-lapidary stone from LA 111435 (b).

Table 15.3. Summary of ground stone artifacts from features, including associated radiocarbon dates.

Site	Feature Type	Feature No.	Feature C14 Date	Manos, One Hand	Manos, Two Hand	Manos, nfs	Metates, Basin	Metates, Slab	Metates, Basin/ Slab	Metates, nfs	Choppers, Tabular Tools	Indet.	**Total**
LA 111429	FCR scatter	6	Mesilla	1	–	–	–	–	–	2	1	–	4
	Large rock-filled roasting pit	11	Protohistoric–modern, Spanish Colonial–modern	2	–	–	–	2	–	1	–	–	5
LA 111435	Rock-filled fire pit	3	Late Archaic	1	–	–	–	–	–	–	–	–	1
	Stain/rodent burrow	7	Mesilla	–	1	–	–	–	–	–	–	–	1
	Small fire pit	4	nd	–	–	–	–	–	–	–	–	1	1
	FCR w/ stain	10	Middle Archaic	–	–	3	–	–	–	–	–	–	3
LA 155963	Stain	9	Protohistoric to modern	–	–	–	–	–	–	–	1	–	1
	Isolated metate	13	nd	–	–	–	–	–	1	–	–	–	1
	Rock-filled roasting pit	14	Mesilla	1	–	–	–	–	–	1	–	–	2
	Stain or small fire pit	15	Late Archaic	–	–	–	–	–	–	1	–	–	1
	Small fire pit w/ FCR	125	Mesilla	–	–	–	1	–	–	–	–	–	1
LA 155964	Large rock-filled roasting pit	1	Early Spanish Colonial to modern	–	–	1	–	–	–	1	1	–	3
LA 156877	FCR scatter/completely deflated fire pit	1	nd	–	–	–	1	–	–	2	–	–	3
Total				5	1	4	2	2	1	8	3	1	27

FCR = fire-cracked rock
nfs = not further specified
nd = no data

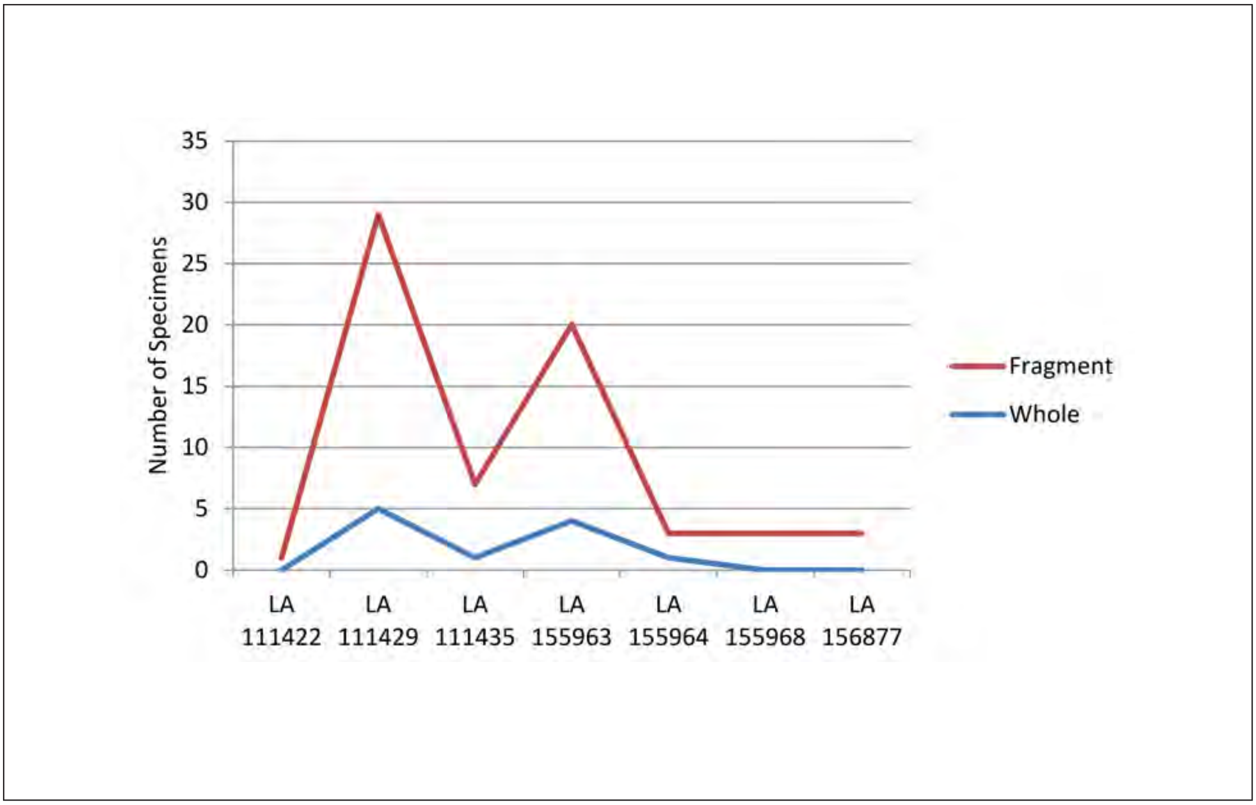

Figure 15.9. Ground stone condition by site.

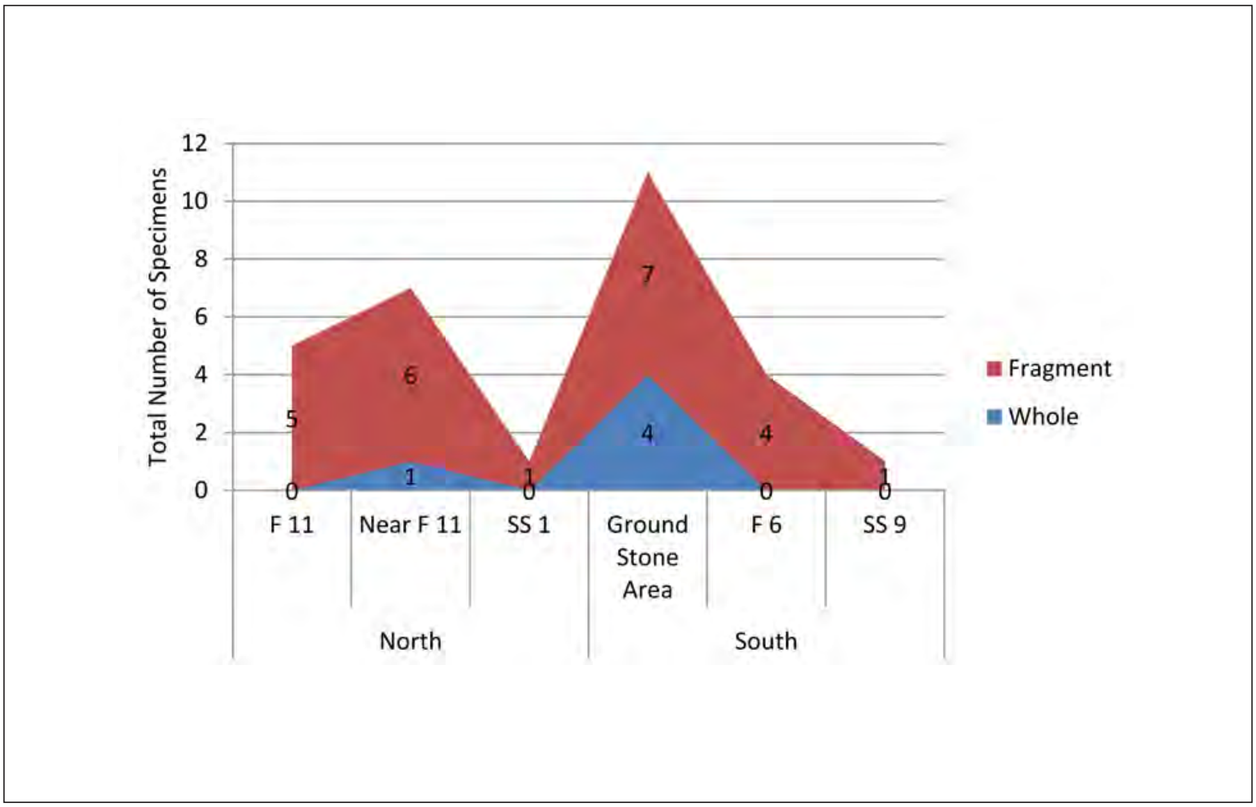

Figure 15.10. LA 111429, ground stone condition by area.

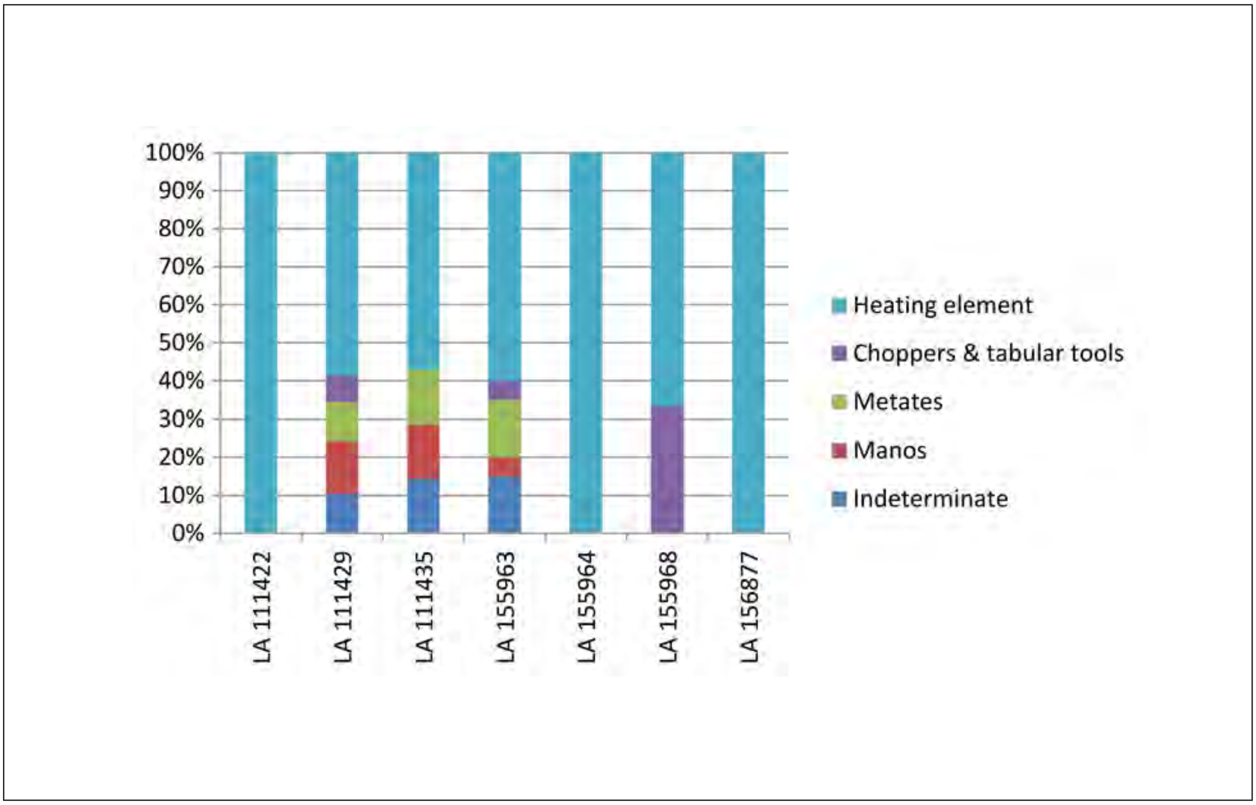

Figure 15.11. Percentage of final ground stone function by site.

the highest number of whole tools, all of which are manos. This is perhaps to be expected, as nine of the whole tools were found on the surface and two came from surface stripping. Fragmentary manos and metates complete the assemblage in that area. Virtually all ground stone tools in this area were recovered during the surface collection. This area contrasts with Feature 11 in that none of the tools were exposed to heat. This may be partially due to the comparatively few thermal features noted in the Ground Stone Area. It may also indicate that processing activities primarily involved hulling and grinding more than parching and cooking. A similar scenario occurred near Feature 6, a large fire-cracked rock scatter east of the site's Ground Stone Area. All of the ground stone from that area was fragmentary, yet none was fire-cracked. This area yielded manos, metates, and a chopper.

Given the multicomponent status of LA 111429 and the fairly ubiquitous occurrence of ground stone tools, this site appears to have served as a long-term, primary gathering and processing location. Interestingly, this site had the highest frequency and percentage of expedient tools, employing both slabs and unmodified cobbles. While thermal features were likely used for most food preparation, including seed parching and cooking flour-based products, heat is not required for all foods. For example, ethnographic sources note that fresh mesquite pods can be crushed and consumed without further preparation (see below).

LA 155963 (n = 20)

Most ground stone tools collected from LA 155963 were from Section A in the northern portion of the site (n = 16), while Sections B and C, to the south, yielded only six tools combined, including uncollected point-provenienced ground stone (Fig. 15.12). Though it is tempting to infer that most ground stone–related tasks were carried out in the site's north end, the concentration of thermal features in Sections B and C clearly indicates that the southern portion of the site witnessed equal, if not greater, activity. Most pieces of ground stone from the site are heat fractured (12/20:60 percent), indicating their use as a heating element. Also, groups visiting the sites at later times may have traveled with their tools or cached them for future use in the same location.

Area A South (Features 18–20; Fig. 9.2): The highest frequency of ground stone at LA 155963 occurs in Area A, in the vicinity of Features 18–20 (n = 10). However, this area has been subjected to modern disturbance, as evidenced by a collector's pile of mano and metate fragments and a possible modern feature (Feature 18). All ground stone artifacts in this area were recovered from the surface. Several sandstone material types are represented among the metate fragments, perhaps additional evidence of modern collection. Radiocarbon dates and botanical remains are not available from these features.

Section A (Features 9, 13–15; Fig. 9.2): Five artifacts occur in a lighter, more dispersed ground stone concentration in the northeastern portion of the site. All ground stone tools were recovered from the surfaces of Early Historic Feature 9 (stain), Feature 13 (isolated metate), Mesilla-phase Feature 14 (rock-filled roasting pit), or Late Archaic/Early Mesilla–transition Feature 15 (stain or small fire pit). Most notable is the basin metate from Feature 13. It is partially reconstructed from six fragments and may have been used elsewhere and cached here. A whole chopper was recovered from Feature 9, which yielded mesquite, saltbush, and yucca remains. It is the only whole tool found in the vicinity of Feature 9. One fragmentary mano represents the only fire-cracked tool. Features in this area date from the Late Archaic/Early Mesilla to the Early Historic period, suggesting that this location was used repeatedly, though possibly less intensively, than others at LA 155963. It is also possible that ground stone tools in this area were originally used elsewhere on the site, particularly in view of their fragmentary condition.

Area B (Features 140–143; Fig. 9.3): Both ground stone and botanical remains suggest that mesquite processing occurred in this area. Two ground stone tools were recovered here, the most interesting being the large two-hand cobble rocker mano, which may have been used for mesquite processing. Feature 141, a small, briefly used fire pit, contained burned amaranth, cheno-am, hedgehog cactus, purslane, mesquite seeds, and grass stems (Table 17.16). While this large mano was not found in direct association with this feature, its proximity may indicate that mesquite pods or seeds were ground into flour and cooked in this hearth.

Area C (Feature 125 and vicinity; Fig. 9.4): This Mesilla-phase thermal feature yielded a single internal basin metate fragment; it was not fire-cracked. Also, three ground stone artifacts were point-provenienced proximate to Feature 125 (small fire pit with fire-cracked rock), but were not collected. No evidence of exposure to heat was observed.

LA 111435 (n = 7)

Ground stone related activity is less in evidence at this site, with manos, metates and fragments occurring (Fig. 15.13). Three mano fragments appear to originate from the same tool, so the more realistic site total may be four. All but one ground stone tool were recovered from feature surfaces or strip levels. Features 3, 4, 7, and 10 each have one tool. The only whole tool is a lightly used, expedient limestone cobble mano from Feature 7.

LA 155964 (n = 3)

All three tools from this site originate from the Early Spanish Colonial to modern component of the large fire-cracked rock thermal feature (Feature 1). Two are lightly used, expedient limestone cobbles, and include a small tabular tool, and a mano fragment. The third tool is a non-vesicular basalt metate fragment. None of the tools are fire-cracked.

LA 155968 (n = 3)

Three metate fragments were recovered from this site, one of which is reshaped into a tabular tool, as discussed earlier in the section on tabular tools. The three fragments are widely dispersed across the site surface. Two occur near the site center, within 20 m of Feature 1, a large roasting pit that dates to the Mesilla phase. The only whole tool, the tabular knife, occurs near the extreme eastern site boundary, in an isolated context. One fragment appears to originate from a basin metate based on the marked concavity of the use surface. All three artifacts display either light or moderate wear, distinguishing them from most project ground stone.

LA 156877 (n = 3)

The three indeterminate type metate fragments all originate from the surface strip of Feature 1, a

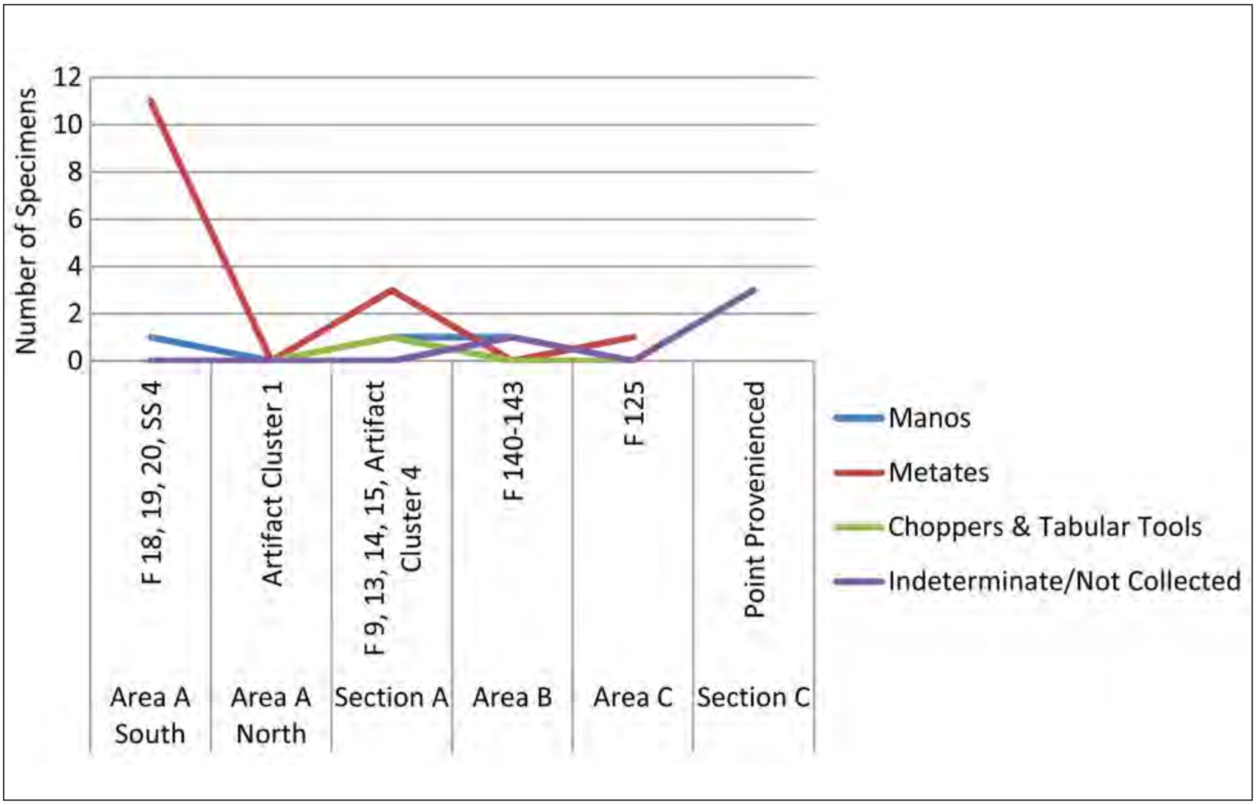

Figure 15.12. LA 155963, ground stone distribution.

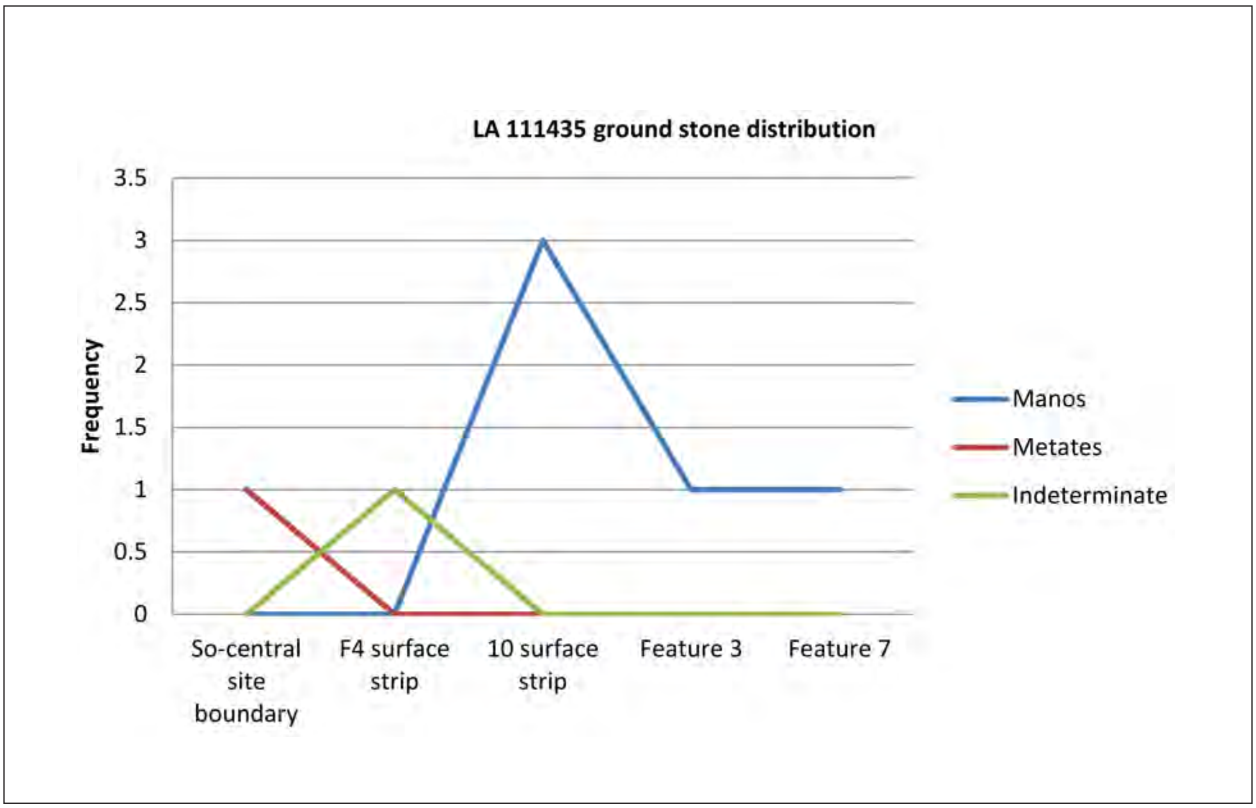

Figure 15.13. LA 111435, ground stone distribution.

fire-cracked rock scatter/completely deflated fire pit. Interestingly, three material types are represented among these fragments, two of which are considerably more abrasive than most project materials: vesicular basalt and coarse-grained sandstone. The marked concavity of the vesicular basalt metate suggests it is an internal basin fragment. Unfortunately, this site is of unknown temporal affiliation, and no botanical remains are available to suggest functional associations. One of the coarse-grained sandstone artifacts is cracked and fractured from exposure to heat.

Ethnographic Seed Processing

Wild seeds. The continued importance of wild foods in the Jornada is evidenced both in the archaeobotanical record and in regional ethnographic studies. Botanical remains from Fort Bliss indicate that the diversity of exploited plants increased during the early Formative phases as compared to the more limited resource range of the Archaic period (Condon 2010:311). Late to middle Archaic-period sites yielded goosefoot and sunflower seeds. Mesquite and saltbush remains were also present, but they were likely used as fuel rather than food. Botanical remains from early Formative-period sites, in contrast, included mesquite, saltbush, goosefoot, sunflower, prickly pear cactus, purslane, and yucca seeds (Condon 2010:311).

The diversity of resources was also greatly expanded by the exploitation of multiple environmental zones. Use of these multiple environmental zones was evident at Mesilla-phase sites in the Fort Bliss project area (Condon 2010:315). Each zone was foraged in different seasons based on resource availability. In warm-weather months, when plants in lower elevations were available, groups moved to the basin, playa margins, and transitional zones adjacent to alluvial fans to forage. Residences would be relocated to the alluvial fan uplands in winter months, where a different suite of resources would be available. One important resource from the lower elevation zones are the wild grasses.

Wild grasses are a staple for many southwestern groups, and are especially important in arid environments (Doebly 1984). Even among groups where agriculture is the primary food source—such as the Hopi (Whiting 1939:18) and Yuma (Castetter and Bell 1951:180)—several wild grasses are an essential dietary element. Grass seed is described as "semicultivated" for the Yuma (Castetter and Bell 1951). At High Rolls Cave, dropseed ranks high among site botanical remains, along with cheno-ams, prickly pear, chenopods, and mesquite (Bohrer 2006:215, Table 18.6). Dropseed frequencies are also high in early Formative phase sites at Turquoise Ridge (Whalen 1994:118, Table 4). Mesilla-phase sites in the Tularosa Basin yielded dropseed (Church and Sale 2003:18, 122). Among the Yuma, an impressive array of seeds is processed by grinding, including mustard, mesquite, sunflower, panic grass, and pigweed (Castetter and Bell 1951:179–211). These seeds are parched and ground, with the flour eaten dry or cooked into a mush by the Mohave, Yuma and Maricopa groups (Kelly 1977 after Castetter and Bell 1951). Australian Aborigines can collect large quantities of grass seed per hour, husking them by rubbing the seeds between the hands (Cane 1989:105). Both dry and soaked seeds are ground using rounded or domed water-rolled pebbles as manos and basin metates (Cane 1989:112–113).

Mesquite. Mesquite-processing methods are extensively documented for many groups through ethnographic studies and later syntheses, all of which repeatedly highlight the importance of this wild resource. Rendering of mesquite pods and seeds was carried out in many ways. Some appear to be almost universally employed, and others appear unique to specific groups, though most involve pounding, crushing, and grinding processes. Pods were pulverized both fresh and dried, and processed into meal, flour, or pulp.

Yuma processing methods were based on pod maturation. Ripe pods were dried and stored for later processing. Dried pods were first crushed in a mortar, then sometimes ground on a metate to produce a finer meal (Castetter and Bell 1951:184). Unripe pods were immediately mashed in a mortar to produce a pulp for beverages. The Pima used both pods and seeds, sometimes grinding them together into various textures ranging from fine flour to coarser meal to pulp, which the White Mountain Apache did as well (Bell and Castetter 1937:25, after Reagan 1929:145). The Pima combined mashed pod juice with corn meal; leaves and bark were powdered for numerous medicinal uses (Hrdlicka 1908). The Mohave and Yuma used only the mashed pods, discarding the fiber and seeds.

In Mohave and Yuma territory, mesquite pods ripen in late June, and earlier in more mesic biotic settings (Castetter and Bell 1951:182). Ripened pods were intensively collected, sometimes involving "sojourns of several days' duration in which they camped" (Castetter and Bell 1951:182). The Pima travelled for this resource as well, relying on mesquite when other food plants failed (Russell 1908:94).

While mortars and pestles figured prominently in the Southwest for food processing, manos and metates were often the tools of choice to pulverize mesquite, which was processed with both sets of tools by the Pima and Yuma. Wood and stone were used for both mortar and pestle; intriguingly, stone tools were reported to produce a smaller volume of ground plant material (Russell 1908:75). Numerous groups employed both tool sets for processing, with wooden mortars and stone pestles used for pulverizing, followed by manos and metates for finer grinding (Schneider 1996:302 and references therein). The Walapai used the two tool sets interchangeably (Hrdlika 1908:260, Kroeber 1935:53 after Bell and Castetter 1951:25). The Pima pounded the seeds and pods in a mortar, as they were "too sticky for the metate" (Bell and Castetter 1937:23). The Chiricahua Apache ground both raw and boiled pods on a metate (Castetter and Opler 1936:41).

The Havasupai dispensed with the mortar altogether, pounding the dried pods on a metate (Bell and Castetter 1937:25). Hayden's experiments with mesquite processing describe use of both mortar and pestle for separating the seeds from the pods, and mano and metate for final processing into flour (1969:156). A wooden pestle was considered more efficient by many native groups for initial mesquite-pod grinding—a stone pestle could cause the unwanted result of crushing the hard seeds into the meal. In barley de-husking experiments designed to inform on processing methods used in classical antiquity, wooden pestles were deemed the most efficient, as the whole seeds could be more easily separated from the hulls (Foxhall and Forbes 1982:77). Mesquite was also processed in earth mortars—a cylindrical hole dug into the ground that was sometimes lined with a basket of arrowweed twigs and split roots (Castetter and Bell 1951:184). Earth and wood mortars may not survive in the archaeological record, however. These ethnographic comparisons suggest that while manos and metates may have been used to process a variety of wild seeds and cultigens, mortars and pestles appear to be specialized tools that were used almost exclusively to pound mesquite seeds and pods.

While botanical remains from the Spaceport project suggest that mesquite was being exploited for food, the mortars and pestles commonly associated with processing this plant were not present. This may be due to several factors. Mesquite pods and seeds may have been processed using metates and manos rather than mortars and pestles. One such tool, found at LA 155963, is the large two-hand mano. Another explanation is that wooden pestles—which would not have survived—were used for the task. The possibility also exists that mesquite was simply not exploited for food, but this is unlikely. The most viable option is that the seeds and pods were collected at the site, but were stored and processed at winter camps, where the tools would have been stored.

Mesquite is mentioned as a key food of the Manso group from the southern Rio Grande and, possibly, the Fort Bliss area. It also serves as a staple of other southern desert groups, both mobile and sedentary (Seymour 2002:333–334). In the project area, however, mesquite may be a secondary resource compared to grasses, as it has dominated the landscape only in the last 200 years (Seymour 2002:334). Others link the widespread expansion of mesquite with the rise of the cattle-ranching industry in the 1880s (Havstad et al. 2006:221). Prior to this, mesquite was limited to valley floors and watercourses, and low-elevation, frost-free areas. Others (Frederickson et al. 2005:289) see long-term fluctuations in mesquite population beginning in pre-European times, based in the complex interaction between mammals that consumed the pods and the human hunters who reduced their population. The presence of burned, fragmented mesquite seeds and mesquite fuel wood in Mesilla-phase features at LA 155963 provide evidence that the shrub was present prehistorically, possibly occurring only along drainages within the basin, though generally in far less abundance than today. The burned mesquite seeds were recovered from Feature 141. Also near this feature is the large, heavy two-hand cobble mano (see above). While mesquite was not prolific prehistorically, it is possible that this large mano was used to process mesquite seeds at the site given the proximate botanical remains in Feature 141.

Yucca. Soaptree yucca (*Y. elata)* is prolific in the project area. The plant served as a primary food source, offering various edible parts such as the root, heart, and leaf bases, which were typically consumed after being baked in pits (O'Laughlin 1980:105–107 and references therein). Prior to the baking process, the plant would have been harvested and prepared using tabular knives that were designed to sever the leaves from the heart, such as those recovered during the current project. Apache ethnographies note the use of knives to trim the leaves from the crown (Castetter and Bell 1938:28, 46, 48–49, 52; Castetter and Opler 1936: 35–36). These tools were also used to pulp leaves as part of the fiber extraction process. A detailed ethnographic study of maguey pulping and fiber-extraction methods used by the Otomí community of Orizabita in Highland Central Mexico illustrates tools with a strong morphological resemblance to tabular knives (Parsons et al. 1990:110, 117, 118). Perhaps the strongest functional association of tabular knives and succulent processing (agave) in an archaeological context derives from Hohokam sites in the Salt-Gila Aqueduct project in southern Arizona (Bernard-Shaw 1983, 1990).

Rainey and Adams (2004) have produced an exhaustive compilation of ethnographic plant uses for the Crow Canyon project, in southwestern Colorado. Innumerable food and non-food uses for yucca are listed, many of which require grinding or heating to process, suggesting the use of manos and metates in succulent leaf processing. For example, the Mescalero Apache baked the trunk and ground it into flour, the Papago ground the fruit into a pulp, and the Pima, Papago, and Navajo pounded the stems to produce soap.

Prickly Pear. Prickly pear cactus had multitudinous ethnohistorical uses, many of which involved grinding and pulping processes. The fruit, seeds, pads, and entire plant were pulped or ground. Preparatory to this stage, the various cactus parts may have been boiled, dried, or burned. The uses for the plant are as numerous as the groups utilizing it. Nomadic groups including the Mescalero Apache, Chiricahua Apache, and Navajo, and sedentary groups such as the Hopi, Laguna, Acoma, San Felipe and Cochiti used prickly pear cactus (Basehart 1974, Castetter and Opler 1936, Lynch 1986, Nequatewa 1954, Castetter 1935, Lange 1968). Other uses are documented in the Trans-Pecos area, where the fruit is juiced or pulped by pounding (Dering 2006:3). Cactus pollen was recovered from metate grinding surfaces from sites in eastern Arizona, providing evidence that ground stone tools were used to process this food (Bryant 1974:407 after Hevly 1964:89).

Ground Stone Summary

Ground stone tools were recovered from seven sites, which range from Paleoindian to Protohistoric occupations, with several being multicomponent sites. The assemblage is predominately manos and metates, with a few choppers and tabular tools. One-hand manos are the most frequent. The large, two-hand mano is unique, and may be a specialized mesquite-processing tool. Slab metates slightly outnumber basins, though the high percentage of fragments precludes a conclusive ratio.

Most tools have received very little shape modification. About half of the one-hand manos are well-shaped, however, suggesting these tools may be more specialized, and possibly stored as site furniture between foraging visits. Though highly abrasive vesicular basalt and sandstone materials are available at several locations in the basin, tool stone of comparatively lower abrasion quality was preferred. Various degrees of wear are evident among project ground stone tools, with moderate to heavy use dominating. Surface rejuvenation is rare, even for moderate to heavy use.

The vast majority of all ground stone is fragmentary (83 percent), and may be related to the percentage displaying evidence of exposure to heat, as evidenced by sooting, reddening, and fire-cracking (n = 14/66, or 21 percent). This suggests that ground stone tools that were not exposed to heat were expended or broken during use and not recycled in thermal features, or that tools used in thermal features are too fragmented to be identified as such. The proximity of ground stone to thermal features was due in part to the excavation focus of these areas, but may be related to tool function.

However, both heating and grinding processes were used for some foods. Stahl (1989:181–183) provides an extensive list of benefits derived from heat treatment of wild foods, including parching and roasting with dry heat, and boiling, steaming, or simmering with moist heat. Heating can also facilitate hulling, prepare foods for storage, or chemically alter foods to reduce toxins and/or increase digestibility. Moist heat, in particular, increases digestibility. Although nutrients can be lost through heat exposure, nutritional gains can offset this loss (Stahl 1989:183). Grinding, pounding, and grating processing methods increase the nutritional value of foods by reducing particle size, which eases digestion (Stahl 1989:172–175). A variety of processing methods can be employed for a single food, and this, in itself, can be considered an intensification of specific resource use (Stahl 1989:185). These combined benefits illustrate the possibility of functional associations between ground stone tool use and thermal features.

Ground Stone Discussion

As Miller and Kenmotsu note (2004:207, 218), the Trans-Pecos region appears deceptively harsh and unforgiving, but actually serves as a rich foraging locale, providing abundant and varied plant resources with the beginning of the Holocene. Gibbs (2003:6–7) posits that "the landscape we see as barren and harsh today was a veritable grocery store for prehistoric peoples." While resource availability has varied over time within the Jornada, wild foods have served as a staple since the Archaic. The drying trend beginning at the end of the Pleistocene allowed for the expansion of plant communities, directly affecting subsistence strategies in Chihuahuan desert environments. The Early Agricultural period is marked by a number of significant changes, including a "decrease in residential mobility, commitment of labor and facilities to the farming of maize and other crop plants, and increased reliance on the storage of maize and other foodstuffs (which) signal the termination of the purely hunting-gathering, Archaic lifeway" (Huckell 1996:343). Miller and Kenmotsu (2004:218, 221) list additional developments in the Early Archaic that are especially pertinent to the ground stone assemblage, such as the exploitation of a broader range of plant resources and technological changes in food processing. Ground stone artifacts make their first appearance, suggesting greater reliance on plant processing. The Middle Archaic may have witnessed increased reliance on cacti and desert succulents, though direct evidence of this is not available (Mallouf 1985, cited by Miller and Kenmotsu 2004:224). The Keystone Dam site yielded a variety of plant remains including four-wing saltbush, cheno-ams, purslane, mesquite, rushes, grasses and cacti. In the Trans Pecos region, the introduction of cultigens marks the Late Archaic (Miller and Kenmotsu 2004:226), signaling the end of a dominant hunter-gatherer economy and the beginning of the transition to a mixed farmer-forager subsistence system in many regions of the Southwest, with gathering of wild seeds becoming increasingly important (Dello-Russo 2006:18).

A wide variety of wild seeds occur in early Formative sites as well, including purslane, chenopodium, amaranth, sunflower, acorn, mesquite, tornillo, mallow, yucca, sumac, bugseed, mustard, cacti, and grasses (Moore et al. 2010:31 and references therein). Early Formative sites in the Fort Bliss area yielded many of these same seed types, all of which were charred (Condon et al. 2010:311). Gibbs, noting that over 1,000 plant species grow in the San Andres Wildlife Resource area, describes it as "a veritable grocery store" (2003:6–7). Grass seed, in particular, was an important resource, evidenced in Late Archaic coprolite remains from Shelby Brooks Cave, often parched (Holloway 1983, cited by Miller and Kenmotsu 2004:229). Leaf succulents such as yucca were also exploited. Wild resources figure into subsistence economy throughout all time intervals, with mesquite seeds and pods of particular importance (Miller and Kenmotsu 2004:249). Various grasses, mesquite, cacti and succulents continue to be gathered during Formative periods. Interestingly, the use of cacti and succulents may have fluctuated with agricultural dependence, and were used most heavily between AD 400 and 1250/1300 (Miller and Kenmotsu 2004:248–249).

The increase in the range of exploited plant materials coincides with the development of ground stone tools used to process these resources. In the Jornada, the reliance on gathered foods persisted until AD 1000, as agriculture was a "risky, low-return proposition" (Moore et al. 2010:32). Even after the advent of agriculture, cultigens are supplemental to wild foods throughout the following Doña Ana phase, though the appearance of two-hand manos is thought to signal increased reliance on agriculture. Cacti and succulent use is more in evidence at the end of the Doña Ana phase as well. Interestingly, the Protohistoric period may have signaled a return to hunter-gatherer subsistence patterns (Upham 1984, 1988).

The abundance of wild resources in the Jornada, including black grama, blue grama, and side-oats grama, has been noted by several late nineteenth and early twentieth century observers, who describe vast, thick stands of grass (Buffington and Herbel 1965:140–141; Dick–Peddie 1966:234 and 1993:18-20). The degradation of grazing lands was documented in the early twentieth century by E. O. Wooton, who deduced that the primary cause was overgrazing (Havstad et al. 2006:7). Clearly, the Jornada del Muerto environs of the prehistoric and Protohistoric periods provided far richer resources than are available today.

Use of the basin areas as essential plant resource zones began in the Archaic and continued into late Formative phases, fluctuating between 2500 BC and AD 1450 in the Fort Bliss area (Condon et al. 2010:218). Lowland sites in the Fort Bliss area are described as "continuously active" (Condon et al. 2007:173). Wild resources continued to figure prominently in the diet into late Formative period, though cultigens begin to occur in higher elevation sites after AD 1000, possibly the result of trade or transport as a mobile resource rather than cultivation (Condon et al. 2010:311–313). In the San Andres Wildlife Refuge area, low-elevation basin sites were intensively used foraging locations, evidenced by greater artifact diversity and much higher ground stone tool frequencies than high elevation sites (Gibbs 2003:6-4–6-6). In the Hueco Bolson, artifacts used in plant processing, primarily ground stone, occur on sites near playas (Church, Sale and Ruth 2001:100).

Condon notes that defining land-use patterns within the bolson, alluvial fan, and upland environs of the Fort Bliss area is problematic, due in part to the intermixing of assemblages from repeated site occupation (Condon et al. 2007:171). This intermixing of tools from multicomponent sites is likely occurring in the Spaceport project area as well, creating issues with identifying temporal trends in tool use. However, the Spaceport ground stone shares several characteristics with the Fort Bliss assemblage, and may allow for some tentative conclusions.

Ground stone material choice and wear patterns as economic indicators. As with the project assemblage, Fort Bliss ground stone tools (Condon et al. 2007:165) were made from minimally abrasive, locally available stone; they display moderate to heavy wear; and they are thought to have been used to process wild, rather than cultivated foods (Condon et al. 2007:173). It is unclear to what extent the project ground-stone material choice, heavy wear, and lack of rejuvenation reflect processing requirements. A few factors suggest that these combined traits denote seed processing: (1) low abrasion materials dominate the project assemblage regardless of cultural affiliation, with the possible exception of LA 155968; (2) botanical remains indicate that only wild seeds are processed at project sites, and (3) archaeological work in the Jornada region suggests that basin sites served as foraging locations for wild foods.

Ground stone from sites in Fort Bliss may offer some clues as to these functional associations. Fort Bliss ground stone is dominated by one-hand manos and basin and concave slab metates (Condon et al. 2010:299–300). Fort Bliss starch analysis indicated that maize and wild rye were being processed, possibly together. Condon concludes that the low processing capacity of the ground stone tools and the type of plants being processed suggests an orientation toward small, seasonally mobile populations (Condon et al. 2010:300). The Spaceport ground stone certainly reflects low processing capacity, though materials are slightly more abrasive than those at Fort Bliss.Murrell (2005) analyzed a large whole-mano assemblage from 115 sites from the Rio Puerco Valley Project in north-central New Mexico that ranged in date from aceramic to AD 1300. Prior to analysis, Murrell conducted use-wear experiments based on replica manos and metates, and arrived at several conclusions regarding the relationship between material type and efficiency. He observed that large manos of highly abrasive materials such as vesicular basalt and sandstone were the most efficient tools in terms of time and amount of material ground. With this observation forming part of the underlying assumptions of changes in mano tool stone and surface area through time, Murrell observed that during aceramic periods, vesicular basalt manos were absent and small metamorphic manos dominated, leading him to conclude that corn meal production was low priority during this time (2005:114). Later periods witnessed an increase in the use of larger, more abrasive manos, with a dramatic increase from AD 900–1000 (Murrell 2005:115). Interestingly, small metamorphic manos fluctuate beginning with the early ceramic periods, never attaining the majority status of the earliest aceramic periods (Murrell 2005:Figure 26). Murrell's research supports the use of low-abrasion materials with wild food processing, noting a positive relationship between abrasive material types, larger mano size and agricultural dependence (2007). The reverse is also true, that the "smallest metamorphic manos" dominate assemblage during hunting and gathering economies (Murrell 2007:49).

Stone examines the impact of raw material scarcity on ground stone technology through the examination of an assemblage from Pueblo Grande, a Classic-period Hohokam site in Arizona (1994). She concluded that residents were willing to expend the time and energy necessary to obtain non-local vesicular basalt for ground stone tools because of its greater efficiency in grinding corn as compared to less abrasive local materials (Stone 1994:691). She further notes that in the current Southwest model, manos of smooth, non-vesicular materials are linked with processing of small, hard seeds on basin metates, and that larger manos of rough or vesicular basalts and rhyolites are associated with trough and slab metates to process large grained seeds (Stone 1994:682).

Adams (1999:87) observed a stark difference in the efficiency of variously textured ground stone tools. In her use-wear experiments with mano and metate sets from the Arizona State Museum, she noted that vesicular materials were far more efficient for corn grinding than "granular" materials such as granite, metaquartzite, and sandstone (Adams 1999:486–487). Vesicular materials also produced less grit in the flour. Though ground material became trapped in the vesicles, surface efficiency was easily restored by cleaning the vesicles. This differs from granular material, which became dull and ineffective as soon as the grains became flattened.

This choice of low-abrasion tool stone coupled with the dominance of heavy wear is mirrored in an ethnographic study of Australian Aboriginals (Smith 1986). Grass seeds are ground on a metate with long, narrow grooves. Mano and metate wear surfaces are very smooth and finely abraded, often becoming polished from silica residue (Smith 1986:32–33). Surface rejuvenation is described as "occasional." Small metaquartzite handstones are used, some of which are carefully manufactured. As in the Southwest during the Holocene, these distinctive tools were developed in response to the need for intensified seed exploitation. This sheen was rarely observed on project ground stone, though low abrasion tool stone and heavily worn, unrejuvenated surfaces are characteristic. Smith's study is challenged by others (Gorecki et al. 1997), who claim that pounding and milling occur on the same metate, and that the concave groove is simply the end product of this use on a slab metate. These two views taken together suggest that while the Australian tools are indeed used for seed grinding, they are also versatile in terms of processing method.

The botanical remains from project sites suggest that several foods were exploited from the Archaic to Protohistoric periods. Grasses, mesquite, cacti, and yucca were recovered from features representing nearly every occupation period. Several factors compromise the potential to assess trends in ground stone tool use over time. Ground stone tool fragments, and possibly even whole tools, were collected and reused as heating elements, destroying their original contexts. During this project, very few tools were recovered from features that yielded radiocarbon dates (Table 15.3). While 27 tools originate from feature surfaces or fill, all but three are fragmentary. Only 12 of these tools are from features with radiocarbon dates, six of which were found on the surface. This leaves six tools in a secure, dated feature-fill context, five of which were used as heating elements. Only one of the six tools is whole: the edged limestone abrader from LA 155964.

The highest frequencies of one-hand manos and metates of both types occur at sites with multiple occupations, particularly LA 111429 and LA 155963, which is likely due to the comparatively larger assemblages found on multicomponent sites. Whether sites with more restricted occupations reflect more limited ground stone morphology is uncertain, as few tools that can be assigned to types are available from such sites. LA 111435 may represent the sole exception, dating from the Archaic to early Formative periods and yielding only basin metates and one-hand manos. Obviously, the high percentage of fragmentary tools and the small assemblage size cast doubt on any temporal associations. Perhaps more indicative of ground stone tool use in the project area is the predominance of unmodified or minimally modified natural forms, suggesting that expedient use of ground stone is more in evidence, regardless of time period. This trend applies to both surface and subsurface artifacts, which display nearly equal frequencies of shaping modification (Fig. 15.14). Surface artifacts display slightly higher levels of modification, which may owe in part to selective surface collection prac-

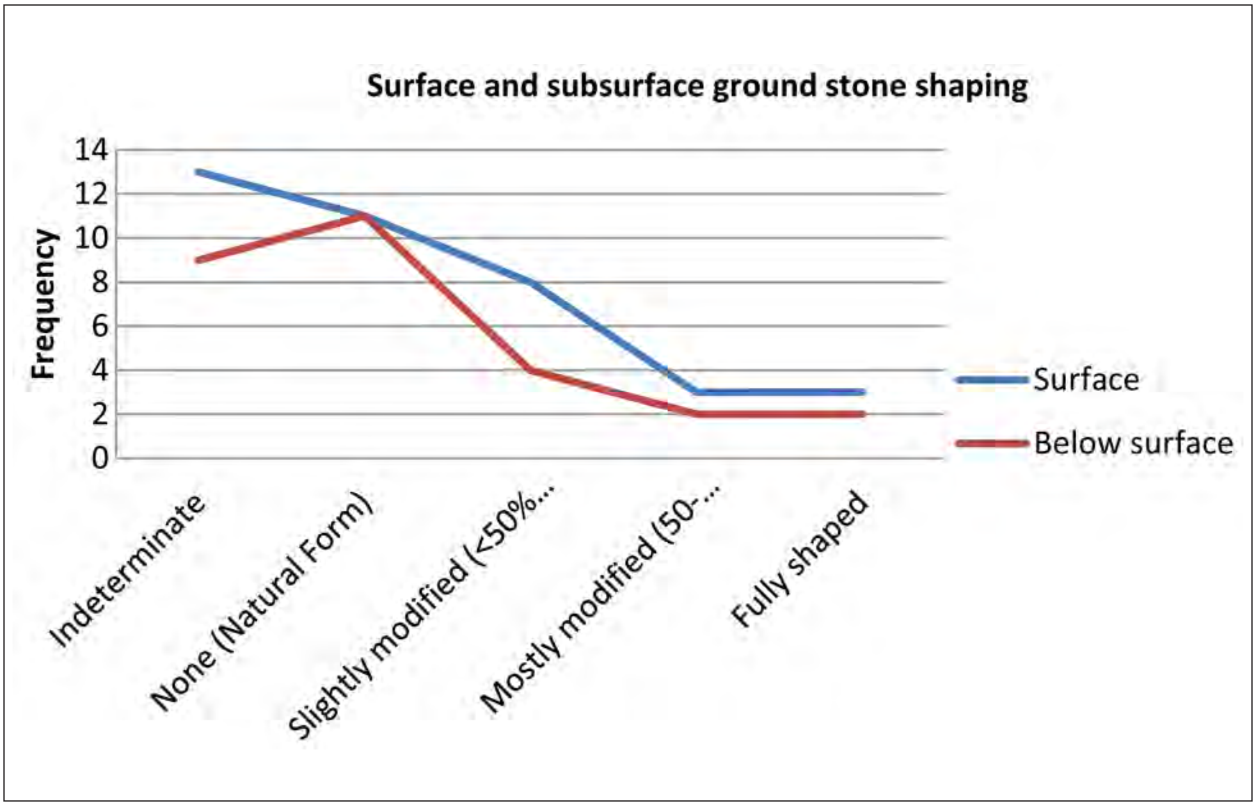

Figure 15.14. Surface and subsurface ground stone shaping.

tices in non-feature areas during data recovery (which favored whole artifacts with greater analytic potential). Several researchers have noted the lack of change in ground stone tools from pre- to post-agricultural economies in many areas of the Southwest (Wills 1988; Adams 1999). Within the Jornada Mogollon, stability in ground stone tool design remained largely constant for 2,000 years after the introduction of cultigens (Huckell 1995:4; Huckell et al. 2002:138; Morris 1990:186). One-hand manos and basin metates are considered characteristic of the Archaic, though these forms continued into the Formative period in many areas of the Southwest (Adams 2002:122, Fig. 5.15), including the Jornada basin and range region.

Wills (1988:16–17) cautions against assigning temporal status to milling stones, citing the long-term technological consistency in the Mogollon Highlands that is independent of cultural change. He further posits that this stability in tool design may indicate functional specialization, noting that the same tools continue to be used as long as the resource availability remains constant. This may have particular applicability to the project area, which served as a rich wild-plant resource area from the Archaic to Protohistoric times.

The stability of tool form may belie complex processing methods, however. The Jornada Basin not only provides abundant plant life, it also offers plants of variable character, possibly necessitating different processing techniques. Grass and mesquite seeds represent two such contrasting foods. While both can be processed by grinding, some of the specific techniques vary. For instance, mesquite processing may entail pounding, which is not done with grass seeds. These two foods alone may require both versatile and specialized tools. This range of tool adaptability is impressively demonstrated in a number of ethnographic studies from the Southwest, Australia, and the Levant area. Wright (1994) lists a vast array of foods processed with the same types of manos and metates by numerous groups in North America, Africa, and Middle East, stressing that while tool design cannot be linked to a specific function or dietary emphasis, it can suggest "overall strategies" (Wright 1994:242). Adams' use-wear experiments (1988, 1993, 1999, 2002, 2010) led her to conclude that changes in ground stone tool design may signal changes in processing techniques, rather than a conversion from gathered to cultivated foods. Noting the long-term continuation of many tool forms with the introduction of cultigens, she suggests that mano and metate design were altered based on an increased reliance on flour-based recipes that used both wild and planted foods (Adams 2002:121).

While many caution against linking ground stone tool form and subsistence patterns, others find strong correlations between the two. Ethnographic tool use illustrates milling stone versatility, yet archaeological studies suggest that ground stone tools can be directly linked to relative dependence on wild versus planted foods. Mauldin's examination of ground stone assemblages from the Pine Lawn Valley in west-central New Mexico led him to identify several characteristics that develop with agricultural intensification (1993). Mano length and use surfaces increased dramatically from Early Pithouse to late Pueblo phases in this area, concomitant with reliance on cultigens. From AD 400–1300, large, bifacial manos were the dominant handstone for most, but not all, time periods, leading Mauldin to conclude that agricultural intensification may have waned during some phases (1993:325–328).

Hard (1986), observing these same attributes of mano length and number of use surfaces, advances this position further by applying ethnography, coprolite evidence, and climate data. Increased reliance on agriculture occurred more slowly in more arid environments where farming would be less productive. Areas such as these display much greater consistency in use of small manos over time than in more mesic environments, where farming was more likely to succeed (Hard 1986). For dozens of southwestern groups, smaller mano size is clearly correlated with hunting and gathering economies (Hard 1986:114–118, Table 10). Perhaps the most compelling correlation between mano size and subsistence is demonstrated by Hard's use of climate data (1986:128–196). Drier environments produce higher yields of wild resources, obviating the need for supplemental agriculture. Hard compares mean mano length for a wide range of climate locations, three of which have high "PB" ratings (an indirect measure of plant food availability) identical to Chihuahuan desert environs: Big Bend, Fort Irwin, and Death Valley, all of which have a mean mano length of 10.6 cm (Hard 1986:154, 160, Tables 14, 16; 173, Table 19). The mean mano length for the Spaceport project is 11.8 cm, larger than that of the foraging economies in Hard's study (Table 15.4). However, the Spaceport mean is based on a small sample of only six artifacts, and includes the large two-hand mano from LA 155963. When this mano is excluded from the calculation, the Spaceport mean mano length drops to 10.6 cm, identical to Chihuahuan Desert locales in Hard's 1986 study.

Hard's work on the relationship between mano size, subsistence economy, and environment continued with a later study that incorporated additional lines of evidence (Hard et al. 1996). In this later study, maize ubiquity and human collagen stable carbon isotope data from six areas and 13 phases in the Southwest are examined to determine the correlation between mano area and agricultural dependence across a large geographic space (Hard et al. 1996:260). The six study areas are Black Mesa, Cedar Mesa, Mesa Verde, Sierra Blanca, the Texas-Oklahoma panhandles, and the southern Jornada. Based on maize ubiquity values, three patterns of farming adoption were suggested: (1) early substantial use followed by continuous increasing maize dependence; (2) initial intensive dependence with little change in later periods; and (3) a long period of minor use followed by substantial dependence. The Southern Jornada reflects the latter, with very low maize ubiquity values in the Archaic and Mesilla phases, steadily increasing in the Doña Ana and El Paso phases (Hard et al. 1996: 283, Fig. 4). Mean mano length increases concomitant with maize ubiquity, from 8.9 cm in the Archaic to 12 cm in the Mesilla phase. The authors suggest that while "mano size is principally related to degree of maize utilization," other factors can affect this relationship (Hard et al. 1996:302). Mano size can be affected by other factors such as the regularity of site use, access to raw material, degree of mobility, use of non-flour recipes, and grinding capacity and user experience (Hard et al. 1996:302 and references therein).

Diehl (1996) arrives at a similar conclusion based on a large mano assemblage from upland Mogollon pithouse villages spanning four occupation phases from AD 200–1000. Mean mano surface area increases over time, and is thought to be based

Table 15.4. Mean whole mano measurements for all sites.

		Length (mm)	Width (mm)	Greatest Thickness (mm)
Manos, one hand	Mean	98	79.5	46.8
	N	4	4	4
	SD	11.2	17.7	7.1
	Minimum	86	60	37
	Maximum	111	96	52
	Range	25	36	15
Manos, two hand	Mean	158	122	75.5
	N	2	2	2
	SD	24.0	42.4	29.0
	Minimum	141	92	55
	Maximum	175	152	96
	Range	34	60	41
Total	Mean	118	93.7	56.3
	N	6	6	6
	SD	33.9	32.1	20.5
	Minimum	86	60	37
	Maximum	175	152	96
	Range	89	92	59

N = count
SD = Standard Deviation

on a higher per capita maize consumption (Diehl 1993:110). In his study of Mimbres Valley Salado ground stone, Lancaster concludes that two-hand manos and trough metates were likely "created to grind corn," while emphasizing that the frequency of basin manos and metates cannot be used to determine the degree of reliance on wild foods (1986:190).

When the ground stone assemblage recovered from this project is compared with the various studies and the ethnographic documentation provided in this chapter, we conclude that the tools recovered from our sites reflect a subsistence system focused on collecting and processing wild plant foods. A variety of processing methods appears to be reflected, but grinding is the most evident in the assemblage. The strong correlations between small mano size and foraging economies noted in the above studies support the hypothesis that sites in the project area served as long-term foraging locations, where the tools most appropriate for the task, one-hand manos and slab metates, were used. Ethnographic tool use provides convincing evidence that milling stones are extremely versatile, both in terms of the range of foods and the methods used to process them; though specialized tools may be required for some tasks, particularly those related to mesquite processing. Site botanical remains indicate that a variety of basin foods are exploited, including grasses, saltbush, mesquite, cacti, and yucca. Saltbush, yucca, and mesquite were also used as fuel. Low-abrasion materials, heavy use, unrejuvenated surfaces, general paucity of tool shaping, and use of local tool stone suggest an expedient assemblage was employed to process these varied resources.

Ornaments

Eight artifacts in this category were found in the Spaceport America project area, including an obsidian cruciform (n = 1), a worked concretion phallic symbol (n = 1), a travertine disc bead (n =

1), a green chert pebble (n = 1), gypsum raw material (n = 1), a Pecos diamond (n = 1), and stone balls (n = 2). These artifacts are from LA 111429 (n = 1), LA 155963 (n = 5), and LA 155968 (n = 2). The materials in the assemblage derive from a mix of local and exotic sources. Local materials within the basin are travertine, gypsum, and sandstone concretions. More distant sources include the Jemez Mountains to the north, the Jarilla Mountains to the south, and the upper reaches of the Pecos River near Roswell.

Obsidian Cruciform (n = 1)

One of the most exciting finds at LA 111429 was an obsidian cruciform (Fig. 15.15). The distinctive shape of these four-pointed artifacts is thought to have originated in Mexico and diffused north into the Southwest, though conclusive evidence of this is lacking (Mountjoy 1971:45; Hemmings 1967:150). Hemmings (1957:158) posits the intriguing possibility of a northern origin based on the strong resemblance between cruciforms from the Paleoindian Iyatayet site in Alaska and those found in Archaic contexts in the Southwest. The Spaceport specimen was found on the surface of LA 111429, in the southern portion of the site, in Paleoindian Area 3, proximate to a large fire-cracked rock scatter (Feature 10). Cruciforms are commonly manufactured from conchoidally fracturing materials, which are flaked into lenticular cross-section forms. After shaping, they are ground on the surfaces, edges, and points, and sometimes polished. Cruciforms are most commonly found in Mexico, but have been recovered at numerous sites in Arizona as well. Hemmings (1967) has compiled many occurrences from these areas and defined four types. The cruciform from LA 111429 most closely resembles Hemmings' Type 1 cruciform, which is known from excavations and surface collections in Arizona, Texas, Sonora, Chihuahua, Durango, Sinaloa, Jalisco, and Nayarit (Hemmings 1967:157–158).

The LA 111429 specimen displays many traits typical of the Type 1 cruciform, including obsidian raw material, four facets on each surface, concave facets along each edge, ground tips, lenticular cross-section, and midpoint of the arms intersecting at right angles. The longest diagonal measurement between tips is 25 mm, within Hemmings□ range of 19□48 cm. It is slightly asymmetrical, which is also typical of Type 1 cruciforms. While cruciforms are commonly manufactured from obsidian, other materials have been used, including flint, chalcedony, metaquartzite, lava, basalt, pitchstone, serpentine, moonstone, mudstone, slate, limestone, and various calcareous and tufaceous rocks (Brook 1966). Cruciforms of bone and pottery are reported from the vicinity of El Paso, Texas (Brook 1966). Brook notes that cruciforms in the El Paso area may date from pre-ceramic periods to AD 1450, though the context of these artifacts is somewhat tenuous. A more secure date of 2675±80 BP to 2605±80 BP (based on marine shell) is given for a cruciform found in Nayarit, Mexico (Mountjoy 1971).

Cruciforms are distinctive both in form and manufacturing technique. Hemmings (1967:157–158), recounting the occurrences of the artifacts in Mexico and Arizona, broadens the temporal range of Type 1 cruciforms to AD 800–1400. The existence of an even earlier—and cruder—cruciform tradition is possible, based on finds at several pre-ceramic sites in Arizona (Hemmings 1967:158 and references therein). Hemmings (1967:162) suggests that cruciforms served either as dice or counters in games that were played in ceremonial contexts by various groups in northwestern Mexico and the Southwest. They are also found as offerings in graves, cremations, and ceremonial paraphernalia (Hemmings 1967:162). They occur most frequently in Arizona and Sonora, with lesser numbers in Chihuahua, Durango, and Texas. Cruciforms are less common in New Mexico, and the Mexican states of Sinaloa, Jalisco, and Nayarit. The burial context of many cruciforms has led others to suggest that they served as atlatl weights (Johnson 1971). This proposed function is based on: (1) the location of the cruciform relative to the body and the male gender of the burial; (2) preserved atlatls with shaped stones for weights; and (3) various attributes that would facilitate hafting the cruciform onto the atlatl, such as its ground, concave edges (Johnson 1971:190–191).

The Spaceport cruciform is manufactured from a clear gray, vitreous obsidian with white spherulite inclusions, which may originate in the Jemez Mountains. Shackley (2005:69) notes the occurrence of "devitrified spherulites" in the Cerro Toledo rhyolite and Valle Grande rhyolite sources of the Jemez Mountains. However, the presence of Jemez obsidian in the Jornada basin does not necessarily infer travel or exchange with groups to the north. Shackley (2002:56) observes that obsidian can travel 250 km in Rio Grande alluvium, from primary sources in the Jemez Mountains and Mount Taylor south to Chihuahua, sometimes arriving in nodules up to 3 cm in diameter. He stresses that this "graphically points to the hazards of deriving exchange inferences based on simple distance to source models" (Shackley 2002:56–58). Interestingly, he cites two discoveries of cruciforms, one of Grants Ridge obsidian and one of Cerro Toledo obsidian, both of which were found at Archaic sites in Chihuahua, Mexico (Shackley 2002, 2005). He suggests that the cruciforms could have been manufactured at any of these three locations—Chihuahua, Grants Ridge, or the Jemez Mountains—as these varieties occur as nodules in Rio Grande alluvium.

Disc Bead (n = 1)

The only formal ornament from the project is a white travertine disc bead from LA 155963 (Fig. 15.16). The bead is split along the bedding planes, but the full diameter is still intact. Interestingly, the bead continued to be used after this, evidenced by the rounded and polished broken edge. It appears to be associated with the early Formative occupation of LA 155963; it was found proximate to a Mesilla-phase thermal feature (Feature 141) in Area B. Artifacts of this type were recovered from pits, subfloor features, postholes, and hearths in rooms at Madera Quemada (a fourteenth-century Jornada Mogollon pueblo located in south-central New Mexico), and included beads, turquoise, and worked fossils (Miller and Graves 2007:132).

Travertine appears to be an unusual bead material in the Jornada region. Church et al. (1996:123–124) notes that artifacts of travertine are uncommon in the Jornada region, possibly because they are not recognized as such. Disc beads are almost exclusively made from shell or bone at Mesilla-phase sites in the Fort Bliss area (Condon et al. 2008, 2010). The Border Star 85 project recovered a bead and carved fragment of travertine thought to originate from spring deposits in the northern Tularosa Valley (1988:275). Church states (1996:123–124) that because travertine is deposited in caves or springs, sources are typically localized.

In a geologic study of the Prisor Hill quadrangle, "travertine mounds" are located within "conspicuous" freshwater limestone beds formed by spring deposits that fed local freshwater ponds and cienegas (Seager and Mack 2003, cited by Seager 2005:unpaginated). Specific locations of these deposits are not listed, but the limestone is part of the Palm Park Formation, which outcrops at Upham Hills, Point of Rocks, and Prisor Hill, the latter being most proximate to the project area.

Phallic Symbol (n = 1)

The project's largest spherical concretion is grooved and pecked into a phallic symbol (Fig. 15.17). It was recovered from the surface in a somewhat isolated context, about 70 m west of Area A South at LA 155963. A very narrow, shallow groove completely encircles the stone at the midpoint (1 mm width, depth <1 mm). The concretion also displays a shallow dimple in the horizontal center of the circular groove (5 mm diameter, 1 mm depth). The entire surface is smooth and lightly polished, either from handling or exposure to high heat, wind, and sand erosion.

Green Chert Pebble (n = 1)

This artifact is associated with the Mesilla-phase component at LA 155968 (Fig. 15.18). It is a green waterworn chert pebble measuring 12 by 9 by 7 mm, with a Moh's hardness rating of 6.5–7.5, that was recovered from the bottom of a large, Mesilla-phase roasting pit (Feature 1), raising the possibility that it may have been placed there during a ritual termination. It is not worked, but the entire surface is polished, suggesting the piece may have been curated. Its waterworn cortex indicates that it eroded from drainages sourced in the mountains bordering the basin, and was possibly procured in lag gravels in Yost or Aleman Draws. Other waterworn chert materials were collected and identified from these drainages during data recovery (see also Chapter 23, this report). While gray and black chert outcrops occur in the San Andres Mountains (Seager 1981) and the Caballo Mountains (Silver 1952), a primary source for green chert could not be found proximate to the project area. The use of natural objects in ritual closure features is perhaps most ubiquitous at Madera Quemada. In one particular closure pit there (Feature 11.2), 153 objects were cached, including shaped (culturally or naturally) stones, marine-shell fragments, crystals, mineral pigments, fossils, ceramics, and wood (Miller and Graves 2007:401–411). Two of the natural objects selected for ritual caching in this feature were green (Miller and Graves 2007:Fig. 15.7) Malachite, turquoise, shell beads, pigments, quartz crystals, and

Figure 15.15. LA 111429, obsidian cruciform.

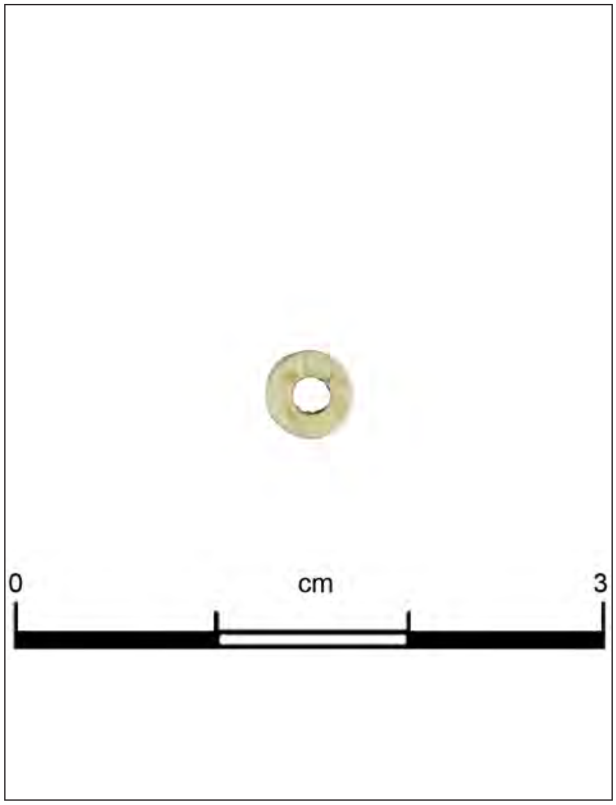

Figure 15.16. LA 155963, travertine disk bead.

Figure 15.17. LA 155963, phallic symbol made from a concretion.

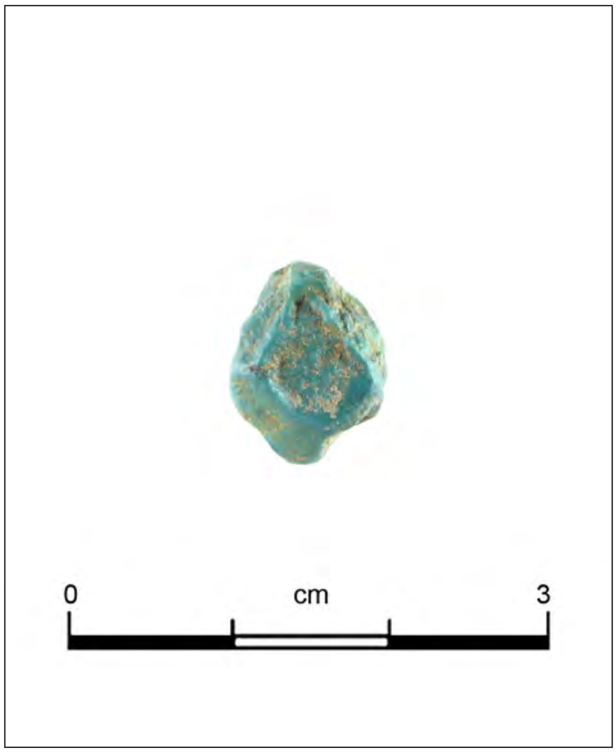

Figure 15.18. LA 155968, green chert pebble.

fossils thought to have served as closure offerings were recovered from room floors and subfloors, storage pits, and postholes at this southern Jornada pueblo village (Miller and Graves 2007:379–412). Pigmented fossils and ground stone tools were also linked with ritual function at Madera Quemada. Objects such as these, in these particular contexts, can be viewed as "dedicatory offerings" placed during residential construction or as closure offerings placed during termination rituals (Miller and Graves 2007:378). Artifacts used for these closure rituals are typically obtained from distant sources. While this function is a possibility for the green chert pebble from LA 155968, it is by no means certain—the pebble could as easily have simply washed into the roasting pit after its abandonment.

Gypsum (n = 1)

One unmodified fragment of gypsum (37 by 36 by 19 mm) was recovered from LA 155963. The gypsum fragment was collected from the surface of Feature 14, a rock-filled thermal feature within a concentration of lithic and ground stone artifacts. Gypsum is common near the project area, most notably at White Sands, east of the San Andres Mountains. Thick gypsum beds also outcrop within the southern San Andres Mountains as part of the Panther Seep Formation (Seager 1981:31). Since this specimen was unmodified, no function can be suggested for it.

Pecos Diamond (n = 1)

This small quartz crystal (8 by 7 by 5 mm) from LA 155963 is a transparent Pecos diamond, which likely originated a considerable distance from the project area in southeastern New Mexico. These unique, double-pointed crystals outcrop along the east side of New Mexico's Pecos River Valley for 100 miles, from Dunlap to Artesia (Albright and Leuth 2003, New Mexico State Parks Series 1999:53–54; Northrup 1959:423–432). While this is perhaps the best-known and most abundant outcrop of double-pointed crystals, they are not unique to the Pecos River Valley. Double-pointed crystals also occur in Grant, McKinley, and Mora counties (Northrup 1959:425, 426), though these areas are a considerable distance from the project area. Pecos diamonds occur in a variety of colors, grading from clear to yellow to orange. The transparent crystals are usually quite small, measuring less than 4 mm (Albright and Leuth 2003:65), half the length of the LA 155963 specimen. The specimen from LA 155963 most closely resembles a bipyramidal, pseudotrigonal crystal (Albright and Leuth 2003: 67, Fig. 6D, second image from left, 66, Fig. 7).

Albright and Leuth (2003:63) state that there is no evidence for prehistoric or historic use of the crystals. While there are few Pecos diamonds in the archaeological record, the possibility exists that the crystals were collected and used ceremonially. Perhaps the most ubiquitous occurrence of quartz crystals is at Madera Quemada, where they are frequently used as closure offerings in ritual terminations and are found in room floors and subfloors, storage pits, and postholes (Miller and Graves 2007:379–412). However, the double-pointed Pecos diamond does not appear to be among the assortment of items used as closure offerings at Madera Quemada.

A large assemblage of Pecos diamonds was analyzed from several sites at Lower Nash Draw near Carlsbad (Wiseman n.d.). While the Lower Nash Draw project is proximate to the source of these crystals, and the vast majority are unmodified, there may be at least some cultural significance to their presence at Spaceport project sites, though it is important to note that the crystals were fairly abundant off-site in the Lower Nash Draw area as well.

The quartz crystal from LA 155963 was found on the surface of Artifact Cluster 4, which yielded Late Archaic-, Mesilla-, and Protohistoric-period features. It is interesting to note that this crystal was found in the same general vicinity as the gypsum fragment and the stone ball (see below) that were found on this site. While none were found in direct feature association, their relatively proximate locations on this large site prompts one to at least consider their possible association with ritual activity in this area.

Stone Balls (n = 2). Two round, unmodified hematitic sandstone concretions were recovered in the project area, one at LA 155963 and the other at LA 155968. Both measure slightly over 2 cm in diameter. No evidence of wear from handling is evident for either.

The stone ball at LA 155968 displays two small naturally formed nipples. This nippled concretion was recovered from a surface-stripped area adjacent to a large, Mesilla-phase roasting pit (Feature 1). This feature also yielded the green-chert pebble discussed above. The ball's near-surface context is not as secure as the green chert's, but it is interesting to consider a ritual association for both of these artifacts with this feature.

The second small concretion, found at LA 155963, displays a light overall polish, possibly the result of handling. It was recovered proximate to the site's Feature 131, a small, dispersed fire-cracked rock scatter. This could indicate that the concretion is associated with the Mesilla- or Protohistoric-occupation periods of the site.

Stone balls are found in closure-offering caches at Twelve Room Pueblo, along with turquoise and shell beads and loose yellow ochre (Jackson and Thompson 2005:17 cited by Miller and Graves 2007:57). Interestingly, no stone balls are recorded from Mesilla-phase sites of the Fort Bliss project. It is possible that ritual use of these natural objects is primarily associated with later Formative-period occupations. Spherical concretions may occur in outcrops in the southern San Andres Mountains, where "abundant concretions" are described in the Love Ranch area (Seager 1981:33).

Ground Stone and Ornaments: Discussion and Conclusions

Ground Stone

The ground stone assemblage reflects the occupation of short-term seasonal foraging camps that were visited to exploit local resources. Most of the abundant and varied resources of the basin appear to have been processed with a versatile, unspecialized tool kit. Ground stone tools were primarily expedient, reflecting low investment in manufacture and maintenance. These same traits also denote an abundance of tool stone. Material types, surface rejuvenation, and wear indicate a preference for the smooth, moderately abrasive surfaces commonly associated with processing of wild plants. Though highly abrasive material is available, it was rarely used. Mano size was comparable to that of various Chihuahuan Desert site locations with foraging economies. Tools were expediently manufactured from local tool-stone sources and used to process a variety of gathered resources, and may have been stored as site furniture for future foraging visits. Broken tools were collected and recycled as heating elements in thermal features. Whole tools may also have been employed in tasks involving heat and were fractured as a result. These characteristics were also observed in the ground stone assemblages of several sites from the Lower Nash Draw project near Carlsbad, where sandstone basin metates and one-hand manos are almost exclusively represented at Archaic foraging campsites (Wening, ms. in prep.). The Lower Nash Draw assemblage almost exclusively comprises sandstone one-hand manos and basin metates with low to moderate abrasion and maintenance wear. The Spaceport tools that could be typed reflect a dominance of one-hand manos and basin or concave slab metates. These tools are not restricted temporally. It is tempting to infer that these forms continued in use from the Archaic to Protohistoric times, and that is certainly possible given the long-term foraging economy of the Jornada basin; but most occurred as fragments and may only represent broken tools collected for use as elements in thermal features. However, the vast majority of characteristics of the ground stone artifacts reflect use by a mobile, foraging population that invested no more than the necessary time to manufacture versatile tools for use in processing a variety of basin resources.

Ornaments

The high mobility of Jornada basin populations may have supported, and even encouraged, substantial trade networks in early Formative periods (Condon et al. 2008:54, 400). Turquoise and shell provide evidence of regional exchange networks involving basin populations (Condon et al. 2008:54). Pacific coast shell, turquoise, and obsidian objects also illustrate the extent of regional contact during the Mesilla phase in the Fort Bliss area (Condon et al. 2008:354–355). These trade networks continued to develop into Pueblo III and IV periods in the southern Jornada Mogollon, evidenced by the presence of exotic items at Madera Quemada (Miller and Graves 2007:1). Items exported from the Jornada region include turquoise, salt, and possibly cacti (Miller and Graves 2007:1).

The obsidian cruciform found at LA 111429 may provide evidence that foraging groups in the Jornada Basin participated in exchange networks extending over a large geographical area, or they were in contact with groups to the north or south. Hemmings (1967:152) notes the occurrence of obsidian cruciforms in locations as far flung as Arizona and Texas in the U.S. Southwest, and Sonora, Chihuahua, Durango, Sinaloa, Jalisco, and Nayarit in Mexico. Unfortunately, many of these earlier reports could not benefit from obsidian-sourcing analysis, so the theory that cruciforms were manufactured in Mexico and traded north derives mainly from their temporal associations in each area. Also, materials are often identified simply as "obsidian." Definitively sourced and dated cruciforms are rare in the literature. A notable exception is the cruciform sourced by Shackley (2005:63–64), who reports that a cruciform from eastern Chihuahua was manufactured from Grants Ridge obsidian, noting that the material was likely procured from secondary source gravels of the Rio Grande, and does not imply trade or contact between groups in Mexico and the Southwest. Shackley emphasizes the extensive reach of Grants Ridge obsidian in river gravels, illuminating the importance of waterworn cortex in assessing the scope of trade networks. As the LA 111429 cruciform is devoid of cortex, its status as a secondarily procured material cannot be confirmed. The artifact could have been manufactured locally from material procured from Rio Grande gravels, or obtained through contact with groups to the north.

Hemmings (1967:157–159) notes the broad temporal association of cruciforms in the Southwest, which ranges from Archaic to late Formative periods. Most occurrences in the Southwest were recovered from Formative contexts, though several derive from preceramic levels associated with the Chiricahua and San Pedro stages of the Cochise Culture in southeastern Arizona. However, Hemmings (1957:158) suggests that cruciforms from Mexico probably predate the earliest Southwestern occurrences by a considerable margin, likening them to "composite" tools from the Old World Upper Paleolithic, which show use on the tools' edges and on their projections.

Other artifacts in the ornament assemblage may be indicators of long-distance procurement. Implications regarding trade or mobility related to the travertine bead depend on the source of the material. If travertine was obtained through travel to Point of Rocks (20 km to the south), it would represent only a moderate distance to travel. If the material was obtained from sources in the northern Tularosa Basin, it would involve a longer and more arduous trip, over the San Andres Mountains, or indicate an exchange with groups living near the source. The 20 km distance would be well within the geographic exchange networks described for the Late Prehistoric site of Wind Canyon in the Trans-Pecos region of Texas, where shell and ceramics were obtained from distant locations (Miller and Kenmotsu 2004:256). The Pecos diamond is a much clearer indication of long-distance acquisition by any means, as the Pecos River lies 230 km (143 mi) directly to the east, over the San Andres and Sacramento Mountain ranges. While the crystals can be found along a lengthy stretch of the river, all of the riverine sources for Pecos diamonds are restricted to the eastern areas of the state.

Miller and Kenmotsu (2004:235) posit that the territorial ranges of Archaic groups is underestimated, noting that obsidian from the Jemez Mountains and Cerro del Medio was found in Fresnal Shelter. The presence of this distantly sourced material may also indicate contact with groups to the north. Obsidian from several locations in Mexico has been found in the Jornada, one of which is Sierra Fresnal, about 100 km southeast of the Hueco and Mesilla Bolsons (Miller and Shackley 1998, cited by Miller and Kenmotsu 2004:235). Miller and Kenmotsu (2004) describe a shifting pattern in obsidian trade in the Trans-Pecos region, observing that Archaic sources were distributed along a north–south axis, shifting to east–west in the Mesilla phase, and reorienting back to the north–south pattern in the Doña Ana and El Paso phases. Whether the LA 111429 cruciform adheres to this pattern is uncertain based on the absence of the waterworn cortex, which would confirm its procurement from secondary sources. However, the early occurrence of cruciforms over a broad geographic range—which encompasses much of the U.S. Southwest and northern Mexico—along with the well-documented exchange of other items such as turquoise and shell, suggest that these items reflect contact between the two regions.

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