A Class III Transect Recording Unit Survey and Geophysical Prospection at the Burro Tanks Site (LA 32227), Chaves County, New Mexico

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Published: Albuquerque, New Mexico: SWCA Environmental Consultants. 2011
Document Type: book
Stable URL: https://core.tdar.org/document/378478/a-class-iii-transect-recording-unit-survey-and-geophysical-prospection-at-the-burro-tanks-site-la-32227-chaves-county-new-mexico
DOI: doi:10.6067/XCV8SJ1K9H

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>
> (1) further the purposes of this Act or the Act of June 27, 1960 [the Reservoir Salvage Act, as amended, 16 U.S.C. 469-469c-1] and
>
> (2) not create a risk of harm to such resources or to the site at which such resources are located."]

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[X] Text or figures have been blacked out on the following pages: *ii*, 1, 5, 7,
[X] The following pages have been removed in their entirety: 2, 3, 4, 98, Appendix A-ALL

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NMCRIS Activity No. 119533

A CLASS III TRANSECT RECORDING UNIT SURVEY AND GEOPHYSICAL PROSPECTION AT THE BURRO TANKS SITE (LA 32227), CHAVES COUNTY, NEW MEXICO

Prepared for

Roswell Field Office
Bureau of Land Management
2909 W. Second Street
Roswell, New Mexico 88201-2019

Prepared by

Matthew S. Bandy

With contributions by Jim Railey, Christopher Carlson, and Blake Weissling

Principal Investigator: Jim Railey

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NMCRIS Activity No. 119533
SWCA Project No. 16788
SWCA Cultural Resources Report No.: 2011-557

November 23, 2011

NMCRIS INVESTIGATION ABSTRACT FORM (NIAF)

1. NMCRIS Activity No.: 119134	2a. Lead (Sponsoring) Agency: Bureau of Land Management (BLM) Roswell Field Office	2b. Other Permitting Agency(ies): N/A	3. Lead Agency Report No.: N/A

4. Title of Report: A Class III Transect Recording Unit Survey and Geophysical Prospection at the Burro Tanks Site (LA 32227), Chaves County, New Mexico
Author(s) Matthew Bandy (with contributions by Christopher Carlson)

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?):
Over the years Burro Tanks (LA 32227 is the primary LA number) has been surface collected by local collectors, and the site has had several burials removed as reported by Don Sawyer of the Lea County Archaeological Society (LCAS) in his site form of June 1973. Don Sawyer reports that 20 burials were removed in the 1950s and two more were removed in the 1960s. According to the report, many of the burials were found under large fire hearths. Although part of the site is listed on the State Register of Cultural Properties (SR 155), current documentation research indicates no formal excavations have taken place on the site. Documentation also indicates that collecting began at least in the 1930s and probably before, and this can be attributed in part to the permanent water source and the reported good fishing in the lake.

The purpose of this project is to provide detailed baseline documentation of the present condition of the site, including protection and research recommendations.

8. Dates of Investigation: (from: August 2 **to:** October 27, 2010**)**

9. Report Date: November 23, 2011

10. Performing Agency/Consultant: SWCA Environmental Consultants
Principal Investigator: Jim Railey
Field Supervisor: Matthew Bandy, Christopher Carlson, Greg Mastropietro
Field Personnel Names: Ryan Brucker, Jennifer Walborn, Cassandra Keyes, Carlos Railey

11. Performing Agency/Consultant Report No.:
SWCA Cultural Resources Report No.: 2011-557

12. Applicable Cultural Resource Permit No(s):
110-2920-10-LL

13. Client/Customer (project proponent):
BLM Roswell Field Office via:
Contact: George MacDonell
George_MacDonell @blm.gov
Address: Roswell Field Office
Bureau of Land Management
2909 W. Second Street
Roswell, NM 88201-2019
Phone: (575) 627-0272; fax: (575) 627-0276

14. Client/Customer Project No.: N/A

15. Land Ownership Status ***(Must be indicated on project map):***

Land Owner	Acres Surveyed	Acres in APE
BLM Roswell Field Office	302.04	N/A
New Mexico State Land Office	173.88	N/A
TOTALS	475.92	N/A

16 Records Search(es):

Date of ARMS File Review: September 24, 2010	**Name of Reviewer(s):** Matthew Bandy	
Date of NR/SR File Review: September 24, 2010	**Name of Reviewer(s):** Matthew Bandy	
Date of Other Agency File Review: September 29, 2010	**Name of Reviewer(s):** Rebecca Hill	**Agency:** BLM

17. Survey Data:

a. Source Graphics ☐ **NAD 27** ☒ **NAD 83**

☒ **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**
Cedar Point, NM (Photorevised 1984)	35103-A8

c. County(ies): Chaves

d. Nearest City or Town: Hagerman, NM

e. Legal Description: The legal description, encompassing the site, is confidential and is presented in Table 1.1.

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

[redacted]

18. Survey Field Methods:

Intensity: ☒ 100% coverage ☐ <100% coverage

Configuration: ☐ block survey units ☐ linear survey units (l × w): ☒ other survey units (specify): Transect-Recording-Units (each unit was 15 × 15 m/225m^2)

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

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

Survey Interval (m): 15 **Crew Size:** 3 **Fieldwork Dates:** August 2–October 27, 2010

Survey/Recording Person Hours: 576 **Total Hours:** ~636 (includes travel)

Additional Narrative: N/A

19. Environmental Setting (NRCS soil designation; vegetative community; elevation; etc.): The project area is within the Mescalero Plain, east of the Pecos River valley and west of the Llano Estacado, which is part of the Southern High Plains. The site itself is situated in a localized dune field surrounding a dry lake bed and the present and eponymous Burro Tank. Vegetation on the site is primarily mesquite and shinnery oak communities, with some grasses, forbs, and cacti.

Two-track roads bisect the project area and cattle grazing has impacted the project area to a significant degree. Burro Tanks—an in-use, mechanically constructed bermed stock tank—is near the center of the project area. A majority of the project area's soil—the basin surrounding the Burro Tanks stock pond—is classified as Faskin-Roswell complex, a well-drained, loamy sand to sandy clay loam. The northwest and the entire eastern portion of the project area is classified as Roswell-Jalmar complex: 60 percent Roswell and 25 percent Jalmar soils, composed of fine sands to an average depth of 81 cm (32 inches) (often in the form of coppice dunes within the project area), with a loamy fine sand beneath. The southwest portion of the project area (where few artifacts or features were observed) is labeled as Faskin fine sand, a loamy fine sand to 48 cm (18 inches) with sandy clay loam beneath. All three soil types are found on 1 to 3 percent slopes (with the exception of dune faces) and are mixed alluvium and eolian deposits derived from parent material of sedimentary rock; all contain high levels of calcium carbonate (a maximum content of 50 percent) and up to 15 percent gypsum content.

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

The Pecos River valley supports desert grassland and riparian communities. The desert grassland communities are dominated by blue and black grama, muhly, dropseed, tobosa, and alkali sacaton grasses. These communities may also contain cholla, prickly pear, yucca, saltbush, Apache plume, mesquite, creosotebush, greasewood, tarbush, and shinnery oak. Local riparian species include cottonwood, tamarisk, bulrush, willow, cattails, cacti, and grasses. These plant communities are largely limited to the area along the Pecos River.

20. **a. Percent Ground Visibility:** 75% **b. Condition of Survey Area (grazed, bladed, undisturbed, etc.):** Grazed but otherwise undisturbed, with the exception of historical and ongoing collection and looting, and vehicle traffic on two-track roads.

21. CULTURAL RESOURCE FINDINGS ☒ **Yes, See Page 3** ☐**No, Discuss Why:**

22. Required Attachments (check all appropriate boxes):
☒ **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: Jim Railey

Signature ______________________ **Date:** November 23, 2011 **Title (if not PI):**

25. Reviewing Agency:	**26. SHPO**
Reviewer's Name/Date:	**Reviewer's Name/Date:**
Accepted ( ) Rejected ( )	**HPD Log #:**
Tribal Consultation (if applicable): ☐ **Yes** ☐ **No**	**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.:
119134	Bureau of Land Management (BLM) Roswell Field Office	N/A

SURVEY RESULTS:

Sites discovered and registered: 0
Sites discovered and NOT registered: 0
Previously recorded sites revisited (*site update form required*): 1
Previously recorded sites not relocated *(site update form required):* 0
TOTAL SITES VISITED: 1
Total isolates recorded: 6 **Non-selective isolate recording?** ☒
Total structures recorded (*new and previously recorded, including acequias*): 0

MANAGEMENT SUMMARY: The cultural resources survey investigated a single archaeological site—LA 32227, recommended eligible to the National Register of Historic Places under Criteria D, and currently listed on the State Register of Cultural Properties (SR 155). Six isolated manifestations were also discovered during this investigation, clustered primarily in the northwestern corner of the project area, on the ground surface along a disturbed, linear pipeline route.

IF REPORT IS NEGATIVE YOU ARE DONE AT THIS POINT.

SURVEY LA NUMBER LOG

Sites Discovered: None

Previously Recorded Revisited Sites:

LA No.	Field/Agency No.	Site Type/Cultural Affiliation and Dates	Eligibility Recommendation
LA 32227	NM-06-1150	Village/Campsites : Paleoindian, Archaic, Jornada Mogollon : 8000 B.C.–A.D. 1500	Criterion D

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CHAPTER 1
INTRODUCTION AND PROJECT DESCRIPTION

The Bureau of Land Management (BLM) Roswell Field Office retained SWCA Environmental Consultants (SWCA) to perform intensive surface documentation of the Burro Tanks site (LA 32227) in Chaves County, New Mexico. This project was funded through the Permian Basin Mitigation Program. It is intended as a study of this site for use in future planning action and is not associated with and particular undertaking.

The project area consists of a single block survey of 476 acres in southwestern Chaves County, [redacted]

The survey investigated a single cultural resource, LA 32227, the Burro Tanks site. Field methodology employed Transect Recording Units (TRUs) to record all cultural material within the project area in 15 × 15–m (49 × 49–foot) squares. This resulted in the delineation of the site boundary, the identification of sectors within the site, and a comprehensive characterization of its surface assemblage. This report details the findings of the survey and contains a detailed analysis of the artifact data collected.

George MacDonell is the Project Manager for the BLM (620 E. Greene St. Carlsbad, NM 88220; telephone [575] 234-5901). The project was conducted out of SWCA's Albuquerque office (5647 Jefferson Street NE, Albuquerque, New Mexico 87109; telephone [505] 254-1115, facsimile [505] 254-1116), with Matthew Bandy (mbandy@swca.com) as Project Manager and Jim Railey as Principal Investigator. Christopher Carlson (ccarlson@swca.com) and Greg Mastropietro (gmastropietro@gmail.com) were Field Supervisors, while Ryan Brucker, Cassandra Keyes, Jennifer Walborn, and Carlos Railey assisted with fieldwork. Anne Russell was the Geographic Information Systems (GIS) Specialist, Justin Elza was the Technical Editor, and Alayne Szymanski and Franchesca Lucero formatted and produced the document.

Details on the location of the investigated archeological sites, as well as nearby sites, including Archaeological Records Management Section (ARMS) data of previous investigations and archaeological sites and surveys within 500 m (1,640 feet) of the project area, are provided in Appendix A. *Locational information is confidential and for official use only—public disclosure of archaeological site locations is prohibited by 16 United States Code (USC) 470hh and 36 Code of Federal Regulations (CFR) 296.18.*

Pages 2, 3 and 4 have been removed to protect confidential site location information.

CHAPTER 2 ENVIRONMENTAL SETTING

The project area is within the Mescalero Plain, east of the Pecos River valley and west of the Mescalero Ridge and the Llano Estacado, which is part of the Southern High Plains.[redacted] The site is located at an elevation ranging between 1,230 and 1,250 m (4,037–4,100 feet) above mean sea level, roughly 3.8 (2.4 miles) west of the Mescalero Escarpment (the Caprock).

GEOLOGY AND GEOMORPOLOGY

The Middle Pecos River valley extends from Sumner Lake south to the New Mexico–Texas state line (Sebastian and Larralde 1989). The Pecos River flows between outwash deposits derived from mountains to the west and the High Plains to the east. Permian limestones have had the greatest effect on topography in the Pecos River valley, but the local bedrock also includes mudstone, sandstone, shale, limestone, dolomite, and gypsiferous and saline evaporites. Structural subsidence and dissolution of evaporite and carbonate units have resulted in the formation of sinkholes and playas that may have provided water sources for early populations. The streams draining the east side of the Pecos River valley are intermittent and tend to be small. About a mile northwest of the project area lies a playa basin called Cedar Lake.

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

Hall (2002) has reported that the area's stratigraphy is the result of alternating periods of dune and soil formation. The local bedrock is formed by Permian and Triassic shale and sandstones, which underlie the Mescalero Sands throughout the whole of the region. Between 100,000 and 600,000 B.P., soil formation led to the development of a Bk petrocalcic horizon that is now evident as caliche. This formation, called the Mescalero paleosol, is exposed throughout the region at various elevations and topographic positions and can be as much as 2 m (6.6 feet) thick.

Above the Mescalero paleosol is a layer of eolian sand composed of yellowish red to red, very fine quartz sand. The sand was deposited after the erosion of the upper layers of the Mescalero paleosol between 70,000 and 90,000 B.P. It is more than 3 m (10 feet) thick in some areas, although it is more commonly only 40 to 60 cm (16–24 inches) thick.

Between 15,000 and 70,000 B.P., the sand sheet partially eroded and then stabilized, allowing a soil to form. The soil is a red Bt paleosol, which reflects a moist climate. In fact, the lack of a calcic horizon suggests that precipitation was more than 500 mm (20 inches) per year, which is 50 percent more than modern precipitation. The Bt horizon is between 50 and 70 cm (20–28 inches) thick, often extending through the entire remnant of the underlying eolian sand layer.

Between 5,000 and 15,000 B.P., rainfall decreased significantly, causing the water table to drop, springs to cease flowing, and many lakes to become dry. The increased aridity led to the formation of a layer of eolian sand composed of reddish yellow, very fine quartz sand above the Bt soil horizon. The sand layer ranges from about 4 to 5 m (13–16 feet) thick at the center of the sand sheet to less than 1 m (3 feet) at the sheet's edges. Although humans occupied the adjacent regions of the Southwest and Great Plains, few archaeological sites dating to this period have been found in the Mescalero Sands, perhaps indicating that the area was avoided.

After 5,000 B.P., the surface of the eolian sands partially stabilized, although limited dune formation continued. Vegetation consisted of well-established desert grassland or desert shrub grassland, although soil formation at this time is not evident. Most archaeological sites rest directly on this somewhat stable surface, and their increased frequency indicates increased human use of this area. Localized soil formation was also common in archaeological sites, where increased organic residue was present.

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

LOCAL TOPOGRAPHY AND SOILS

The following discussion of the local soils is based on identifications, descriptions, and maps (Figure 2.1) using the U.S. Department of Agriculture Natural Resources Conservation Service (2011) Web Soil Survey. A majority of the project area's soil—the basin surrounding the Burro Tanks stock pond—is classified as Faskin-Roswell complex, a well-drained, loamy sand to sandy clay loam. The northwest and the entire eastern portion of the project area is classified as Roswell-Jalmar complex: 60 percent Roswell and 25 percent Jalmar soils, composed of fine sands to an average depth of 81 cm (32 inches) (often in the form of coppice dunes within the project area), with a loamy fine sand beneath. The southwest portion of the project area (where few artifacts or features were observed) is labeled as Faskin fine sand, a loamy fine sand to 48 cm (18 inches) with sandy clay loam beneath. All three soil types are found on 1 to 3 percent slopes (with the exception of dune faces) and are mixed alluvium and eolian deposits derived from parent material of sedimentary rock; all contain high levels of calcium carbonate (a maximum content of 50 percent) and up to 15 percent gypsum content.

[redacted]

LOCAL CLIMATIC CONDITIONS

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

FAUNAL AND BIOTIC COMMUNITIES

The Pecos River valley supports desert grassland and riparian communities. The desert grassland communities are dominated by blue and black grama, muhly, dropseed, tobosa, and alkali sacaton grasses. These communities may also contain cholla, prickly pear, yucca, saltbush, Apache plume, mesquite, creosotebush, greasewood, tarbush, and shinnery oak. Local riparian species include cottonwood, tamarisk, bulrush, willow, cattails, cacti, and grasses. These plant communities are largely limited to the area along the Pecos River.

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

CULTURAL ENVIRONMENT

Humans have exploited the resources in the Pecos River valley and the surrounding uplands for thousands of years. Local gravel outcrops contain tool-grade lithic materials, including quartzite, siltstone, chalcedony, chert, and silicified wood (Jelinek 1967), and gypsum has been mined in the Historic period. The riparian and desert grassland communities contain plant and game species used prehistorically. Acorns from shinnery oak, which are low in tannic acid, may have been an especially important seasonal food source (Wiseman 2000:5). Furthermore, floodwater farming might have been pursued along tributary arroyos, although the high salinity of soils along the Pecos River probably prevented farming along that watercourse. Burro Tanks, specifically, occupies an oasis within the arid Mescalero Plain. This permanent water source would have always attracted game and been an attractive location for camping, hunting, gathering, and even farming.

CHAPTER 3
CULTURE HISTORY AND LITERATURE REVIEW

CULTURAL-HISTORICAL OVERVIEW

Humans have inhabited southeastern New Mexico for at least the last 12,000 years. This occupation reflects a sequence of cultural development from hunting and gathering, through the development of agriculture, to historic and modern life. The culture history of the region is commonly divided into four broad traditions—Paleoindian, Archaic, Ceramic, and Historic—each of which is typified by different cultural adaptations.

PALEOINDIAN TRADITION (10,000–5500 B.C.)

The regional climate during this time was colder and wetter than in subsequent periods, and the local environment probably included savanna-like settings, with larger game and a greater diversity of fauna and flora than were present in historical times.

Paleoindians in the American Southwest are generally portrayed as small bands of highly mobile hunters who preyed primarily on large mammals that are now extinct (e.g., mammoths, bison, sloths, camelids, and horses). Increasing evidence shows that Paleoindians in other regions also hunted smaller animals and collected wild plant resources in addition to hunting big game, raising the possibility that at least some Paleoindian groups in the Middle Pecos River valley and the Llano Estacado might have employed a more generalized subsistence strategy.

Three Paleoindian complexes have been identified in the region, based on morphologically distinct projectile point styles. The Clovis complex is the oldest of the securely dated occupations. It is characterized by fluted points often associated with remains of mammoths, as well as a well-developed general biface and blade technology (Bradley 1993; Collins 1990, 1999:45–71; Gunnerson 1987:10). The Clovis complex lasted from about 12,000 years ago to perhaps as late as 10,500 years ago and spread throughout North America. Clovis period sites are rare in southeastern New Mexico, but several are found here. The type site for the complex, Blackwater Draw (Hester 1972), is just north of Portales. The Diamond Shamrock Enterprises (D.S.E.) El Paso Pipeline project recovered a Clovis point from a site in Chaves County, and a mammoth tusk was found eroding from an arroyo in the vicinity (Phippen et al. 2000:32). Bond (1979) reported additional Clovis period remains from the Haystack Mountain area near Roswell.

The Folsom complex is dated from 9000 to 8000 B.C. and is characterized by points that are generally smaller and more extensively fluted than Clovis points. Hunting focused on now-extinct forms of bison. Folsom remains were found in the area by Bond (1979) and by the D.S.E. El Paso Pipeline project (Phippen et al. 2000:33). A reworked fluted tool fragment was also recovered from a site about 5.5 km (3.4 miles) northeast of LA 2713 during the MAPCO pipeline project (Brown 1998).

After about 8000 B.C., people began to make new varieties of constricted-base and indented-base projectile points that were laterally thinned. The appearance of these point styles marked the beginning of the Late Paleoindian period, generally called the Plano tradition, which lasted until about 5500 B.C. The complex subsumes a variety of point types, of which the Agate Basin type was perhaps the most common in parts of this area. Compared with preceding groups, Late Paleoindian hunters focused more exclusively on bison, which were then restricted to the Great Plains and adjacent grasslands. As a result, Plano Complex remains are rare in the study area and were perhaps largely limited to the Llano Estacado. Agate Basin remains near the study area include butchering tools associated with bison remains found in the Portales level at Blackwater Draw (Agogino and Rovner 1969). Beck and Schermer (1981) also mention an Agate Basin point from the otherwise unreported McCullum site near Blackwater Draw. Agate Basin, Eden, Plainview, and Firstview projectile point fragments were found during the Haystack Mountain and D.S.E. El Paso Pipeline projects (Bond 1979; Phippen et al. 2000:33).

The end of the Paleoindian period coincides with the demise of the winter-dominant precipitation pattern characteristic of the Early Holocene and the onset of a climatic regime similar to today's. Irwin-Williams (1979) argues that by 5500 B.C., climatic conditions in the Southwest were unfavorable for bison, forcing Late Paleoindian groups to withdraw to the central and northern Plains (outside the project area) to maintain their hunting economy. Regardless of the extent to which this scenario is true, a severe drying trend did set in at this time.

In the Permian Basin study area, no Paleoindian radiocarbon dates have been obtained, and only occasional discoveries of Paleoindian projectile points have occurred (Railey et al. 2009). These largely negative findings suggest that Paleoindian use of the Permian Basin study area was not especially intensive, but also reflects the highly mobile lifeway at this time, which tended to leave behind few archaeological remains in datable contexts.

ARCHAIC TRADITION (5500 B.C.–A.D. 550)

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

The necessity of water kept these bands within easy striking distance of fresh water, topographically limiting desirable campsites and forming the sites we now see through repeated use. Due to long-term changes in precipitation patterns, surface and near-surface water were probably more widespread during Middle and Late Archaic times than during the Early Archaic period. Still, people in southeastern New Mexico appear to have been nomadic hunter-gatherers throughout the Archaic periods, and many of their sites are probably the accumulation of reuse of the more desirable campsites. In addition, group size and composition likely varied in response to seasonally and periodically changing economic opportunities, as smaller task groups periodically moved out of residential camps to procure resources in more distant areas (Crawford et al. 1999:18).

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

The most diagnostic artifacts on Archaic sites are projectile points. These points can vary greatly in shape and usually appear less well made than Paleoindian points. If the different morphological types reflect different ethnic or kinship groups, the great variety of point forms from Archaic sites in southern and southeastern New Mexico may indicate that several different Archaic groups used the area (MacNeish 1993:398; Phippen et al. 2000:468–470; Sebastian and Larralde 1989:42). Another possibility is that the different point types reflect reworking and repair of broken points (Flenniken and Wilke 1989).

Most Archaic sites in southeastern New Mexico lack stratigraphic integrity. Archaeologists have consequently had considerable difficulty developing a local temporal and cultural sequence for these sites (Crawford et al. 1999:18; Shelley 1994). Elsewhere in the Southwest, however, more-stratified archaeological deposits have been found that demonstrate significant similarities in Archaic period subsistence patterns across the entire region (Huckell 1996). As a result, archaeologists can apply a widely recognized, three-part division of the Archaic into the Early Archaic period, the Middle Archaic period, and the Late Archaic/Early Agricultural period (see Huckell 1996).

During the Early Archaic period (ca. 5500–3200 B.C.) exceedingly dry conditions limited land use. Sites interpreted as base camps were established near permanent water in some parts of the Southwest (Huckell 1996:332–333; Irwin-Williams 1973). There are very few Early Archaic radiocarbon dates in the Permian Basin study area, suggesting very limited occupation and use of the Mescalero Plain at this time, probably due in part to the overall dry conditions and paucity of surface water sources (Railey et al. 2009). Cobble-filled hearths and earth ovens appeared at some sites after 4800 B.C. Flaked stone assemblages included a large number of heavy chopping tools and crude side scrapers.

Across most of the Southwest, moister conditions apparently led to population growth and a higher frequency of sites during the Middle Archaic period (3200–1800 B.C.). Apparent base camp sites are more numerous, and cobble-filled hearths and earth ovens increase in size and complexity. In addition, simple, shallow pit structures also appear or become more frequent. This evidence, along with changes in grinding stone morphology, suggests that resource procurement was more intensive than during the Early Archaic, with populations systematically exploiting the most productive micro-environments in the region over the course of an annual cycle (Huckell 1996:337–338; Irwin-Williams 1973:7–9). In the Permian Basin study area, radiocarbon dates do not indicate any increased frequency or intensity of occupation relative to the Early Archaic period (Railey et al. 2009; Railey et al. 2011) (Figure 3.1).

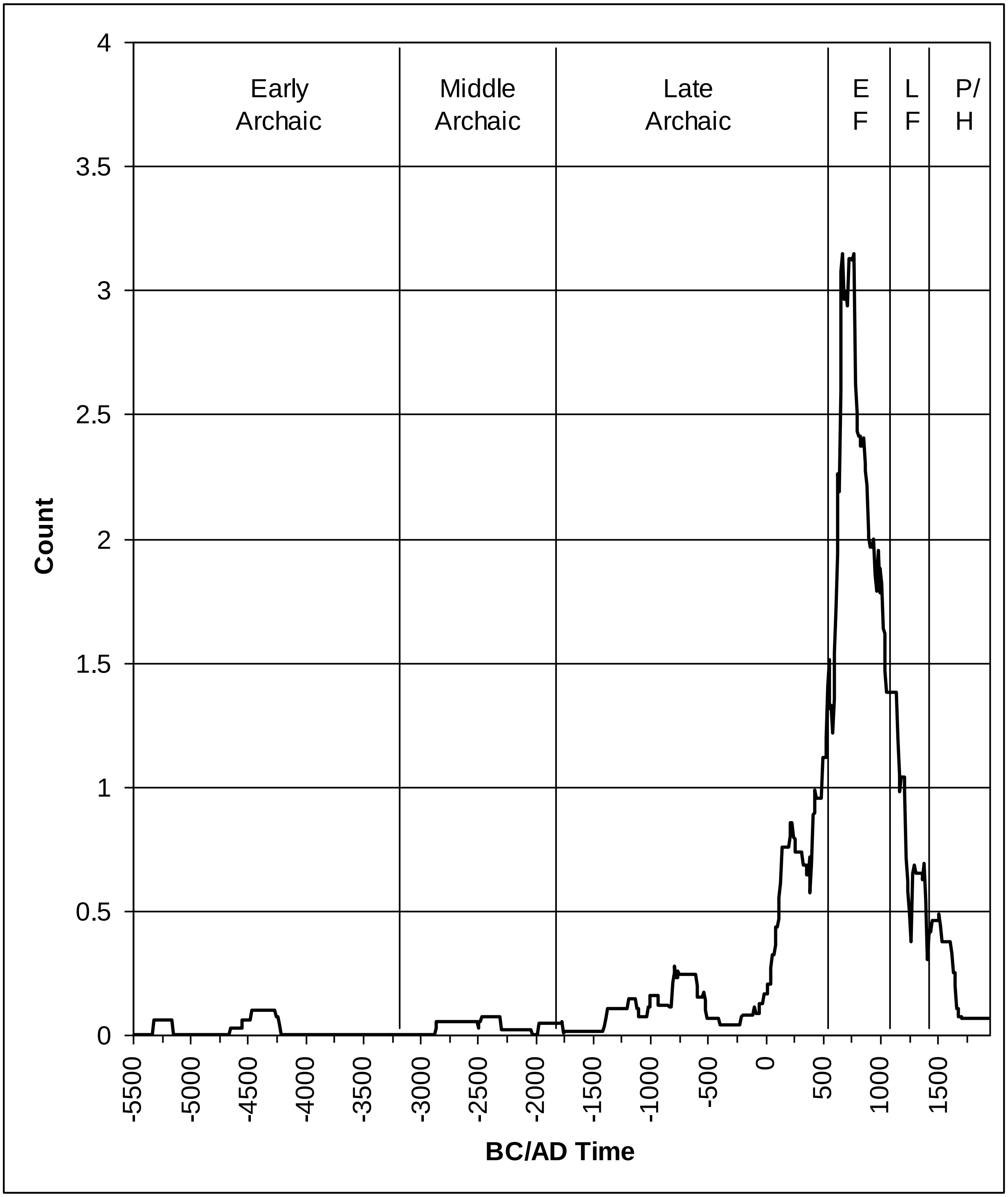

Figure 3.1. Count of archaeological radiocarbon dates from the Permian Basin study area. The counts are based on per-decade fractions of the two-sigma calibrated range for each radiocarbon date (n = 220). EF = Early Formative; LF = Late Formative; P/H = Protohistoric/Historic (from Railey et al. 2009:Figure 9.10).

Radiocarbon dates in the Permian Basin study area show a distinctive pulse beginning in the mid-second millennium B.C. and peaking in the early first millennium B.C., followed by a brief lull (see Figure 3.1). Then, around B.C./A.D. divide, a dramatic rise in the number of radiocarbon dates commences and continues through the end of the Archaic time frame and into the early Ceramic period (Railey et al. 2009, 2011). These data are consistent with evidence from the southeastern New Mexico in general, which shows an increase in the number of Late Archaic sites through time, with more than half of the Archaic sites tallied by Sebastian and Larralde (1989:43) postdating A.D. 1.

The Late Archaic period spans the time during which cultigens, especially maize, became widespread in the Southwest (Huckell 1996:343). The Late Archaic period also appears to have seen a trend toward larger populations, more localized and intensive land use, and the development of increasingly permanent “base camps” (e.g., Irwin-Williams 1979). A likely scenario involves an ongoing fissioning of the regional population into increasing numbers of similarly sized socio-political groups, and to the extent that this is true then territorial circumscription would have become more acute over time. Moister conditions, and an increase in the biomass of the region would have ameliorated the effects of this trend, but drier conditions would likely have exacerbated levels of subsistence stress, competition, and inter-group hostilities.

Research by Katz and Katz (1985, 1993) in the Brantley Reservoir area on the Pecos River near Carlsbad provides a local chronology for the Archaic time frame. Katz and Katz (1993) propose a four-part division of the Middle Pecos Archaic; their Archaic 1 and 2 phases (5200–1000 B.C.) extend from the Early Archaic to the early portion of the Late Archaic period, while their Archaic 3 and 4 (A.D. 1–500) phases represent subdivisions of the Late Archaic period. The sites they studied date between 3000 B.C. and A.D. 750 and are generally open-air camps clustered near the Pecos River. Through time, sites become more common and show evidence for increasingly heavy use of upland resources, including agave and sotol. Burned-rock features appear during the Archaic 3 phase (1000 B.C–A.D. 1). However, there is little or no evidence of early use of domesticates or significant changes from a broad-spectrum hunting and gathering subsistence strategy in or around their study area. The Katzes’ research shows that the regional trends documented by scholars such as Irwin-Williams (1979) and Huckell (1996) do not automatically apply to southeastern New Mexico. This is consistent with data from the Permian Basin study area (Railey et al. 2009, 2011), where there are no remains of cultigens dating from the Archaic time frame.

CERAMIC TRADITION (A.D. 550–1375)

Many of the known archaeological sites in and near the project area are attributed to the Jornada Mogollon culture (see Corley 1965; Leslie 1979), which locally is often referred to as the Formative period or Ceramic tradition. As elsewhere across the Southwest, it is the appearance of ceramics that marks the end of the Archaic tradition and the beginning of what follows. Precisely when ceramics first appeared in southeastern New Mexico remains an open question. In the Sierra Blanca highlands to the west-northwest, over 90 radiocarbon dates from recent excavations in the Hondo Valley indicate that ceramics first appeared there in the early to middle portion of the sixth century A.D. (Railey and Ruscavage-Barz 2008). Along the Pecos River some 31.3 km (19.5 miles) west of the study area, by about A.D. 750 people using pottery established pit house communities (Jelinek 1967; see Stuart and Gauthier 1988:270–274). Wiseman (2000:7) has documented pockets of comparatively more sedentary occupations in the Roswell area. Based on site records, a few locations east of the Pecos River, below the Llano Estacado, may have been seasonal villages, although the supporting evidence for this is somewhat sketchy. Even so, local populations were probably highly mobile compared to many contemporaneous groups elsewhere in New Mexico, and some areas reflect the continuation of Archaic-like mobility and subsistence strategies (Lord and Reynolds 1985; Phippen et al. 2000:34; Railey et al. 2009; Roney 1985; Wiseman 1985). Lord and Reynolds (1985:237) have dubbed the lifeway of these highly mobile hunters and gatherers the "Neo-Archaic," characterized by the same subsistence practices used during the Archaic, with the addition of the bow and arrow. Excavation data from the Permian Basin study area appears to support the continuation of a mobile lifeway based on hunting, gathering, and foraging well into the Ceramic period (Railey et al. 2009, 2011). The apparent continuation of Archaic lifeways can be explained in a variety of ways (see Phippen et al. 2000:34–35; Wiseman 2000:13), but it is likely that groups toward both ends of the sedentary-mobility spectrum shared the resources of the area over a period of centuries (see Sebastian and Larralde 1989:83). Wiseman (2000:13) has noted, though, the difficulty in differentiating between occasional hunting and gathering sites created by more sedentary groups and sites created by full-time hunters and gatherers, and cautions against wholesale acceptance of the hypothesis that two distinct types of groups were present.

Despite our limited understanding of the period, archaeologists have proposed several chronological sequences for the Formative period. One of the most detailed of these sequences was presented by Katz and Katz (1993), which involves seven phases, Formative 1–7. The Katz and Katz phase sequence reflects the distinctive trajectory of developments in southeastern New Mexico relative to other parts of the Southwest and is described here.

FORMATIVE 1 (A.D. 500–750)

Many attributes associated with the Formative 1 phase are similar to those of the preceding Archaic phases. The riverine and upland site settlement pattern persists, as do some projectile point styles. Late Archaic dart points with convex to straight edges, convex to straight bases, and diagonal notching are common. However, Formative points are smaller, with lengths typically less than 3 cm (1 inch), and the reduced size of projectile points suggests the introduction (or at least first widespread use) of the bow and arrow. Formative 1 projectile point types include Leslie's (1978) Types 6C and 6D, which carry over from Archaic 4, and Leslie's 6, 6A, and 6B. These are all dart points, but it remains unclear to what to what extent the atlatl-dart system continued into Formative times, as opposed to collection, possible reuse, and discard of earlier dart points by Formative peoples. The only projectile points that appear to have been demonstrably manufactured during early Formative times were small, corner-notched and strongly shouldered arrow points ascribed to type names such as Bohnam and Scallorn (see Turner and Hester 1993). Ground stone artifacts now include bedrock mortars, one-hand manos, and unshaped metates. The appearance of pottery, notably plain brownwares such as Jornada Brown, Middle Pecos Micaceous Brown, South Pecos Brown, and Alma Plain, is the single most prominent trait differentiating Formative from Archaic phases. Formative 1 includes portions of three local phases in southeastern New Mexico: Late Hueco, the initial portion of the Early 18-

Mile phase, and the Early Globe phase. The Hueco phase covers the eastern extension of the Jornada Mogollon region in southeastern New Mexico (Leslie 1979). Sites of the Early 18-Mile phase are concentrated along the Middle Pecos, between Roswell and Fort Sumner (Jelinek 1967). Katz and Katz (1985) defined the Globe phase from the results of their investigations in the Brantley Reservoir just north of Carlsbad. Much of the evidence for these phases comes from surface archaeological remains, however, so their utility as chronological units remains somewhat uncertain.

In the Permian Basin study area, the Formative 1 time frame corresponds to a continued and dramatic increase in the number of radiocarbon dates (see Figure 3.1), suggesting a peak in population levels, intensity of land use, and continued *extensive* land use as a result of a persistent, mobile hunting-gathering-foraging lifeway (Railey et al. 2009, 2011). These patterns resulted in not only a high number, but also a high *ubiquity* of sites across the open desert landscape, leaving behind high numbers of radiocarbon datable pit features. The persistence of a mobile, hunting-gathering-foraging economy in the Permian Basin is supported by a lack of evidence for cultigens at this time, and also an absence of any structure remains.

FORMATIVE 2 (A.D. 750–950)

Katz and Katz' Formative 2 phase includes traits such as domestic architecture, arrow points, and some black-on-white pottery in addition to the ubiquitous brownwares. It is roughly equivalent to the Early 18-Mile phase (A.D. 750–850), defined by Jelinek (1967:14, see also Stuart and Gauthier 1988:270). In the Brantley Reservoir area, Katz and Katz (1985, 1993:1–127) found that upland adaptations and patterns superseded the riverine adaptations that previously dominated. Further upriver, along the Middle Pecos, the first pit house villages and surface rooms appeared (Jelinek 1967). Clay floor pads from this period were found in excavations near Laguna Plata (Leslie 1979). Haskell (1977), however, has argued that these are natural clay deposits punctuated by rodent disturbance. The kinds of ground stone artifacts associated with Formative 1 are found in this phase as well. Ceramic assemblages are dominated by brownwares such as Middle Pecos Micaceous Brown and South Pecos Brown, but now include Lino Gray as well as Red Mesa Black-on-white in the north and Cebolleta Black-on-white in the south (Katz and Katz 1993). Arrow points include Leslie's (1978) Types 3A and 3B. Local phases subsumed under Formative 2 are Early Querecho (which succeeds the Late Hueco in the eastern extension of the Jornada Mogollon region [Leslie 1979]), Late 18-Mile, and Middle Globe. Again, much of the evidence for these phases comes from surface archaeological remains, rendering their precise temporal associations somewhat questionable.

In the Permian Basin study area, the frequency of radiocarbon dates either peak in the Formative 2 time frame or is well into a precipitous decline, depending on whether the frequency profile based on the simple count method (see Figure 3.1), or cumulative probabilities, is used (Railey et al. 2009, 2011). Either way, by the end of this time frame the number of radiocarbon dates has dropped off considerably from the early Formative peak, suggesting substantial changes in population, land use, and/or subsistence-settlement patterns.

FORMATIVE 3 (A.D. 950–1075)

Settlement trends in the Formative 3 phase feature the formation of larger settlements, and possibly population growth, in some parts of southeastern New Mexico. Although some studies suggest the number of sites in the region is comparable to that in Formative 2, the sites themselves are larger on average (Katz and Katz 1993) and consist of concentrations of small, rectangular pit room villages near permanent lakes within the shinnery oak belt (Leslie 1979). Sites in the Middle Pecos are also more intensively occupied, including sites with shallow pit houses and small, contiguous surface rooms (Jelinek 1967). Characteristic artifacts of the phase include oval basin metates and convex-faced manos; arrow points such as Leslie's (1978) Types 3A–3F, Scallorn variants, and Livermore point types; and a continuation of local brownwares, the addition of local and non-local graywares, and the substitution of Mimbres Black-on-white for Cebolleta Black-on-white in the southern portions of the region (Katz and Katz 1993). This is roughly equivalent to Jelinek's (1967) Late 18-Mile phase (A.D. 900–1000). Other local phases subsumed under the regional phase include portions of the Late Globe in the Brantley Reservoir area (Katz and Katz 1985) and the Late Querecho in the eastern Jornada extension (Leslie 1979).

In the Permian Basin study area, current evidence suggests a much less extensive use of the landscape, if not a *reduction* of local population levels. This is suggested by the continued, precipitous drop in the number of calibrated radiocarbon dates falling within this time span (Railey et al. 2009, 2011). However, there is no clear evidence of farming or the establishment of more sedentary communities at this time, although this may simply reflect a lack of precise chronometric data and systematic excavations at pit house sites in the area.

FORMATIVE 4 (A.D. 1075-1125)

Fewer and smaller sites characterize the Formative 4 period according to Katz and Katz (1993). Pit houses are reportedly present in southeastern New Mexico, but surface structures are unknown. Stuart and Gauthier (1988:273) report both increased frequency and size of sites, perhaps reflecting regional population increase and more intensive site occupations in the region. Subsistence patterns are essentially unknown as flotation samples from this time have yielded little information; the economy may still have focused on wild resources, with limited maize horticulture, but this remains largely speculation. Small, simple fire-cracked rock features are replaced by larger, formal middens of burned rock, perhaps indicating more intensive use of local resources and more sustained use of specific locations (Phippen et al. 2000:473). Artifact trends for this phase include a continuation of the previous phase's point types, mostly corner-notched, strongly shouldered arrow points. Ground stone still includes oval basin metates and one-hand manos with one or two grinding surfaces. Grayware pottery continues to be important, but percentages of local wares increase. Brownwares decrease except for McKenzie Brown. Non-local pottery types include Red Mesa, Socorro, Mimbres, Reserve, and Chupadero Black-on-whites. Portions of local phases assigned to Formative 4 include Mesita Negra along the Middle Pecos, Early Oriental in the Brantley Reservoir area, and Early Maljamar in the eastern Jornada extension (Katz and Katz 1993). In the Permian Basin study area, the frequency of radiocarbon dates continues its dramatic decline during this time frame, suggesting either de-population and/or concentration of local populations into aggregated villages, which remain largely unexcavated or at least undated by chronometric methods (Railey et al. 2009, 2011).

FORMATIVE 5 (A.D. 1125–1200)

Settlement trends in the Formative 5 phase vary among different areas of southeastern New Mexico. Along the Middle Pecos, only three sites were assigned to this phase by Jelinek (1967), although they are all large, and at least one is characterized by rectangular, slab-based surface rooms. Farther south (including the current project area), sites are fewer and smaller along the river, and upland sites are reportedly more numerous. Arrow points make the transition from corner-notched to side-notched forms by the end of this phase. Ceramics remain the same, with fluctuations in local brownware types. Local phases within this regional phase include a portion of the Early McKenzie along the Middle Pecos, Early–Middle Oriental around the Brantley Reservoir area, and Late Maljamar in the eastern Jornada extension. In the Permian Basin study area, the frequency of radiocarbon dates falls to a level below that for the end of the Late Archaic period, indicating either continued de-population of the open desert landscape and/or continued aggregation into nucleated village sites (Railey et al. 2009, 2011).

FORMATIVE 6 (A.D. 1200–1300)

Formative 6 is better represented and more thoroughly dated than previous phases. Major changes on several fronts were either initiated or intensified in the region during the thirteenth century. Earlier, corner-notched arrow point styles with strong shoulders are replaced by side-notched arrow points with wide, squared, or concave bases, and bases appear to become more concave over time (Leslie 1978). These side-notched forms are usually referred to as Harrell, Desert Side-notched, Washita, or Pueblo Side-notched (Justice 2002; Speth 2004; Turnbow 1997; Turner and Hester 1993). Unnotched triangular points are rare in the Southwest but do occur in the Plains (and are especially common in eastern North America) and spill over in small numbers into southeastern New Mexico. In Texas these are usually referred to as Fresno points, and their reported time span (ca. A.D. 800–1700) is not as restricted as those for the other arrow point types discussed above. There is evidence to suggest that these unnotched triangular points are actually pre-forms that were intended to be finished and notched, and as such they were widely transported because these pre-forms were less fragile and susceptible to breakage than finished points (Chesier and Kelly 2006; Dawe 1987; Newlander and Speth 2009; Odell and Cowan 1986).

El Paso painted ware and Chupadero Black-on-white are among the more distinctive decorated wares at this time, and are fairly common (although not necessarily numerous) in sites of this period. Late McKenzie (Middle Pecos), Middle Oriental (Brantley Reservoir), and transitional Maljaman/Ochoa (eastern Jornada extension) are the local phase designations subsumed by this regional phase.

In terms of settlement patterns, a shift to more sedentary villages is clearly evident by the thirteenth century. In the Middle Pecos River valley, along the lower Rio Hondo near Roswell, the Henderson site and Bloom Mound are two prominent, room-block pueblo sites that were established and occupied during this century (Kelley 1984:455–496; Newlander and Speth 2009; Speth 2004, 2005). Further into southeastern New Mexico, evidence suggests that Late Formative period people established more settled and intensively occupied villages by the thirteenth century (if not earlier). Although it has been suggested that southeastern New Mexico was occupied simultaneously by both farmers and hunter-gatherers in the Late Formative period (e.g., Sebastian and Larralde [1989:85–86], radiocarbon dates from the Permian Basin study area calls this assumption into question [Railey et al. 2009:29–57, 2011]). Specifically, the dramatic drop in the number of radiocarbon dates from the Early Formative to Late Formative in the study area is accompanied by continued reduced numbers of sites with Late Formative diagnostic artifacts. This trend seems to evidence a similarly dramatic reduction in mobility because, as people became less mobile and aggregated into villages, they left fewer sites and features across the landscape and so the chances of encountering radiocarbon datable contexts were greatly diminished. Thus, it appears at least possible that mobile hunter-gatherers of the Early Formative period became more settled (although still probably somewhat mobile) villagers during the Late Formative or that settled villagers moved into the area and displaced the mobile hunter-gatherers (or some combination of both).

At any rate, there are numerous Late Formative village sites in southeastern New Mexico, at least most of which were probably occupied during the thirteenth century. These include Bell Lake (Speth 1984), Boot Hill (Corley and Leslie 1960), Laguna Plata (Haskell 1977; Lea County Archaeological Society [LCAS] 1971; Runyan 1972), Maroon Cliffs (Speth 1984), Merchant (Gregory 2006; Leslie 1970; Speth 1984), Monument Spring (Leslie et al. 1968), and a scattering of other sites with known or suspected pit houses and/or surface rooms across southeastern New Mexico and extending into west Texas (Collins 1966, 1968, 1969; Leslie 1970, 1979:186–187). Unlike the thousands of Late Archaic and Early Formative sites in the region with evidence for short-term camping episodes, occupations at these Late Formative villages were anything but casual, as some pit houses were cut into bedrock to depths of 2 m (6.6 feet), surface jacal room blocks were constructed at some sites, the dead were formally buried in these villages, and midden deposits are so rich that these sites have attracted the attention of looters and amateur archaeologists for decades (Speth 1984:9–10). Yet despite previous excavations at sites such as Boot Hill, Laguna Plata, and Merchant, much remains unknown about these Late Formative villages and the lifeways of their inhabitants.

In the Permian Basin study area, the appearance of Late Formative village sites, coupled with the dramatic reduction in the number of Late Formative components across the study area, may signal a dramatic shift in which maize-based farming became an important part of the subsistence economy (Railey et al. 2009, 2011). If so, and as people gravitated to better-watered localities where farming and village life were possible, the Late Formative period in southeastern New Mexico may have also involved a shift toward aggregated settlement and drastically reduced utilization of the open desert floor that characterizes most of the Permian Basin study area.

A similar settlement shift is evident in the better-documented archaeological remains of the Tularosa Valley and Hueco Bolson to the west (see Carmichael 1986; Miller and Kenmotsu 2004). Here, the extensive distribution of sites occupied by mobile hunter-gatherers of the Late Archaic and Early Formative periods was transformed into a different pattern wherein Late Formative sites (including many villages based at least in part on farming) were concentrated along the better-watered basin margins. But for the Permian Basin study area, the relative importance, or even practice, of maize-based farming by these Late Formative villagers remains a hypothesis to be tested, and it has been previously speculated that village sites in the Eastern Jornada region were occupied by hunter-gatherers whose plant-subsistence staples were shinnery oak and mesquite rather than maize (Leslie 1979). Although it is known that Late Formative villages in the Roswell area to the north were engaged in maize-based farming (see Speth 2004), the role of agriculture in the villages of southeastern New Mexico remains an open question, as no flotation samples have yet been collected and processed from these sites.

Even if we assume that maize was grown by Late Formative villagers of southeastern New Mexico, there still remains the question of how important maize farming was in the villagers' subsistence economies. The closest comparative evidence we have to date comes from Henderson and Bloom Mound (Kelley 1984; Powell 2001; Speth 2004, 2005; Speth and LeDuc 2007). For these sites, current evidence

> points to farming as a modest contributor to the diet throughout, with little or no indication of significant intensification in the later part of the sequence (e.g., small numbers of recovered maize remains; ubiquity and abundance of wild seeds; carbon isotope values indicating modest overall intake of C4 plants; low incidence of [dental] caries; small numbers of metates, mostly basin-shaped; and wholly unstandardized one- and two-handed manos). (Speth and LeDuc 2007:46)

In the Late Formative of southeastern New Mexico, it is suspected that evidence for maize farming, if present, will similarly indicate a less-than-full-blown agricultural economy, but this (along with the presence or absence of maize itself) is a question that will need to be explored through systematic excavations. In southeastern New Mexico successful maize farming obviously encountered a challenging environment at best, and with respect to the spread of farming the region can be characterized as a "friction zone," if not an "overshoot zone" where farming eventually had to be abandoned and people reverted to a hunting and gathering subsistence economy (Bellwood 2005:274–275). However, the abandonment of farming (or at least village life) in southeastern New Mexico was not necessarily a return to a hunter-gatherer lifeway similar to that of the Late Archaic and Early Formative periods; rather, for some groups at least, this involved a more specialized economy based on nomadic bison hunting and conditioned by historical forces that culminated in the symbiotic Pueblo-Plains relationship that was witnessed by the Spanish in early historic times.

FORMATIVE 7 (A.D. 1300–1375)

Although represented by very few dated sites, the Formative 7 phase witnessed continued changes that were both dramatic and rapid. Late Formative villagers in southeastern New Mexico were caught up in an increased emphasis on bison hunting after ca. A.D. 1250, a trend that was widespread across this region and elsewhere in the southern Plains (e.g., Baugh 1986; Bell 1962; Bozell 1995; Collins 1968, 1971; Dillehay 1974; Drass and Flynn 1990; Greer 1976; Hughes 1989; Jelinek 1967; Speth 1983, 1984, 2004; Speth and Parry 1978, 1980; Staley 1996). Bison bones are reported among the apparently rich faunal remains observed at Boot Hill (Corley and Leslie 1960:7), but no analysis of these remains has occurred. Leslie (1979:179) reports that subsistence patterns at village sites in southeastern New Mexico included "a small amount of bison," but this inference was not based on any systematic analyses of faunal remains. Bison hunting was apparently of some importance at the Merchant site, where backdirt contained large amounts of bison bone (Speth 1984:11). Laguna Plata is the only site in southeastern New

Mexico where percentage of bison remains has been reported, and there bison accounted for only 3.4 percent of the animal bone fragments identifiable to at least the level of genus, whereas rabbits were the most numerous at 64.3 percent, followed by pronghorn at 19.1 percent (Gray 1977). This contrasts with the Henderson site, a Late Formative small pueblo near Roswell occupied between ca. A.D. 1250 and 1400, for which the most detailed faunal analysis has been carried out in southeastern New Mexico (Speth 2004). At Henderson, rabbit still made up the majority of mammal bones, followed by pronghorn, but bison bones were nearly as numerous as pronghorn and comprised nearly a quarter of all mammal remains found at the site. Considering the differences in potential meat yield between rabbits, pronghorn, and bison, the contribution of bison to the diet of the Henderson Pueblo occupants was obviously substantial. Whether the percentage disparity in bison bones between Laguna Plata and Henderson is a real reflection of difference in subsistence reliance on this beast is unclear. Note that at Henderson,

> the tremendous importance of bison would not have been evident had our excavations focused solely on Henderson's room blocks. Bison remains in these parts of the site were quite scarce … Only when we encountered the deposits in and around the earth oven complexes did the real importance of these animals become apparent. (Speth 2004:421)

Thus, it is possible that the much lower percentage of bison bones in the Laguna Plata assemblage is due to biases in the location of excavations within this sprawling site, rather than an actual indicator of relative reliance on bison in the diet of villagers in southeastern New Mexico. At both Henderson and Laguna Plata, bison kills apparently occurred at some distance from these sites, as the skeletal elements in both faunal assemblages indicate that only choice parts were transported back to the home village. At Henderson, the selective culling of bison parts appears to have increased in the late phase of the site's occupation (early to middle fourteenth century). This corresponds to other evidence suggesting an increased reliance on bison by the site's inhabitants at this time, with more logistical hunts focused on herds that were roaming farther from the village than was the case in the early (middle to late thirteenth century) phase. Evidence from Henderson also suggests a dramatic increase in the communal importance of bison consumption, with remains becoming more concentrated in public spaces (i.e., two huge earth-oven complexes, one of which was in the village plaza). At the same time, the importance of pronghorn declined in the late phase at Henderson, both in terms of contribution to the diet and representation in faunal assemblages from public facilities, as well as hunting strategies with more individual stalking of these animals near the village and less communal hunting of pronghorn.

Speth (2004:422) further suggests that bison hunting at Henderson occurred between the late fall and spring months, and with hunters apparently having to travel great distances from the villages, this created potential scheduling conflicts with planting and harvesting. How far these hunters may have traveled is a question taken up by Newlander and Speth (2009), who examined projectile point and debitage raw materials from both Henderson and the nearby Bloom Mound. Bloom Mound was abandoned slightly later than Henderson, and at least one massacre occurred toward or at the end of its occupation (Kelley 1984:455–496; Speth 2005). From their analysis results, Newlander and Speth conclude that hunting parties from Henderson were venturing as far as central Texas to procure bison (and raw materials for arrow points in the process), but that during the slightly later Bloom Mound occupation, hunting parties were probably not traveling that far on a regular basis, but still making it into the Texas panhandle. Whether hunting parties from Henderson and Bloom were actually traveling such distances is open to competing interpretations of the data, but in any event the shift reflected in raw material data corresponds to a precipitous drop in the number of bison bones from Henderson to the nearby (and slightly later) Bloom Mound. These trends also correspond to a progressive increase in the number of exotic items from the early phase at Henderson to the Bloom Mound occupation, which marks the end of the Pueblo presence in the Roswell area.

Speth (2004, 2005; Newlander and Speth 2009) paints an admittedly speculative, but otherwise plausible, scenario to account for the patterned evidence observed at Henderson, Bloom Mound, and throughout the southwestern Plains. According to this scenario, it was not only environmental conditions that favored an increase in bison hunting beginning in the late thirteenth century, but that bison hunting may also have been a response to profound changes in the Pueblo world to the West. Specifically, one result of the abandonment of the Four Corners region by A.D. 1300 was a huge influx of people into the northern Rio Grande valley, where large Pueblos (some containing more than 1,000 rooms) were constructed in the Classic period (A.D. 1300–1600). Depletion of game and other resources in the vicinity of these mega-villages may have encouraged Pueblo peoples to establish symbiotic trading arrangements with Plains groups, with bison meat and products flowing from the Plains to the Pueblos, and maize, pottery, obsidian, and prestige items going in the opposite direction.[1] At Henderson, this region-wide process prompted the site's inhabitants to focus increasingly on bison hunting, and the site's occupants themselves (or perhaps only some of them) may have become full-time, nomadic bison hunters following the abandonment of the site (Speth 2004:426). At the same time, the apparent reduced focus on bison hunting at the nearby (and slightly later) Bloom Mound, coupled with the substantial increase in exotic items at Bloom Mound relative to Henderson, may signal that the occupants of this site were less focused on bison hunting themselves, and instead served as middlemen between the Pueblo world to the west and the nomadic hunters to the east. The changes in projectile point raw materials suggest that Bloom Mound hunters did not venture as far to the east as their Henderson predecessors. Long-distance mobility may have been curtailed as a result of increasing competition and specialization among nomadic bison hunters out on the plains, some of whom may have been the very assailants that massacred the victims found at Bloom Mound (Newlander and Speth 2009).

As Speth (2004) himself acknowledged, the extent to which this scenario may or may not be true depends on collecting additional data from the region. Moreover, his interpretations of seasonality at Henderson are open to alternative explanations. For example, Hogan (2006:[4]41) suggests that the Henderson site may not have been partially abandoned during the fall and winter months. Rather, the village residents may have remained there during the cold season, subsisting on stored foods in a manner consistent with the settlement-subsistence patterns of other village communities in the southern Plains (see Hughes 1989). As Hogan (2006:[4]41) seems to acknowledge, however, this interpretation does not explain the abandonment of village sites in southeastern New Mexico as elegantly as Speth's scenario. To what extent Late Formative villagers of southeastern New Mexico were caught up in these developments remains an open question, as there have been very systematic excavations that might otherwise shed light on this question.

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1 One critical item for late Pueblo peoples was the bison-hide shield, which became important and widespread following the advent of the recurved bow in the region around A.D. 1300 (see LeBlanc 1999; Speth 2004:425).

During the Formative 7 phase, Katz and Katz (1993) suggest that village architecture in southeastern New Mexico changes from large, deep pit houses to shallower pit houses to single surface rooms. At camp locations, architecture includes stone circles, possibly representing tipi rings. Greater reliance on bison hunting is inferred from the stone rings and a specialized tool kit of shaft smoothers, notched ribs, and four-beveled knives. Leslie's (1978) 2C arrow points are diagnostic. These are small, side-notched points with long, narrow blades and a basal notch. Non-local painted ceramics predominate, with large quantities of corrugated brownwares also heavily represented. El Paso Polychrome, Chupadero Black-on-white, Mexican polychromes, and occasional Rio Grande glaze wares are among the more diagnostic ceramic types. Temporal units defined by others, including the Post-McKenzie (Middle Pecos), Late–Middle Oriental (Brantley Reservoir), and Early Ochoa (southeast) phases fall within Katz and Katz' Formative 7. The end of Formative 7 (and the termination of the Formative tradition) correlates with the "Little Ice Age."

PROTO/ETHNOHISTORIC PERIOD (A.D. 1375–1750)

The Proto/Ethnohistoric period is marked by a continued shift to a more nomadic way of life based on bison hunting. According to Katz and Katz (1993), site sizes and types betray a high degree of mobility, and their locations near water and viewsheds suggest an emphasis on hunting. Before the introduction and spread of the horse, much of the area was inhabited by "dog nomads," who used dogs to haul loads on travois. Sites of this period are best represented along the southern Pecos River. Many of the same site types seen during the previous period are still present: hearths, burned-rock scatters, lithic scatters, and ring middens. However, the hallmark of this period is tipi rings. Katz and Katz (1993) proposed three phases for this time span: Protohistoric 1 (A.D. 1375–1500), Ethnohistoric 1 (A.D. 1500–1600), and Ethnohistoric 2 (A.D. 1600–1750). In the Permian Basin study area, the frequency of radiocarbon dates continues its sharp fall-off during these periods, indicating that the area was depopulated, and/or that the highly nomadic lifeway of the region's people simply did not leave behind many archaeological remains that are chronometrically datable (Railey et al. 2009, 2011).

PROTOHISTORIC 1 (A.D. 1375–1500)

The first phase of the period, Protohistoric 1 may have witnessed the appearance of Athapaskans in the region. Features such as tipi rings and small, triangular arrow points may be diagnostic of these new occupants. Evidence of bison hunting is documented for this period, including a bone bed at the Garnsey site (Speth 1983; Speth and Parry 1980) and a single kill/butchering locality at LA 22107 that dates from either this phase or Ethnohistoric 1 (Staley 1996). Dillehay (1974) has argued that bison were not present in the area until A.D. 1200–1300 and then were fairly numerous until A.D. 1550. Still, southeastern New Mexico appears to have been marginal for bison herds, with increasingly xeric conditions prevailing and a drought appearing in the Garnsey Spring pollen data at A.D. 1450–1500. These data are supported by dental wear patterns on both the Garnsey and LA 22107 bison, suggesting that bison hunting at this time may have been more opportunistic than systematic. Meanwhile, the persistent occupation of several large architectural sites established during Formative 7 times suggests that indigenous populations remained in parts of the area. Leslie's (1978) Types 2D, 2E, and 2F, Washita, and Toyah points are characteristic forms. The only pottery found is Ochoa Indented; no non-local wares appear. The Late Oriental (Brantley Reservoir) and Late Ochoa (Leslie 1979) phases fall within this regional phase.

ETHNOHISTORIC 1 (A.D. 1500–1600)

Ethnohistoric 1 correlates with the first Spanish expeditions into the region. Early Spanish presence on the Llano Estacado includes expeditions by Coronado in 1541, Espejo in 1583, and DeSosa in 1590 (Katz and Katz 1993; Lintz et al. 1988). Native guides often led these early expeditions, and in these cases their routes invariably followed aboriginal trails. During the Early Spanish period, the project area and the surrounding region were used largely as a route to areas farther north. Diagnostic artifacts of this phase are Garza, Toyah, and Leslie's (1978) 2F point types. No pottery is associated with the phase. The Phoenix phase (Brantley Reservoir) and the early Post-Ochoa phase (southeast) are subsumed within the Ethnohistoric 1 regional phase (Katz and Katz 1993).

ETHNOHISTORIC 2 (A.D. 1600–1750)

Ethnohistoric 2 is segregated from the previous phases based on the widespread use of metal and horses by the region's Native American population and the proliferation of written records pertaining to the region. Early Spanish records refer to the presence of several aboriginal groups on the Llano Estacado south of the Canadian River, including the Querechos, Teyas, Vaqueros, Escanzaques, and Faraones. The relation of these groups to better-known historic Native American peoples is problematic. By the early 1500s, Apaches had become established on the northeastern plains of New Mexico. Spanish sources suggest gradual expansion of the Apachean groups to the south and west. During the early 1700s, Comanches displaced the Apachean groups, forcing them to withdraw to the south and into mountainous areas to the west (Lintz et al. 1988). By the early to mid 1800s, Comancheros[2] were actively trading with the Pueblos, the Comanches, and other residents of the Plains. Archaeologically, rock shelters and open camps were occupied for short durations and are associated with ring middens, shallow sheet middens, and metal projectile points. Seven Rivers (Brantley Reservoir) and Post-Ochoa (southeast) are local phase designations (Katz and Katz 1993).

NON-DIAGNOSTIC LITHIC ARTIFACT SCATTERS (10,000 B.C.–A.D. 1700)

Many sites in southeastern New Mexico cannot be placed in the sequence outlined above because they lack diagnostic artifacts. These sites are commonly scatters of flaked stone, sometimes with ground stone (Sebastian and Larralde 1989). Many of the scatters likely date to the Paleoindian and Archaic periods, but the postulated continued presence of Neo-Archaic groups, not to mention early Athapaskans peoples, makes it impossible to date sites that lack diagnostic artifacts such as projectile points. These sites are likely to predate A.D. 1700, after which the Native Americans in the region relied on metal tools.

[2] The Comancheros were Hispanic settlers who traveled onto the Plains to trade with the Comanches following a peace treaty between New Mexico governor de Anza and the Comanches in 1786 (Kenner 1969:78).

Non-diagnostic lithic artifact scatters comprise a significant portion of the local archaeological record. They constitute a unique subset of sites, and special care is needed to examine their assemblages for subtle technological differences that might allow them to be integrated into the larger cultural-historical sequence.

HISTORIC PERIOD (POST–A.D. 1700)

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

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

Substantial Euro-American occupation of the region began after the Mexican War in 1848 (Sebastian and Larralde 1989:117). Military posts were built at Fort Stanton (1855–1896) and Fort Sumner (1862–1868) (Frazer 1972:103–104), allowing and encouraging Euro-American colonization. By 1880 military conflict between Euro-Americans and Native Americans ended, as the Comanches were pushed farther onto the plains and the Mescalero Apaches were confined to a reservation (Sebastian and Larralde 1989:110–117).

Cattle ranchers were attracted to pastures along the Pecos River valley and later on the Llano Estacado. In 1866, Charles Goodnight and Oliver Loving pioneered a cattle trail up the Pecos River, partly to supply beef to the Navajos at Fort Sumner (Pratt and Scurlock 1989:93–94; Sebastian and Larralde 1989:119; Wallis 1957:17). Texas cattlemen seeking new markets after the Civil War quickly followed suit, and the Goodnight-Loving trail was eventually extended to southern Colorado (Simmons 1988:158). John Chisum, who was later called the “Cattle King of America” (Wallis 1957:52), established his headquarters near present-day Roswell and created one of the largest open-range ranches in the country, covering most of southeast New Mexico. Other open-range ranchers also moved into the area (Meinig 1971:Figure 4-1). By 1885, smaller holdings in the area were absorbed by larger ranches such as George W. Littlefield’s LFD ranch (Crawford et al. 1999:24–25). In 1889, drought forced a significant decrease in the number of cattle grazing the region, and settlers began to experience greater success with other economic strategies.

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

Many homesteads were built in eastern New Mexico, but the barrenness of the area and the scarcity of water made success difficult. In fact, ranchers often encouraged homesteading on the open-range areas of their ranches in the hope that they would be able to purchase government land at favorable prices following the homesteaders' eventual failure (Pratt and Scurlock 1989:95). The potential for successful dry-land homesteading improved during the late 1800s, when settlers began to drill water wells (Bauroth 1998:48).

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

Although in hindsight many of the railroad towns were doomed to be short-lived, in the early 1900s the railroad's arrival seemed to guarantee the area's prosperity. The railroad allowed the development of a network of towns and facilitated the movement and sale of local agricultural crops and cattle (Bauroth 1998:39). The railroad also brought manufactured goods into the area, and the use of sawed lumber, bricks, cast stone, and glass increased dramatically. The construction of towns and more formal structures in turn encouraged engineers, masons, carpenters, and architects to move into the area, which in turn led to the introduction of new building styles (Pratt and Scurlock 1989:212–219). By the first decade of the 1900s, homesteading had surpassed cattle ranching as the most significant economic activity in the area. The importance of homesteading further increased relative to ranching after 1904, when the government ordered the ranchers to remove their cattle from the public domain and hundreds of "nesters" poured into the region (Taylor 1991).

The subsequent history of the area parallels that of the adjacent portions of Texas and New Mexico. Southeastern New Mexico experienced an economic boom after World War II as a result of the development of local oil and gas fields. The U.S. military continues to be important to the region. Cannon Air Force base was established near Portales in 1942 and is a significant employer. Today, the primary economic activities in southeastern New Mexico are oil and gas extraction, ranching, dairy farming, and irrigation farming.

CHAPTER 4 PRE-FIELD INVESTIGATIONS, EXPECTED RESOURCES, RESEARCH POTENTIAL OF THE PROJECT AREA, AND FIELD METHODS

PRE-FIELD INVESTIGATIONS

Prior to the survey fieldwork, SWCA archaeologist Christopher Carlson conducted records searches both at the online ARMS database on July 7, 2010. Database records were searched for previously recorded archaeological sites and previously conducted archaeological surveys within 0.4 km (0.25 mile) of the survey area. The Historic Preservation Division (HPD) and National Register of Historic Places (NRHP) database records search was also conducted on July 7, 2010, for properties on the NRHP and the State Register of Cultural Properties (SRCP) within 0.4 km (0.25 mile) of the survey area.

Results of the records searches show that four previous investigations and 13 previously recorded sites have been identified within 0.4 km (0.25 mile) of the survey area (Table 4.1 and Table 4.2). An ARMS screenshot and a map showing these surveys and sites in relation to the project area are shown in Figure A.2 in Appendix A. three of these previously recorded sites—LA 12945, LA 100184, and LA 100193—have been subsumed to the expanded site boundary of LA 32227 during this investigation. The Burro Tanks archaeological site was listed on March 20, 1970, as State Register Property No. 155, the area of which was completely revisited during this investigation.

Table 4.1. Surveys within 0.4 km (0.25 mile) of the Project Area

NMCRIS Number	Performing Agency	End Date of Investigation	Acres Surveyed	Number of Sites Visited
7399	Pecos Archaeological Consultants	13-Jul-1984	55.6	10
12775	Archaeological Survey Consultants	15-May-1986	25.8	1
28550	Agency for Conservation Archaeology: Eastern New Mexico University	27-Jul-1975	169.7	18
42880	TRC, Inc.	20-Apr-1993	1,066	27

Table 4.2. Archaeological Sites within 0.4 km (0.25 mile) of the Project Area

LA No.	Structural / Non-structural	Occupation Type	Maximum Length
12944	Structural	Prehistoric	70
*12945	Non-structural	Prehistoric	300
32227	Structural	Prehistoric	302
43754	Structural	Prehistoric	136
48953	Structural	Prehistoric	96
84668	Structural	Prehistoric	136
*100184	Structural	Unknown	136
100189	Non-structural	Unknown	30

LA No.	Structural / Non-structural	Occupation Type	Maximum Length
*100193	Non-structural	Unknown	43
100194	Structural	Prehistoric	96
100195	Structural	Unknown	96
166981	Non-structural	Prehistoric	56
166982	Structural	Prehistoric	43

*Site was subsumed by LA 32227 (Burro Tanks)

Locational information is confidential, and for official use only—public disclosure of archaeological site locations is prohibited by 16 USC 470hh and 36 CFR 296.18.

EXPECTED RESOURCES

Prior to initiating the survey, SWCA reviewed previous documentation for the site. These include a comprehensive site record completed by Sawyer (1973), compiling information on activities at the site prior to the 1970s, and subsequent recordings by the Agency for Contract Archaeology (Beimly 1975), Pecos Archaeological Consultants (Hunt and Martin 1984) and Mariah Associates (Acklen et al. 1993). On the basis of these sources, SWCA expected to encounter a large, dense scatter of cultural material surrounding the former bed of Burro Lake, and that these materials would date to a long span of time, from 8000 B.C. to A.D. 1400. It was further expected that features would be observed and perhaps some disturbed burials or structures.

RESEARCH POTENTIAL

LA 32227 has tremendous research potential for practically all research questions outlined in the Permian Basin Mitigation Program Research Design (Hogan 2006). However, the fact that the current investigation was limited to surface observations and in-field artifact analysis limited the range of questions that SWCA could address. In terms of the surface data, the site has the potential to illustrate the long-term evolution of Archaic and Jornada Mogollon culture on the Mescalero Plain. In particular, this project has the potential to systematically delimit the site, assess the surface assemblage, identify different sectors of occupation, and compare these in terms of chronology, technology, and demography. A detailed characterization of the site along these lines can contribute to the understanding particularly of the dramatic demographic, settlement, and economic changes that took place in the later portion of the Formative period.

FIELD METHODS

This survey used the TRU methodology. The project area was defined in consultation with the BLM prior to fieldwork. A TRU grid was then established within the project area. Each TRU measured 15 × 15–m (49 × 49–foot), or 225 m² (2,422 square feet). They were arranged in a grid of 107 TRUs east-west by 80 TRUs north-south, for a total of 13,600 TRUs. Individual TRUs are referred to by their position relative to the southwest corner of the study area. Thus, TRU 1-1 occupied the southwest corner of the project area, while TRU 1-80 occupied the northwest corner, TRU 107-80 the northeast corner, and TRU 107-1 occupied the southeast corner.

A 100 percent (intensive) cultural resources pedestrian inventory was conducted by walking parallel transects, each within the center of each TRU, spaced no more than 15 m (49 feet) apart along longitudinal transects. The work was supervised by Field Directors Christopher Carlson, Greg Mastropietro, and Matthew Bandy. Crew members included Jennifer Walborn, Ryan Brucker, Cassandra Keyes, and Carlos Railey. The survey and recording were conducted on August 11 through October 27, 2010, in four field sessions of roughly six days each (excluding travel).

Recording of newly discovered cultural locations was initiated with the pin-flagging of artifacts and other cultural manifestations within each TRU (TRUs were identified in the field using a sub-meter accuracy Trimble handheld global positioning system [GPS] unit, preloaded with the boundary and number for each TRU). The vast majority of artifacts and features recorded were part of the Burro Tanks site (LA 32227).

Cultural manifestations were described and recorded according to current archaeological standards and were mapped with a Trimble GeoXH GPS receiver within each TRU. Resource recording included preparing a plan map and completing a Laboratory of Anthropology (LA) form (post-field, using GPS data), taking photographs of features and representative and diagnostic artifacts, and GPS recording artifact/feature boundaries to the sub-meter level within each TRU.

Feature boundaries—often crossing TRUs—were mapped with a sub-meter GPS unit. All surface artifacts were tallied, analyzed, and associated within each TRU, but were not point plotted. For debitage, maximum flake size in 1-cm increments (e.g., 0–1 cm, 1–2 cm, 2–3 cm, etc.), material type, color, presence of cortex, and completeness were recorded. As approved by the BLM archaeologist, a minimum of 50 flakes were analyzed from each TRU. Flakes beyond 50 were simply tabulated but not analyzed. For ground stone, cores, and lithic tools (cores were included in this category), type (e.g., mano, projectile point, core, metate, biface, etc.); maximum length, width, and thickness (in cm); completeness (broken or complete); and material were recorded (ground stone attributes also included whether the artifact was fire affected or reused). Tested cobbles (intact cobbles with no more than two flake scars) were tabulated by raw material and by size category, but were not individually measured. For burned caliche and fire-cracked rock, only pieces larger than 5 cm in maximum dimension were recorded. Recorded ceramic attributes included ware, type, form (e.g., bowl, jar, plate, etc.), and portion (e.g., rim, body, etc.). Projectile points and other formal tools were photographed with a centimeter scale. Artifacts, including ceramics, bifaces, and ground stone, were representatively photographed sufficiently to illustrate assemblage diversity throughout the site. All obsidian encountered was collected and delivered to Rebecca Hill of the BLM's Roswell Field office, per the office's request, for sourcing studies.

All field records from the survey are on file at SWCA's Albuquerque office (see Project Description for contact information).

CHAPTER 5
SURVEY RESULTS

The cultural resources survey investigated a single archaeological site—LA 32227, recommended eligible to the NRHP under Criterion D. Six isolated manifestations (IMs) were also discovered during this investigation, clustered primarily in the northwest corner of the project area on the ground surface along a disturbed, linear pipeline route. Detailed location information for the cultural property, including maps, Universal Transverse Mercator (UTM) coordinates, and PLSS descriptions, is attached as Appendix A and will be attached only in copies of the report for the BLM reviewer and the State Historic Preservation Officer (SHPO). *This information is confidential, and disclosure thereof is prohibited by Section 18-6-11.1 NMSA 1978 and 36 CFR 296.18.*

LA 32227

UTM/PLSS: See Appendix A, Table A.1
USGS: Cedar Point, NM; 35106-D8 (1973) (Photorevised 1984)
County: Chaves
Elevation: 1,231–1,249 m (4,039–4,100 feet) within the study area
Landowner: BLM Roswell Field Office
Cultural Affiliation and Age: Paleoindian, Archaic, Jornada Mogollon, Protohistoric: 8,000 B.C.–A.D. 1500
Site Type: Village and campsites: features and artifact scatter
Size: 1,613,177 m² (17,364,093 square feet [399 acres])
NRHP Eligibility Recommendation: Eligible under Criterion D
Management Recommendations: Avoidance of the site is recommended in future management actions, as well as measures to control collection and looting.

Additional Site Numbers/Names:

NM-06-827	BLM Roswell District
NM-06-211	BLM Roswell District
NM-06-204	BLM Roswell District
NM-06-203	BLM Roswell District
AR 30-6-211	BLM Roswell District
AR 30-6-204	BLM Roswell District
AR 30-6-203	BLM Roswell District
PAC/Ch-008	Pecos Archaeological Consultants
PAC/Ch-007	Pecos Archaeological Consultants
PAC/Ch-006	Pecos Archaeological Consultants
LA 32274	New Mexico Office of Cultural Affairs Museum of New Mexico, Laboratory of Anthropology
LA 32273	New Mexico Office of Cultural Affairs Museum of New Mexico, Laboratory of Anthropology
LA 32265	New Mexico Office of Cultural Affairs Museum of New Mexico, Laboratory of Anthropology
LCAS B2	LCAS
LCAS B16	LCAS

LCAS B15	LCAS
LCAS 1?	BLM Roswell District
ENM 10087	BLM Roswell District
HPD 155	BLM Roswell District LCAS Eastern New Mexico University New Mexico Office of Cultural Affairs HPD

SITE DESCRIPTION

LA 32227 was first recorded as such by Don Sawyer (1973) in a BLM site record that was exemplary for its time. Sawyer documented the size of the site's surface assemblage and elucidated some of its internal structure, and even went so far as to identify sectors that were occupied during different phases of the site's long history of use. On the basis of previous collections, Sawyer stated that the site was occupied from the Paleoindian period through to the end of the Formative. Particularly useful are his descriptions of the collection and looting that took place at the site from the 1950s through the early 1970s. He mentions specific instances in which burials were removed from the site, and other finds such as whole ceramic bowls and intact, caliche-lined pit rooms.

Subsequent recordings of the site by the Agency for Contract Archaeology (Beimly 1975) and Pecos Archaeological Consultants (Hunt and Martin 1984) added little to the picture of the site presented by Sawyer. Mariah Associates revisited the site for a seismic survey (Acklen et al. 1993), and while the firm added little to the understanding of the site in general the researchers were able to make a significant contribution by establishing an adequate site boundary. Indeed, the site boundary resulting from this project differs only slightly from theirs.

The site itself consists of a discontinuous but locally very dense scatter of artifacts and other cultural material surrounding the former bed of Burro Lake. The water source has been concentrated into a small tank in more recent times, but the former bed of the lake is clearly visible today. Little cultural material is present within the lakebed.

Dunes covered with shinnery oak and mesquite surround the lake bed except in the western and northwestern portions of the site. This is probably due to the prevailing west winds. Within the dunes, cultural materials are visible only in blowouts, and none are present on the sand surface. This indicates that these dunes have formed in more recent times, possibly due to grazing and livestock traffic to and from the tank, both of which would have destabilized the sands in the vicinity. While some areas of the site have been deflated by blowouts, there is no doubt that significant archaeological deposits are buried beneath the dunes in these areas. The northwestern shore of the lake is covered by a dark anthropogenic soil interpreted here as a midden. It is in this area that the majority of the Formative period occupation is located.

SITE BOUNDARY AND SECTOR DEFINITION

In the course of this investigation, the site boundary was defined on the basis of surface artifact distributions. Figure 5.1 displays total artifact counts by TRU. All positive TRUs located within 50 meters of another positive TRU were considered to be inside the site boundary. Since very few positive TRUs were located on top of stable dune surfaces, some allowance was made for the possibility of buried deposits below dunes. In the end, the majority of the positive TRUs (1327 of 1333 positive TRUs) were included within the site boundary, as well as some areas beyond the survey area that appear likely to contain surface artifacts based on the documented distribution within the survey area. Positive TRUs located outside of the site boundary were interpreted as IMs.

The site boundary as defined includes over 99 percent of the artifacts recorded during this investigation. A total of 29,894 artifacts (not including burned caliche and FCR) are included within the site boundary, while only 13 recorded artifacts are located outside of the site boundary.

Sectors were intuitively defined as relatively discrete, bounded concentrations of cultural material. Twenty sectors were defined, and their boundaries are shown in Figure 5.1. The sectors as defined include the vast majority of recorded artifacts, as shown in Table 5.1. Of the 29,894 artifacts recorded within the site boundary, 29,123 (97 percent) were included within the defined sectors. In addition, most positive TRUs (1017 of 1333, or 76 percent) were included within a sector boundary. Those positive TRUs that are not included in a sector have low artifact counts.

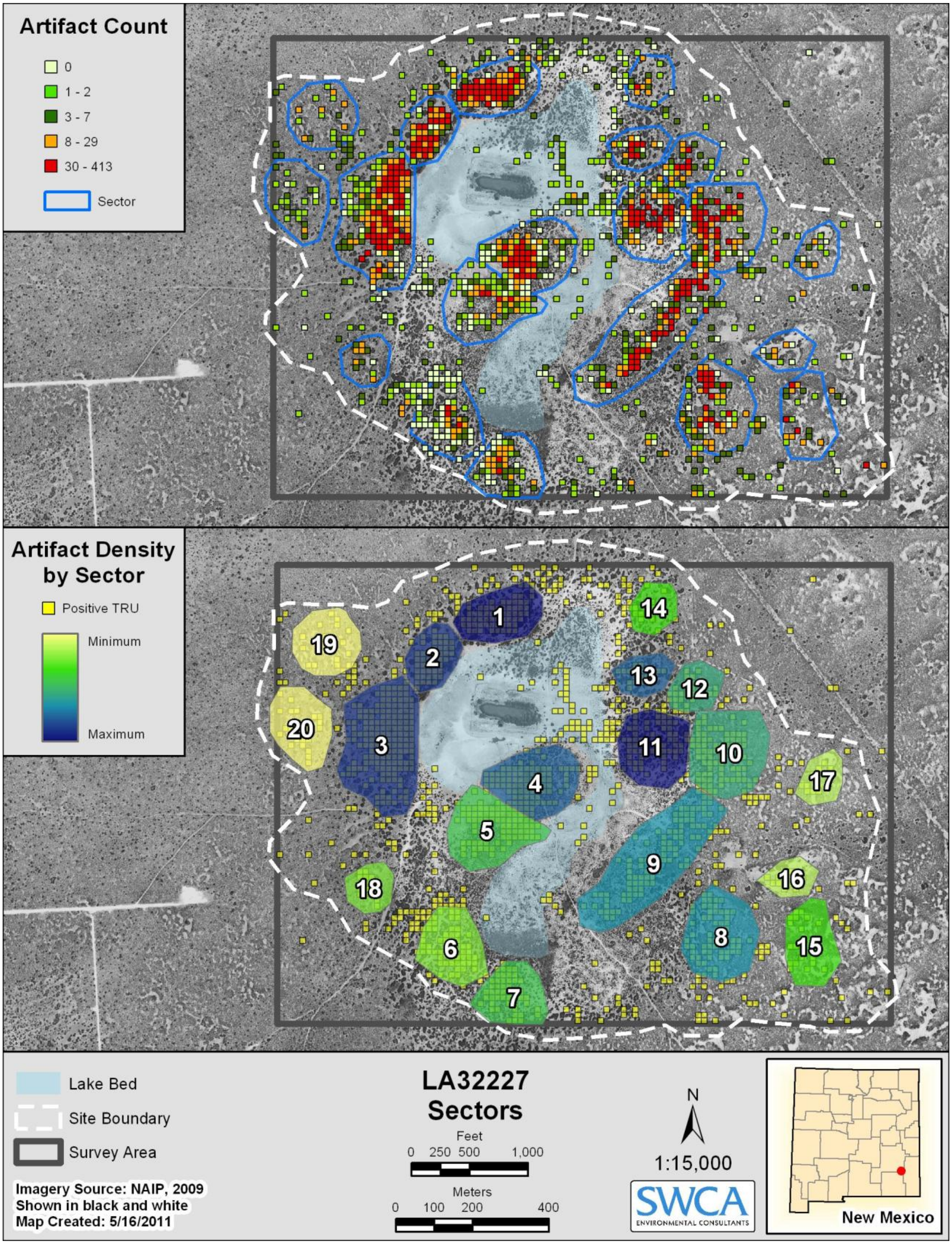

Figure 5.1. Artifact density and sector boundaries.

Table 5.1. Artifact Count and Area by Sector

Sector Number	Area (m²)	Total Artifacts
Whole site	1,613,177	29,894
1	27,342	4,328
2	19,613	1,703
3	61,061	4,835
4	35,410	2,605
5	36,995	590
6	28,775	254
7	25,114	349
8	38,260	2,250
9	65,596	3,900
10	41,517	2,319
11	32,090	3,887
12	15,120	382
13	14,039	868
14	13,983	147
15	26,152	346
16	11,638	60
17	13,229	65
18	13,612	89
19	25,981	79
20	27,690	67

FEATURES

Eight features were discovered during this investigation (Figure 5.2); all were charcoal/ash-stained areas exposed by eolian action and all devoid of associated artifacts other than thermally altered caliche or fire-cracked rock (FCR). Deflated concentrations of burned caliche and FCR were numerous and probably represent the remains of hearths or roasting pits, but these were not recorded as features. It is likely that most, if not all the features are larger than what was visible on the ground surface. Most features—with the exception of Feature 1 on the southern boundary of the study area—were located in areas of sizable coppice dune/blowout formations within sectors with high artifact densities. Feature 8 was found outside this area in an area north of the Burro Tanks Spring, but it was located in a dune/blowout area like the other features to the east. All of the features appear to have potential for yielding macrobotanical and pollen/phytolith remains, and for radiocarbon dating. However, little other than speculation as to feature function can be offered given the parameters of this non-disturbing surface investigation.

Feature 1 was a dense charcoal scatter eroding out of the south face of a dune within a blowout (Figure 5.3). No artifacts or thermally altered rock were found in association with the feature. Feature 2 appeared to be the remnants of a partially deflated hearth at the bottom of a blowout (Figure 5.4). Feature 3 was the largest observed feature of burned and probably organic horizon, exposed on the southern flank of a coppice dune (Figure 5.5). Features 4 and 5, which may be one large thermal feature, appeared as two small neighboring areas of charcoal and ash staining (Figure 5.6). Feature 6 was a dark soil stain associated with a scatter of approximately 20 pieces of burned caliche near the northern base of a coppice dune (Figure 5.7), while Feature 7 was a small, charcoal-stained feature containing no visible charcoal fragments, uncovered by pedestrian traffic (Figure 5.8). Feature 8, also revealed by pedestrian traffic during the investigation (Figure 5.9), consisted of a dark charcoal stain eroding out of a small coppice dune. A summary of feature attributes is provided in Table 5.2.

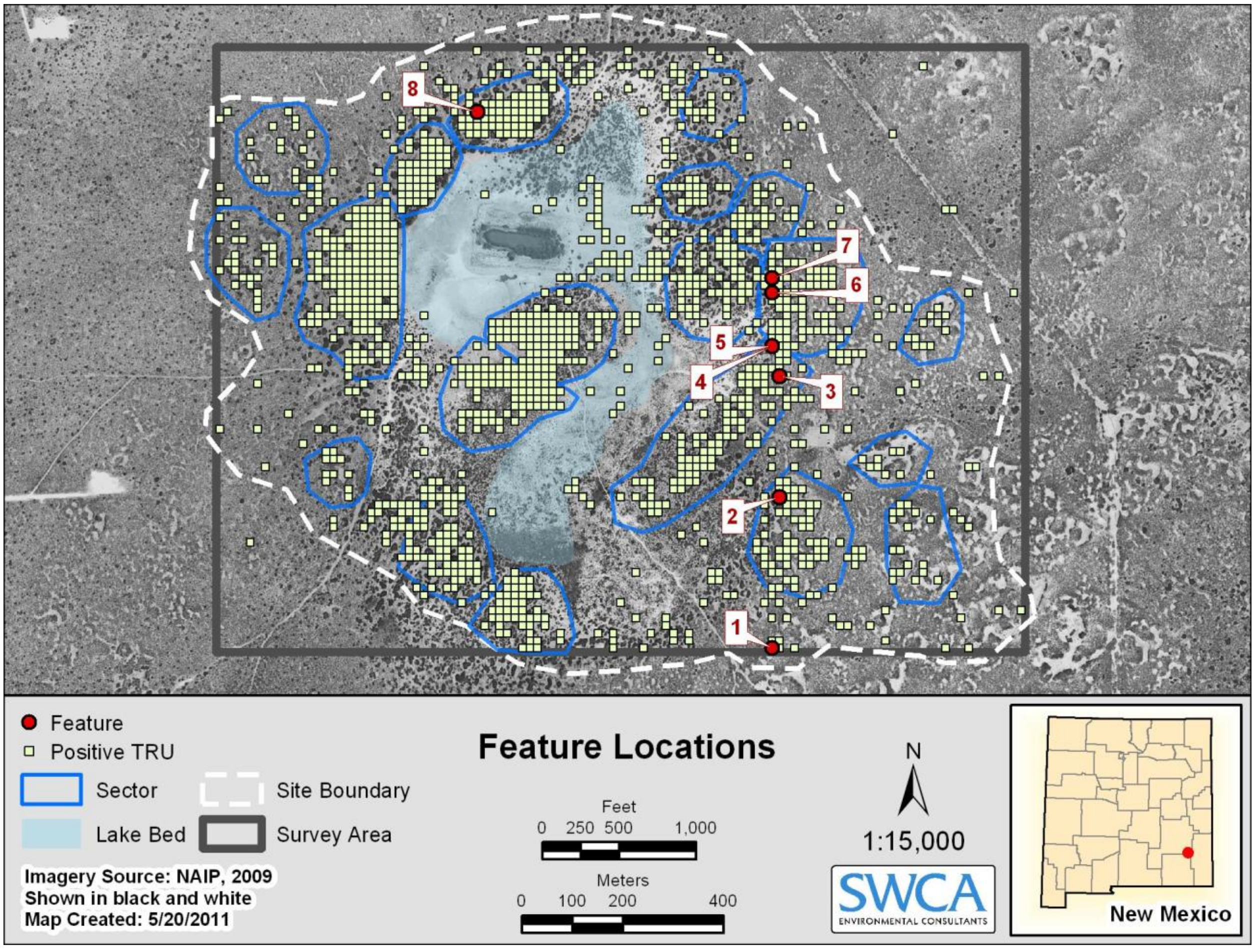

Figure 5.2. Feature locations.

Figure 5.3. Feature 1, facing north (Roll 16788-1, Frame 0074).

Figure 5.4. Feature 2, facing south (Roll 16788-1, Frame 0075).

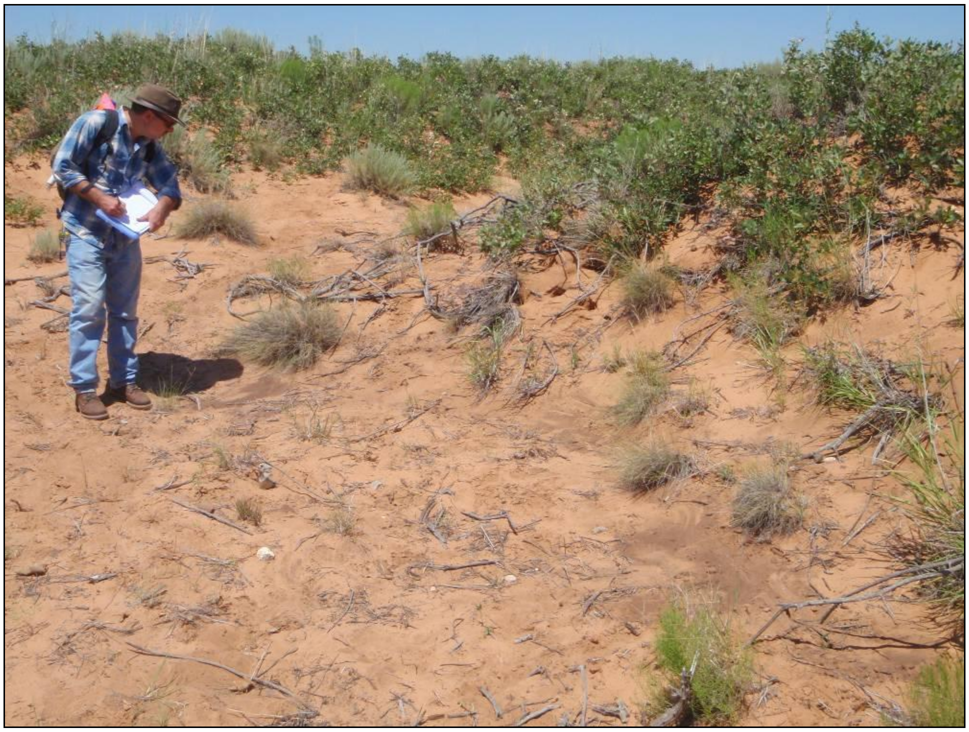

Figure 5.5. Feature 3, facing northwest (Roll 16788-1, Frame 0077).

Figure 5.6. Feature 4 (right of trowel) and Feature 5 (left of trowel), facing south (Roll 16788-2, Frame 0006).

Figure 5.7. Feature 6, a partially deflated hearth with thermally colored caliche in photo center, facing east (Roll 16788-2, Frame 0010).

Figure 5.8. Feature 7, facing south (Roll 16788-1, Frame 0079).

Figure 5.9. Feature 8, facing south (Roll 16788-3, Frame 0018).

Table 5.2. Summary of Feature Attributes

TRU No.	Sector No.	Feature No.	Type	Dimensions (m)	Description	Photo Roll / Frame No.
1–74	–	1	Charcoal Stain	0.5 N-S × 0.6 E-W	Charcoal scatter	16788-1/0074
21–75	8	2	Hearth	0.3 N-S × 0.3 E-W	Partially deflated hearth	16788-1/0075
37–75	9	3	Unknown	5 N-S × 0.2 E-W	Burned organic horizon	16788-1/0077
41–74	9	4	Hearth	0.5 N-S × 0.5 E-W	Ash/charcoal stain	16788-2/0006–0008
41–74	9	5	Hearth	0.5 N-S × 0.5 E-W	Ash/Charcoal stain; 1 m east of Feature 4	16788-2/0006–0008
48–74	10	6	Hearth	0.5 N-S × 0.5 E-W	Dark soil stain and approximately 20 pieces burned caliche	16788-2/0009–0010
50–74	10	7	Probable Hearth	0.3 N-S × 0.3 E-W	Charcoal stain	16788-1/0079
72–35	1	8	Possible Hearth	0.6 N-S × 0.6 E-W	Dark charcoal stain	16788-3/0016–0018

MIDDEN DEPOSITS

Midden deposits, in contrast to features, were defined as relatively large areas of anthropogenic soil, distinguished by a dark color and sometimes by the presence of charcoal and faunal material. A total of 319 TRUs contained midden deposits, so defined, only 24 percent of the 1,333 positive TRUs (Figure 5.10). These TRUs, however, were disproportionately concentrated in a small number of sectors, especially Sectors 1, 2, 3, 4, 9, and 13 (Table 5.3). It is assumed that the concentration of midden deposits in these sectors indicates longer-term and more intensive occupation than in the other sectors; indeed, total midden deposit area is strongly correlated with total artifact count by sector. SWCA hypothesizes that most of the sectors with extensive midden deposits represent ceramic period occupations (see Ceramics below).

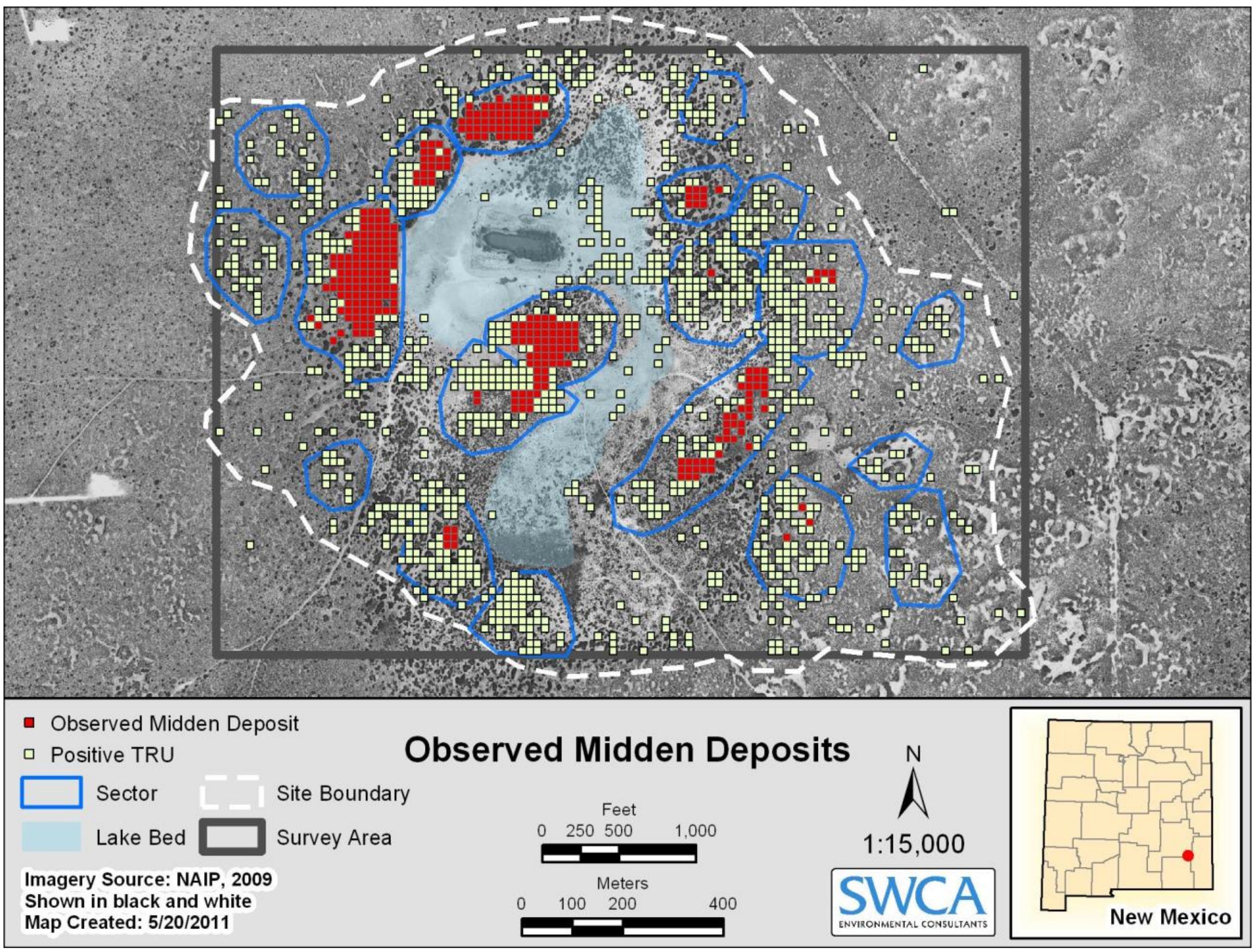

Figure 5.10. Observed midden deposits.

Table 5.3. Artifact Count and Midden Area by Sector

Sector Number	Artifact Count	Midden Area (m²)
1	4,328	12,150
2	1,703	4,500
3	4,835	24,975
4	2,605	11,925
5	590	3,825
6	254	1,350
7	349	0
8	2,250	675
9	3,900	9,450
10	2,319	1,350
11	3,887	225
12	382	0
13	868	2,250
14	147	0
15	346	0
16	60	0
17	65	0
18	89	0
19	79	0
20	67	0

Burned Caliche and Fire-cracked Rock

In total, 30,250 pieces of burned caliche and 3,722 pieces of FCR were tabulated in the course of the investigation (Figure 5.11 and Figure 5.12, Table 5.4). Only burned caliche fragments larger than 5 cm in maximum dimension were recorded. Both of these material types presumably represent cooking activities and were heated and used to boil water or roast food. The FCR was almost entirely composed of small pieces of heavily burned and degraded sandstone. In addition, almost all of the ground stone artifacts recovered in the course of the investigation were highly fragmented and burned. Apparently, most grinding stones at the site were used as boiling stones or cooking rocks at the end of the use-lives.

Burned caliche is considerably more common at the site than is FCR. This fact no doubt reflects the ready availability of caliche at the site—it occurs in outcrops within the site boundary, particular in Sector 4—and the lack of a readily available stone source.

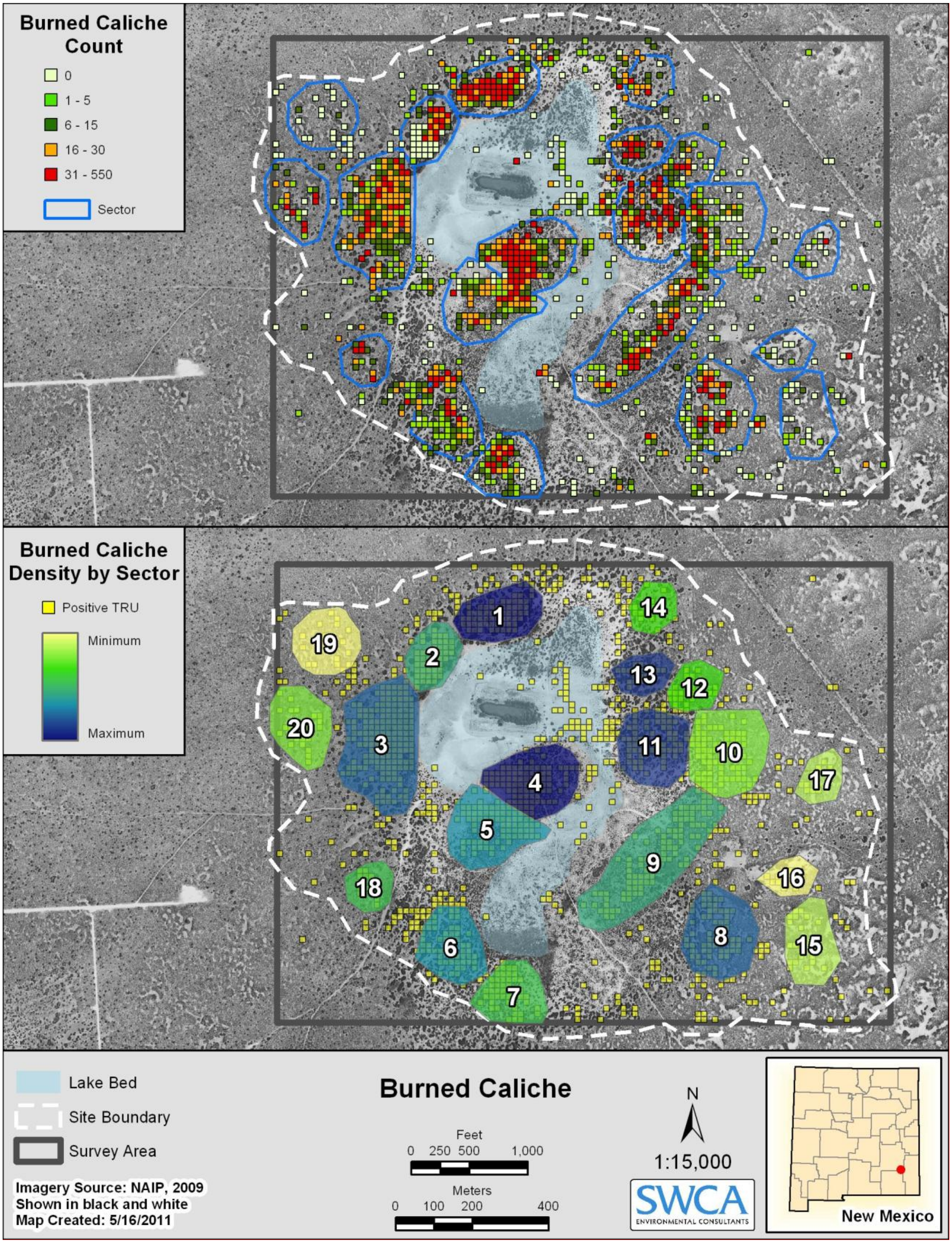

Figure 5.11. Burned caliche distribution.

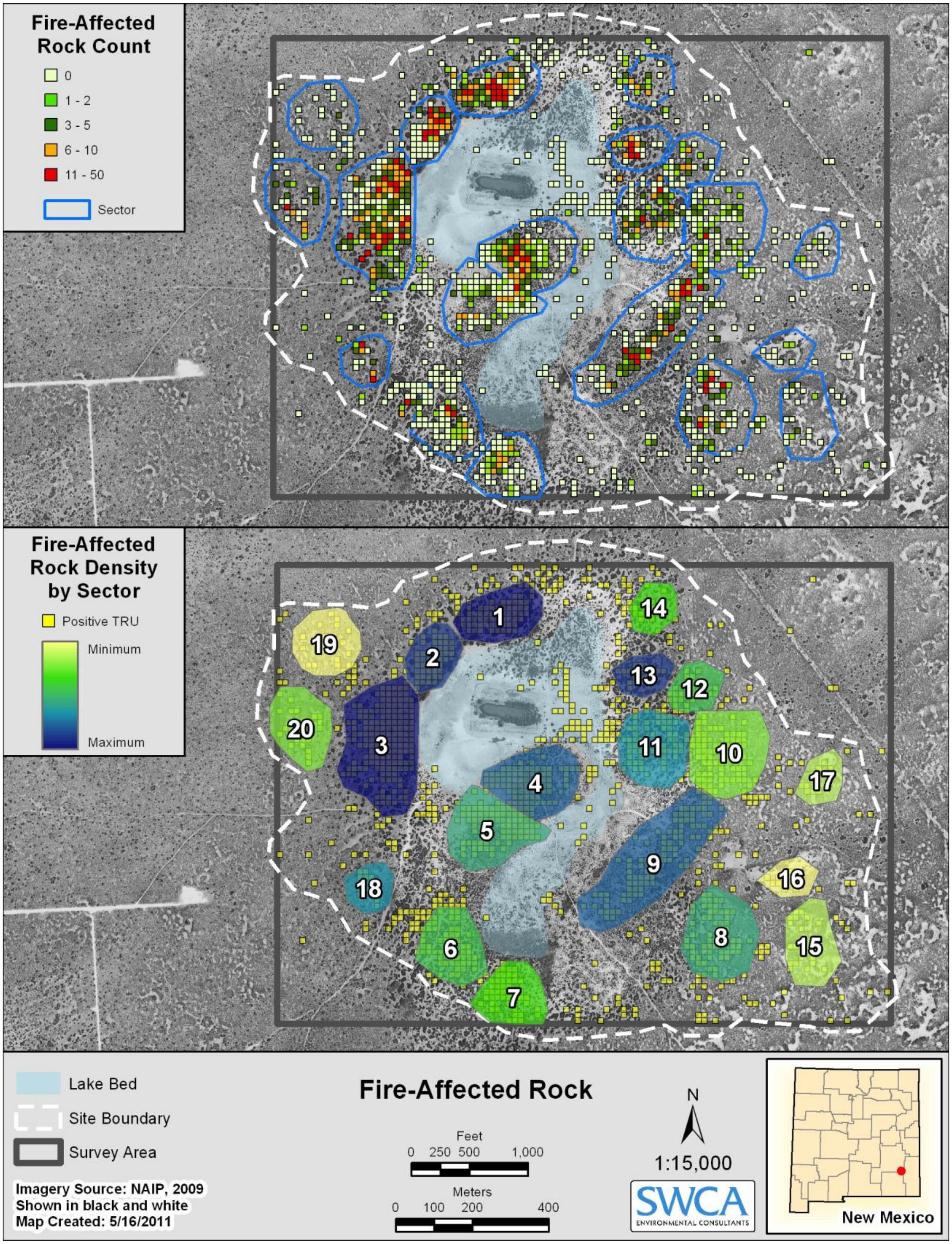

Figure 5.12. Fire-cracked rock distribution.

Table 5.4. Burned Caliche and FCR Counts by Sector

Sector Number	Burned Caliche	FCR
1	3,410	416
2	820	228
3	3,431	938
4	6,206	374
5	1,811	153
6	1,277	95
7	861	71
8	1,958	184
9	2,608	446
10	845	98
11	2,208	196
12	392	50
13	1,116	177
14	382	43
15	42	11
16	12	2
17	72	5
18	405	74
19	19	5
20	488	74

ANIMAL BONE

In total, 2,861 pieces of animal bone were tabulated in the course of the survey (Figure 5.13). The distribution of animal bone was highly correlated with midden area (Table 5.5) and also with total artifact counts. The highest bone densities were observed in Sectors 1, 2, 3, and 4. This suggests that animal bone, like artifact count and midden area, is a good indicator of high occupation intensity. All bones were highly fragmentary, and most were calcined or showed other evidence of thermal alteration. No detailed in-field analysis was conducted, so no data are available on what taxa may be represented in the assemblage. It should also be noted that no human bone was observed in the course of the investigation.

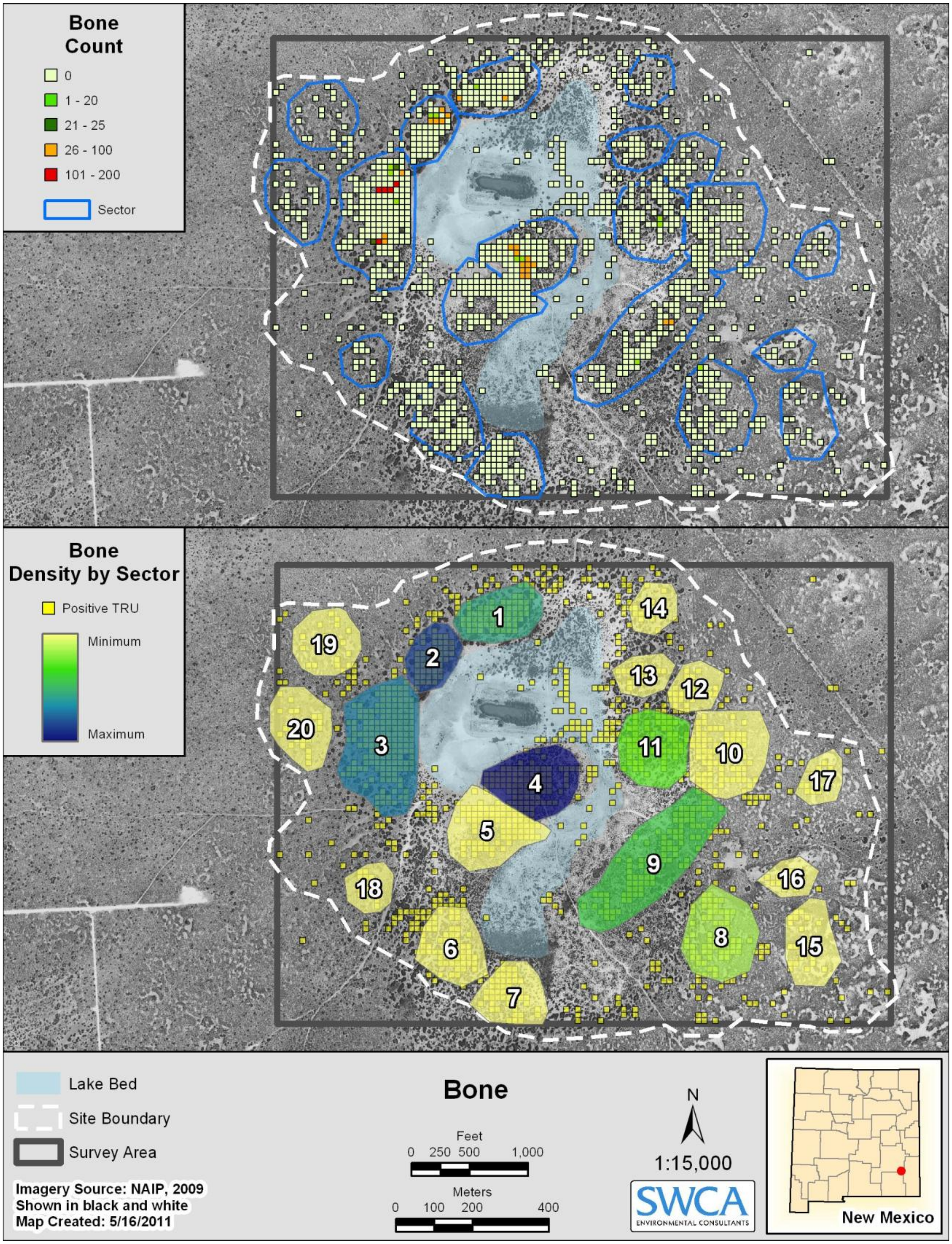

Figure 5.13. Bone distribution.

Table 5.5. Animal Bone Count and Midden Area by Sector

Sector Number	Animal Bone Count	Midden Area (m²)
1	103	12,150
2	405	4,500
3	1,252	24,975
4	915	11,925
5	0	3,825
6	0	1,350
7	0	0
8	1	675
9	145	9,450
10	0	1,350
11	40	225
12	0	0
13	0	2,250
14	0	0
15	0	0
16	0	0
17	0	0
18	0	0
19	0	0
20	0	0

DEBITAGE

In total, 25,221 pieces of lithic debitage were recorded in the course of the survey (Figure 5.14). The recording protocol was to analyze at least 50 pieces of debitage from each TRU, and simply to count the remaining debitage without subjecting it to detailed analysis. Following this protocol, 16,654 pieces of debitage were analyzed in the field, while the remaining 8,567 were tabulated by TRU. Of the analyzed assemblage, 15,583 were complete or partial flakes, preserving at least some flake characteristics, while the remaining 1,071 were shatter, lacking any identifiable flake characteristics (Table 5.6).

One interesting observation is that, unlike animal bone, debitage is not clearly correlated with midden area. While the sectors with large midden areas do have large debitage assemblages, some sectors with little midden—particularly Sectors 8, 10, and 11—also have high debitage counts. This suggests that high debitage density does not necessarily indicate high occupation intensity. Rather, some sectors with high debitage densities may represent palimpsests of a great many low-intensity occupation events spread over a long period of time, rather than shorter-duration episodes of high-intensity occupation. In other words, it may be possible to identify two distinct modes of site formation operating at these different sectors.

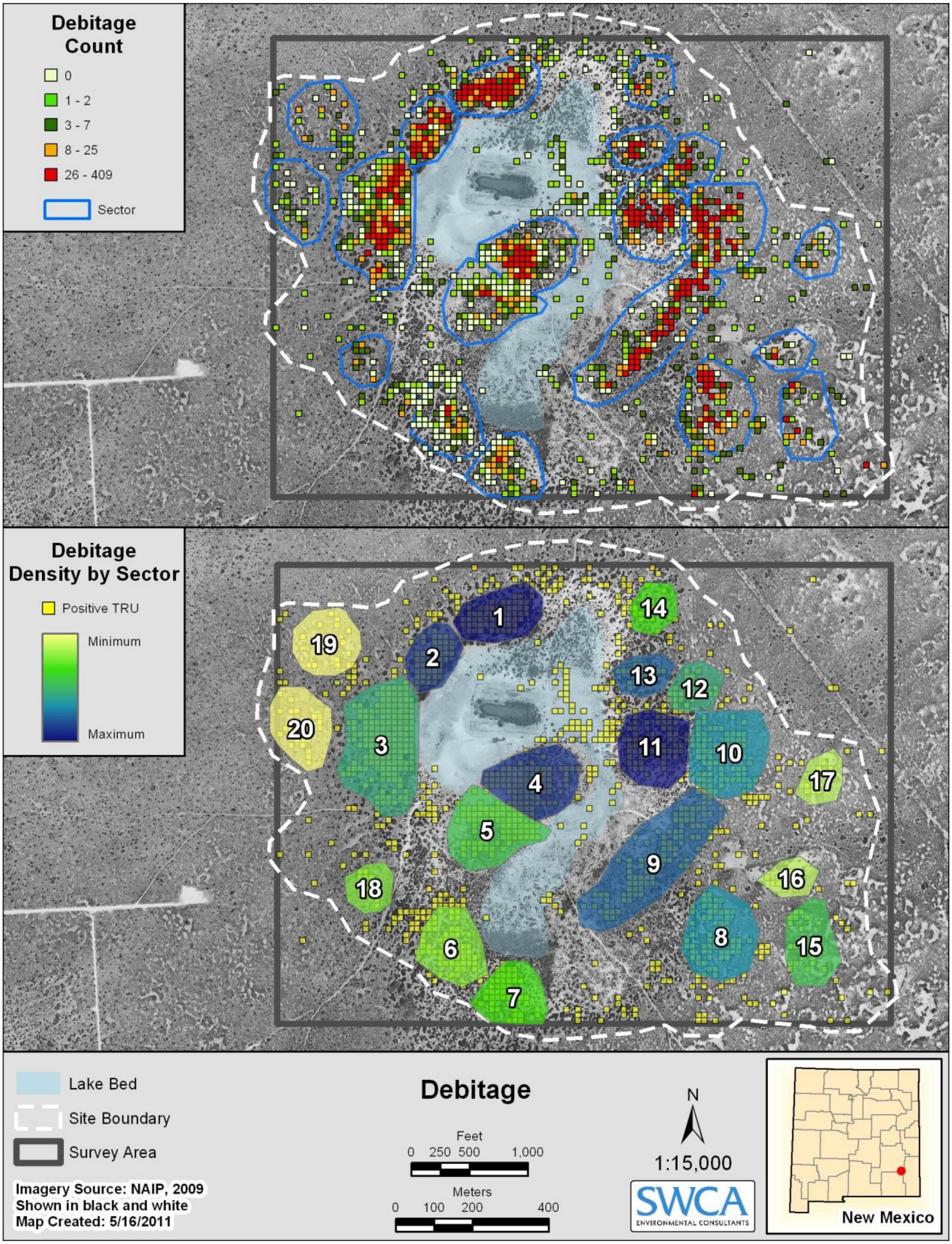

Figure 5.14. Debitage distribution.

Table 5.6. Debitage Counts by Sector

Sector Number	Total Debitage	Analyzed Flakes	Analyzed Shatter
1	3,859	1,924	141
2	1,241	941	74
3	2,880	2,156	95
4	2,179	1,417	42
5	447	387	14
6	194	167	27
7	275	258	17
8	2,042	1,178	126
9	3,708	2,172	133
10	2,098	1,636	110
11	3,744	1,566	69
12	327	307	20
13	808	357	20
14	130	110	20
15	310	230	31
16	57	50	7
17	59	52	7
18	72	64	8
19	75	56	19
20	40	36	4

Nine raw material types are represented in the Burro Tanks debitage sample (Table 5.7 and Table 5.8). By far the two most common were chalcedony and chert, accounting for 91.2 percent of all analyzed debitage. Chalcedony is available locally with nodules naturally occurring within the site boundary. Most of these nodules are small, with a maximum dimension of less than 10 cm. Chalcedony seems to have been used primarily for expedient flake tools, since only the minority of lithic tools is made of this material. The source of the chert at LA 32227 is unknown. It occurs at the site in a wide range of colors and textures. Chert occurs in lag gravels distributed throughout the Pecos River valley and the Mescalero Plain, and is most likely available a short distance from the site. In any case, the extremely heterogeneous nature of chert materials at the site makes any attempt at characterization and source identification well beyond the scope of this survey. Suffice it to say that cherts consistent with the Burro Tanks raw material assemblages are readily available within a day's walk of the site.

Some extrusive volcanics are also present in the assemblage. Basalt and rhyolite occur in small quantities and were most likely procured from Pecos River gravels or from the mountains to the west. Obsidian is very rare and most likely comes from the Mt. Taylor volcanic field, the Jemez Mountains in north-central New Mexico, or Rio Grande river gravels. Interestingly, obsidian only occurs in Sectors 1 through 5. As will become clear in discussion of ceramics, these five sectors represent the principal ceramic period occupations of the site. Apparently obsidian use at Burro Tanks is a relatively late phenomenon.

Quartzite, mainly of a purple or similar color, is the third most common raw material type in the debitage assemblage. This material is common throughout southeastern New Mexico, though its source is unknown. Laumbach (1979:33) claims that it derives from the Ogallala Formation, but it, like chert, is probably widely distributed throughout the Mescalero Plain. Quartzite makes up approximately 7 percent of the site's analyzed debitage assemblage.

Table 5.7. Debitage Raw Material Counts by Sector

Sector	Basalt	Chalce-dony	Chert	Limes-tone	Obsidian	Petrified Wood	Quartzite	Rhyolite	Sand-stone	Unknown
Whole Site	13	9,396	5,779	4	16	48	1,209	6	65	108
1	–	1,104	793	1	6	10	145	–	6	–
2	–	531	344	–	1	–	138	–	1	–
3	1	1,239	702	–	2	–	225	2	2	78
4	1	961	406	–	1	1	88	–	1	–
5	3	268	92	2	2	1	32	1	–	–
6	–	143	40	–	–	–	10	1	–	–
7	–	198	51	–	–	–	26	–	–	–
8	1	706	480	–	–	7	98	–	10	2
9	2	1,419	735	–	–	6	140	–	3	–
10	–	947	650	–	–	11	121	–	17	–
11	1	933	609	–	–	2	86	1	3	–
12	–	178	132	–	–	1	15	1	–	–
13	–	210	126	–	3	1	34	–	3	–
14	–	94	31	–	–	1	4	–	–	–
15	3	167	68	–	–	1	12	–	10	–
16	–	46	10	–	–	–	1	–	–	–
17	–	38	14	–	–	–	4	–	3	–
18	–	26	14	–	–	–	4	–	–	28
19	–	61	8	–	–	–	6	–	–	–
20	–	21	11	–	–	–	8	–	–	–

Table 5.8. Debitage Raw Material Percentages by Sector

Sector	Basalt	Chalce-dony	Chert	Limes-tone	Obsidian	Petrified Wood	Quartzite	Rhyolite	Sand-stone	Unknown
Whole Site	0.1	56.5	34.7	–	0.1	0.3	7.3	0.0	0.4	0.6
1	–	53.5	38.4	–	0.3	0.5	7.0	–	0.3	–
2	–	52.3	33.9	–	0.1	–	13.6	–	0.1	–
3	–	55.0	31.2	–	0.1	–	10.0	0.1	0.1	3.5
4	0.1	65.9	27.8	–	0.1	0.1	6.0	–	0.1	–
5	0.7	66.8	22.9	0.5	0.5	0.2	8.0	0.2	–	–
6	–	73.7	20.6	–	–	–	5.2	0.5	–	–
7	–	72.0	18.5	–	–	–	9.5	–	–	–
8	0.1	54.1	36.8	–	–	0.5	7.5	–	0.8	0.2
9	0.1	61.6	31.9	–	–	0.3	6.1	–	0.1	–
10	–	54.2	37.2	–	–	0.6	6.9	–	1.0	–
11	0.1	57.1	37.2	–	–	0.1	5.3	0.1	0.2	–
12	–	54.4	40.4	–	–	0.3	4.6	0.3	–	–
13	–	55.7	33.4	–	0.8	0.3	9.0	–	0.8	–
14	–	72.3	23.8	–	–	0.8	3.1	–	–	–

Sector	Basalt	Chalce-dony	Chert	Limes-tone	Obsidian	Petrified Wood	Quartzite	Rhyolite	Sand-stone	Unknown
15	1.1	64.0	26.1	–	–	0.4	4.6	–	3.8	–
16	–	80.7	17.5	–	–	–	1.8	–	–	–
17	–	64.4	23.7	–	–	–	6.8	–	5.1	–
18	–	36.1	19.4	–	–	–	5.6	–	–	38.9
19	–	81.3	10.7	–	–	–	8.0	–	–	–
20	–	52.5	27.5	–	–	–	20.0	–	–	–

Cortex was present on 46 percent of analyzed flakes in the Burro Tanks assemblage, though cortex presence varied dramatically by raw material type and to some extent by sector (Table 5.9). Chert and quartzite have consistently lower cortex presence than does chalcedony, and obsidian has very low cortex frequency. All of these results are consistent with the current understanding of the distance these materials were transported. Many of the relatively extreme values in the table most likely are artifacts of small sample size rather than genuinely meaningful patterns. Overall, cortex presence by raw material is remarkably consistent between sectors, reflecting the availability and character of raw materials in the site and surrounding area, and also perhaps pointing to a long-term persistence of lithic procurement and reduction practices through time at the site.

Table 5.9. Percent Cortex Presence on Analyzed Flakes by Sector

Sector	Basalt	Chalce-dony	Chert	Limes-tone	Obsidian	Petrified Wood	Quartzite	Rhyolite	Sand-stone	Unknown
Whole Site	46.2	51.3	38.6	0.0	6.3	60.9	39.4	83.3	46.2	44.9
1	–	50.8	26.6	0.0	0.0	20.0	27.5	–	66.7	–
2	–	48.2	30.5	–	0.0	–	35.3	–	100.0	–
3	100.0	55.1	41.5	–	0.0	–	50.2	50.0	100.0	43.2
4	100.0	59.3	43.2	–	100.0	100.0	51.1	–	0.0	–
5	100.0	62.4	45.5	0.0	0.0	100.0	31.3	100.0	–	–
6	–	52.8	42.4	–	–	–	70.0	100.0	–	–
7	–	64.4	23.9	–	–	–	41.7	–	–	–
8	0.0	45.0	42.2	–	–	85.7	38.5	–	50.0	50.0
9	0.0	49.8	43.4	–	–	40.0	34.1	–	66.7	–
10	–	41.8	37.5	–	–	63.6	34.5	–	23.5	–
11	100.0	45.9	40.1	–	–	100.0	33.7	100.0	100.0	–
12	–	46.7	33.3	–	–	100.0	53.3	100.0	–	–
13	–	49.0	46.2	–	0.0	0.0	52.9	–	66.7	–
14	–	41.0	29.6	–	–	100.0	100.0	–	–	–
15	0.0	51.4	34.4	–	–	100.0	0.0	–	30.0	–
16	–	48.7	30.0	–	–	–	0.0	–	–	–
17	–	50.0	46.2	–	–	–	25.0	–	66.7	–
18	–	68.0	78.6	–	–	–	33.3	–	–	50.0
19	–	78.6	25.0	–	–	–	33.3	–	–	–
20	–	57.9	33.3	–	–	–	50.0	–	–	–

This same continuity is evident in the flake size data (Table 5.10). Flake size was recorded in the field in terms of size categories: size 1 (0–1 cm), size 2 (1–2 cm), size 3 (2–3 cm), size 4 (3–4 cm) and size 4+ (> 4 cm). A flake size index was calculated using the following equation:

```
(S1*0.5 + S2*1.5 + S3*2.5 + S4*3.5 + S4plus*4.5) / total flake count
```

The index is a rough measure of average flake size, and varies from 0.5 to 4.5 in possible values. The data on flake size are broadly consistent with those for cortex presence. Obsidian has the smallest flake size index, reflecting its long transport distances and presumably curated role in reduction strategies. Chalcedony has a higher flake size index than chert, and the coarser materials such as petrified wood, limestone, sandstone, basalt, and rhyolite have higher flake size index values still. Quartzite has a higher flake size index than chert or chalcedony, which to be expected given its coarser texture and the fact that it does not produce very small flakes as do fine materials like chert and chalcedony. However, flake size index values for materials across sectors are broadly consistent, with some extreme values attributable to small sample sizes. Again, this would seem to be evidence for long-term persistence of lithic procurement and reduction practices at the site, conditioned by the availability and character of local raw materials. It may also reflect the scavenging of earlier debitage by the site's later inhabitants.

Table 5.10. Flake Size Index by Sector

Sector	Basalt	Chalce-dony	Chert	Limes-tone	Obsidian	Petrified Wood	Quartzite	Rhyolite	Sand-stone	Unknown
Whole Site	2.65	2.11	1.94	3.00	1.19	2.57	2.30	3.67	2.33	1.94
1	–	1.97	1.65	1.50	1.17	2.40	2.15	–	2.83	–
2	–	2.20	1.80	–	0.50	–	2.26	–	3.50	–
3	4.50	2.31	2.09	–	0.50	–	2.59	2.50	4.00	1.91
4	2.50	1.97	1.50	–	1.50	1.50	1.83	–	2.50	–
5	2.50	2.40	2.23	3.50	1.50	4.50	2.31	4.50	–	–
6	–	2.22	2.47	–	–	–	2.60	3.50	–	–
7	–	2.27	1.93	–	–	–	2.33	–	–	–
8	3.50	2.26	2.18	–	–	3.07	2.56	–	2.70	1.50
9	3.00	2.09	1.95	–	–	1.90	2.02	–	3.50	–
10	–	1.90	2.00	–	–	2.50	2.29	–	1.85	–
11	3.50	1.94	1.88	–	–	3.00	2.34	4.50	1.50	–
12	–	2.19	2.44	–	–	2.50	2.43	4.50	–	–
13	–	2.07	2.09	–	1.50	–	2.32	–	1.50	–
14	–	1.87	1.61	–	–	3.50	2.50	–	–	–
15	1.50	1.89	1.61	–	–	4.50	1.83	–	2.30	–
16	–	1.63	1.50	–	–	–	1.50	–	–	–
17	–	1.88	2.04	–	–	–	1.00	–	1.83	–
18	–	2.70	2.86	–	–	–	2.50	–	–	2.09
19	–	3.10	1.88	–	–	–	3.33	–	–	–
20	–	2.39	2.72	–	–	–	2.13	–	–	–

COLLECTED OBSIDIAN

Twenty pieces of obsidian (as part of 14 field samples) were collected during this investigation on the instructions of Rebecca Hill of the BLM Roswell Field Office to be submitted for obsidian sourcing. All obsidian samples were delivered to Roswell Field Office on October 27, 2010. Observed/collected obsidian clustered in the northwestern portion of the survey area, primarily in Sectors 1 through 5 and 13 (Figure 5.15). Although 20 samples were collected, only 17 were included in the analysis, including 16 pieces of debitage and a biface. Three obsidian flakes were apparently not included in the debitage analysis. These were Field Samples 2 (Sector 1), 3 (Sector 5), and 14 (Sector 4, only one of the two collected obsidian flakes was analyzed). This represents an error on the part of the field crews. Nevertheless, no analytical data are available for these three collected obsidian flakes. Sample details, including location information, are presented in Table A.3 in Appendix A.

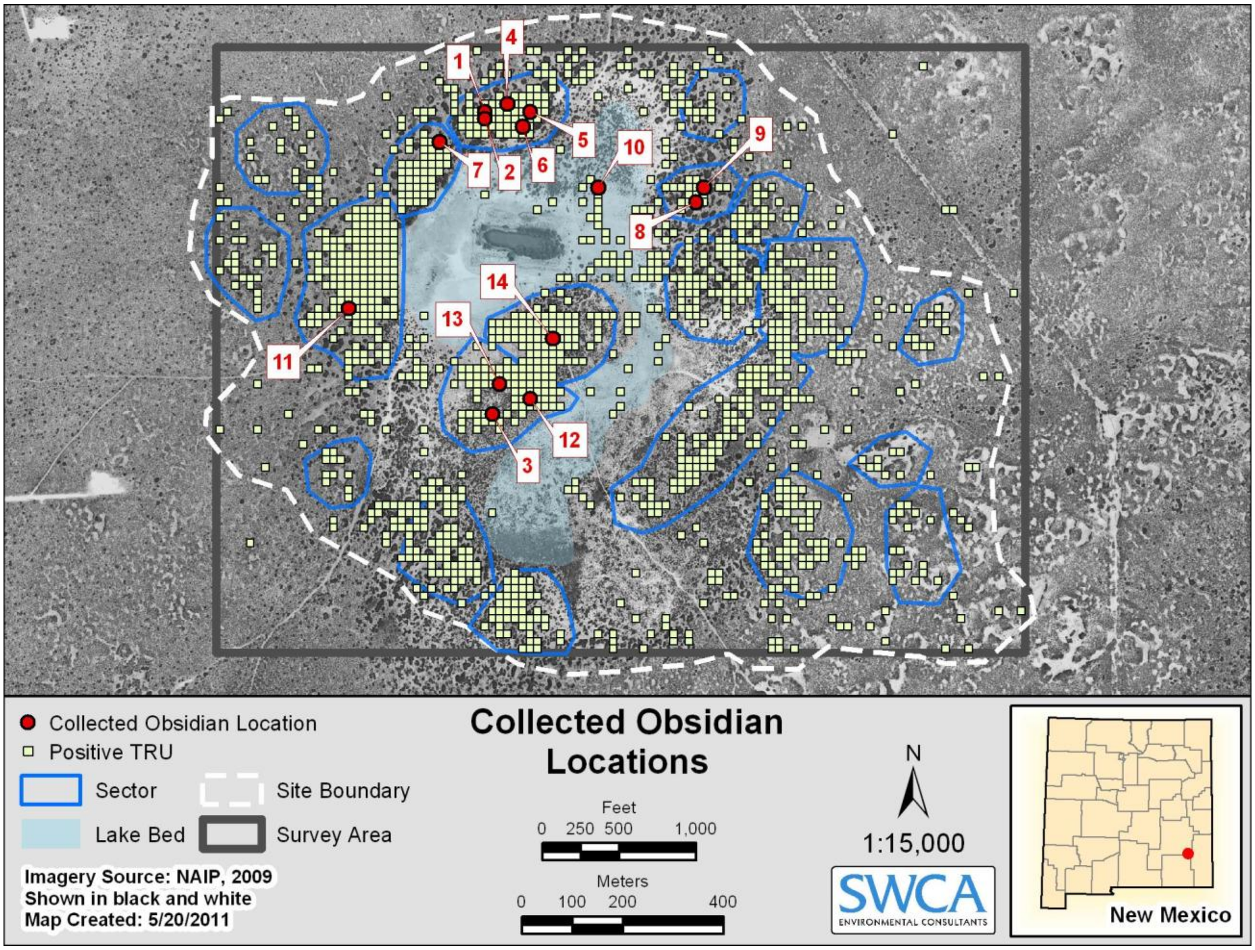

Figure 5.15. Collected obsidian locations.

CERAMICS

In total, 2,913 ceramic fragments were tabulated and analyzed in the course of the investigation (Figure 5.16, Table 5.11). In-field analysis was cursory and consisted only of a brief description, an assignment to a type or ware if possible, and an assessment of vessel form and portion represented. On the basis of ceramic density, the sectors can be divided into two main groups: those with relatively high ceramic densities (greater than 0.5 sherds per 100 m^2) and those with relatively low ceramic densities (less than 0.5 sherds per 100 m^2). Sectors with high ceramic densities are Sectors 1 through 4; the remaining sectors have low ceramic densities. Interestingly, all four of the sectors with high ceramic densities are also characterized by general indicators of high occupation intensity, such as large midden areas, high animal bone counts, and high total artifact counts. In other words, these four sectors appear to indicate intensive occupation episodes, and all date to the ceramic period, late in the site's occupation.

Also interesting is the fact that 85 percent of the obsidian collected from the site was found in these four sectors, or in the adjacent Sector 5 or the adjacent dry lake bed. The pattern is clear. Obsidian use at the site was almost exclusively restricted to the ceramic period occupation.

Some of the remaining sectors also have modest ceramic assemblages, particularly Sectors 5 through 9 and 11 through 13. However, most of these sectors lack large midden areas and have low animal bone counts. Their ceramic period occupations were low intensity in character, probably representing a small number of transient camping episodes. This is comparable to the occupations evident at most of the aceramic sectors. The exceptions are Sectors 9 and 13, both of which have significant midden areas. Sector 9 at least may contain the remains of relatively intensive preceramic occupation.

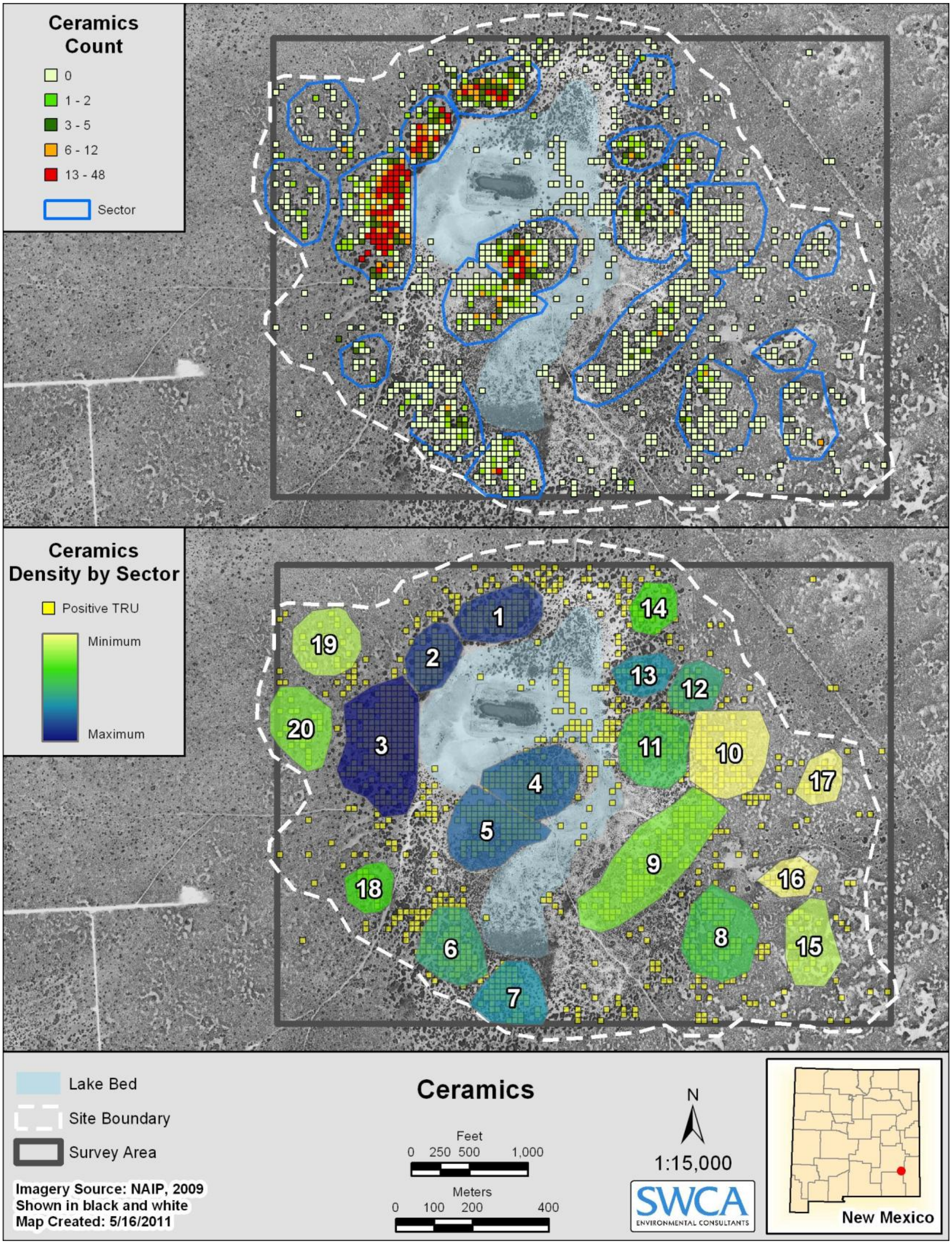

Figure 5.16. Ceramic distribution.

Table 5.11. Ceramic Count and Density by Sector

Sector Number	Ceramic Count	Ceramic density (sherds per 100 m²)
1	332	1.21
2	350	1.78
3	1,591	2.61
4	320	0.90
5	97	0.26
6	31	0.11
7	41	0.16
8	22	0.06
9	19	0.03
10	0	0.00
11	22	0.07
12	17	0.11
13	27	0.19
14	6	0.04
15	6	0.02
16	0	0.00
17	0	0.00
18	6	0.04
19	1	0.00
20	7	0.03

A sample of the more common ceramic types of southeastern New Mexico was observed in the course of the survey. These included Jornada Brown, El Paso Brown, El Paso Bichrome/Polychrome, Chupadero Black-on-white, other black-on-white styles, Lincoln Black-on-red, Three Rivers Red-on-terracotta, San Andres Red-on-terracotta, Corona Corrugated, and Ochoa Indented, as well as various unidentified redwares, brownwares, and graywares. Representative photographs of some of the ceramic types observed and recorded during this investigation are shown in Figure 5.17 through Figure 5.22. Ceramic analysis was completed in the field, and no collections were made, so analysis was by necessity cursory. Moreover, since these were surface artifacts, they were highly fragmented and often heavily eroded, further complicating attempts at identification. Nevertheless, some interesting patterns can be discerned. Ceramic type counts and frequencies by sector are presented in Table 5.12 and Table 5.13. Density distributions of some of these types are shown in Figure 5.23 through Figure 5.26.

Figure 5.17. a. Type 2 brownware sherds, probably South Pecos Brown (Roll16788-1, Frame 0010) and b. Corona Corrugated (Roll 16788-3A, Frame 0055).

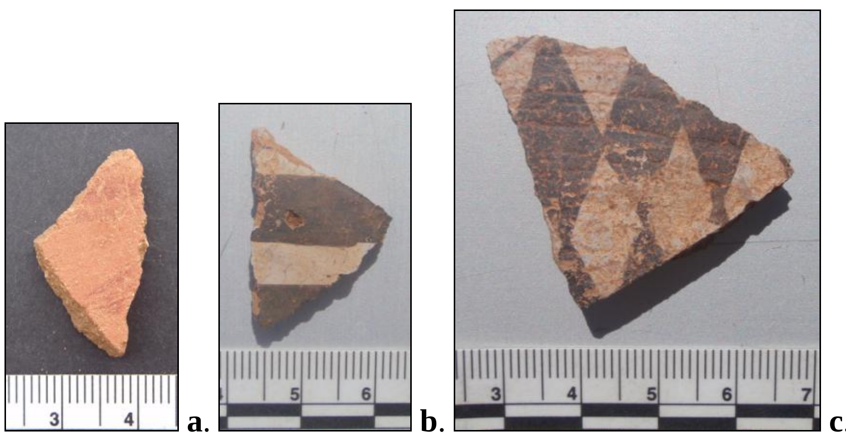

Figure 5.18. a. San Andreas Red-on-terracotta (Roll 16788-3A, Frame 0013); b. Chupadero Black-on-white (Roll 16788-3B, Frame 0056); and c. Chupadero Black-on-white (Roll 16788-3B, Frame 0101l).

Figure 5.19. a. Unidentified incised or comb-decorated sherd (Roll 16788-3B, Frame 0035) and b. Corona Corrugated (Roll 16788-3B, Frame 0148).

Figure 5.20. a. Jornada Brown jar fragment (Roll 16788-3B, Frame 0082) and b. Jornada Brown (Roll 16788-3B, Frame 0066).

Figure 5.21. a. Jornada Decorated (Roll 16788-3B, Frame 0060); b. Ochoa Indented (Roll 16788-3B, Frame 0074); c. Three Rivers Red-on-terracotta bowl rim (Roll 16788-3B, Frame 0184); and d. El Paso Polychrome (Roll 16788-4, Frame 0053).

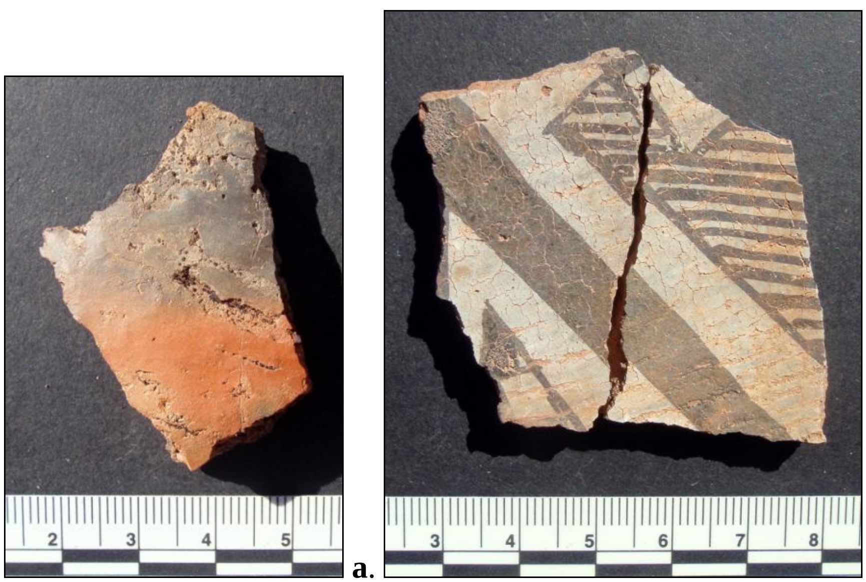

Figure 5.22. a. Unidentified redware sherd (Roll 16788-4, Frame 0039) and b. an unidentified Black-on-white sherd (Roll 167488-4, Frame 0050).

A variety of plain brownwares are present in southeastern New Mexico, and laboratory analysis is normally required to assign a particular sherd to a type. However, in general terms the plain brownwares at the Burro Tanks site can be divided into two broad types.

Type 1 brownwares are characterized by a fine sand or grit temper and relatively fine surface texture, often characterized as polish by field analysts. The majority of the sherds in this group are probably Jornada Brown. Without washing the sherds and inspecting fresh breaks no reliable assessment of temper could be made. Type 1 brownwares date to the Formative 1 through 7 phases of the Katz and Katz (1993) cultural sequence, approximately A.D. 500–1375.

Type 2 brownwares, by contrast, are sometimes characterized by a somewhat rougher surface texture, but are mainly distinguished from the other group by coarse, angular, light-colored temper. The majority of the sherds in this group are probably South Pecos Brown or McKenzie Brown with some admixture of El Paso brownware. The very ubiquity and high frequency of Type 2 brownware (Table 5.12), as well as the small number of El Paso Polychrome sherds observed, are strong indications that the group includes a local brownware in addition to the imported El Paso brownware. If this is the case, then Type 2 brownwares probably date to somewhat earlier in the Formative than the Type 1 brownwares. If the majority of Type 2 brownwares are in fact South Pecos Brown or McKenzie Brown, then the group would indicate a date in the Formative 5 and 6 phases of the Katz and Katz regional sequence, or approximately A.D. 900–1300 (Wiseman 2003:164). This interpretation is strengthened by patterns of association in the assemblage. For example, a high frequency of Type 2 brownwares is correlated with the presence of Three Rivers and San Andres Red-on-terracotta, both of which also date to the Formative 3 through 6 phases.

El Paso Polychrome is an imported type from the Rio Grande valley and is recognizable by its brown paste, coarse temper, and polychrome designs. It is a late type, dating to the Formative 6 and 7, or approximately A.D. 1200–1400.

Chupadero Black-on-white is the most common decorated type at the site, as it is throughout southeastern New Mexico. It is easily recognizable in the field due its distinctive striated interior surface texture. However, its manufacture and use spans a long period, between the Formative 3 through 7 phases of Katz and Katz's regional chronology, or approximately A.D. 950–1400.

Corona Corrugated, a corrugated brownware, is a relatively late type, dating to the Formative 6 and 7 phases, or approximately A.D. 1225–1460. It originated in the Sierra Blanca region, where it replaced Jornada Brown as the standard utility ware. Lincoln Black-on-red, a successor to Three Rivers Red-on-terracotta, is also a later type, dating to the Formative 7 phase.

The other Black-on-white category may include exotic types such as various Mimbres types, Red Mesa Black-on-white, Socorro Black-on-white, and Cebolleta Black-on-white, as well as other types. It may also include a significant number of misidentified Chupadero Black-on-white sherds. The category displays no strong patterning in its distribution and is therefore difficult to interpret. A formal ceramic analysis would be required to render this category meaningful, and it will not be considered further here.

Ochoa Indented is a very late type, dating to Katz and Katz's Protohistoric 1 phase, or approximately A.D. 1400–1500. Only two sherds of Ochoa Indented were documented during the survey. This may reflect a low-intensity occupation in the latest occupation at the site and perhaps a return to a more mobile lifeway.

Finally, a single combed or incised sherd was observed from Sector 7. It is unique at the site and may represent a southern plains type from western Texas.

Table 5.12. Ceramic Types by Sector

Sector	Chupadero Black-on-white	Corona Corrugated	El Paso Polychrome	Grayware	Lincoln Black-on-red	Ochoa Indented	Other Black-on-white	Red-on-terracotta	Redware	Type 1 brownware	Type 2 brownware	Incised/Combed
Whole site	81	18	4	154	3	2	49	15	37	1077	1444	1
1	6	1	–	25	–	–	4	5	5	80	202	–
2	1	1	–	46	–	–	10	2	3	78	208	–
3	48	6	1	63	2	1	24	8	14	664	743	–
4	14	4	2	3	–	1	8	–	1	123	158	–
5	2	3	1	4	1	–	3	–	3	46	34	–
6	6	–	–	1	–	–	–	–	–	17	7	–
7	1	3	–	5	–	–	–	–	6	12	13	1
8	1	–	–	–	–	–	1	–	–	13	7	–
9	–	–	–	–	–	–	–	–	–	5	14	–
11	–	–	–	3	–	–	–	–	–	13	6	–
12	–	–	–	–	–	–	–	–	–	2	15	–
13	2	–	–	–	–	–	–	–	3	8	14	–
14	–	–	–	3	–	–	–	–	–	3	–	–
15	–	–	–	–	–	–	–	–	–	–	6	–
18	–	–	–	–	–	–	–	–	–	5	1	–
19	–	–	–	–	–	–	–	–	–	1		–
20	1	–	–	–	–	–	–	–	1	4	1	–

Table 5.13. Ceramic Type Percentages by Sector (only sectors with n ≥ 25)

Sector	Chupadero Black -on-white	Corona Corrugated	El Paso Polychrome	Lincoln Black -on-red	Ochoa Indented	Other Black-on-white	Red-on-terracotta	Redware	Type 1 brown-ware	Type 2 brown-ware	Incised/Combed
Whole site	3	1	0	0	0	2	1	1	37	50	0
1	2	0	–	–	–	1	2	2	24	61	–
2	0	0	–	–	–	3	1	1	22	59	–
3	3	0	0	0	0	2	1	1	42	47	–
4	4	1	1	–	0	2	–	0	38	49	–
5	2	3	1	1	–	3	–	3	47	35	–
6	19	–	–	–	–	–	–	–	55	23	–
7	2	7	–	–	–	–	–	15	29	32	2
13	7	–	–	–	–	–	–	11	30	52	–

*due to rounding, rows may not sum to 100

Five sectors at Burro Tanks contain 92 percent of the documented surface ceramic assemblage. These are Sectors 1 through 5, mentioned previously as the sectors with evidence of intensive occupation by significant numbers of people over significant stretches of time. These sectors represent the main portion of the site's Formative period occupation. These sectors can also be divided into two groups on the basis of the data contained in Table 5.13.

The first group, consisting of Sectors 1 and 2, is characterized by high frequencies of Type 2 brownwares (approximately 60 percent) and relatively low frequencies of the later ceramic types, including Corona Corrugated, Lincoln Black-on-red, El Paso Polychrome, and Chupadero Black-on-white. These sectors also have relatively high frequencies the red-on-terracotta types, which date to the Formative 4 through 6 phases.

The second group, consisting of Sectors 3 through 5, is characterized by low frequencies of Type 2 brownwares (less than 50 percent) and low frequencies of the earlier red-on-terracotta types. These sectors also have relatively high frequencies of the later types, including Lincoln Black-on-red, Corona Corrugated, and El Paso Polychrome. This group also has a considerably higher percentage of Chupadero Black-on-white than does the first group. Sectors 3 and 4 also contain the only two documented examples of Ochoa Indented, the latest ceramic type present at the site.

In light of these data, it is possible to posit the following scenario for the Formative period occupation of the northwestern portion of the site. Sometime in the Formative 4 through 6 phases (A.D. 1075–1300), an intensive occupation was established in Sectors 1 and 2. This occupation, according to information gathered by Sawyer (1973), contained a significant number of human burials; about 20 were reportedly removed from this area in the late 1950s, as well as an associated "stone pendant."

Sometime in the Formative 7 phase (A.D. 1300–1375), a spatial shift in occupation intensity took place, with the focus of the occupation moving to Sectors 3 through 5. This later occupation was more intensive and larger than the previous one, resulting in the formation of a larger midden area and a much larger total artifact assemblage. Sawyer (1973) reported that several human burials were removed from this area in 1962, that a number of caliche-lined "pit rooms" were also known to exist in this area (specifically Sector 4), and that "a midden of considerable depth" was also present. The assertion that this area represents the latest substantial occupation at the site is further supported by the fact that Sector 3, the main center of this occupation, has the highest density of ground stone and the largest mean ground stone fragment size of any sector at the site (see Ground Stone below), consistent with expected scavenging of these materials from earlier occupations.

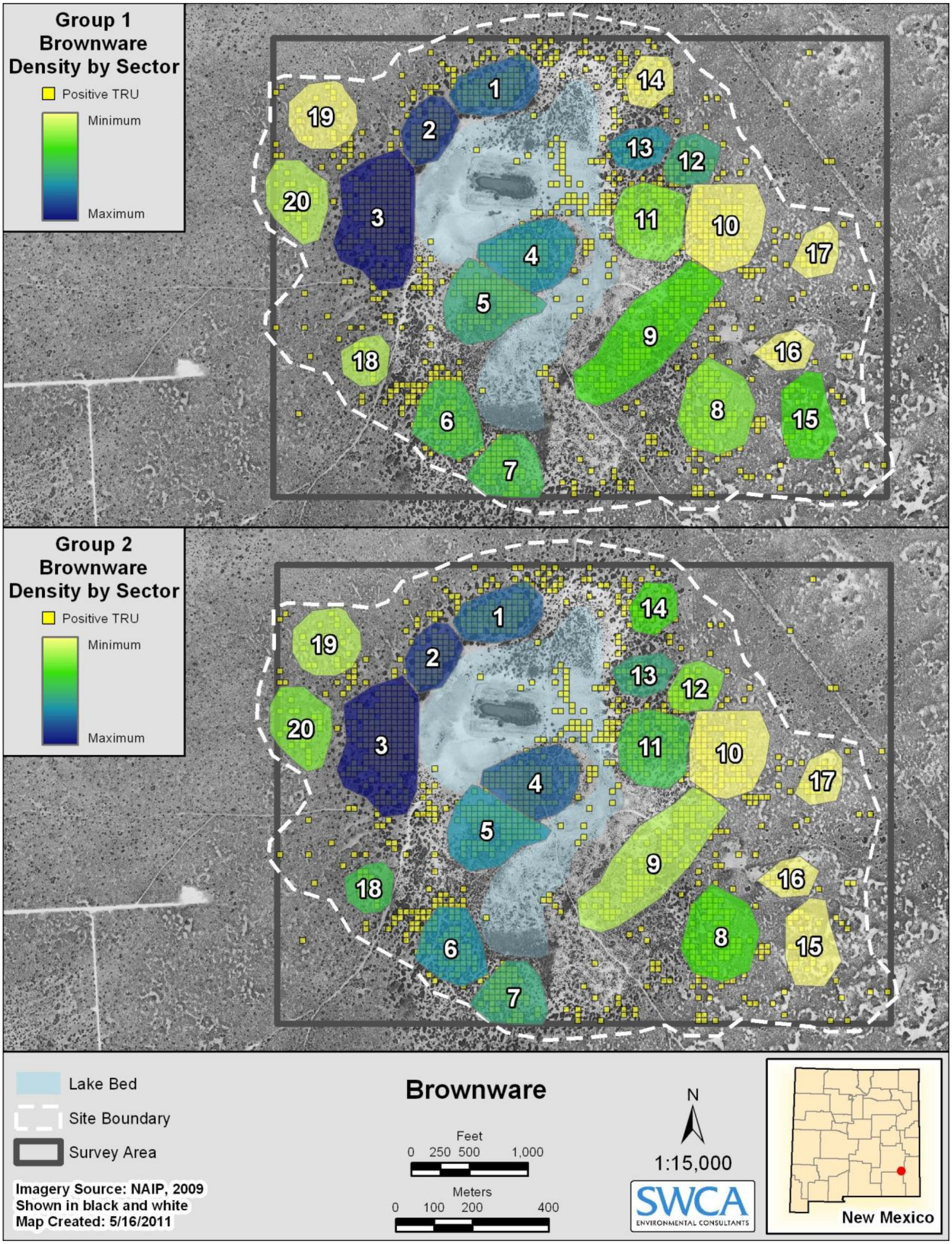

Figure 5.23. Brownware ceramic distribution.

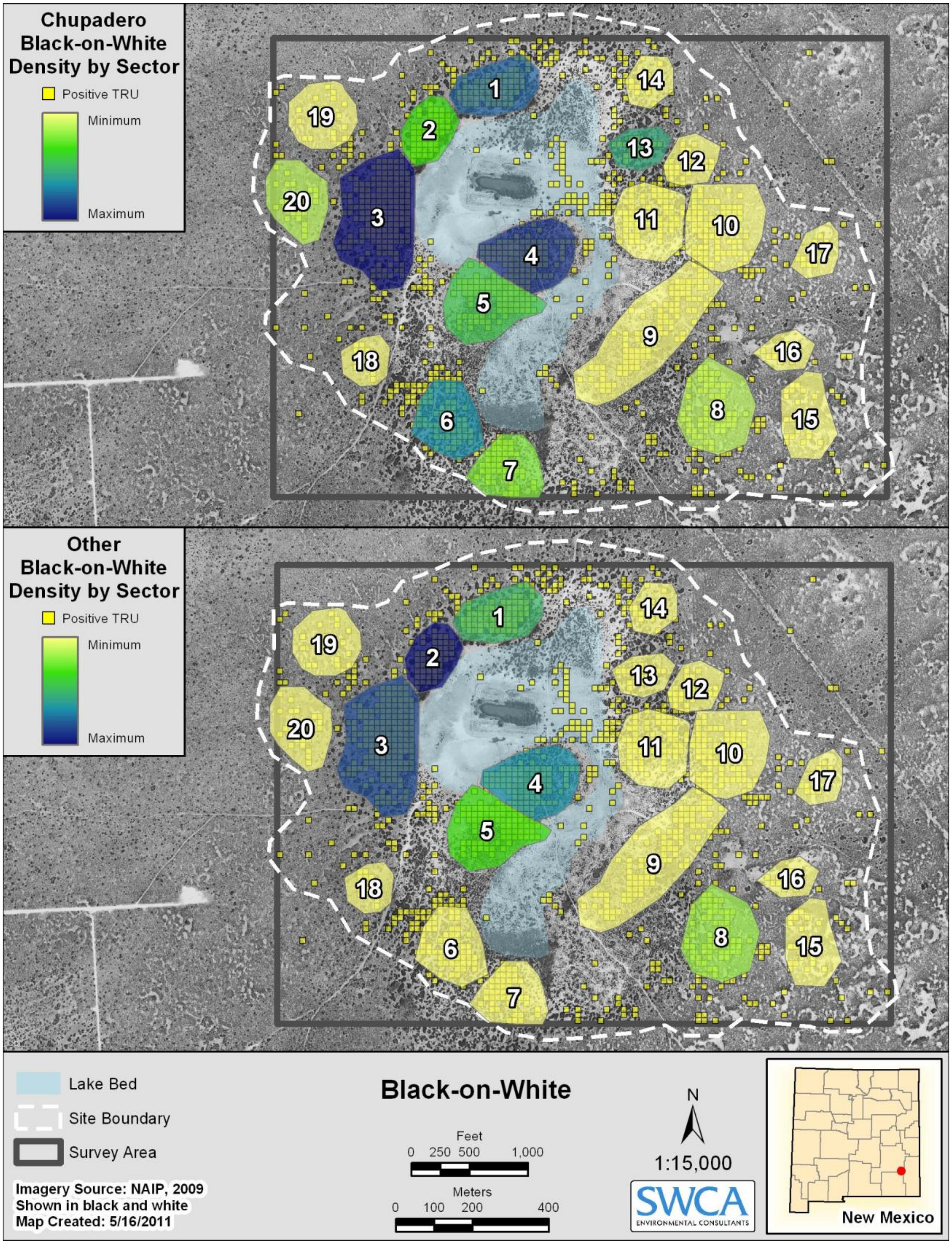

Figure 5.24. Black-on-white ceramic distribution.

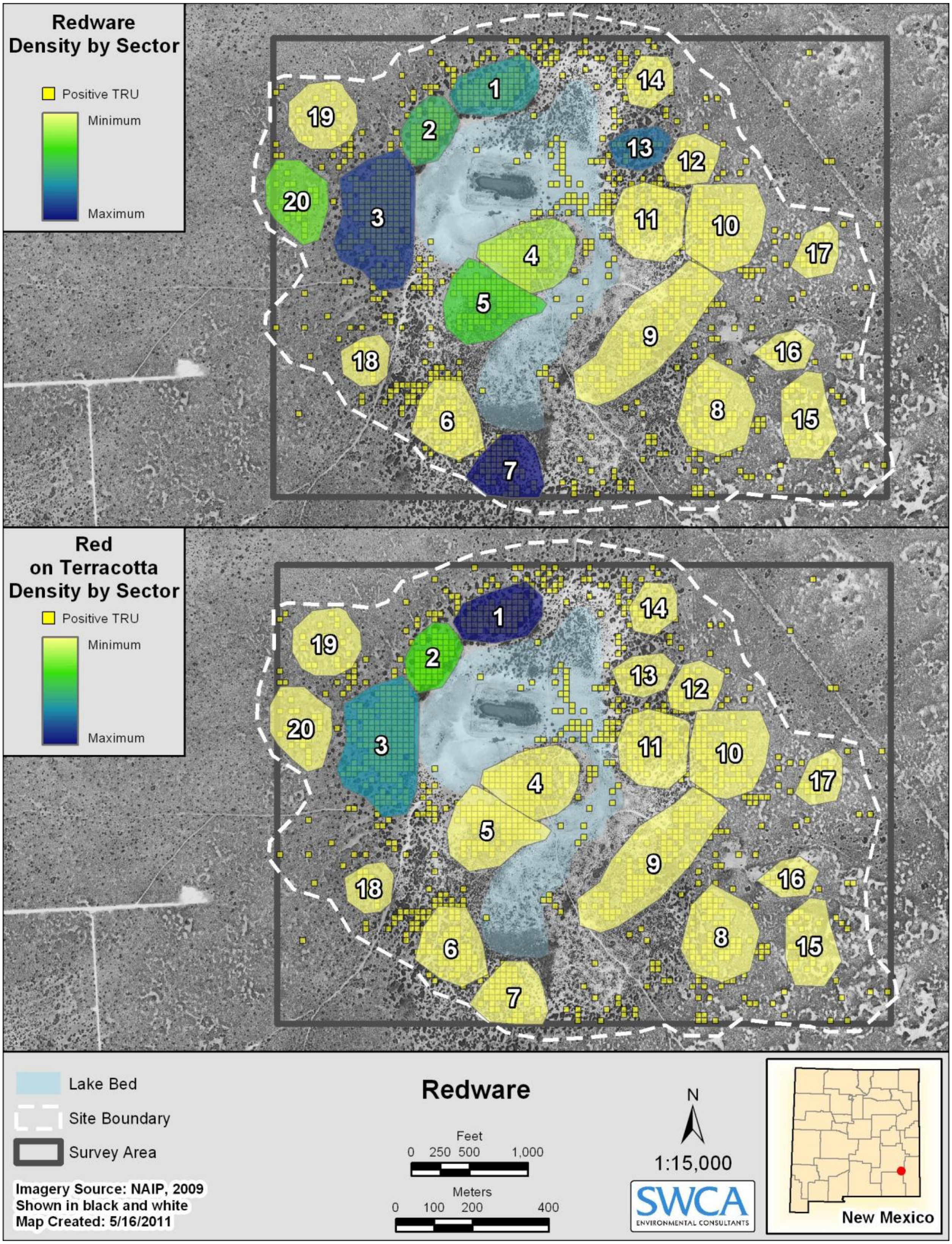

Figure 5.25. Redware and Red-on-terracotta ceramic distribution.

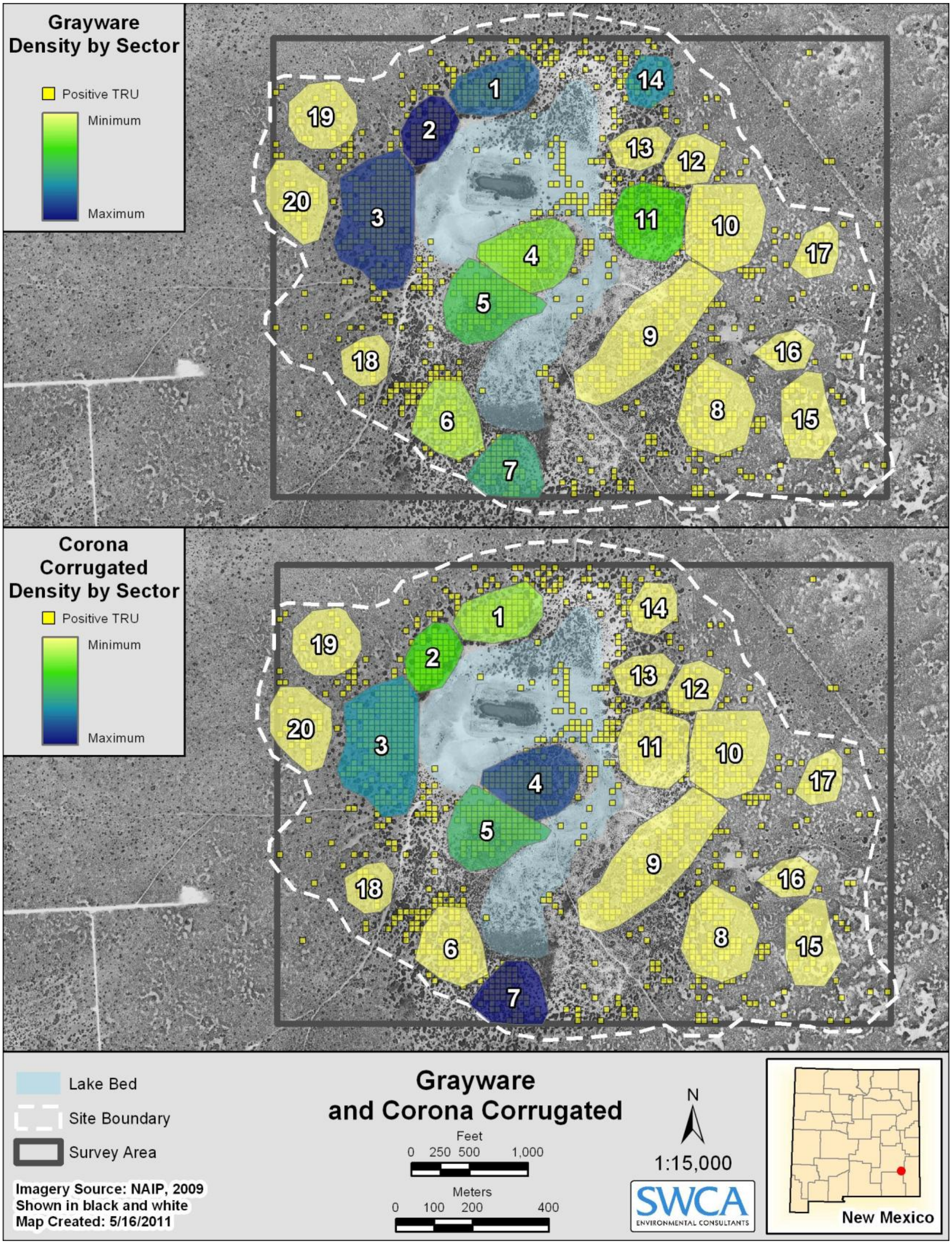

Figure 5.26. Grayware and corrugated ceramic distribution.

PROJECTILE POINTS

The Burro Tanks TRU inventory observed and recorded 31 projectile points and point fragments (Figure 5.27). Of these 31 points, only six are complete (Table 5.14). The midsections and tips were typed as projectile points rather than bifaces based on their overall morphology and late stage shaping through pressure flaking. Seventeen projectile points were identified as dart points and 14 points were identified as arrow points, primarily on the basis of measured or inferred shoulder width. Shott's discriminant function was used for this purpose. It classifies points with a shoulder width of 1.8 cm or greater as dart points and narrower points as arrow points.

Interestingly, the majority of both dart and arrow points, defined in this way, were located in the northwestern quarter of the survey area and mainly in Sectors 1 through 4 and nearby areas. Based on other evidence, and particularly on ceramic distributions, it has been argued that these four sectors represent intensive ceramic period occupations, possibly even small villages. The fact that the majority of Archaic projectile points were also observed in these sectors is probably evidence for the practice of prehistoric artifact collection on the site. In other words, it is likely that the ceramic period inhabitants of the site collected earlier projectile points from other sectors and ultimately discarded or lost them in the ceramic period occupation zones. A similar pattern is evident in ground stone distributions. The unavoidable conclusion, though, is that diagnostic projectile points are not particularly good indicators of occupation period, at least within large, dense, and long-term sites such as Burro Tanks.

It should also be noted, of course, that hundreds of projectile points were collected from the surface of the site in the course of the twentieth century. The sample recorded by the investigations reported here consists only of those artifacts that have been recently exposed or that have for some reason escaped the attention of collectors.

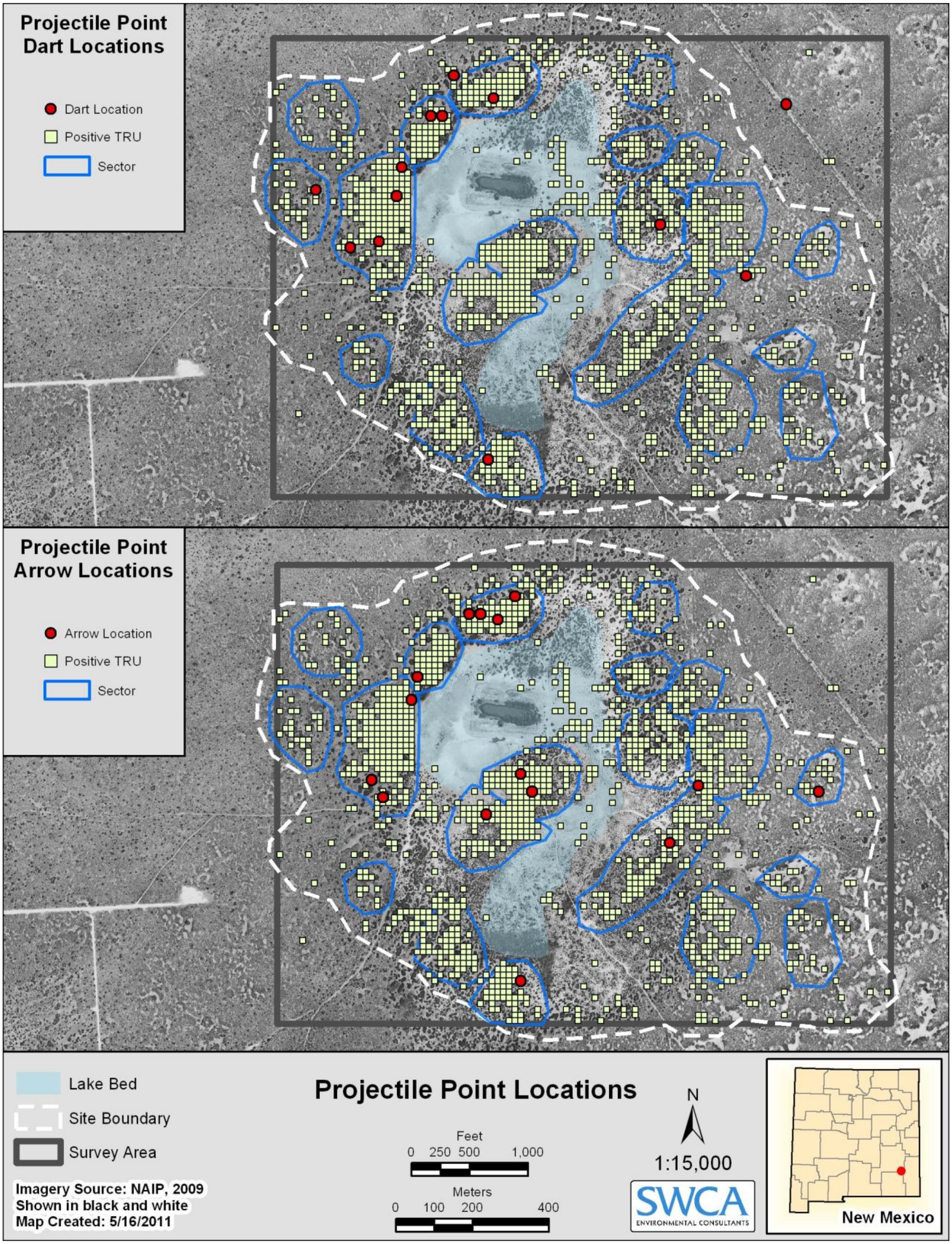

Figure 5.27. Projectile point distribution.

Table 5.14. Projectile Points by Sector and TRU

Sector	TRU	Material	Complete	Length (cm)	Width (cm)	Thickness (cm)
–	39-83	Chert	N	3.2	2.6	0.3
–	74-32	Chert	N	3.5	2.3	0.3
1	70-39	Chert	N	2.2	1.9	0.4
1	71-39	Quartzite	N	1.9	1.4	0.5
1	72-34	Chert	N	2.1	1.5	0.3
1	72-36	Chert	N	2.2	1.8	0.3
1	75-42	Chert	N	1.3	0.9	0.2
2	61-25	Chert	N	2.4	1.6	0.4
2	61-25	Quartzite	Y	1.9	1.0	0.2
2	67-28	Chert	N	3.4	3.2	0.2
2	67-30	Chert	Y	4.6	2.9	0.7
3	40-19	Chert	N	1.6	1.4	0.5
3	43-17	Chert	N	2.1	1.4	0.2
3	44-14	Chalcedony	N	2.1	1.9	0.4
3	45-19	Chert	N	2.7	2.5	0.5
3	53-22	Chert	N	1.9	1.9	0.5
3	57-24	Chert	N	1.5	1.1	0.4
3	58-23	Chert	N	2.2	1.9	0.4
4	41-45	Chert	N	2.1	1.0	0.4
4	44-43	Chert	N	1.9	1.7	0.4
5	35-39	Chert	Y	2.1	1.6	0.3
5	37-37	Chert	N	1.6	1.6	0.4
7	7-38	Chalcedony	N	1.6	2.3	0.5
7	8-43	Chert	Y	2.6	1.4	0.4
9	32-69	Chert	N	0.6	0.5	0.2
9	42-74	Quartzite	N	1.1	1.7	0.5
10	42-74	Quartzite	N	1.1	1.7	0.5
11	48-68	Chert	N	3.8	3.1	0.4
11	49-65	Quartzite	N	1.6	1.8	0.3
17	41-95	Chert	Y	3.1	1.5	0.3
20	54-8	Chert	Y	5.5	2.6	0.3

Nineteen representative projectile point photos are provided in Figure 5.28 through Figure 5.32, typed using Justice (2002) and Railey (personal communication).

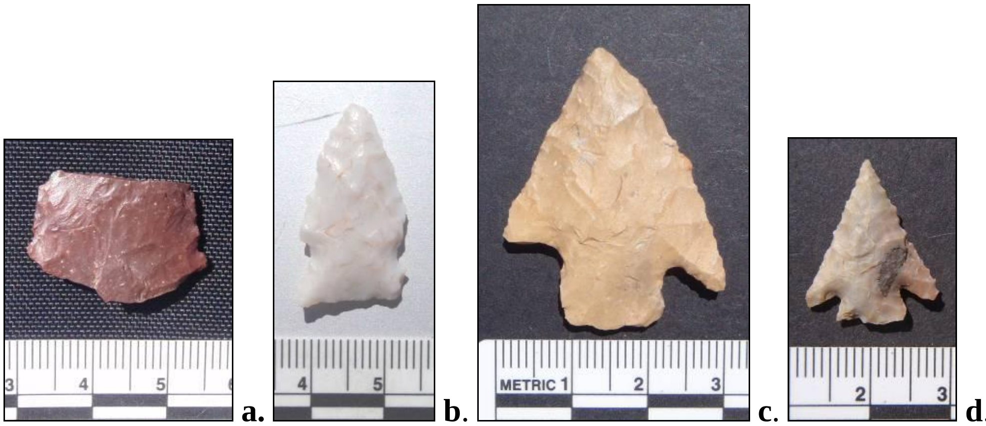

Figure 5.28. From left to right, projectile point a. an indeterminate dart midsection (TRU No. 7-38/Roll 3B/Frame 0096; b. a Pueblo Side-notched arrow point (TRU No. 8-43/Roll 3B/ Frame 0091; A.D. 1200-1500); c. a Late Archaic San Pedro/Cienega/Ellis dart point (TRU No. 69-90/Roll 1/Frame 0026; 800 B.C–A.D. 600); and d. an Early Pueblo probable Dolores Expanding Stem arrow point (TRU No. 35-39/Roll 3A/ Frame 0020; ca. A.D. 600–1000).

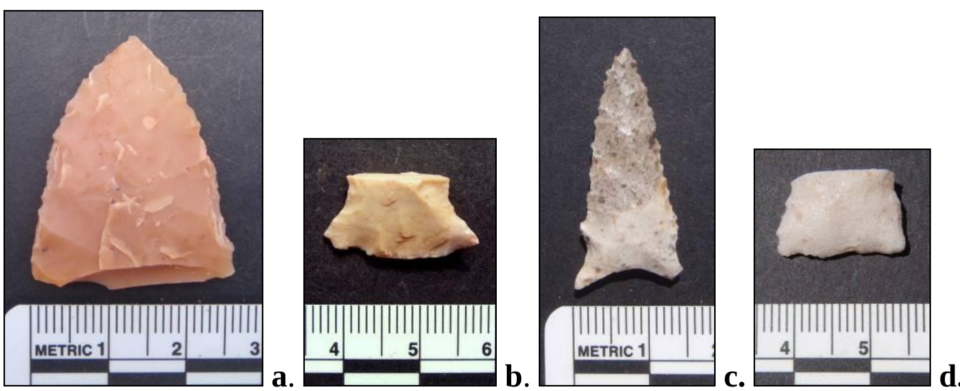

Figure 5.29. From left to right, projectile point a. an unknown Late Archaic dart midsection and tip (TRU No. 39-83/Roll 1Frame 0046); b. a Late Archaic dart base (TRU No. 41-45/Roll 4/Frame 0071; c. an Armijo or possible small San José dart point (TRU No. 41-95/ Roll 1/ Frame 0022; 4500–1500 B.C.); and d. a Late Archaic dart base (TRU No. 42-74/Roll 2/ Frame 0003).

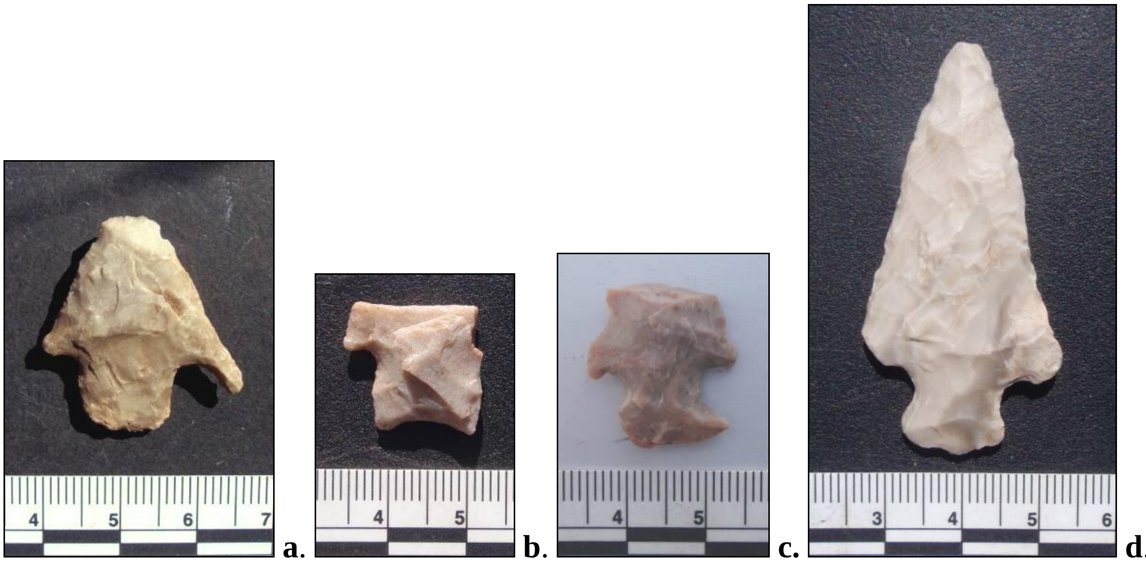

Figure 5.30. From left to right, projectile point a. San Pedro dart point (TRU No. 45-19/ Roll 4/Frame 0085; 1500 B.C–A.D. 300); b. an indeterminate Late Archaic dart point (TRU No. 49-65/ Roll 3B/Frame 0105; c. an Early Pueblo arrow point (TRU No. 53-22/Roll 3B/Frame 0065; and d. a Late Archaic dart point (TRU No. 54-8/Roll 3B/Frame0058).

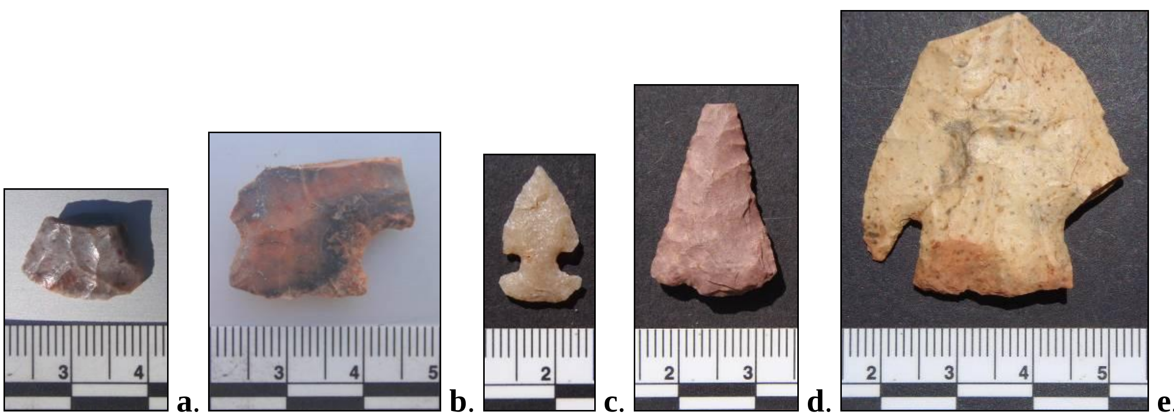

Figure 5.31. From left to right, projectile points a and b. two probable San Pedro dart points (TRU No. 57-24/Roll 3B/Frame 0032 and TRU No. 58-23/Roll 3B/Frame 0038 respectively; 1500 B.C–A.D. 300); c. a Pueblo Side-notched arrow point (TRU No. 61-25/Roll 3A/Frame 0089; ca. A.D. 700–950); d. a probable early Pueblo corner-notched arrow point (TRU No. 61-25/Roll 3A/Frame 0090); and e. a Late Archaic dart point TRU No. 67-28/Roll 3A/Frame 0098).

Figure 5.32. From left to right, projectile points a and b. two probable Gypsum or Datil Cluster dart points (TRU No. 67-30/Roll 3A/Frame 0109 and TRU No. 74-32/ Roll 3A/Frame 0005, respectively (ca. 2000 B.C–A.D. 300).

OTHER LITHIC TOOLS

In total, 160 lithic tools—bifaces, flake tools, and scrapers—were recorded in the course of the survey. These comprised 28 bifaces, 58 flake tools or utilized or retouched flakes, and 74 scrapers (Table 5.15). In general terms, the number of tools correlates with overall artifact assemblage size. Sector 3 in particular stands out as containing a disproportionately large lithic tool assemblage. However, overall general patterns of distribution of bifaces (Figure 5.33), scrapers (Figure 5.34), and flake tools (Figure 5.35) reveal no obviously meaningful patterns (Table 5.16–Table 5.18). There is a weak indication that quartzite tools may be more common in Sectors 1 through 4. However, this pattern is not statistically significant due to the small sample sizes involved. One interesting result is that while scrapers are similar to overall debitage in terms of raw material percentage (chalcedony is more common than chert, which is more common that quartzite), in the case of flake tools this situation is reversed; chert is a more common raw material than is chalcedony. This suggests that chert flakes were more likely than chalcedonyflakes to be used as informal and expedient cutting and scraping tools, while chalcedonywas more likely to be used for more formal, curated tools such as scrapers. No obvious explanation exists for this pattern, but it may reflect the greater availability of large chalcedony flakes, as documented in the debitage analysis.

Photographs of representative lithic tools are shown in Figure 5.36.

Table 5.15. Lithic Tool Counts by Type and Sector

Sector	Bifaces	Flake Tools	Scrapers
Whole Site	28	58	74
1	–	4	5
2	3	4	4
3	5	18	22
4	2	1	2
5	2	1	6

Sector	Bifaces	Flake Tools	Scrapers
6	1	1	1
7	1	–	2
8	–	2	4
9	5	2	7
10	1	6	3
11	5	5	9
12	–	3	2
13	–	3	1
14	–	–	–
15	1	3	–
16	–	–	–
17	–	–	–
18	–	–	1
19	–	–	–
20	1	1	–

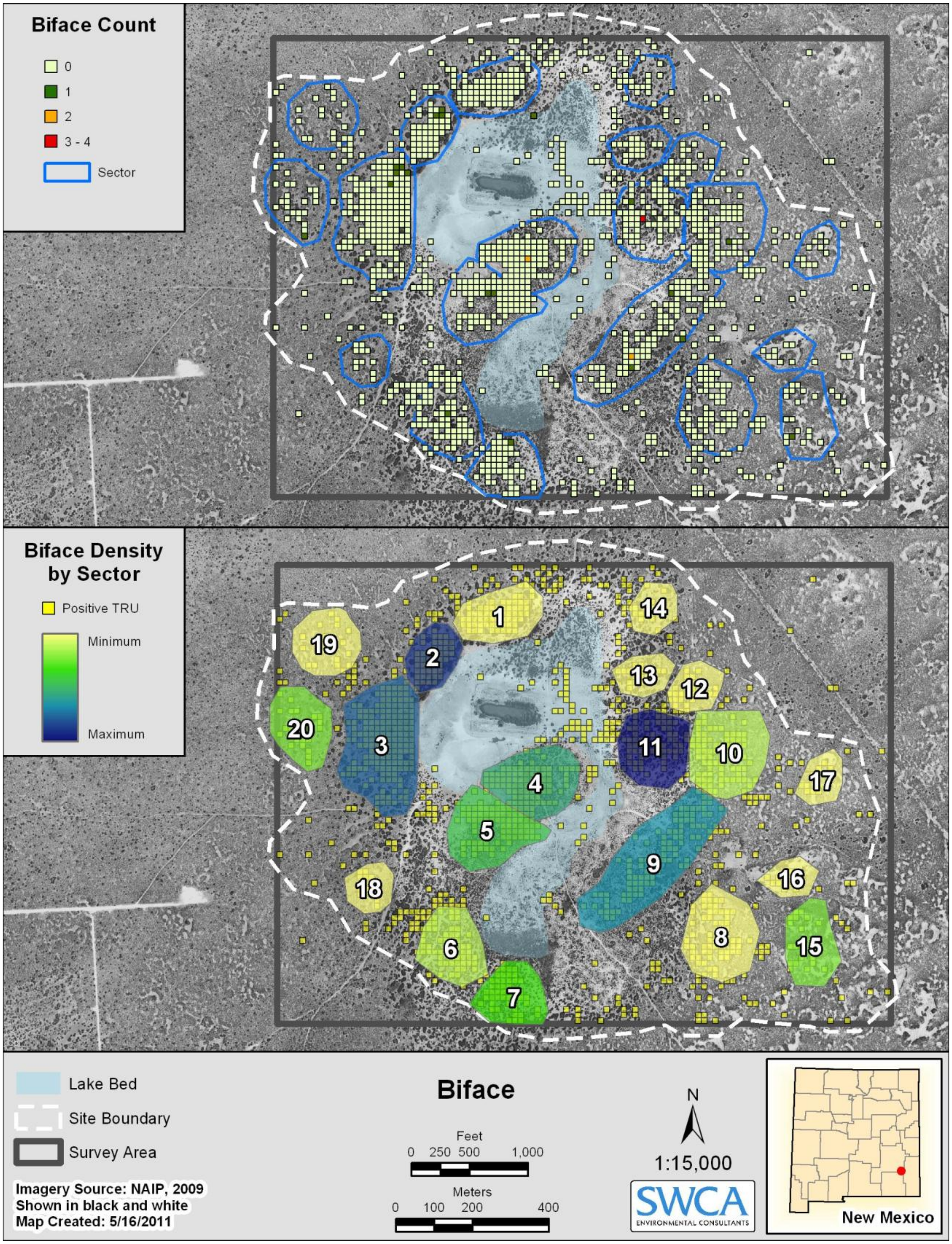

Figure 5.33. Biface distribution.

Table 5.16. Bifaces by Sector and TRU

Sector	TRU	Material	Complete	Length (cm)	Width (cm)	Thickness (cm)
–	67-46	Chert	N	2.6	3.2	0.6
2	67-29	Chert	Y	3.5	2.0	0.6
2	67-30	Chert	Y	6.5	5.1	0.4
2	68-30	Obsidian	N	1.1	0.6	0.2
3	55-21	Chert	N	4.7	1.9	0.6
3	57-22	Quartzite	Y	5.4	4.0	0.6
3	57-24	Chalcedony	N	0.9	0.5	0.4
3	58-22	Chert	N	3.4	2.5	0.8
3	58-23	Chert	N	2.6	2.5	0.5
4	42-45	Chert	N	3.1	1.8	1.5
4	42-45	Chert	Y	5.1	3.1	1.0
5	36-38	Chert	Y	4.1	2.8	0.5
5	36-39	Quartzite	N	3.5	2.6	0.5
6	15-31	Chert	N	4.3	3.6	0.9
7	10-42	Quartzite	N	5.2	4.0	2.3
9	23-63	Chalcedony	N	1.4	1.4	0.9
9	25-63	Chert	N	3.0	1.8	1.0
9	25-63	Chert	N	3.5	2.1	1.1
9	28-72	Chert	N	2.8	1.3	0.3
9	36-70	Chalcedony	Y	6.0	4.0	2.5
10	45-80	Chert	Y	2.9	2.5	0.3
11	49-65	Chert	N	2.7	1.1	0.3
11	49-65	Quartzite	N	1.6	1.7	0.6
11	49-65	Chert	N	2.1	1.2	0.4
11	49-65	Chert	N	1.8	1.6	0.6
11	52-63	Chert	N	3.1	2.0	0.7
15	11-91	Chert	N	1.2	1.0	0.3
20	46-6	Petrified wood	Y	9.6	5.5	1.2

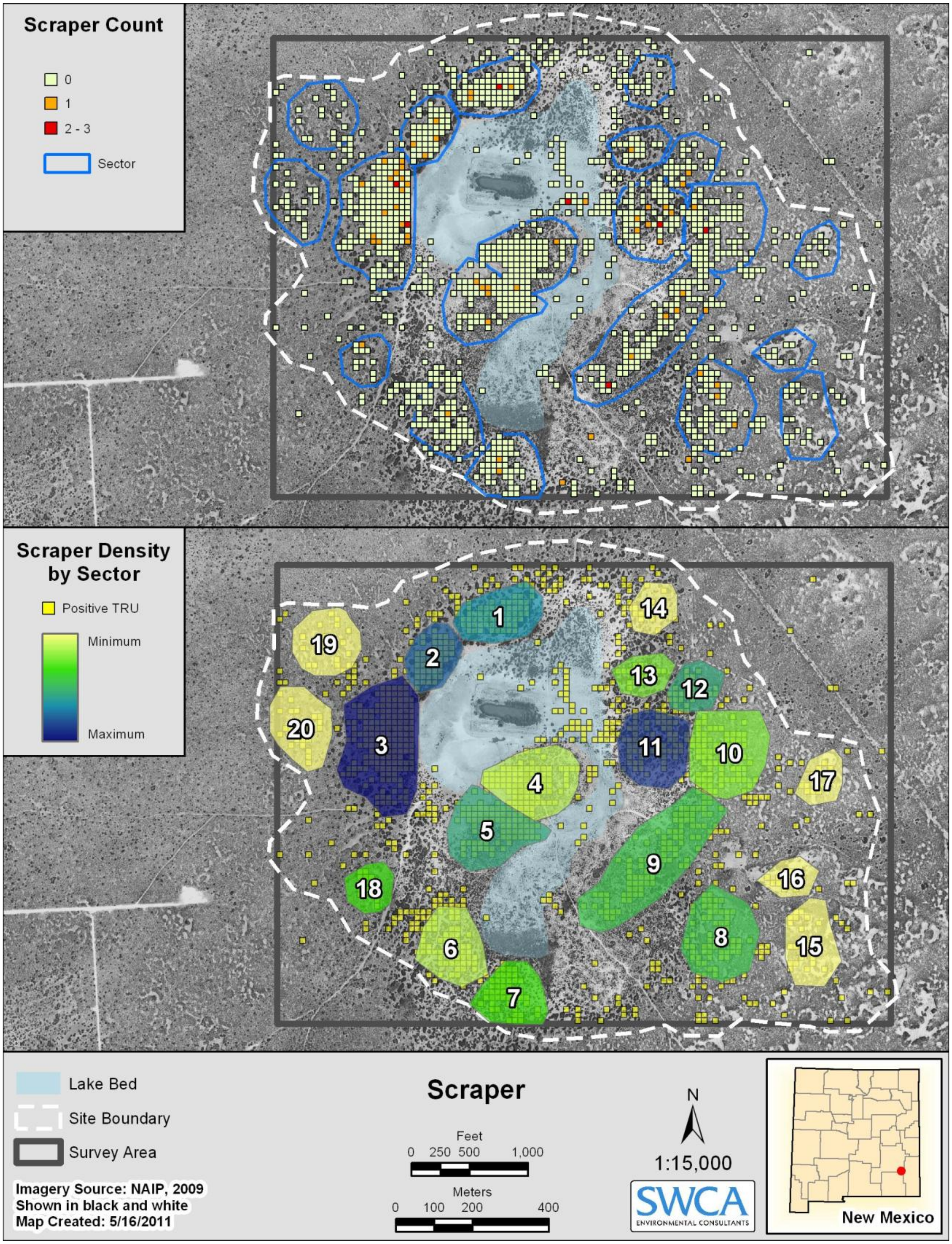

Figure 5.34. Scraper distribution.

Table 5.17. Scraper Counts by Sector and Material

Sector	Chalcedony	Chert	Petrified Wood	Quartzite
Whole Site	35	33	1	5
1	3	1	–	1
2	1	2	–	1
3	10	9	–	3
4	–	2	–	–
5	–	6	–	–
6	1		–	–
7	1	1	–	–
8	2	2	–	–
9	4	2	1	–
10	3	–	–	–
11	5	4	–	–
12	1	1	–	–
13	1	–	–	–
18	1	–	–	–

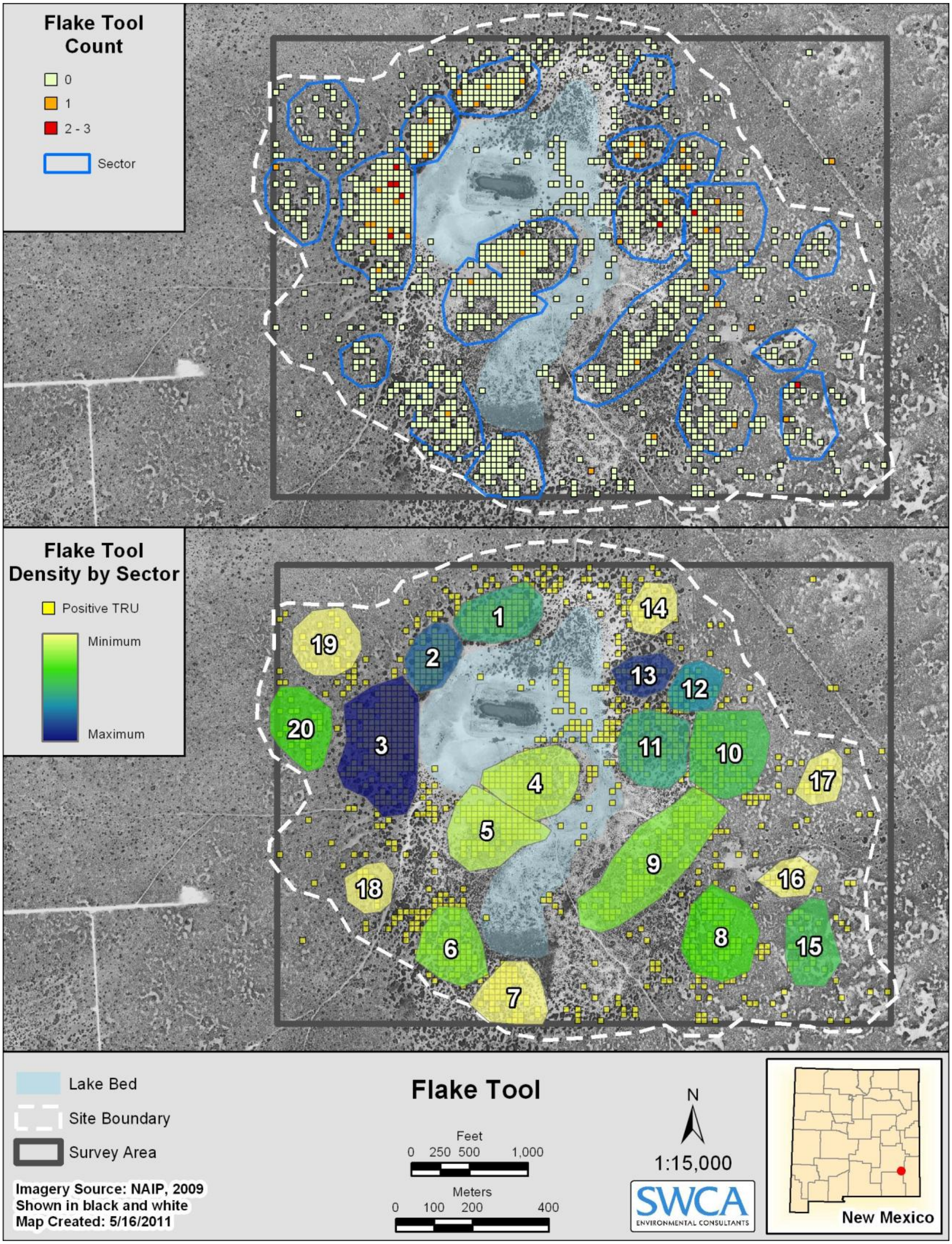

Figure 5.35. Flake tool distribution.

Table 5.18. Flake Tool Counts by Sector and Material

Sector	Chalcedony	Chert	Petrified Wood	Quartzite	Rhyolite
Whole Site	18	34	1	4	1
1	2	2	–	–	–
2	1	3	–	–	–
3	5	10	–	3	–
4	–	1	–	–	–
5	1	–	–	–	–
6	1	–	–	–	–
8	1	1	–	–	–
9	–	1	–	1	–
10	1	5	–	–	–
11	2	2	1	–	–
12	2	–	–	–	1
13	1	2	–	–	–
15		3	–	–	–
20	1	–	–	–	–

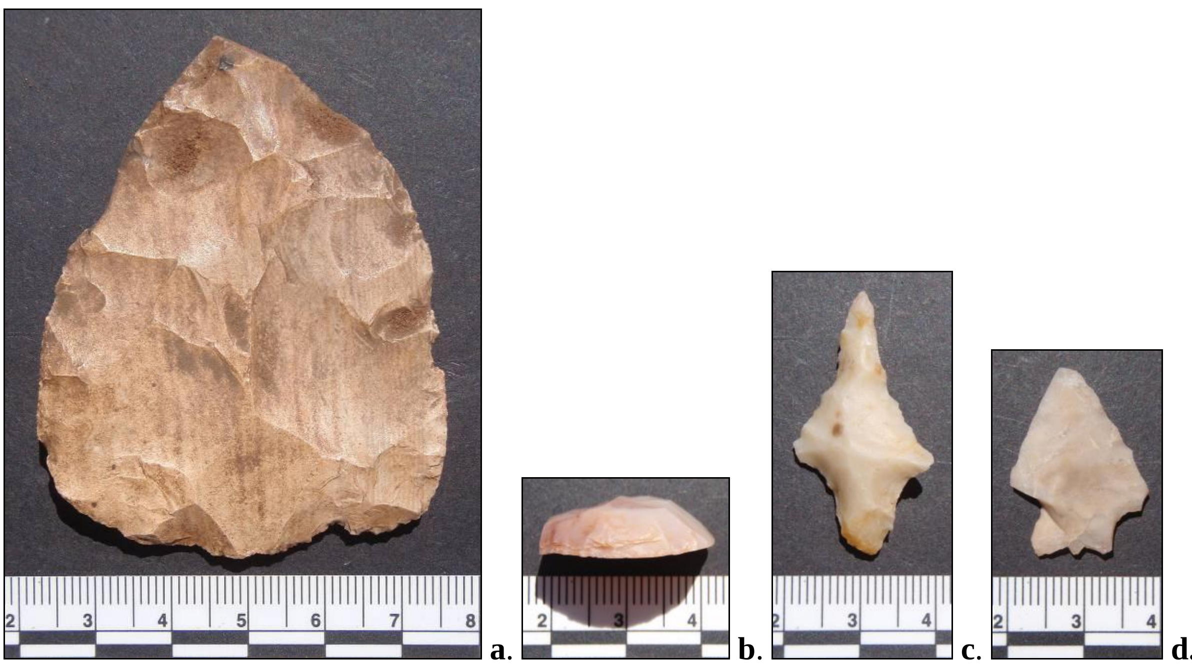

Figure 5.36. a. a biface of petrified wood (Roll 16778-3A, Frame 0112); b. a pink-chert thumb scraper (Roll 16788-3A, Frame 0094); c. a white-chert drill (Roll 16788-3A, Frame 0101); and d. a white chert biface—possibly a recycled/resharpened projectile point (Roll 16788-3A, Frame 0023).

CORES, TESTED COBBLES, AND CORE TOOLS

In total, 804 cores, 122 tested cobbles, and 27 core tools were recorded in the course of the survey. Cores were initially measured and analyzed in the field. However, the large number of cores encountered became a problem, and Rebecca Hill of the BLM Roswell Field Office approved a modified analysis plan in which cores would be identified to material type and assigned to a size class—in the same manner as debitage—rather than measured individually. In the end, 438 cores were analyzed and measured individually, while the remaining 366 cores were assigned to size classes. Analysis in this report will be in terms of size class, since it is a simple matter to convert measured core dimensions to the appropriate size class.

The majority of cores (588, or 73 percent) were of chalcedony, with smaller numbers of chert (180, or 22 percent) and quartzite (35, or 4 percent). One rhyolite core was also recorded. Almost all recorded examples were multi-directional cores optimized for expedient flake removal. No meaningful patterns were obvious in the spatial distribution of cores (Figure 5.37, Table 5.19), or for that matter in the distribution of tested cobbles (Figure 5.38, Table 5.20) or core tools (Figure 5.39, Table 5.21).

Tested cobbles were defined as an intact cobble with no more than two flake scars. With BLM approval, tested cobbles were recorded in the same manner as debitage: size class was noted and raw material was recorded. Tested cobbles of only three raw material types were represented: chalcedony (78, or 64 percent), chert (26, or 21 percent), and quartzite (18, or 15 percent). The presence of tested cobbles of these materials would seem to confirm that chert and quartzite are available in cobble form near to the site, in gravel deposits of the Pecos Valley and Mescalero Plain. Chalcedony, of course, is readily available within the site boundary.

Core tools were defined as cores with evidence of subsequent use for other purposes. Core tools were relatively rare at the site, with only 27 recorded. Most recorded examples (18, or 69 percent) appear to have been used as choppers and exhibit chipping and crushing on sharp edges. A smaller number (5, or 19 percent) were battered, apparently having been used as hammerstones or pecking stones. The remainder (3, or 12 percent) was used as scrapers, exhibiting unifacial retouch and related edge damage on one or more modified edges. As with cores, most core tools were of chalcedony (12, or 44 percent), with smaller amounts of chert (8, or 30 percent) and quartzite (6, or 22 percent) and one limestone example (4 percent) observed.

Photographs of some representative examples of cores and core tools are presented in Figure 5.40 and Figure 5.41.

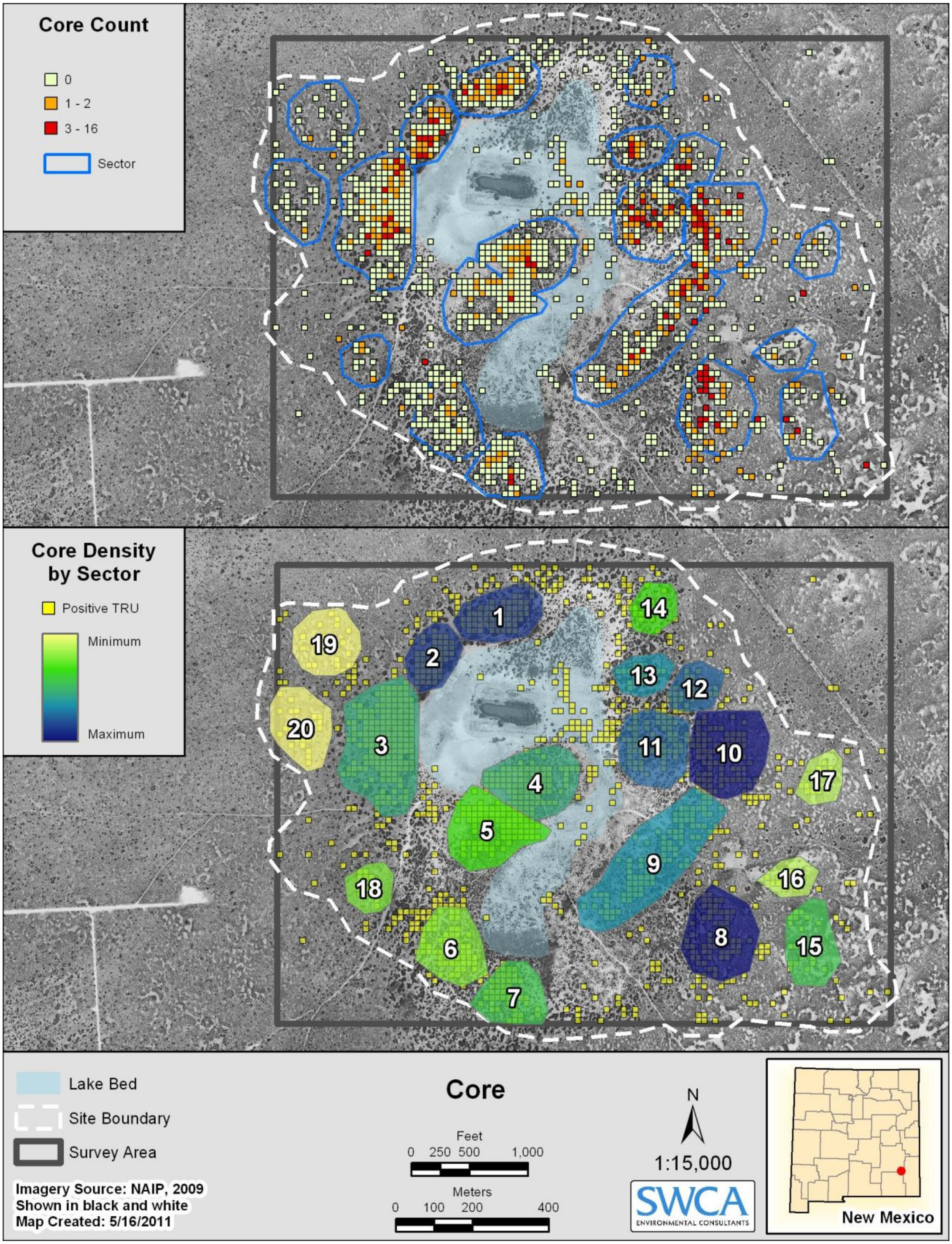

Figure 5.37. Core distribution.

Table 5.19. Core Counts by Sector and Material

Sector	Chalcedony	Chert	Quartzite	Rhyolite
Whole Site	588	180	35	1
1	50	6	–	–
2	50	1	4	–
3	64	8	9	–
4	29	6	3	–
5	12	2	–	–
6	7	–	–	–
7	16	–	1	–
8	80	32	4	–
9	74	13	2	–
10	95	51	6	–
11	52	11	1	1
12	21	4	1	–
13	15	6	2	–
14	4	–	–	–
15	–	12	–	–
16	–	1	–	–
17	–	2	–	–
18	2	1	–	–
19	1	–	–	–
20	2	–	–	–

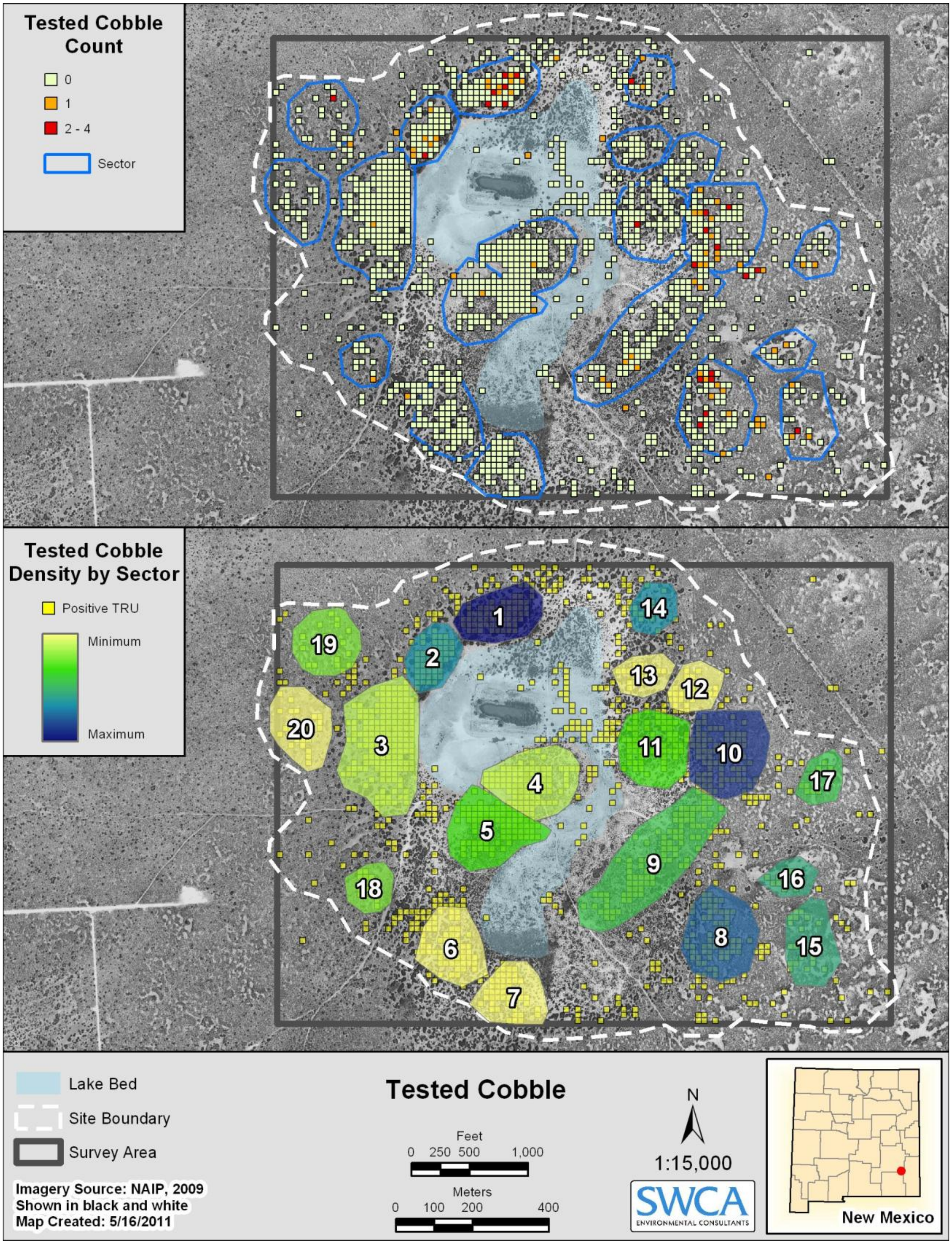

Figure 5.38. Tested cobble distribution.

Table 5.20. Tested Cobble Counts by Sector and Material

Sector	Chalcedony	Chert	Quartzite
Whole Site	78	26	18
1	18	4	2
2	6	–	2
3	1	–	–
4	1	–	–
5	3	–	–
8	7	7	4
9	7	2	2
10	14	2	5
11	4	–	–
14	3	–	1
15	4	2	–
16	2	–	–
17	2	–	–
18	1	–	–
19	2	–	–

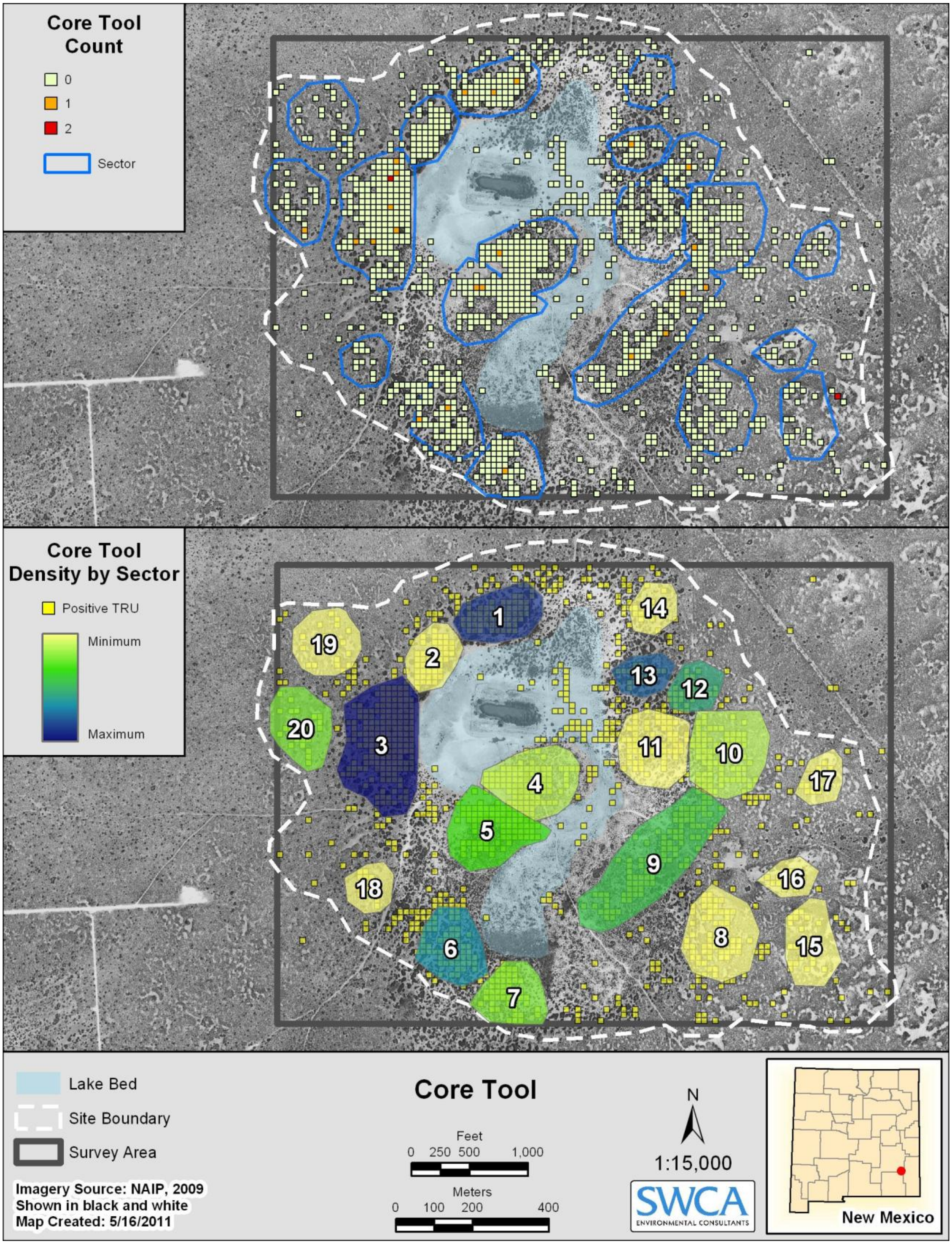

Figure 5.39. Core tool distribution.

Table 5.21. Core Tool Counts by Sector and Material

Sector	Chalcedony	Chert	Limestone	Quartzite
Whole Site	12	8	1	6
1	1	2	–	–
3	4	2	–	2
4	–	–	1	–
5	1	–	–	1
6	1	–	–	1
7	–	–	–	1
9	2	1	–	1
10	1	–	–	–
12	1	–	–	–
13	1	–	–	–
20	–	1	–	–

Figure 5.40. Representative chalcedony cores(Roll 16788-3A, Frame 0044).

Figure 5.41. Left to right: a chalcedony core, a ubiquitous artifact at LA 32227 (Roll 16788-3B, Frame 0020), and a purple quartzite core—another relatively common lithic artifact material at the site (Roll 16788-3B, Frame 0019).

GROUND STONE

In total, 628 pieces of ground stone were recorded in the course of the survey (Figure 5.42 and Table 5.22). The vast majority of these were small fragments of sandstone (595, or 95 percent), with smaller quantities of quartzite (28, or 4 percent) also present. A handful of ground stone fragments of rhyolite and another, unknown material were also observed. In addition, a single incomplete mano made of unburned caliche was recorded. Overall, 77 percent of ground stone fragments showed evidence of burning. Only 10 ground stone artifacts were found to be complete: nine manos and one metate.

It was often possible to determine whether a fragment represented a mano or a metate based on curvature of the modified surface. Overall, 285 fragments (45 percent) were unidentifiable, while 126 (20 percent) came from manos and 217 (35 percent) from metates. In general, metates seem to have been simple grinding slabs of no great thickness.

Sectors varied widely in ground stone density, with the later, more intensively occupied sectors (1–4) having the highest density of ground stone artifacts. This pattern is to be expected given that later residents of the site would likely scavenge and reuse ground stone artifacts present on the surface of the previously occupied sectors. However, the pattern of ground stone fragment size was not expected. Size was measured by multiplying the width by the length of all ground stone artifacts, and is therefore expressed in square centimeters (Figure 5.43). When mean ground stone size is calculated for each sector, it becomes clear that these later sectors, while having high densities of ground stone artifacts, generally do not have larger mean ground stone sizes. This can be attributed to the fact that most ground stone artifacts ended their use-lives as heating stones and therefore as FCR. It appears as if not only complete ground stone artifacts were scavenged from earlier sectors, but that smaller fragments were scavenged as well, for use in stone boiling and cooking. Sector 3, however, interpreted as the primary locus of the site's latest and most intensive occupation, does have the highest ground stone density and the largest mean ground stone fragment size of any sector. These data are another line of evidence supporting the view that Sectors 1 through 4 represent the latest substantial occupations at the site.

One of the rare examples of a complete ground stone artifact from the site, a sandstone mano, is pictured in Figure 5.44.

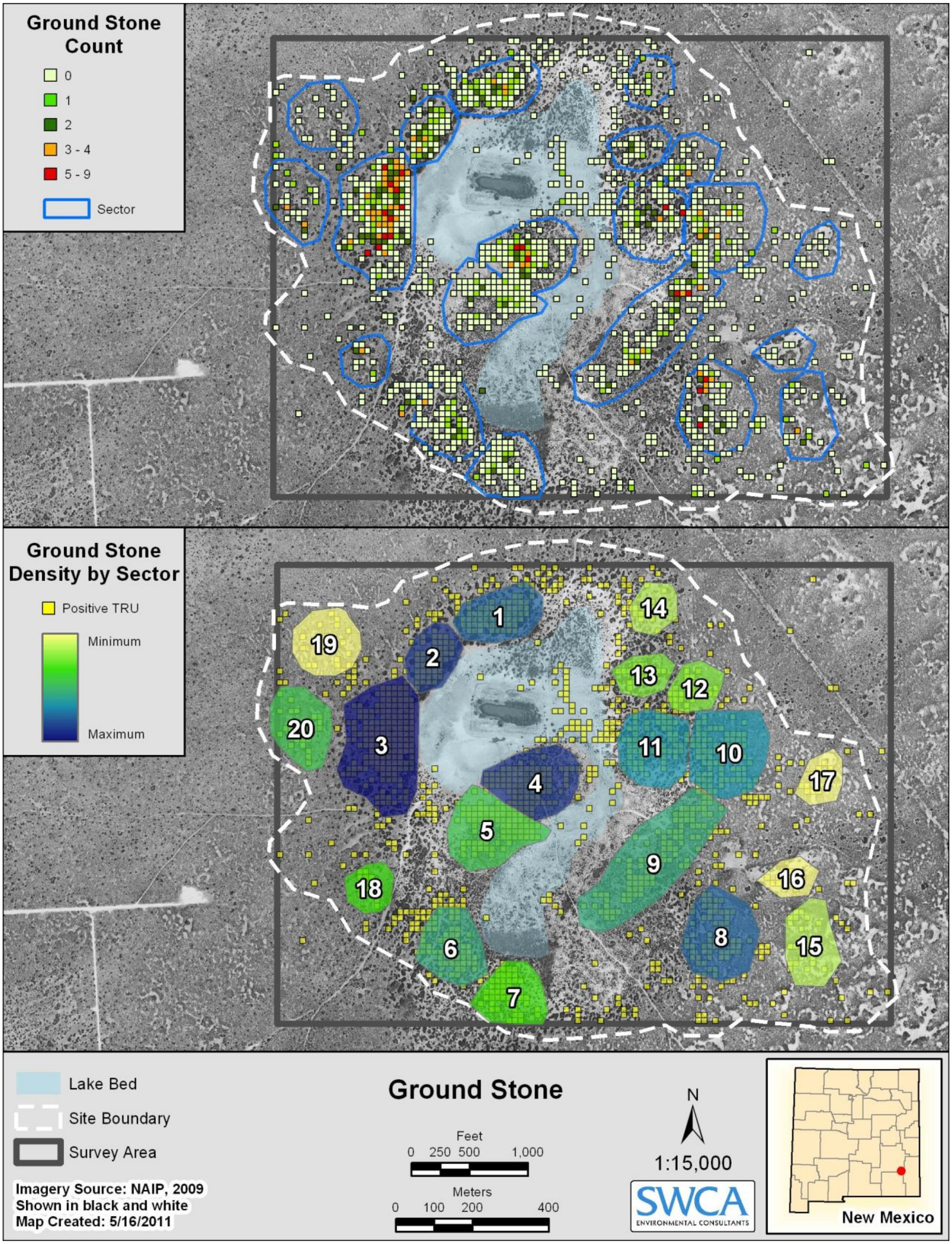

Figure 5.42. Ground stone distribution.

Table 5.22. Ground Stone Count, Density, and Mean Size by Sector

Sector Number	Count	Density (fragments per 100 m²)	Mean size (cm²)
Whole site	627	0.04	51.92
1	40	0.15	45.15
2	34	0.17	40.03
3	221	0.36	61.32
4	59	0.17	38.59
5	17	0.05	29.49
6	17	0.06	44.04
7	10	0.04	57.39
8	46	0.12	51.55
9	53	0.08	47.67
10	36	0.09	70.22
11	32	0.10	33.87
12	6	0.04	25.73
13	5	0.04	19.77
14	3	0.02	40.43
15	8	0.03	50.77
16	0	0.00	0.00
17	0	0.00	0.00
18	6	0.04	35.93
19	0	0.00	0.00
20	14	0.05	52.01

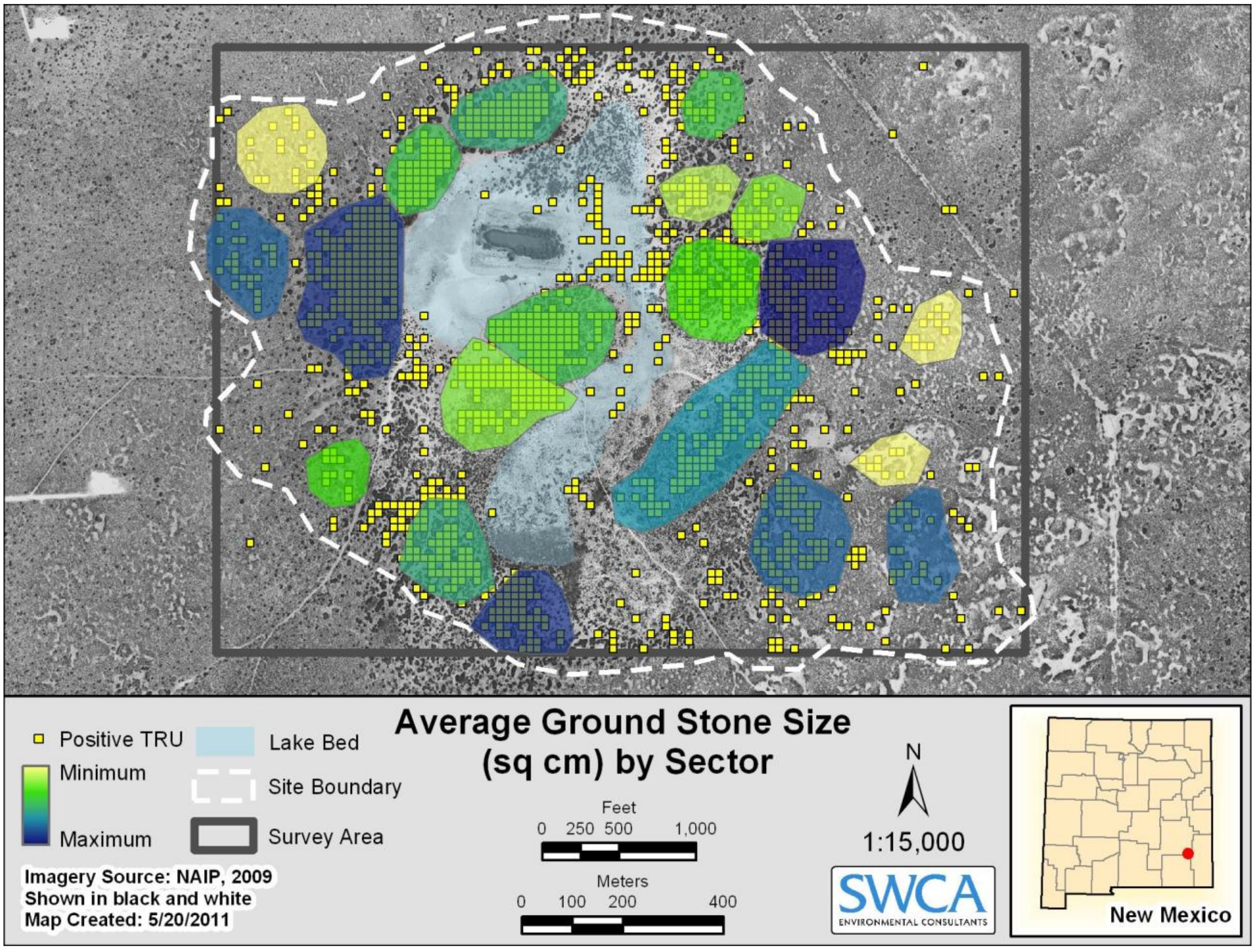

Figure 5.43. Mean ground stone size (length × width).

Figure 5.44. A broken mano exhibiting one flattened and one beveled facet (Roll 16788-1, Frame 0003).

Turquoise Ornament

A single turquoise ornament, a small pendant, was documented at the site. The pendant measures 0.8 × 0.2 × 0.2 cm and was observed in TRU 58-22 in Sector 3 (Figure 5.45). The pendant is broken longitudinally and displays a single perforation for suspension (Figure 5.46). Having been found in Sector 3, it most likely dates to the site's latest period of occupation. The artifact was not collected.

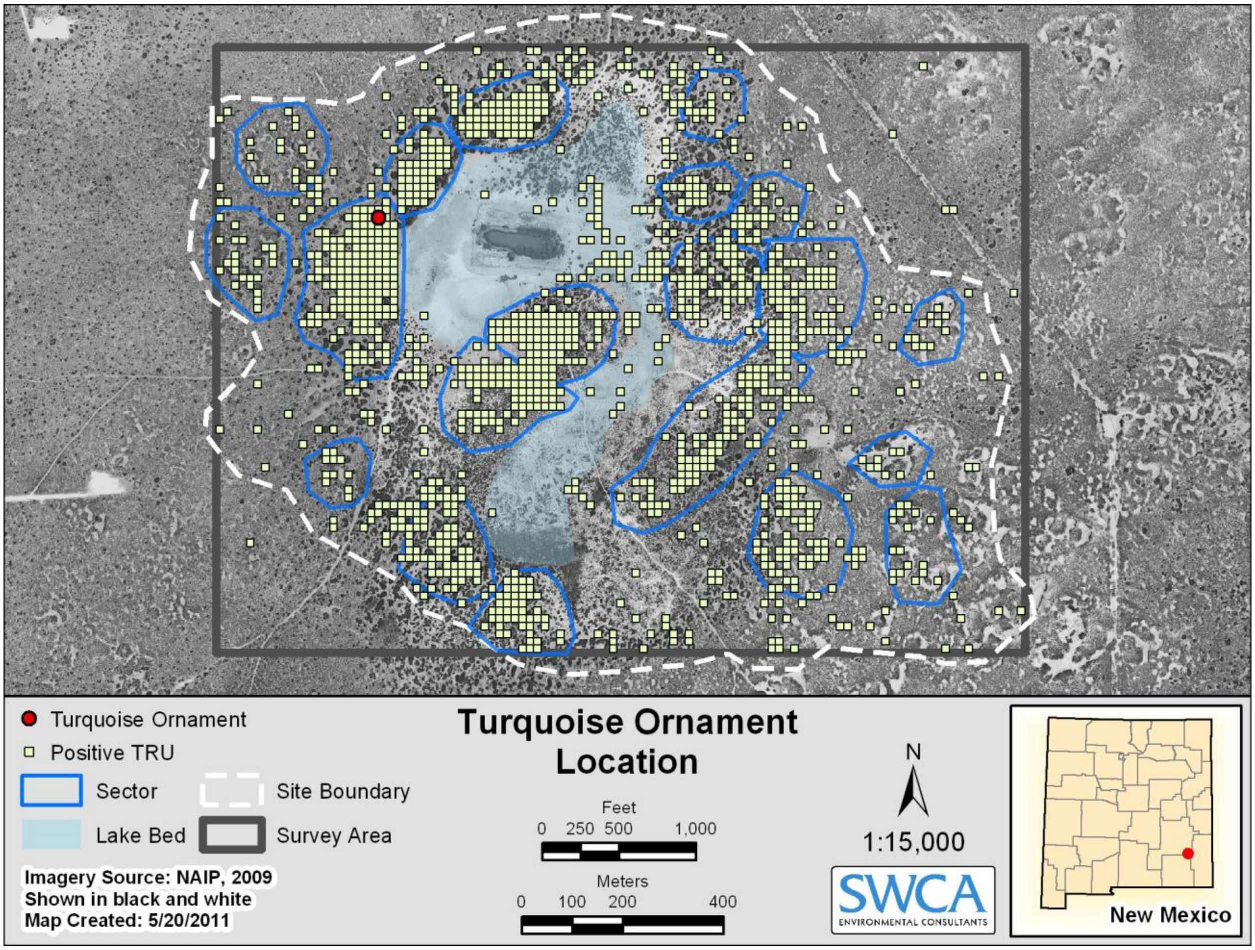

Figure 5.45. Turquoise ornament location.

Figure 5.46. From left to right: front, back, and side view of a partial turquoise pendant.

SITE CHRONOLOGY

The occupation of LA 32227 spans the entire Holocene epoch. The earliest remains are three Paleoindian Fairview points tabulated by Sawyer (1973). Other points reported by Sawyer and documented in this investigation show that the site continued to be used throughout the Archaic and Formative periods, and into the Protohistoric period. Ceramics document intensive occupation of the site between approximately A.D. 1100 and 1400.

SITE INTERPRETATION AND SUMMARY

LA 32227 has been heavily affected by collection and looting in the postwar period. Sawyer (1973), in a site recording exemplary for its time, documented seven collections made between 1950 and 1970 from the northern part of the site (Table 5.23). These collections, surely only a fraction of all materials collected from the site over the decades, include 361 projectile points and 17,403 ceramic sherds. By contrast, only 31 projectile points and 2,913 sherds were documented in the course of this investigation of the entire site. This means that, at a minimum, 92 percent of projectile points and 86 percent of ceramic sherds have been removed from the site's surface. The surface assemblage 50 years ago was at least 10 times as large as the one that exists today, at least as far as the more collectible artifact classes are concerned. In addition, at least 22 human burials have been removed from the site and an unknown number of architectural features have been excavated without documentation. The location of all of these materials remains unknown.

Table 5.23. Collections from LA 32227 Documented by Sawyer

Collection	Number of Artifacts
No information on year or collector	361 projectile points
LCAS in the late 1950s, from Sectors 1–5	9,482 sherds
Robert Leslie, 1963, Sectors 1 and 2	625 sherds
Robert Leslie, 1963, Sectors 2 and 3	4,285 sherds
Robert Leslie and LCAS, 1957–1968, Sectors 4 and 5	2,458 sherds
Robert Leslie, 1963, Sectors 19 and 20	271 sherds
Robert Leslie, year unspecified, Sectors 10–14	312 sherds

In spite of this devastating history of collection and looting, however, the site retains tremendous research potential, as the present investigation has shown. Moreover, numerous sectors retain intact midden deposits and undoubtedly architecture and features as well. Many sectors of the site also contain intact subsurface deposits sealed beneath recent dunes.

The recurrent occupation of this site over a very long time period is due, no doubt, to the presence of a permanent water source. Burro Lake was an oasis on the Mescalero Plain. Most sectors at the site represent palimpsests of multiple short-term, low-intensity occupation episodes that took place throughout the Archaic and Formative 1–3 periods. An exception to this pattern may be Sector 9, which has little evidence of Formative period occupation, yet has very high artifact densities and large midden deposits buried beneath dunes and exposed in blowouts. It is possible that Sector 9 contains the remains of an intensive Archaic period occupation of this site, though this must be tested by future research.

Sectors 1 through 5 represent the remains of an intensive, long-term Formative period occupation. On the basis of ceramic data and other lines of evidence, it has been argued here that Sectors 1 and 2 date to the Formative 4 to 6 phases, and that Sectors 3 through 5 date to the Formative 7 phase. Both occupations would have been long-term settlements that could perhaps be termed small villages. The later of these occupations was the larger and more intensive, with higher artifact inventories and more extensive midden areas. Obsidian debitage is mostly restricted to these areas of later, intensive occupation.

In the Protohistoric period, occupation at the site may have returned to the earlier pattern of short-term camps and generally less intensive use. Data on the Protohistoric occupation are very sparse and cannot support any substantive conclusions.

ELIGIBILITY RECOMMENDATIONS

In spite of its history of large-scale collection and looting in the postwar period, LA 32227 remains one of the most scientifically significant archaeological sites in southeastern New Mexico and is clearly eligible for the NRHP under Criterion D. It is listed on the SRCP and is a clear candidate for formal nomination to the NRHP in the future.

MANAGEMENT RECOMMENDATIONS

It is recommended that LA 32227 be avoided in all future management actions and further that a buffer be established around the site within which ground disturbance should be prevented or minimized. It is further recommended that the site be included in a site steward program if practical, and that the gates leading to the site be locked if at all possible. Collection continues at the site, and looting is probably taking place as well, though on a much smaller scale than formerly. Any action that would minimize casual visitation of the site would slow the rate at which it is being damaged.

ISOLATED MANIFESTATIONS

Six IMs were discovered during this investigation, clustered primarily in the northwest corner of the project area outside the site boundaries on the ground surface along a disturbed, linear pipeline route (a single IM was recorded near the southwest corner of the project area). IM designation was assigned not in the field, but rather as part of post-field analysis while determining the new boundaries of LA 32777 based on artifact distribution and densities within TRUs recorded during this investigation. Because of the relatively broad-brush recording methodology used for TRU recording, with the exception of formal tools, only artifact classes and tallies within each TRU was recorded—no specific measurements or photographs were taken for four of the six IMs. Table 5.24 lists artifact attributes; IM photographs of formal tools are shown in Figure 5.47. UTM coordinates for these artifacts are provided in Table A.3 in the confidential Appendix A.

Table 5.24. Isolated Manifestations Observed during the Investigation

IM No.	TRU No.	IM Description
1	78-94	Two pieces of burned caliche and one piece of FCR
2	69-90	Two pieces of debitage, three pieces of shatter, and one tan chert dart point measuring 5.6 × 3.0 × 0.3 cm
3	59-97	Three pieces of debitage and three pieces of shatter
4	59-98	One bifacially retouched, gray chert flake measuring 3.7 × 2.9 × 0.4 cm
5	48-106	Three pieces of burned caliche
6	15-5	One piece of debitage and two pieces of burned caliche

Figure 5.47. IM 2 (left) and IM 4 (right).

CHAPTER 6
REMOTE SENSING GEOPHYSICAL SURVEY

The BLM retained SWCA to conduct remote sensing geophysical surveys for subsurface cultural resources associated with prehistoric settlement sites for the Burro Tanks archeological site, using three geophysical methods: ground-penetrating radar (GPR), magnetic gradiometry (MG), and electromagnetic induction (EMI). SWCA geophysicist, Dr. Blake Weissling, with the assistance of field personnel from SWCA's Albuquerque office, conducted the surveys and fieldwork on August 23 and 24, 2010.

BACKGROUND OF GEOPHYSICAL METHODS

GPR was selected as the primary technique for near-surface imaging of potential cultural resources at the Burro Tanks survey site. GPR is one of the most commonly deployed remote sensing or geophysical methods in archeological investigations. It is capable of detection and delineation of near-surface targets with a high degree of confidence. GPR is based on the transmission and reflection of an electromagnetic wave in the 50 MHz to 1 GHz frequency range (the frequency range of microwave radar). When a microwave pulse emitted by a transmitting antenna reaches a subsurface layer or boundary represented by a contrast in the velocity of the radar wave (such as that from a stone hearth in contrast with surrounding soil), a portion of the microwave energy may be scattered and/or reflected. It is the reflected energy that is collected and recorded by the receiving antenna. The collection of continuous microwave pulses from a moving antenna generates continuous profile data of the subsurface, significantly aiding the interpretation of subsurface geology as well as subsurface cultural resources. Given optimal site conditions (dry, non-conductive soils), GPR is most suited to the detection and delineation of various cultural resources such as interments, excavations, middens, hearths, soil compaction, etc.

The second technique selected for assessment of cultural resources at the Burro Tanks site was MG. Modern magnetometers can measure the most subtle change or perturbation in the earth's ambient magnetic field due to the influence of near surface magnetized objects. Modern magnetometers can detect weak magnetic fields arising from some archeological resources to less than one part in a half million of the strength of the earth's field. A magnetometer in gradiometer mode employs two separate but identical magnetometers, mounted and aligned on a carrying apparatus at a fixed distance apart (usually 0.5–1 m [1.6–3.3 feet]). As the magnetic field strength of a magnetized object falls off as a function of the cube of the distance, magnetization changes in the near surface environment will influence the bottom sensor more than the top sensor. The difference of the two measurements is the basis of the gradiometer. A significant advantage of the gradiometer is the cancellation of any magnetic noise that is likely to affect both sensors equally such as natural fluctuations in the earth's magnetic field. Subsurface cultural resources that are most likely to be detected by the magnetometer would be ferrous and some non-ferrous metal objects, some burials and their associated excavations, and potentially burned rock middens and cooking hearths.

The final geophysical technique selected was EMI. EMI utilizes low frequency radio waves to induce electrical currents in near-surface electrically conductive objects or materials. These weak electrical currents (called eddy currents) induce a secondary magnetic field that is sensed and recorded by the EMI instrument. Conductors may be metallic objects (both ferrous and non-ferrous), soil minerals (e.g., clays), and soil water or other fluids. EMI results, not unlike MG results, are generally displayed as map-view information. Depending on the transmitting frequency and coil spacing (instrument length), the maximum depth of investigation is typically 5 to 6 m (16–20 feet). Subsurface cultural resources in a site such as Burro Tanks that are most likely to be sensed and mapped by an EMI instrument are metallic objects, excavations and/or fill material, and potentially local soil changes due to human occupation.

METHODOLOGY

INSTRUMENTATION

The primary instrumentation used for the site survey was a GSSI Inc. (http://www.geophysical.com) SIR-3000 GPR system with a 400-MHz antenna. The SIR-3000 system, during data acquisition, is most commonly towed across the ground surface, or when site conditions are appropriate, mounted and pushed in a wheeled cart. Spatial location of the instrument along the survey lines can be monitored and recorded by either GPS technology or a calibrated survey wheel attached to the housing of the antenna. The second geophysical instrumentation deployed on this survey was a Geometrics, Inc. (http://www.geometrics.com), G858 cesium vapor magnetometer (MG), operating in dual sensor, gradiometry mode. This instrument has a nominal depth sensitivity of approximately 1.5 m (5 feet) depending on site conditions and target composition. The third geophysical instrument deployed was a GSSI, Inc. EMP-400 EMI meter, also called the Profiler. It has a depth sensitivity of approximately 3 m (10 feet) in optimal conditions.

In addition to the field instrumentation, the production of subsurface profiles, depth slices, and plan-view maps requires post-processing of raw field data using geophysical analysis software. All GPR field data were post-processed using RADAN for Windows, developed by GSSI, Inc. Three processing techniques were applied to all GPR profiles: removal of horizontal banding (spatial filtering), application of an automatic gain control (AGC) filter, and a zero line datum adjustment. The first technique, horizontal band removal, filters out antenna “ringing” (a common problem with GPR antennas) that may overwhelm or hide underlying geologic structure. The second technique, AGC, accounts for the loss of energy, and thus reflection strength, with depth. The last technique eliminates time delay in the antenna system and sets the first radar return (from the air-ground interface) to time zero. Initial processing of both the EMI and MG datasets was accomplished with MagMap2000, developed by Geometrics, Inc. This software decodes the raw instrument datasets according to pre-set survey designs, and outputs the data in formats for subsequent analysis in GIS or other graphics and visualization packages such as Surfer.

SURVEY DESIGN

One 25 × 25–m (625-m² [82 × 82–foot, or 6,727-square-foot]) geophysical survey area was established within the project area at the Burro Tanks site, approximately 320 m (1,050 feet) due south of the current stock tank (Figure 6.1), within the subsequently defined Sector 5. The site was moderately vegetated with creosotebush and mesquite and had to be cleared prior to the geophysical work by cutting all vegetation flush with the ground surface. Efforts were made to avoid pulling up roots or otherwise disturbing the soil layers.

The survey area encompassed a grid of survey transects spaced at 0.5-m (1.6-foot) intervals. The grid origin was established at the northwest corner of the survey area with transects running approximately west to east. The correct positioning and staking of all grid corners was accomplished with metric survey tapes. All grid corner points were subsequently geolocated with sub-meter GPS units with a UTM World Geodetic System (WGS) 84 coordinate and datum system. Two iron pins (46-cm [18-inch] rebar) were driven in to the northwest and southwest corners of the grid to assist in future geolocation of the study area.

RESULTS AND DISCUSSION

On August 23 and 24, 2010, Dr. Weissling from SWCA's San Antonio office conducted the fieldwork for the project site geophysical characterization with the assistance of field personnel from the Albuquerque office. Site environmental conditions for the overall survey were considered excellent, with no observed surface metal trash (e.g., pieces of barbed wire, metal cans, nails and various hardware), all of which would be considered detrimental to successful magnetic and EMI data acquisition. Site conditions for the GPR survey were also considered excellent due to the clearing of vegetation obstructions.

Fifty GPR lines and 50 EMI lines were acquired in the study grid comprising 2,500 linear m (8,202 linear feet) of data, over a six-hour period on the August 24. Due to inclement weather late in the afternoon of August 24, no MG data could be acquired. Numerous nearby lightning strikes are both a significant noise source for the MG technique, and a serious risk to the safety of the operator. It was decided to postpone the MG survey for the following morning. However, continued bad weather the following morning prevented the MG acquisition altogether.

This large volume of GPR data, however, does not make it feasible or practical to display and/or interpret the results in standard profile view. Acquisition of the GPR data in grid format enables the processing of all of the line data as a 3-D data cube. This cube can then be viewed in plan-view as depth slices of the subsurface. The data in each plan-view slice represent the radar reflection amplitude at that depth level and is somewhat analogous to viewing aerial photograph imagery of historic ground surfaces. It should be noted here that depth information on both GPR profiles and data cubes is based on an estimate of the radar propagation velocity for the subsurface soils at the project site. Specific depth description for radar anomalies in the ensuing discussion are approximations with potential error estimates of ± 20 percent.

GPR RESULTS

Observed depth of radar penetration at the study site was significantly less than that normally achieved with the 400-mHz antenna (~2–3 m [6.6–10 feet]) in optimum soil conditions. Based on field estimates of radar velocity, maximum penetration depth was approximately 1 m (3.3 feet), a likely result of energy attenuation effects due to conductive (saline?) soils. However, the cultural resource targets of interest were considered to be less than 1 m (3.3 feet) deep. As discussed previously, the processing of gridded GPR lines or profiles enables the generation of plan-view depth slices. An evaluation of all depth slices from the surface to 1 m (3.3 feet) suggested that the majority of anomalies of any interest were seen in the top 70 cm (28 inches). One set of GPR depth slices was produced for this report. With a slice thickness of 1 cm (0.4 inch), this set tends to accentuate the more subtle, laterally extensive features (e.g., soil horizons, local soil compaction due to cultural activities) that could be lost by the averaging that ensues when a thicker slice is produced.

The first GPR depth slice (Figure 6.2), at 5 cm (2 inches), depicts a set of features that most likely originate with the surface stone scatter and root clumps from the cut vegetation. It has a mottled, clumpy character that is consistent with the local vegetation pattern. No obvious cultural resource anomaly is visible in this first depth slice.

The second depth slice (Figure 6.3), at 13 cm (5 inches), begins to show a set of features of likely cultural origin. Several threadlike anomalies (thin dark lines) can be seen in this image, generally oriented southeast-northwest, or south-north. These anomalies are most highly developed in the next depth slices, at 15 and 17 cm (6–7 inches) (Figure 6.4 and Figure 6.5, respectively). Their orientation (trending toward the springs) and character (slightly meandering) are suggestive of livestock or wildlife trails through and around vegetation clumps. The ability for radar to detect these features is likely due to a contrast in radar energy transmission and reflection due to localized soil compaction along the trail. Other features of significant interest in this depth slice (see Figure 6.3) are the anomalous bright and dark spots, representing high and low amplitude radar reflections, respectively. The three anomalies (labeled A, B, and C) at the north end of the study site are rather short-lived as they disappear beyond the 17-cm (7-inch) depth level. On the other hand, the anomaly at the sound end of the 13-cm (5-inch) slice (labeled D) is definitely more persistent with depth, being visible to at least the 55 cm (22-inch) depth level. Immediately to the east of anomaly D, first denoted with a yellow circle (also labeled E) in the 15-cm (6-inch) slice (Figure 6.4), is a much larger but less well-defined feature. It appears to grow in amplitude slightly in the 17-cm (7-inch) slice (Figure 6.5), but fades considerably at the 22-cm (9-inch) level (Figure 6.6).

A very curious set of anomalies in the radar data, best seen in the 30-cm (12-inch) depth slice (Figure 6.7), are what appears to be two sets of parallel tracks that transect the study site in broad loops. These features, in an aerial photograph, would be readily identified as vehicular tracks or ruts, and this is what they appear to be in this radar data. However, with a consistent width (center-to-center of tracks) of ~2.2 m (~7.2 feet), they seem to be too wide for the wheel base of modern vehicles. It would be interesting to see if this width matches the wheelbase of common historical period horse or mule-drawn wagons. It should be noted here, that although these features are most visible in the 30-cm (12-inch) depth slice, they are in fact subtly visible in the depth slices at 15 and 17 cm (6 and 7 inches). This shallower depth would be more consistent with historical period resources.

The last anomaly of interest from the GPR data can be seen in the last three depth slices, at 48, 55, and 60 cm (19, 22, and 24 inches) (Figure 6.8, Figure 6.9, and Figure 6.10, respectively). At the top third of the study area (north end) is a broad feature that appears to extend across the study area width. Although a cultural resource origin cannot be ruled out, this feature is likely of natural origin, possibly related to the bedrock surface.

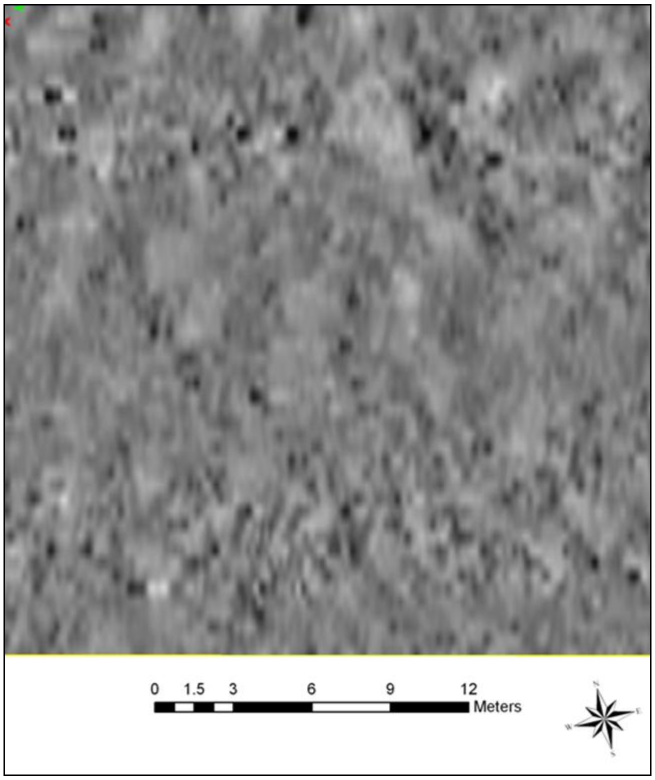

Figure 6.2. GPR depth slice (1-cm thick) centered at 5 cm.

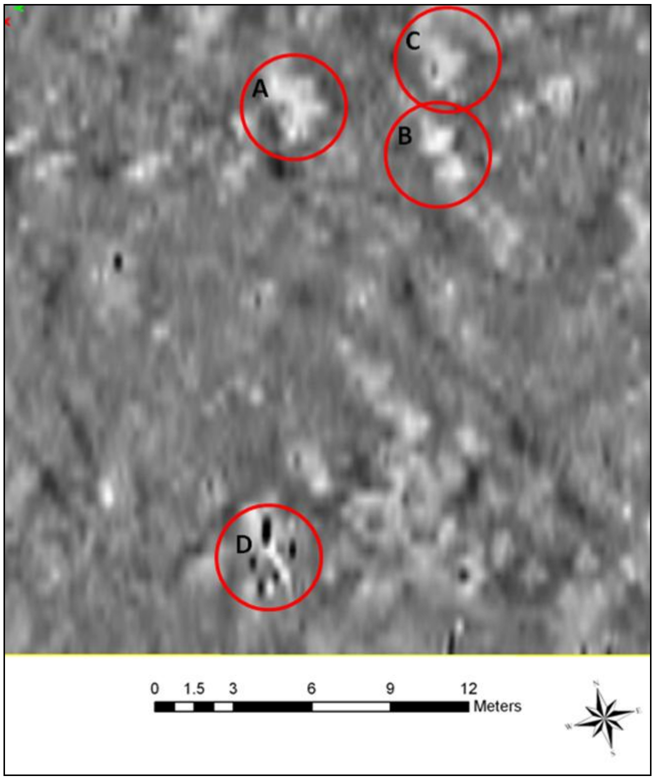

Figure 6.3. GPR depth slice (1-cm thick) centered at 13 cm.

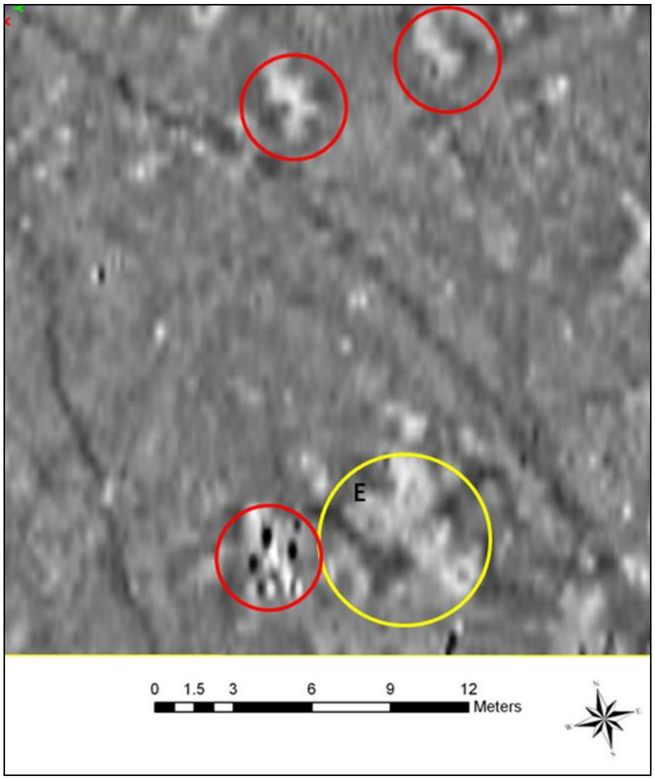

Figure 6.4. GPR depth slice (1-cm thick) centered at 15 cm.

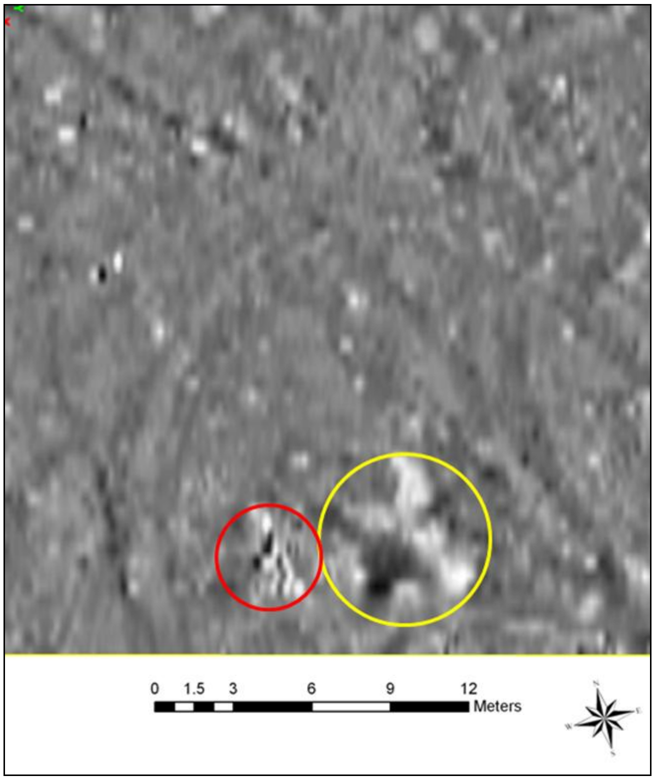

Figure 6.5. GPR depth slice (1-cm thick) centered at 17 cm.

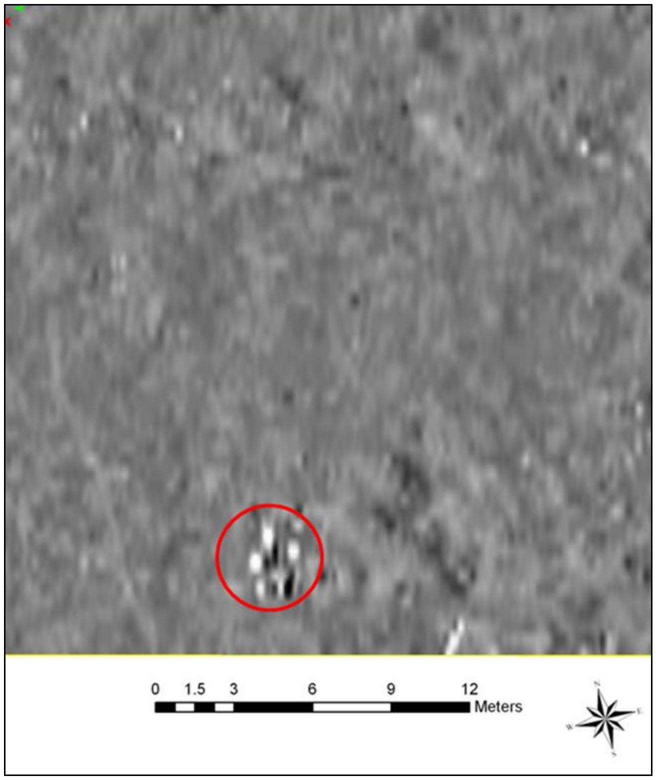

Figure 6.6. GPR depth slice (1-cm thick) centered at 22 cm.

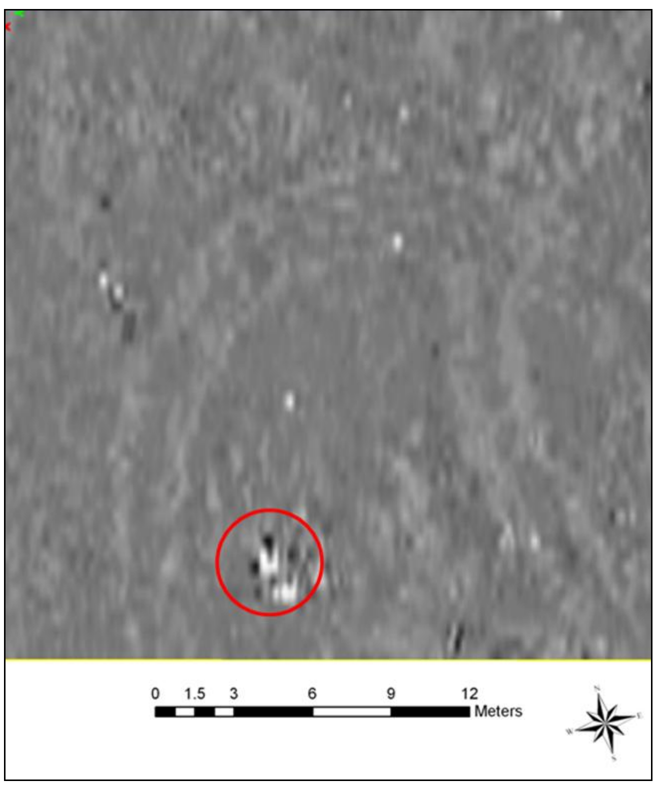

Figure 6.7. GPR depth slice (1-cm thick) centered at 30 cm.

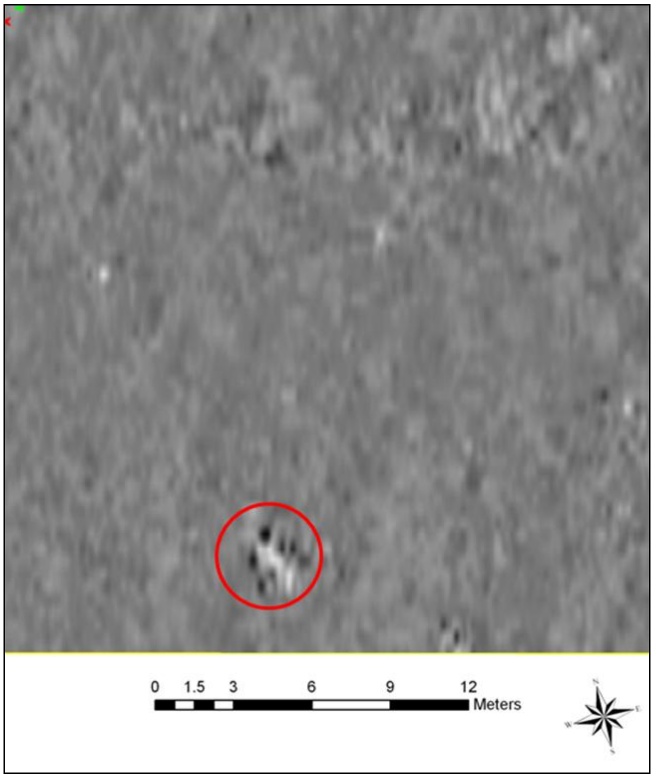

Figure 6.8. GPR depth slice (1-cm thick) centered at 48 cm.

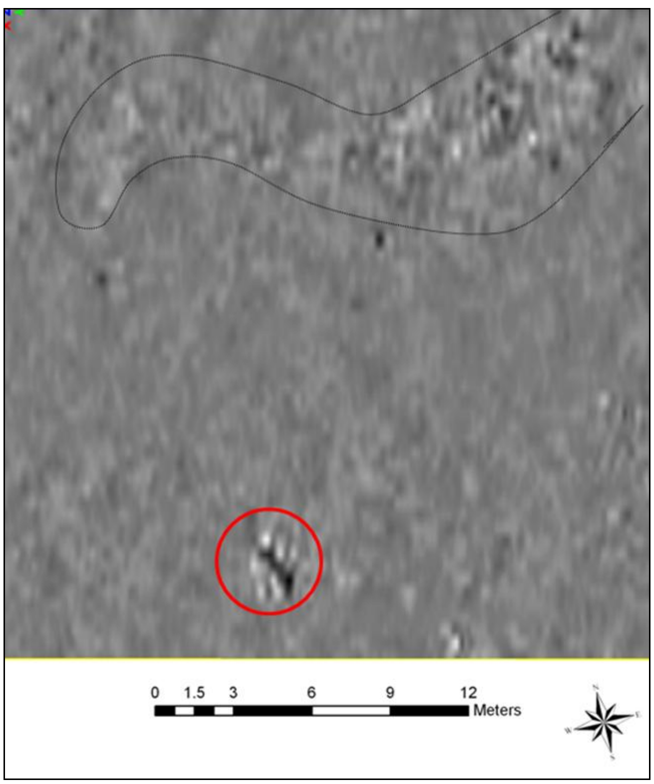

Figure 6.9. GPR depth slice (1-cm thick) centered at 55 cm.

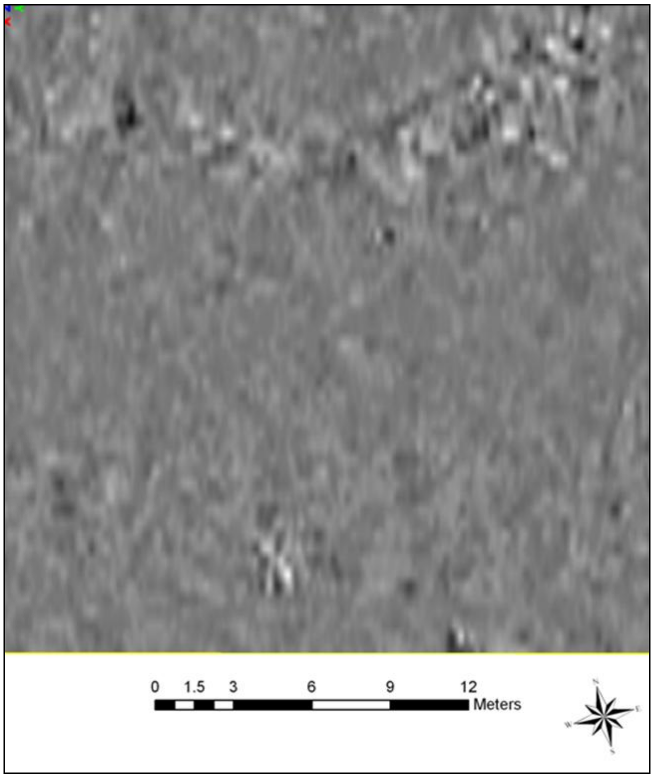

Figure 6.10. GPR depth slice (1-cm thick) centered at 60 cm.

EMI RESULTS

The results from the EMI survey were generally inconclusive. Conductivity data were acquired in three frequencies, 5 kHz, 10 kHz, and 15 kHz. In principle, lower frequencies give greater depth penetration of the EMI signal but with a slight loss of resolution compared to the higher frequencies. The datapoint density was 0.5 m (1.6 feet) in the X-direction (~north-south), corresponding to the line spacing, and approximately 0.25 m (0.82 foot) in the Y-direction (~east-west). This data density was judged to be sufficient to image subsurface conductivity anomalies as small as 0.5 m (1.6 feet) in diameter. An examination of the resultant EMI conductivity maps of the study area did not reveal any convincing anomalous feature potentially associated with a cultural resource. All EMI results showed the characteristic "salt and pepper" pattern, which typically indicates nothing more than the detection of background electromagnetic noise. Only a couple of features of any interest were observed in the 5-kHz EMI result (shown in Figure 6.11). The subtle anomaly identified with the red circle does in fact correspond spatially with the most significant GPR anomaly observed in the depth slices. A second subtle electromagnetic anomaly can be seen along the east edge of the study area (circled in yellow). This one does not correspond with any observed GPR anomaly. The dark linear feature along the western edge of the EMI data is not real—it is an artifact of interference with the metallic ends of the surveyor's tapes used to demarcate the transect lines.

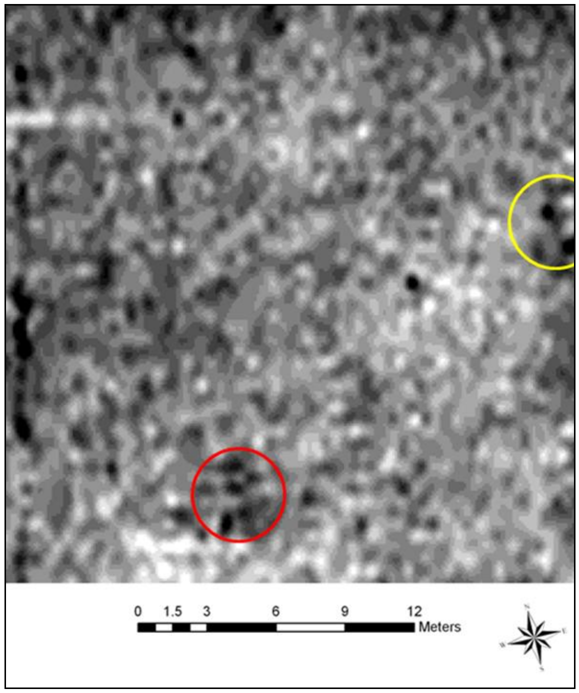

Figure 6.11. EMI 5-kHz conductivity results with annotation of features of interest.

CONCLUSION

Multiple anomalies or features of interest were identified in the survey of the Burro Tanks geophysical study area that will guide future cultural resource investigations. Sufficient information as to the spatial location and targeted depths of potential resources now exists as a result of the geophysical program. As a guide for future excavation the value of the geophysical effort is clear, especially in regards to the discovery of pre-historic hearths and/or middens—if in fact these resources are related to the more obvious radar anomalies. Of additional interest are the potential historic resources that could be related to the conjectured livestock and/or vehicle (wagon?) trails. Without this a priori geophysical evidence for such, the likelihood that conventional cultural resource excavation techniques would or could have identified these subtle resources is quite small.

CHAPTER 7
FINDINGS AND CONCLUSIONS

The current recording of LA 32227 was extremely productive in every way and satisfied every research goal that SWCA had contemplated. To the author's knowledge, no surface investigation of this intensity has even been undertaken at any of the other large, oasis sites on the Mescalero Plain. In collecting fined-grained surface assemblage spatial and analytical data, using the TRU method, SWCA was able to define sectors and illuminate the history of occupation at the site.

Most significantly, SWCA was able to demonstrate that a major transformation took place in the use of the site in the later Formative period, beginning perhaps around A.D. 1100, in the Formative 4 to 6 phases. Earlier occupations at the site, including Paleoindian, Archaic, and Formative 1 to 3 occupations, were low intensity, characterized by short-term campsites probably related to hunting or gathering near the lake. Most of the sectors at the site comprise vast palimpsests of short-term occupations spread out over millennia. Between A.D. 1100 and 1300 (Formative 4–6), however, an intensive, large-scale occupation was established in Sectors 1 and 2 of the site. This occupation created large areas of midden and deposited tremendous quantities of lithics and ceramics. The Formative 4 to 6 occupation can probably be fairly characterized as a small village, and it is entirely possible that the residents lived on the site year-round and grew crops on the margins of the former Burro Lake. There is also some evidence for an increase in trade at this time, since obsidian is present only in these later sectors.

In the Formative 6 to 7 phase (approximately A.D. 1300–1400), the focus of occupation shifted to Sectors 3 through 5. This occupation was even larger, with more artifacts deposited and more extensive midden deposits formed. Again, it can probably be characterized as a small village. Obsidian continued to be present.

This fluorescence of modest village life at LA 32227 is consistent with the pattern identified by Railey et al. (2009:29–57), in which the number of sites on the Mescalero Plain is significantly reduced in the thirteenth century and the probably growing population became concentrated into fewer, larger, and presumably more permanent settlements. This change was accompanied by other indicators of more permanent village life, such as cemeteries, more substantial architecture, and significant midden deposits. The transformation we have documented at Burro Tanks probably also took place at similar sites elsewhere on the Mescalero Plain, such as Boot Hill, Laguna Plata, and Merchant. Many questions remain regarding these Late Formative aggregated settlements, however. In particular it is not clear to what extent the residents of these sites engaged in and depended on maize agriculture. The significant populations that can be inferred from the archaeological remains would seem to imply that agriculture was an important part of the economy of these people. As assessment of farming and maize dependence in these sites is clearly one of the most important questions for future research in southeastern New Mexico.

Similar developments took place in the Roswell area at approximately the same time, with the establishment of village sites such as Henderson and Bloom (Speth 2004, 2005). The inhabitants of Burro Lake no doubt were in close contact with the Roswell villagers and engaged in economic and social commerce with them. The nature of this interaction is also a significant research question. Did the Mescalero Plain villagers obtain maize from the Pecos Valley populations, perhaps in exchange for bison products? This is a question that can only be answered by further research. Did these oasis settlements play a role in the intensified procurement of bison and the related trade that Speth (2004) argues took place after A.D. 1300?

Finally, sometime around A.D. 1400 village life was abandoned at Burro Tanks and probably throughout southeastern New Mexico. Subsequent occupations were ephemeral and transient, similar to the occupations of the Archaic and Early Formative. It is generally accepted that this change represents a shift in economic focus to a more nomadic lifestyle, perhaps focused on bison hunting. At the same time, however, there was a dramatic reduction in regional population. Can this final transformation be understood as an example of social collapse, perhaps rooted in part in growing populations in this resource-limited area? Again, this is a question for future research.

CHAPTER 8
SUMMARY OF RECOMMENDATIONS

LA 32227 remains one of the most scientifically significant archaeological sites in southeastern New Mexico and is clearly eligible for the NRHP under Criterion D. It is listed on the New Mexico SRCP and is a clear candidate for formal nomination to the NRHP in the future.

It is recommended that LA 32227 be avoided in all future management actions, and further that a buffer be established around the site within which ground disturbance should be prevented or minimized. It is further recommended that the site be included in a site steward program if practical, and that the gates leading to the site be locked if possible. Collection continues at the site, and looting is probably taking place as well, though on a much smaller scale than formerly. Any action that would minimize casual visitation of the site would slow the rate at which it is being damaged.

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APPENDIX A
CULTURAL RESOURCES LOCATION INFORMATION

For Official Use Only – Public Disclosure of Archaeological Site Locations is Prohibited by 16 USC 470hh and 36 CFR 296.18

Appendix A has been removed to protect confidential site location information.