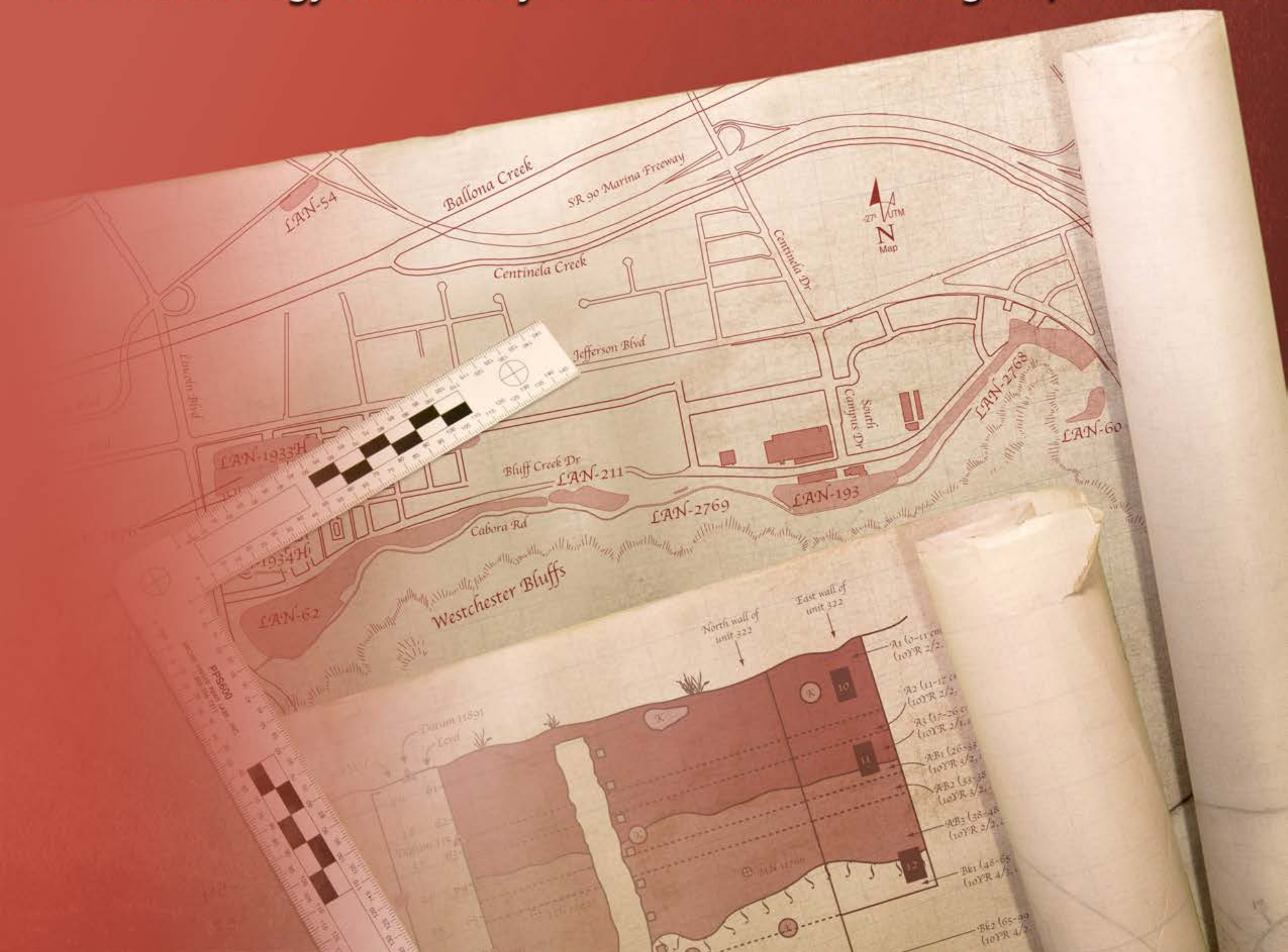
People in a Changing Land

The Archaeology and History of the Ballona in Los Angeles, California



VOLUME 2

Archaeological Sites and Chronology

edited by Benjamin R. Vargas, John G. Douglass, and Seetha N. Reddy

STATISTICAL RESEARCH, INC.
Technical Series 94

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Series Editors
Donn R. Grenda, Richard Ciolek-Torello, and Jeffrey H. Altschul

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with contributions by

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Los Angeles District
Los Angeles, California

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ACHP	Advisory Council on Historic Preservation
AM	archaeomagnetic
AMS	accelerator mass spectrometry
AMSL	above mean sea level
APE	area of potential effects
ARB 30	arbitrary 30-cm soil buffer
ASA	Archaeological Survey Association
ATP	archaeological treatment plan
Beta	Beta Analytic, Inc.
BGS	British Geological Survey
BLAD	Ballona Lagoon Archaeological District
BR	Brainerd-Robinson
cmbs	centimeters below the surface
Corps	U.S. Army Corps of Engineers
CU	control unit
CVF	Coso volcanic field
Delta	Group Delta Consultants, Inc.
EHT	effective hydration temperature
EMTD	Entertainment, Media, and Technology District
EU	excavation unit
FAR	fire-affected rock
FB	Feature Block
FRED	Feature Relationship Empirical Diagram
GPR	ground-penetrating radar
HAER	Historic American Engineering Record
HHIC	Howard Hughes Industrial Complex
HIHD	Hughes Industrial Historic District
HSC	Health and Safety Code
IGRF	International Geomagnetic Reference Field
LMU	Loyola Marymount University
mbs	meters below the surface
MEU	manual excavation unit
MLD	Most Likely Descendant
MSU	mechanical-stripping unit
MTP	Maguire-Thomas Partners–Playa Vista
NAHC	Native American Heritage Commission
NBA	National Basketball Association
NHPA	National Historic Preservation Act
NRHP	National Register of Historic Places
PA	programmatic agreement
PD	provenience designation
PDA	personal digital assistant
PDB	PeeDee belemnite
ppm	parts per million
PRC	Public Resources Code
PVAHP	Playa Vista Archaeological and Historical Project
QA	quality assurance
RCF	rate-correction factor
SCCIC	South Central Coastal Information Center
SHPO	State Historic Preservation Officer
SR	State Route
SR-	Statistical Research, Inc., temporary-site-number prefix
SRI	Statistical Research, Inc.
SRID	Scaling Relational Integrated Database
SU	stripping unit
The Campus	current name for the Entertainment, Media, and Technology District
UCLA	University of California, Los Angeles
UCSB	University of California, Santa Barbara
USGS	U.S. Geological Survey
VGP	virtual geomagnetic pole
VPDB	PeeDee belemnite carbonate standard
WSO	Washabo airport abbreviation

Sponsor: Playa Capital Company, LLC

Volume Title: Archaeological Sites and Chronology. People in a Changing Land: The Archaeology and History of the Ballona in Los Angeles, California.

Project Location: The project area is located in the former Ballona Lagoon, a prehistoric wetland complex in west Los Angeles that is known collectively as the Ballona. That area is today bounded, roughly, by Playa del Rey to the west, Marina del Rey to the north, the Ballona Escarpment (a high bluff) and Del Rey Hills/Westchester Bluffs to the south, and Interstate 405 to the east. It is located approximately 0.5 km east of the Pacific Ocean, near Santa Monica Bay, along that section of the coast; 1.3 km west of the Baldwin Hills; and 1.6–2.6 km north of Los Angeles International Airport. Ballona Creek, a drainage that is now channelized, crosses the project area; Centinela Creek, a spring-fed drainage, once ran along the southern portion of the project area, along the base of the Ballona Escarpment.

Project Description: Statistical Research, Inc., (SRI) conducted research—including testing, evaluation to determine eligibility for listing in the National Register of Historic Places (NRHP), and data recovery—at eight sites in the Ballona (CA-LAN-54/H, CA-LAN-62/H, CA-LAN-193/H, CA-LAN-211/H, CA-LAN-1932/H, CA-LAN-2676/H, CA-LAN-2768/H, and CA-LAN-2769/H) (hereinafter in this volume, the prefix “CA-” and the suffix “/H” will be omitted). Of those eight sites, five were recommended eligible for listing in the NRHP: LAN-54, LAN-62, LAN-193, LAN-211, and LAN-2768. Data recovery was conducted at those five sites (Altschul 1991; Altschul et al. 1991; Altschul et al. 1998a; Altschul et al. 1999; Altschul et al. 2003; Keller and Altschul 2002; Van Galder et al. 2006; Vargas and Altschul 2001a; Vargas et al. 2005). Research designs and plans of work were developed and implemented (after review by regulatory agencies). In addition, related research in the Ballona included a paleoenvironmental study of the area (Volume 1 of the Playa Vista Archaeological and Historical Project [PVAHP] series), analyses and results of material classes and subsistence data (Volume 3 of the series), and bioarchaeology (Volume 4 of the series). The final volume in the series (Volume 5) synthesizes the work presented in other volumes and offers detailed discussions and modeling of the Native Californians, including the Gabrielino/Tongva, who lived in the Ballona for thousands of years. Volume 5 also includes detailed mortuary-analysis ethnohistoric studies for the Ballona. This volume (Volume 2 of the series) presents the methods and results of the data recovery at the five sites. In addition, it details the inventory of the entire project area and documents additional sites that either were found not eligible for listing in the NRHP or were not evaluated.

Project Summary: This volume of the PVAHP series presents the methodology and approach to large data recovery at complex sites in an alluvial context, the results of the chronostratigraphic reconstruction, and the descriptive results of the data recovery, with emphasis on midden-constituent analysis and feature typology. The long-term occupation in the Ballona, from 8,000 years ago through the Mission and early Historical periods, has been well documented through these excavations. The large-scale excavations yielded large data sets with complex temporal and spatial contexts that are discussed in detail in this volume. This project is among the very large-scale and rigorous studies of Native American adaptations in the southern California coastal region, especially for the Mission period Gabrielino/Tongva territory. The data presented here illustrate both stability and change in cultural systems extending back 8,000 years, including denser occupations during the Protohistoric and Mission periods. The most-pronounced changes occurred at the beginning and end of the Intermediate period and at the start of the Protohistoric and Mission periods.

ACKNOWLEDGMENTS

In 2015, Statistical Research, Inc. (SRI), began its 24th year of work on the Playa Vista Archaeological and Historical Project (PVAHP), the project that ultimately resulted in this five-volume series. These final reports offers a broad, as well as specific, understanding of more than 8,000 years of human occupation of the Ballona region and of the relationship between that occupation and the evolution of the Ballona environment. Over the long course of the project, a large number of extraordinary people contributed to its success; to all these people, we are deeply indebted. Although we cannot adequately thank everyone here, below we acknowledge the contributors to the research presented in these report volumes.

First and foremost, we thank the project sponsors for giving us the opportunity to conduct this important work. In 1989, two years before the PVAHP proper began, SRI was hired by Camp, Dresser, McKee (CDM, now CDM Smith) and Planning Consultants Research (PCR) to survey the project area and develop a research design as part of the environmental review process; Jane Yager (PCR) was our initial contact person for the project. After the completion of the initial environmental impact report, SRI was retained by Maguire Thomas Partners (MTP), then the developer of Playa Vista. Robert Miller of MTP ably provided SRI with corporate assistance and was a strong supporter of the PVAHP. In the late 1990s, MTP was replaced by Playa Capital Company, LLC[1], as the project developer. We are indebted to Bruce Harrigan, Marc Huffman, Randy Johnson, Pat Larkin, Cliff Ritz, Patricia Sinclair, Steve Soboroff, and Catherine Tyrrell, who oversee or have overseen the implementation of the PVAHP. Patti Sinclair worked closely with SRI during much of the field and postfield efforts and deserves an advanced degree in archaeology for the amount of knowledge she has gained over this time. During field efforts, Cliff Ritz offered many helpful suggestions on using heavy equipment for the efficient collection of required information on the sites. Specifically, Cliff designed and built a large-diameter coring system that helped us recover buried archaeological sites below groundwater. Marc Huffman has worked side-by-side with SRI on a number of matters related to the implementation of the PVAHP over the years and has been a great facilitator for the project. In 2012, Playa Capital Company, LLC, was purchased by Brookfield Residential.

Compliance with Section 106 of the National Historic Preservation Act was accomplished through a Programmatic Agreement (PA). The signatories to the PA for the PVAHP are the U.S. Army Corps of Engineers (Corps), the California State Historic Preservation Officer (SHPO), and the Advisory Council on Historic Preservation (ACHP). The lead federal agency for this work is the Corps. We appreciate the help of a number of current and former Corps employees, including Aaron Allen, D. Stephen Dibble, John Killeen, Patricia Martz, Pamela Maxwell, Roderic McLean, and Richard Perry. Two consecutive SHPOs, Knox Mellon and Milford Wayne Donaldson, served as important guides for this project; the current SHPO is Carol Roland-Nawi. We thank both of these agencies, as well as members of the ACHP who participated in the project, including the current chairperson, Wayne Donaldson, and Reid Nelson, the director of Federal Agency Programs. Phillip de Barros, John McAlister, and William Want were all instrumental in drafting the PA, and Hans Kreutzberg, Chief of Review and Compliance for the California Office of Historic Preservation helped bring it to a successful conclusion. George Mihlsten and others at Latham and Watkins were a great help with advice on particular aspects of the project.

Peer review has been an integral part of the PVAHP from beginning to end—during prefield research-design creation and fieldwork and during postfield analysis and report writing. The peer-review team reviewed the research design and treatment plans for various sites, met with us multiple times in the field during various excavations, offered important feedback during analysis, and gave critical review of reports. We appreciate and value the feedback and guidance from our peer reviewers, John Johnson, Patricia Lambert, Patricia Martz, Charles Rozaire, and the late Phillip Walker.

Two Tongva/Gabrielino tribal groups signed the PA as concurring parties: the Gabrielino People (represented by Vera and Manuel Rocha) and the Tongva/Gabrieleno Tribal Council of San Gabriel (represented by Cindi Alvitre). As discussed below, we have enjoyed working with these and other Gabrielino/Tongva tribal groups and appreciate the opportunities we have had to interact with them over the course of two decades. We have also enjoyed our interactions with Robert Dorame, who was named Most Likely Descendent for the project by the Native American Heritage Commission, and appreciate his recommendations. We also thank the Native American monitors who worked side by side with SRI on the PVAHP. These monitors, all representatives of various Gabrielino/Tongva Tribal groups, included Martin

[1] The several stages of the Playa Vista development project were overseen by a series of different corporate entities.

Alcala, Richard Alcala, Dana Alcala, Evan Alcala, Tonantzin Carmelo, Virginia Carmelo, Jordan David, Katy Dorame, Mat Dorame, Mercedes Dorame, Robert Dorame, George Dorame, Sam Dunlap, Adrienne Kinsella, Edgar Perez, Theresa Richau, and Abel Silvas. We are proud to have developed such a strong working relationship with these individuals during the PVAHP. We also thank the late Vera Rocha for blessing the PVAHP at the outset of the project.

A number of past and present SRI employees have contributed to project direction, oversight, and management, including Kenneth Becker, Su Benaron, Amanda Cannon, Christopher Doolittle, John Douglass, David Ferraro, Jeffrey Homburg, Angela Keller, David Maxwell, Seetha Reddy, Steven Shelley, and Anne Stoll. We are especially grateful to Benjamin Vargas and Sarah Van Galder Wollwage for their multiple roles directing fieldwork, analysis, and the writing of volumes. The initial survey for the PVAHP was directed by James N. Spain, while Mark Swanson conducted the initial historical research.

Laboratory direction was overseen by a number of different individuals, principally James Clark, Elizabeth Denniston, William Feld (who also did remarkable work with field logistics and setup of the water screening apparatus), Jennifer Howard, Scott Kremkau, LaShawn Lee, and Susan Seifried. Database work (including the creation of a relational database that we have since adapted to use companywide) was essential for all aspects of investigation, and the diligence of Andrew Bean, Robert Heckman, Jim LoFaro, Carey Tilden, and Mark Woodson was indispensible to the project. We thank the many field crew and laboratory technicians who labored so assiduously on different aspects of the fieldwork, laboratory sorting, and analysis. Their efforts are truly appreciated.

The geoarchaeology and geomorphological work was accomplished by many individuals. Led by Jeffrey Homburg, the geoarchaeology team included Eric Brevik, Diane Douglas, David Ferraro, Antony Orme, Manuel Palacios-Fest, Steven Shelley, Caroline Tepley, and Lance Wollwage. We are also indebted to many individuals at SRI who played crucial roles in support of the paleoenvironmental project. Richard Boettcher, Diane Douglas, John Douglass, David Ferraro, Dennis Gallegos, Paul Goldberg, Jeffrey Homburg, Stanley Kling, Doug Macintosh, Richard Macphail, Russell Morse, Manuel Palacios-Fest, Seetha Reddy, Neil Rhodes, Paul Sauder, Peter Wigand, and Steve Williams all played various roles in the field and postfield efforts. A number of consultants contributed to the paleoenvironmental study, including Matt Rowe, Roy Shlemon, Jacob Lipa, Douglas Howard, and William Nailling III, and surveyors at Psomas and Associates; they are acknowledged for mapping the original cores collected for this study. We thank Tracy Spilotro of West Hazmat Drilling Corporation and Tony Morgan of Quaternary Investigations for collecting these cores. Foothill Engineering also collected cores for this project, and we are grateful to Delta Group for sharing data on other cores with us throughout the years. The chronostratigraphical analysis for the project was conducted by William Deaver, Stacey Lengyel, Jill Onken, Benjamin Vargas, and Lance Wollwage.

Material culture studies were conducted by SRI archaeologists and consulting specialists. John Griswold and his associates helped a great deal in the field with conservation of fragile material culture. Lithic analysis was led by Kathleen Hull and Polly A. Peterson, with contributions from Amanda Cannon, Robert Elston, Henry Koerper, Scott Kremkau, Seetha Reddy, Mark Sutton, and Robert Wegener. Shell-bead analysis was conducted by Amanda Cannon after initial contributions from Angela Keller. During the initial identification of shell bead types, Angela Keller consulted with Chester King. Worked-bone studies were led by Janet Griffitts, with assistance from Tina Fulton and Justin Lev-Tov. Glass-bead studies were done by Lester Ross with assistance from Amanda Cannon, John Douglass, and Scott Kremkau. Basketry analysis was conducted by Judith Polanich, while Owen Davis and Peter Wigand conducted the pollen analysis and Seetha Reddy studied the macrobotanical remains. Christopher Garraty analyzed the Native American ceramics, and Karen Swope studied the historical-period artifacts in collaboration with John Douglass. Marcy Gray also analyzed selected historical period artifacts. Faunal analysis (vertebrate and invertebrate) was led by David Maxwell and Sarah Van Galder, with assistance from Justin Lev-Tov John Goodman and Robert Wegener. Ethnohistoric research has principally been conducted by John Douglass, Steven Hackel, and Anne Stoll. An important component of this research was conducted using the Early California Population Project database, housed at the Huntington Library and directed by its general editor, Steven Hackel.

Osteological analysis of remains from CA-LAN-62 was among the most important cultural and scientific components of the project. Osteological work was overseen by Patrick Stanton, with guidance from Phillip Walker. A number of other individuals were important to this analysis—namely, Rhonda Bathurst, Joseph Hefner, Mitch Keur, Tamara Leher, Lorrie Lincoln-Babb, Kenneth Maes, Christopher Nagle, Korri Turner, and Bonnie Yoshida. We acknowledge the generous support and consultation of the late Phillip Walker, who not only was a peer reviewer for osteology, but also offered important insight throughout excavation and subsequent analysis; we appreciate Patricia Lambert taking over as the osteological peer reviewer after his passing.

The PVAHP had several research components, and SRI archaeologists worked closely with a large number of consultants conducting specialized studies, including paleoenvironmental study, radiometric studies, chronological analysis, osteological analysis, ceramic analysis, lithic analysis, faunal analysis, micro- and macrobotanical studies, and historic-artifact analysis. We thank each of these scholars for their participation and their role in making the project a resounding success.

We appreciate the help of SRI's publications staff in completing these five volumes. We thank María Molina, SRI's director of publications for overseeing the many tasks involved. We are especially indebted to Steve Bradberry, John Cafiero, Diane Holliday, Grant Klein, April Moles, Jason Pitts, Peg Robbins, Jennifer Shopland, Luke Wisner, and

Linda Wooden for their work in editing, graphics, and production, which made the volumes read and look as they do. Others who helped with the massive amount of illustrations, graphs, and maps include Ileana Bradford, Marie Echevarría-Delgado, Cindy Elsner-Hayward, William Hayden, Steve Norris, Nicholas Reseburg, James Wallace, and Deland Wing. Seetha Reddy and John Douglass deserve special recognition for coediting and coordinating all five volumes through various drafts and peer and regulatory review, with help from colleagues Jeff Homburg, Patrick Stanton, and Benjamin Vargas on specific volumes.

Finally, we thank Wendy Teeter, curator of the Fowler Museum at the University of California, Los Angeles, for guiding us as we prepared the massive collection of non-burial-related PVAHP material for curation at the Fowler. Wendy was a great help throughout the entire process.

Donn R. Grenda, Richard Ciolek-Torello, and Jeffrey H. Altschul
Series Editors

Excavations in the Ballona Lowlands: An Introduction

John G. Douglass, Seetha N. Reddy, Jeffrey H. Altschul, Donn R. Grenda, Richard Ciolek-Torello, and Benjamin R. Vargas

The Playa Vista Archaeological and Historical Project

Rarely does an archaeologist have the opportunity to investigate the prehistory of an area on more than a small scale. Large-scale projects in southern California are few and have generally treated sites on an individual basis and often with a compliance focus. Since 1990, Statistical Research, Inc. (SRI), has had the unprecedented opportunity to investigate, review, and discuss the archaeology of an entire area, known historically as the Ballona, through the Playa Vista Archaeological and Historical Project (PVAHP). Throughout this time, SRI has been tasked with preserving the record of previously poorly understood resources through archaeological monitoring, testing, and data recovery projects. The archaeological record of the Ballona Lagoon area has been subjected to a varied history of disturbance resulting from agricultural enterprises, urban development, and large-scale industrial activity, and surprisingly, it has endured. It has been our task to peel back the rind of those external forces, in order to expose the archaeological record of human behavior and present our interpretation of its place within the larger region.

This volume presents the methods used and the results of the 20-year PVAHP, which worked toward understanding the complex relationship between humans and the environment in the Ballona. Although our work is not the first in the Ballona area, it represents the first comprehensive attempt to piece together the rich archaeological and historical record on a regional scale. The methods we used to recover that record developed over the life of the project but always worked toward the goals set forth in the research design presented in 1991 (Altschul et al. 1991; see also the revised research design in Volume 1, this series).

Our work has focused mostly on the area below the base of the Ballona escarpment (Figures 1 and 2), although other projects conducted by SRI and others have included sites on the bluff tops (Douglass et al. 2005; Van Horn 1987; Van Horn and Murray 1984, 1985; Van Horn and White 1997), near the edge of the lagoon (Altschul et al. 1992), and at the base of the bluffs (Grenda et al. 1994). The long and complex history of both amateur and professional archaeological work in the Ballona has been presented in detail in earlier publications (Altschul et al. 1991, 2003; see Volume 1, this series). In this volume, we report the archaeological investigations at five multicomponent sites and present data from investigations at several other locations where redeposited archaeological materials have been encountered. We also present the methods, research objectives, and results of the chronostratigraphic study that was conducted in concert with the archaeological excavations.

The PVAHP research in the Ballona Lagoon area is important for several reasons. First, the Ballona has a sequence of human habitation dating back at least 8,000 years (Douglass et al. 2005; see Volume 1, this series)—one of the earliest documented occupations in southern California (Jones et al. 2008). Information regarding that long sequence of occupation at multiple sites, from the PVAHP and adjacent projects, allows us to document and understand changes in production, consumption, health, trade and interaction, cultural affiliation, and other aspects of daily life for the prehistoric and early-historical-period residents of the Ballona. Second, the location of the PVAHP, along Santa Monica Bay and the Ballona Wetlands, offered a unique opportunity to understand the relationship between human settlement and changing environmental conditions over thousands of years. The Ballona, for example, evolved from an open embayment and freshwater lagoon to a sediment-choked wetland over the course of human habitation in the area (see Volume 1, this series, for details on the evolution of the Ballona). In addition, the location of the PVAHP sites within a very short distance from Santa Monica Bay allowed for a better understanding of the relationship between those prehistoric inhabitants and the ocean, including the question of maritime adaptation, which was important for adjacent cultural groups, such as the Chumash. Finally, the PVAHP contains some of the best data recorded in southern California in regard to the effects of Hispanic colonialism on native groups. The identification and excavation of two sites in the PVAHP with strong evidence of Mission period use—LAN-62, a Gabrielino/Tongva burial area, and LAN-211, a nearby domestic area—revealed strong

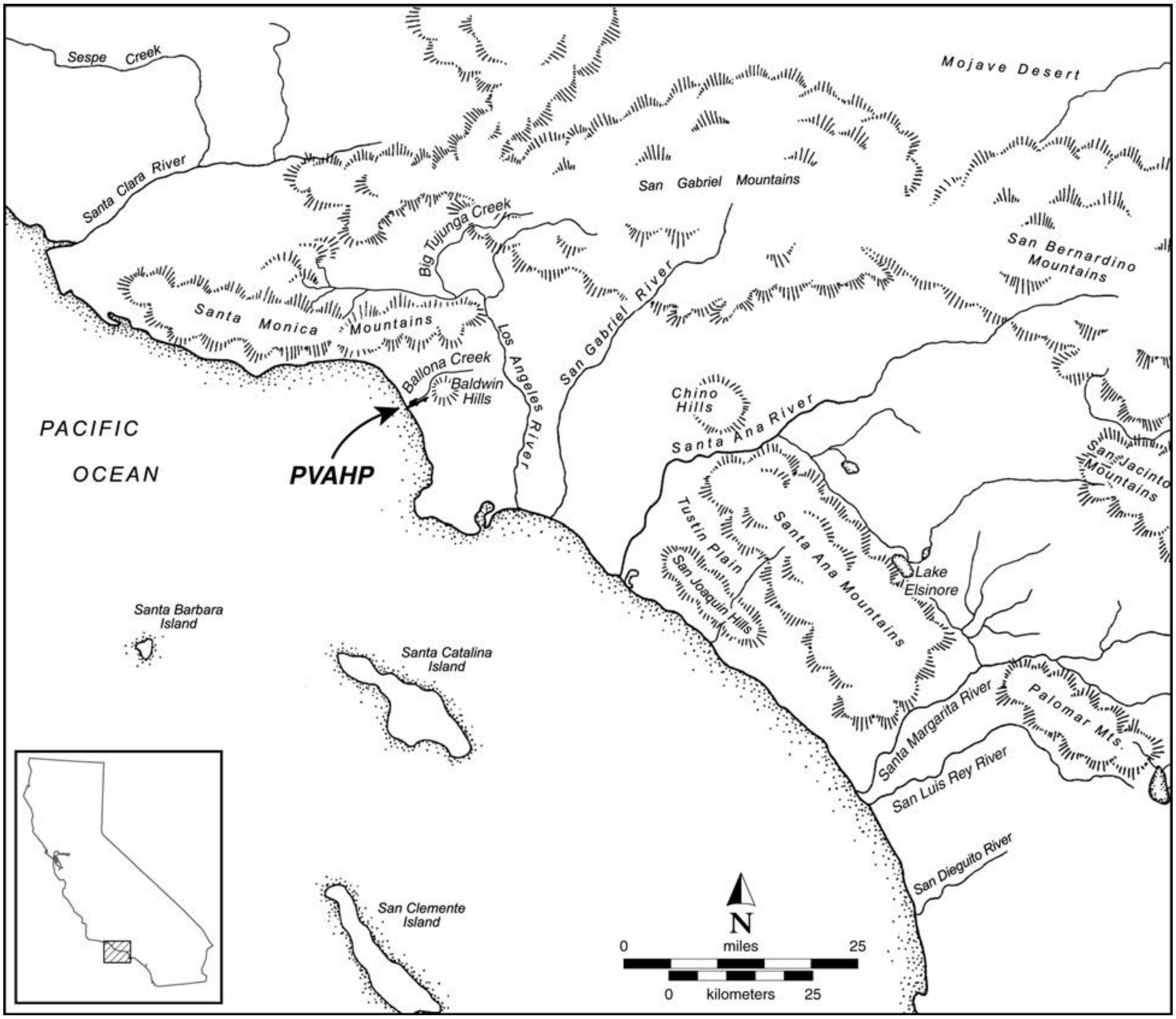

Figure 1. Map showing the location of the PVAHP in California.

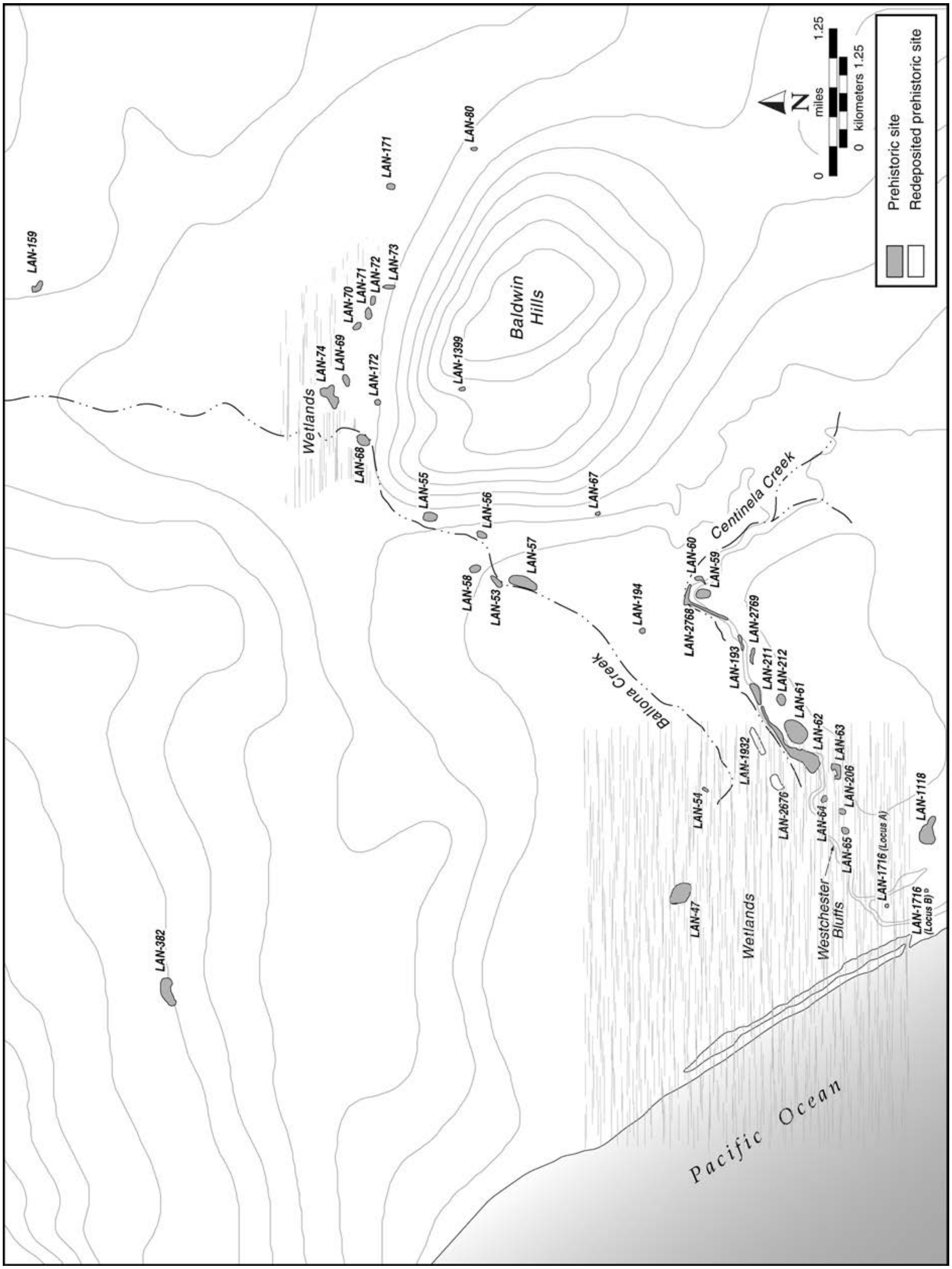

Figure 2. Map showing the locations of prehistoric and early-historical-period archaeological sites in the Ballona region.

and convincing evidence of the transformation of native Californians during that difficult time in the late eighteenth and early nineteenth centuries and the most comprehensive, detailed, and well-documented archaeological evidence in existence concerning Gabrielino/Tongva culture.

Development and Regulatory Background

In the 1970s, soon after Howard Hughes's death, the Summa Corporation, one of his many companies, began plans for developing the project area. Other portions of Hughes's property on top of the bluffs, both east and west of Lincoln Boulevard, were separate from the Playa Vista planned development and were later sold to separate entities. The PVAHP project area, containing 1,087 acres (nearly 2 square miles), was the largest portion of Hughes's property in the Ballona area and was divided, for development purposes, into four areas: Areas A, B, C, and D. Area D was further subdivided into three subareas: Area D1 on the west, Area D2 in the middle, and what was originally known as the Entertainment, Media, and Technology District (EMTD) and is now known as The Campus (Figure 3). Area D2 is now known as The Village. Although SRI conducted archaeological investigations in all four areas, the vast majority of significant historical-period resources were identified in Area D, primarily along the base of the Westchester Bluffs. By the mid-1980s, the original development plans for Playa Vista by Summa Corporation had been approved by the City of Los Angeles and the California Coastal Commission. For many years, much of the 1,087 acres of the original Playa Vista property became slowly surrounded by housing and other urban development.

When Howard Hughes purchased much of the project area in the 1940s and 1950s, there was still substantial open space surrounding it. That was partly by design, because Hughes also owned land on top of the bluffs, overlooking the PVAHP project area. However, during the 1980s and 1990s, much of that land on the bluff tops was sold for development. By the 1980s, suburban housing and commercial development had encroached on all sides, and open space was at a premium. As a result, the portion of the project area that was to be set aside as open space was seen as inadequate by development opponents, and the plan was the subject of litigation.

By the late 1980s, the original plans for the project area were beginning to be restructured under a development team led by Maguire-Thomas Partners–Playa Vista (MTP), which assumed principal ownership of the property. By 1989, MTP had begun new plans for developing the project area that included a reduction of development in 1989 and an increase in the preservation of open space. SRI's initial role as part of the Environmental Impact Report team for the Playa Vista development involved conducting a pedestrian archaeological survey, compiling and summarizing archival sources on the history of the project area and its cultural resources, and developing a comprehensive research design that would aid in the identification, evaluation, and treatment of archaeological and historical resources, including those already known and those anticipated to be found during the course of development (Altschul et al. 1991).

Between 1989 and the present, SRI has conducted its work in phases, beginning with a survey of the project area and the creation of a research design and a programmatic agreement (PA) for the project (Figure 4; see Appendix 1.1, this volume). Later, SRI, along with Greenwood and Associates and Historic Resources Group, undertook historic-building evaluations, testing of historical-period sites, subsurface inventory and testing, evaluation of sites for National Register of Historic Places (NRHP) eligibility, data recovery of eligible sites, monitoring of ground-disturbing activity in the project area, public outreach, analysis, and report writing. The PVAHP series is designed to detail the data recovery phase of work for all native sites recommended eligible for listing in the NRHP as contributing members of the Ballona Lagoon Archaeological District (BLAD) and to offer an understanding of what the accumulated archaeological materials and prehistoric and historical patterns suggest about the use of the Ballona over the past 8,000 years.

Because it required a permit from the U.S. Army Corps of Engineers (Corps) to comply with the Clean Water Act, the project also had to comply with the National Environmental Policy Act and the National Historic Preservation Act (NHPA). Additionally, the project had to comply with state and local laws, most notably the California Environmental Quality Act, and the portions of the project in the coastal zone had to comply with the California Coastal Act. A comprehensive program was developed to ensure that compliance with federal, state, and local laws and regulations was met. Acting as the lead federal agency, the Corps, in consultation with the California State Historic Preservation Office (SHPO), the Advisory Council on Historic Preservation (ACHP), and two groups representing the Gabrielino (a state-recognized but not federally recognized tribe), first determined that the entire 1,087 acres would be considered. The parties then determined that two districts in the PVAHP project area were eligible for listing in the NRHP. The Hughes Industrial Historic District (HIHD) was determined eligible, for its importance to the history of the country through its association with the development and construction of military technology and aircraft, as well as its strong relationship with a person of singular importance in the twentieth century, Howard Hughes. Impacts to the HIHD were mitigated through the preparation of a Historic American Engineering Record (HAER) that documented the buildings, the development and implementation of a management plan for those buildings that could be saved, and the preparation of a detailed history (Greenwood and Associates 1995; Historic Resources Group 1998; SRI et al. 1991).

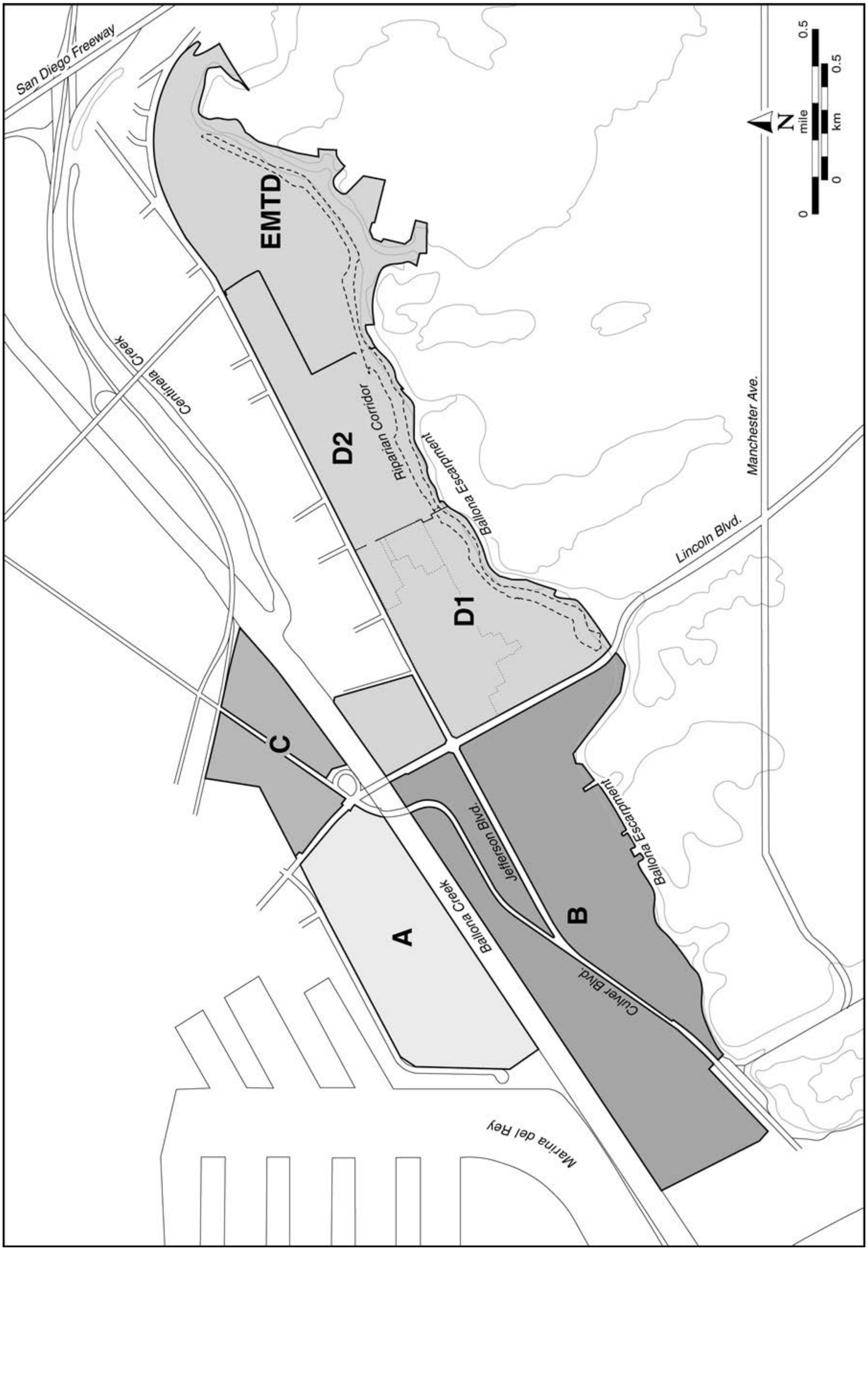

Figure 3. Map of the PVAHP project area, showing Areas A, B, C, and D and the EMTD.

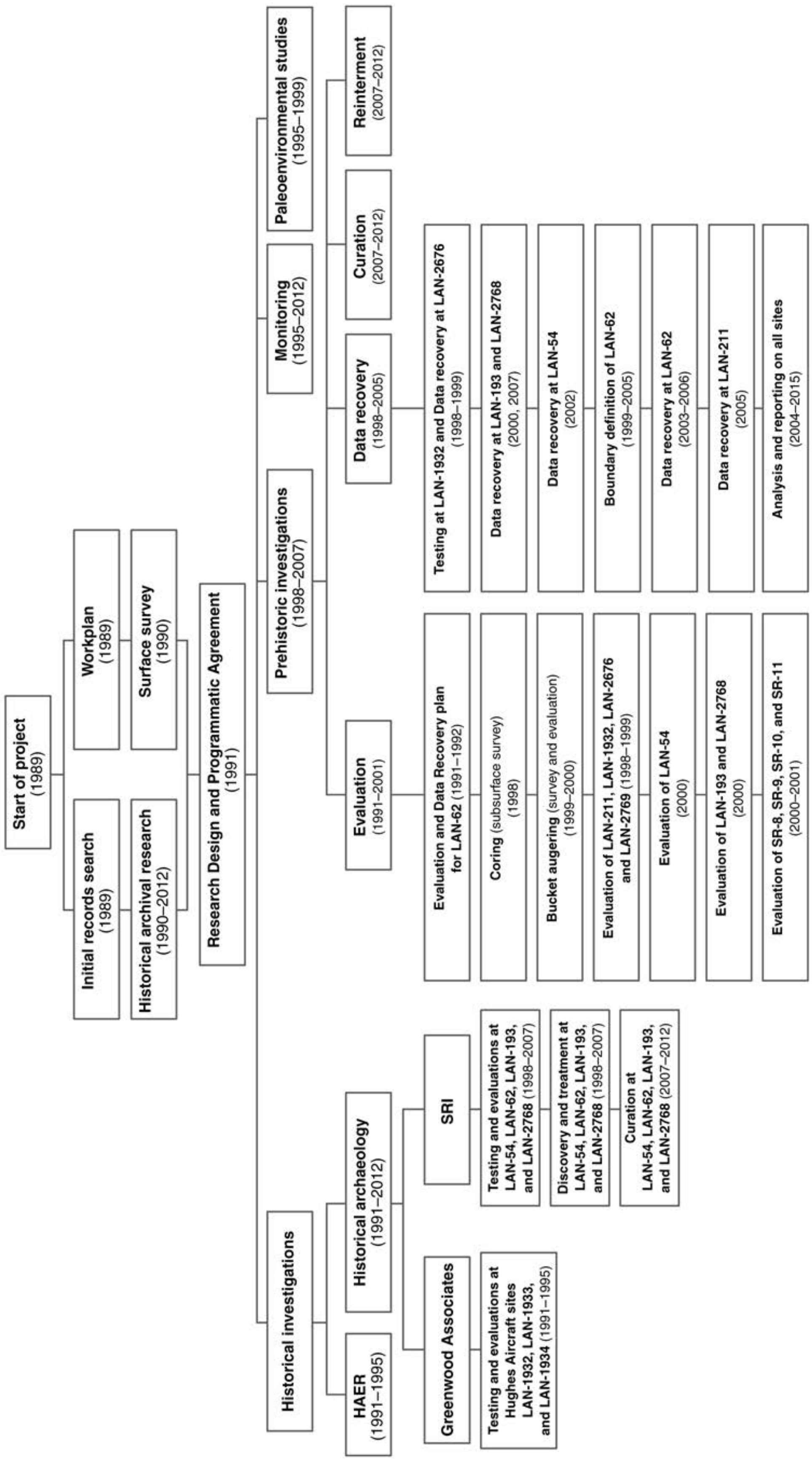

Figure 4. Flowchart of the history of PVAHP research since 1989.

The BLAD, which includes all sites eligible for listing in the NRHP within the PVAHP project area, was determined eligible based on the potential of its resources to contribute to our understanding of the prehistory of the Southern California Bight. The BLAD is the subject of the five volumes in the PVAHP series, which fulfills the obligation to report our findings and to place those findings in their proper cultural and historical contexts.

NRHP-Eligible Archaeological Sites in the PVAHP

In total, seven archaeological sites in the PVAHP have been found eligible for listing in the NRHP—LAN-54, LAN-60, LAN-62, LAN-193, LAN-211, LAN-2676, and LAN-2768—and compose the BLAD (Altschul et al. 1991) (Figure 5). LAN-60, which is partially on Playa Vista property, underwent data recovery in the early 1990s as part of the mitigation related to a University of California, Los Angeles (UCLA), faculty-housing project, unrelated to the PVAHP (Grenda et al. 1994). During data recovery at LAN-2676, the site was determined to be redeposited cultural material rather than an intact archaeological site, and excavation at the site was halted. LAN-2676, as well as another archaeological site, LAN-1932 (which was recommended not eligible), are referred to as "runway sites," because they were created by Hughes Aircraft Company during the extension of its runway during World War II, using redeposited archaeological site materials from two sites along the base of the bluff: LAN-62 and LAN-211.

LAN-54 was located to the south and west of the intersection of the Marina Freeway (State Route [SR] 90) and Culver Boulevard and is the only prehistoric site within the PVAHP that is near the prechannelized location of Ballona Creek. Data recovery included hand-excavation of control units (CUs), mechanical stripping of all intact site materials in the area of potential effects (APE), and hand-excavation of identified features, including three human burials. LAN-54 is a multicomponent site with intact prehistoric components dating to the late Millingstone and early to middle Intermediate periods and also includes a late-historical-period component. Data recovery at LAN-54 consisted of the excavation of 4 exploratory trenches, 10 blocks of excavation units (EUs) (comprising 82 1-by-1-m units), 56 4-by-4-m stripping units (SUs), 8 column samples, and 32 features (including 3 burials). A detailed examination of excavations at LAN-54 is presented in Chapter 8, this volume.

LAN-62 is a large, multicomponent site within the BLAD that had been previously determined eligible for listing in the NRHP (Altschul 1991; Altschul et al. 1991). LAN-62 rests on an alluvial-fan deposit located at the base of the Ballona escarpment, at the western end of the Playa Vista development. For management purposes, SRI divided LAN-62 into seven loci (Loci A–G). The prehistoric occupation at LAN-62 was significantly denser in the southern portion of the site (most of which was designated Locus A), whereas the northern and eastern portions of the site (designated Loci C–G) were characterized by sparse cultural deposits; Locus B had been largely destroyed by historical-period activities. Data recovery in the form of monitoring was conducted in Locus B because it had been highly disturbed and included an area known formerly as the Fire Safety Training Area. Locus B had been subjected to extensive use during the Hughes era, and very little intact soil remained. It appeared that much of that area had been excavated and redeposited or altogether removed, to be used as fill elsewhere on the property (a likely source of LAN-2676). Both Loci A and G had occupations ranging from the late Millingstone period through the Mission period, and they represent the longest occupation sequence in the Ballona. Locus A had a much denser concentration of cultural deposits and features than Locus G and included a dense Native American burial area, including a discrete Mission period burial area. Locus G was located at the northern edge of the large alluvial fan upon which LAN-62 rests, joined to the historical-period marsh in the area. Consequently, the archaeological signature within Locus G was less distinctive, because of the commingling of site and marsh deposits in that area. Loci C and D underwent data recovery, and the results indicated a sparse deposit, although some features were identified during excavations. Loci E and F offered inconclusive or negative evidence of prehistoric occupation.

During the data recovery at LAN-62 Locus A/G, SRI excavated 56 mechanical trenches, 109 mechanical-stripping units (MSUs), 744 units, and 224 nonburial features. In addition, 374 burial features were recovered from Locus A. During and immediately after the excavations, several discrete spatial-analytical contexts were defined at LAN-62, including the burial area and several feature blocks. The focus of the data recovery analysis was on the burial area and three feature blocks. The burial area had the densest concentration of human burials in the Ballona and one of the densest in the Los Angeles Basin. Data recovery at LAN-62 Locus C/D included excavation of 22 trenches, 100 1-by-1-m units, and 10 nonburial features. As discussed above, Loci E and F did not undergo data recovery, because testing resulted in inconclusive or negative evidence of prehistoric occupation. A detailed discussion of excavations at the different loci of LAN-62 is presented in Chapter 9, this volume.

LAN-211 is located on an alluvial fan at the base of the Ballona escarpment, in Area D2 of the PVAHP project area. LAN-211 is a multicomponent site with predominantly Intermediate (3000–1000 B.P.) and Mission (A.D. 1770–1830) period components. The data recovery program at LAN-211 included the excavation of 10 trenches, 370 1-by-1-m units, 3 burial features, and 43 nonburial features. One of the primary contexts at LAN-211 was Feature Block (FB) 1, which measured between 10 and 30 cm thick across an expansive area (153 m^2) and was characterized by high densities of cultural

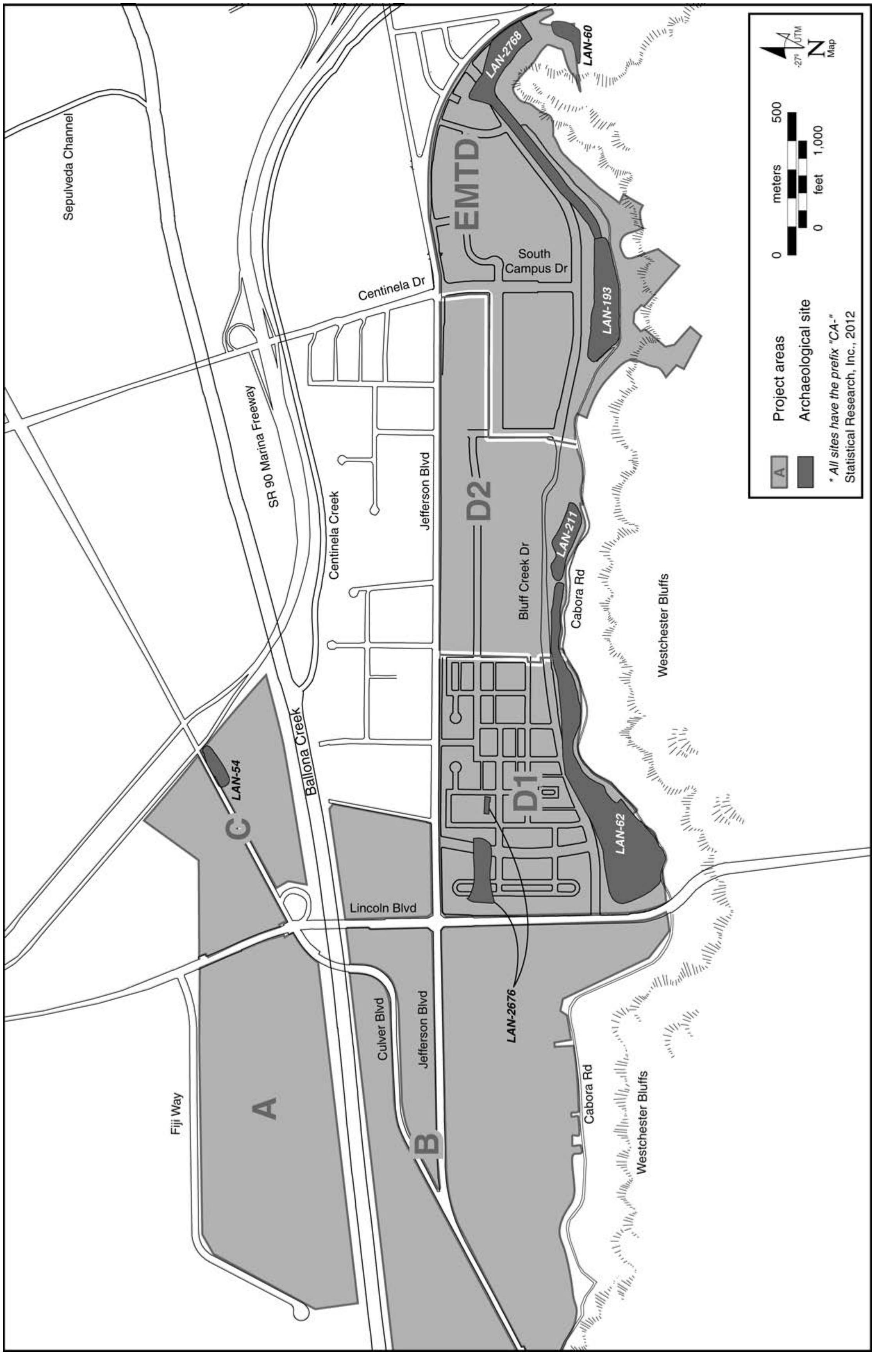

Figure 5. Map showing the locations of PVAHP sites which were determined as eligible for listing in the NRHP (see Figure 253 for all sites in the project area).

and organic remains. A detailed discussion of the excavations at LAN-211 is presented in Chapter 10, this volume.

LAN-193 is situated at the base of the Ballona escarpment, sandwiched between the intersections of two large drainages south of Centinela Creek. Data recovery and subsequent monitoring at the site involved the excavation of 119 1-by-1-m EUs, 15 mechanical trenches, and 55 features: 52 nonburial features and 3 burial features. LAN-193 had late Millingstone and Intermediate period deposits and an early-twentieth-century refuse dump. A detailed discussion of the excavations at LAN-193 is presented in Chapter 6, this volume.

LAN-2768 was located along the base of the Ballona escarpment, within the upper reaches of the historical-period channel of Centinela Creek, in The Campus, on the far-eastern end of the project area. For management purposes, LAN-2768 was divided into four loci of investigation (Loci A–D), which were especially important in light of the large extent of the site. Archaeological investigations at LAN-2768 included the excavation of 11 pothole trenches, 64 linear trenches, 111 1-by-1-m EUs, and 30 SUs. In addition, 79 features, including 76 nonburial features and 3 burial features, were excavated in the four loci of LAN-2768 during the data recovery and monitoring. LAN-2768 comprised Intermediate period deposits and a minor Protohistoric/Mission/Rancho period component. A detailed examination of the excavations at LAN-2768 is presented in Chapter 7, this volume.

Finally, as briefly discussed above, LAN-60 underwent data recovery in the early 1990s (Grenda et al. 1994) for a separate client (UCLA). Located east and south of LAN-2768, around the corner of the Westchester Bluffs from other sites along the base of the bluffs, LAN-60 is a relatively sparse prehistoric site dating primarily to the Intermediate period. The portion of LAN-60 located within the PVAHP project area did not undergo data recovery.

Goals, Objectives, and History of the PVAHP

The PVAHP had several goals. Ultimately, it was designed to meet the requirements of Section 106 of the NHPA through a process of inventory, evaluation, and mitigation of impacts to historic resources on the Playa Vista property. A PA was written for the project, to create specific requirements for that process. But beyond regulatory requirements, the PVAHP created a unique opportunity to understand the paleoenvironmental and cultural history of the area. For over 8,000 years, humans have lived in the Ballona, interacting with an evolving lagoon and wetlands. Ultimately, the research offered by the PVAHP allows an in-depth understanding of that human-environment relationship as well as a perspective on the culture history of this portion of southern California that is unprecedented in its detail and level of documentation. Below, we briefly detail the history of investigation for the PVAHP (see Figure 4).

Record Searches, Inventory, and Creation of a Research Design (1990–1991)

The first step in the process of compliance with federal laws is the identification and evaluation of historic properties by the responsible agency—in this case, the Corps. The Corps reviews all existing information and determines, in consultation with the SHPO and the ACHP, if historic properties may exist in the proposed area of development. If historic properties may exist, then the Corps determines how much additional survey effort is needed to locate them. Next, the Corps identifies all NRHP-listed properties that will be affected by the proposed development, as well as those properties that are not listed but appear to meet eligibility criteria. For the latter group of properties, the Corps, in consultation with the SHPO, applies the NRHP criteria and determines their status.

To comply with the first step in the process, in the summer of 1990, SRI conducted archival- and archaeological-record searches for the area adjacent to Playa Vista, as well as a pedestrian survey of the property. Archival research was conducted at a number of facilities, including the public libraries of Marina del Rey, Santa Monica, Westchester, and Culver City; the special collections and map collections at UCLA and the University of California, Santa Barbara (UCSB), as well as Loyola Marymount University (LMU); the Los Angeles County Hall of Records; the Los Angeles County Records Center; the Los Angeles County Assessor Map Book Archives; and the Hughes Aircraft Company corporate headquarters. Interviews were conducted with local landowners and former Hughes Aircraft Company employees.

An archaeological-records search at the South Central Coastal Information Center (SCCIC), then housed at UCLA, indicated that although a relatively large number of archaeological studies had been conducted in the Ballona, there were no published reports. Most of the work done before 1960 consisted of notes submitted to various members of the UCLA Department of Anthropology or UCLA student papers that had been placed on file at the SCCIC. Projects conducted in conjunction with compliance studies, most of which were done after 1960, were better reported, and some of those studies had been deposited at the SCCIC, including reports by R. L. Pence (1979) and Archaeological Associates, Inc. A few studies, most notably the work of David Van Horn and his firm Archaeological Associates, Inc., were considered proprietary information and were obtained from either Archaeological Associates, Inc., or Planning Consultants Research. Finally, interviews were conducted with archaeologists that have worked in the Ballona, including David Van Horn, Charles Rozaire, Brian Dillon, Keith Johnson, Gary Stanley, and John Murray.

Pedestrian survey of the entire property took place over a 5-week period in July and August of 1990. All identified archaeological sites were recorded on a California cultural resource inventory form. Site-recording procedures were aimed at providing information for determining which sites potentially met the criteria for listing in the state and/or national registers of historic places. Determination of NRHP eligibility at the survey level is difficult in areas where there is a high potential for deeply buried sites. As a result, the Corps concluded that with the exception of LAN-62, more testing was necessary to evaluate sites, whereas pedestrian survey was adequate to identify potential archaeological sites.

In total, 59 percent of the 1,087-acre project area was either obscured by fill or covered by an abandoned runway, roads, parking lots, buildings, and/or dense vegetation. The remaining 41 percent consisted of areas where the present ground surface appeared relatively undisturbed at the time of survey. The various episodes of construction and fill that had affected the project area greatly hampered SRI's ability to identify cultural resources that may once have been exposed.

Based on survey, 17 discrete loci of previously unrecorded cultural materials and 5 isolated finds were identified. Because of the surface conditions, we could not determine whether sites were intact or had been redeposited. As a result, temporary SR- numbers were assigned until such a time as those sites could be further tested and state trinomials could be assigned. The loci comprised 4 shell midden deposits (SR-1, SR-14, SR-15, and SR-16), 6 shell scatters that may have represented cultural deposits (SR-8, SR-9, SR-10, SR-11, SR-12, and SR-13), 3 historical-period sites (SR-2, SR-3, and SR-17), and 4 concentrations of historical-period cultural materials that were thought to have been redeposited (SR-4, SR-5, SR-6, and SR-7). Five of the loci (SR-2, SR-3, SR-8, SR-9, and SR-10) were identified in Area B; 2 (SR-7 and SR-11) were identified in Area C; 10 (SR-1, SR-4, SR-5, SR-6, SR-12, SR-13, SR-14, SR-15, SR-16, and SR-17) were identified in Area D, and none was found in Area A. Additional SR- sites have been identified since the initial 1990 survey, and they are discussed later in this volume (see Chapters 6, 7, and 11). As discussed previously, the sites determined eligible for listing in the NRHP within the project area are included in the BLAD. Historic structures determined to have integrity and association with the Hughes era have been designated as parts of the HIHD.

Finally, a research design (Altschul et al. 1991) was written to guide the research for the PVAHP. Major themes for the research design included human-environment relationships, culture history and cultural dynamics of the Ballona, and historical-period developments in the Ballona (see Chapter 5, Volume 1, this series, for a detailed summary of the 1991 research design and a discussion of additional research questions posed for the project, based on findings since 1991). At the time the research design was written, a treatment plan was also created for the largest and most complex site in the Ballona, LAN-62 (Altschul 1991). In Volume 1, this series, we presented a detailed discussion of research themes for the PVAHP, including evaluation of the themes, based on 20 years of research on the project, and additional research directions.

Creation of a Programmatic Agreement (1991)

Based on the results of the initial records search for and inventory of the property, it was clear that a formal agreement between regulatory agencies under Section 106 was necessary. Initially, it was proposed that a memorandum of agreement be written for the Playa Vista development, for the protection of historic resources. However, it became clear after the survey that there was potential for buried archaeological deposits that had not been visible during the pedestrian survey of the property. For unusually large, phased, or complex projects, such as this one, an alternative to a case-by-case review of site eligibility is a PA, which outlines a review process specific to a particular project, streamlining the Section 106 process. In 1991, a PA for the Playa Vista development project was entered into by the Corps, the California SHPO, and the ACHP; two organizations representing Gabrielino/Tongva and then–Playa Vista developer MTP concurred with the PA.

Additional Inventory and Testing Program: Cores, Bucket Augers, Trenches, Manual Excavation, and Archaeological Monitoring (1998–Present)

In the late 1990s, after initial survey of the property, SRI undertook a four-part testing program to locate and evaluate known and previously unknown cultural resources within Area D. The four phases were (1) coring, to define stratigraphy; (2) bucket augering, to find sites; (3) trenching, to define site boundaries; and (4) manual excavation, to assess site integrity and obtain controlled samples. That strategy resulted in the defining of boundaries for seven sites: LAN-62, LAN-193, LAN-211, LAN-1932, LAN-2676, LAN-2768, and LAN-2769. Of those, LAN-1932 and LAN-2769 were both found not eligible for listing in the NRHP (Ciolek-Torrello 2003). Portions of the testing program (such as trenching) were continued through 2008. Details regarding the inventory and testing methods and maps showing the locations of bucket augers, trenches, and manual excavation can be found in reports by Doolittle and Altschul (1998), Doolittle (1999), and Vargas and Feld (2003a). Details of cores are discussed in Volume 1, this series.

Throughout the PVAHP, monitoring has been an important part of the inventory process. Archaeological monitoring, together with Native American monitoring, occurred whenever ground-disturbing activity in native soil was undertaken, unless the area had previously been cleared. Monitoring allowed archaeologists to understand more clearly where site boundaries may be and helped to identify new discoveries. Four archaeological sites were either partly (components of sites) or wholly first identified during archaeological monitoring within the project area: LAN-1932, LAN-2676, and LAN-2768, and SR-24 (which was subsequently included as part of LAN-2676). All of these sites were buried under fill, which made surface identification impossible, and all but one of them turned out to have been redeposited. Portions of many other sites in the project area have had their boundaries altered as a result of the monitoring efforts. All archaeological monitors in the project area have worked closely with Native American monitors, who are representatives of several different groups of the Gabrielino/Tongva tribal community.

Coring

Beginning in 1994, SRI began a coring program at Playa Vista to understand and model the paleoenvironment of the Ballona during the Holocene (past 10,000 years). The Holocene was a time of great environmental fluctuation, including lower sea levels and changing climate. A major goal of the coring and paleoenvironmental program was to understand the evolution of the Ballona Lagoon and Wetlands and their relationship to human occupation in this area over the past 10,000 years. Environmental reconstruction of the ecosystem that encompassed the Ballona Wetlands has progressed significantly during SRI's 20+ years of research in the area. An extensive coring program has provided more than 300 continuous 7.6-cm (3-inch) cores in the area, and those cores have been used for stratigraphic, chronometric, pollen, mollusk, foraminifera, siliceous-microfossil, and ostracode analyses. Global sea-level rise at the end of the Pleistocene, beginning approximately 18,000 years B.P., was the major factor in the formation of the Ballona. Initially, as the ice caps melted, the inundation of the preexisting shoreline created an inlet at the edge of Santa Monica Bay. For 6,000 years, continued rises in sea level were offset by tectonic activity that raised the land, leading to a long period of relative stability of the shoreline. That stability continued until about 5000 years B.P., when the rate of sea-level rise tapered off, and other factors, such as the rate of sedimentation, became more significant in establishing the shoreline. Details of the paleoenvironmental study for the PVAHP can be found in Volume 1, this series.

Bucket Augers

Mechanical bucket augering was used at Playa Vista to help locate subsurface archaeological sites in areas where the depths of fill materials and the presence of pavement and improvements made backhoe trenches and hand-excavation impossible. Bucket augers, as described in Chapter 4, this volume, are not continuous samples, like cores; rather, they are larger, grosser samples and are collected with a different machine. Bucket augers were used to help evaluate the presence or absence of site material, which was later used to help define site boundaries and offer data used in evaluating whether an area required further testing. Bucket augers were originally adapted as a refinement to the coring program. SRI first used bucket augers in the vicinity of the Howard Hughes Industrial Complex (HHIC), with its numerous standing structures, buried utilities, and large paved areas (Altschul et al. 1999). The results were generally successful, and SRI continued to use the technique in other sections of the PVAHP, including Areas D1 and D2 (Vargas and Feld 2003a). Overall, bucket augers helped complete the inventory process. It is clear that although some bucket-auger results were difficult to determine (for example, determining whether recovered artifacts were from intact or redeposited contexts), these data conveyed important information regarding which areas needed additional testing for formal NRHP evaluation.

Trenching and Manual Excavation

Areas where bucket augers indicated potential site materials received additional work, including trenching and manual excavation units (MEUs), once overburden had been stripped away. All potential sites identified during bucket augering were excavated using both additional methods, to help define site boundaries and contents. Mechanical trenches of various lengths and widths helped to identify site boundaries and integrity through recording and subsequent analysis of exposed soil stratigraphy. Although the SRI trenches successfully exposed cultural deposits in some areas, additional data were needed to characterize the deposits adequately. As a result, in specific places, 1-by-1-m hand-excavation units were dug into trench walls. Because the excavation depths and the instability of fill materials made many trenches unsafe to enter, those units were excavated into potentially intact, culture-bearing soils using either hand-excavation methods (when safe) or mechanical means. Bucket augering was only conducted in Area D. Other areas identified as potential archaeological sites during survey, such as LAN-54, located in Area C, had only cores, trenches, and/or test units dug during testing, depending on site conditions. Because of the concentration of Hughes-era activities as well as the alluvial and colluvial soils near the base of the bluffs, Area D was thought to have the strongest possibility of buried sites.

The differences in the possibility of buried sites between one portion of the project area and another had primarily two causes—natural colluvial and alluvial deposition along the base of the bluffs and Hughes-era construction activity—and

Area D had the highest possibility of buried sites because both were major factors there. The presence of archaeological sites along the base of the bluff was a direct result of the same natural processes that have now covered them; that is, alluvial fans created by natural deposition from the bluffs created elevated areas above the marsh and wetlands that were suitable for long-term occupation. In addition, Hughes-era construction activity either moved archaeological deposits for use as fill or covered archaeological sites with tremendous amounts of fill, as in the case of LAN-62, where data recovery was not possible until up to 20 feet of fill had been removed from the site.

The results of coring, augering, trenching, and hand-excavation throughout Area D revealed cultural remains in various parts of the project area. Many of the cultural materials recovered were found in highly disturbed contexts, representing their history as redeposited fill from Hughes-era activities. The nature of historical-period and more-modern disturbance was highly varied. SRI found that the placement of individual bucket augers as well as other, higher-resolution testing methods provided information only on specific units of space. Results indicated that there had been significant landscape modifications and that the archaeological signature had changed abruptly, both horizontally and vertically, across the project area. In other words, cores, bucket augers, trenches, and hand-excavation units dug only meters apart from one another revealed very different stratigraphic profiles, primarily because of Hughes-era disturbances. Large portions of sites had been entirely removed and replaced with fill, but deep, intact midden deposits were found directly adjacent to those areas.

Inventory Results: Eligible, Not Eligible, and Unevaluated Sites

During the course of survey and subsequent work in the project area prior to the 1990 survey, SRI recorded 25 potential archaeological sites, using a temporary numbering (SR-) system (SR-1 through SR-25; SR-18 and SR-22 were not used) (Table 1). Unless potential sites were unequivocally determined to be parts of previously recorded archaeological sites with state trinomials (e.g., LAN-54), they were assigned temporary numbers in SRI's internal tracking system at the time of discovery. Here, we briefly describe the sites; a more detailed discussion of these sites can be found in Chapter 11, this volume.

In total, five sites (LAN-54, LAN-60, LAN-62, LAN-193, and LAN-211) had been previously recorded on the property by the time of the 1990 survey, and all of them had low-number trinomials originally recorded during the 1950s by UCLA. Prior to their official recording, several of them (including LAN-62) had been recorded in the 1940s by Stuart Peck and other avocational researchers in the Ballona. All five sites have been found eligible for listing in the NRHP.

Eight SR- sites recorded during the 1990 survey and subsequent inventory (SR-13, SR-14, SR-15, SR-16, SR-17, SR-20, SR-21, and SR-25) have been recommended eligible for listing in the NRHP (see Table 1) and found to be contributing elements to the BLAD. (Note that LAN-19 was initially recommended eligible but was later found to have been redeposited [in secondary context] and was determined not eligible.) Of the eight SR-sites recommended eligible, two were part of a new trinomial (LAN-2768), one formed the basis of the HHIC, and the rest were components or portions of previously recorded sites. For example, LAN-62 was a previously recorded site, but because of the deep fill covering portions of the site, it was difficult to identify site boundaries in the beginning of the project. In 1991, LAN-62 was thought to contain several discontinuous loci (within, generally, what is now referred to as Locus A/G). As a result, SR-15 and SR-16 were thought to be new sites. After several rounds of mechanical trenching, it became clear that SR-15 and SR-16 were actually part of LAN-62; furthermore, LAN-62 was defined as a continuous site extending approximately 1 mile in length. A similar confusion occurred in regard to the location of LAN-211. In the 1991 research design, LAN-211 was located within what is now referred to as LAN-62 Locus C/D, based on locational information from the SCCIC. Those same records also had confused the locations of LAN-211 and LAN-193. SR-13, based on interpretation of original site records, was later found to be the actual location of LAN-211.

In addition, 10 sites with SR- numbers were evaluated, found not eligible for listing in the NRHP, and determined not to be contributing elements to the BLAD (SR-2 [LAN-1970], SR-4 [LAN-1934], SR-5 [LAN-1933], SR-6 and SR-23 [LAN-1932], SR-10, SR-11, SR-12 [LAN-2769], and SR-19 and SR-24 [LAN-2676]). Furthermore, some of these were found not to be archaeological sites at all (SR-10 and SR-11), and others were found to be archaeological sites but were not intact or lacked sufficient integrity. For example, SR-2 was a partially dismantled oil-well complex, and SR-4, SR-5, SR-6, and SR-24 were redeposited prehistoric site materials or secondary historical-period and/or modern refuse of relatively recent origin. SR-12 (LAN-2769), though likely in its original location, had poor cultural integrity as a result of Hughes-era activity within its boundaries.

Finally, five sites with SR- numbers were not evaluated (SR-1, SR-3, SR-7, SR-8, and SR-9). SR-1 was destroyed by development on top of the bluff prior to testing. The other four sites are on land that was conveyed to the State of California in 2003–2004, and they are no longer part of the PVAHP. It is likely that SR-8 and SR-9 [LAN-3982] are dredge-spoil locations and not prehistoric archaeological sites. SR-9 also has an indetermined historical period component.

Table 1. SR- Sites Identified during the Initial 1990 PVAHP Survey and Subsequent Inventory of the Project Area

Site No.	Trinomial	Description	Size (m)	Types of Artifacts	Evaluation/Testing/Data Recovery	Evaluation Results
SR-1	none	shell midden; site destroyed prior to testing	165 × 50	flaked stone, shell, and fire-affected rock	none	not evaluated
SR-2	LAN-1970	oil-well complex	250 × 150	concrete pads and wooden piers,	evaluation by Foster (1991)	recommended not eligible
SR-3	none	horse stables with riding ring	190 × 50	some historical-period refuse on the surface, possible prehistoric material	Altschul et al. 1991	not evaluated
SR-4	LAN-1934	historical-period trash deposit (redeposited fill)	400 × 85	glass, ceramic, and saw-cut faunal bone	Altschul et al. 1991; Hampson 1991	recommended not eligible
SR-5	LAN-1933	historical-period trash deposit (redeposited fill)	390 × 90	ceramic, glass, metal, and construction debris	Altschul et al. 1991; Hampson 1991; see also Douglass 2007b	recommended not eligible
SR-6	LAN-1932	historical-period trash deposit (redeposited fill); SR-23 is the underlying native (prehistoric) component	400 × 85	ceramics, glass, metal, construction debris, tile, domestic refuse, lithics, glass beads, and faunal material	Altschul et al. 1991; Hampson 1991; see also Douglass 2007b	recommended not eligible
SR-7	none	historical-period trash deposit	100 × 25	glass, ceramics, metal, wood, and rubber	Altschul et al. 1991	not evaluated
SR-8	none	shell scatter (redeposited shell from dredging?)	115 × 90	shell	Altschul et al. 1991	not evaluated
SR-9	LAN-3982	shell scatter (redeposited from dredging); historical-period features recorded later			Altschul et al. 1991; Douglass 2004c	not evaluated
SR-10	none	shell scatter (redeposited from dredging)	150 × 60	shell	Altschul et al. 1991; Keller 1999	recommended not eligible
SR-11	none	shell scatter (redeposited from dredging)	100 × 25	shell	Altschul 2002; Altschul et al. 1991	recommended not eligible
SR-12	LAN-2769	shell scatter	50 × 8	glass, metal, flaked stone, shell, and bone	Altschul et al. 1991; Altschul et al., eds. 2003	recommended not eligible
SR-13	LAN-211	shell scatter	280 × 70	lithics, shell, bone, glass beads, and ceramics	Altschul et al. 1991; Chapter 10, this volume	recommended eligible
SR-14	LAN-60	shell midden	150 × 115	flaked stone, shell, fire-affected rock, and bone	Altschul et al. 1991; Grenda et al. 1994	recommended eligible
SR-15	LAN-62 Locus A	shell midden	45 × 30	shell, lithics, and faunal bone	Altschul et al. 1991; Chapter 9, this volume	recommended eligible
SR-16	LAN-62 Loci B and C	shell midden	240 × 20	lithics, faunal bone, and shell	Altschul et al. 1991; Chapter 9, this volume	recommended eligible
SR-17	none	HHIC	3,000 × 700	structures and associated infrastructure	Altschul et al. 1991; Greenwood and Associates (1991, 1995)	recommended eligible

continued on next page

Site No.	Trinomial	Description	Size (m)	Types of Artifacts	Evaluation/Testing/Data Recovery	Evaluation Results
SR-18	none					number never assigned
SR-19	LAN-2676	shell midden (redeposited prehistoric fill)	70 × 225	lithics, faunal bone, shell, glass, metal, ceramics, and other historical-period refuse	Altschul et al. 1998	recommended eligible; later found to be redeposited
SR-20	LAN-2768 Loci A, B, and D	shell midden			Chapter 7, this volume	recommended eligible
SR-21	LAN-2768 Locus A	shell midden			Chapter 7, this volume	recommended eligible
SR-22	none					number never assigned
SR-23	LAN-1932	prehistoric and Mission period shell midden (redeposited prehistoric fill); SR-6 is the historical-period component	400 × 85	ceramics, glass, metal, construction debris, tile, domestic refuse, lithics, glass beads, and faunal material	Taşkiran and Stoll 2000a, 2000b	recommended not eligible
SR-24	LAN-2676	shell midden (redeposited prehistoric fill)	60 × 20	shell, lithics, and faunal bone	Altschul 2001	recommended not eligible
SR-25	LAN-193	historical-period feature; component of a prehistoric site		ceramics, glass bottles, metal, domestic refuse, lithics, faunal bone, and shell	Chapter 6, this volume	component of site already recommended eligible

Data Recovery at Eligible Sites

Data recovery was implemented at seven sites recommended eligible for listing in the NRHP and contributing members of the BLAD: LAN-54, LAN-60, LAN-62, LAN-193, LAN-211, LAN-2676, and LAN-2768 (details of data recovery and citations for that work were presented earlier in this chapter). Although LAN-60 is part of the BLAD, it was not excavated as part of the data recovery work conducted for the PVAHP; rather, a portion of the site outside the project area was investigated for another client (Grenda et al. 1994). During implementation of the data recovery programs at LAN-2676, it became clear that the substantial site deposit had been redeposited and was of little research value. Therefore, the data recovery work at that site was halted, and materials recovered prior to that determination were examined, to identify their likely sources.

Documentation and Evaluation of the Hughes Industrial Historic District

In 1991, buildings in the project area associated with the Hughes era were documented and evaluated for eligibility as contributing elements to the HIHD (SRI et al. 1991). Of the 22 structures in the project area associated with Howard Hughes and his companies, 15 were found to contribute to the HIHD. In all, 17 structures were constructed in the project area between 1941, when Hughes Aircraft Company moved to the Culver City site, and 1953, when founder Howard Hughes ended active management of the company. Two of those original buildings had been subsequently removed from the main complex. Each of the buildings played an integral role in the production, research, development, and administration of the plant on a daily basis. Despite some alterations to the buildings over the years, they together remained a physical reminder of the legacy of the Hughes era in southern California and of aviation history. The HIHD was subsequently listed in the NRHP.

To document the buildings and their historic contexts within aviation history, a HAER was completed in 1995 for the Hughes Aircraft Company and the HIHD (Greenwood and Associates 1995). It offered a broad context for the HIHD and its importance, from a local and national perspective. Finally, a Historic Resource Treatment Plan (Historic Resources Group 1998) was created for the HIHD, to aid in the overall master planning of the HIHD and in the repair and maintenance of the contributing elements to the HIHD, as well as to aid interested parties in evaluating the appropriateness of any treatment of the HIHD or its contributing members.

Setting

Below, we briefly summarize the major trends of the paleoenvironment and modern disturbances in the Ballona, including the PVAHP project area. For a detailed description of the reconstructed paleoenvironment of the Ballona area, see Volume 1, this series.

Paleoenvironmental Setting

Paleoenvironmental changes had direct and irreversible effects on human culture across the globe. In that light, two of the most striking changes to impact humans were the terminal Pleistocene/early Holocene postglacial rise in sea level and the trans-Holocene trends of sea-surface-water warming and cooling (Boxt et al. 1999; Inman 1983; Kennett and Kennett 2000). Over the past 10,000 years, during the time when humans have occupied the project area, the paleoenvironment of southern California has changed dramatically. Inman (1983:9) and Curray (1965) noted that the shoreline was significantly different in the past, starting at the onset of the Holocene, with sea levels at least 30 m below present sea level. Sea levels rose dramatically during the early Holocene; then, the rate of their rise slowed down noticeably in the last 4,000 years. Prior to the melting of continental glaciers at the end of the Pleistocene, when sea levels were much lower, the northern Channel Islands were connected as a single landmass now known as Santarosae. During that time, the southern Channel Islands were closer to the mainland, although they were never connected as a single landmass. Fast-paced sea-level rise during the late Pleistocene and early Holocene shifted the mainland shoreline eastward, resulting in inundated valley floors and the creation of steep and narrow bays in some areas (Inman 1983; Kern 1995; Masters 1994; Orme 1993). Between 5,000 and 9,000 years ago, melting of continental glaciers caused sea levels to rise approximately 2–3 cm annually, if not faster (Schneider 1997:112–117). Coastal estuaries, lagoons, and sandy beaches began to be established when the marine transgression slowed in the middle Holocene (ca. 6000–3000 B.P.) (Nardin et al. 1981). That rise in sea level ultimately resulted in aggradation in some estuaries and the silting of some lagoons. The shoreline continued to retreat during the late Holocene, with the erosion of coastal cliffs by sea-wave action (Inman 1983; Kern 1995). Between 5000 and 3000 B.P., the rate of sea-level rise slowed and reached current levels (Inman 1983). Inman's (1983) model presented four stages of coastal evolution: formation of deeply cut valleys when sea levels fell (as they did at the last glacial maximum 20,000 years ago), formation of bays as those valleys were flooded when the sea levels rose, formation of salt-marsh ecozones as the sea levels continued to rise, and ultimate inundation of the lagoons and transformation of rocky beaches to sandy beaches (Masters 1985).

Those paleoenvironmental changes are of critical importance in modeling, interpreting, and understanding the timing and pace of prehistoric human adaptations in the study area. Paleoenvironmental reconstructions indicated that, in addition to rising sea levels, other climatic changes occurred during that time. The growing body of palynological, isotopic, and tree-ring data suggests that, between 8,000 and 10,000 years ago, the climate was much cooler and moister (Heusser 1978; Pisias 1978). That period was followed by a period of warmer and drier conditions known as the Altithermal, which lasted until approximately 5,000 years ago (Antevs 1955). A study of oxygen isotopes indicated that environmental fluctuations were particularly dramatic during the past 3,000 years. Sea-surface temperatures were relatively warm and stable between 3000 and 1550 B.P.; however, the period after that was marked by cold and unstable sea-surface temperatures that lasted until 700 B.P. (Boxt et al. 1999; Kennett and Kennett 2000).

Paleoenvironmental studies in the Ballona (see Volume 1, this series), in combination with macroregional sea-level and climatic data, have shown a succession of landscapes and the development of the lagoon over the last 8000 years. Starting during the early portion of the Holocene epoch, around 7850 cal B.P., seawater began to fill the Ballona Creek/Los Angeles River channel mouth at the Pacific Ocean and was subsumed by the rising ocean levels of the era, thus forming a relatively small bay at the edge of the larger Santa Monica Bay.

By 5730 cal B.P., the river channel was further flooded, causing various preexisting side channels to be covered by shallow bay waters downstream while formerly low-lying riparian areas upstream became marshlands. By 4500 cal B.P., most of the margins of the embayment and the river channel had become marshland, and the river itself had deposited so much sediment that mudflats began to form within the channel's mouth, and sand bars evolved at the former shoreline, partially restricting water flow between the bay and the ocean. At around 3200 cal B.P., marshlands became much more extensive, and sandbars almost entirely enclosed the embayment. The process of continuing siltation led to further reduction in tidal flow, and expansion of sand bars, mudflats, and marshes continued apace over approximately the next 3 millennia. According to radiocarbon dates recovered from soil cores in the Ballona, the landform had reached an approximation of its recent form—an extensive marsh with a number of shifting water channels penetrating a constricted lagoon—by the eighteenth century A.D., or about 200 cal B.P. The Ballona at that time was cut off from the ocean by sand dunes cut by only a single tidal channel.

Preliminary research (Altschul et al. 2003; Altschul et al. 2007; Douglass et al. 2005) delineated four distinct cultural adaptations associated with particular landscape/lagoon development. The first, between 7850 and 3200 cal B.P., during the Millingstone period, was characterized by short-term occupations on Pleistocene terraces and alluvial fans. The subsequent Intermediate period (3200–930 cal B.P.) witnessed an influx of populations, as evidenced in the widespread distribution of sites on the Pleistocene terraces, at creek edges, and in wetland settings. The Late period (A.D. 950–A.D. 1542) was marked by population decline and aggregation of the remaining population around the wetlands and lagoon. During the historical period, which included the Protohistoric (A.D. 1540–1770) and Mission (A.D. 1771–1834) periods, human settlement expanded once again but was concentrated on the alluvial fans near the wetlands, and there were small, isolated settlements on the Pleistocene terraces.

Pertinent to this settlement model is the timing of the barrier that closed off part of Santa Monica Bay around 4500 cal B.P. That barrier resulted in the creation of the lagoon, which was stabilized by 3200 cal B.P. The lagoon began silting around 1950 cal B.P., however, with sediment from the Ballona Creek and Centinela Creek. It is important to note that the Los Angeles River also contributed to the siltation of the Ballona. The Los Angeles River has changed course over time and has flowed into the Pacific Ocean near either Long Beach or the Ballona at different times (Gumprecht 1999). Archival and geomorphological data indicated that the Los Angeles River discharged into Ballona Creek in prehistory as well as in the historical period. For example, in the late eighteenth and early nineteenth centuries, the Los Angeles River turned southwest after leaving the Glendale Narrows, where it joined Ballona Creek, and discharged into Santa Monica Bay. During a catastrophic flash flood in A.D. 1825, however, the river changed to its current course and flowed due south, just east of present-day downtown Los Angeles, and discharged into San Pedro Bay (Gumprecht 1999:141). That course has been largely stabilized since the river was channelized by the Corps in the late 1930s, although periodic flooding has continued.

A Summary of Human Alterations to the Ballona

Human alteration of the Ballona's natural landscape and biological diversity necessarily began with the earliest human settlement of the region, which had certainly occurred by ca. 6500 B.P., and possibly earlier (cf. Altschul et al. 2003:7–16). Extensive modification of the landscape may have begun some 2,000–3,000 years before the arrival of Spanish missionaries and colonists in the eighteenth century A.D., when Native American settlement of the area had reached its maximum density, by around 1000 B.C. (see Appendix C, Volume 1, this series). At that time, human settlers may have significantly affected plant (and, by extension, animal) communities by burning parts of the landscape to encourage certain plants to thrive while discouraging others (Lewis 1993; Timbrook et al. 1993). In addition, they may have affected some animal species' populations positively or negatively through hunting. It is clear, however, that European and European-derived populations in the area made increasingly permanent, and largely negative, impacts on the estuary. Those impacts began with the transformation of the area into cattle ranches and continued through its use for agriculture in the middle and late nineteenth century.

In the early twentieth century, parts of the area became the playground of recreational hunters and beachgoers, and the railroad was brought in around that time. Originally, railroads were one part of a large development scheme planned for the area, to build a seaside city named Port Ballona. The planned community did not come to be, and the planning implementation left behind partially completed dredging, railroad lines extending through the estuary, and a pier (which was later washed away) as the only testaments to the failed venture. In the 1890s, other, separate projects—the construction of the Venice community and the beginnings (and later expansion) of gas and oil exploration and drilling—made even greater impacts. Subsequently, through the mid-twentieth century and up to the present day, other industries made use of the estuary, including Hollywood film studios and the Hughes Aircraft Company facility and airstrip. Also during the early twentieth century, and up until their forced internment beginning in 1942, Japanese immigrants and/or Japanese-Americans leased much of the Ballona land and utilized it for truck farming of various vegetables that required heavy labor, most notably celery (Altschul et al. 1991:63–84). In addition to truck farming, there is evidence that at least one hog farm (the Kitahata Hog Ranch) was located within the site boundaries of LAN-193 during the 1920s. Historical-period photographs and the identification and analysis of a large refuse deposit containing burned and unburned restaurant ware and other restaurant-related debris suggested that the hog farm contracted with local municipalities and businesses to haul away garbage for use as feed for the ranch's hogs. Between developments, government engineering projects rerouted or channelized Ballona and Centinela Creeks, which had fed the estuary, and Marina del Rey was constructed in the 1960s (see Appendix F, Volume 1, this series).

Contents of Volume 2

This volume is divided into 12 chapters. In Chapter 2, we discuss our chronostratigraphic study, including background, methods, and research objectives; the results of the study are presented in Chapter 3. Chapter 4 details field and laboratory methods used during the PVAHP. Chapter 5 offers a detailed presentation of the feature typology for the PVAHP. In Chapters 6–10, we present site-specific methods and excavation results for LAN-193, LAN-2768, LAN-54, LAN-62, and LAN-211, respectively, organized according to the order in which the sites were excavated, so that the reader can grasp the evolution of our methods and our changing understanding of the archaeological record of the Ballona. Chapter 11 offers information on the SR- sites identified during or after the initial site survey that are not discussed in Chapters 6–10. Finally, Chapter 12 summarizes the volume. Numerous appendixes (in electronic format and numbered by chapter) are presented on an attached CD-ROM, and they include such topics as radiocarbon data for dates run for the PVAHP, obsidian-hydration data, a variety of soil-chemistry data, and individual feature descriptions.

Chronostratigraphy: Background, Methods, and Analytical Approaches

Stacey N. Lengyel, Kathleen L. Hull, Diane L. Douglas, Christopher P. Garraty, Jill A. Onken, Lance Wollwage, and Benjamin R. Vargas

Interpreting the imprint left by human beings on the landscape of the Ballona required us to use an extensive suite of tools and to consider a variety of information. Understanding the physical relationships among cultural materials, the episodes of human occupation at particular locations on the landscape, and the dynamic nature of the physical environment that enveloped those activities are key components to the study we refer to as chronostratigraphy. The tools we use are the cultural materials recovered during excavations, the recorded physical relationships of those materials, and chronometric data pertaining to human use and occupation of the sites we study. In this chapter, we present the methods and analytical approaches we used to deal with the PVAHP chronometric and geomorphic data. We also present a culture history pertaining to the Ballona area specifically and the region in general. Those data are presented as a backdrop for viewing and interpreting the site-specific discussions that follow in the remaining chapters of this volume.

Foremost in this study was the dating of material items deposited as a result of the human activities that formed the archaeological sites. Given the archaeological resources available, we relied heavily on radiocarbon dating as the primary chronometric method. The majority of the dates were derived from marine and freshwater shell, but in a few instances, we were able to date botanical specimens, soil humates, or faunal bone. Together with the chronometric data, we also relied on the sedimentary and pedogenic sequences recorded and described for different locations within each archaeological site. Those records allowed for an understanding of the geomorphic setting of archaeological materials recovered during this project on a site-specific scale that could also be related to larger-scale, regional paleoenvironmental reconstruction (see Volume 1, this series). Artifact analyses and historical documents also provided information about the chronological history of the project area. That was particularly true for the most recent archaeological and historical-period occupations for which artifact types or historical records helped to provide more-precise dates. Archival sources were also particularly useful for understanding much of the twentieth-century disturbance to the sites.

In the sections that follow, we refer to terms that have specific meaning in the context of this study. Many of these terms are common in the archaeological vernacular, where they are often used rather loosely. Because we are relying on specific meanings for these terms, clarification of those meanings is important for understanding.

Archaeological episode: This term refers to site-specific periods of human use and occupation. An episode may represent essentially a single event, a continuous occupation over a long period of time, or episodic use over a prolonged period of time. By definition, episodes are defined temporally and should not be confused with loci, which are spatially discrete episodes of human activity. Archaeological episodes, however, may be both temporally and spatially discrete. Episodes are, by definition, temporally discrete and separated by periods of abandonment indicated by intervening volumes of culturally sterile sedimentary deposits, by significant gaps in the chronological evidence, or by stratigraphic qualities, such as superposition and intrusion.

Archaeological horizon: Conceptually similar to an archaeological episode but defined across the project area landscape, an archaeological horizon represents the contemporary use or occupation of different locations across the project area.

Depositional unit: Defined as a layer of sediment laid down as the result of a uniformly consistent environmental regime, this term is not necessarily synonymous with "soil horizon" or "stratigraphic unit."

Recovery unit: This is a generic term that refers specifically to a defined space, either two or three dimensional, in which archaeological observations were made and from which archaeological materials were recovered. At most excavations, the recovery unit is a sediment volume of 0.1 m^3 (1 × 1 × 0.1 m); however, recovery units of other sizes may also be defined, such as trenches, SUs, and so on.

Soil horizon: Defined as a pedogenic horizon that formed in the sedimentary deposits during periods of stable landforms, this term is not necessarily synonymous with "depositional unit" or "stratigraphic unit."

Stratigraphic unit: This is a sedimentary deposit or pedogenic horizon that is objectively different in characteristics and qualities from adjacent deposits or horizons. It is a vertical unit recognized during fieldwork and used to subdivide archaeological deposits into units. We presume that stratigraphic units have some meaning when subdividing archaeological deposits into a meaningful chronological sequence.

Research Domains and Sampling Strategies

The sampling strategy was devised while taking into account a variety of factors, including, but not limited to, the defined research topics, the portions of the archaeological deposits available for investigation, the limitations imposed by the availability of materials for dating in the excavated samples, the limitations of the various dating methods used, the integrity of the archaeological deposits, our prior understanding of prehistory in the region, and our understanding of the project sites based on our field observations and preliminary studies. In all situations, we applied the concepts of stratified sampling when selecting the contexts and materials most appropriate to achieve the overall project research objectives.

We recognize two primary domains in the chronological studies. Each domain has unique requirements that we tried to meet in the chronological-sampling design. The first domain is archaeological and is here called "the archaeological studies." The objective of the archaeological studies was to define the periods of prehistoric occupation across the Ballona. The second domain includes the geomorphological and paleoenvironmental studies, which are here referred to collectively as "the geomorphological studies." These two research domains are discussed below.

Domain 1: The Archaeological Studies

The greatest proportion of our effort was spent on the archaeological studies. The main objective of these studies was to establish the chronological histories of the project sites. These studies had essentially two phases. In the first phase, we attempted to model the archaeological history of each site, to postulate how many discrete archaeological episodes might be present. In the second phase, we gathered chronological information, to place the archaeological episodes into a historical sequence.

We tried to establish models of the archaeological history of each site through an evaluation of the stratigraphic information we gathered during the course of fieldwork and by studying the vertical distribution of artifacts and features within the site matrices. That information was used to reveal whether we were dealing with homogeneous or uniform deposits or deposits that seemed to have inherent structure. We hypothesized that most sites would reveal an inherent pattern of discrete archaeological episodes distributed vertically within the site matrix. Then, the archaeological episodes would provide the analytical structure that would guide the selection of specimens for radiocarbon dating.

The archaeological episodes were our fundamental analytical units. The consistency of the various lines of chronological evidence available was evaluated within the context of those archaeological episodes. We recognized that analysts and project researchers may ask questions about the age of a specific feature, or of a particular category of features. So, we reserved a particular subset of radiocarbon samples for dating prehistoric features, but the key analytical unit for this study was the archaeological episode.

Domain 2: The Geomorphological Studies

The materials selected with respect to the first domain were culturally deposited materials. That ensured that what we were dating had resulted directly from human activities and that the dates obtained applied directly back to the archaeological episodes. The preliminary chronological evidence, however, indicated that human activities within individual sites and across the project landscape were episodic and that often, large periods of intervening time were not represented. Dating the archaeological episodes and individual features contributes to geomorphological and paleoenvironmental studies, but because large periods of time were not represented in the archaeological materials, additional materials from culturally sterile sedimentary or pedogenic units were also studied.

Other Considerations

In conducting this chronostratigraphic study, we took what may seem an unconventional approach to the interpretation of radiocarbon dates. One of the pressing issues in studying radiocarbon dates is to have a secure foundation of prior expectations of what the dates should be, in order to identify erroneous dates. Given the size of the sample that we selected, we expected to get one or more erroneous dates as a result of nothing else but the fickleness of the probabilistic nature of our methods. Conventionally, dates can be arranged according to level or stratigraphic sequence, to determine whether they are consistent across a level or stratum and are ordered properly from youngest to oldest, with the oldest being the deepest in the deposits. In archaeological contexts, that evaluation of internal consistency is often the strongest evidence we have to conclude that a date or an array of dates is probably an accurate representation of the past.

For all of the archaeological studies, we submitted cultural materials for dating. By doing so, we relieved ourselves of the concern that the dates may represent something other than the human behavior in which we were interested. Ancient human behavior is the most likely and reasonable explanation for the presence of cultural materials in deposits.

We recognize that the archaeological deposits at the project sites have been subjected to many factors that have affected the integrity of the original stratigraphic sequence. Those factors are not limited to natural processes, such as erosion and bioturbation, to name but two, but also to human activities that occurred during the same and subsequent occupation horizons and to the nature and configuration of the landform during the occupations. We assume that there was a fundamental integrity to each deposit and to the depositional sequence, but we should not expect it to be perfect. Thus, we went into this study knowing that there was a reasonable probability that we would discover dates that fell out of stratigraphic sequence or that noncontemporaneous dates might occur at the same horizons.

Thus, although we expected there to be some correlation between the sequence of radiocarbon dates and depths below surface, we did not expect one-to-one correlations. Preliminary evaluation of the first sets of dates collected during fieldwork at LAN-62 Locus A (see Chapter 9, this volume) revealed an imperfect but high correlation between radiocarbon age and depth below surface. That was reassuring but also supportive of the sampling strategy proposed for the project.

Dates, whether chronometric or archaeological, were analyzed as a single array. We used various exploratory techniques to search that array for inherent patterns of distribution, both within sites and across the project area. In preliminary evaluations of the radiocarbon dates at LAN-62 Locus A, we discovered a consistent and replicated pattern in the dates. That pattern suggested a periodicity to the archaeological episodes at the site but also an inherent consistency of the dates, because there were no stragglers or outliers in the distributions. In the end, we relied on the strength-in-numbers mantra to determine which dates, if any, may have been erroneous or anomalies. We feel that we have submitted a large-enough suite of dates from each site to have met our expectations of obtaining distinct groups. Thus, uncorroborated dates were treated as outliers or anomalies.

During this project, dating was to be done by combining absolute-dating techniques—those to which actual calendar dates could be assigned—and relative-dating techniques—those based on the soils and stratigraphy at each of the sites. Most of the absolute dates from the PVAHP were based on radiocarbon dating of shell (which is generally common at most of the sites) and, to a lesser extent, botanical remains, charcoal, soil humates, and faunal bone. Because we wanted to control the quality of the radiocarbon samples, we strove to submit only individual items for dating—a single shell, for example. By not submitting composite samples composed of many items, we avoided the possibility of combining items of potentially very different ages into a single date that would almost certainly have been erroneous. The drawback to submitting single items, though, is finding samples with sufficient amounts of carbon to date (see below for a discussion). As a result, nearly all of the radiocarbon dates were run as accelerator mass spectrometry (AMS) dates. In particular instances, obsidian-hydration or archaeomagnetic (AM) dating was also conducted.

The principal objective of this volume of the PVAHP report is to elucidate the chronological sequence of human occupation and land use in the Ballona and at each of the sites that SRI investigated within the PVAHP project area. We summarize our present understanding of the chronology and set the stage for the diachronic analysis and results presented in the other volumes. The analysts contributing to this volume have reconstructed the chronology and occupation history of the Ballona based on stratigraphic reconstructions, the presence/absence of time-sensitive artifacts, and various chronometric-dating techniques. To understand the archaeological record of human occupation, however, it is also essential to explore and understand the complex depositional history of the Ballona, as well as the adverse impacts that have resulted from historical-period and modern construction and development in the project area. A comprehensive reconstruction of human occupation in the Ballona requires detailed evaluations of not just the archaeological remains but also the complex mix of natural and cultural formation processes that have shaped the archaeological record. In the sections that follow, we discuss, separately, the analytical approaches/issues for this study, the methods used to interpret the complex data set created as a result of the archaeological investigations, impacts to the project area, and the culture history of the Ballona and its relationship to the larger region.

Analytical Approaches and Methods

This section provides a detailed discussion of the methods employed for the chronostratigraphic study undertaken for the PVAHP. It also presents a brief overview of the strengths and limitations of those methods, as well as a discussion of issues with chronometric data that are faced in the larger region. Temporal data for the PVAHP sites were available from a variety of sources, providing complementary data sets to assess the ages of these sites. Radiocarbon assays provide absolute dates that are the most precise information on site chronology, but such data focus on features in which organic remains are preserved, and depending on the variety of features available for such dating, the data could elucidate only limited aspects of use at these sites. Obsidian-hydration data were derived from a variety of feature and nonfeature contexts and provided at least a relative site chronology that could clarify vertical and horizontal stratigraphy. The application of proposed source-specific rate formulas can provide absolute-date estimates for contexts, based on obsidian-hydration analysis. The small size of many obsidian artifacts precluded the geochemical sourcing that was necessary to interpret correctly both relative and absolute applications of that technique. Therefore, only relatively large obsidian artifacts could be included in this analysis, potentially excluding components that might have been represented only by small debitage.

A third source of chronological information is temporally diagnostic artifacts and features. The latter include mortuary features, because mortuary practices are thought to have changed through time in this area of coastal southern California. Temporally diagnostic artifacts included projectile points, cogged stones, discoidals, and shell beads, and beads provided the most abundant and precise data for this region. Historical-period artifacts were recovered from different contexts at several of the sites, and artifacts such as glass beads and bottle bases have proven to be other important chronological tools. Artifact and feature cross-dating is based on extant regional chronologies, however, and is therefore not an independent dating method. In addition, some of the artifacts produced and practices represented by features prevailed for hundreds or even thousands of years. Therefore, for some categories of data, temporal information was much more coarse-grained than the information available from radiocarbon dating or even obsidian-hydration dating.

Radiocarbon Dating

Radiocarbon dating was used for making temporal assessments at all sites in the PVAHP project area. Radiocarbon dating is based on measurement of the decay of radioactive carbon (^{14}C) to stable nitrogen (^{14}N) in organic material, such as shell, wood, and bone. Such carbon is created in the atmosphere by the bombardment of stable nitrogen by cosmic rays, and organisms take in both stable (^{12}C) and radioactive carbon from the environment during their lifetimes. Upon the death of the organism, carbon is no longer taken in, and the ^{14}C already present begins to decay to ^{14}N at a fairly constant rate. Thus, radiocarbon dating measures the ^{14}C remaining in the organic material to determine the amount of time that has elapsed since the death of the organism. The rate of beta-particle emissions that reflect the amount of ^{14}C present is an estimate, however; so, radiocarbon dates are always presented with statistical uncertainty (i.e., a "±" statement of the probability of the actual age falling within the given range) that varies based on factors such as sample size. Small samples require extended counting times or even analysis by AMS rather than standard radiometric techniques.

It has also been recognized that various other factors may alter the abundance or decay rate of radioactive carbon within ancient organic materials. For example, the concentration of radioactive carbon in the ocean is lower than that of the atmosphere. Thus, radiocarbon dates based on analysis of marine organisms must be adjusted for the "reservoir effect" (ΔR)—that is, the availability of radioactive carbon in the particular aquatic environment in which those organisms are found. The reservoir effect will vary based on factors such as coastal upwelling (i.e., influx of deep-sea waters to the surface) and the mixture of saltwater and freshwater in estuaries, both of which can deplete ^{14}C in aquatic settings (see Ingram 1998). In the Playa Vista area, there have likely been significant shifts in ^{14}C activity in prehistory, including varying inputs of freshwater into the Ballona through time. In the San Francisco Bay, Ingram (1998) has documented ΔR values ranging from 870 to –170 ^{14}C years over the last 5,000 years, related in part to El Niño events. There have also been changes in atmospheric ^{14}C through time due to the burning of fossil fuels, nuclear explosions, and additional unknown cosmic or environmental events in prehistory. Therefore, radiocarbon dates for both terrestrial and marine samples are generally "calibrated" using tree-ring data for radiocarbon-dated material. Through these methods, radiocarbon dates can be converted to calendric dates with a corresponding statistical-uncertainty factor.

Existing regional archaeological chronologies rely on uncalibrated dates for charcoal and shell, and the reservoir effect has often been taken into account for dates based on shell. Therefore, the current analysis focuses on conventional (uncalibrated) rather than calibrated radiocarbon dates. Studies of ^{14}C activity in modern surface waters of the Pacific Ocean along the southern California coast have indicated a 220 ± 40 ^{14}C year (ΔR) adjustment for radiocarbon dates derived from shell in that area (Ingram and Southon 1996), although Beta Analytic, Inc. (Beta), applied a correction of 225 ± 35 ^{14}C years for the California coast in general to the current radiocarbon results. For the purposes of discussion, tree-ring calibration of all radiocarbon dates is also provided, because these dates are the most accurate indications of when the site was used. In the sections below, we provide more detailed discussion of the issues surrounding the use of radiocarbon as a chronometric tool, with an emphasis on issues for the region.

Sampling Strategy and Data Acquisition

Throughout the project, our sample-selection strategy was dictated first by available materials and second by the integrity of contexts of interest. Although botanical materials such as charred seeds were our first choice for radiocarbon dating, preservation of those materials was fairly poor, except in a few early-historical-period contexts. Well-preserved cortical bones from mammalian food resources were the second choice in datable materials, but again, availability of appropriate specimens was limited to only a handful of contexts. The vast majority of datable materials recovered from the project consisted of various marine- and estuarine-shell specimens, which is consistent with most projects along the southern California coastline.

From a radiocarbon-science perspective, shell specimens constituted the least-preferred materials for dating, because of the interpretive complications introduced by fluctuating carbon reservoirs and potential interspecies differences in radiocarbon absorption. Whenever possible, paired samples of different materials (i.e., paired shell species or paired terrestrial-estuarine species) were selected to mitigate those problems. Additionally, the majority of shell samples submitted for dating consisted of individual venus clamshells, to increase the consistency and quality of the samples. Venus clams were preferred because they were the most common shell species recovered from all sites and investigated contexts, and typically, the recovered specimens were large enough to allow dating of individual shells. We routinely submitted individual shells rather than composite samples in order to avoid temporal mixing from noncontemporaneous materials and from different species.

Despite the associated radiocarbon problems, shell specimens served as valuable temporal markers for archaeological interpretations via indirect dating of past human activities, because it was assumed that all shell specimens recovered from excavated midden areas or features entered the archaeological record as the byproducts of human activity. Thus, each shell date obtained from a site reflected some human event at that site, regardless of how it related to the recovery context. Of course, the confidence with which a shell date could be linked to a particular recovery context increased proportionally to the number of similar shell dates related to that or adjacent contexts. These assumptions underlay the selection strategy employed throughout the project as well as the chronometric interpretations that developed from the dating results.

Because the excavated portions of the project area exhibited seemingly high levels of bioturbation, and the integrity of many features was questionable, we implemented a multileveled sampling strategy with a "strength in numbers" approach that was carried out in several rounds of sample submission between 2000 and 2008. The bulk of radiocarbon samples were selected from successive levels of CUs at each site, to develop the broad temporal framework for a given site and to identify general periods of human activity at that site. The initial rounds of samples were submitted for dating in 2000 and 2004, and they were selected from upper and lower levels of EUs and from obvious strata changes within those units. The results from the samples provided gross temporal constraints for the respective sites and guided the primary round of sample selection in 2006. Based on the initial radiocarbon results and the vertical distribution of archaeological materials, it was postulated that each site reflected multiple episodes of human occupation. In order to isolate those episodes chronometrically, sample selection targeted CU levels that appeared to form the upper and lower boundaries of vertical artifact distributions, as well as peak levels within each distribution. The results from the samples were coupled with interpolated models of the soil stratigraphy across each site and the vertical distribution of archaeological materials, to develop the gross temporal framework for each site, including the identification of potential archaeological surfaces. In some cases, an additional round of CU samples was submitted to further refine that framework or to clarify questions raised by specific results.

Once the temporal framework was established for each site, samples were selected from individual features to determine how they articulated with the site's chronology. Features were selected for dating based on (1) their position within the modeled stratigraphic framework and presumed association with potential archaeological surfaces; (2) their importance for addressing key research questions; (3) the quality of materials available for dating; and (4) the integrity of the feature. Attempts were made to obtain representative feature dates from each potential archaeological surface, although in some cases, no datable materials where available. Furthermore, the contemporaneity of several spatially clustered features was assessed by preferential selection of samples from multiple features in each group. As with the CUs, additional rounds of samples were submitted from some features in order to clarify questions raised by the preliminary results.

The samples selected for each round of dating were submitted to one of two laboratories. All plant and shell specimens were submitted to Beta, in Miami, Florida, for radiocarbon dating, and the AMS method of analysis was selected for samples submitted after 2005. Many of the shell samples submitted in the early rounds of data acquisition were analyzed radiometrically, with or without extended counting, and in all cases, the stable-carbon ratio ($^{13}C/^{12}C$) was measured. Furthermore, the stable-oxygen ratio ($^{18}O/^{16}O$) was measured for many shell samples submitted in 2006 and 2007. Both stable isotopes ($\delta^{13}C$ and $\delta^{18}O$) were measured on bulk carbonate from crushed shell with ± 0.2‰ precision, and they were reported with respect to PeeDee belemnite (PDB).

Faunal-bone samples were submitted to the Rafter Radiocarbon Laboratory AMS facility in New Zealand for radiocarbon dating. That laboratory dates the purified protein form of collagen (i.e., gelatin), which is extracted by demineralizing a physically cleaned bone to collagen and then denaturing the collagen in a weak acid environment under heat and an inert atmosphere. The gelatin is then filtered with a 0.45 μ Acrodisc filter. In addition, the carbon-to-nitrogen ratio (C:N) was measured for each bone sample, to assess the preservation of the dated collagen. Stable-carbon values ($\delta^{13}C$) were reported with respect to the PDB carbonate standard, VPDB, and measured with ± 0.1‰ precision; stable-nitrogen values ($\delta^{15}N$) were reported with respect to N-Air and measured with ± 0.3‰ precision. Samples with C:N ratios greater than 3 were considered to have sufficiently preserved collagen for dating.

Carbon Reservoirs, Radiocarbon Variability, and Apparent Ages

Because the bulk of radiocarbon measurements obtained for this project were made on marine and estuarine shells, we had to consider the effects that fluctuations in the respective carbon reservoirs would have on the samples' apparent ages. Unlike terrestrial organisms, which are in equilibrium with atmospheric carbon, both marine and estuarine shellfish incorporate radiocarbon from dissolved inorganic carbon in water (Tanaka et al. 1986). That has implications for radiocarbon science because the carbon reservoirs that those organisms draw on tend to be depleted in comparison to radiocarbon activity in the atmosphere, leading to older radiocarbon apparent ages.

For marine organisms, that depletion is due in large part to the longer residence times and slower mixing rates of the deep oceans, which act as a significant carbon sink in the global carbon cycle. Whereas carbon has a relatively short residence time (1–2 decades) in the atmosphere, the residence time of carbon in the deep oceans is on the order of 1,000 years (Sigman and Boyle 2000). This means that it takes roughly 1,000 years for a carbon atom entering the ocean reservoir to return to the atmosphere through exchange. Oceanic surface waters, where marine shellfish live, contain a mix of newer carbon obtained from the atmosphere through gaseous exchange and older carbon upwelled from the deep ocean reservoir; consequently, the reservoir age (R[t]) of oceanic surface water, on average, lags the atmospheric reservoir by roughly 400 radiocarbon years (Stuiver and Braziunas 1993). Furthermore, because the world's oceans are not uniformly mixed (e.g., geographic differences in circulation and upwelling patterns), significant regional and local variances (ΔR) from the global marine offset can occur (Ingram and Southon 1996; Stuiver et al. 1986). In areas where older, deep ocean water is upwelled, the radiocarbon content of the surface waters is depleted, and the local reservoir offset is increased with respect to the global average, producing a positive ΔR value (Goodfriend and Flessa 1997). Decreased local offsets and negative ΔR values occur in areas with strong inflows of better-equilibrated, radiocarbon-rich water (Silar 1980). Finally, a number of recent studies have demonstrated that these local reservoir effects are not constant and can vary over time, as well (e.g., Ascough et al. 2004; Austin et al. 1995; Kennett et al. 1997; Roark et al. 2003; Siani et al. 2001). Accurate calibration of marine-shell radiocarbon apparent ages to calendar dates requires that the variances be accounted for.

The reservoir effect in estuarine environments is complicated by the temporally variable mixing of marine and freshwater carbon. Unlike marine sources, radiocarbon concentrations in freshwater sources such as rivers and lakes are typically depleted with respect to the atmosphere because of factors such as dissolved old carbon from geologic sources (e.g., limestone) and slow gaseous-exchange rates (Broecker and Walton 1959; Geyh et al. 1998). Depending on the amount of radiocarbon-depleted (i.e., old) carbon dissolved in groundwater, the reservoir effect associated with freshwater sources can be several hundred to several thousand years old (see Broecker and Walton 1959). Thus, substantial influxes of carbon-depleted freshwater can significantly increase the local reservoir effect in estuarine environments, leading to considerably older apparent ages for estuarine shellfish. That is particularly true for river-dominated estuaries with high levels of hard-water input. On the other hand, estuarine systems dominated by better-equilibrated freshwater may be characterized by lower reservoir offsets than adjacent marine systems, with the consequence that the apparent ages for estuarine shellfish will be younger than those of coeval marine specimens.

In tidally dominated estuaries, freshwater sources contribute proportionally little radiocarbon to the local reservoir, and the overall radiocarbon concentration may be similar to that found in adjacent marine environments (Hogg et al. 1998). In both river- and tide-dominated systems, however, the estuarine radiocarbon concentration reflects a proportional mix of the contributing sources and is not identical to one or the other. Furthermore, radiocarbon concentrations will vary spatially within the estuary depending on proximity to the water source. Theoretically, if the contributing proportion and radiocarbon concentration of each source are known, a mixed calibration curve can be derived with which to calculate calendar ages for estuarine-shell samples. In practice, however, the parameters governing estuarine carbon reservoirs can be extremely complex, and end-member radiocarbon concentration is rarely known empirically. As with marine-reservoir offsets, the local estuarine reservoir effect should be established indirectly from radiocarbon measurements on shell specimens of known age.

Local ΔR Calculations

A review of the literature failed to reveal previously calculated reservoir corrections for the Ballona Lagoon and Marina del Rey areas; thus, determining the reservoir corrections for those areas became an important research goal for the current study. Following standard practice (Ingram and Southon 1996; Reimer et al. 2002; Stuiver and Braziunas 1993), we sought to determine the local offset by comparing the radiocarbon ages of presumably contemporaneous (i.e., paired) terrestrial and aquatic samples, and our sampling strategy prioritized paired terrestrial-aquatic samples from single contexts accordingly. Furthermore, given the documented temporal variability in localized reservoir offsets, we attempted to obtain representative paired samples from throughout the Holocene. In the end, however, only three contexts in the project area (see Chapter 3, this volume) produced paired terrestrial-aquatic samples, and the results from one of those pairs suggested temporal mixing.

Following Stuiver and Braziunas (1993), the ΔR determination was calculated for each sample pair by converting the pair's terrestrial conventional date to an equivalent, or model, marine radiocarbon age and then deducting that equivalent age from the shell's conventional date. The model marine radiocarbon age was determined by finding the intersection of the terrestrial conventional date, plus and minus one standard deviation, with the atmospheric calibration data set (Reimer et al. 2004) and then finding the equivalent marine radiocarbon ages (i.e., conventional, or apparent, ages) from the modeled marine data set (Hughen et al. 2004) for the maximum and minimum calibration data points (Reimer et al. 2002). The midpoint of the model marine age was subtracted from the fractionation-corrected shell date to obtain ΔR. The model marine age obtained in this way for the terrestrial sample reflects the equivalent global surface ocean age of the radiocarbon activity measured in the terrestrial sample. The difference between this model marine age and the actual radiocarbon activity measured in the paired shell sample (ΔR) reflects the local reservoir offset from the global average. The error associated with ΔR was derived from the spread in the marine model age and the reported error in the measured shell age, and it was calculated by taking the square root of the sum of the squared error terms (Reimer et al. 2002). When two or more paired samples were recovered from a single context, a weighted mean ΔR was calculated from the individual ΔR determinations.

The specifics of the samples involved in these calculations and the resulting ΔR values are discussed in the following chapters, where chronometric data are presented, although the ΔR values are given here as well. As stated above, only two of the three contexts that produced paired terrestrial-aquatic samples produced seemingly viable ΔR determinations, and each pertained to a different time period. First, a ΔR of -85 ± 40 radiocarbon years was calculated for two shells from LAN-193 with an associated marine model date of 2600 ± 40 B.P. (390–200 cal B.C.)—very similar to the ΔR value of roughly –40 ± 110 that has been documented for the Santa Barbara Channel islands during that time (ca. 3000–2000 cal B.P.) (Kennett et al. 1997).

The second ΔR value (165 ± 35) was derived from two shells recovered from LAN-62 Locus A/G with an associated marine model date of 910 ± 28 B.P. (cal A.D. 1410–1470). As with the first ΔR value, this value is only slightly less than the average 220 ± 40 ΔR value proposed for that area in the late Holocene (Ingram and Southon 1996). Together, the two ΔR values calculated for the project area suggest that the Ballona Lagoon carbon reservoir tracked the regional marine reservoir fairly closely in the mid- to late Holocene.

Tracking Reservoirs through Stable Isotopes

Because we were only able to calculate local reservoir offsets for two temporal points within the total period of human activity documented for the project area, we had to find another means of identifying appropriate reservoir corrections for our data set. Ideally, that would have involved calculating a mixed calibration curve derived from proportional mixing of the two contributing carbon reservoirs: seawater and river discharge; however, the complexity of the endeavor and the large number of unquantifiable parameters precluded that approach. Instead, we opted for the simpler approach of identifying the predominant carbon contributor at different points over the course of prehistory in the area and applying the associated reservoir correction. A comparison of the average total reservoir correction for southern California (R[f]~620 radiocarbon years) (Ingram and Southon 1996) with the average reservoir corrections calculated for various freshwater bodies in central and southern California (R[f]~300–350 radiocarbon years) (Berger and Meek 1992; Culleton 2006; Sutton and Orfila 2003) indicated that in extreme cases, our corrected radiocarbon ages could be off by as many as 300 years. To reduce that potential error, we turned to the isotopic composition of shell to help identify whether the organisms grew within an environment predominated by seawater and its associated carbon reservoir or by freshwater.

A number of recent studies have demonstrated that stable-carbon and oxygen isotopes from bivalve-mollusk shells can be used to track paleosalinity and stream flow within estuarine environments (Dettman et al. 2004; Halley and Roulier 1999; Ingram, Conrad, and Ingle 1996; Ingram, Ingle, and Conrad 1996a, 1996b; Latal et al. 2004). Although those studies were aimed at reconstructing paleoenvironments, it is not a stretch to extend the technique for our purposes. Oxygen isotopes, in particular, have been shown to track changes in salinity—and thus influxes of freshwater—closely, in large part because the $\delta^{18}O$ of freshwater (~ –3.0‰–20.0‰) tends to be much more negative than that of seawater (~0 ppm) (Rozanski et al. 1993). Recent measurements of $\delta^{18}O$ in westward-flowing groundwater in the Los Angeles Basin range from roughly –7.0‰ to –9.0‰ (Milby et al. 2003) with respect to the Vienna Standard of Mean Ocean Water (Gonfiantini 1984), and the isotopic composition of groundwater recharged in the Los Angeles Forebay ranges from –6.7‰ to –7.5‰ (Land et al. 2004). Furthermore, the isotopic composition of the Los Angeles River measured near Long Beach ranged from –6.26‰ to –11.41‰ over a 4-year period (1984–1987). Those measurements were only slightly less negative than the values reported for the Colorado River ($\delta^{18}O$ = –12.0‰) (Dettman et al. 2004; Schone et al. 2003) and the Sacramento–San Joaquin drainages ($\delta^{18}O$ = –11.6‰) (Ingram, Ingle, and Conrad 1996a), which factored into the paleosalinity projects after which this study is modeled. In both of those study areas, the average $\delta^{18}O$ values of individual mollusk shells (measured with respect to the VPDB) were shown to correlate very well (r^2 = 0.90) (Ingram, Conrad, and Ingle 1996:462) to $\delta^{18}O$ values in ambient water, and shifts between the two values were due primarily to temperature-induced fractionation. Thus, shellfish growing in a river-dominated system should exhibit more negative (i.e., lighter) oxygen values than those growing in a seawater-dominated system.

For their isotopic work in the San Francisco Bay, Ingram, Ingle, and Conrad (1996a; Ingram, Conrad, and Ingle 1996) derived the following relation between the $\delta^{18}O$ value of mollusk-shell carbonate and the $\delta^{18}O$ value of ambient water (Ingram, Conrad, and Ingle 1996:462):

$$\delta^{18}O_{water} = 0.84(\delta^{18}O_{shell}) - 0.36$$

They also derived an equation to calculate the average ambient salinity from $\delta^{18}O$ values recorded in mollusk carbonate shells (Ingram, Ingle, and Conrad 1996a:Eq 2):

$$\text{Salinity} = \{2.94\ \delta^{18}O_{carbonate} - (T°C - 16.9)/ -1.43\} + 34.12$$

where T°C is the average annual water temperature for the particular locality. Together, these equations provide a means to evaluate the salinity and relative $\delta^{18}O$ values of the estuarine water within which individual shellfish lived, and they were used in this study to assess whether an individual dated shellfish derived from a predominantly seawater- or river-water-dominated environment.

In all, we obtained $\delta^{18}O$ values for 58 of our dated shells, including 5 olivella beads and 2 abalone shells, both of which are open marine species. Although many paleoenvironmental studies incrementally sample shells parallel to growth axes in order to reconstruct isotopic growth curves over an organism's life (e.g., Culleton et al. 2006; Goodwin et al. 2001; Schone et al. 2003), we lacked the resources to pursue such high-resolution measurements. Instead, the stable-oxygen ratio ($^{18}O/^{16}O$) was measured on bulk carbonate from crushed individual shells with ± 0.2‰ precision and was reported as $\delta^{18}O$‰ relative to PDB. Because marine and estuarine mollusks deposit calcium carbonate throughout their lifetime, the bulk $\delta^{18}O$ values provide average measurements over the course of the organism's life. Thus, they may relate better to the radiocarbon measurement obtained from the same specimens, because those measurements were obtained on bulk carbonate, as well, and provide an average measurement of radiocarbon uptake by the organisms. The equations from Ingram, Ingle, and Conrad (1996a, 1996b; Ingram, Conrad, and Ingle 1996) reported above were applied to the $\delta^{18}O$ values derived from estuarine shells (i.e., not abalone or olivella), to obtain the estimated $\delta^{18}O$ and salinity values for respective ambient water (Table 2). The results indicated that the $\delta^{18}O$ of water varied between roughly 0.48‰ and –3.38‰ for the 51 analyzed estuarine-shell samples, with a mean value of –0.74‰. Salinity values derived from these results ranged between 36.93‰ and 23.41‰, with an average of 31.93‰. These salinity values were calculated using the average daily temperature of 16.72°C that was measured at the Santa Monica station between 1955 and 2001 (U.S. Department of Commerce 2008), and the average estimated salinity value for this data set is fairly similar to the 26-year average of 34.15‰ that was measured for Santa Monica Bay between 1956 and 1979. The measured salinity values for that period ranged between 27.3‰ and 41.7‰, although 95 percent of the values ranged between 33.0‰ and 35.8‰. These measured values for Santa Monica Bay encompass virtually all of the estimated salinity values from this data set, although the estimated values trend slightly less saline than the measured Santa Monica Bay values. The estimated salinity values can be converted to percent-freshwater estimates by dividing the average Santa Monica Bay value and subtracting from one:

$$\text{Percent Freshwater} = (1 - (\text{Salinityestimated}/34.0))*100$$

Obviously, the resulting values (see Table 2) only provide estimates of the relative freshwater contribution to each organism's ambient environment, but overall, these estimates suggest that the analyzed shellfish lived in seawater-dominated environments. Furthermore, as Figure 6 illustrates, there was no quantifiable spatial or temporal patterning to the fluctuations in estimated salinity; 95 percent of the estimated values plotted above 27.0‰, regardless of recovery locale or measured radiocarbon age. All three values that plotted below 27.0‰ salinity were obtained on venus clamshells recovered from LAN-62 Locus A/G, and it seems likely that those three shells incorporated radiocarbon derived from relatively fresher water than did the rest of the data set. Seven additional organisms appeared to have lived in environments consisting of roughly 10 percent or more freshwater, and all but two of those specimens were venus clams, as well. However, the relatively low percent-freshwater contributions estimated for these organisms (less than 20 percent for all but three specimens) suggests that the use of the local marine-reservoir corrections in addition to the estuarine corrections calculated here will provide realistic age estimates for these specimens. In fact, a simple, linear mixing calculation suggests that the average error introduced by applying the marine correction to most of these specimens without accounting for the freshwater contribution will be less than roughly 60 radiocarbon years:

$$\text{Age Error} = R(f)_{seawater} - \{0.20\ (R[f]_{freshwater}) + 0.80\ (R[f]_{seawater})\}$$

where the average freshwater reservoir effect is roughly 325 radiocarbon years (Culleton 2006), and the average total regional seawater reservoir effect is approximately 620 radiocarbon years (Ingram and Southon 1996).

One last value can be obtained from the open marine species incorporated in this study. Because abalone and olivella live in seawater, the $\delta^{18}O$ values obtained from those species track water temperatures rather than salinity (Goodwin et al. 2001). Thus, these specimens can be used to examine how sea-surface temperatures from roughly the last 650 years compare to the average temperature measured for Santa Monica Bay since 1955. That information is important because the salinity values derived above are temperature-dependent. The $\delta^{18}O$ values measured in shell can be converted to temperature values through the temperature equation utilized by Goodwin et al. (2003:111) (modified from Grossman and Ku 1986):

$$\text{Temperature} = 20.6 - 4.34\ (\delta^{18}O_{shell} - [\delta^{18}O_{water} - 0.2])$$

Table 2. Salinity and δ18O Values of Ambient Water Calculated from Estuarine-Shell Samples

Site No.	Material	Sample No.	Corrected Age (B.P.)	$\delta^{18}O_{shell}$ (‰)	$\delta^{18}O_{water}$ (‰)	Salinity (‰)	Percent Freshwater
LAN-54	littleneck clam	Beta-224055	2770 ± 40	–0.8	–1.03	31.64	6.93
LAN-54	littleneck clam	Beta-224057	2790 ± 40	–0.8	–1.03	31.64	6.93
LAN-54	venus clam	Beta-224053	3100 ± 40	–1.1	–1.28	30.76	9.53
LAN-54	venus clam	Beta-224056	3830 ± 40	–1.9	–1.96	28.41	16.45
LAN-54	venus clam	Beta-224054	3840 ± 40	–0.9	–1.12	31.35	7.80
LAN-54	venus clam	Beta-224058	3880 ± 50	–0.7	–0.95	31.94	6.07
LAN-62 Locus A/G	littleneck clam	Beta-234670	1590 ± 40	–0.8	–1.03	31.64	6.93
LAN-62 Locus A/G	littleneck clam	Beta-231978	2710 ± 50	–0.7	–0.95	31.94	6.07
LAN-62 Locus A/G	littleneck clam	Beta-231975	4290 ± 40	–0.7	–0.95	31.94	6.07
LAN-62 Locus A/G	oyster	Beta-234673	1060 ± 40	–0.8	–1.03	31.64	6.93
LAN-62 Locus A/G	pismo clam	Beta-238392	2950 ± 40	–0.1	–0.44	33.70	0.88
LAN-62 Locus A/G	pismo clam	Beta-230291	4670 ± 40	–0.2	–0.53	33.41	1.75
LAN-62 Locus A/G	scallop	Beta-234671	1780 ± 40	0.2	–0.19	34.58	–1.71
LAN-62 Locus A/G	scallop	Beta-231980	1970 ± 40	–0.1	–0.44	33.70	0.88
LAN-62 Locus A/G	scallop	Beta-231973	1980 ± 40	0.9	0.40	36.64	–7.77
LAN-62 Locus A/G	scallop	Beta-231971	910 ± 40	–0.8	–1.03	31.64	6.93
LAN-62 Locus A/G	scallop	Beta-234672	950 ± 40	0.2	–0.19	34.58	–1.71
LAN-62 Locus A/G	shell	Beta-188625[a]	4250 ± 100	1.0	0.48	36.93	–8.63
LAN-62 Locus A/G	venus clam	Beta-234674	1200 ± 40	–0.7	–0.95	31.94	6.07
LAN-62 Locus A/G	venus clam	Beta-231972	1790 ± 40	–0.5	–0.78	32.52	4.34
LAN-62 Locus A/G	venus clam	Beta-230290	1890 ± 40	–1.1	–1.28	30.76	9.53
LAN-62 Locus A/G	venus clam	Beta-188969[a]	2160 ± 80	–0.8	–1.03	31.64	6.93
LAN-62 Locus A/G	venus clam	Beta-231970	2200 ± 40	–0.5	–0.78	32.52	4.34
LAN-62 Locus A/G	venus clam	Beta-231974	2230 ± 40	–1.0	–1.20	31.05	8.66
LAN-62 Locus A/G	venus clam	Beta-188334[a]	2690 ± 50	–3.6	–3.38	23.41	31.15
LAN-62 Locus A/G	venus clam	Beta-231977	2920 ± 40	–0.8	–1.03	31.64	6.93
LAN-62 Locus A/G	venus clam	Beta-231969	3030 ± 40	–0.7	–0.95	31.94	6.07
LAN-62 Locus A/G	venus clam	Beta-188333[a]	3100 ± 60	–3.0	–2.88	25.17	25.96
LAN-62 Locus A/G	venus clam	Beta-188335[a]	4270 ± 70	–2.8	–2.71	25.76	24.23
LAN-62 Locus A/G	venus clam	Beta-231976	4390 ± 40	–0.2	–0.53	33.41	1.75
LAN-62 Locus A/G	venus clam	Beta-230292	4410 ± 40	–0.9	–1.12	31.35	7.80
LAN-62 Locus A/G	venus clam	Beta-231981	4570 ± 40	–0.6	–0.86	32.23	5.21
LAN-62 Locus A/G	venus clam	Beta-234675	6450 ± 60	—	–0.36	33.99	0.02
LAN-62 Locus A/G	venus clam	Beta-231979	930 ± 40	–1.1	–1.28	30.76	9.53
LAN-62 Locus A/G	venus clam	Beta-188968[a]	980 ± 70	–0.8	–1.03	31.64	6.93
LAN-62 Locus A/G	venus clam	Beta-188967[a]	980 ± 80	0.9	0.40	36.64	–7.77
LAN-62 Locus C/D	pismo clam	Beta-190480[a]	4630 ± 70	–0.5	–0.78	32.52	4.34
LAN-62 Locus C/D	scallop	Beta-190481[a]	4410 ± 110	–0.4	–0.70	32.82	3.48
LAN-62 Locus C/D	venus clam	Beta-230296	1050 ± 40	0.1	–0.28	34.29	–0.85
LAN-62 Locus C/D	venus clam	Beta-191109[a]	1240 ± 40	–1.3	–1.45	30.17	11.26
LAN-62 Locus C/D	venus clam	Beta-230295	880 ± 40	–0.4	–0.70	32.82	3.48
LAN-193	oyster	Beta-230285	2500 ± 40	–1.1	–1.28	30.76	9.53
LAN-211	littleneck clam	Beta-230288	2120 ± 40	–0.6	–0.86	32.23	5.21
LAN-211	littleneck clam	Beta-230287	2230 ± 40	–0.5	–0.78	32.52	4.34
LAN-211	scallop	Beta-230286	660 ± 40	–0.3	–0.61	33.11	2.61
LAN-2768	littleneck clam	Beta-230289	2650 ± 40	–0.6	–0.86	32.23	5.21
LAN-2768	littleneck clam	Beta-230293	2740 ± 40	–0.1	–0.44	33.70	0.88
LAN-2768	littleneck clam	Beta-230294	2880 ± 40	–0.7	–0.95	31.94	6.07
LAN-2768	scallop	Beta-231607	2670 ± 40	–1.8	–1.87	28.70	15.58
LAN-2768	scallop	Beta-230910	2460 ± 40	–0.5	–0.78	32.52	4.34
LAN-2768	venus clam	Beta-231606	2550 ± 40	–0.8	–1.03	31.64	6.93

[a] Samples measured radiometrically, with extended count.

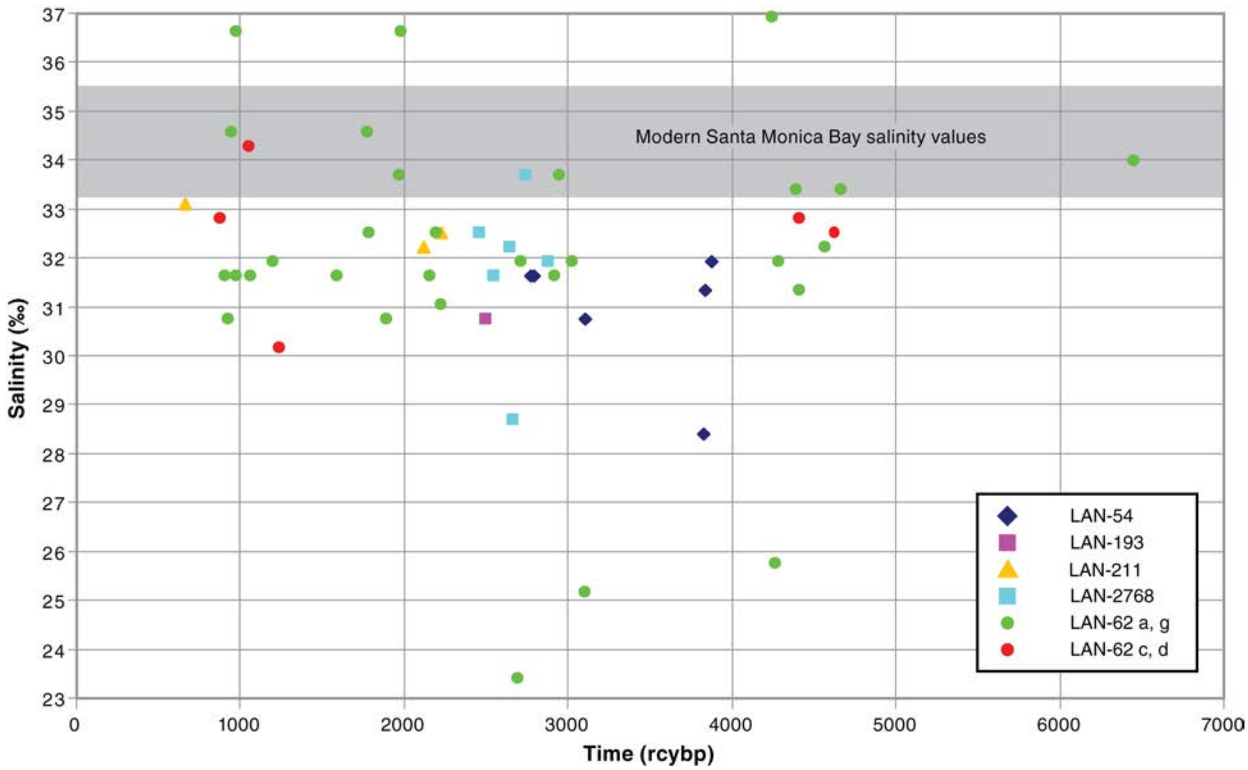

Figure 6. Graphic plot of the temporal distribution of ambient-water salinity values estimated from estuarine-shell samples, broken down by site and depicted against the modern salinity values from Santa Monica Bay, for reference.

Table 3. Temperature $\delta^{18}O$ Values of Ambient Water Calculated from Marine-Shell Samples

Site No.	Material	Sample No.	Corrected Age (B.P.)	$\delta^{18}O_{shell}$ (‰)	$\delta^{18}O_{water}$ (‰)	Temperature (°C)
LAN-62 Locus A/G	abalone	Beta-238866	870 ± 40	–0.3	–0.61	22.77
LAN-62 Locus A/G	abalone	Beta-238870	1130 ± 40	0.6	0.14	18.86
LAN-62 Locus A/G	olivella	Beta-238869	860 ± 40	0.3	–0.11	20.17
LAN-62 Locus A/G	olivella	Beta-238865	900 ± 40	0.1	–0.28	21.03
LAN-62 Locus A/G	olivella	Beta-238868	930 ± 40	0.6	0.14	18.86
LAN-62 Locus A/G	olivella	Beta-238391	970 ± 40	–3.4	–3.22	36.22
LAN-62 Locus A/G	olivella	Beta-238867	1090 ± 40	0.3	–0.11	20.17

where the $\delta^{18}O$ of ambient seawater is assumed to be roughly zero. The results from this equation (Table 3) suggested that average surface temperatures may have been higher than present values, with all but one of the temperature estimates ranging between 18.86°C and 22.77°C. The seventh estimate (36.22°C) seems unusually high for this area, and the fact that it was obtained on an olivella bead suggests that the shell may have originated elsewhere, because olivella beads were traded widely (see Chapter 3, this volume, for more details). If the average temperature of roughly 20°C obtained for the other six specimens is applied to the salinity calculations for the estuarine specimens, the average salinity for the data set shifts to 34.22‰, with 95 percent of the values greater than 29.38‰. It is difficult to know whether the average temperature estimated from the marine samples accurately reflects the water temperature of the Ballona Lagoon for that time period, particularly because those temperatures were estimated from beads, which most likely originated elsewhere, because there was no evidence of production of beads at PVAHP sites, and the shell does not naturally occur in the local area today. It is promising, though, that these data support the assertion of relatively high salinity and, by extension, a seawater-dominated environment. Therefore, we have chosen to apply the local marine reservoir correction, ΔR, to all estuarine samples for periods that are not associated with the local estuarine ΔR values calculated through this study.

Spatial and Temporal Variability in ΔR along the California Coastline

A number of studies have demonstrated that the ΔR for different portions of the California coastline varied throughout the Holocene (e.g., Ingram 1998; Kennett et al. 1997; Roark et al. 2003), with some periods marked by lower-than-modern values and other periods marked by higher-than-modern values. These periods correlate to fluctuations in coastal circulation patterns throughout the Holocene, with the higher ΔR values corresponding to periods of deep-water upwelling events and the lower ΔR values likely reflecting an increase in the flow of younger water to the region (Roark et al. 2003).

The middle Holocene (ca. 8000–2000 cal B.P.), in particular, appears to have exhibited fairly stable circulation patterns and correspondingly stable ΔR values. In the Santa Barbara Channel, the early part of the period (ca. 8000–4000 cal B.P.) was marked by slightly less-than-modern ΔR values (~210 ± 80), whereas the latter half (ca. 4000–2000 cal B.P.) exhibited significantly lower ΔR values (~40 ± 110) (Kennett et al. 1997). Undoubtedly, there were spikes of increased ΔR values during that time, as well, as indicated by intrashell measurements documented by Culleton et al. (2006:392–393) for a 3,500-year-old sea mussel from Daisy Cave. The work of these authors suggests that the period of roughly 4000–3000 cal B.P. was marked by rapid shifts in upwelling intensity, which would have led to highly variable ΔR values on the order of roughly 400 ± 50 to –50 ± 100.

Combining these values with the locally derived ΔR value for the Ballona Lagoon, we have identified three periods with different associated reservoir corrections. First, the ΔR value of 210 ± 80 is applied to all measured shell dates that fall between roughly 8500 and 4200 B.P. (ca. 8000–4000 cal B.P.). Second, measured shell dates that fall between roughly 4200 and 3300 B.P. (ca. 4000–3000 cal B.P.) are corrected with two different ΔR values (400 ± 50 to –50 ± 100), to account for the documented variability within that period, and both corrected dates are reported for that period. Third, the ΔR value of –40 ± 110 is applied to open-marine-shell (i.e., abalone and olivella) dates between 3100 and 2400 B.P. (ca. 3000–2000 cal B.P.), whereas the local ΔR value of –85 ± 40 is applied to estuarine-shell dates of the same age.

The late Holocene (ca. 2000 cal B.P. to the present) appears to exhibit fairly stable ΔR values, as well; however, on average, those values are higher than in the preceding period (Ingram 1998; Roark et al. 2003) and roughly equivalent to modern values (220 ± 40) (Ingram and Southon 1996). Again, some variability in ΔR values on a seasonal or annual basis undoubtedly has occurred during this period, as reflected by intrashell variability for modern sea-mussel shells (Culleton et al. 2006). Therefore, dates obtained on open-marine species from this period are corrected with both the average ΔR value for the period and a maximum ΔR value of 450 ± 40, which is reflective of possible upwelling activity. Estuarine shells from this period are corrected with the local ΔR value of 165 ± 35.

Table 4. Alternate ΔR Values Applied to Each Time Period

Time Period (RCYBP)	Alternate ΔR
2000–0 B.P.	165 ± 35 (estuarine); 450 ± 40 (marine)
3100–2400 B.P.	–85 ± 40 (estuarine); –40 ± 110 (marine)
4200–3300 B.P.	400 ± 50; –50 ± 100
8500–4200 B.P.	210 ± 80

Calibration to Calendar Dates

All radiocarbon determinations obtained for the project were calibrated via OxCal (v. 3.10), using either the terrestrial data set IntCal04 (Reimer et al. 2004) or the marine data set Marine04 (Hughen et al. 2004). In addition, determinations on shell samples were corrected for local shifts in the carbon reservoir by applying the standard modern ΔR value for the southern California coast of 220 ± 40 (Ingram and Southon 1996) to the marine data set. The use of this average ΔR value allows comparison between the dates obtained for this project and calibrated shell dates derived from other southern California projects, as well as the establishment of regional chronologies. The shell dates calibrated with this standard ΔR value provided baseline age estimates for associated contexts.

Furthermore, the diachronic variability in ΔR values was accounted for by deriving alternate calibrated dates for each shell sample using the ΔR value appropriate for the respective period (Table 4). These dates are presented alongside the standard calibrated dates (i.e., ΔR = 220 ± 40), to provide reasonable age estimates for individual samples, given our current understanding of regional reservoir changes. The timing and duration of occupation episodes were estimated from both the age-specific and baseline dates. The former values provided realistic and accurate age estimates, given our current understanding of how the local carbon reservoir has changed through time, whereas the latter values facilitated comparisons with data from other regional projects and chronologies.

Defining Occupation Episodes

Given the diachronic marine-reservoir changes and the uncertainty associated with the marine-derived calibration dates, it seemed prudent to conduct analyses at the group, rather than sample, level. First, the radiocarbon data set from each site was divided into general analytical groups based on gaps or breaks in the temporal distribution of the site's apparent (i.e., uncalibrated) radiocarbon ages. For that exercise, terrestrial radiocarbon ages were converted to marine equivalent ages using the same calculations applied for ΔR calculations. Then, the range of included radiocarbon ages was compared to the documented apparent age range exhibited by known contemporaneous shells, to ascertain whether the group fell within documented limits for a single period or more probably reflected multiple time periods. Finally, the validity and cohesion of the general groups were evaluated statistically, potential subgroups were identified within these groups when possible and appropriate, and the probable temporal gaps between groups were modeled. In all cases, a conservative approach was taken, such that statistically different shell samples would be included in the same group if their radiocarbon-age differences fell within the documented range for contemporaneous shells (see below). Furthermore, although subgroups were identified for a few of the larger episodes, the division between temporally adjacent subgroups was somewhat arbitrary, as indicated by the temporal overlap and statistical similarity of dates assigned to separate subgroups, and these subgroups should not be taken as discrete periods of human activity. The subgroups function simply as placeholders for recognized but indefinable occupations within a defined episode, and they were created for temporally expansive sets of data with no statistically supportable breaks.

Radiocarbon Variability of Coeval Shellfish

Several studies (Anderson 1991; Culleton et al. 2006; Forman and Polyak 1997; Hogg et al. 1998; Ingram and Southon 1996) have demonstrated that contemporaneous shells from different species of mollusk can exhibit seemingly different radiocarbon ages, particularly for estuarine organisms. Ingram and Southon (1996) found differences of 450–1,100 radiocarbon years between different fossil mollusk species collected from the same stratigraphic levels; some of the largest age differences occurred between macoma specimens and either oyster or blue mussel shells. The authors theorized that the variability may be due in part to differences in feeding modes (deposit versus filter feeding) and to seasonal differences in growth (e.g., winter versus spring and fall). In a different study, Hogg et al. (1998) compared the radiocarbon activity measured in modern, coexisting mollusk shells collected from estuarine environments, open-marine intertidal environments, and open-marine subtidal environments. They found that some species produced statistically different measurements from those of coexisting species within single environments; they also found statistical differences between measurements from open-marine intertidal organisms and organisms from either estuarine or open-marine subtidal environments. They attributed the documented variability to feeding-mode differences and increased aeration from intensive wave action in intertidal environments.

In contrast, Ascough et al. (2005) found no statistical differences in radiocarbon ages obtained from five different mollusk species recovered from an archaeological site in Scotland. The analyzed species occupied different ecological niches and utilized different modes of feeding, and the authors concluded that the lack of measurable variability was due to the fact that no large-scale sources of carbon were present, such as carboniferous rocks or significant freshwater input. They did, however, find some statistical differences within species, and they suggested that if all same-species individuals were coeval, those differences may reflect different life environments. The radiocarbon ages obtained from the individual specimens differed by as much as 250 years.

Likewise, Ingram and Southon (1996) and Culleton et al. (2006) demonstrated that significant age differences can occur between coeval specimens of the same species and even between growth bands from an individual organism. In the former study, radiocarbon determinations obtained on four contemporaneous modern mussel shells collected from San Francisco Bay in 1939 exhibited a span of 290 radiocarbon years and were found to be statistically different ($df = 3$; T = 11.06; $\chi^2_{0.05} = 7.8$). In the latter study, four radiocarbon measurements were obtained from a single incrementally sampled modern mussel shell (Museum No. 431902) collected from Santa Barbara in 1936 (Culleton et al. 2006). The measurements spanned 240 radiocarbon years and failed a standard χ^2 test ($df = 3$; $T = 10.4$; $\chi^2_{0.05} = 7.8$), indicating that significant variability in ΔR values can occur over the life of an organism. Based on the variability documented by these previous studies, sets of radiocarbon dates from the current study that differed by up to 300 years were treated as roughly contemporaneous, even if they were found to be statistically different.

Statistical Methods

Both a χ^2 test and OxCal's Combine function were utilized to evaluate the measurable variability in apparent groups of radiocarbon dates. The χ^2 test assesses whether the internal variability of a group is consistent with the errors on the individual measurements, but it does not take into account variability within the calibration curve (Ward and Wilson 1978, 1981). That added dimension was evaluated through the agreement indices associated with OxCal's Combine function (Bronk Ramsey 2005). The Combine function calculates a mean probability distribution for a group from the individual probability distributions associated with the included radiocarbon determinations, and an agreement index is calculated for each radiocarbon determination that reflects how well it matches the group mean. Each probability distribution provides the relative probability that an event (e.g., death of the organism) occurred at a particular time, and the total distribution represents the 2σ calibration range for the associated radiocarbon determination. Perfect agreement between the individual and mean probability distributions yields an index of 100 percent, whereas agreement between only the highest parts of the two distributions (i.e., overlap of only the peaks in the calibration plots) produces an index of over 100 percent. The threshold index for the individual calculation is considered to be 60 percent, and values below that suggest that the determination is an outlier (Bayliss and Bronk Ramsey 2004:34; Bronk Ramsey 2005). The overall agreement index is calculated for a group from the individual agreement indices, and it is compared to a critical value (An) that is dependent on the number of determinations (N) included in the model. The overall agreement index functions similarly to a χ^2 test, in that the model is considered to fail if the overall value drops below the critical value. Although the Combine function is performed on calibrated data, the use of standard versus age-specific ΔR values had little effect on the overall agreement indices; therefore, only the standard ΔR value was used to calibrate shell-derived radiocarbon determinations in the model.

Although the χ^2 test and Combine function are useful for identifying potential outliers in a group and isolating sets of statistically homogenous samples, not all groups identified in this study passed those tests. In some cases, a statistical outlier was within 300 radiocarbon years of all other dates included in the group, and it was kept in the group to compensate for possible reservoir fluctuations. More often, though, the statistically heterogeneous group consisted of a fairly evenly spaced sequence of dates spanning upwards of 400 radiocarbon years and defined primarily by discernible temporal gaps on either end of the sequence. Although these sequences failed the statistical tests and surpassed the documented variability in contemporaneous samples, the fairly consistent spacing of dates within the sequence made it difficult to identify internal temporal divisions with much confidence. Instead, tentative subgroups were identified for these groups, to acknowledge the variability within the identified episodes and allow some comparison of internal sequencing to be made while also recognizing that contemporaneous samples may have been split between subgroups. For most groups, the samples were divided into two subgroups at an episode's temporal midpoint.

Finally, the potential size of the interval separating each set of sequential episodes was modeled using the Bayesian functionality of OxCal. The radiocarbon data were arranged by episode within an OxCal sequence model, and the sizes of the intervals separating sequential episodes were obtained by calculating the difference between the probability distributions in one group and those in the sequential group (Bronk Ramsey 2005). In this way, a probability distribution was obtained for each interval, one that reflected the difference between the sequential groups, and that distribution provided a maximum and minimum size for the interval with 95 percent confidence. Because these calculated values were based on calibrated time, interval ranges are presented for both the standard ΔR and age-specific ΔR values.

Archaeomagnetic Dating

AM dating is a chronometric technique that is commonly utilized in the U.S. Southwest but is applied only rarely to California archaeological features, largely because of the lack of a regional secular-variation curve against which to date AM samples from this area. Although a curve has not been compiled for the region, several sources of secular-variation data were utilized in this project to obtain age estimates for the measured samples. Below, we offer an overview of this dating technique.

Overview of the Technique

The principles of archaeomagnetism were outlined by Eighmy and Sternberg (1990), and the analytical procedures employed for this data set are discussed below. Briefly, archaeomagnetism depends on two related phenomena. First, the earth's magnetic field changes in direction and strength through time. This is known as secular variation and is usually conceptualized as changes in the position of the north magnetic pole. Second, soils contain magnetic minerals that can record the direction of the magnetic field under certain circumstances and thus provide records of past directions of the geomagnetic field. For Playa Vista, we are primarily interested in the magnetic signals acquired by archaeological materials during heating. When those materials are heated above several hundred degrees centigrade, the ferromagnetic minerals become remagnetized parallel to the extant magnetic field. After cooling, that realignment is locked into place until the feature is reheated. Thus, the direction of magnetic remanence that is measured in the laboratory is related to the last time the feature was heated to sufficiently high temperatures, which is usually conceptualized as the last use of the feature.

An AM sample is collected by isolating between 8 and 12 15-cm^3 pedestals of material, encasing the pedestals in a nonmagnetic gypsum plaster, and recording the azimuth of one side of each pedestal, to allow reorientation in the laboratory (Eighmy 1991). Samples are measured in the laboratory through a progressive demagnetization procedure that measures the sample's remanent magnetization; demagnetizes, or magnetically cleans, the sample to a set magnetic field level; and then remeasures the sample's magnetization. This procedure allows spurious magnetic noise to be removed and the primary signal of interest to be isolated. The measured data are averaged to describe the inclination, declination, and strength of the prevailing magnetic field at the time the feature was magnetized. These data, along with associated error terms (α_{95} and precision [*k*]), can be used to calculate the virtual geomagnetic pole (VGP) location associated with the recorded magnetic field and its 95 percent oval of confidence. The VGP is simply the location of the magnetic north pole observed from a particular location, and it differs from the global magnetic north pole in that it includes regional distortions of the field (Butler 1992).

AM data are used to date archaeological features by comparing them to some known direction. For calendrical dating, that involves comparing the measured AM data from a feature to a calibrated reconstruction of secular variation, often referred to as a regional AM reference curve. Because secular variation changes randomly, those reconstructions are created from such sources as historical observations of the field (Barraclough 1995; Malin and Bullard 1981), AM measurements of independently dated archaeological features (Bucur 1994; Clark et al. 1988; Eighmy 1991; Kovacheva 1980, 1997; Kovacheva et al. 1998), paleomagnetic measurements of dated lake sediments (Lund and Banerjee 1985) or lava flows (Champion 1980; Doell and Cox 1965; Hagstrum and Champion 2002), or some combination of the above (Lengyel 2004; Lund 1996; Thompson 1982). AM or paleomagnetic data included in these data sets must be dated independently through other techniques, such as dendrochronology or radiocarbon dating, and precision criteria often require these data to have independent date ranges of 200 years or less (see Eighmy 1991:203; Eighmy et al. 1986:82, 1990:229; LaBelle and Eighmy 1997:432). Furthermore, because secular variation is affected by regional perturbations in the magnetic field, separate curves must be developed for each AM region, which typically encompasses an area that is 1,000 km in diameter (Batt 1997:153; Noël and Batt 1990:Figures 3 and 4; Sternberg 1997:326). Regional reference curves are continually revised as the size and precision of the independently dated magnetic data set increases, and documentation of the curve can be extended to earlier and later time periods.

Secular-Variation Records Employed

Although a secular-variation record has yet to be compiled for southern California, three sources of relevant secular-variation data provide a means of estimating the age of the PVAHP AM samples. First, reference curves for the U.S. Southwest, SWCV595 (LaBelle and Eighmy 1997) and SWCV2000 (Lengyel and Eighmy 2002), provided rough estimates for the ages of these samples, although they could not be used to date the samples precisely, because the geographic separation between the Los Angeles Basin and the portion of the U.S. Southwest covered by the curves introduces magnetic distortion that amplifies the error in the curve. These two curves were constructed solely from independently dated archaeological features in portions of Arizona, New Mexico, and Colorado, and they provide the time depth missing from the other two sources used in this study. The curves have been thoroughly documented elsewhere (LaBelle and Eighmy 1997; Lengyel 1999; Lengyel and Eighmy 2002; see Appendix 2.1, this volume) and are not discussed in detail here.

Table 5. Mean Inclination and Declination Values Calculated from Direct Observations

Year	Inclination (°)	Declination (°)
1700	58.50	6.5
1750	58.50	10.0
1800	58.50	11.5
1850	59.30	13.5
1875	59.50	14.5
1900	59.75	15.0

The seven AM samples recovered from LAN-211 during the PVAHP were all from presumably historical-period features. Thus, we were able to utilize historical observations of the magnetic field from southern California and magnetic-field models for the past 4 centuries to estimate the ages of the features, as well. The historical observations were compiled by Hazard (1917), and the magnetic-field models were based on historical observations of the magnetic field from around the world.

Historical Observations

Hazard (1917) provided a compilation of direct measurements of the magnetic field taken at various locations along the California coastline for the period between A.D. 1700 and 1915. The earliest recordings included in that data set were made by M. Sauvague le Muet in A.D. 1714 at Santa Bárbara and San Diego, although the majority of measurements were taken after roughly A.D. 1850 by the U.S. Coast and Geodetic Survey and various magnetic observatories. Recordings of magnetic inclination and declination made between roughly San Diego and Monterey were compiled for use in the current study. Mean inclination and declination values were calculated from those data for A.D. 1700, 1750, 1800, 1850, 1875 and 1900. For instance, the recorded data from between A.D. 1775 and 1825 were averaged to calculate the mean for A.D. 1800, and the data from A.D. 1863 and A.D. 1888 were averaged to calculate the mean for A.D. 1875. The data suggested that the local magnetic field varied from an inclinational low of 58.50° for A.D. 1700, 1750, and 1800 to a high of 59.75° for A.D. 1900 and from a less-easterly declination of 6.5° in A.D. 1700 to a more-easterly value of 15.0° in A.D. 1900 (Table 5).

Global Models

A secular-variation curve covering the period A.D. 1600–2000 was modeled for the PVAHP locale using Geomagix 2.0 software and British Geological Survey (BGS) and International Geomagnetic Reference Field (IGRF) models. The BGS models (Barraclough 1995; Jackson et al. 2000) were compiled

Table 6. Mean Inclination and Declination Values Calculated from the Global Model

Year	Inclination (°)	Declination (°)
1600	55.86	2.09
1625	55.56	0.65
1650	55.22	–0.91
1675	56.68	1.02
1700	58.19	3.22
1725	59.10	4.93
1750	59.96	6.69
1775	58.72	9.88
1800	57.35	12.98
1825	58.48	12.91
1850	59.61	12.82
1875	59.67	13.46
1900	59.33	14.93
1910.5	59.33	13.43
1911.5	59.33	13.50
1912.5	59.34	13.56
1913.5	59.36	13.62
1914.5	59.39	13.67
1915.5	59.41	13.71
1916.5	59.44	13.74
1917.5	59.44	13.77
1918.5	59.44	13.79
1919.5	59.45	13.80
1920.5	59.46	13.80

from historical readings of the magnetic field, primarily from ship logs and expedition records, and they provide the longest consecutive record of direct field measurements. The majority of those measurements relate to ship travel in the Atlantic and Indian Oceans and the Mediterranean Sea, although declination readings off the California coast were taken in the early 1700s, and inclination readings were added by the early 1800s (Jackson et al. 2000). The sum of those data was used to generate global models of the magnetic field at various points in time, and region-specific field models were then calculated from those global models.

For this study, the BGS models were utilized to calculate field models for the PVAHP locale for the periods between A.D. 1600 and 1900, at 25-year increments. Localized field models covering the period between A.D. 1910 and 1920 were calculated from the IGRF models at 1-year increments. The inclination and declination values calculated through those models are presented in Table 6. The data indicated that the local magnetic field varied from an inclinational low of 55.22° in 1650 to a high of 59.96° in 1750 and from a more-westerly declination of –0.91° in 1650 to a more-easterly declination of 14.93° in 1900. These values are similar to the historical observations compiled by Hazard (1917), and the differences between the two records reflect differences in data density and methodology.

Statistical Dating

Typically, an AM sample is dated by comparing the VGP calculated for the sample to the calibrated regional reference curve. That can be done visually or mathematically. The visual method is intuitively obvious and involves plotting the sample's VGP and associated oval of confidence against the regional reference curve. Visual inspection reveals the time period(s) during which the magnetic north pole was close to the sample's pole position, indicating the best-fit date range for the associated archaeological feature's last firing event. A variety of mathematical methods are available for estimating a sample's date range (e.g., Lanos 2004; LeGoff et al. 2002; Sternberg and McGuire 1990); however, the use of these methods is dependent on the availability of appropriately constructed reference curves with specific statistical parameters. Of the records included in this study, only SWCV595 contained the parameters necessary for true statistical dating, and the samples were dated against that curve through Sternberg and McGuire's (1990) mathematical method. Because of the sinusoidal nature of secular variation, multiple dating options were obtained for all samples that produced dates against that curve. Unlike radiocarbon dating, each of the date ranges represents a separate 2σ date range, and archaeological knowledge is needed to select the most likely dating options. For these samples, the historical-period date ranges were considered to be plausible, although all date ranges are reported.

The other two records were based on historical observations and lacked the statistical parameters necessary for Sternberg and McGuire's method. Instead, samples were dated against those records by calculating the angular distance between the sample VGP and each record VGP and comparing that value to the sample's α_{95}. The sample dated to time periods for which the record VGP was smaller than the sample's α_{95}. For samples that failed to date against any time period, the closest matches are listed.

Finally, the dates produced against all three records were combined to form a "best" date for each sample. These dates are fairly conservative age estimates formulated from the minimum and maximum dates generated from the three records. Because multiple date ranges were produced against SWCV595, only the historical-period date ranges were considered.

Obsidian-Hydration Dating

Obsidian-hydration dating was used to evaluate occupation episodes at LAN-54 (n = 6), LAN-62 (n = 27), LAN-193 (n = 14), LAN-211 (n = 4), and LAN-2768 (n = 22).

Obsidian hydration is a process whereby molecular water (or perhaps simply hydrogen) (see Riciputi et al. 2002) diffuses into a freshly exposed surface of volcanic glass from the surrounding environment. That process creates a visually and structurally distinct layer at the exposed surface that increases in thickness through time. Such fresh surfaces are created during artifact manufacture or breakage; so, the thickness of the hydration band can serve as a measure of how much time has passed since the artifact was created, modified, or broken, depending on the surface examined for hydration.

Obsidian-hydration dating has been the focus of intense research in California since its introduction more than 4 decades ago (Friedman and Smith 1960), largely because of the ubiquity of obsidian in archaeological deposits in many portions of the state and the paucity of radiocarbon-datable materials in many of those areas. Such research has demonstrated that the rate of hydration varies with temperature, relative humidity, geochemical source material, and intrinsic water in the rock structure (e.g., Mazer et al. 1991; Onken 1990; Rogers 2008a; Stevenson et al. 1993, 1996, 1998, 2000). For example, studies have shown that different geochemical sources for obsidian will affect the rate of hydration. Studies have also documented that intense heat or fire can alter or remove existing hydration rims (see Loyd et al. 2002). Finally, research undertaken in California and elsewhere has explored the use of obsidian hydration as both a relative- and an absolute-dating technique (e.g., Fredrickson 1984; Hall and Jackson 1989; Ridings 1996; Tremaine 1993), has examined different methods of hydration-band measurement (Anovitz et al. 1997; Liritzis 2006; Scheetz and Stevenson 1988; Stevenson et al. 2001; Tsong et al. 1978), has considered various methods for estimating effective hydration temperature (EHT) (e.g., Jones et al. 1997; McGuire 1995; Rogers 2007, 2008b), and has applied either empirical archaeological or laboratory-based methods to develop obsidian-hydration rates (e.g., Anovitz et al. 2004; Ericson 1988; Hull 2001; Michels et al. 1983; Rogers 2006, 2008a).

The scope and sophistication of such research has increased significantly in the last 15 years, providing important insights into the merits of different approaches and also suggesting new avenues for derivation of absolute dates from artifactual obsidians. Still, the significance of instrumental advances in hydration measurement or fine-grained distinctions in concentration-dependent rates of diffusion of molecular water (or hydrogen) to archaeological time scales and environmental conditions remains to be demonstrated. Rather, the vagaries of the long-term effects of and changes in EHT seem to be much more substantial obstacles to confident use of obsidian-hydration results for absolute dating than any subtleties in the form of the hydration curve evident in short-term experiments at high temperatures. Extrapolation of experimental results presented by Anovitz et al. (2004) for Pachuca obsidian from Mexico, for example, suggested differences in age estimation of more than 1,000 years for a specimen with 4 μ of hydration, based on a temperature difference of less than 1°C. Although empirical data from archaeological sites spanning a wide temperature gradient have suggested that such profound differences may not pertain to archaeological obsidians commonly found in California (see Hull and Roper 1999), such experimental work underscores the need to treat absolute dates derived from measurements taken via either visual or molecular-instrumental methods as temporal estimates, rather than as precise chronometric measures comparable to dendrochronology or perhaps even radiocarbon dating. That is especially true in light of potential changes in environmental conditions since artifact manufacture and the host of cultural and natural postdepositional factors that might confound the relationship between artifact and deposit (e.g., scavenging or postdepositional burning).

Archaeological research in coastal southern California has contributed relatively little to the scholarly dialogue on obsidian-hydration methodology, given the paucity of artifactual obsidian in the region compared to obsidian-rich sites in eastern, northeastern, and west-central California. Still, archaeological research here has benefited from such studies. Of particular relevance are studies of the hydration of obsidian from the Coso volcanic field (CVF), located approximately 240 km northeast of the PVAHP project area. Although obsidian never constituted a significant proportion of lithic assemblages on the coast, decades of research at sites from San Luis Obispo to Orange County have demonstrated that obsidian from the CVF is the most common geochemical type introduced into the region in prehistory (see Gilreath and Hildebrandt 1997:171). Geochemical results for obsidian artifacts from the PVAHP confirmed that observation, and CVF obsidian also composed the most common type of volcanic glass found at several sites on the bluffs above the Ballona (Douglass et al. 2005). Thus, the methods used to date artifacts of CVF obsidian from recent studies at West Bluffs served as the starting point for interpretation of obsidian-hydration data from the PVAHP sites.

Two hydration rates for CVF obsidian derived from analysis of data from eastern California were initially considered at West Bluffs. The first was Basgall's (1990) hydration rate for CVF obsidian, which was established based on uncalibrated radiocarbon/obsidian-hydration pairs from INY-30, near Lone Pine. Radiocarbon assays from that site were derived from charcoal samples. For application to the coast, a 6 percent per 1°C "correction" for EHT was used, following Basgall's (1990) assessment of a 0.09°C temperature difference between Lone Pine and Malibu (see also Gilreath and Hildebrandt 1997:Table 83). In that study, the EHT at the coast was determined to be greater than that of Lone Pine. Those methods resulted in the following formula: years B.P. = $0.9946 * 31.62\ \mu^{2.32}$. The second rate applied at West Bluffs was a provisional formula developed by Hull and Douglass (2005) from calibrated radiocarbon/obsidian-hydration pairs from INY-30 without the use of any temperature correction. The rate formula in that instance was years B.P. = $52.103 * \mu^2$. As discussed by Hull and Douglass (2005), however, neither method provided dates that were consistent with radiocarbon assays from the study sites, and the authors

Table 7. Western Regional Climate Center Data and Resulting EHT Calculations, Following Rogers (2007)

Location	Average Annual Temperature (°C)	July Average Temperature (°C)	January Average Temperature (°C)	Daily Average Maximum Temperature (°C)	Daily Average Minimum Temperature (°C)	V_a	V_d	y^a	EHT
Santa Monica Pier	16.1833	18.88	13.73	19.33	13.11	9.27	11.2	211.37	17.61
Los Angeles WSO Airport	17.1833	20.62	13.46	21.23	12.94	12.89	14.91	388.46	19.7

[a] At 0 cm in depth.

recognized that derivation of a temperature-dependent rate formulation in future work might prove beneficial. Still, the use of a rate formula based on calibrated radiocarbon dates facilitated comparison with other temporal data from the sites.

Recent studies farther south, in Orange County (Cleland et al. 2007:45–46), also used those two methods, in addition to applying a different EHT estimate to Basgall's (1990) rate formula, following his suggested 6 percent per 1°C protocol. In that case, Rogers's (2007) proposed method was invoked to estimate EHT, although Cleland et al. (2007) did not follow Rogers's (2007) method for incorporating the resulting EHT into rate correction. Contrary to Basgall's (1990) study, weather-station data for the City of Long Beach applied to Rogers's (2007) equations suggested that the EHT on the coast was approximately 2°C cooler than the EHT at Lone Pine, which resulted in dates that were somewhat older than those derived by the methods used at West Bluffs. In addition, Cleland et al. (2007:47) applied yet another hydration-rate formula for the CVF to their data from Landing Hill, based on Stevenson's (1990) laboratory hydration studies. Absolute dates derived via all of these methods, however, were generally at odds with radiocarbon assays, including the suggesting of components that were not otherwise in evidence, and that led the investigators to concede that they were uncertain as to the efficacy of any of the rate formulas they had applied. Conversely, they noted that the obsidian data might have revealed patterns of use other than shellfishing, which was the main source of data for the radiocarbon assays. Thus, obsidian-hydration results from both West Bluffs and Landing Hill raised more questions than answers.

Although the induced hydration-rate formula considered at Landing Hill was not applied to the PVAHP data, the data were initially analyzed using most of the other methods applied by Cleland et al. (2007). For the current study, however, Western Regional Climate Center data for both Santa Monica Pier and Los Angeles Washabo (WSO) Airport were considered, instead of Long Beach (Table 7), using the EHT estimate of 20.378°C for Lubkin Creek (INY-30) (reported by Rogers [2007]) as a basis for establishing the rate-correction factor (RCF). In addition, the EHT RCFs based on Los Angeles WSO Airport and Santa Monica Pier were also applied to the tentative CVF rate formula developed by Hull and Douglass (2005), following methods proposed by Rogers (2007). Individual artifact depths below the surface were incorporated into the calculation, when available, or were otherwise estimated, when unavailable. As is evident in Appendix 2.2, this volume, dates derived via all these methods suffered from the same interpretive uncertainty as dates from both West Bluffs and Landing Hill. That was especially true considering the often-disparate dates derived via different rate formulas and the apparent disparity between radiocarbon and obsidian-hydration dates at most of the sites. It should be borne in mind, however, that the inability to consider standard error of both obsidian-hydration measurements and radiocarbon dates in pair-based rate construction might account for some of the apparent inconsistencies between dates derived via different chronometric methods.

Given the apparently poor performance of dates thus derived, two other options were explored. The first was the possible derivation of a project-specific rate based on radiocarbon-hydration pairs from the PVAHP sites. As illustrated in Figure 7, however, the data set was inadequate for these purposes, because there was no pattern of association between rim thickness and calibrated radiocarbon age (although depth within the deposit was not taken into account in this cursory appraisal). The second method of absolute-date derivation entailed application of the temperature-correction protocols of Rogers (2007) to a newly proposed CVF rate also developed by Rogers (n.d.) (i.e., $38.34x^2$ multiplied by the appropriate RCF). For this portion of the study, RCFs were derived based on temperature data from both Santa Monica Pier and the Los Angeles WSO Airport, and artifact depth was also taken into account, when available.

Discussion of the results of this study is presented in Chapter 3, this volume.

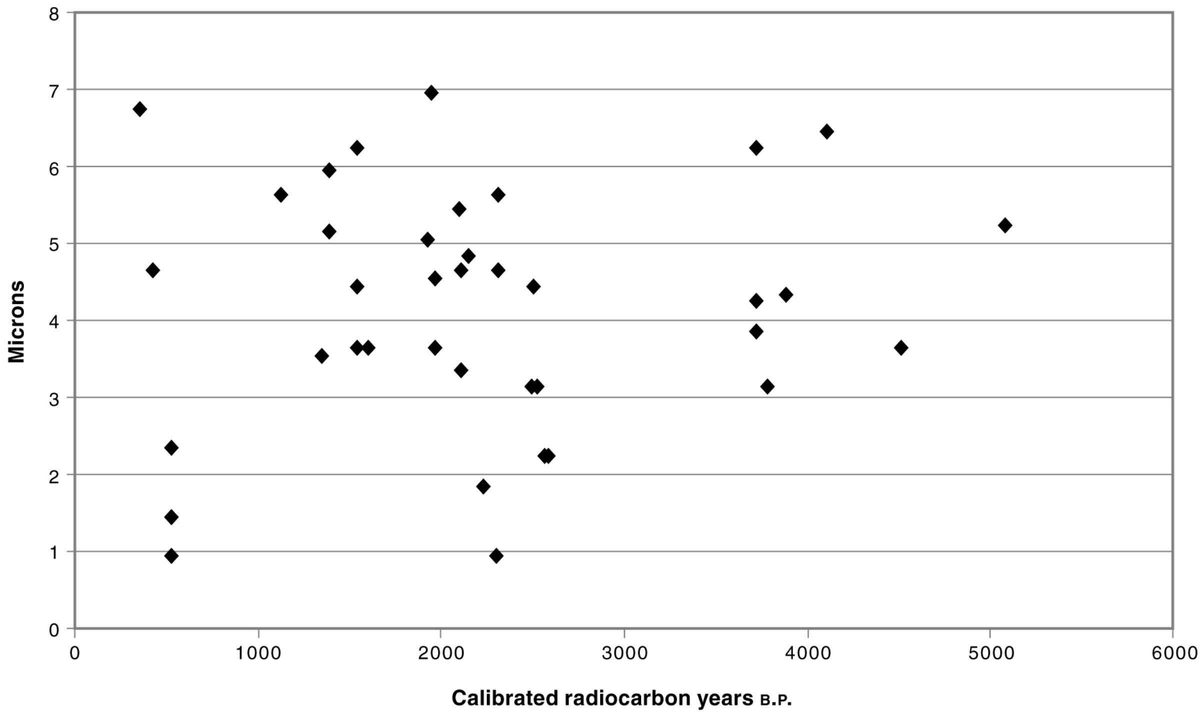

Figure 7. Graphic plot of the association between rim thickness and calibrated radiocarbon age.

Time-Sensitive Artifacts

Various artifacts recovered from the PVAHP project area are potentially time sensitive and provide grounds for cross-dating site components and features, including lithic artifacts, beads, and European-derived artifacts and faunal remains. Potentially temporally diagnostic lithic artifacts included projectile points, cogged stones, and discoidals. Shell, stone, bone, and glass beads also can be ascribed to limited temporal ranges. The presence of ceramic-vessel sherds likely indicates a historical-period occupation. Mortuary practices also are said to have changed over time in the southern California coastal region and may provide another line of evidence for making temporal assignments.

Diagnostic projectile points provide useful temporal information but typically are limited in their effectiveness in making temporal assignments. Diagnostic point types were recovered in low numbers in the project area, and isolated specimens potentially may be recovered from disturbed or secondary contexts. In addition, dating of many of these types relies on information from the Great Basin or from interior California rather than the coast. In addition, some types were used over a very long time span of 1,000 years or longer.

Land-and-groove cogged stones likely indicate a Millingstone period component (ca. 8500–3000 B.P.). In addition, as Moratto (1984:150) pointed out, discoidals have been recovered from caches with cogged stones elsewhere in southern California, suggesting that these two artifact types were contemporaneous during the Millingstone period (see Volume 3, this series).

Harrison (1965:163) and Hudson and Blackburn (1983:196–197) postulated that steatite comales were first used in coastal southern California during the Mission period. Hence, the presence of steatite comales may be indicative of a Mission period occupation (see Chapter 2, Volume 3, this series). Green-glass pressure flakes and a green-glass arrow point recovered from LAN-211 were likely made from glass bottles and additionally indicate historical-period occupation.

Various stone- and shell-bead types are also temporally sensitive. Rigby (1987) developed a typology of stone and bone beads recovered in southern California, many of which can be ascribed to specific time ranges from the Intermediate through Historical periods. Similarly, Bennyhoff and Hughes (1987; see also King 1990) have discussed the temporal implications of various shell-bead types and forms (see Chapter 3, Volume 3, this series). Glass beads can be assigned to temporal ranges during the historical period. The glass-bead collections from the PVAHP included specimens that could be minimally dated to the Mission period (1770–1830) or to the later historical period in the mid- and late 1800s (see Chapter 6, Volume 3, this series).

Native American ceramic artifacts generally occur infrequently in the Los Angeles Basin (Cameron 1999), which limits their potential for illuminating chronological trends. Ceramic sherds are not readily categorized or grouped by color or formal attributes that might be indicative of a temporal sequence. Kealhofer (1991:338) and McLean (2001) have argued that no ceramic artifacts have been recovered from *unambiguous* prehistoric contexts in the Los Angeles coastal area. Although some Gabrielino-Tongva groups probably sporadically acquired ceramic goods from neighboring ceramic-making groups in prehistoric times (e.g., the Cahuilla), present evidence suggests that ceramics were not an important component of the prehistoric Gabrielino-Tongva economy until the historical period. Hence, the presence of ceramic-vessel sherds likely indicates historical-period occupation. In the PVAHP project area, only LAN-211 included a substantial number of ceramic-vessel sherds (115 total sherds) (see Chapter 7, Volume 3, this series).

Natural Stratigraphy

Inspection of the natural subsurface stratigraphy also provides important insights into relative chronology and provides a means of defining distinct site-occupation episodes. To be sure, the natural stratigraphy varies in different geomorphological and depositional contexts of the project area; thus, stratigraphic sequences needed to be analyzed and reconstructed for the variety of depositional environments. The superposition of subsurface materials provided insights into the sequence of discrete episodes of occupation.

The same basic stratigraphy, with some localized variations, was documented in the EUs, trenches, and profiles along the entire base of the bluff. There are three sedimentary facies present in the area investigated. Usually highest in the landscape is the hill-slope facies, which is further subdivided into the back slope and the toe slope. In at least two locations, ravines cut through the hill slope, and alluvial fans (alluvial-fan facies) have formed at the mouths. The alluvial-fan facies make up the locations of most of the archeological remains in the area investigated. The lowest landscape position is the alluvial-plain facies, and it is part of the floodplain formed by Centinela and Ballona Creeks. Where the alluvial-plain facies and the other two facies meet, they tend to interdigitate in complex ways.

The stratigraphic context was determined by observation and analysis of the distinctive soil signatures within the project area. SRI has radiocarbon dated organic materials from each of the subsurface strata and from each depositional context in the project area, which provided insight into the depositional history of the site. Stratigraphic context also allows archaeologists to assign approximate date ranges to the material excavated from the various subsurface strata, with the caveat that some materials may have shifted downward (or, in rare cases, upward) within the subsurface matrix, as a result of bioturbation or other forms of postdepositional disturbance (Waters 1992).

Cultural Stratigraphy

Cultural stratigraphy concerns the definition of occupation episodes associated with subsurface strata and levels and is a product of studying the natural stratigraphy. Reconstruction of cultural stratigraphy requires consideration of both the natural stratigraphy and the chronometric- and relative-dating methods associated with the natural strata. For each site in the PVAHP project area, we defined episodes of occupation and associated date ranges.

The overriding objective in these studies was to establish the chronological histories of the project sites. The studies were undertaken in essentially two phases. The first phase was to model the archaeological history of each site in order to postulate how many discrete archaeological episodes might have been present. The second phase was to gather chronological information in order to place those archaeological episodes into a historical sequence.

We attempted to establish models of the archaeological history of each site through an evaluation of the stratigraphic information we gathered during the course of fieldwork, by studying the vertical distribution of artifacts and features within the site matrices and by selecting a limited number of samples for radiocarbon dating. That information was needed to reveal whether we were dealing with homogenous or uniform deposits or deposits that seemed to have inherent structure. We presumed that most sites would reveal, like LAN-62 Locus A, an inherent pattern of discrete archaeological episodes distributed vertically within the site matrices, which provided the analytical structure that guided the selection of additional specimens for radiocarbon dating. As discussed earlier in this chapter, the archaeological episode was our fundamental analytical unit, and the consistency of the various lines of chronological evidence available was evaluated within the context of those archaeological episodes. We recognized that analysts and project researchers might ask questions about the age of a specific feature or the age of a particular category of features. So, although a large number of radiocarbon samples were selected during fieldwork, we reserved a particular subset of radiocarbon samples for the dating of prehistoric features, but the primary analytical unit for this study was still the archaeological episode.

Conclusion

The methods of chronometric dating of PVAHP sites—including using radiocarbon, AM, and obsidian-hydration methods; diagnostic artifacts; and natural and cultural stratigraphy—were of extreme importance to understanding the natural and cultural history of the archaeological sites within the project area. Radiocarbon dating provided the primary source of chronometric data for the PVAHP, with a total of 200 dates collected. That extensive suite of dates provided, along with the AM and obsidian-hydration dates and diagnostic artifacts, the temporal framework for interpreting past human occupation within the Ballona. As will be discussed in Chapter 3, this volume, the PVAHP sites in the Ballona represent a very long-lived occupation history; some site components date back to over 7,000 years ago, in the project area, and to over 8,000 years ago, in the Ballona in general. The methods discussed here provide the technical expertise needed to investigate and understand the chronometry of the Ballona, discussed in Chapter 3, this volume.

Chronometric-Dating Results

Stacey N. Lengyel, Kathleen L. Hull, Jill A. Onken, and Benjamin R. Vargas

Given the expected time depth of the PVAHP archaeological deposits, chronometric data were emphasized heavily in this study. Radiocarbon dating provided the primary source of chronometric data, and in total, 201 radiocarbon dates were obtained for the project (see Appendix 3.1, this volume). That extensive suite of dates provided the temporal framework for interpreting past human activities from the archaeological record documented by this project. Furthermore, as one of the more extensive sets of dates from the region, the data set provided a springboard for evaluating larger cultural developments in the Los Angeles Basin through time (see Chapter 12, this volume). The radiocarbon data set was supplemented by a handful of AM dates obtained for features from LAN-211 (see Appendix 3.2, this volume). AM dating is particularly useful for Protohistoric period and historical-period deposits, because they are too recent to be dated via radiocarbon. This study is noteworthy, as well, because it represents one of the first applications of AM dating to southern California archaeological contexts. Electronic copies of radiocarbon laboratory reports are presented in Appendix 3.3, this volume.

This chapter presents the radiocarbon and AM dates obtained for the project and identifies probable periods of relatively discrete human activity (i.e., occupation episodes) at each site. Obviously, these activity periods, or episodes, are delineated at the resolution of the respective techniques—in many cases, on the order of 300–500 calendar years. Episodes of activity are defined in this chapter solely on the basis of the chronometric data. Subsequent chapters will detail, for each site, the complex chronostratigraphy in which the chronometric data were evaluated contextually and linked to the material record. The approach taken in this chapter is justified by the fact that the majority of chronometric dates were obtained on marine shells, and it is assumed that all marine shells recovered from these sites are the by-products of human activity. Under that assumption, all shells, even those with low contextual integrity (e.g., because of bioturbation), provided temporal markers for local human activities. From that perspective, there were no "bad" dates, only poor contextual associations.

In addition to radiocarbon and AM dating, this chapter presents the results of obsidian-hydration dating at the five primary PVAHP sites. Because of significant differences in the methods and analysis of obsidian-hydration dating versus either radiocarbon or AM dating, we present the obsidian-hydration-dating results and discussion at the end of this chapter, separate from the other discussions. The methods employed in these studies are discussed thoroughly in Chapter 2, this volume. Therefore, this chapter focuses on presenting the chronometric data obtained from each site and identifying the occupation episodes delineated by those data. In a few cases, paired terrestrial-marine radiocarbon samples were recovered, and the ΔR values calculated from those pairs are presented, as well. Each site chronology concludes with an overview of the timing, duration, and composition of the occupation episodes identified at the site. Finally, the chapter concludes with an overview of the project's chronometric results and the correlation of occupation episodes identified at the investigated sites.

Chronometric Data for LAN-54

Results for LAN-54

The chronometric data recovered for LAN-54 came from 20 radiocarbon samples recovered from CUs 3 and 11 and eight features (Features 1, 7, 12, 16, 23, 24, 29, and 36). Four of those samples were submitted in 2004, to obtain preliminary chronometric information for the site; 10 samples were submitted in 2006, to build the chronometric framework for the site; and 6 were submitted in 2007, to help refine our understanding of how the features articulated with the site chronology. All 20 samples consisted of individual marine shells, including specimens of scallop, venus clam, oyster, littleneck clam, and pismo clam, and all but 2 of them were submitted for AMS analysis (Table 8; see Appendix 3.1, this volume).

Multiple samples were submitted for dating from Features 16 and 24 and from Level 4 of CU 3. The radiocarbon determinations obtained from the two CU 3 samples

Table 8. Radiocarbon Results for LAN-54

Context	Material	Sample No.	Calibrated Age (Standard ΔR)	ΔR	Calibrated Age (Alternate ΔR)	Episode/ Subepisode No.
CU 11, Level 11	venus clam	Beta-194872	2210–1870 cal B.C.	400 ± 50; –50 ± 100	1980–1620 cal B.C.; 2750–2110 cal B.C.	1
CU 3, Level 8	venus clam	Beta-194874	2010–1680 cal B.C.	400 ± 50; –50 ± 100	1800–1440 cal B.C.; 2500–1900 cal B.C.	1
Feature 1	venus clam	Beta-224058	1800–1440 cal B.C.	400 ± 50; –50 ± 100	1600–1240 cal B.C.; 2290–1660 cal B.C.	2
Feature 24	venus clam	Beta-224054	1720–1420 cal B.C.	400 ± 50; –50 ± 100	1520–1190 cal B.C.; 2210–1610 cal B.C.	2
Feature 23	venus clam	Beta-224056	1710–1410 cal B.C.	400 ± 50; –50 ± 100	1510–1180 cal B.C.; 2200–1610 cal B.C.	2
Feature 24	venus clam	Beta-219080	1590–1290 cal B.C.	400 ± 50; –50 ± 100	1390–1030 cal B.C.; 2040–1470 cal B.C.	2
CU 3, Level 7	scallop	Beta-219078	600–210 cal B.C.	–85 ± 40	940–640 cal B.C.	3
CU 11, Level 9	venus clam	Beta-219082[b]	850–410 cal B.C.	–85 ± 40	1350–810 cal B.C.	3A
Feature 24	venus clam	Beta-224053	820–500 cal B.C.	–85 ± 40	1270–820 cal B.C.	3A
CU 11, Level 5	venus clam	Beta-194873[a]	940–390 cal B.C.	–85 ± 40	1220–870 cal B.C.	3A
CU 11, Level 7	pismo clam	Beta-219084	790–460 cal B.C.	–85 ± 40	1170–830 cal B.C.	3A
Feature 36	scallop	Beta-219085	780–440 cal B.C.	–85 ± 40	1140–810 cal B.C.	3A
CU 3, Level 4	venus clam	Beta-194875	760–390 cal B.C.	–85 ± 40	1120–770 cal B.C.	3A
Feature 7	venus clam	Beta-219081	750–400 cal B.C.	–85 ± 40	1100–790 cal B.C.	3A
Feature 12	scallop	Beta-219083	710–370 cal B.C.	–85 ± 40	1010–760 cal B.C.	3A
Feature 29	venus clam	Beta-219076	710–360 cal B.C.	–85 ± 40	1000–750 cal B.C.	3A
Feature 16	littleneck clam	Beta-224057	420–130 cal B.C.	–85 ± 40	810–490 cal B.C.	3B
CU 3, Level 4	oyster	Beta-219077	420–130 cal B.C.	–85 ± 40	810–490 cal B.C.	3B
Feature 16	littleneck clam	Beta-224055	390–110 cal B.C.	–85 ± 40	800–470 cal B.C.	3B
Feature 16	scallop	Beta-219079	380–80 cal B.C.	–85 ± 40	770–430 cal B.C.	3B

Note: All samples were measured via AMS unless otherwise indicated.
[a] Sample was measured radiometrically, with extended counting.
[b] Sample was measured radiometrically.

were found to be statistically different at the 0.05 significance level; however, the two determinations were separated by only 220 radiocarbon years. It is possible that the apparent age difference between the samples reflected postdepositional mixing of noncoeval deposits. It is equally possible, though, that the difference, obtained from a venus clamshell and a scallop shell, reflected interspecies differences in radiocarbon content rather than a true age difference between specimens. The apparent age difference was close enough to documented variability in roughly contemporaneous determinations (see Ascough et al. 2005; Culleton et al. 2006; Ingram and Southon 1996); however, it seemed best to treat them as part of the same broad occupation episode, despite apparent statistical differences.

The three radiocarbon determinations obtained for Feature 24 provided a somewhat different situation. All three determinations were derived from individual venus clamshells, and two of the three determinations were found to be statistically indistinguishable at the 0.05 significance level. The third determination (Beta-224053), however, was statistically different from the other two, with age differences of 620 and 740 radiocarbon years. It seemed likely that the specimen reflects postdepositional mixing and was intrusive to the feature. With the exclusion of that sample, a combined calibrated date of 1610–1410 cal B.C. was calculated for the feature through the Combine feature of OxCal (v. 3.10), using the Marine04 data set (Hughen et al. 2004) and a ΔR of 220 ± 40 (Ingram and Southon 1996). That method was utilized, rather than a weighted, pooled mean, because it factors in the error in the calibration curve by combining the samples' probability distributions (Ward and Wilson 1978). Each probability distribution provides the relative probability that an event (e.g., death of the organism) occurred at a particular time, and the total distribution represents the 2σ calibration range for the associated radiocarbon determination. The combined date for the feature shifted to a maximum of 2030–1620 cal B.C. when the period-specific ΔR of –50 ± 100 was used and to a minimum of 1410–1190 cal B.C. when the ΔR of 400 ± 50 was used.

Finally, statistical comparison of the three radiocarbon determinations obtained for Feature 16, including two on littleneck clam and one on scallop, indicated no difference at the 0.05 significance level. Therefore, a combined calibrated date of 360–180 cal B.C. was calculated for the feature through the

Combine function of OxCal (v. 3.10) (Bronk Ramsey 1995, 2001), using the Marine04 data set (Hughen et al. 2004) and a ΔR of 220 ± 40 (Ingram and Southon 1996). That date range shifted to 760–550 cal B.C. when the age-appropriate ΔR of –85 ± 40 was applied.

Occupation Episodes at LAN-54

Preliminary evaluation of the uncalibrated radiocarbon determinations from the site suggested that at least two or three broad temporal groups were represented in the dated sample (see Table 8). χ^2 tests (Ward and Wilson 1978) and OxCal's postcalibration Combine function were used to evaluate the cohesion of those groups. The tests were run with both the average and the period-specific ΔR values, to evaluate whether group membership changed under different assumed reservoir conditions. Given the potential radiocarbon range associated with roughly contemporaneous specimens, attempts were made to identify the smallest number of statistically distinguishable groups (i.e., lumping rather than splitting groups) without diminishing recognizable patterns in the data.

Below, we summarize the occupation episodes indicated by the radiocarbon dates derived for the site, beginning with the earliest occupation. Occupation episodes are numbered 1–3 for LAN-54; Episode 1 represents the oldest occupation of the site, and Episode 3 represents the most recent occupation.

Episode 1

Episode 1 consisted of a venus clamshell recovered from Level 8 of CU 3 and a second venus clamshell recovered from Level 11 of CU 11. The conventional dates from those two shells differed by 150 radiocarbon years, and they passed both the χ^2 test and the Combine test under the standard ΔR value and the two age-specific ΔR values. The combined age for Episode 1 was 2210–1680 cal B.C. (standard ΔR), 1980–1440 cal B.C. (age-specific ΔR: 400 ± 50), or 2750–1900 cal B.C. (age-specific ΔR: –50 ± 100). Although the younger ends of these date ranges overlap with the earlier portions of succeeding episodes' date ranges by over 100 years, it is possible that the two occupations were separated by as much as 380 years (standard ΔR), 330 years (age-specific ΔR: 400 ± 50), or 410 years (age-specific ΔR: –50 ± 100).

Episode 2

Episode 2 was composed of four venus clamshell samples from Features 1, 23, and 24, and the cohesion of the group was supported by both the χ^2 tests and Combine tests run under the standard ΔR value and the two age-specific ΔR values of 400 ± 50 and –50 ± 100. The conventional dates from those shells spanned 160 radiocarbon years, and the episode had a combined age of 1800–1290 cal B.C. (standard ΔR), 1600–1030 cal B.C. (age-specific ΔR: 400 ± 50), or 2290–1470 cal B.C. (age-specific ΔR: –50 ± 100). This episode preceded the youngest occupation episode(s) at the site by 520–860 years (standard ΔR), 0–280 years (age-specific ΔR: 400 ± 50), or 340–850 years (age-specific ΔR: –50 ± 100), depending on the prevailing carbon reservoirs.

Episode 3

The evaluation of the youngest group of samples (Episode 3) suggested that at least two different periods of occupation were represented by the group. The older Subepisode 3A included seven samples from Features 7 and 36, the aberrant sample from Feature 24, and samples from Levels 4 and 7 in CU 3 and Levels 5, 7, and 9 in CU 11. The conventional dates from those shells spanned 110 radiocarbon years, and they formed a statistically cohesive group (*df* = 6; T = 1.771; $\chi^2_{0.05}$ = 12.592; A = 148.0 percent; An = 26.7 percent) with a span of 110 radiocarbon years. Two slightly younger samples (Beta-219076 and Beta-219083) from Features 29 and 12 may belong to this subepisode, as well, although the statistics were slightly less straightforward. Those two samples passed a χ^2 test with the other samples from Subepisode 3A under both the standard and age-specific ΔR values, and they passed the Combine test when the standard ΔR value was used; however, they marginally failed the Combine test when the age-specific ΔR value of –85 ± 40 was applied. Given the range of uncertainties associated with dating marine shell, though, it seemed best to take the conservative approach and include those samples with Subepisode 3A. Taking all nine samples into account, the calibrated age for the subepisode was 940–360 cal B.C. when the standard ΔR value was used and 1350–750 cal B.C. when the age-specific ΔR value was used.

The younger Subepisode 3B consisted of the three samples from Feature 16 and the younger sample from Level 4 of CU 3. The conventional dates from those samples spanned 50 radiocarbon years, and they formed a very cohesive group (*df* = 3; T = 0.475; $\chi^2_{0.05}$ = 7.815; A = 139.3 percent; An = 35.4 percent). Although the conventional ages for those samples were within 200–300 years of the ages of several samples in Subepisode 3A, including the other sample from Level 4 of CU 3, the gap of 160 radiocarbon years between the two subepisodes and the relative cohesion of each suggested that they reflected different periods of activity. The combined age for Subepisode 3B was 420–80 cal B.C. (standard ΔR) or 810–430 cal B.C. (age-specific ΔR). Those age ranges overlapped slightly with their Episode 3B counterparts, and the midpoints differed between the two episodes by roughly 400 years. Midpoints, however, may not accurately reflect the age distribution of a group of samples, because the probability distributions, or curves, associated with calibrated dates are typically skewed toward one end of the range rather than uniformly distributed. A more realistic estimate of the potential interval separating the two occupation episodes was obtained through OxCal by modeling the episodes as sequential phases (Bronk Ramsey 1995, 2005). In this way, it was estimated that the episodes may have been separated by as many as 190 years when the standard ΔR was used and 160 years when the age-specific ΔR was used.

Finally, one last sample from Episode 3 (Beta-219078) could not be assigned definitively to either subepisode. The sample was recovered from Level 7 of CU 3, and its age was not statistically different from either group. Rather than forced into relationship, the sample was simply assigned to the broad Episode 3 group and was not included in statistical analyses.

Summary

Evaluation of the radiocarbon determinations obtained for LAN-54 suggested that at least four different occupation episodes were represented within the dated sample. The earliest dated occupation at the site (Episode 1) was represented by two samples recovered from the lower levels of CUs. That episode dated to 2210–1680 cal B.C. (standard ΔR), 1980–1440 cal B.C. (age-specific ΔR: 400 ± 50), or 2750–1900 cal B.C. (age-specific ΔR: –50 ± 100).

The dates from Episode 1 overlapped quite a bit with those of the following episode (Episode 2), and at most, the two episodes were separated by 380 years (standard ΔR), 330 years (age-specific ΔR: 400 ± 50), or 410 years (age-specific ΔR: –50 ± 100). Episode 2 included Features 1, 23, and 24 and dated to 1800–1290 cal B.C. (standard ΔR), 1600–1030 cal B.C. (age-specific ΔR: 400 ± 50), or 2290–1470 cal B.C. (age-specific ΔR: –50 ± 100).

Depending on which reservoir correction value was applied, Episode 2 preceded the youngest episodes at the site (Episodes 3A and 3B) by between 520 and 860 years (standard ΔR), 0 and 280 years (age-specific ΔR: 400 ± 50), or 340 and 850 years (age-specific ΔR: –50 ± 100). Episode 3A included Features 7, 12, 29, and 36; an outlier sample recovered from Feature 24; Levels 4 and 7 in CU 3; and Levels 5, 7, and 9 in CU 11. That episode dated to either 940–360 cal B.C. (standard ΔR) or 1350–750 cal B.C. (age-specific ΔR). Episode 3B included Feature 16 and one sample from Level 4 of CU 3 and dated to either 420–80 cal B.C. (standard ΔR) or 810–430 cal B.C. (age-specific ΔR). Although Episodes 3A and 3B overlapped slightly, it was estimated that an interval of up to 190 years (standard ΔR) or 160 years (age-specific ΔR) could have occurred between the two episodes.

Chronometric Data for LAN-62

LAN-62 represented the largest and most complex site investigated within the PVAHP project area; therefore, it is not surprising that the bulk of the radiocarbon effort was expended on delineating the temporal framework for this site. In all, 98 samples recovered from LAN-62 were submitted for radiocarbon dating: 90 from Locus A/G and 8 from Locus C/D. Most of those samples consisted of individual marine shells, including abalone, olivella, scallop, oyster, venus clam, littleneck clam, and pismo clam. Other dated materials included bone gelatin (artiodactyl), soil humates, and charred seeds (barley and canarygrass). Because of the complexity of the site, sample submission occurred in several rounds over the course of 5 years, and the results obtained from each round guided the sample selection for subsequent round(s), including the contexts targeted, the number of samples selected from those contexts, and the materials submitted for dating. The specifics of the samples and the results obtained are discussed within the contexts of the two primary areas investigated at the site: Loci A/G and C/D.

Results for LAN-62 Locus A/G

Radiocarbon dates were obtained for 90 samples recovered from 15 CUs (CUs 25, 26, 114, 115, 141, 233, 316, 320, 321, 323, 333, 344, 422, 682, and 853) and 22 features (Features 4, 26, 137, 145, 169, 207, 234, 249, 294, 335, 384, 419, 449, 518, 621, 640, 672, 673, 684, 687, 688, and 690) excavated within Locus A/G (Table 9; see Appendix 3.1, this volume). Eighty-five of those samples consisted of marine-shell specimens, 3 samples consisted of botanical materials, and 2 samples were bulk sediment samples. The sediment samples were submitted for radiometric analysis, and 24 shell samples were submitted for radiometric analysis with extended counting; the remaining 71 samples were submitted for AMS analysis. The 2 bulk sediment samples (Beta-194254 and Beta-194255) provided cumulative temporal information for cultural-material-bearing strata, and they were useful for chronostratigraphic reconstructions of this part of the site. However, because they could not be related directly to discrete cultural events, they were excluded from the statistical evaluations presented in this chapter.

Although the majority (59 percent) of marine-shell samples from this locus consisted of venus clam specimens, radiocarbon determinations were obtained on scallop, abalone, olivella, oyster, littleneck clamshells, and pismo clamshells, as well. Given the potential for interspecies variability in shell radiocarbon content, eight paired shell samples were submitted from CU 682 and five features (Features 419, 640, 672, 687, and 688), to assess whether the diverse shell assemblage utilized in the study had introduced systematic errors into the dating analysis. Seven of the sample sets paired specimens of venus clam with specimens of littleneck clam, scallop, and oyster, and one set paired specimens of littleneck clam specimen and scallop (Table 10). The apparent age difference between pairs is presented in terms of the venus clam

Table 9. Radiocarbon Results for LAN-62 Locus A/G

Context	Material	Sample No.	Calibrated Age (Standard ΔR)	ΔR	Calibrated Age (Alternate ΔR)	Episode/ Subepisode No.
Feature 690	venus clam	Beta-234675	4910–4530 cal B.C.	210 ± –80	4990–4490 cal B.C.	1
CU 321, Level 94	venus clam	Beta-194257[a]	4740–4450 cal B.C.	210 ± –80	4830–4400 cal B.C.	1
CU 115, Level 76	venus clam	Beta-193300[a]	4650–4320 cal B.C.	210 ± –80	4720–4280 cal B.C.	1
CU 321, Level 92	venus clam	Beta-194256[a]	2890–2590 cal B.C.	210 ± –80	3010–2520 cal B.C.	2
Feature 449	pismo clam	Beta-230291	2860–2520 cal B.C.	210 ± –80	2890–2450 cal B.C.	2
CU 323, Level 80	littleneck clam	Beta-219820	2830–2380 cal B.C.	210 ± –80	2860–2320 cal B.C.	2
Feature 672	venus clam	Beta-231981	2750–2370 cal B.C.	210 ± –80	2840–2320 cal B.C.	2
CU 114, Level 70	venus clam	Beta-193303[a]	2610–2090 cal B.C.	210 ± –80	2680–2020 cal B.C.	3
Feature 673	venus clam	Beta-230292	2480–2140 cal B.C.	210 ± –80	2580–2060 cal B.C.	3
CU 141, Level 73	venus clam	Beta-231976	2460–2130 cal B.C.	210 ± –80	2550–2040 cal B.C.	3
CU 141, Level 75	pismo clam	Beta-235983	2460–2120 cal B.C.	210 ± –80	2540–2030 cal B.C.	3
CU 115, Level 77	venus clam	Beta-193299[a]	2460–2040 cal B.C.	210 ± –80	2550–1980 cal B.C.	3
CU 344, Level 76	venus clam	Beta-193309[a]	2410–2010 cal B.C.	210 ± –80	2470–1940 cal B.C.	3
CU 25, Level 83	unidentified shell	Beta-188625[a]	2430–1820 cal B.C.	210 ± –80	2470–1760 cal B.C.	3
CU 333, Level 77	venus clam	Beta-193301[a]	2420–1760 cal B.C.	210 ± –80	2460–1720 cal B.C.	3
CU 323, Level 78	venus clam	Beta-219838	2360–1950 cal B.C.	210 ± –80	2450–1910 cal B.C.	3
CU 26, Level 75	venus clam	Beta-188335[a]	2380–1900 cal B.C.	210 ± –80	2450–1870 cal B.C.	3
Feature 518	littleneck clam	Beta-231975	2340–1970 cal B.C.	210 ± –80	2440–1920 cal B.C.	3
CU 320, Level 63	littleneck clam	Beta-219819	1580–1200 cal B.C.	400 ± –50; –50 ± –100	1380–950 cal B.C.; 2010–1420 cal B.C.	4
CU 344, Level 68	venus clam	Beta-193304[a]	1590–1120 cal B.C.	400 ± –50; –50 ± –100	1380–890 cal B.C.; 2020–1380 cal B.C.	4
CU 26, Level 65	venus clam	Beta-188333[a]	840–440 cal B.C.	–85 ± –40	1250–840 cal B.C.	5
CU 115, Level 67	venus clam	Beta-193305[a]	780–390 cal B.C.	–85 ± –40	1180–780 cal B.C.	5
CU 114, Level 64	venus clam	Beta-193302[a]	760–390 cal B.C.	–85 ± –40	1140–780 cal B.C.	5
CU 682, Level 48	venus clam	Beta-219839	760–360 cal B.C.	–85 ± –40	1120–740 cal B.C.	5
CU 316, Level 68	venus clam	Beta-231969	760–410 cal B.C.	–85 ± –40	1110–800 cal B.C.	5
CU 682, Level 59	scallop	Beta-219823	740–390 cal B.C.	–85 ± –40	1070–780 cal B.C.	5
CU 320, Level 59	scallop	Beta-219821	730–380 cal B.C.	–85 ± –40	1060–760 cal B.C.	5
CU 422, Level 57	scallop	Beta-193295[a]	730–380 cal B.C.	–85 ± –40	1060–760 cal B.C.	5
CU 321, Level 95	venus clam	Beta-194258[a]	720–380 cal B.C.	–85 ± –40	1020–760 cal B.C.	5
CU 115, Level 65	venus clam	Beta-193298[a]	710–220 cal B.C.	–85 ± –40	1020–570 cal B.C.	5
CU 323, Level 70	venus clam	Beta-219834	710–370 cal B.C.	–85 ± –40	1010–760 cal B.C.	5
Feature 234	pismo clam	Beta-238392	710–360 cal B.C.	–85 ± –40	1000–750 cal B.C.	5
CU 320, Level 50	scallop	Beta-219824	700–340 cal B.C.	–85 ± –40	980–740 cal B.C.	5
CU 141, Level 74	venus clam	Beta-231977	700–330 cal B.C.	–85 ± –40	980–730 cal B.C.	5
CU 682, Level 52	scallop	Beta-219817	700–310 cal B.C.	–85 ± –40	970–720 cal B.C.	5
CU 323, Level 72	venus clam	Beta-219828	520–180 cal B.C.	–85 ± –40	880–550 cal B.C.	6A
CU 320, Level 57	scallop	Beta-219822	520–180 cal B.C.	–85 ± –40	880–550 cal B.C.	6A
CU 114, Level 59	venus clam	Beta-193307[a]	450–100 cal B.C.	–85 ± –40	830–470 cal B.C.	6A
CU 682, Level 52	venus clam	Beta-219825	420–130 cal B.C.	–85 ± –40	810–490 cal B.C.	6A
Feature 640	littleneck clam	Beta-231978	360–30 cal B.C.	–85 ± –40	750–390 cal B.C.	6A
CU 26, Level 69	venus clam	Beta-188334[a]	350–10 cal B.C.	–85 ± –40	740–380 cal B.C.	6A
CU 853, Level 72	venus clam	Beta-235980	250 cal B.C.–cal A.D. 80	–85 ± –40	700–330 cal B.C.	6B
CU 853, Level 76	venus clam	Beta-235981	210 cal B.C.–cal A.D. 100	–85 ± –40	670–300 cal B.C.	6B
CU 316, Level 65	venus clam	Beta-235979	130 cal B.C.–cal A.D. 180	–85 ± –40	490–170 cal B.C.	6B
CU 320, Level 72	littleneck clam	Beta-219816	50 cal B.C.–cal A.D. 250	–85 ± –40	400–120 cal B.C.	6B
Feature 419	venus clam	Beta-231974	cal A.D. 230–540	165 ± –35	cal A.D. 160–440	7A
Feature 169	venus clam	Beta-231970	cal A.D. 260–560	165 ± –35	cal A.D. 190–490	7A

continued on next page

Context	Material	Sample No.	Calibrated Age (Standard ΔR)	ΔR	Calibrated Age (Alternate ΔR)	Episode/ Subepisode No.
CU 233, Level 52	venus clam	Beta-188969[a]	cal A.D. 250–660	165 ± –35	cal A.D. 170–600	7A
CU 333, Level 60	venus clam	Beta-193306[a]	cal A.D. 340–670	165 ± –35	cal A.D. 270–620	7A
CU 141, Level 59	venus clam	Beta-235989	cal A.D. 410–660	165 ± –35	cal A.D. 340–620	7A
CU 682, Level 48	littleneck clam	Beta-219831	cal A.D. 430–680	165 ± –35	cal A.D. 380–640	7A
CU 682, Level 56	venus clam	Beta-219837	cal A.D. 420–720	165 ± –35	cal A.D. 370–670	7A
Feature 419	littleneck clam	Beta-231973	cal A.D. 510–770	165 ± –35	cal A.D. 450–690	7B
Feature 672	scallop	Beta-231980	cal A.D. 530–780	165 ± –35	cal A.D. 460–700	7B
Feature 621	venus clam	Beta-230290	cal A.D. 610–860	165 ± –35	cal A.D. 560–790	7B
CU 141, Level 63	venus clam	Beta-235982	cal A.D. 630–880	165 ± –35	cal A.D. 570–800	7B
Feature 384	venus clam	Beta-231972	cal A.D. 690–970	165 ± –35	cal A.D. 660–900	7B
Feature 688	scallop	Beta-234671	cal A.D. 700–980	165 ± –35	cal A.D. 670–900	7B
CU 114, Level 56	venus clam	Beta-193310[a]	cal A.D. 1230–1510	165 ± –35	cal A.D. 1190–1470	8A
Feature 687	venus clam	Beta-234674	cal A.D. 1290–1460	165 ± –35	cal A.D. 1260–1440	8A
CU 320, Level 47	oyster	Beta-219826	cal A.D. 1300–1470	165 ± –35	cal A.D. 1280–1440	8A
CU 323, Level 64	venus clam	Beta-219832	cal A.D. 1320–1520	165 ± –35	cal A.D. 1300–1470	8A
CU 682, Level 46	oyster	Beta-219829	cal A.D. 1310–1550	165 ± –35	cal A.D. 1300–1490	8A
Feature 687	canary grass	Beta-234677	cal A.D. 1320–1480	N/A	cal A.D. 1320–1480	8A
Feature 684	oyster	Beta-234673	cal A.D. 1400–1630	165 ± –35	cal A.D. 1330–1520	8A
CU 323, Level 62	venus clam	Beta-219833	cal A.D. 1410–1630	165 ± –35	cal A.D. 1330–1530	8A
CU 320, Level 48	venus clam	Beta-188967[a]	cal A.D. 1400–1720	165 ± –35	cal A.D. 1350–1680	8A
CU 323, Level 61	venus clam	Beta-219827	cal A.D. 1440–1650	165 ± –35	cal A.D. 1390–1620	8A
CU 26, Level 58	venus clam	Beta-188968[a]	cal A.D. 1420–1700	165 ± –35	cal A.D. 1390–1670	8A
Feature 687	little barley	Beta-234676	cal A.D. 1400–1620	N/A	cal A.D. 1400–1620	8A
Feature 687	scallop	Beta-234672	cal A.D. 1470–1680	165 ± –35	cal A.D. 1440–1650	8A
CU 682, Level 46	venus clam	Beta-219836	cal A.D. 1470–1680	165 ± –35	cal A.D. 1440–1650	8A
Feature 249	abalone	Beta-238870	cal A.D. 1320–1510	450 ± –40	cal A.D. 1480–1730	8A/B[c]
Feature 207	olivella	Beta-238867	cal A.D. 1330–1570	450 ± –40	cal A.D. 1520–1820	8A/B[c]
Feature 640	venus clam	Beta-231979	cal A.D. 1480–1690	165 ± –35	cal A.D. 1450–1660	8B
CU 333, Level 56	venus clam	Beta-193308[a]	cal A.D. 1490–1870	165 ± –35	cal A.D. 1460–1760	8B
Feature 335	scallop	Beta-231971	cal A.D. 1480–1710	165 ± –35	cal A.D. 1470–1670	8B
CU 323, Level 66	venus clam	Beta-219835	cal A.D. 1520–1820	165 ± –35	cal A.D. 1490–1700	8B
Feature 449	canary grass	Beta-230908	cal A.D. 1490–1960	N/A	cal A.D. 1490–1960	8B
CU 141, Level 52	venus clam	Beta-235978	cal A.D. 1650–1950	165 ± –35	cal A.D. 1540–1850	8B
Feature 137	olivella	Beta-238391	cal A.D. 1460–1670	450 ± –40	cal A.D. 1692–1950	8B/C[c]
Feature 26	olivella	Beta-238868	cal A.D. 1480–1690	450 ± –40	cal A.D. 1713–1950	8B/C[c]
Feature 294	olivella	Beta-238865	cal A.D. 1480–1730	450 ± –40	cal A.D. 1720–1950	8B/C[c]
Feature 4	abalone	Beta-238866	cal A.D. 1520–1810	450 ± –40	cal A.D. 1720–1950	8B/C[c]
Feature 145	olivella	Beta-238869	cal A.D. 1520–1820	450 ± –40	cal A.D. 1720–1950	8B/C[c]
CU 321, Level 89	sediment	Beta-194255[b]	3340–2920 cal B.C.	N/A	3340–2920 cal B.C.	N/A
CU 321, Level 80	sediment	Beta-194254[b]	1950–1690 cal B.C.	N/A	1950–1690 cal B.C.	N/A
CU 323, Level 81	venus clam	Beta-219818	2110–1750 cal B.C.	400 ± –50; –50 ± –100	1870–1510 cal B.C.; 2580–1970 cal B.C.	?
CU 320, Level 53	scallop	Beta-219830	1060–780 cal B.C.	400 ± –50; –50 ± –100	860–500 cal B.C.; 1510–950 cal B.C.	?
Feature 688	littleneck clam	Beta-234670	cal A.D. 900–1180	165 ± –35	cal A.D. 830–1100	?

Note: All samples were measured via AMS unless otherwise indicated.
Key: N/A = not applicable.
[a] Sample was measured radiometrically, with extended counting.
[b] Sample was measured radiometrically.
[c] Depending on which ΔR is applied, samples may belong to either subepisode indicated.

Table 10. Radiocarbon Results from Paired Shell Samples from LAN-62 Locus A/G

Context	Species	Laboratory No.	Corrected Age (B.P.)	Age Difference (Years)
CU 682, Level 46	venus clam	Beta-219836	950 + 40	–160
	oyster	Beta-219829	1110 + 50	–160
CU 682, Level 48	venus clam	Beta-219839	2980 + 70	920
	littleneck clam	Beta-219831	2060 + 40	920
CU 682, Level 52	venus clam	Beta-219825	2790 + 40	–120
	scallop	Beta-219817	2910 + 40	–120
Feature 419, Level 58	venus clam	Beta-231974	2230 + 40	250
	littleneck clam	Beta-231973	1980 + 40	250
Feature 640, Level 1	venus clam	Beta-231979	930 + 40	–1,780
	littleneck clam	Beta-231978	2710 + 50	–1,780
Feature 672, Level 3	venus clam	Beta-231981	4570 + 40	2,600
	scallop	Beta-231980	1970 + 40	2,600
Feature 687, Level 89	venus clam	Beta-234674	1200 + 40	250
	scallop	Beta-234672	950 + 40	250
Feature 688, Level 92	littleneck clam	Beta-234670	1590 + 40	–190
	scallop	Beta-234671	1780 + 40	–190

for the seven pairs and in terms of the littleneck clam in the eighth pair. The results from two pairs seemed to indicate mismatched age groups, with differences of 1,780 radiocarbon years, for the paired venus clam and littleneck clamshells from Feature 640, and 2,600 radiocarbon years, for the paired venus clam and scallop from Feature 672. It seems likely that postdepositional mixing was to blame for those pairings, although it is impossible to determine which of the paired samples was actually related to the recovery feature. Likewise, the 920-year difference between the paired venus clam and littleneck clamshells from CU 682, Level 48, is suggestive of postdepositional mixing rather than potentially contemporary specimens, particularly because the venus clam produced a corrected date similar to dates from deeper levels. The remaining five pairs, however, appeared to consist of relatively contemporary specimens, and the intrapair difference ranged from 120 to 250 radiocarbon years. That range is comparable to the within-shell variability that Culleton et al. (2006) documented for multiple samples recovered from individual shells. It seems likely, then, that for this data set, any true interspecies variability in radiocarbon content was on the order of other known sources of radiocarbon variability.

In addition to matched shell pairs, efforts were made to isolate matched pairs of plant materials and marine shells in order to determine the local reservoir offset for the Ballona (ΔR) at different points in the Holocene. However, botanical preservation was relatively poor at the site, and few datable plant materials were recovered. In the end, a suite of four paired botanical and shell samples were isolated from Feature 687, providing the only opportunity from LAN-62 to determine the local reservoir correction directly. The four samples consisted of five canarygrass seeds (Beta-234677), seven barley seeds (Beta-234676), and individual scallop shells (Beta-234672) and venus clamshells (Beta-234674). The determinations obtained for the two botanical samples were statistically indistinct from each other ($df = 1$; $T = 0.5$; $\chi^2_{0.05} = 3.8$), and a combined conventional age of 460 ± 28 B.P. was calculated. That combined age was converted to the equivalent marine age of 910 ± 28 B.P. through comparison with the terrestrial (Reimer et al. 2004) and marine (Hughen et al. 2004) calibration data sets (Stuiver and Braziunas 1993). The ΔR determination for each shell was then calculated by deducting the combined botanical-equivalent marine age from the shell's conventional radiocarbon age. The associated error for those determinations was derived from the error on the combined sample and on the measured marine age by taking the square root of the sum of the squared error terms (Reimer et al. 2002). A ΔR of 40 ± 50 was calculated for the scallop shell, and a ΔR of 290 ± 50 was calculated for the venus clamshell. A weighted mean ΔR of 165 ± 35 was calculated for those two determinations—slightly smaller than the average ΔR of 220 ± 40 that has been calculated for the southern California coast (Ingram and Southon 1996). The ΔR value calculated in this study likely reflected the mixed freshwater and marine reservoirs present in the Ballona, and it provided a better estimate of the local reservoir correction than one governed solely by marine upwelling. Therefore, it was applied in this study to dates derived from late Holocene–aged estuarine-shell samples (marine conventional dates between roughly 2250 and 600 B.P.), but it was not applied to dates derived from abalone or olivella shell, because those species live in marine environments exposed directly to upwelling deep waters, making a marine reservoir correction more appropriate.

Occupation Episodes at LAN-62 Locus A/G

Evaluation of the 88 cultural radiocarbon dates (i.e., excluding the 2 sediment samples) obtained from this locus suggested that at least eight robust temporal groups were represented within the dated sample. Below, we summarize the occupation episodes indicated by the radiocarbon dates derived for the site, beginning with the earliest occupation. Occupation episodes are numbered 1–8 for LAN-62 Locus A/G; Episode 1 represents the oldest occupation of the site, and Episode 8 represents the most recent occupation.

Episode 1

The earliest episode (Episode 1) documented from this area of the site occurred roughly 6,400 years ago and was represented by three venus clamshells, two of which were recovered from CUs 115 and 321 and one of which was recovered from Feature 690. The conventional dates for those three samples spanned 230 radiocarbon years, although they were not significantly different from each other (*df* = 2; T = 2.478; $\chi^2_{0.05}$ = 5.991; A = 82.8 percent; An = 40.8 percent). The combined age for the group was 4910–4320 cal B.C. (standard ΔR) or 4990–4280 cal B.C. (age-specific ΔR), and it occurred at least 1,400–1,700 years prior to the next-oldest documented episode at the site.

Episode 2

Episode 2 was represented by four shells recovered from Features 449 and 672 and CUs 321 and 323. The conventional dates from those shells spanned 170 radiocarbon years, and they formed a relatively cohesive group (*df* = 3; T = 2.050; $\chi^2_{0.05}$ = 7.815; A = 102.0 percent; An = 35.4 percent). The combined age for Episode 7 was 2890–2370 cal B.C. (standard ΔR) or 3010–2320 cal B.C. (age-specific ΔR). This group was separated from the beginning of Episode 3 by at least 140 radiocarbon years, although the calibrated ages for members of each group overlapped to some extent.

Episode 3

Episode 3 consisted of 11 shell samples recovered from CUs 25, 26, 114, 115, 141, 323, 333, and 344 and Features 518 and 673. The conventional dates from those shells spanned 200 radiocarbon years, and they formed a relatively cohesive group within that period (*df* = 10; T = 3.762; $\chi^2_{0.05}$ = 18.307; A = 154.1 percent; An = 21.3 percent). The combined age for Episode 3 was 2610–1760 cal B.C. (standard ΔR) or 2680–1720 cal B.C. (age-specific ΔR). This episode was separated from the beginning of Episode 4 by roughly 550 radiocarbon years, although the possible difference in the prevailing carbon reservoir (i.e., the ΔR value) for the two groups may reduce that separation to roughly 300 radiocarbon years.

Episode 4

Episode 4 consisted of a venus clamshell recovered from CU 344 and a littleneck clamshell recovered from CU 320. The conventional dates obtained from those two shells were separated by only 20 radiocarbon years, and they were statistically indistinguishable from each other (*df* = 1; T = 0.016; $\chi^2_{0.05}$ = 3.841). The combined age for the two samples was 1590–1120 cal B.C. (standard ΔR), 1380–890 cal B.C. (ΔR = 400 ± 50), or 2020–1380 cal B.C. (ΔR = –50 ± 100). Two additional shell dates bracketed this tentative episode, although each was statistically different from the Episode 4 dates and from those of preceding and succeeding episodes. The older of them (Beta-219818) was obtained from a venus clamshell recovered from CU 323; the conventional date from that shell was 440 radiocarbon years older than the Episode 4 dates and 110 radiocarbon years younger than the youngest date from Episode 3. The younger date (Beta-219830) was obtained on a scallop shell recovered from CU 320, and it was 360 radiocarbon years younger than the Episode 4 dates and 200 radiocarbon years older than the oldest date from Episode 5. Together, the four shell dates defined an 800-year period with a combined age of 2110–780 cal B.C. (standard ΔR), 1870–500 cal B.C. (ΔR = 400 ± 50), or 2580–950 cal B.C. (ΔR = –50 ± 100). As with other sparsely represented periods in the site's history, it is unknown whether the paucity of dates during that 800-year period was an accurate reflection of site use or a product of sampling strategy. It should be noted that this apparently sparsely represented period coincided with a dynamic period of carbon-reservoir fluctuations, although that may have been coincidental.

Episode 5

Episode 5 consisted of a very cohesive set of dates obtained from 15 marine shells recovered from various levels in CUs 26, 114, 115, 141, 316, 320, 321, 323, 422, and 682 and from Feature 234 (*df* = 14; T = 7.814; $\chi^2_{0.05}$ = 23.685; A = 104.3 percent; An = 18.3 percent). The conventional dates obtained from those shells spanned 200 radiocarbon years, although the dates from 14 of the shells fell within 130 years of each other. The oldest shell in the group (Beta-188333) was 70 radiocarbon years older than the next-oldest samples in the group, and it was included in the episode because it was statistically indistinguishable from the other members of the group and statistically different from older samples. The combined age for this group was 840–220 cal B.C. (standard ΔR) or 1250–570 cal B.C. (age-specific ΔR). It should be noted that the younger end of the group was separated from the beginning of Episode 6 by only 60 radiocarbon years and, at most, 90 calendar years. However, the tight clustering of the dates included in Episode 5 suggests that they reflect a distinct episode of human activity in this portion of the site. It is possible that the apparent break between the two episodes was due to sampling strategy and that one or more early date included in Episode 6 was related to the activity documented by Episode 5, instead. However, the scenario posited here is reasonable, given the available data.

Episode 6

Episode 6 included 10 marine-shell samples recovered from Feature 640 and from various levels of CUs 26, 114, 316, 320, 323, 682, and 853. The group spanned 370 radiocarbon years and could be subdivided into two tentative subepisodes. The older Subepisode 6A included 6 samples spanning 150 radiocarbon years (*df* = 5; T = 4.658; $\chi^2_{0.05}$ = 11.071; A = 92.4 percent; An = 28.9 percent) and had a date range of 520–10 cal B.C. (standard ΔR) or 880–380 cal B.C. (age-specific ΔR). The younger Subepisode 6B included 4 samples spanning 150 radiocarbon years (*df* = 3; T = 3.814; $\chi^2_{0.05}$ = 7.815; A = 78.6 percent; An = 35.4 percent) and had a date range of 250 cal B.C.–cal A.D. 250 (standard ΔR) or 700–120 cal B.C. (age-specific ΔR). These subepisodes are tentative, serving primarily as a means to account for the variability within the proposed episode. The division between subepisodes did not necessarily reflect a real break in human activity in this area, because most members of each subepisode were statistically indistinct from one or more members of the other subepisode; however, the internal cohesion of each subepisode was much higher than that of the group as a whole, supporting the idea that multiple periods of human activity were reflected. The episode itself was defined primarily by its temporal separation from the preceding and subsequent groups and the lack of decisive breaks or clustering within the included samples. It was separated from the early end of the subsequent Episode 7 by 240 radiocarbon years, although when the ΔR values proposed here for the two time periods were considered, the gap between the episodes stretched to nearly 500 radiocarbon years, or 340–690 calendar years.

Episode 7

Episode 7 included 13 shells recovered from six features (Features 169, 384, 419, 621, 672, and 688) and CUs 141, 233, 333, and 682. The conventional dates obtained from those shells spanned 450 radiocarbon years, suggesting that, again, more than one episode was represented in the data set; however, the continuity of the conventional- and calibrated-date ranges made it difficult to clearly differentiate separate occupations within that period. Statistical evaluation of the data set suggested that at least two different occupations may have been represented by the 13 shells, although the subepisodes presented here are tentative. The older Subepisode 7A spanned 190 radiocarbon years (*df* = 6; T = 7.702; $\chi^2_{0.05}$ = 12.592; A = 54.8 percent; An = 26.7 percent) and had a date range of cal A.D. 230–720 (standard ΔR) or cal A.D. 160–670 (age-specific ΔR). The younger Subepisode 7B spanned 200 radiocarbon years (*df* = 5; T = 10.377; $\chi^2_{0.05}$ = 11.071; A = 34.8 percent; An = 28.9 percent) and had a date range of cal A.D. 510–980 (standard ΔR) or cal A.D. 450–900 (age-specific ΔR). The two subepisodes overlapped in age, and it is likely that contemporaneous samples were split between the two subepisodes. It was clear that the oldest and youngest members of the larger episode differed in age, but it was more difficult to differentiate between samples in the middle of the range. Tentative division of the larger episode into two internally cohesive subepisodes seemed the most parsimonious way to account for the variability included in the episode.

Overall, this episode was separated from the start of Episode 8, the youngest episode at the site, by roughly 320–840 calendar years. A single date obtained on a littleneck clamshell (Beta-234670) recovered from Feature 688 was intermediate to the two episodes and statistically different from the members of each, including a second shell recovered from the same feature. It is possible that the clamshell reflected an occupation that was missed by our sampling strategy, but without additional data, it is treated here as an isolated date.

Episode 8

The youngest temporal group (Episode 8) identified in this data set covered the past 800 years and included 27 dates obtained from a variety of materials and recovery contexts. The samples included in this group consisted of 19 marine shells recovered from Features 4, 249, 335, 640, 684, and 687 and CUs 26, 114, 141, 320, 323, 333, and 682; 5 olivella beads recovered from Features 26, 137, 145, 207, and 294; and 3 macrobotanical samples recovered from Features 449 and 687. The group was not particularly cohesive, and the included shell conventional dates spanned 420 radiocarbon years, suggesting that more than one episode was represented. However, the fairly continuous spread of the included conventional dates made it difficult to delineate distinct occupation episodes, a task that was complicated further by the uncertainty in individual carbon reservoirs.

Statistical evaluation suggested that at least two to three subepisodes may have been present within Episode 8; however, the composition of those subepisodes changed when different ΔR values were applied to the marine-shell dates. Under the standard ΔR, the 27 samples divided into two groups with dates of roughly cal A.D. 1300–1650 and cal A.D. 1500–1850. Application of the local ΔR calculated from that data set (ΔR = 165 ± 35) to the estuarine-shell samples (i.e., clams, oysters, and scallops) changed the ages of those groups slightly to cal A.D. 1250–1600 and cal A.D. 1480–1850, respectively, although the compositions of the two groups remained the

Table 11. Radiocarbon Results for LAN-62 Locus C/D

Context	Material	Sample No.	Calibrated Age (Standard ΔR)	ΔR	Calibrated Age (Alternate ΔR)	Episode No.
CU 724, Level 77	pismo clam	Beta-190480[a]	2860–2430 cal B.C.	210 ± –80	2890–2340 cal B.C.	1
CU 540, Level 81	scallop	Beta-190481[a]	2640–1970 cal B.C.	210 ± –80	2730–1940 cal B.C.	1
Feature 201	artiodactyl	NZA-28135	cal A.D. 420–560	N/A	N/A	2
CU 534, Level 101	venus clam	Beta-191109[a]	cal A.D. 1270–1450	165 ± –35	cal A.D. 1220–1420	3
CU 534, Level 84	venus clam	Beta-230296	cal A.D. 1410–1630	165 ± –35	cal A.D. 1330–1530	4
CU 534, Level 101	venus clam	Beta-230295	cal A.D. 1500–1810	165 ± –35	cal A.D. 1480–1690	4
CU 923, Level 0	abalone	Beta-193296[a]	cal A.D. 1450–1680	450 ± –40	cal A.D. 1690–1950	4
CU 925, Level 0	abalone	Beta-193297[a]	cal A.D. 1530–1890	450 ± –40	cal A.D. 1720–1950	4

Note: All samples were measured via AMS unless otherwise indicated.
Key: N/A = not applicable.
[a] Sample was measured radiometrically, with extended counting.

same. However, when a ΔR value reflecting an upwelling event (ΔR = 450 ± 50) was then applied to the abalone- and olivella-shell samples, a third and younger group appeared. In that scenario, four olivella beads and one abalone shell formed a historical-period-aged group dating to roughly cal A.D. 1720–1950, and an older olivella bead and an abalone shell shifted from the oldest to the middle group. Although that last scenario is plausible given documented upwelling events for the past few centuries (Culleton et al. 2006), the isotopic signatures ($\delta^{18}O$ and $\delta^{13}C$) obtained for these samples suggested that the shells formed in an environment with little to no upwelling (Eerkens et al. 2005). In light of that, it seemed best to apply the standard ΔR to the abalone- and olivella-shell samples, making the second scenario, in which two subepisodes were identified, a more realistic interpretation of the data. It should be noted that the isotopic signature obtained for the olivella bead (Beta-238391) recovered from Feature 137 was markedly different from those of other beads in the data set and from modern baseline values reported by Eerkens et al. (2005) for different parts of southern California. The very negative $\delta^{18}O$ and positive $\delta^{13}C$ values suggested that the organism grew in a different environment from that of the other specimens included in the data set, one with warmer water, although it is unclear whether that related to a different geographic locale (e.g., Gulf of California) or to climatic fluctuations, such as an El Niño/La Niña–Southern Oscillation event.

Results for LAN-62 Locus C/D

Only eight radiocarbon dates were obtained for Locus C/D, one of which was obtained on a deer long bone recovered from Feature 201 (Table 11; see Appendix 3.1, this volume). The remaining seven dates were obtained on marine shells recovered from five CUs in the loci (CUs 534, 540, 724, 923, and 925), including specimens of abalone, scallop, venus clam, and pismo clam. The deer bone and two venus clamshells were dated via AMS analysis; the remaining five samples were dated through radiometric analysis, with extended counting. Stable-oxygen isotopes were measured for the samples of venus clam, scallop, and pismo clam.

Occupation Episodes at LAN-62 Locus C/D

The results obtained from the eight samples suggested that at least three or four occupation episodes were reflected. Below, we summarize the occupation episodes indicated by the radiocarbon dates derived for the site, beginning with the earliest occupation. Occupation episodes are numbered 1–4 for LAN-62 Locus C/D; Episode 1 represents the oldest occupation of the site, and Episode 4 represents the most recent occupation.

Episode 1

The earliest evidence of occupation (Episode 1) within Locus C/D came from a scallop shell recovered from CU 540 and a pismo clamshell recovered from CU 724. The dates from those two shells differed by 220 radiocarbon years, but they were not statistically different from each other ($df = 1$; T = 2.254; $\chi^2_{0.05} = 3.841$; A = 66.8 percent; An = 50.0 percent). The combined date range for the episode was 2860–1970 cal B.C. (standard ΔR) or 2890–1940 cal B.C. (age-specific ΔR), and it occurred 2,440–3,150 years prior to Episode 2.

Episode 2

An artiodactyl-long-bone fragment recovered from Feature 201 (NZA-28135) provided evidence for the second dated occupation episode in this portion of the site. The fragment produced the calibrated date of cal A.D. 420–560, and it predated the subsequent episode by at least 660 calendar years.

Episode 3

The third occupation episode in this area was represented by one of two venus clamshells (Beta-191109) recovered from Level 101 of CU 534. That sample produced a calibrated date of cal A.D. 1270–1450 (standard ΔR) or cal A.D. 1220–1420 (age-specific ΔR). The conventional date for the sample was 190 radiocarbon years older than that of the oldest sample in subsequent Episode 4, and it was statistically different from all samples included in that episode.

Episode 4

The most recent episode (Episode 4) in this area included two venus clamshells recovered from Levels 84 and 101 of CU 534 and two abalone shells recovered from CUs 923 and 925. The corrected ages for those shells spanned 220 radiocarbon years, which is within the range of potentially contemporaneous specimens. However, it is likely that the abalone shells incorporated carbon from a different, and potentially older, carbon reservoir than the venus clamshells, in which case, the true age difference between those shells could be on the order of centuries. Furthermore, the samples did not form a statistically cohesive group, because the data from one of the venus clamshells (Beta-230296) were statistically different from those of the other four shells. The conservative approach adopted for this project, however, indicated that the four shells should be grouped together, based on the relatively short span separating their conventional dates. The total age for this episode, then, was cal A.D. 1410–1890 (standard ΔR) or cal A.D. 1330–1950 (age-specific ΔR). It should be noted that, based on the calibrated ages, two subepisodes were apparent within this episode, although the subepisodes changed depending on the reservoir correction applied. When the standard ΔR value was applied to all four samples, an older subepisode with a date range of cal A.D. 1410–1680 was suggested by one abalone shell (Beta-193296) and one venus clamshell (Beta-230296), and a younger subepisode with date range of cal A.D. 1500–1890 was suggested by the other abalone shell (Beta-193297) and venus clamshell (Beta-230295). However, when the alternate ΔR values of 450 ± 40 and 165 ± 35 were applied to the abalone and venus clamshells, respectively, the two abalone shells formed a younger subepisode with an age range of cal A.D. 1690–1950, and the two venus clamshells formed an older subepisode with an age range of cal A.D. 1330–1690. Without additional lines of evidence, it is impossible to determine which, if any, of these scenarios best defines the temporal relationship between the samples and reflects the history of dated activity in this area.

LAN-62 Summary

Evaluation of the radiocarbon determinations obtained for Loci A/G and C/D at LAN-62 suggested that at least eight different occupation episodes were represented within the dated sample. Those episodes spanned nearly 7,000 years, from the early Millingstone period through the historical period, although five well-defined temporal gaps were present within the data set. It is unknown, of course, whether those gaps were due to our sampling strategy or reflected true decreases in human activity within the excavated portion of the site. It should be noted that all four of the episodes identified within Locus C/D corresponded well to periods of activity identified in Locus A/G. Those correspondences are discussed below.

Episode 1 encompasses the earliest activities documented in the data set, and it was represented at Locus A/G only. This episode occurred during the early Millingstone period and dated to either 4910–4320 cal B.C. (standard ΔR) or 4990–4280 cal B.C. (age-specific ΔR). It included levels from CUs 115 and 321 at Locus A/G, and it was separated from the start of Episode 2 by at least 1,400–1,700 years.

Both Episodes 2 and 3 spanned the late Millingstone period, and they were documented in both areas of the site. In the Locus A/G area, these episodes appeared to reflect at least two separate periods of activity, although temporal overlap between the included dates suggested that some features assigned to different episodes may have been contemporaneous. By contrast, only a single period of activity was identified for this time period in Locus C/D, and this period spanned the overlap between Episodes 2 and 3. Although the two Locus C/D dates from the period were statistically indistinguishable, they fell within different episodes for the site. Without additional data, it was difficult to ascertain the true temporal relationship between the two contexts, and they were tentatively reassigned to the site-level episodes. Overall, then, Episode 2 included Features 449 and 672 and levels from CUs 321 and 323 at Locus A/G and one level from CU 724 at Locus C/D. This episode dated to either 2890–2370 cal B.C. (standard ΔR) or 3010–2320 cal B.C. (age-specific ΔR), and it was separated from Episode 3 by at most 250 years. The latter episode included levels in CUs 25, 26, 114, 115, 141, 323, 333, and 344 and Features 518 and 673 at Locus A/G and one level from CU 540 at Locus C/D. Episode 3 dated to either 2610–1760 cal B.C. (standard ΔR) or 2680–1720 cal B.C. (age-specific ΔR), and it ended no more than 440 years prior to Episode 4.

The two samples that made up Episode 4 and two additional samples from Locus A/G spanned the 900 radiocarbon years following the end of Episode 3, covering the end of the Millingstone period and the beginning of the Intermediate period. The samples may reflect sporadic activity in this area between roughly 2110 and 780 cal B.C., 1870 and 500 cal B.C., or 2580 and 950 cal B.C., depending on the prevailing carbon reservoir. Episode 4 itself included a level from CU 320 and from CU 344 at Locus A/G and dated to 1590–1120 cal B.C. (standard ΔR), 1380–890 cal B.C. (ΔR = 400 ± 50), or 2020–1380 cal B.C. (ΔR = –50 ± 100).

Episode 5 was documented only in Locus A/G, and it spanned much of the early Intermediate period. This episode included Feature 234 and levels from CUs 26, 114, 115, 141, 316, 320, 321, 323, 422, and 682, and it dated to either 840–220 cal B.C. (standard ΔR) or 1250–570 cal B.C. (age-specific ΔR). This episode was distinguished by a series of very tightly distributed dates, and it was separated from the proposed start of Episode 6 by no more than 90 years.

Episode 6 spanned the early half of the Intermediate period, and it was represented only in the data set from Locus A/G. This episode was divided tentatively into two subepisodes; the earlier Subepisode 6A dated to 520–10 cal B.C. (standard ΔR) or 880–380 cal B.C. (age-specific ΔR), and the later Subepisode 6B dated to either 250 cal B.C.–cal A.D. 250 (standard ΔR) or 700–120 cal B.C. (age-specific ΔR). The older subepisode included Feature 640 and various levels from CUs 26, 114, 320, 323, and 682, and the younger subepisode included levels from CUs 316, 320, and 853. Depending on the prevailing carbon reservoirs, the two subepisodes may have overlapped temporally or been separated by up to 300 years.

Episode 7 occurred at least 340 years after the end of Episode 6 and spanned the transition between the late Intermediate period and the early late prehistoric period. The episode was subdivided into two tentative subepisodes at roughly cal A.D. 500; the earlier Subepisode 7A corresponds to the late Intermediate period portion of Episode 7, and the later Subepisode 7B corresponds to the late prehistoric period portion. The subepisodes were not treated as distinct groups, because the temporal overlap between the included dates precluded a definitive division. The older subepisode included Feature 169, the second sample from Feature 419, and various levels from CUs 141, 233, 333, and 682 at Locus A/G, as well as Feature 201 at Locus C/D. This subepisode dated to either cal A.D. 230–720 (standard ΔR) or cal A.D. 160–670 (age-specific ΔR). The younger subepisode was represented only in Locus A/G, and it included Features 384, 621, and 672; one of two samples from Feature 419; one of two samples from Feature 688; and one level from CU 141. This subepisode dated to either cal A.D. 510–980 (standard ΔR) or cal A.D. 450–900 (age-specific ΔR), and it was separated from the start of Episode 8 by at least 340 years.

Finally, the youngest episode identified at the site (Episode 8) spanned the late prehistoric, Protohistoric, and Historical periods, and it was present in both loci. Two or three possible subepisodes were identified within the episode, depending on the reservoir correction applied, and all three subepisodes were identified at both loci. The oldest Subepisode 8A included Features 207, 249, 684, and 687 and levels from CUs 26, 114, 320, 323, and 682 at Locus A/G and two levels from CU 534 at Locus C/D, although the samples from Features 207 and 249 shifted to Subepisode 8B when the upwelling ΔR value was applied. Subepisode 8A dated to either cal A.D. 1230–1680 (standard ΔR) or cal A.D. 1190–1650 (age-specific ΔR). The middle Subepisode 8B included Features 335, 449, and 640 and various levels from CUs 141, 323, and 333 at Locus A/G and a level from CU 534 at Locus C/D. The subepisode dated to either cal A.D. 1480–1950 (standard ΔR) or cal A.D. 1450–1850 (age-specific ΔR). The youngest possible Subepisode 8C included Features 4, 26, 137, 145, and 294 at Locus A/G and CUs 923 and 925 at Locus C/D, and it dated to roughly cal A.D. 1700–2000. This subepisode was fairly tentative and only existed when the upwelling ΔR value of 450 ± 40 was applied; under the standard ΔR value, these contexts were included in Subepisode 8B.

Chronometric Data for LAN-193

Methods for LAN-193

The chronometric data recovered for LAN-193 came from 17 radiocarbon samples recovered from two features (Features 7 and 9), CU 21, and Bucket Auger 539. All 17 samples were submitted for AMS analysis (Table 12; see Appendix 3.1, this volume). The two bucket-auger samples were submitted during testing, to obtain preliminary estimates of the ages of prehistoric deposits; the 9 CU samples were submitted in 2006, to build the chronometric framework for the site; and the 6 feature samples were submitted in 2007, to help tie the features to the site chronology. One sample, submitted from Feature 7 (NZA-29330), was a piece of artiodactyl long bone, and the other 16 samples from the site consisted of individual marine-shell specimens. The dated marine shell at the site included specimens of abalone, frog snail, moon snail, oyster, pismo clam, and venus clam.

Multiple samples were submitted for dating from Features 7 and 9. The two samples from Feature 9 (Beta-235880 and Beta-235881) consisted of venus clam specimens, and the determinations obtained from them were statistically indistinguishable (*df* = 1; T = 2.180; $\chi^2_{0.05}$ = 3.841; A = 78.6 percent; An = 50.0 percent). A combined date of 570–350 cal B.C. was calculated for Feature 9 from the two samples, using the Marine04 data set and a ΔR of 220 ± 40. That date range shifted to 910–750 cal B.C. when the age-specific ΔR value of –85 ± 40 was applied. The age-specific ΔR value that was applied to the samples from Feature 9 and to other marine samples from the project was calculated from the samples recovered from Feature 7. In all, four samples from that feature were submitted for dating, three of which consisted of marine-shell specimens, including an oyster shell, a moon snail shell, and a frog snail shell, and the fourth of which consisted of an artiodactyl-long-bone fragment. Statistical evaluation of the radiocarbon determinations obtained from the three marine-shell samples indicated no significant difference between the determinations derived from the oyster shell (Beta-230285) and the frog snail shell (Beta-235879) (*df* = 1; T = 0.095; $\chi^2_{0.05}$ = 3.841; A = 122.6 percent; An = 50.0 percent), but the moon-snail-shell sample (Beta-235882) was found to be different from both of those. Given the moon snail shell's much older radiocarbon age, it seemed likely that the specimen reflected

Table 12. Radiocarbon Results for LAN-193

Context	Material	Sample No.	Calibrated Age (Standard ΔR)	ΔR	Calibrated Age (Alternate ΔR)	Episode No.
CU 21, Level 15	abalone	Beta-221554	2360–1980 cal B.C.	210 ± –80	2450–1940 cal B.C.	1
Feature 7	moonsnail	Beta-235882	1900–1570 cal B.C.	210 ± –80	1980–1500 cal B.C.	1
Feature 9	venus clam	Beta-235880	730–380 cal B.C.	–85 ± –40	1040–770 cal B.C.	2
Feature 9	venus clam	Beta-235881	530–190 cal B.C.	–85 ± –40	900–570 cal B.C.	2
Feature 7	frog snail	Beta-235879	150 cal B.C.–cal A.D. 160	–85 ± –40	510–180 cal B.C.	3
CU 21, Level 12	pismo clam	Beta-221557	110 cal B.C.–cal A.D. 200	–85 ± –40	470–160 cal B.C.	3
Feature 7	oyster	Beta-230285	90 cal B.C.–cal A.D. 220	–85 ± –40	450–150 cal B.C.	3
CU 21, Level 3	venus clam	Beta-222333	80 cal B.C.–cal A.D. 230	–85 ± –40	430–130 cal B.C.	3
CU 21, Level 11	pismo clam	Beta-221555	80 cal B.C.–cal A.D. 230	–85 ± –40	430–130 cal B.C.	3
Feature 7	artiodactyl	NZA-29330	390–200 cal B.C.	N/A	390–200 cal B.C.	3
Bucket Auger 539	unidentified shell	Beta-129439	cal A.D. 90–570	–85 ± –40	320 cal B.C.– cal A.D. 200	3/4
Bucket Auger 539	unidentified shell	Beta-129440	cal A.D. 290–600	–85 ± –40	60 cal B.C.– cal A.D. 250	3/4
CU 21, Level 9	venus clam	Beta-222331	cal A.D. 440–680	165 ± –35	cal A.D. 400–650	4
CU 21, Level 6	venus clam	Beta-222334	cal A.D. 440–690	165 ± –35	cal A.D. 410–660	4
CU 21, Level 14	venus clam	Beta-222332	cal A.D. 450–700	165 ± –35	cal A.D. 420–660	4
CU 21, Level 7	venus clam	Beta-222330	cal A.D. 460–710	165 ± –35	cal A.D. 430–670	4
CU 21, Level 10	venus clam	Beta-221556	cal A.D. 460–720	165 ± –35	cal A.D. 430–670	4

Note: All samples were measured via AMS.
Key: N/A = not applicable.

postdepositional mixing, and it was excluded from reservoir-correction calculations. Instead, the conventional dates derived from the oyster shell and the frog snail shell were compared to the equivalent marine age of 2600 ± 40 B.P. calculated for the long-bone sample. That equivalent marine age was obtained by comparing the sample's conventional age of 2234 ± 40 B.P. to the terrestrial (Reimer et al. 2004) and marine (Hughen et al. 2004) global data sets (Stuiver and Braziunas 1993). The ΔR determination for each of the two shells was then calculated by deducting the equivalent marine age for the artiodactyl sample from the shell's conventional radiocarbon age. The associated error for those determinations was derived from the error on the artiodactyl sample and on the measured marine age by taking the square root of the sum of the squared error terms (Reimer et al. 2002). A ΔR of –70 ± 57 was calculated for the frog snail shell, and a ΔR of –100 ± 57 was calculated for the venus clamshell. The weighted mean ΔR of –85 ± 40 was calculated for those two determinations—very similar to ΔR values calculated for the Santa Barbara Channel during that time (Kennett et al. 1997; Roark et al. 2003). The ΔR value calculated in this study likely provides a better estimate of the local reservoir correction for the Ballona, and it was applied to marine conventional dates between roughly 3000 and 2000 B.P.

Results for LAN-193

Evaluation of the 17 radiocarbon determinations obtained for the site suggested that at least four temporal groups were represented in the dated sample. Below, we summarize the occupation episodes indicated by the radiocarbon dates derived for the site, beginning with the earliest occupation. Occupation episodes are numbered 1–4 for LAN-193; Episode 1 represents the oldest occupation of the site, and Episode 4 represents the most recent occupation.

Episode 1

The earliest human activity indicated by the dated sample preceded all other dated activity at the site by more than 1,000 radiocarbon years. This loosely defined period (Episode 1) was indicated by the moon-snail-shell sample from Feature 7 and an abalone sample recovered from Level 15 in CU 21. The radiocarbon determinations obtained from those two samples were separated by 330 radiocarbon years and were statistically different from each other, although it is possible that the observed age difference was due to species-specific differences in carbon content. Both species can be found in intertidal and subtidal areas, and work by researchers in New Zealand (Hogg et al. 1998) found statistical differences in the carbon content of contemporaneous specimens recovered from each of those environments. On the other hand, it's possible, as well, that the moon snail shell did not, in fact, reflect subsistence activities and had been simply picked up off the beach at some point after death. Without additional information, though, it seemed best to assign the two samples to a broad, loosely defined period of site activity.

The age range for this period was 2360–1570 cal B.C. when the standard ΔR value was used and 2450–1500 cal B.C. when the age-specific ΔR value (210 ± 80) was used. It was separated from Episode 2 by at least 1,090–1,480 years (standard ΔR) or 660–1,160 years (age-specific ΔR).

Episode 2

The paired venus clamshell samples from Feature 9 formed the second temporal group (Episode 2) represented in the dated sample from LAN-193. As discussed above, a combined age of 570–350 cal B.C. was calculated for the feature with the standard ΔR value, and an age of 910–750 cal B.C. was calculated with the age-specific ΔR value (–85 ± 40). Incidentally, when the individual sample dates were used instead of the combined date, the age ranges for the feature and the episode expanded to 730–190 cal B.C. and 1040–570 cal B.C., respectively. It was estimated that Feature 9 predated activities associated with Episode 3 by no more than 310 years when the standard ΔR was used or by 280–560 years when the age-specific ΔR was applied.

Episode 3

Episode 3 included samples recovered from three levels of CU 21 and the paired oyster-/frog-snail-shell samples from Feature 7. The radiocarbon determinations obtained from those samples spanned 40 radiocarbon years and formed a temporally cohesive group (*df* = 4; T = 0.291; $\chi^2_{0.05}$ = 9.488; A = 177.5 percent; An = 31.6 percent). The calibrated age range for Episode 3 was 150 cal B.C.–cal A.D. 230 when the standard ΔR value was used and 510–130 cal B.C. when the age-specific ΔR value (–85 ± 40) was used. The interval separating this episode from later Episode 4 lasted roughly 220–510 years when the standard reservoir correction was applied and 530–800 years when the age-specific reservoir corrections were applied. It should be noted that the dates derived from the two bucket-auger samples fell between the two episodes and may or may not reflect a separate period of activity at the site. The determinations from those two samples were statistically indistinct from each other, and each passed a χ^2 test with the samples from at least one of the two episodes; however, they both failed OxCal's Combine tests, making it difficult to confidently ascertain their temporal relationship to the other samples. Furthermore, from a culture-history perspective, the lack of recovery context for the two samples would make it difficult to link the obtained dates to the site's history, and it seemed best to exclude them from further analyses. Although it is possible that those shells reflected a different period of site activity than the other dated samples, there was no way to link those dates to the material culture recovered from the site.

Episode 4

The youngest group (Episode 4) included venus clamshells recovered from five different levels in CU 21. Those five samples produced a very cohesive set of radiocarbon determinations (*df* = 4; T = 0.224; $\chi^2_{0.05}$ = 9.488; A = 156.7 percent; An = 31.6 percent) with a span of only 40 radiocarbon years. The calibrated age for Episode 4 ranged between cal A.D. 440 and 720 when the standard ΔR value was used and between cal A.D. 400 and 670 when the age-specific ΔR value derived for this project (165 ± 35) was used.

Summary

At least four distinct temporal groups were represented in the dated sample from LAN-193, spanning the late Millingstone and Intermediate periods. The earliest human activity documented at the site (Episode 1) was indicated by two marine snail shells recovered from Feature 7 and CU 21. The broad, loosely defined Episode 1 dated to roughly 2450–1500 cal B.C. and occurred at least 1,090–1,480 years (standard ΔR) or 660–1,160 years (age-specific ΔR) before the next-oldest dated occupation at the site. Episode 2 included two dated samples from Feature 9, and it dated to either 570–350 cal B.C. (standard ΔR) or 910–750 cal B.C. (age-specific ΔR). It occurred up to 310 years (standard ΔR) or between 280 and 560 years (age-specific ΔR) prior to Episode 3, which dated to either 150 cal B.C.–cal A.D. 230 (standard ΔR) or 510–130 cal B.C. (age-specific ΔR) and included samples from Feature 7 and three levels of CU 21. Finally, the youngest group documented at the site (Episode 4) included dated marine shell recovered from five levels of CU 21. Episode 4 dated to either cal A.D. 440–720 (standard ΔR) or cal A.D. 400–670 (age-specific ΔR) and occurred roughly 220–510 years (standard ΔR) or 530–800 years (age-specific ΔR) after Episode 3.

Chronometric Data for LAN-211

Methods for LAN-211

Both AM and radiocarbon samples were recovered from LAN-211 and provided chronometric data for the site. In all, 7 AM samples were collected from Features 4, 6, 8, 22, 26, 28, and 35. In addition, 43 radiocarbon samples recovered from eight features (Features 2, 14, 15, 21, 31, 51, 52, and 53) and CUs 6, 9, 10, 119, 120, 274, 353, and 359 were submitted for dating. Four of those samples were submitted in 2000, to obtain preliminary chronometric information for the site; 30 samples were submitted in 2006, to build the chronometric framework for the site; and the 9 samples associated with features were submitted in 2007, to help refine our understanding of how those features articulated with the site chronology. One sample (Beta-230909) consisted of canarygrass seeds, and the rest consisted of individual marine shells of abalone, scallop, littleneck clam, and venus clam. An abalone shell and a venus clamshell submitted in 2004 were analyzed radiometrically; the rest were submitted for AMS analysis (Table 13; see Appendix 3.1, this volume).

AM Analysis for LAN-211

The seven AM samples collected from LAN-211 were the only such samples collected from the project area, and they were collected from thermal features thought to be historical period in age. Those samples were measured by SRI's Archaeomagnetic Research Program shortly after fieldwork in 2006. Appendix 3.2, this volume, details the measurement, analysis, and interpretive techniques used and provides the laboratory report for each sample. Typically, each sample consisted of between 8 and 12 individually oriented specimens that represented the same archaeological event (e.g., the last firing of a sampled hearth). Each specimen was measured, and the measurements from the specimens were averaged to obtain the sample mean. Each mean was then converted to a VGP, which is simply the location of the magnetic pole that would have created the sample mean.

Of the seven AM samples collected from LAN-211, only five produced sufficiently accurate magnetic data to warrant dating. The α_{95} value calculated for a sample provides an indication of that sample's accuracy. The α_{95} is the radius of the 95-percent-confidence area surrounding an AM direction, and the smaller the radius, the more accurate the sample. Experience has shown that the merit of an AM sample can be categorized according to its α_{95} value, such that samples with values of less than 2.5° are rated "excellent," samples with values of less than 5.0° are rated "good," and samples with values of less than 10.0° are rated "marginal." Samples with α_{95} values of greater than 10.0° are deemed too inaccurate for analytical purposes, which was the case for the samples recovered from Features 6 and 26. Of the remaining samples, those recovered from Features 22, 28, and 35 were considered marginal; the sample recovered from Feature 4 was good; and the sample from Feature 8 was excellent.

The VGP locations calculated for the five accurate AM samples are depicted against the U.S. Southwest curve SWCV2000 (Lengyel and Eighmy 2002) in Figure 8, along with their associated ovals of confidence. Although the Southwest curve is not directly relevant to southern California, it provides a good estimate of the shape and location of the secular-variation curve specific to this region. One curiosity that should be pointed out is the propensity for lower VGP latitudes in this data set than typically are encountered in the Southwest or other areas of the western United States (see Hagstrum and Champion 2002). It is unknown whether that is a feature of southern California secular variation, is related to the magnetic quality of the sampled materials, or reflects one or more postmagnetization disturbance processes. It is hoped that additional AM work in this region will help to clarify the pattern.

AM Results for LAN-211

Dates were obtained for the five accurate samples by comparing the directional data (inclination and declination) measured in each to the Southwest secular variation curve (SWCV595) (LaBelle and Eighmy 1997), the geomagnetic-field models compiled by the BGS (Barraclough 1974, 1995) and the International Association of Geomagnetism and Aeronomy (available online at http://www.ngdc.noaa.gov/ IAGA/vmod/igrf.html), and the historical-period field observations published by Hazard (1917) (Figure 9) (see Chapter 2, this volume, for details). The date ranges are presented in Table 14, along with a "best date" range for each feature. The best date is a somewhat subjective attempt to synthesize the three date ranges obtained for each feature and to provide an inclusive and conservative age range. As shown in Table 14, the best date ranges provided for Features 4, 22, and 28 indicated that those features were historical period in age, having been utilized and abandoned at some point in the past 200–300 years. The best date provided for Feature 35 suggested that it predated both Features 4 and 22, although it may have been coeval with Feature 28. Finally, Feature 8 appeared to predate all but Feature 35, and it may have been utilized during the late prehistoric period. More-specific temporal patterns can be obtained through pairwise statistical comparison of sample VGPs; however, that application is warranted only for samples with α_{95} values of less than 5.0°. Not surprisingly, a comparison of the VGPs from Features 4 and 8, the only samples sufficiently accurate for this exercise, found that they were statistically different at the 0.05 significance level, which is in keeping with the respective date ranges.

Radiocarbon Analysis for LAN-211

Multiple samples were submitted for dating from Feature 2, from Level 59 of CU 119, and from Level 60 of CU 274. The two samples from Feature 2 (Beta-230287 and Beta-230909) consisted of a littleneck clamshell paired with several canarygrass seeds. They were selected in order to obtain an estimate of the local reservoir correction; however, the calculated age difference between the two samples strongly indicated that they reflected different events. An equivalent marine age of 810 ± 35 B.P. was calculated for the canarygrass seeds by comparing the sample's conventional age of 360 ± 40 B.P. to the terrestrial (Reimer et al. 2004) and marine (Hughen et al. 2004) global data sets (Stuiver and Braziunas 1993).

Table 13. Radiocarbon Results for LAN-211

Context	Material	Sample No.	Calibrated Age (Standard ΔR)	ΔR	Calibrated Age (Alternate ΔR)	Episode/ Subepisode No.
CU 119, Level 63	littleneck clam	Beta-220599	760–410 cal B.C.	–85 ± –40	1110–800 cal B.C.	1
CU 119, Level 62	venus clam	Beta-220621	750–400 cal B.C.	–85 ± –40	1100–790 cal B.C.	1
CU 120, Level 73	scallop	Beta-220611	740–390 cal B.C.	–85 ± –40	1070–780 cal B.C.	1
Feature 31	venus clam	Beta-235985	730–380 cal B.C.	–85 ± –40	1040–770 cal B.C.	1
CU 119, Level 59	venus clam	Beta-220625	720–380 cal B.C.	–85 ± –40	1020–760 cal B.C.	1
CU 353, Level 65	venus clam	Beta-220603	720–380 cal B.C.	–85 ± –40	1020–760 cal B.C.	1
CU 274, Level 61	venus clam	Beta-220623	710–350 cal B.C.	–85 ± –40	990–740 cal B.C.	1
CU 120, Level 71	scallop	Beta-220626	700–330 cal B.C.	–85 ± –40	980–730 cal B.C.	1
CU 274, Level 62	venus clam	Beta-220605	660–250 cal B.C.	–85 ± –40	970–700 cal B.C.	1
CU 274, Level 60	littleneck clam	Beta-220614	cal A.D. 190–510	165 ± –35	cal A.D. 140–430	2
Feature 2	littleneck clam	Beta-230287	cal A.D. 230–540	165 ± –35	cal A.D. 160–440	2
CU 120, Level 64	littleneck clam	Beta-220612	cal A.D. 310–610	165 ± –35	cal A.D. 250–550	2
Feature 15	littleneck clam	Beta-230288	cal A.D. 370–640	165 ± –35	cal A.D. 290–580	2
CU 274, Level 60	venus clam	Beta-220615	cal A.D. 370–640	165 ± –35	cal A.D. 290–580	2
CU 359, Level 59	venus clam	Beta-220618	cal A.D. 430–680	165 ± –35	cal A.D. 380–640	2
CU 6, Level 6	venus clam	Beta-145027	cal A.D. 420–720	165 ± –35	cal A.D. 380–680	2
CU 359, Level 66	venus clam	Beta-220601	cal A.D. 460–710	165 ± –35	cal A.D. 430–670	2
CU 274, Level 68	littleneck clam	Beta-220606	cal A.D. 460–720	165 ± –35	cal A.D. 430–670	2
CU 359, Level 57	venus clam	Beta-220613	cal A.D. 470–730	165 ± –35	cal A.D. 440–680	2
CU 359, Level 56	venus clam	Beta-220617	cal A.D. 470–730	165 ± –35	cal A.D. 440–680	2
CU 359, Level 58	venus clam	Beta-220620	cal A.D. 540–790	165 ± –35	cal A.D. 470–710	2
CU 359, Level 60	venus clam	Beta-220616	cal A.D. 540–790	165 ± –35	cal A.D. 470–710	2
CU 9, Level 2	venus clam	Beta-145030[a]	cal A.D. 1390–1680	165 ± –35	cal A.D. 1330–1630	3A
Feature 2	canary grass	Beta-230909	cal A.D. 1440–1640	N/A	cal A.D. 1440–1640	3A
CU 120, Level 66	scallop	Beta-220622	cal A.D. 1480–1690	165 ± –35	cal A.D. 1450–1660	3A
Feature 14	venus clam	Beta-235986	cal A.D. 1480–1710	165 ± –35	cal A.D. 1470–1670	3A
Feature 52	scallop	Beta-235987	cal A.D. 1480–1730	165 ± –35	cal A.D. 1470–1680	3A
Feature 21	scallop	Beta-235984	cal A.D. 1490–1810	165 ± –35	cal A.D. 1480–1680	3A
CU 119, Level 73	abalone	Beta-220609	cal A.D. 1430–1650	450 ± –40	cal A.D. 1640–1950	3A/B
CU 9, Level 1	abalone	Beta-145029[a]	cal A.D. 1460–1810	450 ± –40	cal A.D. 1700–1950	3A/B
CU 119, Level 72	littleneck clam	Beta-220607	cal A.D. 1550–1890	165 ± –35	cal A.D. 1510–1810	3B
CU 119, Level 59	scallop	Beta-220624	cal A.D. 1580–1950	165 ± –35	cal A.D. 1520–1810	3B
CU 120, Level 61	venus clam	Beta-220628	cal A.D. 1620–1950	165 ± –35	cal A.D. 1530–1820	3B
CU 353, Level 68	littleneck clam	Beta-220602	cal A.D. 1670–1950	165 ± –35	cal A.D. 1570–1890	3B
CU 119, Level 69	venus clam	Beta-220608	cal A.D. 1692–1950	165 ± –35	cal A.D. 1630–1950	3B
CU 120, Level 62	venus clam	Beta-220619	cal A.D. 1710–1950	165 ± –35	cal A.D. 1660–1950	3B
CU 274, Level 71	scallop	Beta-220604	cal A.D. 1713–1950	165 ± –35	cal A.D. 1670–1950	3B
CU 119, Level 67	scallop	Beta-220610	cal A.D. 1713–1950	165 ± –35	cal A.D. 1670–1950	3B
Feature 53	littleneck clam	Beta-235988	cal A.D. 1720–1950	165 ± –35	cal A.D. 1710–1950	3B
Feature 51	scallop	Beta-230286	cal A.D. 1720–1950	165 ± –35	cal A.D. 1710–1950	3B
CU 120, Level 67	scallop	Beta-220627	cal A.D. 1720–1950	165 ± –35	cal A.D. 1710–1950	3B
CU 359, Level 71	littleneck clam	Beta-220600	360–40 cal B.C.	–85 ± –40	750–400 cal B.C.	?
CU 10, Level 7	venus clam	Beta-145028	cal A.D. 830–1120	165 ± –35	cal A.D. 790–1040	?

Note: All samples were measured via AMS unless otherwise indicated.
Key: N/A = not applicable
[a] Sample was measured radiometrically, with extended counting.

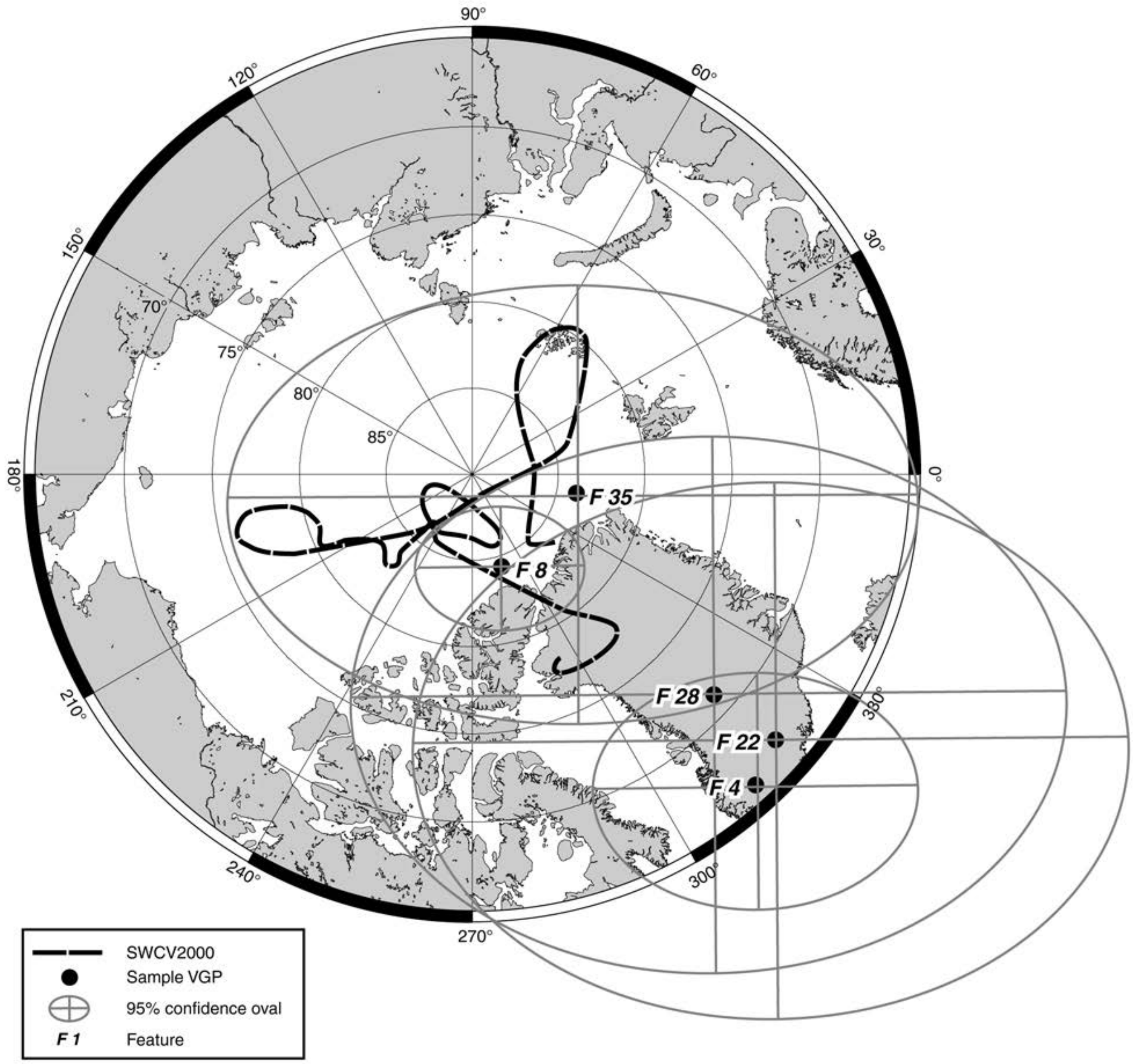

Figure 8. The locations of the VGPs calculated for five AM samples collected from LAN-211. The VGPs were plotted against SWCV2000 for reference. The oval depicted around each VGP reflects the sample's 95-percent-confidence oval.

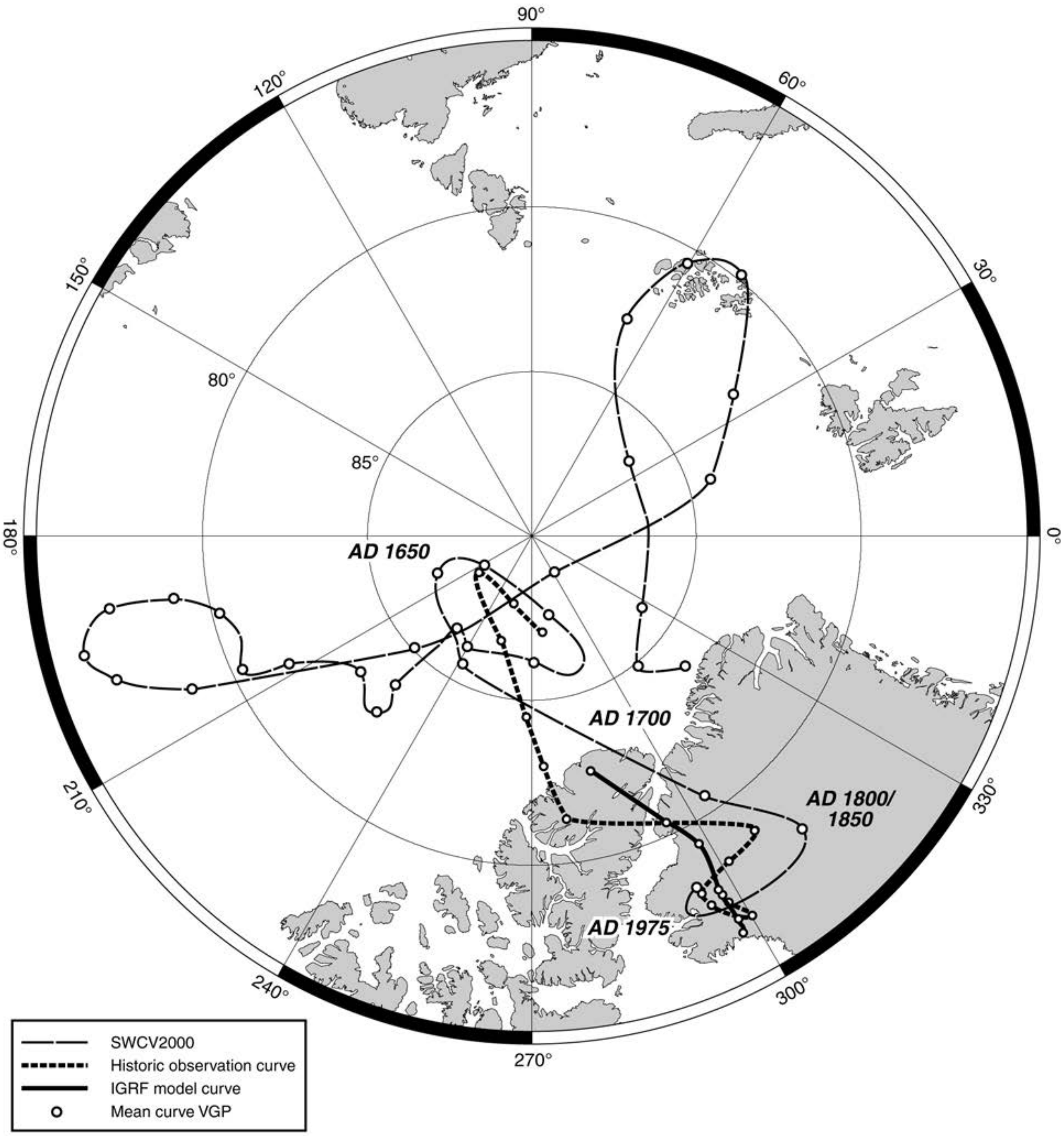

Figure 9. Depiction of the three secular-variation records used to date the LAN-211 AM samples.

Table 14. Results from Seven AM Samples Collected from LAN-211

Feature No.	Sample No.	α^{95}	Paleo-latitude	Paleo-longitude	SWCV595 Date	Modeled Date	Hazard (1917) Date	Best Date
4	SRI 3998	4	65.89	312.38	off-curve; near A.D. 1850–2000	none; near A.D. 1900	none; near A.D. 1875–1900	A.D. 1850–2000
6	SRI 3969	23.5	59.52	309.7	too inaccurate to date	too inaccurate to date	too inaccurate to date	too inaccurate to date
8	SRI 3968	2.2	84.38	287.86	A.D. 635–665, 935–990, 1535–1590, 1760–1815	A.D. 1600–1650, 1700–1750	A.D. 1700–1750	A.D. 1535–1590 or A.D. 1700–1750
22	SRI 3997	9.56	66.86	318.81	A.D. 935–990, 1835–1890	A.D. 1800–1900	A.D. 1850–1900	A.D. 1800–modern
26	SRI 3995	20.24	71.54	9.07	too inaccurate to date	too inaccurate to date	too inaccurate to date	too inaccurate to date
28	SRI 3996	9.65	71.15	317.61	A.D. 935–990, 1760–1990	A.D. 1750–1900	A.D. 1700–1900	A.D. 1750–modern
35	SRI 3999	9	83.83	349.77	A.D. 585–1015, 1385–1990	A.D. 1600–1850	A.D. 1700–1850	A.D. 1600–1850

Deducting that age from the clamshell's conventional radiocarbon age of 2230 ± 40 resulted in an apparent ΔR determination of 1420 ± 53 B.P. That value is highly unrealistic, and it seems likely that the shared recovery context was due to bioturbation or some other postdepositional disturbance factor.

Postdepositional mixing appears to have been a factor for the paired shell sample recovered from Level 59 of CU 119, as well. Those two samples (Beta-220624 and Beta-220625) consisted of a scallop shell and a venus clamshell, respectively, and the conventional dates obtained from the two shells differed by 2,160 years. It should be noted that the conventional age obtained from the younger scallop shell was identical to the marine equivalent age for the canarygrass sample from Feature 2, supporting the argument for mixing between early Intermediate and late prehistoric period deposits. The final paired sample did not exhibit signs of temporal mixing, however. The two samples recovered from Level 60 of CU 274 (Beta-220614 and Beta-220615) consisted of a littleneck clamshell and a venus clamshell, respectively, and the conventional dates from those shells differed by only 130 radiocarbon years. Statistical comparison of the two determinations found them to be indistinguishable at the 0.05 significance level (*df* = 1; T = 2.174; $\chi^2_{0.05}$ = 3.841; A = 67.7 percent; An = 50.0 percent), and a combined calibrated date of cal A.D. 320–550 was calculated for the feature through the Combine function of OxCal (v. 3.10), using the Marine04 data set (Hughen et al. 2004) and a ΔR of 220 ± 40 (Ingram and Southon 1996). That date range shifted to cal A.D. 260–450 when the age-appropriate ΔR of 165 ± 35 was applied.

Radiocarbon Results for LAN-211

Evaluation of the 43 radiocarbon determinations obtained for the site suggested that at least three temporal groups were represented in the dated sample and that possibly four or five occupation episodes occurred within those groups. Below, we summarize the occupation episodes indicated by the radiocarbon dates derived for the site, beginning with the earliest occupation. Occupation episodes are numbered 1–3 for LAN-211; Episode 1 represents the oldest occupation of the site, and Episode 3 represents the most recent occupation.

Episode 1

Episode 1 included nine shell samples from Feature 31 and various levels of CUs 119, 120, 274, and 353. The conventional dates for those nine samples spanned 130 radiocarbon years and formed a very cohesive group (*df* = 8; T = 3.991; $\chi^2_{0.05}$ = 15.507; A = 109.2 percent; An = 23.6 percent). This episode dated to either 760–250 cal B.C. (standard ΔR) or 1110–700 cal B.C. (age-specific ΔR), and it preceded Episode 2 by roughly 880–1,170 calendar years. It should be noted that an isolated date obtained on a littleneck clamshell (Beta-220600) recovered from CU 359 was intermediate to the first two episodes, and it was statistically different from all the samples included in the two episodes.

Episode 2

The group that defined Episode 2 included 13 shells recovered from Features 2 and 15 and CUs 6, 120, 274, and 359. The conventional dates obtained from those shells spanned 290 radiocarbon years, suggesting that more than one occupation was included in the group. Indeed, exclusion of the two earliest samples from the episode resulted in a relatively cohesive group of 11 dates (*df* = 10; T = 11.610; $\chi^2_{0.05}$ = 18.307; A = 58.5 percent; An = 21.3 percent). However, the two early samples were not statistically different from the four next-oldest samples, making it difficult to exclude them altogether. Therefore, rather than attempt to create arbitrary subdivisions within the episode, the entire set of 13 samples was treated as a single temporal group that likely reflected multiple periods of site use. The inclusive date range for this episode was either cal A.D. 190–790 (standard ΔR) or cal A.D. 140–710 (age-specific ΔR), and it was preceded by Episode 1 by roughly 670–910 calendar years. A single date obtained on a venus clamshell (Beta-145030) recovered from CU 10 was intermediate to the two episodes and was statistically different from the members of each. It is possible that the clamshell reflected an occupation that was missed by our sampling strategy, but without additional data, it is treated here as an isolated date.

Episode 3

The youngest group (Episode 3) encompassed the Historical, Protohistoric, and late prehistoric periods and included 19 samples from six features and seven CUs. The conventional dates for those samples spanned 370 radiocarbon years, and they could be divided into two subepisodes. Because both estuarine- and marine-shell samples were included in the episode, the composition of the two subepisodes changed slightly when different ΔR values were applied. The older Subepisode 3A included 6 samples from Features 2, 14, 21, and 52 and from CUs 9 and 120. The conventional dates from those 6 samples spanned 140 radiocarbon years and formed a fairly cohesive group (*df* = 7; T = 4.300; $\chi^2_{0.05}$ = 14.067; A = 103.1 percent; An = 25.0 percent). When the standard ΔR value was used, this group also included two abalone shells recovered from CUs 9 and 119, and the combined age range for the subepisode was cal A.D. 1390–1810 (standard ΔR). Application of age-specific ΔR values shifted the two abalone shells into line with the younger Subepisode 3B, and the combined age range for Subepisode 3A was cal A.D. 1330–1680.

The younger Subepisode 3B included 11 marine-shell samples recovered from Features 51 and 53 and from various levels of CUs 119, 120, 274, 353, and 359. The conventional dates obtained from those samples spanned 160 radiocarbon years and formed a fairly cohesive group (*df* = 10; T = 9.945; $\chi^2_{0.05}$ = 18.307; A = 57.7 percent; An = 21.3 percent). Under the standard ΔR, this subepisode dated to roughly cal A.D. 1550–1950 and included only those 11 samples. When the age-specific ΔR values were used, the two abalone shells from CUs 9 and 119 joined the group, and the inclusive date range shifted slightly to cal 1510–1950.

LAN-211 Summary

At least three or four temporal groups were represented in the dated sample from LAN-211, spanning the Intermediate period through the historical period. The earliest episode (Episode 1) occurred during the early Intermediate period and included samples from Feature 31 and CUs 119, 120, 274, 353, and 359. This relatively well-defined episode dated to either 760–250 cal B.C. (standard ΔR) or 1110–700 cal B.C. (age-specific ΔR) and was separated from Episode 2 by roughly 880–1,170 years, although an isolated date was obtained from CU 359 that fell between the two episodes.

Episode 2 occurred during the early to late Intermediate period and included samples from Features 2 and 15 and CUs 6, 120, 274, and 359. This episode dated to either cal A.D. 190–790 (standard ΔR) or cal A.D. 140–710 (age-specific ΔR) and occurred roughly 670–910 years prior to Episode 3. Similar to the earliest two episodes, an isolated date recovered from CU 10 fell between Episodes 2 and 3.

Episode 3 occurred during the late prehistoric, Protohistoric, and/or Historical periods, and at least two subepisodes were identified within the episode. The older Subepisode 3A included materials from Features 2, 14, 21, and 52 and CU 120 and, when the standard ΔR value was applied, two abalone shells recovered from CUs 9 and 119. This subepisode dated to either cal A.D. 1390–1810 (standard ΔR) or cal A.D. 1330–1680 (age-specific ΔR), both of which overlapped with the date ranges for Subepisode 3B. The younger Subepisode 3B included marine shells recovered from Features 51 and 53 and from various levels of CUs 119, 120, 274, 353, and 359, and it dated to either cal A.D. 1550–1950 (standard ΔR) or cal A.D. 1510–1950 (age-specific ΔR). It is possible that the abalone shells recovered from CUs 9 and 119 belonged to this subepisode, as well, although they only fell within the age limits of the group when an upwelling-related ΔR value (ΔR = 450 ± 50) was applied.

Finally, because radiocarbon dates were not obtained from any of the AM-dated features, it was impossible to tie the two data sets together statistically. However, all of the AM dates obtained for the site agreed with the radiocarbon dates from Episode 3, indicating that those five features were related to that occupation episode. Comparison of the results from the two data sets suggested that Features 8 and 35 may have been associated with Subepisode 3A, and Features 4, 22, and 28 were associated with Subepisode 3B.

Chronometric Data for LAN-2768

Methods for LAN-2768 Locus A

The chronometric data obtained for Locus A came from 20 radiocarbon samples recovered from CUs 3, 8, and 20 and Features 5, 10, 12, 18, 20, 30, and 31. The 12 CU samples were submitted in 2006, to the build the chronometric framework for the site, and the 8 feature samples were submitted in 2007, to help refine our understanding

Table 15. Radiocarbon Results for LAN-2768

Context	Material	Sample No.	Calibrated Age (Standard ΔR)	ΔR	Calibrated Age (Alternate ΔR)	Episode No.
Feature 30	littleneck clam	Beta-230294	600–210 cal B.C.	–85 ± 40	940–640 cal B.C.	1
Feature 113	scallop	Beta-241771	530–190 cal B.C.	–85 ± 40	900–570 cal B.C.	1
CU 20, Level 2	scallop	Beta-220630	460–150 cal B.C.	–85 ± 40	830–510 cal B.C.	1
Feature 20	littleneck clam	Beta-230293	380–80 cal B.C.	–85 ± 40	770–430 cal B.C.	1
CU 3, Level 3	venus clam	Beta-220640	350–20 cal B.C.	–85 ± 40	730–390 cal B.C.	2
Feature 114	scallop	Beta-241770	350–20 cal B.C.	–85 ± 40	730–390 cal B.C.	2
Feature 31	scallop	Beta-231607	330 cal B.C.–cal A.D. 10	–85 ± 40	720–380 cal B.C.	2
CU 8, Level 10	venus clam	Beta-220635	330 cal B.C.–cal A.D. 20	–85 ± 40	720–370 cal B.C.	2
Feature 12	littleneck clam	Beta-230289	320 cal B.C.–cal A.D. 30	–85 ± 40	710–370 cal B.C.	2
CU 8, Level 3	venus clam	Beta-220637	270 cal B.C.–cal A.D. 70	–85 ± 40	700–340 cal B.C.	2
CU 3, Level 5	venus clam	Beta-220639	250 cal B.C.–cal A.D. 80	–85 ± 40	700–330 cal B.C.	2
CU 8, Level 5	venus clam	Beta-220632	210 cal B.C.–cal A.D. 100	–85 ± 40	670–300 cal B.C.	2
CU 20, Level 2	venus clam	Beta-220634	190 cal B.C.–cal A.D. 110	–85 ± 40	610–220 cal B.C.	2
CU 8, Level 8	venus clam	Beta-220636	170 cal B.C.–cal A.D. 130	–85 ± 40	560–190 cal B.C.	2[a]
Feature 20	venus clam	Beta-231606	160 cal B.C.–cal A.D. 140	–85 ± 40	540–190 cal B.C.	2[a]
CU 3, Level 7	venus clam	Beta-220638	160 cal B.C.–cal A.D. 140	–85 ± 40	540–190 cal B.C.	2[a]
Feature 18	venus clam	Beta-235884	150 cal B.C.–cal A.D. 160	–85 ± 40	510–180 cal B.C.	2[a]
CU 8, Level 7	venus clam	Beta-220629	110 cal B.C.–cal A.D. 270	–85 ± 40	470–80 cal B.C.	3
Feature 5	scallop	Beta-230910	40 cal B.C.–cal A.D. 260	–85 ± 40	390–110 cal B.C.	3
Feature 10	venus clam	Beta-235883	cal A.D. 20–330	–85 ± 40	360–50 cal B.C.	3
CU 3, Level 11	venus clam	Beta-220631	cal A.D. 30–340	–85 ± 40	350–40 cal B.C.	3
CU 8, Level 1	venus clam	Beta-220633	cal A.D. 250–560	–85 ± 40	120 cal B.C.–cal A.D. 190	4
Feature 1	canarygrass	Beta-242490	cal A.D. 1480–1950	N/A	N/A	5

Note: All samples were measured via AMS.
Key: N/A = not applicable.
[a] Samples also fit with Episode 2 when the ΔR value of –85 ± 40 was applied.

of how those features articulated with the site chronology. All 20 samples consisted of individual marine shells of venus clam, littleneck clam, and scallop, and all were submitted for AMS analysis (Table 15).

Two sets of paired-species samples were submitted from the site. The first set was recovered from Level 2 of CU 20, and it paired a venus clamshell (Beta-220634) with a scallop shell (Beta-220630). The determinations derived from those samples were statistically different at the 0.05 significance level, and the 230-radiocarbon-year difference between them was marginally outside the range of variability expected for roughly contemporaneous specimens. It seemed likely that two different time periods were reflected by these samples and that postdepositional mixing resulted in the shared recovery context. The second set of samples was recovered from Feature 20, and it paired a venus clamshell (Beta-231606) with a littleneck clamshell (Beta-230293). That sample pair was found to be statistically different, as well, although only 190 radiocarbon years separated the two determinations. That difference was within the documented range of variability exhibited by roughly contemporaneous specimens, although it is still possible that the two specimens reflected different periods of activity.

Results for LAN-2768 Locus A

Statistical evaluation of the 20 radiocarbon determinations obtained for the site suggested that at least four temporal groups were represented in the dated sample. However, the fairly continuous temporal spread reflected by those samples made it difficult to draw firm boundaries between consecutive samples. Following the conservative approach established for this study, samples were split into the fewest number of statistically cohesive groups. It should be noted, again, that those groups were defined at the resolution of radiocarbon analysis, and it is quite likely that a higher-resolution dating technique would distinguish more than four groups. Indeed, as discussed below, a handful of samples assigned to Episode 2 also fit with Episode 3 under alternate carbon reservoirs, highlighting the tentative nature of the boundary between those groups. Below, we summarize the occupation episodes indicated by the radiocarbon dates derived for the site, beginning with the earliest occupation. Occupation episodes are numbered 1–4 for LAN-2768; Episode 1 represents the oldest occupation of the site, and Episode 4 represents the most recent occupation.

Episode 1

The oldest episode documented at the site (Episode 1) included the older samples recovered from Feature 20 and Level 2 of CU 20 and a sample recovered from Feature 30. The conventional dates from those three samples spanned 140 radiocarbon years, although statistically, they formed a relatively coherent temporal group (*df* = 2; T = 2.523; $\chi^2_{0.05}$ = 5.991; A = 83.8 percent; An = 40.8 percent). This episode dated to 600–80 cal B.C. (standard ΔR) or 940–430 cal B.C. (age-specific ΔR), and although these date ranges overlapped with those of Episode 2, the episodes may be separated by as many as 130 (standard ΔR) or 150 (age-specific ΔR) calendar years.

Episode 2

Episode 2 included 12 samples recovered from Features 12, 18, 20, and 31; Levels 3, 5, and 7 of CU 3; Levels 3, 5, 8, and 10 of CU 8; and the younger sample from Level 2 of CU 20. The group spanned 160 radiocarbon years, suggesting that more than one occupation episode may have been represented by the included samples. That finding may reflect the tentative inclusion of the youngest four samples in this group rather than in subsequent Episode 3. Although those four samples were statistically indistinguishable from the rest of the Episode 2 samples under both reservoir-correction values, they also were indistinguishable from the Episode 3 samples when the age-specific ΔR (–85 ± 40) was applied. However, because the Episode 2 samples held up statistically as a group (*df* = 9; T = 5.242; $\chi^2_{0.05}$ = 16.919; A = 140.2 percent; An = 22.4 percent), separation into subepisodes cannot be justified at this time. As a whole, the episode spanned 350 cal B.C.–cal A.D. 160 (standard ΔR) or 730–180 cal B.C. (age-specific ΔR). These age ranges overlapped with those of Episode 3, although as many as 110 (standard ΔR) or 120 (age-specific ΔR) calendar years may separate the two episodes.

Episode 3

Episode 3 included samples recovered from Features 5 and 10 and from Level 11 of CU 3 and Level 7 of CU 8. The conventional dates obtained from those samples spanned 80 radiocarbon years and formed a very cohesive group (*df* = 3; T = 0.939; $\chi^2_{0.05}$ = 7.815; A = 130.9 percent; An = 35.4 percent). It should be noted that the dates obtained for Features 5 and 10 were not statistically different from those associated with Episode 2 Features 18 and 20 under both reservoir-correction values, and interpretations of the relative ages of those features should be utilized cautiously. Episode 3 dated to either 110 cal B.C.–cal A.D. 340 (standard ΔR) or 470–40 cal B.C. (age-specific ΔR), and it predated Episode 4 by no more than 220 years.

Episode 4

The youngest period of activity documented by the samples was indicated by a single venus clamshell recovered from the first level of CU 8 (Beta-220633). That sample was 190 radiocarbon years younger than the next-oldest dated sample from the locus, and it dated to cal A.D. 250–560 when the standard ΔR value was used or 120 cal B.C.–cal A.D. 190 when the age-specific ΔR (–85 ± 40) was applied.

Methods and Results for LAN-2768 Loci B and C

Radiocarbon dates were obtained from two samples from Locus B and one sample from Locus C. The samples from Locus B consisted of scallop shells recovered from Features 113 and 114, and both were submitted for AMS analysis. The conventional dates obtained from those two samples differed by 160 radiocarbon years, and they were statistically indistinct from each other at the 0.05 significance level (*df* = 1; T = 3.284; $\chi^2_{0.05}$ = 3.841; A = 66.1 percent; An = 50.0 percent). The calibrated dates for the two samples were 530–20 cal B.C. (standard ΔR) or 900–390 cal B.C. (age-specific ΔR), and a pooled date of 370–170 cal B.C. (standard ΔR) or 780–530 cal B.C. (age-specific ΔR) was calculated for the pair via the Combine function in OxCal.

A single sample was submitted for dating from Locus C. That sample consisted of roughly 10 carbonized canarygrass seeds recovered from Feature 1 and produced a 2σ calibrated date of cal A.D. 1480–1950, the date range considered to be Episode 5 at the site. The sample indicated that this locus was utilized much more recently than the other portions of LAN-2768, although it is unknown whether that date was representative of the entire locus.

LAN-2768 Summary

At least five different temporal groups were represented in the dated sample from LAN-2768, spanning primarily the Intermediate period, and there was some indication of use during the Late/Protohistoric period transition through the historical period. The oldest group (Episode 1) included samples recovered from Features 20 and 30 and from CU 20 at Locus A, as well as the sample from Feature 113 at Locus B. The ages from those samples spanned 140 radiocarbon years, and the episode dated to 600–80 cal B.C. (standard ΔR) or 940–430 cal B.C. (age-specific ΔR). It was separated from the next-oldest documented episode at the site (Episode 2) by no more than 150 calendar years, although the date ranges for the two episodes overlapped. Furthermore, the distinction between the two episodes was based on the data recovered from Locus A, and the division of samples into two episodes contradicted the findings from Locus B.

It may be that all of the samples reflected a single episode or that the division between episodes should be placed more recently. Without additional information, it was difficult to assess these scenarios, and the episodes identified for the large Locus A data set were utilized. Therefore, Episode 2 included samples from Features 12, 18, 20, and 31 and various levels of CUs 3 and 8 at Locus A, as well as the sample from Feature 114 at Locus B. This episode spanned 160 radiocarbon years and dated to 350 cal B.C.–cal A.D. 160 (standard ΔR) or 730–180 cal B.C. (age-specific ΔR).

Episode 3 dated to 110 cal B.C.–cal A.D. 340 (standard ΔR) or 470–40 cal B.C. (age-specific ΔR), and it included samples from Features 5 and 10 and from CUs 3 and 8 at Locus A. This episode may overlap with the preceding Episode 2, and four of the samples assigned to Episode 2 were statistically indistinct from Episode 3 when the age-specific ΔR value was applied. However, the episodes may also be separated by up to 120 calendar years. Likewise, the dates for Episode 3 overlapped to some extent with the range for Episode 4, although as many as 220 years may separate the two periods of activity. Episode 4 included a single sample from the uppermost level of CU 8 at Locus A, and it dated to either cal A.D. 250–560 (standard ΔR) or 120 cal B.C.–cal A.D. 190 (age-specific ΔR).

Finally, the most recent activity at the site (Episode 5) was indicated by the single sample dated from Locus C. That sample produced a date of cal A.D. 1480–1950, and it occurred 1,350–1,720 years after all other activity documented at the site. It is unknown whether the temporal gap between the latest two episodes reflected a true hiatus in human activity at the site or was a product of sampling bias, particularly considering that only a single context from Locus C was dated.

Summary of Project Chronometric Results

Chronometric data in the form of 200 radiocarbon dates and five AM dates were obtained from 50 features and 52 control units at five sites in the PVAHP research area. Altogether, eight occupation episodes spanning 6,800 calendar years were identified within the data set (Table 16), and several possible subepisodes were identified within many of the younger episodes. Furthermore, at least three distinct gaps in the temporal record were identified within the project data set, although it is unknown whether they reflect occupation hiatuses or gaps in our sampling strategy.

The temporal distribution of the dated samples obtained for the project is illustrated in Figure 10 in the form of weighted probability curves for the project and the sites. The curves were generated through a modified version of the pooled probability method developed by Eighmy and LaBelle (1996) and essentially depict the proportion of chronometric samples that dated to any given year. In order to construct the probability curves, each calibrated-date range included in the respective data set (at the project or site level) was treated as a flat, uniform probability distribution, such that the probability of a sample dating to a particular year within its date range was equal to 1 divided by the total interval. The composite curve was generated by summing the individual probabilities of all samples and then standardizing to 1 by dividing the total value for each year by the total area under the curve. All marine-shell radiocarbon dates included in this exercise were calculated using the standard ΔR.

As both Figure 10 and Table 16 demonstrate, the overall temporal patterns exhibited at most of the sites correlated very well to each other, suggesting that many of the sites were utilized coevally at different points in the mid- to late Holocene. In particular, the record recovered from LAN-62 Locus A/G spanned the entire period documented in the project area, and virtually all of the occupation episodes identified at the other localities were present within that area, as well. The most obvious exception to the pattern was the timing of activities documented at LAN-2768, which exhibited a peak in dated samples between roughly cal B.C. 200 and 200 cal A.D. That period corresponded to a noticeable decrease in dated samples recovered from all other sites but LAN-193, and the offset in dated records may have cultural implications, particularly if the peaks in the distribution curves reflect increased human activity rather than sampling bias.

Overall, the temporal patterns exhibited by the project data set indicated that four major periods of human activity occurred from the late Millingstone through the Historical period and that several occupation episodes occurred within those major periods at the individual sites. The earliest documented activities within the project area were represented by a handful of dated marine shells recovered from LAN-62 Locus A/G and occurred toward the end of the early Millingstone period. Those activities were followed by a 900-year gap in the dated record, spanning the period of 4200–3300 cal B.C. That distinct temporal hiatus was followed by a broad period of activity documented at LAN-54, LAN-193, and both LAN-62 loci. The earliest, widespread period of activity spanned most of the late Millingstone period, and activities documented at LAN-54 occurred somewhat later than those at the other three localities. A 300-year gap at cal B.C. 1200–900 separated the late Millingstone period activities from the well-correlated early Intermediate period spike in dated materials recovered from LAN-62 Locus A/G, LAN-54, and LAN-211 and the offset spike in materials from LAN-2768 and LAN-193. The offset spike was followed by a late Intermediate period spike in dated materials recovered from LAN-62 Locus A/G, LAN-211, and LAN-193, indicating that the project area was utilized fairly extensively throughout the Intermediate period. Finally, a roughly 200-year gap at 1100–1300 cal A.D. separated the Late Intermediate period record from the late prehistoric and Historical period record, which was documented at LAN-211, LAN-2768 Locus C, and both parts of LAN-62.

Table 16. Episodes and Dates, by Site

Episode/Subepisode No., by Site No.	Date (Standard ΔR)	Date (Alternate ΔR)	Date (Alternate ΔR2)
LAN-54			
1	2210–1680 cal B.C.	1980–1440 cal B.C.	2750–1900 cal B.C.
2	1800–1290 cal B.C.	1600–1030 cal B.C.	2290–1470 cal B.C.
3A	940–360 cal B.C.	1350–750 cal B.C.	
3B	420–80 cal B.C.	810–430 cal B.C.	
LAN-62 A/G			
1	4910–4320 cal B.C.	4990–4280 cal B.C.	
2	2890–2370 cal B.C.	3010–2320 cal B.C.	
3	2610–1760 cal B.C.	2680–1720 cal B.C.	
4	1590–1120 cal B.C.	1380–890 cal B.C.	2020–1380 cal B.C.
5	840–220 cal B.C.	1250–570 cal B.C.	
6A	520–10 cal B.C.	880–380 cal B.C.	
6B	250 cal B.C.–cal A.D. 250	700–120 cal B.C.	
7A	cal A.D. 230–720	cal A.D. 160–670	
7B	cal A.D. 510–980	cal A.D. 450–900	
8A	cal A.D. 1300–1650	cal A.D. 1250–1600	
8B	cal A.D. 1500–1850	cal A.D. 1480–1850	
LAN-62 C/D			
1	2860–1970 cal B.C.	2890–1940 cal B.C.	
2	cal A.D. 420–560	cal A.D. 420–560	
3	cal A.D. 1270–1450	cal A.D. 1220–1420	
4	cal A.D. 1410–1890	cal A.D. 1330–1950	
LAN-193			
1	2360–1570 cal B.C.	2450–1500 cal B.C.	
2	570–350 cal B.C.	910–750 cal B.C.	
3	150 cal B.C.–cal A.D. 230	510–130 cal B.C.	
4	cal A.D. 440–720	A.D. 400–670	
LAN-211			
1	760–250 cal B.C.	1110–700 cal B.C.	
2	cal A.D. 190–790	cal A.D. 140–710	
3A	cal A.D. 1390–1810	cal A.D. 1330–1680	
3B	cal A.D. 1550–1950	cal A.D. 1510–1950	
LAN-2768			
1	600–80 cal B.C.	940–430 cal B.C.	
2	350 cal B.C.–cal A.D. 160	730–180 cal B.C.	
3	110 cal B.C.–cal A.D. 340	470–40 cal B.C.	
4	cal A.D. 250–560	120 cal B.C.–cal A.D. 190	

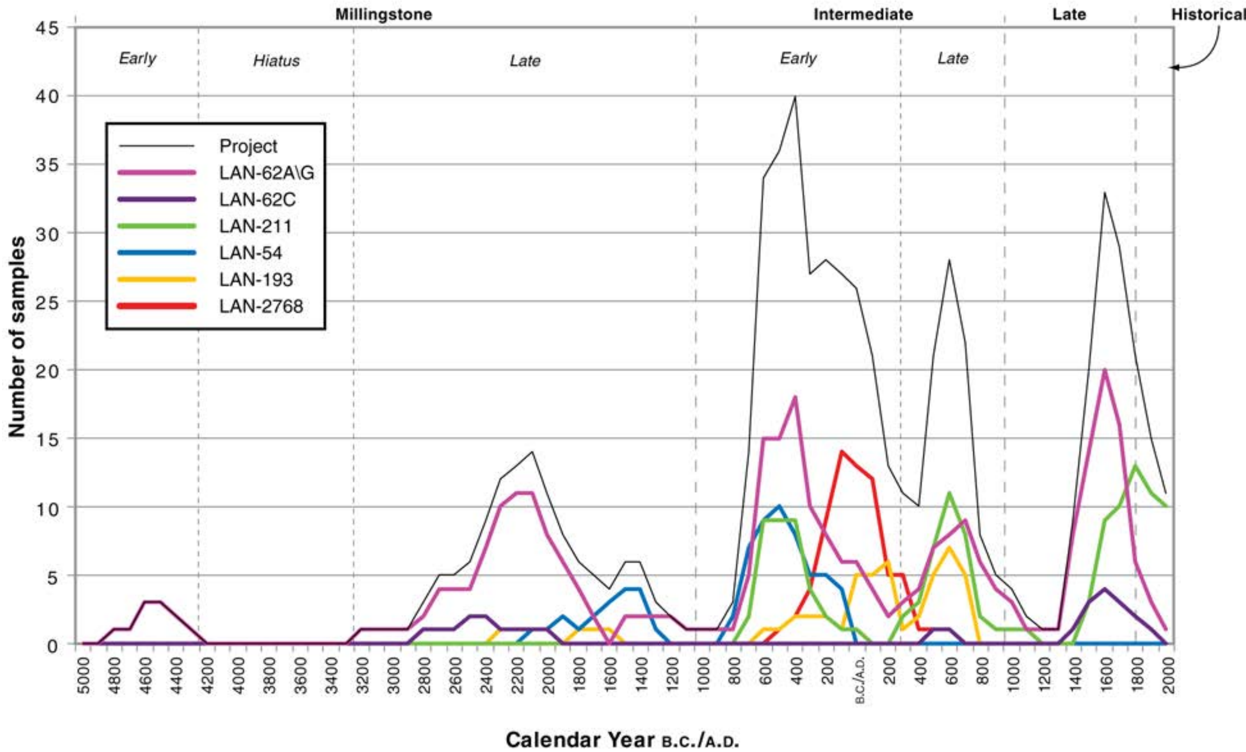

Figure 10. Graphic plot of the weighted probability curve of all radiocarbon dates obtained for this project depicted against the weighted probability curve for each site.

Obsidian-Hydration Discussion and Results

Although the application of multiple methods discussed in Chapter 2, this volume, presented a somewhat bewildering array of possible dates (see Appendix 2.2, this volume), such analysis highlights the fact that caution must be exercised in either over- or underinterpreting hydration results. In addition, given the co-occurrence of samples with disparate hydration rims within the same feature or the apparent stratigraphic reversal of some hydration measurements from individual sites, or both, it was recognized that the data might be more informative in an exercise of hydration-rate methodology than they would be for revealing unequivocal temporal trends. Comparison of resulting age estimates with radiocarbon dates from the same proveniences indicated little concordance between dates derived from obsidian and shell, respectively. Still, the best concordance was found between hydration dates derived using the rate formula employed at West Bluffs, corrected using Rogers's (2007) methods for depth-dependent EHT estimation and temperature data from the Santa Monica Pier.

For example, via those methods, the obsidian sample from Feature 9, CU 60, Level 3, at LAN-193 was estimated to date to 376 cal B.C., within the 530–190 cal B.C. range for that same provenience. Similarly, the date of 223 cal B.C. for obsidian from Feature 12 at LAN-2768 was within the 320 cal B.C.–cal A.D. 30 range for this feature, and the hydration dates of 66 cal B.C. for CU 316, Level 60, and cal A.D. 1479 for CU 323, Level 64, at LAN-62 were within the ranges of calibrated radiocarbon dates on material from, or bracketing levels within, those units. Other methods provided dates approximately 100–300 years younger, and although few hydration dates matched radiocarbon results, it was encouraging that just one rate formula was (with only one exception) the closest approximation in those few cases of concordance. Given these observations, the dates for the CVF derived using the West Bluffs rate with an RCF based on Santa Monica Pier will be used for the remainder of this discussion. Likewise, Rogers's (2007) procedure for EHT estimation was also used to establish EHT for date derivation for the two specimens of Casa Diablo obsidian using the rate formula developed by Hull (2001). No rate formulas are available for either Mount Hicks or Obsidian Butte obsidian from sites in southern California.

Only three CVF artifacts lacked visible hydration, although radiocarbon assays on material from the same proveniences suggested that the absence of hydration did not indicate extremely late deposition; rather, it may be that the hydration rim was damaged or removed from those specimens. For the remaining objects in the PVAHP sample, the range of dates was comparable to results from calibrated radiocarbon assays on shell recovered from all but the earliest components at these sites. Specifically, hydration dates ranged from cal A.D. 1841 to 1493 cal B.C. (109–3443 B.P.), well within the lower range of the radiocarbon dates for the PVAHP sites. Site-specific data, however, revealed either relatively good consistency with or significant disparity from episodes of use identified through radiocarbon, stratigraphic, and other chronological methods. Still, for both sets of sites (i.e., those sites revealing either a good fit or a poor fit), the provenience-specific consistency of hydration dates with chronometric data derived via other means was often poor.

Sites that revealed dates generally consistent with defined episodes of use included LAN-62, LAN-193, and LAN-211. At LAN-62, hydration dates ranged from 1307 cal B.C. to cal A.D. 1841, with three loosely defined clusters evident at cal A.D. 1479–1841, cal A.D. 66–916, and 1307–376 cal B.C. All or portions of these three clusters were consistent with occupation Subepisode 8A (cal A.D. 1500–1850); Episode 7 (cal A.D. 230–980, especially Subepisode 7B [cal A.D. 230–720]); and Episodes 5 (840–220 cal B.C.) and 4 (1590–1120 cal B.C.), respectively. Cottonwood Triangular and Canalino points were found in proximity to the specimens dating to Episode 1, although Cottonwood Triangular points were also recovered near obsidian artifacts dating to Episode 2. Similarly, one Fish Slough Side-notched point was recovered from the same provenience as one of the artifacts that dated to Episode 5. The potential hiatus in occupation ca. cal A.D. 1000–1350 recognized by other dating methods was also mirrored in the hydration data. Given the small number of samples representing any given episode of use, it is difficult to make inferences about changes in site activity through time. Still, all of the flakes dating to Episode 8 were pressure flakes, and the pieces for the other episodes generally included both pressure and percussion biface reduction.

Dates at LAN-193 ranged from 951 cal B.C. to cal A.D. 583. Defining clusters within that span was difficult, although visual examination of the data revealed possible clusters from cal A.D. 583–269, cal A.D. 66–cal 76 B.C., and 615–951 cal B.C. The first two clusters roughly corresponded to Episode 4 (cal A.D. 440–720) and Episode 3 (150 cal B.C.–cal A.D. 230), respectively. The remaining cluster was inconsistent with any occupation episode defined at the site on the basis of other chronometric methods. As noted in Appendix 2.2, this volume, however, a few of the specimens of the earlier age derived from proveniences attributable to the late Millingstone period by other means, although obsidian-hydration dating would place them slightly younger (i.e., in the early Intermediate period). In fact, results for LAN-193 (as well as other PVAHP sites) suggested that the hydration estimates for such components based on the preferred rate formula may have been about 400 years younger than other data would lead us to believe. There were no evident patterns in technology through time, although none of the outliers appeared to represent pressure flaking. Both core reduction and biface reduction were indicated.

Only four obsidian samples from LAN-211 were dated, including one of Casa Diablo obsidian. Only the latter revealed a date that matched an occupation episode identified via other means, and it was also consistent with the recovery of a Cottonwood Triangular projectile point from the same provenience and attribution of the deposit to the Mission period. The date of cal A.D. 916 was consistent with the late Intermediate period attribution of the chronostratigraphic unit with which it was associated, although it didn't fall within any defined occupation episode. Likewise, other obsidian-hydration data from the site were inconsistent with episodes defined on the basis of other chronometric methods. Similar to LAN-62, the specimen dating to the Mission period was a pressure flake, and both biface pressure and percussion flaking of bifaces and cores were represented earlier in time.

Sites with many or all hydration dates significantly different from their ages as indicated by other methods were LAN-54 and LAN-2768. Two clusters were evident at LAN-54, including one dating to cal A.D. 1513–1657 and the other at ca. cal A.D. 1160. Those dates were more than 1,200 years younger than any of the occupation episodes identified at the site by other means, and there were no corroborating data for such late use in the artifact assemblage (e.g., projectile points, glass, or shell beads). Still, the technological data appeared consistent with temporal patterns observed at other sites, because two of the flakes dating to the Protohistoric period were pressure flakes, and the third was a bipolar flake. The use of bipolar reduction suggests possible scavenging of the obsidian from elsewhere, although the hydration analyst did not note dual hydration rims often indicative of such activity. Two of the obsidian flakes from the earlier event were biface percussion flakes, and the technology used to produce the third piece could not be determined.

At LAN-2768, dates ranged from 1493 cal B.C. to cal A.D. 1288, but only six of those dates fell within the range of occupation episodes identified on the basis of other methods. The two oldest dates were within the span of Episode 2 (350 cal B.C.–cal A.D. 160), and four others were within the range of Episode 4 (cal A.D. 372–573). All of the remaining obsidian-hydration dates were much younger, and the relatively tight clustering within the span suggests at least one episode of use that was not evident in the radiocarbon sample. Unlike LAN-54, however, there were other data from LAN-2768 that supported such late use at the site. Specifically, several Cottonwood Triangular points were recovered from LAN-2768, often from proveniences corresponding to obsidian-hydration dates indicative of that age. Both pressure and percussion biface flaking were evident throughout the sequence, although pressure flaking tended to dominate after cal A.D. 800, and percussion flaking was more common before that date. Core reduction was rare but was not restricted to just one time period.

Conclusions

As noted above, the obsidian-hydration dates for the PVAHP sites must be approached with caution, because bioturbation was evident, and confidence in any one rate formula for CVF obsidian in coastal southern California must await further research. Still, a few general observations may be offered. What are particularly striking are those instances in which the obsidian-hydration data did not conform to radiocarbon results, and that was evident in three broad patterns. The first was that obsidian was noticeably absent from deposits prior to 600 cal B.C. Although radiocarbon dates clearly indicated such earlier use, obsidian was apparently not used or was unavailable during much of the Millingstone period. That observation is consistent with the fact that no projectile points of obsidian dating to that time were recovered, except when they clearly represented heirloomed items. The few early points of obsidian found in the PVAHP sites showed significant wear on aretes, suggesting that those pieces were scavenged from elsewhere. The same pattern was evident at Landing Hill (Cleland et al. 2007:47), where no obsidian samples dated to the Millingstone period. By contrast, CVF data for the greater Los Angeles area presented by Gilreath and Hildebrandt (1997:172–173) suggested that the material was available to residents of the region at least 4,500 years ago, although such evidence was most apparent in Orange County.

Second, hydration data from LAN-54 and LAN-2768 suggested that there were late components at the Ballona that were represented only by hydration dates and were not so revealed by radiocarbon dating. That is consistent with findings for both the adjacent bluff-top sites (Hull and Douglass 2005) and the Landing Hill sample (Cleland et al. 2007), as well. At LAN-54, one or two components dating between ca. cal A.D. 1150 and 1600 were identified, and data from LAN-2768 indicated a well-defined component postdating cal A.D. 800. Although such late components at LAN-54 were not revealed in other temporal data, hydration data from LAN-2768 were consistent with the recovery of Cottonwood Triangular points from the site. Thus, obsidian-hydration analysis appears to be an important complement to radiocarbon dating at sites in this area, a conclusion also indicated by the data from Landing Hill (Cleland et al. 2007:47). It is perhaps significant that such late components were revealed at both LAN-54 and LAN-2768, as well as at LAN-62 and LAN-211, because Gilreath and Hildebrandt (1997:173) concluded that there was a decline in or complete cessation in use of CVF obsidian in coastal southern California after A.D. 1300. That was clearly not the case. Their sample specifically excluded data from mission-era contexts (Gilreath and Hildebrandt 1997:171), however, and it is clear from the PVAHP data that obsidian continued to be used during the Protohistoric and historical periods. Cleland et al. (2997:47) speculated that disjunction between hydration and radiocarbon dates might relate to nonutilitarian uses of obsidian.

Finally, it may be of note that hydration results from two sites that fell outside any occupation episodes identified by other means occurred between cal A.D. 1000 and 1300, which appeared as a regional occupation hiatus in radiocarbon results. Thus, it may be that the obsidian-hydration data revealed a different pattern of site use during that time, including occupation or use to which shellfishing was relatively unimportant. It may be significant that radiocarbon dates for that same span were relatively rare at Landing Hill (Cleland et al. 2007:45).

Not unlike Landing Hill (Cleland et al. 2007) and West Bluffs (Hull and Douglass 2005), we are left to conclude that components other than those identified on the basis of radiocarbon dates were present at some of the PVAHP sites, and that was sometimes supported by projectile point data. On the other hand, the proveniences from which many objects were recovered suggested some bioturbation, because hydration dates rarely conformed to the episodes or periods of use for such strata established based on chronostratigraphy. Alternately, it may be that either the rate formulas or the temperature-correction methods were inadequate, resulting in dates—at least for the Millingstone and Intermediate periods, if not also the Late period—that were too young. We must also be mindful that some of the obsidian present may have been scavenged, because the only obsidian points recovered during the PVAHP appeared to be heirlooms. That may support the conclusion of Cleland et al. (2007) that use of obsidian was related to symbolic rather than domestic activities. Data from LAN-54 and LAN-2768 cannot be explained by cultural formation processes, such as heirlooming, because dates were younger than those from the radiocarbon assays. On the other hand, it is possible that other processes, such as fire, might account for the anomalously young dates (i.e., thin rims) on pieces from LAN-54, for example. It is difficult to compare the current data with those of West Bluffs and Landing Hill in more detail, because no depth data are readily available for the other samples such that an adequate correction for EHT may be attempted. In addition, the disparate dates derived by the various methods tested in the current study—and greater confidence in dates that took depth below surface into account when calculating EHT—suggest that use of obsidian-hydration dating in coastal southern California would be greatly enhanced by more-thorough consideration of provenience and formation processes in interpretation.

Field and Laboratory Methods

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Introduction

This chapter presents the field and laboratory methods implemented by SRI during the PVAHP, including the procedures for organizing and analyzing the large quantities of data generated during the project and the methods for curation and for reinterment of human remains and associated artifacts. The PVAHP adopted a range of methods for archaeological investigations in a highly variable working environment. Those investigations included survey, testing, and data recovery excavations; monitoring; documentation of standing structures; archival research; and curation and reinterment of archaeological materials. This volume presents the methods and results of the data recovery undertaken at five intact archaeological sites in the PVAHP (LAN-54, LAN-62 [Loci A–D and G], LAN-193, LAN-211, and LAN-2768). The first data recovery project was conducted at LAN-193 in August 2000, and the last of the data recovery excavations was at LAN-2768 Locus B in June 2007. Other locations (such as LAN-1932 and LAN-2676) were initially believed to contain intact archaeological deposits, but testing on initial data recovery revealed that those sites were redeposited archaeological materials most likely taken from the sites along the base of the bluff. Testing at another site (LAN-2769) revealed heavy disturbance, and data recovery excavations were not warranted. The field and laboratory methods for the archaeological research at the PVAHP sites are presented in this chapter, and data from those excavations are presented in Volume 3, this series.

The five sites contained intact archaeological deposits that varied in thickness, integrity, age, and environmental setting. Methods and procedures varied among those sites and, in some cases, within various loci of a single site. Such variability should be expected, because they were excavated at different times and under different conditions. The data-collection methods have been the result of a cumulative process in which experiences from one phase of the project have shaped excavation and research strategies in later phases of the project. Generalizations are possible, however, and this overview allows us to minimize repetition in subsequent chapters concerning methods and background information. Exceptions to these general methods and approaches are presented for each site in the relevant chapters. This chapter presents field, laboratory, curation, and reinterment methods, and the discussions are generalized, with the understanding that the procedural details pertinent to each site and locus will be presented in subsequent chapters.

Overview of Field Methods

In 1990, when SRI walked the first transects across the Playa Vista property, it was clear that methods traditionally used in southern California archaeological work would have to be rethought. To begin with, most intact native soils on the property were either covered in asphalt, concrete, and/or standing structures or buried under layers of historical-period and modern fill. Traditional methods of pedestrian survey were not going to inform on the potential for buried sites in a built environment, and the thickness of fill made normal hand-excavations impossible. So, at the onset of this project, the challenge was to determine the locations of intact cultural deposits in a modern industrial complex that had been subjected to over 50 years of disturbance and land alteration.

In response to that challenge, SRI developed a multifaceted approach that involved paleoenvironmental research and fieldwork, geoarchaeological investigations, geophysical methods, archival research, the use of nontraditional heavy equipment for systematic subsurface testing across the project area, and traditional hand-excavation methods. One of the major goals of our investigations was large-scale exposure of the prehistoric living surfaces, followed by a focus on the excavation and analysis of features with good archaeological contexts that could provide insight into prehistoric behavior and adaptations. In the following section, we detail the methods used for archaeological investigations for the PVAHP.

Survey

Prior to the PVAHP, attempts had been made to inventory the cultural materials within the project area (e.g., Pence 1979. Van Horn 1984a). Although many amateurs had conducted salvage excavations, and some professional archaeologists had conducted informal surveys of portions of the Ballona, the first formal survey of the property was conducted by R. L. Pence (1979). Pence's survey was only cursory in nature and was followed in 1984 by survey conducted by David Van Horn (1984a). Both surveys only documented the previously recorded sites: LAN-54, LAN-60, LAN-62, LAN-193, and LAN-211. Those researchers were faced with the problems of trying to locate potentially buried sites in an industrial environment largely covered by asphalt and buildings. As a result of the various impediments to conducting traditional survey in the environment, very little new information was gleaned from that early work.

In 1990, SRI was contracted to inventory and evaluate known and potential cultural resources in the PVAHP project area, embarking on a standard intensive survey of the PVAHP project area. The survey was conducted using a two-person crew for a period of 5 weeks in July and August of 1990. SRI's survey area encompassed 1,004 acres, 59 percent of which were "obscured by redeposited fill or covered by an abandoned runway, improved roads, parking lots, buildings, or dense vegetation" (Altschul et al. 1991:26). That number was a bit deceptive, in that much of the area that was unaffected by modern development actually lay within the saltwater marsh and, therefore, had little potential for archaeological materials. "In Area D, where most of the prehistoric sites have been recorded, 86 percent of the surface is either obscured by fill or disturbed, and in Area C, the figure rises to 96 percent" (Altschul et al. 1991:164). It was clear at the time that traditional pedestrian survey would not adequately address the need to identify cultural materials on the property. Despite those impediments, SRI identified "seventeen discrete loci of previously unrecorded cultural materials and 5 isolated finds" (Altschul et al. 1991:26). For more details regarding the nature of those materials, please refer to Altschul et al. (1991). Included in the 17 loci were several locations that would later receive formal archaeological site designations, including LAN-1932, LAN-1933, LAN-2768, LAN-2769, and LAN-3982. Some of the loci were later determined to be components of known sites and thus were subsumed into larger site boundaries. Not all of the sites were determined NRHP eligible, however, and therefore, not all were subjected to data recovery investigations. In some cases, such as LAN-1932, LAN-2676, and LAN-2769, testing revealed either that the sites had been redeposited or that they lacked enough integrity to prohibit them from addressing the research questions described above.

As a result of the pedestrian survey of the property, SRI proposed two districts: the BLAD and the HIHD (see Chapter 1, this volume). The two districts were created to help with evaluations of the buried archaeological deposits and standing structures. Several of the temporary sites identified during the survey were not included in the districts and were evaluated as isolated sites. It was recognized that subsurface testing would be necessary to make final determinations as to the presence and integrity of buried cultural deposits. Further, because many of the areas to be investigated were either built upon or buried under asphalt and fill, nontraditional methods would have to be employed for subsurface investigations. Ultimately, the determination that traditional survey methods would provide only limited insight into the cultural resources was formalized into work plans for the inventory and evaluation of cultural resources within the various work areas defined by Playa Vista.

Buried-Sites Archaeology at Playa Vista

To assess the buried cultural deposits in the project area, SRI used a variety of subsurface-testing techniques, each suited to providing different, but supporting, sets of data. As the results of the subsurface testing were analyzed, the focus shifted to data recovery efforts. The following sections outline the general procedures used for testing and data recovery for the PVAHP. Because of the peculiarities of individual sites, not all techniques and procedures were employed at all sites. For a more detailed discussion of the methods used at each site, see Chapters 6–10, this volume.

Geophysical Investigations

Because modern construction had buried the majority of the cultural remains in the Ballona, SRI decided to use remote-sensing techniques to attempt to "see" below the layers of concrete and fill that covered much of the project area. Remote sensing was carried out on different occasions by Geoscan Research, under the direction of Dr. Lewis Somers, and by the University of Mississippi Center for Archaeological Research, under the direction of Bryan S. Haley. SRI undertook these investigations with the intention of locating subsurface geographic anomalies and identifying the possible locations of buried cultural features, particularly at LAN-62. The initial geophysical investigations employed three different geophysical methods: magnetic-field-gradient survey, resistivity survey, and ground-penetrating radar (GPR). Magnetic-field-gradient surveys were used primarily to map buried utilities and subsurface iron objects. That method also has the potential to identify midden soils. Resistivity surveys were used to discover gross variations in soil type, moisture content, or both. GPR survey was used to map stratigraphic contacts between various soil types. The maps produced were to serve two purposes. First, it was hoped that intact sediments, and possibly even archaeological features, would be identified. Second, the maps would provide information about buried utility lines and other disturbances that were not documented in existing construction maps.

Figure 11. Mechanical coring at LAN-193.

The initial geophysical surveys were focused on areas at LAN-193 and LAN-2768. Each survey area was chosen because it was situated within the Riparian Corridor of the project area, access was fairly easy, and the asphalt covering was not considered a hindrance to the selected methods. For various reasons, however, not all of the available remote-sensing methods were employed in each lot. At each survey tract, a 20-m grid was established over the area to be investigated. Prior to running the equipment, the entire parking area was cleared of loose metal objects, where possible. The same grid was used for all of the methods in each location, so that the data would be comparable. For a more detailed discussion of the methods employed for each of the remote-sensing techniques, see Doolittle (1999:23–35) and Chapters 6 and 7, this volume.

Buried-Sites Testing

The continuing use of the project area for commercial enterprises, the asphalt covering, and the need to maintain access to other portions of the 1,000+-acre project area prevented the use of typical strategies of trenching, hand-excavating of test units, or hand-augering. As a result, mechanical methods of subsurface testing, including mechanical coring and bucket augering, were used. In addition to the coring and augering techniques employed under the supervision of SRI staff members, data from the monitoring of geological coring under the direction of Playa Vista was incorporated into our analyses. The objectives of testing were to determine the presence and extent of subsurface deposits and to provide grounds for assessing NRHP eligibility. SRI designed the test excavations to minimize site destruction and to leave most of the intact subsurface deposits undisturbed for later data recovery excavations.

Coring

The coring program was designed to collect samples for various studies conducted for paleoenvironmental reconstruction and also to identify undisturbed soils in which potential sites may be preserved (Figure 11). Cores are most useful for documenting the stratigraphy of cultural and natural deposits but less useful for identifying the horizontal variability within a particular stratum. A Central Mine Equipment hollow-stem auger drill was used and allowed for continuous soil sampling. These types of coring devices can be used to remove 2- or 3-inch-diameter sections in 5-foot-long segments. The depth and vertical orientation of all core sections were noted by measuring the depth of the borehole after removing each segment. Core sections were examined during recovery for gross soil changes, cultural materials, shell, gravels, or other distinctive materials (Figure 12). Cores were then cut into 2½-foot segments and packed in waxed cardboard boxes for transport and storage. All cores were backfilled upon completion.

The information from cores was used to establish the locations of stable and undisturbed landforms where archaeological sites might be located. The coring program was most useful in identifying soil contacts at depths greater than those reached by the remote-sensing surveys. It was also used to characterize each of the soils and to create a map of probable prehistoric landscapes.

Additionally, the coring program was conceived as a means of site discovery. Despite the small diameter of the cores and the considerable time required for a full analysis of the core data, two areas were identified through coring as containing archaeological deposits. The first was within LAN-193, where the very first mechanical core that was excavated returned a possible lithic artifact at a depth of approximately 15 feet (4.5 m). Archaeological material was also identified in the vicinity of LAN-2768, where a dark-brown soil horizon containing marine shell was noted. Additional information on the methods and results of coring at various sites can be found in Doolittle (1999:28–32) and in Chapters 6–10, this volume.

Bucket Augering

Although coring was useful in identifying buried archaeological sites, the small samples provided little information about the density or range of archaeological materials within the sites. Therefore, a bucket-augering program was implemented to effectively evaluate buried site deposits. Bucket augering is a technique similar to coring, except that the diameter of the excavated hole is much larger (Figure 13). The same basic truck-mounted rig operates the equipment, which is capable of removing 2–3-foot-diameter samples in approximately 1-foot intervals to a depth of 60 feet. The soil collected in the bucket-shaped drill bit is not a continuous section; however, it can be collected and inspected for the presence of subsurface cultural remains. Also, because the auger removes a much larger volume of soil than a coring device, densities of subsurface deposits within sites can be quickly and accurately assessed.

A grid was overlaid onto the PVAHP project area, and bucket-auger locations were placed at roughly 50-m intervals, although the presence of buried utility lines and other subsurface materials necessitated some modifications to the plan (Figure 14). The bucket auger was mounted on a drill rig, similar to the one used for coring, that excavated and retrieved soil, using a hinged bucket drill bit. The hollow-stemmed bucket auger reaches depths of more than 18 m (60 feet) below the ground surface. Two different bucket sizes (12 and 16 inches in diameter) were used during the discovery phase. For each testing location, the crew positioned the truck over a predetermined spot and leveled it to the ground surface. A relatively level surface was needed for the rig to function properly, which limited its effectiveness on the sloping terrain in many parts of the PVAHP project area. The bucket was then rotated and lowered while mechanical force was applied. An archaeologist was present at all times, recording observations and taking depth measurements at regular intervals. The first levels penetrated by the bucket auger were highly disturbed or consisted of modern fill material. After drilling for approximately half a meter, the rig lifted the filled bucket, and the sediment was loaded into a wheelbarrow, so that the archaeologists could inspect the deposits at varying depths. Soils were assigned stratigraphic designations, and where intact soils were encountered, the archaeologists collected soil samples of 40–100 liters for subsequent wet screening. All soils that were dark in color (possibly indicating an anthrosol) or that contained artifacts or ecofacts were sampled for wet screening. Vargas (2003:101–106) and Vargas and Feld (2003a:63–66) provided additional detail concerning bucket-auger procedures and results, and results for individual sites can be found in the chapters that follow.

As with mechanical coring, the bucket-augering process had its limitations. It was quite successful at accurately mapping stratigraphic soil horizons vertically, as well as locating archaeological materials, but the limited size of the exposure made determinations of stratigraphic integrity difficult. Also, there was some amount of mixing of sediments, although we attempted to compensate for that problem through close supervision by the monitoring archaeologist, who maintained a log noting such disturbance. Nonetheless, the bucket-augering process was very successful in identifying buried archaeological deposits. The analysis of bucket-auger units took into consideration some of these constraints, and given the limitations, mechanical trenching tailored to delineate the cultural integrity of buried cultural deposits was recommended. After the augering procedures were completed, SRI personnel wet screened and processed the collected and tagged soil samples. The presence or absence of materials was then plotted onto the overall PVAHP map.

Mechanical Trenching

Mechanical trenching was used in areas where sites were not deeply buried by overburden and alluvium. This process is invaluable for mapping the horizontal and vertical extents of archaeological deposits (Figure 15) and was used extensively in the PVAHP to verify the findings of the bucket-augering program and also to assist with the geoarchaeological studies within sites. In most cases, a backhoe was used for trenching, but in a few places where deposits were more deeply buried, a tracked excavator was used to collect samples of soil and to create exposures of strata (Figure 16). The sizes of trenches varied widely, from small "pothole" trenches of only a few meters to large trenches with exposures of over 70 m. Trenches were excavated with a backhoe or an excavator fit with a smooth bucket, generally in small lifts of 5–10 cm. In some cases, samples of soils that were identified as potentially containing archaeological deposits were screened by hand to recover any artifacts. The stratigraphic profiles of most trenches were recorded, and the trenches were photographed and mapped.

Figure 12. Core sample being removed from the coring bit.

Figure 13. Bucket augering: (*a*) overview of the auger mounted on the rig and (*b*) close-up of auger sample collection.

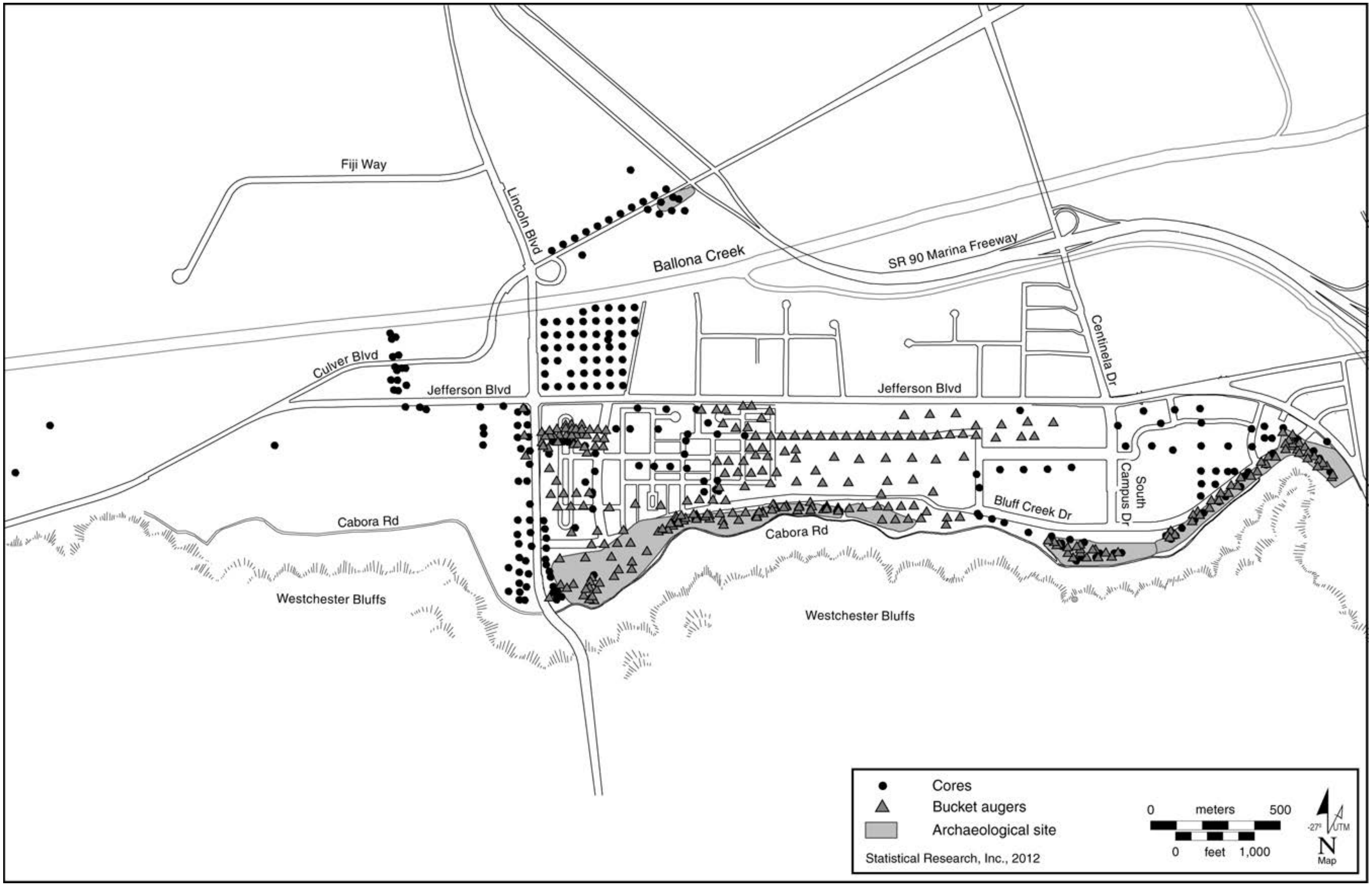

Figure 14. Map showing the locations of cores and augers in the PVAHP project area.

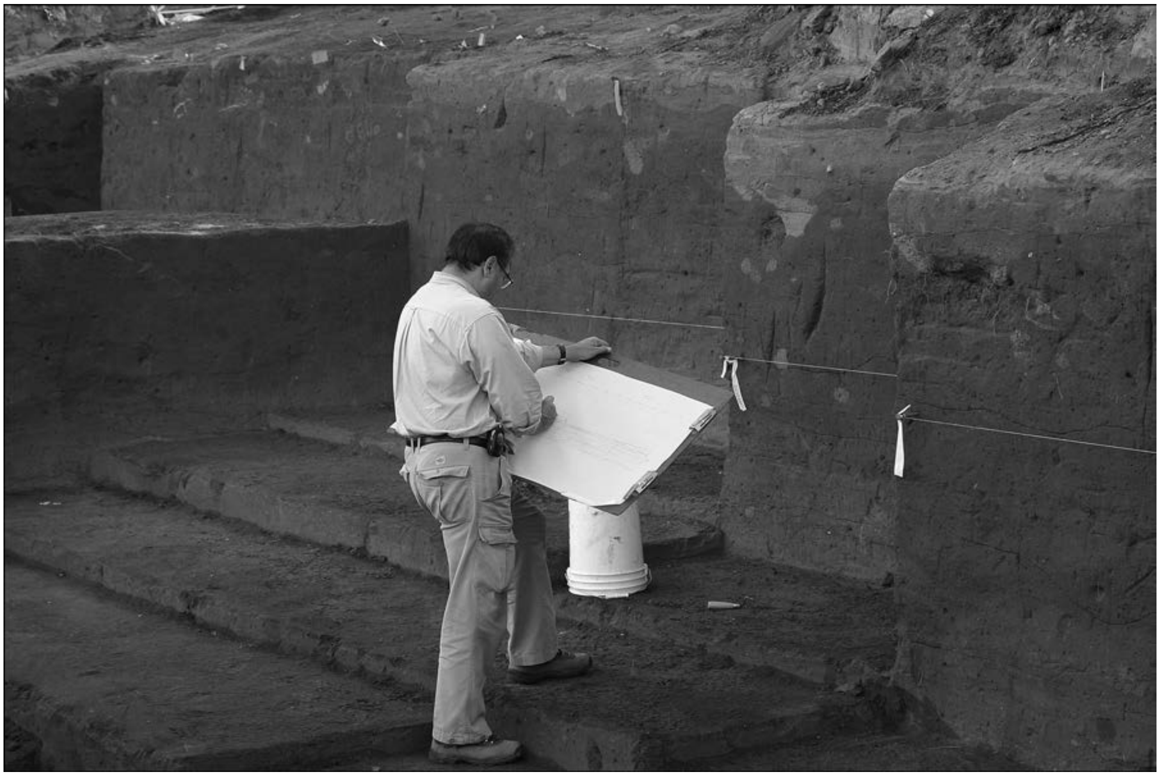

Figure 15. Recording a trench profile.

Figure 16. Mechanical trenching.

The Provenience System

To effectively record the complex suite of information that is lost as a result of the destructive activities of construction and the activities of archaeological excavation, SRI has developed an all-inclusive recording system. The provenience-designation (PD) system allows us to record various observations and also to inventory the material remains, along with their provenience and dimensions on a site. The PD system synthesizes nearly all aspects of field recording into one series of consecutive numbers for each site. There are several benefits to this approach. Field recording and paperwork are simplified by eliminating the multiple strings of designations (typically numbers) used for various activities. Using a comprehensive, sequential numbering system for each archaeological site integrates all spatial units and recovery activities for the site. At the basic level, the PD number is a unique number assigned to record a specific unit of space within an archaeological site. That can include features, backhoe trenches, datums, EUs, hand-scraping or mechanical-surface-scraping units, mapping nails, point-provenienced-collection locations, and surface-collection units. This system also expedites postfield data management and is an integral part of SRI's database system, known as SRID (Scaling Relational Integrated Database). So, in EUs, each 10-cm excavation level was assigned a unique PD number to identify that unit of space. The PD numbers are the means by which we record units of space recovered from the archaeological record. Generally, the numbers begin at 1 on a particular site and can be a potentially infinite sequence of numbers, depending on the excavation and recording strategies employed. The PD number is not merely a tracking system for artifacts but, importantly, represents a spatial unit on the site. The space can be two-dimensional, such as the present ground surface, the floor of a house, or a trench wall, or it can be three-dimensional, such as the volume of a backhoe trench, a level, or a stratum. The space can be delimited by non-arbitrary boundaries (a feature or an artifact) or arbitrary boundaries (such as test pits, trenches, and collection units).

At any site, a provenience log is maintained that records the basic characteristics of excavations, mapping activities, collection units, point-provenienced artifacts, and any other spatial data that might be recorded at the site. Unique PD numbers are assigned to the various observations and are the unique identifiers that follow that set of data throughout the various phases of fieldwork. The PD number acts as an inventory tool that is always unique to its particular unit of recorded space at a site.

Testing/Data Recovery

The test excavations undertaken at the various sites within the project area showed that intact subsurface deposits were indeed present. The following sections briefly outline the methods used during various phases of the data recovery efforts, including trenching, hand-excavation, and mechanical stripping.

Mechanical Trenching

In addition to trenching conducted during the initial testing of the project area, SRI excavated a number of mechanical trenches prior to and during the data recovery efforts. In some cases, the purpose of a trench was to help guide the excavators in removing the overlying fill, to expose the underlying anthropogenic horizons. Trenches were strategically placed in locations along the edges of and within the planned area of subsurface exposure, to provide concrete guidelines for removing the overburden. The trenches also permitted evaluation of the horizontal extent of intact subsurface remains.

Following initial trenching, the overlying fills were removed with an excavator fitted with a flat cutting blade. An archaeologist monitored the fill-stripping procedure at all times and guided the equipment operator when intact deposits were reached. Trench excavation served two purposes. First, trenches were used to define the boundaries of potential sites located during earlier site surveys (Altschul et al. 1991) and by the coring and bucket-augering program. Through trenching, we were able to assess visually the size, depth, and integrity of cultural deposits. Secondly, trenches were used to define soil stratigraphy within particular sites and in the project area generally. Trenching was directed and monitored by SRI staff.

Trenches were carefully graded in roughly 10–20-cm lifts. At several sites, the trenches were excavated into deeply buried cultural deposits, which created unsafe conditions for entering the trench. The subsurface stratigraphy was thus inferred, based on changes in excavated soils (color and texture) and surface-level inspection of the trench sidewalls.

Hand-Excavations

Hand-excavation of 1-by-1-m EUs was conducted at most PVAHP sites. All EUs were excavated in 10-cm arbitrary levels using a combination of shovels, picks, and small hand-tools (Figure 17). Arbitrary levels were used after determining that no culturally significant stratigraphic units could be detected within the intact A horizon. The spatial control afforded by the 10-cm levels and the 1-by-1-m units has proven to be valuable in interpreting midden deposits mixed by centuries of bioturbation. Each 10-cm excavation level was assigned a unique PD number to identify the unit of space being recovered. Excavated materials were then placed in 5-gallon buckets, labeled with relevant provenience information, and taken for screening (see below). Test-pit excavations were terminated in soils determined to be culturally sterile or at the discretion of the field director.

Two types of EUs were excavated at each site, CUs and EU block excavations. CUs were EUs that were placed judgmentally to delineate the horizontal and vertical extents of the site within the project area. In addition to CUs, blocks of EUs were placed in areas that were likely to contain large numbers of features (Figure 18). In some cases, blocks of EUs, either by themselves or from within larger block excavations, were grouped together as feature blocks. Feature blocks incorporated groups of features that appeared to be clustered and may be contemporaneous. Feature blocks could be any size and reflected field interpretations of what investigators thought

Figure 17. Hand-excavations at LAN-62 Locus A.

Figure 18. Feature excavations at LAN-62 Locus A.

might represent activity areas or prehistoric surfaces. In the absence of obvious house pits or visible compacted surfaces, features are the only link to behavior that may exist at a site in spatially meaningful patterns. The excavations of large blocks around individual features and clusters of features allowed for the collection of artifacts and ecofacts that could be used for interpretations of site structure in areas where features were thought to be contemporaneous.

Features discovered during EU excavation were sectioned or divided into quadrants, when appropriate, and excavated in 10-cm levels (Figure 19). In some cases, a feature was excavated as a single unit. Each feature was photographed, and plan and section drawings were made (Figure 20). When artifacts were found in situ and in good condition, they were drawn and photographed (Figure 21). In some cases, the soils between clusters of features also were excavated by hand, to expose the entirety of the features and to investigate connections among them. From selected features, excavators collected flotation and pollen samples.

Mechanical Excavations/Stripping

As part of data recovery, mechanical stripping was carried out at LAN-54, LAN-62, LAN-193, LAN-211, and LAN-2768. Stripping was conducted using Gradall excavators, mechanical excavators, or graders, depending on the slope and terrain (Figure 22). Stripping procedures involved the removal of soils, usually in shallow lifts approximately 4 m wide and dug stratigraphically until culturally sterile strata or the desired depth was reached. Each SU was treated as a separate analytical unit, receiving SU and PD numbers for the various stratigraphic levels excavated and sampled. That activity was closely monitored by a team of archaeologists who continually checked for the presence of cultural features and diagnostic artifacts.

When prehistoric cultural features were encountered during stripping, they were mapped and photographed, and all were excavated by hand. At LAN-62, several were three-dimensionally scanned. Isolated artifacts determined to be either culturally or temporally diagnostic were also mapped with a total station and collected for analysis. Sampling of the stripped soil varied from site to site, based on specific conditions. In some instances, all culture-bearing deposits excavated from SUs were screened. In other cases, the deposits were only sampled. Each sample was assigned a unique PD number, using the same system employed during the test-pit excavations.

All features identified during stripping were excavated. For prehistoric features, excavators collected soil samples from the matrix surrounding each feature as a flotation sample; pollen samples were also collected, when appropriate. Each feature was assigned a single PD and was excavated as a single entity, regardless of depth. Excavators recorded features and made a plan drawing and took a photograph of each. For deeper features, cross-sectional profile drawings were made. Historical-period features were generally defined using hand-excavation, and samples of temporally and behaviorally diagnostic artifacts were collected. Generally, matrix from historical-period features was not processed through flotation but was dry screened using 1/4-inch-mesh-wire screens.

The PVAHP involved a range of methods to identify and then excavate subsurface and buried deposits in a dynamic environmental setting. The level and scale of the excavations in the project were large and resulted in the discovery of prehistoric living surfaces, ritual contexts, a burial ground, and a mourning area.

Special Studies

Traditional artifact analyses of excavated materials from the study sites were complimented with a suite of special soil studies aimed at reconstructing the paleoenvironment of the study area. Those studies included examining natural stratigraphy, microinvertebrate populations, and pH variations (Figure 23).

Column Samples

Upon the completion of the unit excavations, 25-by-25-cm column sample units were excavated adjacent to some of the CU excavations. The samples were collected in 10-cm levels, thus matching the EU levels. They were processed using the flotation method, thus providing control samples for comparison to materials collected in EUs that were screened through 1/8-inch-mesh dry screens. The column samples also provided a controlled sample of midden constituents for comparison to the pollen and flotation samples collected from the feature matrices. SRI soil scientists made detailed profile drawings and collected additional soil samples from multiple locations.

Samples were selected for ostracod analysis and more-detailed procedures aimed at reconstructing the paleoenvironment of the Ballona Lagoon (see Volume 1, this series). In addition to the natural stratigraphy, microinvertebrates were examined to reconstruct changes in salinity within this portion of the lagoon during periods of site occupation. To identify how this portion of the lagoon was used at different times during the late Holocene, cultural features were radiocarbon dated and assigned to stratigraphic contexts, based on the natural stratigraphy.

The sediments from the profiles were described following U.S. Geological Survey (USGS) Soil Survey Manual guidelines. The observations of sediment samples from the profiles included color, mineralogy, particle size, and pH.

Chemical Studies

In addition to the stratigraphic, microinvertebrate, and pollen studies, chemical analyses were also performed on the soil samples taken from profiles during data recovery efforts. The data recorded from those profiles included pH levels, organic content, extractable-phosphorous content, electrical conductivity, density, porosity, and particle size. Soil pH levels and electrical conductivity (dS/M) measure soil salinity, which provides insights into preservation conditions. Phosphorous and organic-content levels potentially indicate human occupation, because most materials discarded by humans tended to be high in organic content and phosphorous, such as animal and plant foods and wooden materials. Together, these

Figure 19. Feature recording.

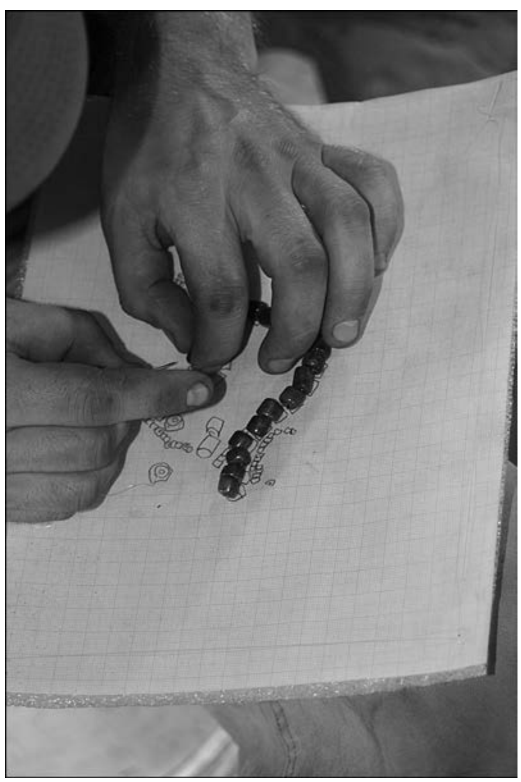

Figure 20. Recording of artifacts: sketching a string of beads in the field at LAN-62 Locus A.

Figure 21. Mechanical stripping at LAN-62 Locus A.

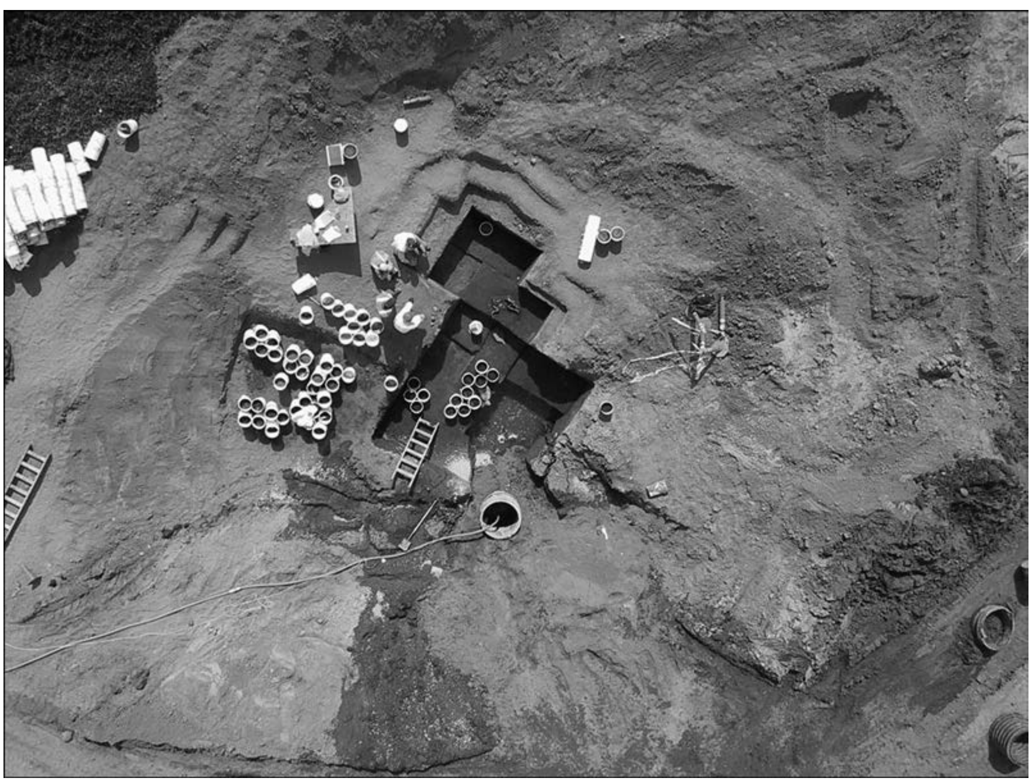

Figure 22. Block excavations at LAN-62 Locus A.

Figure 23. Soil-pH testing in the field laboratory.

studies helped to reconstruct both the environmental and anthropogenic factors that played a part in the creation of the archaeological sites in the project area.

Conservation

Several perishable artifacts were encountered during the excavations at LAN-62, including textiles, basketry, wood, and metal—rare findings at prehistoric coastal sites in the southern California region. Whenever possible, reversible conservation techniques were employed to stabilize those materials for later analysis (see Appendix 4.1, this volume). John Griswold of Griswold Conservation Associates, LLC, a conservation expert, was employed by SRI to help identify and conserve perishable items (Figures 24 and 25). Mr. Griswold trained SRI field technicians to identify items that would require stabilization, and Mr. Griswold and his assistants established a laboratory and storage facility on-site to maintain the stability of conserved archaeological materials.

Overview of Laboratory Methods

This section summarizes the laboratory methods for the washing, cataloging, sorting, quality assurance (QA), and curation of all materials collected during the PVAHP excavations (Figure 26). Under the supervision of the laboratory director, the laboratory staff processed all materials. Below, we outline the stages of materials processing, including screening, sorting, inventory, and cataloging, and sample selection, for the analyses of specific artifact classes and other materials. The methods used for analyses of particular material classes (artifact analyses) are outlined in Volume 3, this series. Any deviations from the methods below are presented for each individual site in Chapters 6–10, this volume.

Figure 24. Conservation of perishable materials (e.g., textiles and basketry) at LAN-62, Locus A.

Figure 25. Conservation of carbonized basketry at LAN-62, Locus A.

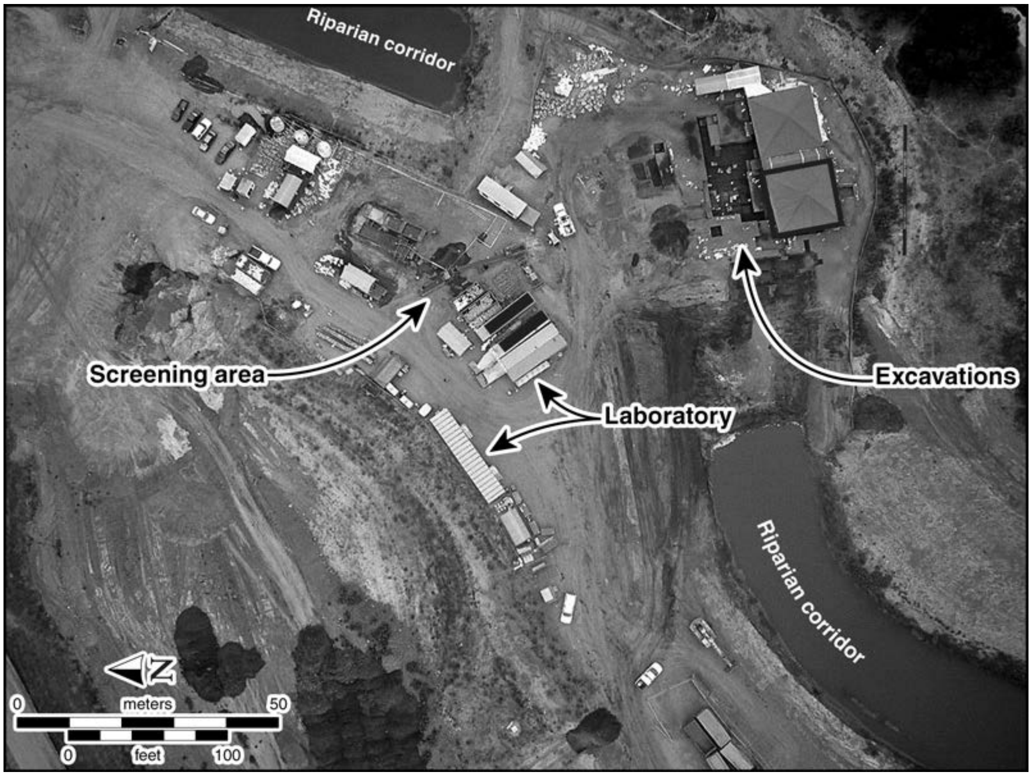

Figure 26. Aerial photograph showing the excavation area, screening area, and in-field laboratory at LAN-62, Locus A.

Screening

The first stage in processing the archaeological site sediments was screening of the excavated materials (from CUs, EUs, and features), and that occurred during PVAHP fieldwork. All sediments collected during excavations were labeled with their field provenience information and taken to SRI's in-field screening facility. The screening method varied over the years and included dry hand-screening, wet hand-screening, and wet mechanical screening (Figures 27–30). Generally, the sediment from human-burial features was dry screened using $^{1}/_{16}$-inch mesh, and soils from EUs with isolated human bones were dry screened using $^{1}/_{8}$-inch mesh. Under the supervision of the on-site laboratory director, all excavated matrix (except from human burials) was dry or wet screened through wire mesh. Mesh sizes varied depending on excavation context, and different screening procedures were used at different sites and in different contexts (see details in the site-specific chapters that follow).

All materials collected in the screens after the wet screening ("bulk materials") were air-dried (including rocks and pebbles), placed in reclosable plastic bags, grouped with materials from the same provenience unit, and shipped to SRI's Redlands laboratory facility for detailed sorting and analysis (Figure 31). In rare cases, additional cleaning of wet-screened materials was required to remove additional dirt or debris.

Collected "grab-sample" and point-provenienced materials were not wet screened but, rather, cleaned in the laboratory prior to inventorying. Fragile items, such as animal bone and rusted metal, were cleaned with a dry brush to remove soil deposits. Selected items were left unwashed for residue analysis, pollen wash, or other analyses that require examination of microscopic and macroscopic residues. Carbon samples were not washed but inventoried and placed in plastic bags and vials, to protect them from contamination and destruction.

Soil samples (pollen and flotation samples) were collected in sterile plastic bags and immediately stored in insulated foam boxes to minimize fluctuations in temperature that could potentially cause condensation and mold formation. After 30 days, unanalyzed pollen soil samples were transferred to refrigerated storage. Selected ground stone artifacts also were identified in the field for pollen-wash analysis. Those ground stone artifacts were rinsed in distilled water to generate runoff containing the pollen residue, which was then collected, stored in sealed glass jars, and preserved with hydrochloric acid.

All bulk and point-provenienced materials and soil bags were tracked using a provenience- and specimen-catalog system. Artifacts from each recovery context were recorded in a database and assigned a unique provenience and catalog number. Each bag of bulk and point-provenienced materials was also assigned a catalog number. The bulk materials were then placed in boxes (which were also assigned tracking numbers) and on shelves for detailed sorting, as explained below.

Figure 27. Manual dry-screening area adjacent to the mechanical screen at LAN-62 Locus A.

Figure 28. Mechanical wet screening: collecting the heavy fraction.

Figure 29. Wet-screening mechanical system at LAN-62 Locus A.

Figure 30. Mechanical wet screening: hand-loading at LAN-62, Locus A.

Figure 31. Wet-screening resulting materials.

Sorting and Inventory

The sorting procedures for the materials varied among the sites and recovery contexts. CUs, prehistoric features, and historical-period features generally required different sorting protocols. Detailed descriptions of sorting procedures are presented for each site in the following chapters, but general procedures are outlined here.

Bulk materials from all sites were sifted through nested screens with varying mesh sizes to segregate the materials into size classes. In most cases, size-sorted materials were separately bagged and labeled according to size category (screen-mesh size) and basic material type, including worked and unworked bone, worked and unworked shell, historical-period artifacts, lithic artifacts, and a miscellaneous "other" category for such materials as mineral samples, large seeds, wood, asphaltum, ochre, and various low-frequency items. The initial sorting did not separate the materials according to finer subcategories within each material class (e.g., lithic tools versus flakes); instead, such analysis was conducted by material-class analysts, who were responsible for making those more-detailed type or material classifications. The initial sorting was conducted by laboratory technicians, who were responsible for scanning bulk materials for diagnostic artifacts (e.g., projectile points) or other "high-priority" materials that were rare in the hand-excavated units. Rocks, gravels, and other nonessential materials collected during screening were retained but not subjected to further analysis.

Given the abundance of faunal remains from sites in the PVAHP project area, an additional step was implemented during the initial sorting to prepare the faunal materials for analysis. Note that only a 25 percent sample of the collected faunal remains was analyzed by the specialists. To prepare a representative random sample from each unit, the initial sorting involved selection of approximately one-quarter of the faunal remains from each context, which was bagged separately for analysis. That selection involved random division of the sample by size or other specific qualities, without deliberate selection of specimens for the 25 percent sample, using a custom-built sample splitter designed for use with archaeological materials.

The subsequent step in sorting involved the inventory of the sorted materials earmarked for additional analysis. Materials within each class and from each provenience unit were recorded by count, with the exception of unworked bone and unworked shell, which were recorded by weight. All information was entered into the database. After the data entry was completed, all the data records were reviewed for errors and compared with the presort and postsort counts, to ensure accuracy. The database was then made available to analysts, who checked the materials they received against the inventory list. The analysts reported any missing or erroneously classified specimens to the laboratory director for database correction.

Flotation samples (soil samples) were analyzed for macrobotanical remains. The samples were processed using nested screens with varying mesh sizes: $^{1}/_{8}$-inch mesh and $^{1}/_{4}$-inch mesh were used to segregate heavy-fraction materials, and a No. 45 (approximately 1/64-inch-mesh) screen was used to capture light-fraction materials. The latter mesh size was chosen to procure small macrobotanical samples but avoid capturing silt or clay particles. All unsorted material was retained until curation, to insure that data that might be useful at a later date were not discarded. The samples were processed using a Dausman Flote-Tech machine (Model A), a self-contained recirculation system consisting of two adjoining chambers with screen boxes (one for heavy fraction and one for light fraction), a water pump (for recirculating water), and a sludge pump (to remove sediment and excess water).

Once materials were sorted, laboratory technicians inventoried the materials, setting aside all nonessential materials not earmarked for additional analysis. The initial laboratory phase involved the data entry of all proveniences entered into the PD log. Information from the PD log was entered into a database for data entry and analysis.

Some materials were recorded as weights, and others were recorded as counts, according to recovery context. After the data entry was complete, the laboratory director reviewed all recorded data for errors and inconsistencies and compared the data entered with the in-field counts and descriptions, to ensure accuracy. The database was then available to the individual materials analysts for detailed classification and analysis. The database also was used to generate summary reports per provenience, to assist with the planning of subsequent phases of analysis.

Deconservation

Many artifacts required deconservation measures once they were removed from the field. Deconservation was required for multiple reasons. In some cases, protective wraps, such as Japanese tissue, obscured the surfaces of the artifacts, making further study impossible. Many of the artifacts that were conserved in the field came from the burial area and were to be reinterred following the completion of the project. Mr. Robert Dorame, the Most Likely Descendant (MLD), requested that all artificial materials be removed from objects that were to be reinterred.

Japanese tissue and excess consolidant were removed by applying additional acetone to the conserved artifact, which redissolved the B72 acrylic. Tissue paper and excess consolidants were then carefully removed by hand. Prior to reinterment, baskets and other artifacts that had been supported by expandable polyurethane spray foam were cleaned, and all foam material was removed from the baskets.

Sampling Procedures

Given the large quantity of materials collected, SRI researchers devised an analytical sampling strategy. SRI's objective in selecting units and features for analysis was to achieve a robust and representative sample of the various loci, behavioral contexts (e.g., subsistence versus ritual features), and temporal components at each site and locus. In most cases, that involved a judgmental selection of CUs and features at each site or locus. For example, both LAN-62 (Locus A) and LAN-211 (FB 1) contained rare and unique Mission period components that warranted special attention, and thus, a large sample of CUs and features were selected for analysis in those locations. Specifics about the selection and sampling criteria for each site and locus are discussed in detail in the following chapters.

Different criteria were used to select CUs and features for detailed analysis. Only portions (i.e., selected levels) of some CUs or EUs were analyzed, primarily at LAN-62 and LAN-211. In other cases, EUs or features were selected for analysis of specific materials or artifact classes. In yet other cases, only point-provenienced artifacts were analyzed, whereas items recovered from bulk recovery contexts (screened materials) were not. In a few cases, the analysts did not examine materials from each of the units or features selected for analysis because some proveniences did not include specimens of some material classes.

The analyses of materials from CUs were intended to garner data from nonfeature contexts, especially the large and virtually continuous midden that encompasses the area along the base of the Ballona escarpment. The analyses of materials from CUs provided a comparative baseline for interpreting artifact densities and subsurface integrity in different loci and areas of the project area. In some cases, they also permitted analysis of materials that may have been associated with a feature cluster (e.g., the burial area at LAN-62) but were not encompassed within the matrix of a specific feature. Analyses of materials from the CUs also provided valuable information concerning deposition rates and intensity of occupation. The CUs and EUs selected for analysis from each site are listed in Appendix 4.2, this volume.

EUs and features were selected for analysis based on several factors, including cultural integrity; spatial, temporal, and contextual representation; and artifact densities, based on field observations. An attempt was made to select features both from a range of vertical and horizontal stratigraphic contexts and from a representative sample of the range of feature types recorded during fieldwork. Key to the selection of features was an understanding of the stratigraphic context of the materials and also their cultural integrity. At some sites, such as LAN-62, LAN-193, and LAN-211, clusters of features excavated together as feature blocks were selected as single large analytical contexts with subfeatures. Not all identified feature blocks were analyzed, but attempts were made to select a representative sample from different stratigraphic/temporal contexts.

One goal of our analysis of the CUs was to compare variability in subsurface densities per level and per cultural stratum among the major artifact classes (flaked stone, vertebrate fauna, and invertebrate fauna), thus providing a basis for inferring temporal changes in rates of artifact deposition and in the materials deposited. Comparing changes in artifact densities among the levels or strata presented a challenge, however, given the very different frequencies of artifact classes. For example, in some CUs, vertebrate-faunal-bone fragments outnumbered flaked stone artifacts by hundreds or thousands, which inhibited a direct comparison of their densities and how they varied among the unit levels and strata. To facilitate comparison, therefore, the densities per level and stratum needed to be standardized among the three artifact classes, which we accomplished by converting the densities into relative-frequency proportional data. We summed the density values per level/stratum in each CU and recalculated them as proportions of the total. Thus, changes in the artifact densities per level or stratum in the CUs could be directly compared among the three artifact classes.

Curation and Reinterment

Following the completion of sorting and other laboratory tasks, all materials recovered during the PVAHP were prepared for their final disposition, either curation or reinterment. This section presents the general methods used during curation and reinterment preparation, as well as the final reinterment and curation activities.

PVAHP curation and reinterment has been guided by the California Public Resources Code (PRC) and Health and Safety Code (HSC). Following the California PRC, the Native American Heritage Commission (NAHC) appointed Mr. Robert Dorame as the MLD for the PVAHP. Treatment and reinterment of Native American human remains and associated grave goods have been guided by HSC §7050.5 and PRC §5097.98.

Determination of Final Disposition Status

SRI, the MLD, and the landowner all agreed that all human remains and burial-related artifacts were to be reinterred. The few burials at LAN-54, LAN-193, LAN-211, and LAN-2768 were found within well-defined contexts, and the decision to reinter those remains and associated materials was clear. The nature of the burial area at LAN-62 Locus A presented a more complex situation, because the burial area penetrated down into earlier occupation levels, mixing materials from many different contexts. Moreover, because of the long-term bioturbation, artifacts from burial and nonburial contexts had further mixed. To determine which materials from LAN-62 Locus A constituted associated grave goods and would be reinterred, discussions among Mr. Dorame; the Corps; SRI; Playa Capital Company, LLC; and the NAHC resulted in discernment of a three-dimensionally defined burial ground. All cultural and biological materials from within that burial area would be reinterred, and all materials, with the exception of isolated human remains, found at LAN-62 Locus A outside that area would be curated. Following the determination of final status, all materials were prepared for curation or reinterment. The methods used in those two dispositions are outlined in the sections below.

Curation

A Curation Agreement (see Appendix 4.3, this volume) was executed between Playa Capital Company, LLC, and the Archaeological Collections Facility of the Fowler Museum of Cultural History at UCLA. The purpose of the agreement was to outline the procedures for the curation of all materials from the PVAHP that were not reinterred. The curation of materials from the PVAHP is driven by the PA among the Corps, Los Angeles District; the ACHP; and the California SHPO (see Appendix 1.1, this volume).

The Curation Agreement is a standard agreement, with a few minor changes made specifically for this project. The exceptions included the following: (1) SRI was permitted to submit basketry, metal, and other fragile items that required climate control; (2) SRI was permitted to submit bags containing various types of bulk materials; and (3) SRI was permitted to curate some items in plastic containers rather than archival boxes. Those exceptions were based on the sheer volume of cultural materials recovered during excavations. The QA procedures and curation preparation for the materials that did not fall under those exceptions are provided below.

All artifacts designated for curation were sorted by site and placed in archival-quality 4-ml plastic bags and acid-free Hollinger curation boxes. All bags were checked to make sure non-curate-quality materials, such as aluminum foil, non-acid-free paper, and certain plastics, were removed. Bagged items were usually retained in their original bags, unless the bags were damaged or were not 4-ml bags. Fragile items were wrapped in polyethylene foam, archival tissue paper, and/or high-density polyethylene materials. Items that were too large to fit into a curation box (e.g., metates and bowls) were wrapped with the same protective materials. A reference picture was attached to the top of each oversized item, so that such items did not have to be unwrapped to be identified. Curation-quality information cards were placed in each bag and included provenience information, such as site number, EU number, level number, PD number, and material type.

The location of each bag of artifacts was tracked using the database, and boxes of artifacts were stored, grouped by site number, until they were curated. Each box contained a printed inventory that listed general provenience information and material type for each artifact bag in the box and had a label on the outside that included the site number, box number, and accession number. Generally, but not always, boxes were sorted by material type. All items from Phase 1 of the PVAHP were curated at UCLA in 2009. As of December 31, 2011, Phase 2 materials have been prepared for curation, but they remain in storage at Playa Vista, pending the conclusion of outstanding ligation.

Reinterment

On March 3, 2008, the final preparation process for reinterment began at the on-site facility at Playa Vista. During that process, final analysis, documentation, and reporting of human remains and associated cultural items were conducted. No destructive analyses were performed on any human remains. Items to be reinterred were separated into three contexts. The first comprised the human burials, which were found at LAN-54, LAN-62, LAN-211, LAN-193, and LAN-2768; the overwhelming majority were found in the burial area at LAN-62 Locus A. The burials included the actual human remains, as well as artifacts and other materials that were found in direct association with the burials. The second context comprised isolated human remains found at the five sites listed above, during excavation and subsequent laboratory analyses. Those remains could not be associated with any of the burial features and were handled separately, by their provenience information. The third context comprised the numerous artifacts from nonburial contexts in the LAN-62 Locus A burial area that were to be reinterred, as well. The procedures used during the preparation for reinterment varied somewhat for each of the three contexts and are discussed below.

Human Burials and Isolated Human Remains

Human burials from LAN-62 Locus A made up the vast majority of the reinterred remains from the PVHAP. A few human burials were also found at LAN-54, LAN-193, LAN-211, and LAN-2768. Isolated human remains were also found at LAN-62 Locus A, LAN-54, LAN-193, LAN-211, and LAN-2768. In most cases, the isolated pieces of bone were small fragments that had moved after burial and could no longer be associated with their original burial contexts. Once removed from the field, all human remains were stored in a climate-controlled structure on the Playa Vista property. All artifacts and soils recovered from burial features were also stored on the Playa Vista property. Those materials were stored by burial-feature number.

The first step in the reinterment process involved taking an inventory of all materials associated with each burial feature. Inventory sheets were printed for each feature, listing all of the materials recovered during excavation. The inventories were checked against the boxes of materials, to insure that all materials were accounted for. Native American monitors from the Gabrielino/Tongva tribe took part in all inventory checks and signed at the bottom of each inventory list once all materials had been accounted for. After all of the materials from a burial feature were collected and checked against inventories for accuracy, they were transported to a small tent set up outside the climate-controlled structure for the next step in the reinterment process: bundling.

Mr. Dorame had requested that all human remains and other burial-related items be bound in deerskin prior to reinterment. Identifiable individuals and associated artifacts were placed in individual bundles. Other bone that was present in a burial feature but not identifiable to the individual level was placed in a single bundle, separate from other individuals in the feature. Human remains recovered from isolated contexts were also bundled. If cranial fragments or teeth were present in an isolated context, they were bundled separately, by provenience. All other isolated human bone not associated with an individual burial feature and not consisting of isolated cranial fragments or teeth were placed together, by site, in large bundles. All bundles were assigned individual container codes that were scanned into SRI's database, so that their contents could be tracked, to ensure that no items were misplaced prior to reinterment.

After the bundles had been created, Mr. Dorame conducted private ceremonial activities with the bundles from each feature. When Mr. Dorame and his Native American assistants had completed the ceremonial activities, the bundles were tied closed with a leather thong and transported by hand, by SRI personnel, back to the Playa Vista storage building to await final reinterment.

Other Reinterment Items

In addition to the human remains, several thousand artifacts from LAN-62 Locus A that were not directly associated with particular burial features or other human remains but that were located within the burial area described above were also reinterred. The bags containing those artifacts were identified and separated from items to be curated and then were stored in a designated area at Playa Vista, by site, until reinterment.

Reinterment

In preparation for the reinterment process, SRI created three-dimensional representations of the proposed reinterment area, which was located in the Ballona Discovery Center site, within Playa Vista, as requested by Mr. Dorame (Figure 32). Because of the complicated layout of the burial features, Mr. Dorame and SRI agreed to lay the burial bundles from LAN-62 Locus A, LAN-54, LAN-193, and LAN-2768 in rows in a single level, in positions mimicking the spatial relationships that the sites had with one another. The sites had all been located during Phase 1 of the PVAHP, and the Phase 1 reinterment was completed in 2008. The human remains and associated grave goods from LAN-211 in Phase 2 of the PVAHP could not be reinterred in 2008 due to pending litigation and were stored in a secure facility

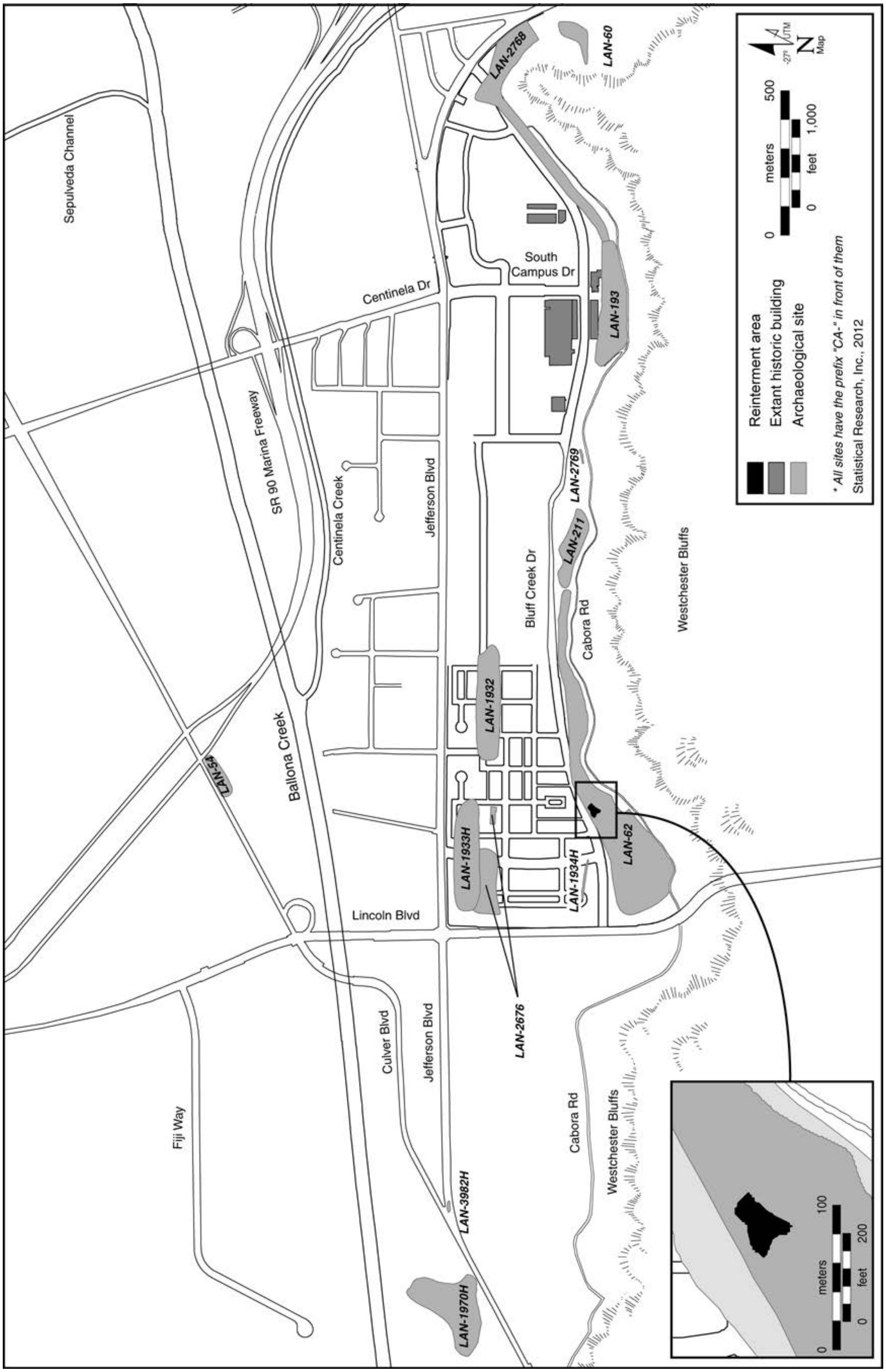

Figure 32. Map showing the location of the reinterment area.

at Playa Vista. After litigation was complete, these human remains and associated grave items from LAN-211 that had been found during Phase 2 of the PVAHP were reinterred in May 2012 at the direction and aid of Mr. Dorame. Because the reinterment area was designed at the request of Mr. Dorame to permit Phase 2 items to be reinterred at a later date, those items were placed in the center of that area. The rest of this section describes the reinterment of the Phase 1 human remains and associated goods.

The first step of the reinterment process in the field for remains from Phase 1 consisted of the excavation of the footprint of the reinterment area to a depth of approximately 11.5 feet above mean sea level (AMSL). After that footprint had been excavated mechanically, SRI set out points for the individual burial features in the proper locations within the reinterment area. Boundaries for the placement of nonburial features and artifacts from LAN-62 Locus A were also established at that time.

Once the reinterment area had been excavated, lists of features and materials to be reinterred in each row were created. With the use of those lists, feature materials, including bundles and buckets of burial soil, were placed on pallets in preparation for movement to the reinterment area. Burial features were placed on pallets and wrapped with plastic. One burial feature was placed on a pallet at a time. In some cases, two pallets were required to move a single burial feature.

After points for burial-feature locations had been set in the reinterment area, pallets containing the appropriate feature numbers were moved by truck from the storage facility at Playa Vista to the reinterment site. At the reinterment area, the pallets were unloaded.

SRI staff conducted a final check to insure that all materials from a particular burial feature were accounted for. SRI staff then transported the bundle(s) by hand to the appropriate reinterment location. Soils that were associated with a particular burial feature, contained in buckets, were poured over and around the burial-feature bundle(s).

For materials not associated with a particular burial feature, such as isolated human remains or nonburial features and other artifacts selected for reinterment, the reinterment process was very similar. Bundles and/or bags of artifacts were transported to the reinterment area via the same process described above for burial features. Once at the reinterment area, those materials were placed in their designated locations. For artifacts and nonburial features, for which no bundles were created, materials were removed from plastic bags and placed in their appropriate locations.

Once the final burial features, isolated human remains, and other reinterred artifacts had been placed and soils from specific burial features had been placed on their respective features, an additional layer of soil was placed on top of the entire reinterment area. That soil was from the LAN-62 burial area, recovered from nonburial-feature contexts that contained human remains. The soil had been stored in large containers on the Playa Vista property until the reinterment process was completed. After all features and other reinterred materials, as well as all burial soils, had been placed, a layer of heavy mesh screen was placed over the top of the burial area. On top of that layer of mesh screen was placed a final layer of clean fill measuring approximately 3 feet in thickness. That fill was sculpted into a low mound and subsequently planted with native plant species.

Native American monitors were present at every step in the reinterment process. In addition, in December 2008, a reinterment ceremony day was held at Playa Vista, and the MLD and other Gabrielino/Tongva participated in ceremonial remembrance activities.

Conclusions

As evident in this chapter, the PVAHP was an ambitious undertaking that involved a wide range of field recovery methods and laboratory analyses. The methods implemented in both the field and the laboratory varied slightly among the five sites and will be addressed in each site-specific chapter. One of the major findings of the project was the large number of nonburial features. The next chapter, Chapter 5, discusses the typology and description of the PVAHP features and presents their final interpretations as relevant to our understanding of prehistoric behavior in the Ballona.

Feature Classification

Christopher P. Garraty, Benjamin R. Vargas, John G. Douglass, and Richard Ciolek-Torello

The PVAHP Feature-Classification System

The five intact sites investigated had variable numbers of prehistoric and historical-period features, as discussed in detail later in this volume. The methods of excavation and analysis that were first defined in the research design (Altschul et al. 1991) have been tailored to target features and their associations within the archaeological record. Analysis of features and their contexts was a critical part of the overall research design and comprised a crucial line of evidence for addressing the three historic contexts of the PVAHP: Human-Land Relationships, Culture History and Cultural Dynamics of Prehistoric Settlement, and Historic Development of the Ballona (Altschul et al. 1991:20–35).

In this section, we outline the feature-characterization procedures used by SRI during the PVAHP and explain the evolution of the current classification system used for the feature descriptions presented for individual sites in Chapters 6–10, this volume. We focus on the postfieldwork feature-classification system and, in the following section, explain how that classification factored into interpretations of feature function. In the final section, we discuss the criteria for identifying prehistoric activity areas and provide examples that illustrate how that identification complemented our interpretations of site activities. Feature descriptions, organized by site, are presented electronically in Appendix 5.1, this volume. We take a broader approach to feature interpretation and distribution of activities in the Ballona in general in Volume 5, this series.

The features discussed in the following chapters were originally classified in the field as belonging to one of 10 types indicative of prehistoric and historical-period activities: activity area, animal burial, artifact concentration, hearth, human burial, pit, rock cluster, structure, thermal feature, and historical-period feature. The definitions of these categories are as follows:

- *Activity area*: Locus of domestic or ritual activities thought to encompass a group of contemporaneous features. Each of these areas was usually composed of two or more features in proximity to one another and within the same archaeological stratum. Activity areas and composite features are discussed in more detail below.

- *Animal burial*: Location of the intentional burial of an animal. Generally, these features were identified by the presence of encompassing pits, indicating intentional placement of the animal, as opposed to dumping behavior associated with subsistence activity.

- *Artifact concentration*: A distinct cluster of artifacts. In some cases, concentrations included items that appeared to have been cached purposefully. More typically, however, this feature type was applied to discrete clusters of artifacts that could not be characterized more accurately without further analysis.

- *Hearth*: Most of these features were classified on the basis of evidence of in situ burning, such as the presence of heavily oxidized soils and associated charcoal or ash stains. In some cases, they were recognized based on the presence of a tight cluster of pieces of fire-affected rock (FAR) within a pit or with multiple courses (see below).

- *Human burial*: Locus of the purposeful burial of one or multiple people. Burial treatments included inhumations and cremations as well as variations on those practices. In a few cases, burial pits were identifiable and could be used to designate feature boundaries. In most cases, however, no pits were visible, and the feature boundaries were arbitrarily defined based on the layout of the bodies.

- *Pit*: An intrusive soil anomaly generally filled with a distinguishing matrix or a concentration of artifacts.

- *Rock cluster*: A discrete concentration of modified and/or unmodified rocks, including FAR, ground stone, and flaked stone artifacts. These deposits were distinguished from thermal features by the absence of in situ burning (oxidized or charred soils), although some of the rocks may have been thermally altered.

- *Structure*: A dwelling for an individual or small group that accommodated a variety of everyday domestic activities (e.g., eating or sleeping). This designation was also used for features that related to human dwellings or elements or components of dwellings, such as groups of postholes.

- *Thermal feature*: A discrete location of in situ thermal activity. Thermal activity was usually identified through the presence of oxidized or carbonized soils, concentrations of charcoal or ash, and/or abundant FAR.

- *Historical-period feature:* A feature related to late-nineteenth- or twentieth-century activities, such as farming activities or Hughes-related land use. Generally, these features have been subsumed under one of the above feature types (e.g., artifact concentration), but their late-historical-period or modern affiliations were noted.

Revised Feature-Classification System

The 10 feature categories were used to characterize and record features during fieldwork. Once fieldwork was completed, however, and the full range of feature types was recognized, it became clear that the initial classification was inadequate for addressing the identified historic contexts and associated research questions. The creation of a formal feature-classification system for the PVAHP was a process that was not finalized until several years after the data recovery excavations. Another observation that influenced our decision to develop a comprehensive classification system was that different PVAHP sites had similar features. It became clear over time that the size, morphology, and content of features were relatively consistent among the sites, with the conspicuous exception of the burial area in Locus A of LAN-62. In addition, concurrent with data recovery excavations at LAN-62, SRI analyzed a suite of features from archaeological data recovery excavations at three sites on top of the bluffs overlooking the Ballona: LAN-63, LAN-64, and LAN-206A (Douglass et al. 2005). Those three sites were control-graded to the base of the archaeological deposits, exposing nearly 400 prehistoric features that dated mostly to the Intermediate period. Generally, the prehistoric features uncovered at those sites resembled many that were uncovered at the PVAHP sites, although significant differences were apparent, especially among mortuary and ritual features, which were older than those encountered at LAN-62.

Douglass et al. (2005) developed a feature-classification system for the three bluff-top sites that was partly modeled on DiGregorio's (1987:181–217) earlier feature analysis at LAN-63 (see Van Horn 1987a). To enhance comparison between the PVAHP sites and others in the Ballona, we applied what we learned from Douglass et al.'s classification system as a framework for the revised classification system discussed in this chapter. It became clear, though, that some modification to their system was required to accommodate the greater diversity of feature types exposed during data recovery excavations at the PVAHP sites. We further determined that the system should not be simply a group of stand-alone categories but, rather, should be "systematized" to account for variability in different attributes and criteria, such as shape, material content, presence/absence of a pit, presence/absence of evidence of thermal activity, and so on. The system thus required characterization of features in different ways based on various salient attributes. Unlike DiGregorio's or Douglass et al.'s previous systems, our system is explicitly hierarchical in structure, as illustrated in Figure 33, and involved several levels, or "domains," of classification and interpretation.

Important to our approach to characterizing features is a distinction between classification and interpretation. Features were classified at several levels based on the descriptive attributes discussed in the following sections, such as morphology and content. Hence, our classification system is mostly descriptive and not interpretive. In contrast, the interpretation of feature function relied on an inferential process that linked the descriptive attributes to the presumed behaviors responsible for those defining attributes, based on empirical observations or analogies. For example, we can infer from the presence of oxidized soils and a clear pit outline that a feature functioned as a hearth. We describe each of the classification "domains," or attribute criteria, in the following sections.

Isolated and Composite Features

At the broadest level, we distinguish between isolated and composite features to distinguish individual features from groups of related features likely created during a single occupation event or episode. A composite feature is defined as a spatially associated concentration of two or more subfeatures that form a discrete activity area. For example, Feature 1 at LAN-211 consists of a large concentration of more than 20 thermal and nonthermal subfeatures (mostly hearths) that were found in the same stratum and clearly were part of the same depositional episode or occupation surface. By contrast, isolated features are not spatially associated with other features

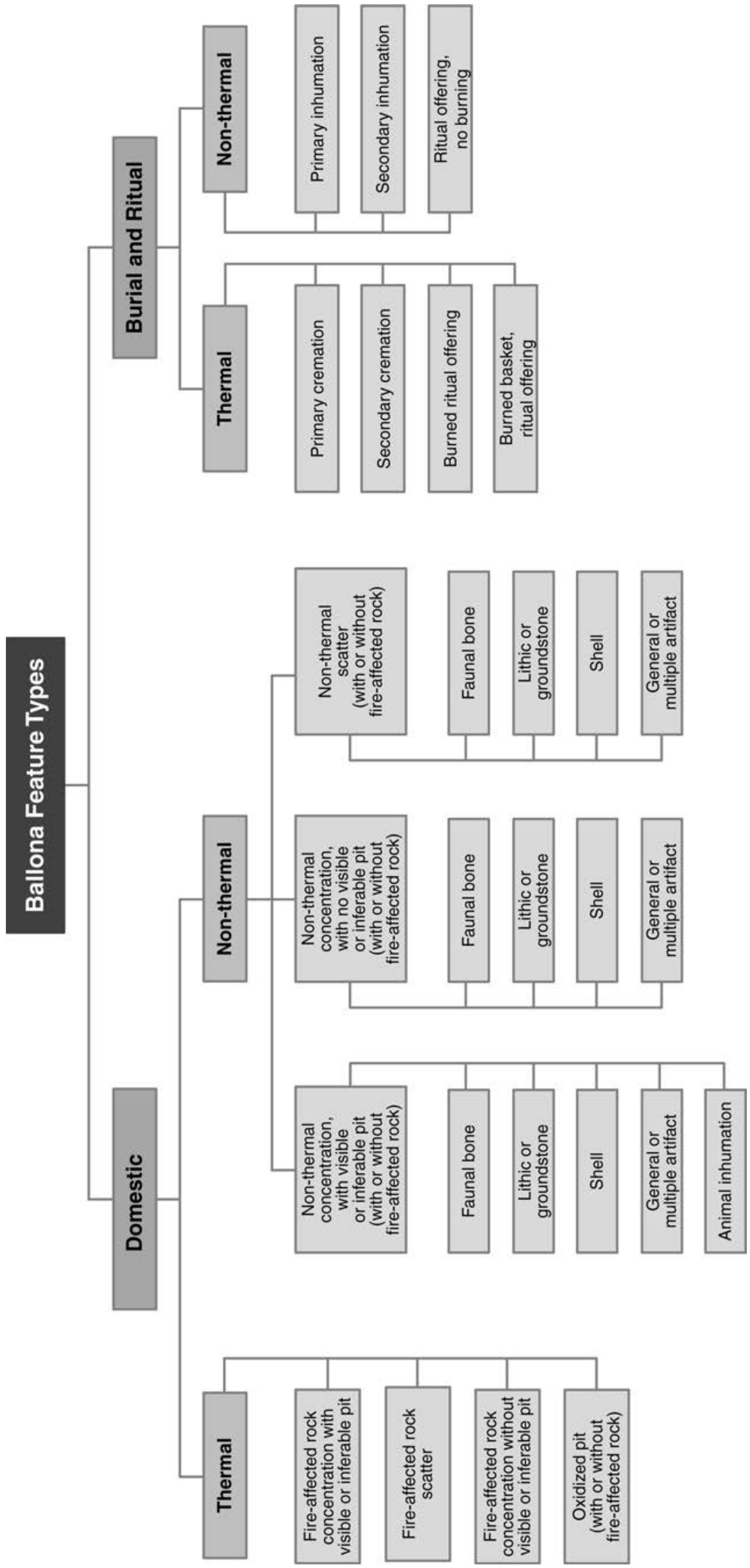

Figure 33. Flowchart of PVAHP feature types.

(laterally or stratigraphically) and thus are not clearly part of a larger group of related features. As shown in Figure 33, all isolated and composite features were subdivided into domestic or burial/ritual deposits and into thermal or nonthermal deposits (see below). Overall, most features within the PVAHP were classified as isolated deposits, although subsequent analyses suggested that some of those isolated remains *might* have been parts of larger activity areas (see below).

Analyses of individual features may help explain an ancient activity (or possibly several), but concentrations of contiguous associated features—i.e., activity areas—can provide a broader-scale view of the range of activities that occurred during a discrete occupation episode. That approach is especially important for understanding prehistoric occupations, because the Ballona was a longtime locus of resource-collection trips by mobile hunter-gatherer groups. The various prehistoric features and activity areas thus may represent a palimpsest of discrete camping loci and resource-processing stations generated from many logistical trips and depositional events.

The distinction between isolated and composite features was especially important in the case of LAN-193 (see Chapter 6, this volume). At that site, the data recovery excavation focused on three composite features (Features 7–9), each of which encompassed three to five subfeatures. Large blocks of hand-excavation units were established to expose each of the composite features and their constituent subfeatures and material remains. The excavation efforts at LAN-193 were thus mainly concentrated on those groups of features rather than the individual isolated features, although a handful of arbitrary units also were excavated to expose and characterize isolated deposits. Several blocks of units also were excavated at LAN-62 to expose and record possible composite features.

Domestic, Burial/Ritual, and Late-Historical-Period Deposits

At a broad level, all features recorded during the data recovery excavations were also classified as burial/ritual features, domestic features, or late-historical-period/modern features (deposited after ca. 1850). In this study, "domestic features" refers exclusively to premodern indigenous deposits (pre–A.D. 1830) generated in connection with one or more prosaic domestic activities, such as food preparation, heating, toolmaking, processing of hunted or gathered resources, etc., and "Prehispanic and Mission period" refers to Mission period or earlier features deposited by native peoples prior to the large-scale occupation of the Ballona by Mexican and Euroamerican settlers beginning around A.D. 1820. Those features mainly were domestic hearths, discard areas for various subsistence-related debris (e.g., FAR, food remains, or debitage), possible cairns or posthole supports, or other domestic deposits. By contrast, burial/ritual features generally related to activities by premodern indigenous peoples related to mortuary ritual and interment. Nearly all of the burial/ritual features identified in the PVAHP project area appeared to have been related to mortuary activities and postburial mourning activities, because most were found associated with the burial area at LAN-62.

Distinguishing between burial/ritual and domestic features requires interpretation, of course, but at a fundamental level. In most cases, the distinction is obvious—for example, the presence of human remains indicates a human burial feature—but a small number of deposits could be viewed as "borderline" cases, mainly those interpreted as ritual offerings. Such deposits frequently contained deliberate arrangements of rocks and possibly ritual-related paraphernalia, such as whole abalone shells, burned basketry, textiles, concentrations of shell or glass beads, and ground stone bowls. Some of those features were covered in ochre or asphaltum, further suggesting a ritual function. Moreover, *all* of the deposits classified as nonburial ritual features in the PVAHP project area were recovered near or adjacent to one or more human burials, which underscored their mortuary-ritual function.

Note that the composite features (activity areas) also were subdivided into ritual and domestic deposits based on inspection of their constituent subfeatures. An example of a domestic composite feature is Feature 1 in LAN-211, which encompassed mostly hearths and discard areas containing subsistence-related materials. Feature 384 in Locus A of LAN-62 is an example of a burial/ritual composite feature. The large composite feature encompassed seven subfeatures that contained burned mortuary offerings, including burned basket fragments and concentrations of shell and glass beads and burned seeds. Together, these features constituted a probable mourning area adjacent to the burial area in Locus A. Technically, the burial area also qualifies as a burial/ritual composite feature, but we have not assigned a unique feature number to that area.

Late-historical-period/modern features also were generally self-evident based on their content or association. In most cases, the deposits included easily recognized late-historical-period artifacts, such as Euroamerican-style ceramics, bottles, porcelain, metal fragments, broken glass, wood, saw-cut bone (mainly cow and pig), plastic and rubber products, and other such materials. Most of the deposits with these materials suggested domestic trash from residential contexts. The Ballona functioned as a ranching and farming location during the late 1800s and early 1900s. Some features also included bricks and concrete fragments, pipelines, railroad-related materials, and wooden posts, suggesting structural remains and possible industrial debris. Most of these features probably postdated the Euroamerican land boom in the mid-1800s and predated the establishment of the HHIC in the 1940s, although a small number probably were deposited by Hughes Aircraft Company.

Thermal and Nonthermal Deposits

All features also were broadly classified as either thermal or nonthermal deposits based on the presence or absence of evidence of in situ thermal activity (oxidized soil) or a prevalence of thermally altered materials in the feature (e.g., FAR or burned bone). Our rationale for that distinction concerned interpretations of feature function: the frequency of thermal and nonthermal deposits within a discrete activity area, locus, or site can provide valuable insights into ancient activities and land-use patterns. The effectiveness of the distinction became especially evident in our analysis of intersite and intraregional differences in activities and land use during the Intermediate period.

For domestic features, most thermal deposits were composed mainly of FAR, even in the absence of evidence of in situ thermal activity (thermal features without evidence of in situ thermal activity were especially frequent at LAN-193 and LAN-2768). Other features exhibited oxidized and burned soils, indicating in situ thermal activity, and we interpreted them as hearths (especially the younger and better-preserved features at LAN-211). Features were classified as nonthermal domestic features based on the prevalence of nonthermally altered remains, even if a small amount of FAR, burned bone, or other thermally altered material was present in the feature matrix.

For burial/ritual deposits, features coded as thermal mostly included cremated or partially cremated human remains, which were recovered exclusively in the large Protohistoric/Mission period burial area in LAN-62. Other thermal burial/ritual features included nonburial mortuary offerings that contained evidence of in situ thermal activity or a prevalence of burned remains (e.g., burned basket fragments). Nonthermal burial/ritual features included inhumations and nonburial ritual offerings that exhibited no evidence of thermal alteration.

A small number of features were coded as "mixed," because they contained both thermal and nonthermal remains. The overwhelming majority of mixed features were human burials recovered at LAN-62 that contained a mix of noncremated and cremated human bone. In those cases, we did not classify the features based on the predominance of noncremated or cremated remains, because for analytical purposes, we wanted to preserve the distinction among burial features, categorizing them into those that contained inhumations, those that contained cremations, and those that contained a mix of buried and cremated remains.

Composite features also were classified as thermal or nonthermal based on their constituent subfeatures. For example, three composite features excavated at LAN-193 (Features 7–9) contained only thermal subfeatures—all FAR concentrations or scatters—and all three composite features were classified as thermal features. A few composite features were classified as nonthermal based on the exclusive presence of nonthermal subfeatures. A few composite features were classified as "mixed," because they contained a mix of thermal and nonthermal subfeatures. Feature 1 at LAN-211 is one example; the subfeatures included a larger number of thermal deposits (mostly hearths) and a smaller number of nonthermal-refuse deposits.

Feature Morphology

At a more detailed level, each domestic feature was classified into one of the more-specific categories shown in Figure 33, based on feature morphology (vertical and horizontal extent and shape) and the presence/absence of a visible pit outline. A morphological distinction was made between deposits that were largely concentrated and those that were scattered. Our reason for that distinction was that the "degree" of dispersal or concentration of feature constituents provides insights into the systemic context of the feature (see Schiffer 1987). For instance, scattered deposits may indicate materials that were discarded on an ancient surface (e.g., an FAR scatter may mark the location of a rake-out area for a hearth or roasting pit or the location of a surface roasting area). By contrast, concentrated deposits may have been deposited in a roasting pit or earth oven that is no longer visible or may have been deliberately piled on an ancient surface (e.g., a rock cairn). The shape of a concentration also provides a clue to its function: a convex-shaped pile of rocks probably represents a rock cairn placed on the surface, whereas a lens-shaped rock pile was probably placed in a pit. To be clear, however, we acknowledge that the "degree" of concentration/dispersal of remains will have been heavily influenced by postdepositional processes, such as bioturbation or modern mechanical disturbance.

The presence/absence of visible pit outlines was also vital for distinguishing between surface and buried deposits. The presence of oxidized and burned soil with a pit outline (oxidized pits) indicates the unambiguous remains of a hearth, for example. The presence of nonthermal materials in association with a pit outline suggests discard of domestic debris in a pit, possibly a previous storage or cooking pit. The presence/absence of a pit outline also may be affected by postdepositional processes, however; some pit outlines may have been obliterated or heavily "diffused" as a result of centuries (or millennia) of bioturbation by insects and rodents. For example, we suspect that the high frequency of FAR concentrations/scatters as well as the dearth of identifiable hearths at LAN-193 and LAN-2768 can be attributed to the long-term effects of bioturbation and leaching of organic material, which may have rendered indistinct any pit outlines and oxidized soils indicative of hearths. Therefore, many of the FAR concentrations identified at those sites in fact may be the weathered and heavily bioturbated remnants of hearths.

Morphological attributes and the presence/absence of a pit did not factor into our classification of burial/ritual features. For human-burial features, the level of scatter or concentration was largely irrelevant to feature interpretation. Nor did that distinction factor into our interpretations of nonburial ritual deposits. The material components and the presence/absence of evidence of thermal alteration were more central to those interpretations.

Material Components

The more-detailed level of feature classification also required classification based on the *predominant* materials composing a feature. The material components of features were, of course, vital to our interpretations of feature function. For thermal domestic features, the dominant components were typically FAR fragments or oxidized and burned soils. Features with oxidized and burned soils can be reasonably interpreted as hearths, but FAR fragments imply several functional possibilities, including thermal cleanout deposits, disturbed hearths (if the remains were concentrated), roasting pits, or surface roasting activities (see below). FAR, in concentrations and scatters, was perhaps the most frequent and widespread feature material found throughout the PVAHP project area.

Nonthermal domestic features presented a large number of possible functional types, as shown in Figure 33. The categories of nonthermal domestic scatters and nonthermal domestic concentrations (with or without pit outlines) were further subdivided according to the dominant nonthermal materials composing the features. The nonthermal material classes included faunal bone, lithic/ground stone artifacts, and shell. We also devised a "general/multiple artifact" subcategory to indicate features that contained more than one of those material classes in roughly comparable proportions. In some cases, we also pointed out the presence of FAR in the nonthermal domestic features, which helped distinguish whether a feature contained a mix of thermal and nonthermal domestic debris.

To be clear, not all of the subcategories of nonthermal domestic features were applied. Generally, features containing exclusively or predominantly shell and faunal bone were rarely recorded in the PVAHP project area, because they would have been difficult to distinguish from general midden material; for example, no features were classified as shell or faunal-bone scatters, and only a handful of shell and faunal-bone concentrations were recorded. Even so, we opted to include those subcategories in our classification system, to be consistent in how we applied our defining criteria and for comparison with other Ballona sites where such features have been more common. Far more frequent were general/multiple artifact concentrations or scatters and lithic/ground stone concentrations or scatters. For whatever reason, lithic and ground stone artifacts were frequently recovered with few accompanying nonlithic remains, but features containing abundant shell and faunal bone were typically recovered with various accompanying materials and were therefore coded as general/multiple artifact features.

A small number of nonthermal domestic features with visible pits contained the articulated or partially articulated skeletal remains of animals, including canines, an immature deer, and a seal; they were classified as animal inhumations. Technically, those features could have been classified as faunal-bone concentrations, but we opted instead to distinguish purposeful animal inhumations from faunal-bone concentrations, to indicate the presence of articulated skeletal remains of one or several animals. Features containing articulated animal skeletons were probably functionally distinct from jumbled concentrations containing faunal bones from multiple animals (or species). The former suggest caching or storage locations (or possibly ritual activity), and the latter imply discard locations for processed faunal bone (e.g., discarded meal refuse).

Among the burial/ritual features, the dominant material components of human burials, of course, were human bones. More pertinent to our material-based classification, however, was whether the bone exhibited evidence of thermal alteration. The burials containing mostly burned and calcined human remains were classified as cremations; those containing only unburned bone were coded as inhumations. All of the burial features excavated outside LAN-62 contained relatively well-articulated inhumations that exhibited no evidence of thermal alteration. Within the burial area at LAN-62, however, most features contained remains of multiple individuals that exhibited varying levels of articulation, and many exhibited a mix of thermally altered and unaltered bone. Other sites in the Ballona contained both articulated inhumations lacking evidence of thermal alteration and cremations. The classification system also distinguished between primary and secondary inhumations and cremations. In practice, however, primary and secondary interments were not always readily distinguishable, especially at LAN-62.

Our abstract system did not perfectly accommodate empirical reality where the burials that contained a mix of cremated and noncremated bone were concerned. In most of the latter cases, usually one (or several) largely intact inhumation (or inhumations) was the dominant feature component, but scattered cremated and noncremated bone remains were recovered within the feature matrix, as well. We did not devise a category for those "mixed" cases in our system. Rather, we typically defined those cases as primary or secondary inhumations or cremations and noted any "secondary" human components recovered within the matrices. For example, many of the burials recovered at LAN-62 were classified as "primary inhumation(s) with scattered cremated remains." Despite the permutations, the classification system was largely effective and had to be slightly modified only to accommodate these cases.

We have already discussed the material components of features that represented nonburial ritual offerings. As explained, material components of those features included burned baskets, abalone shell, textiles, shell or glass beads, and ground stone bowls. The presence of ochre or asphaltum also potentially indicated ritual offerings. We also made a distinction between thermal ritual offerings with burned baskets and those without burned baskets, because burned baskets were restricted to the Mission period in the burial area at LAN-62, and segregating those features from other thermal offerings highlighted ritual behavior related to that occupation component. No such distinctions were made for nonthermal burial-offering features.

The Problem of Variable Data Quality

One problem in our feature-classification system concerned the variable levels of scrutiny to which different features were subjected. The material remains recovered from many features were subjected to analysis by specialists (e.g., lithic or faunal analysts), including all of the human burials. However, because of the large number of features and the vast quantity of associated materials recovered, the analysts sampled the nonburial-feature population. As a result, unanalyzed features were classified based solely on in-field characterizations and field notes. Moreover, the proportions of analyzed materials also varied among the nonburial features selected for analysis.

The variable levels of scrutiny likely affected feature classifications and interpretations to some extent, although we have no way of quantifying the extent of that bias. In the case of human burials, analysis of the material components probably had little impact on our final classifications, except to the extent that it helped distinguish primary from secondary interments. However, the potential for misidentification was likely more pronounced for many domestic features, which were generally classified and distinguished based on their material contents. In some cases, feature materials may have been misidentified in the field because of the difficulty of identifying uncleaned materials. For example, as explained above, FAR, ground stone, and unmodified cobbles are often difficult to distinguish with certainty prior to cleaning, and that can lead to erroneous feature classification. Hence, erroneous classification and interpretation were considerably more likely for unanalyzed features than for analyzed features.

To be clear, nearly all of the PVAHP features were classified based on detailed field notes and, where possible, the results of material analyses. Only one domestic feature was not classified because of insufficient data: an indeterminate rock cluster at LAN-2768. However, we cannot rule out the possibility that additional feature classifications were predicated on inaccurate data. For example, it is possible that some features may have been misclassified as thermal deposits, if unmodified cobbles or naturally broken rocks were misidentified as FAR fragments in the field.

Revised Feature Interpretations

The classification attributes described above provided the grounds for interpreting feature functions in the revised classification system. In this section, we discuss our interpretation of feature functions based on the various descriptive attributes. The major interpretive categories are discussed below.

Animal Burials

Several prehistoric animal burials were recorded at LAN-62, including a seal, a juvenile deer, and several canines. Features interpreted as animal burials also have been recovered at several prehistoric sites in the region, including Encino Village (several canines and a hawk) (Mason 1986), Landing Hill (badger) (Cleland et al. 2007), and numerous sites on the mainland and coast with canines (Sutton 2008; see summary of canine burials in Rick et al. [2008]), indicating a precedent for the recovery of animal inhumations at coastal southern California sites. In addition, several horse skeletons from nonprehistoric contexts were exposed within the PVAHP project area, although it was unclear whether any of them was deliberately interred in the ground. Those particular horse burials were, in addition, historical-period or modern placements, rather than native.

As an example of animal burials, we highlight Feature 307 at LAN-62 Locus A (Figures 34 and 35). Feature 307 measured approximately 0.24 by 0.23 m and 0.23 in depth and was irregular in plan view. An animal (canine) inhumation, it was a moderately clustered group of unarticulated canine bones, some featuring signs of burning and cut marks. The feature was found within the burial area and near three human burials (Features 59, 60, and 276) but showed no clear association with any of them. There was a clear lack of articulation of the canine bones, and the long bones had been placed above the head. It was clearly a secondary burial. Although it is unclear whether the feature had ritual significance or had simply been processed and discarded, its location within the burial area suggested the former.

Caches

These features included concentrations of particular classes of artifacts that appeared to have been purposefully buried for storage or safekeeping. Ideally, a visible pit outline would be present to indicate deliberate burial, but none of the possible caches in the PVAHP project area was associated with a visible pit. Typically, one artifact category was prominent (e.g., a stone bowl or a metate), although other artifact types may also have been present. At the PVAHP sites, we *tentatively* interpreted several features as possible caches, but each of those features was functionally ambiguous. For example, one feature at LAN-54 consisted of a complete metate and a lithic flake, but no pit outline was evident. It was thus unclear whether the metate had been deliberately cached or simply discarded on the ancient surface. By contrast, caches appeared to have been more common on top of the bluffs at LAN-63, where numerous examples of paired manos and metates or complete bowls and mortars (paired with pestles) were often found buried in the midden, likely for later use. Note that all of the PVAHP features interpreted in the field as possible caches included ground stone artifacts, usually

Figure 34. Photograph of Feature 307, an animal (canine) burial, LAN-62 Locus A.

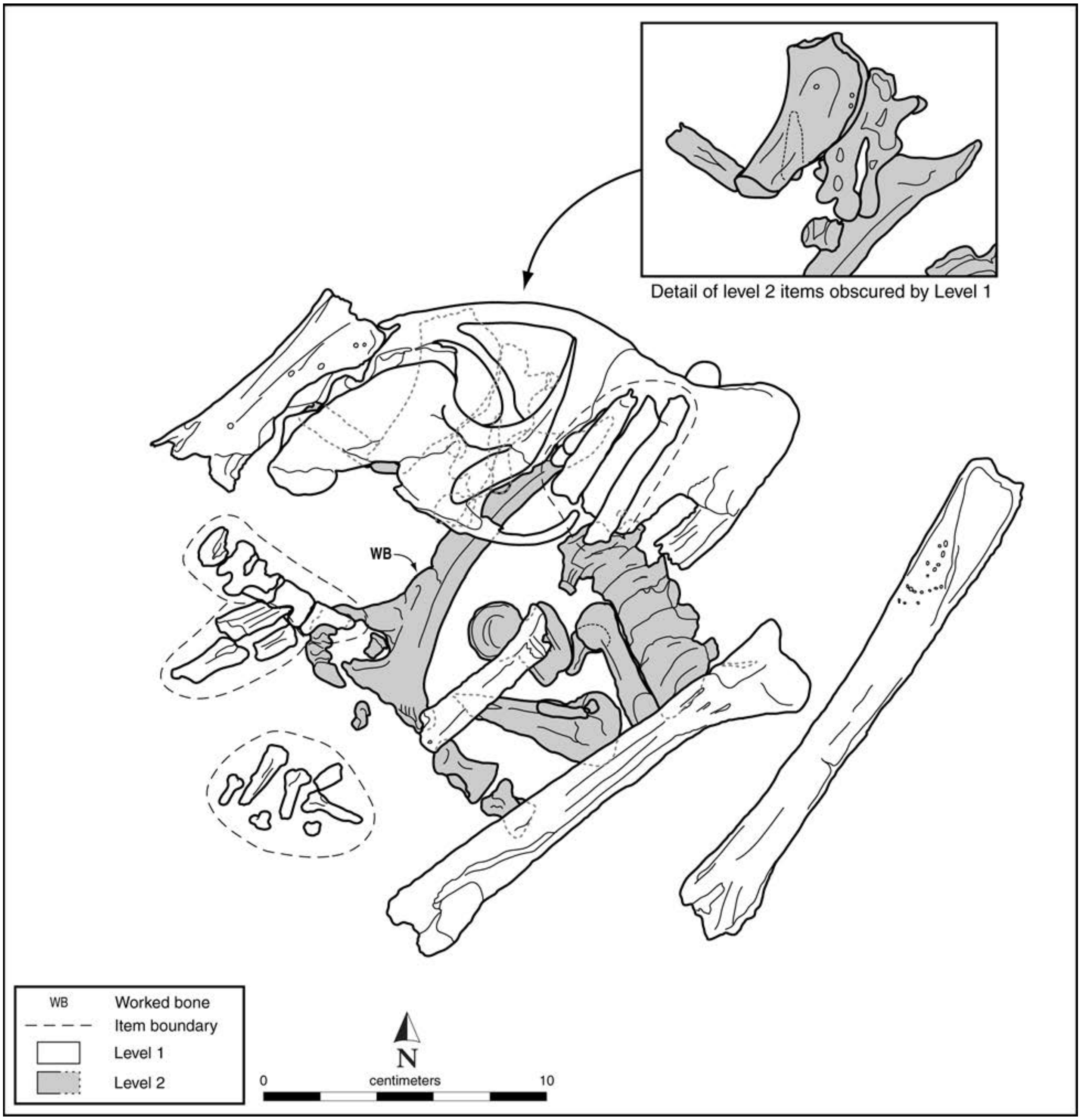

Figure 35. Drawing of Feature 307, an animal (canine) burial, LAN-62 Locus A.

fragments, and were classified as "lithic/ground stone concentrations." Most of those deposits also were mixed with other debris, such as FAR and flaked stone; the presence of the latter implied discard areas rather than caches, but it is possible that they were not parts of the original deposits. In addition to those attributes, storage pits (of which there were few in the PVAHP feature collection) were also categorized generally as parts of caches. Overall, given their ambiguity, many of the possible caches were interpreted as probable discard areas for the broader feature analysis presented in Volume 5, this series.

We offer three examples of storage pits or caches to illustrate some of the diversity of this feature type. Feature 201, located in Locus C of LAN-62, is an example of a storage pit and a possible cache (Figures 36 and 37). Discovered during hand-excavations, Feature 201 consisted of a pit that contained the remains of an articulated juvenile deer and other scattered faunal remains. The pit, which measured approximately 0.9 by 0.7 m and approximately 1.2 m in depth, was roughly circular in shape and cylindrical in cross section and had a distinct boundary. Feature fill consisted of varying hues of silty sand layered from top to bottom within the pit, perhaps indicating that the pit had been filled in several episodes, including one with the deposition of the juvenile deer. In addition to the deer, the feature fill contained a small number of flaked stone debitage and other lithic artifacts and lacked marine shell.

Feature 541, in Locus A of LAN-62, is an example of a storage pit, a cache, or a domestic trash pit (Figure 38). Measuring approximately 0.80 by 0.93 m and approximately 0.10 m in depth, Feature 541 had a nearby subfeature, Feature 542. Both Features 541 and 542 were shell concentrations placed in shallow pits. Artifacts collected from the features consisted of a dense cluster of marine shell and small quantities of flaked stone debitage and artifacts and unworked faunal bone. Feature 542 was located approximately 0.20 m northeast of Feature 541. No ash or soil change was identified to indicate thermal activity related to the feature.

Finally, Feature 635, in Locus A of LAN-62, is another example of a possible cache or a domestic-discard area (Figure 39). The small feature measured approximately 0.17 by 0.16 m and 0.07 m in depth and consisted of a tight-cluster of 1 projectile point and 19 tarring pebbles, 1 of which appeared to be fire affected. There was no apparent soil change, such as oxidation, nor was there ash or other material associated with in situ thermal activity. There was no evident pit associated with this feature.

Cairns or Post Supports

A cairn is nominally a dense and discrete cluster of unmodified rocks or ground stone fragments within a small area (approximately 35 cm in diameter or less). These features resemble small compact hearths but contain little or no FAR. Two subcategories were distinguished: those that consisted entirely of unmodified rocks and those that consisted entirely of whole and fragmented ground stone. The function of these features is unknown, but they may have functioned as post supports or markers (e.g., for burial or ritual areas). Winterborn (1967:15) identified a number of small rock concentrations and rock rings similar to these cairns at the Goff's Island site, near the mouth of Aliso Creek in Orange County, often associated with arrangements of postholes. Several of the postholes were lined with rocks, which Winterborn interpreted as reinforcements for the posts. Similar features were found in southern Orange County at ORA-116 and ORA-1298; Macko (1998) bisected those features and found voids in their centers that he interpreted as post molds. In the Ballona, cairns were relatively common at the bluff-top sites (Douglass et al. 2005). Post supports may have been vital at the PVAHP and bluff-top habitation sites, where structures may have been built in unconsolidated sands. These features were classified in the field as "lithic/ground stone concentrations" (with or without visible pit outlines).

Feature 520, in Locus C of LAN-62, is an example of a cairn (Figures 40 and 41), albeit deflated. Measuring approximately 0.30 by 0.40 m and approximately 0.27 m in height, this cairn consisted of an irregular cluster of rock that contained approximately 25 ground stone fragments, several flaked stone tools, a few unworked cobbles, and a collection of over 300 faunal bones within the fill. Only a few of the lithic artifacts recovered had been fire affected. Sectioning of the feature did not reveal that the contents had been placed in a pit, because the surrounding soil had a color and a texture similar to those of the feature fill. The shape of the feature suggested its function as a cairn, although it appeared deflated.

Domestic-Discard Areas

These features were the most numerous in the PVAHP project area and generally consisted of concentrations or scatters of domestic debris (FAR, faunal bone, shell, debitage, ground stone fragments, etc.). We interpreted several variants of domestic-discard areas.

General Discard Areas

The most frequent were "generalized" or "generic" discard areas related to multiple domestic tasks. These features were classified as "general/multiple artifact concentrations" (with or without visible pits) or as "general/multiple artifact scatters" and tended to include some mix of FAR, faunal bone, lithic artifacts, shell, and sometimes low-frequency materials. The mix of remains suggested discard areas for debris generated from multiple domestic tasks, including cooking or heating (FAR and burned faunal bone), eating (shell and faunal bone), cutting (flaked stone), grinding (ground stone fragments), and possible stone-tool production or curation (debitage). We suspect that the ancient site occupants accumulated debris generated from various tasks and discarded it in a single location, perhaps outside the main camping and activity area.

Figure 36. Oblique photo of Feature 201, a buried juvenile deer, LAN-62 Locus C.

Figure 37. Plan-view photograph of Feature 201, a buried juvenile deer, LAN-62 Locus C.

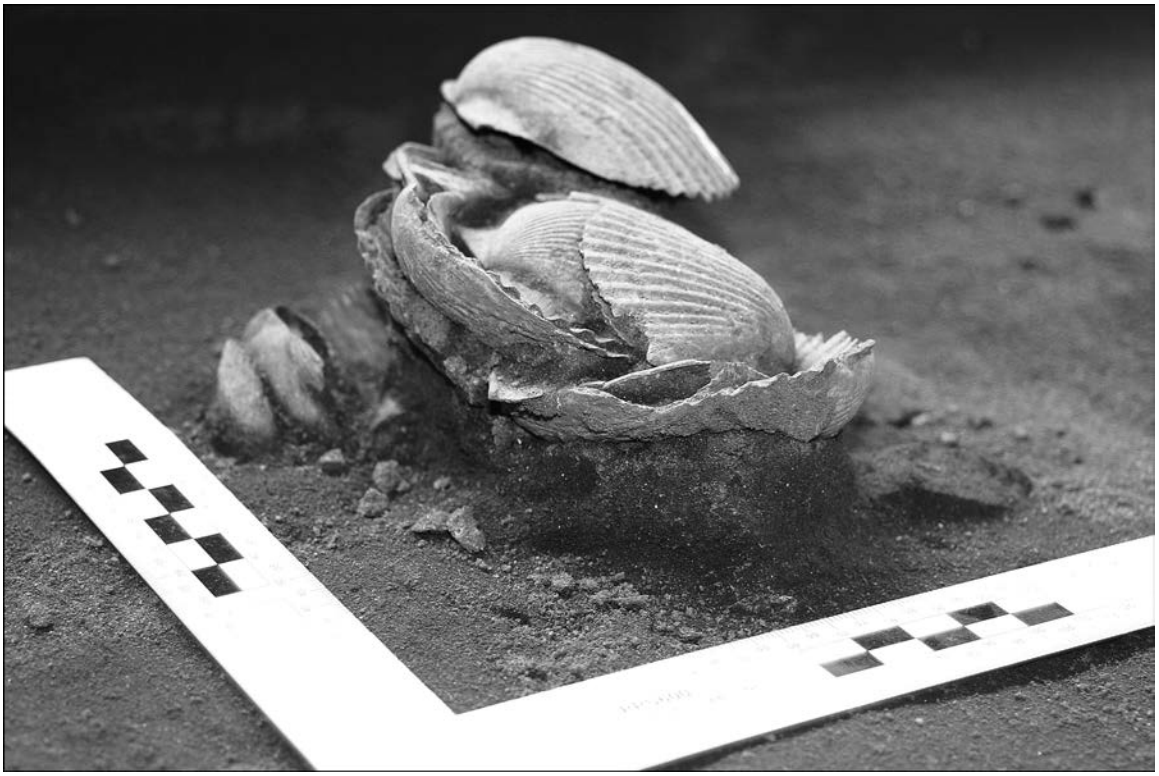

Figure 38. Oblique photograph of Feature 541, a scallop cache, storage pit, or domestic trash dump, LAN-62 Locus A.

Figure 39. Plan-view photograph of Feature 635, a cache of tarring pebbles, LAN-62 Locus A.

Figure 40. Plan-view photograph of Feature 520, a cairn, LAN-62 Locus A.

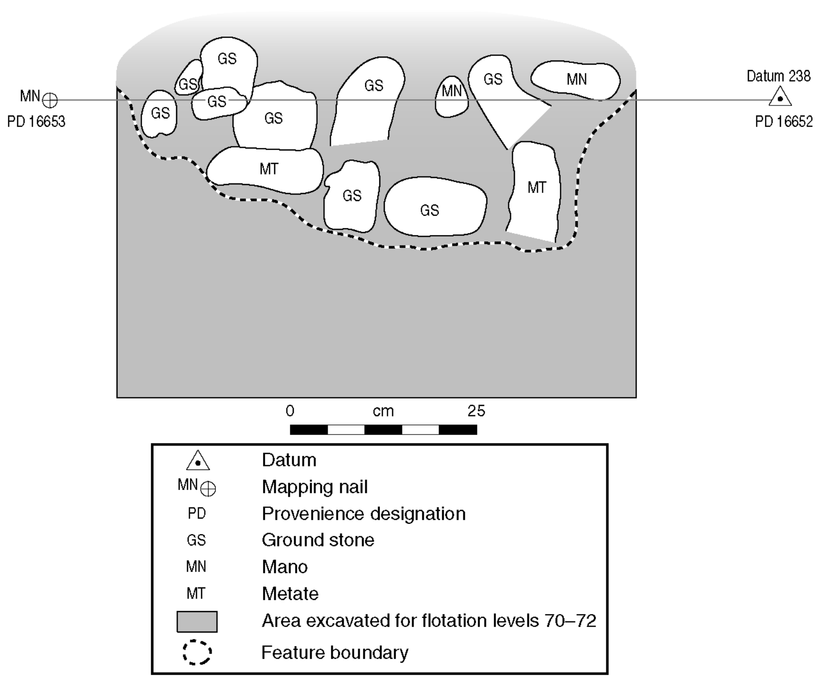

Figure 41. Profile drawing of Feature 520, a cairn, LAN-62 Locus A.

Figure 42. Plan-view photograph of Feature 419, a general discard area, LAN-62 Locus A.

Some of the deposits were found in association with visible pit outlines, suggesting disposal of accumulated debris in pits, including perhaps preexisting storage pits or cleaned-out cooking pits. The feature category of trash-filled pits was subsumed under the category of general discard areas in the PVAHP feature categories.

Here, we discuss three examples of discard areas. Feature 419, in Locus A of LAN-62, was a cluster of FAR, ground stone, shell, flaked stone, unmodified and burned faunal bone, and unmodified cobbles and measured approximately 0.90 by 1.25 m and approximately 0.20 m in depth (Figures 42–44). It had four subfeatures associated with it: Features 509, 535, 536, and 572. The feature had an irregular shape and a distinct, diffuse boundary. Unworked marine shell was the most abundant artifact type in the fill of Feature 419, and scallop (*Argopecten ventricosus*) was the most abundant species present. Analysis indicated that six different species of shell were present in the feature, although approximately 20 percent of the shell was so fragmentary that it could not be accurately identified to the species level. Many of the shells collected from the feature were whole valves. The lack of oxidized soil, ash, and large charcoal suggested that thermal activity had not been present, and the large quantity of whole shells suggested that the feature was a domestic-discard area.

Feature 483, in Locus A of LAN-62, was a pit measured approximately 0.50 by 0.36 and approximately 0.18 m in depth (Figures 45 and 46). It was composed of a cluster of unworked marine shell (including many whole valves), faunal bone, and lithic artifacts. Although there were several different species represented in the feature, the most prevalent species was scallop. Lithic artifacts were infrequent and consisted of FAR fragments and small quantities of flaked stone debitage. The feature fill was similar to the surrounding soil in color and texture, with the exception of a thin, ashy layer along the feature edge that delineated its edges and bottom. The feature margin and interior lacked indicators of thermal activity, such as oxidized soil or charcoal. Based on the attributes of the feature, it was interpreted as a domestic-discard area.

Finally, Feature 619, in Locus A of LAN-62, was a pit measuring 1.10 by 0.80 m and approximately 0.45 m in depth (Figures 47 and 48). Discovered during stripping, the fill soil was darker and sandier than surrounding sediments. The pit was an elongated oval that was bell-shaped in profile and contained small quantities of faunal bone, flaked stone tools and debitage, and marine shell. Based on its attributes, Feature 619 was interpreted as a pit containing domestic refuse (a domestic-discard area).

Hearth-Cleanout Deposits

Most of these features probably formed as a result of removing fire-affected stones from hearths for the purposes of cooking in baskets or bowls; that interpretation assumes that the stones were then set aside or scattered near the locations of the hearths. However, in many cases, no nearby hearths were observed,

Figure 43. Plan-view drawing of Feature 419, a general discard area, LAN-62 Locus A.

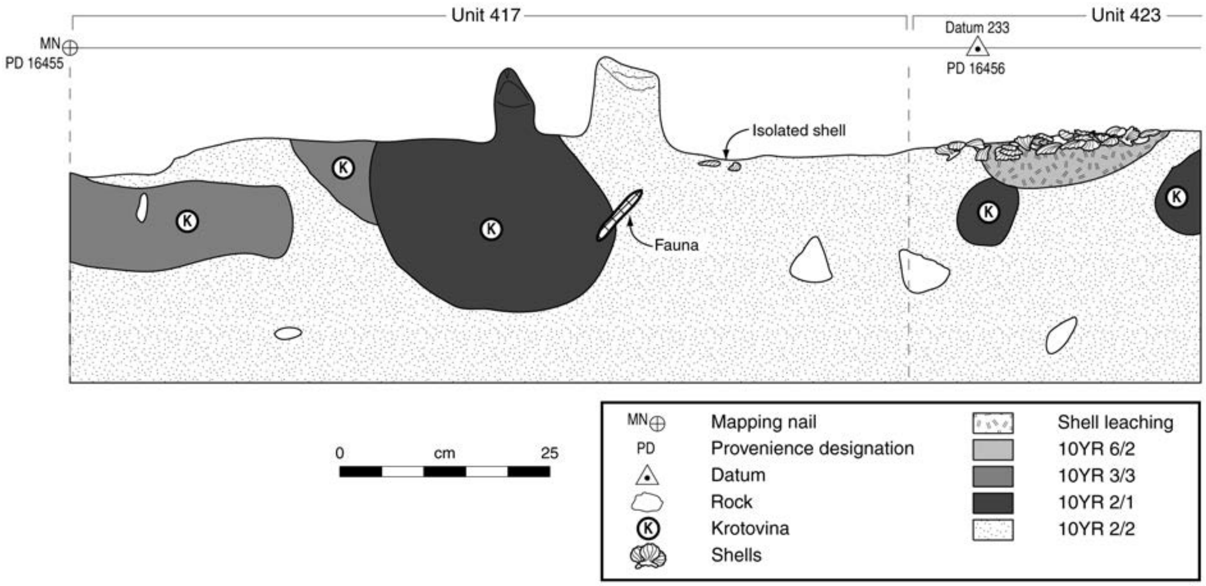

Figure 44. Profile drawing of Feature 419, a general discard area, LAN-62 Locus A.

Figure 45. Profile photograph of Feature 483, a general discard area, LAN-62 Locus A.

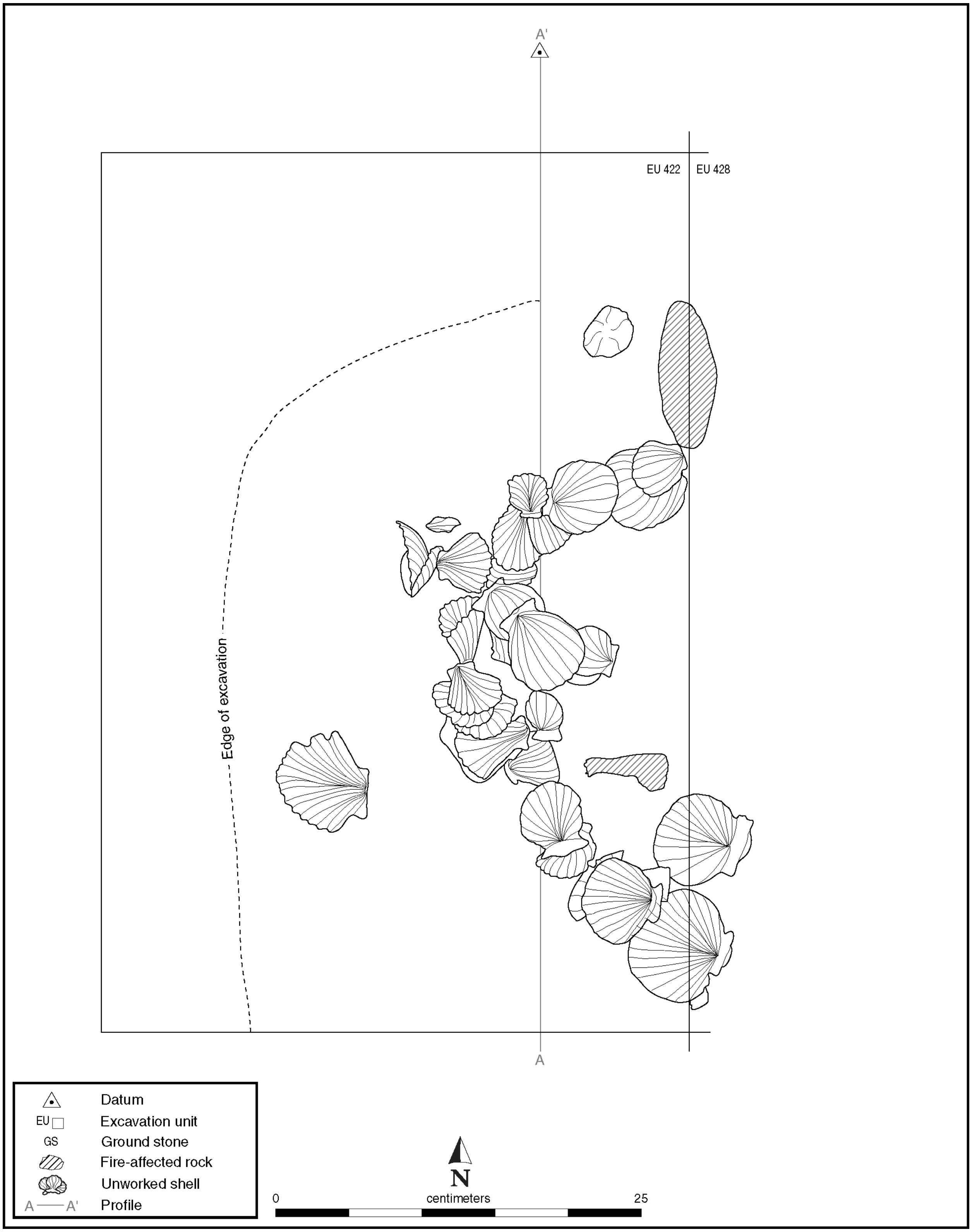

Figure 46. Plan-view drawing of Feature 483, a general discard area, LAN-62 Locus A.

Figure 47. Profile photograph of Feature 619, a general discard area, LAN-62 Locus A.

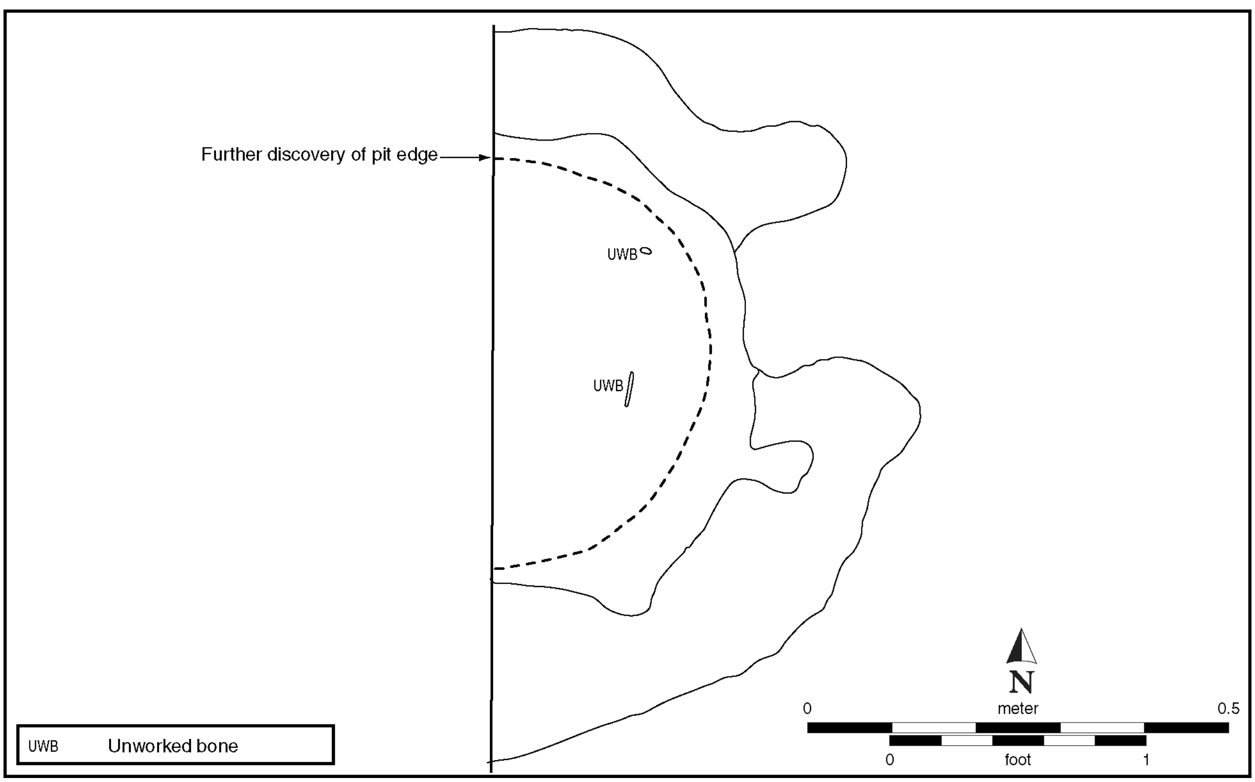

Figure 48. Plan-view drawing of Feature 619, a general discard area, LAN-62 Locus A.

which undermined that interpretation. One possibility is that the nearby hearths were no longer visually identifiable as hearths at the time of excavation, as a result of bioturbation or other postdepositional disturbances (see above). Another possibility is that these features marked the locations of surface-level cooking or heating features, which were not placed in pits and generated little or no oxidized soil. Those sorts of functions, as less-formal thermal features, may also explain some of the forms seen within the hearth-cleanout category. In some examples, although there were tight clusters of rocks, there were only single layers of rock, suggesting no pits. Other examples suggested that these features were formed in pits, because there were multiple levels of rocks, even if there were no visible pit outlines. Many of these features contained small numbers of artifacts or ecofacts other than FAR, such as flaked stone and shell, which may suggest that FAR was accumulated (after it had cooled), along with other domestic debris, and deposited in locations outside the camp or settlement area. That hypothesis also helps explain the dearth of evidence of hearths in the vicinities of posited hearth-cleanout deposits. Hearth-cleanout deposits were typically classified in the field as "FAR concentrations without pits" or as "FAR scatters." These types of features were found at all five intact PVAHP sites.

Here, we present four examples of hearth-cleanout deposits that represent some of the variability in size, shape, and constituents. Feature 480, LAN-62, was located northeast of the burial area, in CU 628 (Figures 49 and 50). This feature originated in Stratum IV, which generally dates to the Late through Mission periods. Feature 480 consisted of a tight cluster of lithic artifacts and measured 0.40 by 0.41 m and 0.24 m in depth. All artifacts collected from the feature had been fire affected; most were otherwise unmodified cobbles, and there were a small number ground stone fragments. Excavation of the feature revealed that there appeared to be no difference in color or texture between the feature fill and the surrounding matrix and no evidence of ash, charcoal, oxidation, or other thermal alteration. There was no discernible pit, and the feature integrity was high.

Feature 622, located east of the burial area at LAN-62, was composed of a very tight concentration of lithic artifacts, unmodified rock, faunal material, and other artifacts (Figure 51). It originated in Stratum IV, which generally dates to the Late through Mission periods. The feature measured 1.16 by 1.00 m and approximately 1.29 m in depth. Based on field notes, approximately two-thirds of the itemized artifacts had been fire affected, and one-third of the collection had been broken ground stone fragments. Approximately one-third of the stone in the feature was unmodified cobbles. Only two ground stone artifacts were fully identifiable in the field—one mano and one core. Excavators noted that there was no defined pit outline, although given the depth of the deposit, the contents of the feature were clearly placed in a pit. The lack of ash, oxidation, charcoal, and other thermal evidence suggested that the FAR had been heated elsewhere and then placed in the feature. There was high integrity to the feature and no evidence of rodent disturbance.

Feature 628, at LAN-62, northwest of the burial area, was discovered during mechanical stripping (Figures 52 and 53). It originated in Stratum IV, which generally dates to the Late through Mission periods. Measuring 0.72 by 0.58 m and 0.27 m in depth, the feature consisted of a tight cluster of lithic artifacts (primarily ground stone), faunal bone, and shell; ground stone and FAR were found more peripherally. Artifacts in the feature appeared to have been placed in a pit, based on the multiple layers, but no pit margin was apparent during excavation. Although small amounts of charcoal were present in the feature fill, there was no evidence of thermal activity in the surrounding soil, no ash, and only a few artifacts with charcoal staining.

Feature 640, northeast of the burial area at LAN-62, was discovered during mechanical stripping (Figures 54 and 55). It originated in Stratum IV, which generally dates to the Late through Mission periods. The feature was a large cluster of tightly arranged FAR, faunal remains, ground stone, and flaked stone artifacts measuring approximately 1.0 by 0.5 m and 0.3 m in depth. The feature fill did not contain ash, charcoal, oxidized soil, or other indications of in situ burning. Excavators noted that the FAR at the base of the feature was more friable than the FAR closer to the top. The 89 items collected from the feature had been overwhelmingly fire affected.

In summary, hearth cleanouts varied widely in shape, size, and constituents. Some features identified as hearth cleanouts were tight clusters of FAR and other artifacts, whereas others were highly scattered. At the adjacent West Bluffs project, some features that were identified during the PVAHP as hearth cleanouts were classified as hearths. For the PVAHP typology, we took into account the presence of soil oxidation, ash, charcoal, and other evidence of in situ thermal activity in making the determination between an intact hearth and a hearth cleanout, but because of the soil conditions at West Bluffs, ash, charcoal, and soil oxidation were absent from most contexts. In addition, for the PVAHP typology, we also took into account the ages of features, if dates were available, because more-recent hearths would have had better-preserved evidence of in situ thermal activity.

Shellfish-Processing Areas

These features included discrete concentrations or scatters consisting mainly of shell. They were likely single-task discard locations related to the processing of shellfish. For the most part, these features were rare in the PVAHP project area; shell was commonly recovered in PVAHP features, but typically in association with other material classes in the "general" discard areas described above. Shellfish-processing areas were more common on top of the bluffs, in the Millingstone component at LAN-64 (Douglass et al. 2005). The features interpreted as shell-processing areas were all excavated at LAN-62 and were classified as "shell concentrations" (without visible pit outlines), but shell also was very abundant in several "general" discard features at LAN-54.

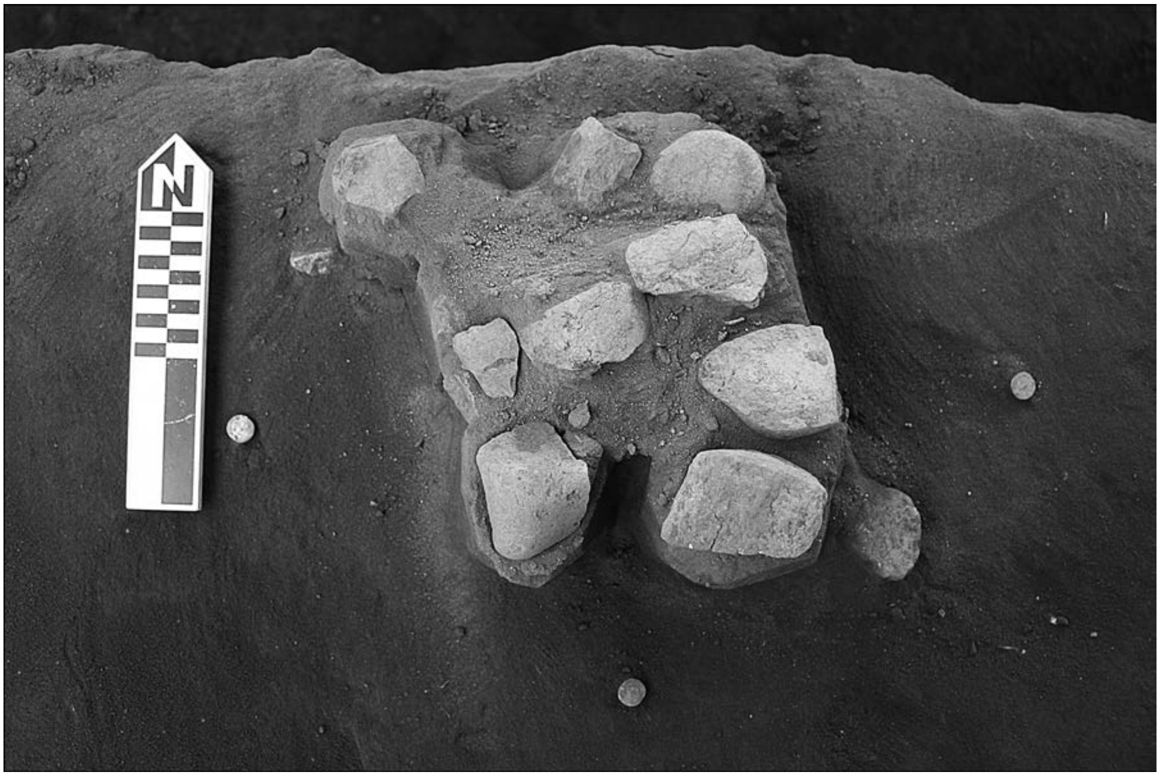

Figure 49. Plan-view photograph of Feature 480, a hearth cleanout, LAN-62 Locus A.

Figure 50. Plan-view drawing of Feature 480, a hearth cleanout, LAN-62 Locus A.

Figure 51. Plan-view photograph of Feature 622, a hearth cleanout, LAN-62 Locus A.

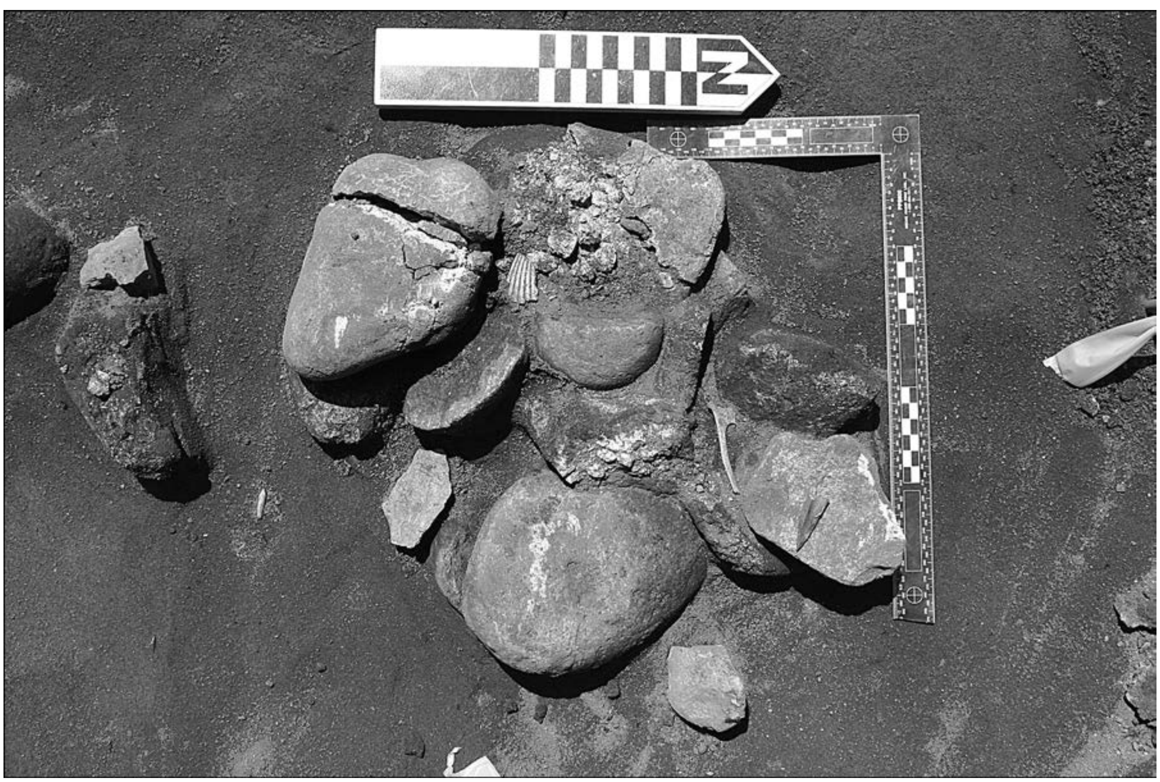

Figure 52. Plan-view photograph of Feature 628, a hearth cleanout, LAN-62 Locus A.

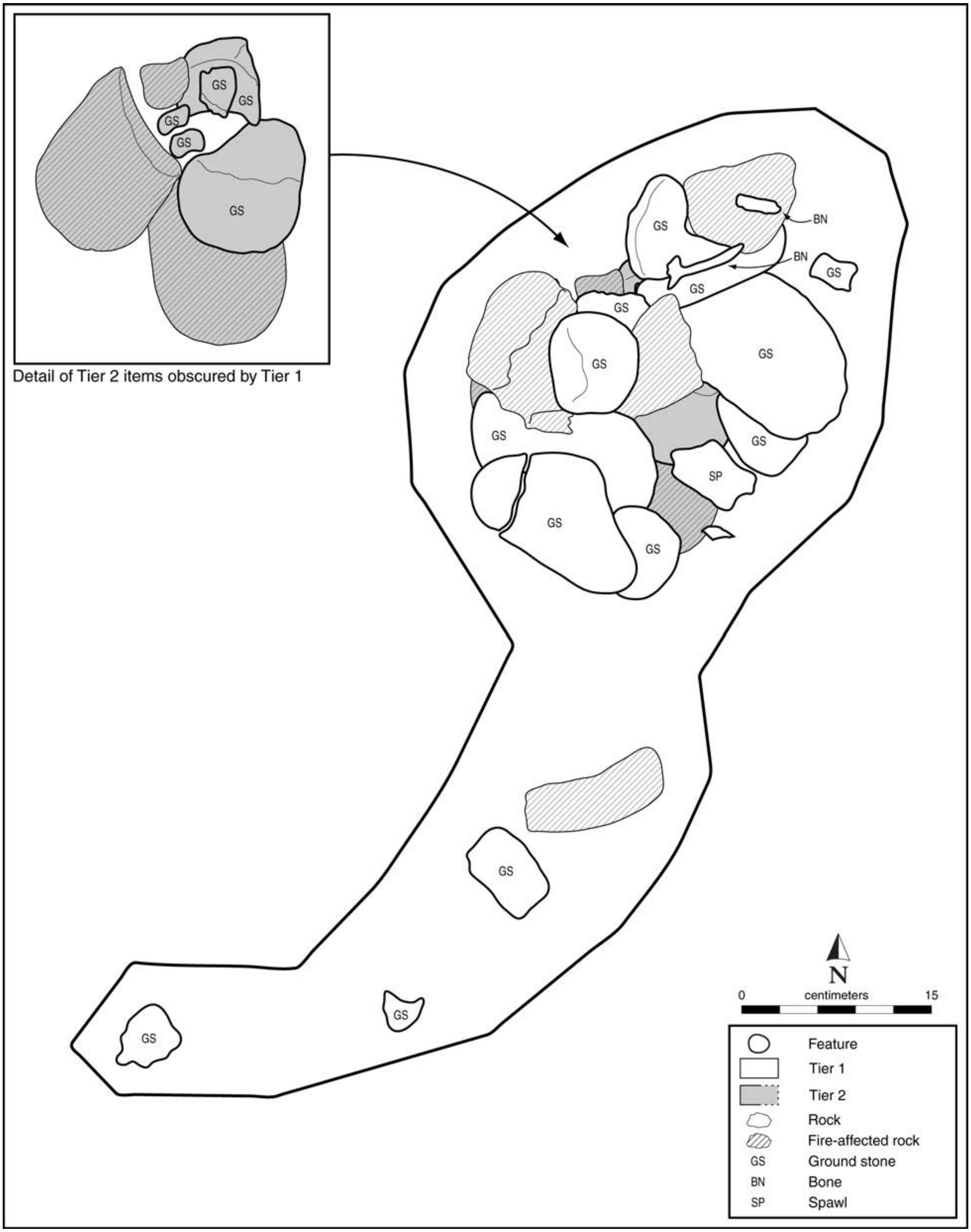

Figure 53. Plan-view drawing of Feature 628, a hearth cleanout, LAN-62 Locus A.

Figure 54. Plan-view photograph of Feature 640, a hearth cleanout, LAN-62 Locus A.

Figure 55. Plan-view drawing of Feature 640, a hearth cleanout, LAN-62 Locus A.

As an example of a shellfish-processing area, we highlight Feature 563 at LAN-62, in the heart of Locus A (Figure 56). The feature measured approximately 0.22 by 0.21 m and 0.05 m in depth and consisted of a concentration of scallop shells. Those shells were concentrated in a constricted space that may have been a pit, because the shells were densely packed on top of one another. There was a combination of whole, partial, and fragmented pieces surrounded by dense clay and silty sand. No other artifacts were recovered from that context, although the surrounding matrix contained a wide mixture of artifacts, suggesting that the feature had high integrity. It was designated as a subfeature of Feature 541, a larger, nearby concentration of shell. Feature 563 was situated within Stratum IV, which generally dates to between the Late and Mission periods.

Discard Areas for Cobbles/ Manuports

This interpretation refers to a group of functionally ambiguous features uncovered at LAN-2768 consisting of mostly unmodified cobbles (possible manuports). The cobbles did not exhibit evidence of thermal cracking or spalling, suggesting FAR deposits. Moreover, the deposits were not small or tightly concentrated enough to cairns or posthole supports (although they may have dispersed as a result of postdepositional disturbance). Determination of their function will require additional testing, but they have been tentatively interpreted as discard areas related to some unknown activity. These features were classified in the field as "lithic/ground stone concentrations" (without visible pit outlines).

Feature 7, in Locus A of LAN-2768, is an example of a discard area for cobbles and manuports (Figure 57). This feature was originally found during mechanical stripping and measured approximately 0.90 by 0.61 m and 0.33 m in depth. It was composed of a number of tightly clustered unmodified cobbles and lithic artifacts in an ovate area. Several outliers to the primary cluster were found up to 1 m northwest of the central concentration. There was no evidence of thermal activity. The majority of lithic artifacts bore evidence of minimal expedient use, and a small number of ground stone artifacts also made up a portion of the collection. Faunal bone and marine shell were found sparsely scattered within the feature fill of dark-brown, silty sand.

Flaked-Stone-Production/ Curation Area

This is a discrete concentration of formal flaked stone tools and/or debitage that suggests a probable location of stone-tool production or curation. Only one PVAHP feature (at LAN-62) was interpreted as a flaked-stone-production/curation area. It was classified in the field as a "lithic/ground stone concentration" (with no pit outline) and encompassed an area of about 30–40 cm in diameter, suggesting a limited depositional event.

Feature 686, in Locus G of LAN-62, is an example of a flaked-stone-production/curation area (Figure 58). Originally found during mechanical stripping, the feature measured approximately 0.50 m in diameter and had no evidence of in situ thermal activity. It consisted of a small cluster of flaked stone artifacts and contained no evidence of faunal bone or shell. The soil surrounding the feature was a sandy silt located near the base of the cultural deposit in this portion of the site.

Hearths

As explained above, the features interpreted as hearths generally exhibited evidence of in situ thermal activity, such as heavily oxidized soils, charcoal, or ash, and were classified as "oxidized pits." In a few cases, however, we inferred probable hearths based on the presence of FAR concentrations associated with visible pit outlines ("FAR concentrations, with visible pit"). Other FAR concentrations that were interpreted as hearths exhibited multiple courses of rocks but no evident pit outlines ("FAR concentrations, no visible pit"). We followed Douglass et al.'s (2005) distinction between large hearths (greater than 70 cm in diameter) and small hearths (less than 70 cm), based on the sample of hearths identified at the West Bluffs project, on the top of the bluffs, adjacent to the project area. Below, we offer examples of small and large hearths to illustrate some of the variation, as well as similarities, among hearths identified in the PVAHP.

Feature 18, at LAN-211, is an example of a small hearth (Figures 59–61). Measuring approximately 0.50 by 0.46 m, this ovate feature was composed of a thin, shallow lens of oxidized soil and a small number of pieces of FAR. Feature fill included a small number of flaked stone lithic artifacts and faunal bones. The feature fill was a dark patch of soil surrounded by a thermally altered soil lens and was interspersed with flecks of charcoal and ochre.

Four examples of large hearths are highlighted here. Feature 83, in the central portion of LAN-62 Locus A, measured 0.65 by 0.70 m and approximately 0.13 m at its maximum depth (Figures 62 and 63). This deep, basin-shaped hearth contained a combination of FAR, shell, and various lithic tools. Although no oxidized soil was identified during excavation, the presence of ashy soil around the perimeter of the feature helped to distinguish it as a hearth.

Feature 21, at LAN-211, was located in the central portion of FB 1 (Figures 64 and 65). Measuring 1.56 by 0.80 m and approximately 0.17 m in depth, this feature was an oval-shaped hearth composed of a small number of unshaped rocks, one-third of which were fire affected; a small quantity of shell; a large quantity of burned and unburned faunal bone; worked stone; and a varied and abundant quantity of carbonized seeds, all within an oxidized pit. The feature was

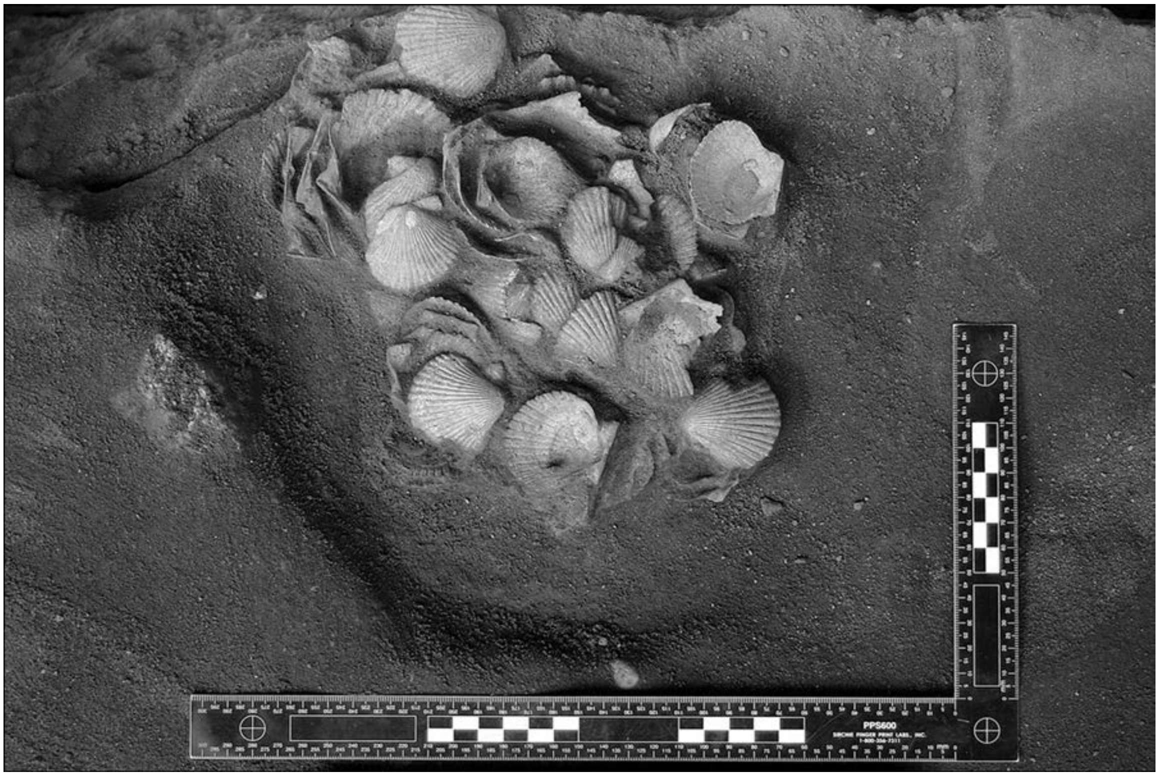

Figure 56. Plan-view photograph of Feature 563, a shellfish-processing area, LAN-62 Locus A.

Figure 57. Plan-view photograph of Feature 7, a discard area for cobbles and manuports, LAN-2768 Locus A.

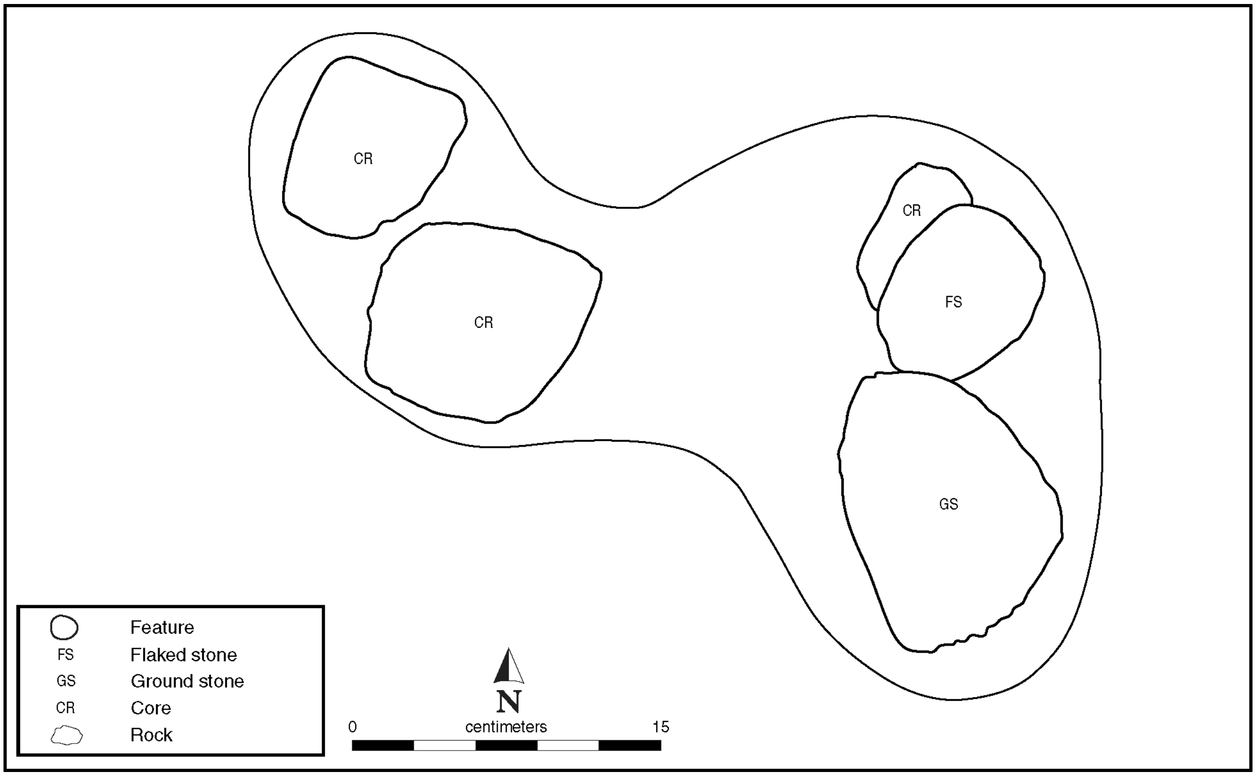

Figure 58. Plan-view drawing of Feature 686, a flaked-stone-tool-production area, LAN-62 Locus G.

Figure 59. Plan-view photograph of Feature 18, a small hearth, LAN-211, prior to excavation.

Figure 60. Plan-view photograph of Feature 18, a small hearth, LAN-211, after partial excavation.

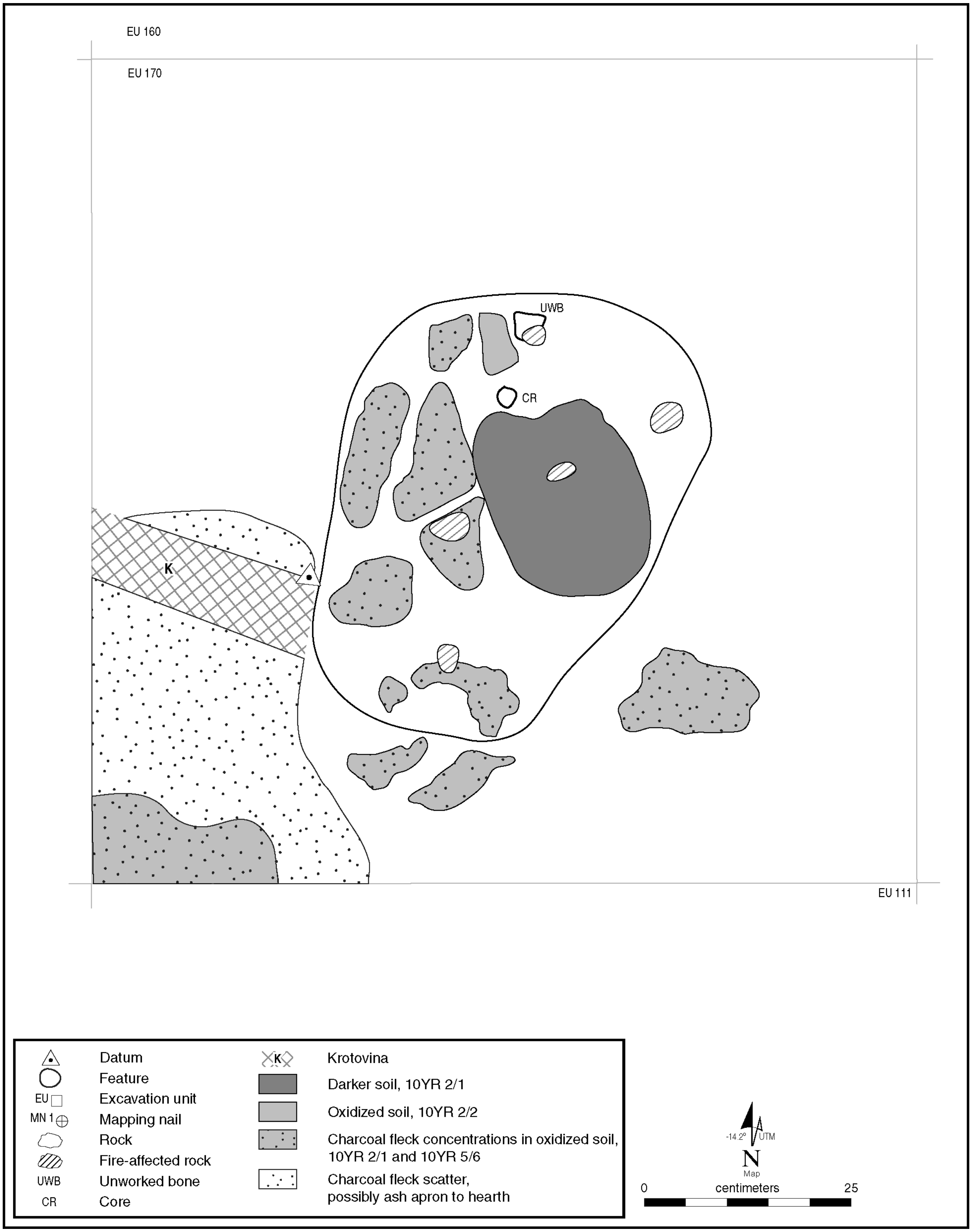

Figure 61. Plan-view and profile drawings of Feature 18, a small hearth, LAN-211.

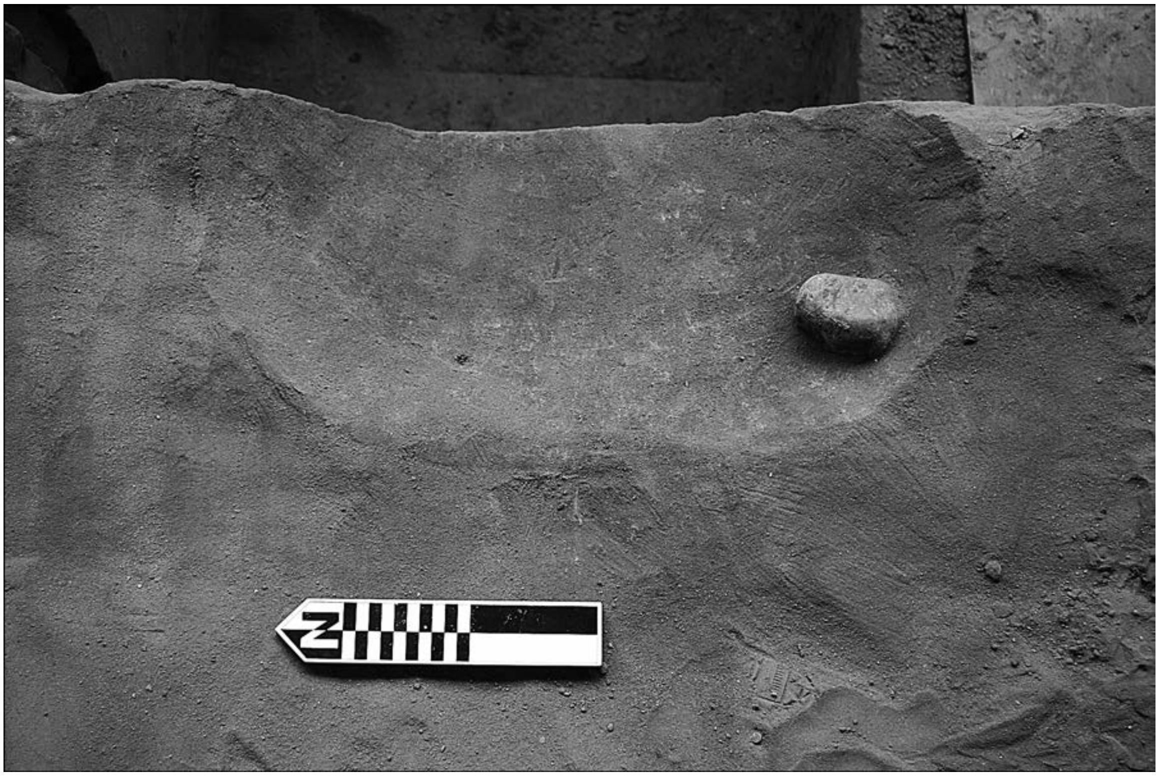

Figure 62. Plan-view photograph of Feature 83, a large hearth, LAN-62 Locus A.

Figure 63. Profile photograph of Feature 83, a large hearth, LAN-62 Locus A.

Figure 64. Plan photograph of Feature 21, a large hearth, LAN-211, prior to excavation.

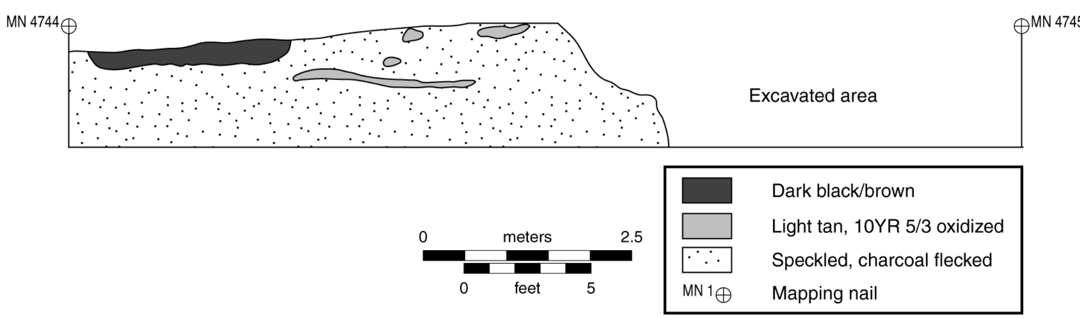

Figure 65. Profile drawing of Feature 21, a large hearth, LAN-211.

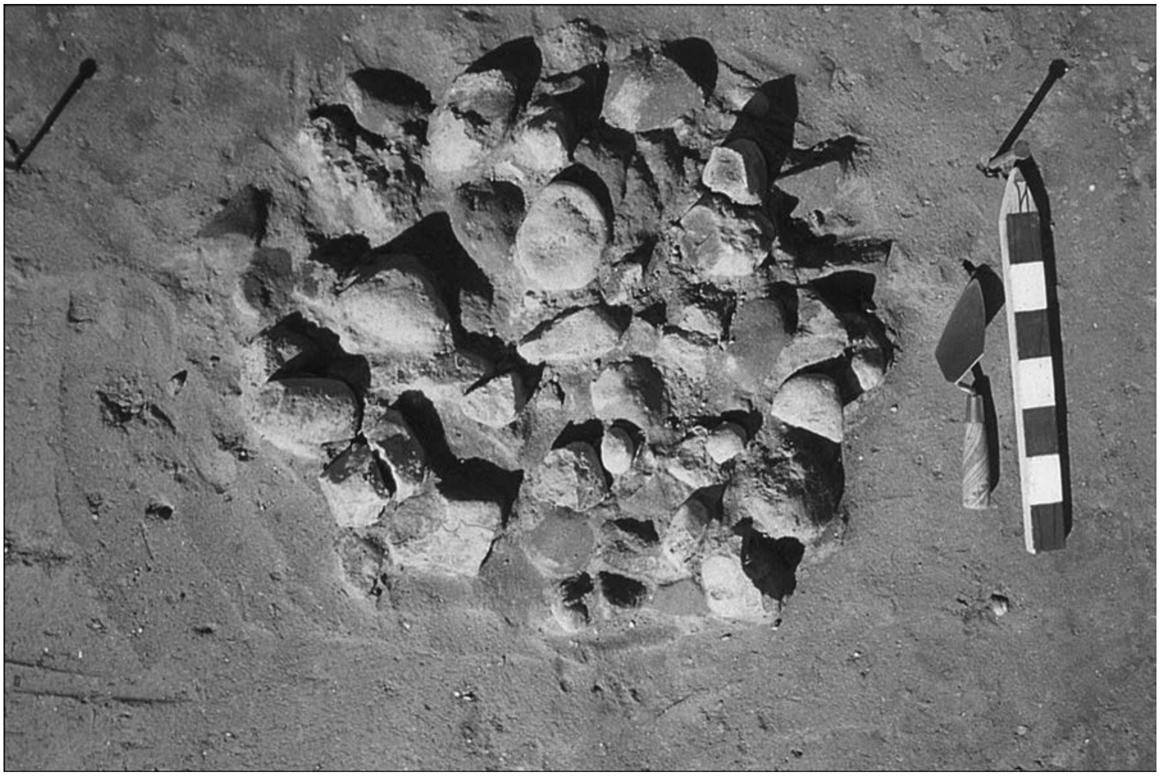

Figure 66. Plan-view photograph of Feature 12, a large hearth, LAN-2768.

originally discovered as a layer of patchy, oxidized soil. Beneath that was feature fill abundant with charcoal, bone, and FAR and another layer of oxidized soil that defined the base of the feature. The feature fill contained large quantities of charcoal and carbonized seeds, including domesticated taxa, such as peas, barley, and the only example of maize from any of the PVAHP sites. The domesticated seeds, as well as a scallop shell dating to 890 ± 40 cal B.P., suggested that the feature may have been used and reused between the Late and Mission periods.

Feature 26, also at LAN-211, was located in the central portion of FB 1. This large hearth measured 1.48 by 1.46 m and approximately 0.16 m in depth and had an irregular cross-sectional shape. The presence of oxidized soil and charcoal helped to identify the feature as a hearth. The lack of rodent disturbances and tightly clustered artifacts indicated high feature integrity. The feature fill included a moderate quantity of unworked stone, FAR, ground and flaked stone, burned and unburned faunal bone, shell, a relatively large amount of worked shell (including shell beads), and a high number of carbonized seeds, among other artifacts. The feature fill was distinctly lighter in color than the surrounding soil and bore evidence of thermal activity in the form of oxidized soil and frequent charcoal.

Finally, Feature 12, at LAN-2768 Locus A, along the northwestern edge of the site, is also a good example of a large hearth (Figures 66 and 67). It measured approximately 1.48 by 0.84 m and 0.30 m in depth and consisted of over 100 densely clustered lithic artifacts and shells. The majority of the stone (including formed ground stone tools and unworked stone) had been heavily fire affected. The large number of pieces of FAR, the presence of ashy sediments, and the evidence of in situ thermal activity helped to identify this feature as a hearth.

Overall, then, small and large hearths in the PVAHP project area exhibited a range of sizes, shapes, and constituents. Hearths from all time periods may have consisted of pits with medium to dense clusters of FAR and evidence of thermal activity, such as ash, charcoal, and oxidation. Some hearths that dated to the more-recent past may also have exhibited stronger evidence of those hearth indicators, especially charcoal and oxidized soil. The hearths from LAN-211 offered as examples above exhibited clear evidence of oxidized soil and reuse through time, whereas other hearths, such as Feature 12 at LAN-2768, did not contain evidence of oxidation.

Human Burial

These features required little interpretation beyond the classification criteria outlined above. The interpretive distinction between primary and secondary inhumations and cremations was factored into the classification process, as explained above. Examples of these types of features are presented in Volume 4, this series, which is dedicated to bioarchaeological analysis of the burial features at PVAHP sites.

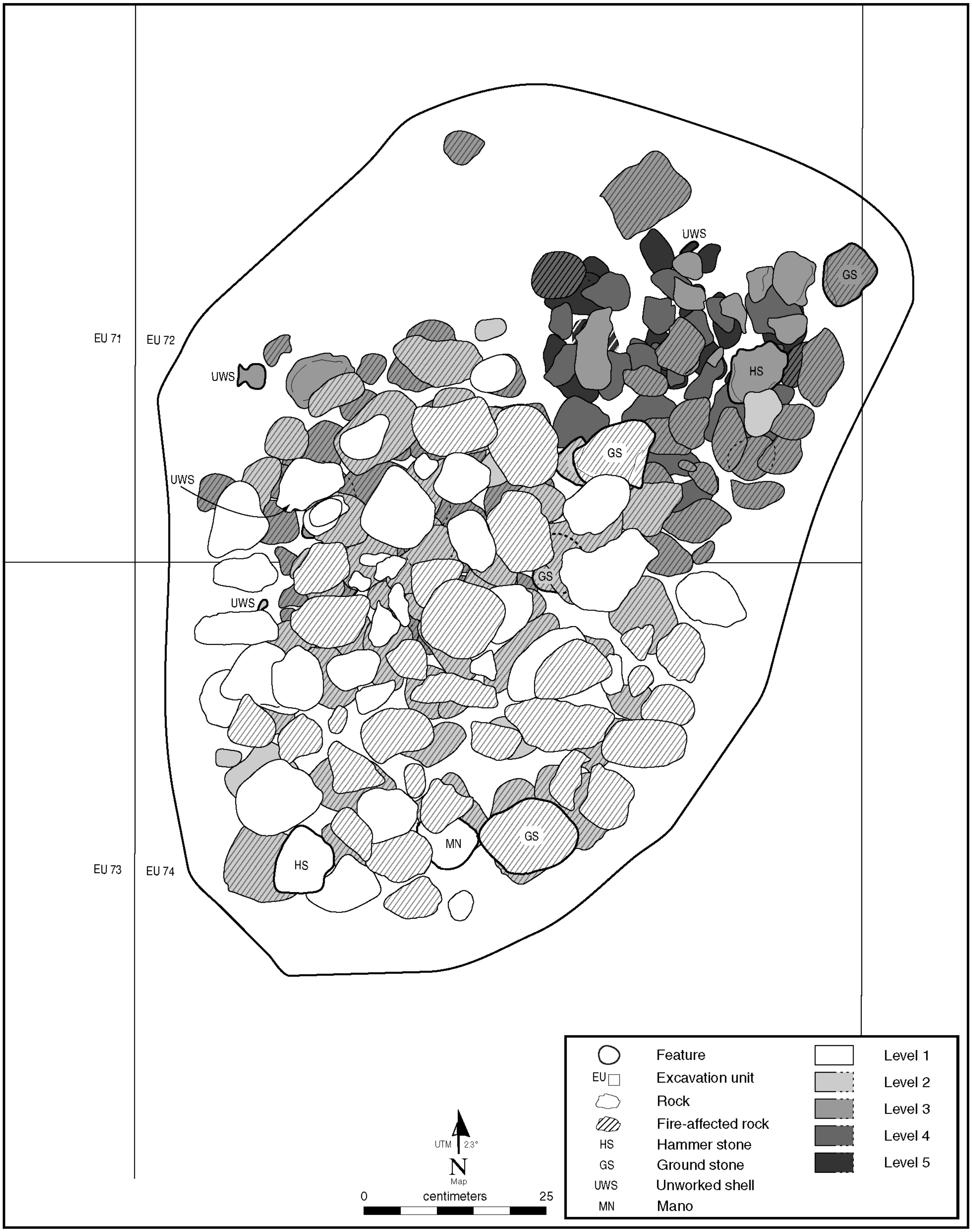

Figure 67. Plan-view drawing of Feature 12, a large hearth, LAN-2768.

Mortuary Offerings

These deposits generally lacked subsistence-related materials and contained possible ritual paraphernalia, as explained above. They also were consistently situated near human burials, suggesting a mortuary function. Examples of these features included the cached clusters or strands of shell and glass beads near the burial areas in Locus A of LAN-62 (see Chapter 9, this volume). Outside LAN-62, several features interpreted as ritual offerings included deliberately arranged concentrations of purposefully broken ground stone, shell, and other materials that suggested no apparent utilitarian function. These features corresponded to our "ritual offering, no burning" category.

We offer four examples of mortuary features to help illustrate the diversity of these features. Because the vast majority of the human burials identified during the PVAHP were located in Locus A of LAN-62, all the examples discussed here are from that location.

Feature 68 was an irregularly shaped feature that primarily contained textile-fragment imprints in asphaltum (rather than actual textile fragments) and large numbers of shell and glass beads (Figures 68 and 69). Measuring approximately 1.0 by 0.80 m and 0.60 m in depth, Feature 68 also contained several small pieces of isolated human bone, faunal bone, nutshell fragments, chunks of charcoal and ochre, and ground stone and steatite fragments. The textile was a coiled fragment that the excavator of the feature suggested may have been a bag that functioned as a container for the shell and glass beads. The feature was related to burial Feature 14, which had similar types of artifacts present.

Feature 75 was an irregularly shaped feature that contained over 700 glass and shell beads in rows, suggesting that some of them had been originally strung together (Figures 70 and 71). In total, 11 strands were recovered in sequence, and some are illustrated in Chapter 6, Volume 3, this series. Measuring approximately 0.15 by 0.15 m and 0.10 m in depth, this small feature also contained an abalone shell that also contained beads. Given the context of the feature within the burial area, it was interpreted as a mortuary feature.

A final example of a mortuary feature is a portion of burial Feature 227 (Figures 72 and 73). Although Feature 227 was defined in the final classification as a burial feature, it contained both a human burial and a concentration of artifacts interpreted as a mortuary feature context. The latter included a concentration of artifacts located immediately west of the primary individual in the burial feature and measured approximately 0.15 m in diameter. The concentration of artifacts included three elongated, waterworn pebbles with ochre staining; three ovate, waterworn pebbles with ochre staining; a biface; two glass beads; shell fragments; a hand-painted Chinese-porcelain rice-bowl fragment with "Four Seasons" decoration; a salt-glazed-stoneware child's or demitasse cup; a shard of a colorless-glass machine-made bottle; an olive-green-bottle shard likely from a wine bottle; two fragments of a one-piece cast-copper button; and a worked-bone tube. As discussed in Chapter 8, Volume 3, this series, the Chinese porcelain, the salt-glazed cup, and the copper buttons were relatively rare in early Colonial California, especially in Native American contexts. Those and other Hispanic items, however, were purposefully placed in the same context with the Native American items, such as shell beads and waterworn pebbles. The direct context of the concentration of artifacts with a human burial suggested its interpretation as a mortuary context within a burial feature.

Mourning Features

These features correspond to our "burned ritual offering" and "burned basket, ritual offering" categories. At least two types of mourning features have been distinguished in the Ballona. One type is similar to those found throughout southern California, especially at LAN-63 (Douglass et al. 2005). They include large numbers of purposefully broken ground stone tools, bowls, and other artifacts and cover areas that measure up to several meters in length and width. Usually, some of the ground stone tools have been stained with ochre. In addition, high-value or exotic materials, such as steatite, schist, abalone shell, whalebone, ochre, and shell and stone beads, have often been included. Another type of mourning feature was recognized in the PVAHP project area: a group of shallow pits filled with burned basketry and carbonized seeds placed near the edge of the burial ground at LAN-62. Below, we offer three examples of mourning features to illustrate the variation, as well as the similarities, among the deposits: Subfeatures 384, 433, and 458; all were part of FB 3.

Subfeature 384 was a large, complex, irregularly shaped feature measuring approximately 5.4 by 3.1 m and 0.54 m thick (Figures 74–77). It consisted of a large, dense concentration of artifacts; large quantities of charcoal, textile, and basketry fragments; concentrations of burned seeds; and a number of pits containing burned seeds, baskets, and artifacts. As discussed in Chapter 5, Volume 3, this series, coiled and twined basketry were collected from the feature, as was cordage. Several fragments of white, decomposed fiber, identified as grass chaff, were also recovered from the feature. A wide variety of artifacts were found in the deposit, including asphaltum and asphaltum-covered basketry, non-asphaltum-covered basketry, textiles, cordage, glass beads, shell beads, ground and flaked stone, FAR, ochre, and tarring pebbles, as well as worked and unworked faunal bone and some isolated human remains. Many of the artifacts appeared to have been purposefully broken and placed in the feature. There was little evidence of in situ thermal activities associated with the feature, including a lack of oxidized soil and the presence of unburned material mixed with burned artifacts. Alternatively, it appeared that objects had been burned or purposefully broken elsewhere and then transported to the feature. A number of subfeatures were associated with this large, dense feature, including Features 45, 433, 454, 456, 458, 467, and 475. Features 433 and 458 are discussed in more detail below. Excavators in the field suggested that, based on stratigraphy, some of the subfeatures appeared to predate others, suggesting that the area had been used for multiple events.

Figure 68. Plan-view photograph of Feature 68, a mortuary offering, LAN-62 Locus A.

Figure 69. Plan-view close-up photograph of Feature 68, LAN-62 Locus A, showing glass beads and basketry.

Figure 70. Close-up photograph of a portion of Feature 75, a mortuary offering, LAN-62 Locus A. Notice the presence of glass beads in the original, strung position. See Volume 3, this series, for photographs of single examples of glass-bead strands from this feature.

Figure 71. Plan-view drawing of Feature 75, a mortuary offering, LAN-62 Locus A, indicating the locations of glass-bead strands and shell beads.

Figure 72. Overview of mortuary-offering burial Feature 227. This mortuary offering includes Hispanic and native items, including waterworn pebbles, glass shards, ceramic sherds, a whole cup, and marine shell.

Figure 73. Ceramic sherd that is part of burial Feature 227. This photograph is a close-up of a portion of a Chinese ceramic vessel (see Swope and Douglass 2011).

Figure 74. Overview photograph of a portion of Feature 384, a mourning feature, LAN-62 Locus A, illustrating the high density of burned materials, including basketry, textiles, and seeds, within its boundaries.

Figure 75. Close-up photograph of a portion of Feature 384, a mourning feature, LAN-62 Locus A, showing portions of burned basketry.

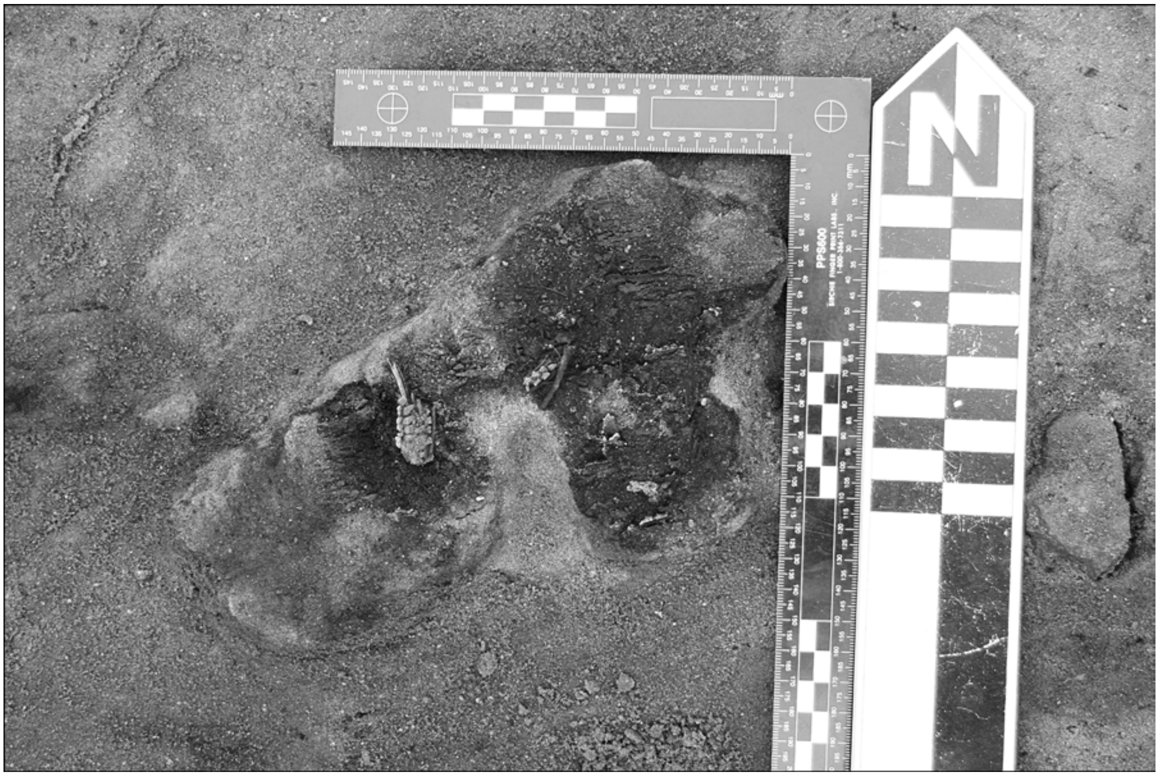

Figure 76. Close-up photograph of a portion of Feature 384, a mourning feature, LAN-62 Locus A, showing burned basketry, botanical remains, and other material.

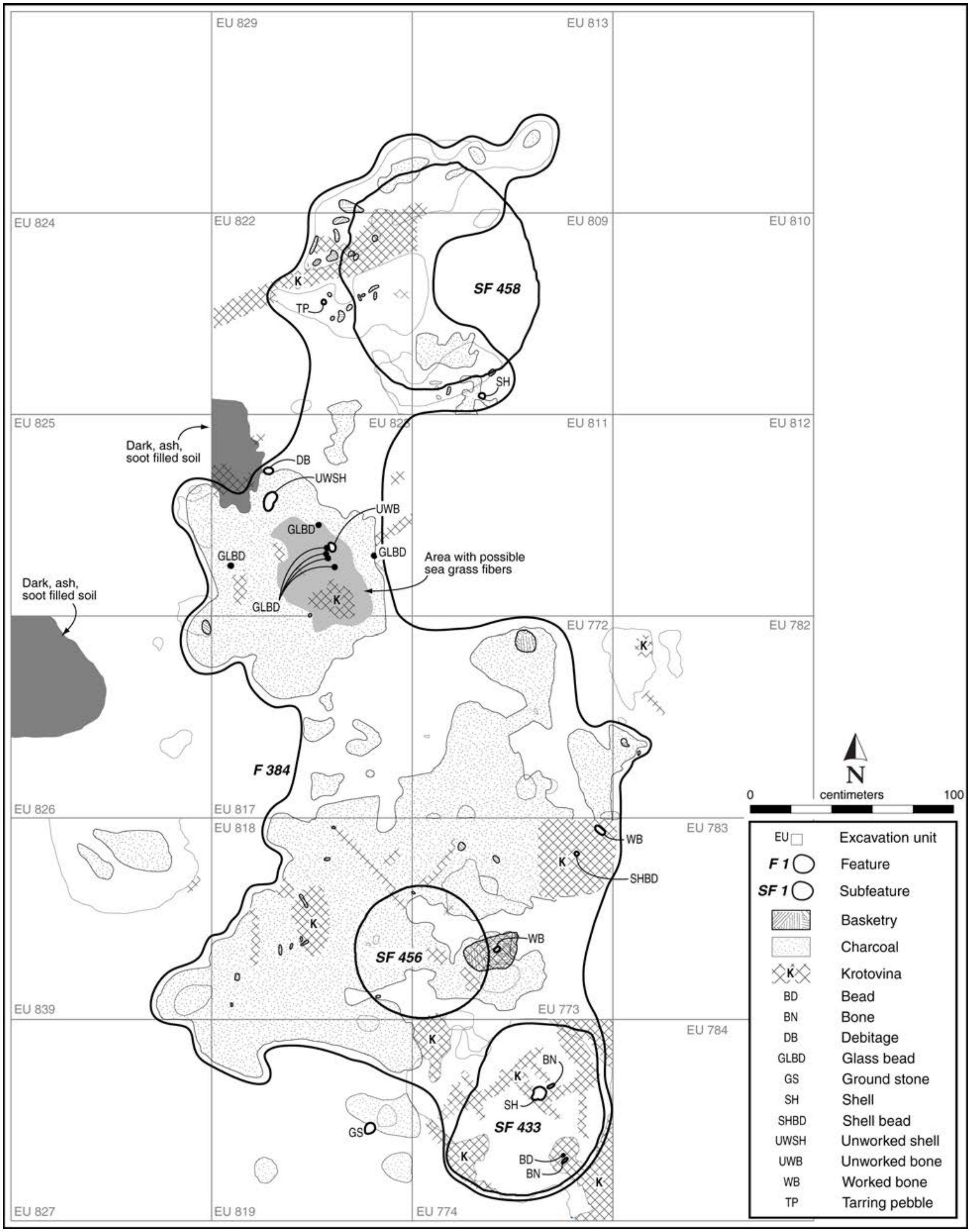

Figure 77. Plan-view drawing of Feature 384, a mourning feature, LAN-62 Locus A. Notice the presence of different loci of burned and/or purposefully broken artifacts, including ground stone, shell and glass beads, seeds, basketry, and textiles.

Subfeature 433, a subfeature of Subfeature 384, consisted of a pit containing a dense concentration of charcoal and other burned materials, including small quantities of basketry, botanical remains, and other textiles (Figure 78). The feature measured approximately 0.87 by 0.59 m and 0.16 m in depth. In addition to carbonized remains, moderate quantities of unworked faunal bone, shell beads, unworked marine shell, and flaked stone debitage were also recovered. Several pieces of worked bone, shell, and glass were recovered from the feature fill, including a large number of shell beads and a smaller quantity of glass beads. It is unclear whether the presence of beads was partially the result of bioturbation, because rodent burrows were present throughout the feature and had impacted its integrity.

Finally, Subfeature 458, another subfeature of Subfeature 384, was the largest of several similar pit features within FB 3 (Figures 79 and 80). The feature was roughly circular and measured just over 1 m in diameter and approximately 0.15 m in depth. The upper portion of the feature had been heavily disturbed by rodent activity, but the outline of the pit was visible at lower levels. The pit contained almost entirely burned basketry, carbonized botanical remains, ground stone fragments, and worked faunal bone. Analysis indicated that there were multiple baskets present within the feature: 80 coiled basketry fragments, 18 twined basketry fragments, and 2 cordage fragments. The lack of oxidized soil in the feature suggested that like those found in many features in FB 3, the artifacts had been burned elsewhere and deposited in the pit. It is possible, however, that the baskets were burned in a low-intensity fire that did not thermally alter the surrounding soil.

Roasting Pits

These were distinguished from hearths by their greater size. One example of a roasting pit was excavated at LAN-2768 and was situated in what appeared to have been a preexisting structure measuring roughly 2.5 by 2.3 m in diameter—considerably larger than any feature interpreted as a hearth. Roasting pits also likely involved different cooking practices than hearths. Hearths presumably were used for cooking over open-air fires, whereas roasting pits, also referred to as earth ovens (Van Horn 1987a), probably involved high-temperature heating in pits covered with soil and vegetation, a process typically intended for slow-cooking purposes. Roasting pits recorded elsewhere in southern California have been generally large, multicourse concentrations of FAR, charcoal, and ash that contained hundreds of cobbles exhibiting exposure to extreme heat. The size range of these features can vary: some recorded roasting pits are as large as 3 m in diameter, and others have measured 1 m or less. The posited roasting pit recorded at LAN-2768 fell within that range and was classified in the field as an "FAR concentration in pit." See discussion of Feature 24 at LAN-2768 below, after the discussion of structures.

Structures

Only one possible prehistoric structure was identified during the PVAHP, the aforementioned pit structure at LAN-2768 that was later reused as a roasting pit (Feature 24). The ovoid-shaped pit included two intramural pits, both of which also were classified as thermal features but probably initially functioned as intramural storage pits. No other prehistoric structures have been identified in the Ballona, which underscores the importance of this feature. Given the prevalence of FAR in the feature, it was classified in the field as an "FAR concentration in pit."

Feature 24, in Locus A of LAN-2768, is a prime example of a roasting pit and also the only example of a prehistoric structure (Figures 81 and 82). It was originally discovered during mechanical stripping of the site during data recovery excavations and measured approximately 2.6 by 2.3 m in an ovate area. Subsequent to the discovery of its northern portion, clearing of the area exposed the full extent of this large, complex feature. Feature 24 had a basin-shaped profile and was defined by a discrete floor discernible as a layer of highly compact soil. The feature was composed of two subfeatures discovered beneath the FAR lens (Features 30 and 31) and was bounded on its northeastern and southwestern corners by postholes (Features 23 and 29). At the time of discovery, a cobble lens composed primarily of FAR covered approximately two-thirds of the feature. The feature fill appeared dark and ashy, but the flotation samples yielded little charcoal or carbonized seeds.

Feature 24 contained a large number of unshaped pieces of FAR. Large amounts of flaked stone debitage, faunal bone, and marine shell were also recovered. Mammal bones made up the majority of the faunal collection, but fish and reptile remains were also identified. As much as half the bone recovered showed direct evidence of burning. With the exception of the ashy fill and thermally altered artifacts, there was little evidence to suggest that the feature was associated with lots of in situ thermal activity. Little charcoal was discovered in flotation, and the soil did not display the signs of oxidation typically associated with hearths and roasting pits. The lack of oxidized soil, however, may be due, in part, to the age of the feature, which dated to the Intermediate period. The majority of features with clear evidence of oxidation dated to the Late through Mission periods; it is possible that the oxidized soil from burning in older deposits did not preserve well.

In conclusion, it appeared that Feature 24 functioned in two different ways through time. The basin and floor of the feature were constructed first, forming the base of a partially subterranean structure that also had a superstructure, as indicated by the presence of post molds. Excavators in the field believed that the structure may have been a sweat lodge. Subsequent to its use as a structure, its floor and basin were covered with cobbles and other assorted lithic artifacts, to create a large roasting pit. The numerous pieces of FAR found in situ on the floor of the structure supported that interpretation. It is possible that through time, this roasting pit was cleaned

Figure 78. Oblique photograph of Feature 433 (subfeature of Feature 384), a mourning feature, showing the profile of the shallow pit that contained a number of burned and purposefully broken objects, LAN-62 Locus A.

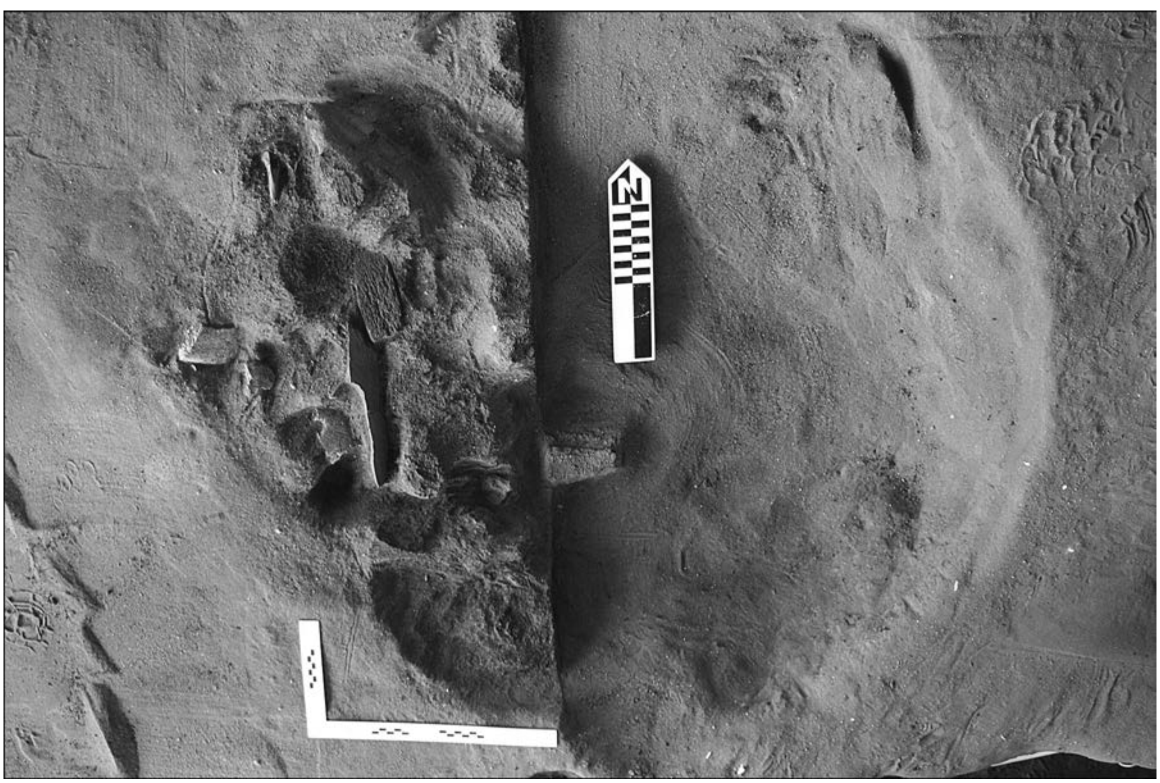

Figure 79. Plan-view photograph of Feature 458 (subfeature of Feature 384), a mourning feature, LAN-62 Locus A, showing the shape and depth of the feature, as well as the burned and purposefully broken objects contained within it.

Figure 80. Plan-view drawing of Feature 458 (subfeature of Feature 384), a mourning feature, LAN-62 Locus A.

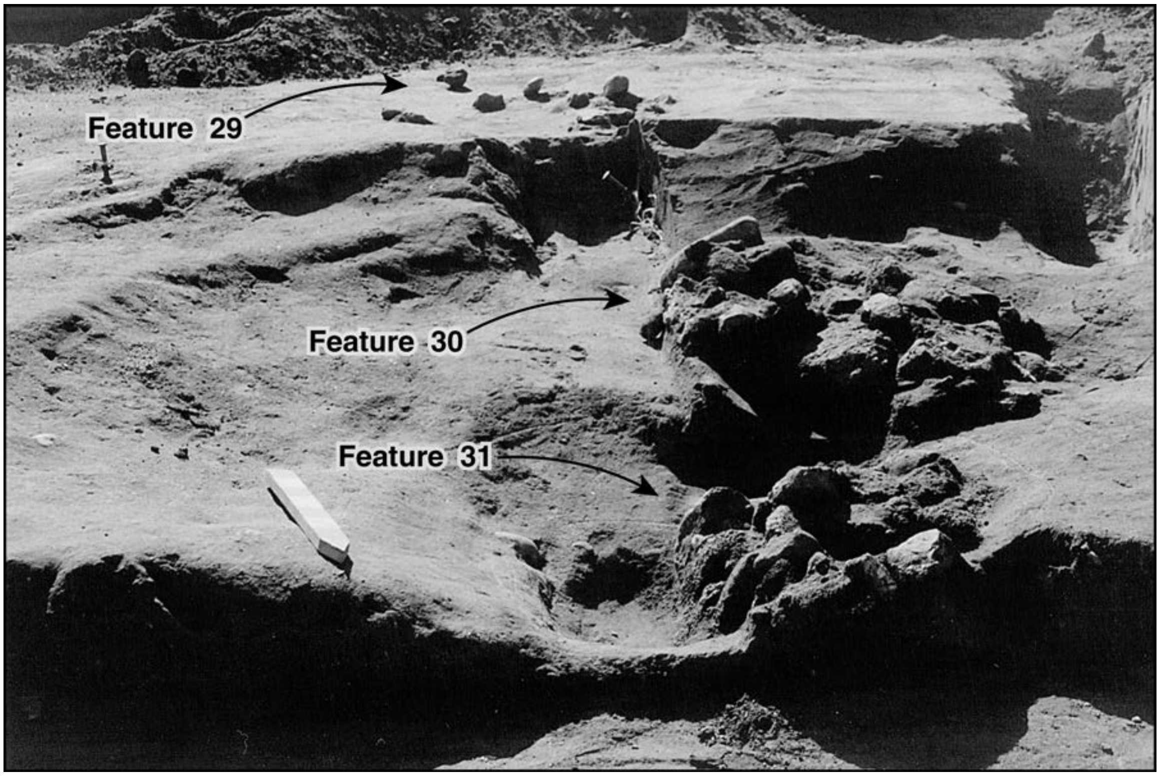

Figure 81. Photograph of Feature 24, a house pit, LAN-2768, view to the south, after complete removal of the FAR associated with the feature's last use as a roasting pit, showing Features 29, 30, and 31.

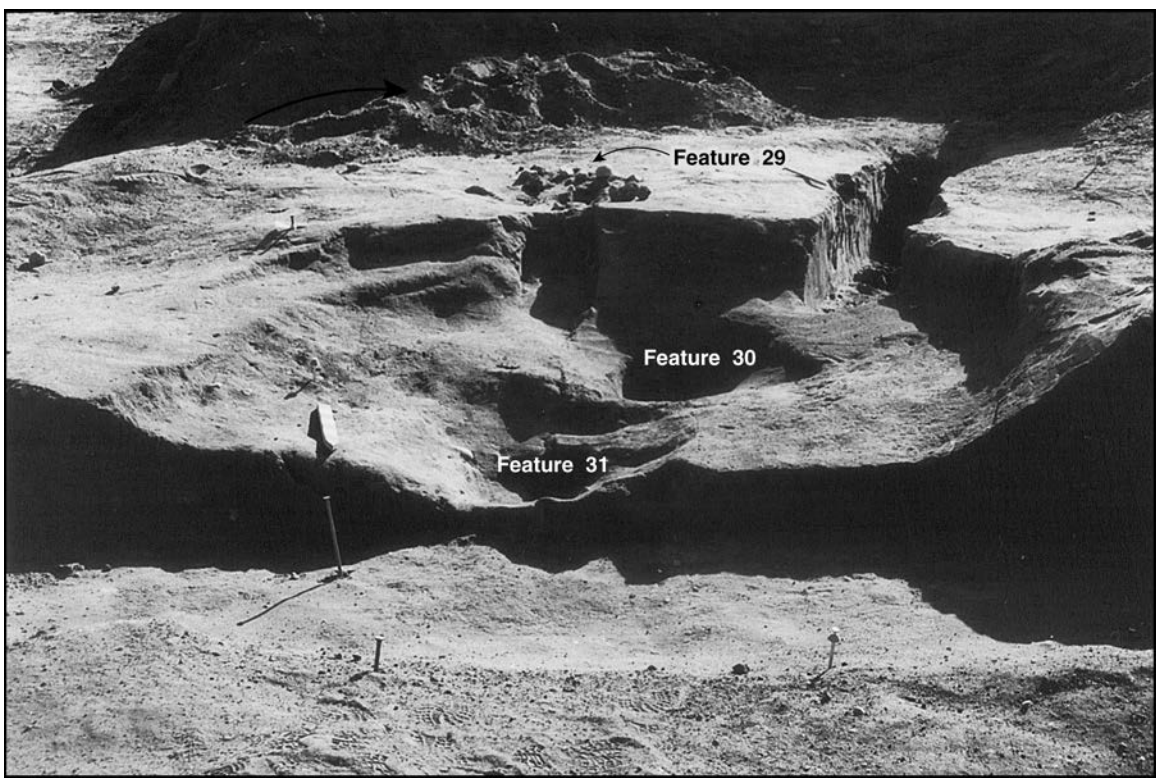

Figure 82. Photograph of Feature 24, a house pit, LAN-2768, view to the south, after removal of half of the FAR associated with the feature's last use as a roasting pit, showing Features 29, 30, and 31.

out and reused multiple times, as evidenced by the lack of charcoal in the deposit. Alternatively, the rocks could have been heated in a fire nearby and then placed into the basin.

Identifying Prehistoric Activity Areas

In addition to feature analyses, the site discussions presented in Chapters 6–10, this volume, also include analyses of potential activity areas at each site. "Activity areas" here refers to discrete concentrations of features that indicated contemporaneous and discrete loci of human activity. Generally, activities were only identified where two or more features exhibited a well-defined vertical and horizontal association within the subsurface matrix, suggesting both temporal and spatial relationships. Chronometric data provided additional grounds for inferring temporal associations among adjacent features.

In some cases, activity areas were identified during fieldwork, designated as composite features, and assigned unique feature numbers. For example, the close spatial associations among the subfeatures that constituted composite Features 7–9 at LAN-193 were apparent during fieldwork, and indeed, a data recovery plan was developed at that time to expose, map, and record the subfeatures comprised by each composite feature. In those cases, blocks of excavation units were explicitly situated to investigate the various subfeatures, as well as the "nonfeature" spaces between the subfeatures, to understand the relationships among them and, in turn, provide a solid empirical basis for interpreting the functions of the activity area. In addition to the three composite features at LAN-193, large blocks of hand-excavation units were strategically placed to investigate composite features at LAN-62 (FBs 3, 4, and 7) and LAN-211 (FB 1). Moreover, the massive, contiguous excavation block that covered the burial areas in Locus A of LAN-62 essentially served the same purpose, although the burial area was not designated as an activity area.

Additional possible activity areas were identified after fieldwork, during the feature analyses, and are discussed in Chapters 6–10, this volume; those areas, however, were not assigned feature numbers or excavated in large blocks of EUs. For example, possible prehistoric activity areas were identified at LAN-2768, LAN-54, and LAN-62. One example was a concentration of six Millingstone period features excavated in the southern part of LAN-54, within a roughly 10-by-10-m area: four discard areas that contained mostly shell, a hearth-cleanout deposit, and a concentration of flaked stone and ground stone artifacts. Together, those features potentially indicated a shellfish-processing workstation (or workstations) dedicated to the processing of shellfish and the production/curation of stone tools required for that task (as evidenced by the ground stone and flaked stone concentration). The four discard areas were probably toss zones associated with specific processing activities. The thermal feature suggested that heating was used during that process, but it is also possible that the areas functioned as camping locations, and the hearth was constructed for cooking and heating purposes (for details, see the discussions in Chapters 8 and 12, this volume).

Historical-Period and Modern Features

A number of features recorded in the PVAHP area were related to late-nineteenth- or early-twentieth-century occupation and land use (post–A.D. 1850, generally), such as farming, ranching, and, more recently, Hughes Aircraft Company operations. None of these features was classified as thermal or ritual/burial deposits, which simplified the classification process. The late-historical-period/modern deposits were classified as belonging to one of several general categories: structural remains, trash dumps or trash pits, animal burials, leach pits, cisterns, wells, and other types of related features. Trash dumps or pits generally included domestic debris, such as bottles, porcelain, metal fragments, and broken glass. Lower-frequency materials included saw-cut bone (including cow and pig), plastic and rubber products, charcoal, eggshells, and marine shell. For example, a very large trash deposit likely related to hog ranching in the 1920s was uncovered at LAN-193. Structural remains consisted of structure-related debris, including some combination of wooden posts, bricks, glass, concrete fragments or footings, and metal nails and posts. In addition, several features contained the remnants of relict wells, pipelines, cisterns, and a rail spur, several of which probably were constructed by the Hughes Aircraft Company. Several late-historical-period/modern animal burials were recorded along the bluff, all of which contained fully or partially articulated horse skeletons. The horses were probably interred (or buried naturally) during the era of ranching or agricultural land use in the late 1800s or early 1900s. Features related to early farming or development in the area, including wells, railroad tracks, and leach pits, were also identified. Lastly, in addition to these, there were other modern disturbances identified at sites, including previous test pits, augers and drillings, trenches, and a variety of other similar types of features; these are included in the list of features presented in the appropriate appendix for each site-specific chapter but are generally not discussed in detail in the chapter text.

LAN-193 Field Methods and Excavation Results

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This chapter presents the field methods used at LAN-193 and discusses the results of the data recovery fieldwork. The chapter has four sections. The first section outlines the history of archaeological investigation at LAN-193. The second section presents an overview of the field methods used during the data recovery excavations. The third section is an overview of the laboratory methods and sampling procedures used to select proveniences for detailed materials analyses; in that section, we explain the rationale used in selecting samples of features and 1-by-1-m CUs for detailed analyses. The final section is an overview of the general results. That section includes discussion of results of a midden-constituent analysis based on analyses of materials excavated from selected CUs in various areas of the site. The latter part of the section focuses on the range of feature types at LAN-193 and on identifiable groups of feature types, or "activity areas." The results of detailed analyses of specific artifacts and other materials are discussed in subsequent volumes of this series.

Site Setting

Situated at the base of the Ballona escarpment and at the intersection of two small drainages south of spring-fed Centinela Creek, LAN-193 was an ideal location for a prehistoric habitation site (Figure 83). The site rested relatively undisturbed below asphalt and layers of flood sands for many years, until plans to construct the Riparian Corridor—a storm-water-management, water-quality, and habitat area—prompted archaeological investigations of a portion of the site by SRI.

The history and location of LAN-193 have often been incorrectly intertwined with those of LAN-62. Although it would be a mistake to conclude that LAN-62 and LAN-193 are one and the same site, many past discussions of LAN-193 likely pertained to LAN-62. For example, it appears that in R. L. Pence's (1979) archival survey of the Playa Vista property, he was discussing LAN-193, and his references were to Peck's 1947 report on the Mar Vista site, which clearly described LAN-62 (Altschul and Ciolek-Torrello 1997). The first official record of LAN-193 was produced by Hal Eberhart at UCLA, in 1952 (Pence 1979; Van Horn 1984a:33–34), and the site was described as a village. The "village" moniker may have been an overstatement, based on confusion with LAN-62, located over 1 km to the south and west.

The site record appears to have been filled out by Eberhart based on information from various sources, and it is unclear whether he actually visited the site. In fact, it is doubtful that professionally trained archaeologists ever saw the site prior to SRI's work in 1999 (Altschul et al. 1991:Figure 37; Van Horn 1984a). R. L. Beals is purported to have excavated at LAN-193 in 1939 (Altschul and Ciolek-Torrello 1997:18), but in that case, as in those previously discussed, the artifacts he collected were more consistent with LAN-62 than with the sparse midden site that was found at the recorded location of LAN-193. It is possible that Beals's artifacts were from another village site that may once have existed at or near the current location of LAN-193 or from a component that has been altogether removed.

A large hog farm was established at LAN-193 in the early twentieth century and was run by the Kitahata family (Bancroft Library, University of California, Berkeley 2006). The Kitahata hog-farming operation acquired restaurant refuse to feed their pigs, separating out edible food items to supplement their hog feed (Blair 2006). Kitahata also had a city contract to receive the garbage. Refuse collected by the hog farmers may have been the origins of the early-twentieth-century trash deposit, possibly visible as debris strewn on the ground outside the hog-pen fence. There was an outbreak of pneumonic plague in 1924 in Los Angeles, during which many people died, and rats were blamed for the spread of the disease (Deverell 2004:172–206). Los Angeles and other (especially West Coast) municipalities decided to crack down on rat populations by literally hunting and killing rats with "rat pack patrols" (*Los Angeles Times*, 22 November 1924:A6; 30 November 1924:B1, B3). Specifically targeted in municipal rat-hunting and cleanup efforts were Japanese-owned and Mexican-owned businesses and communities. The Kitahata farm was among the places targeted for rat removal and cleanup by those patrols. The digital photographic archives of Los Angeles at the Bancroft Library, University of California, Berkeley (2006), show pictures of the farm that are labeled "Kitahata after the cleanup from rat infestation 1924" (Figure 84). The farm buildings

Figure 83. LAN-193, at the start of SRI's data recovery project in 1999, view to the northwest.

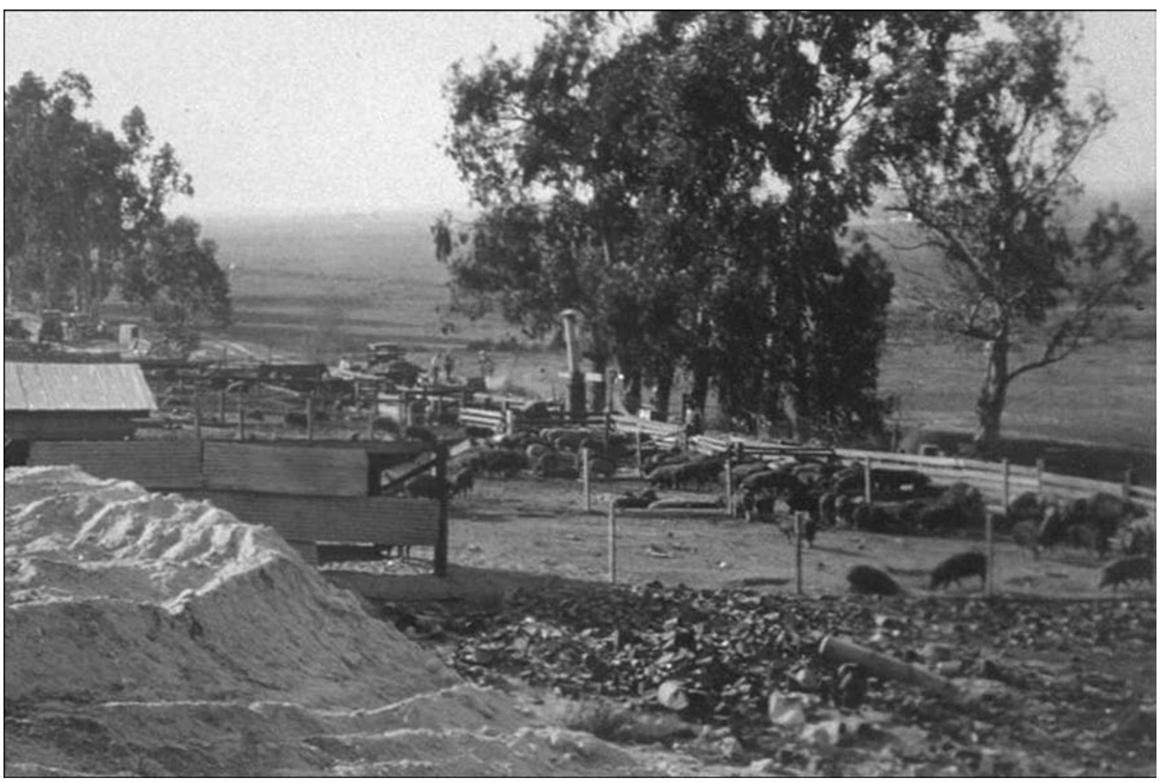

Figure 84. Kitahata Hog Ranch, LAN-193 (photograph courtesy of the Bancroft Library, University of California, Berkeley, Call No. 1988.052:271-PIC).

and fences appeared little different from how they had looked before the cleanup. That the buildings were still standing after the cleanup is interesting, in that numerous buildings viewed as derelict or containing rats were destroyed between 1924 and 1925 (Deverell 2004:172–206).

Aerial photographs show that at the time when the site record was completed, the site was likely under asphalt from the Hughes Aircraft Company plant, as early as 1952. Altschul and Ciolek-Torrello (1997:17–19) provided a detailed history of the issues surrounding the discovery and location of LAN-193.

Archaeological Background

Early Investigations

As stated above, it is unlikely that any professional archaeologist ever excavated or viewed the site prior to its being buried under fill and asphalt as a result of Hughes Aircraft Company activities. Rozaire and Belous's (1950) survey report did not discuss LAN-193, and Pence's (1979) survey report was the first discussion of this site by a professionally trained archaeologist. Pedestrian survey by Pence (1979) did not reveal any evidence of the site, although he stated that cultural materials were likely covered and protected by the asphalt parking lot associated with the Hughes Aircraft Company plant. A later survey of the property by Van Horn (1984a) provided no further clues as to the condition of the site, again because of the fact that the area was covered in asphalt. Van Horn (1984a) recommended that removal of the asphalt and formal testing was the only way to confirm the existence of the site.

SRI's Investigations at LAN-193

SRI's investigations at LAN-193 started with archival research and a pedestrian survey of the Playa Vista property in 1990 (Altschul et al. 1991). As with previous researchers, SRI found no visible surface indications of LAN-193 and recommended subsurface investigations to evaluate the presence and/or significance of the site.

An alternative method of identifying subsurface cultural materials was required to locate and evaluate LAN-193. SRI proposed a two-phase strategy: (1) site-discovery phase and (2) evaluation phase (Altschul and Ciolek-Torrello 1997). In Altschul and Ciolek-Torrello's (1997) original work plan, the discovery phase consisted of both noninvasive and mechanical-excavation techniques, including magnetometer surveys and mechanically excavated cores; the evaluation phase included mechanically excavated trenches and hand-excavated test pits and subsequent analysis of materials recovered. The results of that work were presented in detail in the archaeological treatment plan (ATP) for the entire area of The Campus (Altschul et al. 1999) and will be only briefly discussed here.

Geophysical Investigations

Three geophysical methods were used to detect subsurface anomalies at LAN-193: magnetic-field-gradient survey, resistivity survey, and GPR survey. The goals of the combined methods were to identify buried utilities and other subsurface iron objects, to map stratigraphic contacts between various soil types, and to identify possible locations for subsurface prehistoric features. Prior to conducting the surveys, the entire asphalt surface was cleared of any metal debris, and a 20-m grid was established over the site. The presence of the asphalt surface was not thought to be problematic for the surveys.

Geophysical studies at LAN-193 were successful at locating soil contacts, buried utilities, and other subsurface disturbances. In particular, GPR was able to define three possible soil contacts beneath the LAN-193 parking lot that were thought to represent intact and undisturbed sediments, an inference that was later corroborated by the resistivity data from the same area. In general, however, the remote sensing was unsuccessful. The magnetic-field-gradient survey was dominated by underground utilities and iron objects. Because those disturbances were located near the surface, they effectively masked any anomalies in the deeper-lying sediments below. The data obtained in the LAN-193 parking lot from both the resistivity and GPR surveys were intriguing but ambiguous. The soil contacts detected could have indicated changes in subsurface sediments, but they also could have been related to changes in soil moisture. Testing and mechanical coring was required to obtain a clearer picture of the subsurface stratigraphy and to expose the sediment contacts.

The results of geophysical work at the site have been described in detail in the ATP for the EMTD by Altschul et al. (1999), and the reader is encouraged to review that document for details. The presence of subsurface utility lines, fill containing metal artifacts, and disturbance from twentieth-century construction activities obscured the results of the work. Subsurface anomalies were essentially masked by those disturbances. GPR was successful, however, at identifying three soil contacts. Resistivity data corroborated the presence of those soil contacts, although the data were ambiguous. It was unclear whether the contacts were real or related to elements such as moisture. Also, it was unclear whether the contacts represented intact deposits or were related to fill episodes. In the end, the ambiguous remote-sensing data confirmed the need for mechanical means of creating exposures and collecting quantifiable data.

Mechanical Coring and Bucket Augering

The continuing use of the area for commercial enterprises, the asphalt covering, and the need to maintain access to other portions of the 1,000+-acre project area prevented us from using commonly used subsurface methods, such as trenching, test-unit excavations, and hand-augering. Consequently, SRI applied two other methods of subsurface testing: mechanical coring and bucket augering.

The mechanical-coring program was designed to identify undisturbed soils where potential sites may have been preserved (see Chapter 4, this volume, for details on the method and application). In accordance with Altschul and Ciolek-Torrello's (1997) work plan, a set of cores was to be placed at set intervals in a cruciform pattern near the presumed location of LAN-193 (see Figure 14). In addition, several judgmentally placed cores were to be excavated within the HHIC and to the north, in the area of the old runway. The coring program was carried out over several months in 1998. Detailed analysis of the soil profiles from the cores was conducted and was presented in the ATP for the area of the EMTD/The Campus (for details, see Altschul et al. 1999:41–47).

Caroline Tepley of UCLA analyzed the core samples at the Playa Vista field laboratory in late 1998 and interpreted the sedimentary environment for each core segment (e.g., marsh, lagoon/intertidal, and beach contexts), following Reineck and Singh (1973) and Orme (1990). In all, Tepley identified many sediment-texture classes, which were grouped together as subtypes of four broader sediment classes. She also described soil colors for the core samples, which fell into four main color classes. By collapsing Tepley's descriptive data into 16 sediment-texture/color types, large-scale trends in sedimentological regimes were inferable. Tepley, along with SRI personnel, also identified invertebrate remains in the core segments. Invertebrate identifications were standardized during synthesis and incorporated into the core-testing database. In particular, gastropods (e.g., *Cerithidea*, *Physa*, and *Melampus*) and pelecypods (*Ostrea* and *Chione*), as well as unidentified shell fragments, were recognized in the cores.

In addition to coring, SRI also undertook a bucket-augering program in 1998 to expose a larger subsurface area, which provided firmer empirical grounds for evaluating site integrity and extent (see Chapter 4, this volume, for a discussion of augering).

Results of Testing

The testing phase at LAN-193 helped to define the site boundary and also to identify a previously unrecorded site (LAN-2768). The mechanical-coring process was useful in identifying the locations of potential sites, and the bucket-augering process provided more-detailed data on stratigraphy and the nature of cultural materials within the site. Note, however, that although bucket augering and coring do not provide accurate archaeological information, compared to traditional trenching or hand-excavation techniques, they do provide effective means of detecting deeply buried cultural deposits.

In all, approximately 12 cores were excavated into the parking lot within the site area of LAN-193. The first of the cores produced a possible lithic artifact located 11–15 feet below the surface. That was the only artifact discovered during the mechanical-coring process at LAN-193. We were unable to correlate core stratigraphy to the remote-sensing data; even so, both methods indicated likely undisturbed soils immediately below the parking lot. The parking lot was constructed sometime after 1949, but the extent of leveling or truncation prior to the lot's construction is unknown. We suspected that the upper soils may have been truncated and possibly redeposited within the HHIC as fill during construction episodes (especially for construction of a runway). Monitoring of construction in an area to the north of the parking lot, in the industrial complex, suggested more severe disturbance and probably no remaining intact archaeological materials. Although artifacts were recovered during monitoring, they had probably been redeposited from a nearby site.

The bucket-augering process in the LAN-193 site area was designed to determine whether darker soil horizons discovered during the coring process, as well as the contacts discovered during remote sensing, in fact represented intact archaeological deposits. In particular, SRI archaeologists were seeking to detect evidence of what Eberhart described as a "village site" in the 1950 site record for LAN-193. Twenty bucket-auger units were excavated in the parking lot that covered LAN-193; archaeological materials were recorded in 10 of the units (see Figure 14). Based on those results, SRI defined the site dimensions as covering an area of ca. 225 m east–west and ca. 40 m north–south. Site depths ranged from 1 to 4.5 m below the surface (mbs), with an average depth of about 1 m.

The data from the bucket augers suggested that the site we discovered was a low- to medium-density artifact scatter that did not conform to the original description of LAN-193. The site had low densities of shell and lithic artifacts but higher densities relative to other tested site areas. The soils at LAN-193 did not exhibit the dark, organic-rich nature identified in other known archaeological deposits within the PVAHP area and other southern California coastal midden sites. In all, the testing results made clear that intact archaeological deposits were present at LAN-193 but that the site clearly did not encompass a "village," as Eberhart had suggested. Chronometric data recovered from the bucket-auger units suggested an Intermediate period (ca. 1000 B.C.–A.D. 1000) occupation. Based on the results of the testing phase, SRI concluded that LAN-193 was eligible for listing in the NRHP as a contributing element of the PVAHP (see Altschul 1991). The testing program determined that LAN-193 contained "intact midden deposits that will produce data critical to addressing important issues in the prehistory of the Ballona Lagoon region" (Altschul et al. 1999:110). In light of that determination, SRI developed a treatment plan to mitigate the impacts from planned construction projects, mainly construction of the Riparian Corridor (Altschul et al. 1999).

The treatment plan identified three major components: characterization of site constituents, feature identification, and feature recovery (Altschul et al. 1999). Characterization of site constituents (including middens) was to be accomplished through sampling, using hand-excavated units and mechanical trenching.

Data Recovery Methods

Data recovery undertaken at LAN-193 was conducted to mitigate the effects of construction of the Riparian Corridor (Figure 85). Construction of the Riparian Corridor removed a substantial portion of LAN-193. As our understanding of the extent of the site changed through monitoring and other activities, the total area of intact site disturbed by the construction of the Riparian Corridor also changed from our descriptions in the ATP (Altschul et al. 1991) to approximately 25,000 m^2.

Data recovery at LAN-193 was conducted in three phases (Table 17). The first data recovery phase commenced on August 27, 2000, and consisted of mechanical trenching, hand-excavation, MSUs, and feature recovery within a limited area. The second phase consisted of monitoring of mechanical excavations for a water-control feature known as the "V-ditch" and recovery of a large historical-period feature (Feature 600). The final phase consisted of MSUs, monitoring, and feature recovery during construction of the Riparian Corridor. The results of the initial and final stages of data recovery are presented below. Methods and monitoring results from the second phase (monitoring of the V-ditch) have been previously reported (Beardsley et al. 2001). Results from monitoring of the construction of the Riparian Corridor also have been reported elsewhere (Denniston and Douglass 2007a, 2007b).

Data Recovery Phase 1

Our initial understanding of LAN-193 was based on the results of the bucket-auger excavations, which did not support the previous suggestion of a "village" site. However, as the results of the data recovery presented below will attest, the bucket-augering process provided a firm basis for locating intact deposits and detecting site boundaries, but it has proven to be lacking as a technique for assessing site content. Based on the sparse nature of materials recovered from bucket-auger units, a relatively limited data recovery program was proposed for LAN-193 (Altschul et al. 1999). The Phase 1 data recovery program entailed the excavation of mechanical trenches, EUs, and MSUs and feature recovery.

Mechanical Trenching

The first phase of data recovery at LAN-193 consisted of exploratory mechanical trenching using a standard backhoe fit with a flat blade, the objective of which was to delineate the horizontal and vertical extents of the intact site deposits prior to the formal placement of trenches and EUs. Fifteen "pothole" trenches were excavated to varying depths in the project area. Formal recording of stratigraphic data was not conducted at that time, because the exploratory trenches were used to confirm the locations and depths of intact deposits. That strategy successfully identified and confirmed the presence of cultural deposits found with bucket augers. However, the thickness of the archaeological deposits and fill posed a severe problem. The natural lenses and construction-related fill were so thick that a standard backhoe was unable to expose the deeper cultural deposits. Moreover, the trenches were very deep and contained unstable fill, which prevented safe entrance into the trenches to record the profiles and soil information.

Once it became clear that thick, intact deposits were present at the site, SRI revised the excavation plan for the main exploratory trench. The overburden was not to be removed prior to our excavations, and thus, safety issues necessitated that the main trench be "stepped" to conform to safety provisions. In doing so, a fairly large portion of the site materials had to be stripped and removed to expose the deep-lying archaeological deposits. Trenching, therefore, accomplished the dual role of exposing archaeological deposits and mechanical stripping in a portion of the site (Figure 86).

The initial pothole trenching allowed the archaeologists to detect the eastern and western boundaries of the site, but the crew was unable to work in the southern portion of the site because of constraints from ongoing construction activities. Four EUs were excavated instead, and they served as "control units" for midden-constituent analysis. Because many features were spatially concentrated, they were exposed and left for later excavation. That trenching method facilitated placement of blocks of test pits and identified areas of interest for further investigation. Thus, during Phase 1, the methods involved a combination of hand-excavation of EUs and trenching, as well as mechanical stripping of a portion of the area.

The trenching and stripping process was conducted initially using a backhoe fit with a 3-foot bucket with a flat blade attached. The process involved slowly peeling back soils in small (approximately 5-cm) lifts and closely inspecting for features or major stratigraphic changes. When possible, the main trench was excavated to the bottom of the cultural deposit, but often, features were encountered, and the trench was abandoned. Consequently, the main trench was not excavated as a single trench but, rather, was broken into several smaller units (Figure 87). Nine trenches were excavated with varying lengths and depths. Stratigraphic soil profiles were recorded at locations within the main and ancillary trenches deemed important by SRI's geoarchaeologist. Because of the stepped nature of the trenching program, profiles were recorded

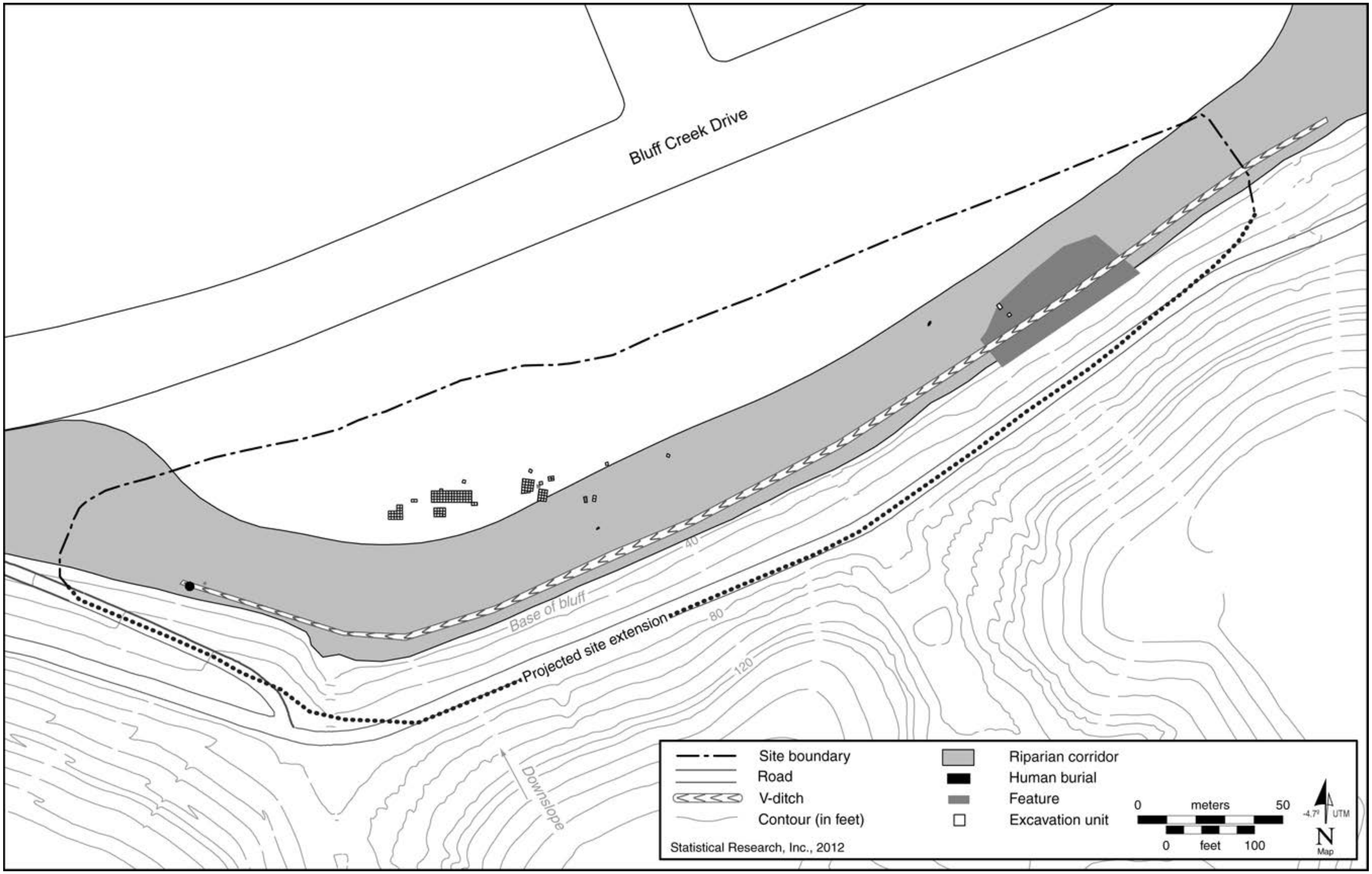

Figure 85. Plan view of hand-excavations and the V-ditch at LAN-193.

Table 17. Summary of Data Recovery Excavations at LAN-193

Phase	Description
First phase	mechanical trenching
	hand-excavation units
	feature excavation
Second phase	mechanical trenching
	mechanical-excavation units
	hand-excavation units
	feature excavation
Third phase	feature excavation

Figure 86. Photograph showing the stepped trenching operation, LAN-193, view to the east.

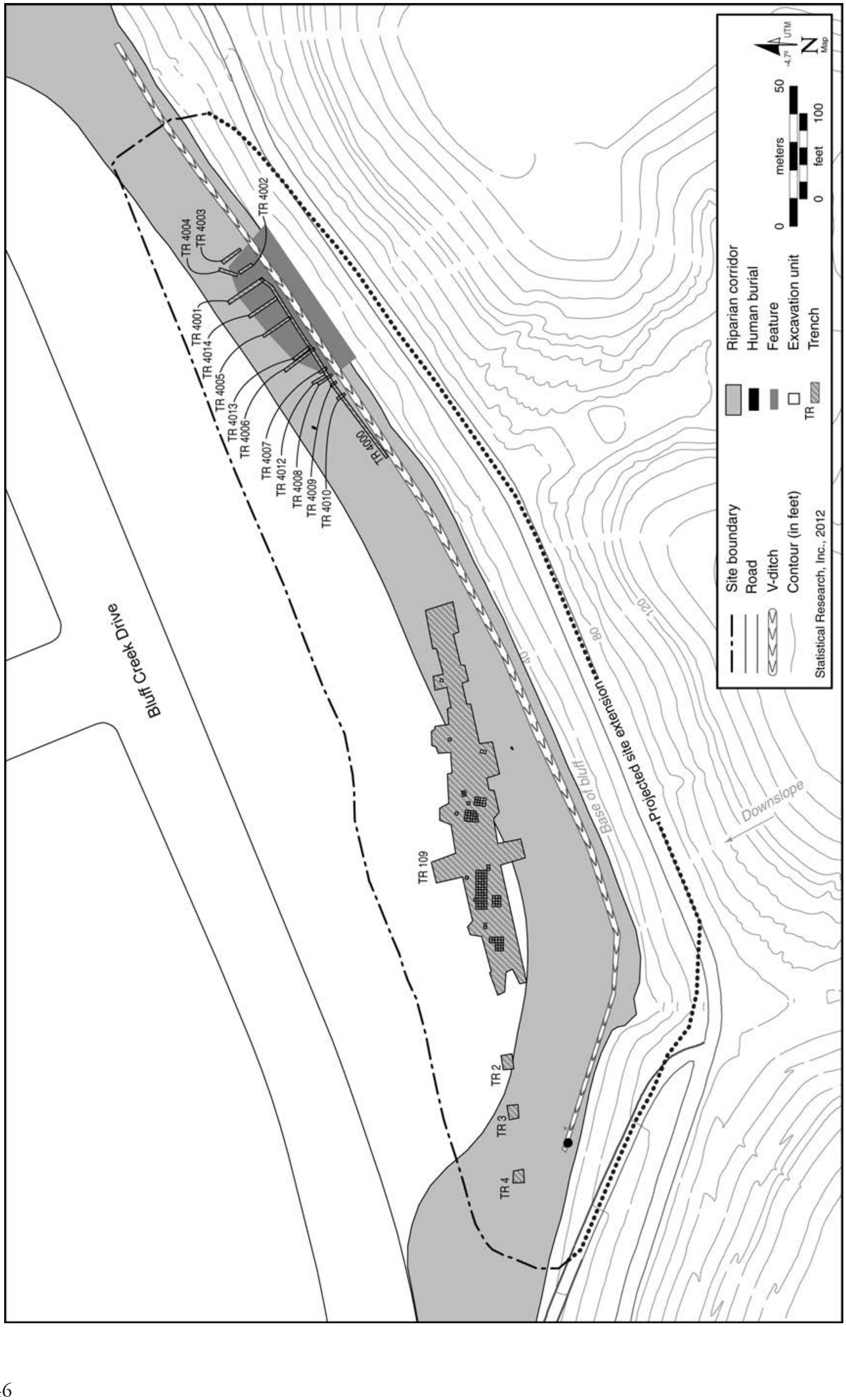

Figure 87. Map of trenches and cleared area during data recovery Phase 1, LAN-193.

in vertical sections along the stepped walls of a particular trench—i.e., two adjacent units for the upper and lower steps of the trench sidewall.

Hand-Excavation

In total, 119 1-by-1-m units were excavated by hand, including 4 CUs for the midden-constituent analysis and 115 EUs that were parts of blocks surrounding features encountered during the trenching/stripping process (Figure 88). The CUs were placed judgmentally to cover the horizontal and vertical extents of the site within the project area. The EUs were placed at roughly 20-m intervals in an east–west line across the excavation area. In addition to CUs, blocks of EUs were situated to expose groups of features thought to be potentially contemporaneous—i.e., "activity areas" (Figure 89). Feature blocks varied in size, depending on the size of each feature concentration. In the absence of obvious house pits or visible compacted surfaces, inspection of spatial patterns of features potentially indicated past activity areas. Stratigraphic relationships among features provided hypothetical ties that could be tested with the collection and analysis of data from those contexts. The excavation of large blocks around individual features and clusters of features allowed for the collection of artifacts and ecofacts that could be used for interpretations of site structure in areas where features were thought to be contemporaneous. The feature recovery strategy is discussed in more detail below.

All 1-by-1-m EUs were excavated in 10-cm arbitrary levels using a combination of shovels, picks, and small hand-tools. Each 10-cm excavation level was assigned a unique PD to identify that unit of space (see Chapter 4, this volume, for explanation of the PD system). All excavated soils were placed in 5-gallon buckets and labeled with PD information. EUs were terminated when sediments determined to be culturally sterile were encountered or when a feature area terminated. CUs were excavated through the entire intact cultural deposit, so that the whole stratigraphic sequence and archaeological deposit was sampled. FBs were terminated at different intervals, depending on the interpretations of field personnel. During excavation, large artifacts or potential feature items were individually mapped and collected. In some EUs, measured soil profiles were drawn, photographed, and recorded from areas determined to be stratigraphically significant by SRI's geoarchaeologist.

MSUs

Mechanical stripping was conducted concurrent with hand-excavation and trenching. During the trenching process, it became apparent that a standard backhoe blade was not large enough to accomplish the goals of both trenching and stripping. So, a tracked excavator fit with a 4-foot flat-bladed bucket was used to complete the trenching/stripping process. The larger excavator had a longer reach and a wider bucket, allowing for larger areas to be exposed in less time. The stripping process involved removing soils in relatively small (approximately 5-cm) lifts to expose features. During that process, fairly large areas were designated for mechanical stripping, and distinct PD numbers were assigned to individual artifacts collected during stripping. When distinct features were discovered, a feature number was assigned, and mechanical excavations halted in the immediate area. Soils from MSUs were not collected or screened.

Feature Recovery

Numerous prehistoric features were encountered during the mechanical-stripping and trenching processes. Discovery of a large number of features was unanticipated, in light of the sparse deposits recovered from the previous bucket-auger units. A revised strategy of feature recovery was thus developed in the field and included two different methods. First, concentrations of features were interpreted as potential activity areas or surfaces, and the strategy was to collect data from discrete feature locations as well as the spaces around the potential activity loci. That strategy was intended to collect information concerning site activities, such as food processing or lithic manufacture, that centered on hearths and other features. Efforts were focused on single occupation surfaces—i.e., concentrations of features (proposed activity areas). That required the placement of large blocks of 1-by-1-m EUs in the areas surrounding the feature concentrations. Four blocks of EUs were excavated in that manner (see Figure 89). Most of the blocks appeared to be in similar strata, suggesting that they may have been contemporaneous. Generally, the blocks were not excavated completely through the cultural deposit to sterile soils.

The second feature-recovery method involved isolated features that were either stratigraphically or spatially distinct from the concentrations excavated in the FBs. Such isolated features were recovered in three ways. First, 1-by-1-m EUs were placed over the locations of a discrete feature, and materials were collected from within the particular feature boundaries as well as in the areas immediately adjacent to them. Second, an isolated feature was exposed, and excavation was limited to the discrete feature boundary. And finally, in some isolated cases, a feature was exposed and described, but no materials were collected.

Data Recovery Phase 2

Phase 2 of the data recovery at LAN-193 involved monitoring of trenching along the southern edge of the site and the subsequent recording and recovery of Feature 600, a large historical-period refuse deposit (Beardsley et al. 2001). The trenching was conducted for a temporary water-control feature known as the "V-ditch" that spanned the length of the

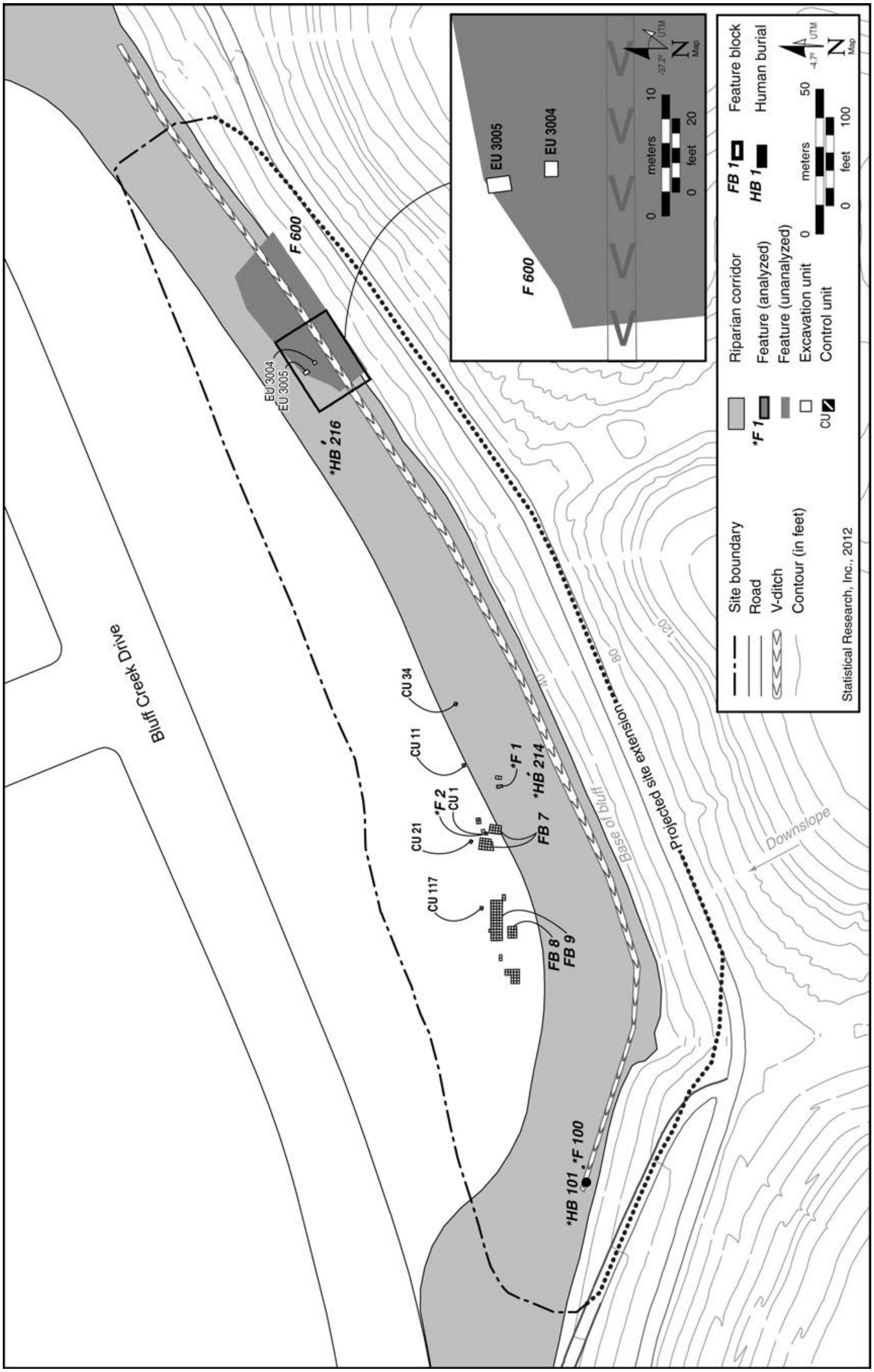

Figure 88. Data recovery EU locations at LAN-193.

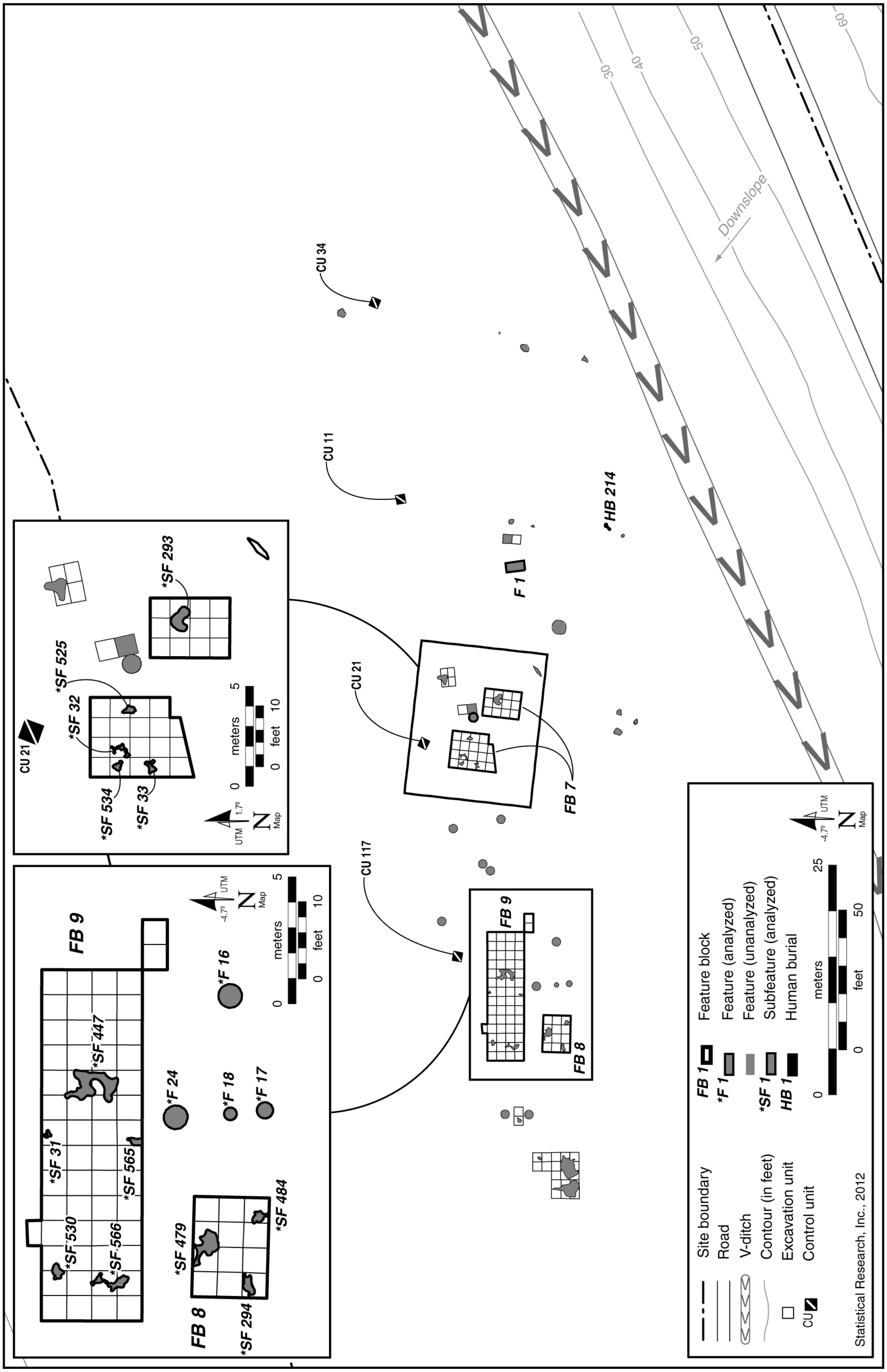

Figure 89. Prehistoric-feature excavations at LAN-193.

LAN-193 boundaries (see Figure 85). The trench was excavated using a backhoe fit with a modified blade. The blade of the backhoe was shaped into a "V," allowing for excavation of the ditch and sidewalls in only a few clean lifts. Consequently, monitoring involved inspection of sidewalls in the ditch after a cut had been made—a marked contrast to the controlled stripping procedures conducted during the first phase of data recovery. Intact prehistoric midden deposits and a large historical-period refuse dump (Feature 600) were identified. While the ditch was open, SRI archaeologists and geoarchaeologists inspected the exposed deposits and mapped the soil profile. Intact deposits were documented in that manner, and a work plan was developed to address Feature 600.

Trenches and mechanical- and hand-excavation units were used to delineate and characterize the Feature 600 refuse deposit (see Figure 88). Excavations took place at the site on two different occasions. The first phase was conducted on June 14, 2001, and included the excavation of 4 backhoe trenches, 3 mechanical-excavation units, and 1 EU. The second phase of work was conducted on February 2, 2005, and included the excavation of 11 additional backhoe trenches and 1 EU. Trenches were excavated using a standard backhoe fit with a flat blade, in small (approximately 5-cm) lifts to expose the historical-period feature. The extent and thickness of the feature was identified and mapped with a total station, so that it could be tied to the overall PVAHP map. Mechanical-excavation units were excavated using the same backhoe that was used for trenching. The mechanical-excavation units measured 3 by 3 feet (approximately 1 by 1 m) and were excavated stratigraphically to recover samples of material from two distinct lenses that appeared to have been divided by a flood deposit or sand layer. Those materials were dry screened and later cleaned for analysis. The EUs measured 1 by 2 m and 1 by 1 m, respectively. Each EU was excavated stratigraphically to recover materials from strata that were thought to be distinct during the excavation process.

Data Recovery Phase 3

The final phase of data recovery involved monitoring of mechanical excavation of the Riparian Corridor and recovery of features identified during that process (Denniston and Douglass 2007a, 2007b) (see Figure 85). This monitoring phase involved close supervision of soil removal by a combination of excavators, scrapers, bulldozers, and other heavy equipment. During the process, archaeologists followed heavy equipment, as soils were removed from within the Riparian Corridor.

Generally, heavy equipment removed soils in small lifts with flat blades, so that clean cuts were made, and archaeological features were clearly visible and only minimally disturbed, if encountered. Archaeologists followed the equipment closely, and when a nonburial feature was discovered, an area surrounding the feature was cordoned off, so that further excavation would be halted until feature recovery was completed. When a burial feature was encountered, a larger area, measuring approximately 10 m around the burial feature, was closed off, to further the heavy-equipment excavation, per the request of the MLD. All features were identified, excavated, and recorded according to previously described SRI standards.

Laboratory Methods

The laboratory methods at LAN-193 followed the methods presented in Chapter 4, this volume; only the exceptions to those methods are discussed here. Sediments from LAN-193 excavations were screened through 1/8-inch-wire-mesh screens using both dry- and wet-screening methods. In some cases, to reduce the number of buckets sent to the water-screening facility, excavated soils were "dry" screened through 1/8-inch-wire-mesh screens near the EU. The remaining soil and artifacts were then sent to the water-screening facility to be cleaned. In other cases, all buckets of excavated soil were sent to the water-screening facility for processing. Materials from all nonburial features and column samples were collected for flotation screening. The soil matrix from EUs was wet screened using 1/8-inch-mesh wire screens. Soils collected from burial features were dry screened through 1/16-inch mesh to avoid destruction of the bone fragments and other materials from exposure to pressurized water.

Sorting Procedures

The sorting procedures varied based on the recovery contexts at LAN-193. EUs, prehistoric features, column samples (flotation), and historical-period features involved different sorting protocols. The bulk materials excavated from the EUs were sifted through a 1-inch screen to segregate fragments of FAR greater than 1 inch in size; smaller FAR fragments were not sorted for additional analysis. All materials were classified according to material class, bagged, and labeled. Collected material classes included FAR (greater than 1 inch in size), historical-period artifacts, lithic artifacts, worked and unworked shell, worked and unworked bone, and a miscellaneous "other" category (see Appendix 6.1, this volume). The "other" category includes a variety of low-frequency materials, such as fired-clay artifacts, seeds, wood, asphaltum, ochre, and others. With the exception of FAR, no material classes were classified according to screen size. Technicians recorded all FAR, historical-period artifacts, lithic artifacts, worked bone, worked shell, and "other" artifacts as counts. Unworked bone and shell were weighed to the nearest gram but not counted. All collected material types were bagged separately and placed on shelves in preparation for the detailed analyses. All remaining rocks, gravels, and FAR fragments smaller than 1 inch in size were rebagged in their original containers and set aside for curation.

Table 18. Contexts Selected for Analysis, LAN-193

Context	Type and Temporal Association	Analysis Done
CU 11	early Intermediate and late Millingstone periods	L, V, IV
CU 21	early Intermediate and late Millingstone periods	L, V, IV, WB
CU 34	early Intermediate and late Millingstone periods	L, V, IV
CU 117	early Intermediate and late Millingstone periods	L, V, IV
FB 7	activity area, Intermediate and Millingstone periods	V, WB
FB 8	activity area, Intermediate period	V, WB
FB 9	activity area, early Intermediate period	L, V, IV, WB, MB, C
Subfeature 31	rock cluster, early Intermediate period	L, V, IV
Subfeature 447	rock cluster, early Intermediate period	L, V, IV
Subfeature 530	rock cluster, early Intermediate period	L, V, IV
Subfeature 565	rock cluster, early Intermediate period	L, V, IV
Subfeature 566	rock cluster	L, V, IV
Feature 1	rock cluster, early Intermediate period	L, V, MB
Feature 2	animal burial, historical period	V
Feature 100	rock cluster, Intermediate period	V, WB
Feature 101	burial, Intermediate period	L, V, WB, MB, OS
Feature 214	burial, Intermediate period	L, V, OS
Feature 216	burial, Intermediate period	L, V, OS
Feature 600	domestic trash dump, historical period	H

Key: C = ceramic artifacts; H = historical-period artifacts; IV = invertebrate-faunal remains; L = lithic artifacts; MB = macrobotanical; OS = osteological (Volume 4, this series); V = vertebrate-faunal remains; WB = worked bone.

A different procedure was used for processing bulk materials from features at LAN-193. The matrix recovered from nonburial features was sorted using a mechanical flotation device; the heavy fraction was sent to the laboratory for sorting and processing. The matrix from burial features was dry screened using 1/16-inch wire mesh and submitted to the laboratory for sorting. The heavy-fraction and wet-screened materials from features were segregated according to material classes but were not size sorted. The material classes segregated included worked and unworked bone, charcoal, historical-period artifacts (diagnostic and nondiagnostic), lithic artifacts, worked and unworked shell (fragment, hinge, and whole), and "other" artifacts and materials (see above). Unworked bone and unworked shell were weighed to the nearest gram, but all other materials were recorded as counts. FAR was not counted or weighed, but its relative abundance was noted in the relational database. All remaining materials, along with the FAR, were rebagged in their original containers and set aside for curation.

Another sorting method was used for processing materials from historical-period features and deposits. All materials were sifted through 1/4-inch-mesh screens, to size sort the materials. The materials collected in the 1/4-inch screen were sorted by material class, including bone, ceramic artifacts, glass fragments, metal, plastic, shell, and "other" miscellaneous artifact and material types. Only diagnostic materials were recorded (as counts) and bagged for subsequent detailed analyses. All nondiagnostic materials were weighed and set aside for curation.

The heavy-fraction materials procured from flotation samples in nonfeature contexts were processed differently. All materials were sifted through a 1/8-inch-mesh screen, and certain material classes were segregated and bagged separately for analysis, including charcoal fragments, historical-period artifacts, lithic artifacts, worked and unworked bone, worked and unworked shell, and "other" materials (see above). Charcoal fragments and unworked shell were weighed to the nearest gram, but all other materials were recorded as counts. The materials smaller than 1/8 inch in size (i.e., not collected in the sorting screen) were unclassified, bagged in bulk, and set aside for curation.

Analysis and Sampling

Four EUs were analyzed as CUs, and 7 features, 3 feature blocks, and 5 subfeatures were selected for detailed artifact and ecofact analyses (Table 18). These proveniences were selected to achieve a representative sample of the range of feature types, temporal contexts, and excavated locations in different areas and contexts at the site. All materials from the historical-period features and nonfeature deposits were subjected to detailed analyses. The four CUs were spaced to provide a sample of materials from all areas of the site (see Figure 88).

The features selected for analysis included three human burials and three nonburial FBs, and the analysis varied by context (see Table 18). The feature blocks were FBs 7, 8, and 9, and each was a large and dispersed activity area that encompassed subfeatures and a large block of EUs. The three burial features were the only human burials excavated at LAN-193. The human remains from burial Feature 101 were analyzed by physical anthropologist Dr. Phillip Walker, and the human remains from burial Features 214 and 216 were analyzed by SRI staff osteologists. The osteological analysis is presented in Volume 4, this series.

Excavation Results

LAN-193 spans approximately 425 m east–west and varies from 60 to 100 m north–south (see Figure 88). The boundary to the south has not been distinguished, but it is probable that the site extends for some distance into the artificial slope on that end. To the north, portions of the site were likely destroyed by the construction of buildings associated with the HHIC. Through the various stages of data recovery, SRI was able to identify a multicomponent archaeological deposit containing a number of prehistoric features and a relatively thick but sparse midden. The results of excavations and the prehistoric activities that characterize the site, as well as the nature and duration of the site's occupation by Native Americans in the prehistoric period, are presented in the discussions below. The detailed results of the various analyses are presented in Volume 3, this series.

Stratigraphy and Chronometric Reconstructions

The site is situated on two alluvial fans that have coalesced at the base of two drainages cut into the bluff. Alluvial fans were used as residential locations by prehistoric populations in the Ballona. The A horizons formed in relatively stable, well-drained areas and, in this case, would have been elevated slightly above the marsh for people to live and conduct various activities. At LAN-193, occupation and use of these areas was evidenced in the presence of prehistoric features on what was likely the lower portion of the fans. The stratigraphic sequence is relatively simple and similar to that of most sites situated along the base of the bluffs. Large soil exposures were documented by geoarchaeologists and are described in detail below.

Natural Stratigraphy

Nine soil profiles were documented at the site: Profiles 1–3 (Trench 1A), Profile 4 (Trench 2), Profiles 5 and 6 (Trench 1), Profiles 7 and 8 (east of the main excavation area, near a temporary drainage feature), and Profile 101 in the western portion of the site (at the western extent of the temporary drainage feature mentioned above). Profiles 1 and 4 were closely examined to reconstruct the depositional history of LAN-193.

Stratum Descriptions

Two representative profiles at LAN-193 are described, including Profile 1 from Trench 1A and Profile 4 from Trench 2. Profile 1 (Trench 1A) was representative of the general site stratigraphy on one of the alluvial fans (Figure 90). Profile 4 (Trench 2) was to the west of Profile 1, a short distance from the base of the bluff, and encompassed a marsh-floodplain facies near the northwestern end of the site (Figure 91). With the exception of deposits exposed in Profile 4, where the alluvial and marsh deposits interface, stratigraphy across the site was relatively consistent.

Profile 1 (Trench 1A) was located in well-drained locations on the alluvial fan and consisted of laminated, sandy alluvium washed out of the two ravines during episodic floods. In general, the pH of fan deposits is neutral to moderately alkaline (pH 6.9–7.9), and organic matter content is very low (1 percent) (see Appendixes 6.2–6.7, this volume). The fan deposits may be divided into numerous subunits, and the presence of a recently buried, weakly developed soil with recognizable A and B horizons facilitated recognition of three major strata.

Stratum I (BA, Bt1, and Bt2/C horizons), the deepest fan deposits exposed during excavation (2.9 m and deeper), consists of brown sand with massive structure and few (<1 percent) subangular gravels. B horizon development in this stratum was indicated by the presence of clay lamellae, suggesting that the soil developed under an extended period of environmental stability. The age of the lamellae is uncertain, but they appeared less well developed than those documented at LAN-62 and LAN-211, suggesting that the fan surface at LAN-193 stabilized at a later time. In all likelihood, the lamellae formed after the Pleistocene, possibly during the early to middle Holocene.

Stratum II is a weakly developed A horizon with dark-gray to dark-grayish-brown soil and massive structure (AC, A1, A2, A3, and AB horizons). The soil's sediment matrix contains loamy sand with few (<1 percent) subangular gravels and slightly elevated pH levels (up to 7.9) and organic content (up to 0.6 percent), relative to the underlying B horizon deposits.

Stratum III overlies the A horizon on the alluvial fans and is composed of laminated deposits that probably represent deposition during the 1938 flood event (C1 and C2 horizons). These brown to dark-yellowish-brown beds of loamy sand have massive structure and neutral to slightly alkaline (7.2) pH levels.

Stratum IV, the uppermost stratum, is composed of construction fill. Earthmoving activities related to construction of the HHIC truncated Stratum III deposits or mixed it with fill materials. Across the site, these materials consist of brown to pale-brown, gravelly, loamy sand.

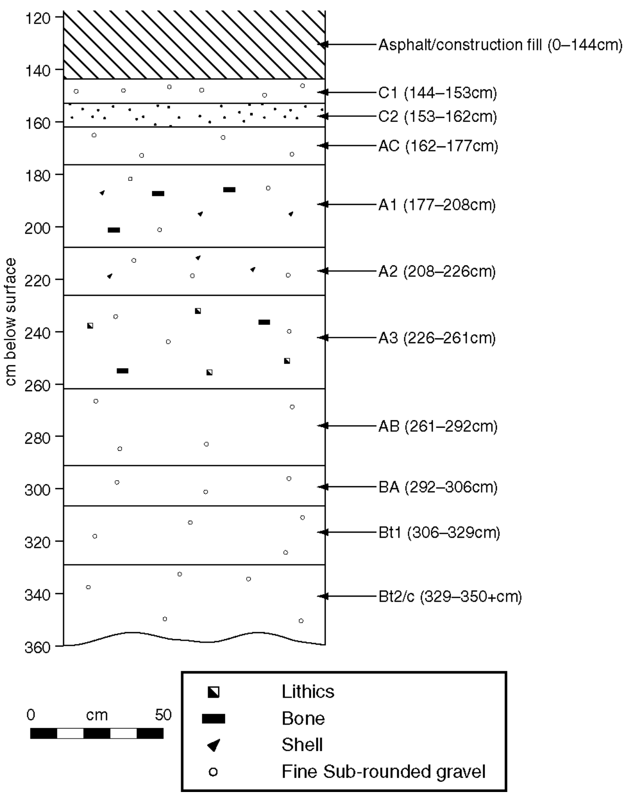

Figure 90. Stratigraphic soil profile for Trench 1A, Profile 1, LAN-193.

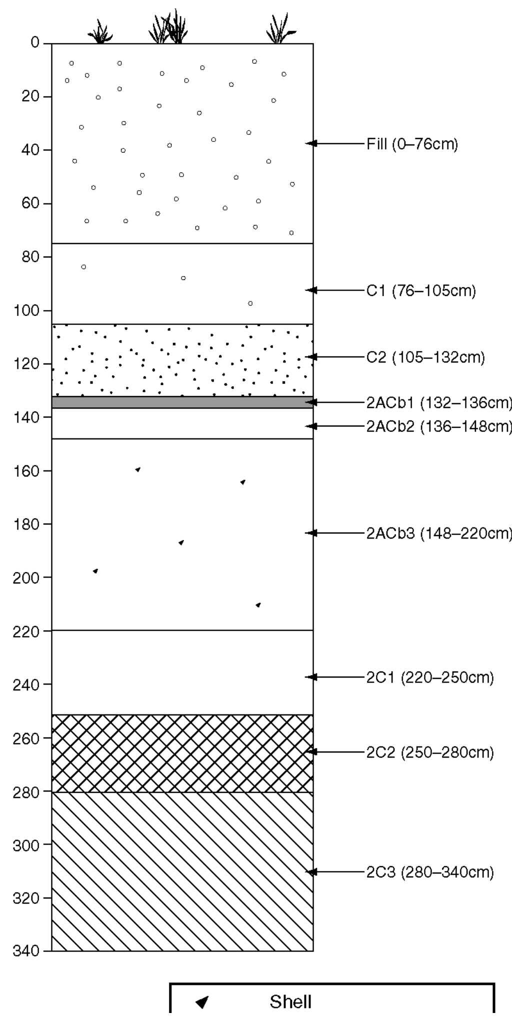

Figure 91. Stratigraphic soil profile for Trench 2, Profile 4, LAN-193.

Table 19. Temporal Designations at LAN-193

Episode No.	Date (Standard ΔR)	Date (Alternate ΔR)	Cultural Period
1	2360–1570 cal B.C.	2450–1500 cal B.C.	late Millingstone
2	570–350 cal B.C.	910–750 cal B.C.	early Intermediate
3	150 cal B.C.–cal A.D. 230	510–130 cal B.C.	middle Intermediate
4	cal A.D. 440–720	cal A.D. 400–670	late Intermediate

Profile 4 (Trench 2) was located in the fan-marsh interface in the western portion of the site and presented a slightly different depositional history than was observed in the alluvial-fan deposits. Three major deposition strata were observed in Profile 4. Stratum I consists of sandy alluvial deposits, suggesting that the fan extended to this area. Stratum II showed evidence of persistent water inundation and probably formed when marshes impinged on the foot of the fan. Stratum III, like Stratum I, consists of sandy alluvium, reflecting renewed growth of the fan; laminations apparent in upper levels of this stratum are potentially associated with the 1938 flood.

Stratum I in Profile 4 (2C1, 2C2, and 2C3 horizons) contains sandy alluvium derived from erosion of the bluff. However, unlike well-drained sediments on the alluvial fan, Stratum I, in the fan-marsh interface, witnessed no B horizon development and instead appeared to be gleyed. Stratum I deposits are dark to very-dark gray in color with higher (7.7–7.9) pH values than those measured in Profile 1.

Stratum II (2ACb3, 2ACb2, and 2ACb1 Horizons) contains an upward-fining sediment sequence that was laid down as backwater marshes increasingly dominated the depositional environment around the margins of the alluvial fans. Sediments in the lowermost subunits (2ACb3 and 2ACb2) consist of very-dark-gray to black, slightly acidic (pH of 6.5), loamy sand with clear, smooth lower boundaries. The uppermost subunit of Stratum II (2ACb1) contains a thin (4-cm-thick), slightly acidic (pH of 6.5), black A horizon with greatly elevated amounts of clay (>20 percent) and organic carbon (>6 percent), compared to the deposits above and below this subunit. Although the smooth boundaries between the lower subunits indicate a gradual increase in available moisture, the lower boundary of subunit 2ACb1 is wavy and abrupt, perhaps signaling a shift in nearby stream channels. That shift in channels resulted in the establishment of relatively stable backwater ponds in the site area that were repeatedly inundated during heavy rains.

Stratum III (C2 and C1 deposits) caps the Stratum II marsh deposits and contains beds of sand that reflect recent growth of the alluvial fan. As in Profile 1, these sediments appeared brown to dark brown in color, have massive structure, and are slightly alkaline (pH of 7.5). The uppermost subunit (C1) contains few laminations and closely resembles deposits in other site areas that were laid down during the 1938 flood event.

In sum, four major depositional strata were observed in the alluvial-fan portion of LAN-193: two episodes of fan deposition and a laminated flood deposit below historical-period/modern fill (see Figure 90). At the bottom of the trench, Stratum I contains clay lamellae (designated a Bt/C horizon) (see the stratigraphic summary for LAN-62 in Chapter 9, this volume, for a discussion of the significance of lamellae as indicators of long-term geomorphic stability). The age of the lamellae is uncertain, but they appeared to be less well developed than those documented at LAN-62 and LAN-211. In all likelihood, the lamellae formed after the Pleistocene, possibly during the early to middle Holocene. Stratum II consists of weakly developed A, AB, and AC horizons that likely formed during the establishment of stable backwater ponds that were repeatedly inundated during heavy rains. Stratum III contains several lamellae that are probably related to the 1938 flood. The lamellae are covered by layers of fill (Stratum IV) related to historical-period and modern earthmoving activities.

Cultural Stratigraphy

To examine the correlation between the depositional history of LAN-193 and the cultural occupation along the base of the bluff in this area, we plotted the elevations of excavated features and cultural materials recovered from the CUs relative to soil/sediment horizons present at the site. The occupation sequence at LAN-193 was inferred from 17 radiocarbon samples recovered from Features 7 and 9, CU 21, and Bucket Auger 539. All 17 of the samples were submitted for AMS analysis (see Appendix 6.8, this volume). The 2 samples from the bucket-auger unit were submitted during testing, to obtain preliminary estimates of the ages of prehistoric deposits; the 9 CU samples were submitted in 2006, to build the chronometric framework for the site; and the 6 feature samples were submitted in 2007, to help tie the features to the site chronology. The 17 samples included 1 piece of artiodactyl long bone from Feature 7 and 16 individual shells from the site (10 clamshells, 1 oyster shell, 1 abalone shell, 2 snail shells, and 2 unidentified shell specimens).

The distribution of cultural materials within natural horizons and their associated radiocarbon dates suggested four prehistoric occupations (Table 19; see Chapter 3, this volume). In addition, two historical-period or historical-period through modern occupations were identified through artifactual, architectural, and/or archival data. Occupation episodes were numbered from 1–6 for LAN-193; Episode 1 represents the oldest occupation. The episodes were defined as follows:

Episode 1: late Millingstone period (2450–1500 cal B.C.)
Episode 2: early Intermediate period (1040–190 cal B.C.)
Episode 3: middle Intermediate period (510 cal B.C.–cal A.D. 230)
Episode 4: late Intermediate period (cal A.D. 400–720)
Episode 5: Euroamerican period (1848–1941)
Episode 6: HHIC (1941–1980s)

The listed date ranges for Episodes 1–4 incorporate the calibrated 2σ ranges derived from both the standard and age-specific ΔR correction values, which were applied to control for the "reservoir effect" in radiocarbon assays derived from shell specimens (see Chapter 3, this volume). The incorporation of both corrections produced larger date ranges than would have been the case with only one algorithm, because the two corrections produce slightly different sigma ranges. Detailed assessment of cultural materials associated with these episodes is presented in Volume 3, this series.

For Episode 5, the date range covers the general time period after California statehood (1848) and prior to the founding of the HHIC around 1941. As discussed in Chapter 6, Volume 3, this series, 14 glass and ceramic beads reported from LAN-193 indicated occupation during the mid- to late 1800s. Two late-historical-period features, a horse inhumation and an extensive trash dump, also likely dated to Episode 5. The date range for Episode 6 covers the period of operation of Hughes Aircraft Company.

Importantly, Episodes 2–4 were combined into a single broader Intermediate period temporal assignment for the analyses of artifacts and ecofacts presented in this and subsequent volumes of this series. One reason for the use of broadly defined period assignments was that, in some cases, the finer episode distinctions resulted in reduced sample sizes that rendered the samples impractical for artifact and ecofact analyses. In addition, the resolution of the radiocarbon dates was not always sufficient to support the detailed episode distinctions. In the case of LAN-193, six features (Features 1, 7, 9, 101, 214, and 216) were assigned to the broadly defined Intermediate period, but period assignments were not inferred for additional features.

Episode and Period Descriptions

Episode 1 is located in the sands associated with Stratum I, near the contact with Stratum II. This loosely defined period was indicated by a moon-snail-shell sample dated from FB 7 and an abalone-shell sample recovered from CU 21, Level 15 (also in FB 7). The radiocarbon determinations obtained from those two samples were separated by 330 radiocarbon years and were statistically different from each other, although it is possible that the observed age difference is attributable to species-specific differences in carbon content. Both species can be found in intertidal and subtidal areas, and work by researchers in New Zealand (Hogg et al. 1998) found statistical differences in the carbon content of contemporaneous specimens recovered from each of those environments. However, it is possible, as well, that the moon snail shell did not, in fact, reflect subsistence activities and was simply picked up off the beach at some point after death or entered the feature matrix as a result of vertical mixing of cultural materials. The most plausible explanation for the disparity in the ages of the samples from FB 7 relates to their possible displacement within the midden.

The age range for this period is 2360–1570 cal B.C. (standard ΔR) and 2450–1500 cal B.C. (age-specific ΔR), suggesting a pooled age range of 2450–1500 cal B.C. for Episode 1 (late Millingstone period). It is separated from Episode 2 by at least 1,090–1,480 (standard ΔR) or 660–1,160 (age-specific ΔR) years. Without additional information, it seems best to assign the two samples to sporadic, low-level human occupation and land use during the late Millingstone period.

Episode 2 is associated with the sandy-loam horizon in the lower levels of the A horizon. The radiocarbon samples assigned to this episode derived from two venus-clamshell samples recovered from Feature 9, a large activity area. The two radiocarbon assays indicated a combined sigma range of 570–350 cal B.C. (standard ΔR) and 910–750 cal B.C. (age-specific ΔR). Incidentally, when the individual sample dates were used, rather than the combined date, the age range for the feature and the episode expanded to 730–190 cal B.C. and 1040–570 cal B.C., respectively, suggesting a pooled date range of 1040–190 cal B.C. (early Intermediate period). It was estimated that the feature predated activities associated with Episode 3 by no more than 310 years, when the standard ΔR was used, or by 280–560 years, when the age-specific ΔR was applied.

Episode 3 is also located in the loamy sands associated with the thick A horizon. This episode was inferred from three samples recovered from CU 21 and the paired oyster-/frog-snail-shell samples collected from FB 7. As with Episode 4, the radiocarbon determinations obtained from the samples spanned 40 radiocarbon years and formed a temporally cohesive group ($df = 4$; $T' = 0.291$; $T'_{0.05} = 9.488$; A = 177.5 percent; An = 31.6 percent) that is at least 320 radiocarbon years younger than the next-oldest set of dates. The age ranges for Episode 3 were 150 cal B.C.–cal A.D. 230 (standard ΔR) and 510–130 cal B.C. (age-specific ΔR), suggesting a pooled date range of 510 cal B.C.–cal A.D. 230 (middle Intermediate period). The interval separating this episode from Episode 4 was estimated to be roughly 220–510 years when the standard reservoir correction was applied and 530–800 years when the age-specific reservoir corrections were applied.

Episode 4, the youngest prehistoric episode, is generally located in the upper portion of the thick A horizon and was inferred based on assays from clamshell specimens from five different levels in CU 21. Those five samples produced a very cohesive set of radiocarbon determinations ($df = 4$; $T' = 0.224$; $T'_{0.05} = 9.488$; A = 156.7 percent; An = 31.6 percent) with a span of only 40 radiocarbon years and are separated from Episode 3 by 450 radiocarbon years, which supports the assertion that the groups reflected different episodes in the site's history.

Note that the dates derived from the bucket-auger samples fell between these two episodes and potentially reflected a separate occupation episode at the site. The determinations from those two samples were statistically indistinct from each other, and each passed a χ^2 test with the samples from at least one of the two episodes; however, they both failed OxCal's Combine tests, making it difficult to confidently ascertain their temporal relationship to the other samples. Moreover, the ambiguous recovery context for the samples complicated their stratigraphic association, and therefore, we excluded them from further analyses. In addition, although it is possible that they reflected a different period of site activity than did the other dated samples, there is no way to link them to the material culture recovered from the site. With the exclusion of the bucket-auger samples, the age for Episode 4 ranged between cal A.D. 440–720 (standard ΔR) and cal A.D. 400–670 (age-specific ΔR), suggesting a pooled date range of cal A.D. 400–720 (late Intermediate period).

Episode 5, the most recent occupation episode, is associated with human land use during the Euroamerican period, which we identified based on the presence of a horse-inhumation feature, a large trash dump, and other late-historical-period artifacts scattered throughout the site. Among the scattered artifacts were 14 glass and ceramic beads (from MSUs) with color, shape, and technological attributes that indicated a mid- or late-nineteenth-century occupation. Although several beads indicated a possible Rancho period (1830–1848) occupation, the majority postdated the Rancho period (see Chapter 6, Volume 3, this series). Notable in that regard was the presence of four Prosser molded-ceramic beads, which postdate 1840, when the molding process was patented in Europe, but probably were not present in western North America before the mid- to late 1840s. Moreover, Prosser beads were not present among the Rancho period collection from LAN-2768. Thus, the beads from LAN-193 probably indicated an early Euroamerican period occupation rather than a Rancho period occupation.

Other Euroamerican period materials were the remnants of relatively modern use of the site area in the early twentieth century for farming, ranching, and especially industrial activities. Historical maps and photographs identified early-twentieth-century occupation of the site by ranchers, and the development of the HHIC can be traced through historical aerial photographs. Also, large refuse dumps likely related to the use of the site in the 1910s and 1920s as a hog farm. A veneer (sometimes very thick) of modern fill containing artifacts of various materials and functions was also identified and covered most of the intact deposits at the site. Much of that material had been highly disturbed and appeared to have been moved around and reworked as fill for many years. Excavations of the refuse-deposit feature uncovered a large number of artifacts, a portion of which were analyzed and are reported in Volume 3, this series.

Episode 6 relates to use of the area by the Hughes Aircraft Company in the mid-1900s. Just north of the intact portion of the prehistoric component of the site lies the heart of the HHIC. A large number of buildings—including offices, hangars, and various other outbuildings and infrastructure—likely disturbed large portions of the intact prehistoric and historical-period site materials. Most of LAN-193 was covered with asphalt and used as a roadway (Hughes Way) or parking area. As noted above, construction and earthmoving activities by the Hughes Aircraft Company created many disturbances to the site and had much to do with the movement of fill. The company leveled much of the area for construction by removing any rills, berms, or raised areas within the site area and thereby destroying or truncating archaeological deposits throughout the area of the complex.

Summary

Most of the sediment at LAN-193 is composed of alluvial-fan deposits formed from erosion of the sand dunes on top of the adjacent bluff during heavy rainfall. In most areas of the site, the lowest level (Stratum I) is composed of a stable alluvial fan that likely formed during the middle to late Holocene. Above those deposits is a weakly developed A horizon (Stratum II), from which most of the archaeological deposits at the site were recovered. The upper strata (Strata III and IV) are modern deposits related to late-historical-period and modern flooding events (especially the 1938 flood) and construction activities conducted in the mid-1900s by the Hughes Aircraft Company. In the western portion of the site, Stratum II evidences an upward-fining sediment sequence likely resulting from inundation and marsh development. The presence of the marsh at the western edge of the site may have been an important impetus for occupation of the area near the end of the Millingstone period and throughout the Intermediate period.

Generally, the site displayed good stratigraphic integrity, and the soil profile was relatively consistent throughout the site and in other locations along the base of the Ballona escarpment. There was clear evidence of construction activities related to the HHIC facilities, especially in the presence of fill materials containing construction debris and in the fact that intact, natural flood deposits appeared truncated. A horizon soils identical to those containing cultural materials were also identified as redeposited lenses within those fill deposits, further indicating disturbance. Bioturbation was noted in all intact soil strata, and it is clear that cultural materials have migrated downward and likely upward as a result of that activity.

Six distinct occupation episodes were inferred, based on radiocarbon dates and time-sensitive materials. Episode 1 was indicated for the site by two marine snail shells recovered from FB 7 and CU 21 and suggested likely infrequent and low-intensity occupation during the late Millingstone period (ca. 3000–1000 B.C.). A larger number of feature and CU levels were assigned to Episodes 2, 3, and 4 that corresponded to the early, middle, and late Intermediate period (ca. 1000 B.C.–A.D. 1000). Those results thus conformed to radiocarbon results from several neighboring sites in the Ballona and suggested that the peak period of prehistoric occupation occurred during the Intermediate period. It is possible that evidence of later-prehistoric- or early-historical-period occupations was removed and obliterated during construction events in the mid-1900s. Episode 5 is associated with agricultural, domestic, and industrial land use in the Ballona during the Euroamerican period. The final occupation, Episode 6, encompasses the era of the Hughes Aircraft Company in the mid- to late 1900s.

Site Integrity/ Disturbance

Higher portions of the alluvial fans described above may have been occupied, as were lower portions, but they appear to have been truncated by twentieth-century ranching and construction activities. The presence of redeposited A horizon soils containing cultural materials in their fill pointed to the possibility that the upper portions of those fans had been cut and reused. A horizon soils containing cultural materials appeared to thicken with proximity to the bluff edge and basically disappeared to the north, where construction and buildings likely removed them altogether. During various phases of monitoring of the demolition of some of the buildings, prehistoric artifacts were recovered from disturbed fill deposits in and around the buildings.

Early photographs showed a large hog farm located within the boundaries of LAN-193 (see Figure 84). A very large (approximately 60-by-20-m) refuse pit likely associated with the farm was identified near the eastern boundary of the site. That refuse pit clearly cut into prehistoric materials and may have destroyed features. During trenching, several areas were identified that appeared to be later-twentieth-century refuse deposits, possibly related to HHIC activities. Overall, despite the numerous intrusions into the area from twentieth-century activities, the site appeared to retain much of its stratigraphic integrity. It is unclear how much of the site was removed, although it is likely that a fair amount of damage occurred from ranching and construction activity.

Midden-Constituent Analyses

Four 1-by-1-m EUs were selected as CUs for midden-constituent analysis (see Figure 88). Data from these CUs were used to compare the character of middens at various locations within the site, including the extent and nature of occupation episodes. The midden represents the habitation debris, including food remains and the refuse of daily life, of populations who inhabited the site. Of course, postdepositional disturbances, such as bioturbation, farming, and modern construction activities, have obscured and altered the archaeological deposits. The number of levels assigned to each episode varied slightly among the four CUs. Levels assigned to Episodes 1, 2, and 3 were present in CUs 11, 34, and 117, but Episode 4 was absent; Episode 4 was only present in CU 21 (along with Episodes 1 and 3). Episode 5 was not included in this analysis.

The four CUs were located within the central portion of the site, where the data recovery efforts were concentrated. The units were situated along an east–west alignment at roughly 20–25-m intervals (see Figure 88). CUs 11 and 34, in the eastern half of the alignment, were not in proximity to features, except for a single isolated FAR scatter a few meters north of CU 34 (Feature 210). In contrast, CUs 21 and 117 were situated within an area with dense features, including two large activity areas: Features 7 (CU 21) and 9 (CU 117).

Spatial variability in artifact/ecofact densities among the four CUs is discussed below, including differences in densities of particular material classes. Subsequently, temporal variability and trends in the density data are presented.

Spatial Patterning

The highest artifact/ecofact densities were recovered in CUs 11 and 21 (Table 20; see Appendix 6.9, this volume). The high density in CU 11 was surprising, because it was not located close to any features or activity areas, and the nearest feature was about 12 m to the southwest. It is unusual for the highest-density midden remains to be located some distance from the nearest loci of human activities. We suspect that the areas with high-density midden remains were "toss zones" for the nearby activity areas with concentrations of features; debris generated from food preparation and toolmaking may have been discarded away from the activity areas, and surface debris was probably regularly cleaned out and removed from those areas. The results from CU 117support this hypothesis. CU 117 was situated near a large activity area (Feature 9) and indeed included low-density midden remains. The site occupants may have frequently swept and cleaned the area, thus leaving low-density refuse deposits.

The results of CU 21 did not follow this behavioral model. CU 21 was located close to another large activity area (FB 7), and if the areas around the activity areas had been regularly cleaned, we would expect both CUs 21 and 117 to have contained relatively low artifact/ecofact densities. When the entirety of CU 21 was considered, it did not support the hypothesis. However, it appeared that the bulk of the midden accumulation in the vicinity of CU 21 occurred after the abandonment of the nearby activity area. The midden

Table 20. Artifact/Ecofact Density per Occupation Episode and Cultural Period in Four CUs, LAN-193

Level Nos., by CU No. (1 by 1 m)	Natural Stratum	Episode No.	Cultural Period	Volume (m^3)	Lithic Artifacts				Vertebrate Fauna		Invertebrate Fauna	
					Flaked Stone Count (n)	Flaked Stone Density (n/m^3)	Ground Stone Count (n)	Ground Stone Density (n/m^3)	NISP	Density NISP/m^3	Weight (g)	Density g/m^3
CU 11[a]												
2–11	A	3	early Intermediate	1.0	500	500.0	—	—	4,427	4,427.0	0.1	0.1
12–15	A	2	early Intermediate	0.4	138	345.0	—	—	1,519	3,797.5	5.4	13.5
16–20	AB/Bt/C	1	late Millingstone	0.5	129	258.0	—	—	695	1,390.0	—	—
Subtotal				1.9	767	403.7	—	—	6,641	3,495.3	5.5	2.9
CU 21[b]												
4–10	A	4	Intermediate	0.7	634	905.7	1	1.4	2,278	3,254.3	25.8	36.9
11–13	A	3	early Intermediate	0.3	238	793.3	—	—	1,005	3,350.0	41.6	138.7
14–18	AB/Bt/C	1	late Millingstone	0.5	354	708.0	—	—	1,153	2,306.0	23.9	47.8
Subtotal				1.5	1,226	817.3	1	0.7	4,436	2,957.3	91.3	60.9
CU 34[c]												
3–7	A	3	early Intermediate	0.5	125	250.0	1	2.0	236	472.0	—	—
8–11	A	2	early Intermediate	0.4	81	202.5	—	—	395	987.5	0.1	0.3
12–14	AB/Bt/C	1	late Millingstone	0.3	41	136.7	—	—	106	353.3	—	—
Subtotal				1.2	247	205.8	1	0.8	737	614.2	0.1	0.1
CU 117[d]												
3–5	A	3	early Intermediate	0.32	217	678.1	—	—	747	2,334.4	—	—
6–8	A	2	early Intermediate	0.30	189	630.0	—	—	688	2,293.3	—	—
9–11	AB/Bt/C	1	late Millingstone	0.30	79	263.3	—	—	259	863.3	—	—
Subtotal				0.92	485	527.2	—	—	1,694	1,841.3	—	—

Key: NISP = number of identified specimens.
[a]Level 1 of CU 11 consisted of fill associated with Episode 5.
[b]Level 1 of CU 21 consisted of fill, and Levels 2 and 3 consisted of mixed A horizon soil; all three levels were associated with Episode 5.
[c]Level 1 of CU 34 consisted of fill associated with Episode 5; Level 2 consisted of mixed A horizon soil that could not be associated with a particular episode.
[d]Levels 1 and 2 of CU 117 consisted of fill associated with Episode 5.

densities in CU 21 peaked in the levels assigned to Episode 4 (late Intermediate period), which appeared to postdate the nearby activity area (FB 7). Two radiocarbon assays from FB 7 suggested a period of use during the late Millingstone or middle Intermediate period (Episodes 1 and 3). The areas around CU 21 may have been frequently swept and cleaned of debris in Episode 1 or 3, during the period of use for the adjacent activity area.

The low artifact/ecofact density in CU 34 most likely reflected its distance from the dense cluster of features and activity areas located roughly 50 m to the west. That location was probably infrequently used for prehistoric activities, resulting in low levels of artifact/ecofact accumulation.

The composition of midden remains among the four CUs was relatively consistent (see Table 20). Faunal bone composed 75–90 percent in each CU, and shell remains were absent or sparse (0–1.6 percent). Flaked stone artifacts composed about 10–25 percent. One minor variation concerned CU 11, which contained a lower percentage of flaked stone (11 percent) than the other three CUs (21–15 percent) and a higher percentage of faunal bone (90 percent) than the others (75–78 percent). One explanation is that defleshing and deboning occurred farther away from the activity areas, which included features indicative of cooking and heating. CU 11 could mark the location of a task-specific activity area that was related to processing hunted meat but generated few or no features.

The dearth of shell remains at LAN-193 is typical of the sites located along the bluff edge in the central portion of the PVAHP project area (see Altschul et al. 2003). Shell densities tended to be higher in Locus A of LAN-62 and in Locus A of LAN-2768, located at the western and eastern edges of the escarpment within the project area. However, shell densities were very low in the "central" bluff-edge midden deposits: LAN-193, LAN-211, and Loci C and D of LAN-62. Those areas may have been farther removed from the lagoon shoreline during the peak era of prehistoric human occupation during the late Millingstone and Intermediate periods. Presumably, processing of shellfish would have occurred close to the acquisition location—i.e., nearer to the shoreline of the lagoon.

Temporal Patterning

Table 20 presents the densities of lithic artifacts (flaked stone and ground stone), vertebrate-faunal remains, and invertebrate-faunal remains in the four CUs, by episode (the breakdown by level in each CU is presented in Appendix 6.9, this volume). Figures 92–95 illustrate the differences in artifact/ecofact densities, by level and episode, for each of the four CUs; these illustrations provide grounds for inferring changes in occupation intensity, assuming a correlation between the artifact/ecofact densities and land use and occupation. The density of invertebrate fauna is not shown for CUs 34 and 177, because it was very low in those CUs. We do illustrate the invertebrate density for CUs 11 and 21, because they were slightly higher, but nevertheless concentrate mainly on the more-robust flaked stone and faunal-bone data in inferring temporal variation.

The densities per episode differed among the CUs, suggesting possible variability in episodes of peak occupation intensity in different areas of the site. The pattern in CU 11 suggested peak occupation during Episode 3 (see Figure 92); in CU 21, the peak occupation intensity was during Episode 4 and, to a lesser extent, during Episode 3 (see Figure 93); and in CU s34 and 117, there were peaks during Episode 3 (see Figures 94 and 95). Overall, the peak or most-intensive occupation occurred during Episodes 3 and 4 (middle and late Intermediate periods) with less-intensive and, perhaps, more-sporadic occupations during Episodes 1 and 2 (late Millingstone and early Intermediate periods). Note that Figures 92–95 illustrate variation in density per level at LAN-193, but they do not reveal any well-defined trends or patterning in the data.

Summary

The midden-constituent analyses indicated spatial and diachronic variation in artifact/ecofact densities. Midden composition was relatively consistent among the four CUs, but artifact/ecofact densities tended to be higher in CU 11, located away from the features and activity areas, and in CU 21, located closer to the features and activity areas. The high density in CU 11 was attributed to dumping of subsistence-related debris in areas several meters away from high-use activity areas. In CU 21, the dense midden remains probably accumulated subsequent to the abandonment of the activity area (FB 7). Another spatial pattern concerns the very low density of invertebrate-faunal remains among the CUs at LAN-193, which was consistent with the results of midden analyses in adjacent loci investigated along the Ballona escarpment in the central portion of the PVAHP project area.

Temporal trends in the midden remains suggested a relatively low-intensity occupation during the late Millingstone period (Episode 1) and early Intermediate period (Episode 2) and more-intense occupation during the later Intermediate period (Episodes 3–4). The trends in densities per level were ambiguous. In a deposit in which there has been less bioturbation, the subepisode occupation surfaces may be identified by drastic differences in the densities of cultural materials throughout excavation levels. Some peaks were evident among the levels assigned to a single episode for some CUs, but we were unable to detect well-defined peaks suggestive of subepisode occupation surfaces. The fact that this area was likely fairly active, in terms of bioturbation, as well as the large amount of sediment accumulation in the area may have had a bearing on the density of cultural materials seen within and between arbitrary excavation levels.

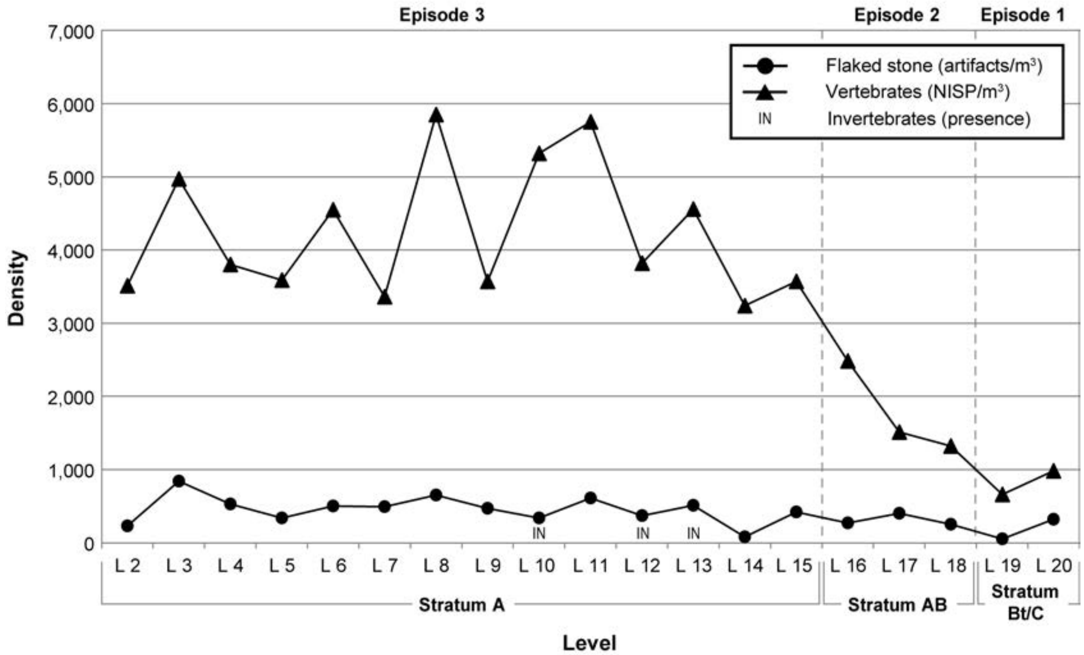

Figure 92. Artifact/ecofact density per level and episode, CU 11, LAN-193.

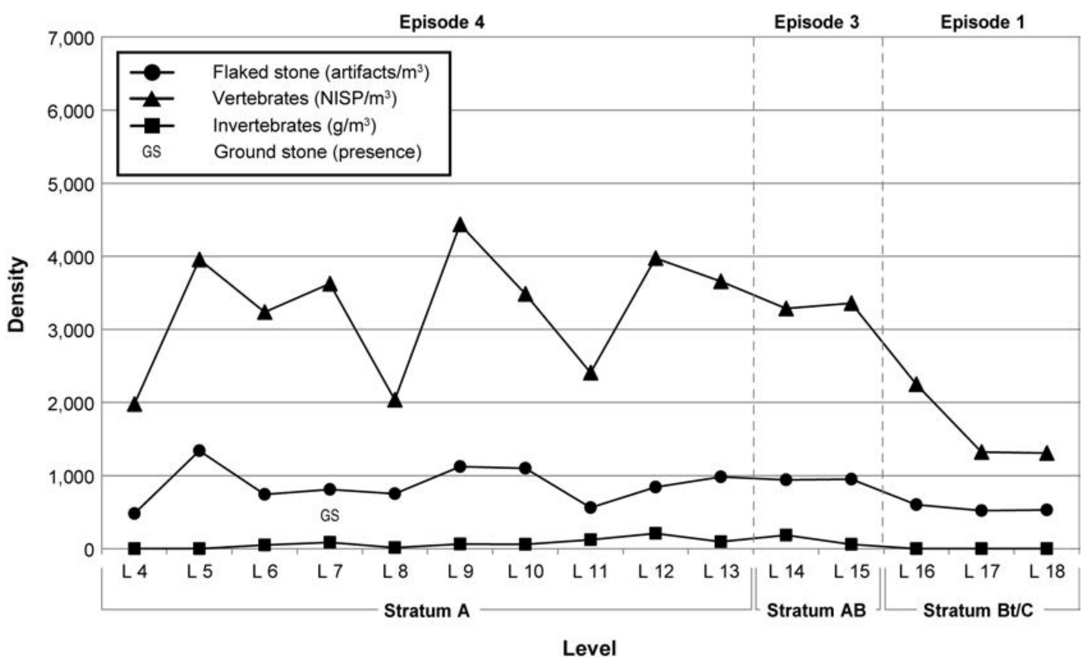

Figure 93. Artifact/ecofact density per level and episode, CU 21, LAN-193.

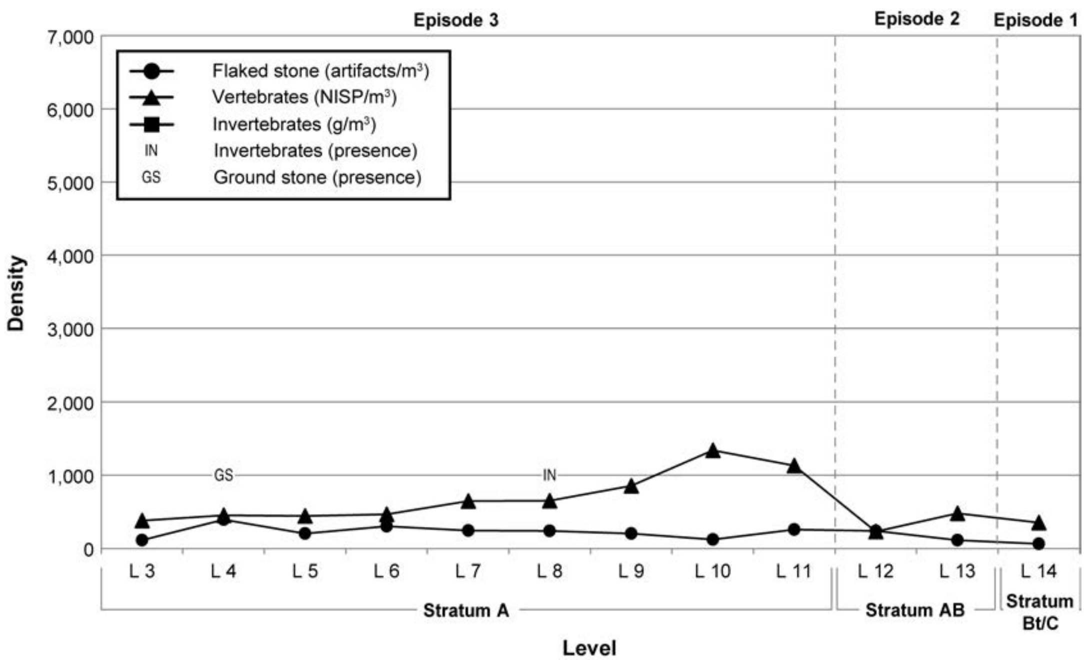

Figure 94. Artifact/ecofact density per level and episode, CU 34, LAN-193.

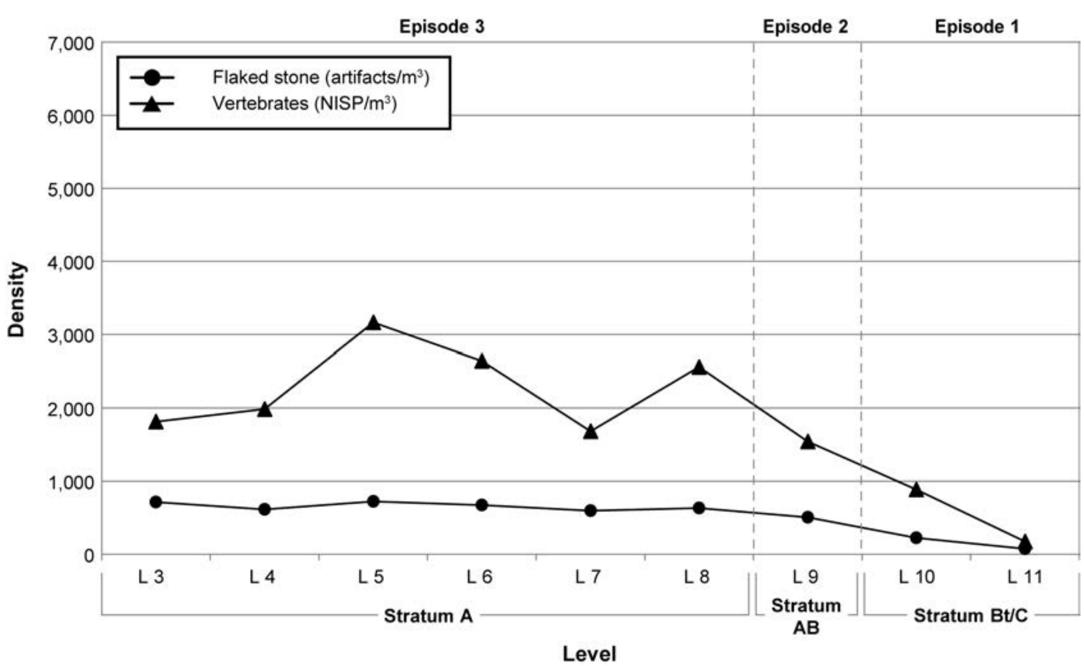

Figure 95. Artifact/ecofact density per level and episode, CU 117, LAN-193.

Nonburial-Feature Analysis

In total, 55 features were excavated at LAN-193 (see Appendix 6.10, this volume, for brief descriptions, classifications, and temporal associations). Figure 89 shows the locations of excavated features within the loci of investigation at LAN-193. The majority of features (47 of 55, or 85 percent) were located in a dense cluster in the western portion of the site. The cluster lies on the western slope of a former alluvial fan and drainage. The large fans emanating from the escarpment clearly were preferred locations for the establishment of temporary camps and resource-processing loci among the prehistoric and Protohistoric period inhabitants of the lowland Ballona. Another cluster of features was evident on the eastern edge of the former fan, in Loci C and D of neighboring LAN-2768. By contrast, only 4 features were exposed in the eastern portion of LAN-193, despite mechanical testing and subsurface exposure during construction of the Riparian Corridor.

Only three prehistoric features were recorded during monitoring near the northeastern edge of the site. The small number of features in that area is surprising, given that it is on a former alluvial fan and on the opposite side of a drainage (that cut through the fan) from the aforementioned cluster of features exposed during data recovery in the western portion of LAN-193. Additional features and archaeological deposits may have been present in the eastern portion of LAN-193 at one time but were likely removed or severely truncated during construction activities by Hughes Aircraft Company in the mid-1900s.

Relatively few features were recorded in the central portion of the site, despite subsurface exposure during construction of the Riparian Corridor in 2005 (Denniston and Douglass 2007a, 2007b). Some deeply buried features may be present below the base of the Riparian Corridor, but it is also possible that any features or cultural deposits in that area were removed by downcutting of former drainages on the relict alluvial fan. The presence of a drainage might have also prohibited prehistoric settlement or temporary encampments in that location. Of the 55 features excavated, 5 were selected for analysis, and the results are presented in Volume 3, this series.

Feature Classification and Interpretation

The feature typology developed for the PVAHP and discussed in Chapter 5, this volume, was applied to the features at LAN-193. Feature classification involved several levels or "domains." At a broad level, features were classified broadly as burial/ritual, domestic, or late-historical-period/modern (post-1850) features (Table 21). The overwhelming majority at LAN-193 (53 of 55 features, or 96 percent) were prehistoric in age, mostly dating to the late Millingstone and Intermediate periods. Most of them (49 of 53, or 92 percent) were classified as domestic deposits (or composite features with domestic subfeature components). Also identified were four prehistoric burial/ritual features (three human inhumations and one probable ritual deposit) and two late-historical-period/modern features (discussed in the following section).

Features also were classified as either thermal or nonthermal, based on the presence/absence of evidence of in situ thermal activity (oxidized soil) or the prevalence of thermally altered materials (e.g., FAR or burned faunal bone). For example, a feature composed predominantly of FAR was classified as a thermal feature, even in the absence of evidence of in situ thermal activity. However, many features included mostly unburned, discarded materials, such as flaked stone and shell, and smaller amounts of FAR and burned bone, and those features were classified as nonthermal, based on the prevalence of the nonthermally altered materials. Slightly more than three-quarters of features at LAN-193 were classified as thermal (42 of 55, or 76 percent); nonthermal features accounted for about 24 percent (13 of 55). All of the burial/ritual (n = 4) and late-historical-period/modern (n = 2) features were classified as nonthermal deposits. By contrast, among the domestic features, about 86 percent (42 of 49) were classified as thermal deposits. Domestic features included three large activity areas (Features 7–9) that encompassed several subfeatures; however, the subfeatures in the three activity areas were all thermal deposits.

At a more detailed level, features were classified into the more-specific formal categories discussed in Chapter 5, this volume, based on morphology (vertical and horizontal) and

Table 21. Summary of Feature Classifications at LAN-193

Morphology/Composition	Count	Percentage of Total
Domestic features		
General/multiple artifact concentration, no pit	2	3.6
FAR concentration, in pit	4	7.3
FAR concentration, no pit	22	40.0
FAR scatter	9	16.4
Lithic/ground stone concentration, no pit	7	12.7
Lithic/ground stone scatter	2	3.6
Activity area (thermal)	3	5.5
Subtotal	49	89.1
Burial/ritual features		
Human burial	3	5.5
Ritual offering, no burning	1	1.8
Subtotal	4	7.3
Late-historical-period/modern features		
Animal burial	1	1.8
Trash dump	1	1.8
Subtotal	2	3.6
Total	55	100.0

content. As shown in Table 21, most excavated features were thermal deposits mainly composed of FAR (63 percent), including 26 FAR concentrations (47 percent) and 9 less-discrete FAR scatters (16 percent). FAR concentrations and scatters constituted 71 percent of the domestic features. The 4 FAR concentrations in pits were interpreted as probable hearths, although no ash or oxidized soil was observed; to be sure, however, we cannot rule out the possibility that they were nonthermal domestic pits into which FAR fragments had been discarded. The FAR concentrations without pits, which constituted the majority of domestic features, probably indicated hearth-cleanout deposits, although we cannot rule out the possibility of hearths in which pit outlines were no longer visible (e.g., as a result of soil disturbance and bioturbation). Several of these features contained nonthermal materials, such as flaked stone (e.g., Feature 1), which suggests mixed discard areas with thermal and nonthermal refuse.

The FAR scatters likely marked locations of hearth-cleanout residue and deposits. Many of those deposits also contained a mix of thermal and nonthermal refuse. For the most part, those features were not located adjacent to probable hearths, which, on the surface, may seem to undermine our interpretation. However, it is possible that FAR from hearths, along with other debris, was discarded in toss zones along the edges of camping and activity areas, where the hearths probably would have been located. Also classified as thermal features were the three large activity areas (FBs 7–9), each of which contained between three and five subfeatures, all with thermal characteristics.

The nonthermal features excavated at LAN-193 were morphologically and compositionally variable. Most were classified as lithic/ground stone concentrations (n = 7) or scatters (n = 2), which together composed 16 percent of all features and 19 percent of domestic features. Although grouped in the same general category, the nine lithic/ground stone features were compositionally different. Three deposits (Features 31, 32, and 33) were irregularly shaped concentrations of FAR and ground stone fragments, two of which were located adjacent to one another (Features 32 and 33, both subfeatures of Feature 7). Those deposits were functionally ambiguous and may simply have been hearth-cleanout deposits mixed with a small amount of nonthermal ground stone refuse, but their consistency in composition and shape (irregular) may suggest a specific, yet-unknown function. Two other lithic/ground stone features (Features 22 and 23) also contained a mix of FAR and ground stone pieces within irregularly shaped areas, but the latter deposits were more scattered than the former deposits and covered a larger area. Notably, Features 22 and 23 were located adjacent to one another, but their function was also uncertain.

Two nonthermal lithic/ground stone concentrations (Features 21 and 24) were interpreted as possible cairns or post-hole supports. Feature 21 contained a mix of ground stone fragments and unmodified cobbles within a small area of ca. 50 by 40 cm; Feature 24 contained a small concentration of unmodified cobbles covering a very small area of 15 by 10 cm. Such small, tight concentrations of cobbles or ground stone pieces could have functioned as supports for wooden posts or structures (see Ciolek-Torrello 1998; Douglass et al. 2005), possibly for temporary structures or hunting blinds. One other lithic/ground stone deposit (Feature 19) consisted only of a single small metate fragment, which we considered to be functionally ambiguous.

Two additional nonthermal deposits (Features 5 and 6) were classified broadly as general/multiple artifact concentrations. They generally contained a mix of material classes in roughly equivalent proportions (see Chapter 5, this volume). Feature 5 consisted of a concentration of debitage and ground stone, along with small amounts of unworked shell and faunal bone and a few unmodified cobbles. That deposit probably contained a mix of refuse generated from various subsistence-related activities, such as preparation and consumption of food. Feature 6 consisted of an asphaltum concentration with abundant debitage, unmodified cobbles, and a ground stone fragment. That feature likely included refuse generated from stone-tool-production and curation activities; the asphaltum presumably was used for hafting projectile points onto wooden shafts.

The four prehistoric burial/ritual features (Features 101, 208, 214, and 216) were three primary inhumations, located, respectively, in the western, central, and eastern portions of the site area, and a ritual offering. The interred individuals included one adult male in Feature 101 (35 years of age or older) and two adult females in Features 214 and 216 (18–34 and 20–30 years of age, respectively). Given that those three features were not clustered together on the site, they were most likely unrelated mortuary events. Each of the individuals perished during logistical resource-collection forays in the area and was buried in the approximate vicinities of their places of demise. The fourth prehistoric burial/ritual feature was a nonthermal artifact concentration (Feature 208) interpreted as a mortuary offering and was located about 1 m northwest of inhumation Feature 214. The deposit consisted of two halves of a metate stacked on top of one another and resting on an abalone shell. The deliberate arrangement of the metate fragments and abalone shell, as well as their proximity to a human burial, indicated a mortuary-ritual function for this feature. Additional remains included a small number of lithic flakes, ground stone fragments, and faunal bone, some or all of which may not have been deposited as part of the mortuary offering.

Table 21 presents our functional classification of features at LAN-193, and Table 22 presents our final interpretations of the features. About two-thirds of the features (35 of 55, or 64 percent) were interpreted as thermal discard areas (or probable thermal discard areas) that mainly included FAR fragments and, in some cases, small amounts of nonthermal debris. Those features suggested a prominent focus on thermal activities among the prehistoric occupants of the site, but the precise nature of the thermal activities is unknown. Shell and faunal bone were generally infrequent among those features (but see discussion of Feature 9, below). Even so, one would expect to have recovered a larger amount of shell

Table 22. Summary of Feature Interpretations at LAN-193

Final Interpretation	Count	Percentage of Total
Domestic features		
Large hearth	3	5.5
Small hearth	1	1.8
Hearth cleanout	11	20.0
Hearth cleanout or disturbed hearth	24	43.6
Domestic-discard area	4	7.3
Cairn or post support	2	3.6
Disturbed cache or discard area	1	1.8
Activity area	3	5.5
All domestic features	49	89.1
Burial/ritual features		
Human burial	3	5.5
Ritual offering	1	1.8
All burial/ritual features	4	7.3
Late-historical-period/modern features		
Animal burial	1	1.8
Historical-period trash deposit	1	1.8
All late-historical-period/modern features	2	3.6
Total	55	100.0

or faunal-bone remains within the feature matrices had they functioned as facilities for cooking and consuming animals or shellfish. The focus of activities associated with the thermal features at LAN-193 remains elusive (see discussion in Chapter 12, this volume).

Only four features at LAN-193 were interpreted as "generalized" domestic-discard areas, containing a mix of debris generated from various domestic activities (e.g., thermal activity, food preparation, tool making/curation, and so on). The generalized discard areas composed only 8 percent (4 of 49) of the domestic features excavated at LAN-193. At LAN-62, by contrast, "generalized" domestic-discard areas constituted about half the domestic features recorded at the site (see Chapter 9, this volume). The dearth of generalized domestic-discard areas at LAN-193, as well as the predominance of thermal discard areas, may suggest a narrower range of activities at LAN-193 than at LAN-62 (and other sites). Note that many of the thermal features at LAN-193 contained flaked stone and ground stone debris, suggesting discard areas for nonthermal as well as thermal activities; nonetheless, those features did not exhibit the range and diversity of materials recovered from features at LAN-62. This pattern of intersite variation is explored in more detail in Chapter 12, this volume.

Four features at LAN-193 were interpreted as possible hearths, based on the presence of FAR and pits, but none exhibited ash or burned and oxidized soil (Figure 96). Our interpretation of these features as hearths thus should be considered tentative, because we cannot rule out the possibility that they were pits into which FAR fragments had been discarded, as explained above. However, no well-defined hearths were encountered within the area of investigation at LAN-193, and the large number of proposed thermal-cleanout features clearly indicated that the prehistoric occupants constructed hearths at the site. More likely, these and many of the other features defined as cleanout deposits probably marked the locations of ancient hearths, but the evidence of in situ thermal activity was obliterated over the course of 2–3 millennia of bioturbation by burrowing animals and insects. If so, then LAN-193 stands in marked contrast to the much younger remains encountered in Feature 1 of LAN-211 (ca. 300–500 years old), which contained a number of well-defined hearths with clear evidence of in situ burning. Perhaps the well-defined features at LAN-211 would have more closely resembled those at LAN-193 had they been subjected to bioturbation over an equally long span.

We distinguish here between small hearths (less than 70 cm in diameter) and large hearths (more than 70 cm in diameter) based on Douglass et al.'s (2005) study of hearths at the bluff-top sites of LAN-63 and LAN-64, located about 2.3 km southwest of LAN-193. Using those criteria, the possible large hearths outnumbered the small hearths by 3 to 1, which may suggest a need for intensive or large-scale thermal activities (cooking and heating) to accommodate a large group. In addition, the larger hearths could also be indicative of community-level food preparation and consumption, as opposed to family-level activities centered on smaller hearths.

Occupation Surfaces

Our analyses of occupation surfaces focused on the range of features and feature types pertaining to each occupation episode or period, in an effort to infer changes in site function and land use over time. Lengyel et al. (Chapter 2, this volume) defined four occupation episodes for LAN-193, and the chronometric data were available for three large, thermal activity areas (FBs 7, 8, and 9) and a thermal feature (Feature 1). Based on chronometric data and stratigraphic associations, Lengyel et al. inferred occupation episodes for one-third of the prehistoric features (17 of 53).

The radiocarbon dates for FBs 7, 8, and 9 suggested that they were used primarily in Episodes 2 and 3 and minimally in Episodes 1 and 4, thus placing site occupation (as it pertains to those FBs) in the early and middle Intermediate period (see Table 19). The dates from CU 21 indicated occupation during the late Intermediate period in Episode 4 and, minimally, during the late Millingstone in Episode 1.

The features assigned to Episodes 2 and 3 were compositionally and, very likely, functionally similar. For example, all of the subfeatures of FBs 7, 8, and 9, as well as Feature 1, were classified as thermal deposits (hearth-cleanout deposits or disturbed hearths). Hence, even if FBs 1, 7, 8, and 9 were indeed chronologically different, we could detect no

Figure 96. Photograph of Feature 100, a large hearth or discard area, LAN-193.

diachronic variability in feature functions. That result complemented the results of the midden-constituent analysis, discussed above, which illustrated changes in midden density over time but revealed no clear patterns of change concerning midden content or discard rates for different material classes. Both the feature and midden studies thus indicated a more or less consistent land-use pattern during the Intermediate period, albeit with probable modulations over time in the frequencies or rates of recurrence of those activities at the site.

The site appeared to have been sparsely used or inhabited during the late prehistoric and early historical periods, given the absence of features and midden deposits datable to the late Intermediate, Late, and Protohistoric/Mission periods. However, the recovery of several Rancho period glass beads suggested at least a minor occupation component dating to the mid-1800s (see above). A large artifact concentration (Feature 600), likely a trash dump that was used over the course of several years or decades, and a horse inhumation (Feature 2), composed a well-defined late-historical-period occupation surface. The horse inhumation (Feature 2) potentially dated to the Rancho period or to the subsequent late-historical-period occupation in the early 1900s. The large dumping area (Feature 600) included abundant ceramic sherds, bottles, metal fragments, and preserved wooden artifacts and a small number of plastic items. Most of the remains were related to domestic activities, specifically eating and food preparation, and were probably accumulated there by hog farmers at the Kitahata Hog Ranch (Bancroft Library, University of California, Berkeley 2006) and used as feed for their livestock. Datable bottle and ceramic fragments suggested a period of refuse disposal in the 1920s to 1930s, indicating a span of occupation immediately prior to the construction of Hughes Aircraft Company facilities. The feature was deposited during the era of hog ranching at the site, in the early 1900s, which persisted until the winter of 1924–1925, when the ranch was "cleaned up" during the rat infestation and pneumonic plague in Los Angeles (Figure 97). It appears that the Kitahata Hog Ranch and other hog ranches in the area moved out as a result of cleanup activities. Farming activities soon developed in the area and continued for a time, even after Howard Hughes purchased the property.

Activity Areas

Three large features excavated at LAN-193, FBs 7, 8, and 9, were classified as activity areas that encompassed three to five subfeatures, all located in the western portion of the site, within an area of about 40 by 15 m (see Figure 89). There was little variability in the feature compositions among the three activity areas; each was composed of only thermal features. FB 7 included one hearth-cleanout deposit and four cleanout deposits or disturbed hearths (Figure 98), FB 8 included three hearth-cleanout deposits (Figure 99), and FB 9

Figure 97. Kitahata Hog Ranch cleanup, 1924 (photograph courtesy of the Bancroft Library, University of California, Berkeley, Call No. 1988.052:272-PIC).

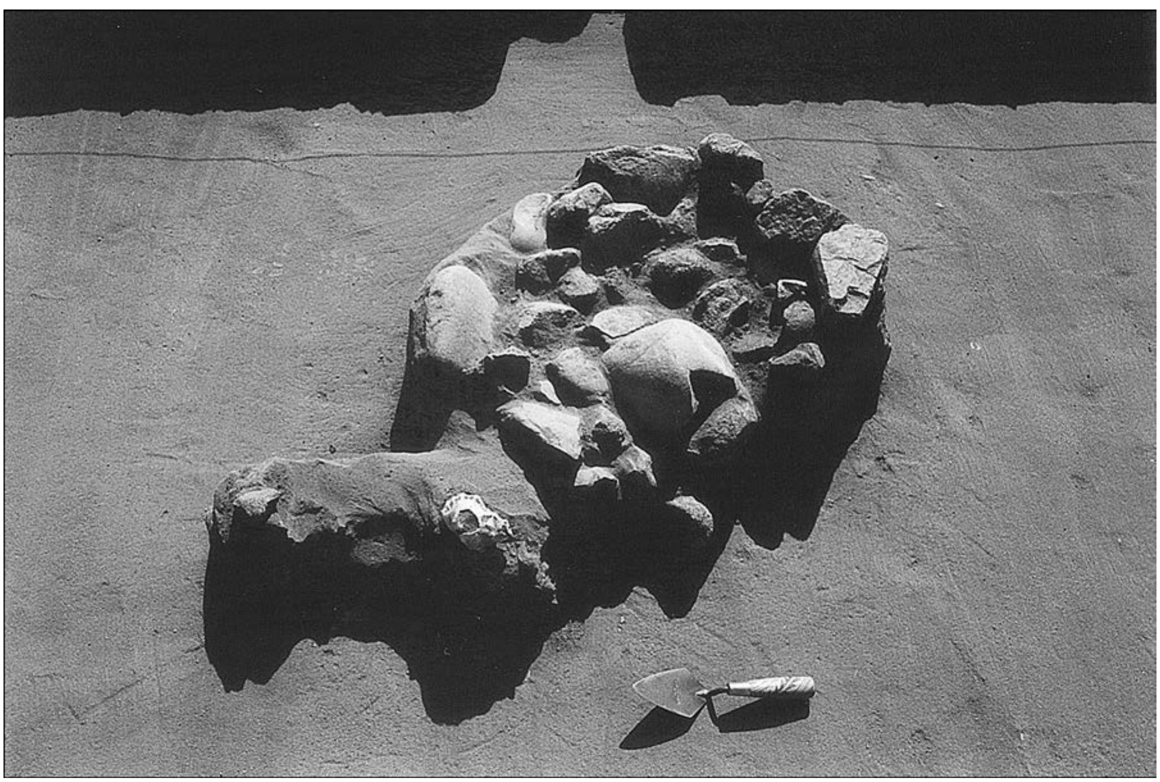

Figure 98. Subfeature in Feature 7, LAN-193.

Figure 99. Subfeature in Feature 8, LAN-193.

encompassed two cleanout deposits and three cleanout deposits or disturbed hearths. Within each activity area, the features were mainly composed of FAR fragments, and there were small numbers of flaked stone and unmodified cobbles. Shell and faunal bone were absent from or rare in features in each of the activity areas.

When the material remains from the three activity areas were compared, some differences emerged (χ^2 = 30,424.5; *df* = 10; *p* = <.001) (Table 23). The collections from FBs 7 and 8 were dominated by expedient-use lithic materials (mostly FAR) and flaked stone (mostly debitage), which together composed 97 and 98 percent of the materials, respectively, in those two activity areas but only 23 percent in Feature 9. By contrast, the collection from Feature 9 was dominated by faunal bone, which composed 76 percent of the analyzed specimens, compared to about 1 percent in both Features 7 and 8. Shell was sparse in all three activity areas but slightly more frequent in Feature 7 (1.2 percent) than in Features 8 and 9 (0.2 percent and 0.1 percent, respectively). On the whole, however, processing of shellfish appeared to have been infrequent in each of the three activity areas.

To quantify the statistical differences between FB 9 and FBs 7 and 8, the Brainerd-Robinson (BR) coefficients of similarity were calculated (Brainerd 1951; Robinson 1951). The BR coefficient provides a pairwise method of quantifying similarities between two collections (with the same variable definitions) based on variable percentages—in this case, of artifact/ecofact classes. The BR calculation is 200 minus the sum of the differences in variable percentages (Percentage A – Percentage B), or

$$BR = 200 - \Sigma\,(piA - piB).$$

With this calculation, a value of 200 indicates maximum similarity between the two collections, and a score of 0 indicates maximum difference. For ease of interpretation, the BR coefficients are rescaled as percentages between 0 and 100 (by dividing the raw BR score in half), and a value of 100 indicates identical type percentages between the two collections. As expected, the BR coefficient between FBs 7 and 8 was relatively high (BR = 74.3), suggesting similar artifact/ecofact compositions. By contrast, the BR coefficient between FB 9 and FBs 7 and 8 were considerably lower (BR = 49.5 and 48.0, respectively), suggesting substantially different material compositions.

Overall, the similar feature and artifact/ecofact compositions in FBs 7 and 8 suggested remains generated from the same or similar activities. One possibility is that those two areas functioned as loci for heat treating, manufacturing, and curation of flaked stone tools, given the predominance of flaked stone debitage. Alternatively, those areas may have been used to process and prepare perishable materials that left no visible traces in the archaeological record. If so, those activities probably required frequent cutting with flaked

Table 23. Artifact/Ecofact Compositions of Three Proposed Activity Areas, LAN-193

Feature No.	Value	Faunal Bone	Worked Bone	Lithic (Expedient Use)	Lithic (Flaked Stone)	Ground Stone	Shell	Total
FB 7	count	79	5	3,631	3,374	42	84	7,215
	feature percent	1.1	0.1	50.3	46.8	0.6	1.2	
FB 8	count	48	5	2,954	862	30	8	3,907
	feature percent	1.2	0.1	75.6	22.1	0.8	0.2	
FB 9	count	26,052	22	148	7,835	41	27	34,125
	feature percent	76.3	0.1	0.4	23.0	0.1	0.1	

Note: Percentages have been rounded to the nearest tenth.

stone tools and, possibly, frequent heat exposure, which might explain the prevalence of thermal features. Perhaps the activity areas encompassed by FBs 7 and 8 marked the locations of logistical camps established for the purpose of procuring and processing raw plant resources, which may have required stone cutting tools but left no durable remains in the archaeological record. By contrast, FB 9 had a very high frequency and proportion of faunal-bone fragments, indicating that the site inhabitants focused on preparation and cooking of animal resources, especially hunted mammals. Mammal bones dominated the faunal collection from FB 9 (95 percent of identified taxa), and bird, reptile, and bony and cartilaginous fish bones were recovered in lower frequencies. Note, however, that faunal bone was rarely recovered within the thermal subfeature matrices in FB 9, possibly suggesting that mammals and other animals were not frequently subjected to heat exposure at the site. Rather, the thermal deposits probably marked the locations of temporary logistical camps where task groups prepared hearths for warmth and likely to prepare meals for the trip, but it seems unlikely that the bulk of the procured animals were subjected to thermal exposure at the site. More likely, the site inhabitants cut, deboned, and possibly divvied up the hunted animal meat for transport back to a base camp located outside the immediate area, discarding the unwanted bones or bone fragments in toss zones on or near the activity area.

The three activity areas (FBs 7, 8, and 9) are classified here as discrete activity “loci,” but we acknowledge that their subfeatures may not have been deposited during the same occupation event. Rather, each area may represent a palimpsest of thermal features and midden remains deposited over a long span, in recurring use of the “activity area.” However, if the various subfeatures in each activity area had, in fact, been deposited during of the same occupation events, then the presence of multiple thermal features within those loci would imply a large task group that required multiple hearths. One possibility is that the activity areas were contemporaneous but specialized according to task: perhaps the men in the group focused on hunting and preparing mammals in FB 9 and, concurrently, the women focused their efforts on gathering and preparing plant resources in FBs 7 and/or 8. Note, however, that the compositional differences among the three activity areas may reflect other processes, too. For example, the large number and proportion of faunal bones at FB 9 might have been products of discard patterns unrelated to the subfeatures. In other words, we cannot rule out that the thermal subfeatures in FB 9 postdated most of the faunal remains recovered within the feature area; those subfeatures may have intruded on a preexisting midden containing abundant faunal bone. The dearth of faunal bone within the matrices of thermal subfeatures lends some credence to that possibility.

Summary of Nonburial-Feature Analysis

In total, 55 features were excavated at LAN-193, most of which were classified as thermal domestic features. The majority of those features probably were discard areas for thermal debris from hearths, although some may represent the disturbed (by bioturbation) remains of ancient hearths. A small number of nonthermal domestic features probably functioned as discard areas related to various nonthermal activities, such as stone-tool making/curation, or as cairns or posthole supports. In addition to domestic features, 4 burial/ritual features were exposed, including 3 human inhumations and 1 likely nonthermal offering deposit situated adjacent to 1 of the burials. Two historical-period features included a large trash dump dating the early 1920s and 1930s and a horse inhumation of indeterminate age.

No diachronic patterning was evident among the prehistoric features, and all of those features likely represented palimpsests of remains deposited at different times over the course of many centuries during the Intermediate period. Most of the remains dated to the early and middle Intermediate periods, including those from three activity areas (FBs 7, 8, and 9), each entirely composed of thermal deposits. The feature compositions of the three activity areas were virtually identical, but FB 9 differed considerably from FBs 7 and 8 in artifact/ecofact composition. FB 9 included abundant faunal bone (mostly mammals), in contrast to FBs 7 and 8, which included few faunal bones and high proportions of flaked stone debris and FAR. We tentatively suggest that FB 9 functioned as a locus for processing hunted animal resources, and FBs 7 and 8 may have functioned as processing stations for plant resources that left no archaeological remnants.

Site Summary

Data recovery at LAN-193 resulted in the definition of Intermediate period occupation (both early and late Intermediate), a small late Millingstone period component, and a subsequent historical-period component associated with the Rancho period and later periods. The midden-constituent analysis revealed an interesting habitation pattern, wherein the refuse-discard areas were well outside the activity areas related to food processing and consumption. The characteristics of the features and middens indicated domestic-related habitation and no specialized functions related to nondomestic aspects of prehistoric lifeways.

LAN-2768 Field Methods and Excavation Results

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This chapter summarizes the results of data recovery excavations at LAN-2768, located near the historical-period path of Centinela Creek and adjacent to the Ballona Escarpment, in an area of Playa Vista previously known as the EMTD and now known as The Campus. The Campus complex encompasses the eastern portion of the PVAHP project area. The Campus falls within the BLAD, which was previously determined eligible for listing in the NRHP (see Altschul et al. 1991, 1999). For management purposes, LAN-2768 was divided into four loci of investigation (Loci A–D), in light of the large size of the site (Figure 100).

Unlike most other sites within the PVAHP project area, LAN-2768 had not been recorded prior to SRI's investigations of the Playa Vista area in the late 1990s. SRI first identified possible subsurface cultural remains during a systematic coring program in 1998 and later validated the presence of site remains during subsurface testing within The Campus complex (Doolittle 1999; Souders 1999). Testing revealed subsurface cultural remains between two previously recorded sites: LAN-60 and LAN-193. Together, LAN-60, LAN-193, and LAN-2768 form a long, continuous expanse of subsurface midden deposits and features along the base of the bluff in The Campus complex (Altschul et al. 1999:6), albeit with varying artifact densities and integrity. Although one could argue that the three sites are a single, larger site, we opted instead to retain the existing site distinctions, mainly because of the long history of previous research at LAN-60 (Farmer 1936; Grenda et al. 1994; Rozaire and Belous 1950; Van Horn 1984a) and LAN-193 (Pence 1979; Van Horn 1984a; see also Altschul and Ciolek-Torrello 1997:18).

Generally, the subsurface midden deposits at The Campus sites are less dense than those recovered from LAN-62 and LAN-211 to the west. Based on the relatively low-density scatters, Altschul et al. (1999) suggested that no prehistoric village or long-term occupations were established within The Campus vicinity. Previous investigations at the Centinela site supported that hypothesis (Grenda et al. 1994). Based on the results from data recovery, Grenda et al. (1994:5) interpreted the Centinela site as a locus of "repeated temporary camping activity." The other sites in The Campus also were probably recurrent and short-term loci used for resource procurement (logistical camps), producing a palimpsest of features and cultural debris that accumulated over a long period of time.

SRI's investigations at LAN-2768 occurred in advance of several proposed construction projects within the PVAHP project area, including the construction of a Riparian Corridor along the base of the bluff, a new road (Bluff Creek Drive), a training facility for the Los Angeles Clippers National Basketball Association (NBA) basketball team (Altschul and Ciolek-Torrello 1997; Altschul et al. 1999; Cannon and Vargas 2008), and other building developments (Grenda 2007). Given the extensive scale of those construction efforts, SRI was able to locate and investigate subsurface remains over a large portion of the currently defined site, especially areas along the base of the bluff, the proposed location of the Riparian Corridor. Some areas of the site were not subjected to archaeological investigation, however—most notably, a roughly 0.24-km^2 (ca. 600-by-400-m) area located within Locus A and adjacent to Locus B was not investigated because of a large fill pile at that location during data recovery excavations adjacent to it.

Two data recovery projects took place at LAN-2768 during the course of the PVAHP project. The first project, in 2000, concentrated mostly on Locus A and a small area of Locus C. The second project, in 2007, focused on Locus B, in advance of the construction of the Clippers facility (Figure 101). SRI's 2007 data recovery in Locus B of LAN-2768 was summarized by Cannon and Vargas (2008). Additional features and subsurface remains were evaluated during monitoring of construction of the Riparian Corridor in 2005 and were reported by Denniston and Douglass (2007a, 2007b) and Douglass (2007b). This chapter synthesizes previous reports but also incorporates new information inferred from stratigraphic and chronometric studies and detailed analyses of materials from selected features and EUs.

The chapter is divided into four sections. The first section presents an overview of previous research at the site, including SRI's testing program in the late 1990s, which led to the initial discovery of LAN-2768. In the second part, we outline the methods employed for the data recovery and monitoring efforts at LAN-2768. The third section provides an overview of the laboratory methods used to prepare and curate the materials collected from the site for detailed analysis. In the

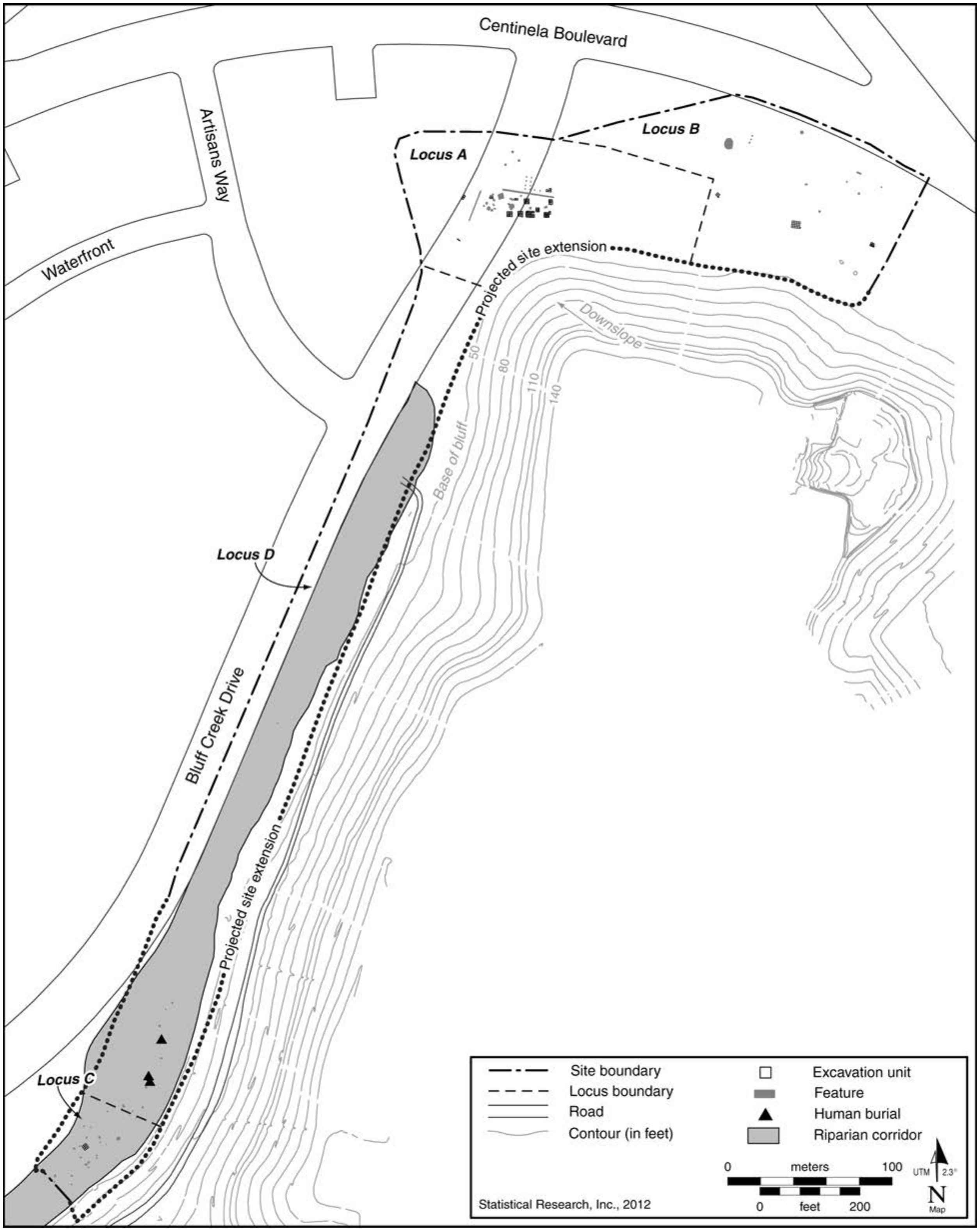

Figure 100. Map showing impacts to LAN-2768, including the Riparian Corridor.

a

b

Figure 101. Data Recovery at LAN-2768: (*a*) excavation blocks at LAN-2768 Locus B, view to the southeast; (*b*) wet screening, with excavation blocks in the background, LAN-2768 Locus B, view to the southeast.

final section, we discuss the various results of the excavations, including paleoenvironmental reconstruction, chronology, occupation intensity, and land use. To be clear, our objective in this chapter is to provide a descriptive overview of results concerning general chronological and spatial trends, midden composition and densities, occupation episodes, and feature interpretations. Results of detailed analyses of specific artifact classes and other materials are discussed in Volume 3, this series.

Site Setting

LAN-2768 is located in the eastern part of the PVAHP project area, along upper Centinela Creek and the base of the Westchester Bluffs (Altschul et al. 1999; see also Boettcher and Kling 1999; Davis 1998; Palacios-Fest 1998). The site encompasses a long and relatively narrow prehistoric midden situated on the upper terrace of the relict Centinela Creek (now channelized and submerged). The midden is more or less continuous throughout The Campus complex, and LAN-2768 encompasses approximately 850 m of midden along the base of the Ballona Escarpment. The channelized alignment of Centinela Creek crosscuts the site in the western portion of Locus A. Prior to channelization, it is likely that Centinela Creek meandered or at times intersected Ballona Creek. An aerial photograph (Figure 102) shows a relic channel of the creek meandering out into the central portion of the property, likely pushed out by sediments flowing from the bluff tops.

The site is situated in what was primarily a freshwater habitat in premodern times, consisting of a riparian biotic community with areas of freshwater marsh in the northernmost extent of the site. Centinela Creek, though considerably smaller than Ballona Creek (which intermittently captured the flow of the Los Angeles River), likely flowed year-round. It was fed by springs and provided a consistent and reliable source of potable water. Available resources in the riparian zone include wood, terrestrial fauna, and other riparian resources. In addition, nearby marshes provided fish, shellfish, birds, small mammals, and a broad range of plant resources, including edible plants and materials for making basketry and matting.

The local environment was not static in the past. The Ballona was generally unsuitable for long-term human settlement prior to about 6,500 years ago, when the area sustained an open and unstable bay environment. The earliest occupations at that time likely consisted of ephemeral resource-collection excursions to collect marine resources, generating scant material remains. As Palacios-Fest's (1998) ostracod analysis has shown, however, after about 6,500 years ago, the Ballona Lagoon gradually transformed from a brackish, open estuary to a lagoonal estuary increasingly fed by freshwater sources. During that transformation, a gradual process of sedimentation from Ballona and Centinela Creeks began to create freshwater marshes surrounding the lagoon. It appears that by about 4,000 years ago, the landscape in The Campus vicinity supported a predominantly freshwater habitat and stable landform along upper Centinela Creek that was amenable to human habitation. The lagoon shoreline may have been located slightly west of The Campus complex.

As explained below, human habitation at LAN-2768 peaked during the last millennium B.C. (early Intermediate period), subsequent to the formation of a stable and primarily freshwater habitat in the Ballona. By that time, LAN-2768 and surrounding sites in The Campus complex probably would have been appealing settlement locations to mobile groups. As Altschul et al. (1999:14) explained, Centinela Creek supplied potable water, as well as aquatic and riverine resources, in all but the driest years. Riparian plant and animal communities likely covered much of LAN-2768 at that time, offering an abundant array of plant and animal resources. In normal or dry years, the area along Centinela Creek likely was desirable for human settlement; in wet years, the settlers could have moved to higher ground on top of the bluffs. Over the last 3,000 years or so, the lagoon gradually contracted due to continual siltation, and by about A.D. 1000, it was almost completely encircled by freshwater marshes. As lagoon resources diminished, the Ballona became increasingly less attractive to human inhabitants. By 200 years ago, the lagoon no longer sustained areas of open water: siltation transformed the wetlands, creating a system of mudflats, salt flats, and freshwater channels, including Ballona Creek and Centinela Creek (see Volume 1, this series).

Potential Impact to Cultural Resources

As Altschul and Grenda (1999:111) explained, LAN-2768 was heavily affected by recent construction. In 2005, a Riparian Corridor was constructed in the southwestern portion of the site (Loci C and D), along the base of the bluff, where archaeological midden deposits are prevalent (see Figure 100). The Riparian Corridor begins north of the intersection of Bluff Creek Drive and Artesian Way and extends to the southwest, covering about a 500-m stretch that includes Loci C and D (and extending in to neighboring LAN-193). Construction of the Riparian Corridor was thought to require grading as deep as 4.5 mbs in some places; SRI anticipated removal of substantial midden deposits (see Altschul and Grenda 1999). The construction through LAN-2768 did not disturb the site remains as heavily as had been anticipated (Denniston and Douglass 2007a:15, 2007b:15–16), but even so, grading and trenching activities breached native soils in some places with intact midden deposits (Denniston and Douglass 2007a:18).

Another recent impact to the archaeological area was construction of Bluff Creek Drive and associated utilities adjacent to the Riparian Corridor. Bluff Creek Drive extends farther north and covers a longer linear stretch than the Riparian Corridor, including portions of Locus A. The road itself was

Figure 102. Aerial photograph dated June 18, 1934, showing a relic channel of Centinela Creek (courtesy of the Benjamin and Gladys Thomas Air Photo Archives, Fairchild Collection, UCLA Department of Geography; Flight C-3060, Frames 19 and 50).

elevated above the then-existing grade and did not adversely affect the site deposits. Buried utility lines and a storm drain were constructed beneath the road, however, and required deeper excavation, which breached the subsurface archaeological site in some areas.

Additional construction was conducted in the northern portion of the site in Loci A and B. A new practice facility for the Los Angeles Clippers was constructed in Locus B, requiring the removal of a portion of the prehistoric midden deposits, a small number of prehistoric features, and the remains of historical-period structures dating to the early and mid-1900s (Cannon and Vargas 2008). In 2007, a joint venture between Tishman Speyer Properties and Walton Street Capital acquired certain lots near LAN-2768 and funded additional exploration in the western portion of Locus A and areas to the west, outside the formally defined site area (Grenda 2007). Subsurface testing revealed a mix of intact and disturbed archaeological deposits. Construction on the lots has not begun but, depending on implement location and design, could adversely affect prehistoric midden deposits previously observed during testing in the western portion of Locus A.

To mitigate the impacts of these and other construction-related activities, SRI conducted data recovery operations in Loci A and B. A series of 1-by-1-m EUs in those loci provided a robust sample of materials from the midden deposits; after that, SRI opted to concentrate on detecting, recording, and excavating features exposed during monitoring, rather than systematically collecting and recording more midden remains. SRI archaeologists also monitored all construction episodes within the site area; during the monitoring, they evaluated and, if necessary, excavated any significant cultural remains.

Archaeological Background

Early Investigations in The Campus Complex (prior to 1998)

LAN-2768 was first recorded by SRI personnel in 1998, and thus the site does not have as long and detailed a research history as the neighboring LAN-60 and LAN-193, which brings up the question of why previous researchers failed to detect cultural remains in the site area. In this section, we briefly describe the research history of The Campus complex to understand better why previous researchers failed to identify LAN-2768. Amateur investigators have conducted fieldwork in the Ballona at least since the early 1900s. One or more of these investigators likely observed or collected archaeological materials from The Campus vicinity, possibly including LAN-2768 (see Bates 1963; Palmer 1906; Wallace 1984). Few of those early investigations were formally documented, however, and the documented ones have been of marginal quality. Because collections from those investigations have been poorly documented and their locations uncertain, they possess limited research potential for better understanding prehistoric and early-historical-period settlement and land use in the Ballona. For example, in 1931, faculty member Professor M. S. Moore of Polytechnic High School in Los Angeles excavated at the intersection of Jefferson Street and Centinela Boulevard and encountered burials and ground stone artifacts. The excavations were prompted when Professor Moore's student, Mr. Melvin Redhead, encountered eroding ground stone in the area (*Los Angeles Times,* 1 April 1931:A9).

In the 1930s, amateur archaeologist Malcolm Farmer (1936) recorded the nearby site of LAN-60. Three years later, another amateur archaeologist, F. H. Racer, described LAN-60 in additional detail (Rozaire and Belous 1950:35). By the early 1950s, however, when Rozaire and Belous visited LAN-60, much of the site had been disturbed as a result of construction and the installation of utility lines. Rozaire and Belous (1950) filed a site record at that time. Around the same time, UCLA archaeologist Hal Eberhart filed a site record for LAN-193, but probably without ever having visited the site (Pence 1979; Van Horn 1984a:33–34). None of those early researchers recognized the cultural remains associated with LAN-2768 located between the two sites but, instead, devoted more attention to the denser cultural deposits at LAN-62 and LAN-211 to the west, in Area D (see Chapter 9, this volume).

Professional archaeologists did not return to The Campus area until the late 1970s and early 1980s, when two crews of cultural resource management archaeologists led by Pence (1979) and Van Horn (1984a) separately surveyed the area. Neither identified LAN-2768 as a discrete site, however. Pence's survey in the late 1970s was merely cursory and not did systemically cover the entire area along the base of bluffs. In the early 1980s, Van Horn identified scattered cultural remains on the surface but interpreted them as redeposited materials from LAN-59, located on top of the bluff, overlooking the site. By the time Pence and Van Horn surveyed the area, the intact cultural deposits that constitute LAN-2768 were probably buried below fill and construction debris related to Hughes Aircraft Company construction projects. Much of the site area had been disturbed from decades of farming, construction, and leveling that limited the visibility of the site remains on the surface in most areas.

The Discovery of LAN-2768 (1998)

When SRI conducted pedestrian survey at Playa Vista in 1990, there were no surface indicators of prehistoric occupation at LAN-2768. Altschul et al. (1991:155–157) recorded a light scatter of cultural remains on the surface of a talus slope along the Ballona Escarpment (SR-14) that they believed to be part of LAN-60. Yet they observed no surface remains at LAN-2768. By the time SRI initiated a subsurface testing program in 1998, the only known sites in The Campus area were LAN-60, LAN-193, and SR-1, a shell midden located on the bluff edge (Altschul et al. 1991:146–150). (SR-1 was destroyed in the early 1990s, when the bluff face was resculpted to accommodate a housing development unrelated to Playa Vista.)

In light of the history of landscape modification and development in the Ballona, SRI archaeologists realized that intact archaeological deposits may be present but deeply buried beneath a thick layer of artificial fill and alluvium/colluvium. As early as the 1940s, beginning with Pence's (1979) archaeological investigations in what later came to be known as Area D1 of the PVAHP project area, archaeologists were aware of Hughes Aircraft Company's earthmoving activities and landscape modifications on the site of the company headquarters. Pence documented the company's earthmoving activities and their effects on the archaeological record in the Playa Vista area. It was thus clear that traditional archaeological testing methods, such as trenching and manual test units, would be insufficient to expose the potentially buried deposits.

In the mid- to late 1990s, SRI developed a two-phase testing strategy to locate and evaluate deeply buried subsurface deposits across the project area (Altschul and Ciolek-Torrello 1997). During the first phase, SRI employed geophysical survey, using remote-sensing technology to detect intact and disturbed subsurface remains (Doolittle 1999:24–28). It was especially useful for probing beneath a large asphalt parking lot that covered portions of LAN-193 and LAN-2768. During the second phase, SRI implemented a systematic program of mechanical coring and bucket-auger testing that exposed deeply buried deposits without incurring the high costs of large-scale excavation (Vargas et al. 2003).

Both testing phases were carried out in 1998, with a twofold objective: (1) detect and evaluate subsurface remains and (2) determine their vertical and horizontal dimensions (Altschul and Ciolek-Torrello 1997). A corollary objective was to determine whether the archaeological deposits were intact or had been redeposited from sites on the overlying bluff, as Van Horn (1984a) had argued. We discuss SRI's two methods for detecting deeply buried sites in the following subsections.

Geophysical Analyses

The geophysical survey incorporated three different methods: magnetic-field-gradient survey, resistivity survey, and GPR survey (Doolittle 1999:24–28). Magnetic-field-gradient surveys are frequently employed to map buried utilities and subsurface iron objects but also can potentially be used to identify midden soils. Resistivity surveys are used to discover gross variations in soil type and moisture content. GPR survey offers a means of mapping stratigraphic contacts between various soil types. Hence, these geophysical techniques provide different and complementary ways of identifying subsurface contacts between soil types, including contacts between intact and disturbed soils—an important component of research in the former HHIC. The geophysical analyses were carried out by Geoscan Research, Inc., under the direction of Lewis Somers (Doolittle 1999:24–25). For SRI's purposes, these techniques offered a way of detecting subsurface anomalies without physically exposing subsurface remains or removing the asphalt that covered much of the project area.

The geophysical surveys focused on two parking lots in areas now designated as Loci C and D of LAN-2768. (A third lot, in LAN-193, also was analyzed [see Chapter 6, this volume].) These lots were chosen because they were situated in readily accessible areas within the Riparian Corridor. For various reasons, however, different remote-sensing techniques were employed in each parking lot (for details, see Doolittle 1999). A 20-m grid was established in each analyzed lot prior to investigation.

The magnetic-field-gradient survey was performed in one of the two lots, using a vertical-magnetic-field gradiometer with a sensor spacing of 0.5 m and a sensitivity of 0.1 nT. Survey lines were scanned in a north–south direction, at four data samples per square meter. Data processing and display were performed using Geoplot 2.2 software. The magnetic-field-gradient survey in one lot was dominated by an underground pipe or drain that ran the entire length of the lot and a number of cement parking curbs containing rebar. However, the method did not shed light on the presence of subsurface archaeological resources or native soils.

The resistivity survey was performed in the same lot, using an EM-31 Geonics conductivity meter and following the same north–south-scanning lines. Surfer spatial-analysis software was used to process and display the results. Like the magnetic-field-gradient survey, the resistivity data displayed little information and was dominated by buried metal beneath the parking lot curbs.

Finally, the GPR survey was performed, using a Sensors and Software Pulse Echo 1000 operating at 225 MHz. Survey lines were scanned along a north–south axis at 20- and 50-m transects spaced at 10-m intervals. The radar mapping was only effective to a depth of 4 to 5 m, however. The GPR data revealed three detectable soil contacts indicating soil changes at roughly 1.2 m, 2.2 m, and 3 mbs, but the cause and relevance of those soil changes were unclear.

In all, the remote-sensing program provided mixed results. On one hand, the magnetic-field-gradient and resistivity surveys were only able to detect underground utilities and iron objects near the surface, thus masking the deeper-lying soil changes and subsurface below. Those results were of limited value for detecting archaeological deposits. On the other hand, the GPR survey successfully revealed subsurface soil changes, although their precise nature required subsurface exposure. For example, it was unclear whether the soil contacts detected during the GPR survey reflected changes in soil texture, soil moisture, or other causal factors. SRI archaeologists decided that subsurface exposure through mechanical subsurface probing was needed to investigate the anomalies.

Subsurface-Probing Techniques

Following the geophysical survey, SRI designed a mechanical-coring program with the intent of identifying potentially intact subsurface deposits (Souders 1999). Each of the core sections was examined for soil changes, artifacts, shell, or other distinctive materials that potentially indicated a site deposit. Altschul and Ciolek-Torrello (1997) originally developed a plan for the excavation of 50 core samples at roughly 50-m intervals within The Campus complex. However, in light of the ambiguous geophysical survey results, SRI opted instead to excavate 60 cores, which were judgmentally placed in areas with suspected subsurface remains.

None of the mechanical cores revealed very dark soils that would potentially indicate a buried archaeological surface. However, two areas revealed salient soil-color changes that might point to the presence of subsurface cultural deposits. One area was located near the then-defined boundaries of LAN-193 (later defined as Locus C of LAN-2768). The other area was located to the southeast of LAN-60, in an area that had not been previously recorded as an archaeological site (later defined as Locus A). Additional coring in the latter area revealed a dark-brown soil horizon containing marine-shell fragments that were determined to be from intact deposits. Based on SRI's defined site boundaries, the SCCIC subsequently assigned the trinomial LAN-2768 to that area. This site was subjected to data recovery excavation in 2000.

Although useful in locating the site remains, the coring results were not adequate for the archaeologists to evaluate the horizontal extent or vertical depth of the deposits. Furthermore, the limited subsurface exposure provided very little information about the density or range of archaeological materials. Other methods were required to achieve more-substantial subsurface exposures. For example, SRI excavated a single trench and located the midden before the bucket augering. Consequently, SRI implemented a program of bucket-auger testing in 1998. In the original research design for testing in The Campus area, Altschul and Ciolek-Torrello (1997) did not propose bucket augering; it was only when other probing methods proved to be inadequate or overly costly that SRI considered that option. SRI determined that bucket augering offered an effective and relatively low-cost method of probing for deeply buried cultural deposits without completely removing the thick mantle of overburden (Doolittle 1999:33–34).

SRI used a systematic bucket-auger-testing strategy to detect the presence and depth of existing subsurface cultural remains (see Chapter 4 for details). In total, 43 bucket-auger units were excavated within the site area of LAN-2768. The first units were placed in the vicinities of the cores that produced dark soils (Locus A); from there, subsequent units were systematically extended outward in other directions. That approach proved effective, because the archaeologists uncovered varying densities of archaeological resources covering a large area. Subsurface cultural remains were observed in 28 of the 43 units (65 percent). In some areas, artifact densities exceeded those previously recorded at LAN-193 (Doolittle 1999:36). Units that did not contain site materials were predominately located in the toe slope of the bluff. Two radiocarbon dates from intact deposits in the southern portion of LAN-2768 suggested occupation during the Intermediate period, ca. A.D. 230–600 (Doolittle 1999:36).

In all, archaeological resources were observed along a more or less continuous area adjacent to and along the Ballona Escarpment, between LAN-193 and LAN-60 (see Figure 100). Based on the testing results, Altschul et al. (1999:110) recommended LAN-2768 eligible for listing in the NRHP. Despite the relatively continuous stretch of cultural deposits, SRI identified some particularly high-density remains in the eastern portion of LAN-2768, in an area encompassing roughly 200 m east–west by 50 m north–south, later known as Locus A. The subsequent data recovery in 2000 mainly focused on that area.

Data Recovery Methods

Data recovery occurred during various excavation episodes at LAN-2768. The first episode of data recovery occurred at Locus A and a small area of Locus C in 2000. In 2005, SRI excavated additional features during construction monitoring for the Riparian Corridor in Loci B, C, and D. More recently, in 2007, SRI conducted data recovery in Locus B. We describe the methods employed for each of these investigations in this section.

Data Recovery in Locus A (2000)

The first data recovery excavations at LAN-2768 focused on Locus A, where the densest subsurface remains were observed during testing. Much of the northern and western portions of Locus A have been heavily disturbed as a result of historical-period construction. The channelized alignment of Centinela Creek (a subterranean corrugated pipeline) extends along a roughly north–south trajectory through the center of the locus, and much of the site in that area was destroyed during the channelization process. Another concrete pipeline, likely an electrical conduit, also was mapped through part of the northern portion of the locus, along with three large cisterns, a concrete platform, and relict concrete footings from a historical-period warehouse. In light of those disturbances, SRI opted to concentrate its data recovery efforts on the generally intact site deposits in the southeastern portion of the locus.

As proposed by Altschul et al. (1999), data recovery at LAN-2768 required multiple stages of fieldwork, starting with exploratory trenching and concluding with the identification and recovery of significant features (Figure 103). SRI developed a multiphase work plan to complete the following tasks: (1) mechanical trench excavation, to identify areas of intact native soils; (2) excavation of linear trenches, to expose wall profiles; (3) removal of overlying fill, to expose native soils; (4) manual excavation of 1-by-1-m units, to procure samples of materials from the general midden deposits (see below); (5) systematic mechanical stripping of the intact soils in a portion of the locus, to reveal features; and (6) manual excavation of features discovered during the stripping excavations (Figures 104 and 105).

Mechanical Trenching and Overburden Removal

SRI's first step was to excavate trenches mechanically in order to locate intact deposits, evaluate the depth of the fill, and guide future decisions concerning the locations of future trenches and hand-excavated units. One obstacle to the trench excavations was the deep layer of loose artificial fill overlying the intact native soils in the area; the fill was laid down in the mid-1900s by Hughes Aircraft Company (see Doolittle 1999). SRI's initial plan was to mechanically excavate a series of long, linear trenches that transected the locus, but that approach was later determined to be inappropriate, in light of the thick layer of fill. The linear trenches were likely to collapse, because of the loose texture and the depth of the fill.

SRI thus opted, instead, to excavate a series of 11 "pothole" trenches (Pothole Trenches 1 and 3–12) (see Figure 103). They were excavated in a stepped fashion, with the deepest exposure in the center and several shallower "steps" along the edges. The stepping procedure allowed the excavators to dig deep trenches while reducing the threat of sidewall collapse and allowed crewmembers to enter the trenches safely and record soil information. The pothole trenches were semisystematically situated at roughly 20- to 25-m intervals, forming three linear, east–west bands that crosscut the locus. However, the proposed Pothole Trench 2, which would have been located between Pothole Trenches 1 and 3, was not excavated, because of the discovery of a previous subsurface disturbance.

The systematic trenching revealed variability in the depth of the overlying fill in different areas of the locus. The fill in the northern and northwestern portions of the locus was particularly deep; that fill apparently had been added to level off a slight preexisting surface gradient in the area. In some areas, the fill was too thick to reach the deeply buried site deposits and extended deeper into the subsurface than SRI personnel had previously surmised based on the bucket-auger results. In addition, native soils in much of the locus had been removed or heavily truncated during construction of a buried pipeline along the alignment of the former location of Centinela Creek.

The trenching results showed that the intact midden deposits had been partially truncated as a result of earthmoving activities by Hughes Aircraft Company in the mid-1900s. The trench excavations also revealed that, as with most sites located along the bluff, the midden is substantially thicker in areas located closer to the bluff, particularly in the southeastern portion of the locus. Overall, however, the midden deposit beneath the fill was relatively thin (1–1.5 m in thickness), partially because of truncation, and had a low density of cultural materials relative to sites elsewhere along the bluff, particularly LAN-62 and LAN-211.

After completion of the pothole trenches, SRI archaeologists excavated six linear trenches in selected areas of the locus with shallower fill deposits (Linear Trenches 1–6) (see Figure 103). The purpose of those trenches was to expose the subsurface stratigraphy so that wall profiles could be inspected and drawn. Four of the six linear trenches were judgmentally placed in the southeastern portion of the locus, along the edges of the site area, where the fill was thinner and the native soils could be safely exposed for analysis. One linear trench (Linear Trench 6) was placed to the east of Locus A, in an uninvestigated area between Loci A and B. Another (Linear Trench 2) was excavated in the western portion of the locus, crosscutting the old alignment of Centinela Creek.

Linear Trenches 2 and 5 were placed in marsh deposits. Deep trenches were excavated to expose the deep-lying marsh deposits. In both cases, the trenches were excavated as series of steps, to permit the archaeologists to inspect and record the subsurface stratigraphy without incurring sidewall collapse. As explained below, CUs were excavated into the "steps" adjacent to Linear Trenches 2 and 5, to obtain detailed stratigraphic information. SRI soil scientist Dr. Jeffrey Homburg recorded detailed geomorphological information and collected soil and pollen samples from the exposed trench walls. Several flotation and pollen samples were taken from Linear Trench 2.

Subsequent to the trench excavations, SRI oversaw removal of the fill overlying the features and midden deposits in the southeastern portion of the locus. The overlying fills were removed with a mechanical excavator fitted with a flat cutting blade. The trenches provided concrete guidelines for estimating fill depths and for guiding the mechanical removal of fill to expose the buried native soils.

Manual Excavation of CUs

Once the overlying fill had been removed, the next step was to manually excavate a series of 1-by-1-m CUs. Most of the sites located along the bluff edge in the Playa Vista area, including LAN-2768, are characterized by a nearly continuous "background" scatter of prehistoric midden deposits. The purposes of the CU excavations, therefore, were to obtain samples of materials from the scattered midden deposits and to record wall profiles.

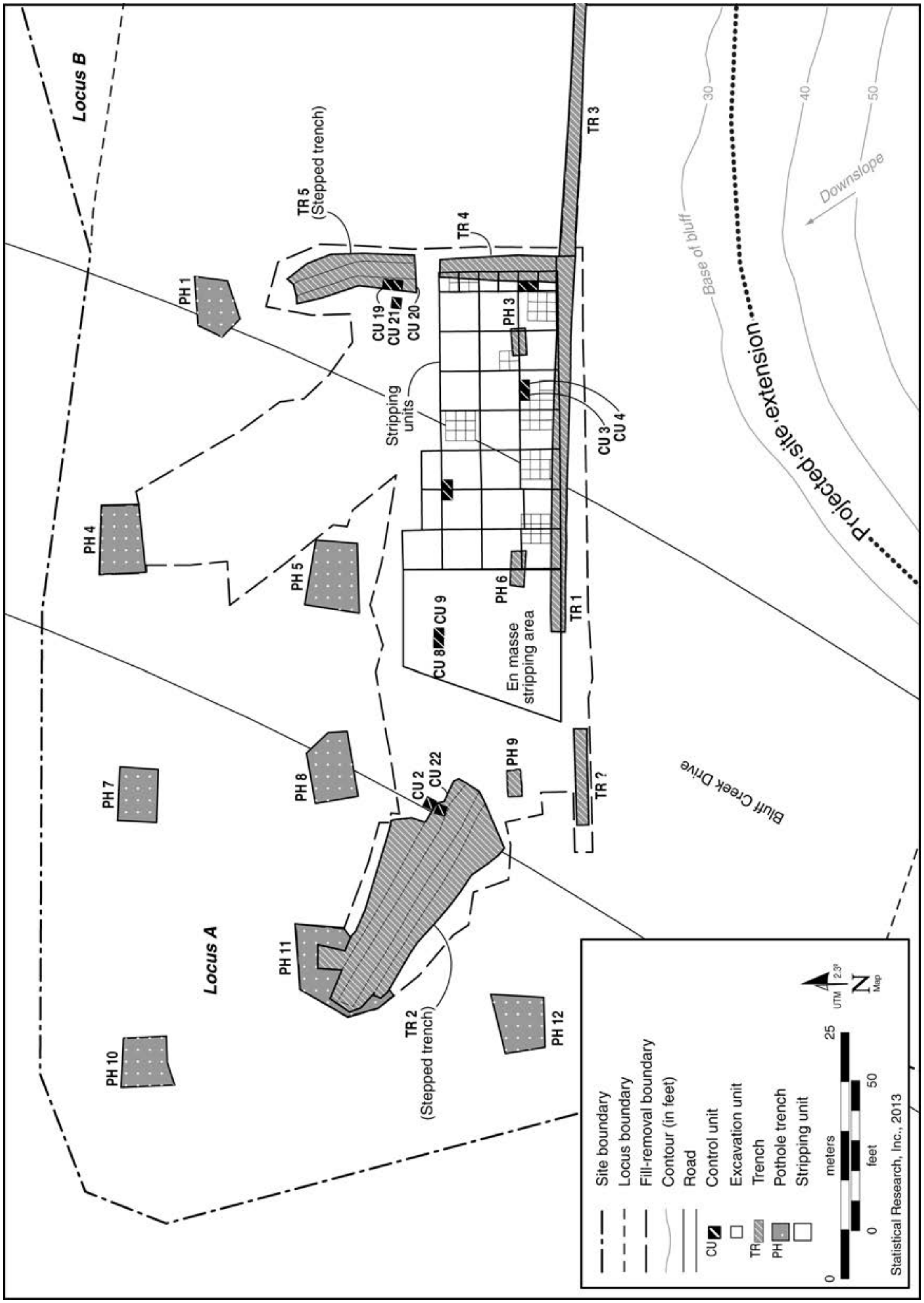

Figure 103. Map showing the locations of trenches, CUs, column samples, and MSUs in LAN-2768 Locus A from the data recovery in 2000.

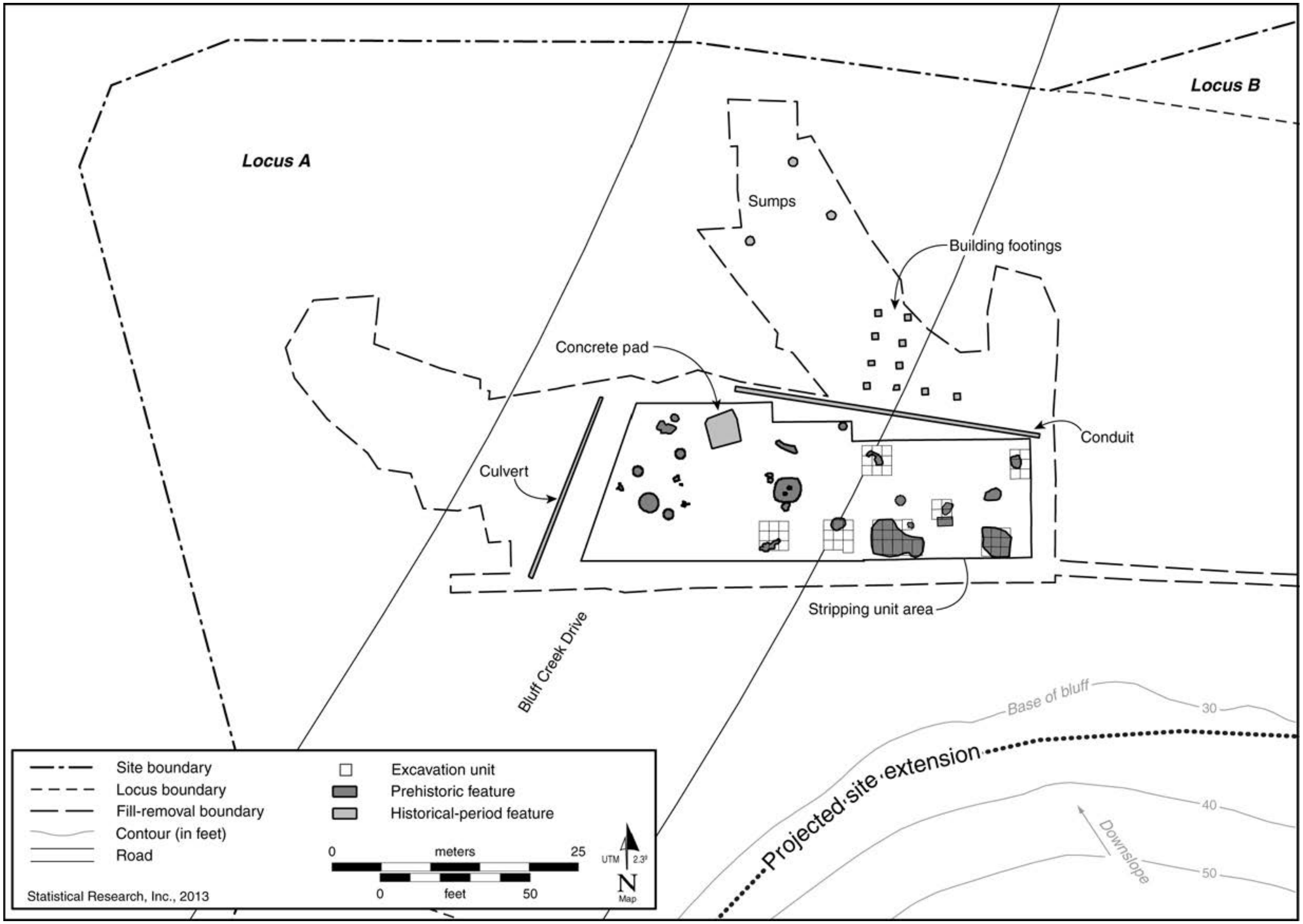

Figure 104. Map showing the locations of features discovered during the data recovery in LAN-2768 Locus A.

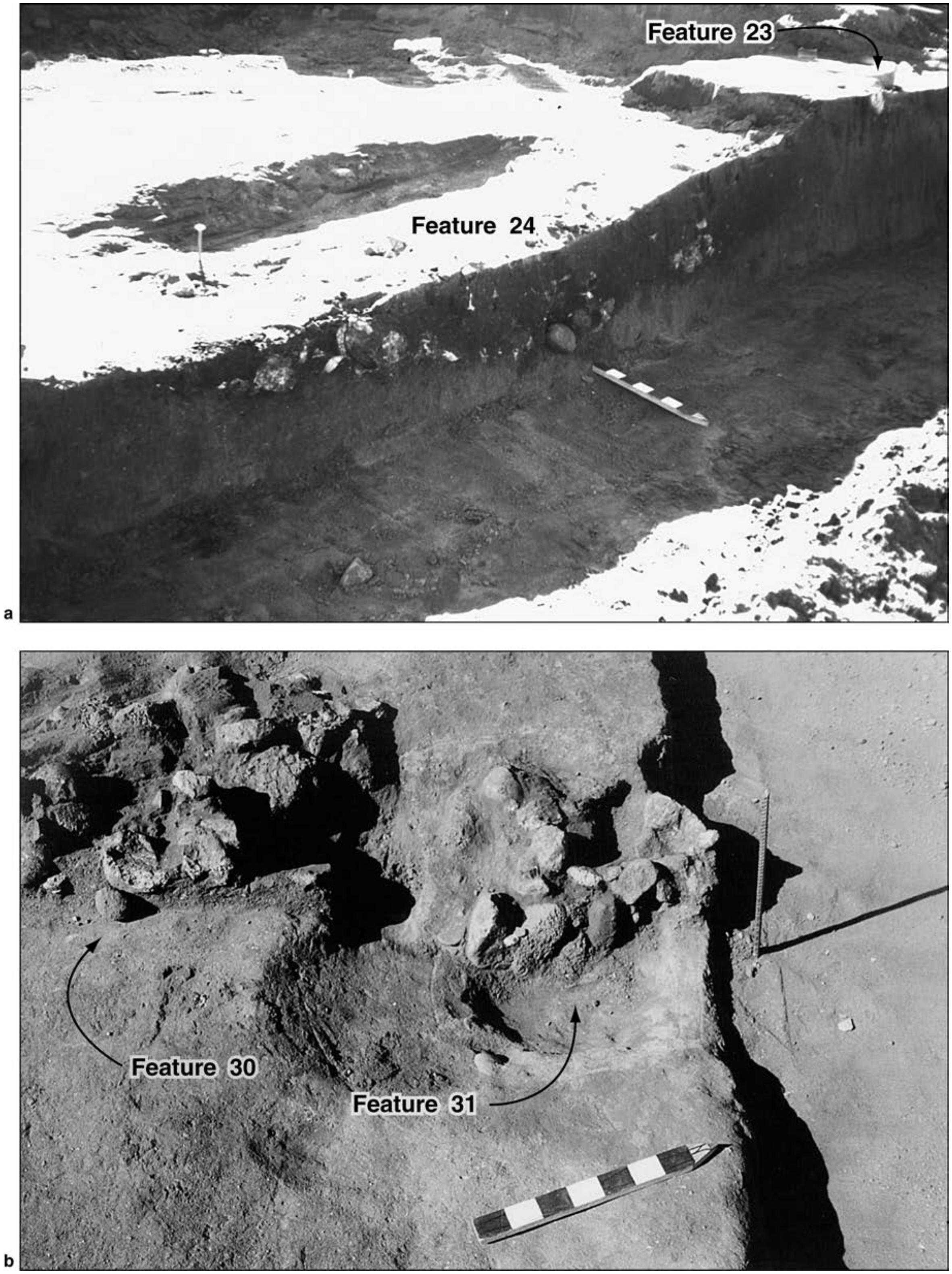

Figure 105. Photographs of Features 24, 30, and 31 in LAN-2768 Locus A: (*a*) Feature 24, a house pit, in the trench face prior to excavation; (*b*) Features 30 and 31, rock-filled pits adjacent to Feature 24.

In total, 13 CUs were excavated in Locus A, mostly in the southeastern portion of the locus (see Figure 103). The 1-by-1-m units were hand-excavated in arbitrary 10-cm levels, in pairs of adjacent units. Five of the units were excavated into the stepped sidewalls adjacent to Linear Trenches 2 and 5. CUs 2 and 22 were excavated in the two surrounding stepped sidewalls of Linear Trench 2; CUs 19, 20, and 21 were excavated in the stepped sidewalls of Linear Trench 5. The purpose of those units was to obtain soil information for the upper portion (upper step) and lower portion (lower step) of the trench profiles. Excavated soils were collected in 5-gallon buckets, labeled with relevant provenience information, and transported to SRI's on-site wet-screening facility for processing (see below). Two prehistoric features (Features 1 and 2) were discovered during the unit excavations, excavated as discrete entities, and assigned PD numbers.

Once the CU excavations were complete, SRI archaeologists excavated 20-by-20-cm column samples into one sidewall of one unit from each CU pair. The purpose of those samples was to collect minute remains, such as macrobotanical remains, that would not have been recovered during screening using 1/8-inch-mesh screen. The samples were collected using a combination of arbitrary 10-cm levels and stratigraphic levels. Pollen samples were taken from the center of each level of the column samples.

MSUs

Subsequent to completing the 1-by-1-m CUs and column samples, the excavation crew systematically stripped the intact cultural deposits in the southeastern portion of the locus. The purpose of the SUs was to detect feature remains in the intact A horizon. The stripping was conducted using a backhoe fitted with a flat cutting blade on a 3-foot-wide bucket. A two-person archaeology crew guided the backhoe operator at all times. The soil from each unit was assigned a unique PD number and was transported by front-end loader to the stockpile area immediately east of the excavation area, where the soil from each SU was stored as a separate pile and marked with a grading stake labeled with the PD number. A sample of the excavated soils from each SU was mechanically dry-screened through 1/4-inch-mesh screen (see below).

The area was initially stripped in 2-by-2-m units, beginning at the northern extent of Linear Trench 4. The first 6 units (along the eastern edge of the stripped area) were excavated as 2-by-2-m units. However, because of time concerns, SRI opted to excavate the remainder of the stripped area in 4-by-4-m units. Additional 22 4-by-4-m and 2 2-by-4-m SUs were excavated in the southeastern portion of the locus. The soils were removed in roughly 5–10-cm passes, with provenience maintained to the 50-cm level. When artifacts or unusual soil changes were encountered, however, archaeologists halted the backhoe and investigated the soil changes by hand. Any concentrations of artifacts or discernible soil stains were flagged as possible features, further mechanical excavation in that SU ceased, and stripping was moved to the next adjacent unit. Each isolated artifact was point-provenienced within the SU, given a unique item number, and collected for analysis. On the final day of fieldwork, rather than laying out formal SUs, the large area to the west of the previously excavated block of SUs was stripped mechanically en masse, terminating in the vicinity of the relict Centinela Creek channel. The purpose of that mass-stripping effort was to expose and excavate as many features as possible. When a possible feature was located, an archaeologist flagged the location for further hand-excavation; a pedestal of soil was left intact around the possible feature, and stripping continued. Ten features were discovered and excavated in that area (see Figure 104).

Feature Recovery

Twenty-nine prehistoric features were investigated in Locus A during data recovery (Figure 106; see Figures 104 and 105). An additional 7 late-historical-period or modern features also were uncovered but were not investigated to the same extent as other features on the site, to avoid exposure to hazardous materials from prior industrial uses of the site area. In a few cases, features were encountered during CU excavation, but the majority was discovered during mechanical stripping. In most cases, blocks of 1-by-1-m EUs were placed around features and excavated, specifically to uncover features and the areas of space adjacent to them.

The methods of feature recovery varied. Features excavated using blocks of EUs were sectioned or divided into quadrants corresponding to each 1-by-1-m EU and excavated in 10-cm levels. In all, SRI excavated seven feature blocks at Locus A. If a feature fit within the limits of a single 1-by-1-m area, it was sectioned along an arbitrary bisecting line and excavated in 10-cm levels. In other cases, particularly in the area stripped en masse, each feature was excavated as a single unit. In a few rare cases, features were exposed and described, but no cultural materials were recovered. The excavators made plan drawings and photographed each feature and, in some cases, also recorded a cross-section profile. In some cases, the soils between clusters of features also were excavated by hand, to expose the entirety of the features and investigate connections among them. For selected features, the excavators collected flotation and pollen samples: flotation samples were collected from Features 1–4, 7, 12, 13, 16–20, 22–25, and 29–30, based on cultural integrity. Pollen samples were collected from Features 24 and 31 (note that there were only 29 features, but feature numbers go higher, because several features were voided postfieldwork, when they were determined to be modern). The features recorded in Locus A included a variety of thermal and nonthermal artifact concentrations and rock clusters.

One feature that warranted considerable effort was Feature 24, uncovered in SUs 57 and 58 (see Figure 105), which encompassed an ovate area measuring 2.3 by 2.6 m and was composed of dark, burned soils and a lens of fire-affected cobbles overlying a heavily compacted floor. Feature 24 was

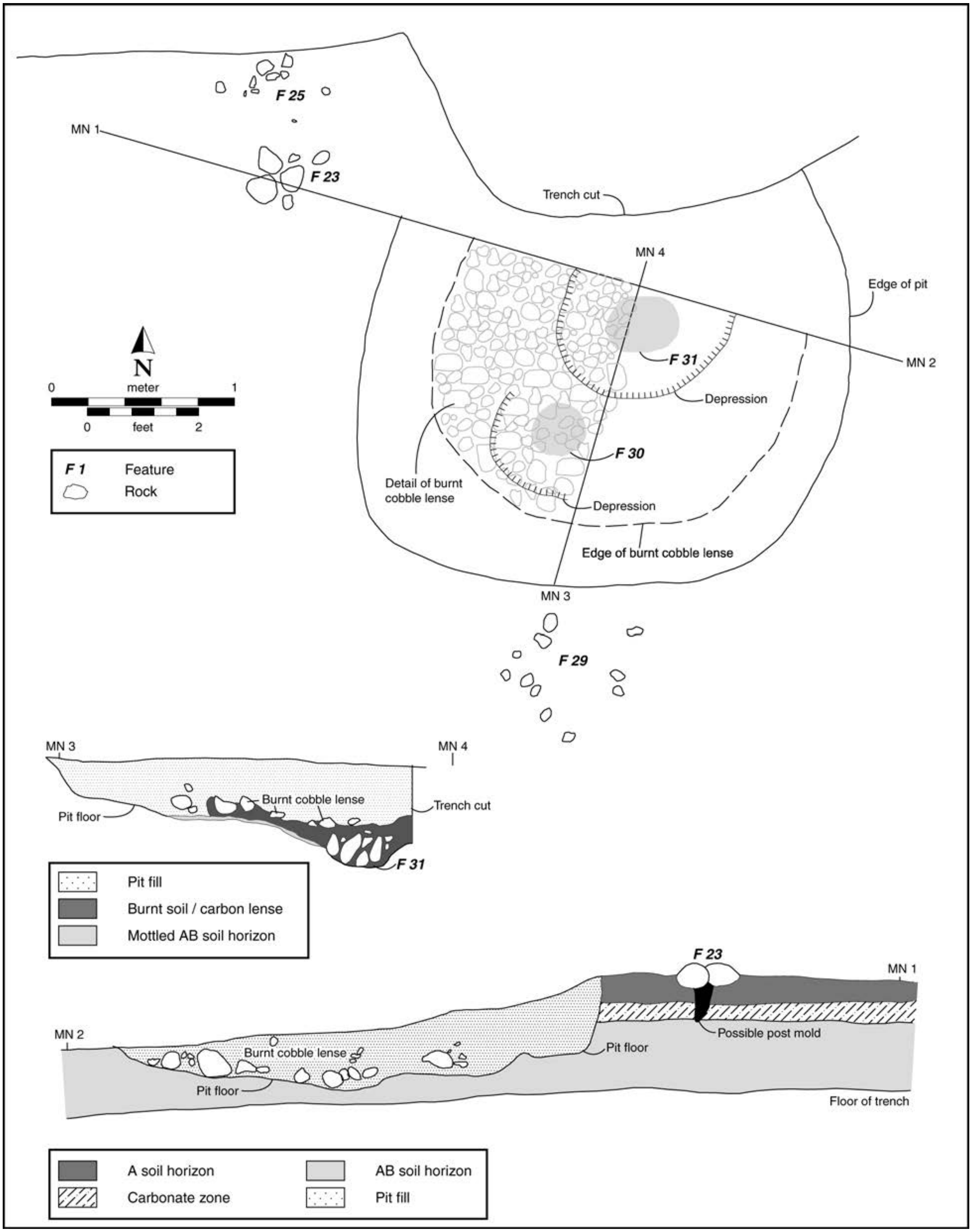

Figure 106. Plan views and profiles of Features 23–25 and 29–31, LAN-2768.

interpreted as a possible house floor that was later reused as a roasting pit. Three features were designated as subfeatures of Feature 24: 2 intramural pits (Features 30 and 31) and an extramural rock cluster (Feature 23) (see Figure 106). Feature 24 was found on the final day of fieldwork, when the backhoe clipped the northern portion of the feature during the SU excavations. To expedite feature removal, the overlying soils were removed to expose the top of the feature, and the east–west profile created by the backhoe was illustrated. The remainder of the feature was then bisected along a north–south axis. The eastern half of the feature was fully excavated as a single unit, which exposed the north–south profile. After drawing the western-wall profile, the remainder of the feature was excavated as a single unit, along with the two intramural subfeatures. A column sample also was excavated within the feature matrix.

No intact burial features were found in Locus A. However, scattered human remains were found during wet screening of soils collected from Feature 12 and in SUs 34 and 57. The fragments included the remains of one adult and one subadult; the majority of the remains were associated with the adult. The adult skeletal remains were about 10–15 percent complete but were insufficient to infer sex. Notably, the recovery loci were roughly 16 m apart, which confirmed SRI's suspicion that portions of the site had been highly disturbed by earthmoving activities. In light of these finds, SRI opted to screen all soils collected from these and adjacent proveniences, but no additional human remains were found.

Excavation in Locus C (2000)

Soon after completing the data recovery in Locus A, SRI excavated a single trench and a block of EUs in Locus C (formerly Locus 2). SRI conducted the excavation in response to the discovery of intact cultural deposits through monitoring of a utility trench in an area that was believed to be between LAN-193 and LAN-2768. The linear trench was roughly 53 m in length and was oriented at a slightly northwest–southeast angle (Figure 107). The trench cut through the virtually continuous midden deposit along the base of the bluff at a roughly perpendicular angle. Approximately 1 m of flood deposits overlay a relatively thick A horizon that contained prehistoric cultural materials.

A single excavation block composed of nine 1-by-1-m units was excavated adjacent to the eastern wall of the trench (see Figure 107). As explained above, SRI's rationale for the unit excavations was to obtain samples of materials from the exposed midden deposits. The overlying fill was stripped to expose the top of the A horizon prior to the manual excavation, and the units were excavated in arbitrary 10-cm levels, using the same procedures outlined above for Locus A. The transition to the sterile AB horizon occurred at different depths in the units. On average, the EUs were excavated approximately 1.5 m through the intact archaeological midden deposits.

Artifacts were generally sparse in the EUs, and evidence of bioturbation was prevalent. Recovered artifacts included flaked stone debitage, ground stone, faunal bone, FAR, and occasional shell. One feature (Feature 300) was uncovered in Levels 2 and 3 along the southern edge of the block, between CUs 8007 and 8008. The feature consisted of a concentration of FAR associated with a mano and a metate fragment within a matrix of dark soil. A concentration of carbonized seeds also was recovered from this feature. One radiocarbon date from a *Phalaris* sp. seed obtained from the feature matrix indicated a Late period or Protohistoric/Mission period deposit. The feature, likely a hearth and associated cleanout debris, was not fully exposed, because it extended into the southern wall of CUs 8007 and 8008.

Monitoring Construction of the Riparian Corridor (2005)

Additional features were recorded and excavated in LAN-2768 during the monitoring of construction along the base of bluff, in connection with the creation of the Riparian Corridor and Wetlands in 2005 (Figure 108) (Denniston and Douglass 2007a, 2007b; Douglass 2007b). That construction required considerable amounts of grading and trenching, and in many construction areas, the fill was sufficiently thick to shield the deeply buried archaeological resources from the adverse impacts. In the area nearer to the bluff edge, however, the overlying fill was relatively shallow and lay directly above native soils containing archaeological site materials.

Thirty-six features were discovered in Loci C and D during monitoring (see Figure 107), many in a roughly 300-m stretch along the base of the bluff, between the previously defined site areas of LAN-2768 and LAN-193 (Denniston and Douglass 2007a). The area was designated as Locus C of LAN-2768 in light of those discoveries. Most of the features were prehistoric rock clusters that contained FAR mixed with various additional discarded materials related to subsistence activities (see below). Three prehistoric human burials also were discovered. Two burials (Features 108 and 109) were situated adjacent to one another in the southern portion of Locus D. A third (Feature 112) was situated roughly 25 m north of Features 108 and 109.

The 36 features are concentrated in the southern portion of Locus D and in Locus C, including several features along the boundary of LAN-2768 and LAN-193. Notably, however, no features were discovered in the easternmost extent of LAN-193, directly west of the concentration in Loci C and D. It is possible that the concentration of features had continued into the eastern portion of LAN-193 but was removed as a result of earthmoving activities in the mid-1900s. We suspect that a natural rise may have been present at the eastern edge of LAN-193 prior to the mid-1900s but was leveled for farming or during construction of the HHIC.

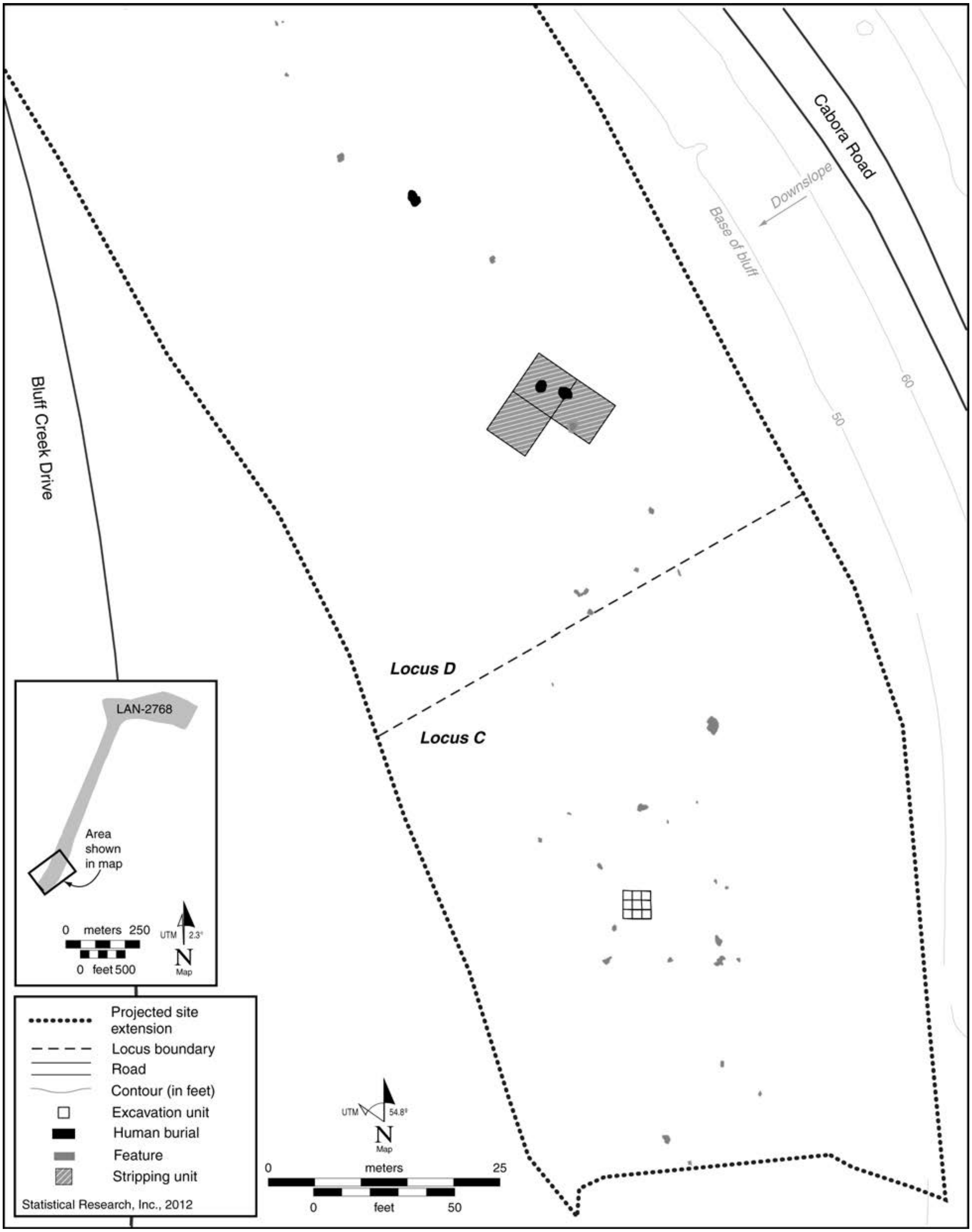

Figure 107. Map showing the locations of excavations and features at LAN-2768 Loci C and D.

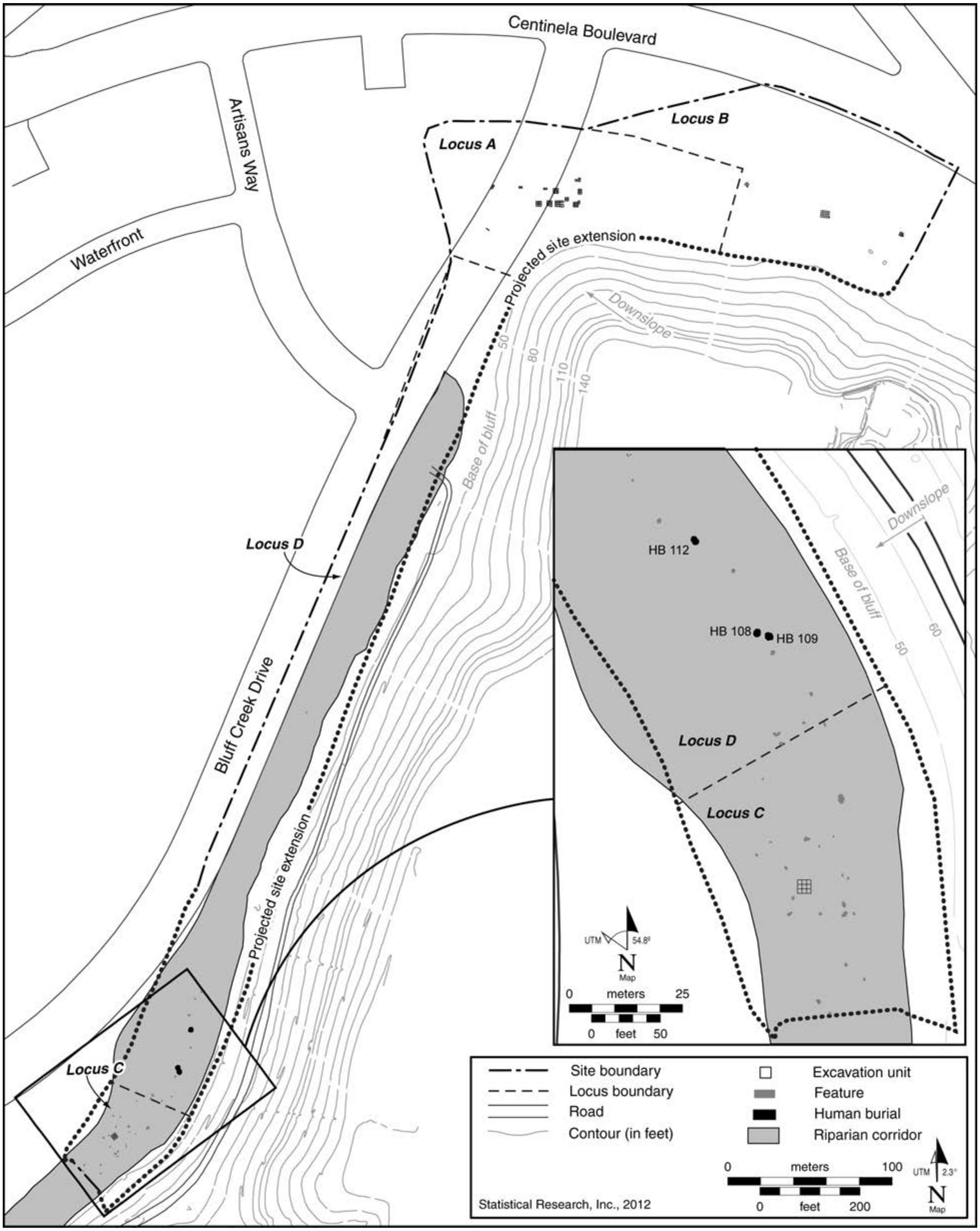

Figure 108. Map showing the locations of features recorded during monitoring of construction for the Riparian Corridor, LAN-2768.

Data Recovery in Locus B (2005 and 2007)

In 2005, SRI initiated a testing program in Locus B in advance of construction of a new training facility for the Los Angeles Clippers. The parcel of land on which the construction was planned (Lot 33) had not been previously tested or evaluated, because of the excessive amount of fill that covered the deep-lying archaeological resources. At the time of the previous data recovery project in Loci A and C, plans for construction in Locus B had not been developed. In 2005, SRI developed a testing and data recovery plan designed to mitigate the adverse effects of the construction in Locus B. The work stages included: (1) mechanical excavation of trenches, (2) manual excavation of test pits, and (3) manual excavation of features (Vargas et al. 2003:272–276). Subsurface testing, including mechanical trenching, occurred in 2005, and the data recovery occurred in 2007 (Cannon and Vargas 2008) (Figure 109; Table 24).

Mechanical Trenching (2005 and 2007)

Preliminary earthmoving activities for construction of the Clippers facility began in June 2005. In total, six linear backhoe trenches (Linear Trenches 13–18) were excavated within the APE at that time (see Figure 109). Intact prehistoric cultural deposits were identified in four trenches located north of the toe slope of the bluff. In addition, the remains of a historical-period structure were recovered in Linear Trench 17 (Features 100–102), situated in the middle of the APE (Grenda 2005a, 2005b), and portions of four other historical-period structures (Features 104–107) were found during monitoring in the northeastern part of the locus. The seven historical-period features included two portions of a railroad spur that likely predated the Hughes era, as well as a brick-lined pit and four historical-period trash pits. The historical-period features were discovered in the overlying fill but extended into native soils. At that time, an SRI field technician who monitored those activities reported the presence of intact cultural deposits in the native soils beneath the thick mantle of overlying fill. Consequently, SRI proposed another trenching program in the APE (Cannon and Vargas 2008).

The discovery of historical-period remains was not surprising. Topographic maps and aerial photographs from the early twentieth century indicated the presence of several historical-period structures within the APE, some of which were related to the Los Angeles Pacific Electric Railway trolley line. Data recovery completed in 2000 in Locus A had previously revealed several features, such as concrete footings and leach pits, likely related to industrial activities in the area. The historical-period remains in Locus B may have included structures or facilities related to the trolley line, including a possible portion of a station building (Mesmer Station). The APE also encompassed at least one historical-period farmstead and several warehouses related to Hughes Aircraft Company.

In all, the 2005 testing revealed roughly 2,800 m^2 of intact archaeological subsurface deposits in the deep-lying native soils beneath the footprint of the proposed Clippers facility. The uppermost portion of the intact midden deposits had been truncated as a result of past earthmoving activities, however. To evaluate subsurface remains and detect features, SRI proposed to manually excavate 1 percent of the site area within the APE, resulting in 28 m^2 of MEUs (Grenda 2005a, 2005b).

In 2007, SRI conducted additional testing to evaluate the integrity and extent of the historical-period component in Locus B (Cannon and Vargas 2008; Grenda 2005a). Six additional trenches (Linear Trenches 19–23 and 25) were excavated within the APE, using a standard backhoe fit with a flat blade (see Figure 109). The backhoe excavated the trenches in small (5–10-cm) lifts, under the direct supervision of an SRI archaeologist. A sample of the native soils collected during the excavation was collected for dry screening with 1/8-inch-wire-mesh screens. No features were found during the trench excavations. Also, testing revealed a low density of cultural materials, including a mix of prehistoric and historical-period remains. The low-density scatter of prehistoric artifacts and materials was consistent with findings in Locus A and elsewhere at LAN-2768.

MEUs (2007)

Following the removal of the overlying fill, SRI conducted data recovery excavations in native soils in Locus B. The manual excavation focused on the southern portion of the Clippers parcel, because of the previous observations of intact prehistoric deposits in that area (nearer to the bluff face). In total, 28 1-by-1-m units, divided among three large blocks of contiguous units (Blocks 1–3), were excavated within the APE (see Figure 109). The excavation blocks consisted of one 4-by-5-m block and two 2-by-2-m blocks. The 2-by-2-m blocks were situated on the eastern and western sides of the locus (MEUs 524–527 in the west and MEUs 500–503 in the east). The larger block was situated in the center of the locus (MEUs 504–523). The units were excavated in 10-cm arbitrary levels and were terminated when the excavators encountered soils determined to be culturally sterile. In addition, 50-by-50-cm column samples were excavated adjacent to each of the three excavation blocks, in the east wall of the southeasternmost unit of each block.

During excavation, large artifacts were individually mapped and collected. Stratigraphic soil profiles were recorded in each excavation block, and soil and micromorphology samples were collected from each of the identified strata. Prior to and during the data recovery excavations, SRI personnel also monitored all ground-disturbing construction activities within the APE. Much of this monitoring work ran concurrently with SRI's data recovery operations. Often, trenches

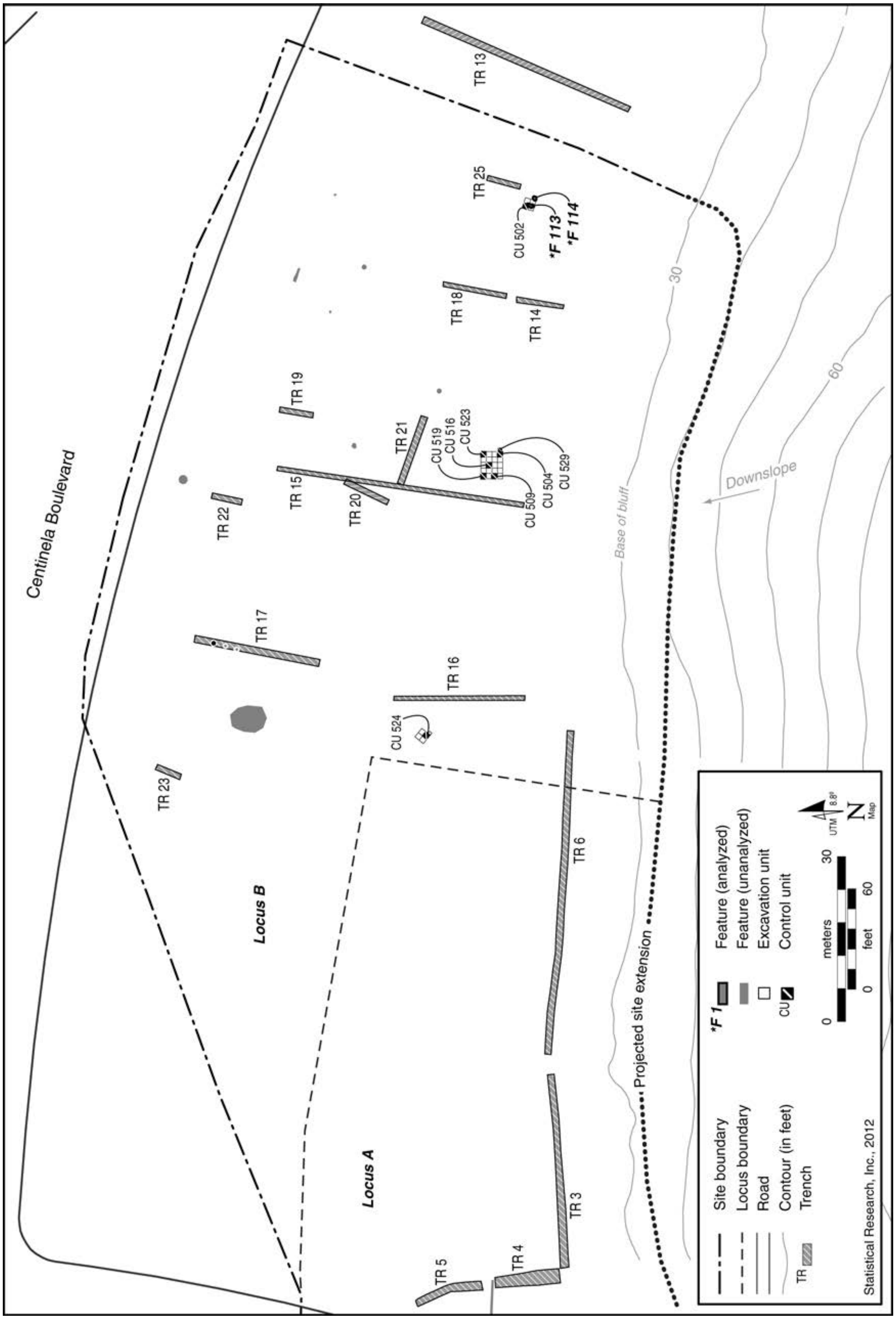

Figure 109. Excavations at LAN-2768 Locus B.

Table 24. Excavation Summary, LAN-2768

Description	Excavated (n)
Exploratory trenches	
Locus A (pothole)	11
Locus A (linear)	6
Locus B	11
Locus C	1
Total	29
EUs (1 by 1 m)	
Locus A	22
Locus B	28
Locus C	9
Total	59
Stripping units	
Locus A[a]	30[b]
Feature-excavation units (1 by 1 m)	
Locus A (7 blocks)	52
Features	
Locus A	29
Locus B	14
Locus C	16
Locus D	20
Total	79

[a] Does not include the informal stripping area to the west of the stripping units.
[b] Stripping units varied in size and included 6 2-by-2-m units, 22 4-by-4-m units, and 2 2-by-4-m units.

were excavated for the placement of footings or other infrastructure related to construction of the facility on the property. The trenches were monitored closely by SRI staff, and in fact, they were very useful for assisting in mapping the vertical and horizontal extents of intact site materials within the project area. Members of the Native American community also monitored all ground-disturbing activities.

Feature Recovery

Two prehistoric features were encountered during the block excavations, both located in Block 1, in the southeastern portion of the APE (Features 113 and 114). Both were artifact concentrations composed of scattered FAR and shell. The features were excavated as discrete entities and assigned unique PD numbers. In addition, six historical-period features were discovered during monitoring, including artifact concentrations and brick-lined cisterns or wells. Because of safety concerns, however, only the two artifact concentrations were excavated and described in detail. The features are described further below.

Additional Testing near Locus A (2007)

In 2007, Tishman Speyer Properties and Walton Street Capital developed a plan for construction on several parcels adjacent to the western edge of Locus A (Grenda 2007). SRI thus developed a comprehensive trenching plan to evaluate the parcels within that area that had not been previously investigated. In total, 34 trenches were excavated, 6 of which contained intact cultural remains (Figure 110). Intact archaeological deposits were only found in the northwestern portion of the site, within the known boundaries of Locus A. SRI archaeologists excavated about 3,800 m^2 of intact deposits in that area, with an average thickness of approximately 50 cm.

This work provided a means of better defining the western boundary of LAN-2768, because intact subsurface deposits did not extend west of the previously defined western boundary of Locus A. It also confirmed the presence of intact prehistoric midden remains near the base of the bluff, a pattern also observed elsewhere in the PVAHP project area. In addition, the generally thin midden deposits in that area suggested truncation resulting from past earthmoving activities in the area, most likely by Hughes Aircraft Company in the mid-1900s. To the west of Locus A, a number of trenches revealed secondary deposits of cultural materials that clearly had been redeposited as fill during the Hughes era.

Summary

The excavations at LAN-2768 revealed a long scatter of prehistoric midden deposits that mostly dated to the early Intermediate period (see below). The prehistoric midden deposits were concentrated on the alluvial fan, within about 30 m of the base of the bluff. Those deposits were more or less continuous along the bluff throughout the site area, with varying densities, but the majority of features were concentrated in two locations: Loci A and C/D (the southernmost extent of Locus D and continuing into adjacent Locus C). Most of the features uncovered in Locus B related to occupations during the early to mid-1900s.

In total, 79 features were recorded during the data recovery at LAN-2768. The majority of prehistoric features appeared to be thermal or nonthermal rock clusters, including hearth-cleanout deposits and other refuse deposits. The artifacts from features and CUs (general midden areas) were predominately lithic materials, including FAR, manuports, ground stone artifacts (manos, metates, pestles, mortars, and bowl fragments), and flaked stone tools and debris (cores, flakes, and flaked stone tools). Historical-period remains included leaching pits, railroad-related features, several wells or cisterns, and various trash deposits. Recovered historical-period materials included glass, metal, ceramics, pipe fragments, and wooden objects.

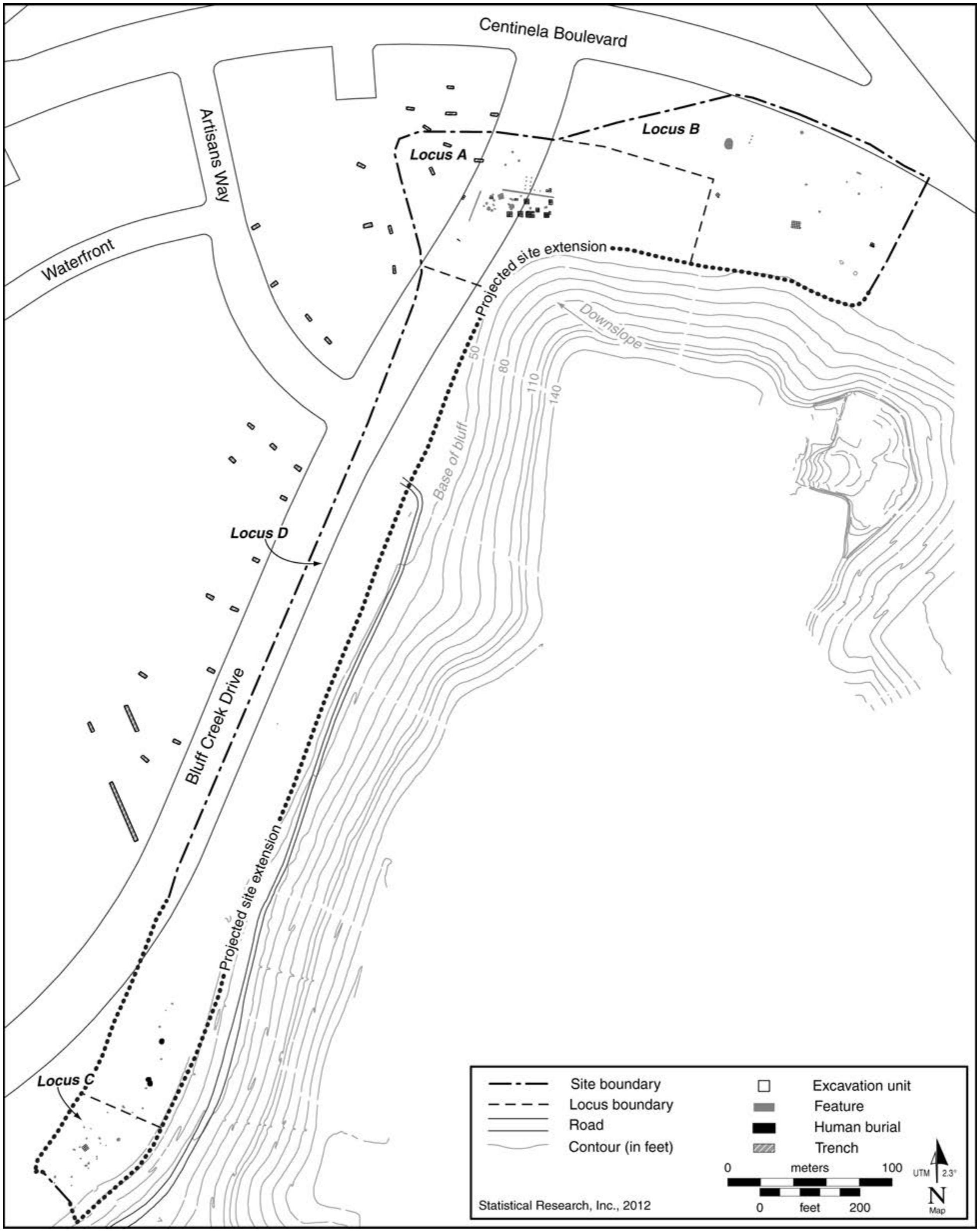

Figure 110. Trenches excavated for the Tishman Speyer Properties project, 2007, LAN-2768.

Laboratory Methods

This section provides a summary of the laboratory methods related to washing, cataloging, sorting, QA, and curation of all materials recovered during the various data recovery excavations at LAN-2768. Below, we outline the stages of materials processing, including screening, sorting, inventory tracking, and sample selection for the analyses of specific artifact classes and other materials. Note that the sorting procedures varied slightly between the 2000 and 2007 data recovery projects. A general discussion of the laboratory procedures is presented in Chapter 4, this volume; we focus here on the aspects of the laboratory methods that related specifically to LAN-2768.

Screening

The first stage in materials processing was screening of the soil matrix excavated during fieldwork. Excavated materials from units and portions of some SUs were wet screened using a 1/8-inch-mesh screen. For all nonburial features, materials were processed with a flotation device. Soils from burial features recovered during stripping of the Riparian Corridor were dry screened using 1/16-inch-mesh screen. Matrix from proveniences with isolated human remains was dry screened in the field, using 1/8-inch-mesh screen. During the 2007 data recovery in Locus B, the excavated soils were first dry screened through 1/8-inch-wire-mesh screens and later wet screened using 1/8-inch-wire-mesh screens.

All screened materials were dried (including rock and pebbles), placed in reclosable plastic bags, grouped with materials from the same provenience unit, and shipped to SRI's Redlands laboratory facility for sorting and analysis. Fragile items, such as faunal bone and rusted metal, were cleaned with a dry brush to remove soil deposits. Selected items were left unwashed for residue analysis, pollen wash, or other analysis of minute residues.

Sorting Procedures

The sorting procedures varied for different recovery contexts at LAN-2768. Excavated soils from EUs, nonburial features, burial features, column samples (flotation), and SUs required different sorting protocols. In addition, sorting procedures changed over time. The earlier sorting procedures employed in connection with the data recovery excavations in 2000 were slightly altered during later excavations in 2007. We separately review the various sorting procedures for each recovery context below.

The bulk materials recovered from the EUs during the 2000 investigations were sorted using a series of nested screens with 2-inch, 1-inch, 1/2-inch, and 1/4-inch mesh. FAR fragments from the 2-inch- and 1-inch-mesh screens were collected and separately bagged for analysis; smaller FAR fragments recovered in the 1/2-inch- and 1/4-inch-mesh screens were not collected. All other materials were sorted according to the four mesh-size categories and basic material types, including worked and unworked bone, worked and unworked shell, historical-period artifacts, lithic artifacts, and a miscellaneous "other" category that encompassed such materials as fired clay, seeds, wood, asphaltum, ochre, and various low-frequency materials. The sorting criteria for the artifact types and material classes from LAN-2768 are presented in Appendix 7.1, this volume. The materials assigned to each of the material categories were bagged separately and labeled for analysis. Unworked shell and charcoal fragments were recorded by weight (in grams); all other materials categories were recorded by count. The remaining rocks and gravels, materials smaller than 1/4 inch in size (i.e., not collected in the sorting screens), and FAR fragments smaller than 1 inch in size were rebagged in their original containers and set aside for curation.

Materials from nonburial features were sorted using the same procedures. However, a 1/8-inch-mesh screen was added to refine the size-sorting criteria. The materials from the 1/8-inch-mesh screen were partially sorted for well-formed and diagnostic artifacts only. The purpose of that sorting method was to locate diagnostic artifacts and other "high-priority" materials that were rare or not present in the hand-excavated units (see Appendix 7.2, this volume).

The screened materials collected during excavation of the SUs were not size-sorted but were scanned for artifacts, human bone, and diagnostic faunal bone. The material classes segregated from the bulk materials and saved for analysis included potential human-bone fragments, diagnostic faunal bone, possible lithic tools, worked bone and shell, and "other" artifacts and materials of special significance (see above).

Different sorting procedures were used for processing materials from burial features and proveniences with isolated human remains at LAN-2768. The bulk materials from SUs were sorted using a single screen with 1/2-inch mesh. The laboratory technicians segregated and separately bagged all bone fragments and teeth collected in the 1/2-inch screen for detailed analysis. The remainder of the bulk materials (other than bones and teeth) was scanned for diagnostic artifacts, formed tools, and other rare artifacts. No unworked shell, unworked bone, or nondiagnostic materials (flakes, FAR, or unworked stone materials) were collected from those proveniences. Only human-bone fragments and temporally diagnostic artifacts were collected from the smaller materials not collected in the 1/2-inch screen. All other materials were rebagged and placed in their original containers.

The heavy fractions from flotation samples were sorted through a series of five nested screens with 2-inch, 1-inch, 1/2-inch, 1/4-inch, and 1/8-inch mesh. However, only materials collected in the 1/4-inch-mesh screens and larger were segregated and bagged for detailed analysis; the sorting methods were the same as those employed for the CUs (see above). The material collected in the 1/8-inch-mesh screen were scanned for rare or diagnostic artifacts and noted in the database. The remaining materials from the 1/8-inch-mesh screen were not analyzed.

The sorting procedures used to process materials excavated in 2007 varied slightly from those employed in 2000. All bulk materials were sifted through only two nested screens with 1/4-inch and 1/8-inch mesh. The materials were then sorted according to the two size categories and the basic material types, including worked and unworked bone, glass, diagnostic historical-period artifacts, metal fragments, seeds, mineral samples, and worked and unworked shell. The smaller materials that passed through the 1/8-inch screen were scanned for diagnostic or important artifacts.

Inventory Tracking

The inventory information was entered into a relational database (see Chapter 4, this volume, for details on inventory tracking). After the data entry was complete, the laboratory director reviewed all data records for errors and inconsistencies and compared the data entered with the in-field counts and descriptions, to better ensure accuracy. The database was then made available to the individual materials analysts (e.g., lithic or faunal) for detailed classification and analysis. The database also was used to generate summary reports per provenience.

Analysis and Sampling

The excavated portion of LAN-2768 covered a large area and included a large number of features and EUs. Accordingly, a relatively large number of features were selected for analyses. Most of the features and CUs selected for analysis were from Loci A (2000) and B (2005), the main foci of data recovery excavations.

Locus A

The purpose of the CU analyses was to evaluate the "background" of midden deposits in different areas of the locus. The units selected for that analysis from Locus A included CUs 2/22 (considered one analytical unit), 20/21 (one analytical unit), 3, and 8. The units were spaced to provide samples of materials from all areas of the site (Figure 111). As explained above, CUs 2 and 22 and CUs 20 and 21 were adjacent units situated on the "steps" alongside the stepped trenches (Linear Trenches 2 and 5). In both cases, one unit was excavated in the upper step, to obtain a profile of the upper soil strata, and the other was excavated in the lower step, to obtain a profile of the deeper soil strata. Thus, the two units provided information concerning a single stratigraphic profile. Otherwise, these units were spatially segregated and encompassed distinct geomorphological contexts. CUs 2/22 were situated in the interface of the relict marsh and the alluvial fan adjacent to the Ballona Escarpment; the other units were located in fine-grained alluvial-fan deposits (see below).

Features selected for analysis included 17 nonburial features (Features 3, 10, 12, 14, 15, 18–20, and 23–31) (Table 25), which accounted for 57 percent of features in Locus A (17 of 29). The features included rock clusters, artifact concentrations, artifact scatters, and a possible structure floor later reused as a roasting pit (Feature 24). Most of the selected features (12 of 17) were interpreted as domestic-discard areas of some sort, including debris from hearth-cleanout episodes (6 features). One other feature appeared to have functioned as a hearth. Yet another may have functioned as a cairn or a rock-lined post support. Two intramural features associated with Feature 24 may have functioned as cooking or storage pits. The features not selected for analysis included various domestic-discard areas.

Exceptions to this sampling strategy were made for some material classes. For example, historical-period artifacts recovered during excavations of prehistoric features were not analyzed, because they did not contribute to the feature interpretation. Worked shell was not recovered from any of the features in Locus A. Also, given the large quantities of faunal remains from the PVAHP sites, only a subset of the selected features were sampled for invertebrate- and vertebrate-faunal analysis. In Locus A, faunal analysis focused only on CUs 3 and 8 and the nonburial features. The rationale for selecting those features and CUs for analysis is discussed in various chapters in Volume 3, this series.

Locus B

Three CUs in Locus B were selected for analysis: MEUs 502, 504, and 524. They were the southeastern units in each of the three excavation blocks in the eastern, central, and western portions of the locus (see Figure 109). The two prehistoric features discovered during data recovery also were selected for analysis (Features 113 and 114). None of the historical-period features was subjected to detailed analysis.

Loci C and D

Three burial features discovered during monitoring of the Riparian Corridor in 2005 were selected for analysis (Features 108, 109, and 112) (see Figures 107 and 108). They were the only human-burial features found at LAN-2768, although scattered fragments of cremated human bone were found in Locus A (see above). The human remains from the burial features were analyzed by SRI staff osteologists. No EUs were selected for analysis from Loci C and D. Detailed descriptions and analyses of these burial features are presented in Volume 4, this series.

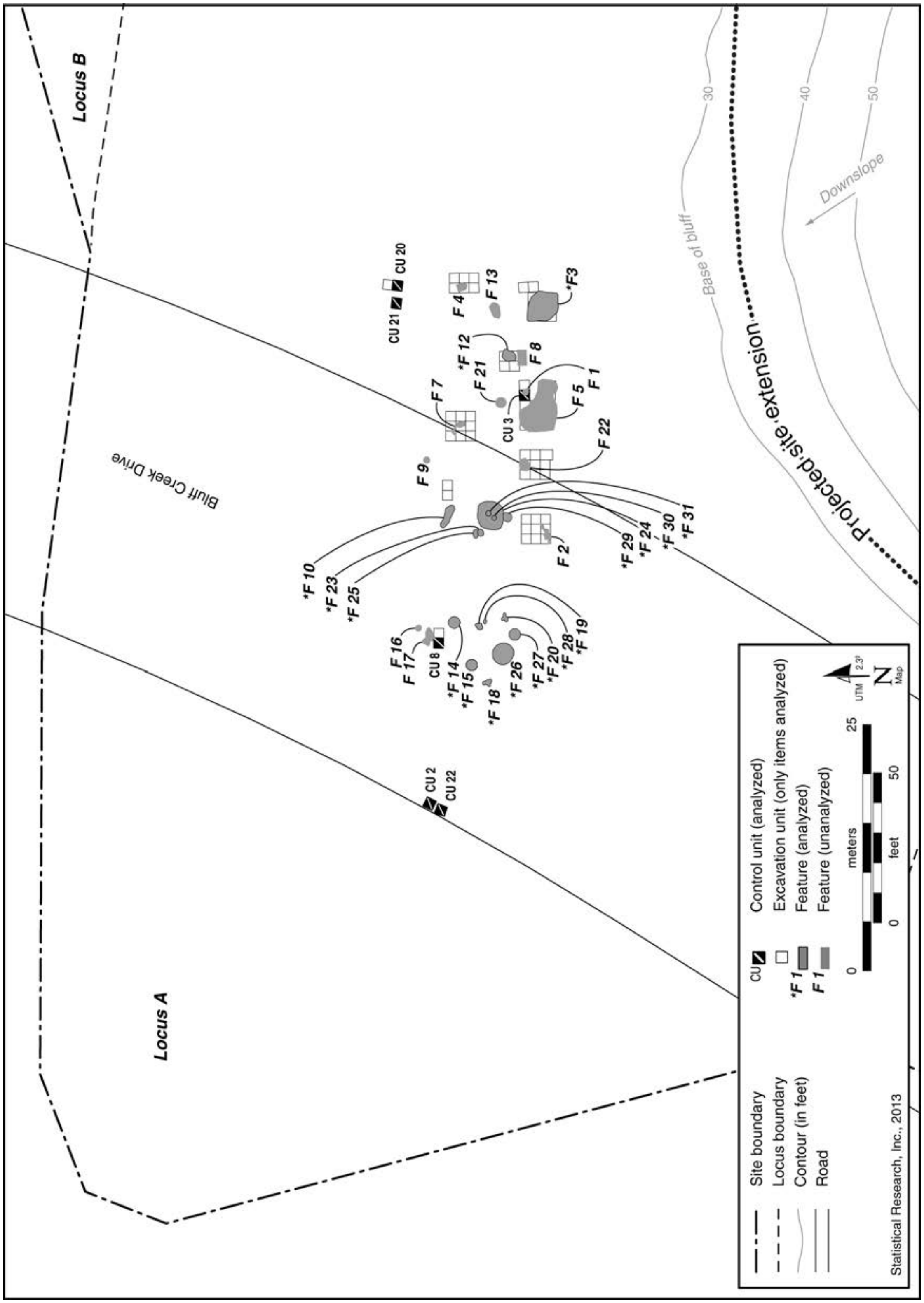

Figure 111. Map showing the locations of CUs and features selected for analysis, LAN-2768 Locus A.

Table 25. Features Selected for Analysis, LAN-2768

Feature No., by Locus	Feature Type	Lithics	Vertebrates	Invertebrates	Worked Shell	PEB
Locus A						
3	FAR concentration, no pit	x	x	x	x	
10	FAR concentration, no pit	x	x	x	x	
12	FAR concentration, in pit	x	x	x	x	x
14	FAR scatter	x	x	x	x	
15	lithic/ground stone concentration, no pit	x	x	x	x	
18	FAR concentration, no pit	x	x	x	x	x
19	FAR concentration, no pit	x	x	x	x	x
20	FAR scatter	x	x	x	x	x
23	lithic/ground stone concentration, no pit	x	x	x	x	
24	FAR concentration, in pit/possible structure	x	x	x	x	x
25	general/multiple artifact concentration, no pit	x	x	x	x	x
26	lithic/ground stone concentration, no pit	x	x	x	x	
27	FAR concentration, no pit	x	x	x	x	
28	lithic/ground stone scatter	x	x	x	x	
29	lithic/ground stone concentration, no pit	x	x	x	x	x
30	FAR concentration, in pit/intramural pit	x	x	x	x	x
31	FAR concentration, in pit/intramural pit	x	x	x	x	x
Locus B						
113	FAR scatter	x	x	x	x	
114	FAR scatter	x	x	x	x	x
Locus D						
108	human burial	x				x
109	human burial			x		x
112	human burial	x				x

Key: PEB = paleoethnobotany.

Environmental and Chronometric Reconstructions

In this section, we discuss the history of natural deposition and human land use at LAN-2768, based on analyses of soil-formation processes, and detailed chronometric data is discussed. Most of the site matrix at LAN-2768 consists of alluvial-fan sediments that have accumulated along the base of the bluff. However, late Holocene marsh deposits were evident in areas more distant from the bluff, in the relict floodplain of Centinela Creek (see Volume 1, this series). Soil profiles in these various depositional contexts were analyzed, to aid in reconstruction of the paleoenvironment. In addition, radiocarbon dates from excavation contexts facilitated inferences of approximate date ranges for the depositional episodes in both the fan and marsh deposits.

We describe first the natural stratigraphy of the area, in order to reconstruct the changing paleoenvironment, and then the cultural stratigraphy and the occupation episodes inferred from chronometric data, time-sensitive artifacts, and detailed analyses of stratigraphic soil profiles.

Natural Stratigraphy

Stratigraphic information for 12 soil profiles in Loci A, B, and C of LAN-2768 was recorded and analyzed. Rather than describe each of the profiles and present repetitive data, the following discussion presents the natural stratigraphy inferred from detailed inspections of a sample of 6 profiles in different locations within the three loci. The selected profiles were the following:

- Profile 1 (Locus A, northern wall of Linear Trench 1) (Figure 112),
- Profile 5 (Locus A, northern wall of Linear Trench 2) (Figure 113),
- Profile 10 (Locus B, southern wall of CUs 524 and 525) (Figure 114),
- Profile 11 (Locus B, southern wall of CUs 504 and 505),
- Profile 12 (Locus B, western wall of CUs 501 and 502), and
- Profile 8 (Locus C, southern wall of CU 9001) (Figure 115).

In Locus A, Profiles 1 and 5 encompassed the low alluvial-fan and Holocene marsh deposits (respectively). In Locus B, Profiles 10 and 11 were located at the juncture between the foot slope and the toe slope of the alluvial fan, near the center and western end of Locus B. Profile 12 was located in the toe slope of the fan, near the eastern edge of the locus. In Locus C, Profile 8 was located in an area of alluvial-fan deposits. Overall, Profiles 1, 8, 10, 11, and 12 characterized alluvial-fan deposits along the base of the bluff in Loci A, B, and C, and Profile 5 characterized the marsh deposits in the northern portion of locus A. We separately discuss the results from Loci A, B, and C below.

Five distinct stratigraphic units were identified in Profile 1, and eight were identified in Profile 5 of Locus A. Xix stratigraphic units were described in Profile 10, four were described in Profile 11, and five were described in Profile 12 of Locus B. In Locus C, 6 stratigraphic units were identified in Profile 8. Given this variability, we present the stratum descriptions separately for each profiled unit, but stratum designations have been partially standardized among the loci: in all three loci, Stratum II consisted of sandy loam to loamy sand alluvial-fan sediments, and Stratum III consisted of loam to silty clay loam marsh or slack-water deposits.

Stratum Descriptions

Several profiles were studied to reconstruct the landscape and included profiles in Loci A, B, and C.

Locus A: Alluvial Fan

Profile 1 (Linear Trench 1) was located within a low alluvial fan below the Ballona Escarpment, near the southern edge of the locus (Table 26; see Figures 103 and 112). It was situated within a well-drained portion of the alluvial fan and consisted of alluvial and colluvial sands that had accumulated during episodic floods and erosion from the overlying bluffs. In general, the pH levels of fan deposits in Linear Trench 1 were moderately alkaline (pH 7.2–8.1) (see Table 26).

Stratum I, the deepest stratum of Profile 1 (106–120 cm below the surface [cmbs]), revealed a Bk horizon consisting of brown and dark-brown, hard sand. The sediments in this horizon have massive structure and moderate amounts of fine, medium, and coarse subangular and subrounded gravels (less than 3 percent) and are noneffervescent and moderately alkaline (pH 8.1). No artifacts, bone, or shell remains were recovered from this stratum.

Stratum II is a weakly developed A horizon with four subunits (A1, A2, A3, and AB horizons) and is composed of dark-gray to dark-grayish-brown loamy sand with massive structure. Subangular and subrounded gravels are present but sparse, fining upward (1–3 percent). In general, the pH for the A1 and A2 horizons was neutral (pH 7.2 and 7.3, respectively), but the pH for the A3 and AB horizons was slightly alkaline (pH 7.5 and 7.7, respectively). These subunits generally contained sparse shell and faunal remains, except in the A3 horizon, where only shell was present. A compacted area was present in the uppermost A1 horizon and likely was formed during the Hughes era, from the weight of heavy machinery.

Locus A: Holocene Marsh

Profile 5 (Linear Trench 2) (see Figure 113) was located within a seasonally inundated marsh deposit in the Ballona/Centinela Creek floodplain in the northern part of Locus A (Table 27; see Figure 103). In general, the pH levels of the marsh deposits were moderately alkaline (pH 7.6–8.0) (see Table 27). Sediment deposits consisted of primarily fine-grained Holocene stream alluvium likely deposited during periods of marsh encroachment at the base of the alluvial fan (see Figure 113). In contrast to the well-drained sediments on the alluvial fan, the soil-sediment characteristics of Profile 5 indicated that this area of the site was repeatedly inundated by flooding during the Holocene.

Stratum I (3C4 horizon), the deepest stratum in Profile 5, is approximately 13 cm thick and consists of very-dark-gray to black loam with some yellowish-brown mottling. The sediments are massive in structure and slightly alkaline in pH (7.7) and contain no gravels or roots. These sediments were likely deposited in a low-energy backwater of Centinela Creek.

Stratum II includes four subunits (2C1, 2C2, 2C3, and AC horizons), each ranging from 9 to 15 cm in thickness and containing no gravels or roots. The lowest subunit of Stratum II (2C3) consists of an olive-colored silt loam with fine, yellowish-brown mottling and is moderately alkaline (pH 8.0). The subunits overlying the silt loam are composed of light-gray sand (2C2) and light-gray sand to loamy sand (2C1) and are slightly alkaline (pH 7.7 and 7.8, respectively). The AC horizon is composed of gray to dark-gray sandy clay loam with some yellowish-brown mottling. Like subunits 2C2 and 2C1, the AC horizon is slightly alkaline (pH 7.7). Each subunit is distinctive, and there are abrupt smooth boundaries between them; the shift from silt loam to sand to sandy clay loam suggests that these subunits represent changes in the depositional environment. The lowest part of

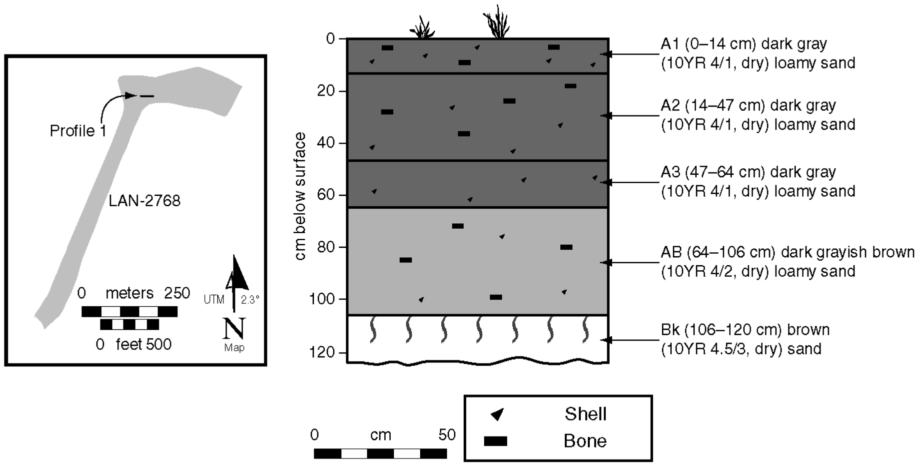

Figure 112. Profile 1, LAN-2768 Locus A.

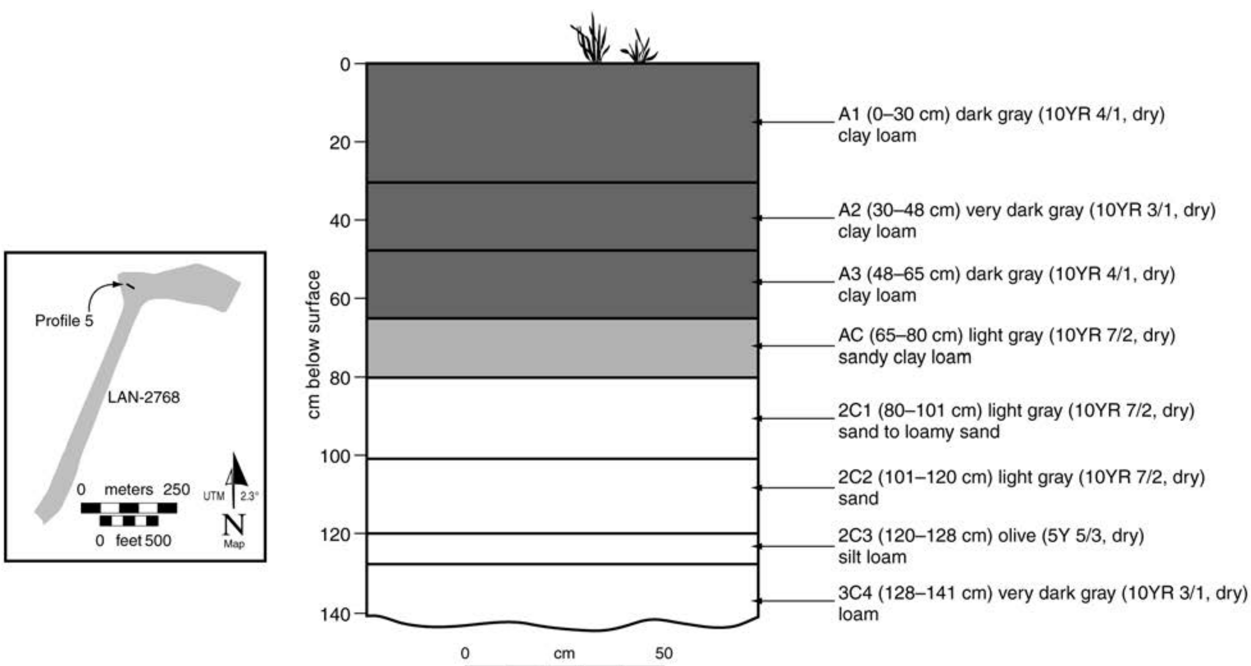

Figure 113. Profile 5, LAN-2768 Locus A.

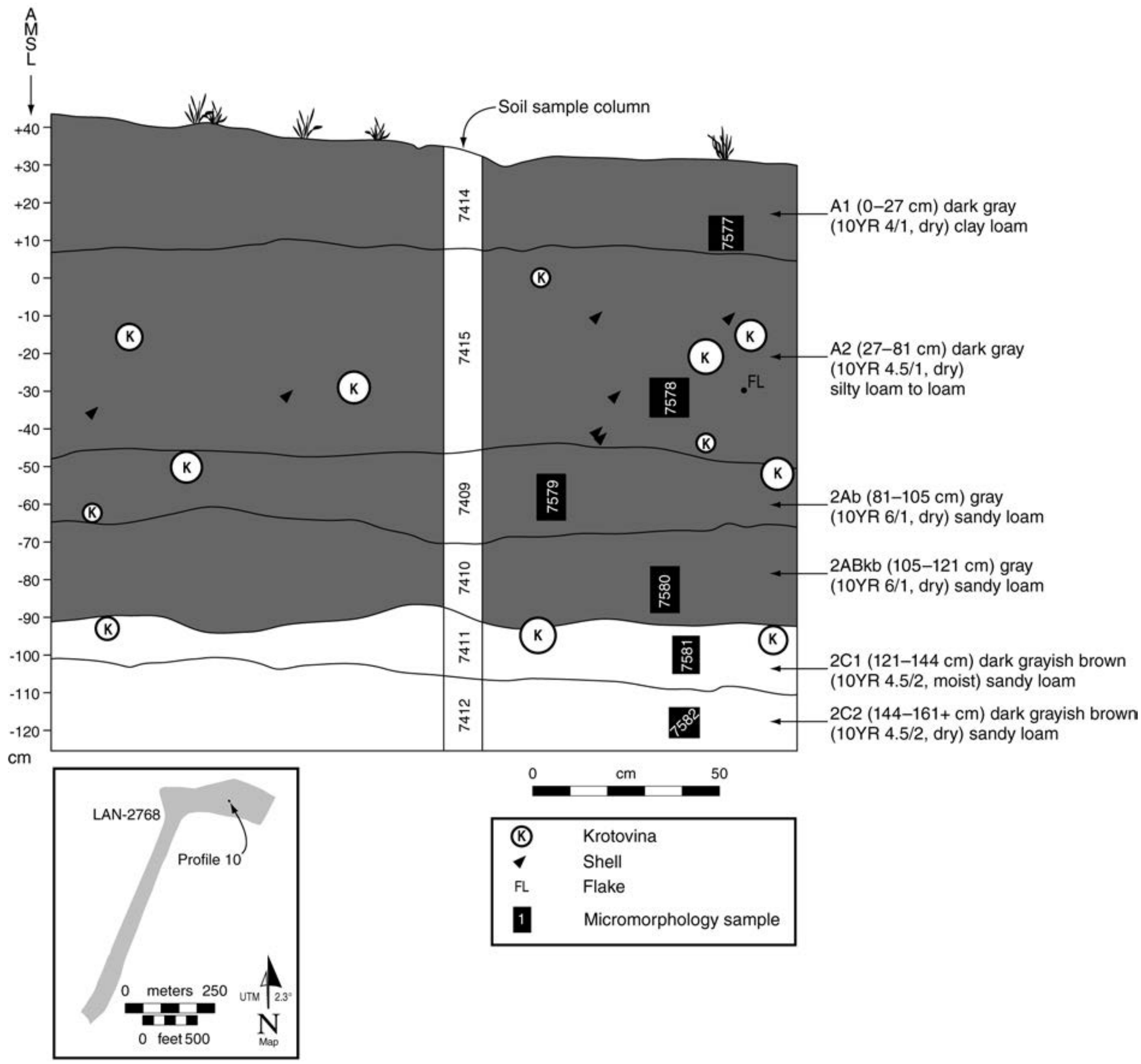

Figure 114. Profile 10, LAN-2768 Locus B.

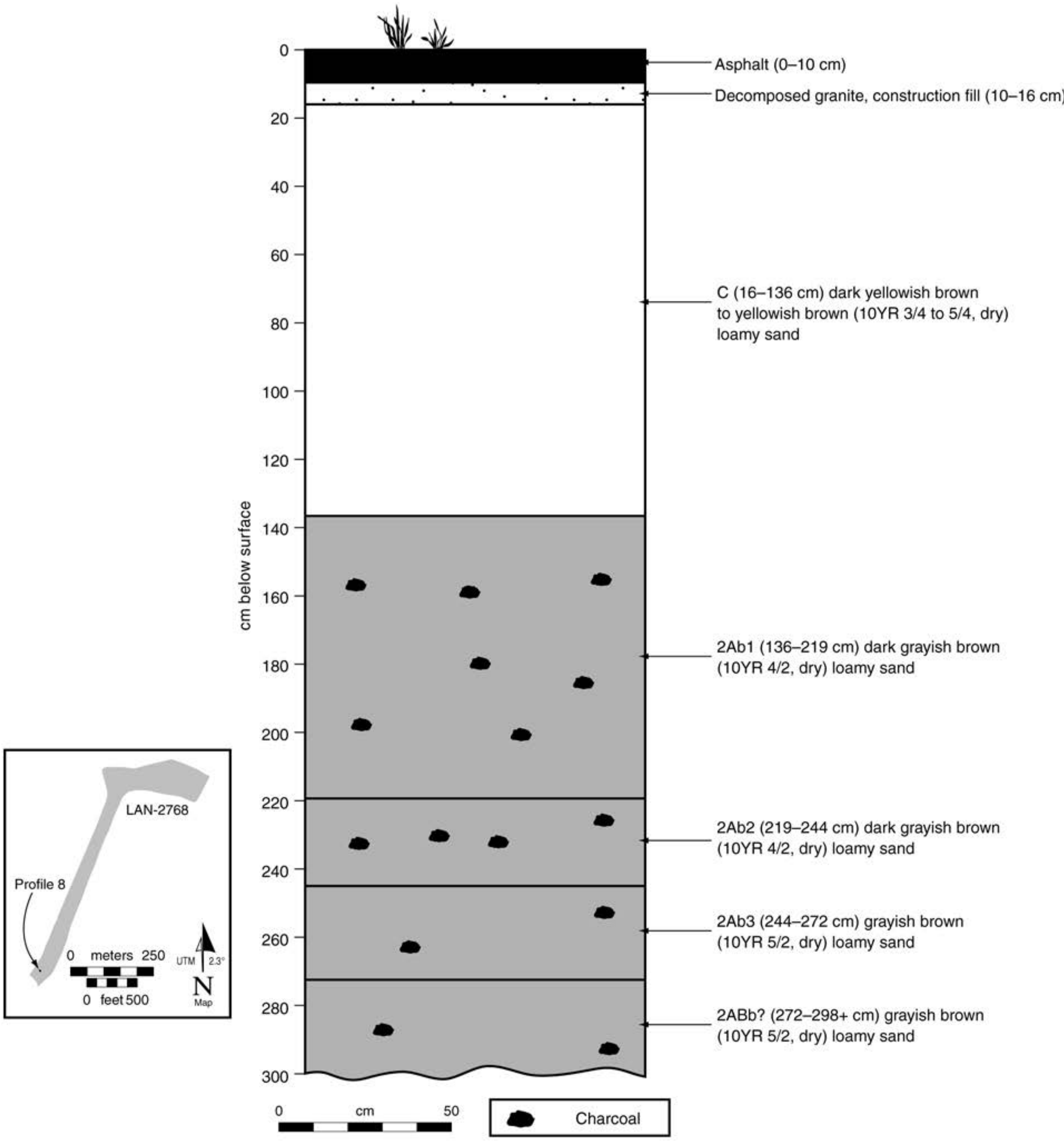

Figure 115. Profile 8, LAN-2768 Locus C.

Table 26. Profile 1 (Linear Trench 1), LAN-2768 Locus A

Horizon	Depth (cmbs)	Description	Stratum	Notes
A1	0–14	Dark-gray (10YR 4/1) loamy sand (very dark gray [10YR 3/1] moist); massive structure; very hard, nonsticky, nonplastic; ~1% fine subrounded to rounded gravel; no roots; noneffervescent; neutral (pH 7.2); clear smooth boundary; contains sparse shell and bone.	II	Compacted traffic pan due to the weight of heavy machinery.
A2	14–47	Dark-gray (10YR 4/1) loamy sand (dark gray [10YR 3/1] moist); massive; moderately hard, firm, nonsticky, nonplastic; ~3% fine, medium, and coarse subangular and subrounded gravel; no roots; slightly effervescent; neutral (pH 7.3); clear smooth boundary.	II	Alluvial-fan deposits; sparse shell and bone.
A3	47–64	Dark-gray (10YR 4/1) loamy sand (dark gray [10YR 3/1] moist); massive; slightly hard, friable, nonsticky, nonplastic; ~3% fine, medium, and coarse subangular and subrounded gravel; no roots; strongly effervescent; slightly alkaline (pH 7.5); gradual smooth boundary.	II	Alluvial-fan deposits; sparse shell.
Ab	64–106	Dark-grayish-brown (10YR 4/2) loamy sand (brown to dark brown [10YR 4/3] moist); massive; hard, firm, nonsticky, nonplastic; ~3% fine, medium, and coarse subangular and subrounded gravel; no roots; strongly effervescent; slightly alkaline (pH 7.7); clear smooth boundary.	II	Alluvial-fan deposits; sparse shell and bone.
Bk	106–120+	Brown (10YR 4.5/3) sand (dark brown [10YR 3.5/3] moist); massive; hard, firm, nonsticky, nonplastic; ~3% fine, medium, and coarse subangular and subrounded gravel; no roots; noneffervescent; moderately alkaline (pH 8.1).	I	Alluvial-fan deposits; No artifacts or ecofacts.

Table 27. Profile 5 (Linear Trench 2), LAN-2768 Locus A

Horizon	Depth (cmbs)	Description	Stratum	Notes
A1	0–30	Dark gray (10YR 4/1) clay loam (very dark gray [10YR 3/1] moist) with few distinct, fine to medium yellowish-brown (10YR 5/6 moist) mottles; moderate coarse to very coarse prisms; very rigid, rigid, very sticky, very plastic; no gravel; no roots; slightly effervescent; slightly alkaline (pH 7.6); clear smooth boundary.	III	Alluvial-fan deposits.
A2	30–48	Very-dark-gray (10YR 3/1) clay loam (black [10YR 2/1] moist); moderate coarse prisms, parting to strong coarse granules; moderately hard, firm, nonsticky, nonplastic; no gravel; no roots; slightly effervescent; slightly alkaline (pH 7.7); clear smooth boundary.	III	
A3	48–65	Dark-gray (10YR 4/1) clay loam (very dark gray [10YR 3/1] moist) with common distinct, medium yellowish-brown (10YR 5/6 moist) mottles; weak to moderate coarse granules; weak to moderate slightly hard, friable, nonsticky, nonplastic; no gravel; no roots; strongly effervescent; slightly alkaline (pH 7.7); clear smooth boundary.	III	
AC	65–80	Gray (10YR 5/1) sandy clay loam (dark gray [10YR 4/1] moist) with common distinct, fine to medium yellowish-brown (10YR 5/6 moist) mottles; massive; hard, firm, nonsticky, nonplastic; no gravel; no roots; strongly effervescent; strongly alkaline (pH 7.7); abrupt smooth boundary	II	Minor flood deposition and stable backwater.
2C1	80–101	Light-gray (10YR 7/2) sand to loamy sand (light brownish gray [10YR 6/2] moist) with few prominent, fine yellowish-brown (10YR 5/6 moist) mottles; massive; hard, firm, nonsticky, nonplastic; no gravel; no roots; strongly effervescent; slightly alkaline (pH 7.8); clear smooth boundary.	II	

Horizon	Depth (cmbs)	Description	Stratum	Notes
2C2	101–120	Light-gray (10YR 7/2) sand (light brownish gray [10YR 6/2] moist) with common prominent, fine yellowish-brown (10YR 5/6 moist) mottles; massive; hard, firm, nonsticky, nonplastic; no gravel; no roots; slightly effervescent; slightly alkaline (pH 7.7); abrupt smooth boundary.	II	
2C3	120–128	Olive (5Y 5/3) silt loam (olive [5Y 4/3] moist) with few prominent, fine yellowish-brown (10YR 5/6 moist) mottles; massive; hard, firm, nonsticky, nonplastic; no gravel; no roots; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.	II	Low-energy backwater of Centinela Creek.
3C4	128–141+	Very-dark-gray (10YR 3/1) loam (black [10YR 2/1] moist) with common distinct, fine yellowish-brown (10YR 5/8 moist) mottles; massive; hard, firm, nonsticky, nonplastic; no gravel; no roots; slightly effervescent; slightly alkaline (pH 7.7).	I	

the stratum appeared to represent a low-energy backwater area of Centinela Creek that was subsequently inundated by minor flood deposits. In the past, after floodwaters subsided, a relatively stable backwater surface was consistently established in this area.

Stratum III (A1, A2, and A3 horizons) is composed of dark-gray to very-dark-gray clay loam deposits with some yellowish-brown mottling and contains no gravels or roots. The loamy sediments of Stratum III, found from 0 to 65 cmbs, contain a moderately developed soil. Overall, the A horizon possesses well-developed pedogenic properties, including moderate to strong granular structure.

Locus B

The stratigraphic profiles varied in different areas of Locus B. Therefore, we separately describe the strata in each of the three analyzed profiles. Profile 10 in Locus B was located at the juncture of the foot slope and toe slope of the alluvial fan and was composed of sandy loam sediments derived from episodic floods and erosion from the Ballona Escarpment in the late Holocene (Table 28; see Figure 114). The fan alluvium is overlain by a silt loam to clay loam marsh deposit from 0 to 81 cmbs, representing encroachment of the marsh in that section of the fan. The fan and marsh deposits were moderately alkaline, with pH values of 8.0–8.1 (see Table 28). Only Strata II and III were recorded in Locus B.

Stratum II in Profile 10 (2C2, 2C1, 2ABkb, and 2Ab horizons) consists of a fining-upward sandy loam fan deposit with weak soil development. The soil is composed of a dark-gray 2Ab horizon underlain by a gray 2ABkb horizon and a dark-grayish-brown C horizon. This soil has massive structure, is moderately alkaline (pH 8.0), and has slight effervescence throughout. The 2ABkb and 2Ab horizons had sparse lithic and faunal concentrations, and the 2C1 and 2C2 horizons contained noncultural faunal remains associated with krotovina. The fining-upward sequence of sandy loam sediments suggested a relatively continual alluvial sedimentation followed by a period of geomorphic stability during which soil formation took place.

Stratum III in Profile 10 (A1 and A2 horizons) consists of a black to very-dark-brown silt loam to clay loam marsh deposit that extends from 0 to 81 cmbs. The A2 horizon has developed weak coarse subangular blocky structure and is moderately alkaline (pH 8.1) and has negative effervescence. A few fine subrounded to subangular gravels (less than 1 percent) were also present. The A2 horizon had moderate to high concentrations of lithic, shell, and faunal remains. This silt loam stratum represents a shift to a lower-energy backwater/marsh depositional environment. The upper 27 cm of Profile 10 is composed of an A1 horizon consisting of a black to very-dark-brown clay loam upper-marsh deposit that has moderate fine to coarse blocky structure and is moderately alkaline (pH 8.1) and noneffervescent. Stratum III had low concentrations of lithic and shell remains. This stratum represents continued low-energy deposition in a marsh or backwater environment.

Profile 11 in Locus B (CUs 504 and 505) also was located at the juncture of the foot slope and toe slope of the gently sloping alluvial fan that extends from the base of the Ballona Escarpment (Table 29). Three distinct strata were exposed, consisting of loamy sand to sandy loam fan alluvium and loam marsh deposits. These deposits displayed weak soil development and were neutral to moderately alkaline (pH 7.1–8).

Stratum IIa in Profile 11 (3Bwb horizon) consists of a very-dark-grayish-brown, massive loamy sand from 131 to 165+ cmbs, with common fine to coarse, strong-brown, spherical Fe^{3+} masses. This stratum was moderately alkaline (pH 8.0) and very slightly effervescent. Stratum IIa had very low shell and lithic densities and moderate concentrations of faunal remains. The loamy sand deposits within this stratum represent higher-energy alluvial deposition during episodic flooding events.

Stratum III (2ABkb1 and 2ABkb2 horizons) developed in loamy marsh deposits and displayed weak medium to coarse subangular blocky structure with medium to extremely

Table 28. Profile 10 (CU 524), LAN-2768 Locus B

Horizon	Depth (cmbs)	Description	Levels	Stratum	Notes
A1	0–27	Black to very-dark-brown (10YR 2.5/1 moist) clay loam (30% clay); moderate fine to coarse subangular blocky structure; rigid consistence, moderately sticky; moderately plastic; few subrounded and subangular gravels (<1%); common very fine to fine pores; noneffervescent; field pH 8.1; clear smooth boundary.	2–6	III	Marsh deposit with few artifacts and shell.
A2	27–81	Black to very-dark-brown (10YR 2.5/1 moist) silt loam to loam (25% clay); weak fine to coarse subangular blocky structure; extremely firm consistence; moderately sticky; moderately plastic; few subangular and subrounded gravels (<1%); common very fine to fine pores; noneffervescent; field pH 8.1; gradual smooth boundary.	6–11	III	Lower marsh deposit with highest artifact/shell density.
2Ab	81–105	Dark-gray (10YR 4/1 moist) sandy loam (10% clay); structureless massive; very firm consistence; nonsticky; nonplastic; few subangular and subrounded gravels (<1%); field pH 8.0; very slightly effervescent; few faint medium to coarse 10YR 4/6 (dry) spherical Fe^{3+} masses; clear smooth boundary.	11–13	II	Upper-fan deposits.
2ABkb	105–121	Gray (10YR 5/1.5 moist) sandy loam (8% clay); structureless massive; very firm consistence; nonsticky; nonplastic; few subangular and subrounded gravels (<1%); field pH 8.0; very slightly effervescent; many very to extremely coarse dendritic 10YR 4/1 (dry) noncemented carbonate masses in matrix; clear smooth boundary.	13–16	II	Fan deposit, bottom of cultural deposits.
2C1	121–144	Dark-grayish-brown (10YR 4.5/2) sandy loam (8% clay); structureless massive; friable consistence; nonsticky; nonplastic; few subangular and subrounded gravels (<1%); field pH 8.0; common coarse to very coarse distinct 10YR 2.5/1 to 10YR 4/6 (moist) cylindrical to irregular iron-manganese noncemented masses; 10YR 4.5/2 reduced matrix; clear smooth boundary.	16–17	II	Some bone (noncultural) in krotovina.
2C2	144–161+	Dark-grayish-brown (10YR 4.5/2) sandy loam (7% clay); structureless massive; friable consistence; nonsticky; nonplastic; few subangular and subrounded gravels (<1%); field pH 8.0; common coarse to extremely coarse distinct 10YR 2.5/1 to 10YR 4/6 (moist) cylindrical to irregular iron-manganese noncemented masses; 10YR 4.5/2 reduced matrix.	17–18	II	Some bone (noncultural) in krotovina.

Notes: Profile 10; profile PD 7379; profile-datum PD 7377; mapping-nail PD 7378; line-level elevation 5.64 m AMSL; slope = 3 percent; slope aspect = N (10°); block 3 CUs 524 and 525, southern wall; described by Jeff Homburg and Julie Minor 5/30/07. Parent material = Holocene fan alluvium/colluvium and marsh/river alluvium; landform = foot-slope/toe-slope juncture; no vegetation, mechanically removed; 1.5 m of fill over cultural deposits; recent fill is very compact; 3-cm-thick asphalt slab at top; fill mostly decomposed granite.

Table 29. Profile 11 (CU 504), LAN-2768 Locus B

Horizon	Depth (cmbs)	Description	Stratum	Notes
A	0–37	Dark-grayish-brown (10YR 4/2 moist) sandy loam (10% clay); structureless massive; friable consistence; nonsticky; nonplastic; few fine to coarse subrounded gravels (2%); no roots; field pH 7.1; very slightly effervescent; abrupt smooth boundary.	IIb	Fan alluvium, very compact at top.
2Abkb1	37–89	(10YR 3.5/2 moist) loam (22% clay); weak medium subangular blocky structure; firm consistence; slightly sticky; slightly plastic; common very fine roots and many very fine pores throughout; few fine to medium subrounded gravels (1%); field pH 8.1; very slightly effervescent; common coarse to extremely coarse 10YR 7/1 (dry) irregular and dendritic noncemented $CaCO_3$ masses on peds and in matrix; clear smooth boundary.	III	Edge of fan, with admixture of marsh deposit.
2ABkb2	89–131	(10YR 4/2 moist) loam (20% clay); weak medium to coarse subangular blocky structure; friable consistence; nonsticky; nonplastic; common very fine roots and many very fine pores throughout; few fine to medium subrounded gravels (4%); field pH 8.0; slightly effervescent; common medium to extremely coarse 10YR 7/1 (dry) irregular and dendritic noncemented $CaCO_3$ masses on peds and in matrix throughout; abrupt smooth boundary.	III	$CaCO_3$ accumulation from capillarity above groundwater; very sparse shell.
3Bwb	131–165+	Very-dark-grayish-brown (10YR 3/2 moist) loamy sand (6% clay); structureless massive; friable; nonsticky; nonplastic; few very fine roots throughout; field pH 8.0; very slightly effervescent; common fine to coarse 7.5YR 4/6 (moist) spherical Fe^{3+} masses.	IIa	Marks color change from C horizon, thus a cambic horizon.

coarse dendritic and irregular light-gray $CaCO_3$ masses (see Table 29). A calcic lens has developed in the 2ABkb2 horizon, representing the accumulation of carbonates from capillary action above the water table. The 2Abkb1 and 2ABkb2 horizons were moderately alkaline (pH 8.0–8.1) and very slightly to slightly effervescent. The lower 2ABkb2 horizon, from 89 to 131 cmbs, had dense concentrations of lithic and faunal remains. The overlying 2ABkb1 horizon had lower lithic and faunal densities but higher concentrations of shell.

In Stratum IIb in Profile 11 (A horizon), from 0 to 37 cmbs, a dark-grayish-brown A horizon has developed in sandy loam fan alluvium. This horizon had a neutral pH (7.1), is very slightly effervescent, has massive structure, and is highly compact. A few fine to coarse subrounded gravels (2 percent) were also present throughout. The compaction observed in the upper part of this horizon was likely the result of Hughes-era landscape modification by heavy machinery. Stratum IIb had sparse concentrations of lithic and shell remains and a low faunal density.

Finally, Profile 12 in Locus B was located in the upper toe slope of the alluvial fan that extends from the base of the Ballona Escarpment (Table 30). The stratigraphy exposed in this profile consisted of silty clay to silt loam marsh deposits and loam to sandy loam alluvial-fan sediments. The sediments throughout the profile were generally finer grained (higher clay and silt content) than those in Profiles 10 and 11.

Stratum IIIa in Profile 12 (3wb horizon) consists of dark-brown silty clay to silty clay loam—a marsh or backwater deposit (see Table 30). This soil horizon has developed weak subangular blocky structure and has many medium-yellowish-brown, dendritic Fe^{3+} masses. The silty clay sediments within this stratum represent a low-energy slack-water or marsh depositional environment.

The deposits within Stratum II (1Ab1 and 2Ab2 horizons) consist of sandy loam fan alluvium with a few fine subangular and subrounded gravels (less than 1 percent). The dark-grayish-brown 2Ab1 and 2Ab2 soil horizons have developed weak subangular blocky structure and are moderately alkaline (pH 8.0–8.1). The shift from silty clay sediments in Stratum IIIa to sandy loam deposits in Stratum II represents a shift from a low-energy slack-water environment to a higher-energy alluvial environment.

Stratum IIIb in Profile 12 (A and ABk horizons) is composed of a black A horizon underlain by a dark-gray ABk horizon developed in silt loam to silty clay loam marsh or slack-water sediments. These horizons have developed weak to moderate subangular blocky structure and are moderately alkaline (pH 8.1–8.2). The ABk horizon, from 26–65 cmbs, contained higher densities of lithics, shell, and faunal remains than did other horizons/stratums. Features 113 and 114 (both artifact concentrations) originated in the ABk horizon and extended into the underlying 2Ab1 horizon (Stratum II).

Table 30. Profile 12 (CU 501), LAN-2768 Locus B

Horizon	Depth (cmbs)	Description	Stratum	Notes
A	0–26	Black (10YR 2/1 moist) silty clay loam (30% clay); moderate (?) structure; very friable; moderately sticky; moderately plastic; few fine subrounded gravels (<1%); common very fine roots throughout and common very fine tubular pores; field pH 8.2; very slightly effervescent; abrupt smooth boundary.	IIIb	Marsh or slack-water sediments.
ABk	26–65	Dark-gray (10YR 4/1 moist) loam to silt loam (22% clay); weak (?) structure; very friable consistence; slightly sticky; slightly plastic; few fine subrounded gravels (<1%); common very fine roots throughout and common very fine tubular pores; field pH 8.1; slightly effervescent; abrupt smooth boundary.	IIIb	Marsh or slack-water sediments; peak in artifact/ecofact density; Features 113 and 114 originated in this horizon.
2Ab1	65–90	Dark-grayish-brown (10YR 4/2 moist) loam to sandy loam (18% clay); weak (?) structure; slightly rigid consistence; slightly sticky; slightly plastic; few fine subangular gravels (<1%); few very fine roots throughout and few very fine tubular pores; field pH 8.1; very slightly effervescent; abrupt smooth boundary.	II	Higher-energy alluvial environment.
2Ab2	90–114	Dark-grayish-brown (10YR 4/2 moist) loam to sandy loam (18% clay); weak (?) structure; slightly rigid consistence; slightly sticky; slightly plastic; few fine subrounded gravels (<1%); few very fine roots throughout and few very fine tubular pores; field pH 8.0; very slightly effervescent; abrupt smooth boundary.	II	Higher-energy alluvial environment.
3Bwb	114–130	Dark-brown (10YR 3/3 moist) silty clay to silty clay loam (42% clay); moderate (?) structure; slightly rigid consistence; very sticky; very plastic; no roots or pores; field pH 7.9; no effervescence; many medium 10YR 5/6 (moist) dendritic Fe^{3+} masses.	IIIa	Low-energy slack-water or marsh deposit.

Locus C

Profile 8 in Locus C (CU 9001) was located within an alluvial-fan deposit (Table 31; see Figure 115). The upper strata of Locus C had been subjected to modern construction disturbance. Asphalt was present from 0 to 10 cmbs, and construction fill, including decomposed granite and other debris, was present from 10 to 16 cmbs. The soil deposits from 16 to 136 cmbs were composed of a well-defined C horizon that appeared to represent deposits associated with the 1938 flood. Beneath those coarser flood deposits lay loamy sand that had accumulated during the Holocene as a result of episodic erosion of the adjacent bluff.

Stratum I includes four subunits (2Ab1, 2Ab2, 2Ab3, and 2ABb horizons) and was located from 136 to 298+ cmbs. It is composed of stratified loamy sand with massive structure; no gravels or roots were present in this stratum. Clear to gradual boundaries in sediment coloration is the primary characteristic differentiating the sediment horizons: the color grades upward from grayish brown to very dark grayish brown. The lower horizons—Subunits 2Ab2, 2Ab3, and 2ABb—are each approximately 25 cm thick and contain very little charcoal. In contrast, the uppermost 2Ab1 subunit contains abundant charcoal inclusions. Light-colored, vertical streaks were abundant in the 2Ab3 horizon but were less frequent in the other subunits.

Stratum II in Profile 8 (C horizon) is a well-defined horizon of highly stratified fan alluvium that likely formed during the 1938 flood. The dark-yellowish-brown to yellowish-brown loamy sands are massive in structure and extend from approximately 136 cmbs to the surface (below the construction fill). The stratum is capped by modern fill and contains less than 0.1 percent fine subangular and subrounded gravel and no roots. A sand-filled channel was evident from 103 to 136 cmbs and was marked by an abrupt smooth boundary. The upper portion of the C horizon was truncated by Hughes-era construction activities in the mid- to late 1900s.

Cultural Stratigraphy

To examine the correlation between the depositional history and the human occupation of LAN-2768, we plotted the elevations of excavated features and cultural materials recovered from the CUs and EUs relative to the natural stratigraphic horizons. In total, 23 radiocarbon dates from features and unit levels at LAN-2768 provided a means of dating the depositional contexts: 20 assays from Locus A, 2 from Locus B, and 1 from Locus C (Table 32). Analyzed specimens included 17 clamshells, 5 scallop shells, and 1 grass-seed

Table 31. Profile 8 (CU 9001), LAN-2768 Locus C

Horizon	Depth (cmbs)	Description	Stratum	Notes
Fill	10–16	Decomposed granite, construction fill.	n/a	Beneath the 0–10-cm asphalt parking lot.
C	16–136	Dark-yellowish-brown to yellowish-brown (10YR3/4 to 5/4) loamy sand (dark yellowish brown to light yellowish brown [10YR 4/4 to 6/4] moist); massive; soft to moderately hard, very friable to firm, nonsticky, nonplastic; ~0.1% fine subangular and subrounded gravel; no roots; noneffervescent; abrupt smooth boundary.	II	Probably relates to 1938 flood deposit; sand-filled channel cut into the fan alluvium.
2Ab1	136–219	Dark-grayish-brown (10YR 4/2) loamy sand (very dark grayish brown [10YR 3/2] moist); massive; slightly hard, friable, nonsticky, nonplastic; no gravel; no roots; noneffervescent; abrupt smooth boundary.	I	Coarse flood deposits accumulated during episodic erosion of bluff; concentration of charcoal 1.5 m west of southeastern corner of block.
2Ab2	219–244+	Dark-grayish-brown (10YR 4/2) loamy sand (very dark grayish brown [10YR 3/2] moist); massive; soft, very friable, nonsticky, nonplastic; no gravel; no roots; noneffervescent; gradual smooth boundary.	I	Coarse flood deposits accumulated during episodic erosion of bluff; sparse charcoal and light-colored vertical streaks.
2A3	244–272	Grayish-brown (10YR 5/2) loamy sand (dark grayish brown [10YR 4/2] moist); massive; soft, very friable, nonsticky, nonplastic; no gravel; no roots; noneffervescent; clear smooth boundary.	I	Coarse flood deposits accumulated during episodic erosion of bluff; sparse charcoal and light-colored vertical streaks.
2ABb?	272–298+	Grayish-brown (10YR 5/2) loamy sand (dark grayish brown [10YR 4/2] moist); massive; soft, very friable, nonsticky, nonplastic; no gravel; no roots; noneffervescent.	I	Coarse flood deposits accumulated during episodic erosion of bluff; sparse charcoal and light-colored vertical streaks.

Table 32. Radiocarbon Dates, LAN-2768

Material	Sample No.	Locus	Feature No.	CU No.	Level No.	Calendar Age (Standard)	Calendar Age (ΔR)	Episode No.
Littleneck clam	Beta-230294	A	30			600–210 B.C.	940–640 B.C.	1
Scallop	Beta-241771	B	113			530–190 B.C.	900–570 B.C.	1
Scallop	Beta-220630	A		20	2	460–150 B.C.	830–510 B.C.	1
Littleneck clam	Beta-230293	A	20			380–80 B.C.	770–430 B.C.	1
Venus clam	Beta-220640	A		3	3	350–20 B.C.	730–390 B.C.	2
Scallop	Beta-241770	B	114			350–20 B.C.	730–390 B.C.	2
Scallop	Beta-231607	A	31			330 B.C.–A.D. 10	720–380 B.C.	2
Venus clam	Beta-220635	A		8	10	330 B.C.–A.D. 20	720–370 B.C.	2
Littleneck clam	Beta-230289	A	12			320 B.C.–A.D. 30	710–370 B.C.	2
Venus clam	Beta-220637	A		8	3	270 B.C.–A.D. 70	700–340 B.C.	2
Venus clam	Beta-220639	A		3	5	250 B.C.–A.D. 80	700–330 B.C.	2
Venus clam	Beta-220632	A		8	5	210 B.C.–A.D. 100	670–300 B.C.	2
Venus clam	Beta-220634	A		20	2	190 B.C.–A.D. 110	610–220 B.C.	2
Venus clam	Beta-220636	A		8	8	170 B.C.–A.D. 130	560–190 B.C.	2
Venus clam	Beta-220638	A		3	7	160 B.C.–A.D. 140	540–190 B.C.	2
Venus clam	Beta-231606	A	20		1	160 B.C.–A.D. 140	540–190 B.C.	2
Venus clam	Beta-235884	A	18			150 B.C.–A.D. 160	510–180 B.C.	2
Venus clam	Beta-220629	A		8	7	110 B.C.–A.D. 270	470–80 B.C.	3
Scallop	Beta-230910	A	5			40 B.C.–A.D. 260	390–110 B.C.	3
Venus clam	Beta-235883	A	10			A.D. 20–330	360–50 B.C.	3
Venus clam	Beta-220631	A		3	11	A.D. 30–340	350–40 B.C.	3
Venus clam	Beta-220633	A		8	1	A.D. 250–560	120 B.C.–A.D. 190	4
Canarygrass	Beta-242490	C	300			A.D. 1480–1950		5

(*Phalaris* sp.) sample, all of which were submitted for AMS (see Chapter 3, this volume). Calibrated age ranges were calculated using OxCal v. 3.10 (Bronk Ramsey 1995). Unfortunately, no time-sensitive artifacts (e.g., certain styles of shell beads or projectile points) were recovered from features in LAN-2768 to support or augment the dates inferred from the radiocarbon assays.

In Chapter 3, this volume, stratigraphic locations and chronometric data were analyzed to infer eight relatively discrete occupation episodes within LAN-2768. The episode designations were standardized across the loci, to facilitate comparison between loci. The five earliest episodes were defined based on calibrated radiocarbon dates obtained from features and midden deposits; the sixth episode was defined based on the recovery, from a nonfeature context, of glass beads dated to the mid-1830s to the mid-nineteenth century (Chapter 6, Volume 3, this series). The final two episodes were represented by later, historical-period features and artifacts. The episodes were numbered 1–8; Episode 1 is the earliest component:

Episode 1: early Intermediate period (940–80 cal B.C.)
Episode 2: early to middle Intermediate period (730 cal B.C.–cal A.D. 160)
Episode 3: middle to late Intermediate period (470 cal B.C.–cal A.D. 340)
Episode 4: late Intermediate period (120 cal B.C.–cal A.D. 560)
Episode 5: Protohistoric to Mission period (cal A.D. 1500–1600/1780–1800)
Episode 6: Rancho period (A.D. 1834–1848)
Episode 7: Euroamerican period (A.D. 1848–1941)
Episode 8: HHIC (ca. 1941 to the 1980s)

The listed date ranges for Episodes 1–5 incorporated the 2σ ranges derived from both the standard and age-specific ΔR values. Note the substantial overlap among Episodes 1–4, all of which dated to the Intermediate period; however, statistical analyses of the radiocarbon data suggested discrete and separate groups.

The episodes were unevenly represented among the loci. Locus A, the most thoroughly studied of the loci, included Episodes 1–4. In Locus B, Episodes 2–4 were likely represented, but the dearth of radiocarbon dates made it difficult to distinguish between Episodes 2 and 3, and thus we applied a less-distinct Episode 2/3 in Locus B. In Locus C, one radiocarbon date from Feature 300 (hearth) produced a sigma range that encompassed the Protohistoric and Mission periods, which we designated as Episode 5. However, it is unlikely that most of the surrounding features were coeval with the hearth; based on the materials recovered from nearby LAN-193, we surmised that most of the surrounding features in Locus C and the southern portion of Locus D probably predated that feature; most likely dated to the Intermediate period. We suspect that most of those features dated to the Intermediate period, based on the prevalence of Intermediate period dates and the similarity of feature types from LAN-193 and the other loci of LAN-2768, as well as the absence of materials commonly associated with later occupations in the Ballona.

Importantly, the earlier episodes were combined into more-broadly defined period assignments for the analyses of artifacts and ecofacts presented in subsequent volumes. In the broader period assignments, all of the features and unit levels assigned to Episodes 1–4 were grouped into a single Intermediate period group. One reason for those episode combinations was that in some cases, the finer episode and subepisode distinctions resulted in reduced sample sizes that rendered them impractical for artifact and ecofact analyses. Additionally, the resolution of the radiocarbon dates was not always sufficient to support the detailed episode distinctions. Despite those limitations, our analyses of features and midden densities presented below relied on episode distinctions.

Episode Descriptions

The episodes were standardized across loci, and a single episode-classification system was developed to accommodate the three loci from which radiocarbon dates were obtained. Tables 33 and 34 list the episode assignments for, respectively, CU levels and features. Some of those proveniences were assigned to episodes based on radiocarbon dates, but most were not directly dated but, rather, were assigned to episodes based on stratigraphic associations with radiocarbon-dated features and unit levels.

The oldest episode documented at the site, Episode 1, was identified in the alluvial-fan deposits of Stratum II, based on four radiocarbon dates (two scallops and two clamshells) from Loci A and B, including two features in Locus A (Features 20 and 30), one CU in Locus A (CU 20), and Feature 113 in Locus B. The conventional dates from those three samples spanned 140 radiocarbon years but formed a statistically coherent temporal group. The combined sigma ranges (four assays combined) of 600–80 cal B.C. (standard ΔR) and 940–430 cal B.C. (age-specific ΔR) indicated a pooled date range of 940–80 cal B.C., suggesting occupation during the early Intermediate period. Although those date ranges overlapped with the dates for subsequent Episode 4 by approximately 250 calendar years, our chronometric analyses also indicated that the two episodes may be separated by as many as 130 calendar years (standard ΔR) or 150 calendar years (age-specific ΔR). Features 14, 15, 24, and 31 were assigned to Episode 1 based on stratigraphic associations.

Episode 2, which also was associated with alluvial-fan deposits in Stratum II, was identified from 13 radiocarbon assays (10 venus clamshells, 1 littleneck clamshell, and 2 scallop shells). Dated proveniences included four features in Locus A (Features 12, 18, 20, and 31), one feature in Locus B (Feature 114), and various unit levels in Locus A (portions of CUs 3, 8, and 20). Those assays produced a combined date range of 350–160 cal B.C. (standard ΔR) or 730–180 cal B.C. (age-specific ΔR) and a pooled date range of 730–160 cal B.C., suggesting occupation during the early

Table 33. Episode Assignments for CU Levels, by Locus, LAN-2768

Level No(s)., by CU No.	Natural Stratum	Episode No.	Cultural Period	Sigma Range[a]
		Locus A		
2				
1–4	A1	3	middle to late Intermediate	470 cal B.C.–cal A.D. 340
5–7	A2	2	early to middle Intermediate	730 cal B.C.–cal A.D. 160
8–10	A3	2	early to middle Intermediate	730 cal B.C.–cal A.D. 160
22				
1–2	A3	2	early to middle Intermediate	730 cal B.C.–cal A.D. 160
3–5	A4	2	early to middle Intermediate	730 cal B.C.–cal A.D. 160
6–8	A5	2	early to middle Intermediate	730 cal B.C.–cal A.D. 160
9–10	AB	2	early to middle Intermediate	730 cal B.C.–cal A.D. 160
11–12	Bw	1	early Intermediate	940–80 cal B.C.
3				
1–2	A	3	middle to late Intermediate	470 cal B.C.–cal A.D. 340
3–8	A	2	early to middle Intermediate	730 cal B.C.–cal A.D. 160
9–10	AB	2	early to middle Intermediate	730 cal B.C.–cal A.D. 160
11	AB	2/3	middle Intermediate	730 cal B.C.–cal A.D. 340
8				
1–2	A1	4	late Intermediate	120 cal B.C.–cal A.D. 560
3–5	A2	3	middle to late Intermediate	470 cal B.C.–cal A.D. 340
6	A3	3	middle to late Intermediate	470 cal B.C.–cal A.D. 340
7	A4	2/3	middle Intermediate	730 cal B.C.–cal A.D. 340
8–9	A4	2	early to middle Intermediate	730 cal B.C.–cal A.D. 160
10- 12	AB	2	early to middle Intermediate	730 cal B.C.–cal A.D. 160
13–15	Bw	1	early Intermediate	940–80 cal B.C.
21				
2–4	A1	3	middle to late Intermediate	470 cal B.C.–cal A.D. 340
5–6	A2	2	early to middle Intermediate	730 cal B.C.–cal A.D. 160
20				
1–2	A2	2	early to middle Intermediate	730 cal B.C.–cal A.D. 160
3–5	A3	2	early to middle Intermediate	730 cal B.C.–cal A.D. 160
6–8	A4	2	early to middle Intermediate	730 cal B.C.–cal A.D. 160
9–10	AB	2	early to middle Intermediate	730 cal B.C.–cal A.D. 160
11-14	Bw	1	early Intermediate	940–80 cal B.C.
		Locus B		
502				
2–4	A	4	late Intermediate	120 cal B.C.–cal A.D. 560
5–8	AB k	2/3	middle Intermediate	730 cal B.C.–cal A.D. 340
9	AB k/2Ab1	2/3	middle Intermediate	730 cal B.C.–cal A.D. 340
10–11	2Ab1	2/3	middle Intermediate	730 cal B.C.–cal A.D. 340
12	2Ab1/2Ab2	2/3	middle Intermediate	730 cal B.C.–cal A.D. 340
13	2Ab2	2/3	middle Intermediate	730 cal B.C.–cal A.D. 340
14	2Ab2/3Bwb	1	early Intermediate	940–80 cal B.C.
15–16	3Bwb	1	early Intermediate	940–80 cal B.C.
504				
7–10	A	4	late Intermediate	120 cal B.C.–cal A.D. 560
11	A/2AB kb1	2/3	middle Intermediate	730 cal B.C.–cal A.D. 340
12–16	2AB kb1	2/3	middle Intermediate	730 cal B.C.–cal A.D. 340
17	2AB kb1/2AB kb2	2/3	middle Intermediate	730 cal B.C.–cal A.D. 340
18–19	2AB kb2	2/3	middle Intermediate	730 cal B.C.–cal A.D. 340
20	2AB kb2/3Bwb	2/3	middle Intermediate	730 cal B.C.–cal A.D. 340

continued on next page

Level No(s)., by CU No.	Natural Stratum	Episode No.	Cultural Period	Sigma Range[a]
21–23	3Bwb	1	early Intermediate	940–80 cal B.C.
524				
2–5	A1	4	late Intermediate	120 cal B.C.–cal A.D. 560
6	A1/A2	2/3	middle Intermediate	730 cal B.C.–cal A.D. 340
7–10	A2	2/3	middle Intermediate	730 cal B.C.–cal A.D. 340
11–12	2Ab	2/3	middle Intermediate	730 cal B.C.–cal A.D. 340
13	2Ab/2AB kb	2/3	middle Intermediate	730 cal B.C.–cal A.D. 340
14–15	2AB kb	2/3	middle Intermediate	730 cal B.C.–cal A.D. 340
16	2AB kb/2C1	2/3	middle Intermediate	730 cal B.C.–cal A.D. 340
17	2C1/2C2	2/3	middle Intermediate	730 cal B.C.–cal A.D. 340
18	2C2	2/3	middle Intermediate	730 cal B.C.–cal A.D. 340

[a] Combined standard and age-specific ΔR corrections.

Table 34. Episode Assignments for Features, LAN-2768

Feature No.	Locus	Episode No.	Cultural Period
300	C	5	Protohistoric to Mission
2	A	3	early Intermediate
3	A	3	early Intermediate
4	A	3	early Intermediate
5	A	3	early Intermediate
8	A	3	early Intermediate
10	A	3	early Intermediate
13	A	3	early Intermediate
16	A	3	early Intermediate
22	A	3	early Intermediate
12	A	2	early to middle Intermediate
18	A	2	early to middle Intermediate
19	A	2	early to middle Intermediate
23	A	2	early to middle Intermediate
25	A	2	early to middle Intermediate
26	A	2	early to middle Intermediate
27	A	2	early to middle Intermediate
28	A	2	early to middle Intermediate
29	A	2	early to middle Intermediate
114	B	2	early to middle Intermediate
14	A	1	early Intermediate
15	A	1	early Intermediate
20	A	1	early Intermediate
24	A	1	early Intermediate
30	A	1	early Intermediate
31	A	1	early Intermediate
113	B	1	early Intermediate

to middle Intermediate period. The sigma ranges overlapped with the ranges for Episode 3 by approximately 280 calendar years, but as many as 110 calendar years (standard ΔR) or 120 calendar years (age-specific ΔR) may separate them. Features 19, 23, and 25–29 in Locus A also were assigned to Episode 2 based on their stratigraphic association with the dated features.

Note, however, that two radiocarbon assays obtained from Feature 20 in Locus A were assigned to both Episodes 1 and 2. The later-dated shell specimen was obtained from a higher level in the feature than the specimen assigned to Episode 1. The two dates overlapped by 175 calendar years, but chronometric analyses also indicated that the upper levels of Feature 20 may have been as much as 195 calendar years (standard ΔR) younger than the portion of the feature associated with Episode 1. That feature was tentatively assigned to Episode 1. Another problematic date was derived from Feature 31 in Locus A, an intramural subfeature of Feature 24 that was assigned to the previous Episode 1 (based on an assay from a second intramural pit, Feature 30). We assigned Feature 24 and its subfeatures to Episode 1 based on its stratigraphic placement relative to other dated features. If that is correct, the later date obtained from Feature 32 may have been erroneous; perhaps the dated shell specimens entered the feature matrix from a shallower location as a result of bioturbation.

Episode 3 was also associated with Stratum II. Four radiocarbon specimens recovered from Features 5 and 10 and CUs 3 and 8 in Locus A were used to define the episode (three venus clamshells and one scallop shell). The conventional dates obtained from those samples spanned 80 radiocarbon years and formed a relatively cohesive group. The date range for Episode 3 spanned 110 cal B.C.–cal A.D. 340 (standard ΔR) or 470–40 cal B.C. (age-specific ΔR), with a pooled date range of 470 cal B.C.–cal A.D. 340. That time period is generally associated with the middle to late Intermediate period. However, as noted above, the sigma ranges overlapped with dates determined for Episode 4 by about 280 calendar years, but as many as 110 calendar years (standard ΔR) or 120 calendar years (age-specific ΔR) may separate them. Other features assigned to this occupation episode based on their stratigraphic associations included Features 2–4, 8, 13, 16, and 22, all in Locus A.

Like earlier occupation episodes observed at the site, Episode 4 was also associated with Stratum II. However, it was defined based on a single venus clamshell from CU 8 in Locus A that generated a sigma range of cal A.D. 250–560 (standard ΔR) or 120 cal B.C.–cal A.D. 190 (age-specific ΔR), indicating a combined date range of cal A.D. 120–560. That calibrated date indicated at least a modest occupation during the late Intermediate period. The calibrated age for that sample overlapped with the one for the previous occupation (Episode 3) by approximately 250 calendar years, but as many as 220 calendar years (age-specific ΔR) may separate the two episodes. Only the upper two levels of CU 4 and no features were assigned to this episode.

Episode 5 was also associated with Stratum II, but it was identified only in Locus C, in association with a possible hearth (Feature 300). One radiocarbon sample from *Phalaris* sp. seeds produced 2σ dates of cal A.D. 1500–1600 and cal A.D. 1780–1800, which suggested probable occupation during the Protohistoric or Mission period. The presence of some glass beads in the vicinity corroborated human land use in the area during and after the Protohistoric or Mission period, but that date essentially applies only to Feature 300, which was located higher in the subsurface profile and likely postdated most of the surrounding features in the area. In light of the predominance of features dated to the Intermediate period in Loci A and B and at LAN-193, however, we suspect that most of the features excavated in Locus C and the southern part of Locus D (other than Feature 300) also probably dated to that much earlier period, although we were unable to confirm our suspicion, because of a paucity of datable materials in those features.

Episode 6 was defined based on the recovery of 20 glass beads that exhibited color, shape, and technological attributes consistent with Rancho period dates of manufacture, ca. 1830–1848 (Chapter 6, Volume 3, this series). The beads were recovered during the excavation of SUs in Locus A, however, and were not found in features, EUs, or other well-defined depositional contexts. We were, therefore, unable to determine whether they were recovered in primary or secondary context. Some or all of the beads may have been deposited during one or several episodes of fill redeposition associated with construction activities by Hughes Aircraft Company or earlier farming or industrial activity. We found no additional features or other evidence (archaeological or documentary) for a Rancho period occupation, but any such materials might have been removed as a result of Hughes Aircraft Company's construction and earthmoving activities. The project area was part of the Rancho Ballona at that time (see Stoll et al. 2003:26–31), and it is possible that Native American ranch hands residing in the area used and discarded or lost the glass beads.

Episode 7 was defined based on various lines of evidence of occupation during what we broadly refer to as the Euroamerican period, between the date of California statehood in 1848 and the establishment of the HHIC in 1941. Various lines of anecdotal and documentary evidence indicated a Euroamerican period of occupation. This period encompasses the land boom in the area surrounding the Ballona in the 1880s. Soon after, the Ballona largely was used as a recreational area for hunting and boat and automobile racing. A portion of the Pacific Electric line extended through the area beginning in the early 1900s. By the 1920s, the Ballona was being used for various purposes, including farming and oil extraction.

Documentary and anecdotal evidence of Euroamerican period land use and occupation within LAN-2768 was spotty, however. Surveyor George Hanson's handwritten notes and field maps from the 1870s indicated the presence of several structures in the area below the bluff, including several in the vicinity of LAN-2768 (Stoll et al. 2003:36–38, Figure 17). One structure, labeled "Mais House," appeared to be located within the site area, but no archaeological evidence of the structure has been found (Figure 116). Data recovery excavations exposed

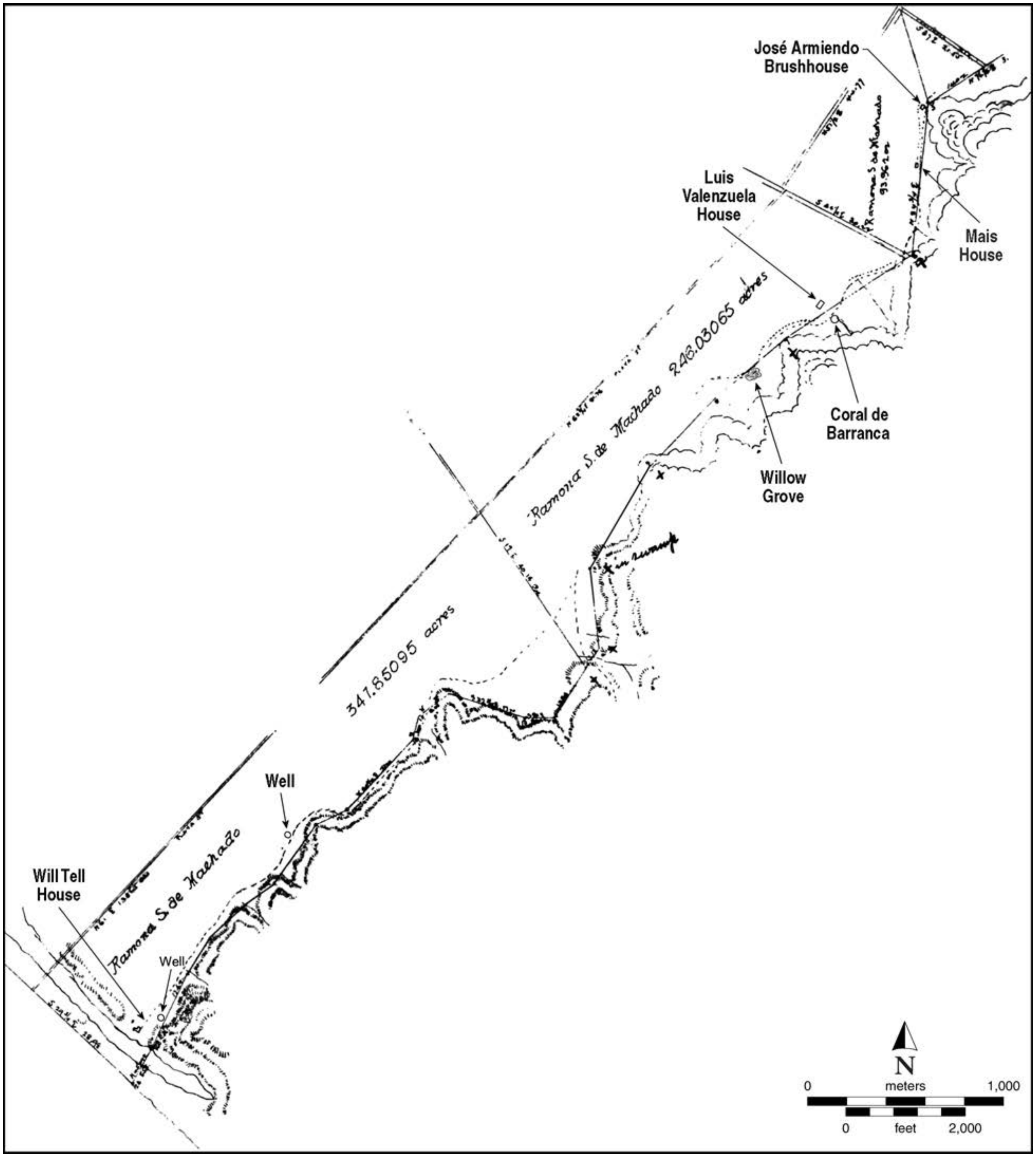

Figure 116. Map showing the overlay of the 1875 survey notes detailing Native American residences near LAN-2768.

structural remains in Loci A and B that may have dated to this period, including wells, concentrations of wooden posts, and concrete footings. In addition, a historical-period trash pit in Locus B (Feature 204) revealed temporally diagnostic ceramic and glass fragments suggesting occupation between the 1910s and 1930s.

Episode 8 refers to the period of operation of the HHIC, from the early 1940s through the 1980s. The bulk of the industrial buildings and runway were situated to the west of LAN-2768, however. Portions of LAN-2768 appeared to have been covered by asphalt during this period and used as a roadway (Hughes Way) and parking area (Altschul et al. 1991:88). However, a number of features recorded in Locus B—including three leach pits, a pipeline, structural remains, and a rail spur (see below)—probably indicated the location of a Hughes Aircraft Company structure (or structures) and transportation hub.

Perhaps the most significant legacy of the Hughes era at LAN-2768, however, was the company's landscape modifications. Much of the formerly undulating terrain in areas along the base of the bluff was leveled and flattened to make way for construction of buildings and other facilities (Peck 1947). Those leveling practices resulted in the truncation or removal of archaeological deposits throughout the site area.

Summary of Natural and Cultural Stratigraphy

The analyses of the natural and cultural strata at LAN-2768 indicated changes in the physical landscape and human land use at the site over several-thousand years. Studies of soil stratigraphy indicated a marshy sediment deposition in the vicinity of the former Centinela Creek and alluvial deposition in areas closer to the Ballona Escarpment. In many areas of the site, however, including areas with recent alluvial deposition, a deeper deposit of marsh or slack-water sediments underlies a more recent and stable deposit of alluvial deposits and well-developed soils. These observations suggest a transition from a marshier or slack-water environment to a more stable landform around the transition into the Intermediate period, a time span associated with the earliest evidence of human habitation at LAN-2768.

Analyses of 23 radiocarbon assays indicated a period of peak human occupation during the early Intermediate period. Those dated features and midden deposits suggested that most of the prehistoric occupation occurred from about 950 B.C. to A.D. 300, subsequent to landform stabilization in the site area. Three discrete occupation episodes were identified (Episodes 1–3), as well as a period of seemingly lighter human occupation during the late Intermediate period, in the early centuries of the first millennium A.D. (Episode 4). Prehistoric human occupation appeared to have been sparse after that time, although one radiocarbon date from Locus C indicated at least a modest human occupation during the Protohistoric or Mission period (Episode 5) that may have been coeval with the more-intense and more-substantial Protohistoric to Mission period occupations at LAN-211 and LAN-62 to the west.

Recovery of 20 glass beads indicated a Rancho period occupation (Episode 6), but no features or additional artifacts were recovered to shed light on the nature and extent of the occupation. Various features probably dated to the Euroamerican period (Episode 7), including several structural features and a trash pit in Loci A and B. A survey map dated to 1875 indicated several structures in or near the site area, but no archaeological evidence of these features has been found. A final occupation episode conforms to the period of operation of the HHIC (Episode 8). A portion of LAN-2768 probably was used as a parking lot at that time, but exposure of several leach pits and a rail spur during data recovery in Locus B indicated the location of a structure and a transport facility.

Site Integrity/Disturbance

There was a fair amount of disturbance noted at LAN-2768, mostly resulting from historical-period use of the area. An unknown amount of the upper portion of the deposit appeared to have been truncated by historical-period activities. As at most sites in the Ballona, the deposit was much thicker closer to the bluff edge. During the time data recovery was undertaken, a large amount of fill material rested on the extreme eastern edge of the site (the location of Parcel 33), prohibiting any work in that area.

In particular, disturbance to LAN-2768 in Locus B was recognized in several forms, including bioturbation, the application and removal of fill, grading, and other activities associated with historical-period use of the area. Aerial photographs of the area from the 1930s showed a railroad spur, roads, and numerous structures. Later activities from the HHIC also impacted the site. Those past activities appeared to have truncated the uppermost portion of LAN-2768B. During the excavation of Block 3, for example, fragments of historical-period railroad ties were noted in the upper levels. Drainage from the bluffs caused the formation of erosional channels or gullies that likely cut through the cultural deposits, as well.

Midden-Constituent Analyses

As explained above, seven EUs from Loci A and B were selected for detailed analysis, to acquire samples of materials from the midden deposits (CUs): four from Locus A (including two composite units [see above]) and three from Locus B. These units were excavated in arbitrary 10-cm levels that were subsequently assigned to specific episodes (see above). We discuss the results from Loci A and B separately.

In this section, we will discuss the changes in artifact densities, to delineate spatial and temporal trends in the midden remains and to distinguish periods of low- and high-intensity midden deposition. The results of the analyses of artifact and ecofact densities (flaked stone, faunal bone, and shell) are presented by level and by episode. We have opted to report densities on a per-level, per-episode basis, to show the variability in densities within each episode. Variability in artifact densities among levels assigned to a single episode was evident in several units, suggesting possible discrete subepisode or occupation surfaces within statistically defined episodes (see Chapter 3, this volume). Subepisode-density peaks were especially evident in CUs 2/22, 8, and 20/21 in Locus A, in which over 1 m of midden remains were assigned to a single episode (Episode 2 [see below]). Those levels encompassed a great deal of variation in artifact densities, and much of that variation was masked when the per-level data were merged into the broader episodes.

The number of levels assigned to each episode varied among the six CUs. Levels assigned to Episodes 2 and 3 (or Episode 2/3 in Locus B) were present in all of the CUs. Those episodes represented the peak periods of human occupation and land use at the site. Levels assigned to Episode 1 were present in all but two units (CU 3 in Locus A and CU 524 in Locus B). Episode 4 was represented in only one unit in Locus A (CU 8) and in all three units in Locus B. Episode 5 was not detected in any of the CUs. It is possible, however, that some post–Intermediate period deposits had been removed or truncated in the late 1900s during Hughes Aircraft Company construction activities.

Locus A

Four CUs from Locus A were selected for analysis, including two "composite" units (CUs 2/22 and 20/21) for which the upper and lower portions of two adjacent units (encompassing different subsurface strata) were combined to form a single unit (see above for details). The units provided a window into the midden remains in various areas of the intact portion of the locus (i.e., the southern portion). CU 20/21 was located in the east-central area of the locus. CU 3 was in the southeast portion of the site, within an area of dense feature deposits. CU 8 also was located within an area of dense feature deposits in the south-central portion of the locus. Finally, CU 2/22 was located in the west-central portion of the locus, outside the area of dense feature deposits.

The densities of lithic artifacts (flaked stone and ground stone, by count), vertebrate-faunal remains (NISP), and invertebrate-faunal remains (by weight) per cubic meter are presented in Table 35 by episode for each of the four CUs in Locus A (see Appendix 7.3, this volume, for data on each level). Figures 117–120 illustrate the distributions of artifact and ecofact densities by unit level and occupation episode for the four CUs.

Spatial Patterning

Artifact/ecofact densities varied greatly among the four CUs (Figure 121). Overall, CUs 20/21 and 8, in the east-central and south-central areas of the locus, yielded the highest densities of cultural materials. The high densities in CU 20/21 were surprising, given the dearth of features in its immediate vicinity; however, a few features were located 5–10 m to the south of this unit. Perhaps, the area around CU 20/21 functioned as a "toss zone" for foods prepared and processed in the features to the south. Interestingly, CU 3, which was located about 15 m southwest of CU 20/21 and closer to several features, had a conspicuously lower overall densities of cultural materials. As in the case of LAN-193, where control units with low densities of materials tended to be near feature concentrations and those with higher densities were farther away, the lower densities in CU 3 suggest that the byproducts of food preparation and consumption were discarded away from the areas where they were prepared. However, this pattern does not hold true for the other CUs. CU 8, which was located within a cluster of features, had much higher artifact/ecofact densities than CU 3, and CU 2/22, located away from the activity areas, had the lowest densities of cultural materials.

Note, however, that densities varied among three major material classes: flaked stone, vertebrate fauna, and invertebrate fauna. In most control units, the density of vertebrate fauna was much higher than that of invertebrate fauna. In CU 20/21, however, there was a slightly higher density of invertebrate fauna than vertebrate fauna. Furthermore, CU 20/21 had the lowest density of flaked stone artifacts (see Table 35), yet it possessed very high densities of both invertebrate and vertebrate fauna. In fact, it had the highest density of invertebrate fauna (see Table 35), more than three times that of CU 8, which had the second-highest density of invertebrate fauna. The differences may partly relate to temporal changes in depositional patterns, but they also could indicate spatial variation in deposition practices during contemporaneous occupation episodes. Although no features were observed in the area around CU 20/21, it may mark a shell-processing or -discard location. CU 8, located near several discard features and hearths, contained a much higher density of vertebrate fauna. Perhaps activities related to the processing of vertebrate fauna created more features than did activities related to the processing of shell.

Temporal Patterning

Figures 117–120 show the variations in densities among the artifact/ecofact classes by level and episode for the four CUs. Changes in densities by level within each episode were erratic and, in some cases, did not indicate clear patterning. Furthermore, the densities of the three material classes showed generally distinct patterns of change, with few instances of

Table 35. Artifact/Ecofact Density per Occupation Episode and Cultural Period in Four CUs, LAN-2768 Locus A

Level Nos., by CU No. (1 by 1 m)	Natural Stratum	Episode No.	Cultural Period	Volume (m^3)	Lithic Artifacts: Flaked Stone Count (n)	Lithic Artifacts: Flaked Stone Density (n/m^3)	Lithic Artifacts: Ground Stone Count (n)	Lithic Artifacts: Ground Stone Density (n/m^3)	Vertebrate Fauna: NISP	Vertebrate Fauna: Density ($NISP/m^3$)	Invertebrate Fauna: Weight (g)	Invertebrate Fauna: Density (g/m^3)
CU 2/22												
1–4	A1	3	middle to late Intermediate	0.38	52	136.1	1	2.6	1,697	4,442.4	280.0	733.0
5–20	A2/A3/A4/ A5/AB	2	early to middle Intermediate	1.63	839	515.4	1	0.6	3,743	2,299.1	233.4	143.4
21–22	Bw	1	early Intermediate	0.20	10	51.0	—	—	52	265.3	—	—
Subtotal				2.21	901	408.4	2	0.9	5,492	2,489.6	513.4	232.7
CU 3												
1–2	A	3	middle to late Intermediate	0.15	22.	150.7	7	47.9	602	4,123.3	17.0	116.4
3–10	A/AB	2	early to middle Intermediate	0.81	128	158.4	2	2.5	3,692	4,569.3	478.3	592.0
11	AB	2/3	middle Intermediate	0.09	7	79.5	—	—	132	1,500.0	51.0	579.5
Subtotal				1.04	157	150.7	9	8.6	4,426	4,247.6	546.3	524.3
CU 8												
1–2	A1	4	late Intermediate	0.21	51	242.9	—	—	883	4,204.8	222.0	1,057.1
3–12	A2/A3/ A4/AB	2/3	middle to late Intermediate	0.98	493	504.1	3	3.1	6,953	7,109.4	1,688.6	1,726.6
13–15	Bw	1	early Intermediate	0.30	173	576.7	—	—	1,669	5,563.3	1.0	3.3
Subtotal				1.49	717	481.9	3	2.0	9,505	6,387.8	1,911.6	1,284.7
CU 20/21[a]												
2–4	A1	3	middle to late Intermediate	0.30	50	166.7	—	—	1,196	3,986.7	427.7	1,425.7
5–16	A2/A3/ A4/AB	2	early to middle Intermediate	1.06	173	163.8	—	—	5,144	4,871.2	6,448.9	6,106.9
17–20	Bw	1	early Intermediate	0.40	32	80.8	1	2.5	309	780.3	102.0	2,57.6
Subtotal				1.75	255	145.5	1	0.6	6,649	3,795.1	6,978.6	3,983.2

Key: NISP = number of identified specimens.
[a]Level 1 of CU 20/21 consisted of fill that could not be associated with a particular episode.

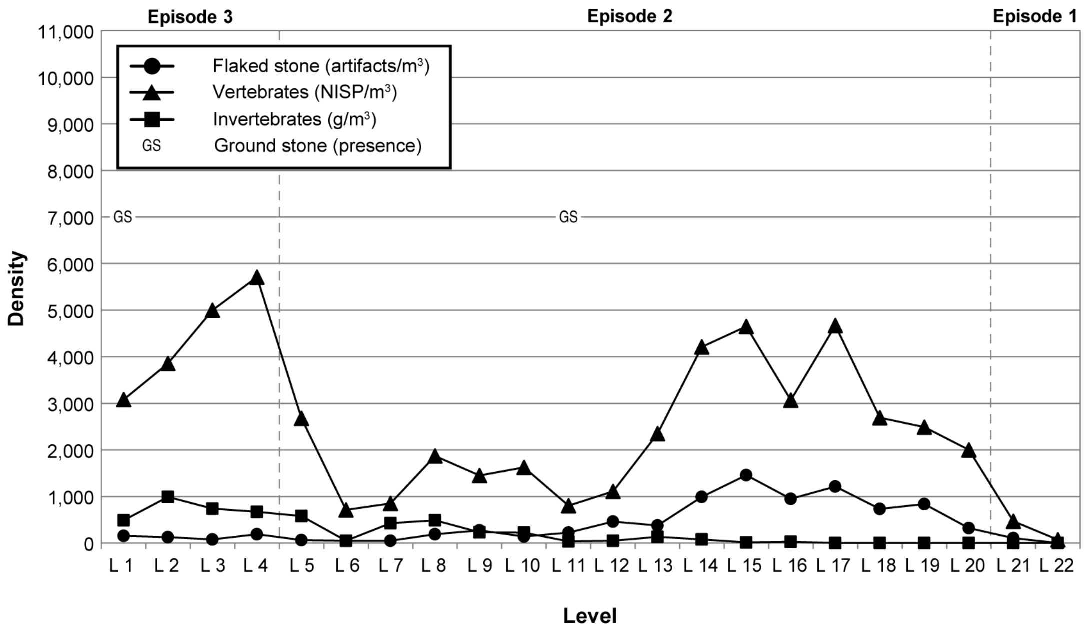

Figure 117. Artifact/ecofact density per level and episode, CU 2/22, LAN-2768 Locus A.

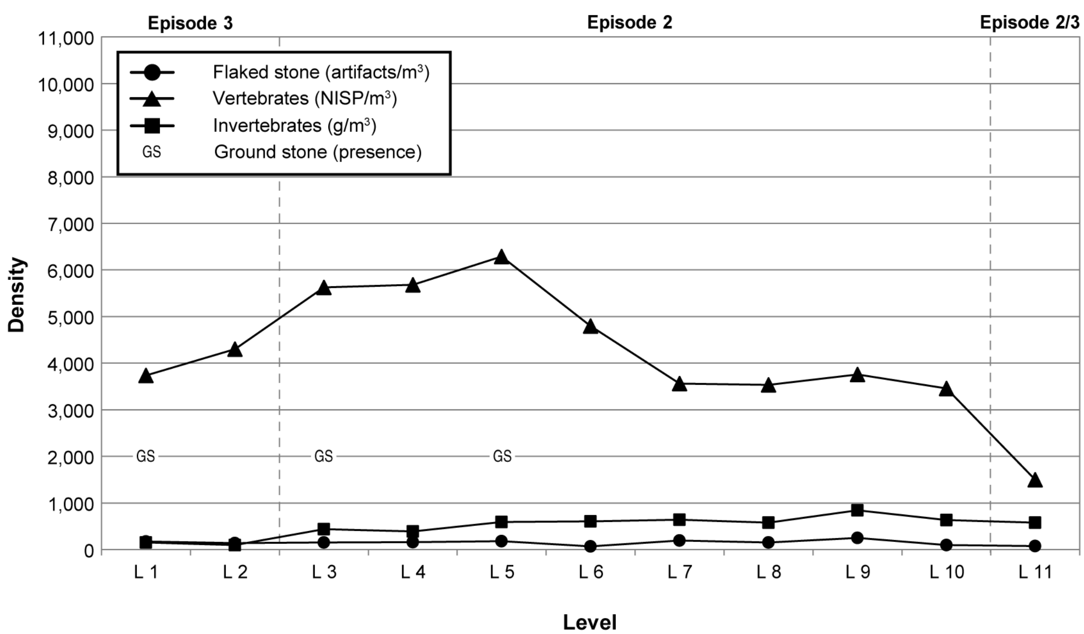

Figure 118. Artifact/ecofact density per level and episode, CU 3, LAN-2768 Locus A.

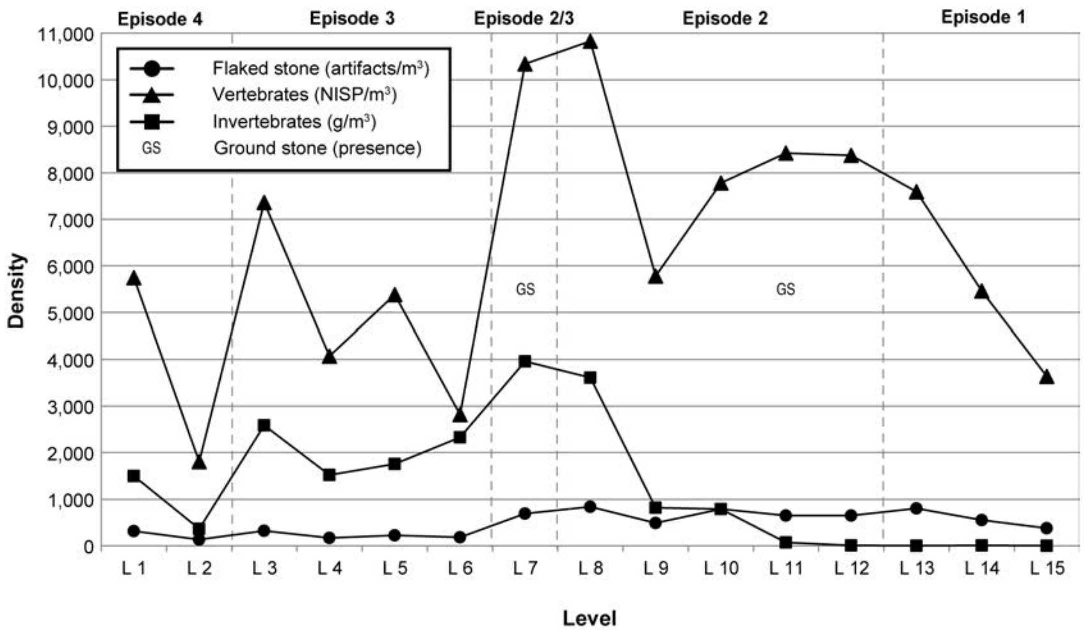

Figure 119. Artifact/ecofact density per level and episode, CU 8, LAN-2768 Locus A.

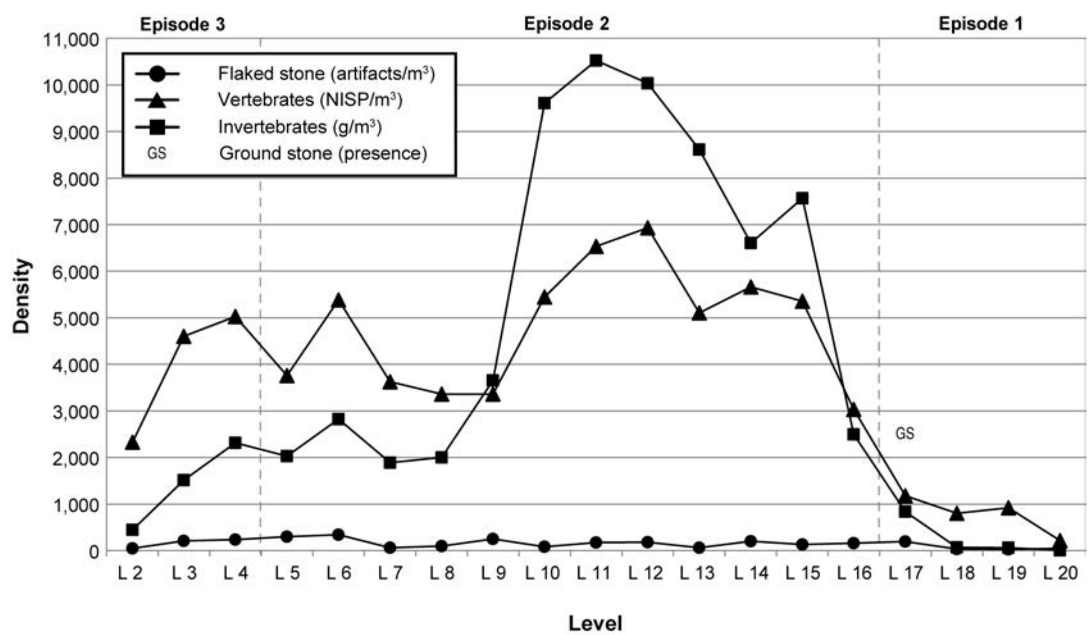

Figure 120. Artifact/ecofact density per level and episode, CU 20/21, LAN-2768 Locus A.

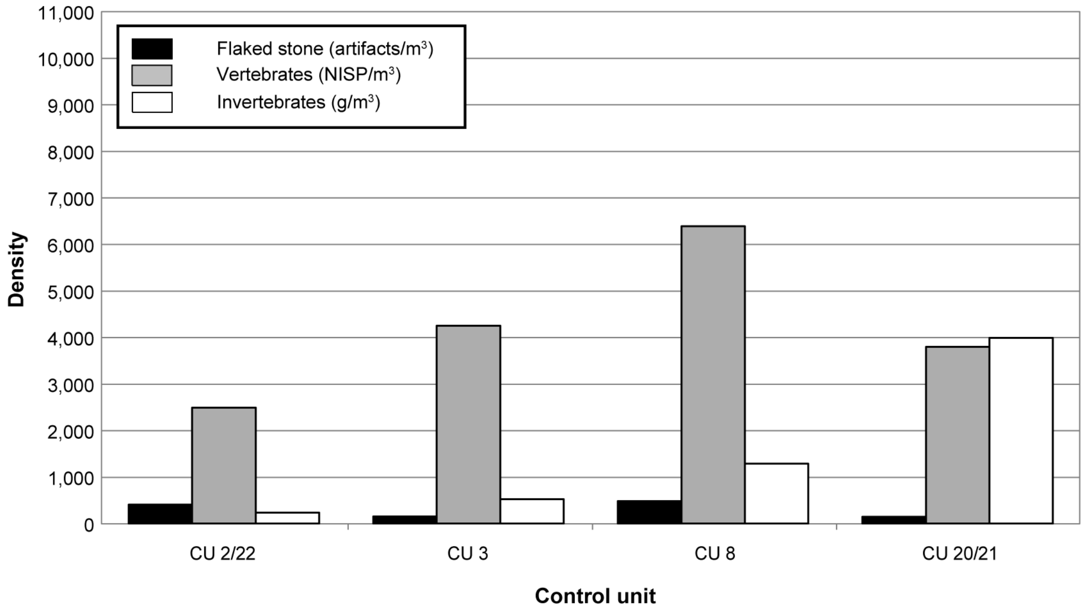

Figure 121. Artifact/ecofact density per CU, LAN-2768 Locus A.

overlapping peaks. One notable exception was CU 20/21 (see Figure 120), which showed a possible bimodal pattern, with peaks for both vertebrate and invertebrate fauna in Levels 3–6 (Episode 2/3) and in Levels 10–15 (Episode 2). CU 2/22 showed peaks in vertebrate faunal density in Level 4 (Episode 3) and in vertebrates and flaked stone in Levels 14–17 (Episode 2) (see Figure 117). CU 3 (see Figure 118) showed a peak in vertebrate faunal density in Levels 3–6 (Episode 2). CU 8 (see Figure 119) showed peaks in vertebrate faunal density throughout the sequence (Episodes 1–4), peaks in invertebrate faunal density in Episodes 2 and 3, and a slight peak in flaked stone density in Episode 2.

As noted above, compiling the density data per episode masked many important per-level density changes. Nonetheless, the per-episode patterns showed interpretable trends in the density data. Overall, the artifact densities generally underscored the above observation of a peak during Episode 2. In CUs 2/22 and 20/21, at least two of the material classes reached their peak densities in levels assigned to Episode 2. The highest density of vertebrate fauna in CU 2/22 was in Levels 3 and 4 (Episode 3); CU 8 (see Figure 119) and CU 20/21 had lower peaks for both vertebrate and invertebrate fauna. These data suggested that Locus A was most intensively occupied during the early–middle Intermediate period (Episode 2) and to a lesser extent in the middle–late Intermediate period (Episode 3). The early Intermediate period (Episode 1) and late Intermediate period (Episode 4) were well represented only in CU 8, suggesting that occupation during these periods was much more restricted.

A comparison of artifact/ecofact densities among the units also revealed changes in assemblage composition over time. In three units where Episode 1 was represented (CUs 2/22, 8, and 20/21), invertebrate density is very low during this time period. In CUs 8 and 20/21, invertebrate density increased dramatically during Episode 2, with a lesser peak during Episode 3. In CU 2/22, there was a slight increase in invertebrate density during Episode 3. Flaked stone density was consistently low, but there were slight peaks in CU 2/22 during Episode 2 and in CU 8 during Episodes 2 and 2/3. These patterns suggest subtle shifts in land-use practices from the early Intermediate period (Episode 1) to the middle Intermediate period (Episode 2). Processing of shell resources may have been relatively unimportant in the earliest occupations in Locus A during the early Intermediate period but became increasingly important during the middle and late Intermediate periods, perhaps indicating a change in diet and subsistence practices or a change in foci of resource exploitation in the area over the course of the Intermediate period.

Locus B

Three CUs were selected for analysis in Locus B, including one unit in each of the three excavations blocks in the eastern (CU 502), central (CU 504), and western (CU 524) portions of the locus. Levels assigned to Episodes 2/3 and 4 were represented in each of the three CUs. The lowest levels of CUs 502 and 504 contained levels related to a slightly older occupation that has been assigned to Episode 1. Densities for both levels and episodes are presented to show the variability within the levels assigned to each occupation episode (Table 36; Figures 122–124; see Appendix 7.4, this volume).

Table 36. Artifact/Ecofact Density per Occupation Episode and Cultural Period in Three CUs, LAN-2768 Locus B

					Lithic Artifacts				Vertebrate Fauna		Invertebrate Fauna	
Level Nos., by CU No. (1 by 1 m)	Natural Stratum	Episode No.	Cultural Period	Volume (m^3)	Flaked Stone Count (n)	Flaked Stone Density (n/m^3)	Ground Stone Count (n)	Ground Stone Density (n/m^3)	NISP	Density ($NISP/m^3$)	Weight (g)	Density (g/m^3)
CU 502												
2–4	A	4	late Intermediate	0.22	1	4.5	—	—	31	140.9	32.5	147.7
5–13	Abk/2Ab1/2Ab2	2/3	middle Intermediate	0.90	70	77.8	1	1.1	833	925.6	772.0	857.8
14–16	2Ab2/3Bwb	1	early Intermediate	0.33	3	9.1	—	—	74	224.2	2.1	6.4
Subtotal				1.45	74	51.0	1	0.7	938	646.9	806.6	556.3
CU 504												
7–10	A	4	late Intermediate	0.35	6	17.1	1	2.9	93	265.7	4.7	13.4
11–20	A/2ABkb1/ 2ABkb2/3Bwb	2/3	middle Intermediate	1.00	42	42.0	2	2.0	1,149	1,149.0	594.1	594.1
21–23	3Bwb	1	early Intermediate	0.30	17	56.7	—	—	430	1,433.3	1.2	4.0
Subtotal				1.65	65	39.4	3	1.8	1,672	1,013.3	600.0	363.6
CU 524												
2–5	A1	4	late Intermediate	0.40	15	37.5	1	2.5	197	492.5	111.1	277.8
6–18	A1A2/2Ab/ 2ABkb/2C1/2C2	2/3	middle Intermediate	1.30	98	75.4	—	—	1,609	1,237.7	1,841.9	1,416.8
Subtotal				1.70	113	66.5	1	0.6	1,806	1,062.4	1,953.0	1,148.8

Key: NISP = number of identified specimens.

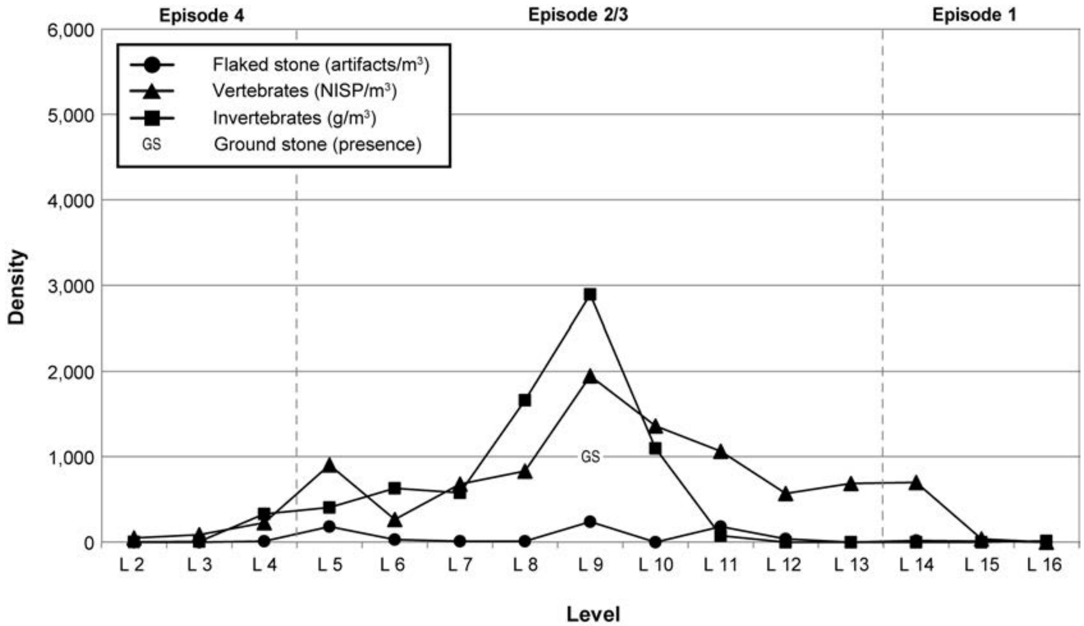

Figure 122. Artifact/ecofact density per level and episode, CU 502, LAN-2768 Locus B.

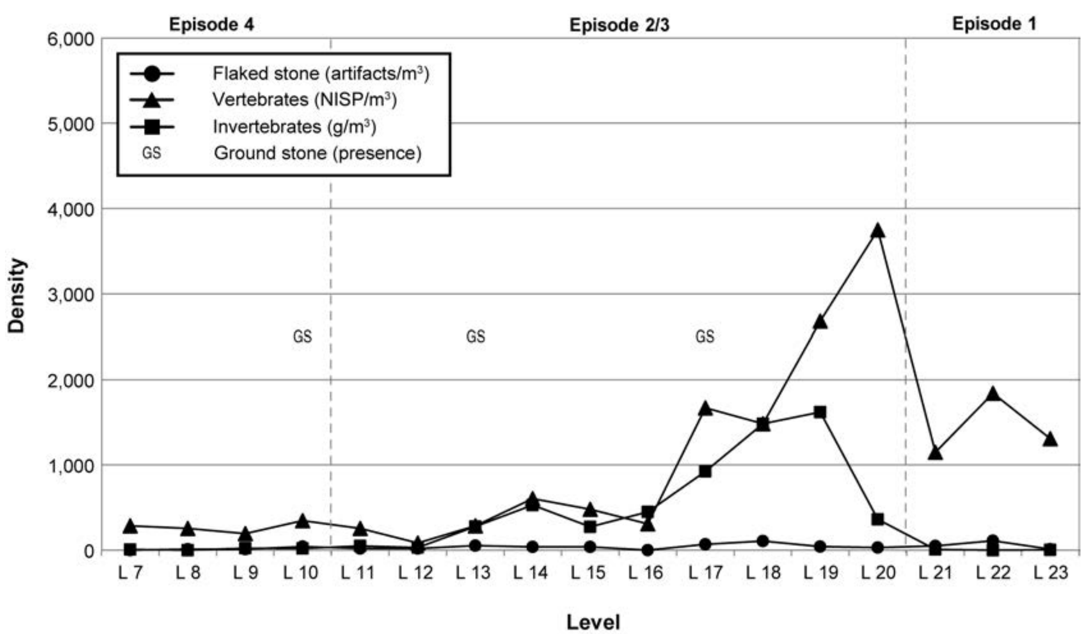

Figure 123. Artifact/ecofact density per level and episode, CU 504, LAN-2768 Locus B.

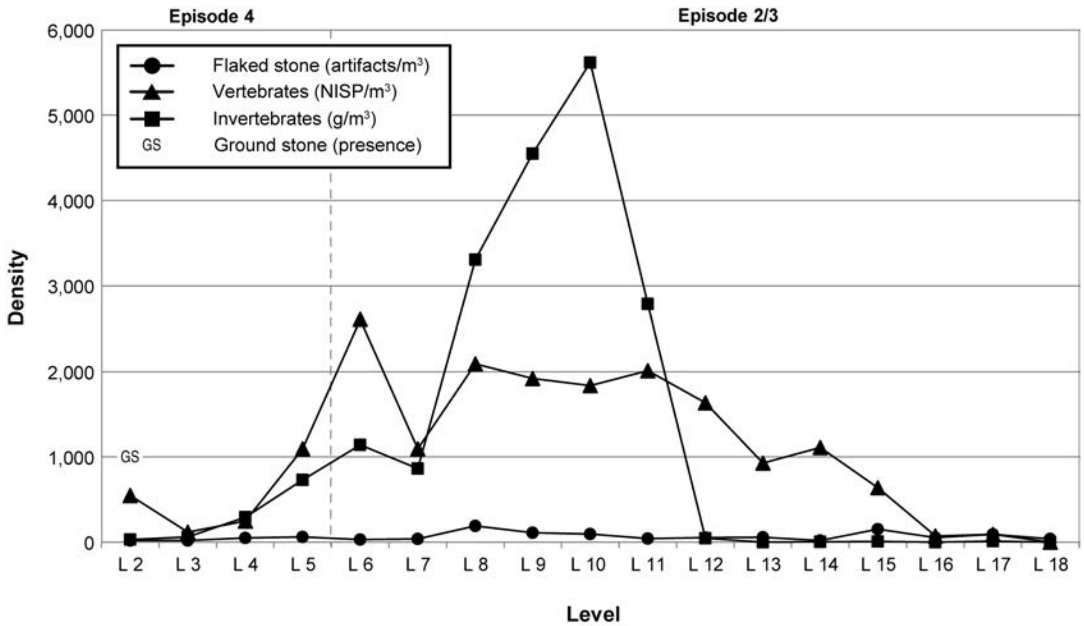

Figure 124. Artifact/ecofact density per level and episode, CU 524, LAN-2768 Locus B.

Spatial Patterning

Figure 125 illustrates the variability in artifact/ecofact densities among the three CUs, including a well-defined increase in density from east to west. CU 524, the westernmost unit of the three, contained the highest densities of all three material classes. Prehistoric occupation thus may have been most intense in the western portion of the locus, which was closest to Locus A. CU 524 contained only slightly higher lithic and vertebrate-faunal densities than the other units, but the density of invertebrate-fauna in CU 524 was over two times greater than that of CUs 502 and 504 (see Table 36). This pattern suggests more-frequent deposition shell in the western portion of this locus than in other areas. Interestingly, CU 20/21, which was located at the eastern edge of Locus A, had an even higher density of invertebrate fauna than the other Locus A control units. Although CUs 20/21 and 524 are located over 100 m apart (see Figures 103 and 109), these two control units may have been closer to the ancient lagoon shoreline and Centinela Creek, where site inhabitants likely procured shellfish and other riparian and aquatic resources.

Temporal Patterning

Figures 122–124 show the variations of densities among the artifact/ecofact classes, by level and episode, for the three CUs at Locus B. Although changes in density by level within each episode were erratic, some patterning was evident. In CU 502, artifact/ecofact densities peaked in Level 9, with a lesser peak in Level 5; both levels were associated with Episode 2/3 (see Figure 122). In CU 524, densities generally peaked between Levels 7 and 11, which suggests peak occupation intensity in the middle and upper levels assigned to Episode 2/3 (see Figure 124). In CU 504, conversely, densities peaked between Level 17 and 20, in the lower levels assigned to Episode 2/3, with a lesser peak during Episode 1, suggesting a peak in occupation intensity that was earlier than the occupation evidenced in CUs 502 and 524 (see Figures 122 and 124).

In all three CUs, Episode 2/3 was represented within 90–130 cm of midden remains that might have encompassed one or more discrete occupation surfaces or subepisodes. In CU 502 (see Figure 122), the levels assigned to Episode 2/3 (Levels 5–13) encompassed two, or possibly three, distinct peaks in artifact densities, suggesting several possible subepisodes or occupation surfaces. A similar pattern was also evident in CU 524 (see Figure 124). The 13 levels in CU 524 were assigned to Episode 2/3 included several possible peaks in artifact densities, although those peaks were less distinct than in CU 502. In CU 504 (see Figure 123), a single peak was evident in the deepest levels (Level 17–20), which were assigned to Episode 2/3, with a lesser peak in Level 22 (Episode 1). The per-episode densities suggested peak occupation intensities during Episode 2/3 in all control units. Episode 1 was represented by low densities of all cultural materials in CUs 502 and 504, with a lesser peak in vertebrate faunal remains in CU 504. Episode 4 was represented in all three control units by low densities of all cultural materials, with a slightly higher densities of both vertebrate and invertebrate fauna in CU 524.

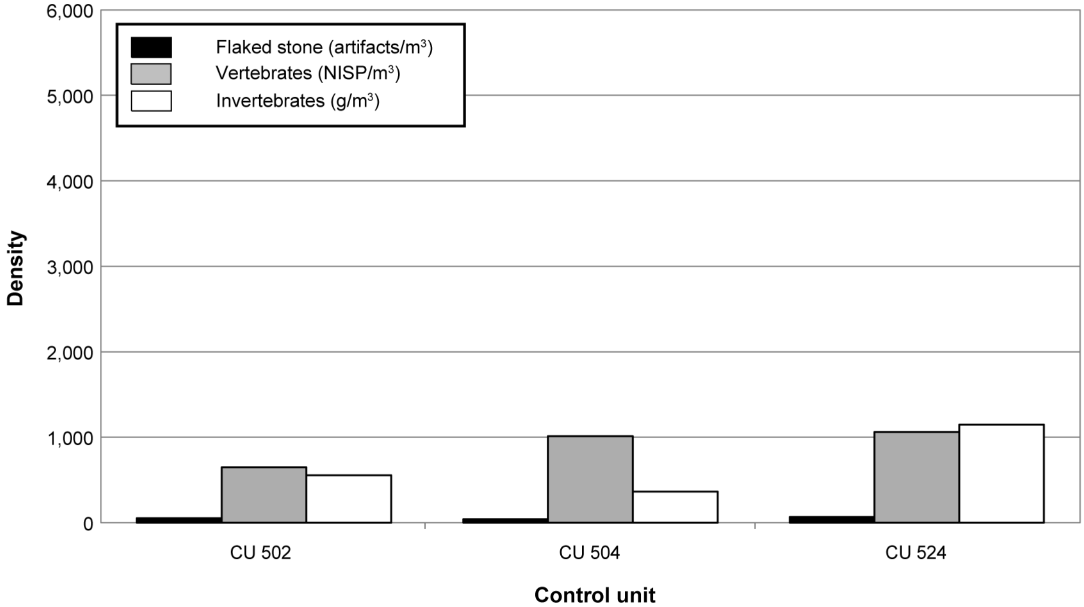

Figure 125. Artifact/ecofact density per CU, LAN-2768 Locus B.

Importantly, the low densities of invertebrate fauna observed in the lowest levels of CUs in Locus A also were evident in Locus B. All three control units evidence a pattern of increased use of invertebrates during Episode 2/3. In CU 504, this increase was evident in the lower levels assigned to this episode. In CU 502, there was a sharp increase in invertebrate faunal density in the middle levels above Level 10, with a gradual decrease above Level 8 (see Figure 122). Interestingly, density of invertebrate fauna exceeded that of vertebrates in Levels 8 and 9 of this unit, although vertebrates outnumbered invertebrates in the unit overall (see Table 36; Figure 122). In CU 524, there was a tremendous increase in invertebrate density in the middle to upper levels (Levels 8–11). Although the density of invertebrate fauna was higher in CU 524 than the other Locus B units, their density only exceeded that of vertebrates in these four levels (see Figure 124). In CU 504, invertebrate density exceeded vertebrate density only in Level 16, and it was only a very slight difference in this case (see Figure 123). All three CUs evidenced a pattern of increased use of invertebrate fauna over the course of Episode 2/3, with a peak use in the latter part of this episode in the area of CU 524. Importantly, use of invertebrates declined greatly during Episode 4. This pattern directly parallels that observed in in Locus A, although there are more indications of exploitation of invertebrate fauna in the latter area during Episode 4 (see above).

In both loci, increased exploitation of invertebrates may indicate changes in land-use and subsistence practices over the course of the Intermediate period. The earliest occupants, during the early Intermediate period, seldom procured and processed shellfish in Loci A and B of LAN-2768. Instead, most of the subsistence activities appear to have been focused on vertebrate fauna. By the middle Intermediate period, however, the site inhabitants increasingly processed and discarded shellfish in this area. By Episode 4, shellfish processing largely returned to the early Intermediate period pattern.

Analysis of Features

Details of the 79 features excavated in the four loci at LAN-2768 during the data recovery and monitoring excavations are presented in Appendix 7.5, this volume. Included are the episode assignments (see above) and the calibrated sigma ranges for the radiocarbon dates obtained from dated features (the listed data ranges encompassed both the standard and the age-specific ΔR values).

Although distinct concentrations of features were present within the large site area, we distinguished three discrete feature groups (see Appendix 7.6, this volume, for listing). Group 1 encompassed the dense concentration of prehistoric features in Locus A (Figure 126). Group 2 included a second concentration of prehistoric features in Locus C and the southern portion of Locus D (Figure 127). Group 3 was a concentration of mainly historical-period features in Locus B, roughly 150 m east of Locus A (Figure 128). These feature concentrations were spatially segregated (by up to 500 m, in the case of Groups 1 and 2) and may have involved different cultural activities and functions. Consequently, the features from the three areas should not be treated as single units of

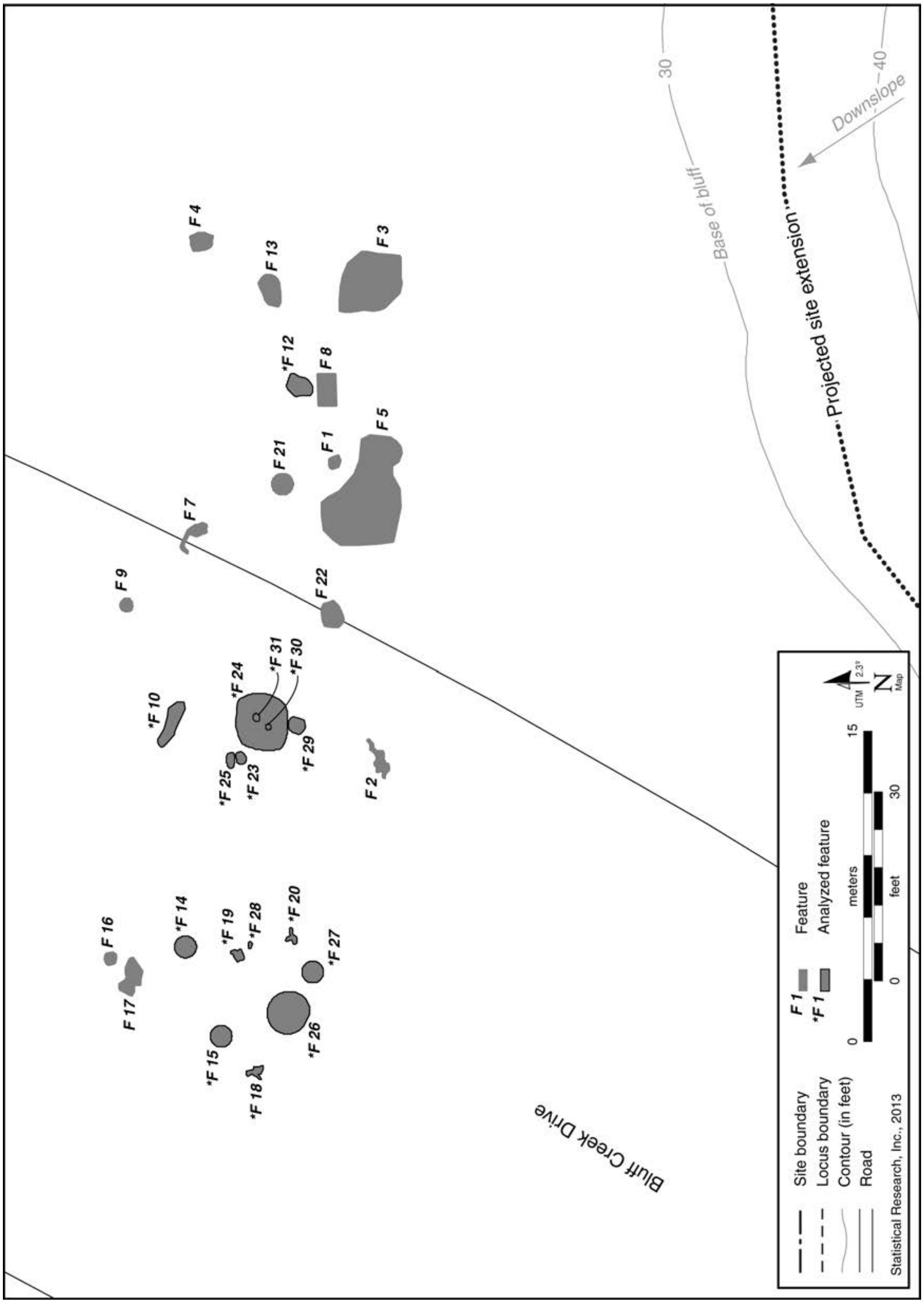

Figure 126. Map showing the locations of features in Group 1, LAN-2768 Locus A.

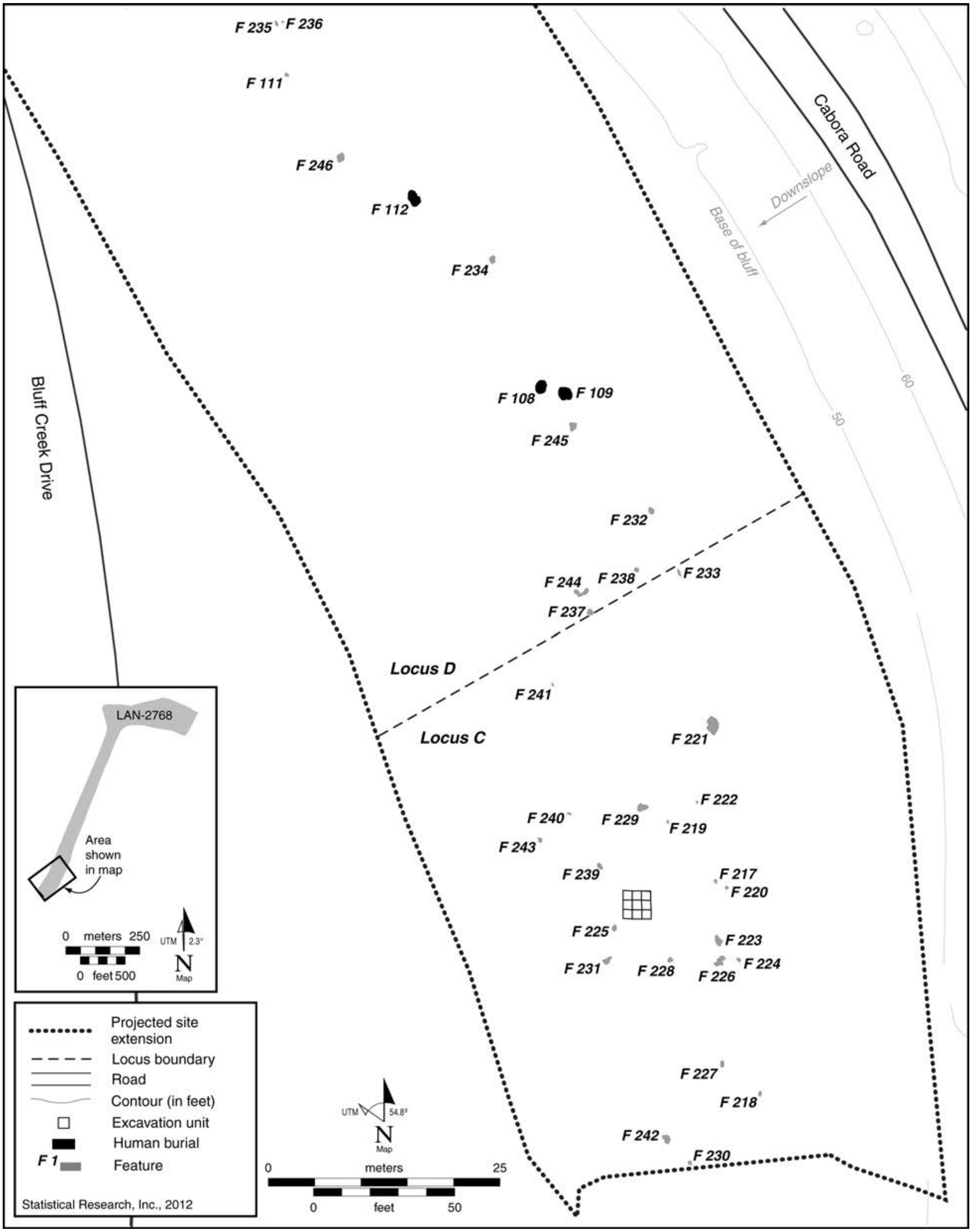

Figure 127. Map showing the locations of features in Group 2, LAN-2768 Loci C and D.

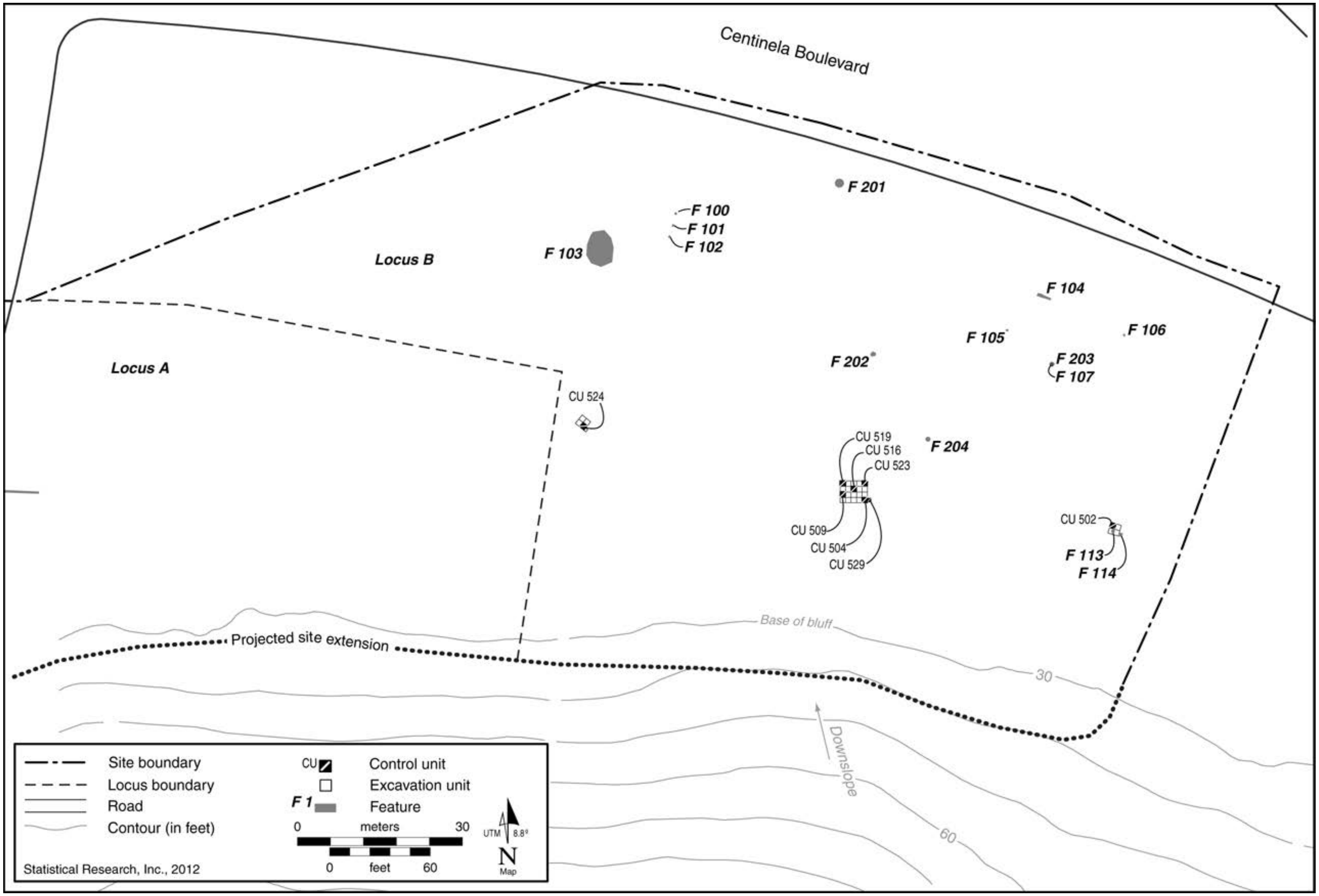

Figure 128. Map showing the locations of features in Group 3, LAN-2768 Locus B.

analysis but analyzed as separate activity surfaces with distinct functions. Group 1 accounted for slightly more than one-third of the features excavated at LAN-2768 (29 of 79, or 37 percent). Group 2 accounted for nearly half the features (36 of 79, or 46 percent). Eighteen percent of features (14 of 79) were excavated as Group 3 in Locus B.

Feature Classification

The features at LAN-2768 were classified using the multi-level typology outlined in Chapter 5, this volume. DiGregorio (1987) adopted a similar approach to defining features, using more-general (basic, formal) and detailed (functional) classification types at nearby LAN-63, atop the Westchester Bluffs (see also Douglass et al. 2005). At a broad level, features were classified as burial/ritual features, domestic features, or late-historical-period/modern features (post-1850). In the case of LAN-2768, most features (65 of 79, or 82.3 percent) were classified as domestic features (including 2 composite features with domestic components). Also identified were 3 burial/ritual features (3.8 percent), all inhumations, and 11 late-historical-period/modern features (13.9 percent).

Features also were classified as either thermal or nonthermal based on the presence/absence of evidence of in situ thermal activity (oxidized soil) or the prevalence of thermally altered materials (e.g., FAR or burned faunal bone). For example, a feature composed predominantly of FAR was classified as a thermal feature, even in the absence of evidence of in situ thermal activity. However, many features included mostly unburned, discarded materials, such as flaked stone and shell, and smaller amounts of FAR and burned bone, and those features were classified as nonthermal based on the prevalence of the nonthermally altered materials.

In the case of LAN-2768, just over half the features were classified as thermal (41 of 79, or 52 percent). The majority of those were deposits dominated by FAR, although some nonthermal contents were present in many of them. The nonthermal features (34 of 79, or 43 percent) included a variety of functional types, but most appeared to be domestic-discard areas with various subsistence-related debris. Three features were classified as mixed, including a possible prehistoric structure that was later reused as a roasting pit (Feature 24). That feature was classified as "mixed," because it appeared to have been used for both thermal and nonthermal functions during its use life. Two intramural pits within Feature 24 (Features 30 and 31) also were classified as mixed. They could have been used as nonthermal storage pits or as thermal cooking pits during the structure's use life, but they no doubt later functioned as part of the large thermal roasting pit. Mixed deposits composed 4 percent of the site features. All of the burial/ritual and late-historical-period/modern features were classified as nonthermal. One feature was not sufficiently investigated to make such a determination (Feature 103).

At a more detailed level, features were classified into the more-specific formal categories listed in Chapter 5, this volume, based on morphology (vertical and horizontal) and content. As shown in Table 37, more than half the features

Table 37. Feature Classifications, LAN-2768

Morphology/Composition	Count	Percentage of Total
Domestic features		
FAR concentration, in pit[a]	15	19.0
FAR concentration, no pit	15	19.0
FAR scatter	14	17.7
General/multiple artifact concentration, no pit	7	8.9
General/multiple artifact concentration, no pit, with FAR	1	1.3
Lithic/ground stone concentration, in pit	1	1.3
Lithic/ground stone concentration, no pit	10	12.7
Lithic/ground stone scatter	1	1.3
Indeterminate	1	1.3
Subtotal	65	82.3
Burial/ritual		
Primary inhumation	3	3.8
Subtotal	3	3.8
Historical-period/modern features		
Structure remains	4	5.1
Trash pit	7	8.9
Subtotal	11	13.9
Total	79	100.0

[a] Includes Feature 24 (structure) and associated Features 30 and 31 (intramural pits), which were residential features later reused as roasting pits.

recorded at LAN-2768 (44 of 79, or 56 percent) were FAR concentrations or scatters, including deposits with or without visible pit outlines. Carbonized seeds and burned faunal bone also were frequently recovered. Many of those features may have been deposits from cleaned-out hearths, but many of the FAR deposits in pits could have been hearths that had been heavily disturbed from bioturbation or other postdepositional processes. None of these features exhibited oxidized soils or other, more-direct evidence of in situ thermal activity, a common problem in prehistoric contexts in the Ballona.

Eight features (10 percent) were classified as general/multiple artifact concentrations. Those features were generally classified as nonthermal deposits, although some contained a mix of thermal (mainly FAR) and nonthermal remains. They probably contained debris related to various domestic and subsistence-related activities, including cooking, nonthermal food preparation (e.g., grinding or deboning), and stone-tool production or curation.

Twelve features were classified as lithic/ground stone concentrations or scatters (15 percent). Those features may have functioned as discard areas for a limited set of domestic activities, such as stone-tool production, or as cairns or supports for wooden posts. Most of those features at LAN-2768 were composed of cobbles (manuports) and exhibited no visible evidence of thermal exposure or other alteration. Their functions were ambiguous, however. Many were loosely scattered and contained a large number of cobbles and thus did not appear to have functioned as structural supports. Again, Feature 103, a domestic feature in Locus B, was not subjected to a sufficient level of investigation to infer morphology or function.

The three burial/ritual features were primary inhumations, all of which were excavated in Locus D. The interred individuals were all adults, including one possible female, one possible male, and one individual of indeterminate sex. Each of the burials had been highly disturbed, and much of the skeletal remains were missing from each context. Burial/ritual features composed 3.8 percent of the features at LAN-2768.

Table 38 presents the distribution of final inferred feature functions (including thermal and nonthermal features), subdivided by feature group. Among the thermal features, hearth-cleanout deposits (some of which may have been disturbed

Table 38. Feature Classes and Final Interpretations per Feature Group, LAN-2768

Final Interpretation	Group 1		Group 2		Group 3		Total[a]	
	n	%	n	%	n	%	n	%
Nonthermal features								
Domestic-discard area	17	58.6	—		—		17	21.8
Cairn or post support	1	3.4	2	5.6	—		3	3.8
Human burial	—		3	8.3	—		3	3.8
All nonthermal features	18	62.1	5	13.9	—		23	29.5
Thermal features								
Large hearth	1	3.4	5	13.9	—		6	7.7
Small hearth	—		5	13.9	—		5	6.4
Hearth	—		1	2.8	—		1	1.3
Hearth cleanout	2	6.9	3	8.3	—		5	6.4
Hearth cleanout or disturbed hearth	5	17.2	17	47.2	2	15.4	24	30.8
All thermal features	8	27.6	31	86.1	2	15.4	41	52.6
Mixed features								
Structure floor/roasting pit[b]	1	3.4	—		—		1	1.3
Intramural cooking pit	2	6.9	—		—		2	2.6
All mixed features	3	10.3	—		—		3	3.8
Late-historical-period/modern features (nonthermal)								
Historical-period trash deposit	—		—		1	7.7	1	1.3
Historical-period leach pit	—		—		3	23.1	3	3.8
Historical-period pipeline	—		—		1	7.7	1	1.3
Historical-period well	—		—		2	15.4	2	2.6
Historical-period structure	—		—		4	30.8	4	5.1
All late-historical-period/modern features	—		—		11	84.6	11	14.1
Total	29	100.0	36	100.0	13	100.0	78	100.0

[a] Excludes one uninvestigated domestic feature in Locus B.

[b] Structure that appeared to have been reused as a thermal feature (roasting pit) after abandonment.

hearths) were the most prevalent (36 percent) and were a little more than twice as frequent as hearths (17 percent). Hearths generally possessed evidence of in situ thermal activity, such as oxidized soils, dense charcoal inclusions, or feature matrices composed of dark soils. In contrast, cleanout features typically contained FAR and other thermally altered materials but no evidence of in situ thermal activity. Note, however, that the distinction was difficult to detect in some cases. For example, several inferred hearths contained no evidence of in situ thermal activity, such as oxidized soil, but some had ephemeral outlines of pits. We suspect that those features had functioned as hearth pits and were reused as discard areas; the oxidized soils and charcoal may have been removed during cleanout episodes or as a result of bioturbation.

The large hearths (more than 70 cm in diameter) were distinguished from the small hearths (less than 70 cm in diameter) based on Douglass et al.'s (2005) study of hearths at the bluff-top sites of LAN-63 and LAN-64. Under these criteria, large hearths (n = 6) and small hearths (n = 5) were almost equally represented at LAN-2768. Among the 24 features defined as possible disturbed hearths, 18 were classified as small, and 6 were classified as large. An example of a large hearth was Feature 12, located in the eastern portion of Locus A, which consisted of a large number of fire-affected cobbles, ashy soil, a small number of carbonized seeds, various other flaked and ground stone fragments, some shell and bone, and almost no charcoal. Although there were no signs of thermal alteration to the soil underlying the feature, the constituents seemed to indicate that the feature had functioned as a hearth. In profile, it could be seen that the feature was slightly subterranean, and there appeared to be a cluster of cobbles immediately adjacent to the main concentration that may have been the result of cleanout activity or indirect hot-stone cooking. In that process, the stones were heated and placed into baskets containing the food that was to be cooked. Feature 12 presented a good example of the difficulties involved in interpreting remains typically recovered in southern California. Although there were no obvious signs of in situ burning, and there was relatively no carbon remaining, it seemed clear that the feature functioned as a hearth. Often, postdepositional processes alter the form of such features, and we are left with simply a dispersed cluster of FAR. In the case of Feature 12, conditions were such that it retained high integrity, and we were able to make the determination that it was a thermal feature.

The nonthermal features encompassed a miscellaneous array of feature functions, including human burials, postholes or cairns, various nonthermal-refuse deposits and discard areas, and a structure floor. The most prevalent were nonthermal discard areas (22 percent). The features assigned to that category mostly consisted of unmodified cobbles, typically in association with ground stone and flaked stone artifacts and, occasionally, other materials (shell and faunal bone). Some of those features may have consisted of cobbles associated with thermal activities that were not subjected to sufficient heat to produce thermal alteration (e.g., cracking and spalling), but they were functionally ambiguous. One large nonthermal feature in Locus A (Feature 5) was interpreted as a living surface consisting of an amalgamation of nonthermal-refuse deposits intermixed with scattered lithic, shell, and bone remains.

Other nonthermal features included three possible cairns or posthole supports. These features were compositionally very similar to other features interpreted as nonthermal deposits; both mainly contained clustered, unburned cobbles in association with small numbers of flaked stone artifacts and small amounts of faunal remains. The primary difference was that the possible postholes or cairns were generally small in plan and highly concentrated (possibly from having been confined to small holes); a slight depression was evident in the case of Feature 23. The mixed features (i.e., those with thermal and nonthermal functions) included a possible structure floor (Feature 24 in Locus A) associated with two intramural pits (Features 30 and 31) that appeared to have been reused as a thermal feature (roasting pit) subsequent to the structure's abandonment. These features indicated a possible residential function in Locus A during the early Intermediate period.

The late-historical-period/modern features, of which 11 were recorded at the site, included 10 sets of structural remains and 1 trash deposit; all were recorded in Locus B. The 10 structural features included 3 historical-period structures (concentrations of wooden posts), 1 unknown historical-period structure, 2 wells, 3 leach pits, and 1 abandoned pipeline. They likely dated to a combination of early-twentieth-century ranching/farming and industrial activities in the area (postdating 1942). Historical-period maps and aerial photographs showed a significant amount of activity in the area, beginning in the early 1900s. As explained above, a map of the HHIC showed buildings in the vicinity of Locus B. The trash pit (Feature 204) included various sorts of domestic debris, including ceramics, glass, metal, and bottle fragments. Temporally diagnostic remains suggested a date range from the 1910s through the 1930s. Feature 204 was a domestic feature that predated the HHIC (early twentieth century); however, the other 10 historical-period/modern features likely were related to Hughes Aircraft Company industrial activities in the mid-1900s (post-1942).

Spatial Distribution of Feature Classes

Table 39 summarizes the distribution of general feature types per feature group. Domestic features dominated Groups 1 and 2 (100 and 92 percent, respectively), and late-historical-period/modern features were more frequent in Group 3 (79 percent). The results indicated two principal loci of premodern Native American activity within LAN-2768: Groups 1 (Locus A) and 2 (Locus C and the southern portion of Locus D). Few such features were recovered outside those two areas, and that could be because of subsurface disturbance and truncation related to Hughes Aircraft Company

Table 39. General Feature Types per Feature Group, LAN-2768

General Feature Type	Group 1		Group 2		Group 3		Total	
	n	%	n	%	n	%	n	%
Domestic	29	100.0	33	91.7	3	21.4	65	82.3
Burial/ritual	—		3	8.3	—		3	3.8
Late historical period/ modern	—		—		11	78.6	11	13.9
Total	29	100.0	36	100.0	14	100.0	79	100.0

construction activities. In contrast, Group 3 (Locus B) primarily was the focus of industrial activities. The structural remains there were likely related to waste-disposal and transport facilities in the area. Table 39 also shows the variability of feature functions among the three groups, and Group 3 was clearly distinguished by the prevalence of historical-period features, as discussed previously.

Next, we will concentrate mainly on the differences between Groups 1 and 2, both of which encompassed large, continuous areas of prehistoric features, but this discussion does not incorporate chronological patterns in the data. Instead, the diachronic changes in land use and feature distributions are explored.

In Group 1, nonthermal features outnumbered thermal features by 2.3 to 1 (18 to 8). In Group 2, conversely, thermal features outnumbered nonthermal features by 6.2 to 1. That pattern suggests different functions in the two areas of the site. On one hand, Group 1 encompassed a greater diversity of feature types, including thermal-refuse deposits, nonthermal-refuse deposits, possible architecture (Feature 24), pit features, a hearth, and possible postholes or cairns. Locus A may have encompassed a portion of a residential area in which a variety of activities would have occurred, resulting in the formation of various feature types. On the other hand, Group 2 mainly consisted of hearths and hearth-cleanout features. The predominance of thermal features in Group 2 may indicate a limited focus on cooking and subsistence-related activities in that area. The area along the base of the bluff in Loci C and D likely consisted of a palimpsest of temporary logistical camps that were used during resource-acquisition and resource-processing trips near the ancient lagoon shoreline.

Another contrast between the two groups concerns the ratios of hearths to cleanout features. In Group 1, cleanout deposits or probable cleanout deposits outnumbered hearths by 7 to 1. In Group 2, cleanout or probable cleanout features outnumbered hearths by only 1.8 to 1 (20 to 11). That pattern is consistent with the interpretation offered in the previous paragraph. The hearth (or hearths) in the residential area in Locus A may have been continually reused by nearby residents and subjected to frequent cleanout episodes. In contrast, in Loci C and D, resource-collection trips to the area may have been sporadic over hundreds of years, resulting in palimpsests of hearths and associated cleanout areas. Each hearth may have been reused and cleaned on several occasions over a short period of time, but over a longer span of time, subsequent visitors to the areas probably constructed new hearths, resulting in a higher ratio of hearths to cleanout deposits.

In sum, the ranges of feature types in Groups 1 and 2 suggest possible differences in function for the two areas of the site. The interpretations should be considered tentative, however, and require additional testing. Nor does the above comparison consider the chronology or contemporaneity of features—a matter we explore in the following section. Another caveat is that additional features probably were present in the vicinities of both groups but have been destroyed as a result of earthmoving in the mid-1900s. As explained above, possible leveling in this area and in the adjacent, eastern portion of LAN-193 may have destroyed many of the features in Group 2. The channelization of Centinela Creek in Locus A during the early 1900s also may have obliterated features associated with Group 1.

Occupation Surfaces

Twenty-four of the 29 features excavated in Locus A were assigned to one of the five occupation episodes described above. In this section, we discuss detectable patterns in the distributions of features and feature types during each episode. In the following section, we discuss possible clusters of contemporaneous features that formed discrete activity areas.

Locus A (Group 1)

Six features were assigned to Episode 1 (early Intermediate period), including a structure (Feature 24) and associated intramural pit features (Features 30 and 31) in the western portion of the excavated area in Locus A. It is unclear whether the structure was used as a residence or ritual structure or served some other function. The three other features were two hearth-cleanout features (one may have been a disturbed small hearth) and a nonthermal-refuse deposit, which may have functioned as a cooking and storage feature associated with the structure. These features were located within 5 m of one another and roughly 10 m west of Feature 24 and may have functioned as extramural food-preparation areas. However, we were unable to conclusively determine whether the features assigned to Episode 1 were truly contemporaneous.

Ten features in Locus A were assigned to Episode 2 (early to middle Intermediate period), including an equal number of thermal features (one hearth and four cleanout deposits or disturbed hearths) and nonthermal features (four nonthermal-refuse deposits and one possible posthole support or cairn). All but one of the features assigned to Episode 2 were generally located in the western portion of the excavated area in Locus A. The one exception, Feature 12 (large hearth), was located in the eastern portion of the excavated area. The hearth may have been situated at a distance from other activity areas to avoid smoke inhalation or other fire dangers. The range of features assigned to Episode 2 suggested a possible shift in land-use patterns. The Episode 1 occupation appeared to have been residential, and the Episode 2 occupation seemed to have been focused solely on subsistence activities.

Nine features were assigned to Episode 3 (middle to late Intermediate period), most of which were nonthermal-refuse deposits. Three other features were interpreted as thermal-cleanout deposits (one may have been a disturbed small hearth). Most salient was a shift in the spatial arrangement of Episode 3 features relative to those of earlier episodes. The features assigned to earlier episodes were mainly concentrated in the western portion of the excavated area, whereas the majority of features assigned to Episode 3 were located in the eastern portion. Also, the range of features assigned to Episode 3 was variable. In contrast to Episode 2, the features assigned to Episode 3 were predominantly nonthermal-refuse deposits. Notably, all of the nonthermal deposits assigned to Episode 3 consisted mostly of unmodified cobbles (manuports) and small amounts of bone, shell, and lithic artifacts. As explained above, the function of those deposits is unclear, but the presence of faunal remains suggested subsistence activities. The shift in feature composition implied a change in dietary and food-processing practices from Episode 2 to Episode 3.

None of the features excavated in Locus A were assigned to Episode 4. As mentioned above, only two levels of CU 8 with low-density deposits were assigned to this episode, which indicates a modest late Intermediate period occupation. The light scatter of artifacts associated with this episode was more consistent with an interpretation of infrequent, short-term visits to the locus to collect resources. It also suggested that food or other resources were no longer processed or prepared in Locus A. It is possible that inflows of freshwater into the Ballona Lagoon around that time reduced the area's appeal as a reliable and consistent source of maritime resources.

Overall, prehistoric human occupation and land use in Locus A was most intensive during the early and middle Intermediate period (roughly 1000 B.C.–A.D. 300). It is important to note, however, that the native soils in Locus A had been partly truncated by construction activities in the early and mid-1900s. It is possible, therefore, that additional archaeological deposits dating to the late Intermediate period and later periods were removed during modern and historical-period earthmoving activities.

Locus B (Group 3)

Only two prehistoric features were excavated in Locus B (Features 113 and 114). The dearth of features in the area suggested that Locus B rarely functioned as a locus of prehistoric human activities or that it was used for activities that left few material traces in the form of features. The presence of midden deposits indicated at least sporadic deposition of refuse from human activities. Two prehistoric features (Features 113 and 114) were identified as thermal-cleanout deposits or possibly small, disturbed hearths; one each was assigned to Episodes 1 and 2. This area likely functioned as a locus of low-intensity cooking and processing of food resources procured from the nearby lagoon shoreline and riparian area. Notably, the two features were uncovered in the eastern portion of Locus B, away from the denser midden deposits in the western portion of the locus (CU 524). That may reinforce the argument above that areas of midden deposition were situated away from loci of human activities, as evidenced in the presence of features.

Loci C and D (Group 2)

In total, 36 prehistoric features were uncovered in Loci C and D. Unfortunately, only 1 (Feature 300 in Locus C) generated materials that were amenable to radiocarbon dating. Feature 300 was a hearth composed of a concentration of FAR fragments and other materials. Among the materials were carbonized seeds that were submitted for AMS dating, and the results indicated a Protohistoric to Mission period date range, which has been identified as Episode 5.

Because most of the features were not analyzed, we were unable to obtain datable materials from other features excavated in Loci C and D. We were thus unable to determine whether that date range was applicable to other features in the vicinity. Clearly, however, the overwhelming majority of prehistoric features and midden deposits excavated in The Campus complex (LAN-2768 and LAN-193) were used during the Intermediate period. All but a few of the radiocarbon dates obtained from LAN-193 and from Loci A and B of LAN-2768 indicated occupation during the Intermediate period. Also note that temporally diagnostic artifacts common to Late and Mission period contexts in the Ballona were absent from The Campus complex sites. Consequently, we can reasonably infer that many, and likely most, of the features excavated in Loci C and D also dated to the Intermediate period.

Moreover, most of the features excavated in this area were thermal features (see above), which suggested a consistent functional component of the site—i.e., the range of features did not suggest a variety of functions associated with different occupation episodes. Above, we suggested that the Loci C and D features represented a palimpsest of hearths and associated cleanout areas that had accumulated in the area over the course of hundreds of years, during sporadic logistic resource-collection trips. We suspect that most of the features were used and formed over the course of the Intermediate period, although a small number of features may have dated to the late prehistoric or early historical period. Further analysis incorporating a larger number of radiocarbon dates would greatly enhance our understanding of this area.

Activity Areas

In this section, we discuss the inference of activity areas through the analysis of spatial distributions and concentrations of features assigned to each episode. An activity area was defined as a discrete concentration of features assigned to the same episode. The spatial and temporal associations of such features may indicate contemporaneous and discrete loci of human activity. In the case of LAN-2768, we were only able to infer possible activity areas for Locus A. Locus B included only two prehistoric features, and the absence of dated features from Locus C prevented identification of contemporaneous features or activity areas.

The most salient potential activity area in Locus A was centered on Feature 24, a possible structure assigned to Episode 1, and its intramural and surrounding features. Surprisingly, three features located directly adjacent to Feature 24—all of which appeared to be possible extramural domestic features (Features 23, 25, and 29)—were assigned to the subsequent occupation episode (Episode 2). As explained above, however, the inferred date ranges for Episodes 1 and 2 overlapped, and thus Features 23, 25, and 29 may have been contemporaneous with Feature 24. A second possibility is that Feature 24 was reused as a roasting pit during Episode 2 and that Features 23, 25, and 29 were associated with that later incarnation. Features 23 and 29 were interpreted as possible posthole supports or cairns, and Feature 25 was interpreted as a nonthermal-refuse deposit. Given those interpretations, it is not clear how they would have been used in connection with the roasting pit.

A second possible activity area encompassed a concentration of features assigned to Episode 2 in the western portion of the excavated area in Locus A. That area contained five features located within a roughly 5-by-5-m area (Features 18–19 and 26–28): four small thermal-refuse deposits surrounding a large nonthermal deposit (Feature 26) composed of unmodified cobbles and lithic artifacts. The functional relationship among the features is not clear, but they may have been used in concert to prepare or process food and resources acquired from the nearby lagoon and riparian area. The area may have been used to process shellfish or vertebrate fauna, both of which were recovered from Features 18 and 19 and in the CU levels assigned to Episode 2.

No activity areas were evident among the features assigned to Episode 3. The features were generally scattered, and no discrete spatial concentrations were discernible. More likely, the features assigned to Episode 3 represented a palimpsest of discrete features that had been formed during sporadic visits to the area over the course of several decades or centuries.

The concentration of late-historical-period features probably related to the HHIC (Episode 8) in Locus B also composed a discrete activity area, even though the features were not spatially clustered within a small area. Those features included various structural remains, three leach pits, two wells or cisterns, a pipeline, and a rail spur. This activity area probably marks the location of a transport facility within the complex, as indicated by the rail spur. The leach pits, cisterns, and pipeline probably indicate a sewage facility associated with the buildings in the area, as shown on a map of the complex.

In sum, the chronometric data suggested changes in prehistoric activities conducted within the investigated areas of Locus A during the Intermediate period. The early Intermediate period occupation (Episode 1) appeared to have been focused on a possible residential structure and several associated extramural features. The subsequent middle and late Intermediate period occupations (Episodes 2 and 3) likely shifted to a focus on the acquisition and processing of resources, probably resources garnered from the Ballona Lagoon. However, the manner in which those resources were processed appeared to have changed during the middle to late Intermediate period. Judging from the predominance of nonthermal features among the Episode 3 features, compared to equal numbers of thermal and nonthermal features in Episode 2, we argued above that food-preparation activities may have shifted from a thermal to nonthermal form of processing.

Site Summary

Data recovery investigations by SRI uncovered intact site deposits in four loci at LAN-2768. Much of the archaeological deposits, however, had been heavily disturbed or completely obliterated, as a consequence of earthmoving and construction activities in the early and mid-1900s, principally by Hughes Aircraft Company. In other areas, however, deep-lying prehistoric midden deposits were completely or partially intact beneath a thick mantle of redeposited fill. Despite the heavy disturbance, concentrations of features were discovered in three areas of the site: (1) in the southeastern portion of Locus A, (2) in Locus B (mostly historical-period features), and (3) over a large, continuous area encompassing Locus C and the southern portion of Locus D.

SRI initially identified LAN-2768 as an intact archaeological site in 1998, during subsurface testing within The Campus complex. Mechanical coring and bucket-auger excavations revealed archaeological resources in a dark-brown soil matrix in areas later designated as Loci A and C (Doolittle 1999). SRI subsequently determined that the archaeological site encompassed various areas along the base of the bluff, between the previously recorded sites of LAN-60 and LAN-193 (Altschul and Grenda 1999).

Since 2000, nearly the entire site area of LAN-2768 has been subjected to varying levels of subsurface investigation and exposure. SRI has excavated 43 mechanical-bucket-auger units, 11 pothole trenches, 18 linear trenches, 59 EUs, 52 feature-excavation units, and 30 SUs (see Table 24). In addition to the formal SUs in Locus A, a large area to the west of the main excavation area in Locus A was stripped but was not excavated using formal units. Moreover, a very large swath was exposed during construction of the Riparian Corridor in 2005, and 43 additional features were discovered in Loci B, C, and D.

SRI conducted testing and data recovery excavations in Locus A in 2000. The southeastern portion of Locus A, nearer to the bluffs, contained intact middens and features. The northern and western portions of Locus A had been heavily disturbed via channelization of Centinela Creek, leveling, and other construction activities. Building footings and other remains from historical-period structures were observed in portions of the locus. In some areas in the northern portion of Locus A, the archaeologists were unable to expose very deeply buried native soils; a thick layer of fill appeared to have been laid down to level off a slight downward gradient.

A variety of features also were excavated in the southeastern portion of Locus A, beneath the thick fill in that area, including a mix of thermal and nonthermal features and a possible structure floor associated with several intramural and extramural features. The features in the southeastern portion of Locus A suggested a possible residential area dating to the early Intermediate period (Episode 1). It is plausible that additional residential features may be present, but not yet detected, in nearby areas or, alternatively, may have been destroyed as a result of historical-period and modern disturbances. The later occupations in Locus A (Episodes 2 and 3) more likely represented palimpsests of seasonal visits to the area over the course of several centuries, to procure marine or other resources. An analysis of artifact densities in four CUs suggested peak occupation intensity during the middle Intermediate period (Episode 3). Midden deposits dated to the late Intermediate period (Episode 4) also were uncovered in Locus A, but no excavated features were assigned to that episode. Recovery of 20 shell beads from SU excavations in Locus A suggested at least a modest Rancho period occupation in the area (Episode 6, 1830–1848), but no features or trash deposits were assigned to that period.

SRI conducted testing, monitoring, and data recovery in Locus B, in connection with the construction of a practice facility for the Los Angeles Clippers NBA basketball team in 2005 and 2007. As was the case in Locus A, SRI encountered completely or partially intact midden deposits in the southern portion of the locus, along the base of the bluff. Two prehistoric thermal-refuse features also were encountered in that portion of the site. In the northern half of the site, SRI recorded historical-period features during testing and monitoring, including portions of structures, leach pits, wells, a rail spur, and a trash deposit. Most of those features were related to early- and mid-twentieth-century farming and industrial activities in the area, as well as Hughes Aircraft Company industrial activity (Episodes 7 and 8). One feature, a trash pit, contained bottle glass and ceramics that indicated occupation in the early 1900s, prior to the Hughes era (1910s–1930s, Episode 7).

Intact deposits also were present along the base of the bluff in Loci C and D. Most of SRI's investigations involved monitoring during construction of a Riparian Corridor near the bluff edge in 2005. Thirty-six features were discovered in Locus C and the southern portion of Locus D during a brief excavation project in 2000 and during monitoring for the Riparian Corridor in 2005. The majority of features in that vicinity were prehistoric thermal features; especially prevalent were refuse deposits from hearths. The prevalence of thermal features suggested a limited array of activities that were most likely related to the heating of food acquired from the nearby lagoon edge and riparian zone. We suspect that Loci C and D were used as locales for short-term resource-collection trips near the ancient shoreline of the Ballona Lagoon during the Intermediate period. One radiocarbon assay from a hearth feature generated a Protohistoric or Mission period date, but we suspect that most of the features in that area dated to the Intermediate period, given the predominance of Intermediate period features and deposits elsewhere in The Campus complex and the Intermediate period radiocarbon dates obtained near the three burials in the area.

LAN-54 Field Methods and Excavation Results

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This chapter summarizes the results of archaeological data recovery conducted by SRI at LAN-54. The preliminary results of the data recovery excavations were reported by Keller and Altschul (2002), and this chapter synthesizes that report and also incorporates new information inferred from analyses of geomorphology, site features, and stratigraphic and chronometric data, as well as artifacts and ecofacts recovered during data recovery excavations. According to the site boundaries on file at the SCCIC, LAN-54 encompassed a roughly 70-by-30-m area located to the south and west of the intersection of the Marina Freeway (SR 90) and Culver Boulevard. LAN-54 is the only prehistoric site within the PVAHP project area that is located near the prechannelized location of Ballona Creek. That is especially important, considering that in premodern times, Ballona Creek intermittently captured the flow of the Los Angeles River, which may have heightened the site's appeal for prehistoric occupants. In light of the data recovery by SRI, we have expanded the site boundaries to encompass a larger area of approximately 155 by 45 m.

Testing and data recovery excavation by SRI at LAN-54 occurred in advance of a planned widening of Culver Boulevard and the on-ramp onto the Marina Freeway (SR 90). The surface of LAN-54 is obscured by the presence of structures, modern roads, a railroad spur, and a large earthen berm. In light of the modern disturbance, the archaeological data recovery was limited to the portions of LAN-54 within the street-widening right-of-way and the footprint of a recently removed structure, a former packinghouse. The testing phase occurred in 2000 and involved excavation of six small trenches (2–4 m in length) within and surrounding the defined site area, to determine the presence and extent of subsurface deposits (Vargas and Altschul 2001b). The subsequent data recovery in 2002 focused more narrowly on the portions of LAN-54 found to be intact within the street-widening right-of-way and the footprint of the recently removed Blue Goose Packing House (Keller and Altschul 2002; Pence 1979).

Data recovery consisted of hand-excavations of CUs, mechanical stripping of all intact site materials, and hand-excavation of identified features, including three human burials. The results of the data recovery suggested that LAN-54 was a multicomponent site with intact prehistoric components dating to the late Millingstone and early to middle Intermediate periods, as well as a minor historical-period component (evidenced by four features and scattered historical-period debris). The densest concentration of intact prehistoric features and cultural materials was recovered in the southern portion of the project area (Keller and Altschul 2002). The northern portion was heavily disturbed by construction of the Blue Goose Packing House and an associated rail-spur line in the early twentieth century, although some intact subsurface deposits were observed beneath the footprint of the structure in the far-northern portion of the site (Keller and Altschul 2002).

This chapter is organized in four sections. The first section presents an overview of previous research at the site, including the subsurface testing in 2000 by SRI (Vargas and Altschul 2001b). Then, we outline the methods employed for data recovery at LAN-54 (Keller and Altschul 2002). The third section provides an overview of the laboratory methods used to prepare and curate materials collected from the site for detailed analysis. In the final section, we discuss the results of the data recovery excavations. Our main objective in the last section is to provide general results concerning chronological and spatial patterns, midden composition and densities, occupation episodes, interpretations of chronostratigraphic data, and feature interpretations. More-detailed interpretations of recovered artifacts, ecofacts, and other analyzed materials are presented in subsequent volumes.

Site Setting and Configuration

Environmental Context

LAN-54 is located along Ballona Creek, south of the prechannelized alignment and north of the present-day channelized alignment. The site also was located close to where the prechannelized route of Centinela Creek merged into Ballona Creek, near Culver Boulevard. Prior to channelization in the twentieth century, both creeks meandered across the floodplain and emptied into the Ballona Lagoon, depositing freshwater and silt. In addition to the marine resources available in the lagoon, the creeks supported a riparian environment with a variety of freshwater plant and animal resources (Altschul et al. 1992:363–372). Access to those resources likely made LAN-54 appealing to prehistoric occupants as a location for various activities, including hunting, fishing, and gathering of wild resources. However, at varying times in the past, Ballona Creek captured the flow of the Los Angeles River, producing occasional floods that disrupted human land use in the site vicinity.

In addition, soil properties from analyzed areas of LAN-54 indicated that the central portion of site, just south of the former packinghouse (the northern portion of the stripped area), had a slightly elevated landscape advantage at some point in prehistory. That slightly elevated knoll provided better drainage and would have heightened the appeal of LAN-54 as a logistical camp. Indeed, the densest concentration of artifacts at the site was recovered in that area, indicating that it was a favored location of human occupation. Detailed analysis was not conducted on subsurface sediments in the more-heavily disturbed areas to the north, beneath the former packinghouse. Detailed discussion of the prehistoric environmental setting can be found in Volume 1, this series.

Area of Potential Impact

As Vargas and Altschul (2001a:21) explained, improvements to Culver Boulevard included widening the road on both the northern and southern sides, as well as the on-ramp to the Marina Freeway. Another potential impact involved planned improvements to utility lines and other services in the area between the right-of-way and the earthen berm. Road construction and utility improvements were expected to remove intact subsurface deposits within the known site boundaries of LAN-54, except for those that may be permanently capped under the large earthen berm to the south and east. As previously described, LAN-54 probably encompassed a larger area when it was first recorded in 1949. Since then, however, roughly 30–40 percent of the site has been destroyed, as a result of road construction, installation of utility lines, and other construction; another 30–40 percent has been permanently capped beneath earthen fill imported during the construction of Marina del Rey.

Archaeological Background

Early Investigations

Archaeological investigations in the Ballona date to at least the early twentieth century, although no investigations at LAN-54 prior to the 1940s have been documented. Various amateurs, such as F. M. Palmer (1906) and F. H. Racer (Bates 1963:47; Wallace 1984), are known to have searched for archaeological resources in the Ballona in the early twentieth century, but it is unclear whether their investigations included the area now defined as LAN-54. Later, amateur archaeologists, such as Malcolm Farmer (1934) and Stuart Peck (1947), explored the area in the 1930s and 1940s, but neither appears to have ventured into the vicinity of LAN-54. The first amateur known to have conducted investigations at LAN-54 was William Deane, who collected materials in the area during the 1940s and 1950s. In light of Deane's early collections at the site, LAN-54 became known as Deane's Broken Mortar Site in the late 1940s and 1950s. In the early 1950s, Marlys Theil (1953) described and photographed some of Deane's collections, but she made no specific mention of LAN-54 or Deane's Broken Mortar Site.

LAN-54 was first formally recorded on November 27, 1949, by Hal Eberhart, a survey archaeologist at UCLA (Pence 1979; Van Horn 1984a:29). Eberhart filed a site record defining LAN-54 as a "probable village site" located "on both sides of Culver Blvd. just southwest of where it is joined by Alla Rd." Confusingly, a second site form filed by "J. & H. Eberhart" *on the same day* described the site more narrowly as an "artifact area" located "just S. of Culver Blvd. C. 50' W. of Alla Rd." The reason for the discrepancy is unclear.

In 1979, R. L. Pence conducted a large reconnaissance survey in the Playa Vista area, including at LAN-54. According to Pence (1979:10–11), "[a] portion of the site exists west of the intersection of Culver Blvd. and the on-ramp of the Marina Freeway. A portion exists east of that same intersection and forms a part of the parking lot of a Skateboard park on that corner. A small portion exists behind the Blue Goose Packing House building on the southern side of the intersection." Several years later, Archaeological Associates, Ltd., resurveyed the area and found "clear evidence of LAN-54 under the on-ramp, as described by Pence. The section of the deposit is exposed in both the eastern and western ramp escarpments but is most clearly seen on the east" (Van Horn 1984a:37). Although they found a "disturbed midden" on the northern edge of Culver Boulevard, Van Horn concluded that the only intact portion of the site was probably "under the pavement of the Marina Freeway access ramp and possibly under the parking lot of the health club" (Van Horn 1984a:38).

In 1990, SRI surveyed the vicinity of LAN-54 as part of the PVAHP but identified no archaeological features or deposits on the surface (Altschul et al. 1991). On subsequent visits, however, SRI personnel observed shell deposits and patches of dark soil at the foot of the fill pile on the southern side of Culver Boulevard and on the bank of the Marina Freeway off-ramp (Richard Ciolek-Torrello, personal communication 2000). In addition, the SRI excavation crew did not observe any prehistoric cultural materials on the surface during the testing phase in 2000 (Vargas and Altschul 2001b). Those previous investigations made clear that surface survey would be insufficient to validate the presence and extent of LAN-54, and consequently, subsurface testing was determined to be necessary.

Archaeological Testing at LAN-54

SRI's 2000 testing program focused on exposing subsurface deposits within the proposed site and surrounding area (Vargas and Altschul 2001b). The objective of testing was to determine the presence and extent of subsurface deposits in order to obtain information to assess NRHP eligibility. SRI designed the test excavations to minimize site destruction and leave most of the intact subsurface deposits undisturbed for later data recovery excavations. The Blue Goose Packing House and associated facilities were still present at that time, which also restricted the areas accessible to testing. The testing involved mechanical excavation of four trenches, 2–4 m in length, within the accessible portions of the site and in adjacent areas to the east, west, and south of the then-known site boundary (see Vargas and Altschul 2001b) (Figure 129). Trenches were excavated to varying depths from 1 to 3 m but were usually terminated when it became clear that no subsurface cultural materials were present. Appendix 8.1, this volume, summarizes the results of the testing at LAN-54.

Only Trench 2, located along the southwestern edge of the defined site boundary (roughly 435 feet southwest of the intersection of Culver Boulevard and the Marina Freeway), yielded an intact A horizon with premodern archaeological deposits. Dry screening of over 200 liters of excavated soil through 1/4-inch screens yielded fragments of oyster (*Ostrea lurida)*, venus clam (*Chione* sp.), scallop (*Pecten* sp.), and razor clam (*Tagelus* sp.) and a small quantity of lithic debitage (Vargas and Altschul 2001b:14). Most of the artifacts recovered from the A horizon in Trench 2 were coated with a thick layer of caliche.

Four other trenches—located 50–100 m outside the defined site, in surrounding areas—yielded no intact deposits. A final trench in the eastern part of the site also revealed no cultural deposits, but subsurface exposure showed that the area had been heavily disturbed by modern construction. Overall, testing results indicated the presence of intact prehistoric cultural deposits in the southern portion of the project area, in the vicinity of Trench 2. Based on the presence of intact prehistoric deposits in the A horizon, Vargas and Altschul (2001b) recommended LAN-54 eligible for listing in the NHRP, under Criterion d.

The testing results provided a basis for designing the data recovery excavations (Vargas and Altschul 2001b). Vargas and Altschul (2001b) concluded that 60–70 percent of the original site recorded in 1949 had been destroyed through modern construction of roads, utilities, and commercial structures. Consequently, investigations of the intact deposits provided information about only a portion of the site, which nevertheless was deemed vital because of the lack of known prehistoric sites along Ballona Creek in the Ballona. Based on the testing results, Vargas and Altschul (2001a) developed a treatment plan for data recovery at LAN-54, described in the following section. Their research design was predicated on the investigation of three research themes: human-environmental relationships and land use in the Ballona Lagoon, migration, and social organization. They designed a data recovery program to obtain data to address each of those themes and the corollary hypotheses.

Field Methods for Data Recovery

Vargas and Altschul's (2001a:21–25) multiphase data recovery research design called for exploratory trenching to identify and assess all significant subsurface features. They devised a five-phased approach: (1) mechanical trench excavations to identify horizontal and vertical site limits, (2) mechanical stripping of overlying fill (an area of about 120 by 20 m), (3) manual excavation of CUs within intact cultural deposits, (4) systematic stripping in intact site areas to expose the top of the culture-bearing A horizon (a total area of around 650 m^2), and (5) manual excavation of features identified during stripping. The activities were focused within the APE encompassed by the road widening for Culver Boulevard and the Marina Freeway. The methods were consistent with Vargas and Altschul's (2001a) research design and were altered little during the course of the fieldwork (Keller and Altschul 2002). The EUs from LAN-54 are illustrated in Figure 130 and summarized in Table 40.

The building foundation of the packinghouse was removed prior to the 2002 data recovery, which exposed a large area of the site that was not accessible during testing. Therefore, part of the initial trench excavations was focused within the previously inaccessible footprint of the packinghouse, concentrating specifically on areas that were determined to be less heavily disturbed by modern construction.

Mechanical Trenching and Overburden Removal

Three initial trenches were placed at the outset of the data recovery at LAN-54 (see Figure 129). The purpose of the trenches was to help guide the excavators in removing the overlying fill and exposing the underlying A horizon. The three trenches were strategically placed in locations along the edges of, and within, the planned area of subsurface exposure, to provide guidelines for overburden removal. The trenches were also used to evaluate the horizontal extent of intact subsurface remains. The excavators located the intact A horizon beneath roughly 0.3–1.5 m of mixed fill in the southern and far-northern areas of the site. The A horizon had been heavily truncated or removed in the central portion of the site, beneath the former packinghouse. As a result, no CUs or SUs were situated in that heavily disturbed area, although one historical-period feature was recorded.

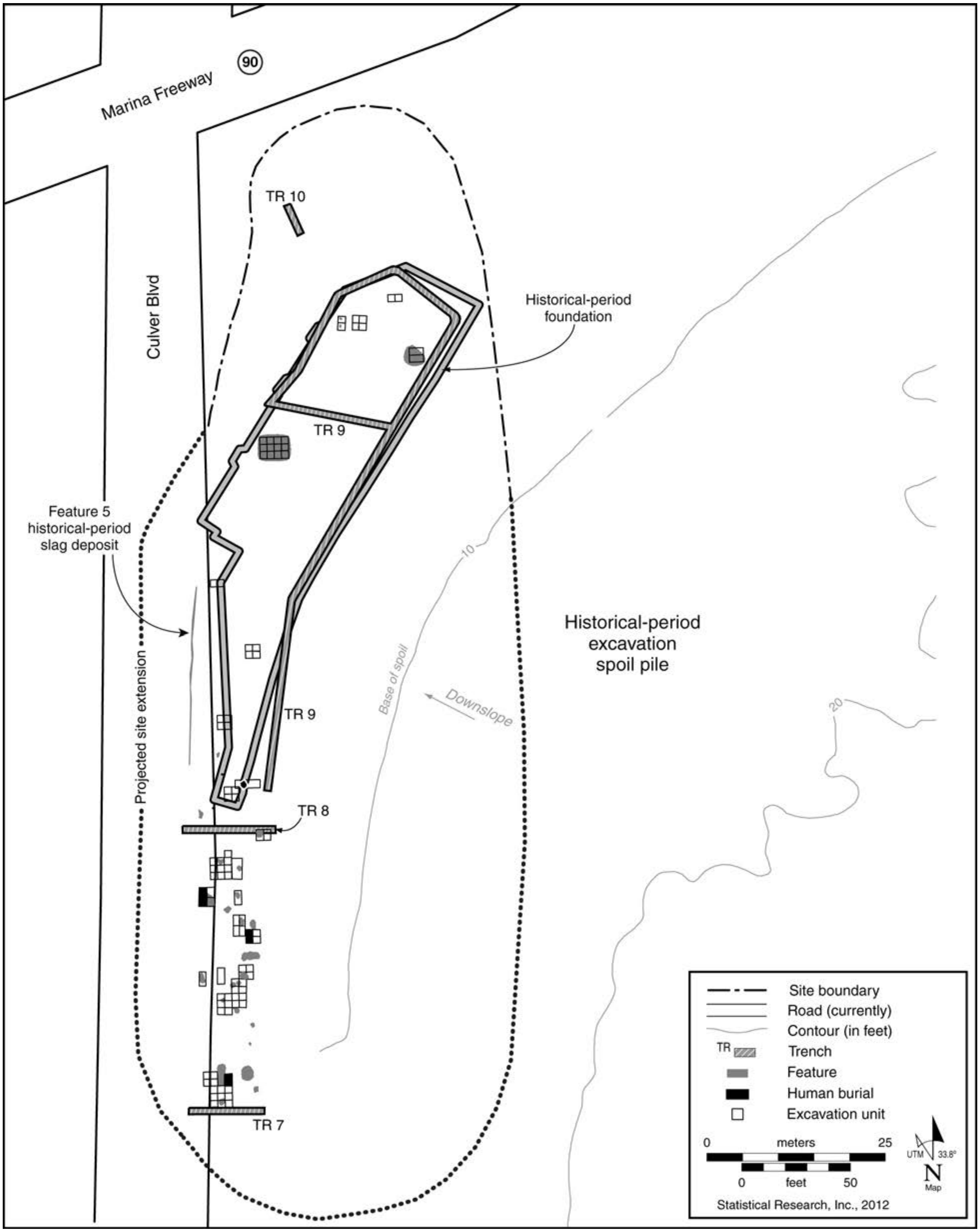

Figure 129. Map of LAN-54, showing the locations of data recovery trenches and excavation units.

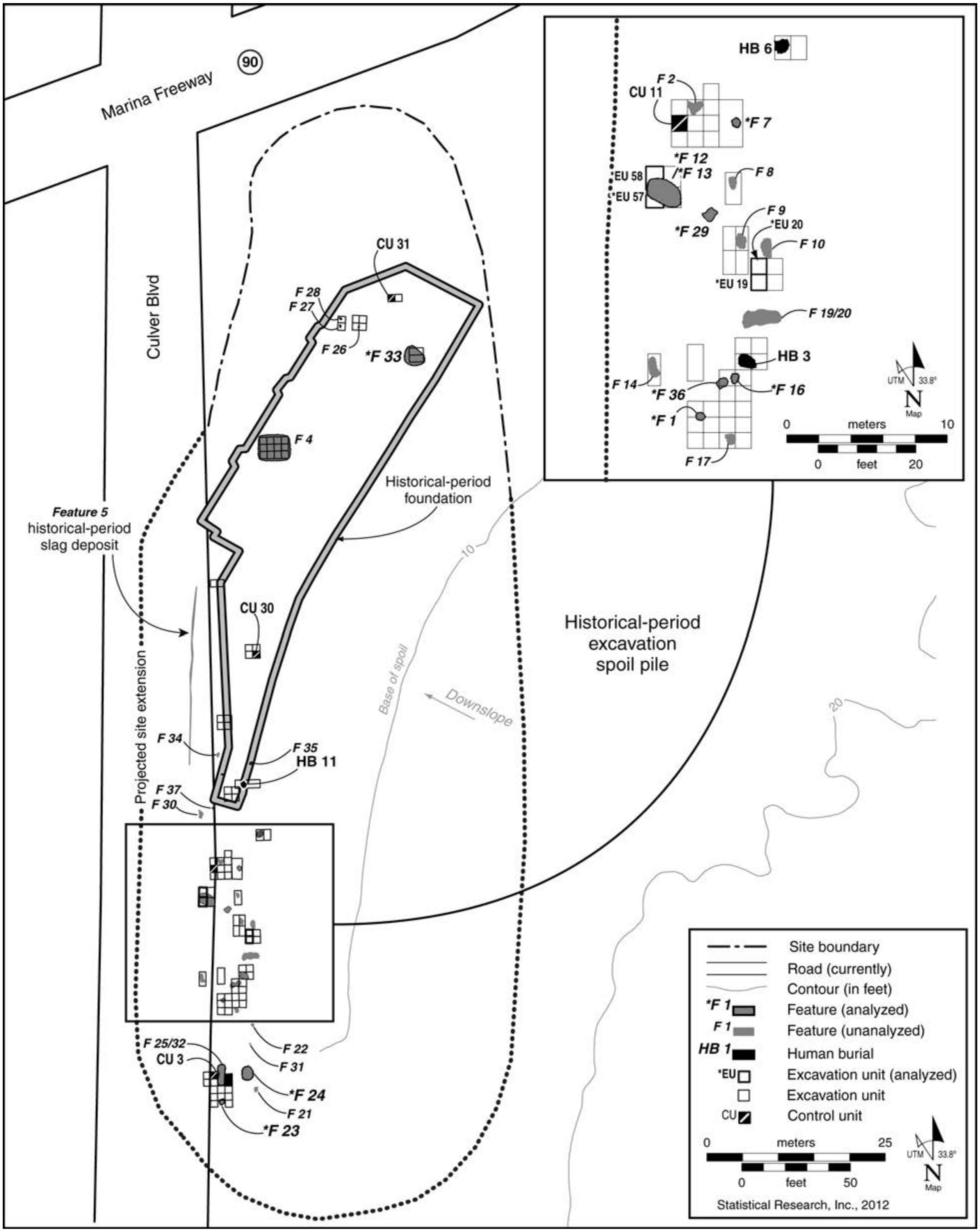

Figure 130. Map of LAN-54, showing the locations of hand-excavated units, features, and analyzed contexts.

Table 40. Trenches, EUs, SUs, and Features from Data Recovery at LAN-54

Description	No. Excavated
Exploratory trenches	4
EUs (2 by 2 m)	10 (7 within the intact site and 3 within areas where the site appeared to have been previously removed)
SUs	56
Features	32

Following initial trenching, the overlying fills were removed with an excavator fitted with a flat cutting blade. An archaeologist monitored the fill-stripping procedure at all times and guided the equipment operator when intact deposits were reached.

A final trench, Trench 10, was excavated in the area to the northwest of the packinghouse during the data recovery, to better define the site limits, especially in light of previous observations of archaeological materials near the intersection of Culver Boulevard and the on-ramp to the Marina Freeway (Van Horn 1984a). No artifacts or cultural deposits were observed during the excavation. However, later wet screening of a sample of collected soils revealed cultural materials, including lithic artifacts, faunal remains, and glass fragments. In addition, isolated human remains were found during the preparations for repatriation of soil collected from Trench 10. Those results suggested that the boundaries of LAN-54 extended into the area near the intersection of Culver Boulevard and the on-ramp to the Marina Freeway, as had been suggested previously by Van Horn (1984a).

In all areas, a thin layer of fill ranging from 4 to 10 cm in depth was left intact above the A horizon, to protect the deposits and to avoid unintentionally removing any feature fill or intact artifact deposits. Fill materials were removed from the LAN-54 area by dump truck and taken to a designated location within the Playa Vista development.

Manual Excavations

Once the overlying fills had been stripped, a series of 10 EUs was situated within the project boundaries. Seven 2-by-2-m EUs were placed at 10-m intervals within the intact portion of the site. Where exploratory trenching indicated that the site deposit had not been removed through previous construction activities, the excavators established 3 additional 1-by-2-m EUs, spaced at 20-m intervals. All EUs were further subdivided into 1-by-1-m EUs and were excavated in arbitrary 10-cm levels, forming spatially segregated blocks of contiguous units. As features were identified in the EUs, they were excavated as discrete entities and assigned unique PD numbers (see Chapter 4, this volume, for details on recovery methods). Upon the completion of the EU excavations, 8 25-by-25-cm column-sample units were excavated adjacent to 11 EUs (see Appendix 8.2, this volume). SRI soil scientists made detailed wall-profile drawings and collected additional soil samples from two locations at LAN-54: (1) the southeastern wall of CU 3 and (2) the northeastern wall of Trench 8. Those samples were selected for ostracod analysis and more-detailed procedures aimed at reconstructing the paleoenvironment of the Ballona Lagoon in the vicinity of LAN-54 (see Volume 1, this series). They also were used to reconstruct the depositional history of the site (see below).

MSUs

Subsequent to completing the EU excavation and column-sample collection, the A horizon was systematically stripped, beginning at the far-southeastern edge of the site, along a transverse exploratory trench (Trench 7) (see Figure 129) (see Chapter 4, this volume, for stripping methods). In total, 56 SUs were excavated within the APE. Most of the units were 4 by 4 m in area, although some in the northwestern portion of the site were irregular in shape and size, to accommodate the edges of the APE. Thirty units were excavated in the intact area of the site in the southeastern portion of the APE, an area totaling 480 m^2. Ten additional SUs (some with irregular shapes) were excavated in the partially intact northwestern area of the APE, beneath the eastern portion of the footprint of the packinghouse.

Although somewhat variable, the A horizon averaged 60 cm in depth and overlay a visually distinct grayish-green sandy clay loam identified as a sterile C horizon (Cgkm). In all instances, stripping continued 10–20 cm into the C horizon to collect any artifacts that might have shifted downward within the subsurface matrix as a result of bioturbation or water movement. When artifacts or unusual soil changes were encountered, archaeologists halted the backhoe and investigated the area in question, by hand. Any concentration of artifacts or discernible soil stain was flagged as a possible feature; a pedestal of soil around the possible feature was left undisturbed for hand-excavation. Isolated artifacts were point-provenienced within the SU, given unique item numbers, and collected for analysis.

Feature Recovery

Concurrent with the mechanical stripping, all identified features were excavated during the removal of the A horizon (see Figure 130). Soil samples, flotation samples, and, where necessary, pollen samples were collected from the matrix surrounding each feature. The pedestals of soil surrounding the features were excavated to the sterile C horizon. In some cases, the soils between closely spaced features also were excavated by hand to detect any connections between features. Three prehistoric human-burial features were encountered at LAN-54 (Features 3, 6, and 11). A detailed description of the excavation and treatment protocols for human remains are presented in Volume 4, this series.

Summary

The data recovery at LAN-54 consisted of exploratory trenches (n = 4), 10 blocks of EUs (comprising 82 1-by-1-m units), 4-by-4-m SUs (n = 56), and column samples (n = 8). Those excavations revealed two areas of intact site deposits separated by a large area of modern disturbance under the former Blue Goose Packing House, where the A horizon had been obliterated. Within that disturbed area, Feature 4, a historical-period wooden structure, was encountered, and it was interpreted as the possible remains of a structure or light-rail line. The intact deposit located to the south of the packinghouse was significantly denser and contained most of the prehistoric features identified at the site. The second prehistoric site deposit, at the northern end of the site, contained a truncated A horizon. A modest number of artifacts; sparse, weathered marine-shell fragments; and three indistinct features were recorded along the western edge of the stripping area. A final exploratory trench (Trench 10) located northwest of that sparser deposit (just south of the project area boundary, at the intersection of the Marina Freeway and Culver Boulevard) revealed a less-truncated and relatively intact A horizon. Prehistoric and historical-period cultural materials, including isolated human remains, were recovered during wet screening of the soils from Trench 10.

In total, 32 features were recorded during the data recovery at LAN-54. (Note that several feature numbers from field designations were combined, and others were later interpreted as probable nonfeatures; therefore, the number of features reported by Keller and Altschul [2002] differs.) Artifacts recovered from features and CUs (general midden areas) included ground stone artifacts, stone tools and debitage, hammerstones, FAR, manuports, and worked-bone tools. Faunal remains were dominated by bay and estuary marine-shell species (mainly *Argopecten* sp., *Ostrea lurida*, and *Chione* spp.); other faunal remains included fish, bird, marine mammals, and terrestrial mammals. The upper fill and mixed levels also contained significant numbers of cow or horse bones related to historical-period occupations in the Ballona Lagoon. The results of those analyses are presented in Volume 3, this series.

Laboratory Methods

This section provides a summary of the laboratory methods implemented for cataloging, sorting, QA, and curation of all materials collected during excavations at LAN-54. Chapter 4, this volume, presents the laboratory procedures, and in this section, we discuss only the procedures that differed for LAN-54.

Screening

Soils excavated from the A horizon and features were generally too clayey to permit dry screening; the field team thus relied primarily on wet screening to detect and remove cultural materials. Therefore, all excavated matrix was wet screened through cloth mesh of varying mesh sizes. Soils collected from CUs were wet screened through 1/8-inch mesh. Soils from features (with the exception of flotation samples from column samples) were wet screened through 1/4-inch mesh. A sample of the soils collected from SUs and test pits was wet screened using a mechanical sorting machine fitted with a 1/8-inch-mesh screen. Materials collected from those units were first dry screened using a mechanical-screening plant and then sent to a water-screening facility at Playa Vista.

Flotation soils from Column Samples 1 and 4 were analyzed for macrobotanical remains, using nested screens. Screen-mesh sizes of 1/8 and 1/4 inch were used to segregate heavy-fraction materials, and a No. 45 screen (ca. 1/64-inch mesh) was used to capture light-fraction materials. The latter mesh size was chosen to capture minute macrobotanical samples.

Sorting

The sorting procedures varied for the different recovery contexts; in other words, different sorting protocols were implemented for the CUs, EUs and prehistoric and historical-period features.

For the EUs and SUs, the bulk samples collected from each PD unit during the wet-screening process were sorted. First, the samples were sifted through a series of nested screens with mesh sizes of 2 inches, 1 inch, 1/2 inch, 1/4 inch, and 1/8 inch (larger-mesh screens were placed over smaller-mesh screens). However, when it became too time-consuming, the process changed and used only two screen-mesh sizes (1/4 inch and 1/8 inch). All sorted materials were thus categorized according to two screen-size categories (1/4 inch and greater and 1/8 inch). The sorting criteria for various artifact types and material classes are summarized in Appendix 8.3, this volume. Any very small materials that were not captured in the 1/8-inch screen (i.e., very small items) were scanned for diagnostics (for example, shell-hinge fragments, projectile point fragments, or other high-priority artifacts and materials) and saved for analysis; all other very small items were discarded. FAR, unworked stone (manuports), and some botanical remains (wood and charcoal) were not sorted and bagged but, instead, weighed or counted and not saved for analysis. The artifacts collected during the sifting process were classified by material class. All materials from the bulk samples were separately bagged and labeled based on (1) screen size and (2) artifact class. All remaining residues, mainly rocks and gravels, were re-bagged and placed in their original containers.

A different procedure was used to sort materials excavated from column samples and prehistoric features. The sampling units were processed using flotation, which created both heavy- and light-fraction materials. The heavy-fraction samples were processed in the same manner as the EUs (i.e., sifted through 1/4-inch and 1/8-inch screens for size sorting and subsequently categorized by material class). However, the procedures differed in terms of the material collected from the nested screens. All unworked shell, unworked bone, seeds, and diagnostic historical-period artifacts were collected and bagged from the 1/4-inch sort. From the 1/8-inch sort, however, only diagnostic historical-period artifacts were segregated and retained for analysis. The other sorted bulk materials were inventoried and stored for later curation. All materials from the light-fraction sample were collected and subjected to detailed analysis.

A different sorting procedure was also employed for the historical-period features. Again, all bulk materials collected were sifted through 1/4-inch and 1/8-inch screens, but *only* glass, metal, ceramic, and other diagnostic historical-period artifacts were collected. Also, one sample of each nondiagnostic artifact type from each artifact class was sorted; for example, if nondiagnostic glass fragments of various colors were collected, one "representative" sample specimen of each color variant was collected for additional classification and analysis. Again, all materials were bagged and labeled according to screen size and artifact class. All other sorted bulk materials not collected for additional analysis were inventoried and stored for curation.

Inventory and Data Processing

Inventory and data processing of materials from LAN-54 followed the standard protocols discussed in Chapter 4, this volume.

Analysis

Particular EUs and features were selected for detailed analysis, totaling 17 proveniences that represented a sample of the range of feature types and spatial and temporal contexts: 4 EUs that were used as CUs, 3 human-burial features, and 10 nonburial features. The 4 CUs (CUs 3, 11, 30, and 31) were spatially segregated and provided information on middens located in different parts of the undisturbed areas of the site (see Figure 130).

In total, 13 features were selected for analysis, including burials (n = 3), rock clusters (n = 3), artifact concentrations (n = 6), and a pit (Table 41). The results of the analyses of osteological and mortuary remains from the 3 burials are discussed in Volume 4, this series. Of the 6 artifact concentrations, 2 were possible special-function or ritual-related deposits (Features 16 and 36), and 2 of them (Features 12 and 13) together constituted a single larger feature that may have been an activity area containing multiple and roughly contemporary hearth-cleanout deposits

Table 41. Features Selected for Analysis from LAN-54

Context	Type and Temporal Association	Analysis Conducted[a]
CUs		
3	late Millingstone to Intermediate period	L, V, IV
11	late Millingstone to Intermediate period	L, V, IV
30	late Millingstone to Intermediate period	L, V, IV
31	late Millingstone to Intermediate period	L, V, IV
Features		
1	rock cluster, Millingstone period	L, V, IV, WS, MB
3	burial, Intermediate period	L, V, IV, WS, MB, OS
6	burial, Intermediate period	L, V, IV, WS, MB, OS
7	rock cluster, Intermediate period	L, V, IV, WS, MB
11	burial, Intermediate period	L, V, IV, WS, OS
12	artifact concentration, Intermediate period	L, V, IV, WS, MB
13	artifact concentration, Intermediate period	L, V, IV, WS
16	artifact concentration, Intermediate period	L, V, IV, WS, MB
23	rock cluster, Millingstone period	L, V, IV, WS, MB
24	pit, Millingstone period	L, V, IV, WS, MB
29	artifact concentration, Intermediate period	L, V, IV, WS, MB
33	artifact concentration, historical period	L, V, IV, WS
36	artifact concentration, Intermediate period	L, V, IV, WS, MB

Key: C = ceramics; H = historical-period artifacts; IV = invertebrates; L = lithics; MB = macrobotanical; OS = osteological (Stanton et al. 2009); V = vertebrates; WB = worked bone; WS = worked shell.
[a] Analysis conducted on all materials recovered.

and domestic-discard areas. The 3 rock-cluster features were likely deposits from hearth-cleanout episodes.

The feature types not selected for analysis included a number of possible thermal and nonthermal refuse deposits and shell dumps, most of which were prehistoric in age. Those features were typically smaller in size, contained fewer artifacts, or were more heavily disturbed than the ones selected for analysis. Several unanalyzed features were excavated in the highly attenuated A horizon in the northern portion of the site, and some of them, in fact, may have been nonfeatures. They were judged to be less informative of prehistoric and historical-period processes and activities than the features selected for analysis.

Exceptions to that sampling strategy were made for some material classes. For example, macrobotanical remains from three of the four CUs selected for analysis were not analyzed. The soils/geomorphology study was only conducted in CUs 3 and 11, not CUs 30 and 31, because a representative sample from two CUs was adequate for interpretation of the geological and depositional history of the site. The analytical procedures, sampling criteria, and results for each individual material class are presented in Volume 3, this series.

Site Integrity

The integrity of LAN-54 has been compromised as a result of historical-period and modern construction and earthmoving activities. LAN-54 was located outside the footprint of the former Hughes Aircraft Company headquarters and therefore was not subjected to disturbance related to leveling and infilling of the wetlands. However, the site was located in an area of heavy construction related to road grading, railroad development, and building construction, most prominently the Blue Goose Packing House.

One major source of disturbance concerned the construction of an electric-rail spur in the early twentieth century that extended through a portion of LAN-54. In 1902, a *Los Angeles Times* article reported that "[t]wo grading outfits comprising 100 men each are employed in leveling up the right of way and putting it into shape for track laying" (*Los Angeles Times*, 7 August 1902:A1). The Los Angeles and Pacific Railroad Company constructed the 14-mile-long "Ballona branch of the Santa Monica electric road" to connect the main line in Los Angeles to the city of Redondo, and it was completed on October 19, 1902. The Alla Road train station that serviced that line was constructed along Ballona Creek, likely near and to the south of LAN-54. One feature excavated within the APE of LAN-54 (Feature 4) was likely part of the rail spur that formerly extended near the site area, along the current alignment of Culver Boulevard. The line was abandoned in 1919, but the initial construction of the rail spur, station, and associated facilities likely removed subsurface features and cultural deposits in the western portion of LAN-54.

Historical-period and modern road construction also likely destroyed portions of LAN-54. Lincoln Boulevard was constructed in the 1920s, and by 1930, the rights-of-way for Jefferson and Culver Boulevards also were fully graded. In the 1960s, the Marina Freeway (SR 90) was constructed through the northern portion of LAN-54. The construction of the Marina Freeway may have been particularly destructive. Pence (1979) and Van Horn (1984a:38), based on separate surveys in the area, surmised that the densest archaeological concentration at the site was in the vicinity of the Marina Freeway on-ramp. If so, much or all of those remains likely were partially or completely obliterated as a result of road grading and other construction, because, as explained above, in 1990, SRI surveyors observed shell and patches of dark soil at the foot of the fill pile on the southern side of Culver Boulevard and on the bank of the Marina Freeway off-ramp (Richard Ciolek-Torrello, personal communication 2000). Prehistoric archaeological resources likely were present in the vicinity of the Marina Freeway on-ramp prior to the 1960s.

Additional disturbance occurred during construction of the cement flood channel for Ballona Creek, which was completed in 1935. However, that construction also may have had a positive impact. During construction, much of the soil and muck dredged up from the creek was piled alongside the channel, creating a large earthen berm. The berm may have protected any subsurface remains, if present, from subsequent construction and earthmoving activities. That berm was later added to, during the construction of Marina del Rey in 1963.

It seems likely that the building that later became the packinghouse was originally constructed because of its proximity to the rail spur. However, after the rail spur closed in 1919, it was reused as an agricultural packing facility. The construction of the large building clearly damaged the archaeological subsurface remains. As explained above, much of the A horizon beneath the footprint of the structure had been either obliterated or heavily truncated. Prehistoric features, including Features 11 and 34, were located immediately adjacent to the southern extent of the building footprint. Thus, it is very likely that the construction of the packinghouse destroyed some features beneath the southern portion of the building. In the northern portion of the building, the construction truncated, but did not completely destroy, the subsurface A horizon. Sparse prehistoric cultural materials were recovered in that area.

In sum, the A horizon has been heavily truncated in portions of LAN-54 in the vicinity of the packinghouse, and any number of archaeological features and deposits may have been removed during road and railroad construction. Hal Eberhart, a survey archaeologist at UCLA, filed a site record in 1949 in which he interpreted LAN-54 as a "probable village site," based on the dense distribution of archaeological resources (see Pence 1979; Van Horn 1984a:29). The features recovered in the PVAHP project area were generally related to food-processing and mortuary activities, likely from short-term, logistical resource-collection camps, but no credible evidence of a residential habitation was recovered. Perhaps remains indicating a more substantial habitation were destroyed as a result of late-historical-period and modern construction.

Stratigraphy and Chronometric Reconstructions

This section examines how changes in the configuration of the Ballona Lagoon during the Holocene affected human use of the wetland, as reconstructed from an examination of sedimentary deposits and archaeological materials recovered from LAN-54. We first outline the methods employed to reconstruct the history of deposition and cultural use of the lagoon as observed at LAN-54. Subsequently, our interpretation of the depositional environment and associated biota in that portion of the lagoon during the late Holocene is presented. Finally, we examine the distribution of cultural materials within those different depositional environments, as observed in CUs excavated at LAN-54.

Natural Stratigraphy

Methods

LAN-54 lies on the floodplain of Ballona Creek, south of the former channel depicted on historical maps and north of its existing channelized route. Sediments on that part of the floodplain consist of an upward-fining sequence of loams and sandy clay loams overlain by silty clay loams. Two profiles were selected to examine the depositional history of the site (Figures 131 and 132). Profile 1 was located in the eastern wall of CU 3, near the southwestern end of the site. Profile 2 was located in Trench 8, which roughly bisected the central portion of the site in a northwest–southeast transect. In addition to the natural stratigraphy, microinvertebrates were examined to reconstruct changes in salinity within that portion of the lagoon during periods of site occupation. To identify how that portion of the lagoon was used at different times during the late Holocene, cultural features were radiocarbon dated and assigned to stratigraphic contexts based on the natural stratigraphy.

The sediments from the profiles were described following USGS Soil Survey Manual guidelines (USGS 2007). The observations of sediment samples from Profiles 1 and 2 included color, mineralogy, particle size, and pH. In addition, the abundances of ostracod and mollusk species represented in the samples were also documented. Those analyses were undertaken to delineate distinctive stratigraphic units within the site. Twelve stratigraphic units were identified in Profile 1 (see Figure 131), and 9 were identified in Profile 2 (see Figure 132) (differences in the number of stratigraphic units across the site were primarily associated with differences in fill episodes across the site). Sediment and microinvertebrate samples were collected from natural stratigraphic units for analysis in the laboratory, to refine reconstructions of the depositional history and environment of the lagoon.

Stratum Descriptions

In this section, we describe the stratigraphy observed at LAN-54 and reconstruct the local environment, based on sedimentological and microinvertebrate data. Three major depositional strata were observed at LAN-54: two distinct floodplain deposits below modern/late-historical-period fill. The deeper floodplain deposits consisted of an upward-fining sequence of loams and sandy clay loams overlain by silty clay loams (see Appendix 8.4, this volume). However, much of the floodplain deposit in Stratum II had been truncated or removed as a result of construction of the Pacific Electric Railroad, Culver and Speedway Boulevards, and the Blue Goose Packing House in the early twentieth century. As noted above, those construction projects, especially the last, removed most of the premodern archaeological resources from the central area of LAN-54.

Stratum I, the oldest deposit, was located between 1.3 and 1.9 m AMSL in the two analyzed profiles and was composed of the Cgk, Cgkm, and AC horizons. The C horizon materials consisted of sandy alluvium deposited by shifting stream channels. Microinvertebrates (i.e., *Succinea* sp.) recovered from the AC/C horizon matrix indicated that moist soils were present, possibly associated with riparian conditions, and that water had moved slowly in that area. After their deposition, C horizon sediments became strongly cemented with carbonates as a result of capillary action and precipitation of carbonates above the water table; cementation was greatest immediately below the transition to the AC horizon. The soil was moderately alkaline (pH 7.8–8.2), which was conducive to the preservation of faunal remains.

Stratum II contained a well-developed A horizon that, in the site area, was truncated and buried by layers of fill (Stratum III) related to historical-period and modern earthmoving activities. The silty sediments were located from 1.9 to 2.4 m AMSL in the two profiles and contained a moderately developed soil. However, differences in the composition of sediments and microinvertebrate assemblages between Profiles 1 and 2 suggested that the western end of the site (Profile 1) (see Figure 131) was located nearer to the shoreline of the relict lagoon and that the central portion of the site (Profile 2) (see Figure 132) was located more distant from the ancient shoreline (Palacios-Fest 2002). The A horizon possessed well-developed pedogenic properties, including moderate to strong granular structure and common pores. As in Stratum I, the soil was moderately alkaline (pH 8.1).

Stratum III was composed of late-historical-period/modern construction fills. It was a very gravelly sandy loam that ranged in color from light gray to dark brown and

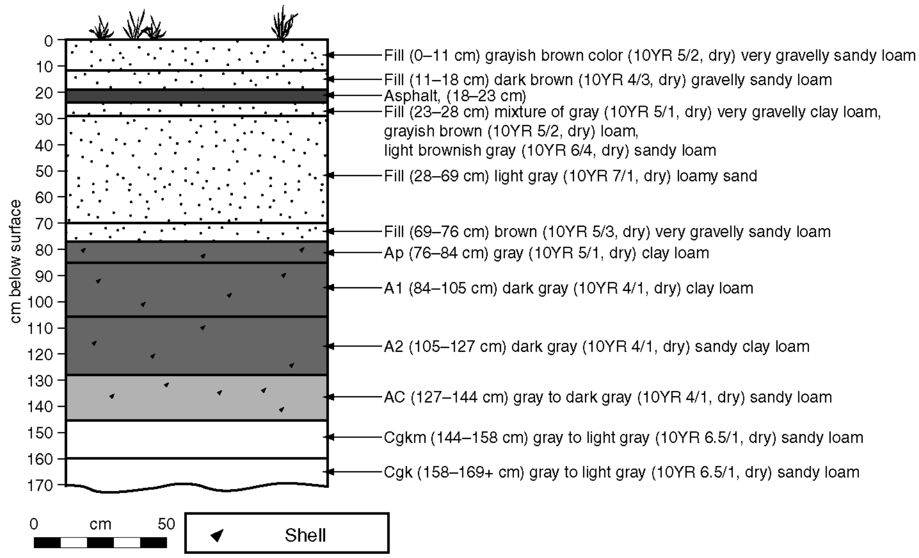

Figure 131. Illustration of stratigraphic soil Profile 1, LAN-54.

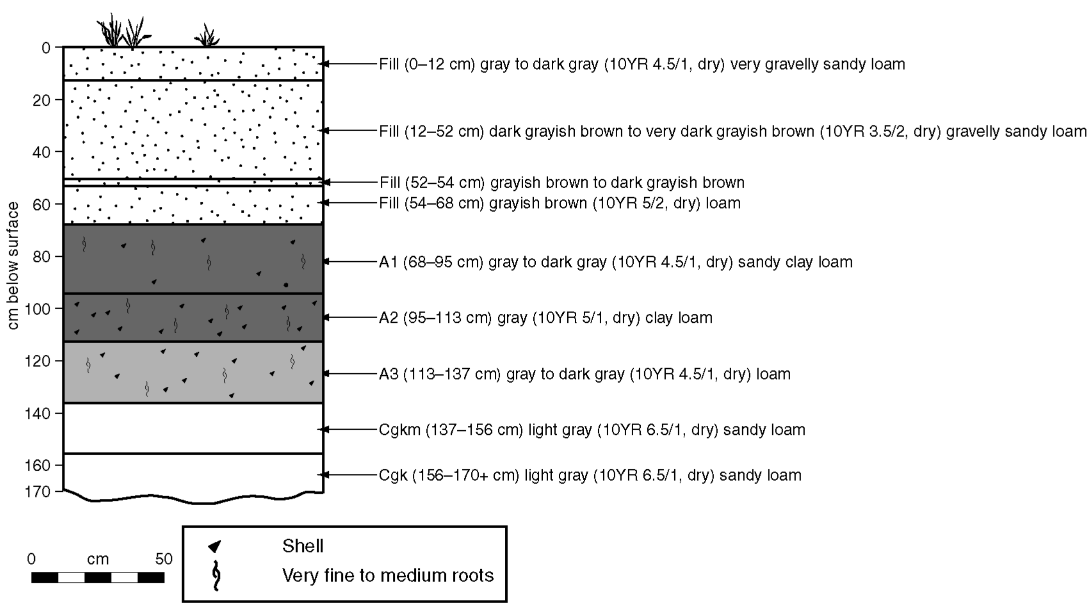

Figure 132. Illustration of stratigraphic soil Profile 2, LAN-54.

encompassed up to 0.75 m in thickness. A variety of construction activities since the 1880s had generated multiple episodes of fill deposition. Along the southwestern edge of the site (Profile 1), a layer of asphalt measuring approximately 5 cm thick was present at about 0.2 mbs.

Variability in the sediment textures in Profiles 1 and 2 indicated that the central portion of the site (Profile 2) was slightly higher in elevation than the western end of the site (Profile 1). The higher sand content in the Stratum II sediments from Profile 2 (31 percent) contrasted to the Stratum II sediments from Profile 1 (18 percent), which suggested higher-energy deposition of coarser sediments on the ancient knoll (see Appendix 8.4, this volume for details); the central area of the site was estimated to have been about 1 m higher in elevation than the western end. The vertical distribution of redoximorphic features in the profiles further suggested that the western end of the site had been inundated by groundwater more frequently than the central portion. However, both profiles suggested that the land surface remained above the water table most of the time. Even so, the slightly elevated knoll in the central part of the site would have provided an attractive locus for a temporary camp near the edge of the lagoon.

Geophysical Soil Analyses

Geophysical data were obtained from Profiles 1 and 2 at LAN-54, including pH levels, organic content, extractable-phosphorous content, electrical conductivity, density, porosity, and particle size. Soil pH levels and electrical conductivity (dS/M) measure soil salinity, which provides insights into preservation conditions. Phosphorous and organic-content levels potentially indicate human occupation, because most materials discarded by humans tend to be high in organic content and phosphorous, such as animal and plant foods and wooden materials.

Overall, soil pH and electrical conductivity varied little between the two profiles (see Appendix 8.5, this volume, for data). The pH levels did not exceed 8.4, indicating insignificant sodium content. Bone remains, composed of collagen, fats, and proteins embedded within an inorganic matrix of the mineral hydroxyapatite ($Ca_5[PO_4]_3OH$), are the least soluble of the organic remains and are best preserved at a pH level of 7.88. The observed levels did not substantially vary from that ideal level, suggesting relatively good conditions for preservation. Over all levels, the mean pH and conductivity levels for Profiles 1 and 2 were roughly equal (respectively, 8.1 and 8 for pH and 0.63 and 0.55 for conductivity). More variable were the levels among the subsurface strata. In both units, pH and conductivity levels tended to be higher in the A horizon, peaking in the A1 stratum. Conductivity levels declined in the deeper strata, suggesting lower soluble-salt content.

Organic-content and total-phosphorous concentrations also exhibited higher levels in the A horizon, which was consistent with the archaeological evidence of more features and denser midden deposits. In both units, both total-phosphorous levels and organic content exhibited pronounced peaks in Strata A1, A2, A3, and Ap, with single-stratum peaks in A1. Those data confirmed a peak period of human occupation during the early to middle Intermediate period, which corresponded to the A horizon. Organic-content and total-phosphorous levels did not substantially vary among the units' A horizons. The levels in Profile 1 were only slightly higher, perhaps because of accumulation of organic materials during periods of inundation in the lower-lying areas of the site.

Microinvertebrate Analysis

Palacios-Fest (2002) conducted a detailed paleoenvironmental reconstruction of the vicinity of LAN-54 based on analyses of microinvertebrate remains in Profiles 1 and 2. In total, 18 soils samples were extracted from those two profiles for the analysis (see Palacios-Fest 2002 for an overview of methods). Analyses of ostracod and other microinvertebrate species provided grounds for inferring changes in the environments and the extent to which the terrain had been inundated with brackish or fresh waters.

The results from Profile 1 in the southern portion of site revealed evidence of brackish-water inundation in the lower portions of the units, indicating proximity to the estuary lagoon. The upper portion was dominated by freshwater species, however, indicating a transition to a more freshwater setting because of sedimentation from Ballona Creek and the Los Angeles River over the last 3,000 years. Profile 2, by contrast, was located further inland from the lagoon shoreline, given the low abundance of microinvertebrates. The absence of ostracods in Profile 2 indicated a drier but periodically moist terrain, as evidenced by the presence of snails. Those data suggested that the site area was located adjacent to the northern shoreline of the relict lagoon. Both profiles were situated above the water table most of the time, but Profile 1 indicated more-frequent inundation and that it was closer to the lagoon to the south. Profile 2 likely was situated on a knoll or natural rise that prevented frequent inundation. As explained below, that knoll would have provided an appealing location for temporary camps.

Most of the human occupation of LAN-54 occurred soon after the formation of a stable landform adjacent to the lagoon shoreline during the late Millingstone and early Intermediate periods. Human occupational intensity appears to have declined as the estuary environment slowly graded to a marshier, freshwater environment over the course of the last 3,000 years (Palacios-Fest 1998, 2002). The gradual replacement of the lagoon with freshwater marshes may have contributed to the decline in human occupation at LAN-54; evidence has suggested that LAN-54 was infrequently occupied after about 2,000 years ago.

Cultural Stratigraphy

Methods

To examine the correlation between the depositional history of LAN-54 and human use of that part of the Ballona, the elevations of excavated features and CU levels were plotted relative to the sediment strata. In addition, radiocarbon dates were obtained on shell specimens from eight features (Table 42) and two CUs (Figure 133) (see Chapter 3, this volume). Most features and CU levels were assigned to one of five occupation episodes, based mainly on the radiocarbon assays:

Episode 1: late Millingstone period
Episode 2: late Millingstone period
Episode 3A: late Millingstone/early Intermediate period
Episode 3B: early Intermediate period
Episode 4: Euroamerican period (based on artifacts, not radiocarbon assays)

The date ranges for Episodes 1–3B incorporated the calibrated 2σ ranges derived from both the standard and age-specific ΔR correction values, which were applied to control for the "reservoir effect" in radiocarbon assays derived from shell specimens (see Chapter 3, this volume). The incorporation of both corrections produced larger date ranges than would have been the case with only one algorithm, because the two corrections produced slightly different sigma ranges. The episode assignments for age-assigned features are listed in Table 42. Episode 4 had an inferred date range that was based on recovered artifacts (not radiocarbon assays) and was arbitrarily defined as the time span between the establishment of California statehood in 1848 and the founding of the HHIC in 1941.

In addition to the episode assignments, broader period assignments were inferred for 26 features (including some that were not sampled for ^{14}C dating), based on chronometric data, stratigraphic placement, and time-sensitive artifacts (such as temporally diagnostic shell beads). The features were assigned to two periods: Millingstone and Intermediate. Generally, features in Episode 2 were assigned to the late Millingstone period (no features were assigned to Episode 1), features in Episode 3A were assigned to the late Millingstone/early Intermediate period, and features in Episode 3B were assigned to the early Intermediate period. Most of the analyses presented in Volume 3, this series, were based on the broader period assignments rather than the more-narrowly defined episode assignments. The period assignments and the data used to infer them are listed in Table 42.

Episode and Period Descriptions

Episode 1 was defined on the basis of ^{14}C assays obtained from two clamshells recovered from the lower levels of Stratum I in CUs 3 and 11 (see Chapter 3, this volume). Radiocarbon dates for those specimens generated sigma ranges of 2210–1680 cal B.C. (standard ΔR), 1980–1440 cal B.C. (age-specific ΔR: 400 ± 50), or 2750–1900 cal B.C. (age-specific ΔR: –50 ± 100), a span associated with the late Millingstone period (Table 43). No features were recovered from that horizon, but several pieces of flaked stone debitage and faunal elements were recovered near the bottom of Stratum I, in the western end of the site (see Figure 131). Sedimentological analyses and the distribution of microinvertebrates indicated that that portion of the site had been located near the shoreline of the ancient lagoon. The presence of terrestrial invertebrates (n = 16) adapted to moist soils and riparian habitats supported the supposition that it was a shoreline environment. The absence of features suggested that the location had been inhabited infrequently, and likely for short durations.

Episode 2 was associated with an occupation surface at the transition between Strata I and III. Four radiocarbon assays were obtained from three features: two from Feature 24 (refuse pit) and one each from Features 1 and 23 (both domestic-discard areas). Those assays indicated combined sigma ranges of 1800–1290 cal B.C. (standard ΔR), 1600–1030 cal B.C. (age-specific ΔR: 400 ± 50), or 2290–1470 (age-specific ΔR: –50 ± 100) for Episode 2, which suggested occupation during the late Millingstone period. So, Features 1, 23, and 24, assigned to Episode 2, were defined as Millingstone period features in the broader temporal assignments. Features 2, 9, 10, 14, 21, 22, 25/32, 31, 35, and 37 also were assigned to Episode 2, based on stratigraphic placement.

Episode 3A originated in the middle of the A horizon, at an elevation of approximately 2.1–2.2 m AMSL, but the original occupation surface may have corresponded to the top of the A2 horizon. Ten radiocarbon assays were obtained from five features and specific levels in CUs 3 and 11. Dated features included Features 7, 12/13, 24, 29, and 36, which included four domestic-discard areas and one possible ritual-offering location involving thermal activity (Feature 36). Those assays indicated combined sigma ranges of 940–360 cal B.C. (standard ΔR) or 1350–750 cal B.C. (age-specific ΔR), suggesting occupation around the time of the late Millingstone to early Intermediate period transition. Feature 24, from which three dates were obtained, was assigned to Episode 3; two of the dates indicated sigma ranges consistent with the earlier Episode 2, and one was associated with Episode 3. Three additional features (Features 8, 19/20, and 30) also were assigned to Episode 3, based on stratigraphic placement.

The most recent occupation, Episode 3B, appeared to originate in the upper part of the A horizon (A1). Four radiocarbon assays were obtained from two clamshells, one oyster, and one scallop, including three assays from Feature 16 (nonthermal ritual offering) and Level 4 of CU 3. Those dates suggested combined sigma ranges of 420–80 cal B.C. (standard ΔR) or 810–430 cal B.C. (age-specific ΔR), indicating occupation in the early Intermediate period. Based on their stratigraphic positions, additional domestic-discard areas (Features 3, 6, 8, 17, and 34) also were assigned to this

Table 42. Age Assignments for Features, LAN-54

Feature No.	Feature Type	Episode No.	Cultural Period	Approximate Age Range (cal B.P.)	Calibrated Age (Standard ΔR)	Calibrated Age (Age-Specific ΔR)
1	hearth	2	late Millingstone	3300–3700	1800–1440 cal B.C.	1600–1240 cal B.C.; 2290–1660 cal B.C.
2	living surface	2	late Millingstone	3300–3700		
3[a]	burial	3B	early Intermediate	2050–2350		
4	artifact concentration	4	historic modern			
5	activity area	4	historic modern			
6	burial	3B	early Intermediate	2050–2350		
7	hearth	3A	late Millingstone/ early Intermediate	2300–2700	750–400 cal B.C.	1100–790 cal B.C.
8	refuse deposit	3B	early Intermediate	2300–2700		
9	refuse deposit	2	late Millingstone	3300–3700		
10	refuse deposit	2	late Millingstone	3300–3700		
11	burial	3B	early Intermediate	2050–2350		
12/13	living surface	3A	late Millingstone/ early Intermediate	2300–2700	710–370 cal B.C.	1010–760 cal B.C.
14	possible refuse deposit	2	late Millingstone	3300–3700		
16	ritual deposit	3B	early Intermediate	2050–2350	390–110 cal B.C.; 420–130 cal B.C.; 380–80 cal B.C.	800–470 cal B.C.; 810–490 cal B.C.; 770–430 cal B.C.
17	refuse deposit	3B	early Intermediate	2050–2350		
19/20	refuse deposit	3A	late Millingstone/ early Intermediate	2300–2700		
21	refuse deposit	2	late Millingstone	3300–3700		
22	possible cleanout	2	late Millingstone	3300–3700		
23	rock cluster/cleanout	2	late Millingstone	3300–3700	1710–1410 cal B.C.	1510–1180 cal B.C., 2200–1610 cal B.C.
24	structure floor	2/3A	late Millingstone/ early Intermediate	3300–3700	1720–1420 cal B.C.; 1590–1290 cal B.C.; 820–500 cal B.C.	1520–1190 cal B.C., 2210–1610 cal B.C.; 1390–1030 cal B.C., 2040–1470 cal B.C.; 1270–820 cal B.C.
25/32	possible living surface	2	late Millingstone	3300–3700		
26	artifact concentration		not determined			
27	artifact concentration		not determined			
28	artifact concentration		not determined			

continued on next page

Feature No.	Feature Type	Episode No.	Cultural Period	Approximate Age Range (cal B.P.)	Calibrated Age (Standard ΔR)	Calibrated Age (Age-Specific ΔR)
29	living surface	3A	late Millingstone/ early Intermediate	2300–2700	710–360 cal B.C.	1000–750 cal B.C.
30	refuse deposit	3A	late Millingstone/ early Intermediate			
31	rock cluster	2	late Millingstone	3300–3700		
33	artifact concentration	4	historic modern			
34	possible refuse deposit	3B	early Intermediate	2050–2350		
35	artifact concentration	4	Historic Modern			
36	ritual deposit	3A	late Millingstone/early Intermediate	2300–2700	780–440 cal B.C.	1140–810 cal B.C.
37	rock cluster	2	late Millingstone	3300–3700		

[a] Shell-bead date (minimum 6550 B.C., maximum A.D. 1834).

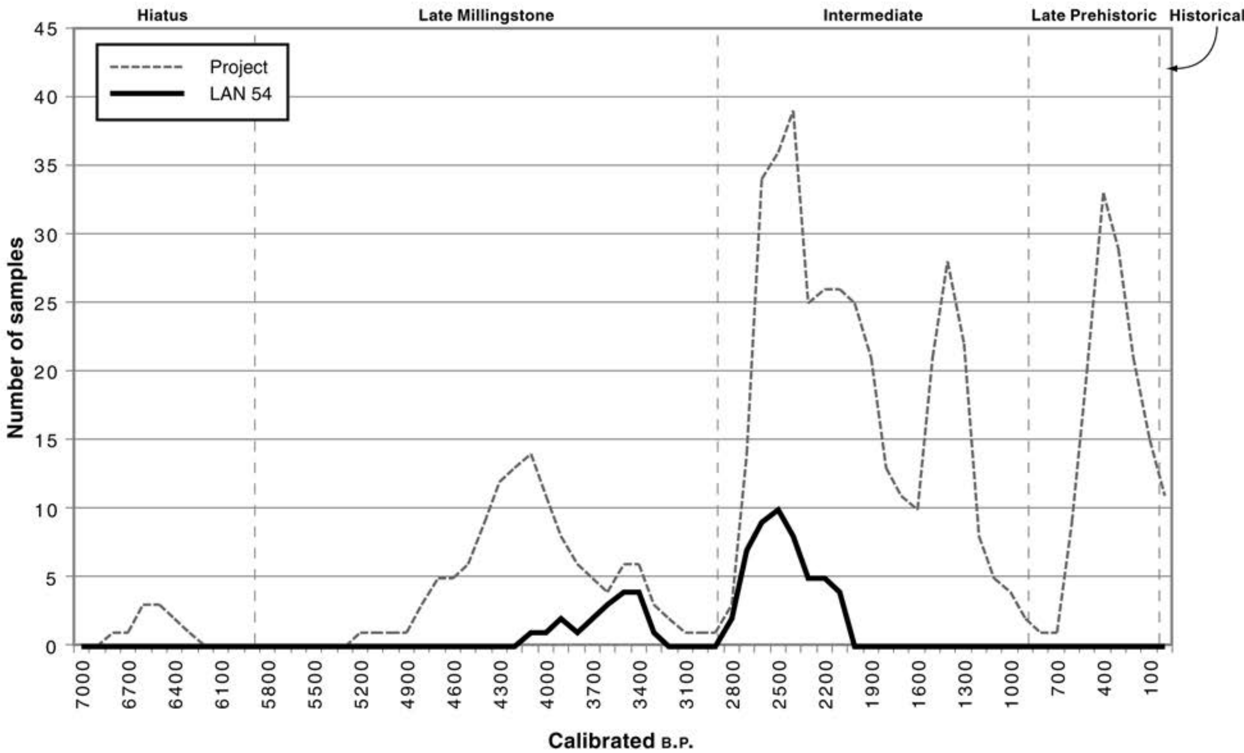

Figure 133. Distribution of radiocarbon dates at LAN-54.

Table 43. Temporal Designations, LAN-54

Episode No.	Date (Standard ΔR)	Date (Age-Specific ΔR)	Date (Age-Specific ΔR2)	Cultural Period
1	2210–1680 cal B.C.	1980–1440 cal B.C.	2750–1900 cal B.C.	late Millingstone
2	1800–1290 cal B.C.	1600–1030 cal B.C.	2290–1470 cal B.C.	late Millingstone
3A	940–360 cal B.C.	1350–750 cal B.C.		late Millingstone/early Intermediate
3B	420–80 cal B.C.	810–430 cal B.C.		early Intermediate

episode. This occupation surface appeared to have been largely destroyed by mechanical grading of the site surface; however, some features intruding into deeper deposits were preserved, whereas the "midden" deposits near the surface were largely razed. Although calibrated age ranges for Episodes 3A and 3B overlapped slightly, depending on applied calibration-correction values, an interval of up to 190 years may separate the two occupations (see Chapter 3, this volume). Eight features from Episodes 3A and 3B were assigned to the Intermediate period in the broader chronology (see Table 42).

Episode 4 refers to the Euroamerican period occupation (1848–1941). That period encompassed a number of changes in land-use patterns in the Ballona, including early ranching and farming and later establishment of industrial structures and urban infrastructure. Regarding the latter, early infrastructure development in the vicinity of LAN-54 included construction of a rail line and station (Alla Station) and several roads (especially Culver Boulevard). The packinghouse also was constructed in the early twentieth century. Four late-historical-period features recorded in the project area probably related to those early-twentieth-century developments, including a lens of coal slag adjacent to Culver Boulevard (Feature 56), structural remains (Feature 4), and two trash dumps that contained constriction debris (Features 33 and 35). The structure and construction debris probably related to the construction and use of the rail station and packinghouse.

Summary

The sediment matrix at LAN-54 was composed mainly of fine-grained floodplain deposits. Three depositional strata appeared to be represented. The deepest deposits (Stratum I) contained sandy, fluvial floodplain deposits. Above those deposits, increasingly silty deposits (Stratum II) indicated a period of time during which flooding had diminished; the sedimentary record suggested lower energetic flow and reduced sediment loads. Stratum II also showed strong soil development and contained archaeological midden deposits reflecting drier conditions and less water inundation, indicating a stable landform that supported pedogenic development and human settlement. The lower floodplain strata revealed a fining-upward trend reflecting the gradual migration of stream channels away from the site and establishment of channelized marshes in the area, perhaps in response to base-level rise caused by climbing sea levels during the Holocene.

The stratum designations, in conjunction with chronometric data, provided a means of making episode and period assignments for the CU levels and most of the features. Episode assignments were inferred by correlating feature depths to the "known" level assignments derived from the CUs. Five occupation episodes were defined at LAN-54: four prehistoric occupations (Millingstone and early Intermediate periods) and a Euroamerican period occupation probably dating to the early twentieth century.

Midden-Constituent Analyses

Data from the four CUs were used to characterize the spatial and temporal variability in the midden deposits at LAN-54. CUs 3, 11, 30, and 31 were excavated in 10-cm arbitrary levels that were subsequently assigned to the natural and cultural strata identified at the site. All four CUs included at least two levels of A horizon materials with dense cultural deposits. Three CUs (CUs 3, 11, and 30, from south to north) were located in the southern portion of the site, where the buried A horizon was intact (see Figure 130). CU 31 was located in the northern portion of the site, where the A horizon had been partially truncated. Radiocarbon samples were obtained from selected levels of the CUs and provided grounds for assigning the levels to specific periods and episodes (Appendixes 8.6 and 8.7, this volume). The number of levels relating to each episode varied among the four units.

Trends in lithic artifacts and vertebrate- and invertebrate-faunal materials in the four CUs indicated both temporal and spatial variability. Table 44 presents the densities of these three main artifact/ecofact classes by episode, and the density data by level are presented in Appendix 8.8, this volume. For Table 43, the levels were collapsed into episodes; however, some variability was noted within episodes, suggesting discrete occupation events or surfaces within the duration of a single identifiable episode. Bioturbation, which is widespread in the project area, may also have contributed to this variability. Therefore, the focus here is on discussions of trends by episodes.

The artifact/ecofact densities varied tremendously among the four CUs. For example, the density of flaked stone artifacts from CUs 3 and 11 was much higher than that of CUs 30 and 31 by a factor of 10 to 1 or more. The difference in vertebrate and invertebrate density between these four units was even greater, with CU 3 having vertebrate faunal density 100 times greater than CU 31 and an invertebrate faunal density over 900 time greater than CU 31 (see Table 44). Overall, these data showed a gradient in midden density within the site area, with denser deposits in the southern half of the site and relatively sparse deposits in the northern half. The pattern, of course, paralleled the same spatial trend in feature densities and site integrity, as explained above.

Despite these differences, the density data presented by level generally show comparable peaks in artifact/ecofact densities. In the cases of CUs 3 and 11 (Figures 134 and 135), flaked stone densities are generally flat, owing to the relatively low frequencies of this material class. Faunal densities, especially invertebrate density, exhibited peaks during Episode 3. This is especially evident in CU 11, where the peak was most pronounced during Episode 3A. Episode 2 was absent from CU3, but there were low densities of cultural material during Episode 2 in the remaining control units. Episode 1 generally exhibited the lowest densities of all material classes in all four control units, although there are higher densities of fauna in Level 11 of CU 11, suggesting that a substantial occupation was present in this area during Episode 1. The density values for CUs 30 and 31 were so low that they showed no variability and are not illustrated here. Overall, the trends in artifact/ecofact densities suggested peak occupation occurred during Episodes 3 and 3A (late Millingstone/early Intermediate period), with some occupation in the late Millingstone period There appears to be little change in the nature of the occupation other than the great expansion in shellfish processing and discard during the late Millingstone/early Intermediate period.

Nonburial-Feature Analysis

Appendix 8.9, this volume, lists the types and interpretations of all features excavated at LAN-54 during the data recovery (detailed feature records are presented in Appendix 5.1, this volume). SRI excavated a total of 32 features at LAN-54.

Feature Classification and Interpretation

The feature typology outlined in Chapter 5, this volume, was implemented to classify each of the 32 features excavated

Table 44. Artifact/Ecofact Density per Occupation Episode and Cultural Period in Four CUs, LAN-54

					Lithic Artifacts				Vertebrate Fauna		Invertebrate Fauna	
Level Nos., by CU No. (1 × 1 m)	Natural Stratum	Episode No.	Cultural Period	Volume (m^3)	Flaked Stone Count (n)	Flaked Stone Density (n/m^3)	Ground Stone Count (n)	Ground Stone Density (n/m^3)	NISP	Density ($NISP/m^3$)	Weight (g)	Density (g/m^3)
CU 3[a]												
2–3	A1	3B	early Intermediate	0.21	5	47.6	—	—	127	1,211.4	147.0	1,417.4
4	A1/A2	3	Intermediate	0.11	35	333.3	—	—	107	1,019.0	337.8	3,217.1
5–6	A2/AC	3A	late Millingstone/ early Intermediate	0.21	7	32.7	—	—	24	112.3	258.5	1,209.4
7	AC	3	Intermediate	0.10	2	20.8	—	—	12	124.7	57.7	599.5
8–10	AC/Cqk	1	late Millingstone	0.30	9	30.5	1	3.4	18	61.0	44.7	151.5
Subtotal				0.92	58	465.0	1	3.4	288	2,528.4	845.7	6,594.9
CU 11[b]												
3–4	A1	3B	early Intermediate	0.20	4	19.8	—	—	32	158.0	421.9	2,083.5
5–9	A2/AC	3A	late Millingstone/ early Intermediate	0.50	101	203.0	1	2.0	1,200	2,412.1	8,760.9	17,609.8
10	Cqk1	2/3	late Millingstone/ Intermediate	0.11	6	57.1	1	9.5	95	904.8	620.1	5,905.7
11–13	Cqk2	1	late Millingstone	0.30	11	37.3	—	—	227	769.5	285.9	969.2
Subtotal				1.10	122	110.9	2	1.8	1,554	1,412.7	10,088.8	9,171.6
CU 30[c]												
2–4	A	3	Intermediate	0.30	5	16.7	—	—	18	60.0	75.6	252.0
5	A/Cqk	2/3	late Millingstone/ Intermediate	0.10	2	20.0	—	—	1	10.0	11.4	114.0
6	Cqk	1	late Millingstone	0.10	—	—	—	—	—	—	—	—
Subtotal				0.50	7	14.0	—	—	19	38.0	87.0	174.0
CU 31[d]												
2–5	A	3	Intermediate	0.39	8	20.3	—	—	12	30.5	4.1	10.4
6	A/Cqk	2	late Millingstone	0.10	—	—	—	—	2	20.7	0.1	1.0
7	Cqk	1	late Millingstone	0.10	—	—	—	—	—	—	—	—
Subtotal				0.59	8	13.6	—	—	14	23.7	4.2	7.1

Key: NISP = number of identified specimens.
[a]Level 1 of CU 3 consists of a mixture of fill and A horizon soils that could not be associated with a particular episode.
[b]Levels 1–2 of CU 11 consist of a mixture of fill and A1 horizon soils; the latter was associated with Episode 3B.
[c]Level 1 of CU 30 consists of fill that could not be associated with a particular episode.
[d]Level 1 of CU 31 consists of fill that could not be associated with a particular episode.

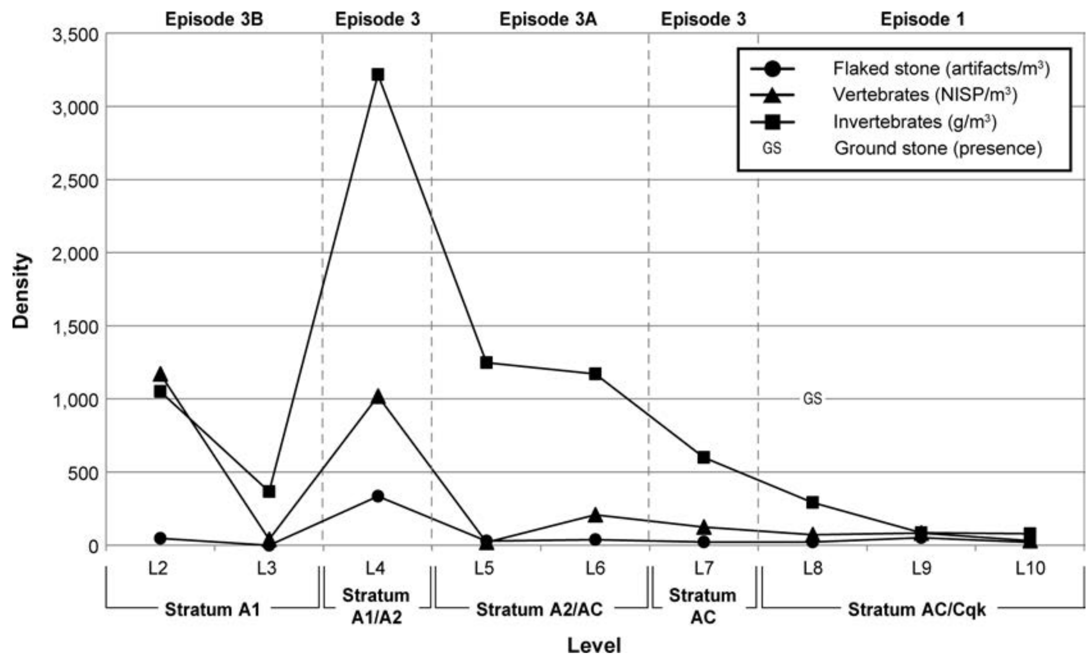

Figure 134. Artifact/ecofact density per level and episode, CU 3, LAN-54.

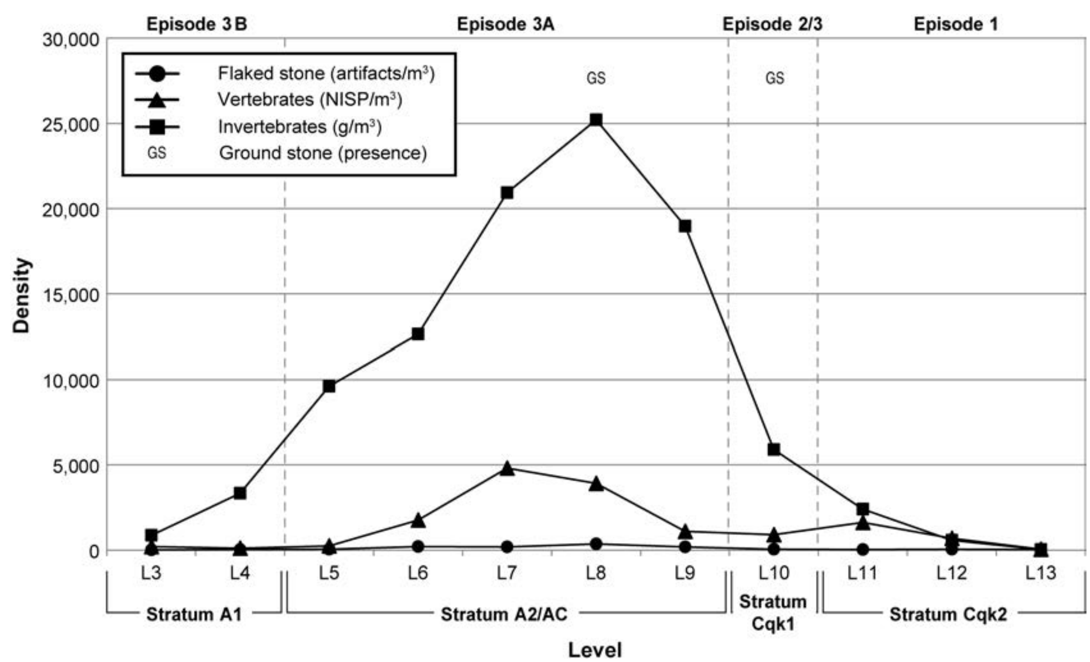

Figure 135. Artifact/ecofact density per level and episode, CU 11, LAN-54. *Note*: The scale for density is larger than that of Figure 134 because of the much higher density values.

Table 45. Distribution of Feature Classes, LAN-54

Morphology/Composition	Count	Percentage of Total
Domestic features		
General/multiple artifact concentration in pit, with FAR	1	3.1
General/multiple artifact concentration, no pit	6	18.8
General/multiple artifact concentration, no pit, with FAR	4	12.5
General/multiple artifact scatter	3	9.4
General/multiple artifact scatter, with FAR	1	3.1
Lithic/ground stone concentration, no pit	2	6.3
Lithic/ground stone concentration, no pit, with FAR	1	3.1
Activity area (hearth-cleanout deposits)	1	3.1
FAR concentration, no pit	3	9.4
FAR scatter	1	3.1
Subtotal	23	71.9
Burial/ritual		
Burial	3	9.4
Ritual offering, no burning	2	6.3
Subtotal	5	15.7
Historical-period/modern features		
Historical-period domestic trash dump	3	9.4
Historical-period structure remains	1	3.1
Subtotal	4	12.5
Total	32	100.0

Note: Percentages have been rounded to the nearest tenth.

at LAN-54. The classification system involved several levels of detail. DiGregorio (1987) adopted a similar approach to defining features at nearby LAN-63, using more general (basic, formal) and interpretive (functional) classifications types. At a broad level, features were classified as burial/ritual features, domestic features, or late-historical-period/modern features (post-1850). In the case of LAN-54, most features (23 of 32, or 72 percent) were classified as domestic features (1 was a composite feature with domestic components) (Table 45). Five features (16 percent) were classified as burial/ritual features: 3 human burials and 2 probable offering features. Four features (13 percent) were classified as late-historical-period or modern features.

Features also were classified as either thermal or nonthermal, based on the presence/absence of evidence of in situ thermal activity (oxidized soil) or the prevalence of thermally altered materials (e.g., FAR or burned faunal bone) in the feature. For example, a feature composed predominantly of FAR was classified as thermal, even if in situ thermal activity was not evident. Most domestic features at the site included mostly unburned, discarded materials, such as shell and lithic artifacts, with smaller amounts of FAR and burned bone, and those features were classified as nonthermal, based on the prevalence of nonthermally altered contents; 78 percent of the features at LAN-54 were classified as nonthermal (25 of 32 features), and 22 percent were classified as thermal (7 features). Of the domestic features, 78 percent (18 of 23) were classified as nonthermal, and 5 percent were classified as thermal (22 percent). All of the burial/ritual features were classified as nonthermal. All but one of the late-historical-period/modern features were nonthermal; one coal-slag pile (Feature 5) was classified as thermal.

At a more detailed level, features were classified into the more-specific formal categories described in Chapter 5, this volume, based on morphology (shape and size) and content. As shown in Table 45, roughly half the features (15 features, or 47 percent) could be classified broadly as general/multiple artifact concentrations containing a variety of artifact types, including FAR in many cases. One of those features was associated with a visible pit outline, which could indicate a hearth or storage pit that was reused as a trash pit. These nonthermal refuse deposits were generally characterized by the presence of unworked shell or lithic artifacts with no evidence or with only modest evidence of thermal activity. Most of the features interpreted as this type ranged in size from less than 30 cm^2 to almost 2 m^2 in area. They were generally not deep, and they appeared to have been "surface" deposits that had not been placed in pits or depressions. This was a broad functional category that encompassed several different activities or depositional contexts and included subsistence-related debris generated from a variety of tasks, which we refer to as "generalized" discard areas. One such feature was a saucer-shaped refuse pit (Feature 24) measuring about 1.5 by 1.5 m in area and appearing to have received trash deposits related to a number of different activities. The excavators observed discrete areas with specific materials. The northwestern section of the feature contained a concentration of unworked shell, the southwestern section contained roughly twice as many lithic artifacts as other areas, and the western half of the feature contained more faunal bone than the eastern half.

Shell was typically the most prevalent material in the generalized deposits. For example, Feature 8 contained more than 10,000 g of unworked shell mixed with flaked stone, ground stone, faunal bone, and FAR within an area of roughly 75 by 65 cm. Feature 19/20 contained over 20,000 g of unworked shell over a larger area (2 by 15 m), intermixed with lower quantities of other artifact types (but no FAR). Features 10, 21, and 29 contained more than 1,000 g of shell, and Features 9, 25/32, and 34 included between 500 and 1,000 g. Feature 22 contained a lower density of shell than the other shell-dump feature (ca. 200 g within a 72-by-58-cm area), but shell nonetheless dominated the feature assemblage. Other features, however, include relatively sparse shell remains mixed with small concentrations of ground stone, flaked stone, and unmodified cobbles. Feature 2, for example, contained mainly battered ground stone and a small amount of shell and faunal bone.

No clearly defined hearths were recovered at LAN-54, but five features (16 percent) were classified as possible hearth-cleanout deposits (Features 1, 7, 14, 23, and 28). These features were distinguished by their relative abundance of FAR fragments compared to other cultural materials and differed from hearths by the absence of oxidized soils. They varied from other probable domestic-discard areas in the proportions of FAR and thermal contents relative to nonthermal contents. Several of the generalized discard features discussed above included FAR and, therefore, likely encompassed deposits derived from hearth-cleanout episodes. In Features 10 and 29, for example, FAR fragments were present, but unworked shell and other artifacts outnumbered FAR fragments.

Three additional domestic features were classified as lithic/ground stone concentrations (with and without pits). Feature 26 was primarily composed of a large metate associated with a small amount of debitage, and we interpreted it as a possible ground stone cache. Two other features were classified as cairns or post supports (Features 27 and 37); both consisted of small concentrations of cobbles, FAR fragments, or ground stone fragments that could have been used to help stabilize posts for a shelter or other makeshift structure.

Three of the burial/ritual features were human burials: two burials of adult females (Features 3 and 11) and one burial containing two adult females (Feature 6). Two others were possible ritual-offering deposits. One deposit (Feature 16) included a concentration of cobbles and shell that appeared to have been deliberately arranged. That feature may have been associated with nearby Feature 3. A second deposit (Feature 36) included a large abalone shell that seemed to have functioned as a container for a large FAR fragment and was surrounded by a deliberately arranged circle of shell specimens.

Five features excavated during data recovery related to mortuary and possible ritual behavior. Three burials were excavated in the APE, and all three contained skeletal remains of adult females ranging in age from early twenties to mid-forties. Features 3 and 11 included a single individual, and Feature 6 included two individuals. Each of the individuals was interred in a flexed or semiflexed position, and orientations and placements varied.

Features 16 and 36 were tentatively interpreted as deposits relating to ritual activities or other nonsubsistence behaviors. Those deposits seemed to include structured arrangements of artifacts, not haphazardly discarded refuse. Feature 16 included clusters of shell that appeared to have been arranged around a heavily worn cobble; that deposit may have been associated with burial Feature 3, located less than 1 m away. Feature 36 also included what appears to be a deliberate arrangement of shell and stone.

Four late-historical-period/modern features were excavated near or beneath the footprint of the former packinghouse. Feature 5 consisted of a linear lens of burned materials—mainly coal slag—running parallel to Culver Boulevard. That feature may have been related to the original construction of the road in the early twentieth century. Feature 4 was composed of oil-infused wooden boards placed parallel to each other that may have marked the location of a historical-period structure, a railroad line, or a deposit of railroad-related equipment. Features 33 and 35 consisted of concentrations of historical-period artifacts. The former was associated with a large trench, and the latter was a rubble-filled pit that had possibly been used as a footing.

Occupation Surfaces

Small amounts of lithic debris and faunal bone in the stratum were associated with Episode 1 (late Millingstone period), but no features were assigned to that episode. The scattered artifacts were more consistent with an interpretation of sporadic logistical visits to the site location for resource collection or other purposes. The dearth of features suggested that food or other resources were not frequently processed or prepared in the vicinity at this time. It is important to recall, though, that the APE encompassed only a portion of the site, and much of the surrounding area has been largely destroyed by historical-period and modern construction. It is possible that a more substantial Episode 1 occupation was present in the area but that the remains have been destroyed or were buried beneath the existing berm.

We are more readily able to infer site function for Episodes 2, 3A, and 3B, because of the presence of multiple features associated with those occupations. Table 46 summarizes the feature classifications and functions for each of those episodes. The largest group of prehistoric features was assigned to Episode 2 (late Millingstone period), including the features in the southernmost extent of the project area. That is significant, because no Millingstone period sites had previously been identified along the edge of the lagoon in the Ballona (Stoll et al. 2003:15). The

Table 46. Feature Interpretations, LAN-54, per Episode

Feature Interpretation	Episode 2		Episode 3A		Episode 3B		Episode 4		Unknown		Total
	n	%	n	%	n	%	n	%	n	%	n
Domestic											
Domestic-discard area	8	66.7	4	66.7	3	42.9	—		—		15
Hearth cleanout or disturbed hearth	3	25.0	1	16.7	—		—		1	33.3	5
Cairn or post support	1	8.3	—		—		—		2	66.7	3
All domestic features	12	100.0	5	83.4	3	42.9	—		3	100.0	23
Burial/ritual											
Human burial	—		—	—	3	42.9	—		—		3
Ritual offering	—		1	16.7	1	14.3	—		—		2
All burial/ritual features	—		1	16.7	4	57.2	—		—		5
Historical-period/modern											
Historical-period trash deposit	—		—		—		3	75.0	—		3
Historical-period structure	—		—		—		1	25.0	—		1
All historical-period features	—		—	—	—		4	100.0	—		4
Total	12	100.0	6	100.0	7	100.0	4	100.0	3	100.0	32

features dated to Episode 2 appeared to have been related to subsistence activities, such as the cooking and processing of food. All of these features were domestic-discard deposits and were likely used for processing shellfish, fish, bird, and mammal species for subsistence purposes. Shellfish, mainly marine species, appeared to have been a major of focus of those activities, because shell dominated the collections from several features. The Episode 2 occupants of LAN-54 probably procured and processed food at the site sometime subsequent to the stabilization of the landform and lagoon shoreline. Notable, however, was that six of the eight features dated to Episode 2 (excluding the indeterminate feature types) appeared to indicate nonthermal processing activities. If so, it appears that the subsistence activities at that time related to the preparation of raw foods, especially shellfish. Perhaps cooking activities occurred in a separate location. These features probably represent a palimpsest of debris deposits during various logistical trips to the Ballona during the occupation span.

The range of feature types dated to Episode 3A (late Millingstone/early Intermediate period) was similar to that for Episode 2. All six features generally appeared to have been related to subsistence activities, including two hearth-cleanout features, two shell dumps, and two indeterminate refuse deposits. Those features suggested continued use of the area as a temporary or seasonal locus for logistical resource collection and processing. As was the case with the Episode 2 features, unworked shell dominated several of the feature assemblages. One possible difference was that the FAR deposits appeared to be common in the Episode 3A features; all but one of the probable subsistence-related features assigned to Episode 3A included at least modest concentrations of FAR. That may suggest a change in dietary and food-processing practices during the interval between the two occupation episodes. One feature was tentatively identified as a possible locus of ritual activities (Feature 36) and included a large abalone shell beneath a large, thermally altered rock associated with a ring of shells.

The features assigned to Episode 3B suggested a drastic change in site function in the early Intermediate period. Three of the seven features assigned to that episode were burials, and one was identified as a locus of ritual or other special-function activities (Feature 16). The three burials were primary inhumations of adult females interred in fully flexed or semiflexed positions. The possible ritual deposit may have been a votive area or mortuary offering associated with burial Feature 3. Two other features dated to Episode 3B were nonthermal deposits mostly consisting of unworked shell and containing smaller amounts of other artifacts. Those features suggested continued use of the site as a locus for processing food, but not to the extent that it had been used during the previous episodes. In all, these features did not indicate a central focus on resource procurement and processing during Episode 3B. Rather, the area appeared to have functioned as a locus of mortuary and ritual activities. The smaller number of features assigned to Episode 3B than to Episodes 2 and 3A suggested generally less-intensive use of the project area during Episode 3B. During that span—roughly 2,800–200 years ago—the lagoon was probably slowly filling with sediments that gradually cut the area off from inflows of marine resources. The local environment was in the process of becoming more marsh-like at that time, and freshwater resources likely replaced marine resources. That transition may have rendered the site area less appealing to human settlers and might explain the reduction in the number of food-processing features from the early to the middle part of the Intermediate period.

Activity Areas

Activity areas were inferred by analyzing the spatial distributions and concentrations of features assigned to each episode. We defined an activity area as a discrete concentration of features assigned to the same episode. The spatial and temporal associations of such features may indicate contemporaneous and discrete loci of human activity. Most of the prehistoric features were concentrated in the southern portion of the site, between Trenches 7 and 8 (south of the packinghouse). A small number were recorded in the attenuated A horizon in the northeastern portion of the APE. Our discussion of activity areas focuses exclusively on the prehistoric features located to the south of the former packinghouse.

As explained above, the Episode 2 occupation likely occurred sometime after the formation of the lagoon shoreline to the south of the site; the 12 features assigned to that episode were probably located slightly north of the ancient shoreline. The southernmost extent of the site included a small concentration of 6 features within a roughly 10-by-10-m area: various nonthermal food-processing features and 1 possible hearth-cleanout deposit. That concentration qualified as a discrete activity area related to subsistence activities, but it was impossible to infer whether the features were used simultaneously or represented a palimpsest related to separate events. Six other features assigned to Episode 2 were scattered in various locations to the north and were not parts of larger concentrations of contiguous features. No spatial association or patterning was evident among those features.

Most of the Episode 3A features were concentrated within a limited area in the southern portion of the site. Notably, the features were located in two relatively discrete clusters (Figure 136). One concentration formed a roughly circular pattern in the central portion of the southern excavation block. That cluster consisted of several probable hearth-cleanout deposits and two domestic-discard areas dominated by unworked shell. The spatial arrangement of those features suggested the possibility that they were roughly contemporaneous. They may have been used during a single visit to the site or in a closely associated series of visits involving processing and cooking of food resources, especially shellfish; the circular pattern could indicate toss zones surrounding a central work area or processing station (Douglass et al. 2005). Three of the four features contained abundant shell concentrations (Features 7, 8, and 29) ranging from 1,300 g to over 10,000 g. Three additional features were scattered to the north and south of the central feature cluster. Features 19/20 and 30 were isolated subsistence features dated to Episode 3. As explained below, although, we suspect that Feature 36, a probable ritual deposit, may, in fact, have been part of a mortuary complex assigned to Episode 3B.

Most of the features assigned to Episode 3B were related to mortuary and ritual activities. One possible activity area could be tentatively interpreted as a locus of mortuary-ritual activities. Burial Feature 3 was spatially associated with two ritual/special-function features (Features 16 and 36) (see Figure 130). Although Feature 36 was assigned to the previous Episode 3A occupation, its close spatial association with Features 3 and 16 suggested that it might actually have been part of a small mortuary complex dating to Episode 3B. The proximity of those features and their compositional similarity suggested that they may have been contemporaneous, even though they were assigned to different episodes. The two other burials (Features 6 and 11) were spatially isolated from the other features. Two features related to subsistence activities (Features 17 and 34) also were spatially isolated and did not appear to have been part of a larger, contiguous activity area.

The late-historical-period/modern features (Episode 4) mostly were recorded in the central and northern portions of the APE, adjacent to and underneath the footprint of the former packinghouse. No historical-period features were recorded in the southern portion of site, where most of the prehistoric features and intact deposits were located. Feature 4, located beneath the footprint, was a wooden structure interpreted as the possible remains of a light-rail line. Feature 5 consisted of a lens of burned coal slag adjacent to Culver Boulevard. Feature 33, located beneath the packinghouse footprint, was a large refuse deposit that contained over 13,000 artifacts, primarily glass, metal objects, and chinaware. Feature 35 was probably a pole-footing pit; it had been excavated into the C horizon adjacent to the footprint. Although they were not spatially contiguous, several of these features may have related to a single occupation, a discrete activity locus related to the construction of the roadways and railroad line during the early twentieth century.

In sum, the chronometric data suggested changes in prehistoric activities conducted within the APE of LAN-54 from the late Millingstone to early Intermediate period. The three earliest occupations appeared to have been focused on the acquisition and processing of subsistence resources, likely marine resources from the Ballona Lagoon. The features pertaining to those periods may not have been contemporary but could reflect a palimpsest of seasonal visits to the area over the course of several centuries. However, the spatial patterning of some of the features suggested that they may have been contemporaneous. In Episode 3B, the focus appeared to have shifted from subsistence-related activities to mortuary-ritual activities. The late-historical-period/modern features generally were located beneath or adjacent to the footprint of the former Blue Goose Packing House.

Site Summary

The data recovery investigations indicated that the APE of LAN-54 encompassed intact prehistoric site deposits that had been only partly disturbed by the construction of the packinghouse and the associated rail-spur line in the early twentieth century. Intact or partially intact prehistoric deposits were

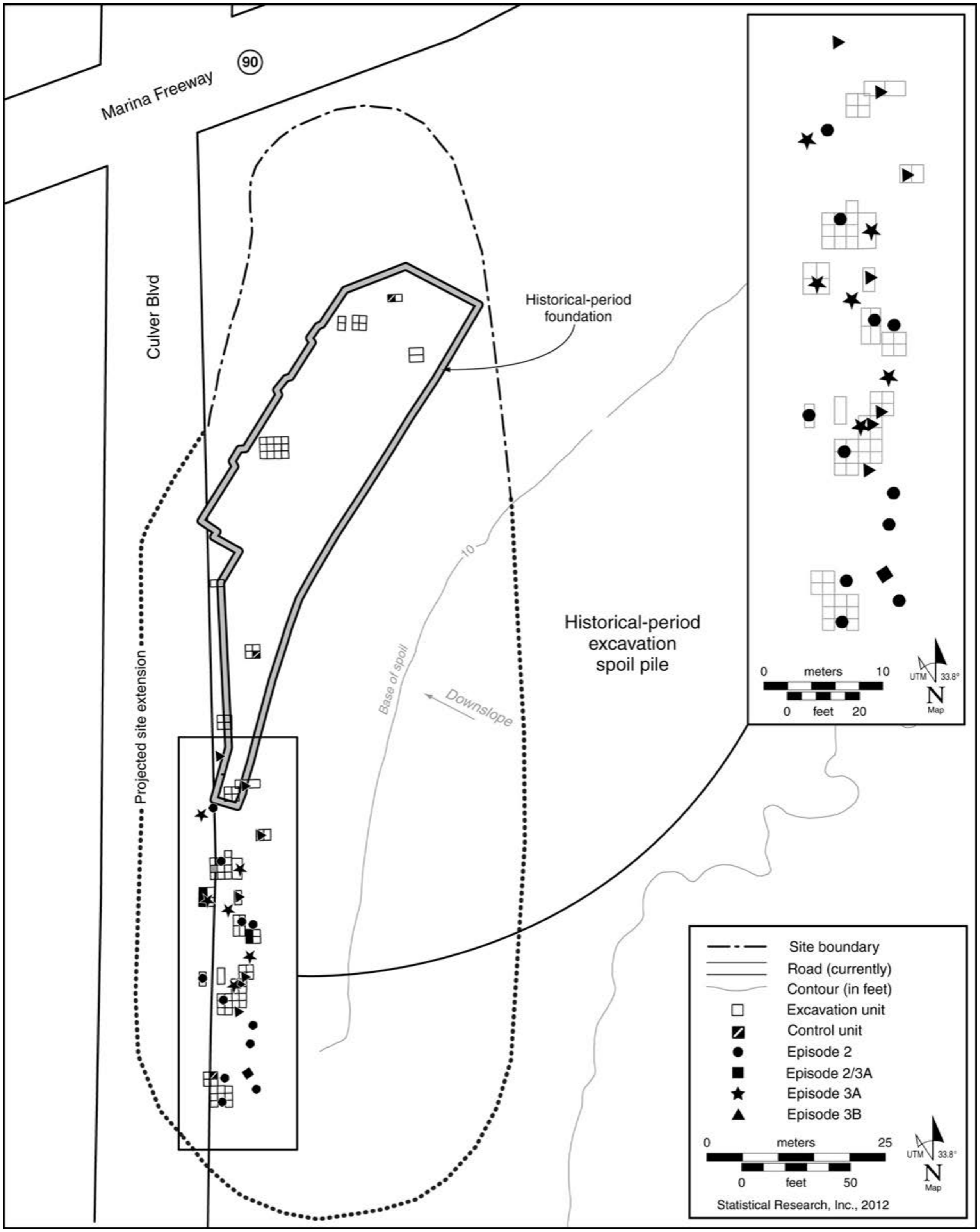

Figure 136. Map of LAN-54, showing the locations of activity areas dated to Episodes 2, 3A, and 3B.

recovered to the north and south of the packinghouse. The area south of the packinghouse contained the densest and least-disturbed prehistoric deposits, including a large quantity of marine shell and identifiable features. The culture-bearing A horizon had been partially truncated in the area to the north of the packinghouse, but sparse prehistoric and historical-period remains (including isolated human remains) were recovered there, along with three small prehistoric features (two of which may not have been features; see above). Several historical-period features were also excavated beneath and adjacent to the footprint of the former packinghouse.

The CUs yielded a range of lithic and faunal materials from the A horizon, including ground stone implements, flaked stone objects, hammerstones, large numbers of FAR fragments and manuports, and worked-bone tools. Faunal remains, predominately shell, were particularly prominent in those units. The shell remains were mostly from bay- and estuary-marine species. The predominance of marine shell underscored the importance of shell acquisition and processing in the vicinity of LAN-54, mainly during the late Millingstone and early to middle Intermediate periods. Also recovered were smaller quantities of bone remains from other faunal species, including fish, birds, marine mammals, and terrestrial mammals. The upper fill and mixed levels also contained cow or horse remains dating to the historical period.

In total, 32 features were excavated, including several groups of compositionally similar features located in proximity to one another that were combined to form larger, composite features. All features were partially or completely excavated. Most of the features were prehistoric and likely dated to the late Millingstone period and early to middle Intermediate period. Most of the prehistoric features were refuse deposits related to subsistence activities, specifically nonthermal and thermal food-preparation activities. Especially frequent were refuse deposits related to the processing of marine shellfish. Three burials and two probable ritual or special-function deposits also were excavated within the APE. The four historical-period features were the remains of a rail line and three refuse deposits of various sorts.

As the only prehistoric site located along Ballona Creek within the BLAD (Altschul et al. 1991), LAN-54 is vital for reconstructing the cultural history of the Ballona. Vargas and Altschul (2001b) outlined three primary areas of research concerning LAN-54: (1) the environment and human adaptation, (2) migration, and (3) social organization. The data recovered during the PVAHP most-directly related to the first area of research. LAN-54 was an appealing location for settlement and resource acquisition during a roughly 2,500-year span during the late Millingstone and Intermediate periods. Mobile groups likely tailored their food-collection and mobility strategies to take advantage of the availability of marine resources, especially shellfish, in the vicinity of the then-recently formed marine lagoon.

By the first millennium A.D., though, the lagoon underwent a period of sedimentation, mainly from Ballona Creek, and was increasingly inundated with freshwater resources. The area was clearly less appealing to area settlers during that time. The prehistoric settlement at the site clearly indicated a pattern of human adaptation to changing environmental and landscape conditions. That adaptation pattern was best evidenced in the apparent shift in site function from a focus on resource acquisition in the late Millingstone and early Intermediate periods to a focus on mortuary-ritual activities by the middle Intermediate period, when marine-lagoon resources were being gradually depleted as a result of freshwater inundation and marsh formation.

The materials and features excavated at LAN-54 also shed new light on research questions concerning social organization and migration. Spatial patterning among contemporaneous features and activity areas was not readily apparent, which limited our ability to infer site structure or socially meaningful group activities. Although some features appeared to have been spatially correlated, we were unable to preclude the possibility that much of the site represents a palimpsest of discrete and isolated depositional episodes that formed over the course of several-hundred years. The presence of burials, one of which appeared to have been associated with ritual features, may shed light on mortuary practices and ritual behavior, though. The three burials were all adult females, which is important for reconstructing gender relations and possible differences in the mortuary treatment of men and women. Those burial features provided the best sources of information concerning social organization.

LAN-62 Field Methods and Excavation Results

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This chapter summarizes the results of data recovery excavations at LAN-62, a large, multicomponent site within the BLAD, previously determined eligible for listing in the NRHP (see Altschul et al. 1991). LAN-62 rests on an alluvial-fan deposit at the base of the Ballona Escarpment, at the western end of Area D1 of the Playa Vista development (Figure 137). It has been recognized as one of the more important archaeological sites in the Ballona Wetlands since the 1950s. Previous investigators, both amateur and professional, postulated that the site was occupied at different times during the Intermediate and Late periods and the early historical period (Archaeological Associates 1988; Freeman et al. 1987; Peck 1947; Van Horn et al. 1983).

When it was first formally recorded in the 1940s, the boundaries of LAN-62 included an area of subsurface cultural deposits in the southwestern portion of the site—what is now known as Locus A. However, as explained below, SRI's testing efforts in the late 1990s revealed a nearly continuous, linear expanse of subsurface cultural resources along the base of the bluff that encompasses an area considerably larger than the original site area recorded in the 1940s. The site was thus extended nearly a kilometer to the east of the original site area. The site area originally defined as LAN-211 was redesignated as Locus D of LAN-62, and the site area of LAN-211 was moved to the east to encompass a separate area of intact subsurface deposits.

The first part of this chapter outlines the history of archaeological investigations at LAN-62, from amateur studies in the mid-twentieth century through SRI's recent comprehensive testing program, to elucidate how previous efforts informed SRI's data recovery strategy at LAN-62.

Site Setting and Configuration

The boundaries of LAN-62 extend along the base of the Ballona Escarpment, close to Lincoln Boulevard on the southwest and trending to the northeast and north for varied distances. The cultural deposits at LAN-62 appear to have been continuous along the base of the bluffs until modern disturbances removed portions of them. Prior to modern alterations, Centinela Creek meandered along the base of the Ballona Escarpment, becoming enveloped by the freshwater marsh somewhere near the present location of Lincoln Boulevard. Early topographic maps and aerial photographs showed the creek prior to its channelization by Howard Hughes in the early 1940s. All loci of LAN-62 would have been ideally situated near that source of spring-fed, potable water, as well as the many resources of the freshwater and salt marshes, Ballona Creek, the lagoon, and the sandy-beach shoreline just over 2.5 km to the west. The current alignment of Lincoln Boulevard is deceptive in that it appears to follow a natural drainage or gap, but early topographic maps showed that the drainage that formed the large fan at Locus A was not in the location of Lincoln Boulevard but approximately 300 m to the east.

For management purposes, LAN-62 has been divided into seven loci (Loci A–G). The main locus, (Locus A), is on the foot slope of a Holocene alluvial fan that formed north of and below the Ballona Escarpment and the El Segundo Sand Hills (a broad Pleistocene sand sheet that extends from the Ballona Escarpment southward to the Palos Verdes Hills and from the Pacific Ocean eastward, 5–8 km inland). The Ballona Lagoon and nearby wetlands are to the north and northwest of Locus A. The apex of the alluvial fan on which Locus A is centered is about 200 m east of Lincoln Boulevard. That fan is the largest and most prominent of a series of fans that formed below the escarpment. The relatively stable fan provided an elevated surface above the seasonal flooding of the marsh.

Because Locus B had been so disturbed (see below), geomorphic descriptions were not recorded at that location. Locus C, a narrow strip of land about 20 m wide at the juncture of the colluvial foot slope and alluvial-fan deposits with the marsh deposits, is located northeast of Locus A. Locus D is located west of LAN-211 and east of Locus C. Similar to Locus C in its landscape setting, Locus D is situated along the base of the bluff, on a narrow strip of land at the juncture of the colluvial foot slope and alluvial-fan deposits and the marsh deposits. LAN-62 Locus G is on the distal fan immediately north of Locus A, where the fan deposits grade to, and interdigitate with, estuarine deposits of the Ballona Creek/Los Angeles River and Centinela Creek floodplains and associated wetlands.

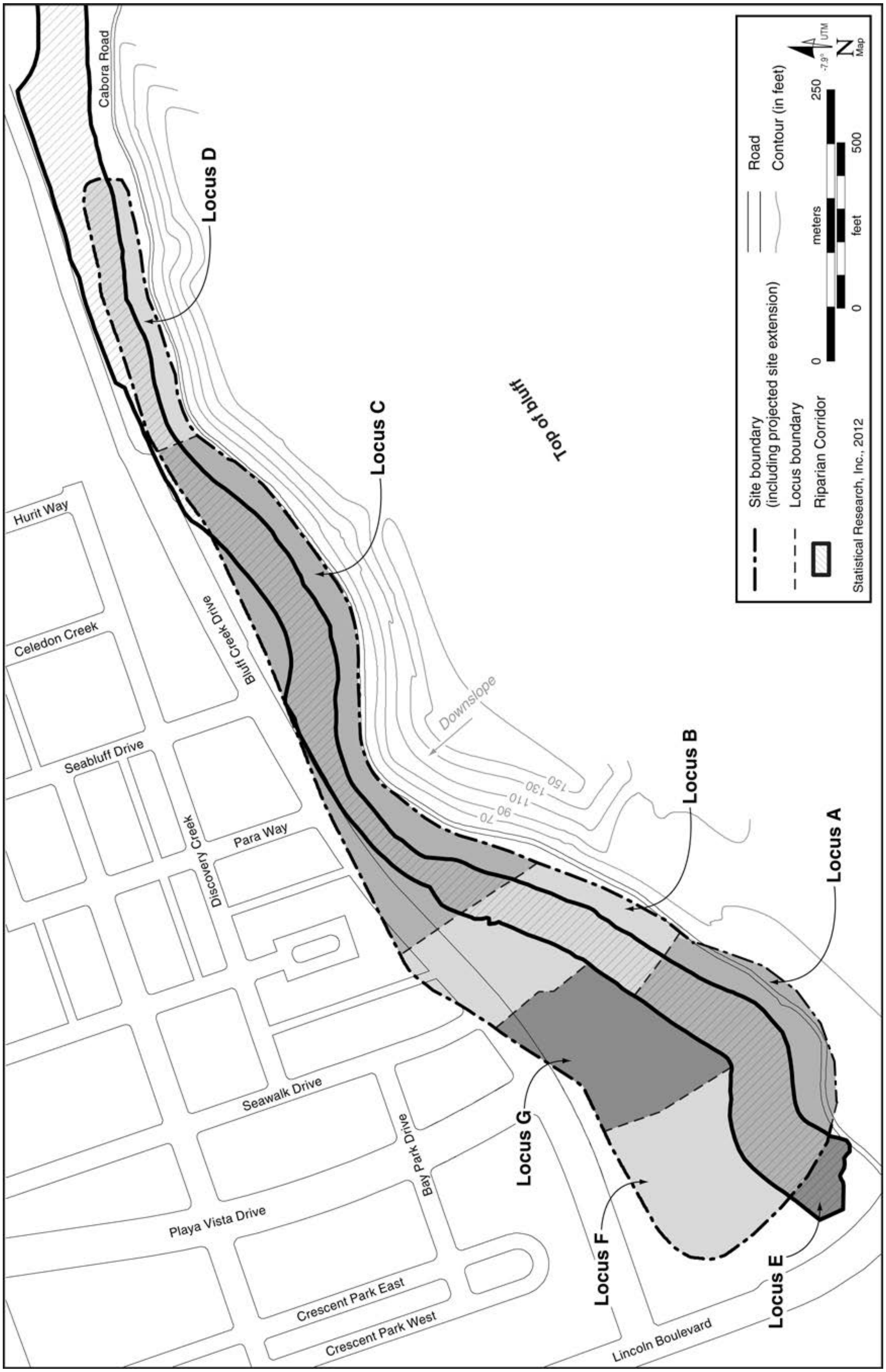

Figure 137. Map of LAN-62, including all project loci and the Riparian Corridor.

Archaeological Background

LAN-62 is one of the oldest known sites in the Ballona and has been subjected to more frequent and intensive archaeological investigation than any other site in the PVAHP project area (Altschul et al. 1991:115–121; Van Horn 1984a:30–31). Formal archaeological investigation at LAN-62 originated in the mid-twentieth century, but informal collecting and amateur studies probably date back to the early years of modern development in the Los Angeles coastal area in the late 1800s and early 1900s. An eclectic mix of amateur and professional archaeologists with varying interests have conducted fieldwork at LAN-62 over the last century. In the following sections, we provide a brief overview of previous research at LAN-62, separately discussing the contributions of amateur and professional investigators. In the final section, we summarize SRI's testing program and explain how the testing program and previous research projects informed SRI's plan for data recovery at LAN-62.

Amateur Investigations

Amateur studies and informal collection of indigenous artifacts were prevalent in the Ballona during the early and mid-twentieth century, resulting in a diffusion of artifact collections from unknown proveniences. A dentist from Redondo Beach, F. M. Palmer, was one of the first known amateurs to explore archaeological resources in the Los Angeles coastal area, but it is unknown whether he visited the Ballona (Wallace 1984). Another amateur archaeologist, medical doctor F. H. Racer, also made collections along the coast in the early decades of the 1900s, at least through the 1930s (Bates 1963:47; Wallace 1984). In an unpublished 1939 manuscript, Racer documented sites throughout the coastal area, including the Ballona. Based on his descriptions, the site Racer identified as "No. 15," located "at the west end of Centinalia [*sic*] and Jefferson Streets," likely referred to LAN-62, LAN-211, LAN-2768, and/or LAN-60 (Stoll et al. 2003:46–47); it is unclear, based on the description, to where exactly along the base of the bluff he was referring.

Both Palmer's and Racer's collections may have included items procured from LAN-62. Unfortunately, the current locations of their collections are unknown. It is possible that portions of their collections were bought and maintained by local museums; however, given their uncertain proveniences, they possess limited value for better understanding prehistoric and early-historical-period settlement and land use in the Ballona.

The young archaeologist Malcolm Farmer (1934) conducted the first well-documented archaeological survey in the Ballona during the 1930s. His stated objective was not to plunder for artifacts but to systematically identify and record site locations. SRI archaeologists initially believed that Farmer's "Playa Del Rey Site # 4" referred to LAN-62 (Altschul et al. 1991:115). However, during a subsequent interview with SRI staff, Farmer stated that he had never surveyed the low-lying areas below the Ballona Escarpment (Stoll et al. 2003:47, Figure 23). His survey encompassed only the upland areas atop the escarpment and, therefore, could not have included LAN-62. Unlike many amateur collectors at the time, Farmer wisely turned over his collections to the Southwest Museum in Los Angeles for proper storage and curation. Rozaire and Belous (1950) later used Farmer's notes to create official site records.

Available documents suggested that Stuart Peck (1946, 1947), an assistant museum curator at UCLA and an amateur archaeologist at the time, oversaw the first formal excavations at the site. Peck excavated at what he called the Mar Vista site (later designated LAN-62) from 1942 through 1945 (Van Horn 1984a:31; Peck 1947). The site was easily accessible during the war years, because gasoline rationing prevented longer trips to the Mojave Desert, where much of the research in southern California had been previously undertaken.

Although not formally educated as an archaeologist (he was a dentist by training), Peck was a skilled and careful excavator who diligently recorded his findings and possessed a sharp knowledge of archaeological systematics (especially stone-artifact categories). His excavation project took place soon after Hughes Aircraft Company constructed a landing strip just north of the site in 1942. He observed that much of the site matrix—heavily laden with cultural materials—was used as fill for construction of the landing strip. Peck's (1947:1) admirable reason for choosing the Mar Vista site for his project was to gain experience in archaeological excavation methods without causing irreparable harm to intact archaeological deposits; the recently disturbed site offered an ideal opportunity to hone his skills without adversely affecting the site's integrity.

Peck (1946, 1947) excavated a number of human burials as well as dense deposits of cultural materials (such as ground stone, flaked stone, worked bone, worked shell, and faunal materials) at the Mar Vista site. Based on his inspection of projectile point styles and shell beads, he concluded that the site was primarily a late prehistoric period occupation, although he specifically reported that there were no historical-period artifacts present in the deposit (Peck 1947:9). However, the presence of both inhumations and cremations led him to suggest separate components, arguing that the inhumations pertained to an earlier component than the cremations. The sheer density and extent of the cultural materials suggested that the site had been occupied year-round, which Peck interpreted as evidence of a prehistoric village rather than a temporary camp or short-term habitation.

Unfortunately, the absence of accurate maps detailing Peck's excavations has made it difficult to precisely relocate Peck's excavation loci (but see Van Horn et al. 1983). However, his written notes implied that he conducted his investigations slightly north and east of the area SRI has designated Locus A (Figure 138). It is likely that Peck's research in Locus B was slightly east of the burial area at LAN-62, because an area approximately 500 feet long immediately

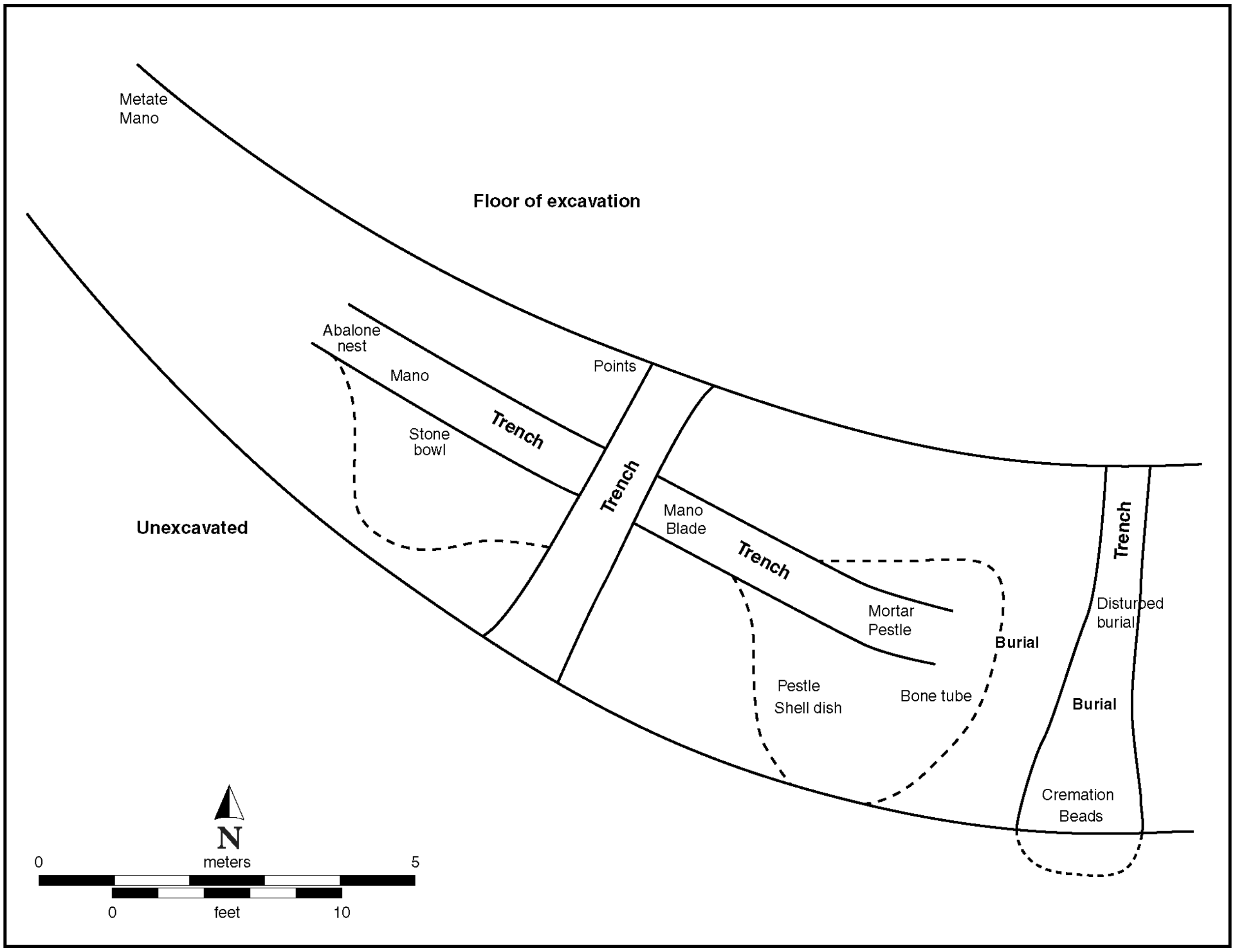

Figure 138. Redrawn map of Peck's 1940s excavations within the boundaries of LAN-62 (redrawn from Peck [1947:12]).

east of the burial area was found to have been mechanically removed, likely during the Hughes era. The length of the disturbance approximated the 250-by-500-foot excavation, to the depth of 8–12 feet, that Peck (1947:1) described in his report. Peck (1947:1) reported that all archaeological materials, down to a "hardpan," had been removed for use as construction fill for the expansion of the Hughes Aircraft Company runway. Although it is not clear, the "hardpan" described may have been marsh deposits, which consist of heavy clay deposits that are difficult to excavate. Peck's excavations were along the base of the bluff, at the southern terminus of the Hughes Aircraft Company excavations. A photograph of the expansion of the runway, showing two haul roads from Loci A–D of LAN-62 to the runway, is presented in Figure 139. It is unclear from the photograph which areas of the site were excavated for runway fill, given the angle from which it was taken.

In 1948, shortly after Peck completed his work at LAN-62, amateur archaeologists D. L. Luhrs and R. M. Ariss (1948) conducted a survey at the site and observed up to 6 feet of fill and overburden. They observed human and faunal bone in a 6-foot cut of an embankment at the site, beneath several feet of modern debris and fill. They estimated the total site area as 250 by 500 feet. Working with the Archaeological Survey Association (ASA) of Southern California and the Los Angeles County Museum of Natural History, Luhrs and Ariss filed the first formal site record for LAN-62, including a map indicating three deposits that they called LA:1, LA:2, and LA:3 (Figure 140). LA:1 and LA:2 appeared to fall within the currently defined boundaries of Locus A, and LA:3 fell within what is now Locus C. In 1948, Ariss sent a letter to the Hughes Tool Company requesting permission to conduct excavations through the auspices of the ASA. At that time, apparently, Ariss was unaware of the excavations that had been conducted by Peck, who, interestingly, was also a member of the ASA. After a response from the Hughes Tool Company, apparently Ariss subsequently learned of Peck's investigations and was satisfied that enough work had been done at the site. A letter in 1949 described Peck's work and the fact that no further work was necessary. The site card was filled out in 1948, 1 day prior to the first letter of inquiry's being sent to Hughes Tool Company. Unfortunately, the site maps on the card did not detail Peck's excavations or the locations that had been disturbed by Hughes Aircraft Company activities.

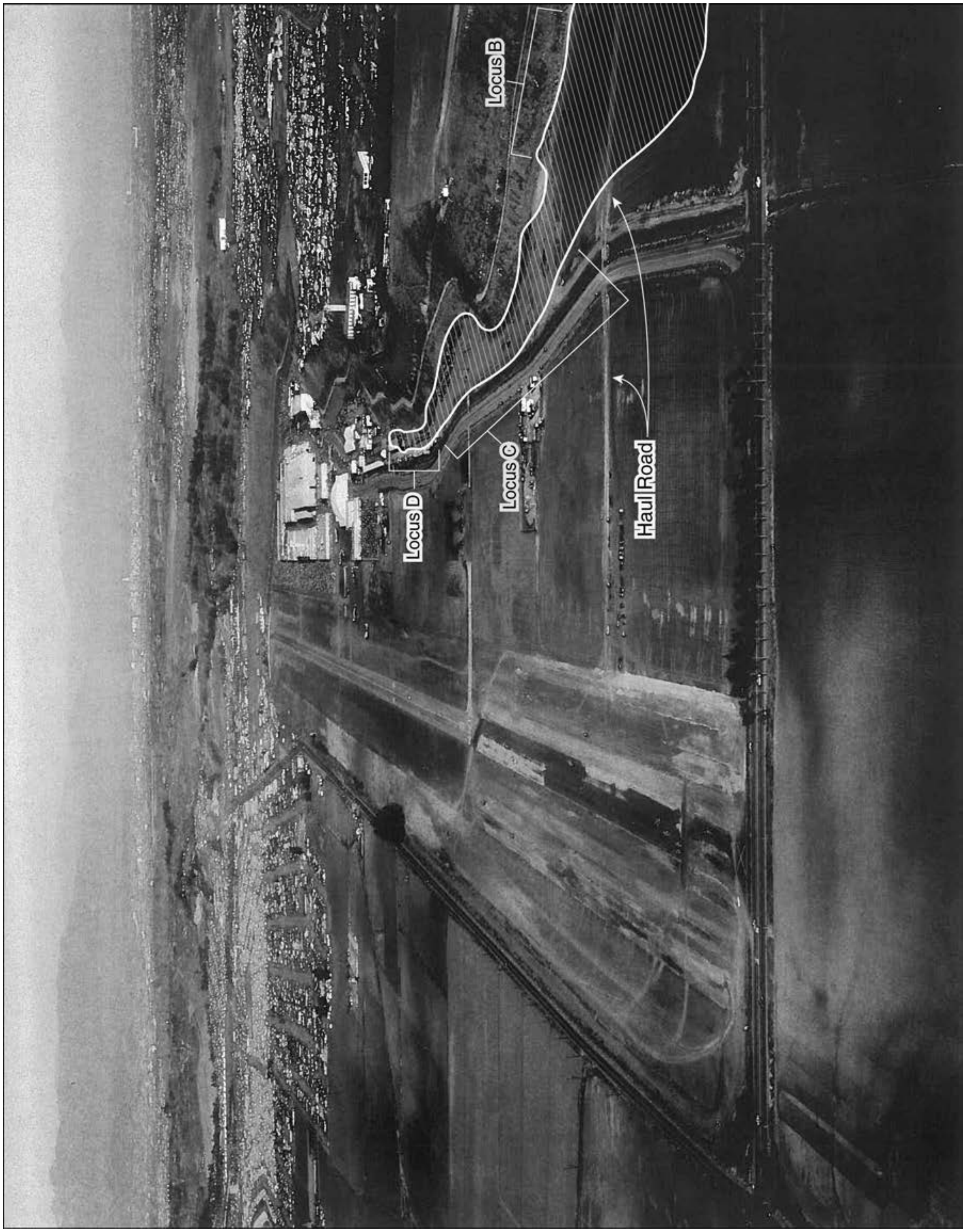

Figure 139. Oblique aerial photograph showing soil transportation, possibly from Loci A and B, during Hughes Aircraft Company runway-extension construction (Courtesy of Playa Capital Company, LLC; Raytheon archives, Negative No. C-11617).

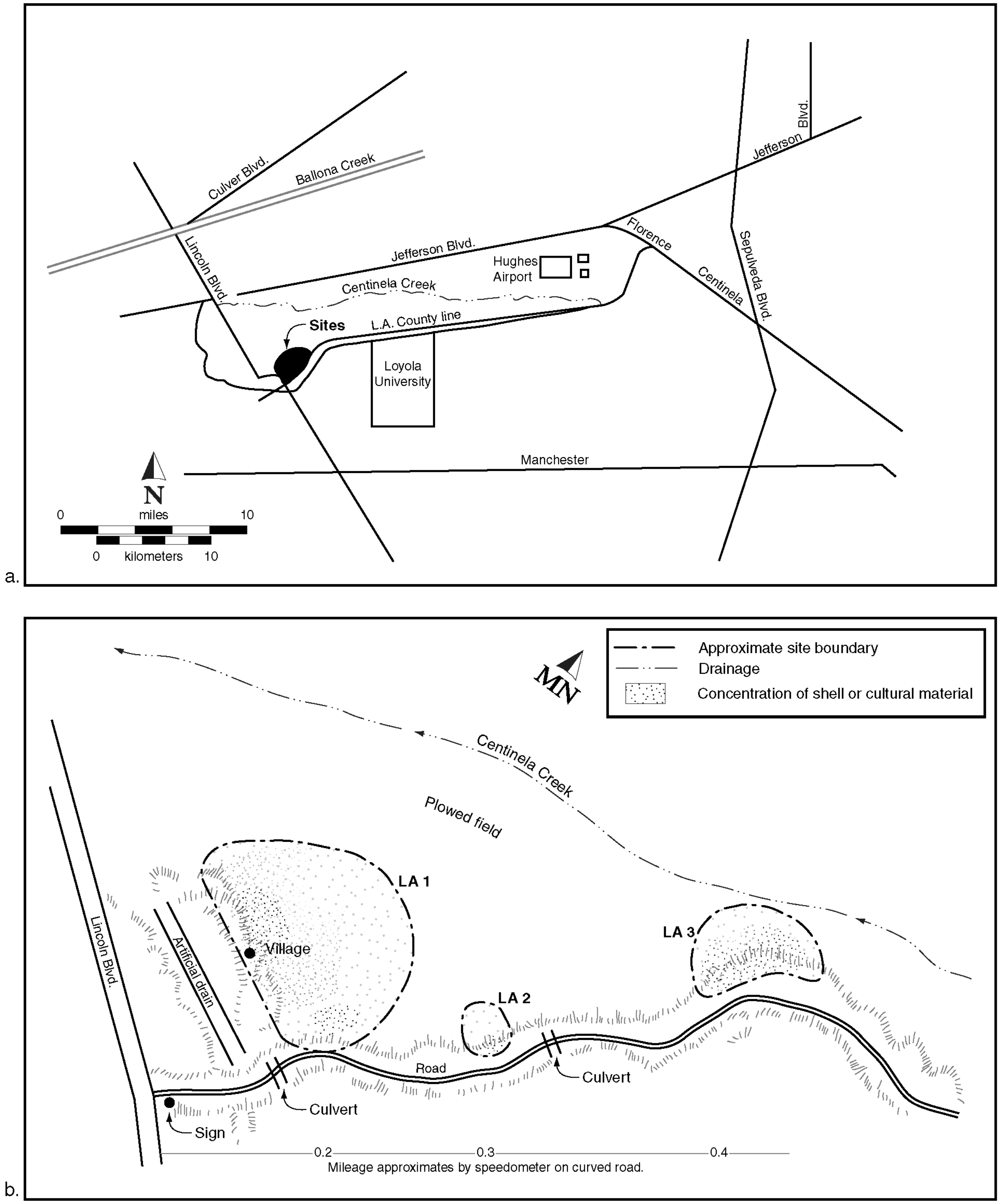

Figure 140. Redrawn 1948 ASA site-card map (Luhrs and Ariss 1948), showing (*a*) the project area and (*b*) the locations of LA:1 (SRI Locus A), LA:2 (SRI Locus B), and LA:3 (SRI Locus C).

Around the same time as Peck's excavations in the 1940s, amateur collectors Oscar Shulene and William Deane sporadically combed the Ballona for indigenous artifacts. From 1939 through 1949, Shulene conducted dozens of unauthorized excavations and surface collections and, after 1947, concentrated his efforts specifically on LAN-62. From 1947 to 1949, he removed large collections of artifacts from LAN-62 and may have excavated up to 15 prehistoric human burials. Shulene later presented his collection materials to two UCLA anthropology students, Charles Rozaire and Russell Belous, who described Shulene's collection in a 1950 paper summarizing the state of archaeology in the Ballona Creek area (Rozaire and Belous 1950). Deane also excavated and removed cultural materials from the site, starting in 1947. His brother worked as a grading contractor for Hughes Aircraft Company and informed him of the cultural resources of LAN-62. Many of Deane's finds were later reported by Marlys Thiel (1953), who also described four inhumations that Deane had excavated. Neither Deane nor Shulene possessed excavation skills on par with Peck and, consequently, their findings were poorly documented. The only known records of their findings are photographs of selected artifacts; little or no provenience information was presented in the papers by Thiel (1953) or Rozaire and Belous (1950). Photographs from Rozaire and Belous's report also showed looters' pits on the slope above the bean fields. It is possible that those pits were remnants from amateurs, such as Shulene and Deane.

Professional Investigations

Nels Nelson (1912) was the first professionally trained archaeologist to visit the Ballona. Nelson visited the area during a brief visit to southern California, under the auspices of the American Museum of Natural History in New York, to survey prehistoric "campsites" and "refuse heaps" along the California coast, from Topanga Canyon to San Diego Bay, including the Ballona. Nelson recorded and described sites throughout that large area and therefore was the first scholar to write about sites in the Ballona. Based on his description, the area Nelson recorded as "Site No. 4" appeared to be what is now LAN-62, which he classified as a refuse heap. Nelson did not visit the site, per se, but described it based on an interview with a hunter who resided in the area, reporting a large accumulation of materials at Site No. 4 that included human bone.

Nearly 20 years later, Arthur Woodward (1932) of the Los Angeles County Natural History Museum directed an archaeological expedition to investigate sites in the Los Angeles area, including the Ballona. The fieldwork was actually conducted by Richard Van Valkenburgh, an employee of Woodward's at the museum, who had done extensive excavations in other areas of southern California during that period. By the mid-1930s, the expedition comprised collections from a number of sites, at least three of which were in the Playa del Rey–Ballona area. The collections included manos, mortars, shell artifacts, flaked-stone artifacts, and projectile points. It is unclear whether the expedition conducted work at LAN-62.

Rozaire and Belous (1950) were the first trained archaeologists to formally record LAN-62 prior to its being deeply buried as a result of alluvium deposition and construction by Hughes Aircraft Company. They filed a formal site record for LAN-62 based on Peck's work at the base of the bluffs, east of Lincoln Boulevard; their description appears to have been taken directly from Peck's 1947 report (Altschul et al. 1991:116). Rozaire and Belous created the second formal, detailed map of the site (Figure 141). They also filed site records for sites recorded by Malcolm Farmer (although Farmer stayed on the bluff tops during his recording in the 1930s). They described LAN-62 as a series of back-dirt piles wedged between the base of the bluff and a plowed bean field and, even at that early date, observed already-considerable disturbance and removal of overburden related to then-recent construction. Rozaire and Belous also identified the potential regional importance of the site. On the site record, they stated, "Probably a key site for the area. Should be investigated further with test trench or pits. . . . Will be difficult to dig—sev. Ft. of overburden, certain areas have been torn up" (Rozaire and Belous 1950). They also conducted survey in the Ballona area and made surface collections that were stored at the Southwest Museum of the American Indian in Los Angeles, now part of the Autry National Center.

Professional archaeologists did not visit LAN-62 again for another 30 years, when R. L. Pence (1979) conducted survey on the Hughes Aircraft Company property. By that time, the site had been deeply buried below several meters of alluvium and modern fill, except on its northern edge and along portions of the bluff face, where Pence observed small pockets of cultural materials on the surface. The thick cover of overburden and fill made it impossible for Pence to assess the full extent of the site using only pedestrian survey methods.

The 1980s ushered in a wave of professional research at LAN-62 that met with varying degrees of success. Brian Dillon and several associates surveyed the property but, like Pence, failed to determine the site's horizontal extent (Dillon 1982a, 1982b; Dillon et al. 1983). Soon after, Chester King and Clay Singer (1983) oversaw test excavations at LAN-62, in an effort to assess the site's extent. However, they, too, found sparse evidence of intact cultural deposits, because of the deep covering of overlying fill and alluvium. Notably, King and Singer (1983:1) interpreted the site as the possible location of the early Gabrielino village of *Suangna*. However, early historical maps showed that *Suangna* was actually located farther south, in the city of San Pedro. They apparently confused the place name *Suangna* with *Sa'angna,* which Johnston (1962) had previously located in the Ballona. However, as explained elsewhere (see Stoll et al. 2003:19–26; Van Horn et al. 1997a, 1997b; Vargas 2003), Johnston also erred in locating *Sa'angna* in the Ballona, because it was a place name that had been created by Johnston, not an actual village name.

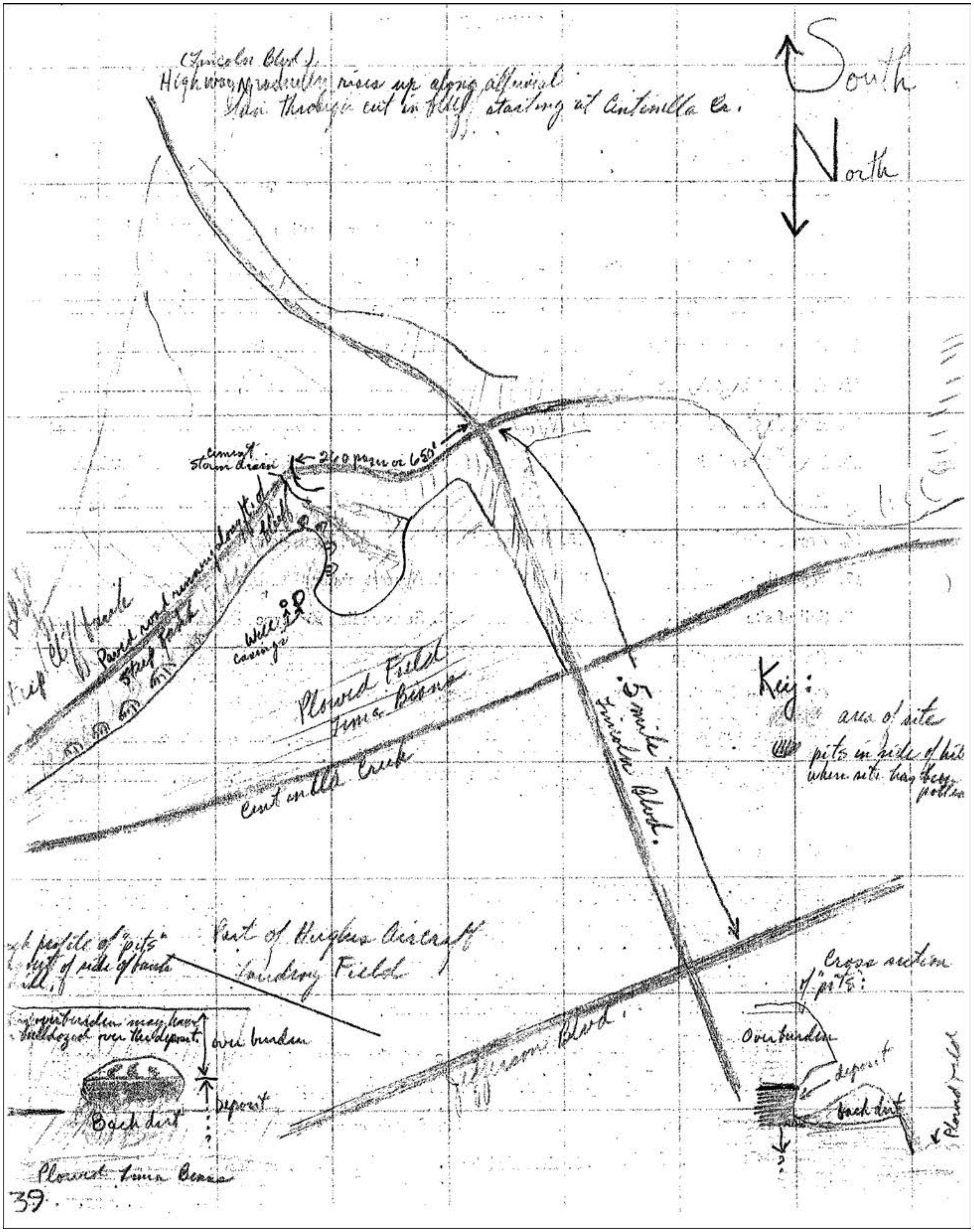

Figure 141. Site map of LAN-62 created for the original site card by Rozaire and Belous for UCLA.

David Van Horn (1984a; Van Horn et al. 1983) met with greater success in locating and evaluating LAN-62 than had his predecessors. Van Horn visited the site (with Dillon) in 1982 and, in the following year, excavated a series of mechanical trenches and hand-dug test pits, in an effort to define the site boundaries. Unlike King and Singer, Van Horn and Dillon successfully exposed subsurface deposits in the eastern portion of the then-understood site boundary (now referred to as Locus A) along the face of the bluff, which they designated LAN-62A. Van Horn and colleagues estimated a roughly 1-m-thick deposit of cultural materials extending about 85 m north from the edge of the escarpment, across what had been a low talus between two natural drainages. They estimated that the site had originally extended another ca. 80 m to the west and that approximately 75 percent of the site had been destroyed as a result of construction activities during the Hughes era (Van Horn et al. 1983:6). According to Van Horn and associates, LAN-62A corresponds to the locus excavated by Peck in the 1940s and recorded by Rozaire and Belous in 1950.

They also identified a second, previously unknown subsurface deposit roughly 20–30 m southwest of LAN-62A, designated LAN-62B, which they described as a large midden measuring 1.2 m in depth and buried deep below a thick overburden of modern alluvium and fill (Van Horn 1984a). Van Horn and colleagues only investigated a small area on the eastern periphery of LAN-62B, though, including one mechanical trench and a single 1-by-1-m test unit. Overall, Van Horn and colleagues' 1983 excavations succeeded in revealing dense deposits of deeply buried cultural materials at LAN-62 and purportedly relocated Peck's 1940s project area. However, they were unsuccessful in both determining the horizontal extent of the site and exposing the full depth and stratigraphy of the deeply buried cultural deposits.

Van Horn and colleagues' subsequent excavations at LAN-62B in 1987 were more successful in identifying the site's horizontal boundaries (Freeman et al. 1987; Van Horn 1987). They mechanically excavated a series of "wedge" trenches emanating out from the known areas of cultural deposits to define the site's full extent. Wedge trenches included ramps to allow heavy equipment to enter the trenches; most modern testing of sites with trenches has utilized a trackhoe excavator, which, because of its long arm, is able to excavate more deeply and safely than Van Horn's "wedge" method. Employing a mix of mechanical and hand-excavation techniques, they identified cultural deposits buried beneath 2.4–3.2 m of overlying alluvium and fill (Freeman et al. 1987). They observed the densest subsurface midden deposits in the southern portion of the site, along the escarpment. However, no cultural deposits were observed in the "edge" trenches farther to the north, which provided grounds for estimating the northern boundary of the site.

In all, Van Horn and colleagues' 1987 excavations were moderately successful in delineating the site area. However, the thick overburden once again prevented the excavators from safely exposing a full vertical profile of the midden deposits. Nevertheless, one pattern observed during the excavations concerned the changes in frequencies of shell species at varying depths within the observable midden. The lower levels of the test units in the midden contained higher proportions of oysters (*Ostrea* sp.) and scallops (*Pecten* sp.), and the upper level contained a higher proportion of littleneck clam (*Protothaca staminea*). Van Horn posited that the change in shellfish species was likely related to processes of siltation in the Ballona Lagoon (Van Horn 1987). More importantly, Van Horn and colleagues revealed at least two temporal components at the site, confirming Peck's earlier assertions.

Van Horn and associates returned to the site again in 1988, with the goal of better defining the cultural stratigraphy of LAN-62B (Archaeological Associates 1988). Upon their return, the 1988 field crew was surprised to find an even-thicker stratum of overburden, which had increased by about 3–4 feet from the previous year, likely resulting from the recent construction of the Hughes Aircraft Company's corporate headquarters on the bluffs above the site. In some areas, the overburden extended up to 6.1 m in depth. In all, Van Horn and associates excavated an additional 12 mechanical trenches of varying lengths (Archaeological Associates 1988:23). Unfortunately, in light of the increased depth of the overburden, they were only able to expose the deep-lying midden deposits in 8 of the 12 trenches. Moreover, none of the trenches could be excavated to a sufficient depth to expose a vertical profile of the midden. However, by placing trenches along the edges of the known site area and in adjacent off-site areas, they were able to better define the site boundaries.

A detailed map of Van Horn and associates' testing locations and results would have been a valuable asset for later archaeological projects at LAN-62. Unfortunately, problems with the printed scale on their published maps made it difficult to properly relocate their testing locations. During SRI's data recovery excavations at LAN-62 in 2003–2004, however, many of Van Horn and colleagues' EUs and trenches were located and mapped, allowing SRI to better reconstruct and illustrate their work at the site. An example of one of Van Horn and colleagues' test pits, identified by SRI during data recovery, is shown in Figure 142. The locations of their EUs and trenches, from one of their maps, are shown in Figures 143 and 144.

Overall, in contrast to other archaeological projects in the late 1970s and 1980s, Van Horn and associates successfully located intact subsurface cultural deposits deeply buried below a thick layer of modern alluvium and fill. Their work also indicated the approximate northern boundary of the site. Based on the sheer volume and thickness of the cultural deposits, Van Horn and colleagues, echoing Peck's (1946, 1947) observation, suggested that the site had housed a permanent or semipermanent village occupation with, minimally, two temporal components. Overall, their results heavily influenced SRI's testing and data recovery strategy for LAN-62 in the late 1990s. Significantly, no evidence of an early-historical-period occupation was observed in their work.

Figure 142. Photograph of a test pit excavated by Archaeological Associates in the 1980s identified during data recovery by SRI at LAN-62 Locus A in 2003–2004.

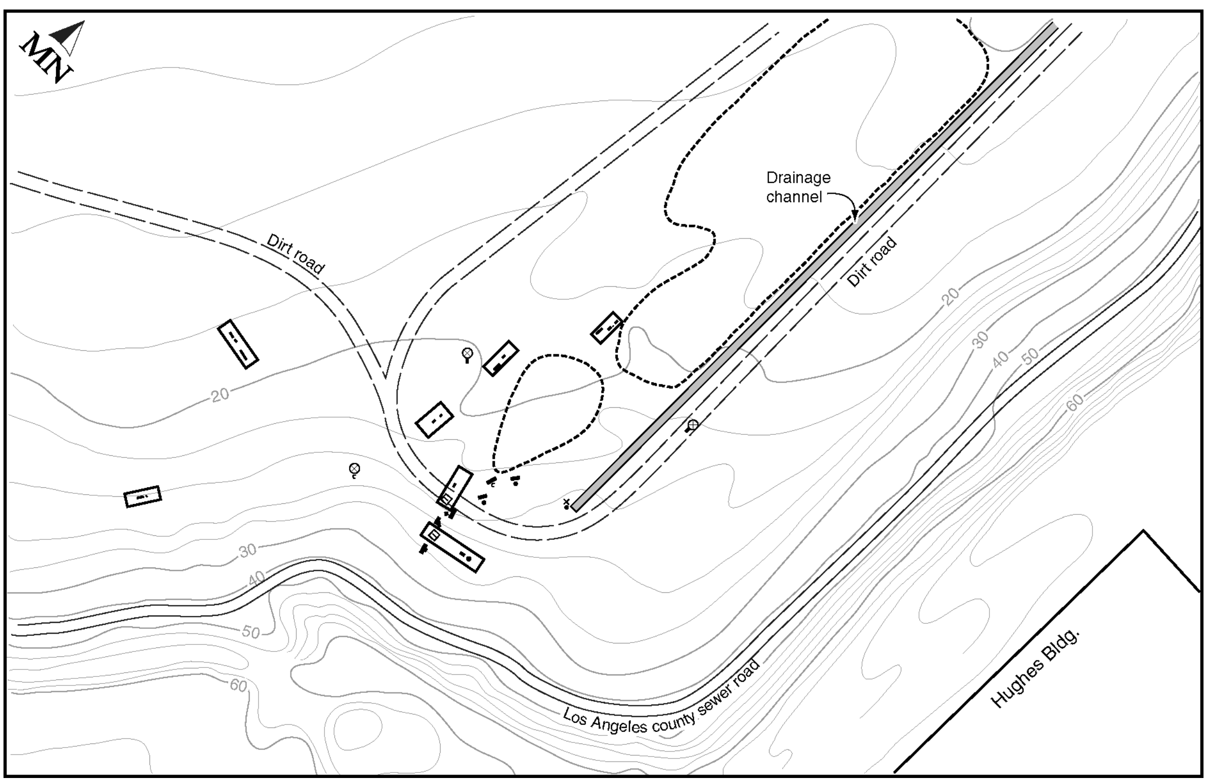

Figure 143. Map showing the locations of archaeological investigations within the boundaries of LAN-62 Locus A by Archaeological Associates in the 1980s (redrawn from Archaeological Associates 1988:Figure 2).

Figure 144. Photograph of LAN-62 Locus A, showing the drainage channel and road depicted in Figure 145 at the time of SRI's initial survey, view to the northwest.

SRI's Investigations

SRI's investigations at LAN-62 began in 1989 with Altschul and Ciolek-Torrello's (1990) overview essay on archaeology in the Ballona Lagoon area. The following year, Playa Vista contracted SRI to oversee the evaluation and treatment of archaeological resources. Soon after, Altschul and his colleagues (Altschul 1991; Altschul et al. 1991) devised an ATP for the site, to evaluate the abundance and integrity of cultural resources in the PVAHP project area.

Treatment Plan (1991)

Work at LAN-62 (as well as LAN-211) was predicated on a wetlands-restoration project and construction of the Riparian Corridor along the base of the Ballona Escarpment (see Figure 137). The ATP was geared toward work within the APE of the Riparian Corridor. In light of the previous research at LAN-62, Altschul et al. (1991:166; see also Altschul 1991), in agreement with the Corps, recommended LAN-62 (along with LAN-211) eligible for listing in the NRHP.

The ATP for LAN-62 provided for data recovery, and fieldwork activities were to be focused on evaluation and mitigation procedures within the Riparian Corridor. Altschul et al. (1991) assumed that the area outside the proposed Riparian Corridor would not be adversely impacted during construction and proposed manual excavations over an area of 200 m^2 in what was thought to be the combined site areas of LAN-62 and LAN-211 but was ultimately determined to be entirely LAN-62. LAN-211 was located to the east and was subjected to its own ATP.

Revised Work Plan (1999)

As the results of previous projects had made clear (Archaeological Associates 1988; Freeman et al. 1987; Peck 1946, 1947; Van Horn 1984a; Van Horn et al. 1983), pedestrian survey alone was insufficient for identifying and evaluating the deeply buried cultural deposits at LAN-62. For that reason, the authors of the 1991 ATP (Altschul 1991; Altschul et al. 1991) assumed that subsurface testing would not be feasible at LAN-62 prior to the onset of construction activities. They therefore listed removal of the overburden as the first field task. However, new technologies and methods for subsurface probing permitted archaeologists to expose deeply buried deposits without incurring excessive costs or creating unsafe work conditions (Grenda et al. 1999:3).

To better define the scope of the data recovery efforts, SRI developed a subsurface-exploration program that used a combination of bucket augers, sediment cores, and backhoe trenches (Doolittle and Altschul 1998; Vargas 2003; Vargas and Feld 2003a). Grenda et al. (1999:38) outlined a revised set of objectives and protocols based on improved technology: (1) provide high-resolution information concerning site integrity, (2) better define the horizontal extent of the archaeological resources, (3) expose the depth and stratigraphy of the midden, and (4) infer possible activity areas and other intrasite patterns. They designed a systematic sampling strategy to optimize the likelihood of intersecting subsurface cultural resources.

As Grenda et al. (1999:33) explained, bucket augers are generally well suited for locating subsurface deposits and collecting vertical provenience information in a controlled manner. Archaeologists can readily inspect the removed soils for artifacts, dark soil colors, or other indications of cultural deposition, and the bucket auger can reach depths of up to 18.3 m (60 feet). But during the course of the bucket-auger excavations, it became clear that the thick overburden of loose fill and alluvium overlying the deeply buried cultural deposits presented unforeseen problems. At some point in the process, the sidewalls of all of the bucket-auger holes collapsed. In some cases, sidewall collapses left little time for field personnel to fully inspect and record the stratigraphy of the cultural deposits, although in most cases, the field crews were able to record sufficient data to achieve the goals set out in the 1999 revised work plan.

Sediment cores provided another level of information to assist in identifying potential areas of archaeological concern. Group Delta Consultants, Inc. (Delta), carried out the sediment coring as part of their environmental testing program. SRI staff members closely monitored the coring and reviewed the core logs containing detailed stratigraphic information that were provided by the soil engineers. In areas with complex subsurface deposits and stratigraphy, the plan called for the excavation of backhoe trenches to expose a larger, continuous area of subsurface cultural materials. However, because of safety concerns and a high water table, trenching was only possible in areas with shallow subsurface deposits (less than 5 feet below the surface). During 2005, overburden removal permitted trenching directly into the subsurface cultural deposits. Trenching work was best suited for areas along the base of the bluffs, where overburden and fill materials were less thick.

As explained below in more detail, for management purposes, SRI divided LAN-62 into seven distinct management loci (Loci A–G) (see Figure 137). Although some of those loci designations were not made until the exploration program had been completed, we refer to them in this section to facilitate our discussion of the results. Loci A, B, C, and D refer to the original site areas where Peck, Van Horn, and others focused their investigations. Loci E–G were later-added areas of investigation to the west of and adjacent to Loci A and B and were discovered through the bucket-augering and monitoring processes.

SRI conducted investigations at LAN-62 and other portions of Area D on separate occasions in 1998, 1999, 2001, and 2005 (Doolittle and Altschul 1998; Vargas 2003; Vargas and Feld 2003a). In the following sections, we separately describe the results for each of those field investigations.

1998 Investigations

The first phase of investigations in 1998 included the excavation of bucket-auger units within the then-known boundaries of LAN-62 (now Locus A) as previously identified by Van Horn and colleagues (Archaeological Associates 1988; Freeman et al. 1987; Van Horn 1984a; Van Horn et al. 1983). The primary purpose of the bucket-auger units was not to investigate LAN-62, per se, but to compare subsurface cultural materials from LAN-62 to those from LAN-2676, roughly 1 km to the northwest. The objective of that comparison was to determine whether the cultural deposits at LAN-2676 had originated from LAN-62 as redeposited fill used in the construction of the original Hughes Aircraft Company runway in the 1940s. That said, bucket-auger testing at LAN-62 also allowed a better understanding of the approximate boundaries of the site and what areas near the known boundaries may need additional testing.

The field crew excavated, in total, 8 bucket-auger units at LAN-62, as a baseline of comparison to 38 bucket-auger units from LAN-2676. To facilitate the recovery of cultural materials, each excavated level was assigned a unique PD number and set aside for wet screening. All of the soils collected from LAN-62 were wet screened for artifacts and other cultural materials, using 1/8-inch-mesh hardware cloth. Five of the 8 bucket-auger units included artifacts and other cultural deposits at subsurface depths of between 1.5 and 5.5 mbs (Doolittle and Altschul 1998:30–43). Only sand was recovered from the 3 other units, but SRI personnel were unable to rule out the possibility that cultural deposits were present below the bases of those units. In one case (CU 3), the bucket auger had been situated on the edge of a relict earthen construction ramp, where the depth of the overburden may have been greater than in other areas of the site.

Despite those difficulties, the 1998 fieldwork was successful in detecting high-density subsurface deposits at LAN-62. The positive bucket-auger units from LAN-62 were densely laden with artifacts and cultural debris; in fact, the artifact densities at LAN-62 were four times greater than those at LAN-2676 (Doolittle and Altschul 1998:37). Yet the results did not provide sufficient resolution to determine the horizontal extent or the depth of the midden deposits at LAN-62 (Doolittle and Altschul 1998:41–42). The results made clear that additional investigations would be necessary to better characterize the horizontal and vertical dimensions of the site. Consequently, SRI continued work at LAN-62 the following year.

1999 Investigations

In 1999, SRI excavated 29 bucket-auger units in and around the known site of LAN-62 (Vargas 2003; Vargas and Feld 2003a). Subsurface cultural deposits were recovered from 14 of the units. Twelve units appeared to be culturally sterile or contained cultural materials from non-intact or disturbed contexts, and 3 others yielded ambiguous results, largely because of sidewall collapse (see above). In addition, 12 cores were drilled in or near LAN-62 and provided additional information concerning the presence and integrity of the subsurface materials, thereby complementing the bucket-auger results (see Vargas 2003 for details).

As Vargas (2003:106–108) explained, the placement of the bucket augers began in the known site area on the eastern edge of Locus A and continued to the northeast along the base of the bluff, following a linear stretch of cultural deposits into what was later classified as Loci B, C, and D. The bucket-auger tests showed that the densest and most-intact subsurface cultural materials occurred in Locus A. In the central and eastern portions of the site, the bucket-auger tests revealed less-dense deposits interspersed with heavily disturbed areas and sterile soil (Vargas 2003:108). The area of Loci B, C, and D has long been subjected to heavy disturbance from historical-period farming and modern construction.

Having realized the extent to which the site continued to the east of Locus A, SRI personnel subsequently decided to excavate 17 backhoe trenches of varying lengths in Loci B, C, and D, to supplement the bucket-auger results and to better distinguish the northern boundary of the site in those areas (Vargas 2003:111–112; Vargas and Feld 2003a:66). The trenching produced perplexing results, though. Some trenches revealed undisturbed soil horizons, and others in the same general vicinity exposed heavily disturbed, mixed deposits. As Vargas (2003:112) pointed out, "moving only 10–20 m in any direction often resulted in completely different, often contradictory, results." He concluded that over a century of historical-period and modern development in the area had "created a 'Swiss Cheese' effect in the area below the bluff" (Vargas 2003:112)—i.e., a mosaic of localized pockets of disturbed, less-disturbed, and intact subsurface matrices. The trenches and bucket-auger units did not offer sufficient subsurface exposure to make sense of the depositional episodes responsible for creating that complex condition.

In addition to the work at Loci B, C, and D, 20 bucket-auger units also were excavated in the area later designated as Loci F and G, to the north of Locus A (Vargas 2003:110). In some of the units, the cultural materials were intermixed with modern debris (e.g., concrete or bricks) in the overlying fill. In other units, cultural materials were recovered, but their stratigraphic contexts and integrity were unknown. The trenches in Loci F and G clearly had been subjected to disturbance from modern construction, but the extent of the disturbance was unclear. In many cases, the results were deemed to be indeterminate, because the field crew was unable to adequately record subsurface stratigraphic information to evaluate integrity. Once again, the thickness of fill deposits made evaluation of the subsurface integrity of cultural materials nearly impossible. However, 4 of the 20 units encountered definite intact subsurface cultural deposits, all located on the toe slope of the bluff, in Locus A.

Overall, the 1999 exploration program was successful in tracking the horizontal dimensions of the site and extending the eastern boundary of LAN-62. LAN-62 and neighboring LAN-211 essentially form a long but discontinuous line of cultural deposits along the Ballona Escarpment. Locus D of LAN-62 encompassed the area formally recorded as LAN-211A and LAN-211B. However, the complex subsurface stratigraphy undermined efforts to characterize the vertical dimensions of LAN-62. Those results indicated that larger subsurface exposures were needed to fully understand the complicated history of disturbance and deposition at the site.

2001 Investigations

In 2001, SRI initiated a third field investigation at Loci B, C, and D of LAN-62, to understand the depositional history and disturbance in the area (Vargas 2003:112–117; Vargas and Feld 2003a:66–69). After removing brush and construction debris, SRI excavated 22 backhoe trenches and 7 mechanical test units. Two sets of trenches were placed along the northern periphery of the site and within the Riparian Corridor (see Vargas 2003 for details). The trenches were carefully excavated in roughly 20-cm increments, to detect cultural strata and changes in soil color. Many trenches were excavated into deeply buried cultural deposits, which created unsafe conditions for entering them. In those cases, the subsurface stratigraphy was inferred based on changes in excavated soils (color and texture) and surface-level inspection of trench sidewalls. Samples of soils from all excavated levels (and all soils from cultural deposits) were collected for wet screening (see above).

Fifteen of the 22 trenches revealed intact subsurface cultural deposits and anthropogenic soil horizons. In general, the cultural deposits were relatively shallow and readily defined near the base of the bluff. However, it became clear that the cultural deposits had become increasingly buried the greater their distance from the bluff edge. The trenching also showed that subsurface cultural deposits had been severely truncated or completely removed during modern construction activities, a pattern also more pronounced in the trenches farther from the bluff. In some areas, soils containing cultural deposits had been used as construction fill, resulting in a bedding of cultural bands and sandy fill in many of the trenches, especially in Locus B. Evidently, recent and historical-period land use had not been as intensive along the toe slope of the bluff as it had been in areas away from the bluff.

After the trenching was complete, SRI excavated seven units to define the content of the cultural horizons. The units were excavated into the sidewalls of trenches with what were thought to be intact cultural deposits. Given the unsafe depths of the deposits in some areas, the units were mechanically excavated using a 3-foot-wide, flat backhoe blade, which closely approximated a 1-by-1-m unit. The soils from each unit were removed in roughly 20-cm increments and subsequently screened, sorted, and analyzed, offering an empirical framework for evaluating the content and integrity of the subsurface deposits. All but one of the units contained intact cultural deposits; the one exception (CU 2) included lithics and faunal remains mixed with modern and historical-period debris that likely had resulted from redeposition related to modern construction.

The 2001 field program shed light on the "Swiss Cheese" pattern observed during the 1999 investigations. The trenching showed that the pattern of disturbance generally followed a gradient: the most-intact and less-deeply buried cultural deposits were recovered adjacent to the Ballona Escarpment, and the pattern graded toward increasingly more-disturbed and more-deeply buried deposits with greater distance from the escarpment. It also revealed different levels of disturbance among the site loci; in particular, Locus B appeared to have been subjected to more construction-related disturbance than the other loci. In addition, the 2001 program showed that the nearly continuous subsurface cultural lens at LAN-62 had been severely truncated or, in some areas, completely removed as a result of land leveling and modern construction.

Importantly, the results of the 2001 program allowed SRI researchers to locate areas with intact cultural deposits at LAN-62 and to develop a data recovery strategy focused on those areas (see below). Another important result of the 2001 investigations was that the SRI crew identified the top elevations of the cultural strata, which proved vital in guiding the overburden removal during the data recovery excavations, as described below.

2005 Investigations

Part of the 1999 exploration program focused on the area now defined as Loci F and G of LAN-62, north of Locus A. Several bucket-auger units were excavated within those loci, along with seven others in the nonsite area to the north of the loci. As had been the case in many areas of Loci B, C, and D, the bucket-auger units revealed generally sparse cultural materials intermixed with modern debris, indicating disturbance related to modern construction. However, the 1999 results were regarded as indeterminate, because the archaeologists had been unable to directly inspect the lower levels of the units and evaluate the subsurface stratigraphy.

In 2005, additional investigations were conducted in Locus G; no additional work was conducted in Locus F. It was determined that there would be no impacts into native soils by construction activities at Locus F; therefore, no testing plan was enacted. Although the results of the bucket-auger program had been inconclusive as to the integrity of buried cultural deposits in that area, the construction-related activities were clearly only going to be conducted in fill materials. In view of the previously indeterminate results in 1999, the objective of the 2005 test excavations in Locus G was to assess the integrity of the subsurface cultural materials (Vargas and Douglass 2009). The investigations included mechanical overburden removal and mechanical excavation of 18 backhoe trenches of varying lengths. Nine trenches were excavated prior to the overburden removal. Although subsurface cultural deposits were identified in each of the 9 trenches, the field crew were unable to safety record the subsurface stratigraphy of the trenches, because of the depths of the deposits and the frailty of the trench sidewalls. One additional trench was excavated to expose the profile of a feature, which was determined to be a probable secondary deposit of late-historical-period debris.

To expose and record the deeply buried cultural deposits safely, SRI mechanically removed the overburden of loose fill and alluvium within a portion of the APE of Locus G. Once the overburden had been removed, eight additional trenches of varying lengths were excavated. The presence of groundwater in several of the trenches again prohibited detailed recording of the subsurface stratigraphy. Despite that limitation, however, the field crew was able to record the vertical depth and horizontal extent of the intact cultural lens. In all, 12 of the 18 trenches in Locus G revealed intact cultural deposits, suggesting approximately 6,200 m^2 of intact archaeological deposits of varying thickness (from 0.5 to 2.5 m). The varying thickness indicated that the cultural lens had been severely truncated in some areas, as a result of construction during the Hughes era. Generally, the deposits were thickest in the southwestern portion of the project area and thinner to the north and east.

In 2005, SRI also excavated three trenches in the footprint of the Riparian Corridor in Locus E, the westernmost portion of LAN-62. Each of the trenches contained a deeply buried, redeposited A horizon containing historical-period debris—likely secondary deposits related to construction during the Hughes era or to earlier farming or ranching activities. However, no intact prehistoric period materials or soil horizons were identified from the sample of soils collected for wet screening. Given the results of the project, SRI opted to forego further excavations in Locus E, because there were no intact archaeological deposits present.

Implications of the Exploration Program

On the whole, SRI's exploration program was far more successful than previous attempts to locate and map the extent of LAN-62. The 1998 program successfully exposed intact subsurface site deposits in Locus A. The 1999 program showed that the site was considerably larger than previous researchers had suggested and that it, in fact, was formed of a long and nearly continuous line of cultural deposits (in varying densities) adjacent to the bluff edge, starting in Loci A (the originally defined site area), C, D, and G. The 2001 program provided insights into the complex depositional history of the site and located areas with more-intact and less-intact subsurface deposits, and the 2005 investigations revealed partially intact subsurface cultural deposits in Locus G but no significant deposits in Locus E. As mentioned above, excavations at Locus F were not conducted, because construction activities were not planned to intrude into the native soils identified during the bucket-augering process. Overall, these results provided firm grounds for planning the data recovery operations at LAN-62.

The exploration results required that SRI researchers reevaluate the ATP and data recovery plan devised in 1991. SRI presented a work plan for data recovery in September 2003 (Altschul 2003a, 2003b; Vargas et al. 2003), and the Corps approved that work plan in November 2003. The 2003 work plan shifted the scope of the data recovery to accommodate the expanded site area of LAN-62 and to target the known locations of intact deposits. The plan expanded the coverage of manual excavations from the 200 m^2 proposed in the original treatment plan (Altschul et al. 1991) to 360 m^2. SRI estimated an area of 35,972 m^2 within the APE of LAN-62; the 360-m^2 area of excavation therefore encompassed roughly 1 percent of the total APE for the Riparian Corridor. The following year, SRI was approved to expand the area of manual excavation again, by 140 m^2, to include a larger portion of a burial area in Locus A (see below), thereby increasing the total area of manual excavation to 500 m^2 (Altschul 2004). LAN-62 was divided into discreet loci, for management purposes (see Figure 137). Locus A (13,000 m^2), which encompasses the largest and most-intact cultural deposits, was the principal focus of the data recovery. The testing results showed that Locus B (7,000 m^2), to the east of Locus A, had been subjected to extensive grading during the Hughes era, which had severely truncated or completely removed most of the cultural deposits in the area. Locus C (17,000 m^2), to the east of Locus B, also had been heavily disturbed by construction, but thick lenses of intact cultural deposits had been preserved in some areas. Locus D (10,000 m^2) encompasses the easternmost portion of LAN-62. It had been severely disturbed as a result of construction by Hughes Aircraft Company, but pockets of intact deposits were still located (Van Galder et al. 2006). Locus G revealed approximately 6,200 m^2 of partially truncated subsurface cultural deposits. SRI's exploration program did not clearly define intact subsurface cultural deposits in Loci E and F.

Data Recovery Methods

Disturbance to the site from historical-period and modern activities led us to subdivide the portion of LAN-62 that had been located during Phase 1 into several distinct loci. Those areas were sampled from blocks of hand-excavated test pits.

Overburden Removal

Through exploration and removal of fill soils, it was determined that the extent of intact cultural deposits at LAN-62 in Phase 1 was approximately 36,000 m^2. As defined in the ATP, the overburden-removal phase was to expose intact cultural deposits within the impact area of the Riparian Corridor. The removal of overburden in Locus A began on September 11, 2003, and involved the use of paddlewheel and belly-loader scrapers, which, under the direction of SRI staff archaeologists, removed imported and natural fill overlying intact cultural deposits. When intact deposits were identified, archaeologists halted the excavations and moved equipment to new areas. That process took approximately 2 months and was successful in defining the horizontal site boundaries that, in some cases, had been buried for over 60 years. Because of the presence of potentially contaminated and highly disturbed soils, it was not deemed necessary to remove overburden soils in Locus B. Determining the intact portions of Locus B, if present, was to become part of the monitored grading phase, which is described below. Overburden removal was not conducted at Loci C and D in all areas; rather, overburden was removed from planned locations of manual excavation blocks. Where excavation blocks were located near the edge of the escarpment, there was very little overburden to remove. In other cases, as distance from the bluff edge increased, more overburden had to be removed. In Locus G, overburden removal was extensive. For most of the site area, many meters of natural alluvium and imported fill had to be removed with a combination of paddlewheels and excavators prior to conducting hand-excavations and stripping activities. In Locus A, there were several meters of fill on top of site materials to be removed; Van Horn in the 1980s had reported over 5 m of fill present in that general area.

Geophysical Methods

Geophysical methods were used only at Locus A as part of the data recovery program. After overburden soils were removed, a team from the University of Mississippi Center for Archaeological Research conducted geophysical surveys of the central portion of Locus A. The team was headed by Bryan S. Haley and was assisted by SRI mapping staff, using a Model FM-36 fluxgate gradiometer, which was designed specifically for use in archaeological applications. Geophysical survey was conducted along a grid created by SRI, and survey ropes, with markings every meter, were used for positioning the survey. Readings were taken at 0.25-m intervals along transects separated by 0.5 m within a 20-m grid. The survey covered a total area of 1,600 m^2 (Figure 145). According to Haley (2003), a large part of the survey was negated by the presence of asphalt in the topsoil. Asphalt is known to have a strong magnetic signature, and in the case of the LAN-62 survey, its presence interfered with the results significantly. Because of that interference, Haley chose to focus on the southwestern portion of the survey area. Haley did identify several magnetic anomalies with signatures that it was felt might be indicative of subsurface prehistoric features. Results of that work are discussed in the Geophysical Results section of this chapter.

Manual Excavation

After overburden had been removed and horizontal boundaries delineated within the impact zone of the Riparian Corridor, manual excavation of the units was begun. No manual excavation was designated for Locus B, because of the circumstances described above. In Loci A and C, manually excavated test pits were placed based on the results of the initial testing phases and the field observations of middens subsequent to the removal of overburden. With some minor variations in procedures due to the presence of groundwater, manual excavation was conducted in essentially the same way in Loci A and C. Excavation began with a small crew in Locus A and became a much larger operation. Excavations in Locus C began approximately 3 months after the start of excavations in Locus A.

Because of the success of the overburden-removal phase in exposing the site, it was deemed unnecessary to excavate mechanical trenches, as had been proposed in the plan of work; that is, mechanical stripping had revealed the horizontal dimensions of the site. The vertical dimensions of the site could be obtained by manual excavation, thereby recovering artifacts and information that would have been lost in mechanical trenching. Manual excavation at Locus A began in November 2003 and was completed in August 2004. Per the work plan, 1 percent of the site area to be affected by the Riparian Corridor was to be manually excavated. The amount

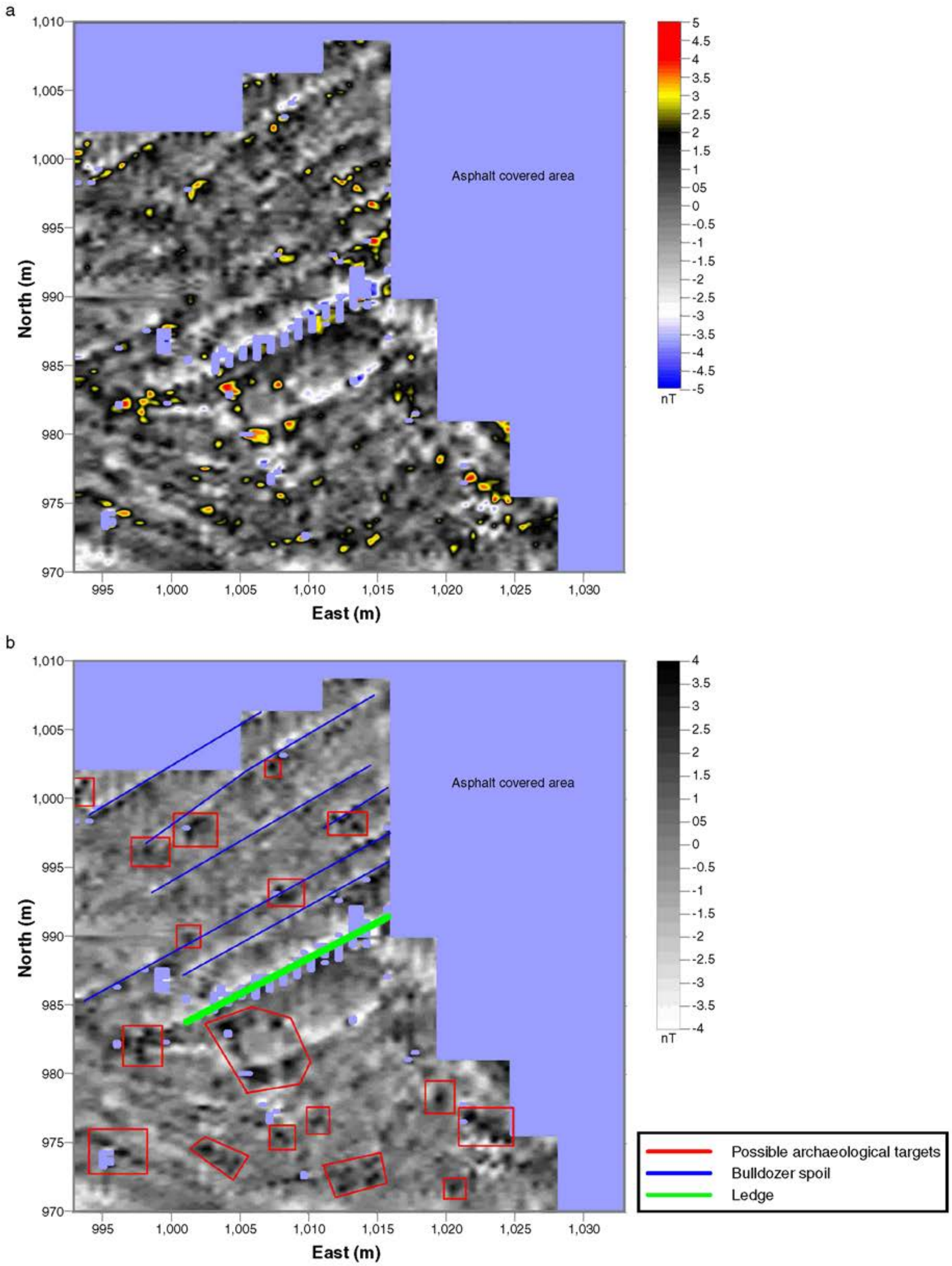

Figure 145. Magnetic-gradient image of LAN-62 Locus A (*a*) with blanking performed for areas of asphalt and (*b*) with interpretations of possible features.

Figure 146. Photograph of tented block excavations at LAN-62 Locus A, view to the northeast.

of manual excavation for the Phase 1 site area was calculated in October 2003 (Altschul 2003b) at 360 m^2, which was approved by the Corps. It was determined that 272 m^2 would be excavated in Locus A and 64 m^2 in Locus C, and 24 m^2 were to be excavated as discretionary units in any of the loci, where deemed necessary. The purpose of excavating the designated 360-m^2 area was to obtain controlled samples that would reveal the vertical sequence of cultural deposits and that could be compared to other samples from across the site and from other sites at Playa Vista. Conducting those excavations was often a difficult task, considering that, in many areas, cultural deposits were thicker than 3 m. Further complicating our efforts was the fact that a significant amount of the site was below the water table in both Loci A and C. The excavation methods employed at LAN-62 included complete recovery of all features within the site boundaries and the details of their stratigraphic relationships. That technique provided a unique opportunity to view the features in their proper contexts and, importantly, with associated cultural materials and enabled us to infer relationships and to make statements about site structure and the use of space.

Locus A

Excavation at Locus A was originally planned for two large blocks and a single 2-by-40-m north–south-trending transect of test pits across the middle of the site (Figure 146). In all, 272 m^2 were to be excavated within those blocks in Locus A. Initial excavations within the north–south transect in Locus A encountered several burials tightly clustered in the southern portion of the site. At that point, a 10-by-10-m block of test pits was opened adjacent to the burial locations. Several burial features were discovered in that additional block, leading us to reevaluate our excavation strategy in Locus A. The apparent density of the burial area led us to call another meeting with the peer-review committee to assess whether the methods outlined in the work plan were sufficient. On January 19, 2004, the Playa Vista peer-review team met on-site. They suggested that the number of hand-excavated EUs be increased to encompass the entirety of the burial area within the impact area. Concerns were raised that our emphases on the burial area not detract from collecting samples of the archaeological middens outside that area. The peer-review committee urged SRI to continue to sufficiently sample other portions of the site outside the burial area.

With concurrence from the Corps, SRI expanded the manual-excavation area to encompass the entire horizontal and vertical extent of the burial area within the impact zone (Altschul 2004). That area expanded as burial features were encountered in relatively high density within the impact area. Figure 147 shows the locations of the blocks and areas excavated as a result of our modifications to the initial work plan. As shown in the figure, some of the originally proposed EUs were never excavated, whereas others fell within the larger burial-area excavations. Blocks of test pits outside

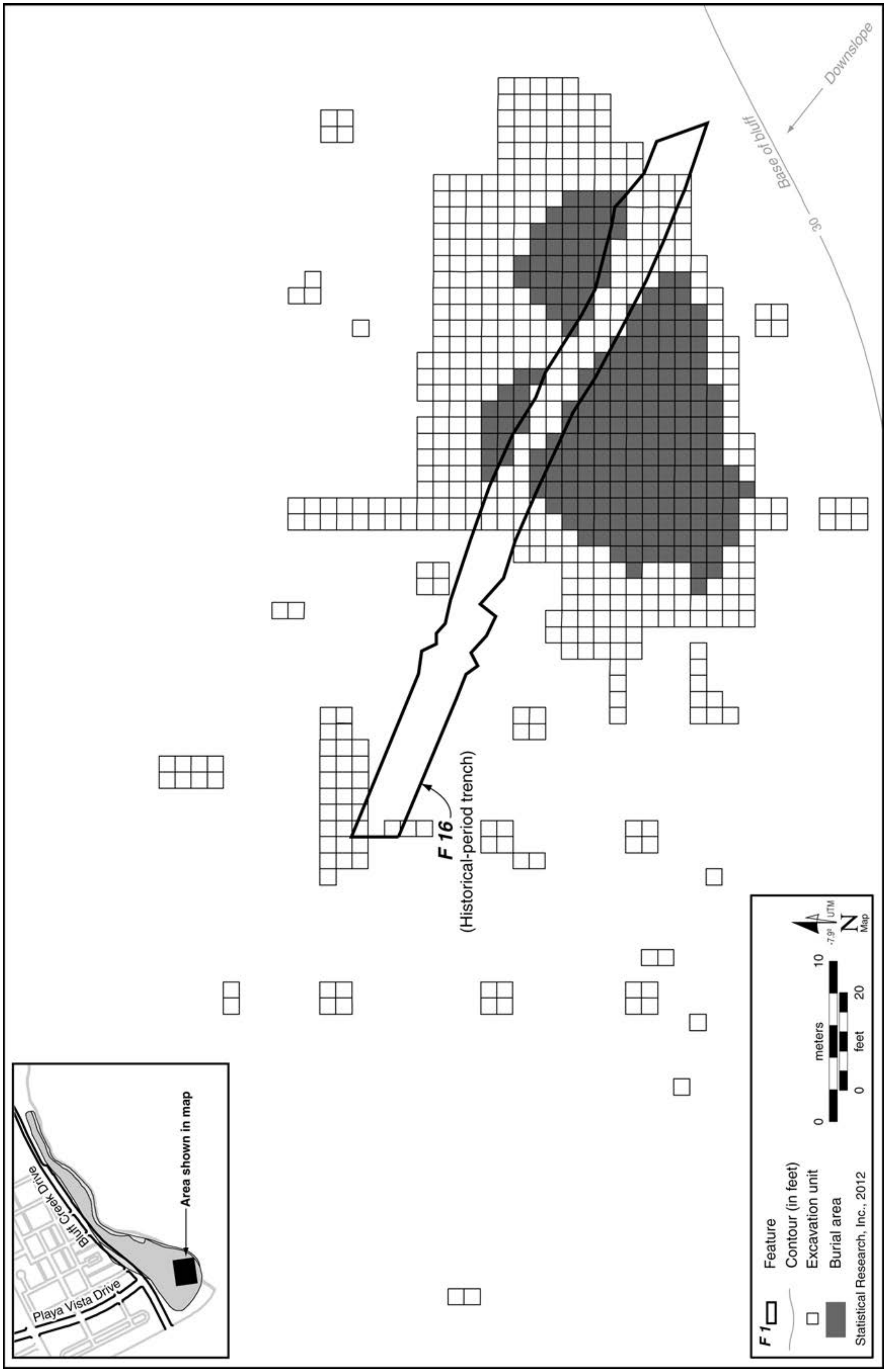

Figure 147. Map showing the locations of the hand-excavation units at LAN-62 Locus A.

Figure 148. Photograph of excavation within a deep unit at LAN-62 Locus A. Note the hydraulic shoring of the EU and the water pump in the corner of the unit to extract water seepage because the unit was excavated below the water table.

the estimated burial area were excavated so that all areas of the site within the impact zone could be adequately sampled. The original 360 m^2 that was to be excavated through the entirety of the cultural deposits was maintained, and an additional 322 m^2 was added to ensure that we recovered, by hand, all human remains within the impact area. When possible, excavations in the main burial area were conducted in layers across the entirety of the block. In that manner, both nonburial and burial features that might have been contemporaneous were encountered by excavators simultaneously. During the excavations, archaeologists excavated units and nonburial features. When burial features were encountered, archaeologists uncovered the extent of the feature. Once a burial feature was exposed, trained osteologists began excavation and in-field analysis, sometimes with the assistance of an archaeologist. In some cases, because of the high number of burials, once a burial was discovered, excavation was halted, if it was not going to be conducted for some time. That limited the time period during which some burials were exposed in the field.

Certain units were excavated to sterile soils, and others were excavated to depths determined to be below the burial area. In the northwestern portion of Locus A, mechanical cores revealed deeply buried cultural deposits. Safe hand-excavation was only possible to approximately 1.5 mbs in much of that area. In addition to the depth of the deposit, the presence of groundwater made deep EUs unstable. Two different strategies were employed to investigate deep deposits safely. In some cases, a complicated set of shoring and dewatering procedures was developed, so that excavators could work safely. In other cases, where 2-by-2-m blocks were to be excavated to the bottom of the archaeological deposit, a combination of hydraulic-shoring and dewatering procedures was used. In those cases, plywood structures were built to take stress off the surface surrounding the excavations. Hydraulic shoring was also used in combination with plywood sheeting to protect against caving in of sidewalls. As excavations proceeded in the 2-by-2-m unit, a pit was excavated in one corner, where an electrical pump was placed to capture and evacuate pooled water. In that manner, water was continually pumped from the EU so that the excavator could remove excavated soils and make observations (Figure 148).

In other cases, excavations were conducted to approximately 1.5 mbs and then left until mechanical stripping had been conducted in the surrounding area. After mechanical stripping had been conducted, the excavation block was then excavated by hand until the bottom of the deposit could be reached safely. Percolating groundwater was also pumped from the excavations during that process.

Tracking the various excavations and the large quantities of materials required a sophisticated set of procedures. A complete, fully staffed field laboratory was established on-site to tackle that problem. The laboratory included an in-field data-entry station. Networked computers tied to a central database allowed all manual-excavation forms to be entered and printed in the field, and so, in that manner, data-entry tasks were completed in the field. Data entries were checked for errors and corrected while the archaeologists responsible for completing field forms and performing hand-excavation were on-site and before features were processed (for further details, see Chapter 4, this volume).

As it became clear that the numbers of excavated features and units were going to be substantial, SRI realized the need to institute a bar-coding system for labeling excavation proveniences and tracking the movement of materials through the various stages of excavation, screening, and laboratory work. Personnel responsible for screening used handheld personal digital assistants (PDAs), linked via a wireless network, to track buckets of excavated matrix prior to screening. Point-provenienced artifacts were also given bar-coded labels to speed the inventory process and to ensure that no artifact was misplaced or separated from its provenience information. The use of bar codes and in-field data entry worked to speed the excavation, screening, and field-inventory processes and, most importantly, assisted with QA (for further details, see Chapter 4, this volume).

Locus B

Because of the highly disturbed nature of the deposits and the presence of contaminated soils, no manual excavations were conducted in Locus B. All construction activity in that area was monitored.

Locus C

Excavations in Locus C were to consist of four 4-by-4-m blocks equaling 64 m^2 (Figure 149). Whereas excavations in Locus C did not require the complicated set of excavation and recording procedures necessary in Locus A, our efforts there were made difficult by the presence of groundwater at rather shallow depths relative to the cultural deposit. As in Locus A, test pits were excavated in arbitrary 10-cm increments, and provenience was maintained to the 1-by-1-m unit. In almost all cases, the excavation blocks at Locus C encountered groundwater within 1 mbs or less, which required a complicated set of dewatering procedures. In most cases, excavation blocks were surrounded by deeply excavated trenches filled with gravel and fed into a deep "sump" hole with an electric water pump. In that way, groundwater drained from the pedestaled excavation area into the gravel-filled trench and into the sump hole at the low end of the slope. Water was then continually pumped from the sump hole to a different location, where it was filtered and recharged.

In some cases, the cultural deposits extended more than 3 mbs, requiring field technicians to excavate in completely saturated soils. Because of the wet condition of the matrix, identifying soil anomalies was a difficult task. Despite the difficulties inherent in excavating through saturated soils, excavators were able to identify several features in the matrix in Locus C. At certain depths, it became impossible to drain excavation areas efficiently, and a strategy of coring was used, so that samples of the midden could be collected and the bottom of the cultural deposit could be identified. A hollow core measuring approximately 12 inches in diameter was pushed through the soil at the bases of the EUs and was then removed and opened, so that on-site geomorphologists and archaeologists could determine where the soils became culturally sterile (Figure 150). The matrix from those continuous cores was then divided stratigraphically and collected for later processing in the same manner as the excavated unit levels.

As in Locus A, nonfeature matrix from EUs was taken to the water-screening facility and processed through the screening plant. Soils from features were collected as flotation samples and also returned to the water-screening facility for processing through the flotation device. No human burials were encountered within the boundaries of Locus C. That recovery system, engineered and constructed by Playa Vista Vice President of Infrastructure Cliff Ritz, proved invaluable to our recovery of soils from Locus C.

Locus D

At LAN-62 Locus D, we initially suggested that an area of approximately 3,600 m^2 existed within the APE, which resulted in an area of 36 m^2 proposed for hand-excavation (Altschul 2005). We estimated that the cultural deposit averaged 2 m in depth across the site, and in total, approximately 72 m^3 would be hand-excavated during data recovery.

Data recovery excavations undertaken in 2004 in Locus C of LAN-62 encountered a substantial cultural deposit, of which approximately 64 m^3 was excavated. Because that work had been conducted adjacent to the western edge of Locus D, it was proposed that a sufficient sample of cultural materials had been collected from that area. With agreement from the Corps, SRI proposed excavations in intact areas within the eastern portion of LAN-62 Locus D. To meet the goals set forth in the work plan, we proposed to excavate several blocks of contiguous 1-by-1-m test pits (Figure 151). The manual-excavation phase at LAN-62 Locus D began in August 2005 and was completed the following month. Thirty-nine 1-by-1-m test pits were excavated by hand, and one feature was encountered during those excavations. The manual-excavation procedures in Locus D were identical to those in Loci A and C, except that the problems of excavating below the water table did not occur in Locus D, and therefore, the dewatering procedures were unnecessary.

Locus E

Intact archaeological deposits were not identified in Locus E during the exploration phase; therefore, there was no further work conducted in that area.

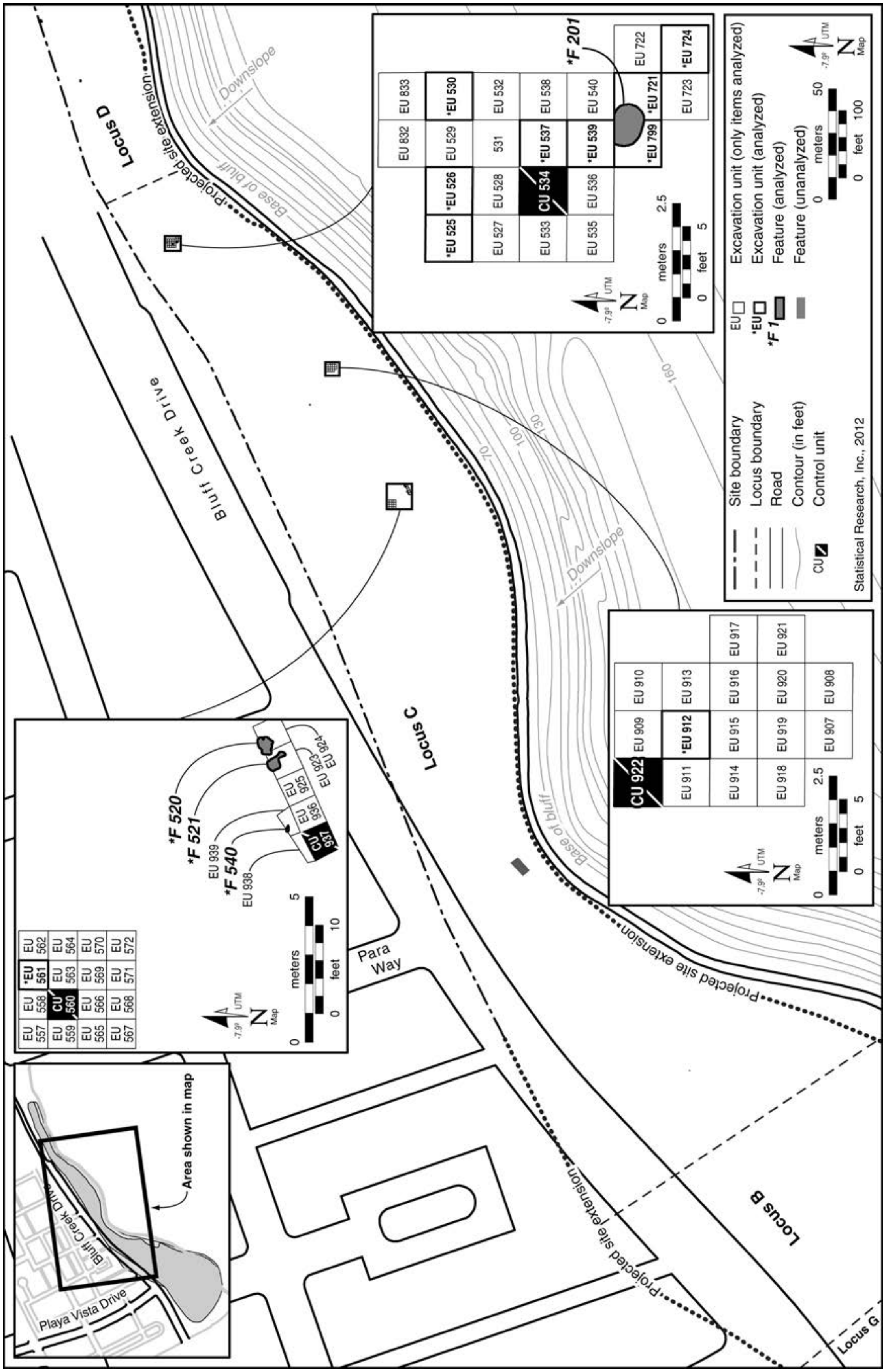

Figure 149. Map showing the locations of EUs, control columns, and features identified at LAN-62 Locus C.

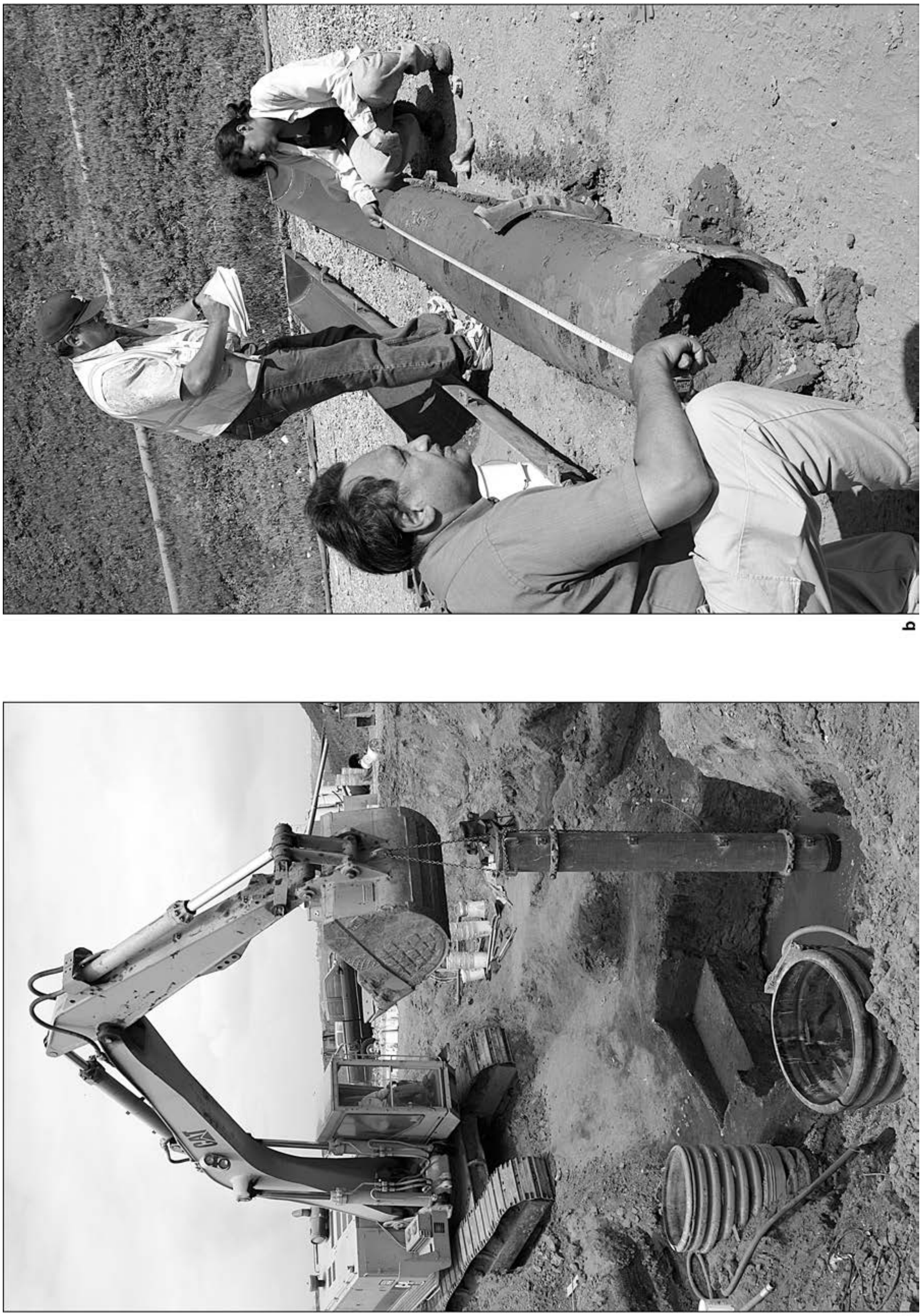

Figure 150. Photographs from LAN-62 Locus C: (*a*) mechanical coring and (*b*) recording of collected soil core.

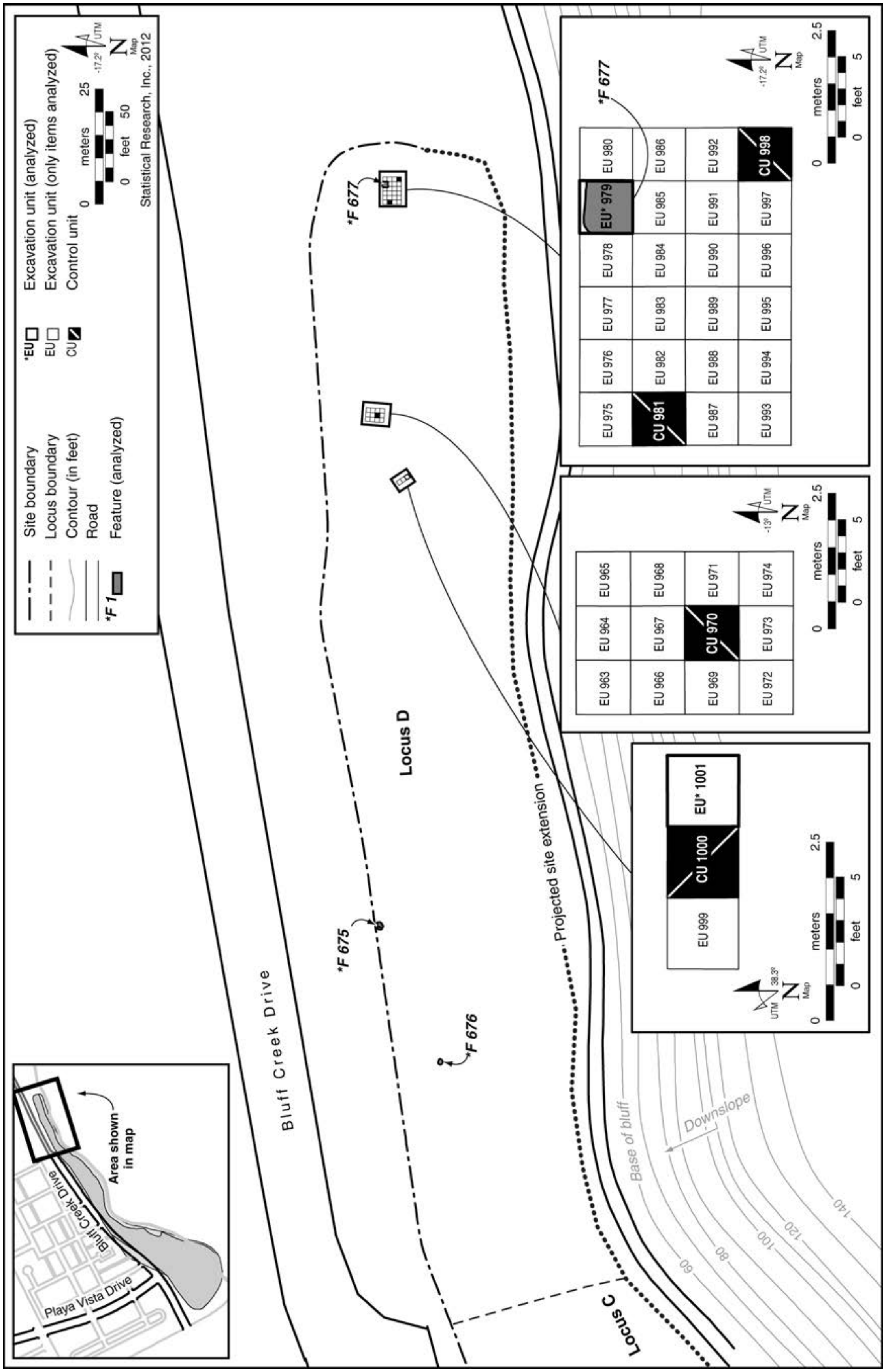

Figure 151. Map showing the locations of EUs, control columns, and identified features at LAN-62 Locus D.

Locus F

Exploration was not conducted in Locus F, because it was determined that impacts were not going to intrude into intact native soils. Because there were to be no impacts to potentially buried cultural materials, there were no manual excavations conducted in Locus F.

Locus G

Based on the work plan and standardized treatment of other archaeological sites in the BLAD, SRI proposed to hand-excavate 1 percent of the site in the APE, for a total of 62 m^2. Placement of the blocks was designed to capture the most complete profile of cultural materials within the project area. Initially, the plan was to place one large block in the southwestern area and several smaller blocks in other areas of the APE, but field conditions did not allow for the excavation of different blocks of units. Percolation of underground water into one of the blocks designated in the northeastern portion of the locus forced us to adopt a new strategy. It was determined that all of the effort would be focused in one block of EUs in the southeastern portion of the locus, where earlier trenching had shown that the thickest intact archaeological deposits existed (Figure 152).

A complicated set of dewatering procedures was required for the excavations. To facilitate the excavations, a deeply excavated trench surrounded the block and fed into a deep "sump" hole with an electric water pump. In that manner, groundwater drained from the pedestaled excavation area into the trench and then into the sump hole at the low end of the slope. Water was then continually pumped from the sump hole and used to control dust during the mechanical-stripping process.

Most 1-by-1-m test pits were excavated in 10-cm arbitrary levels, but some of the units were excavated in 20-cm arbitrary levels, using a combination of shovels, picks, and small hand-tools. Excavated materials were placed in 5-gallon buckets and labeled with relevant provenience information. Test-pit excavations were terminated in soils determined to be culturally sterile. In that manner, the block was excavated through the entire intact cultural deposit, to an average depth of approximately 1.5 m. During excavation, large artifacts or potential feature items were individually mapped and collected. Measured soil profiles from areas determined to be stratigraphically important by SRI's geoarchaeological specialist were drawn, photographed, and recorded.

Screening

The screening of the excavated soil matrix occurred during field excavations in all loci of LAN-62. All nonfeature materials collected during excavations were labeled with their proper field provenience information and taken to SRI's in-field wet-screening facility. To process the large amount of excavated material efficiently, a mechanical wet-screening facility was employed. Earlier excavations at other sites in the PVAHP had also used a derivation of the mechanical-screening plant, but LAN-62 was the first site in the project to use the water-screening capabilities of the Powerscreen Mark II screening plant. The screening plant was successful at removing most of the less-than-1/8-inch sediments from the excavated proveniences, and field technicians conducted the final sediment removals by hand (for illustrations of the screening process, see Chapter 4, this volume).

To alleviate some initial concerns that the screening plant might be too rough with the excavated materials and artifacts, SRI conducted tests with excavated materials that were screened by hand and processed via the screening plant. Our tests involved splitting several proveniences that contained various densities of middens, running one set through the screening plant and manually screening the other sets with a traditional dry screen. Both sets of materials were given a final rinse by hand. The sets of materials were compared and were found to be in virtually identical condition. None of the SRI staff members that were involved in the testing could distinguish any differences in the condition of the materials that had been screened, including marine shell, faunal bone, and lithic artifacts.

Matrix from nonfeature contexts was moved from excavation areas to the screening station using a Bobcat Toolcat loader and a skip loader, to reduce the labor and time involved in moving excavated materials on-site. Even with the highly mechanized operation, the speed of excavation often outpaced the speed at which we could screen matrix. For that reason, we placed excavated matrix into 5-gallon plastic buckets labeled with the proper provenience information.

Matrix from nonburial features was processed in a Dausman Flote-tech Model A flotation device. By contrast, the matrix from burial features was dry screened by hand through 1/16-inch-mesh screens, per the request of the MLD. After screening, the matrix from each burial feature was collected individually, by provenience, for later reburial with the excavated remains. Matrix that contained isolated human remains was hand-screened through 1/8-inch-mesh screens. The remaining soil from those contexts was saved in bulk for future reburial.

Data Processing and Maintenance

To control the spatial dimensions of the archaeological record, SRI archaeologists tracked all recovery contexts in the project area using an arbitrary numbering system, or PD system. The PD system contains vital information concerning each archaeological recovery space, including location and dimensions (length, width, and depth), and provides a simple and effective system for tracking all features, arbitrary units, mapping nails, and point-provenienced artifacts. The PD system is the means by which spatial data are recorded

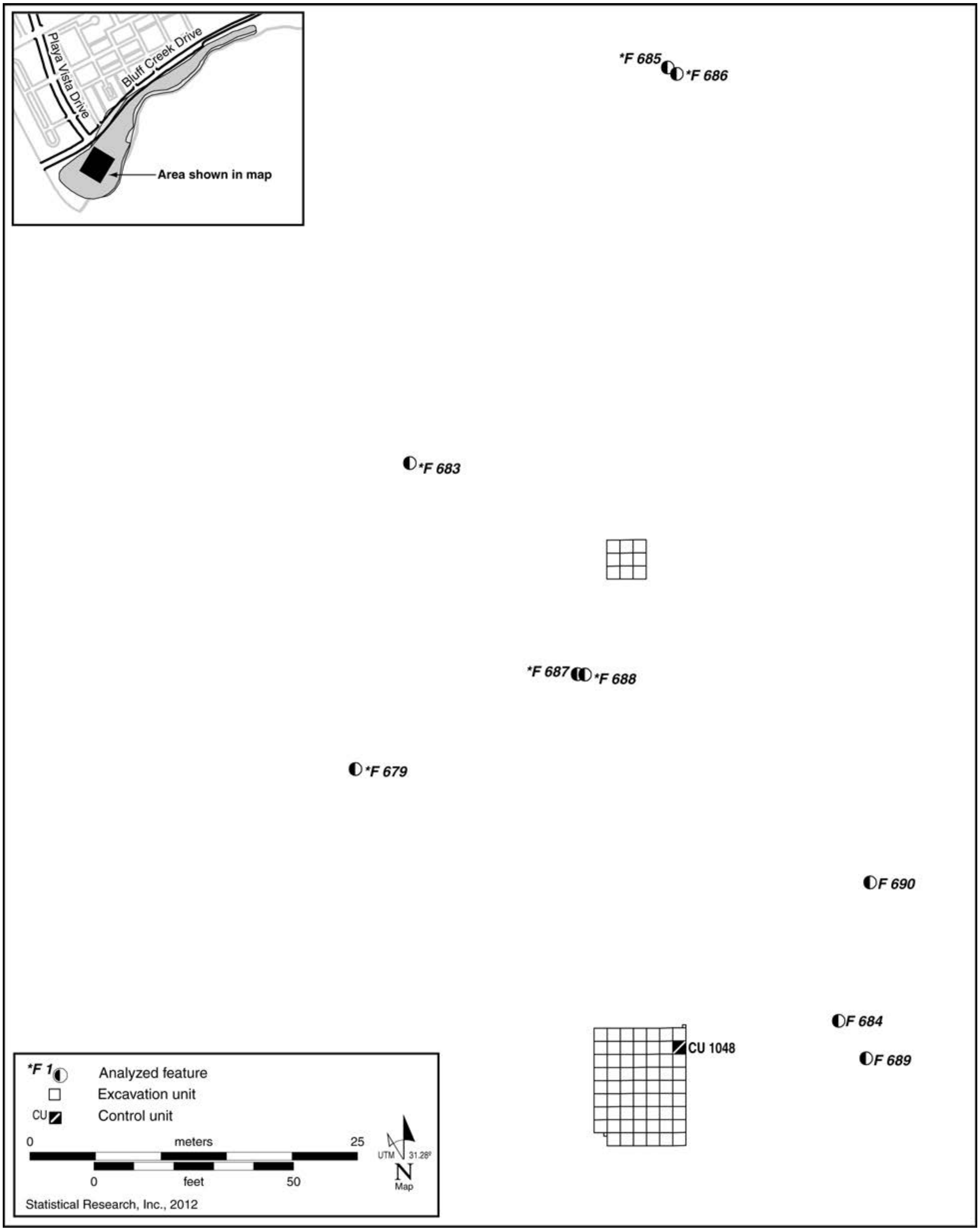

Figure 152. Map showing the locations of EUs, control columns, and identified features at LAN-62 Locus G.

and maintained through all phases of work, including excavation, laboratory processing, analysis, reporting, and finally curation. Using the PD system allows for the reclassifying of features into behaviorally meaningful units of analysis, such as structures, burials, pits, walls, or other feature types. Some of that reclassification occurs during the course of the fieldwork, but additional work may occur during analysis, after the data retrieved from each provenience have been evaluated.

At all loci of LAN-62, a large amount of data was collected, and it was realized early in the process that a database system was necessary to maintain inventory control. During data recovery operations in Locus A, SRI staff information specialists and archaeologists developed SRID, a relational database system created to control the flow of data through all phases of archaeological work. The key component related to fieldwork was the in-field data-entry system, which allowed SRI crew chiefs to enter provenience information and create paperwork at the locations of the excavations. Those data were instantaneously tied to the SRID system, thereby forgoing later data entry of provenience information from field forms. The benefit of that process was not only that data-entry steps could be eliminated but that problems could be recognized during the field process and get quickly resolved. That process also involved the use of bar-code printing for the tracking of point-located artifacts and buckets of excavated soil. The bar-coding system allowed us to electronically track proveniences and associated artifacts and soils throughout the screening, inventory, sorting, analysis, and curation/repatriation phases. QA procedures were also greatly enhanced by the ability to track the enormous volume of materials electronically.

Mechanical Stripping

Below, we outline methods for mechanical stripping at LAN-62 for the areas in which it was conducted, organized by locus.

Locus A

The final phase of fieldwork, the monitored mechanical stripping of Locus A, began in July 2004 and was completed in August 2004. Monitored mechanical stripping began in the western portion of Locus A and proceeded to the east through all intact cultural deposits within the impact area. Mechanical stripping was conducted so that all features within the impact area could be identified and recorded or excavated prior to construction-related activities in the APE. In that process, in total, 99 MSUs were excavated. Mechanical stripping was conducted under the supervision of a team of archaeologists and mapping personnel, using both an excavator and a Gradall tracked excavator fitted with a smooth bucket. The tracked excavator proved to be a very useful tool in that process because of its ability to remove very small lifts, if necessary. Stripping procedures involved the removal of soils in small (2–10-cm) lifts, approximately 4 m wide, dug stratigraphically until culturally sterile strata were reached. SU and PD numbers were assigned to the various stratigraphic levels excavated. In some cases, samples of mechanically stripped soils from particular strata were saved for later water screening to recover midden samples, and those bulk proveniences were later sorted for diagnostic artifacts. That activity was closely monitored by a team of archaeologists who continually checked for the presence of cultural features and diagnostic artifacts.

When prehistoric cultural features were encountered during stripping, they were mapped and photographed, several were laser-scanned, and all were excavated by hand. Examples of two pits identified during mechanical stripping are shown in Figure 153. Isolated artifacts determined to be either culturally or temporally diagnostic were also mapped with a total station and collected for analysis. Overall, the mechanical-stripping phase at Locus A was instrumental in locating a number of features that might otherwise have been missed, had only test-pit excavation been conducted.

Loci B and C

Monitored stripping was conducted in both Loci B and C using an excavator fit with a smooth bucket. The stripping activities were run simultaneously with hand-excavations in Locus A. Unlike at Locus A, mechanical excavations were not conducted in SUs in Loci B and C. Mechanical stripping was closer to traditional monitoring procedures, and grading personnel worked closely with SRI staff archaeologists in that process. In Locus C, most of the soil removed from within the impact area consisted of either imported or natural fill. Only 1–3 feet of soil were removed through intact native soils, some of which contained cultural materials. One prehistoric and two historical-period features were recorded during stripping at Locus C. Stripping and slope stabilization did allow for the identification of buried cultural materials that extended into the artificial slope created below the Los Angeles North Outfall Sewer line along the base of the bluffs during its construction in the 1920s. Monitored stripping within Locus B revealed an extremely disturbed area consisting mostly of recent construction fill.

Locus D

Mechanical stripping ran concurrently in portions of Locus D while hand-excavation was proceeding in other portions of the site. Stripping began in the western portion of Locus D and continued, moving east, at different times through the end of fieldwork. Monitored mechanical stripping was conducted using a combination of elevating motor scrapers (commonly referred to as belly-loader or paddle-loader scrapers) and tracked excavators. Similar to Loci B and C, discreet SUs were not excavated; machinery was used to strip soils in small lifts approximately 5–10 cm thick. Excavation continued until culturally sterile strata or the bottom depths of

Figure 153. Photograph showing pit features as areas of darker soil identified during mechanical stripping at LAN-62 Locus A.

the Riparian Corridor excavations had been reached and was closely monitored by a team of archaeologists who continually checked for the presence of cultural features, diagnostic artifacts, and stratigraphic changes.

When prehistoric and historical-period nonburial features were encountered during stripping, they were mapped, photographed, and excavated by hand. Isolates determined to be either culturally or temporally diagnostic were also mapped with a total station and collected for analysis.

Locus G

Mechanical stripping was conducted concurrently with hand-excavations in Locus G, using a tracked excavator fit with a smooth bucket. The stripping was conducted in the same manner as in Locus A, except that no midden samples were collected for later screening. SUs measured approximately 10 by 10 m and were excavated to varying depths. In that manner, buried features were discovered in a controlled fashion and isolated for later hand-excavation. As with mechanical stripping in other loci, when features were discovered, larger areas surrounding them were investigated, to help identify archaeological surfaces or potential activity areas, if they existed. Isolated artifacts encountered during stripping and determined to be either culturally or temporally diagnostic were mapped with a total station and collected for analysis.

Feature Recovery

Below, we outline the methods employed for feature recovery in areas in which it was conducted, organized by locus.

Locus A

Feature excavation in Locus A was conducted with several different methods, depending on the type of feature and the nature of its discovery (stripping or hand-excavation). After the beginning of the excavations, procedures changed somewhat for more efficiency in excavation. Burial and nonburial features shared some similar excavation procedures, but at the request of the Native American MLD, burial features were treated differently in some ways (see below). Features were generally treated as unique entities, although, if possible, larger feature areas or feature blocks were identified during excavations as groupings that were thought to have been behaviorally and temporally contemporaneous. In such cases, we maintained notes and descriptions of individual features and possible associations between features. Also, levels in particular arbitrary units surrounding the features in a feature block were identified for later analysis.

Both nonburial and burial features were encountered in Locus A through the processes of hand-excavation, mechanical stripping, and mechanical trenching. In each of those scenarios, the recovery of features varied somewhat. At the outset of the project, features were generally discovered during hand-excavations. Depending on the layout of a particular burial or nonburial feature and its relationship to the boundaries of arbitrary units, it may have been sectioned according to those boundaries. When excavated in that manner, separate PD numbers were assigned to 10-cm levels excavated within particular unit boundaries. If a feature was encompassed wholly within a particular unit, it would be assigned only a single PD number per 10-cm level. Later, that process was refined for better efficiency, so that the boundaries of units were disregarded, and features were excavated as individual entities. A single PD number was assigned for all of the recovered soils within a feature boundary, unless stratigraphic distinctions were identified in the feature, in which case PD numbers were assigned to particular strata. Matrix from nonburial features was processed in a Dausman Flote-tech Model A flotation device. A small sample of soil was also collected from each feature provenience to be used for pollen analysis later, if deemed necessary. Matrix collected from historical-period features was occasionally screened through 1/4-inch mesh at the excavation location, and samples were also collected for flotation.

In Locus A, the density of burial features made for extremely tight and difficult working conditions. Often, burial features intersected each other, and sometimes it was difficult to distinguish particular individuals (especially considering the lack of identifiable burial pits). Generally, small hand-tools, such as trowels, small wood-sculpting tools, and brushes, were used to excavate burial features. Hand-drawn, scaled maps were created of all features. When possible, maps were electronically created (see below). Detailed descriptions of individual features were created by field staff and updated later, when analysis of recovered materials had been completed.

Burial features were generally excavated in the same manner as nonburial features, but the methods differed somewhat on the level of in-field analysis and recording. Special requests by the Native American MLD also called for particular types of excavation procedures unique to burial features. Because the burial features were much more complex and generally contained much higher numbers of point-provenienced materials, SRI sought new, more-efficient methods for mapping them. SRI enlisted the help of Michael Kowalski, first attempting to use lidar as a means to map burial features three-dimensionally. Lidar simply could not pick up the level of detail necessary for mapping the burials properly, though, and the process was slow. SRI then employed a Konica Minolta Vivid 910 Non-Contact Three-Dimensional Digitizer, which allowed us to create a digital scan that was used as the base for a two-dimensional feature map that could be annotated and filled in with detail. That method proved extremely effective and efficient. When possible, nonburial features were also scanned, and maps of them were produced, in that manner.

Burial-feature excavation differed from nonburial-feature excavation in a number of ways because of procedural requests by the MLD. On other projects, burial fill (the matrix surrounding the human remains and within a definable burial pit) has sometimes been processed using the flotation method, so that any carbonized seeds or materials of a very fine size could be collected and analyzed. In the PVAHP, the MLD requested that burial matrix not be processed with the flotation device but, rather, that SRI personnel hand-screen the matrix through 1/16-inch-mesh wire screens. That request was made a few weeks after the excavations began; therefore, the matrix of a few burial features was processed using the flotation method. When burial features were dry screened, all matrix (including that which filtered through 1/16-inch-mesh screens) was collected in 5-gallon buckets, lidded, and marked with the appropriate provenience information. In that manner, soils associated with particular burial features could be reunited with the remains when they were buried.

Another MLD request was that a 30-cm buffer be excavated around the boundaries of burial features (referred to as the Arbitrary 30, or ARB 30, buffer). That soil was excavated and also screened by hand, but the remnant matrix was not saved individually for each feature. The remaining screened soils were collected and stored in bins, to be placed as fill in the area identified for burial at a later date. Often with burial features at LAN-62, there were no identifiable burial pits, and therefore, the boundaries of burial features were roughly a few centimeters outside the actual human remains and associated artifacts. In a few rare cases, a burial pit was identifiable, and it was not necessary to excavate an ARB 30 buffer.

When human remains in burial features were in good condition, they were mapped and removed for later laboratory analysis. In many cases, however, preservation was poor, and thus, osteologists conducted as much analysis in the field as possible. Excavations at LAN-62 had the benefit of a large team of osteologists with different analytical specialties who were able to conduct intensive in-field analyses of cases in which bone preservation was poor. A specialized set of tools and field forms was required in those cases. In nonburial features, generally, the feature constituents were hardier than bone, and thus we were able to analyze selected features later, in a laboratory setting.

In some cases, perishable materials, such as basketry, textiles, metal, and wood, were recovered in burial and nonburial features. Because such artifacts are rare at mainland coastal southern California archaeological sites, SRI employed the help of a conservation specialist. Mr. John Griswold, senior conservator and principal of Griswold Conservation Associates, LLC, was contracted by SRI to conduct complex conservation methods during fieldwork and to train certain SRI archaeological staff to perform simple conservation methods on certain classes of artifacts. Mr. Griswold was also contracted to perform stabilization work on many artifacts after they had been removed from the field. An example of the processes of conserving and removing basketry materials in the field is illustrated in Figure 154.

At the request of the MLD, all conservation work, especially that relating to artifacts recovered from burial features, was to use reversible techniques, so that materials could be removed prior to repatriation of the artifacts. Also at the request of the MLD, no conservation work was to be conducted on any human remains. Conservation work was very useful for helping

a b c d

Figure 154. Photographs illustrating the process of conservation of basketry elements in Feature 35 at LAN-62 Locus A, showing (*a*) conservation of exposed basketry, followed by (*b*) careful removal of the basketry from a soil pedestal in (*c*) different portions of the feature and (*d*) final placement on a solid surface.

to stabilize particular classes of artifacts so that specialists could analyze them at a later time. At the time of treatment, a report detailing the procedures and types of materials used on a particular artifact was created, and that report was updated and maintained as artifacts were stored and, occasionally, retreated. Subsequent to analysis and prior to repatriation, all burial-related artifacts that had received some form of conservation treatment were deconserved, and all materials or chemicals were removed. The complete report of Griswold's work detailing the level of care and methods used, in addition to the results of analyses of particular artifacts, is presented in Appendix 4.1, this volume.

Loci B, C, D, E, F, and G

Feature recovery procedures in Loci B, C, D, and G were the same as in Locus A. However, no burial features were recovered from those contexts. No features were encountered in Loci E and F.

Laboratory Methods

This section provides a summary of the laboratory methods related to washing, cataloging, sorting, QA, and curation of all materials collected from LAN-62. Below, we outline the stages of materials processing, including screening, sorting, cataloging, and sample selection for the expert analyses of specific artifact classes and other materials.

Data recovery for LAN-62 excavations was conducted in five loci (Loci A–D and G). Different processing, sorting, and sampling (for analysis) procedures were implemented in the different loci and recovery contexts. Also, the procedures implemented at LAN-62 to define features and CUs for analysis were far more complex than at the other sites in the project area.

Screening

The first stage in materials processing was to screen the soil matrix excavated during fieldwork. Most of the soils excavated from CUs and SUs (without evidence of human remains) were mechanically wet screened, using a machine fitted with a $^{1}/_{8}$-inch-mesh screen. The wet-screened and floated materials were dried in the sun, placed in reclosable bags, grouped with materials from the same provenience unit, and then inventoried on-site prior to being sent to storage. During excavations in Locus A, some materials were selected for sorting and analysis so that initial characterizations and preliminary midden analysis could be used to inform excavations. During the inventory process, QA procedures were undertaken to check for provenience errors or other errors that may have occurred during fieldwork. A small sample of materials collected during excavation (selected for special analysis) was not wet screened or washed in the field. Fragile items, such as basketry, wood, fragile faunal bone, and rusted metal, were either cleaned with a dry brush to remove soil deposits or sent directly to the laboratory in the matrix that encompassed them. Other items were left unwashed, for residue analysis, pollen wash, or other analysis of minute residues on artifact surfaces.

Sorting

The sorting procedures varied based on the recovery context. CUs, nonburial features, burial features, features and CUs with possible human remains, and column samples (flotation) required different sorting protocols. Here, we separately review the various sorting procedures for each recovery context.

All bulk materials from CUs and nonburial features (not including provenience units with possible human remains) were sifted through nested screens with $^{1}/_{4}$-inch and $^{1}/_{8}$-inch mesh. All materials collected in the screens were sorted according to (screen-mesh) size category and basic material type, including worked and unworked bone, glass, diagnostic historical-period artifacts, metal fragments, seeds, mineral samples, worked and unworked shell, lithic artifacts, and a miscellaneous "other" category for fired clay, mineral samples, seeds, wood, asphaltum, ochre, and various low-frequency artifacts and materials. Any materials sifted with the $^{1}/_{8}$-inch screen were scanned for diagnostic artifacts and other "high-priority" materials. Materials from a small sample of CUs were sifted using a flotation machine (with a $^{1}/_{16}$-inch screen), rather than wet screened, but the sorting procedures for those CUs were the same. The sorting criteria for the artifact types and material classes from LAN-62 can be found in Chapter 1, Volume 3, this series.

Materials assigned to each of the material categories were separately bagged and labeled for detailed analysis. Unworked shell, unworked bone, and charcoal fragments were recorded by weight (in grams); all other materials categories were recorded by count. Some materials, such as charcoal (botanical specimens), indeterminate historical-period artifacts, FAR, ochre, and asphaltum, were not segregated and separately bagged for analysis, but their presence was recorded in the database. The remaining rocks and gravels, nondiagnostic artifacts smaller than $^{1}/_{8}$ inch in size (i.e., not collected in the sorting screens), and other uncollected materials were rebagged in their original containers and set aside for curation.

Nonburial features and column samples were processed using a flotation machine fitted with 0.285-mm-mesh (for the light fractions) and 1-mm-mesh (for the heavy fractions) screens. The heavy fractions from flotation samples were sorted in the laboratory, to segregate artifacts and other materials for detailed analysis; the light fractions were bagged separately and set aside for detailed macrobotanical analysis. The heavy-fraction materials were sorted using the same procedure outlined above for CUs (nested $^{1}/_{4}$-inch- and $^{1}/_{8}$-inch-mesh screens). Again, any materials sifted through the $^{1}/_{8}$-inch screens were scanned for diagnostic artifacts and other "high-priority" materials.

A different sorting procedure was used for processing bulk materials from burials and proveniences with possible isolated human remains. The bulk materials were sifted through 1/2-inch-mesh screens to identify and segregate the larger bone fragments. Those materials were then scanned for diagnostic artifacts, human remains, or other "high-priority" materials (see Volume 3, this series, for details). Only bone larger than 1/2 inch (i.e., collected in the mesh screen), teeth, and diagnostic and formed artifacts were collected from those proveniences. All visible human bone was collected. With the exception of bone, the collected materials were not sorted according to size. No unworked shell, charcoal (botanical), indeterminate historical-period artifacts, FAR, ochre or asphaltum, bone fragments smaller than 1/2 inch, or other nondiagnostic materials were separated for analysis; such items were bagged together, and their presence was recorded in the database.

Inventory

Once materials had been sorted, the laboratory technicians inventoried them, setting aside all sorted materials not earmarked for additional analysis. As explained above, some materials were recorded by weight and others by count, which varied according to recovery context. All human teeth or other identifiable human remains collected were bagged together but separated from the rest of the bone. The inventory information was then entered into SRID. After data entry had been completed, laboratory staff reviewed all data records for errors and inconsistencies and compared the data entered to the in-field counts and descriptions, to ensure accuracy. The database was then made available to individual materials analysts (e.g., lithics or faunal) for detailed classification and analysis.

Analysis

Given the enormous quantity of materials collected during the excavations at LAN-62, rather than analyzing *all* excavated materials, SRI devised a sampling strategy for the detailed materials analyses. The features and CUs selected for analysis varied among the four excavated loci of LAN-62. A particularly complex and comprehensive sampling strategy was used to select CUs for analysis in Locus A, which contained a large number of burial and nonburial features spanning a period of approximately 7,000 years. Given the importance and uniqueness of that locus, large numbers of features and CUs were selected for analysis. In this section, we separately discuss the units and features selected for analysis in each of the five loci.

Locus A

Locus A is by far the single most intensively studied area of LAN-62 and, indeed, within the entire PVAHP project area (along with Feature 1 at LAN-211). Over 600 features were excavated in Locus A, mostly from a very large Protohistoric and Mission period burial area. The selection of features, EUs, and CUs in Locus A therefore focused primarily on the Protohistoric and Mission period burial area. All or portions of 259 CUs and EUs were selected for some level of analysis, 214 of which were located within the burial area. In addition, all or portions of 442 features were selected for analysis, of which 374 (85 percent) were human burials. All human-burial features were analyzed completely. The limits of the burial area are shown in Figure 155. Below, we separately discuss the sampling strategies for selecting units and features within and outside the burial area.

Selection of Features and Units within the Burial Area

Given the uniqueness and importance of the burial area in Locus A, SRI archaeologists coordinated an enormous research effort to analyze a large sample of the materials and artifacts recovered from features and EUs associated with it. Different sampling criteria were used for selecting features and EUs for analysis within the burial area. The burial area encompassed an area of roughly 25 by 17 m and included hundreds of human burials, nonburial features, and EUs. The area is bisected by a long trench (Feature 16), which had removed a large swath of the burial area. Despite that disturbance, the remainder of the burial area was largely intact when SRI conducted excavations. SRI excavated the entire remaining, intact part of the Mission period portion of the burial area and much of the surrounding area.

The excavated area in and near the burial area in Locus A encompassed hundreds of EUs. It was impractical to analyze the materials from every unit. The SRI research team therefore required more-rigorous means of defining the EUs and levels within the burial area. The spatial extent of the units selected for analysis was defined using a modified version of the convex-hull (or convex-envelope) model to define the burial area. The convex hull is a mathematical model used to define the smallest possible convex polygon containing all points in *n*-dimensional vector space. A simple intuitive (two-dimensional) metaphor for the convex hull is a rubber band stretched around a series of pins or nails; the rubber band will assume the shape of the smallest possible convex polygon that encloses each of the pins or nails.

In the PVAHP study, the modified convex hull encompassed the three-dimensional space of the burial area. Rather than points, though, the units to be bound were actually EUs with squared edges (hence the modification). SRI archaeologists defined the burial features that constituted the proposed burial area. Using that as a baseline, SRI archaeologist William Hayden then developed an algorithm (in a geographic information system) to define the EUs and excavation levels that most closely bound the features that composed the core of the burial area. Put another way, he created a polygon that incorporated the minimum number of EUs and levels that directly contained the burial-area features. The modified convex hull was therefore created as a way to define a discrete three-dimensional

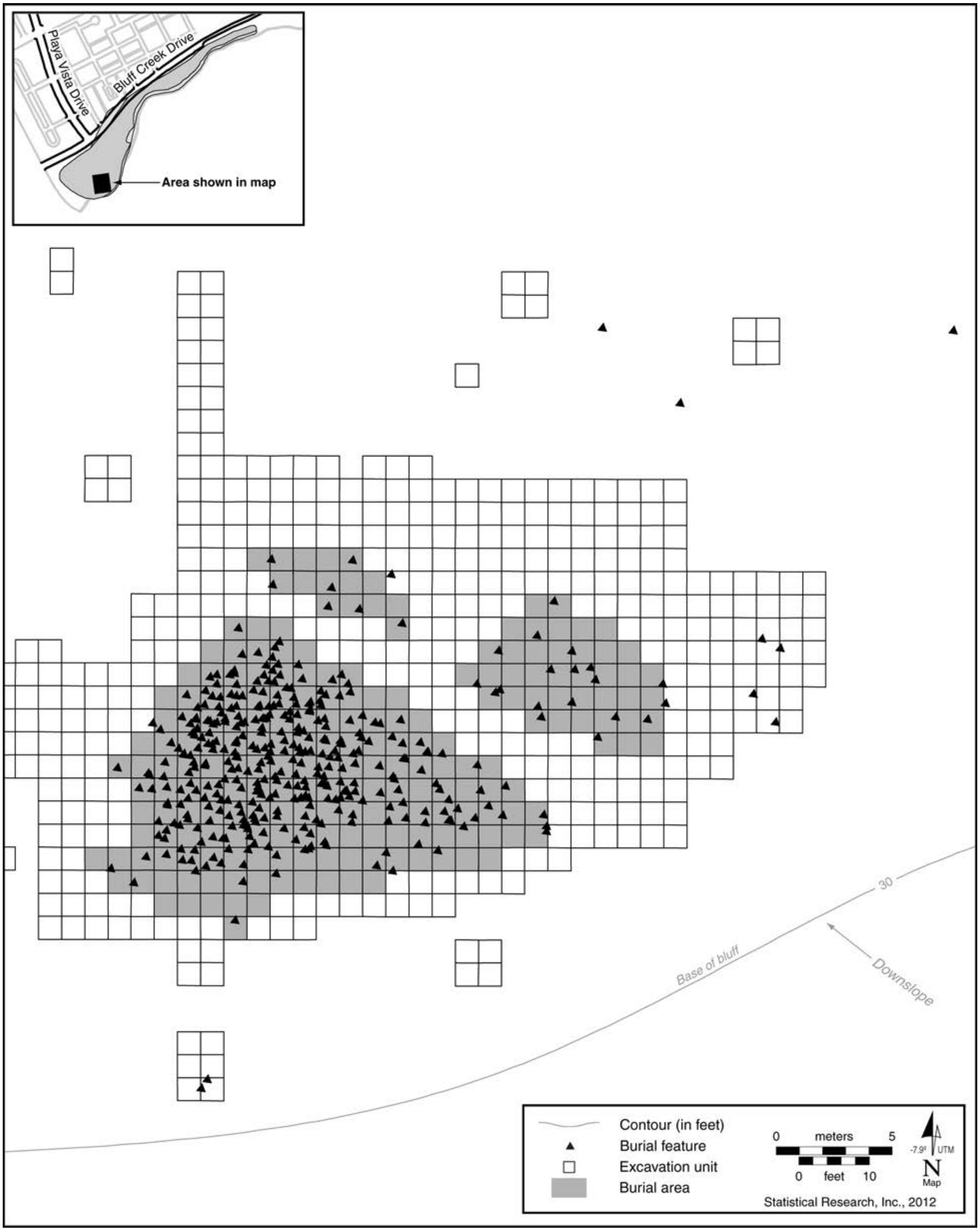

Figure 155. Map illustrating the burial area and burial features at LAN-62 Locus A.

space around the densest concentration of burials (essentially, the core area of the burial ground). The modified convex hull encompassed specific levels of 213 EUs; only the levels related to the burial episodes were selected for analysis. However, because Feature 16 had bisected and removed a portion of the burial area, the convex hull (i.e., burial area) was defined as three discrete areas instead of one (see Figure 155).

The purpose of creating the modified convex-hull model was to allow the analysts to inspect artifacts and materials not included in defined feature-excavation contexts. That was imperative, because feature boundaries rarely could be clearly defined; burial pits were absent from the soil matrix from the excavations. Many of the items and materials recovered from outside the defined feature contexts likely were associated with the burials but may have been displaced via bioturbation. In other cases, items may have been deliberately placed in areas farther from the burial and may not have been clearly associated with any burial feature. We strongly suspect that many of the artifacts and materials from nonfeature contexts within the burial area were deposited in connection to mortuary-ritual or interment activities but were not associated with specific burial features. Another critical point that made analysis difficult was the fact that the burials were intrusive features. The burials had been excavated into existing midden, much of which appeared to date to the late Intermediate or early Late period. There were also nonburial domestic features that had existed in the midden deposit prior to its use as a burial ground. The presence of domestic nonburial features and midden not only complicated our analysis of the burial ground but also created difficulties in attempting to select chronometric samples from both burial and nonburial features.

Three additional EUs were selected for detailed analyses of the floated light-fraction materials from the entire excavated-unit soil matrix (i.e., from all levels). The purpose of that selection was to obtain a representative sample of materials for detailed macrobotanical studies.

All human-burial features and associated materials from Locus A were subjected to analysis. In total, 374 human-burial features from LAN-62 were analyzed (see Volume 4, this series). Human remains were analyzed in great detail, both during fieldwork and in a laboratory setting by SRI osteologists. Dr. Phillip Walker of UCSB served as an advisor and was routinely consulted during the process, in regard to procedures for recovery and analysis. Dr. Walker also visited the site during excavations as a member of the Playa Vista Peer Review Committee. Detailed discussions of the excavation and analytical methods employed in the osteological study are provided in Volume 4, this series.

In total, 20 nonburial features (some with isolated human remains) from within the burial area were selected for analysis (Figure 156) (see Appendix 9.1, this volume). Most of the features were likely related to the burial area. Many contained burial goods, such as glass and shell beads, textiles, ground stone bowls, basketry, and various other artifacts. Some items appeared to have been coated or sprinkled with asphaltum or ochre. Others appeared to have been related to ceremonial activities or food preparation. Those features were selected for analysis, to understand mortuary and ritual activities in the Ballona.

Selection of Features and Units outside the Burial Area

In all, 41 EUs were selected for analysis from outside the burial area in Locus A (Figure 157). One additional EU was selected for flotation analysis of all matrix soils. Given the dense material deposits in Locus A, SRI archaeologists devised two lists of CUs for analysis. CU List A included 10 CUs selected for analysis: 7 in the large central excavation block, 2 in a small block to the west of the main block, and 1 in a small block to the north. For abundant material classes, researchers were given the option of analyzing a smaller subsample of 6 CUs. An even-smaller subset was selected for the analysis of vertebrate faunal remains, because of the extremely large amount of faunal material in the collections from Locus A.

In addition, two EUs outside the burial area were selected for detailed flotation analysis of all excavation levels. Both units were located just outside and slightly north of the burial area. Again, the purpose of the analysis was to obtain a representative sample of light-fraction materials for detailed macrobotanical studies.

During fieldwork, SRI archaeologists conducted a study of lithic, shell, and faunal materials from a sample of 10 EUs located outside the main burial area in Locus A. Those units were scattered throughout the excavated portion of Locus A. They sorted and identified 77,142 bone and shell specimens and 3,895 stone artifacts from those units. Samples were selected for radiocarbon analysis from selected proveniences representing various stratigraphic contexts identified during excavations, and a preliminary chronometric framework was devised. Their study revealed changes over time in prehistoric subsistence practices and raw-material sources for stone tools.

Fifty features in Locus A that were not associated with the burial area were selected for analysis (see Figure 156). In that sample, 30 features were identified as parts of "feature blocks"—clusters of features that were spatially related and thought to have been contemporaneous or indicative of activity areas. Feature blocks were identified by both horizontal proximity and stratigraphic similarity. Twenty other features were selected from other locations on the site, to analyze a sample of different feature types from different locations, both horizontally and vertically, and from different stratigraphic contexts.

Several blocks of features were identified as potentially containing contemporaneous sets of features, and three were selected for further analysis. Figure 156 shows the locations of the three feature blocks; the particular features that were analyzed are highlighted in the figure. In each block, only the excavation levels associated with specific cultural strata were analyzed. FB 3 encompassed what we interpreted as a large mourning feature. The features analyzed in FB 3 included those containing burned basketry (sometimes associated with shallow pits and/or burned artifacts or seeds), four

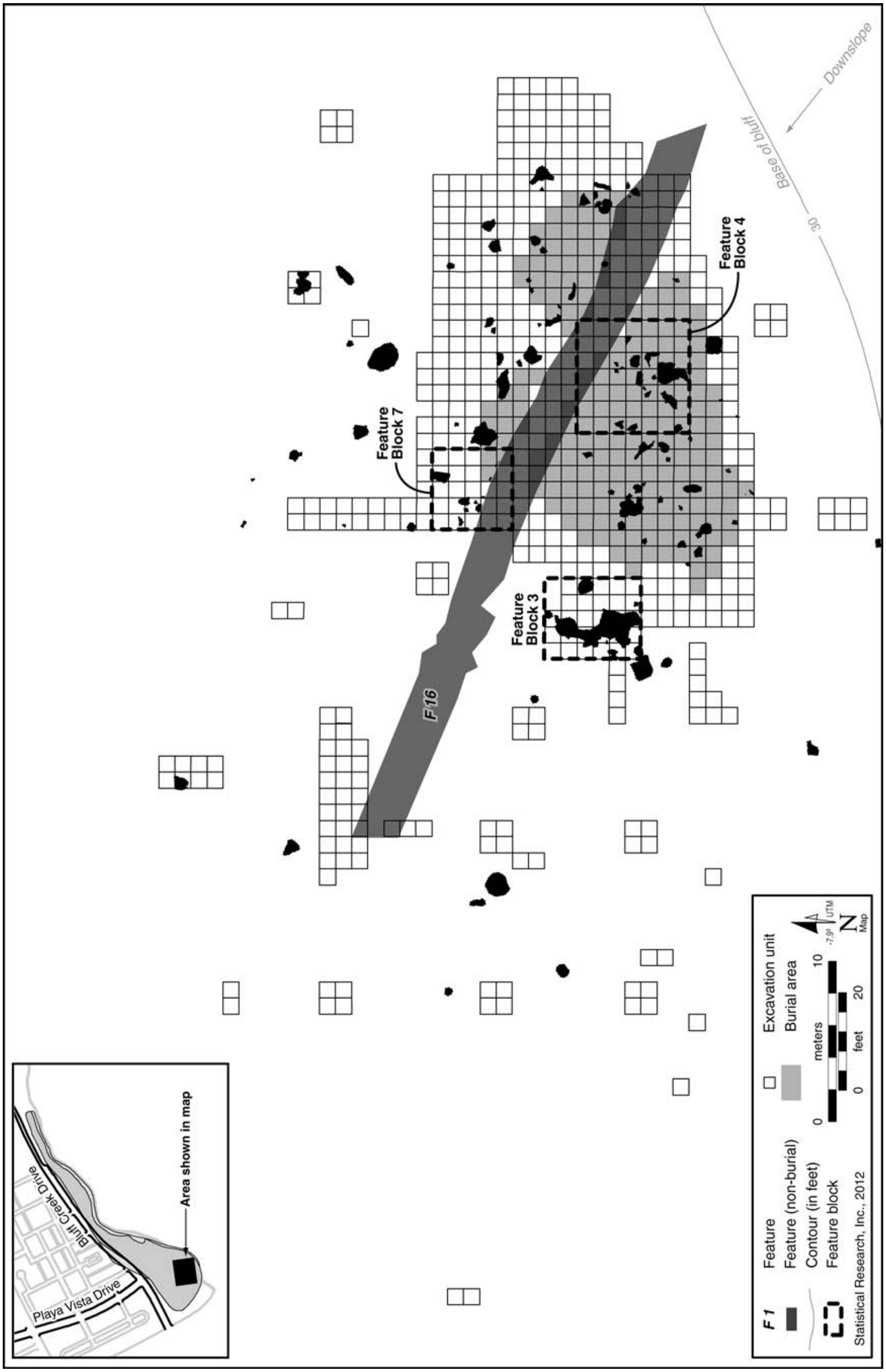

Figure 156. Map showing the locations of nonburial features and feature blocks selected for analysis at LAN-62 Locus A.

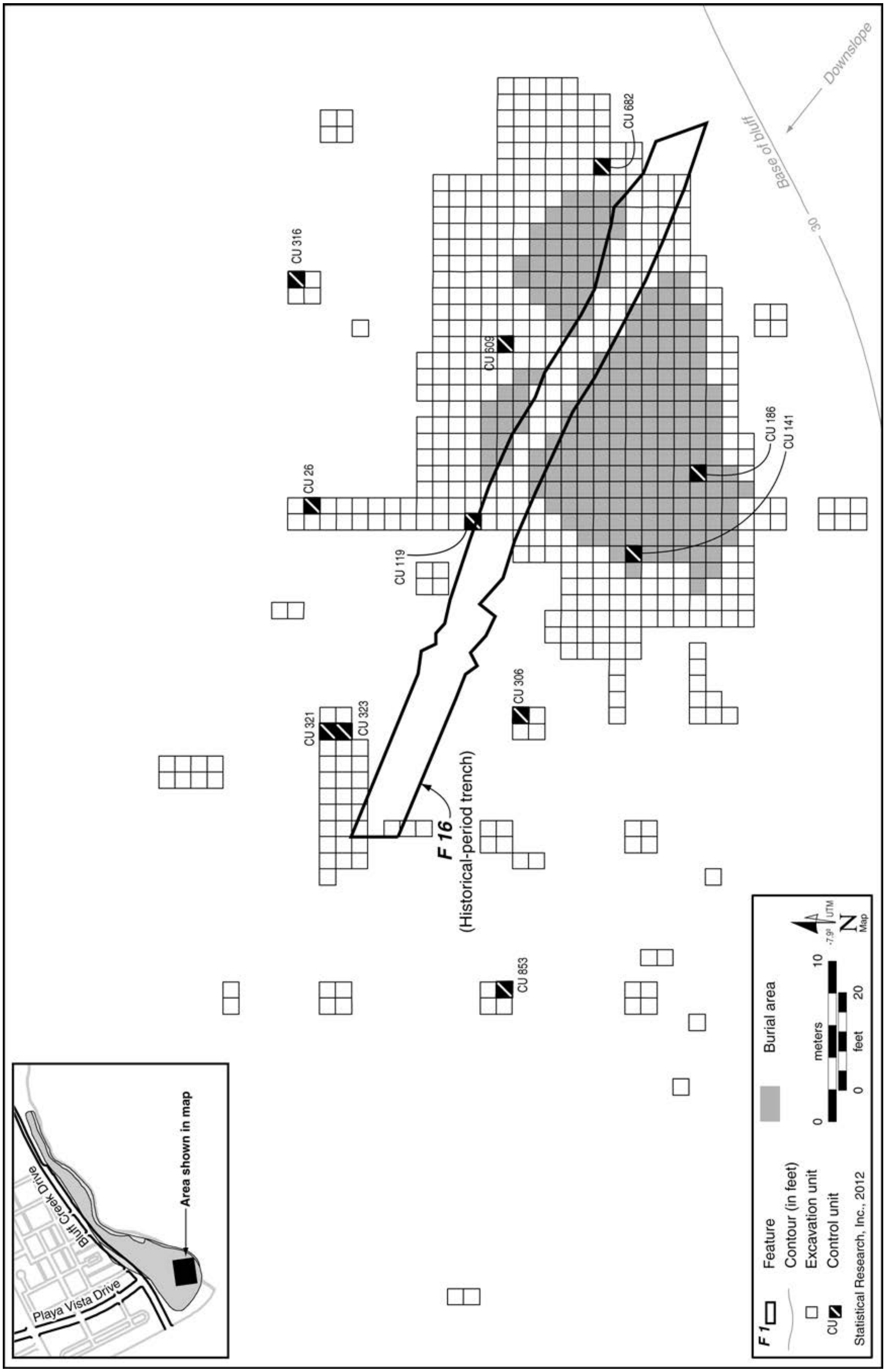

Figure 157. Map showing the locations of EUs and CUs selected for analysis, LAN-62 Locus A.

concentrations of refuse from hearth-cleanout episodes, and eight artifact concentrations (see Appendix 9.1, this volume). The analyses of materials from FB 3 highlighted ritual practices in the Ballona, likely during the Mission period.

In FB 4, the analysis focused on an Intermediate and Late period activity area excavated in Stratum IV. FB 4 horizontally overlapped the eastern and southeastern portions of the burial area but was more deeply buried and appeared to have been domestic in nature. In total, 13 EUs were selected for analysis, but only the excavation levels that constituted Stratum IV were analyzed. In addition, all larger point-provenienced artifacts and materials from all EUs within the feature block were analyzed (except materials recovered during the bulk-materials-sorting procedures outlined above).

In addition, 12 features were analyzed from FB 4, most of which were related to a series of food-preparation and hearth-cleanout episodes (see Appendix 9.1, this volume). One feature was a rock cluster with no fire-affected artifacts, suggesting a possible storage locus for ground stone and flaked stone artifacts. The other 11 features, such as Features 419 and 612, appeared to have been related to various cleanout episodes. Feature 419 included 9 subfeatures, all mostly composed of shell and faunal refuse (sometimes in shallow pits). Those features and subfeatures were selected for analysis, to obtain detailed data regarding Intermediate and Late period diet and subsistence practices in the Ballona.

FB 7 was a Millingstone period activity area located directly north of and partially overlapping the burial area. Like FB 4, however, FB 7 was more deeply buried (Stratum II) than the Mission period burial area. Ten EUs in FB 7 were selected for analysis. As with FB 4, all larger point-provenienced artifacts and materials (item analysis) recovered from all EUs within FB 7 were analyzed. Four features were selected for analysis from FB 7 (Features 449, 573, 574, and 623), and all of them appeared to have been related to hearth-refuse disposal and cleanout (see Appendix 9.1, this volume). Analyses of materials from those features shed light on diet and subsistence practices in the Ballona during the Millingstone period.

Twenty-one additional nonburial features from scattered locations in Locus A (outside the burial area) also were selected for analysis (see Figure 156) (see Appendix 9.1, this volume). That sample encompassed a range of feature types and temporal contexts. More than half (n = 13) were rock clusters or artifact clusters that likely formed as a result of one or several hearth-cleanout episodes. Five others were pits, probably used for storage. Two features, a rock cluster and an artifact concentration, were defined as possible small activity areas. One other nonburial feature selected for analysis included a large, burned whalebone (and various smaller materials) that might have functioned as a marker for the burial area. Overall, the prevalence of hearth-cleanout and storage features underscored SRI's stated research goal of investigating long-term changes in subsistence practices and land use in the Ballona (Altschul et al. 1991).

Locus B

No materials were excavated, collected, or analyzed from Locus B.

Locus C

Four CUs and one nonburial feature were selected for analysis from Locus C (see Figure 149). The three CUs came from each of the three excavation blocks situated in Locus C. CUs 937 and 560 were noncontiguous units located 10 m apart but were analyzed as a single unit. Both CUs were at different locations on the toe slope of the escarpment, and analyzing them as a continuous unit allowed for sampling of all strata in that location. Two of the seven features excavated in Locus C were selected for analysis (see Appendix 9.2, this volume).

Locus D

Four CUs were selected for analysis in Locus D. Given the abundance of faunal remains in the area, only CU 1000 was selected for complete faunal analysis. Three nonburial features were also selected for analysis. The CUs selected for analysis were from three excavation blocks (Blocks A–C) in the eastern portion of Locus D. Two of the CUs in the largest excavation block (Block B), located near the eastern edge of the site, were analyzed. One unit apiece was analyzed from the smaller Blocks A and C, located roughly 45–60 m to the west of Block B (see Figure 151).

All three features excavated in Locus D were selected for analysis, and all three dated to the late historical period, most likely the early twentieth century. Feature 675 included the articulated remains of an adult horse, associated with additional scattered faunal remains, which probably was deposited in the marsh in the late historical period (most likely the early twentieth century), when the Ballona housed several ranches. Feature 676 was a small historical-period artifact concentration that likely dated to sometime during or after the 1930s. Feature 677 was a pit filled with historical-period trash (glass, metal, porcelain, and other materials), likely domestic debris.

Locus G

One CU and nine features from Locus G were selected for analysis (see Figure 152). Seven of the nine features were broadly defined as rock clusters, but several functional categories appeared to have been represented in the sample. Five of the features were interpreted as caches for ground stone artifacts or other lithic artifacts and materials. Two other rock clusters were functionally ambiguous and had been subjected to postdepositional disturbance. Two other features broadly defined as artifact scatters may have been the remains of ritual activities and a hearth-cleanout episode.

Curation Procedures

All artifacts designated for curation were sorted by site and placed in archival-quality 4-ml plastic bags and acid-free Hollinger curation boxes. All bags were checked to make sure non-archival-quality materials, such as aluminum foil, non-acid-free paper, and certain plastics, had been removed. Bagged items were usually retained in their original bags, unless the bags were damaged or were not 4 ml in size. Fragile items were wrapped in polyethylene foam, archival tissue paper, and/or high-density polyethylene materials. Items that were too large to fit into curation boxes (e.g., metates and bowls) were wrapped with the same protective materials. A reference picture was attached to the top of each oversized item so that unwrapping was not necessary to determine the contents. Curation-quality cards placed in each bag included the provenience information.

The location of each bag of artifacts was tracked using SRID, and boxes of artifacts were stored, grouped by site number, until they were taken for final curation. Each box contained a printed inventory listing the general provenience information and material type for each artifact bag in the box. Generally, but not always, boxes were sorted by material type. Curated materials have been housed at the Fowler Museum curation facility at UCLA.

Chronostratigraphic and Geoarchaeological Analyses

In this section, we discuss the methods employed to reconstruct the history of natural deposition and human land use at LAN-62. We first discuss the natural stratigraphy of the area and reconstruct the paleoenvironment. We then present the cultural stratigraphy and infer occupation episodes. These results were based on detailed analyses of stratigraphic soil profiles (see Appendix 9.6, this volume), 98 radiocarbon assays, and analyses of dozens of time-sensitive artifacts from Loci A, C, D, and G.

Natural Stratigraphy

Methods

Thirty-four of 110 total recorded profiles from LAN-62 (listed in Appendix 9.5 and described in Appendix 9.6, this volume) were used to reconstruct the natural stratigraphy and geomorphic setting: 26 profiles from Locus A, 3 each from Loci C and D, and 2 from Locus G. Most of the profiled units were situated in alluvial-fan deposits, but several encompassed the toe slope of the alluvial fan, where it interfingers with freshwater-marsh deposits. SRI geoarchaeologists recorded detailed stratigraphic and soil information in each of the 34 units selected for analysis. Prior to conducting that work, the overlying construction fill was mechanically removed to expose the underlying intact cultural deposits.

SRI conducted a variety of soil analyses in selected units to aid in interpretations of the formation, alteration, and preservation of subsurface remains. Those analyses included examinations of dissolved salts, electrical conductivity, pH levels, and Mehlich 2–extractable phosphorus. In addition, analysis of organic matter and calcium carbonate were undertaken at SRI's soil laboratory in Tucson; particle-size analyses were conducted at the University of Northern Illinois Physical Geography Laboratory, under the direction of Michael Konen; and analyses of total and available phosphorus and organic matter (Walkley-Black method) were measured at the Milwaukee Soil Laboratory, under the direction of Mary Jo Schabel.

Stratum Descriptions

The first part of this section describes the natural stratigraphy of LAN-62 Loci A, G, C, and D. The second part summarizes the results of the soil particle-size and compositional analyses.

Locus A

The analysis of 25 soil profiles at LAN-62 Locus A revealed six subsurface strata, which are briefly summarized in Table 47 (see Appendix 9.6, this volume, for detailed profile descriptions). A schematic cross section of Loci A and G illustrating the strata and major soil horizons in that part of the site is presented in Figure 158. Figures 159–162 (showing Profiles 1, 2, 8, and 10, respectively) are examples of profiles that exhibited deep and detailed stratigraphic sequences. Generally, the natural stratigraphy of Locus A is dominated by fan alluvium that has been modified by groundwater fluctuation. Periods of geomorphic stability are associated with buried A horizons that mark episodes of gradual to minimal aggradation of the fan surface. The deeper Bk and Bt horizons are composed of marsh deposits or interdigitated marsh and fan deposits along the relict floodplain of Centinela and Ballona Creeks, which, at various times in the past, captured the flow of the Los Angeles River.

The deepest soil stratum exposed in Locus A, Stratum I (Bk/Bt horizon), consisted mainly of dark-brown (10YR 3/3 moist) sand or loamy sand to black (N 2.5/0) sandy clay, divided into two facies: the alluvial fan (If) and the marsh (Im) facies. The marsh facies extends north into Locus G, where the alluvial-fan deposits interfinger with riparian-marsh deposits in the floodplain. The alluvial-fan deposits primarily are derived from material eroded from upslope areas of the bluff. The marsh deposits resulted from the accumulation of stream alluvium, mainly silt and clay slack-water deposits on the Ballona Creek (or Los Angeles River) floodplain.

The alluvial-fan portion of Stratum I is the basal noncultural deposit that underlies the archaeological resources in Locus A.

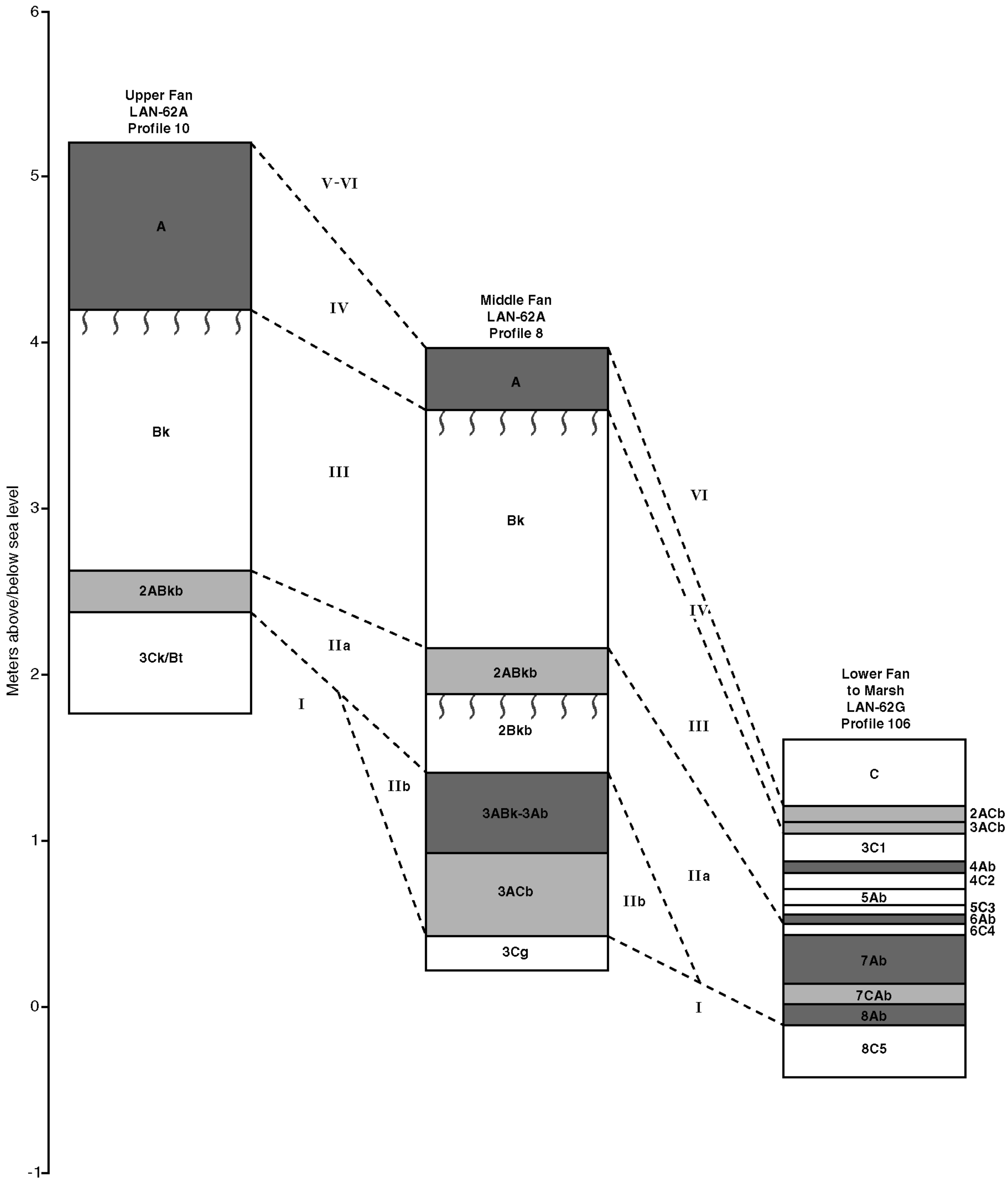

Figure 158. Schematic stratigraphic cross section of LAN-62 Loci A and G, showing the strata and major soil horizons for the alluvial-fan and marsh deposits.

Table 47. Stratigraphic Summary, LAN-62 Locus A

Stratum	Description	Age Estimates
I	Fan alluvium with buried Bk horizon and clay lamellae; noncultural basal deposit underlying cultural deposits.	before 6200 cal B.P. and possibly Pleistocene
IIb	Midden deposit associated with the 3Ab horizon found only in Profile 8, just above the water table.	~6200 cal B.P.
IIa	Midden deposit associated with the 2Ab horizon.	~4200–4400 cal B.P.
III	Fan alluvium; contained fewer artifacts than overlying and underlying midden deposits.	~3000–3700 cal B.P.
IV	Upper midden associated with a thick mollic A horizon; contained intrusive burials in burial ground.	~850–3000 cal B.P.
V	Historical-period deposit with heavy bioturbation and no intact archaeological features.	~A.D. 1850s–1928
VI	Fan alluvium, ditch fill, and modern, earthen construction-fill material.	post-A.D. 1938

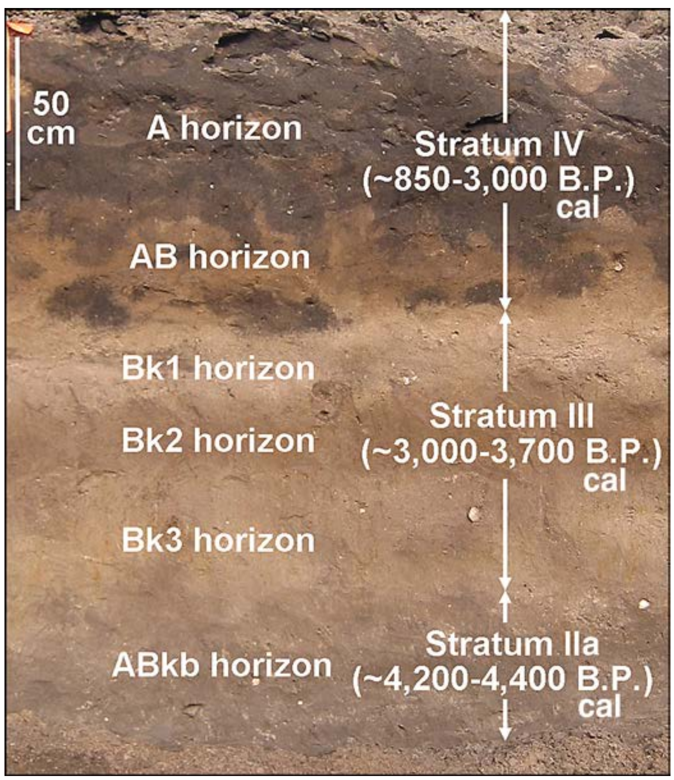

Figure 159. Photograph of Profile 1 at LAN-62 Locus A, showing soil strata and associated dates in radiocarbon years B.P.

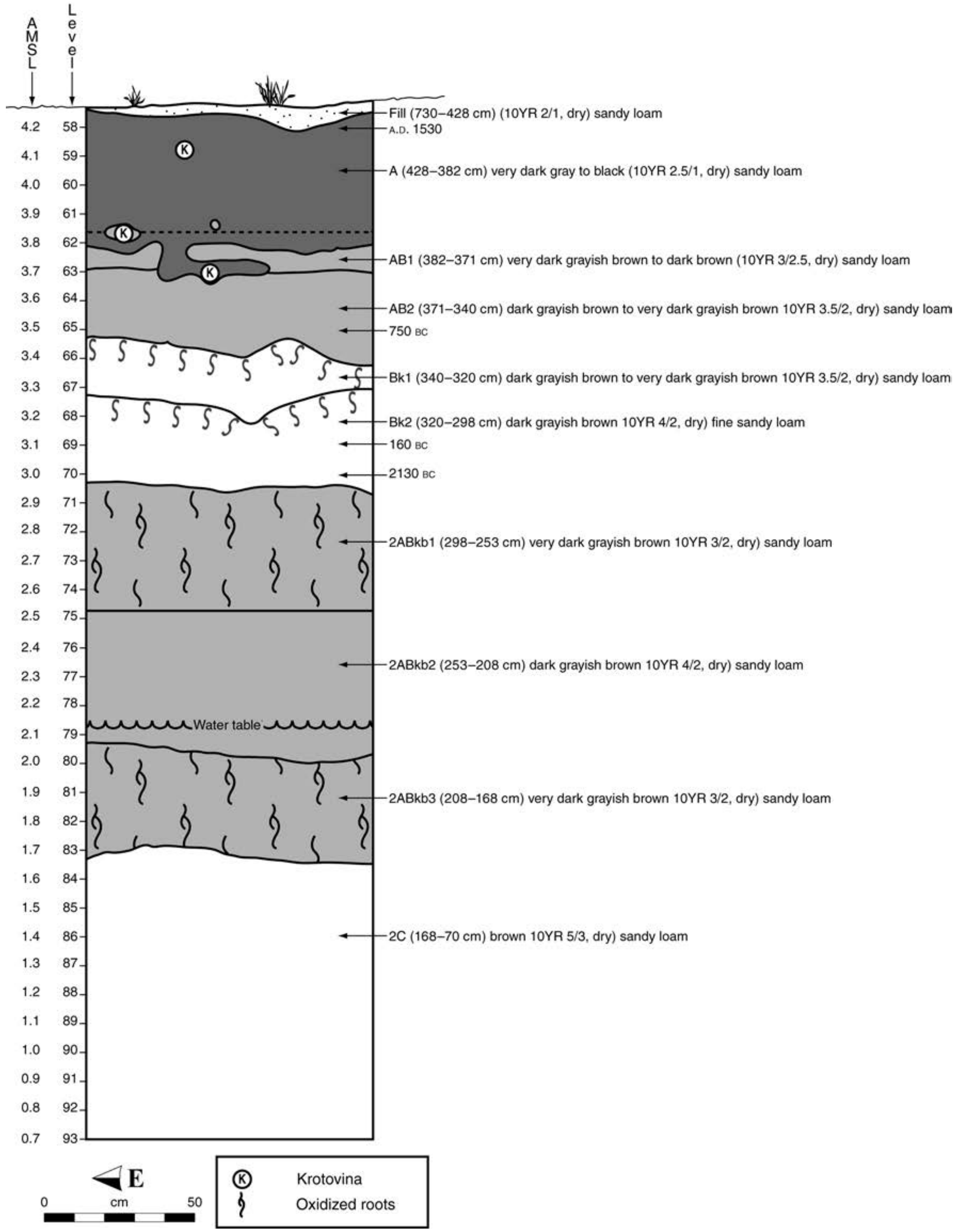

Figure 160. Profile 2 at LAN-62 Locus A.

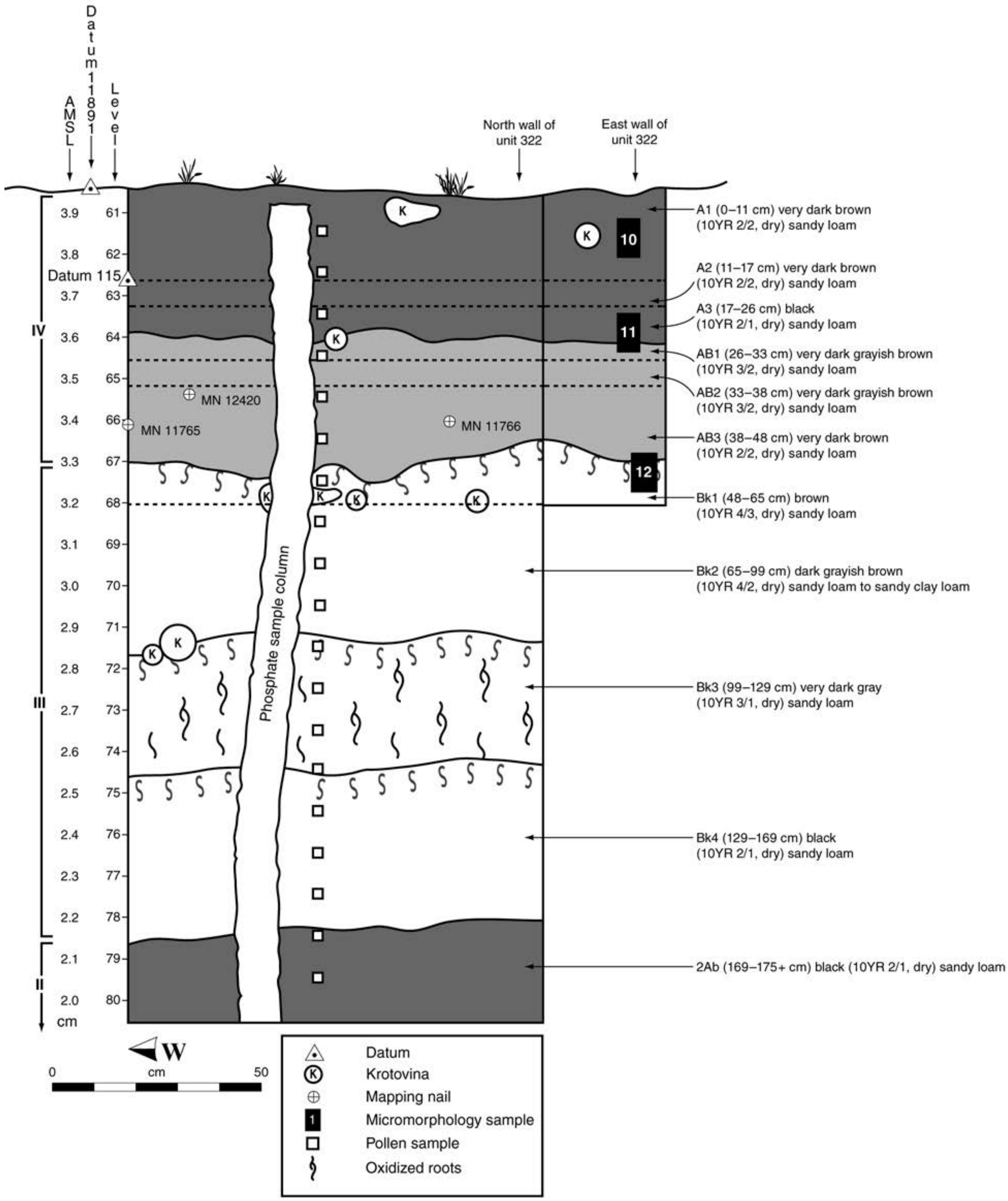

Figure 161. Profile 8 at LAN-62 Locus A.

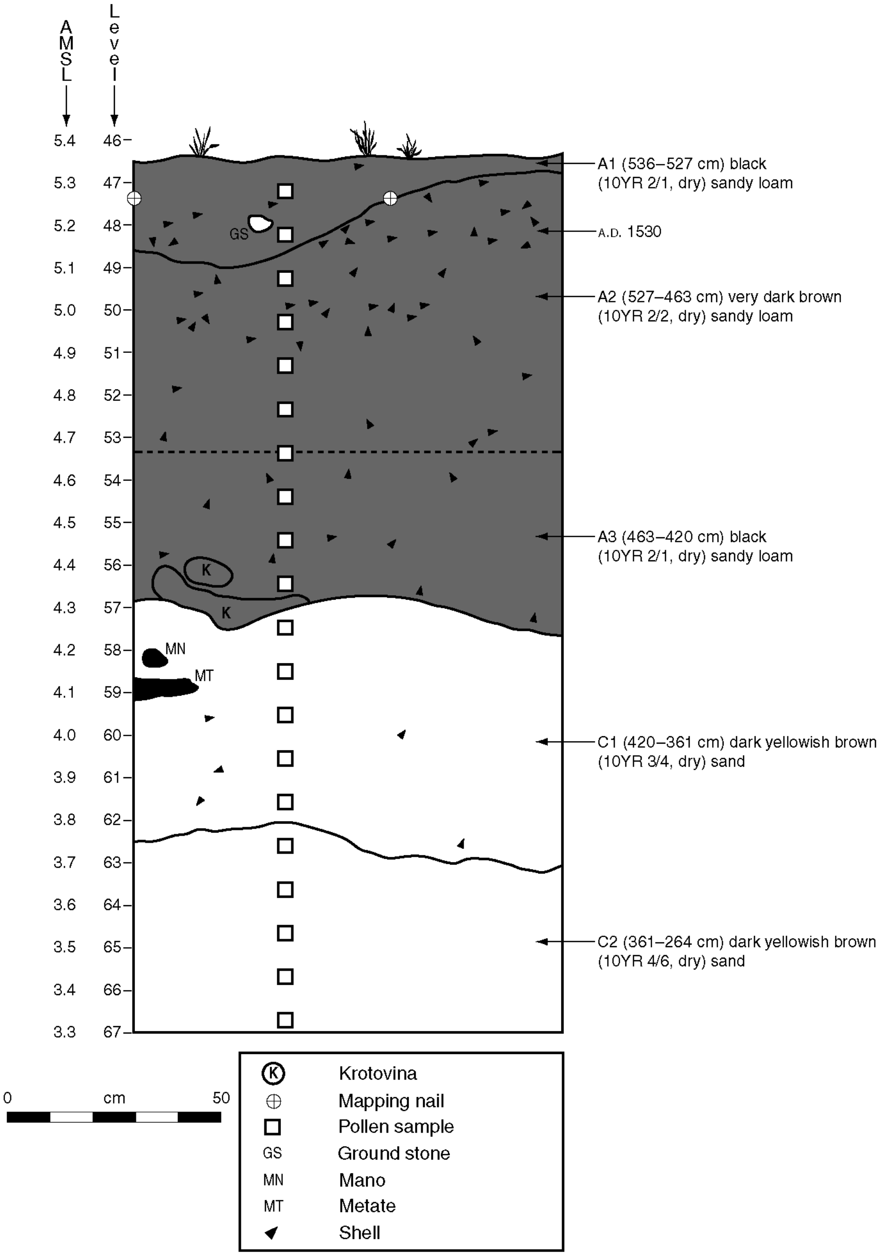

Figure 162. Profile 10 at LAN-62 Locus A.

The only artifacts recovered from Stratum I appeared to be in the fill of krotovina (rodent burrows) that intruded from overlying deposits. Nearer to the bluff, Stratum I was marked by a buried Bk/Bt horizon; clay lamellae occurred within the Bk horizon. The lamellae marked thin bedding planes of clayey strata where the clay had been translocated downward through the sandy matrix via illuviation (i.e., downward translocation of clay). The lamellae probably formed exclusively near the base of the bluff, where runoff water infiltrated the foot slope below the back slope of the bluff, providing wetting fronts that translocated clays downward. The lamellae formed undulating ribbons resulting from the variable speeds and depths of the wetting fronts over short distances—a function of microtopographic variability at the surface.

The age of Stratum I is unknown, but the presence of lamellae suggested that it may date to the Pleistocene. At a minimum, it predates Stratum IIb, which dates to roughly 5000–4200 B.C. No charcoal or organic datable materials were recovered from Stratum I.

Stratum II (2ABkb and 3ABkb-3Ab-aAbCb horizons) in Locus A consists of dark-grayish-brown to grayish-brown sand or loamy sand on the lower fan; in the upper fan, it consists of very-dark-gray to grayish-brown sand or sandy loam. This stratum initially was thought to be the oldest buried

A horizon in the locus (2ABkb horizon), but in Profile 8, a deeper and older buried A horizon was observed within the water table (3ABkb-3Ab-3ACb horizons). Together, the two buried A horizons (2ABkb and 3ABkb-3Ab-3ACb horizons) were designated as Strata IIa and IIb, respectively. Carbonate additions were found in both of the deeply buried A horizons, indicating upward translocation in the capillary fringe above spring-fed groundwater rich in calcium carbonate. Redoximorphic features were also found within and above the buried A horizons, indicating groundwater fluctuation.

Radiocarbon dates suggested an age of deposition for Stratum IIa of ca. 3000–2300 cal B.C.; the deeper Stratum IIb was deposited ca. 5000–4200 cal B.C. Stratum II was found in most of the profiles, but it was not identifiable in upslope areas of the fan, where Stratum I (Bk/Bt) was recorded (in Profile 10) (see Figure 162). In all likelihood, the absence of Stratum II in the upslope areas is attributable to obliteration and removal stemming from soil-welding processes, during which large amounts of water infiltrated the foot slope over several millennia. Even though Stratum II could not be identified with certainty in all areas of Locus A, peaks in Mehlich 2–extractable phosphorus (see below) were found in various areas that may have indicated the presence of buried A horizons of similar age.

Stratum III (Bk and Bk1-Bk2-Bk-3 horizons) marked the Bk horizon on the upper fan (such as in Profile 10) and the Bk1-Bk2-Bk3 sequence on the lower fan (such as in Profile 1). Stratum III consists mainly of a light-brownish-gray silt loam or sandy loam and likely represents a zone of more-rapid deposition than was evident in the thicker A horizons (Strata II and IV). It contained carbonate filaments and redoximorphic features, indicating a fluctuating water table in the lower areas of the fan. Radiocarbon dates suggested a period of deposition of about 1700–1000 cal B.C.

Stratum IV (A horizon) is an approximately 1-m-thick anthropic buried A horizon. This cumulic stratum was formed during a period of stable to slowly aggrading geomorphic conditions on the alluvial fan, mainly under grassland vegetation. Stratum IV soils range in color in different areas of the fan but are mainly very-dark-gray to very-dark-grayish-brown sand or loamy sand. This stratum is thickest on the upper (or proximal) fan and thinnest on the lower (or distal) fan. Some of the variation in thickness is a consequence of mechanical truncation during the Hughes era in the mid- and late twentieth century. Stratum IV was documented in all soil profiles and exhibited high phosphorous levels, suggesting intense human occupation and land use during the period in which it was formed, primarily the Intermediate period (ca. 2000 B.C.–A.D. 1100). This stratum remained intact after A.D. 1100 through the mid-1800s; however, Mission period burials intruded into Stratum IV in Locus A. Dual peaks in phosphorus levels within Stratum IV suggested at least two occupation surfaces (see below), neither of which was macroscopically visible in the stratigraphic profile.

Stratum V is a historical-period deposit (ca. A.D. 1850s–1938) that has been disked and graded as well as heavily bioturbated. These deposits predate deposition related to the substantial flooding events of 1931 and 1938. Stratum VI consists of a highly stratified mix of modern alluvial and colluvial deposits underlain by post-1938 ditch fill and fan alluvium. The construction fill contained a wide variety of modern and historical-period artifacts, including fragments of concrete, asphalt, and other materials. Aerial photographs indicated extensive land modification during the Hughes era. No radiocarbon dating was obtained for Strata V and VI, which were clearly historical period in age.

Locus G

Locus G encompassed an area farther removed from the Ballona Escarpment than Locus A and included alluvial-fan and marsh deposits interfingered along the toe slope of the escarpment. The alluvial-fan deposits recorded throughout most of Locus A grade into marsh deposits on the floodplains of Ballona and Centinela Creeks. Two soil profiles from Locus G (Profiles 105 and 107) were analyzed. Profile 107 is illustrated in Figure 163 (see Appendix 9.6, this volume, for detailed stratum descriptions). Five strata that correlated to those identified in Locus A were identified in the analyzed profiles from Locus G. However, no equivalents to Strata V and IIb in Locus A were observed; the Locus G profiles only included Strata I, IIa, III, IV, and VI.

Stratum I (8C horizon), the deepest stratum, is a marsh deposit that extends from 175 to more than 200 cmbs. The stratum soil consists of moist, black loamy fine sand that was only observable in Profile 105. Artifacts were recovered in the upper levels of the stratum, near the contact with Stratum II, but they may have descended into the stratum as a result of bioturbation. The precise age of Stratum I in the Locus G deposit is unknown, but as in Locus A, it may date to the Pleistocene.

Stratum IIa (6Ab, 6C, 7Ab, and 8Ab horizons) consists of alternating layers of fan and marsh deposits that extended from 107 to 175 cm in depth in Profile 105. The stratum encompasses four horizons of generally dark and moist soils: 6Ab and 6C (dark-greenish-gray silty clay), 7Ab (greenish-black silt), 7C (black silty clay), and 8Ab (dark-brown fine sandy loam) horizons. The horizons grade from marsh deposits in the deeper horizon (8Ab) to alluvial-fan deposits in 6Ab and 6C, and the 7C horizon encompasses an abrupt, smooth boundary between those depositional contexts. No radiocarbon dates were obtained from this stratum in Locus G, but the age probably closely matches that of Stratum IIa in Locus A (ca. 5000–4200 B.C.).

Stratum III (4Ab, 5Ab, 4C, and 5C horizons) consists of alternating layers of alluvial-fan and stream sediments and marsh deposits that extended from 73 to 107 cmbs in Profile 105. The deeper horizons (5Ab and 5C) formed from deposition of stream alluvium, but the upper levels are alluvial-fan deposits (4Ab and 4C). The 5C horizon is highly micaceous, which indicated a correlation to the Centinela Creek alluvium. As in Locus A, Stratum III probably encompasses a period of deposition of about 1700–1000 B.C.

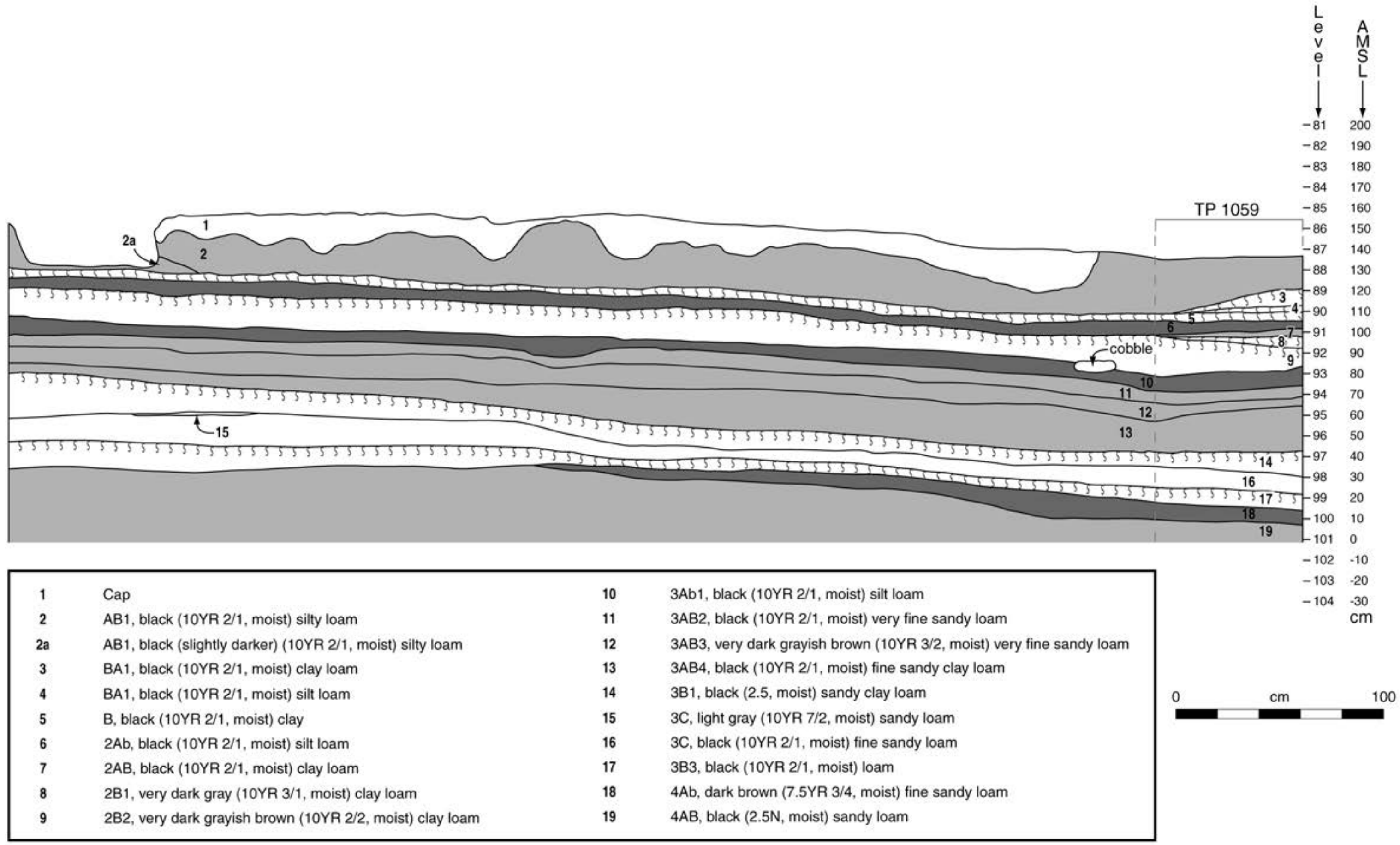

Figure 163. Profile 107 at LAN-62 Locus G.

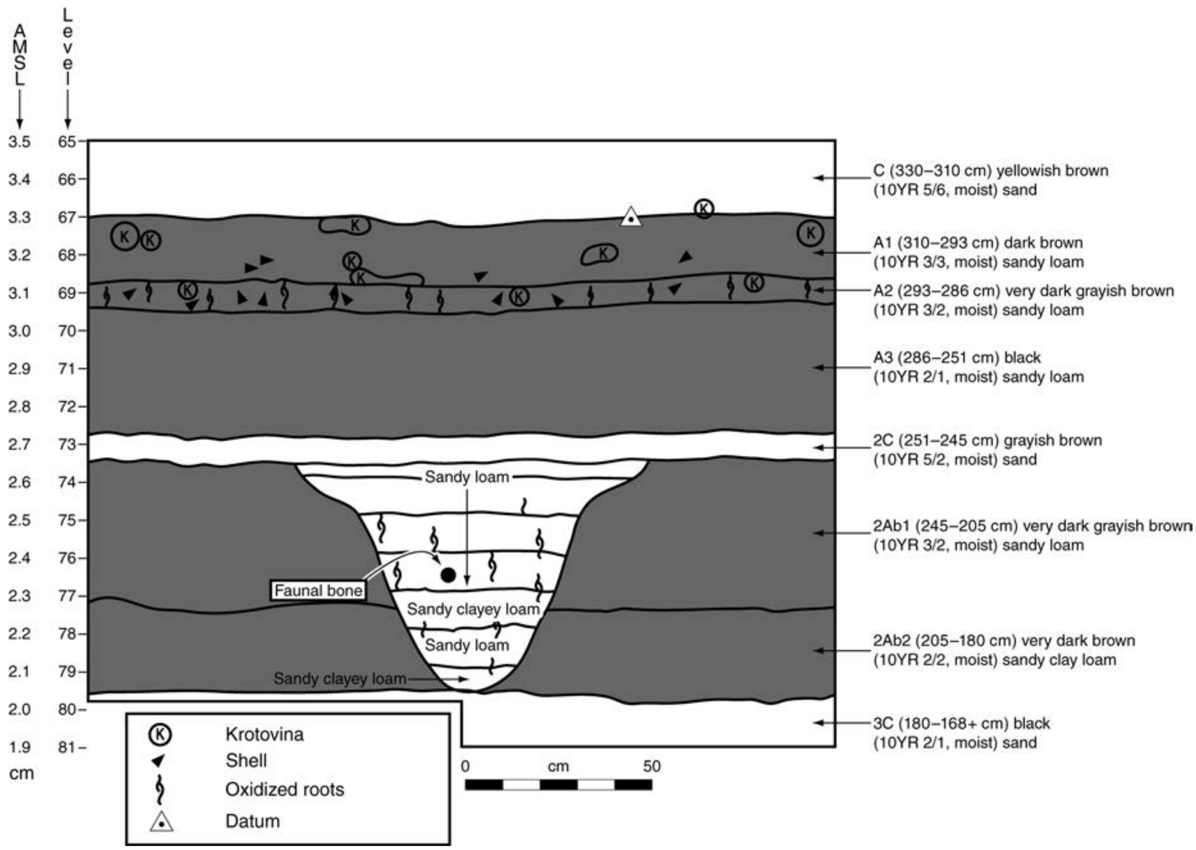

Figure 164. Profile 17 at LAN-62 Locus C.

Stratum IV (2ACb, 3ACb, 3C1, and 3C2 horizons) consists of fan and marsh deposits encompassing soil deposits between 42 and 73 cmbs in Profile 105. The deeper depositional horizons (3C1 and 3C2), both consisting of dark-gray loams, are marsh deposits with no evidence of artifacts. The 2ACb and 3ACb horizons are historical-period distal-alluvial-fan deposits that consist of a very-dark-gray silt loam or loamy sand; both horizons probably were formed during the Protohistoric and historical periods, from the A.D. 1500s through 1800s. The youngest stratum, Stratum VI (recent colluvial and alluvial sediments), is a brown loamy sand that caps the underlying cultural deposits of Locus G; it was deposited during the 1938 flood along the distal end of the alluvial fan.

Locus C

The landscape in Locus C is primarily composed of Holocene alluvial-fan sediments and colluvium that have accumulated along the base of the bluff. SRI geoarchaeologists examined three stratigraphic profiles from Locus C, but we focus here on Profile 17, to illustrate the stratigraphic sequence (Figure 164) (see Appendix 9.6, this volume, for detailed stratum descriptions). The sequence includes five strata: Strata I, II, III, IV, and VI. As was the case in Locus G, no Stratum V was recorded; instead, the youngest stratum was labeled Strata VI, to conform to the sequence from Locus A. Profile 17 was generally representative of the entire locus, but some minor stratigraphic variability was evident at the juncture of the fan and marsh deposits near the bluff, where groundwater and runoff were concentrated, causing slight alterations in the stratigraphy. In those areas, calcium carbonate was concentrated just above the zone of the fluctuating water table, at shallow depths.

Stratum I (2C and 3ACb horizons), the deepest exposed stratum, consists of a thick, buried A horizon that extended from about 85 to 150 cmbs in Profile 17. The soils range from a dark-gray to a brown loamy sand. Stratum II (2Ab1, 2Ab2, 2ABk1, and 2ABk2, and 2C horizons) contains the bulk of the cultural deposits in Locus C. In Profile 17, this stratum included a large, stratified pit feature (Feature 201) that originated at the contact with Stratum III; the feature fill was composed of a black clay loam upgrading to a sandy loam. The stratum is composed of dark-grayish-brown to very-dark-grayish-brown sandy clay loams; the lower horizons indicated evidence of a fluctuating water table.

Stratum III (A horizon) is a thin 2C horizon (light-brownish-gray sand) that extended from 80 to 86 cmbs in Profile 17. Stratum IV (A1 and A2 horizon), a buried A horizon, extended from 20 to 80 cmbs in Profile 17; it contains three soil horizons: an A1 horizon (brown loamy sand), an A2 horizon (very-dark-grayish-brown loamy sand), and an A3 horizon (very-dark-gray loamy sand). The soil color was

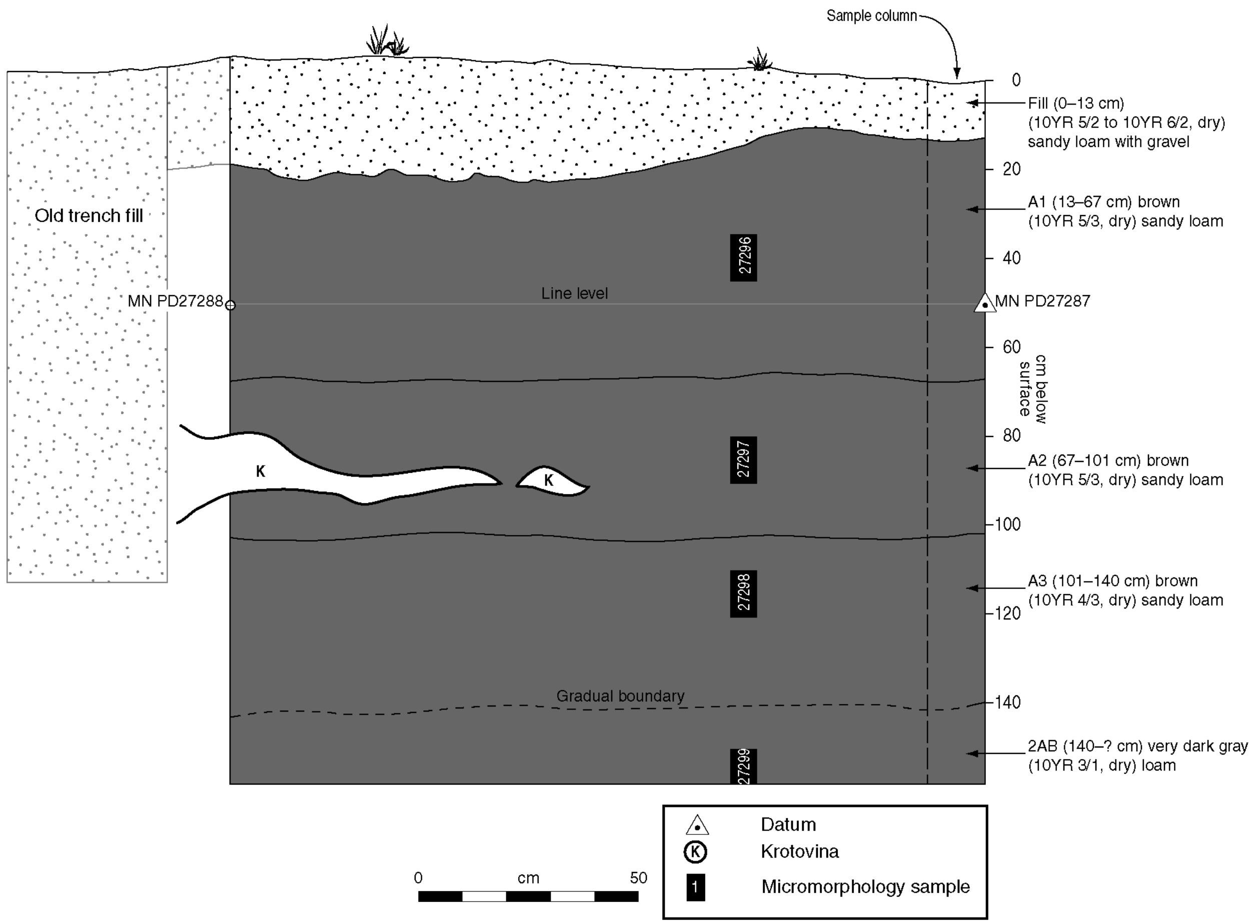

Figure 165. Profile 103 at LAN-62 Locus D.

noticeably grayer with increasing depth, because of the prevalence of groundwater that has removed the soil iron content from the deeper levels. Indeed, redoximorphic features were observed in the lower horizons and indicated the upper limit of the fluctuating water table. The shallowest stratum, Stratum VI (C horizon), is a layer of brownish-yellow sand that extended from the surface to a depth of 20 cmbs in Profile 17. This finely laminated deposit was likely associated with the 1931 or 1938 flood episodes. Similar layers of flood deposition were recorded in Loci A, D, and G.

Locus D

Locus D also was situated along the base of the bluff, along a narrow strip of land at the juncture of the colluvial foot slope and alluvial-fan and marsh deposits. Three profiles were documented at Locus D, but the stratigraphic sequence described below is based on Profile 103, located in the foot slope of the Ballona Escarpment (see Appendix 9.6, this volume, for detailed descriptions). Only three strata were recorded in Locus D, here identified as Strata III, IV, and VI, to conform to the strata labels in the other loci. No artifacts were observed during profile recording in Locus D, indicating a sparse cultural deposit in the locus. Although Profile 102 was generally representative of the entire locus, one minor area of variability concerned the higher levels of organic content in the lower elevations along the foot slope, as represented in Profile 103 (Figure 165), which extended into the underlying organic-rich marsh deposits below the admixed colluvium and fan alluvium that compose most of the soil in Locus D. That marsh deposit continues to the east along the Riparian Corridor, to the periphery of LAN-211.

Stratum III (Bk and Bg horizon), the deepest stratum recorded in Profile 102, marked a zone of carbonate enrichment in the upper levels of the stratum and a gleyed zone in the deeper levels. This stratum is divided into a Bk horizon (gray sandy loam to sandy clay loam), which indicated the upper limit of the fluctuating water table, and a Bg horizon (gray sandy loam to sandy clay loam), marked by a permanent water table. Stratum IV (A1, A2, ABk2, and ABk3 horizons) is a cumulic A horizon with an underlying transitional AC horizon. This stratum encompasses an A1 horizon (very-dark-brown sandy loam), an A2 horizon (black sandy clay loam), an ABk1 horizon (very-dark sandy clay loam), an ABk2 horizon (very-dark-gray sandy clay loam, with few light-gray, cylindrical carbonate masses), and an ABk3 horizon (very-dark-brown loam to sandy clay loam). Finally, Stratum VI (AC horizon) is a brown sandy fan deposit that extended from the surface to a depth of 47 cmbs in Profile 102. This laminated stratum marked the 1938 flood deposit observed in many areas along the base of the bluff.

Analyses of Geochemical and Particle-Size Trends

A variety of geochemical and particle-size analyses were conducted in Loci A, C, and D, to garner additional information about the depositional and cultural history of LAN-62. Here, we separately discuss the results for each locus.

Locus A

Figure 166 illustrates stratigraphic changes in pH level, electrical conductivity, and concentrations of total dissolved salts, organic matter, calcium carbonate (Profile 2 only), and Mehlich 2–extractable phosphorus (Profile 8 only) with increasing depth. Figure 167 shows the particle-size variation with increasing depth in six profiles in the locus (Profiles 1, 2, 3, 8, 10, and 13). Finally, Table 48 and Figure 168 show the means and standard deviations, by stratum, of all recorded soil properties, based on detailed examinations of 225 soil samples obtained from Profiles 1–14 in Locus A. Appendixes 9.7 and 9.8, this volume, present the geochemical and particle-size data, respectively, for Loci A, C, and D.

Soil pH levels, an indicator of the acidity or alkalinity measured on a logarithmic scale from 0 to 14, increased with depth in Profile 2 (and elsewhere in Locus A), from a mean of 7.5 in Stratum IV to about 8.1 in Strata I and II. Soil pH values in that slightly to moderately alkaline range provide excellent conditions for the preservation of shell ($CaCO^3$) and bone, materials that are abundant in features and midden deposits in the Ballona. The pH levels rarely exceeded 8.4, indicating insignificant sodium content. Bone remains, composed of collagen, fats, and proteins embedded within an inorganic matrix of the mineral hydroxyapatite ($Ca_5[PO_4]_3OH$), are the least soluble of the organic remains and best preserve at a pH level of 7.88. Higher pH levels in the deeper strata were caused by precipitation of calcium carbonate within and above the fluctuating water table. During excavation, calcium carbonate was commonly observed as white nodules or particles in the dried walls of the EUs, some of which migrated upward via capillary action above the groundwater level. Groundwater in the deeper deposits in Locus A indicated a zone of episaturation, a perched water table that overlies a fine-textured confining layer of lower permeability (i.e., an aquiclude) below the cultural deposits.

Electrical-conductivity (a function of soil salinity) and total-dissolved-salt levels exhibited ranges of variation virtually identical to the range observed for pH levels. Conductivity increased with depth to the interface of Strata I and II and then decreased with depth in Stratum I. One exception to that pattern was an observed slight peak in Stratum IIa, a buried A horizon dating to the Millingstone period.

The highest levels of soluble salts were found in Stratum II, although the high standard deviation indicated substantial variability among the sample locations (see Table 48; Figure 168). Soluble salts were more soluble than calcium carbonate, indicating that they were more easily mobilized and, consequently, were concentrated in the capillary fringe above the groundwater boundary. Soluble-salt levels were far below those that would adversely impact the preservation of bone and other cultural materials.

Organic matter, a potential indicator of human occupation (because of enrichment from discarded plant and animal debris), decreased in the deeper levels in Profile 2. For Locus A as a whole, however, organic concentrations peaked in Stratum II, although the concentrations varied substantially along the sample locations (see Table 48). Judging from its darker color, however, Stratum IV, a younger, buried A horizon dating to the late prehistoric and historical periods, visually appeared to contain very high organic content; the higher content in Stratum II therefore came as a surprise. The higher levels of organic matter in Stratum II than Stratum IV may have been attributable to the effect of calcium-carbonate coatings on soil particles that masked organic matter in the deeper strata. In addition, rhizoconcretions (calcium-carbonate masses formed in the rhizosphere, where calcium carbonate is excluded from water uptake by plant roots above the groundwater), which were especially abundant in Strata II and III, partially masked organic matter in the deeper strata below Stratum IV. Not surprisingly, given the absence of in situ cultural remains, the lowest organic-concentration levels were recorded in Stratum I.

Analyses of phosphorus concentrations long have provided successful means of detecting human activity surfaces (see Sjoberg 1976). Phosphorus levels generally increase as a result of various human activities that incorporate organic materials, such as ash, bone, plant material, excrement, and so on, into the surrounding ground surface. Phosphorus is largely insoluble and stable in most soils for extended periods of time. Moreover, phosphorus is fixed as calcium phosphate and therefore is not easily mobilized in alkaline soils, such as those recorded in Locus A. Consequently, current phosphorus levels provided an excellent indicator of human occupational intensity. SRI geoarchaeologist Jeffrey Homburg analyzed Mehlich 2–extractable-phosphorus levels, a fraction of the total soil phosphorus content that is easily enriched by discarded organic debris.

Noncultural deposits in Stratum I functioned as a suitable control for assessing phosphorus levels in the other strata. Three samples from Stratum I yielded mean phosphorus levels of about 71 mg/kg (or parts per million [ppm]) with a standard deviation of 63 ppm. Natural "background" levels of phosphorus also were inferred from phosphorus tests of 193 soil samples collected from eight soil cores obtained from outside Locus A, which indicated a mean phosphorus level of 72 ppm and a standard deviation of 57 ppm, roughly

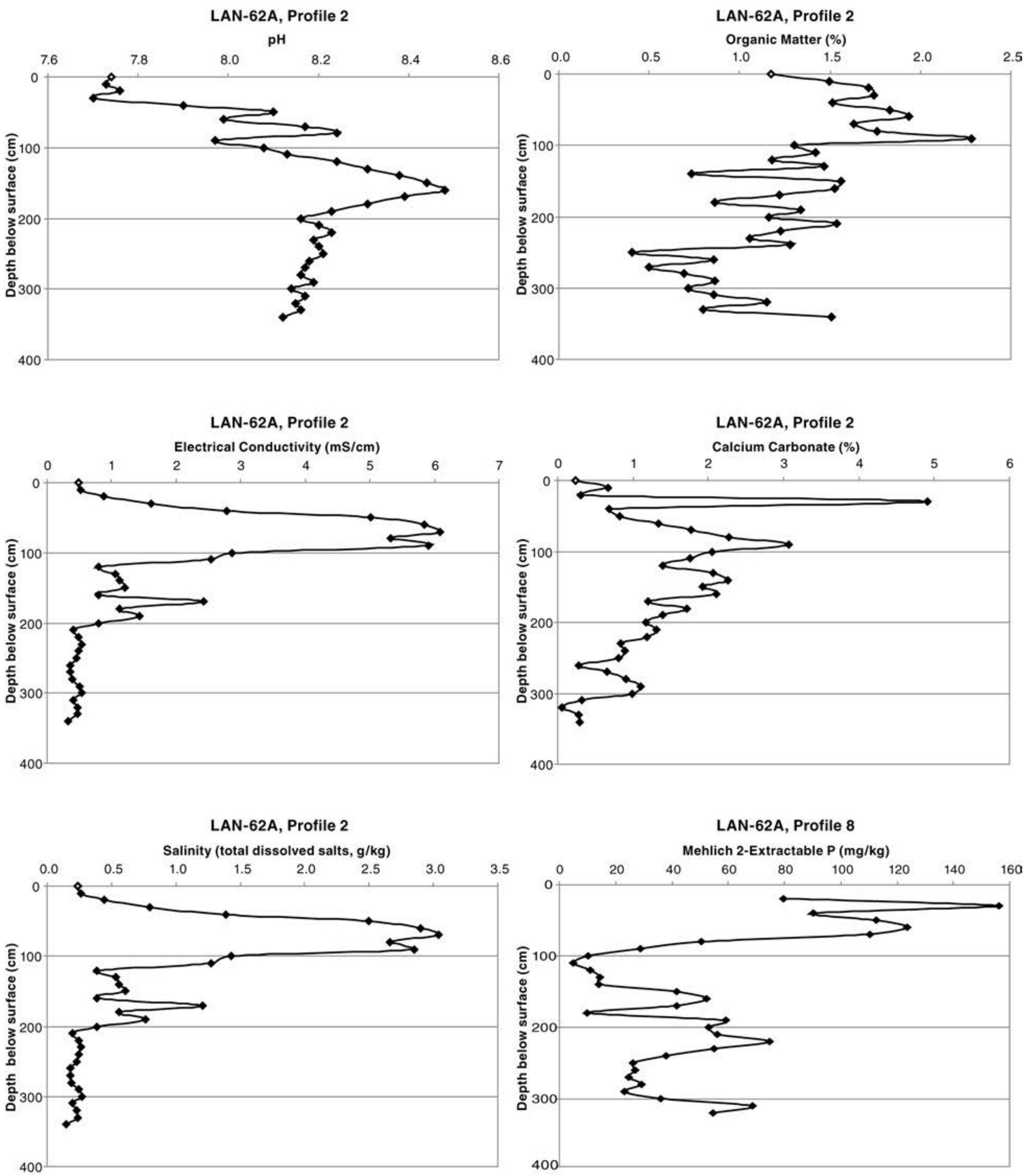

Figure 166. Depth trends for soil properties (pH, electrical conductivity, total dissolved solids, organic matter, calcium carbonate, and phosphorus) at LAN-62 Locus A.

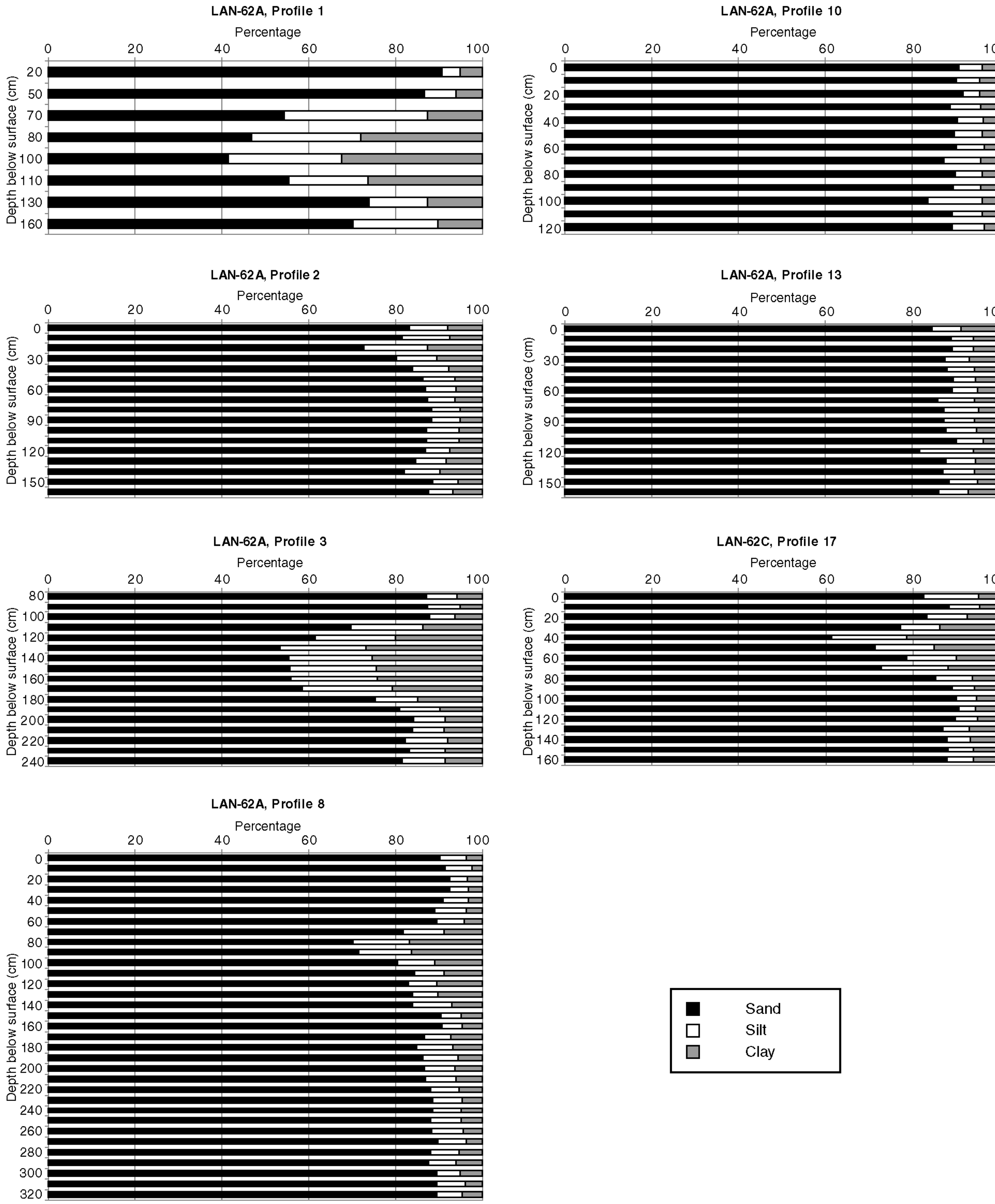

Figure 167. Particle-size graphs for LAN-62 Loci A and C.

Table 48. Means and Standard Deviations of Soil Properties for LAN-62A Strata

Soil Property	Units	Stratum I			Stratum II			Stratum III			Stratum IV		
		n	Mean	σ	n	Mean	σ	n	Mean	σ	n	Mean	σ
pH	1:1 soil:water	9	8.11	0.08	35	8.14	0.18	30	7.98	0.10	119	7.52	0.49
Electrical conductivity	(mS/cm)	9	0.52	0.13	35	0.72	0.45	30	1.07	1.15	119	1.17	1.61
Salinity (total dissolved salts)	(g/kg)	9	0.26	0.07	35	1.16	4.17	30	0.53	0.56	119	0.58	0.80
Organic matter	(%)	8	1.08	0.29	28	1.75	2.24	4	1.55	0.50	20	1.46	0.23
Calcium carbonate	(%)	8	0.57	0.36	28	2.22	2.16	4	2.07	0.72	20	1.06	1.05
Mehlich 2–extractable phosphorus	(ppm, mg/kg)	3	70.8	63.3	32	184.0	115.6	26	118.6	93.7	64	228.8	126.7
Sand	2-0.063 mm	4	87.3	0.9	46	86.6	2.4	26	74.2	15.0	44	82.2	10.0
Silt	63-2 mm	4	7.6	0.8	46	7.4	1.6	26	12.4	6.6	44	10.2	5.5
Clay	<2 mm	4	5.1	1.5	46	5.9	1.4	26	13.3	8.7	44	7.6	5.3
Geometric mean	2–0 mm	4	168	7	46	157	24	26	98	51	44	135	41
Geometric mean	2 mm–2 mm	4	224	26	46	214	29	26	162	52	44	191	38

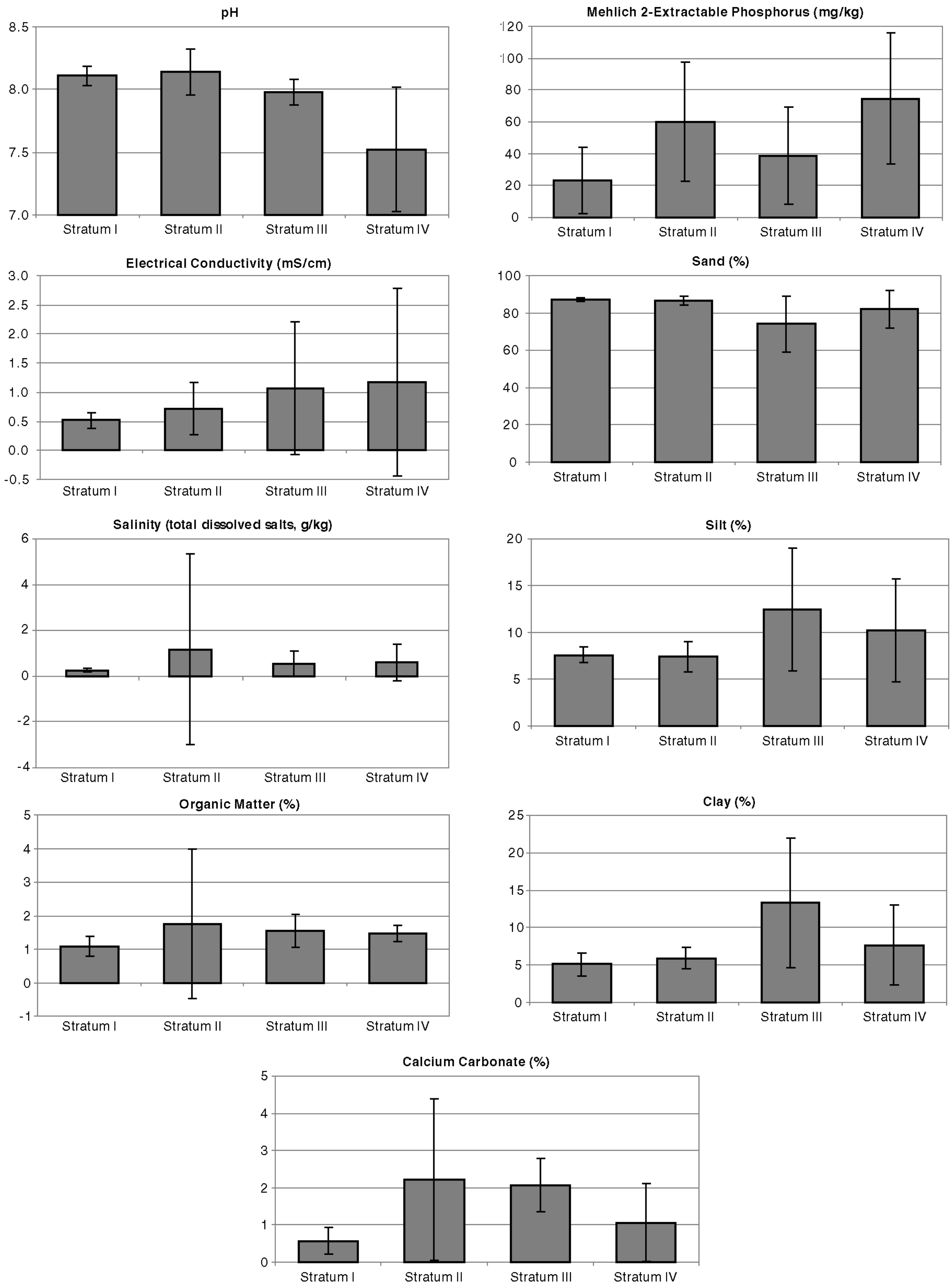

Figure 168. Graphs of means and standard deviations for pH, electrical-conductivity, salinity, organic-matter, calcium-carbonate, phosphorus, and particle-size data by stratum for LAN-62 Locus A.

equivalent to the phosphorous levels in noncultural Stratum I. Those levels were viewed as natural background concentrations against which the cultural strata were compared. As a conservative benchmark, we determined that extractable-phosphorus concentrations higher than ca. 120–150 mg/kg (or ppm) indicated a significant anthropogenic signal.

Generally, the highest phosphorus concentrations were observed in soil samples from Stratum IV, and somewhat smaller concentrations were observed in Strata II and III. Many of the samples drawn from Stratum IV exhibited phosphorus concentrations two to three times higher than the inferred "background" levels, although concentrations were variable. Six or seven such peaks were identified in different levels of Profile 8, each of which probably correlated to buried occupation surfaces. A number of phosphorus peaks were also identified in Profiles 3 and 10, as shown in Figure 169. Notably, phosphorus peaks typically correlated to peaks in lithic artifacts and bone concentrations, especially in Profiles 8 and 10 (see below). Lithic and bone concentrations, however, were poorly correlated to the phosphorus peaks in Profile 3, located to the north of the burial area. The reason for that exception is difficult to infer, but in some cases, noncultural processes sometimes generate high phosphorus content.

Particle-size distributions varied little with depth in Locus A. The highest sand and lowest clay contents were recovered from Strata I, II, and IV, which were dominated by loamy sand in most profiles and landscape positions of Locus A. Stratum III contrasted sharply with the other strata in Profiles 1, 3, and 8, with its relatively low sand and high silt and clay contents. The levels with high clay content were concentrated in Stratum III, which indicated a period of slow, low-energy soil deposition on the fan. With the exception of clay lamellae in Stratum I, textural variability in Locus A reflected variability in deposition on the alluvial fan, rather than soil-formation processes, such as chemical and physical weathering and illuviation.

Locus C

Analyses of extractable-phosphorous concentrations and of particle size were conducted on soil samples from three stratigraphic profiles in Locus C (Figure 170). Three to four peaks were apparent in the upper 2 m of each of the profiles, suggesting possible discrete occupation surfaces. Phosphorus concentrations in Profiles 17 and 70, in the central and northeastern areas of Locus C, were generally low (at or below the upper limits of the natural background levels, ca. 120–150 ppm), indicating a minimal anthropogenic signal. Those areas of Locus C probably were not loci of intense human occupation and land use, or at least not the sort of land use that would generate organic debris.

By contrast, Profile 71, in the southwestern part of Locus C, exhibited peak extractable-phosphorus concentrations that were considerably higher than background levels and comparable to those observed in Strata II and IV in Locus A. The southwestern portion of Locus C clearly was subjected to intense human occupation and land use. Also notable is that the highest phosphorus peak in the locus was recorded in the lowest levels of Profile 71. Unfortunately, because of the high water table, that unit could not be excavated to an adequate depth to expose any deep-lying cultural deposits. Based on the results, however, deeply buried cultural deposits possibly dating to the early Millingstone or pre-Millingstone period may be present in that location.

The particle-size distributions were similar to those documented in Locus A; textures were dominated by sand and low quantities of clay (see Figure 167). Stratum IV in Locus A exhibited lower sand content and higher clay concentrations than Stratum IV in Locus C, probably because of the influence of marshy slack-water deposits at relatively shallow depths near the base in Locus C.

Locus D

Analyses of extractable-phosphorous concentrations, organic content, pH levels, and soil porosity were conducted on soil samples from the profiles in Locus D. Figure 171 illustrates the geochemical soil data for Profiles 102 and 103 in Locus D. The trends with depth were generally consistent between the two sample locations, except for differences in organic-matter content in the lower levels. The higher organic content in Profile 103 is attributable to the unit's lower landscape position than that of Profile 102; the lower part of Profile 103 extended to the underlying organic-rich marsh deposits below the admixed colluvium and fan alluvium (see above).

Soil pH levels varied from slightly acidic near the modern surface to moderately alkaline in the lower strata. Levels above pH 7 are generally good for bone preservation, and thus the absence or paucity of bone in Locus D is not attributable to bone destruction from soil acidity. Calcium-carbonate levels tended to increase with depth, similar to the trend for pH, except in the lowest part of Profile 102, the Bg horizon of Stratum III, which is in the permanent water table.

Two, possibly three, peaks in extractable-phosphorus levels were identified in Profiles 102 and 103 in Locus D. The phosphorus concentrations were all below 100 ppm, though, which is in the range of natural background levels in the project area. The results provided minimal evidence of human living surfaces or activity areas. None of the observed peaks in phosphorus levels was associated with archaeological indicators of activity areas (i.e., peaks in shell, faunal bone, or lithic concentrations).

Depth trends in porosity tend to mirror the trends for porosity: the most-porous soils are associated with the highest gravel levels. Porosity is inversely related to bulk density, a measure of soil compaction. The finest-textured soils tend to have the lowest bulk density, because they have a more efficient packing arrangement of finer soil particles. Soils with organic matter also tend to have lower bulk densities, because of the effect that organic matter has in binding mineral soil particles together.

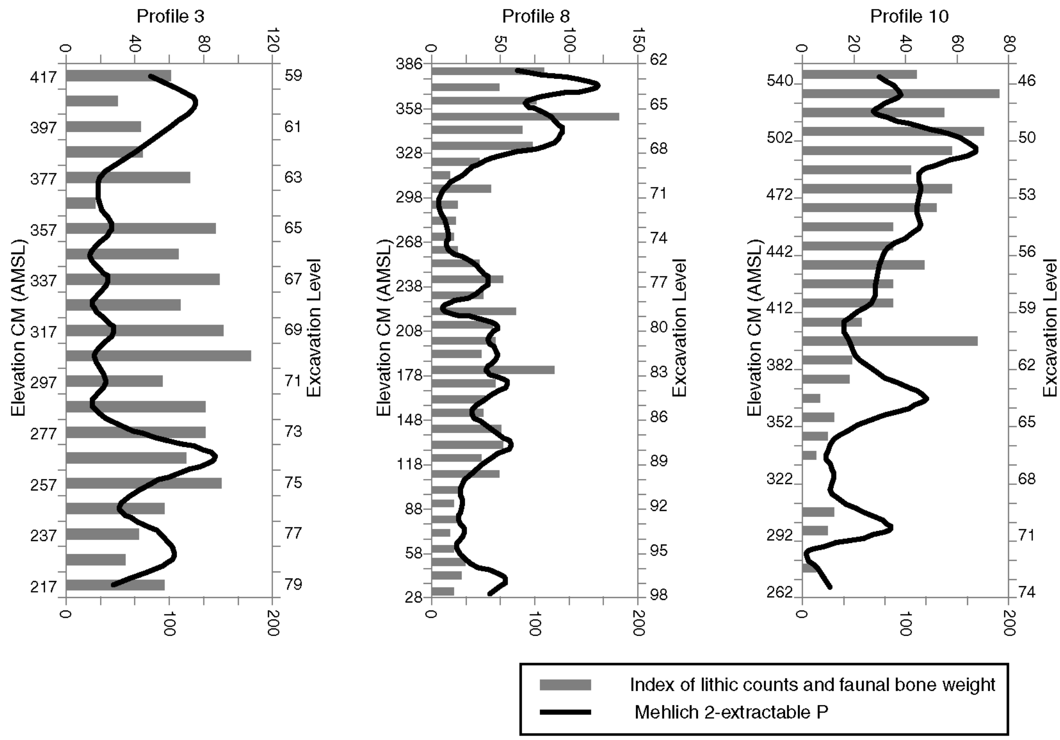

Figure 169. Depth trends for Mehlich 2–extractable phosphorus relative to an index of lithic artifact counts and faunal bone weight for Profiles 3, 8, and 10 at LAN-62 Locus A.

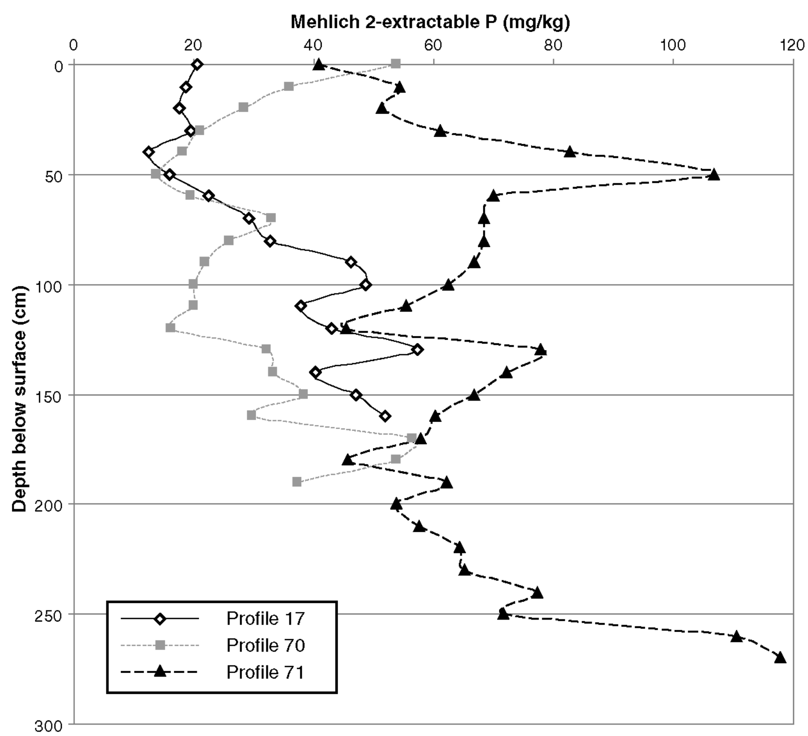

Figure 170. Depth trends of Mehlich 2–extractable phosphorus for LAN-62 Locus C, Profiles 17, 70, and 71.

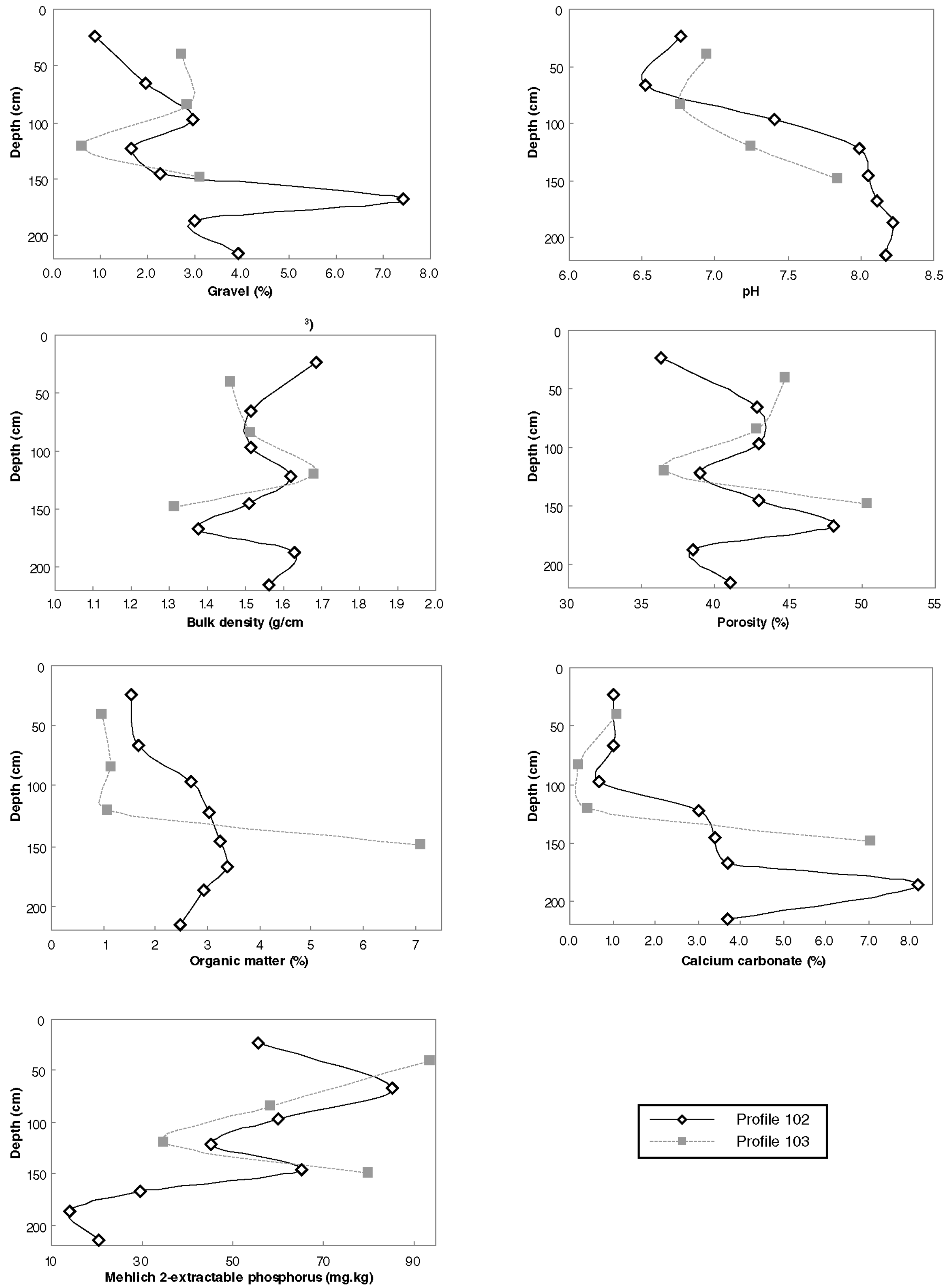

Figure 171. Depth trends for gravel, pH, bulk density, porosity, organic matter, calcium carbonate, and phosphorus for LAN-62 Locus D.

Disturbance

Considering the amount of natural, historical-period, and modern disturbance to different portions of LAN-62, a surprisingly large portion of the site was found intact during our data recovery operations in the various loci. Natural disturbance in the form of bioturbation, flooding, and erosion have acted on the site constituents for millennia, and historical-period and modern disturbances in the form of farming, ranching, and large earthmoving projects have been more recent but highly damaging processes. Soil studies and documentation during fieldwork helped to identify the various forms of bioturbation and natural geologic processes acting on subsurface archaeological resources. Archival documentation in the form of aerial photographs, maps, memoirs of individuals who worked in the area, and news articles documented the history of disturbance to the site during the Euroamerican era. The following section briefly presents the effects of some of those factors on the archaeological record that was recovered from LAN-62. Understanding the complex nature of the stratigraphic and temporal contexts that frame our discussions of the archaeology of the Ballona requires an understanding of the various postdepositional and cultural forces that play on that record. Interpreting the archaeological record necessarily required us to be aware of the various factors that affected the features, the midden, and the individual artifacts and ecofacts that we have recovered during our work (Schiffer 1987).

Bioturbation caused by the burrowing activities of pocket gophers, other rodents, and insects have had a significant effect on the integrity of cultural deposits at LAN-62. Generally, bioturbation may move artifacts upward, downward, or laterally within a subsurface matrix, and the effects will vary according to the size, weight, and density of the subsurface artifacts (Balek 2002; Bocek 1986; Johnson 1989; Waters 1992). Animal, insect, and root burrows tend to move larger objects upward in the subsurface matrix and smaller objects downward. Generally, bioturbation tends to produce (1) denser artifact deposits in deeper excavation levels; (2) size-sorting of artifacts, such that deeper levels contain higher proportions of smaller artifacts than shallower levels; and (3) mixing of earlier and later cultural deposits in subsurface contexts (Waters 1992).

Pocket gophers are notorious agents of stratigraphic disturbance at archaeological sites in California, and that is certainly the case in well-drained, sandy sites in the PVAHP project area. Gopher activity in some regions may cause a complete turnover of soil contexts in as little as 5–7 years, according to Bocek (1986, 1992). Smaller artifacts are more likely than larger artifacts to fall into cavities or voids created by burrowing animals, causing size-sorting of the subsurface remains. Pocket gophers typically dig burrows that are about 7–8 cm in diameter; feeding burrows generally occur within 20 cm of the surface, but nesting burrows may extend as deep as 50 cmbs. Feeding burrows account for the majority of digging activity; so, artifacts smaller than the burrow widths are easily translocated, but mainly within 20 cm of the soil surface.

Infilled burrows, or krotovinas, were found concentrated in the upper part of Stratum IV in Locus A. They were also common at and just below the contact of Strata III and IV. Some burrows were found in deeper strata, as well, but they were much less frequent in the strata near or within the zone where groundwater fluctuated. Artifacts and ecofacts have been translocated upward and downward as a result of burrowing activities, but it is important to note that the preservation of distinctive soil horizons suggested a high degree of stratigraphic integrity. Had the subsurface deposits been excessively churned and mixed, soil horizons would no longer have been recognizable. The edge of Locus A, where it grades to marsh deposits, indicated the highest degree of stratigraphic integrity.

Although many features showed clear signs of animal intrusion, there was a surprisingly high level of integrity to most. Burial features often had evidence of burrowing through particular sections; yet things as delicate as strands of beads and the alignment of human remains were found intact. The major problem that bioturbation presented to this study was the mixing of small artifacts vertically and horizontally through the deposit. Because we were unable to perform destructive analyses on human remains, for example, dating burial features relied on the identification of temporally diagnostic artifacts and radiocarbon dating of shell that was thought to be associated. With items that are moved throughout the midden, such as shells and beads, radiocarbon dating becomes problematic, unless the items are recovered in a reliable context (an example would be a strand of beads around a person's wrist). In many cases, features that did not have diagnostic artifacts were dated using pieces of shell that appeared to be associated. Because of the action of bioturbation, it was often difficult to say for certain that the shell or other dated item was recovered from a strong context within the feature. What is then required to really ascertain confidence in the dating of a feature is the selection of multiple items from a feature for radiocarbon dating. That can be cost prohibitive and also limits the number of features that can be investigated. On the PVAHP project, especially at LAN-62 Locus A, every effort was made to acquire specimens for radiocarbon dating that were from strong archaeological contexts. Efforts were also made to date matched pairs of carbon and shell, if possible.

The Ballona has been a highly dynamic environment during the millennia that humans have occupied the area. Throughout that time, environmental perturbations (both short and long term) have worked to alter the landscape that humans have lived on. Historical-period flooding episodes have been widely documented. The effects of flooding have likely helped to preserve archaeological materials below the base of the bluffs. Aerial photographs have documented large alluvial fans formed at the bases of drainages throughout the property, depositing several feet of sediment, sometimes in a matter of days (Figure 172). Flooding intermittently created large areas of standing water that would have inundated subsurface as well as surficial deposits (Figure 173). The effect of inundation is poorly understood, but it is likely that

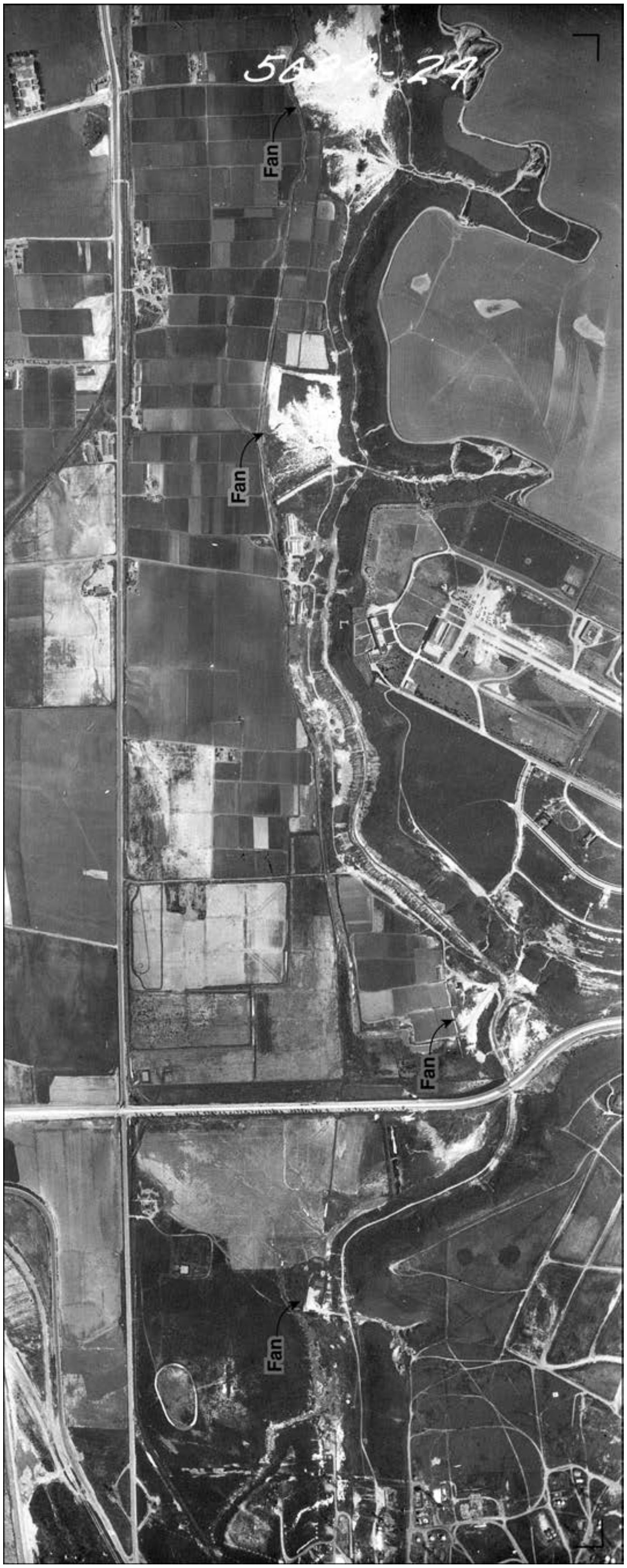

Figure 172. Aerial photograph showing fans formed during heavy rains and flooding in the spring of 1938 (courtesy of the Benjamin and Gladys Thomas Air Photo Archives, Fairchild Collection, UCLA Department of Geography; Flight C-5084, Frames 22 and 24).

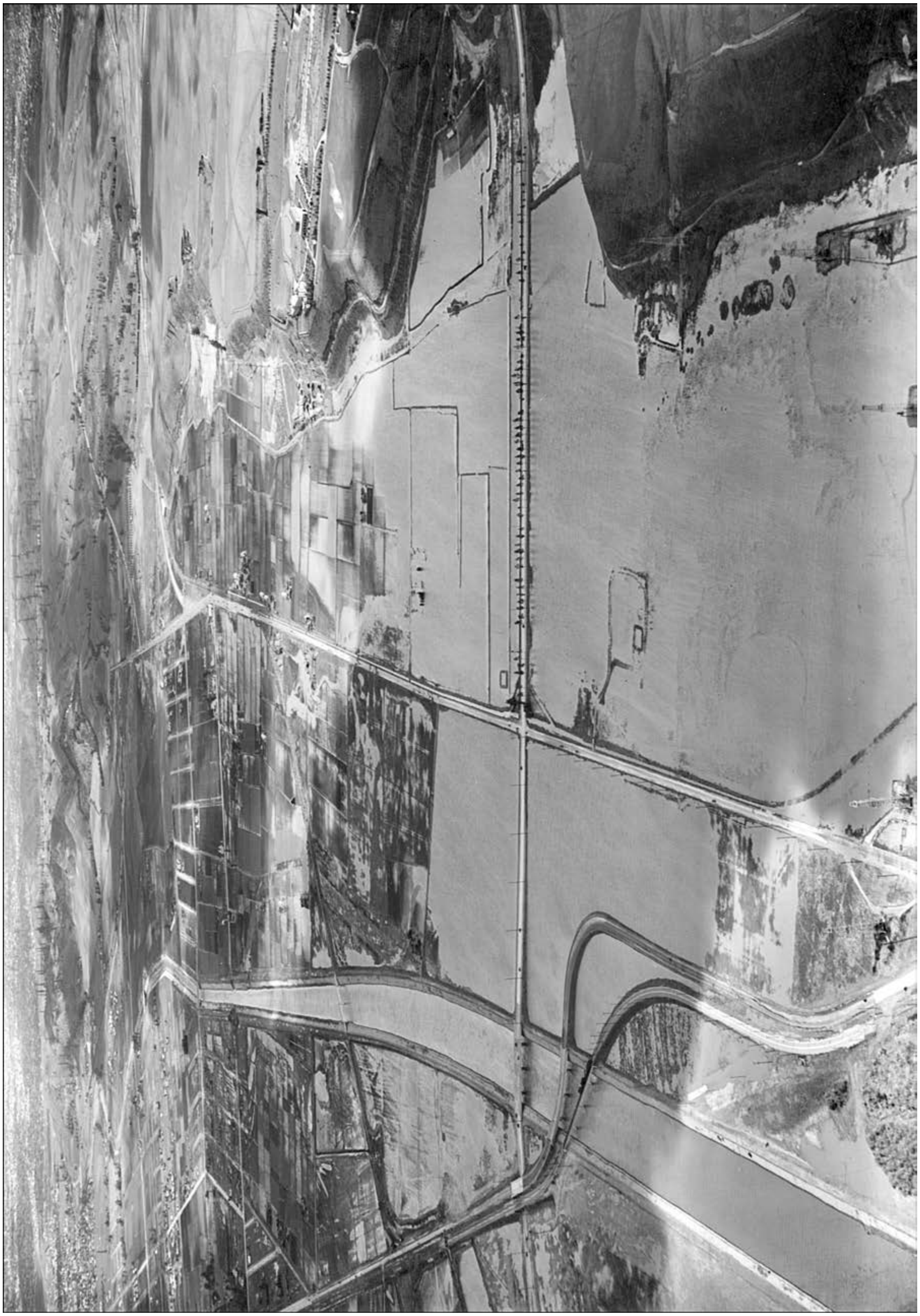

Figure 173. Aerial photograph of the western portion of the PVAHP project area, inundated in the 1938 flood (courtesy of the Benjamin and Gladys Thomas Air Photo Archives, Spence Collection, Department of Geography, UCLA).

continuous cycles of wetting and drying had some negative effects on the preservation of particular types of archaeological resources. The possibility that certain types of organic materials were leached from anthropogenic soils has certainly been discussed by SRI geomorphologists and archaeologists, and it is a subject that deserves further investigation.

By far, the most-damaging effects to the archaeological record have been impacts from historical-period and modern farming, ranching, and industrial activities. During the early historical period, during which cattle grazing was the primary economic endeavor, the Ballona remained relatively undeveloped, with only a few structures dotting the landscape (see Stoll et al. [2003] for a detailed discussion). Adobe and thatched structures, as well as associated corrals, appear to have been the only structures that existed for many years until the early twentieth century. Although it is unlikely that the living quarters of landowners and their personnel had much of an impact on the landscape, cattle grazing surely did. Grazing of vast tracts of land in the Ballona surely affected drainage patterns, as protective brush was depleted on hill slopes and in the floodplains. The effects of that type of activity have been documented throughout the southwestern United States, especially in California. The effects on sites in the Ballona were likely related to increases in siltation rates, as native plant communities that acted as natural barriers to slope wash were denuded by herds of cattle. At some level, that increased siltation may have actually worked to preserve archaeological materials, as large flows of colluvial materials scoured from the bluffs above covered those deposits during episodes of heavy rains. Aerial photographs from the modern period showed that kind of siltation even after the channelization of many of the drainages.

It was not until the early twentieth century that a significant amount of development was seen in the Ballona. One of the first major projects to affect cultural resources in the Ballona was large-scale construction activity associated with the placement of the North Outfall Sewer line in 1924. The sewer line ran along the base of the Ballona Escarpment, across the project area. That major undertaking resulted in the development of an artificial slope to support the massive line, and later, an access road was added. The artificial slope covered archaeological deposits along the base of the bluffs that were likely exposed or near the natural surface at the time. It is unknown how much preparation or excavation may have taken place that would have impacted the deposits as the sewer line was being constructed.

A review of aerial photographs and USGS topographic maps showed an increased amount of development in the Ballona area during the mid- to late 1920s (Figure 174). From archival research, it is clear that the area of Locus A saw a significant amount of activity through ranching and farming and later construction activities associated with the HHIC. In Figure 174, a fairly large hog farm and associated structures can be seen in the locations of Loci A and G, and other structures can be seen in the distance, in the area of Locus D. Later photographs have shown that agricultural fields covered much of Locus A and the surrounding project area and were placed in and around the then-unchannelized Centinela Creek (see Figure 102). It is unknown how much earthmoving activity was conducted during those early farming and ranching ventures. In Figure 174, it appears that little or no grading was done in Locus A; in fact, structures seem to simply have been built on the existing slope. Later photographs have shown a portion of the slope still intact, although it appeared that there was some amount of leveling of the area where bean fields were planted. Although it is clear that fields were tilled and disked, it is unknown how much of the archaeological deposit at LAN-62 was disturbed. During excavations, it was clear that the upper portion of the deposit had been truncated and mixed. It was assumed at the time that it was the result of plowing and/or disking related to agricultural activities.

Probably one of the most significant impacts to LAN-62 was the excavation of a large trench through a portion of the burial area in Locus A. That trench (labeled Feature 16 during fieldwork) appeared to have been mechanically excavated and cut through the northeastern portion of the burial ground. It is unknown when the ditch was excavated, and a review of aerial photographs dating to the late 1920s was not successful in pinpointing an excavation date; however, the feature appears to have been visible as late as the 1940s (Figure 175). It is possible that the ditch was created or improved during the installation of the North Outfall Sewer line in 1924, but clear evidence is lacking. Feature 16 was likely responsible for the destruction of numerous burial and nonburial features. Some burial features were partially covered in the bluff sands that made up the fill of the ditch. Large numbers of artifacts were found in the Feature 16 fill, including artifacts as large as whole metates and middens containing shell and bone. The ditch was in excess of 3 m on the surface and narrowed significantly at its bottom, forming a V-shape. Figure 176 illustrates the cross section of Feature 16 as exposed during data recovery excavations. The ditch was likely excavated with heavy equipment, as evidenced in the damage to certain artifacts in the form of scrape marks. Initially, the fill was piled to the western side of the ditch, as shown in the 1948 site record (Luhrs and Ariss 1948) (see Figure 140).

For many years, collection by amateur archaeologists and others interested in Native American artifacts has taken place at the site and in the region. Peck and Rozaire and Belous all described that activity in their reports. In Rozaire and Belous' map of the site, looters' pits were shown in several locations along the base of the bluffs, on the toe of the slope (see Figure 141). Looting was common in the Ballona and likely resulted in the excavation of a fairly large number of human burials and other materials. It appears that much of that looting took place on the slopes above the excavations in the various loci of LAN-62. The large amount of natural and human-made fill that covered the central portion of the site probably protected the main burial area. In fact, early accounts of the site failed to indicate intact site deposits in the densest portion of the burial ground.

Figure 174. Oblique aerial photograph taken February 4, 1929, showing Lincoln Boulevard and LAN-62 (courtesy of the Benjamin and Gladys Thomas Air Photo Archives, Spence Collection, UCLA Department of Geography; Negative No. E-2450).

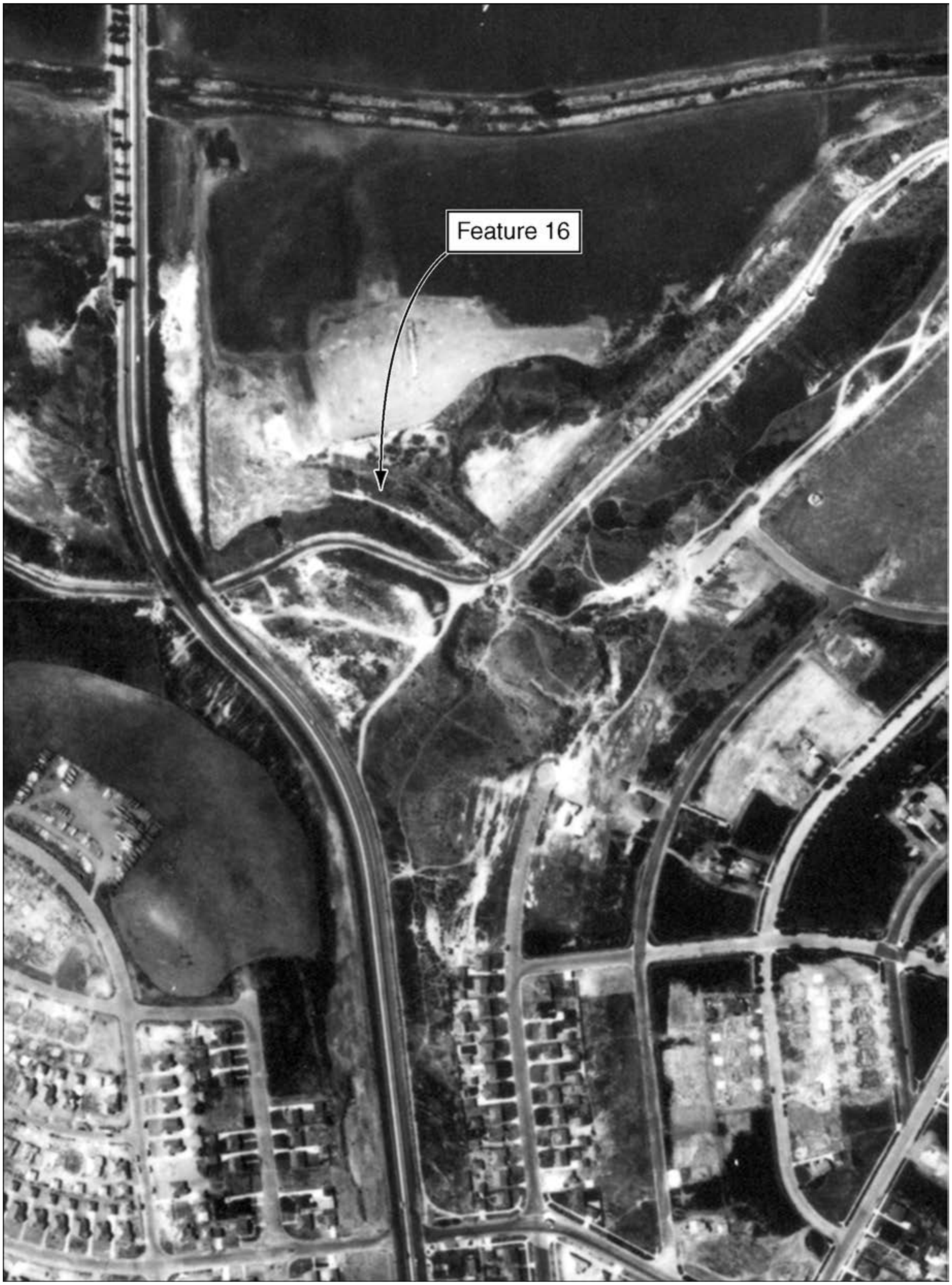

Figure 175. 1946 aerial-photograph close-up possibly showing Feature 16 (courtesy of the Benjamin and Gladys Thomas Air Photo Archives, Fairchild Collection, UCLA Department of Geography; Flight C-10622, Frame 1:42).

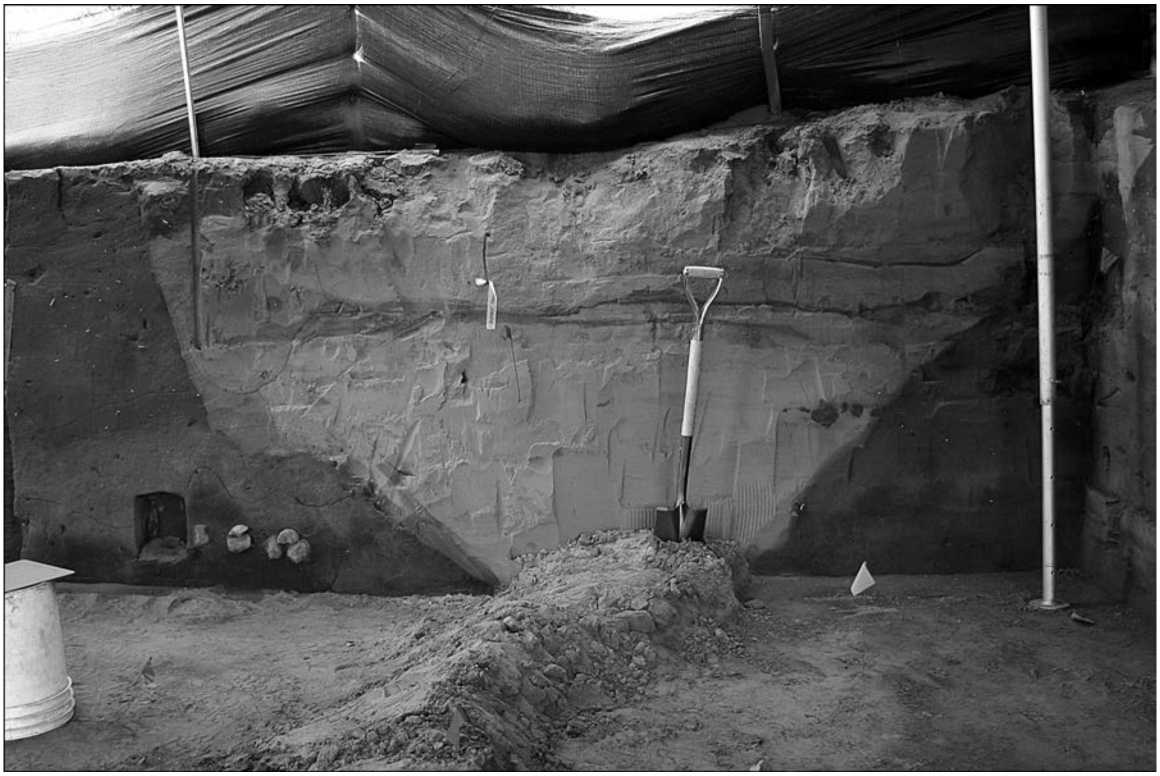

Figure 176. Photograph of the profile of Feature 16, LAN-62 Locus A, during data recovery excavations in 2003/2004, view to the east.

The development of the HHIC probably had the most-significant impacts to cultural materials in the PVAHP project area. Hughes Aircraft Company moved massive amounts of soil from the bluff tops and in the lowlands to erect large buildings and the runway spanning the length of the property. Peck (1947) detailed the removal of soils from LAN-62 (likely Locus B) for the purposes of constructing and maintaining the runway. Loci B, C, and D seem to have been most affected by Hughes Aircraft Company–related activities; Locus A seems to have been somewhat spared from the effects of those activities. Archaeological deposits on the toe slope and below appeared to have been removed or severely truncated in Loci B, C, and D. Archival research has detailed direct evidence of that activity in progress, including the oblique photograph shown in Figure 139, as well as details of the removal of site material for the runway recorded by Peck (1947). Detailed soils studies during data recovery operations at the various loci detailed the nature of those truncated deposits. It is clear that much of those deposits was transported to the runway as fill material. Monitoring in those areas revealed redeposited archaeological material at locations such as LAN-2676 and LAN-1932.

Cultural Stratigraphy

In the discussions that follow, details on the nature of disturbance at each locus are presented.

Methods

We employed two approaches to inferring an occupation sequence at LAN-62. First, many features and groups of contiguous CU levels were assigned to specific periods or episodes based on various sources of information, primarily chronometric data (calibrated radiocarbon dates), the presence of time-sensitive artifacts (e.g., temporally diagnostic shell beads, glass beads, and European-derived plant and animal domesticates), and stratum associations. Those methods were used to assign features and CU levels to specific occupation episodes and to more-broadly defined periods.

A second approach to inferring a chronological sequence was employed specifically for the burial area in Locus A. Stanton and colleagues designed a relational diagram to model and infer the complex relationships among the hundreds of tightly clustered burial and nonburial features in the burial area; it was labeled the Feature Relationship Empirical Diagram (FRED) and is similar to a Harris matrix (see Chapter 4, Volume 4, this series). To implement this study, SRI developed a means of incorporating feature spatial-relationship data into a database that generated a relational diagram for each feature, using visualization software. Here, in the first subsection, we discuss the broader period and episode assignments, and in the second subsection, we provide a brief overview of the implementation of FRED to model features within the burial area.

Chronometric Studies and Episode Assignments

To examine the correlation between the depositional history and human occupation, we plotted the elevations of excavated features and cultural materials recovered from the units relative to the natural stratigraphic horizons. In total, 98 organic samples were submitted for radiocarbon dating: 90 samples from Loci A and G and 8 from Loci C and D. Most of the samples were marine-shell fragments from abalone, olivella, scallop, oyster, venus clam, littleneck clam, and pismo clam. Additional dated materials included bone gelatin (artiodactyl), soil humates, and charred seeds (barley and canarygrass).

The radiocarbon samples from Locus A and G included organic specimens from 15 CUs and 22 features (see Appendix 9.9, this volume). Eighty-five specimens were marine-shell fragments, 3 were botanical remains, and 2 consisted of bulk-sediment samples. The sediments and 24 of the shell samples were analyzed through radiometric analysis with extended counting; the remaining 71 samples were submitted for AMS analysis (see Chapter 3, this volume). Radiocarbon assays from Loci C and D were obtained for 8 organic samples recovered from 5 CUs and 1 feature (see Appendix 9.10, this volume). Radiocarbon assays for 3 of those samples were derived from AMS analysis, and the other 5 were derived from radiometric analysis, with extended counting.

In this section, we mainly summarize Lengyel's episode assignments for a subset of features and CU levels at LAN-62. Lengyel's analyses revealed eight relatively discrete occupation episodes that predated the late-historical-period land use of the Ballona. We have added two more occupation episodes that cover spans of land use and occupation during the late historical period. The episodes are numbered 1–10, and Episode 1 represents the earliest component. Lengyel grouped Episodes 6–8 into discrete "subepisodes" designated with letters (a, b, and c). The subepisodes were statistically less separable and distinct than the broader episode assignments, and all exhibited sigma ranges that overlapped. Lengyel's ability to statistically distinguish subepisodes was contingent upon which reservoir correction was applied (see Chapter 3, this volume). For instance, when one correction algorithm is applied, subepisodes may be statistically distinct, but that may not be the case when the other algorithm is applied.

The following episode and subepisode designations were standardized across loci to facilitate site-wide comparisons. Also reported are the period assignments and calibrated sigma ranges:

- Episode 1: early Millingstone period (4990–4280 cal B.C.)
- Episode 2: late Millingstone period (3010–2320 cal B.C.)
- Episode 3: late Millingstone period (2680–1720 cal B.C.)
- Episode 4: late Millingstone/early Intermediate period (2580–500 cal B.C.)
- Episode 5: early Intermediate period (1250–200 cal B.C.)
- Episode 6: early Intermediate period (880 cal B.C.–cal A.D. 250)
  - Subepisode 6A (880–10 cal B.C.)
  - Subepisode 6B (700 cal B.C.–cal A.D. 250)
- Episode 7: late Intermediate period (cal A.D. 250–980)
  - Subepisode 7A (cal A.D. 160–720)
  - Subepisode 7B (cal A.D. 450–980)
- Episode 8: late prehistoric and Historical periods (cal A.D. 1190–1900s)
  - Subepisode 8A (cal A.D. 1190–1680)
  - Subepisode 8B (cal A.D. 1450–1950)
  - Subepisode 8C (cal A.D. 1460–1950)
- Episode 9: Euroamerican period (A.D. 1848–1941)
- Episode 10: HHIC (A.D. 1941–1980s)

Note that the date ranges listed above for Episodes 1–8 incorporated the calibrated 2σ ranges derived from both the standard and age-specific ΔR values. The incorporation of both correction algorithms produced larger date ranges than would have been the case with only one algorithm, because the two corrections produced slightly different sigma ranges. For example, the sigma range for Episode 1 varied depending on whether the standard ΔR (4910–4320 cal B.C.) or age-specific ΔR (4990–4280 cal B.C.) was used to interpret the radiocarbon assays. The sigma range reported above incorporated the broader range covered by *both* correction algorithms, resulting in a "stretched" date range of 4990–4280 cal B.C. That reporting protocol also explains the substantial overlap in the date ranges for Episodes 2–6, which spanned the late Millingstone and Intermediate periods.

Importantly, many of the earlier episodes (Episodes 1–8) were combined into larger temporal units (generally by period) for the analyses of artifacts and ecofacts presented in this and other volumes (see Volumes 3 and 4, this series), including the features analysis below. For example, for many analyses, Episodes 2–4 and Episodes 5–7 were merged into more-broadly defined Millingstone and Intermediate period groups. One reason for the episode combinations was that in some cases, the finer episode and subepisode distinctions resulted in reduced sample sizes that rendered them impractical for artifact and ecofact analyses.

A second reason for combining episodes was that the resolution of the radiocarbon dates was not always sufficient to support detailed episode and subepisode distinctions. For example, the distribution of radiocarbon dates among the strata indicated no logical sequence (as evidenced in Appendixes 9.9 and 9.10, this volume). Several samples in deeper strata generated more recent dates than samples in the upper strata, which probably reflected the effects of bioturbation and vertical movement of dated materials among the strata. Many of the shell specimens from which radiocarbon assays were obtained may have been translocated by rodent activity. The fine-resolution episode distinctions therefore proved to be tenuous when analyzing the heavily mixed subsurface remains. We determined that it was more prudent to create diachronic units of analysis based on larger and more-inclusive groups of excavation levels to optimize chronological separation. Therefore, broader period distinctions were more appropriate for the analyses of features, artifacts, and ecofacts.

In contrast with Episodes 1–8, Episodes 9 and 10 were not defined based on chronometric data but on the presence of historical-period features and artifacts. The date range for Episode 9 does not represent a known occupation span within the site area but a broadly defined time range referred to as the Euroamerican period, which encompassed nearly a century, from the establishment of California statehood in 1848 to the founding of the HHIC in the early 1940s. Episode 10 represents a time span from the 1940s through 1980s during which Hughes Aircraft Company maintained its operations in the area.

Episode Descriptions, Loci A and G

In light of the complexity of the chronometric results in Loci A and G, we separately discuss the episode assignments for the Millingstone, Intermediate, and Late/historical periods, briefly describing the episodes here.

Millingstone Period (Episodes 1–4)

Episode 1, the earliest occupation, was associated with alluvial deposits in the deeper levels of Stratum IIb. Items used to define this episode included three shell specimens from a hearth in Locus G and selected levels in EU 115 and CU 321 in Locus A (see Appendix 9.9, this volume). The conventional dates for the three assays encompassed 230 radiocarbon years but were not statistically significantly different (see Chapter 3, this volume). The combined age for the shells was 4910–4320 cal B.C. (standard ΔR) or 4990–4280 cal B.C. (age-specific ΔR). Those sigma ranges encompassed a pooled range of 4990–4280 B.C., indicating an early Millingstone period occupation (ca. 6500–4000 B.C.). Roughly 1,400–1,700 calendar years separated Episode 1 from the subsequent Episode 2, indicating a possible occupation hiatus after Episode 1. No temporally diagnostic artifacts were recovered from the features or unit levels assigned to this episode.

Episode 2 was associated with alluvial-fan deposits in the upper levels of Stratum IIb. Radiocarbon assays from four shell specimens collected from two features and selected levels of two CUs were used to define this episode. The combined ages of the radiocarbon assays for Episode 2 were 2890–2370 cal B.C. (standard ΔR) and 3010–2320 cal B.C. (age-specific ΔR), which encompassed a pooled time range of 3010–2320 B.C. Episode 2 was separated from the beginning of Episode 3 by at least 140 radiocarbon years, although the calibrated ages for members of each group overlapped to some extent. Episode 2 was assigned to the late Millingstone period (ca. 3000–1000 B.C.).

Intermediate Period (Episodes 5–7)

Episode 5 was associated with alluvial-fan deposits in Stratum III. Radiocarbon assays from 15 shell specimens were used to define this episode. Those assays were calculated on shells recovered from one feature and specific levels of 10 CUs. The combined age for the shell specimens used to date Episode 5 ranged from 840 to 220 cal B.C. (standard ΔR) or 1250 to 570 cal B.C. (age-specific ΔR). Together, those ranges encompassed a pooled date range of 1250–220 cal B.C., likely indicating occupation during the first half of the early Intermediate period (ca. A.D. 1000 B.C.–A.D. 400). The date range for Episode 5 overlapped with that of Episode 6, but a tight clustering of dates that defined Episode 5 suggested a relatively distinct episode (see Chapter 3, this volume).

Episode 6 was associated with the alluvial-fan deposits in Stratum III. It was also the earliest episode in which Lengyel detected possible subepisodes of occupation, here labeled Subepisodes 6A and 6B. Radiocarbon assays from six shell specimens were used to define Subepisode 6A. Those samples were recovered from Feature 640 and levels in five CUs. The combined age range for the shell specimens used to date Subepisode 6A was 520–10 cal B.C. (standard ΔR) or 880–380 cal B.C. (age-specific ΔR). The sigma ranges for Subepisode 6A therefore indicated a pooled date range of 880–10 cal B.C., suggesting an early Intermediate period occupation.

Lengyel defined Subepisode 6B based on calibrated dates from four shell specimens recovered from three CUs in Locus A. Those assays produced a combined date range of 250 cal B.C.–cal A.D. 250 (standard ΔR) or 700–120 cal B.C. (age-specific ΔR), which rendered a pooled age range of 700 cal B.C.–cal A.D. 250, indicating occupation during the latter half of the early Intermediate period. Together, Subepisodes 6A and 6B encompassed an occupation span during the middle and latter parts of the early Intermediate period. Overall, Episode 6 was separated from Episode 7 by 240 radiocarbon years, although when the ΔR values for the two time periods were considered, the gap between the episodes stretched to nearly 500 radiocarbon years (340–690 calendar years).

Episode 7 was associated with the alluvial-fan deposits in Stratum IV. Lengyel was able to tentatively divide Episode 7 into Subepisodes 7A and 7B. Subepisodes 7A and 7B, and their separation into subgroups, were more statistically secure than Subepisodes 6A and 6B, because of the larger number of calibrated dates used to define them. Again, the subepisodes exhibited overlapping sigma ranges and rarely were factored into the materials analyses presented below or in subsequent volumes (see Volumes 3 and 4, this series), but the episode as a whole was well-defined: a gap of 580 radiocarbon years, or roughly 320–840 calendar years, separated occupation Episode 7 from the subsequent Episode 8.

Lengyel (Chapter 3, this volume) defined Subepisode 7B based on calibrated dates from six shell specimens recovered primarily from four features and specific levels of CU 141. Those assays produced a combined date range of cal A.D. 510–980 (standard ΔR) or cal A.D. 450–900 (age-specific ΔR) and a pooled age range of cal A.D. 450–980, indicating occupation during the late Intermediate period. Note, however, that two radiocarbon assays were obtained from Feature 688 (rock cluster), but only one of the two assays could be assigned to Subepisode 7B. The second radiocarbon assay produced a substantially later date range of cal A.D. 830–1180. Together, the pooled sigma ranges for Feature 688 suggested a possible age range from about A.D. 670 to 1100; for that reason, Feature 688 was ascribed to a transitional late Intermediate/Late period category.

On a broader level, a large number of features were assigned to a general "Intermediate" category. That group included the 13 features that composed FB 4, a cluster of rock concentrations, pits, and other subsistence-related features. No radiocarbon samples were directly obtained from that feature block; rather, it was ascribed to the "Intermediate" category based on its stratigraphic position and association. Also assigned to that broad category were Levels 93–99 of CU 1048 in Locus G.

Late, Protohistoric, and Mission Periods (Episode 8)

Episode 8 was associated with the alluvial-fan deposits in Strata IV and V, which extended from the alluvial bench to the former marsh. This broadly defined episode covered approximately 800 years and was defined by 27 dates obtained from a variety of materials and recovery contexts. Lengyel subdivided Episode 8 into Subepisodes 8A, 8B, and 8C, but only a small number of features and CU levels were assigned to one of those subepisodes.

Subepisode 8B was defined based on six radiocarbon assays from five shell specimens and one botanical sample. Those dated specimens were recovered from three rock clusters and levels in three CUs. The radiocarbon assays yielded sigma ranges of cal A.D. 1480–1950 (standard ΔR) and cal A.D. 1450–1850 (age-specific ΔR), with a pooled age range of cal A.D. 1450–1950, indicating a likely Protohistoric or Mission period feature deposition. Selected levels from CU 26 also were assigned to this subepisode.

Subepisode 8C was the youngest and most tentative of the three subepisodes of Episode 8 and, furthermore, was only statistically distinguishable when the age-specific ΔR correction was applied (see Chapter 3, this volume). Lengyel defined this subepisode based on radiocarbon assays on five shell specimens from five human burials. Those assays produced a combined date range of cal A.D. 1460–1820 (standard ΔR) or cal A.D. 1692–1950 (age-specific ΔR) and a pooled age range of cal A.D. 1460–1950, which was virtually identical to the combined age of Subepisode 8B. As noted above, however, standard ΔR is probably more accurate for abalone and olivella shell, suggesting the date range of A.D. 1460–1820, which encompasses the end of the Late period, the Protohistoric period, and most of the Mission period. In all, this subepisode would probably be better characterized as Subepisode 8B/C, in light of the temporal overlap with Subepisode 8B.

In addition to radiocarbon dates, several of the buried features assigned to Subepisode 8C contained temporally diagnostic shell beads and glass beads (see Chapter 6, Volume 3, this series). It is not clear whether the beads were deliberately interred with human remains (i.e., it is possible that they were translocated into the feature matrix as a result of bioturbation). The beads minimally offered additional lines of evidence for inferring the age range of the burials, but that information is tentative because of their questionable stratigraphic context.

Late Historical Period (Episodes 9–10)

The late-historical-period occupation in the Ballona encompassed two episodes: the Euroamerican period (1848–1941, Episode 9) and the Hughes era (1941–1980s, Episode 10), which broadly refer to the period of Euroamerican inhabitation of the region following California statehood in 1848. The Euroamerican period witnessed the development of the region as a major urban area on the outskirts of Los Angeles and the reorientation of the Ballona landscape from a rural ranching locus to, first, a locus for crop and hog farming and, eventually, an industrialized complex with an urban infrastructure. Historical documents and anecdotal evidence verified the presence of structures in the area along the base of the bluff during the late 1800s, probably residences for ranch hands or farm workers (see Stoll et al. [2003] for a detailed discussion) (see Figure 116). By the early twentieth century, Lincoln Boulevard had been constructed along the western edge of LAN-62 and may have disturbed archaeological resources. The early twentieth century witnessed increasing recreational use of the marshy area by residents of Los Angeles and other nearby cities along the coast.

Episode 10 represents the span from the 1940s through 1980s, during which Hughes Aircraft Company maintained its corporate headquarters in the PVAHP project area. The entire site was situated within the area of the former complex, but most of the company buildings and parking lots were located in the eastern part of the project area, near LAN-193 and LAN-211. Company construction efforts required leveling and flattening of the previously undulating landscape of the area along the bluff, resulting in removal or truncation of the subsurface archaeological deposits. That activity created a mosaic pattern of intact archaeological deposits in the region, but the burial area in Locus A was largely left intact.

Episode Descriptions, Loci C and D

Evaluation of eight radiocarbon assays from Loci C and D indicated four occupational episodes (see Chapter 3, this volume, for a detailed discussion of those samples). Episode 1, the oldest episode, was associated with alluvial-fan deposits in Stratum II. Radiocarbon assays were obtained from two shell specimens in CUs 724 and 540. Those assays produced a combined date range of 2860–1970 cal B.C. (standard ΔR) or 2890–1940 cal B.C. (age-specific ΔR). The pooled age range of 2890–1940 cal B.C. suggested occupation during the first half of the late Millingstone period (ca. 3000–1000 B.C.). The two shell samples were over 2,500 radiocarbon years older than the marine-equivalent conventional date for the long-bone fragment that defined Episode 2 (see below), indicating chronological separation between the episodes. Although defined as a single episode within Loci C and D, Lengyel (Chapter 3, this volume) assigned the level from CU 724 to Episode 2 in Loci A and G (which also served as the site-wide episode designations) and assigned the level from CU 540 to Episode 3. No temporally diagnostic artifacts were associated with this episode.

Episode 2 in Loci C and D was associated with alluvial-fan deposits in Stratum III. One radiocarbon date was obtained from an artiodactyl-long-bone fragment recovered in Feature 201 (animal burial), which generated a pooled age range of cal A.D. 420–560. The pooled age range indicated a late Intermediate period occupation (ca. A.D. 400–1000). Episode 2 postdated Episode 1 by 2,500 radiocarbon years and predated Episodes 3 by at least 660 calendar years, indicating a chronologically distinct occupation. No temporally diagnostic artifacts were associated with this occupation episode. Lengyel assigned this episode to Episode 7A in the site-wide chronology.

Episode 3 in Loci C and D was located within Stratum IV and was defined by a single radiocarbon date from a shell specimen from CU 534. The assay produced a combined date range of cal A.D. 1270–1450 (standard ΔR) or cal A.D. 1220–1420 (age-specific ΔR). The pooled age range of cal A.D. 1220–1450 suggested a Late period occupation. Episode 3 overlapped the earliest dates used to define Episode 4 by 30 calendar years (standard ΔR) and 90 calendar years (age-specific ΔR); however, the groupings were statistically discrete and likely indicated separate occupation episodes. No temporally diagnostic artifacts were associated with this occupation episode. Lengyel assigned this episode to Subepisode 8A in the site-wide chronology.

Episode 4 was associated with alluvial-fan deposits in Stratum IV. Radiocarbon assays from two shell specimens from selected levels of three CUs produced a combined date range of cal A.D. 1410–1890 (standard ΔR) or cal A.D. 1330–1950 (age-specific ΔR) and a pooled age range of A.D. 1330–1950. Those results indicated a Protohistoric or Mission period occupation. (*Note:* Lengyel expressed concerns about combining the four assays into a single group, because of the different marine reservoir effect for venus clams and abalone; see her discussion in Chapter 3, this volume, for details.) No temporally diagnostic artifacts were associated with this occupation episode. Lengyel assigned this episode to Subepisode 8C in the site-wide chronology, but Subepisode 8B/C would probably be more accurate.

The late-historical-period occupation of the site was briefly discussed in the previous section. It is worth pointing out, however, that four of the eight late-historical-period features were recorded in Loci C (n = 2) and D (n = 2). Those features included remnants of a structure and three trash deposits, all of which probably dated to the latter part of the Euroamerican period.

Stratigraphic Evaluations in the Burial Area

In this section, we briefly outline the chronological information derived from Stanton and colleagues' analyses of stratigraphic and diachronic relationships among features in the burial area, using FRED, which was designed as an exploratory tool for identifying and defining vertical and horizontal spatial relationships among features in the burial area in Locus A (see Chapter 4, Volume 4, this series). It is a derivative of a Harris matrix, which Harris (1979) designed in the 1970s to understand complex stratigraphic sequences at archaeological sites in Winchester, England. A Harris matrix is a graphic diagram in which earlier archaeological deposits are shown on the bottom, later deposits are represented on the top, and archaeological contexts whose sequential relationships cannot be determined via direct observation of site stratigraphy are plotted at the same level. One limitation of the Harris matrix, however, is that it defines relationships exclusively on stratigraphic relationships and does not incorporate other chronological information, such as chronometric data and time-sensitive artifacts.

FRED was designed to take into account stratigraphic relationships as well as other chronological information. These data provide a means of defining relationships among features when stratigraphic positioning alone is unclear. To implement FRED, an assortment of chronological and stratigraphic information is entered into a relational database that allows users to define temporal relationships among features (i.e., whether Feature X is earlier or later than Feature Y) based on a suite of data. Temporal relationships among multiple features can be illustrated graphically using visualization software. For a detailed discussion of operational procedures and results of FRED, please see Volume 4, this series.

FRED was used to classify burial and nonburial features within the burial area into one of five groups: Mission period, Protohistoric period, prehistoric, historical period (broadly speaking), and indeterminate. The majority of features were classified as Mission period or prehistoric, and relatively few were classified as Protohistoric period. FRED also was used to define subgroups of features, comparable to Lengyel's episodes and subepisodes, but with different and more-comprehensive input data. Stanton and colleagues defined a number of subgroups of burials within the burial area (see Chapter 4, Volume 4, this series). Although all of the subgroups dated to the broader Mission period, they were able to infer probable earlier and later interments among the subgroups. For instance, they inferred that their Subgroup 3, situated along the western edge of the burial cluster, probably was made up of some of the earliest Mission period burial features at the site. Also, in Subgroup 1, they found that the earlier interments were situated above the later interments, which is attributable to disturbance of earlier burials during later interment episodes.

The results of analyses based on FRED were integrated into the final period assignments for artifact, ecofact, and other analyses of features in Locus A. It helped to generate possible temporal groups and subgroups within the burial area, but the algorithm was not used to infer finer period distinctions for features that predated the burial area; again, those were broadly classified as “prehistoric.” Final episodes were based on a consensus among the Playa Vista analysts and on chronometric data, time-sensitive artifacts, stratum associations, and, where possible, the inferences generated from FRED.

Summary and Final Period Assignments

The chronostratigraphic and geoarchaeological studies shed new light on both the natural and cultural history of LAN-62. The geoarchaeological studies highlighted natural site-formation processes at LAN-62. Detailed analyses of soil changes and stratigraphy revealed changes and gradual changes in sedimentation processes, including the formation of the marshland and riparian environments and the subsequent process of alluvial- and colluvial-fan development along the base of the bluff. The geochemical studies focused on variations in the conditions of organic preservation of bone and other materials. Generally, the soils proved to be relatively alkaline and conducive to the preservation of bone, an especially important finding in light of the prevalence of human burials within the site boundaries. Finally, these studies also revealed substantial bioturbation in the site area, mostly attributable to rodent activity, which accounted for the extensive mixing of subsurface remains, which could explain, for example, the frequent lack of correlation between radiocarbon dates and stratum locations of sample materials.

The geoarchaeological study also focused on cultural formation processes, including analyses of organic-content and phosphorous levels, both of which are sensitive to human occupational intensity. Organic-content and phosphorous levels increase as a result of many human activities, such as discard of food debris or decomposition of shelters or other constructions made with perishable materials. Areas of peak phosphorous and organic content indicated likely occupation events or episodes within the subsurface strata in Loci A, C, and D, predominantly Locus A. In addition, geoarchaeological studies also highlighted patterns of postdepositional human disturbances, especially disturbance and truncation that resulted from the widespread earthmoving activities of Hughes Aircraft Company in the mid-twentieth century.

The cultural stratigraphic studies summarized here focused on the history of human occupation at LAN-62. In total, 98 radiocarbon assays were obtained for LAN-62, most from Locus A. Based on the chronometric data, Lengyel (Chapter 3, this volume) identified eight episodes of occupation at LAN-62 that spanned nearly 7,000 years from the early Millingstone period (ca. 5000 B.C.) through the Mission period in the late A.D. 1700s and early 1800s. However, a small number of features were included in Lengyel’s analysis, which necessitated an assessment of period assignments from a larger number of features, using more-broadly defined period designations, specifically the Millingstone, Intermediate, late Protohistoric, Protohistoric/Mission, and Mission periods. The narrowly defined episode assignments proved to be impractical for the analyses of artifacts/ecofacts and features, including the feature study presented below.

One major problem with the calibrated radiocarbon-dating results concerned the narrow time ranges of the Late period (A.D. 950–1540), Protohistoric period (A.D. 1540–1770), and Mission period (A.D. 1770–1830). The three periods witnessed substantial social, cultural, and demographic changes, and understanding those important changes hinges on our ability to distinguish them chronologically. However, the sigma ranges rarely provided sufficient resolution to make such distinctions. For example, the sigma ranges generated from all of the later assays encompassed at least two of the periods and sometimes all three; several obtained sigma ranges extended from the A.D. 1300s and1400s through the 1800s and 1900s (when both reservoir corrections were applied), which indicated dates of deposition in the Late, Protohistoric, Mission, or post-Mission period. In those cases, the results of FRED and the presence of temporally diagnostic materials proved to be invaluable. Even so, many features had to be assigned to a broadly defined Late/Mission period group, because they lacked diagnostic artifacts and/or because their stratigraphic relationships were problematic.

The later period assignments were therefore inferred based on multiple lines of evidence, including calibrated radiocarbon dates, time-sensitive artifacts or other materials, stratum locations, and, for the burial areas, the results generated from FRED. Time-sensitive artifacts included temporally diagnostic styles of shell beads, glass beads, and projectile points. The presence of other time-sensitive materials indicated a likely date in the Mission period (or, arguably, the Protohistoric period), including glass beads, stone *comales* (cooking griddles), and European plant and animal domesticates. The results of the FRED analysis also provided a means of distinguishing earlier from later components within the broadly defined Late/Mission period for the burial area. Note, however, that the presence of time-sensitive materials is not always conclusive, because some materials could have been secondarily deposited in a feature matrix as a result of bioturbation or other forms of subsurface disturbance.

The final period assignments are listed in Appendixes 9.11 and 9.12, this volume. Appendix 9.11 lists the final assignments for human burials only, excluding features for which period assignments were not inferable. Appendix 9.12 lists final assignments for nonburial features, again excluding the unassigned cases.

Late-historical-period occupations (Episodes 9 and 10) covered the era of early ranching and farming in the site area (Euroamerican period) and, later, the establishment of the HHIC and an urban transportation infrastructure in the area (Hughes era). Eight features recorded in the site area probably dated to the latter portion of the Euroamerican period, in the early twentieth century. No clear archaeological evidence of earlier late-historical-period occupation was uncovered during the data recovery, but much of the evidence may have been obliterated by the construction and earthmoving activities of Hughes Aircraft Company.

Geophysical Results

Results of the magnetic-gradient work indicated a significant impact to the site by modern activity. Much of the eastern 10 m and northern 5 m of the survey area was heavily covered in asphalt, which produced a strong remnant magnetic signature (see Figure 145). A test of a large piece of the asphalt produced readings well above 100 nT. Therefore, archaeological features were obscured, and little information could be revealed in areas that contained abundant asphalt. To simplify that, the areas with heavy concentrations of asphalt were removed from the imagery and were not analyzed further (Figures 177 and 178).

In addition to asphalt, another modern feature visible with the magnetic-gradient imagery was spoil from heavy equipment that had graded soil in the area while removing fill from the site. Although many of the spoil piles were small and easily walked over during the magnetic survey, they were visible as high and low alignments, possibly because of high iron content in the soil. In addition, an elevation drop associated with a ledge created by heavy machinery produced a strong signature visible in the middle of the survey area.

Despite the visibility of spoil piles and asphalt, several magnetically high anomalies were visible that may have been related to archaeological features (see Figures 177 and 178). In terms of amplitude, the possible features are much weaker than asphalt and are in the range of 2–5 nT, which is consistent with subtle archaeological features, such as pits. Also, they crosscut heavy-machinery spoil piles visible in the imagery. One particularly noticeable arrangement of these was centered in the southwestern portion of the magnetic-gradient survey area and consisted of a parameter of magnetic highs surrounding a magnetic low.

Four of the anomalies that were outside the area to be excavated during data recovery were shovel tested following the geophysical survey. Two of those areas yielded basalt, possibly fire affected, that was not local and was cultural in origin. A test on a piece of basalt produced readings of 5–10 nT.

After excavation of LAN-62 Locus A, where the magnetic-gradient survey occurred, SRI tested the proposed feature locations through analysis of what had been identified in these areas. Because the geophysical survey area was located on top of the burial area at LAN-62, SRI hypothesized that the areas identified in the survey as possible features may have related either to burial features or to metal objects.

As one can see in Figure 177, which illustrates the geophysical-survey results overlaid by burial features, there does not appear to be a high correlation. The high density of burials within the geophysical-survey area, including many very close to the surface that were studied using geophysical methods, suggests that burial features, which consist mainly of burials in pits, are not reflected in Figure 177. In Figure 178, we illustrate the results of geophysical survey with either individual pieces of metal (or recorded as such) or EUs with pieces of metal. The vast majority of the metal found in that portion of the site was associated with burials. As shown in Figure 178, there appears to have been no close correlation between the interpreted prehistoric features and the metal objects.

In conclusion, then, it appears that, although the geophysical survey was affected by modern disturbances, such as asphalt, spoil piles, and uneven ground from heavy machinery, many anomalies that may represent prehistoric features were identified. Comparison of the geophysical features to actual features identified, however, suggested that the possible features identified did not represent actual features, and the survey did not identify the large, dense burial area in the central portion of the survey area.

Midden-Constituent Analysis

A number of EUs from Loci A, C, D, and G were selected for detailed analysis, to acquire a sample of materials from midden deposits, and those EUs are referred here to as CUs. The CUs were excavated in 10-cm arbitrary levels that were subsequently assigned to the natural and cultural strata identified at the site. In this section, we analyze and discuss changes in artifact and ecofact frequencies (lithics, faunal bone, and shell) and how they varied by occupation episode. The purpose of the analysis was to detect spatial and diachronic trends in the midden remains and distinguish periods of low- and high-intensity midden creation.

Radiocarbon samples were obtained from many of the unit levels and provided a means of assigning levels to episodes or periods. In Locus A, the 10-cm excavation levels were assigned

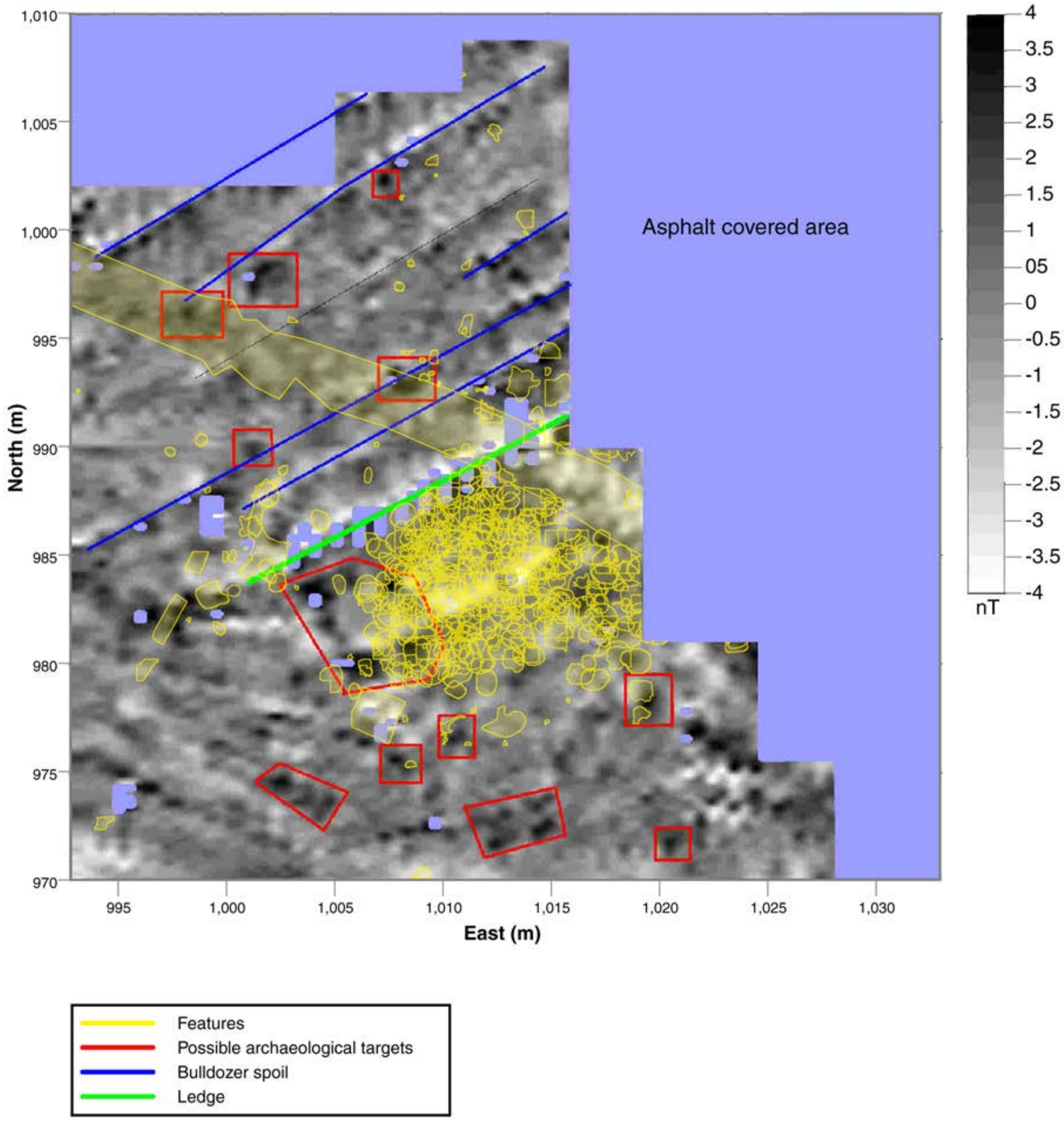

Figure 177. Figure showing the relationships between the geophysical results, including the hypothesized feature locations, and the actual locations of burial features, LAN-62.

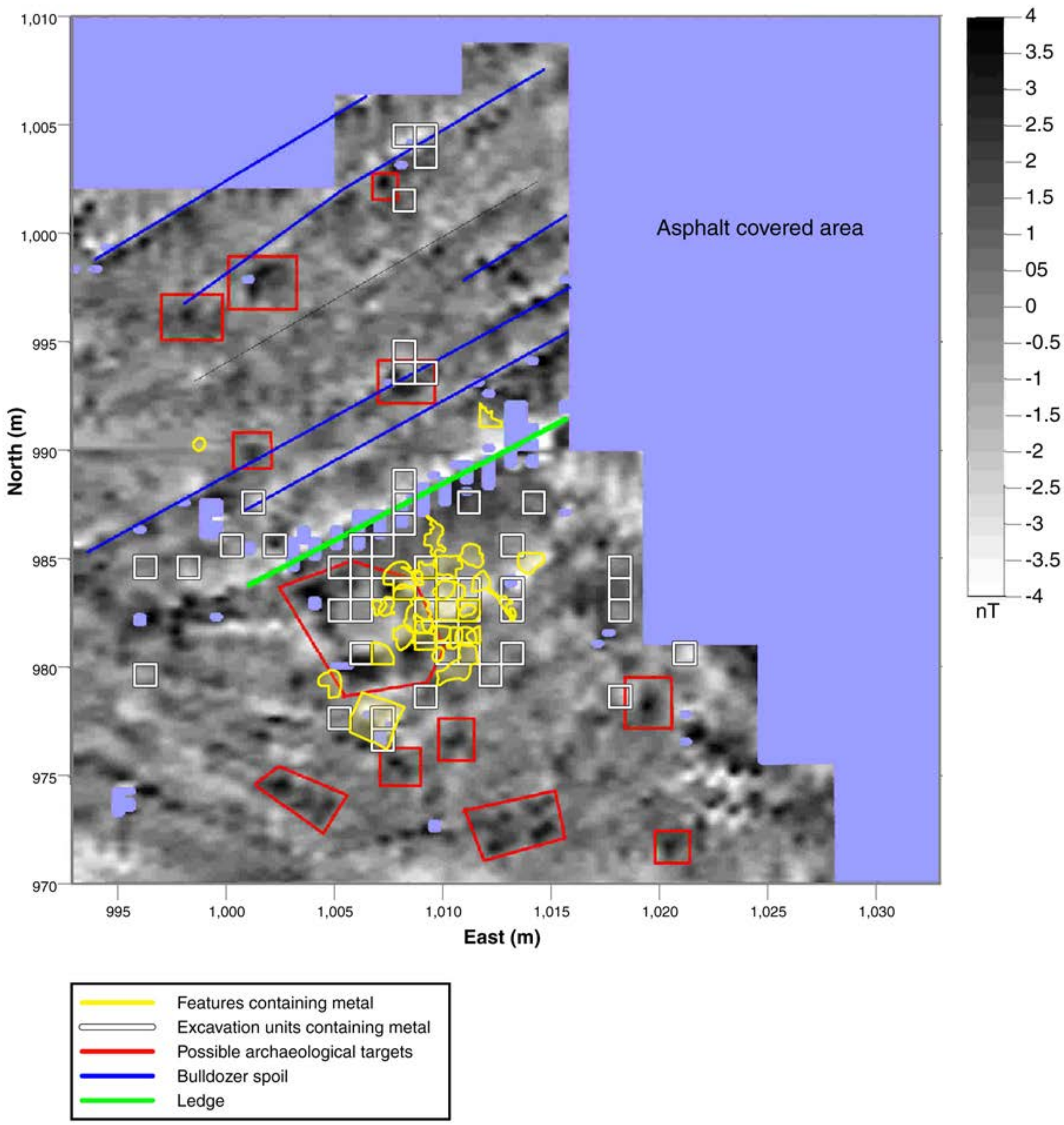

Figure 178. Figure showing the relationships between the hypothesized feature locations from the geophysical results and the locations of features with metal artifacts, LAN-62.

to specific occupation episodes (see Chapter 3, this volume). We did not include Lengyel's subepisode designations in our analysis, however, because they included only a small number of levels, which severely limited their effectiveness for robust analysis of subsurface trends. Most of the unit levels (or groups of levels) were assigned to broader episodes or, in many cases, composite episodes, such as Episode 5/6 or 7/8; those composite groups indicate that the chronostratigraphic information was insufficient to make more-specific episode assignments.

In contrast to Locus A, the CU levels in Loci C, D, and G were assigned to broader periods rather than the specific episodes. In Loci C and D, all but a few of the excavated levels were assigned to the Late or Late/Mission period (Episode 8 in Locus A), which lessened the need for finer-grained episode distinctions. Here, we separately discuss the results of the midden-constituent analysis for Loci A and G, in the western portion of the site, and the results for Loci C and D, to the east, along the base of the bluff.

Loci A and G

Below, we detail the analytical procedures, episodes of peak occupation, and spatial patterns for Loci A and G.

Analytical Procedures

Six CUs were selected for midden-constituent analysis: five in Locus A and one in Locus G (see Figures 157 and 152, respectively). The number of levels assigned to each episode varied among the six CUs. For instance, Episode 1 (early Millingstone period) was only defined in the deepest levels of CU 321/323, and none of the units that included unit levels or groups of levels was assigned to Episode 4 (late Millingstone/early Intermediate). By contrast, Episodes 2 or 3 (late Millingstone period) were defined in all but one of the units, Episodes 5 or 6 (early Intermediate period) were defined in four units, and Episode 8 was defined in all of the units. Episode 7 (late Intermediate period) was defined only in CU 141, although levels in several units were assigned to composite Episode 5/6/7 or 7/8.

Table 49 lists the densities of lithic artifacts (count), vertebrate-faunal remains (number of individual specimens), and invertebrate-faunal remains (weight); the densities are the counts or weights per cubic meter for each episode in the six CUs. Note that several unit levels or groups of levels were excluded from the per-episode density calculations, because of their ambiguous chronological assignments. Figures 179–184 graphically illustrate changes in artifact/ecofact densities by time period for each of the CUs. We illustrate densities on a per-episode basis in the figures below, in order to show variability in artifact densities by time period. Rather than graphically presenting the level-by-level data, which we believe offers more noise in the data because of heavy bioturbation of the sites, we focused on the larger-picture episodes, to understand changes in material culture across time.

Episodes of Peak Occupation

Figure 185 illustrates the total density per episode for Loci A and G (some episodes were grouped together because of overlapping episode assignments). The bars indicate the density of each artifact/ecofact category by episode. Most evident in Figure 185 are much higher densities of invertebrate remains from Episodes 5–8 (early Intermediate through Late/Mission periods) and the much higher densities of vertebrate remains in the Late/Mission periods relative to the late Intermediate period. Figure 185 suggests that there was a surge in occupational intensity during the Intermediate period, culminating in the densest occupation during the Mission period.

Figure 185 also shows that shell remains were absent from the deposit from the earliest episode (early Millingstone period) and constituted only a small percentage of the Episode 2/3 deposit (late Millingstone period). However, shell percentages roughly doubled in proportion in the three later episodes, with a spike during the Intermediate period. Shellfish was rarely exploited during the Millingstone period but became a more central component of the diet during the Intermediate and subsequent periods. Increased consumption of shellfish may reflect changes in environmental conditions from the Millingstone to Intermediate period, during which the Ballona shifted from a brackish, open-estuary environment to a lagoonal estuary environment increasingly fed by freshwater sources, after about 4000 B.C.; that change may have facilitated shellfish availability in the area.

Vertebrate faunal density was extremely high relative to the other artifact/ecofact categories during the Millingstone period, but this was the result of the absence of shellfish in the diet. Vertebrate faunal density increased dramatically in the early Intermediate period, when invertebrates were introduced into the diet and occupational intensity increased. Surprisingly, vertebrate faunal density decreased in the subsequent late Intermediate period, when shell consumption increased dramatically. Vertebrate faunal density increased once again in the Late/Mission period, as the diet appears to have been balanced better between vertebrate and invertebrate fauna. The proportion of flaked stone in the assemblage peaked in Episode 1 and declined rapidly thereafter; however, Figure 185 suggests the highest density of flaked stone was in the late Intermediate period. To some extent, the higher proportion of flaked stone in the Millingstone period reflected the dearth of shell, but the low proportion in Episodes 7/8 and 8 may suggest a legitimate change in stone-tool-processing or conservation practices during the Late/Mission period.

Table 49. Artifact/Ecofact Density per Occupationa Episode and Cultural Period in Six CUs, LAN-62 Loci A and G

			Lithic Artifacts				Vertebrate Fauna		Invertebrate Fauna	
CU No. (1 by 1 m), by Locus	Episode No. or Cultural Period	Volume (m^3)	Flaked Stone Count (n)	Flaked Stone Density (n/m^3)	Ground Stone Count (n)	Ground Stone Density (n/m^3)	NISP	Density ($NISP/m^3$)	Weight (g)	Density (g/m^3)
Locus A										
CU 141	8	0.30	172	573.3	1	3.3	2,187	7,290.0	182.1	607.0
	7/8	0.60	181	299.7	2	3.3	3,307	5,475.2	286.6	474.5
	7	0.60	149	248.3	6	10.0	2,589	4,315.0	1,225.5	2,042.5
	5	0.60	234	390.0	3	5.0	1,330	2,216.7	1,431.0	2,385.0
	3	1.10	324	294.5	10	9.1	5,677	5,160.9	557.7	507.0
Subtotal		3.20	1,060	330.8	22	6.9	15,090	4,709.7	3,682.9	1,149.5
CU 316	8	0.72	259	362.2	—	—	4	5.6	2,767.6	3,870.8
	7/8	0.10	39	390.0	—	—	—	—	648.3	6,483.0
	5/6	0.60	438	730.0	2	3.3	4	6.7	2,588.0	4,313.3
	3	0.60	236	393.3	—	—	6	10.0	249.3	415.5
Subtotal		2.02	972	482.4	2	1.0	14	6.9	6,253.2	3,103.3
CU 321/323	8	0.66	459	698.1	7	10.6	3,679	5,595.4	983.6	1,496.0
	5/6	1.10	355	322.7	2	1.8	2,387	2,170.0	836.5	760.5
	2/3	0.90	442	491.1	4	4.4	3,959	4,398.9	1,661.9	1,846.6
	2	0.70	191	272.9	3	4.3	1,076	1,537.1	199.1	284.4
	1[a]	0.32	46	143.8	—	—	73	228.1	—	—
Subtotal		3.68	1,493	406.0	16	4.4	11,174	3,038.5	3,681.1	1,001.0
CU 682	8	0.16	62	400.0	—	—	—	—	1,015.1	6,549.0
	5/6/7	0.90	385	429.0	9	10.0	6	6.7	4,589.9	5,114.1
	5/6	0.36	110	305.6	7	19.4	—	—	292.6	812.8
Subtotal		1.41	557	394.3	16	11.3	6	4.2	5,897.6	4,175.3
CU 853	8[b]	0.32	20	62.5	2	6.3	509	1,590.6	234.6	733.1
	6	0.60	69	115.5	1	1.7	468	783.3	289.1	483.8
	3	0.11	17	154.5	—	—	13	118.2	1.1	10.0
Subtotal		1.03	106	103.2	3	2.9	990	963.5	524.8	510.8

continued on next page

CU No. (1 by 1 m), by Locus	Episode No. or Cultural Period	Volume (m^3)	Lithic Artifacts				Vertebrate Fauna		Invertebrate Fauna	
			Flaked Stone Count (n)	Flaked Stone Density (n/m^3)	Ground Stone Count (n)	Ground Stone Density (n/m^3)	NISP	Density ($NISP/m^3$)	Weight (g)	Density (g/m^3)
Locus G										
CU 1048[c]	8	0.30	21	70.6	—	—	33	110.9	1.0	3.4
	7/8	0.13	36	266.7	1	7.4	163	1207.4	1.2	8.9
	5/6/7	0.78	497	639.2	2	2.6	1,147	1475.2	303.4	390.2
	2/3	0.10	47	470.0	—	—	94	940.0	—	—
Subtotal		1.31	601	458.8	3	2.3	1,437	1,096.9	305.6	233.3

Key: NISP = number of individual specimens.

[a] Excludes Level 95, a deep level assigned to Episode 5, because surrounding levels were assigned to Episode 1.

[b] Excludes Level 72, a shallow level assigned to Subepisode 6B, because surrounding levels were assigned to Episode 8.

[c] Grouped episode assignments for CU 1048 were inferred from archaeological period assignments.

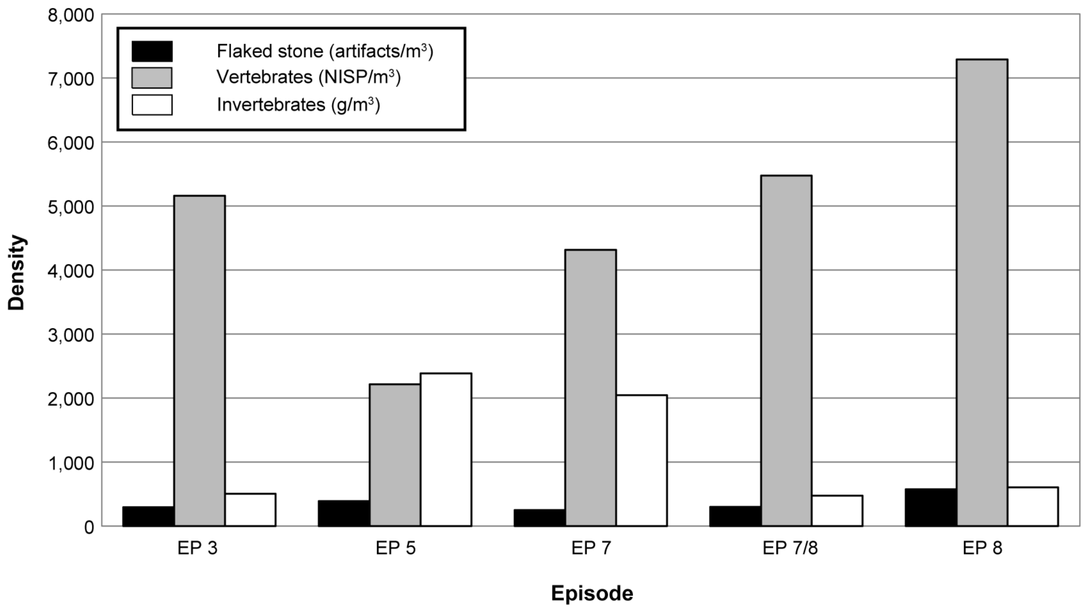

Figure 179. Artifact/ecofact density per episode, CU 141, LAN-62 Locus A.

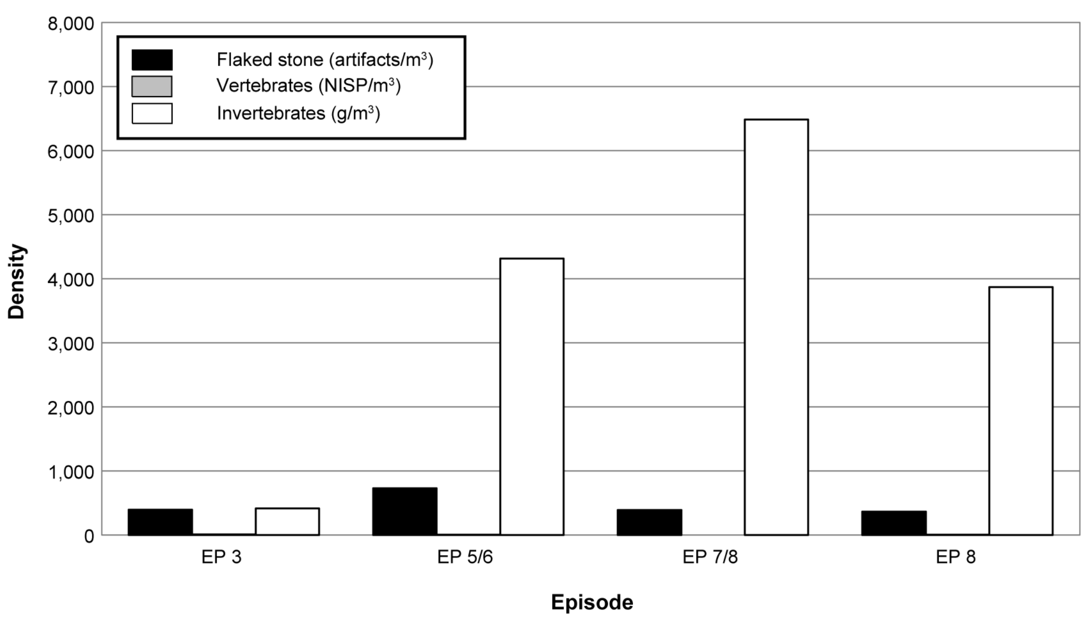

Figure 180. Artifact/ecofact density per episode, CU 316, LAN-62 Locus A.

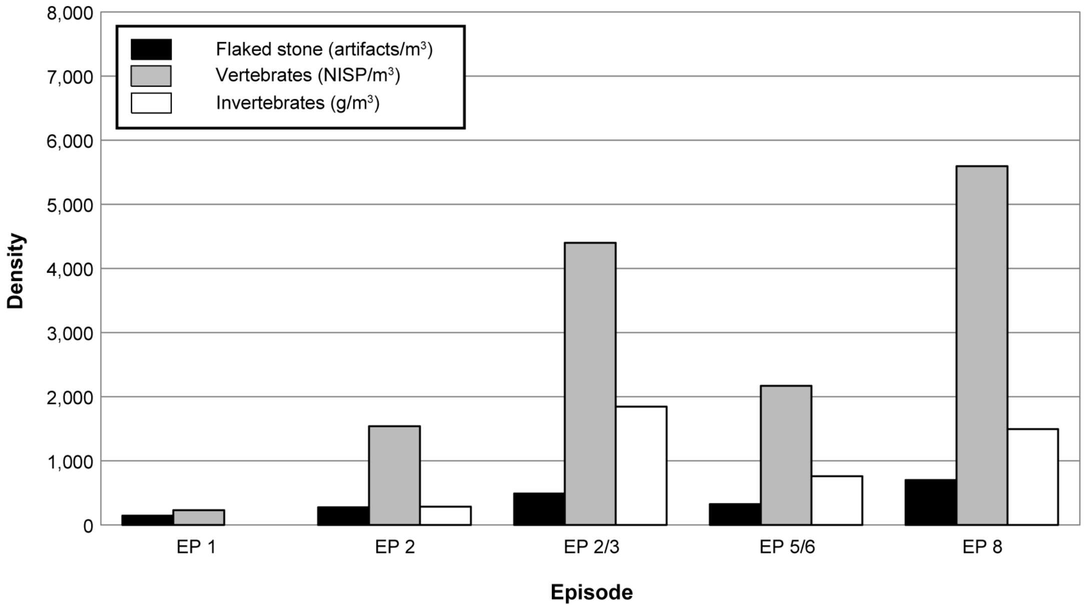

Figure 181. Artifact/ecofact density per episode, CU 321/323, LAN-62 Locus A.

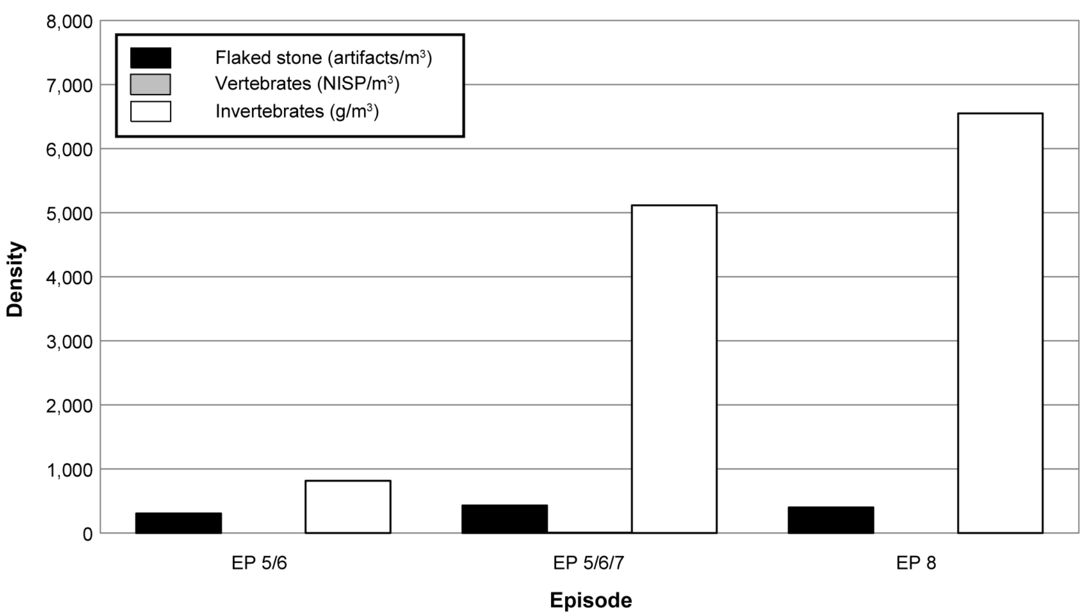

Figure 182. Artifact/ecofact density per episode, CU 682, LAN-62 Locus A.

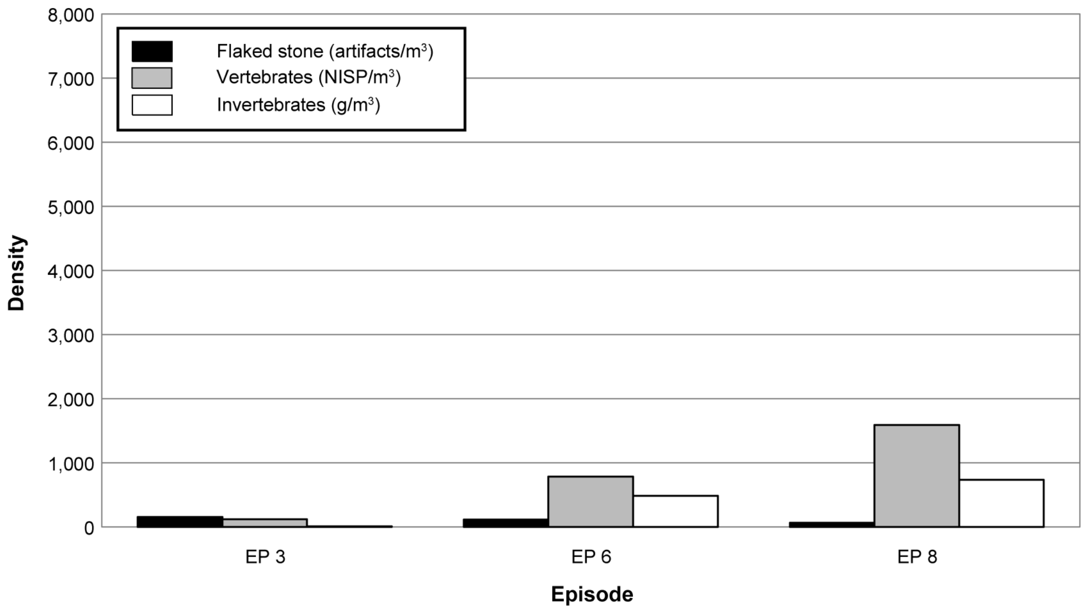

Figure 183. Artifact/ecofact density per episode, CU 853, LAN-62 Locus A.

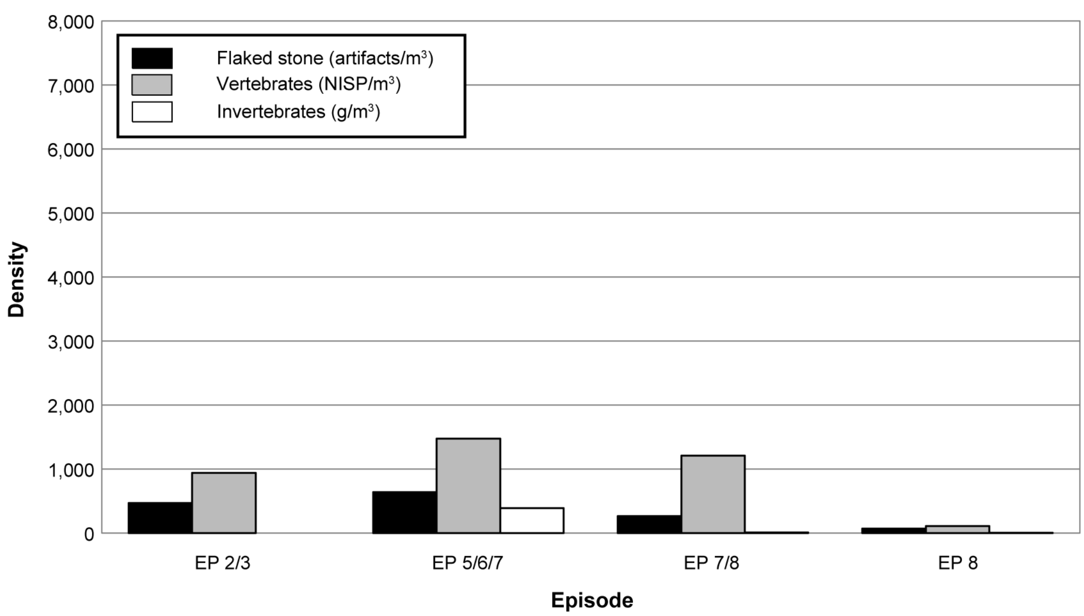

Figure 184. Artifact/ecofact density per grouped episode, CU 1048, LAN-62 Locus G.

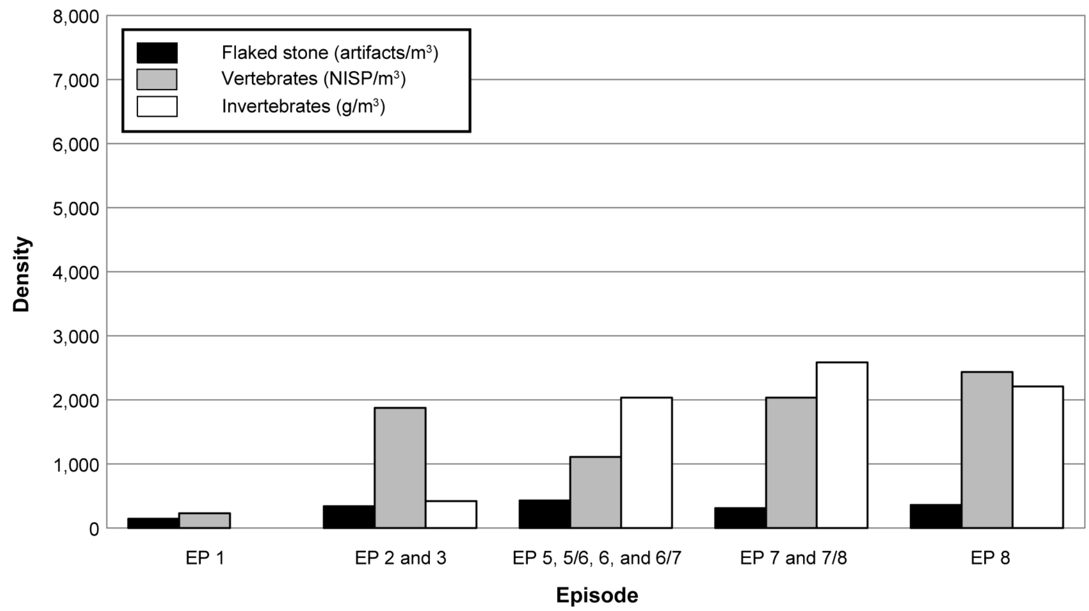

Figure 185. Artifact/ecofact density per episode (or grouped episode) averaged by CUs, LAN-62 Loci A and G.

Spatial Patterns—Spatial Distributions of Material Classes

Quantities of artifacts and ecofacts varied widely among the units in Locus A, as was especially evident in the faunal collections Vertebrate fauna were extremely abundant in CUs 141 and 321/323 but virtually absent in CUs 316 and 682 (Figure 186). Although the density of vertebrate fauna was higher in CUs 1048 and 853 than that of invertebrates and flaked stone, overall density of all artifact/ecofact categories was relatively low in these units. By contrast, the density of invertebrates was very high in CUs 316 and 682. A Pearson's correlation coefficient (r) showed a negative correlation between vertebrate and invertebrate faunal densities ($r = –0.642$, excluding CU 1048). Flaked stone density correlated with invertebrate density ($r = 0.627$), but there was no correlation between flaked stone and vertebrate fauna ($r = –0.084$). The correlation of flaked stone and invertebrates was surprising, given that flaked stone tools presumably would have been more frequently used to process vertebrate fauna than to process invertebrates.

That pattern of variation in artifact/ecofact densities exhibited a spatial component. The units with very high shell densities and very low bone densities were located in the eastern portion of Locus A; conversely, the three units with very high faunal-bone densities and relatively low shell densities were situated in the central and western portions of Locus A. Hence, processed shell was more frequently discarded in the eastern portion of the locus, and byproducts from processing terrestrial animals and bony fish were more frequently discarded in the western and central portions of the locus.

These differences in the discard locations of invertebrate and vertebrate fauna may be related to site structure or activity areas within the locus. The eastern area of the locus may have been situated closer to the lagoon edge or the ancient alignment of Centinela Creek, which would account for the higher shell densities. The western and central portions of the locus could have encompassed a more stable land area (e.g., a knoll) that would have been more conducive to activities related to processing, cooking, and serving meat from hunted land animals and bony fish.

Notably, the pattern of variation was, for the most part, consistent over all occupation episodes; for example, the density of vertebrate fauna was extremely low in CUs 316 and 682 throughout the occupation sequence, not only during one specific episode (compare Figures 179–184). The only exception to this pattern was the almost equal density of vertebrate and invertebrate fauna in CU 141 during Episode 5 (see Figure 179). Interestingly, the most-divergent patterns are evident in CU 141. Vertebrate faunal density was extremely high during Episode 3, a peak that was not exceeded until Episodes 7/8 and 8. By contrast, invertebrate faunal density peaked in Episodes 5 and 7 before being dramatically reduced in the final episodes of occupation. Overall, the long-term consistency in discard practices suggests that the selection of activity-area locations within the locus (i.e., locations for butchering meat or preparing shellfish) probably were not arbitrary but reflected proximity to stable landscape features, such as a knoll or lagoon edge, respectively. Only in CU 141 does there appear to have been a shift in discard from vertebrate to invertebrate fauna, before the discard of vertebrate fauna became dominant once again.

Also worth noting is the variation in overall artifact/ecofact densities in different areas of Loci A and G. The units with the

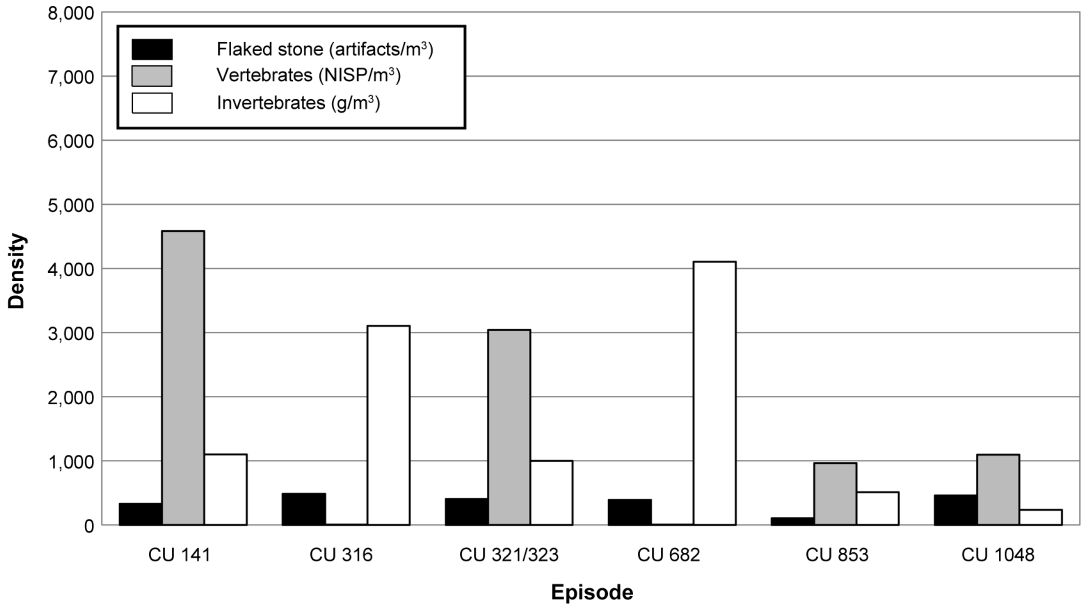

Figure 186. Artifact/ecofact density per CU (all episodes), LAN-62 Loci A and G.

lowest overall densities were CU 1048 in Locus G and CU 853 in the western portion of Locus A. Those areas were probably peripheral to the major foci of settlement in the central and eastern portions of Locus A, which not surprisingly, also encompassed much denser concentrations of features than did the western edge of Loci A and G (see below).

Spatial Distributions of Episode/Period Components

A closer inspection of spatial patterning provides additional insights into the occupational history of Loci A and G.

Among units in Locus A, generally the highest or near-highest densities were associated with the Episode 8 component (see Figures 179–184). As shown in Figure 187, artifact/ecofact densities for Episode 8 were highest in CUs 141, 321/323, and 682. The high densities in CUs 141 and 682 were to be expected, given their proximity to the large cluster of burials and mortuary features in Locus A, but the high density of vertebrate fauna in CU 321/323 might suggest that the area to the northwest of the burial area also encompassed activity areas that generated large amounts of debris, possibly related to the butchering of meat or bony fish. The high proportion of shell to the virtually nonexistent faunal bone in CUs 682 and 316 suggested that those areas may have been focused on shell use or dispersal more than other portions of the site. CUs 316 and 853, at the eastern and western edges of Locus A, respectively, contained lower-density deposits for Episode 8 and may have been situated on the periphery of the Late/Mission period activity loci. The very low density in CU 1048 of Locus G also suggested that it may have been far removed from the main areas of activity during the Late/Mission period.

Only CUs 141, 316, and 1048 included levels assigned to Episodes 7 or 7/8 (late Intermediate/Late period); CUs 141 and 316 were located in the eastern portion of Locus A, and CU 1048 was located in Locus G (Figure 188). These results suggested that the late Intermediate/Late period component in the area was concentrated in the eastern portion of Locus A and continued to the north into Locus G. No evidence of Episode 7 was observed in the units farther to the west. However, even within Locus A, there was a marked difference in the discard of vertebrate and invertebrate fauna, with a high density of invertebrates in CU 141 and a low density in CU 316, as well as the reverse pattern for vertebrate faunal density in these two units. The artifact/ecofact density in Locus G was well below that of Locus A, which may support the argument that Locus A had been established as the central focus of occupation by the late Intermediate period.

There also appears to be variation among the different CUs with an early Intermediate period component (Episodes 5 and 6) (Figure 189). Generally for this period, there was overall less density among the units than in the later Late/Mission period. CU 1048 in Locus G, however, contained a much higher density for this period than for the Late/Mission period, suggesting that there was greater use of areas farther away from the bluffs than in earlier periods. Also of note is that there appears to be less reliance on vertebrate fauna during the Intermediate period than in the Late/Mission periods, based on a comparison of Figures 187 and 189. Finally, it is interesting to note that CUs 316 and 682 once again had virtually no vertebrate faunal remains during the early Intermediate period,. The late Millingstone period component (Episodes 2 and 3) was largely concentrated in CUs 141 and 321/323 in Locus A (Figure 190). This component was not identified in CU 682, and CU 316 contained only a small amount of material assigned to this component, indicating a sparse late Millingstone period

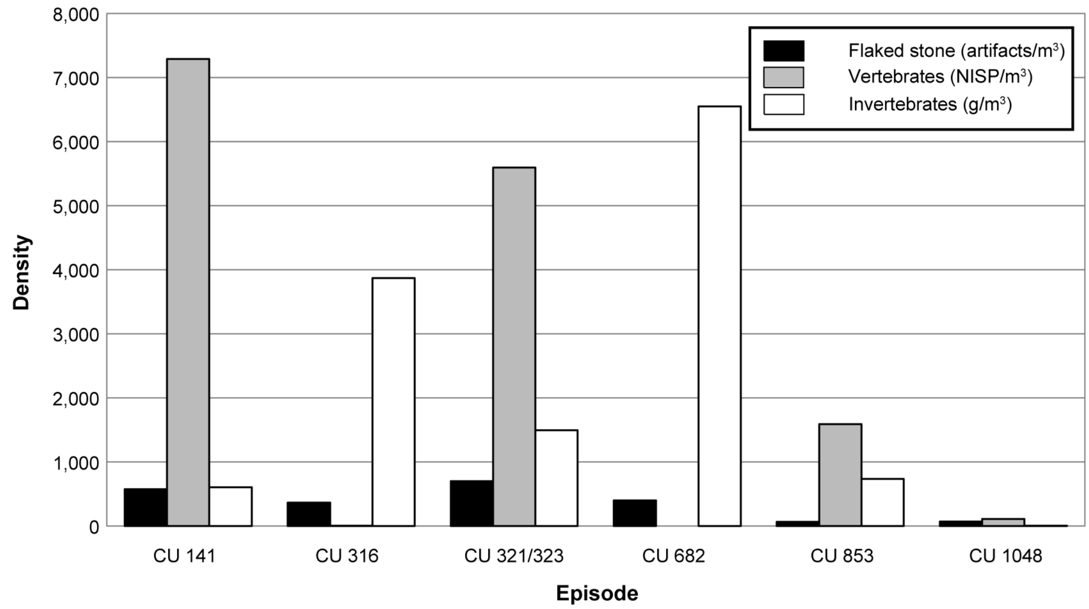

Figure 187. Artifact/ecofact density per CU, Episode 8 (Late/Mission period), LAN-62 Loci A and G.

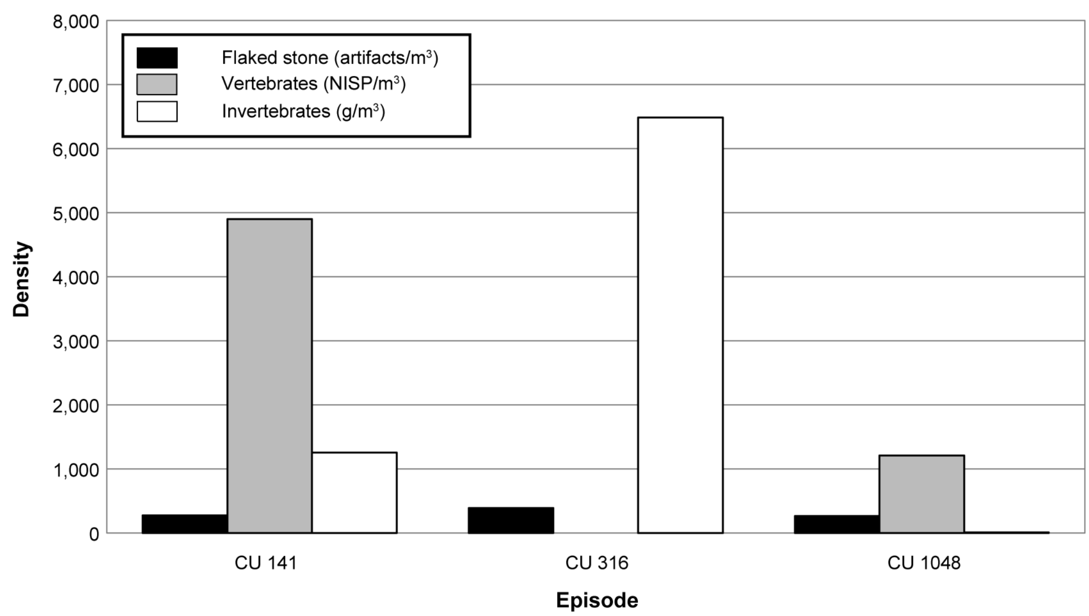

Figure 188. Artifact/ecofact density per CU, Episodes 7 and 7/8 (late Intermediate/Late period), LAN-62 Loci A and G.

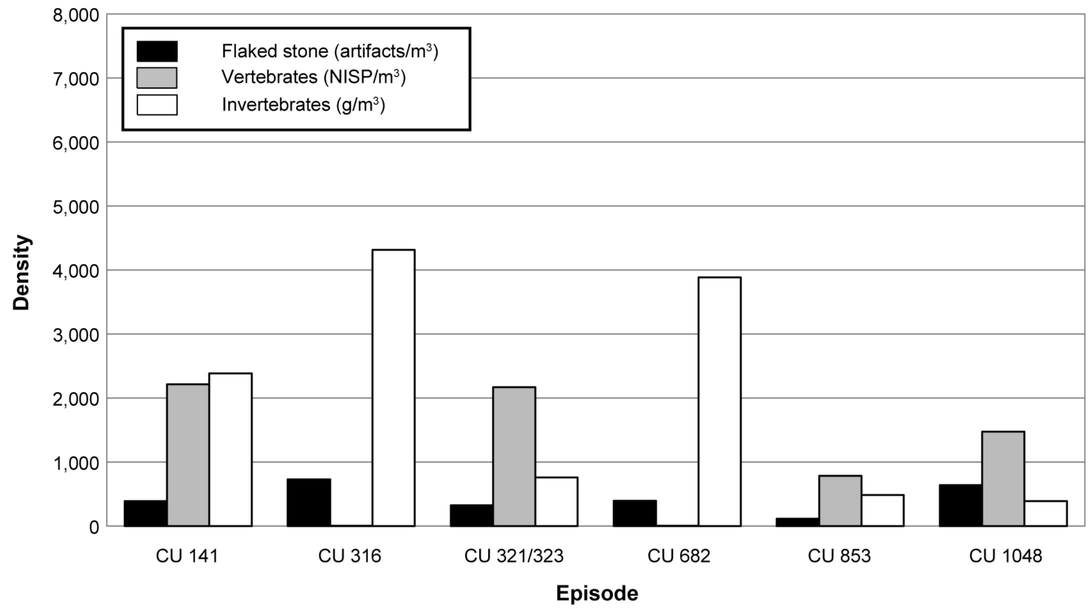

Figure 189. Artifact/ecofact density per CU, Episodes 5, 5/6, 6, and 6/7 (early Intermediate period), LAN-62 Loci A and G.

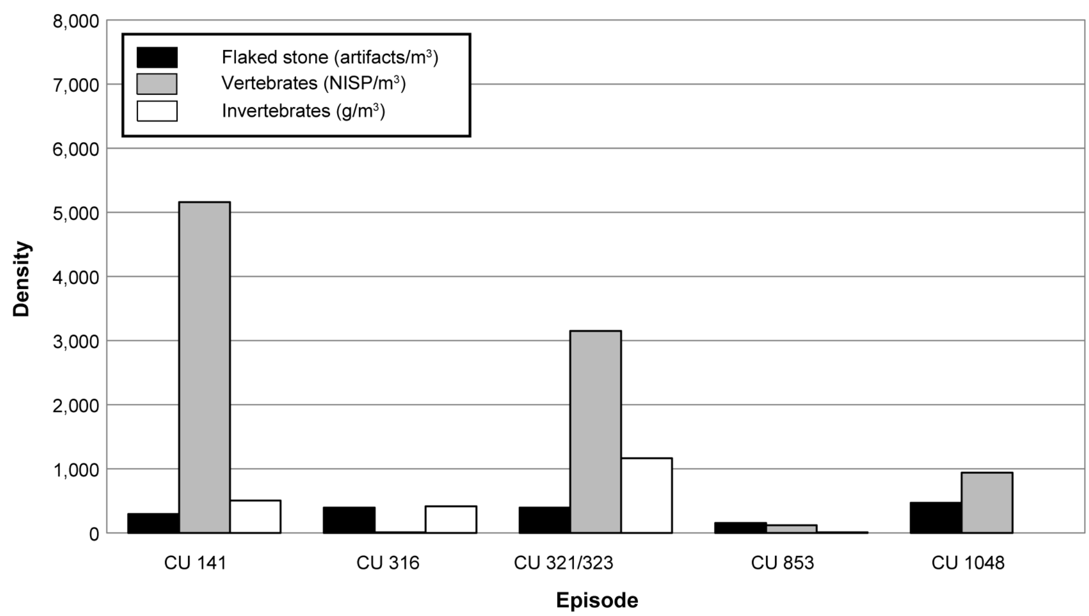

Figure 190. Artifact/ecofact density per CU, Episodes 2 and 3 (late Millingstone period), LAN-62 Loci A and G.

presence in the eastern portion of Locus A. Only CU 321/323 contained levels assigned to Episode 1 (early Millingstone period), which underscores the scarcity of occupation during that span. Importantly, these two units had the highest density of cultural materials in all time periods except the early Intermediate period. This peak occupation included the Late/Mission period burial ground, suggesting that the latter was placed in the central and longest-occupied portion of the site.

Loci C and D

In total, seven CUs were selected for midden-constituent analysis, including three in Locus C and four in Locus D (see Figures 149 and 151, respectively). Features were sparse and widely dispersed, suggesting sporadic and occasional use of the area for limited activities (e.g., resource-collection forays). The seven CUs in these loci therefore provided a sample of midden remains outside and adjacent to the areas of more-intense human occupation and land use in Loci A and G and at LAN-211.

The units in Loci C and D did not exhibit the long sequence of occupation episodes observed in Loci A and G. Rather, the overwhelming majority of unit levels were assigned to the Late or Late/Mission period, the equivalent of Episode 8 in Loci A and G. Consequently, a diachronic study of change in midden densities—comparable to that presented above for Loci A and G—was not feasible in Loci C and D. Only CUs 937 and 1000 included earlier components. In CU 937, the deeper levels were primarily assigned to the Millingstone period; in CU 1000, the deeper levels were assigned to the Intermediate period. Table 50 lists the densities of the material classes per cubic meter for each cultural stratum in the CUs. Figures 191–196 graphically illustrate the artifact/ecofact density of each unit. It was not possible to assign any of the levels to the occupational episodes identified in Loci A and G. We report densities per level for units that contained only Late/Mission period components in an effort to detect multiple living surfaces within this time period. We use bar graphs in cases where multiple components were identified within a unit. Also, for several of the CUs, one or two material classes were excluded from the graphs because of small numbers of artifacts/ecofacts from those particular classes.

Periods of Peak Occupation

Figure 197 graphically illustrates the artifact/ecofact densities per period across all CUs in Loci C and D. To calculate the graph, we excluded one level in CU 937 that was assigned to a vaguely defined Late/Millingstone period occupation. It is not surprising that the majority of the units in Loci C and D (see Figure 197) contain Late/Mission period occupations, as Loci C and D are located between large Late/Mission period components in neighboring Locus A and at LAN-211. In fact, the highest density of cultural material in these two loci is found in a Late period component in CU 534, in Locus C. Loci C and D probably accommodated a number of limited-activity areas for the occupants in the larger adjacent habitation and activity areas. What is surprising, however, is the high density of late Millingstone period materials in CU 937 in Locus C. Although Millingstone materials are restricted to a single unit, the density of these materials is much higher than that of Locus A and is among the highest densities of Millingstone period materials found in the entire project. As in the case of the other time periods represented at these two loci, almost all of the cultural materials consist of vertebrate fauna. In addition, a moderately high density of vertebrate remains assigned to the Intermediate period was found in CU 1000 in Locus D.

Spatial Patterns

Figure 198 demonstrates the range in artifact/ecofact density among the seven CUs in Loci C and D; to facilitate interpretation, the units are arranged from west to east (left to right). In other words, they can be viewed according to their distances from the primary occupation area in Loci A and G. In general, densities are considerably higher in Locus C, which is closer to Locus A, whereas the easternmost units in Locus D contained very sparse cultural materials. Hence, the bulk of the midden remains were located in Locus C and probably contained debris related to the high-intensity occupation in Locus A.

The distribution of material classes also varied between Loci C and D. Vertebrate fauna dominated the unit collections in both loci, which suggested that preparation of animal meat was a prevalent prehistoric activity in these loci. Although there was variability in the percentages of flaked stone and shell, overall they were very scarce, compared to faunal bone. Shell was sparse throughout Loci C and D (2.1 percent or less), with the exception of CU 937, in which shell constituted about 11 percent of the collection. Again, the greater proximity of CU 937 (the westernmost unit) to Locus A may have been significant in this respect.

The dominance of subsurface deposits assigned to the Late/Mission period undermined efforts to infer spatial patterns for each of the occupation components in Loci C and D. The Intermediate and Millingstone period components were each observed in only one unit; hence, spatial comparison of artifact/ecofact densities was only feasible for the Late/Mission period (Figure 199). Most surprising in the Late/Mission period component was the very high density of materials in CU 534, located on the eastern edge of Locus C, which did not support argument that densities peaked closer to the more-intensely used activity areas in Locus A. That said, the excavations in Locus C were clustered relatively tightly; so, in a general sense, the more intense occupation in Locus C during the Late/Mission period compared to Locus D does suggest that proximity to Locus A may have played a part in intensity of occupation.

Table 50. Artifact/Ecofact Density per Occupation Episode and Period in Six CUs, LAN-62 Loci C and D

CU No. (1 by 1 m), by Locus	Cultural Period	Volume (m^3)	Lithic Artifacts				Vertebrate Fauna		Invertebrate Fauna	
			Flaked Stone Count (n)	Flaked Stone Density (n/m^3)	Ground Stone Count (n)	Ground Stone Density (n/m^3)	NISP	Density ($NISP/m^3$)	Weight (g)	Density (g/m^3)
Locus C										
CU 534	Late	2.72	538	197.8	2	0.7	10,665	3,921.0	239.4	88.0
CU 922	Late/Mission	1.30	29	22.3	—	—	531	408.5	9.3	7.2
CU 937	Late/Mission	0.84	79	94.0	2	2.4	924	1,100.0	178.2	212.1
	Millingstone/Late	0.10	12	120.0	—	—	233	2,330.0	48.1	481.0
	late Millingstone	1.74	362	208.0	7	4.0	4,828	2,774.7	185.9	106.8
Subtotal		2.68	453	169.0	9	3.4	5,985	2,233.2	412.2	153.8
Locus D										
CU 970	Late/Mission	0.62	1	1.6	—	—	137	221.0	—	—
CU 981	Late/Mission	1.47	13	8.8	—	—	336	228.6	—	—
CU 998	Late/Mission	1.48	4	2.7	—	—	383	258.8	8.4	5.7
CU 1000	Late/Mission	1.33	6	4.5	—	—	728	547.4	13.3	10.0
	Intermediate	0.50	—	—	—	—	474	948.0	10.3	20.6

Key: NISP = number of individual specimens.

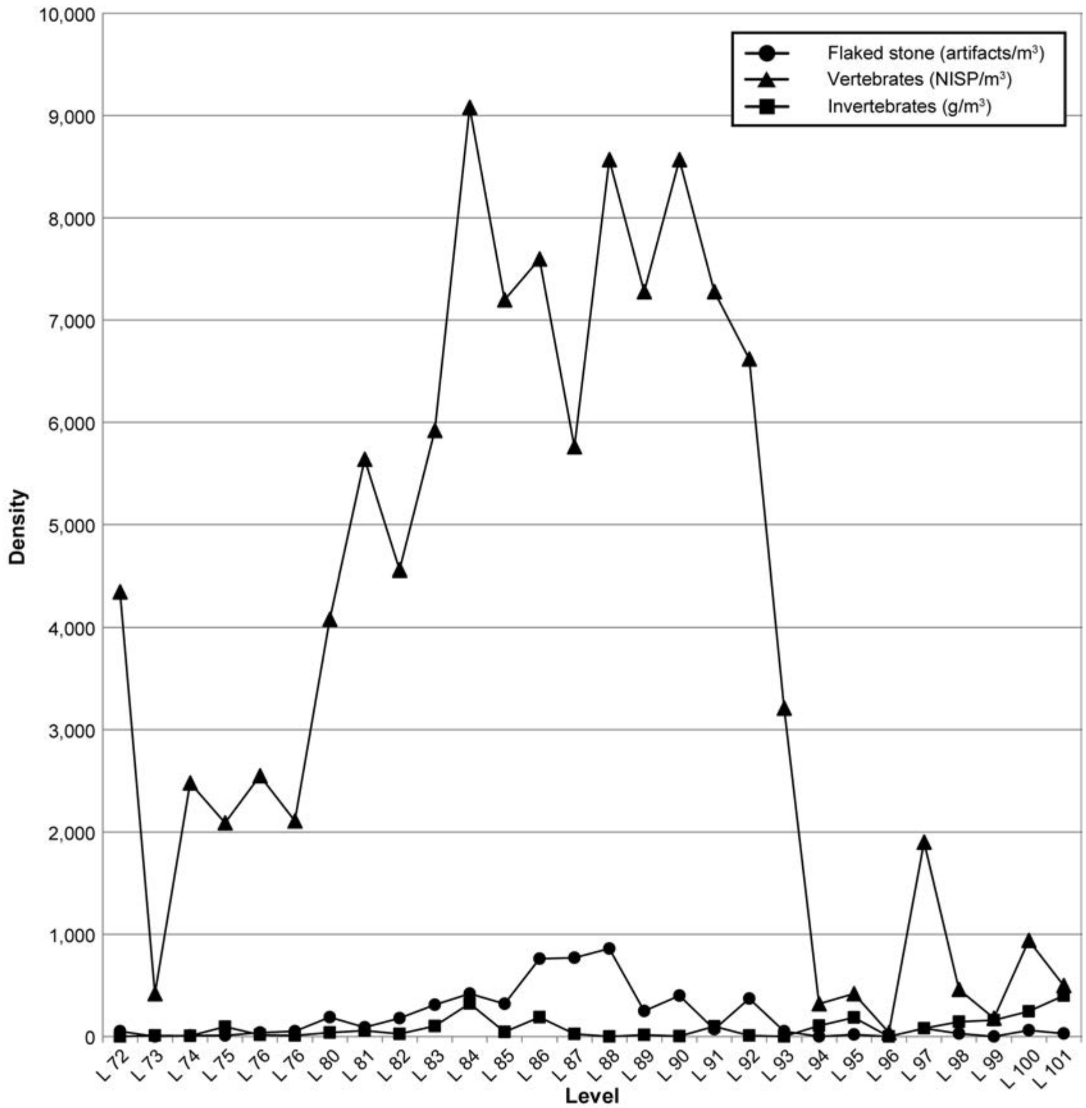

Figure 191. Artifact/ecofact density per level, CU 534, LAN-62 Locus C.

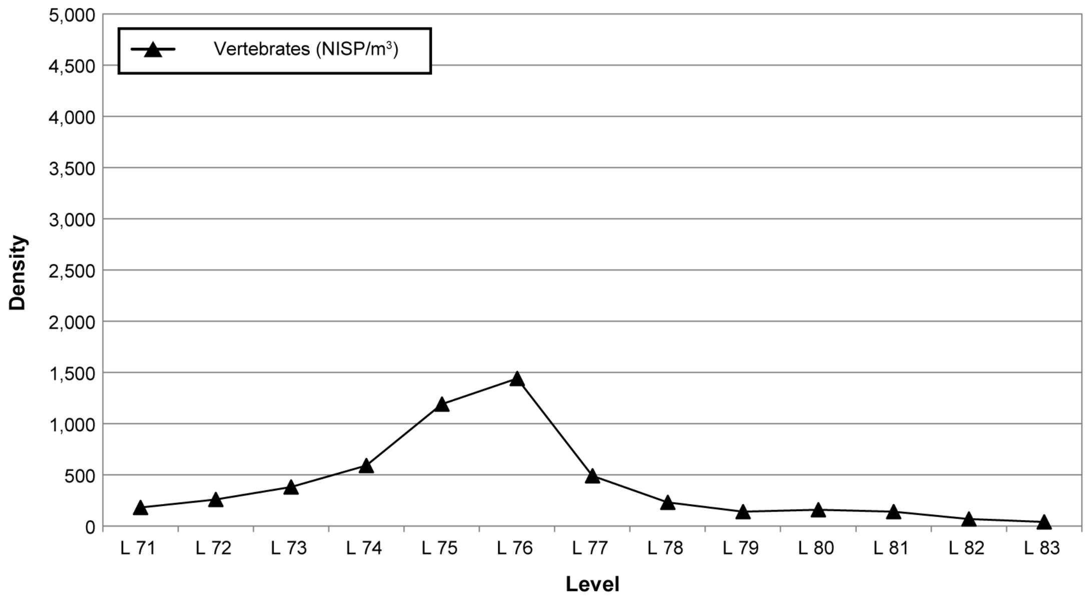

Figure 192. Artifact/ecofact density per level, CU 922, LAN-62 Locus C. *Note*: Lithic and invertebrate artifacts were not included because of the very small collection sizes.

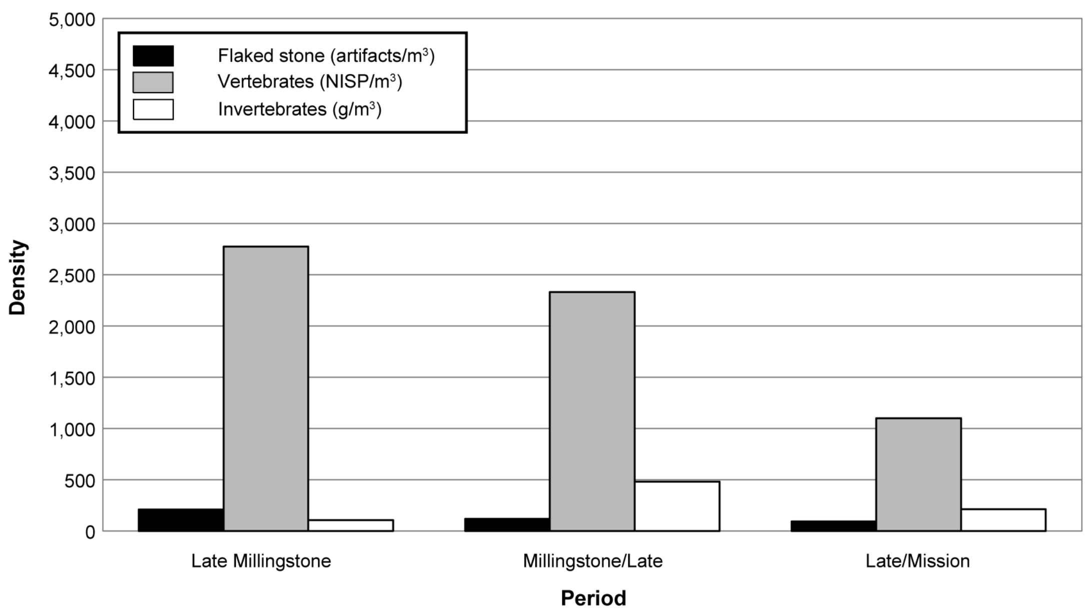

Figure 193. Artifact/ecofact density per period, CU 937, LAN-62 Locus C.

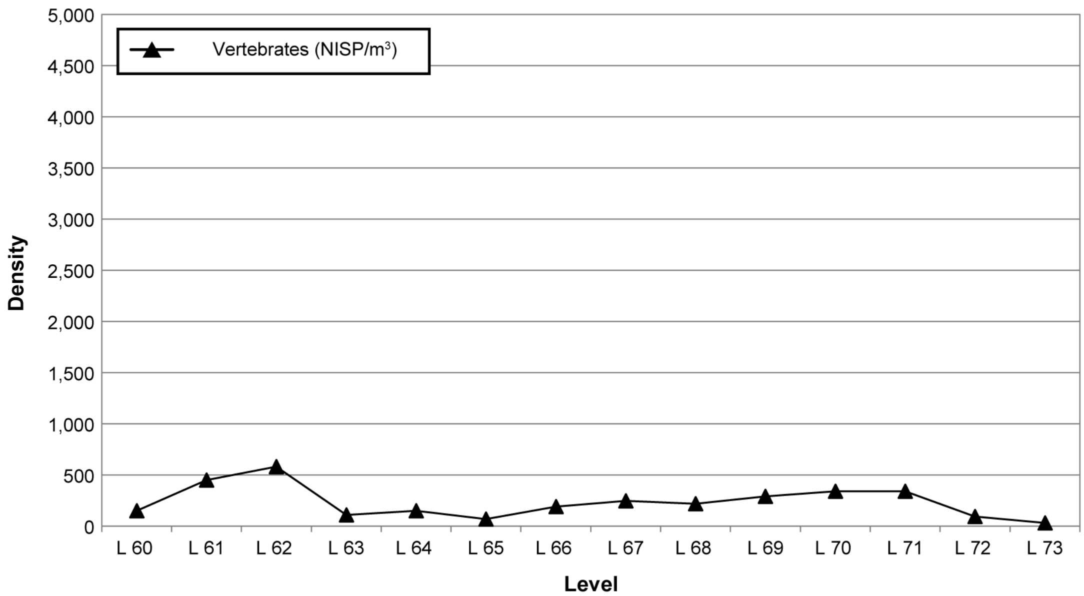

Figure 194. Artifact/ecofact density per level, CU 981, LAN-62 Locus D. *Note*: Lithic and invertebrate artifacts were not included because of the very small collection sizes.

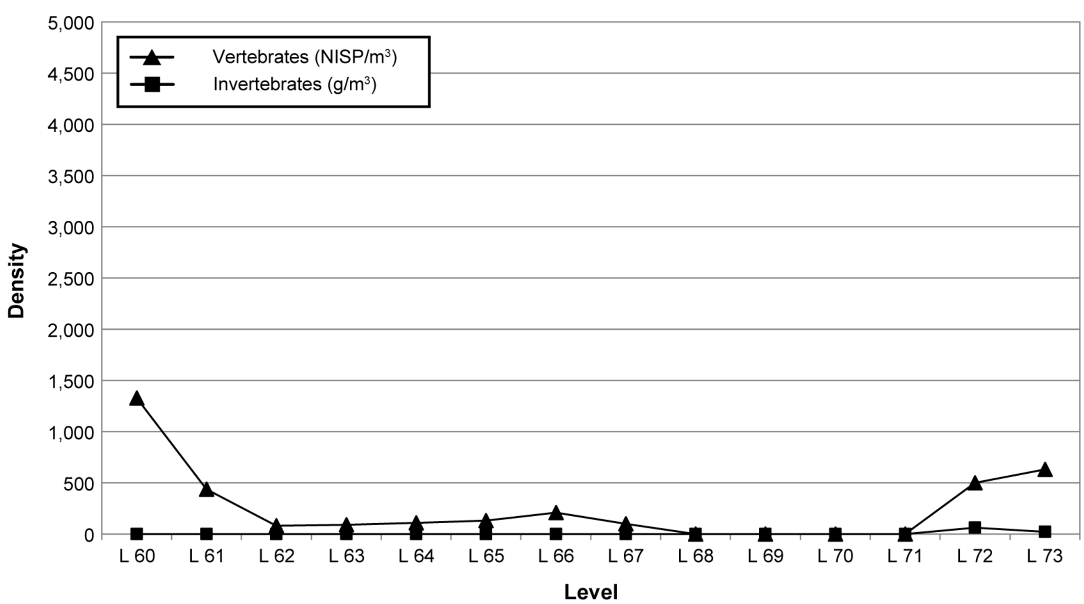

Figure 195. Artifact/ecofact density per level, CU 998, LAN-62 Locus D. *Note*: Lithic artifacts were not included because of the very small collection size.

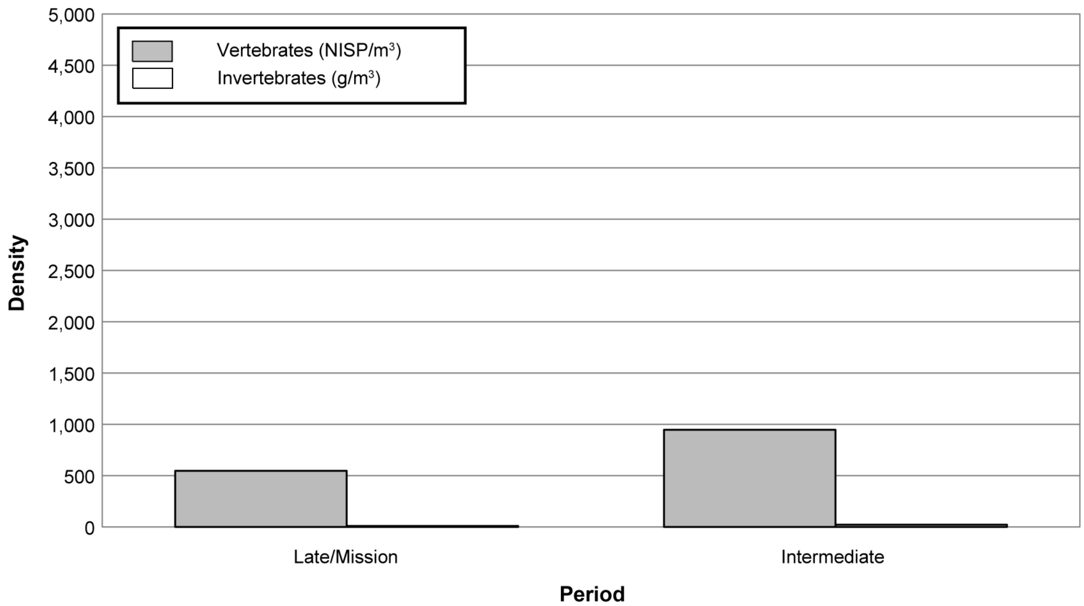

Figure 196. Artifact/ecofact density per period, CU 1000, LAN-62 Locus D. *Note*:Lithic artifacts were not included because of the very small collection size.

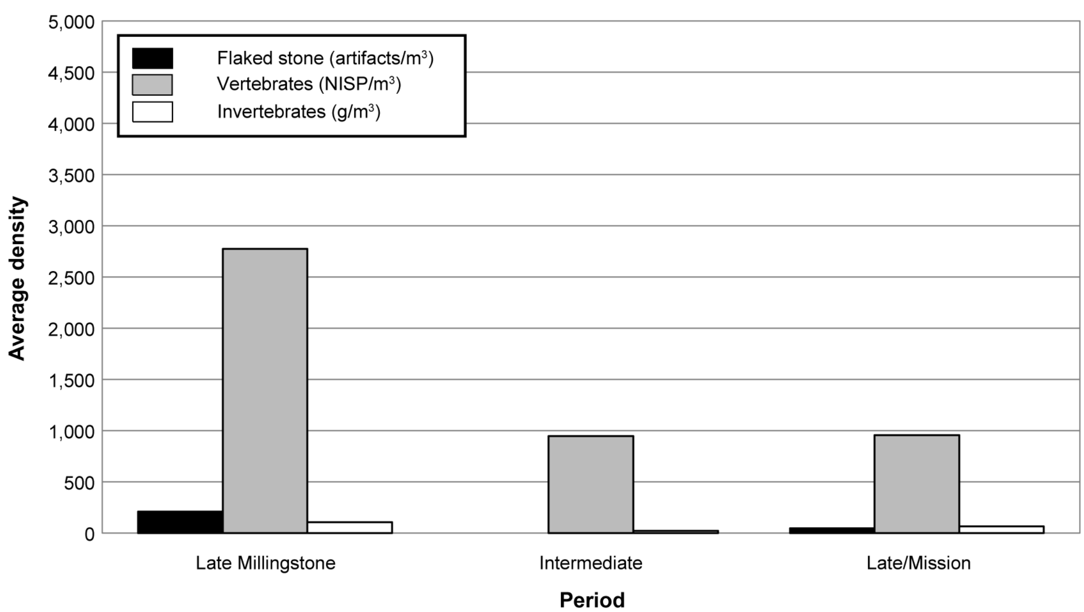

Figure 197. Artifact/ecofact density per archaeological period averaged by CUs, LAN-62 Loci C and D.

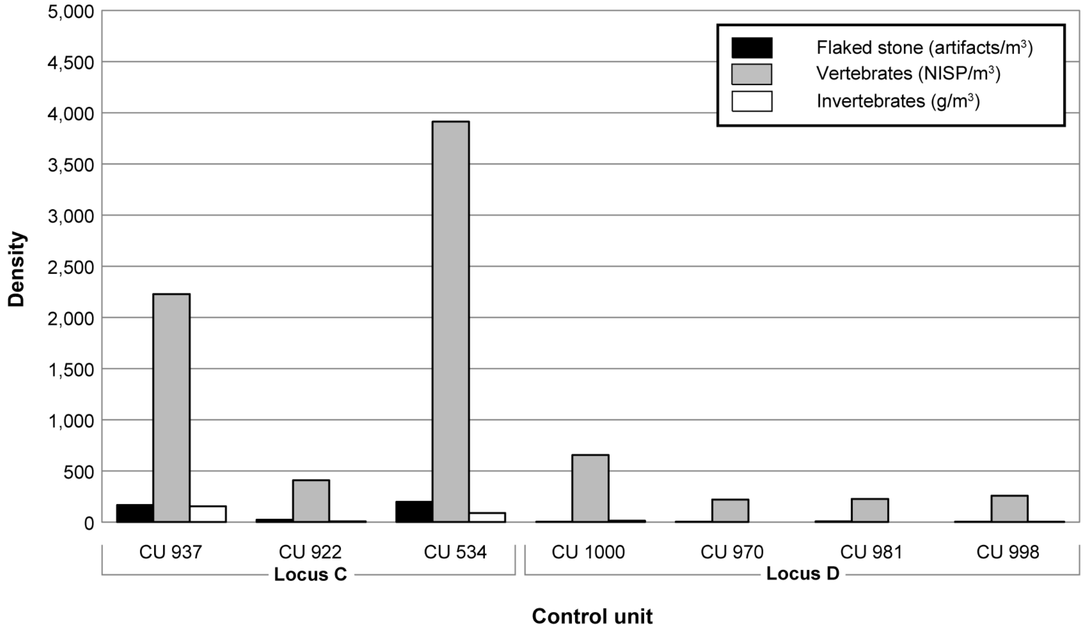

Figure 198. Artifact/ecofact density per CU (all episodes), LAN-62 Loci C and D, arranged from west (left) to east (right).

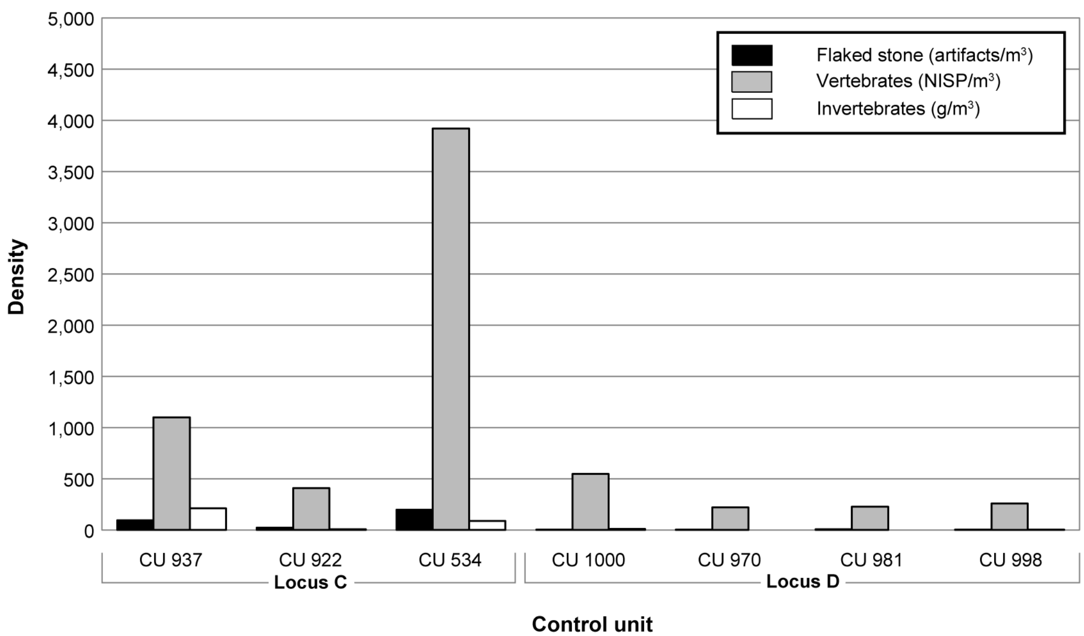

Figure 199. Artifact/ecofact density per CU, Late/Mission period, LAN-62 Loci C and D, arranged from west (left) to east (right).

With respect to this pattern, the moderately high density of Intermediate period materials in CU 1000 in Locus D is unexpected. Intermediate period occupations are the most widespread in the Ballona of all time periods and are found in all areas and on all landforms where occupation was identified (Altschul et al. 2005). Thus, it is surprising that no evidence of Intermediate period occupation was found in Locus C, which evidenced more-intensive occupation than Locus D. Whereas the Late/Mission period occupations at Loci C and D may represent an extension of the contemporaneous occupation of Loci A and C, the Intermediate period occupation in Locus D may represent an isolated settlement unrelated to the Intermediate period occupation at Loci A and C. The concentration of Millingstone period materials in CU 937 in Locus C also may represent a small settlement isolated from the sparser Millingstone period materials found in Locus A.

Feature Analysis

Below, we discuss the analysis of features, organized by locus.

Loci A and G

Appendix 5.1, this volume, offers brief feature descriptions and classifications of 608 features excavated in all loci of LAN-62 (598 in Loci A and G and 10 in Loci C and D). Given the large number of excavated features, we include here separate maps of human burials (374 features) (see Figure 155) and nonburial cultural features (224 features) (Figure 200) in Loci A and G (the other 10 features, all nonburial features in Loci C and D, are shown in Figures 149 and 151, respectively).

Most of the features were located within a dense cluster of burials in the large, central excavation block in Locus A. As shown in Figure 155, the burials were concentrated in that central area, although a small number of isolated burials were located to the east-northeast and south of the main burial cluster. The nonburial features were distributed more or less continuously in the vicinity of the main excavation block, with higher densities closer to the bluff edge (see Figure 200). Notably, nonburial features were virtually absent from a roughly 10-by-10-m area inside the dense middle portion of the burial cluster; presumably, features in the Late period midden were removed from that area during the interments of human remains in the Late/Mission period. Both burial and nonburial features were removed during excavation of a historical-period trench (Feature 16) that crosscuts the northeastern portion of the main burial area.

Feature Classification

We employed the feature typology outlined in Chapter 5, this volume, to classify each of the features excavated at LAN-62. Our typology involved several levels of classification, which helped to accommodate the varying levels of detail. At a broad level, features were classified as burial/ritual features, domestic features, or late-historical-period/modern features (post-1850). In some cases, it was difficult to distinguish between domestic and burial/ritual features, resulting in a largely arbitrary classification. For example, Feature 604 was a well-defined pit within the burial cluster but was devoid of artifacts. It was therefore unclear whether it had functioned as a domestic storage pit that no longer contained material contents or as an unused or disturbed burial pit. We opted for the former interpretation, but our decision was arbitrary.

Also at a broad level, the features were classified as either thermal or nonthermal. FAR fragments and thermally altered faunal bone were recovered in varying amounts from most of the domestic features. Consequently, we determined that a feature had to contain *predominantly* thermally altered materials (e.g., FAR and burned bone) or exhibit evidence of in situ thermal activity (e.g., oxidized soil) to be classified as thermal. Features with only small amounts of FAR or burned bone and larger amounts of unburned materials generally were classified as nonthermal. Many burial features were classified as “mixed” because they contained elements of both thermally altered (cremated or partially cremated) and nonthermally altered human remains.

At a more detailed level, features were classified into the more-specific formal categories listed in Chapter 5, this volume, based on morphology and content. The majority of features in Loci A and G were classified as primary or secondary inhumations, primary or secondary cremations, FAR concentrations, FAR scatters, activity areas, burned baskets (offerings), burned votive offerings, nonthermal ritual offerings, thermal or nonthermal pit features, historical-period trash dumps or trash pits, and various types of artifact/ecofact concentrations.

Based on these classifications and other information, we inferred the probable function of each feature, as listed on the feature-summary forms presented in Appendix 5.1, this volume. Detailed examples of the final feature interpretations, many of which were from LAN-62, are presented in Chapter 5, this volume. The inferences were based on a variety of available information, including artifact/ecofact composition, morphology (e.g., concentration or scatter), presence/absence of a pit, evidence of thermal exposure (or non-exposure), and so on. Note, however, that the features were subjected to varying levels of detailed analysis and scrutiny, resulting in different levels of confidence and certainty about the interpretations. The column on the far right in Appendix 5.1 indicates whether a feature was subjected to detailed analysis. Our interpretations of features that were *not* subjected to detailed analyses were tentative.

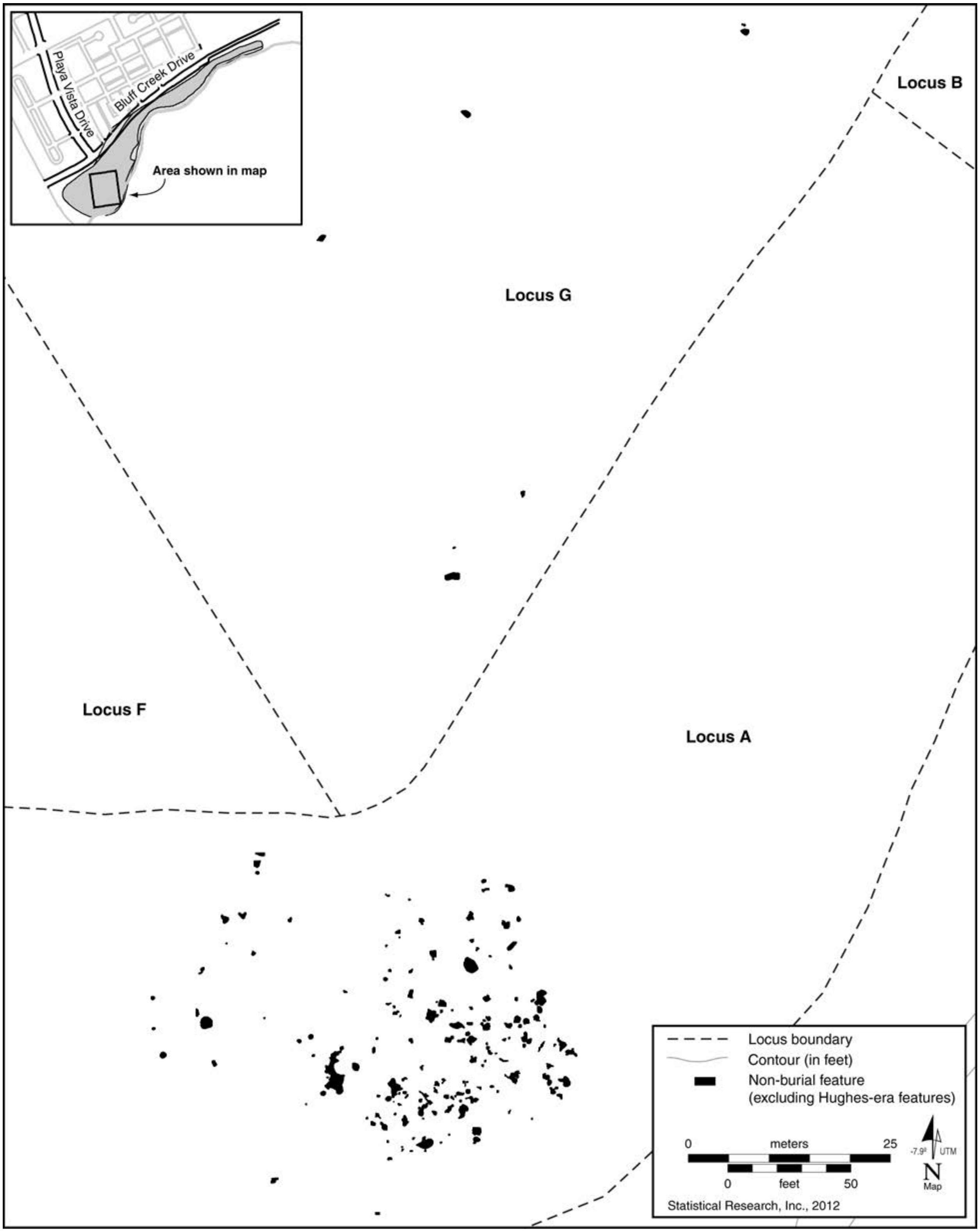

Figure 200. Map showing the locations of nonburial features in LAN-62 Loci A and G.

Table 51 summarizes the final feature classifications (see Chapter 5, this volume, for details on the difference between feature categories and final feature interpretations) for Loci A and G, and Table 52 summarizes the final feature classifications for Loci C and D. Burial/ritual features constituted nearly 70 percent of the features (410 features), and domestic features constituted roughly 30 percent (179 features). Only 2 percent of the features were classified as late historical period/ modern (19 features), which included modern disturbances (6 features), all but one of which were located in Locus G. In the following subsections, we separately discuss the analysis of feature frequencies for burial/ritual features, domestic features, and late-historical-period/modern features.

Burial-/Ritual-Feature Classification

Features with human remains (inhumations and cremations) composed nearly two-thirds of all features (62 percent) and approximately 90 percent of burial/ritual features. Nearly all of the burial/ritual features were in Locus A, with the exception of a few animal burials in Loci C and G. Here, we present a brief overview of the burial/ritual features; for detailed discussions of the human remains and burial contents, see Volume 4, this series.

Features of which primary inhumations were the main components composed almost half of all features and roughly two-thirds of the burial/ritual features. Only five secondary inhumations were identified, largely because of the difficulty of distinguishing secondary interments; only cases in which the osteologists or archaeologists identified clear evidence of secondary interment (e.g., asphaltum-covered bones) or defleshing (e.g., postmortem cut marks) were classified as secondary inhumations. Far more common were features with isolated and disarticulated bones (unburned), which could indicate a disturbed primary inhumation or a secondary inhumation. Features in which isolated and disarticulated bones were the main components composed approximately 15 percent of all features and roughly a quarter of the burial/ ritual features. Note that many of the features classified as primary inhumations contained disarticulated skeletal remains (burned and unburned) of other individuals; in many of those cases, the burial pits excavated for the more-intact inhumations probably impinged on and disturbed previously existing inhumations and cremations. In a few cases, that was clearly visible as the burials were being excavated.

Features in which primary cremations were main components were far less frequent than primary inhumations and composed roughly 1 percent of all features and roughly 2 percent of the burial/ritual features. Distinguishing primary and secondary cremations is fraught with complication, however. Primary cremations were only inferred in cases with clear evidence of in situ thermal exposure, such as burned wood or organic remains in association with the cremated remains. Only four features exhibited conclusive evidence of a secondary cremation. These interpretations were limited to cases from which in situ burning was absent and in which the feature matrix exhibited little evidence of disturbance. Far more common than primary or secondary cremations were features with isolated burned or calcined remains that had been highly disturbed or scattered; those features composed roughly 20 percent of all features and roughly 30 percent of burial/ritual features. Indeed, the majority of the cremated remains were recovered in association with primary inhumations. In those cases, it seemed likely that the interments of the primary inhumations impinged on and disturbed previously existing cremation interments.

Roughly 10 percent of the burial/ritual features contained no or few human remains. Most of those features probably functioned as ritual or ceremonial offerings associated with the burial area and were divided between thermal deposits and nonthermal deposits. The thermal features included burned basket offerings, burned votive offerings, and concentrations of burned whalebones, which may have functioned as offerings or as place markers that were subsequently burned. One large composite feature (FB 3) appeared to date primarily to the Mission period and encompassed various thermal ritual subfeatures; it was interpreted as a probable mourning feature (see below). The nonthermal features generally included concentrations of probable ritual goods, such as strands of shell or glass beads, textile fragments, worked-bone tools, abalone shell, and asphaltum- and ochre-covered materials.

Domestic-Feature Classification

A large proportion of domestic features at LAN-62 (see Tables 51 and 52) could be broadly defined as either generic domestic-discard deposits or hearth-cleanout/domestic-discard deposits. Those features were not associated with visible pits and appeared to have been surface deposits. The two categories overlapped, as explained above; the only substantive difference concerned whether FAR fragments constituted the predominant material class. For instance, most of the features defined as domestic-discard deposits had at least some FAR, and most hearth-cleanout features had at least a small amount of nonthermal debris. Indeed, the bulk of the domestic-feature classes potentially could be more broadly defined as domestic-discard areas.

Domestic storage or trash pits constituted the second-most-frequent category. Those features exhibited visible pit outlines, but it was unclear whether they functioned as storage or trash deposits. Most contained at least some burned bone or other thermally altered materials, suggesting trash deposits. However, we could not rule out the possibility that they had initially functioned as storage pits and later became receptacles for domestic trash prior to abandonment. Some animal burials may be viewed as variants of this category, as explained above. Together, domestic trash or storage pits and animal burials composed about 14 percent of domestic features.

Most of the remaining features belonged to low-frequency categories that indicated specific functions. Large and small hearths constituted less than 5 percent of the domestic features, although several of the hearth-cleanout features, in fact, may have been unrecognizable and heavily disturbed hearths, as explained above. Cairns and caches, both of which were difficult to define with certainty, also composed less than

Table 51. Summary of Domestic-Feature Interpretations, LAN-62 Loci A and G

Interpretation, by Category	Count	Percentage of Total
Domestic features		
Cache	5	2.9
Possible cache	1	0.6
Cairn	2	1.1
Domestic-discard area	60	34.5
Domestic trash or storage pit	8	4.6
Domestic trash pit	8	4.6
Shellfish-processing area	4	2.3
Fire pit	2	1.1
Flaked-stone-tool-production/curation area	1	0.6
Hearth cleanout	30	17.2
Hearth cleanout and domestic-discard area	15	8.6
Hearth cleanout or domestic-discard area	26	14.9
Large hearth	1	0.6
Small hearth	5	2.9
Storage pit	6	3.4
Subtotal	174	100.0
Burial/ritual features		
Human burial	374	91.2
Mortuary offering	31	7.6
Mourning feature (composite)	1	0.2
Whalebone marker	1	0.2
Animal burial	3	0.7
Subtotal	410	100.0
Historical-period/modern features		
Historical-period structure	1	7.1
Historical-period trash deposit	5	35.7
Historical-period trench	1	7.1
Modern disturbance	6	42.9
Soil anomaly	1	7.1
Subtotal	14	100.0
Total	598	100.0

Note: Percentages have been rounded to the nearest tenth.

Table 52. Summary of Feature Interpretations, LAN-62 Loci C and D

Interpretation, by Category	Count	Percentage of Total
Domestic features		
Storage pit	1	10.0
Hearth cleanout	1	10.0
Domestic-discard area	1	10.0
Hearth cleanout and domestic-discard area	2	20.0
Historical-period/modern features		
Animal burial	1	10.0
Historical-period trash deposit	3	30.0
Historical-period structure	1	10.0
Total	10	100.0

5 percent each of domestic features. One feature was defined as a location for flaked-stone-tool production or curation. Stone-tool production was no doubt commonplace, but the debris generated from that activity was infrequently recovered as discrete deposits. Flaked stone debitage was prevalent in many features and throughout the surrounding midden deposits (see midden-constituent analysis, above).

Late-Historical-Period/Modern Feature Classification

Only 14 features dated to the late historical or modern period. They were of a variety of feature types, including historical-period trash deposits or structures, historical-period disturbances, modern disturbances, and a soil anomaly. These features generally contained similar artifact constituents, including glass fragments, glass bottles, ceramics, porcelain, metal fragments, and saw-cut faunal bone, all of which suggested domestic deposits. Three of the features in Locus G intruded into the stratigraphic layers created by the 1931 or 1938 flood episodes, indicating a date of deposition sometime after those events. Several of these features also contained plastic and rubber materials, which supported a date of deposition in the 1930s or later. Several of the features—including Feature 16, a historical-period trench that bisects the burial area, as well as several trash dumps—likely dated to the early twentieth century, and others were related to previous archaeological work conducted by Archaeological Associates in the 1980s.

Occupation Surfaces and Activity Areas

Our analyses of occupation surfaces focused on the range of features and features types pertaining to each occupation period, in an effort to infer to changes in site and locus function over time. The analyses required detailed chronological information (e.g., chronometric data and evaluations of time-sensitive artifacts) and assignments of features to specific occupation episodes or time periods. In Loci A and G, approximately one-quarter of the 598 features were assigned to a period based on various chronological indicators, including calibrated radiocarbon dates, time-sensitive artifacts, and stratigraphic provenience, but much fewer (18 features, or 3 percent) were assigned to one of Lengyel's narrowly defined occupation episodes. For that reason, we concentrate here only on the 151 features with period assignments.

Features from Loci A and G were assigned to one of five periods: Millingstone, Intermediate, Late, Protohistoric, and Mission. In many cases, however, available chronological information did not provide sufficient resolution to distinguish among Late, Protohistoric, and Mission period features. Consequently, 30 of the 151 features (approximately 20 percent) were assigned to one of three "composite" groups: Late/Protohistoric period, Late/Mission period, and Protohistoric/Mission period. We excluded the very broadly defined Late/Mission period features from our analysis, given their chronological ambiguity. We also merged the Late and Late/Protohistoric period features, to bolster the sample of features.

Figure 201 illustrates the number of features assigned to each period. The number of Mission period features (96 features, mostly burials) was 6–24 times greater than the numbers assigned to the other periods, indicating a peak occupation during the Mission period (including the Protohistoric/Mission period). Another, much smaller peak was evident during the Intermediate period (15 features). That pattern was consistent with the results of the midden-constituent analysis presented above, which also indicated a peak in artifact/ecofact densities in levels assigned to the Late/Mission period and a smaller peak in levels assigned to the Intermediate period. Below, we discuss occupation surfaces separately for each period.

Millingstone Period

Eight features in Loci A and G were assigned to the Millingstone period: seven in Locus A and one in Locus G (Figure 202). Feature 690 in Locus G was far removed from the others, but the features in Locus A were generally concentrated within a roughly 20-by-20-m area in the eastern half of the large excavation block. Three of the features formed a tight cluster within that area, which we have classified as FB 7.

The Millingstone period features included seven domestic deposits and one probable ritual deposit. The ritual deposit was composed of a concentration of thermally altered whalebones and small fragments of cremated human bone in association with shell beads and small amounts of FAR, flaked stone, and unworked shell. Although that feature was assigned to the Millingstone period based on its deep stratigraphic position, it is likely that the cremated human bones were intrusive from the Late/Mission period burials. The shell beads indicated a style that long postdated the Millingstone period (ca. A.D. 1150 or later), suggesting an intrusive element. The feature may have been deposited as a ritual offering of whalebone during the Millingstone period, but clearly, the feature matrix was subsequently disturbed, probably as a result of the burial interments during the Late/Mission period.

The seven domestic features in Locus A formed an arc along the western side of the large excavation block (see Figure 202), perhaps conforming to the edge of some relict geographical feature (e.g., a raised area or berm). They included four nonthermal deposits and two thermal deposits. The thermal deposits were primarily composed of FAR fragments without pits and probably indicated hearth-cleanout deposits or disturbed hearths. In both features, however, nonthermal materials were also recovered, including flaked stone and unworked shell, suggesting "generalized" discard locations that included a mix of FAR and nonthermal domestic debris. Three of the four nonthermal deposits in Locus A also were composed of thermal and nonthermal domestic debris, including smaller amounts of FAR, without visible pit

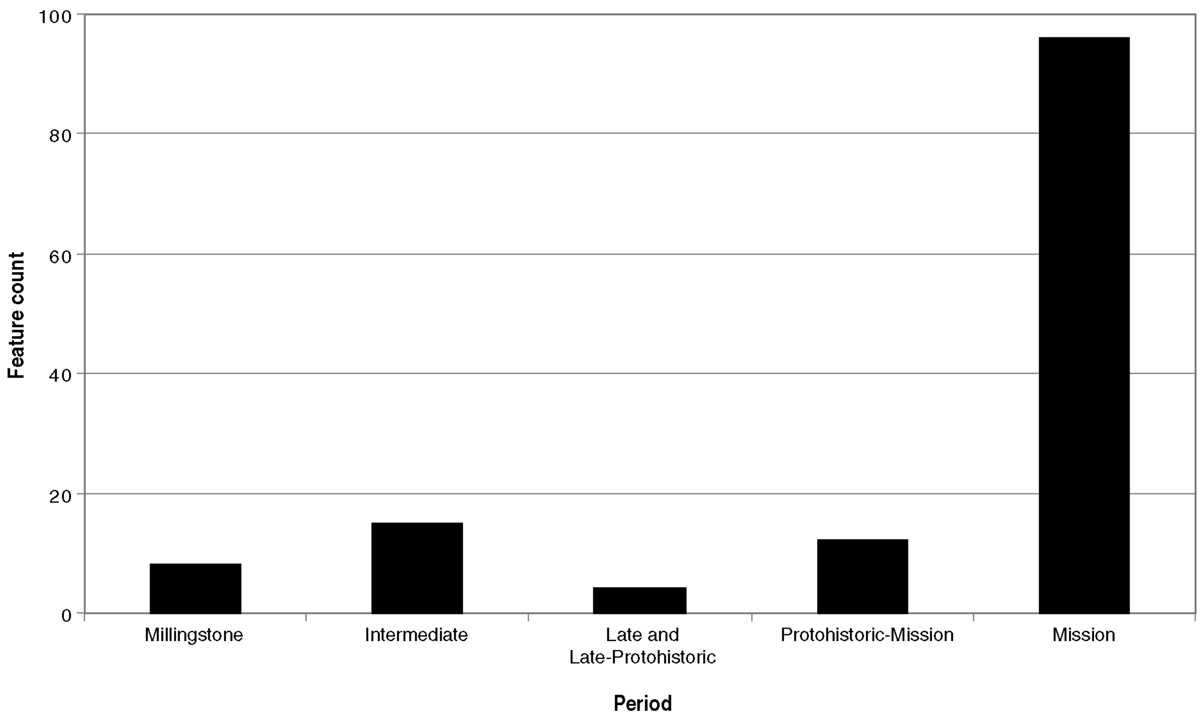

Figure 201. Feature counts (burial and nonburial) per period, LAN-62 Loci A and G.

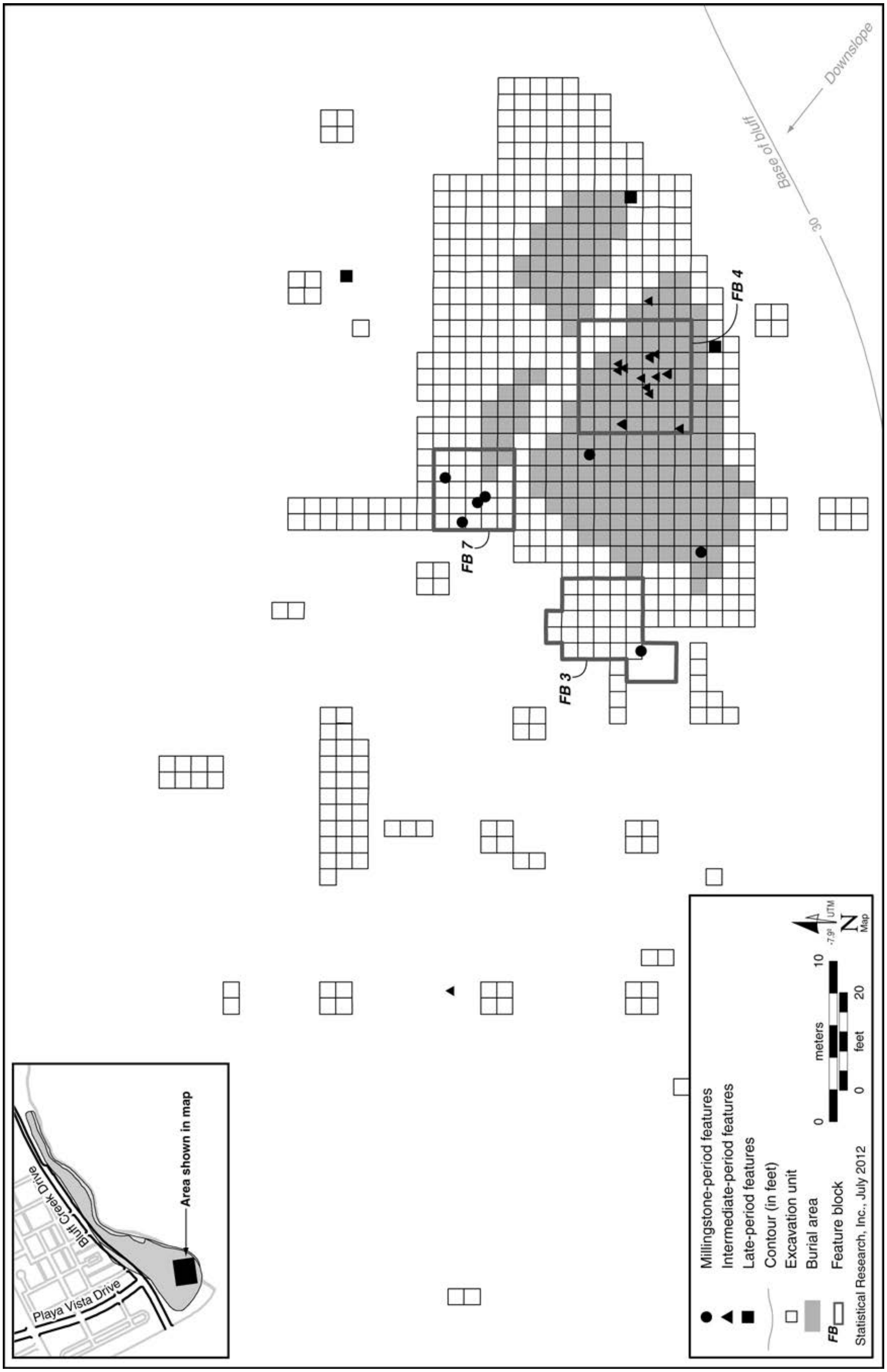

Figure 202. Map showing the locations of Millingstone, Intermediate, and Late period nonburial features in LAN-62 Locus A.

outlines. Each of those features probably was composed of discarded subsistence-related materials accumulated during short-term resource acquisition in the Ballona.

Feature 574 mostly consisted of ground stone fragments and unmodified cobbles within a small area of about 19 by 17 cm, suggesting a possible cairn or post support. It was situated adjacent to Features 573 and 623, a nonthermal- and thermal-discard area, respectively. The three features formed FB 7 and were probably functionally correlated, but their functional relationship is indeterminate. We discuss this feature in more detail below.

FB 7 appeared to have been part of a single depositional event. However, other features assigned to the Millingstone period probably were deposited at different times during the ca.-3,000-year span of the Millingstone period occupation in Loci A and G. The four radiocarbon dates obtained from the eight features supported that argument. Feature 690 in Locus G (4990–4490 cal B.C.) long predated the other features. One date from Feature 449 (2890–2520 cal B.C.) preceded the dates obtained from Features 518 and 673 (2440–1920 cal B.C. and 2580–2060 cal B.C., respectively). These dates underscored that the features were not contemporaneous and probably represented a palimpsest of debris generated from various separate and unrelated occupation events between about 5000 and 2000 B.C.

Feature 690 in Locus G was defined as a discard area for both thermal and nonthermal debris, with primarily unworked shell and small amounts of flaked stone, FAR, and faunal bone. The feature generally resembled most of the Millingstone period features in Locus A, with the addition of a largely intact ground stone bowl and metate and four manos. We suspect that the feature functioned as a domestic-discard location for subsistence debris that was subsequently reused as a ground stone cache.

In sum, the Millingstone period features mostly appeared to have been related to subsistence activities, such as cooking and processing of food, including hunted meat, fish, and shellfish. The features were relatively concentrated along a north–south alignment in the western portion of the large excavation block that may have marked the location of a relict berm or shoreline. With the exception of the three features that composed FB 7, the features appeared to have been deposited during different occupation episodes over a roughly 3,000-year span. We suspect that individuals or small groups sporadically made logistical trips to the Ballona to obtain aquatic, marshland, or riparian resources and that during those trips, they generated and deposited subsistence-related debris.

Intermediate Period

Fifteen features in Loci A and G were assigned to the Intermediate period, including 14 in Locus A and 1 in Locus G (Feature 688). Thirteen of the 14 features in Locus A were concentrated in the south-central and southeastern portions of the large excavation block, close to the bluff edge. Within that area, 12 features were concentrated in a roughly 10-by-10-m area in the south-central portion of the block. One additional feature in Locus A (Feature 621) was located about 35 m northwest of that feature concentration.

The concentration of 13 features in Locus A included 1 human burial and 12 domestic deposits related to subsistence activities. Although the spatial association would suggest that the features were contemporaneous, calibrated radiocarbon dates from the burial and 1 domestic feature indicated separate depositional episodes. The date for the burial feature was 1000–360 cal B.C., predating the domestic feature by at least several centuries (cal A.D. 160–440 and 450–770). We suspect (but cannot determine conclusively) that the 12 domestic features within the concentration were roughly contemporaneous during the middle or late Intermediate period, between ca. A.D. 200 and 800. The human remains were probably interred earlier, during the early Intermediate period, in the first millennium B.C.

The burial feature included a largely intact primary inhumation of a young adult female (17–25 years of age), along with scattered and disarticulated remains of at least two other individuals. Presumably, the intact inhumation impinged on and disturbed previously existing human remains. Disarticulated remains of an infant were recovered, along with partially blackened cranial fragments of an individual of indeterminate age and sex. Charcoal fragments also were recovered, suggesting in situ burning of the cremated remains. It was unclear whether all (or any) of the human remains had been interred during the Intermediate period. The radiocarbon date for the feature was obtained from a clamshell that perhaps had been associated with an earlier burial or other occupation event. The feature was situated within the large Late/Mission period burial cluster; it is therefore plausible that an inhumation dating to the Late/Mission period impinged on a previously existing early Intermediate period or other feature.

The 12 domestic features in the Intermediate period cluster included 2 thermal features and 10 nonthermal features. All appeared to have been discard areas related to subsistence activities. FB 4 (Figure 203) was designated an analytical context that encompassed these features, which were thought to represent an activity area. The features that composed FB 4 were characterized by 1 dense concentration of FAR and other dense deposits of unworked shell, faunal bone, and a small amount of flaked stone with little or no FAR. Bony fish remains were particularly prevalent in these features, in contrast to the majority of discard features in the area, in which mammal bones predominated.

Most of the other features in the cluster were compositionally similar to Features 509, 535, and 536. Features 413, 542, 571, and 572 were refuse deposits (without visible pits) composed mainly of unworked shell and faunal bone; Features 542 and 563 were almost exclusively composed of unworked shell. Two pit features (Features 483 and 541) also included dense deposits of unworked shell and faunal bone, most of which had been blackened or calcined, suggesting trash pits rather than storage pits. It is possible that subsistence-related debris were discarded in abandoned hearth pits.

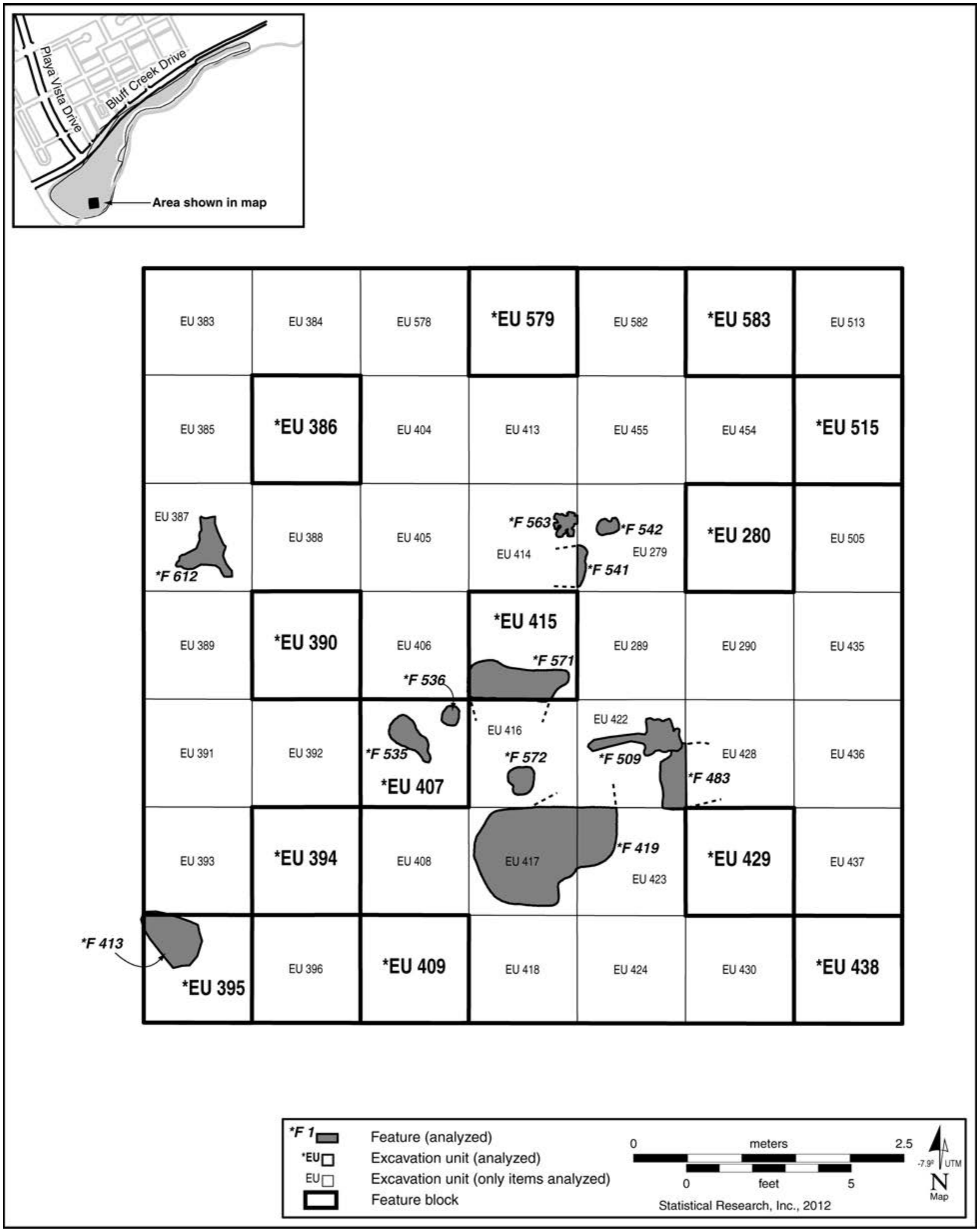

Figure 203. Map of Feature Block 4, showing individual Intermediate period features and units analyzed, LAN-62 Locus A.

Indeed, a lens of ash was visible in one of the two pits (Feature 482), suggesting possible in situ thermal activity. Notable was the prevalence of bony-fish remains in Features 483, 541, 571, and 572, as was also the case in Features 509, 535, and 536 (mammal bones were more prevalent in Feature 413), which suggested a preference for bony fish among the Intermediate period inhabitants. In addition, FAR was absent from or rare in most of the features in the cluster, suggesting that FAR was discarded in separate locations from faunal bone and shell. The reason for that pattern was unclear, but perhaps the food debris was discarded during or soon after a meal, and the FAR remains were discarded later, at the time of abandonment.

Three Intermediate period features were recorded outside the main cluster in Locus A. An oxidized pit interpreted as a small hearth was located roughly 10 m east of the feature cluster. It may have been coeval with the clustered features to the west, but if so, it was unclear why it would have been situated at a distance from the other features. More likely, the hearth was constructed during a separate occupation episode.

A probable trash pit was located roughly 35 m to the northwest of the main cluster. It probably indicated a separate occupation episode from the main feature cluster. The pit mainly included mammal bones, about half of which exhibited evidence of thermal alteration. Small amounts of unworked shell, FAR, and flaked stone also were recovered. The feature may have been an abandoned hearth that was filled with discarded food debris subsequent to its use as such, although in situ thermal activity was absent. One radiocarbon date obtained from the feature suggested a late Intermediate period of deposition (cal A.D. 560–680).

One Intermediate period domestic-discard deposit was excavated in Locus G. No pit was evident, suggesting a probable surface discard area. Discarded materials included FAR, unmodified cobbles, faunal bone, and unworked shell. In this case, both food debris and FAR appeared to have been discarded in the same location. This feature probably postdated the Intermediate period features in Locus A, although the sigma ranges partially overlapped; two radiocarbon assays produced sigma ranges of cal A.D. 670–980 and cal A.D. 830–1180, suggesting a very late/terminal Intermediate period date of deposition.

In sum, the Intermediate period features mainly were related to domestic subsistence activities. The concentration of domestic features in Locus A could suggest a somewhat more intense period of occupation during the late Intermediate period, however. These spatially contiguous subsistence-related features presumably were contemporaneous and may indicate a larger or longer-term occupation (unlikely permanent) or a series of repeat occupations over several years. Features outside the main cluster probably were deposited during isolated episodes of logistical resource acquisition in the area, an argument supported by the variable sigma ranges. One isolated human burial in Locus A may have been interred during the early Intermediate period.

Late and Late/Protohistoric Periods

Only four features were assigned to this period, suggesting a relatively light occupation during the first half of the second millennium A.D. Three of the features were located in Locus A, and one was located in Locus G (Figure 204). Figure 204 illustrates only the features found in Locus A. Of course, because there were many features that could not be dated, these period assignments reflected only known data. Calibrated sigma ranges for three of the features indicated occupation from the A.D. 1300s through the early 1700s. One radiocarbon assay generated a sigma range in the Intermediate period (cal A.D. 190–560) but was assigned to the Late period on the basis of stratigraphic position and the presence of a Canalino-style projectile point that postdated A.D. 950.

The four features all were classified as domestic features. Three of the four were classified as nonthermal, but each contained small amounts of FAR. One feature was classified as a thermal feature; it was mainly composed of FAR but also included small amounts of nonthermal materials, such as faunal bone, unworked shell, flaked stone, and ground stone. Essentially, they all appeared to have functioned as "generalized" domestic-discard areas, and one feature contained a higher proportion of FAR than the others. These features probably contained subsistence-related debris generated during temporary occupations in the Ballona.

The four features were not in close proximity, and it was unclear whether they had been formed during the same occupation or land-use event. None was located closer than 10 m from another Late or Late/Protohistoric feature. The Late or Late/Protohistoric occupations in Loci A and G probably constituted a palimpsest of subsistence-related features formed during various resource-collection events during the course of about 3 or 4 centuries, from the A.D. 1300s to early 1700s.

Protohistoric/Mission Period

In total, 12 features were assigned to the Protohistoric/Mission period: 9 human burials and 3 domestic features (Figure 205). All were located in Locus A. Calibrated radiocarbon dates from 4 burial features suggested calibrated sigma ranges from the A.D. 1300s through 1900s; however, the sigma ranges rarely provided sufficient resolution to distinguish Late from Protohistoric period occupations or Protohistoric from Mission period occupations. In most cases, additional chronological information was required. Most of the features were assigned to the Protohistoric/Mission period based on stratigraphic position (e.g., provenience in relation to dated features or time-sensitive artifacts).

Five of the burials were located within the dense cluster of burials, and four others were excavated outside the cluster to the north and south. Thus, about half the Protohistoric/Mission period burials (4 of 9) were outside the dense cluster, which may suggest that the main burial cluster was not perceived as the "core" of the burial area during the Protohistoric period; that perception probably occurred later, during the Mission

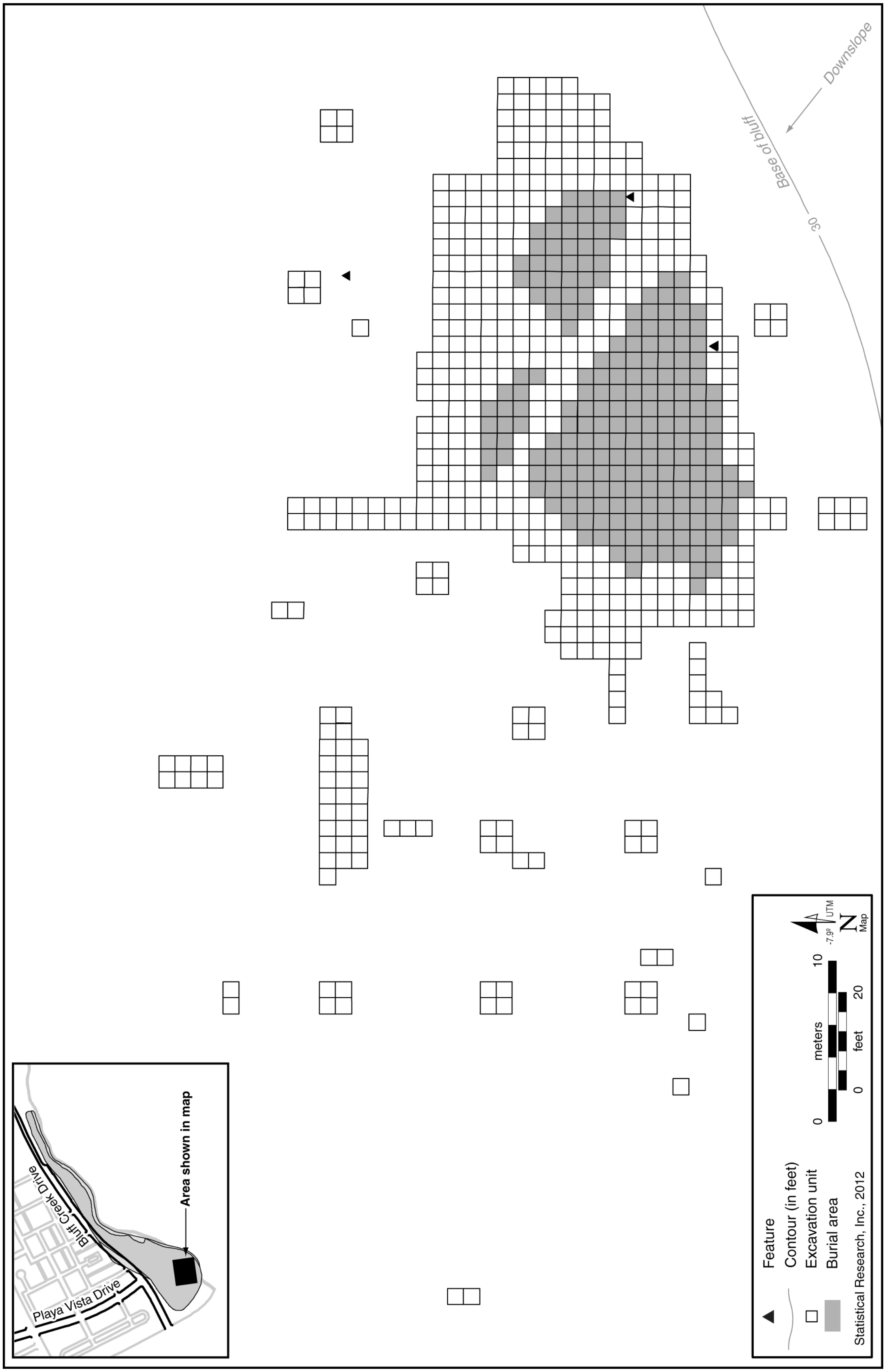

Figure 204. Map showing the locations of Late period and Late/Protohistoric period features in LAN-62 Locus A.

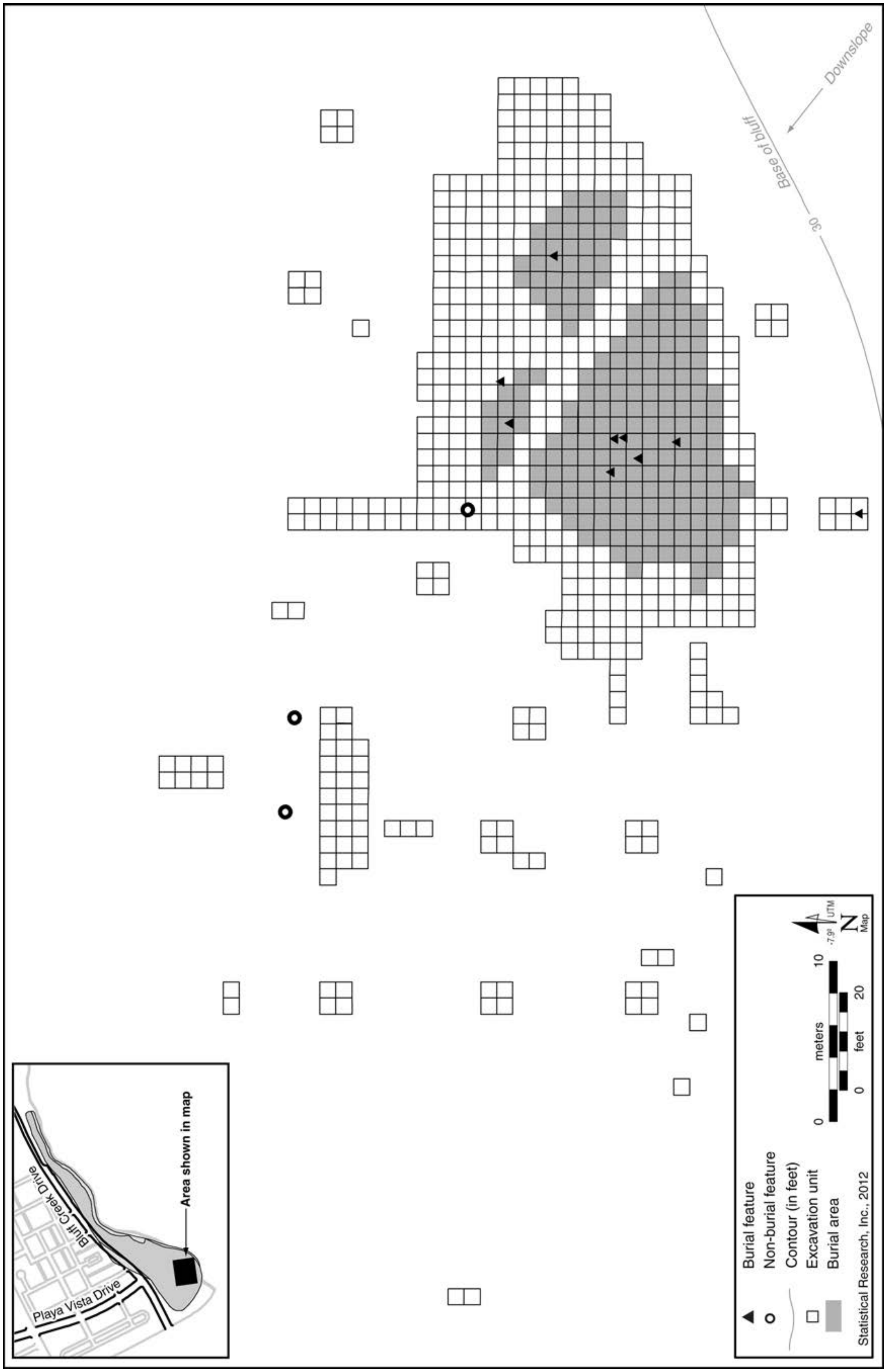

Figure 205. Map showing the locations of Protohistoric/Mission period features in LAN-62 Locus A.

period. One caveat to that inference, though, is that the Protohistoric/Mission period burials in the denser areas of the main cluster were far more likely to have been severely disturbed by later interments. Thus, the high proportion of burials outside the main cluster assigned to the Protohistoric/Mission period may reflect higher levels of post-interment disturbance and skeletal displacement within the cluster. We suspect that the dense burial cluster contained additional Protohistoric period burials that were removed or displaced by later interments.

The burials included three features consisting only of primary inhumations. Five others were primary inhumations in association with scattered, unburned remains or with partially burned and calcined remains, suggesting that the intact inhumations had disturbed or removed previously existing inhumations or cremations. One additional burial consisted of both a primary and a secondary inhumation.

The Protohistoric/Mission period primary inhumations included 2 female adults, 3 possible female adults, 1 male adult, a subadult of indeterminate sex, and 2 adults of indeterminate sex; the secondary inhumation was an adult, possibly male. That small sample did not provide an accurate indication of the demographic profile of the Protohistoric/Mission period burials, given the substantial disturbance and the high number of burials that could not be confidently assigned to a specific period. However, the prevalence of adult females and probable adult females in the sample (5 of 10 inhumations, 5 of 7 identified by sex) is at least worth noting. Only 2 inhumations were identified as adult males or probable males. A detailed discussion of the demographic profile in the burial area is presented in Volume 4, this series.

Three domestic features were assigned to the Protohistoric/Mission period, all located at a distance of 5 m or greater from the main burial area in Locus A. One feature was located in the northwestern portion of the main excavation block, and the other two were located in SUs farther to the northwest. The distance between the domestic features and the burial area may indicate that inhabitants refrained from performing domestic subsistence tasks in the direct vicinity of the burials, although we cannot rule out the possibility that some of the seemingly domestic, subsistence-related features were in fact locations of food preparation for feasts associated with the burial area.

The three domestic features were "generalized" domestic-discard areas with no evidence of pit outlines; they were composed of a mix of FAR fragments and various nonthermal materials, such as unworked shell and flaked stone debitage. Faunal bone was rare among the three features. Although we have defined them as domestic features, each also contained small amounts of possible ritual paraphernalia, including shell beads, whole abalone shell, a worked-bone tool, and a large chunk of asphaltum with attached remnants of basket or cloth. These features could be interpreted as ritual features, but it is worth emphasizing that the constituent elements in all three cases primarily included prosaic domestic debris, such as FAR, flaked stone, and unworked shell, none of which are indicative of ritual practices.

A number of EUs in the western portion of the burial area appeared to contain a hardpan surface several centimeters thick. Though not defined as a feature, the relatively thin, yet very hard, surface appeared to date to the Late or Protohistoric period component of the burial area and may have functioned as a surface for ceremonial activity, such as dancing. Because the Late period component of the burial area had been heavily impacted and highly disturbed by later burials, the hardpan lens is not well understood. A more detailed discussion of the surface and its possible function and role in the burial area is further developed in Chapter 6, Volume 5, this series.

In sum, the Protohistoric/Mission period occupation was concentrated in Locus A and consisted primarily of human burials; three scattered domestic features were located away from the burial area, to the northwest. The burials were about evenly distributed within and outside the dense cluster of burial features in Locus A; however, more burials dating to this period may have been interred in the burial cluster but been displaced or removed during later interment episodes in the Mission period.

Mission Period

In total, 96 features (all located in Locus A) were assigned to the Mission period (Figure 206) based on inspections of calibrated radiocarbon dates, the presence of time-sensitive materials (temporally diagnostic shell and glass beads and European plant and animal domesticates), and stratigraphic positions relative to other dated features. The features were mainly burial/ritual features, including human burials (75 features) and ritual offerings (18 features). Only 3 domestic features in Locus A were assigned to this period.

The human burials assigned to the Mission period were mostly concentrated in the western half of the burial cluster in Locus A (65 of the 75 burials were within the cluster) (see Figure 206). Glass beads also were heavily concentrated in the western half of the cluster (Figure 207). The majority of burials in the eastern half of the cluster presumably predated the Mission period, which could suggest a process of "drift" over time in new burial locations as the burial area became increasingly congested. We cannot rule out the possibility, however, that the observed spatial pattern of glass-bead distribution reflects social variability (e.g., status differences) rather than chronological variability.

The 75 human burials included 55 features of which 1 or 2 primary inhumations each were the principal components, 19 features with isolated and disarticulated remains of 1 or more individuals each, and 1 cremation (primary or secondary context was indeterminate). All but 15 of the primary inhumations were associated with disarticulated remains of 1 or several individuals each, distinct from the interred inhumation (including cremated remains), which largely underscored the extent to which the more-intact inhumations had displaced or removed the older, preexisting interments. Several of the primary inhumations included well-articulated skeletal elements of 2 individuals each. In those cases, each pair of individuals presumably was interred during the same event.

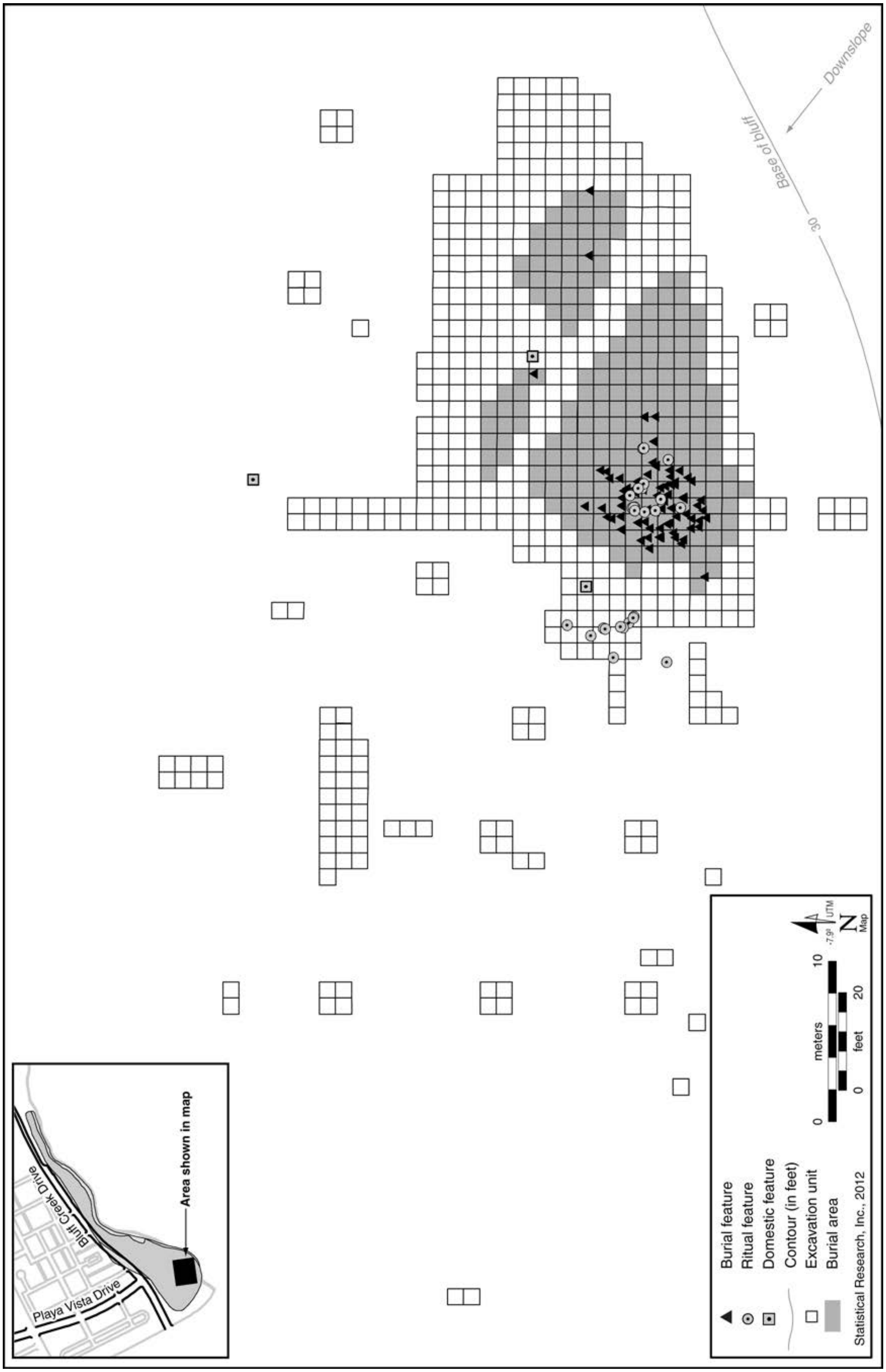

Figure 206. Map showing the locations of Mission period features in LAN-62 Locus A.

Figure 207. Map showing the distribution of glass beads in burial features in LAN-62 Locus A.

Age and sex information was inferable for 64 interred individuals (excluding disarticulated remains). The primary inhumations included adult females (20 individuals) or possible adult females (8 individuals). Together, adult females and possible adult females composed 44 percent of all identified remains (28 of 64). In contrast, adult males (7 individuals) and possible adult males (1 individual) composed only 13 percent (8 of 64). Adults of indeterminate sex composed another 23 percent (15 of 64, including the cremation). Thus, among adults identified by sex, females and probable females outnumbered males and probable males by 3.5 to 1. Also present were subadults, children, infants, and fetuses. Together, non-adults composed about 20 percent (13 of 64) of the burial interments.

Eighteen features were classified as ritual offerings, all of which likely had been deposited during ceremonies associated with the burial area. Thermal offerings were slightly more frequent than nonthermal offerings, and all but 1 of the thermal deposits were concentrated within a roughly 8-by-4-m area about 4 m to the west of the main burial cluster; 1 additional thermal offering was located within the burial cluster. Many of these features were included in FB 3, which was identified during fieldwork as representing an area of possible concentrated ritual activity (Figure 208). That group of thermal offering features may have indicated a single depositional event or, alternatively, an area of recurrent use for rituals involving burned offerings and mourning rituals. Perhaps the western orientation of the mourning-ritual area connoted sacred significance or ritual efficacy.

Five of the eight thermal offerings within the concentration were associated with visible pit outlines, suggesting that some burned offerings had been intentionally buried. However, none of the thermal features exhibited oxidized soil or other evidence of in situ thermal activity. Perhaps the thermal activities were not sufficiently intense to oxidize the surrounding soils. Alternatively, the ritual thermal activity may have occurred elsewhere, and if so, the features only indicated locations of interment of previously burned votive materials.

Seven of the thermal features—mainly concentrated to the west of the burial area—contained the remains of 1 or more burned baskets each. The baskets presumably functioned as containers for burned materials (see Chapter 5, Volume 3, this series, for a detailed discussion of textiles and basketry from LAN-62 Locus A). Several of the features contained multiple baskets; Feature 458, for instance, was estimated to have included at least 10. One basket fragment in Feature 35 was lined with asphaltum. Several features contained additional burned or unburned textiles in association with the basket remains, which could have functioned as cloth containers for some of the offerings. In addition to burned basketry and textiles, many of the features in FB 3 contained extremely high numbers of carbonized seeds. Over 370,000 seeds were analyzed from just nine of the features included in FB 3. That number represents just a sample of the number of carbonized seeds recovered from features in the block (see Chapter 14, Volume 3, this series, for details on carbonized plant remains from FB 3). A combination of native plant species and introduced domesticates were recovered from the feature, indicating its use during the Mission period.

The nonperishable contents of the burned-basket offerings varied. Some features contained relatively small collections, mainly beads or faunal bones. By contrast, other features contained abundant and diverse arrays of materials, including glass and shell beads, mineral fragments (concretions), charcoal fragments, flaked stone debitage, and unworked shell. One feature additionally contained several stone *comal* fragments, a stone-bowl fragment, bone tools, FAR, and a Cottonwood Triangular point. Shell and glass beads were recovered in varying quantities in all but one of the burned-basket features. Several also contained charred faunal bone, which, considered with the carbonized seeds, suggested inclusion of ritual food offerings or, alternatively, deposition locations for food consumed during feasts. No human bones were recovered among the features located outside and to the west of the burial cluster.

Two additional thermal offerings exhibited no evidence of burned basketry or textiles but contained contents similar to those in the burned-basket features. One feature was a pit defined by an area of dark soil and charcoal flecks that contained about 120 shell beads, a worked-bone tool, and abundant burned faunal bone. The other feature exhibited no visible pit but contained about 275 shell beads, along with burned faunal bone and a ground stone bead. Given the similarity of their contents to those of the burned-basket features, it is plausible that these features had once contained burned-basket remains that subsequently decomposed and were no longer visible during the excavation.

Feature 331 is a nonthermal feature in an area between FB 3 and the main concentration of burials. It is interesting in that it was composed of a combination of FAR, broken ground stone artifacts, and other faunal materials in a relatively tight cluster, in a space that was relatively devoid of other features. Feature 331 was interpreted as a ritual feature related to the burial ground and possibly associated with the mourning area that FB 3 may represent. The feature was similar to others recovered at sites throughout southern California that have been interpreted as mourning features (Cleland et al. 2007; Douglass et al. 2005; Hull et al. 2006; Walker 1952). Such features typically have large numbers of purposefully broken ground stone artifacts and other ritual materials and sometimes contain human remains. Generally, they are fairly large, sometimes encompassing areas of several square meters. Feature 331 is thought to date to the Mission period, but similar features elsewhere in southern California typically date to the Intermediate period. Similar features were recovered at the bluff top sites of LAN-63 and LAN-61, albeit on a much larger scale and from much earlier temporal contexts. The location of Feature 331 between a clearly defined ritual space (FB 3) and the dense burial concentration appeared to have been purposeful and seemed to point to its function as a ritual feature.

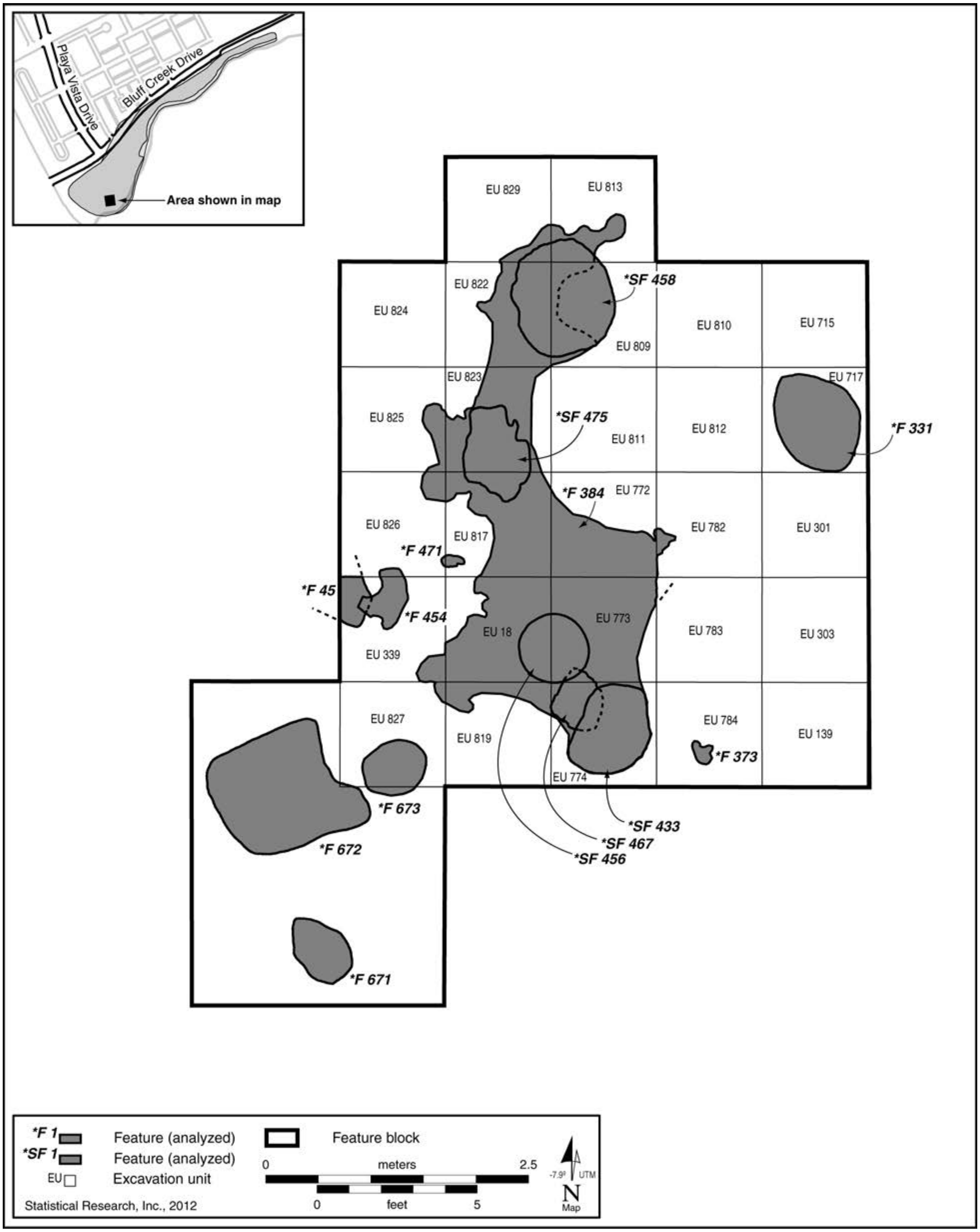

Figure 208. Detail map of the Feature Block 3 mourning area, showing individual features, LAN-62 Locus A.

FB 3 represented a very unique discovery within the PVAHP project and for the region as a whole. Ethnohistoric descriptions of mourning-ceremony procedures have been rare in southern California, and archaeological examples have been even rarer. Caches of carbonized seeds have been found in other areas, such as on San Clemente Island (Eisentraut 1990), but are relatively unknown in mainland southern California settings. The large number and condition of basketry fragments from this feature also represented a unique opportunity, because these types of materials have also been rarely found in mainland contexts. Analyses of carbonized seeds and basketry are presented in detail in Chapter 14, Volume 3, this series, and a detailed discussion of mortuary practices is presented in Volume 4, this series.

In contrast to the thermal offerings, all of the nonthermal offerings were situated within the burial cluster. Although we have interpreted them as offerings, some or all of them, in fact, may have consisted of displaced burial goods that were removed from direct association with skeletal remains. Only one feature was associated with a visible pit outline, indicating a "true" offering interred separately from the human remains, but no pit outlines were visible among the seven other nonthermal offering features. All but one of these features were primarily composed of dense concentrations or scatters of shell or glass beads (or both). Four consisted of one or several linear arrangements of shell or glass beads indicating that they had been strung together in strands (i.e., necklaces or bracelets). Those four features may have been displaced burial goods rather than offerings.

Three additional features were composed of large scatters of glass and shell beads that did not appear to have been strung together into strands. One feature was recovered in association with decomposed textile fragments, suggesting that the beads had been placed in a textile container (bag). Scattered beads in the other two features probably were not placed in containers but were recovered in association with other possible ritual paraphernalia: two incised steatite tablets, red-ochre fragments, an abalone shell, and a stone drill point. Feature 122 is a pit feature demarcated by dark soil that contained a concentration of glass beads, shell beads, and faunal bone. Feature 29 differed from the other nonthermal offerings in that no shell or glass beads were recovered. The main constituents were ground stone artifacts (a bowl, a pestle, and various fragments), along with a whole abalone shell and a worked-bone tool covered with asphaltum.

Two domestic features were situated outside and to the north of the burial cluster. One was located only 2–3 m from the edge of the burial area; the other was roughly 18 m to the north. Both were classified as thermal features, based on the high proportions of FAR to nonthermal materials. Both features appeared to have functioned as domestic-discard areas, mainly for FAR and faunal bone (mostly mammals). Also present in lesser amounts were flaked stone artifacts, ground stone fragments, and unworked shell. The feature located closer to the concentration of burials also included a small number of worked-bone tools. The proximity of the features to the burial area suggested a possible function related to mortuary or ritual activity. We suspect that they were related to food-preparation activities for feasts and communal ceremonies.

In sum, nearly all of the Mission period features in Locus A were related to the dense burial area. Most of the features in this group were human burials, followed by features related to rituals and ceremonies. Only two features were classified as domestic features, both of which contained subsistence-related debris, such as faunal bone and FAR, but those deposits also could have represented discard areas for food consumed during feasts and public ceremonies. The area of Mission period features in Locus A very likely functioned as the mortuary and ritual focus of the Mission period community in the Ballona, with residential areas apparently located in and near LAN-211, about 1.5 km to the east of Locus A.

Summary

Land-use practices appeared to have remained more or less consistent in Loci A and G during the roughly 5,000-year span of the Millingstone and Intermediate periods (and perhaps also the early part of the Late period). The early occupations mostly consisted of discard areas with debris that had been generated during short-term logistical resource-procurement trips in the Ballona. Mobile groups in the coastal area probably had long been drawn to the area for aquatic, marshland, and riparian resources and at least occasionally established logistical camps in the area. Fish and shellfish were obtainable in the area. In addition, freshwater streams and lagoon resources may have drawn animals, making the Ballona an appealing locus for hunting. Faunal bones, fish bones, and shell were prevalent in feature and midden remains throughout the occupation sequence. It is unlikely, however, that Locus A and G sustained permanent or semipermanent habitations during the earlier periods, for which the evidence indicated similar land-use practices to those at other sites in the lowland Ballona.

Sometime around the mid-second millennium A.D., however, land-use patterns shifted in the area, from a prosaic locus of logistical resource collection to a sacred locus of human burial and mortuary ritual. The Protohistoric/Mission and Mission period features primarily consisted of human burials and mortuary offerings associated with the burial area. Only a handful of Protohistoric/Mission and Mission period features were classified as domestic deposits, some or all of which may have functioned as discard areas for debris generated during feasts and feast preparations. Three domestic features assigned to the Protohistoric/Mission period were located away from the burial area and may have predated the founding and "sacralization" of the burial location. If so, logistical land use in Loci A and G may have persisted through the first half of the second millennium A.D.

Activity Areas

In this section, we discuss the inference of activity areas through analysis of the spatial distributions and concentrations of features assigned to each period. "Activity area" here refers to a discrete concentration of features assigned to the same period. The spatial and temporal associations of such features may indicate contemporaneous and discrete loci of human activity.

Few activity areas were evident among the Millingstone period features. Most of the Millingstone and Intermediate period features were probably related to isolated logistical camps. However, several features appeared to have been contemporaneous and functionally intertwined, most conspicuously FB 7 (Figure 209), which consisted of a possible cairn/post support or other site-"furniture"-type feature adjacent to a domestic-discard area with FAR and other debris; a second discard area with primarily FAR was located about 1.5 m to the northwest. The relationship among these features is unclear, but it is possible that the cairn could have supported a makeshift shelter for a logistical camp or acted as a rest for basketry or other tools. Most of the domestic debris had been discarded within or adjacent to the shelter. Most of the thermal debris may have been discarded a meter or so away from the flammable elements of the shelters. No hearth was excavated in the vicinity, but a nearby feature may have been the remains of a disturbed hearth. A similar group of three features was also excavated in Locus C, about 1 km to the east.

For the Intermediate period, again many of the features probably consisted of isolated discard areas or hearths related to short-term logistical camps. As explained, 12 features were located within a roughly 10-m radius and may have been part of the same depositional event and, therefore, formed a larger activity area (although we cannot rule out the possibility that they represented separate and unrelated events within an area of recurrent use) (see Figure 203). The compositional similarity of the discard features supported the possibility of a discrete activity area: the majority of the features contained dense concentrations of unworked shell and faunal bone, and there was an unusually high proportion of bony-fish remains. Several other discard areas were predominately composed of unworked shell and mammal bones, and a small number of deposits contained mainly FAR.

The spatial arrangement of the 12 features provided insights into their relationship. The 6 deposits with abundant bony-fish concentrations formed a dense cluster in the middle portion of the feature group (see Figure 203), and the 3 deposits with abundant shell and mammal bone were located along the periphery of the feature group, on the northern and southwestern edges. It is possible that a few of the features were deposited during a separate occupation event, but the dense group of features with abundant bony-fish remains probably were deposited during a single occupation event. Perhaps these features represented "toss zones" formed during a camping venture focused on the collection and processing of bony-fish species. The features with FAR deposits also were situated along the edges of the group, on the south and northwest. They may have been part of the same depositional episode, but perhaps hearth debris and other thermal remains were discarded along the periphery of the camping area, away from flammable shelter materials.

No activity areas were identified among the features assigned to the Late/late Protohistoric period, but very clearly defined activity areas were readily inferable for the Protohistoric/Mission and Mission periods. The dense burial area was a salient activity area devoted to mortuary and ritual activities and likely was perceived as a sacred location that "housed" the remains of deceased family members and ancestors. For the Mission period, the concentration of thermal offering features located several meters west of the burial area was another salient activity area focused on mortuary-mourning rituals, another probable sacred location. There appeared to have been some separation of particular types of ritual activity and the actual locations of the burials. A small mourning feature appeared to separate the main concentration of burials from the ritual space occupied by the burned-basketry and seed offerings that made up the feature identified as FB 3. The burial space may also have been demarcated by the placement of whalebone or other markers that would likely have been visible on the ground surface (Figures 210 and 211).

Loci C and D

Table 52 offers a summary classification of 10 features excavated in Loci C and D: 7 in Locus C and 3 in Locus D (see Figures 149 and 151, respectively). These features were distributed more or less continuously along the base of the bluff. Loci C and D contained a very low feature density, which was consistent with the low-density midden remains. A radiocarbon date was obtained for only 1 of the prehistoric domestic features. Hence, analysis of occupation surfaces was impossible. However, 3 of the domestic features formed a tight cluster and could be reasonably interpreted as an activity area.

Feature Classification

The features in Loci C and D included five domestic features and five late-historical-period/modern features. The domestic features included three thermal and two nonthermal features. The thermal features were FAR concentrations with no visible pit outlines. One feature in Locus C consisted of only two FAR fragments with no additional materials, likely indicating the cleaned-out remains of a small hearth or the remnants of a heavily disturbed hearth. The latter interpretation is more likely, given the absence of hearth features from the immediate vicinity; cleanout features presumably would have been situated within a short distance of a hearth. Two features in Locus C included primarily FAR fragments in association

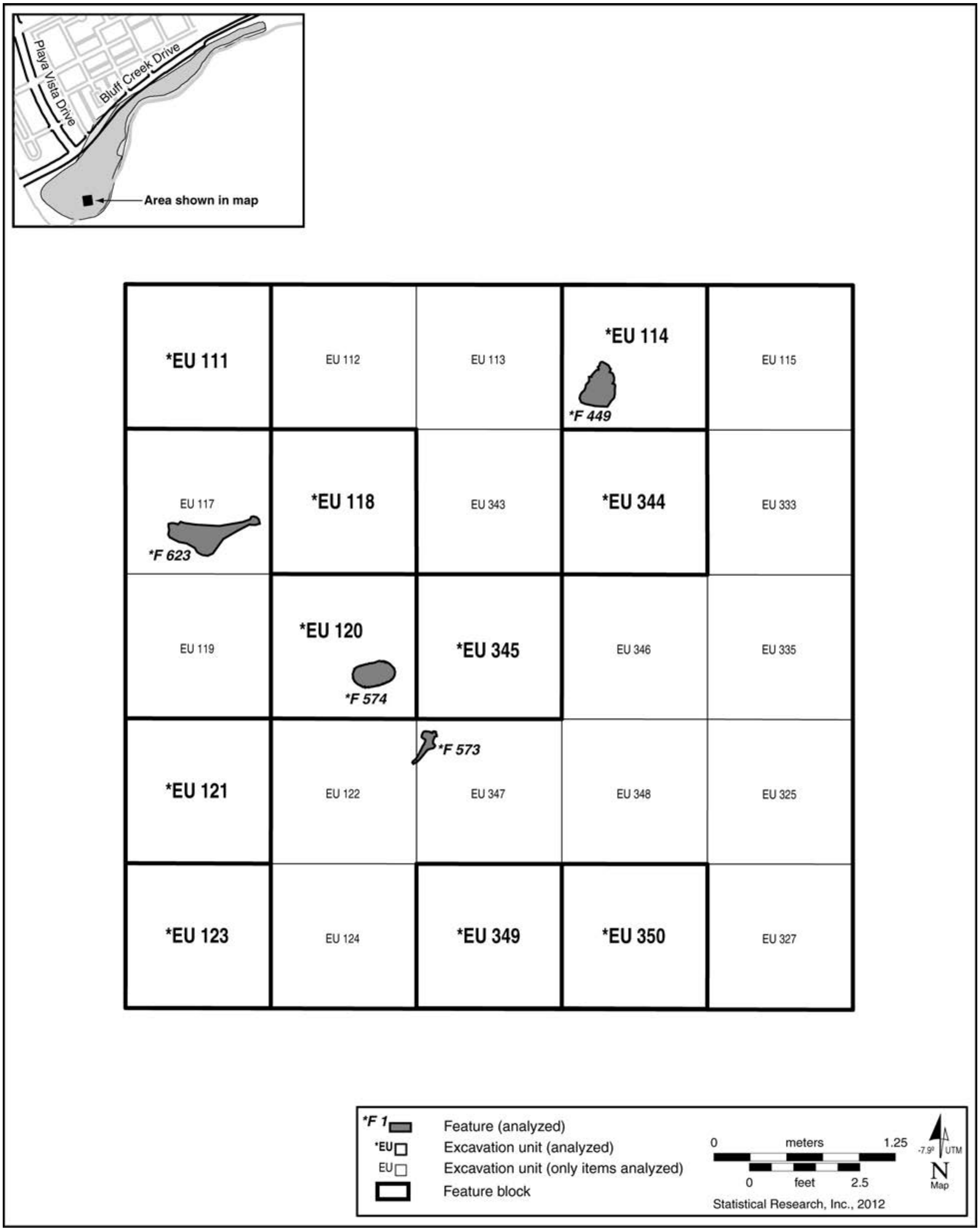

Figure 209. Detail map showing individual Millingstone period features and analyzed EUs in Feature Block 7, LAN-62 Locus A.

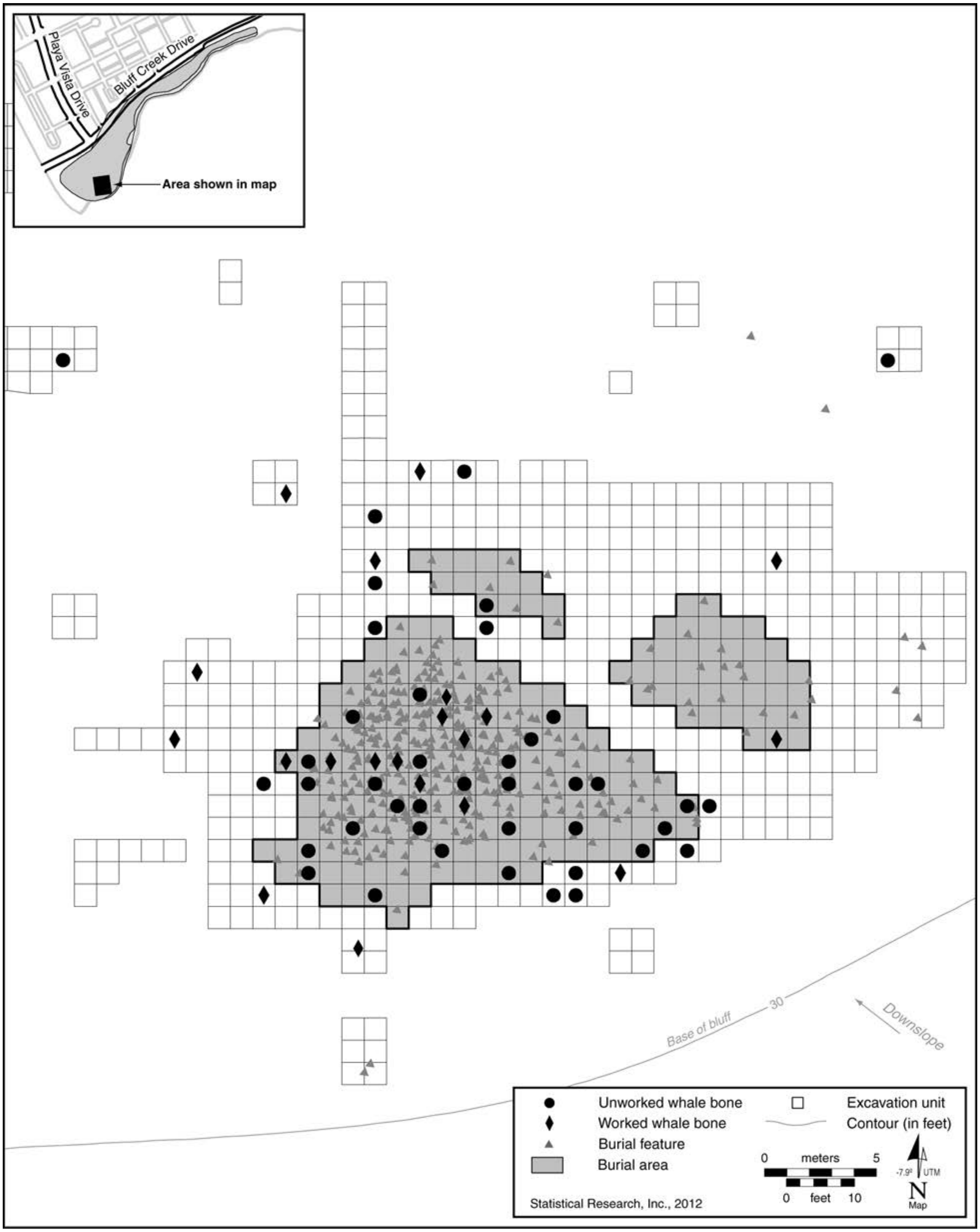

Figure 210. Map showing the distribution of whalebone within and surrounding the burial area, LAN-62 Locus A.

Figure 211. Photographs of possible whalebone grave markers in the burial area, LAN-62 Locus A.

with faunal bones, mostly mammals; flaked stone debitage; and small numbers of ground stone. Again, it was unclear whether those features functioned as hearths or as cleanout deposits, but one may have been a disturbed hearth with no visible pit outline or evidence of in situ thermal activity. The latter features were located within a 2-m radius and probably were deposited during the same occupation event.

The nonthermal features included an animal inhumation and a possible cairn or post support, both located in Locus C. The animal inhumation consisted of an articulated juvenile deer skeleton and a small amount of flaked stone debitage, which generated a sigma range of cal A.D. 420–960, suggesting a late Intermediate period of interment. The deer carcass was likely stored or cached in the feature location but never exhumed for consumption. The possible cairn or post support consisted of a cluster of about 25 manos, metate fragments, and other ground stone fragments, along with abundant faunal bone, within a small area of about 30 by 40 cm. It is unlikely that the faunal bones would have been deposited during construction of a cairn or post support; they may have been secondary deposits.

The late-historical-period/modern features included three trash pits, a possible structure, and an articulated skeleton of an adult horse. The three trash deposits generally contained similar contents, including metal fragments, glass, ceramics, food debris (eggshells and saw-cut faunal bone), and plastic debris. Those remains primarily appeared to be related to domestic activities, although one of the trash pits also contained debris related to construction activities. One feature included a series of truncated posts surrounded by a base of red bricks and concrete. Most of that structure had been truncated in the mid-twentieth century, during subsequent construction episodes by Hughes Aircraft Company. Its function is indeterminate. The horse inhumation appeared to have been deposited in the relict marsh, probably in the early twentieth century.

Activity Areas

Features 520, 521, and 540 formed a tight cluster and probably were parts of a single activity area, although their age is indeterminate. In contrast, the other domestic features were not spatially associated with other features and presumably were isolated deposits related to single-event procurement camps. The late-historical-period/modern features also were isolated and scattered throughout Loci C and D and thus did not appear to have been spatially or functionally connected or related to a single depositional episode. We focus exclusively here on Features 520, 521, and 540—the only potential activity area in the eastern portion of LAN-62.

The three features were compositionally similar to FB 7 in Locus A. In both cases, a possible cairn or post support was located immediately adjacent to a domestic-discard area with FAR and other subsistence-related debris, and a second discard area was located 1–2 m to the northwest. Like FB 7, the possible cairn could have marked the location of a shelter for a temporary camp or could have represented site "furniture" (e.g., used as a basket or pot support). The adjacent features could have been indicative of discard areas where food waste and other refuse were discarded during the camping episode. We suspect that a more distant discard area marked the location of a heavily disturbed hearth that was filled with domestic debris when the camp was abandoned. That feature exhibited no evidence of in situ thermal activity, but bioturbation or other postdepositional disturbance may have obliterated such evidence.

Conspicuously absent from the three features were unworked-shell remains. That pattern was consistent with the results of the midden-constituent analysis, which also revealed very sparse shell remains in these loci. If this group of features were related to a single resource-collection trip, then it appears that the purpose of the trip was the hunting of game, rather than fishing or collecting shellfish.

LAN-211 Field Methods and Excavation Results

Christopher P. Garraty, Benjamin R. Vargas, Sarah Van Galder, Stacey N. Lengyel, Jeffrey A. Homburg, Jill A. Onken, and John G. Douglass

This chapter summarizes the results of data recovery excavations at LAN-211, a multicomponent site that predominantly dated to the Intermediate (3000–1000 B.P.) and Mission (A.D. 1770–1830) periods. The site rests on an alluvial-fan deposit located at the base of the Ballona Escarpment, in Area D of the PVAHP project area, and forms part of the BLAD, which has been determined eligible for listing in the NRHP (Altschul et al. 1991). LAN-211 is entirely located within the Phase 2 work area (Figure 212). A portion of the site was impacted by construction of the Riparian Corridor, and SRI conducted data recovery excavations to mitigate those impacts.

The precise location and boundary of the site have been sources of confusion over the last few decades. SRI's testing efforts in the 1990s (Altschul et al. 2003:5–6, 49–50) showed that the area previously defined as LAN-211A and LAN-211B (noncontiguous loci) by Van Horn and associates (Archaeological Associates 1988; Freeman et al. 1987; Van Horn 1984b) was, in fact, a continuation of LAN-62, a linear expanse of cultural resources stretching along the base of the Ballona Escarpment, southwest of the currently defined site of LAN-211. Accordingly, the area previously designated as LAN-211A and LAN-211B was redefined as part of LAN-62 (see Chapter 9, this volume). LAN-211 was redefined to encompass an area of intact subsurface cultural deposits to the east of LAN-62, an area formerly designated as SR-13 (Altschul et al. 1991; Altschul et al. 2003).

The first part of this chapter outlines the history of archaeological investigation at LAN-211, from amateur studies in the early and mid-twentieth century through SRI's comprehensive subsurface-testing program. This section elucidates how the previous efforts helped SRI prepare for the subsequent data recovery at LAN-211.

Site Setting

Archaeological deposits at LAN-211, like several other sites, are located primarily on the foot slope of an alluvial fan below the Ballona Escarpment. The Ballona Lagoon and nearby wetlands are to the west and northwest of the site, much of which rests on an elevated fan; however, a significant portion of the site was documented to the north, where fan deposits are interfingered with marsh deposits. The site rests just below and adjacent to a deeply cut drainage that, prior to being filled during the construction of LMU, would have been the source of a significant amount of siltation from the bluffs above.

The hill-slope facies marks the northern edge of the Ballona Escarpment. In the area of LAN-211, the northern edge of those hills forms a steep, east–west-trending bluff. In elevation, the base of the bluff rises from 4.5–6 m to more than 45 m AMSL on the summit, over a horizontal distance of about 30–40 m. There was ample evidence of slope failure and slumping visible along much of the bluff face. Steep slopes and geomorphic instability would have made the back slope of the hill-slope facies an unsuitable setting for human occupation. The foot slope at the base of the bluff is the gentle slope below the back slope. The foot slope has undergone some erosion, as indicated by occasional rills and gullies that have been filled in and the erosion lag deposits, but the dominant geomorphic process has been deposition.

The lower, back slope along the entire length of the bluff was modified when the North Outfall Sewer was constructed in the 1920s. Construction of the sewer line involved building an artificial bench and excavating a long trench on the back slope of the bluff. A narrow access road (Cabora Road, formerly Sewer Line Road) was built between 1929 and 1945, over the sewer line. To stabilize the sewer and the road, earthen fill was placed to form an artificial berm that covers the back slope below the sewer and some places where the sewer and the road cross alluvial fans. Soil material from the construction might have been the source of some strata found at archaeological sites at the base of the bluff. The artificial berm has worked to protect cultural resources at the base of the bluff. Unknown amounts of cultural materials lie intact beneath the berm. Excavations into the slope at LAN-211 identified intact deposits extending into the artificial bluff face for a substantial distance and, in fact, never reached a definite boundary. Some cultural materials at LAN-211 were found extending into the adjacent freshwater-marsh deposits, especially to the west, within the Riparian Corridor, as well as to the north, outside the Riparian Corridor. The Riparian Corridor was built more

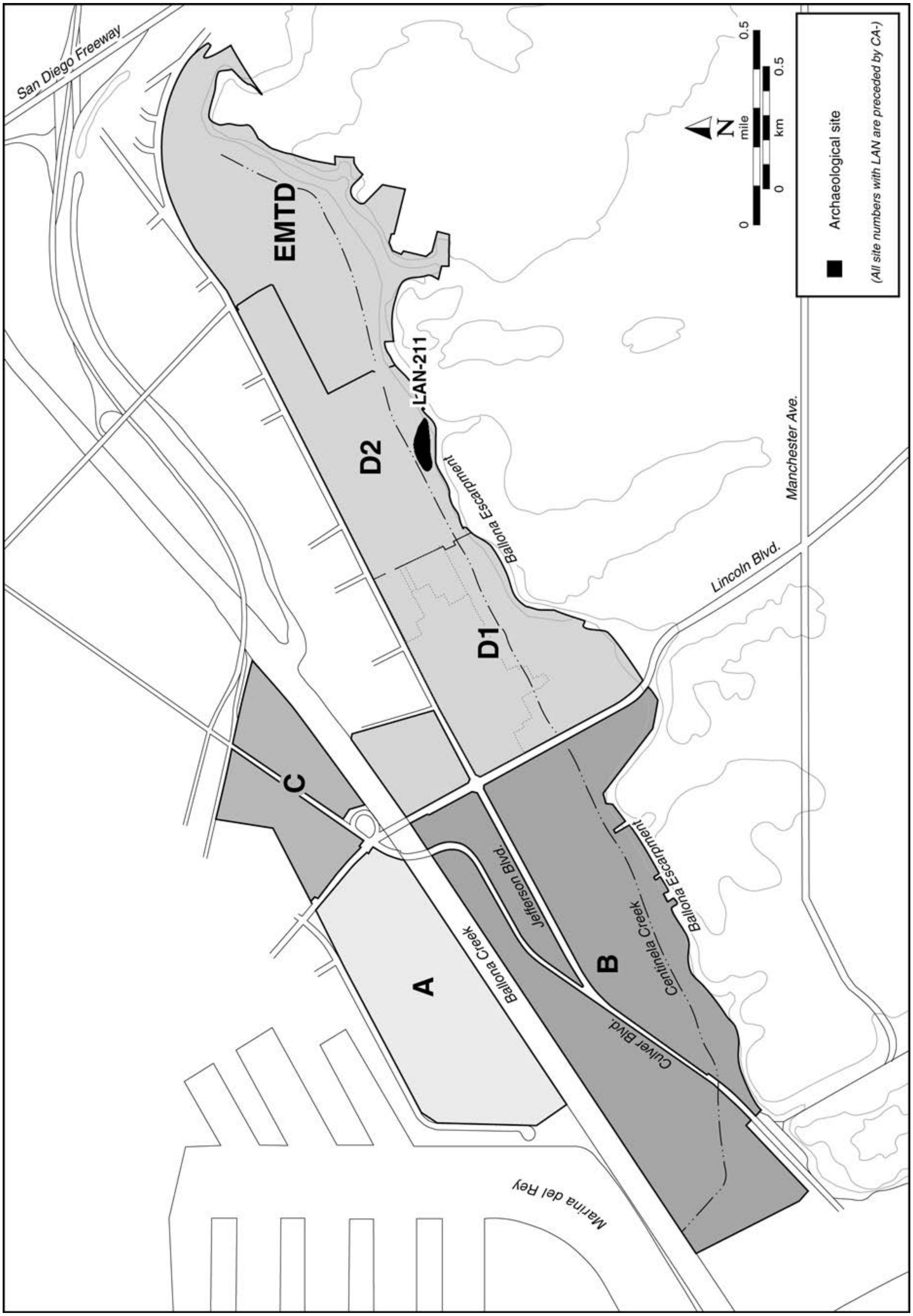

Figure 212. Map highlighting the location of LAN-211 within the project area.

or less along one of the former courses of Centinela Creek, a freshwater stream that previously provided potable water to the human populations who once resided and camped along the base of the bluff.

The inhabitants of LAN-211 would have had easy access to both floral and faunal riparian resources, as well as those in freshwater and salt marshes and on the nearby sandy beach. SRI's investigations indicated that the inhabitants of the site exploited these varied niches. Surprisingly, the inhabitants of the site also conducted activities at the interface between the freshwater marsh and the foot slope. In SRI's earlier work, it was presumed that the presence of marsh deposits signaled an end to the cultural deposits, but as features and archaeological middens were recovered from the foot-slope areas as well as from the intermingled slope and freshwater-marsh deposits, we had to rethink our approach.

Archaeological Background

This section is divided into two subsections. The first provides an overview of previous research in the vicinity of LAN-211, prior to SRI's work. The second subsection describes SRI's initial work efforts at LAN-211. The objective of these discussions is to demonstrate how previous projects provided information that was important to the development of SRI's data recovery strategies.

Previous Investigations

There is considerable debate and confusion about the location of LAN-211. In the following discussion, some of the issues will be presented, as well as the resolution that SRI offers concerning where the site is located. Throughout the early twentieth century, many amateur archaeologists and collectors removed artifacts and analyzed materials from sites in the Ballona. Those collections likely included portions of the dense and extensive cultural deposits located along the base of the bluff at LAN-62 and LAN-211. A handful of those early collectors recorded their findings. F. M. Palmer (1906), an amateur archaeologist, investigated archaeological sites along the Los Angeles coast in the early 1900s. It is unclear whether he visited sites in the Ballona, but his site descriptions suggested that he was at least aware of them (Altschul et al. 2003:46; Wallace 1984). F. H. Racer (1939), another early collector, later visited sites in the Ballona, possibly including LAN-211 or neighboring LAN-62. Unfortunately, because of their uncertain provenience, those collections possessed limited value for better understanding prehistoric settlement and land use in the region.

Another amateur archaeologist, William Deane, excavated sites in the Ballona in the late 1940s. Deane's brother, who worked as a grading contractor for Hughes Aircraft Company, regularly informed Deane about archaeological resources on company property. In 1953, UCLA student Marlys Thiel interviewed Deane and wrote a description of his field observations and collections, including four inhumations that he had excavated on Hughes Aircraft Company property (Thiel 1953). One of the sites Deane recorded, which he called "Site No. 1," appeared to correspond to the location of LAN-211. Thiel included photographs of some of the more remarkable items in Deane's collection, including an abalone-shell bowl, a deer-bone whistle, shaft straighteners, and projectile points.

Around the same time that Deane conducted work in the area, Dorothy Luhrs of the Los Angeles County Natural History Museum conducted a survey along the base of the bluffs, including the vicinity of LAN-211 (Luhrs and Ariss 1948, cited in Freeman et al. 1987:6). In 1948, Luhrs recorded a surface deposit measuring about 150 by 400 feet (45.7 by 121.9 m) located on a stream terrace roughly 20 feet (6.1 m) south of Centinela Creek; she designated the deposit LA:3. Luhrs observed looter holes (up to 1.5 m in depth) and piled artifacts on the surface, making clear the extent to which looters had ransacked the area in the early and mid-twentieth century. She also recorded a "considerable quantity" of shell (abalone, clam, and oyster), ground stone fragments (bowl fragments and pestles), hammerstones, and human "toe bones" (cited in Freeman et al. 1987:6).

Five years later, in 1953, an unnamed person, probably Hal Eberhart, filed a site record for LAN-211 (see Pence 1979). Eberhart worked for the Archaeological Survey at UCLA and filed a number of site records for the Ballona around that time. Surprisingly, the recorder equated LAN-211 with LA-29, another site recorded by the Los Angeles County Natural History Museum. The site record made no mention of Dorothy Luhrs's work at LA:3; rather, the recorder mainly drew from William Deane's observations, as described by Thiel (1953). The record described the site as situated "on a terrace . . . 220 feet [67.1 m] east of Lincoln Boulevard," which Deane had designated "Site No. 1" (Thiel 1953). The recorder appeared to have been unaware of Luhrs's work (Altschul et al. 1991:122). (Note that the location is what SRI has now defined as LAN-62 Locus D.)

Professional archaeologists next visited LAN-211 in 1979, when R. L. Pence conducted a survey of the Hughes Aircraft Company property. Pence (1979) successfully relocated the area of LAN-211 that had been recorded by Deane and Thiel. He observed a small area of shell and lithic debris; however, the amount of debris was inconsistent with Deane's and Thiel's descriptions, which indicated far-denser and more-abundant cultural deposits. Pence observed that the site had been subjected to construction-related disturbance over the course of the roughly 30 years since Deane had recorded the site. Part of the site had been destroyed during construction of an underground fuel-storage complex, and an asphalt parking lot had been built over another area of the site. Pence documented sparse deposits of shell and lithic debris in the small area of the site that remained exposed on the surface.

Five years later, Van Horn and associates attempted to relocate the small surface exposure of LAN-211 described by Pence (Van Horn 1984a:34). Van Horn was specifically interested in exploring a possible historical-period component of the site. Based on W. W. Robinson's mention, in 1939, of Indian workers' residing at the base of the bluff below LMU, Van Horn speculated that LAN-211 may contain remains of a historical-period indigenous occupation. Despite comprehensive testing, however, Van Horn and colleagues did not detect cultural resources in the area that Pence had identified as LAN-211, nor did they detect evidence of a historical-period occupation in the area (Van Horn 1984a:40). In his report, Van Horn expressed uncertainty regarding whether the deposits had been removed or destroyed as a result of disturbance or, perhaps, had been wrongly reported in that location.

During the course of testing along the bluff edge, however, Van Horn and associates detected a second midden deposit to the west of the area that had been identified by Pence and Deane/Thiel that Altschul et al. (1991:122–124) suggested may correspond to Luhrs's LA:3. Rather than designate a new site number for that deposit, Van Horn designated it LAN-211B and designated the original site area described by Pence and Deane/Thiel LAN-211A (Van Horn 1984a:39). LAN-211B was located roughly 120–150 m west of LAN-211A.

Van Horn (1984a:35) also excavated 15 backhoe trenches slightly north of LAN-211B, to test for subsurface cultural resources prior to the construction of a concrete retention basin. As had been the case at LAN-62 (see Chapter 9, this volume), the trenches revealed very thick subsurface cultural deposits, in excess of 2 m in depth in some places. However, excavators did not observe cultural deposits in areas located farther from the bluff edge, to the north of LAN-211B, nor did they encounter cultural deposits during the construction of the retention basin. Based on those results, Van Horn concluded that LAN-211B probably did not extend to the north of the observed midden deposit along the base of the bluff.

In 1987, Van Horn and colleagues carried out more-extensive testing in the vicinity of LAN-211B, in an effort to identify the horizontal and vertical dimensions of the site (Archaeological Associates 1988; Freeman et al. 1987). They excavated 16 backhoe trenches and 5 wedge trenches along the base of the bluff. Based on the testing results, they concluded that the midden deposits at LAN-211B were, in fact, secondary fill that had been redeposited in the area during several modern episodes of construction (Freeman et al. 1987:31–32). Below the redeposited fill, however, they located an intact horizon of dark soil and cultural deposits up to 3 mbs (1.2 m below the layer of fill). Because of the thick overlying deposits of fill and construction debris, Van Horn and colleagues were unable to expose a full vertical profile of the deeply buried cultural resources in all their test trenches. In areas where the subsurface deposits were relatively shallow and accessible, they manually excavated a series of 1-by-1-m units and found dense artifact deposits, including lithic debris, projectile points, faunal remains, shell, and shell artifacts; the deposits ranged in thickness from 0.4 to 1.4 m. Based on the recovery of a number of chronologically sensitive artifacts in the test units, Van Horn and colleagues interpreted LAN-211B as a multicomponent site with broadly defined earlier (500 B.C.–A.D. 1000) and later (post–A.D. 1000) components.

Van Horn and associates (Archaeological Associates 1988; Freeman et al. 1987) failed to detect cultural resources in the vicinity of LAN-211A—likely the original area that Deane/Thiel had defined in the 1950s. Instead, they observed deeply buried, intact deposits elsewhere along the base of the bluff, which they designated as LAN-211B. They found cultural deposits closer to the bluff edge but not in areas farther away from the bluff. Considering the depth of the overlying fill, however, Altschul et al. (1991:124) questioned that interpretation and suggested that cultural deposits at LAN-211 may extend farther to the north but may be too deep to expose through conventional archaeological excavation methods. Van Horn and colleagues' trenches were excavated to a depth of 3 mbs, which may not have been deep enough to expose any very deeply buried deposits. Significantly, none of the previous investigations suggested the presence of a Prehistoric or Mission period component.

SRI's Investigations at LAN-211

Previous research at LAN-211 indicated the presence of intact subsurface resources, but the depth and extent of those resources were undetermined. As Altschul et al. (2003:52) explained, in the beginning, "they found themselves confronted by confused site labels and uncertain site boundaries." Moreover, Altschul et al. (1991:60) also speculated that LAN-211B may be a continuation of LAN-62 to the west.

SRI surveyed the area in 1990 and, like Van Horn and colleagues, did not find substantial surface cultural materials at LAN-211A, the area thought to correspond to Thiel's and Deane's descriptions (Altschul et al. 1991:157–160). SRI staff observed heavy disturbance in the vicinity of LAN-211B. Modern debris and several drainage ditches obscured the surface over much of the area, and a large, concrete catchment basin appeared to have destroyed the eastern portion of the site. They found scattered cultural debris on the surface of LAN-211B. However, it was unclear whether those cultural materials were in primary or secondary context; the materials might have eroded down from LAN-61 (located on the bluff top above LAN-211) or, alternatively, been redeposited when the area was graded for construction by Hughes Aircraft Company.

Importantly, during the same survey, Altschul et al. (1991:155) located a likely intact deposit of cultural materials slightly east of the area then defined as LAN-211 that they designated SR-13. Unlike LAN-211A and LAN-211B, SR-13 possessed a quantity and diversity of artifacts more fitting of Luhrs's and Thiel's/Deane's descriptions that may have been the same site that Luhrs had recorded in 1948 as LA:3 (see Altschul et al. 2003:52). They described the site as "an intact, thick midden deposit. The soil is homogenous, suggesting that it is in situ, as opposed to having been sloughed off the bluff top" (Altschul et al. 1991:155).

To resolve the many questions stemming from the survey results, SRI archaeologists concluded that subsurface testing would be necessary to locate the boundaries of the site, infer the site chronology, and evaluate the integrity of the subsurface cultural resources. As the results of previous projects and their own survey had made clear (Archaeological Associates 1988; Freeman et al. 1987; Peck 1946, 1947; Van Horn 1984a; Van Horn et al. 1983), pedestrian survey alone was insufficient to identify and evaluate the deeply buried cultural deposits at LAN-211. Altschul et al. (1991) thus devised an ATP in 1991 to evaluate the abundance and integrity of subsurface cultural resources in the PVAHP project area, including LAN-211.

Based on previous research and SRI's survey at LAN-211, however, Altschul et al. (1991), in agreement with the Corps, recommended LAN-211 eligible for listing in the NRHP. Further evaluation of LAN-211 for NHRP eligibility was determined to be unnecessary.

Defining the Site Boundary

In the ATP, Altschul et al. (1991) assumed that subsurface testing would not be possible until the overburden of fill and construction debris had been fully removed. However, as Grenda et al. (1999) subsequently realized, bucket-augering technology provided an effective and less-costly means of probing for deeply buried cultural deposits without completely removing the overburden. SRI thus developed a systematic bucket-auger-testing strategy to detect the presence and depth of existing subsurface cultural resources. The bucket-auger-test region encompassed Areas D and D2, including LAN-62, LAN-211, SR-13, and areas in-between.

Grenda et al. (1999) outlined a set of objectives for the bucket-auger testing: (1) provide high-resolution information concerning the site, (2) better define the horizontal extent of the cultural resources, (3) expose the depth and stratigraphy of the deposits, and (4) infer possible activity areas or other intrasite patterns (Grenda et al. 1999:38). According to Vargas (2003:106–108), the placement of the bucket-auger units began in the known site area of LAN-62 and continued northeast along the base of the bluff. The auger holes revealed a virtually continuous stretch of cultural resources along the base of the bluff, from the then-known site area of LAN-62 (Locus A) to the areas previously defined as LAN-211A and LAN-211B. As Altschul et al. (1991:60) had previously speculated, the newly defined and expanded site area of LAN-62 encompassed LAN-211A and 211B, and the previous site designations were discarded. SRI designated as LAN-211 the area of intact cultural resources that had been previously recorded as SR-13. The boundary of SR-13 was distinct from the lines of cultural deposits along the bluff that composed the very large site of LAN-62.

SRI developed a three-phased work plan to define the depth and extent of LAN-211 (Figure 213) (see Vargas 2003:118–136; Vargas and Feld 2003a:69–73). The first phase involved excavation of 11 bucket-auger units in and around the deposits. The bucket-auger-unit locations were positioned on a grid at 50-m intervals. Units that would have been in areas where buildings, utility lines, or other modern features prevented subsurface probing were moved to nearby locations. A sample of excavated soils was wet screened for artifacts and other cultural materials, using 1/8-inch-mesh hardware cloth. Concurrent with SRI's bucket-auger excavation, Delta carried out the sediment coring as part of their environmental testing program. SRI archaeologists monitored that coring work, and the core data provided a second source of information for locating cultural deposits. For the second phase, SRI mechanically excavated three backhoe trenches, to expose a more continuous subsurface area and better define the site boundaries. For the third phase, SRI archaeologists manually excavated 11 1-by-1-m EUs in four areas of the site, to provide fine-grained geomorphic data and procure a controlled sample of the midden deposit. All soils from those 11 units were collected for wet screening.

Bucket-auger-unit excavations began in 1999. Overall, 5 of 11 bucket-auger units and 1 core revealed intact cultural deposits. Less-dense deposits were recovered from 5 other bucket-auger units and 1 core. The densest intact deposits were recovered from under an asphalt parking lot along the base of the bluff; apparently, the deposits had been left undisturbed during construction of the parking lot. As had been observed at LAN-62, however, the integrity of the subsurface deposits varied in different areas of the site. Some trenches exposed relatively undisturbed deposits, whereas others in the same vicinity had been heavily disturbed. Vargas (2003:120) concluded that over a century of historical-period and modern development in the area had "created a 'Swiss cheese' effect in the area below the bluff" (Vargas 2003:112)—i.e., a mosaic of more-disturbed, less-disturbed, and intact subsurface soil matrices. Generally, the overburden of fill was considerably thicker in areas of the site located farther from the bluff edge.

In 2001, SRI initiated the second (trenching) and third (manual excavations) phases of the work. For the second phase, SRI archaeologists excavated three backhoe trenches. In one trench, the field crew observed areas of intact cultural deposits measuring roughly 1 m in thickness (Vargas 2003:121–122). However, portions of the cultural horizon had been truncated by historical-period farming and construction activities. In other segments of the trench, disturbance had completely obliterated subsurface cultural resources. The excavation crew encountered disturbed materials in another trench and a possible anthropogenic horizon (but no cultural materials) in the third trench.

For the third phase, SRI archaeologists manually excavated 11 EUs in five different areas of LAN-211; each area included from 1 to 5 1-by-1-m units; some were situated adjacent to other units, forming a larger excavation block (Vargas 2003:124–136). The units were generally placed in areas with

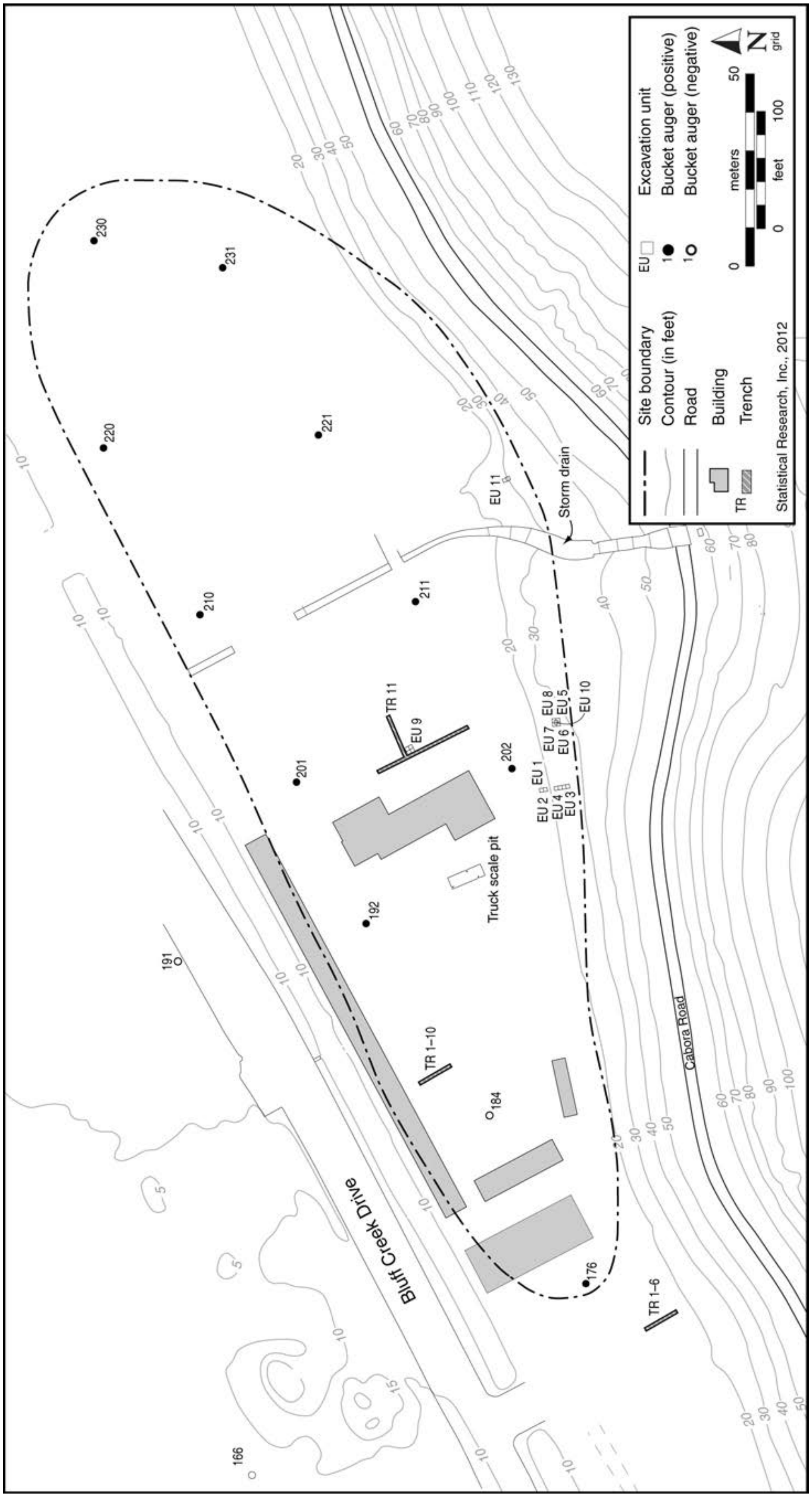

Figure 213. Map showing the locations of testing-phase investigations at LAN-211 (bucket augers, EUs, and trenches).

known intact subsurface deposits and excavated in 10-cm levels. They revealed varying levels of subsurface integrity, as well as different densities and compositions of cultural materials.

Most notable were the units situated on the large alluvial fan in the southern part of the site, along the bluff edge, which revealed a large area of dark subsurface soils and thick, intact cultural deposits. Those deposits included particularly high densities of vertebrate and invertebrate remains. Four radiocarbon samples submitted from the EUs indicated Late period as well as Protohistoric period and/or early-historical-period components. However, the radiocarbon specimens that indicated a Late period date had been found in questionable contexts. Temporally diagnostic glass beads recovered from the EUs also indicated a probable Protohistoric period and early-historical-period occupation. Based on the testing results, SRI proposed a detailed data recovery operation that largely focused on the Protohistoric period and early-historical-period components (Altschul et al. 2003:52–53; Vargas et al. 2003).

Research Design for Data Recovery

The Protohistoric period in southern California began in 1542 with the arrival of Spanish explorer Juan Rodriguez Cabrillo to Santa Catalina Island. European settlement during the Protohistoric period was generally sparse. The founding of Mission San Gabriel in 1771 marked the end of the Protohistoric period and the beginning of the Mission period (1770–1830). More importantly, however, that period transition signified the establishment of substantial and permanent Hispanic occupation in the area. By that time, indigenous populations were coexisting with the burgeoning Hispanic presence in the region. That important transition provided the sociocultural backdrop for the Protohistoric period and early-historical-period occupation of the Ballona.

The principal objective of the data recovery operations at LAN-211 was to understand the social and economic relationships (if any) between indigenous peoples residing in the Ballona and Hispanic settlements in the surrounding areas, including Missions San Gabriel and San Fernando, the Pueblo of Los Angeles, and the various Hispanic ranchos. To explore those relationships, Vargas et al. (2003:258–271) posited a model with three scenarios and associated archaeological test implications. The first scenario posited a gentile or renegade occupation in the Ballona by non-Christianized "renegades" and/or ex-neophyte "renegade or fugitive" Gabrielinos (Vargas et al. 2003:258). A second scenario hypothesized that indigenous peoples had occupied the Ballona (possibly for short-term trips) under the auspices of one of the nearby Spanish missions. A third scenario proposed that the Ballona had been occupied by ex-neophyte or gentile indigenous peoples who regularly interacted with secular European settlers in the Pueblo of Los Angeles or on the various ranchos.

Each of those scenarios created different archaeological expectations regarding settlement patterns and material culture at LAN-211. For example, each suggested different implications concerning the presence and abundance of European-style versus traditional, indigenous artifacts. Although preliminary analyses of materials gathered during the testing phase suggested minimal interaction with Hispanic settlers at either the missions or secular settlements, additional data were necessary to better test the model. Vargas et al. (2003) outlined the data requirements needed to test their hypotheses and proposed a multipronged strategy of archaeological excavation, paleoenvironmental reconstruction, and ethnohistoric research.

Field Methods

The archaeological excavations included five work phases: (1) mechanical stripping of overburden; (2) mechanical trenching; (3) hand-excavation of CUs (covering 1 percent of the site area); (4) mechanical stripping of the area of direct impacts within the APE, to expose subsurface features and other cultural materials; and (5) hand-excavation of features (Table 53). The entire site of LAN-211 (27,000 m^2) fell within the APE for the construction of the Riparian Corridor (Van Galder et al. 2006). Consequently, the work efforts were intended to sample the full range of cultural resources and mitigate the impacts of the proposed construction. SRI proposed to manually excavate a total area of 270 m^2, a 1 percent sample of the site, in two large blocks of contiguous 1-by-1-m units.

Table 53. Summary of Data Recovery Excavations at LAN-211

Phase	Description
Phase 1	Mechanical stripping of overburden.
Phase 2	Mechanical trenching.
Phase 3	Hand-excavation of 370 1-by-1-m CUs.
Phase 4	Mechanical stripping of the area of direct impacts within the APE, to expose subsurface features and other cultural remains.
Phase 5	Hand-excavation of 46 features (3 burials and 43 nonburials).[a]

[a] SRI's preliminary report on data recovery within the Phase 2 project evaluation at LAN-62 Locus D and LAN-211, Playa Vista, California (Van Galder et al. 2006), included a total of 50 features; after subsequent analysis, 4 nonburial features were voided, because they were determined to be noncultural.

However, the field crew soon observed that many EUs encountered groundwater prior to exposing the deepest levels of subsurface deposits. Because of potential contamination in the underlying groundwater, those deeply buried deposits could not be investigated. Consequently, in 2005, the Corps granted SRI permission to expand the area of manual excavation to 370 m^2, to include areas of the site located on higher ground, where groundwater would not impinge on the data recovery operations. In that way, samples of archaeological materials could be collected for study that were thought to be culturally and temporally equivalent to the deeply buried and potentially contaminated materials in the lower areas of the site. All hand-excavated soils were wet screened through $^1/_8$-inch-mesh hardware cloth. Nonburial-feature soils were processed through a floatation device, and burial features were dry screened by hand through $^1/_{16}$-inch-mesh wire screens.

SRI expected to encounter human remains at LAN-211 during the data recovery operations and developed specific protocols for treating the remains based on recommendations from Mr. Robert Dorame, the MLD. SRI conducted data recovery at LAN-211 in 2005.

Overburden Removal

The first phase of mechanical stripping removed modern fill to a depth just above intact cultural deposits at LAN-211. Fill consisted of natural colluvial deposits, redeposited soils, and imported soils placed over intact, natural soil horizons. Fill was removed using an excavator fitted with a flat blade on its bucket and both paddle-wheel and belly-loading scrapers. Stripping was conducted within the boundaries of the proposed Riparian Corridor and was directed and closely monitored by SRI staff archaeologists. When intact soil horizons were identified, excavations were halted and moved to new locations. A gravel parking area, pavement, and several buildings once covered the surface of LAN-211. Stripping within the site boundaries required mechanical removal of buildings and associated basement structures as well as other Hughes Aircraft Company–related infrastructure. The depth of fill varied greatly across that large area from only a few centimeters to more than 2 m in some areas.

Mechanical Trenching

Excavations conducted at LAN-211 in 1999 revealed an intact and dense archaeological midden in a portion of the site (Altschul et al. 2003). The results of bucket-auger tests helped to define the site boundaries. There remained some question as to the integrity of the cultural deposits in the northeastern portion of the site, where SRI had been unable to open larger excavation areas. In 2005, once overburden had been removed and buildings demolished in those areas, it was possible to excavate another series of trenches to further delineate the site boundaries. Eight trenches were excavated prior to undertaking manual excavations at LAN-211 (Figure 214). The new set of trenches was critical to identifying the extent of intact cultural materials at LAN-211.

Mechanical trenching performed before the 2005 hand-excavations had been sufficient for the completion of the second element of the ATP. Two additional trenches were excavated within the site boundaries during the hand-excavation phase. One of those trenches was excavated in the lower, northern portion of the APE; the other trench was excavated on the slope, in the southern portion of the site boundary. Both trenches were placed to investigate the depth of cultural deposits at LAN-211.

All trenches were excavated with either a backhoe or an excavator fit with a flat blade, usually 3 feet in width. Small lifts were excavated to reveal features or other anomalies, as well as to investigate soil changes. After mechanical excavation, both walls of each trench were cleaned with a shovel or trowel, to help document soil stratigraphy and the presence, integrity, and composition of cultural deposits. After a trench sidewall had been prepared, documentation, including photography and a measured drawing delineating identifiable soil characteristics, took place. Samples for pollen, phytolith, soil testing, and flotation were collected when deemed necessary.

Hand-Excavation of Units

The APE for LAN-211 was considered to be the boundaries of the Riparian Corridor (Altschul et al. 2003:249–251). Although the site measured approximately 27,000 m^2, direct impacts within the Riparian Corridor were calculated as 14,000 m^2, and a total of 270 m^2 was proposed for hand-excavation. Using a combination of the data from testing in 1999 and from additional trenches and overburden removal in 2005, SRI proposed excavations in two large blocks of contiguous 1-by-1-m units, plus several other units to be placed at our discretion. However, field conditions, namely excavation difficulties due to groundwater, forced reconsideration of that strategy.

A single trench placed in the northwestern portion of the site indicated that intact, buried cultural deposits existed to depths of over 3 mbs. The presence of groundwater prevented safe excavation at certain depths; therefore, a strategy had to be devised for collecting data from the range of appropriate archaeological contexts at the site. As had been presented in the original data recovery plan (Altschul 1991:4), it was necessary to recover samples of cultural materials from all identifiable contexts within the APE. Because groundwater was encountered prior to reaching noncultural sediments, excavations had to be halted prior to reaching the lowest cultural deposits. During the 1999 testing program, SRI's geomorphologist determined that the lowest strata were the same as strata recorded in the lower portion of the deposits higher on the slope (Altschul et al. 2003).

In total, 101 test pits were located in the northern part of Excavation Blocks A and B; those pits were hand-excavated

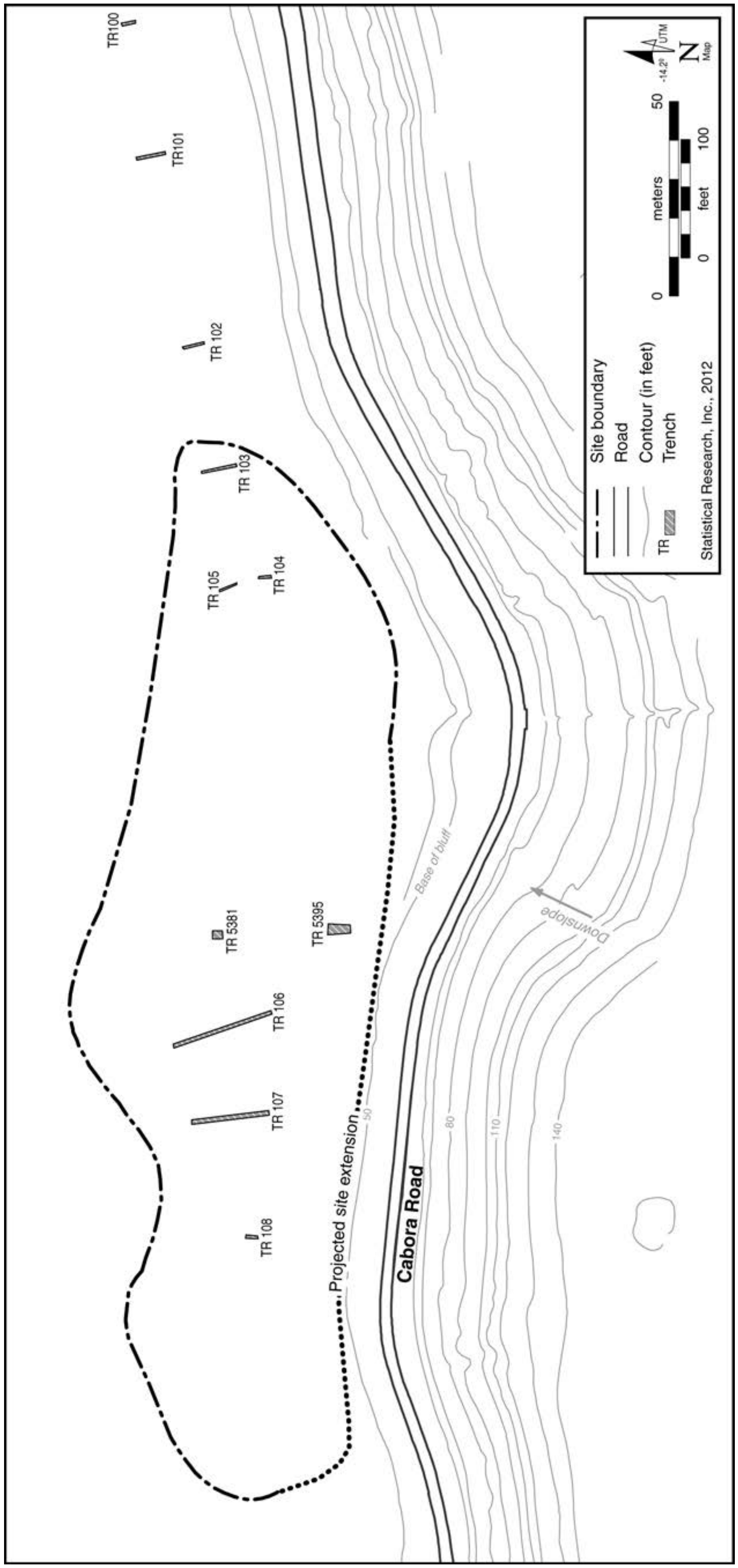

Figure 214. Map showing the locations of trenches excavated in 2005 to define the LAN-211 site boundaries.

to below the uppermost cultural stratum and stopped prior to hitting groundwater. In southern units, where cultural deposits did not dip as deeply as in the north, we were able to dig 168 test pits through the entire column of cultural strata. To collect data from the deepest, and potentially oldest, deposits at LAN-211, a plan was devised to excavate, on the slope, a number of test pits equal to the number of those that had not reached the lower strata in Excavation Blocks A and B.

Figure 215 details the results of that excavation strategy. A consequence was that a substantially larger area (371 m^2) was excavated by hand than had been outlined (270 m^2) in the original and revised work plans. At LAN-211, 370 1-by-1-m units were excavated by hand, in five excavation blocks (Excavation Blocks A–E). Excavations began on September 9, 2005, and were completed in the Riparian Corridor on November 18, 2005. Excavation of the bluff face was completed on December 9, 2005.

Units were excavated in arbitrary 10-cm levels. All excavated materials from nonfeature contexts were placed in 5-gallon buckets labeled with the relevant provenience information, for transport to the wet-screening facility. To process the large volume of excavated materials efficiently, a mechanical wet-screening facility was employed. A Powerscreen Mark II screening plant, fitted with a double-deck $^1/_2$-over-$^1/_8$-inch-mesh wire screen and spray nozzles, was used to wet screen hand-excavated materials from nonfeature contexts.

Nonburial features were processed using a Dausman Flote-Tech Model A flotation machine. In keeping with the requests of the MLD, matrix from burial features was dry screened and processed by hand through $^1/_{16}$-inch-mesh wire screens. All matrix from individual burial features was collected separately, with the appropriate provenience information, so that those materials could be reunited with the remains for later reburial.

Experience from previous excavations at Playa Vista had shown that tracking the various excavations and the large quantities of materials required a sophisticated set of procedures. As part of that system, an in-field data-entry station was set up. Networked computers linked to a central database allowed all manual-excavation forms to be completed and printed in the field. In that manner, data-entry tasks were completed in the field. Entries were checked for errors and corrected before features were processed and while the archaeologists responsible for completing field forms and performing the hand-excavation were on-site.

A bar-coding system was used for labeling excavation proveniences and items collected during the fieldwork. Personnel responsible for screening used handheld PDAs linked via a wireless network to track buckets of excavated matrix prior to screening. Point-provenienced artifacts were also given bar-coded labels, to speed up the inventory process and to ensure that none was misplaced or separated from its provenience information. The use of bar codes and in-field data entry worked to expedite the excavation, screening, and field-inventory processes and, most important, assisted with QA.

Mechanical Stripping

Generally, mechanical stripping ran concurrently with hand-excavation. Monitored mechanical stripping was conducted using a combination of a tracked excavator fitted with a smooth bucket and belly-loading scrapers. The scrapers worked in the outlying areas of the site, and the excavator was used in the high-density areas. The mechanical excavator was used to strip soils in small lifts approximately 3 feet wide, digging stratigraphically until a culturally sterile stratum or the bottom depth of the Riparian Corridor excavations had been reached. When the scraper was used, an archaeologist followed it closely, identifying and collecting isolated diagnostic cultural materials and features. All mechanical stripping was closely monitored by a team of archaeologists and mapping personnel who continually checked for the presence of cultural features, diagnostic artifacts, and stratigraphic changes.

When nonburial features were encountered during stripping, they were mapped, photographed, and excavated by hand. Burial features were mapped and excavated by hand but not photographed. Isolates determined to be either culturally or temporally diagnostic were also mapped with a total station and collected for analysis. All areas impacted by excavations related to the construction of the Riparian Corridor were mechanically stripped under the direction of SRI personnel.

Feature Recovery

Feature excavation at LAN-211 was conducted via several different methods, depending on the type of feature and the nature of its discovery (stripping or hand-excavation). Burial and nonburial features shared some similar excavation procedures, but at the request of the MLD, burial features were treated differently in some ways.

In total, 46 features, including 43 nonburial and 3 burial features, were encountered at LAN-211 through the processes of hand-excavation, mechanical stripping, and mechanical trenching (Table 54). Note that there were initially 50 features, but subsequent to analysis, 4 nonburial features were voided, because they were determined to be noncultural. The recovery of features varied, depending on the type of feature (burial versus nonburial). At the outset of the project, features were generally discovered during hand-excavations. When a feature was discovered during EU excavation, the boundaries of the EU were disregarded, and the feature was excavated as an individual entity. A single PD number was assigned to all of the recovered soils within a feature boundary, unless stratigraphic distinctions were identified in the feature, in which case PD numbers were assigned to particular strata. The matrix surrounding the feature within an arbitrary EU was collected with the pertinent provenience information and kept for later water screening. Matrix from within nonburial-feature boundaries was processed in a Dausman Flote-tech Model A flotation device. Both heavy-fraction (>1 mm) and

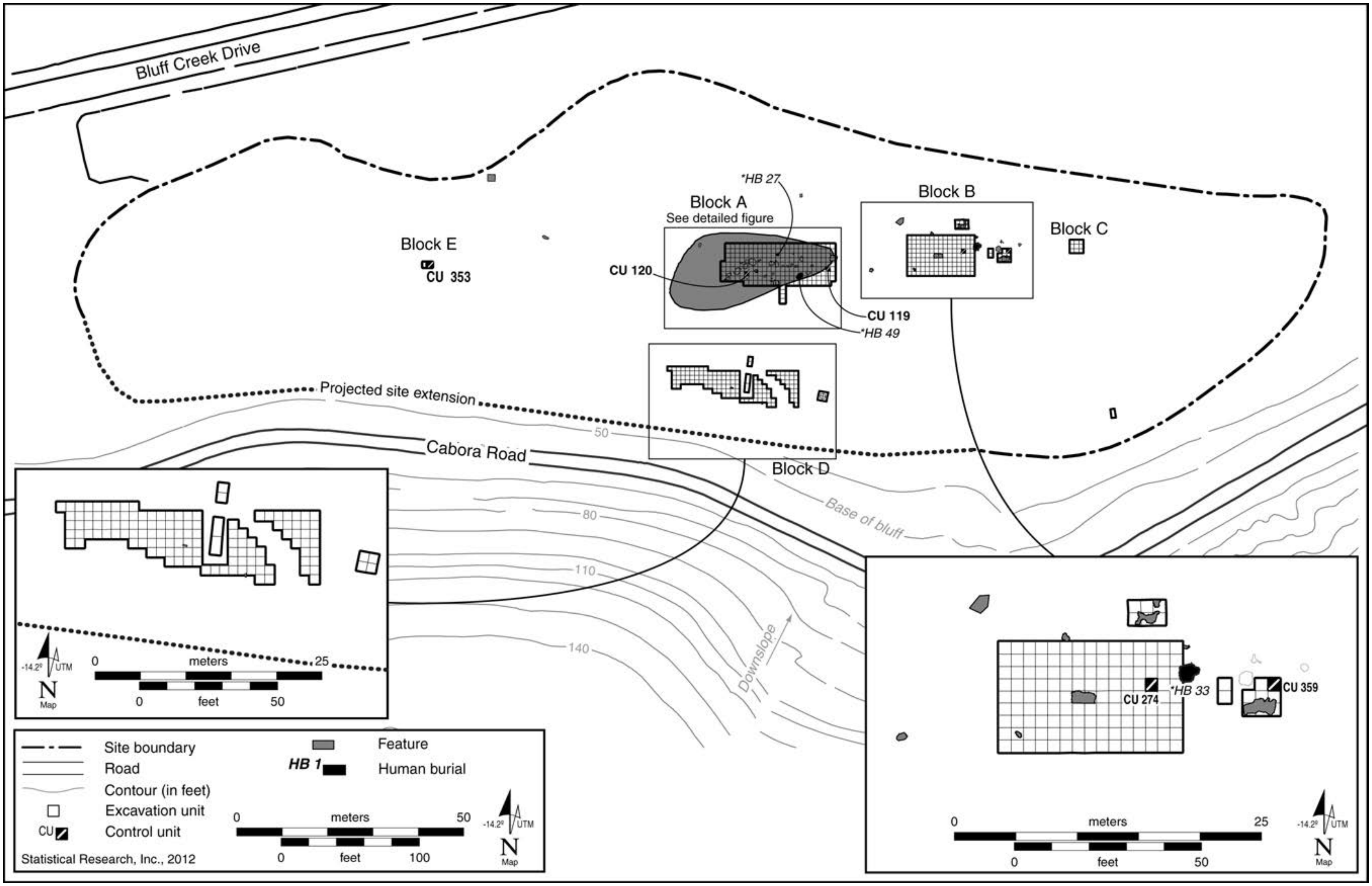

Figure 215. Map showing the locations of units excavated at LAN-211 during data recovery.

Table 54. Features Selected for Analysis from LAN-211

Feature No.	Subfeature No.	Feature Field Type	Analytical Context	Analysis Level
1		activity area	Feature 1 checkerboard (nonburial)	items only
1	4	hearth	Feature 1 nonburial subfeature	full analysis
1	5	rock cluster	Feature 1 nonburial subfeature	full analysis
1	6	hearth	Feature 1 nonburial subfeature	items only
1	8	hearth	Feature 1 nonburial subfeature	full analysis
1	12	hearth	Feature 1 nonburial subfeature	items only
1	13	rock cluster	Feature 1 nonburial subfeature	full analysis
1	14	hearth	Feature 1 nonburial subfeature	full analysis
1	16	hearth	Feature 1 nonburial subfeature	items only
1	17	hearth	Feature 1 nonburial subfeature	items only
1	18	hearth	Feature 1 nonburial subfeature	items only
1	19	hearth	Feature 1 nonburial subfeature	items only
1	21	hearth	Feature 1 nonburial subfeature	full analysis
1	22	hearth	Feature 1 nonburial subfeature	items only
1	24	rock cluster	Feature 1 nonburial subfeature	items only
1	25	rock cluster	Feature 1 nonburial subfeature	items only
1	26	hearth	Feature 1 nonburial subfeature	items only
1	28	hearth	Feature 1 nonburial subfeature	items only
1	41	hearth	Feature 1 nonburial subfeature	items only
1	42	hearth	Feature 1 nonburial subfeature	items only
1	50	hearth	Feature 1 nonburial subfeature	items only
1	51	hearth	Feature 1 nonburial subfeature	full analysis
1	52	rock cluster	Feature 1 nonburial subfeature	full analysis
2		artifact concentration	nonburial features outside Feature 1	full analysis
11		pit	nonburial features outside Feature 1	full analysis
15		rock cluster	nonburial features outside Feature 1	full analysis
27		burial	inside Feature 1	full analysis
29		rock cluster	nonburial features outside Feature 1	full analysis
30		rock cluster	nonburial features outside Feature 1	full analysis
31		hearth	nonburial features outside Feature 1	full analysis
33		burial	outside Feature 1	full analysis
39		rock cluster	nonburial features outside Feature 1	full analysis
40		activity area	nonburial features outside Feature 1	full analysis
45		hearth	nonburial features outside Feature 1	full analysis
46		rock cluster	nonburial features outside Feature 1	full analysis
49		burial	outside Feature 1	full analysis
53		rock cluster	nonburial features outside Feature 1	full analysis
56		rock cluster	nonburial features outside Feature 1	full analysis

Note: In total, 38 of the 46 features were selected for detailed analysis. Not included were Features 3, 23, 34, 35, 37, 38, 48, and 54.

light-fraction (0.285–1 mm) samples were recovered from that process and stored separately for later analysis. A small sample of soil was also collected from each feature provenience, to be used for pollen analysis later, if deemed necessary. Matrix collected from twentieth-century historical-period features was occasionally screened in 1/4-inch-mesh screens at the excavation locations, and samples were also collected for flotation.

Generally, small hand-tools, such as trowels, small wood-sculpting tools, and brushes, were used to excavate nonburial features. Photographs were taken of nonburial features, and hand-drawn maps were created. Detailed descriptions of individual features were created by field staff and later updated, when analysis of recovered materials had been completed. Features were generally treated as unique entities, although if possible, larger feature areas or feature blocks were identified during excavations as groupings thought to be temporally contemporaneous—for example, FB 1, a large Mission period activity area that encompassed a number of subfeatures over a roughly 9-by-17-m area. In such cases, notes and descriptions of individual features, as well as possible associations between features, were maintained. Also, levels in particular arbitrary EUs surrounding the features in a feature block were identified for later analysis.

Burial features were generally excavated in the same manner as nonburial features, but methods differed somewhat in the levels of in-field analysis and recording. Mapping nails were placed in the feature area, and the location was mapped with a total station. These mapping nails were later used to georeference feature drawings, so that each feature could be placed in project maps. Excavation of burials differed from that of nonburial features in a number of ways, because of procedural requests by the MLD. During earlier excavations at LAN-62, the MLD requested that the matrix not be processed with the flotation device but, rather, hand-screened by SRI personnel through 1/16-inch-mesh wire screens. When burial features had been dry screened, all matrix (including what filtered through 1/16-inch-mesh screens) was collected in 5-gallon buckets, lidded, and marked with the appropriate provenience information, so that soils associated with particular burial features could be reunited when the remains were reburied.

Another request of the MLD was that a 30-cm buffer be excavated around the boundaries of each burial feature (referred to as the ARB 30). That soil was excavated and also screened by hand. There were no identifiable burial pits in any of the burial features at LAN-211; therefore, the boundaries of burial features were roughly a few centimeters outside the actual human remains and associated artifacts. One burial feature was discovered during mechanical stripping, and the MLD's representative requested that SRI dry screen the back dirt from a very large area surrounding the location of the burial, to insure that all human remains had been identified and collected.

When human remains in burial features were in good condition, they were mapped and removed for later laboratory analysis. In some cases, however, bone preservation was poor, and thus, osteologists conducted as much analysis in the field as possible. A specialized set of tools and field forms was required while excavating burials and conducting in-field analysis. Generally, the constituents of nonburial features were hardier than bone, and thus, we were able to analyze selected features in a laboratory setting.

Screening

Screening occurred during fieldwork at LAN-211. All nonfeature materials collected during excavations were labeled with the proper provenience information and taken to SRI's in-field wet-screening facility. To process the large amounts of excavated materials efficiently, a mechanical wet-screening facility was employed, as described in Chapter 4, this volume. Although the screening plant was successful at removing most of the less-than-1/8-inch-sized sediments from excavated proveniences, field technicians conducted the final sediment removals by hand.

Matrix from nonfeature contexts was moved from excavation areas to the mechanical-screening station with a skip loader, to reduce the labor and time required to move excavated materials on-site. Even with the highly mechanized operation, the speed of excavation often outpaced the speed at which we could screen matrix. For that reason, we placed excavated matrix into 5-gallon plastic buckets labeled with the proper provenience information.

Matrix from nonburial features was processed in a Dausman Flote-tech Model A flotation device. By contrast, the matrix from burial features was dry screened by hand through 1/16-inch-mesh screens. After screening, the matrix from each burial feature was collected individually by provenience for later reburial with the excavated remains. Matrix that contained isolated human remains was hand-screened through 1/8-inch-mesh screens. The remaining soil from those contexts was saved in bulk for future reburial.

Laboratory Methods

This section provides a summary of laboratory methods related to washing, cataloging, sorting, QA, and curation of all materials collected from LAN-211. A general discussion of the laboratory procedures is presented in Chapter 4, this volume; we focus here on the aspects of the laboratory methods that related specifically to LAN-211.

Sorting

Sorting procedures varied based on the recovery contexts at LAN-211. CUs, nonburial features, burial features, features and CUs with possible human remains, and column samples (flotation) required different sorting protocols. We separately review the various sorting procedures for each recovery context below.

All bulk materials from CUs and nonburial features (not including proveniences with possible human remains) were sifted through two nested screens with 1/4-inch and 1/8-inch mesh. All materials collected in the screens were sorted according to (screen-mesh) size and basic material type, including worked and unworked bone, worked and unworked shell, historical-period artifacts, lithic artifacts, and a miscellaneous "other" category that encompassed materials such as fired clay, mineral samples, seeds, wood, asphaltum, ochre, and various low-frequency artifacts and materials. The sorting criteria for the artifact types and material classes from LAN-211 are listed in Appendix 10.1, this volume. Any materials sifted through the 1/8-inch-mesh screen were scanned for diagnostic artifacts or other "high-priority" materials that were rare or not present in the hand-excavated units (see Appendix 10.2, this volume).

The materials assigned to each of the categories were separately bagged and labeled for analysis. Unworked shell, unworked bone, and charcoal fragments were recorded by weight (grams); all other materials categories were recorded as counts. Some materials, such as charcoal (botanical specimens), indeterminate historical-period artifacts, FAR, ochre, and asphaltum, were not segregated and separately bagged for analysis but were recorded in the database as present. The remaining rocks and gravels, nondiagnostic artifacts smaller than 1/8 inch in size (i.e., not collected in the sorting screens), and other uncollected materials were rebagged in their original containers and set aside for curation.

A different sorting procedure was used for processing materials from burial features and proveniences (features or units) with possible human remains. The bulk materials were sifted with a 1/2-inch-mesh screen to identify and segregate the larger bone fragments. The materials were then scanned for diagnostic artifacts, teeth, or other "high-priority" materials (i.e., "diagnostic sort"). Only bone larger than 1/2 inch (i.e., collected in the screen), teeth, and diagnostic and formed artifacts were collected from those proveniences. With the exception of bone, none of the collected materials was sorted according to size. No unworked shell, charcoal (botanical), indeterminate historical-period artifacts, FAR, ochre, asphaltum, bone fragments smaller than 1/2 inch, or other nondiagnostic materials were collected for analysis but were recorded in the database as present.

Inventory

Once materials had been sorted, the laboratory technicians inventoried them, setting aside all sorted materials not earmarked for additional analysis. All human teeth and other isolated bone fragments collected were bagged together, separately from the rest of the bone remains. The inventory information was entered into a database. After data entry was complete, the laboratory director reviewed all data records for errors and inconsistencies and compared the data with the in-field counts and descriptions, to better ensure accuracy. The database was then made available to the individual materials analysts for detailed classification and analysis. The database also was used to generate summary reports per provenience, to assist with planning and budgeting for subsequent phases of analysis.

Artifact and Material Sampling

Given the large quantity of materials collected during excavations at LAN-211, rather than analyzing all excavated materials, SRI devised a sampling strategy for the detailed materials analyses. Particularly important for the analysis of materials from LAN-211 was a robust sample of analyzed proveniences associated with FB 1, a large Mission period activity area that encompassed a number of subfeatures over a roughly 9-by-17-m area. Given the importance and unique nature of the feature, SRI researchers selected a large number of EUs from Feature 1 for analysis. SRI developed a comprehensive sampling strategy for EUs, to ensure unbiased spatial coverage of the entire feature area. The EUs and features selected for analysis are separately discussed below.

CUs and EUs

Five CUs were selected for full analysis, and portions of 88 EUs were selected for partial analysis (specific excavation levels only). The 5 CUs were CUs 119, 120, 274, 353, and 359, and they were spaced to provide a sample of materials from various areas of the site (Figure 216). CUs 120 and 119 were located in Excavation Block A, which encompassed much of the Feature 1 activity area. CU 120 was located within the area encompassed by Feature 1, and CU 119 was located just outside the defined boundary of Feature 1, near the eastern edge of Excavation Block A. The other 3 CUs were located in other areas of the site, CU 274 in large Excavation Block B (east of Excavation Block A) and CUs 353 and 359 in smaller excavation blocks in the eastern and western portions of the site.

Given the importance of the Mission period deposits in Feature 1, SRI implemented a procedure to select a large sample of associated EUs. Feature 1 was a stratum of dense feature and cultural deposits. Therefore, the sampling strategy required consideration of the vertical dimensions of the feature (10–30 cm in thickness), as well as its horizontal extent. Half the EUs within Feature 1 were selected for analysis. To achieve a sample of the area encompassed by Feature 1, SRI implemented a "checkerboard sample," in which every other EU was selected for analysis, as shown in Figure 217. Appendix 10.3, this volume, lists the EUs and levels included in the sample. In all, the Feature 1 sample included portions (1–3 levels) of 88 EUs.

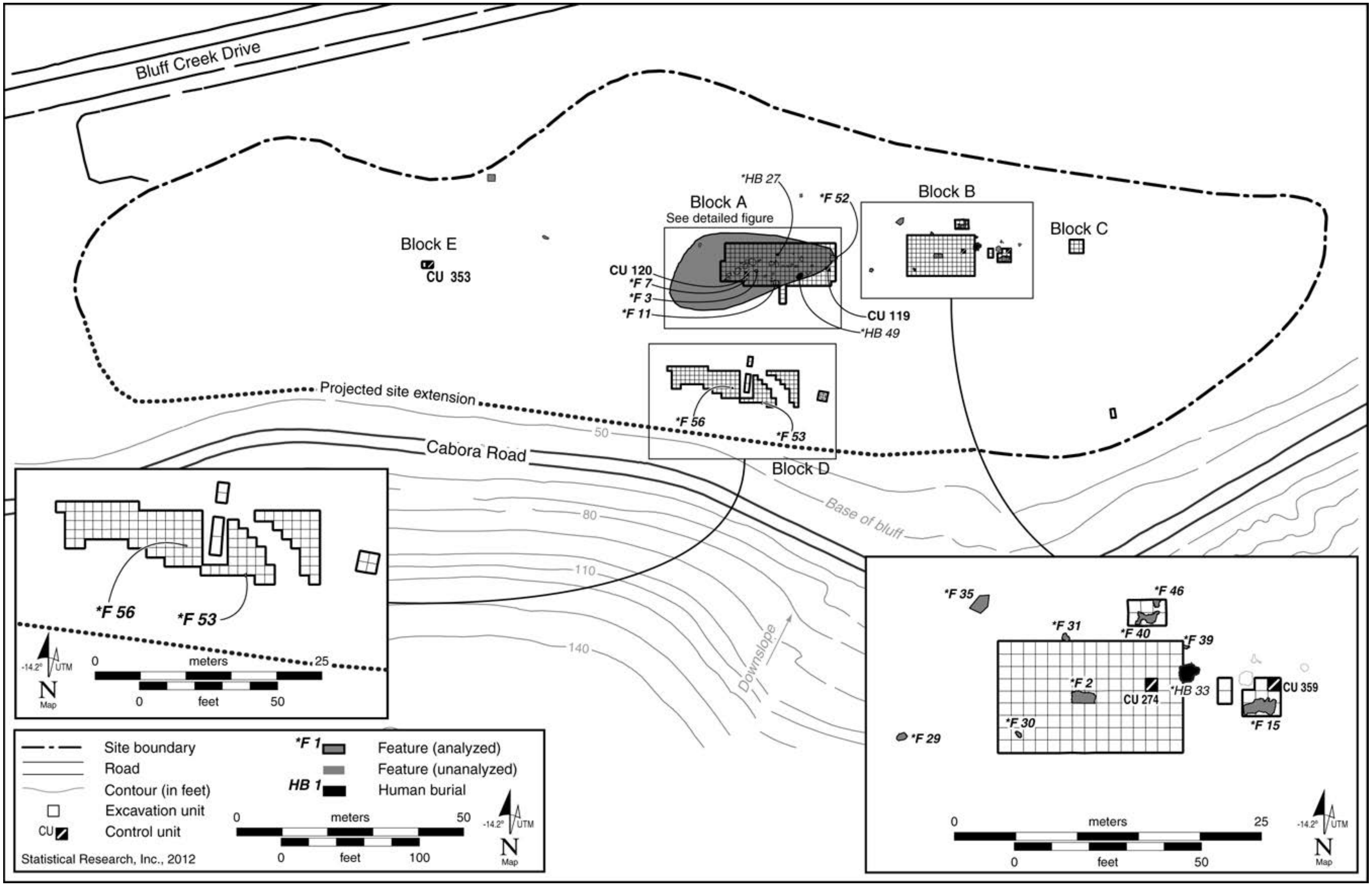

Figure 216. Map showing the locations of CUs and features selected for analysis at LAN-211.

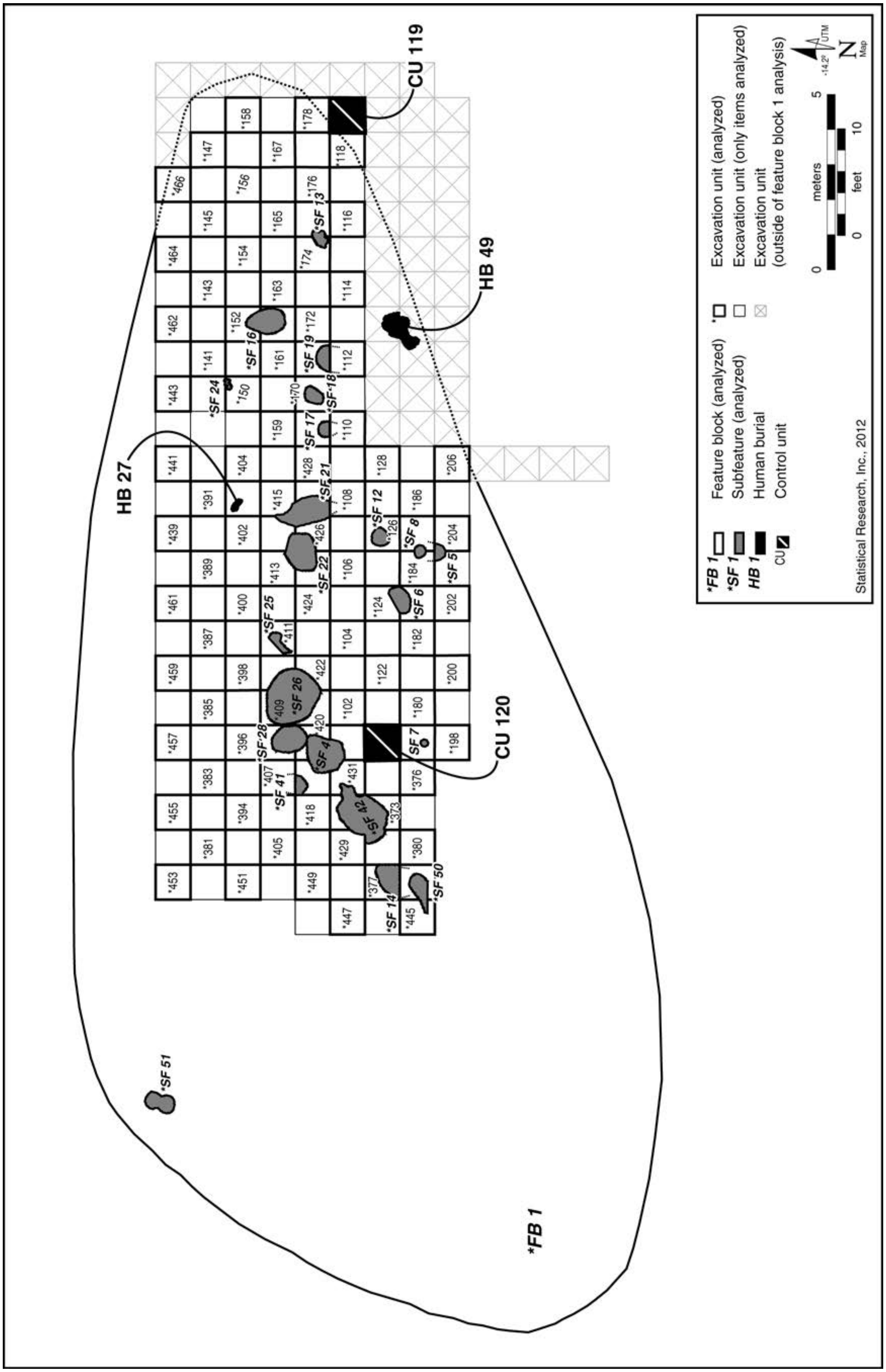

Figure 217. Map showing the locations of CUs and subfeatures selected for analysis in FB 1 at LAN-211.

Features

In total, 46 features were excavated at LAN-211 during data recovery. Note that, initially, SRI reported 50 features, but subsequent to analysis, 4 nonburial features were voided, because they were determined to be noncultural. The 46 features included 3 burials (burial Features 27, 33, and 49) and 43 nonburial features. The 3 burial features were analyzed and are reported in Volume 4, this series. Of the 43 nonburial features, 35 (81 percent) were selected for analysis: Feature 1, 21 subfeatures of Feature 1, and 13 features outside Feature 1 (see Figure 217). The levels of detail in the analyses varied between features. Overall, 20 features (from both outside and inside Feature 1) were subjected to full analyses of all materials collected; 14 subfeatures of Feature 1 were limited to analyses of larger point-provenienced artifacts (items).

Thirteen features outside Feature 1 were selected for full analysis. Those features were located in various portions of LAN-211. One hearth was in the western portion of the site. Two probable hearth-cleanout features selected for analysis were in a large excavation block at the base of the bluff, in the south-central portion of the site. Eight others were in or near Excavation Block B, in the eastern portion of the site: 1 hearth, 1 small activity area, and 6 likely hearth-cleanout features or discard loci. Two others were in Excavation Block A, in the central portion of the site. One hearth-cleanout feature or discard locus was just outside the defined boundary of Feature 1. Another pit feature was within the area defined as Feature 1 but below the excavation levels (Stratum A) associated with Feature 1.

Full analyses of 7 subfeatures of Feature 1 (6 hearths and 1 hearth-cleanout feature or discard locus) were conducted. Item analyses were conducted on 14 additional subfeatures: 12 hearths and 2 rock clusters interpreted as cleanout features or discard loci. Detailed analyses of the materials from those subfeatures, in conjunction with the analyses of materials from CUs, created a comprehensive empirical basis for interpreting the activities performed in the area encompassed by Feature 1 and shed light on the Mission period occupation of the Ballona.

Chronostratigraphic and Geoarchaeological Analyses

In this section, we discuss the history of natural deposition and human land use at LAN-211, based on analyses of soil-formation processes and detailed chronometric data. Most of LAN-211 is situated on the foot slope of an alluvial fan below the Ballona escarpment. However, a portion of the site extends into the adjacent freshwater marsh to the west and north, in an area farther from the bluff edge. Soil profiles in various depositional contexts at the site were analyzed, to achieve a more complete reconstruction of the stratigraphy. The natural stratigraphy of the area is first described here, and then the natural and cultural depositional histories are reconstructed. The cultural stratigraphy and occupation episodes inferred from detailed analyses of soil stratigraphy and radiocarbon assays are also presented.

Natural Stratigraphy

In total, 27 soil profiles were documented in EUs and trenches in various areas of the site. Prior to that work, the overlying construction fill and modern alluvium were mechanically removed, to expose the deeper-lying, intact, natural strata and cultural deposits. In total, 27 wall profiles were drawn and analyzed, and of those, 7 profiles were subjected to detailed analysis and provided the primary grounds for reconstructing the natural stratigraphic sequence. The 7 analyzed profiles were the following:

- Profile 1 (southern wall, trench located immediately north of CUs 352 and 353, western portion of the site),
- Profile 2 (eastern wall of EUs 137 and 138),
- Profile 3 (western wall of EUs 101 and 120),
- Profile 7 (northern wall of EUs 272 and 273),
- Profile 8 (eastern wall of EUs 359, 361, and 437),
- Profile 12 (northern wall of EUs 453 and 454), and
- Profile 13 (western wall, trench located east of EUs 521 and 536–544).

Most of those EUs were situated in areas of alluvium or mixed alluvium/colluvium near the base of the bluff, but several encompassed areas of alluvial fan interfingered with freshwater-marsh deposits.

Several soil samples were analyzed for composition, to aid in the interpretation of the stratigraphic information. Soil pH levels, Mehlich 2–extractable phosphorus, and bulk density were analyzed in the field laboratory. Organic-matter and calcium-carbonate analyses (loss-on-ignition method) were later completed at the SRI soil laboratory in Tucson. The particle-size and nitrogen analyses were conducted at the University of Northern Illinois Physical Geography Laboratory, and the analyses of total and available phosphorus and organic matter (Walkley-Black method) were measured at the Milwaukee Soil Laboratory.

Stratum Descriptions

Figure 218 shows the locations of selected analyzed profiles at LAN-211. A sequence of seven strata was recorded and is summarized in Table 55, and portions of the sequence are illustrated in Figure 219 (see Appendix 10.4, this volume, for detailed profile descriptions). Profiles 1, 2, 3, and 13 represent the range of stratigraphic sequences in different depositional contexts. Profile 1 was located away from the bluff, in an area of relict freshwater marsh (Figure 220). Profile 2 was typical of the alluvial-fan deposits that encompass most of the site (Figure 221). Profile 3 showed the soil changes at the juncture of the alluvial fan and the marsh (Figure 222), and Profile 13 showed the strata on the colluvial bench along the bluff edge (Figure 223). The stratigraphy in all of the areas is dominated by fan alluvium that has been altered by changes in geomorphic stability and by modifications resulting from soil-formation processes and groundwater fluctuation. Periods of geomorphic stability produced three buried A horizons, or surface horizons that mark episodes of slow or no aggradation on the fan. Those A horizons probably mark separate depositional episodes during the late Holocene period. The majority of features and midden deposits were recovered in the buried A horizons.

Stratum I, the deepest stratum, was largely devoid of cultural materials and consists of a Bt/C horizon near the base of the bluff. Clay lamellae were recorded within the C horizon in most of the profiles; however, the profiles farther from the bluff possessed a basal 2C horizon that lacked lamellae. The age of Stratum I is unknown, probably, but it ranges in age from the Pleistocene to the mid-Holocene. It consists of oxidized but otherwise relatively nonweathered, brown loamy sand with dark-grayish-brown clay lamellae, most of which are less than 1 cm thick. The presence of the lamellae in some units indicated that the lower alluvial fan has remained geomorphically stable since the period in which the sediments were deposited.

Stratum II is a thick (40–80-cm) buried A horizon (2Ab horizon) that consists of grayish-brown sand to loamy sand on the fan, grading to gray to dark-gray loamy sand at the edge of the fan, near the marsh. Unmodified cobbles in Stratum II probably represent colluvial materials redeposited from the lower bluff to the south. Cultural materials mainly included lithic artifacts, some of which may have been translocated into the deeper stratum as a result of bioturbation; a number of krotovina stains were recorded near the contact of Strata I and II. Calibrated radiocarbon dates suggested that Stratum II was formed during the middle or latter part of the first millennium B.C.

Stratum III, which ranges from about 20 to 40 cm in thickness, is a Bk horizon formed on the alluvial fan that intergrades to 2Cg and 2Cgk horizons in the marsh deposits. The carbonates are derived from fluctuating groundwater levels in the marsh and from springs on the bluff that drain onto the alluvial fan. The Bk horizon consists of a pale-brown sandy loam with light-gray threads of calcium carbonate and consists of a more silty and clayey soil than the sandier soils in the deeper strata. The marshy 2Cg and 2Cgk horizons are composed of mottled-gray to light-gray sandy clay loam, as exemplified by Profile 3 (see Figure 222). Calibrated radiocarbon dates suggested that the Stratum III soils were deposited during the middle to late Intermediate period (during the later centuries B.C. through roughly A.D. 800).

Strata IV and V are marked by the buried A1 and A2 subhorizons, respectively, which were also best exemplified by Profile 3. Stratum V (A1 horizon) consists of dark-gray loamy sand that indicated accumulation of alluvial-fan deposits. Stratum IV (A2 horizon) consists of very-dark-gray sandy loam to sandy clay loam that marks a juncture of the marsh and the fan deposits. The top of the A1 horizon had been truncated mechanically on the alluvial fan, and both the A1 and A2 subhorizons had been truncated at the juncture between the fan and the marsh. The Protohistoric period and early-historical-period features and cultural materials at LAN-211 were concentrated in Stratum IV, which also encompassed the Feature 1 activity area.

The uppermost Strata VI and VII are composed of historical-period and modern deposits and debris. Stratum VI is a historical-period deposit of laminated fan alluvium that dated to the 1938 flood in the Ballona. It consists of highly laminated layers of grayish-brown and dark-gray loamy sand. Stratum VII included relatively recent (post-1938) deposits of construction fill and modern alluvium/colluvium. It had been stripped prior to commencement of the data recovery excavations.

Analyses of Geochemical and Particle-Size Trends

A change in chemical and physical properties was noted with increasing depth in Profiles 1, 2, 3, and 13. Figures 224 and 225 show the particle-size trends with depth in those profiles. Table 56 and Figure 226 present the means and standard deviations, by stratum, for all soil chemical properties, based on a data set of 63 samples from those profiles. Figure 227 shows the means and standard deviations, by stratum, for all soil physical properties, based on the same data sample. All geochemical and particle-size data for those profiles are listed in Appendixes 10.5 and 10.6, this volume, respectively. Appendix 10.5, this volume, lists soil data for 293 surface samples collected from the upper 5 cm of soil; those samples were collected in a 2-m grid pattern from the soil underlying Stratum VII, the earthen construction fill that was removed prior to the data recovery excavations.

Soil pH levels indicated relative "degrees" of soil acidity versus alkalinity, as measured on a logarithmic scale that ranges from 0 to 14, in which 0 indicates maximum acidity. In the fan and alluvial deposits, pH levels were slightly to moderately alkaline (pH 7.6–8), in a range that is excellent for the preservation of shell ($CaCO^3$) and bone. The pH levels have been strongly buffered by additions of calcium carbonate from groundwater.

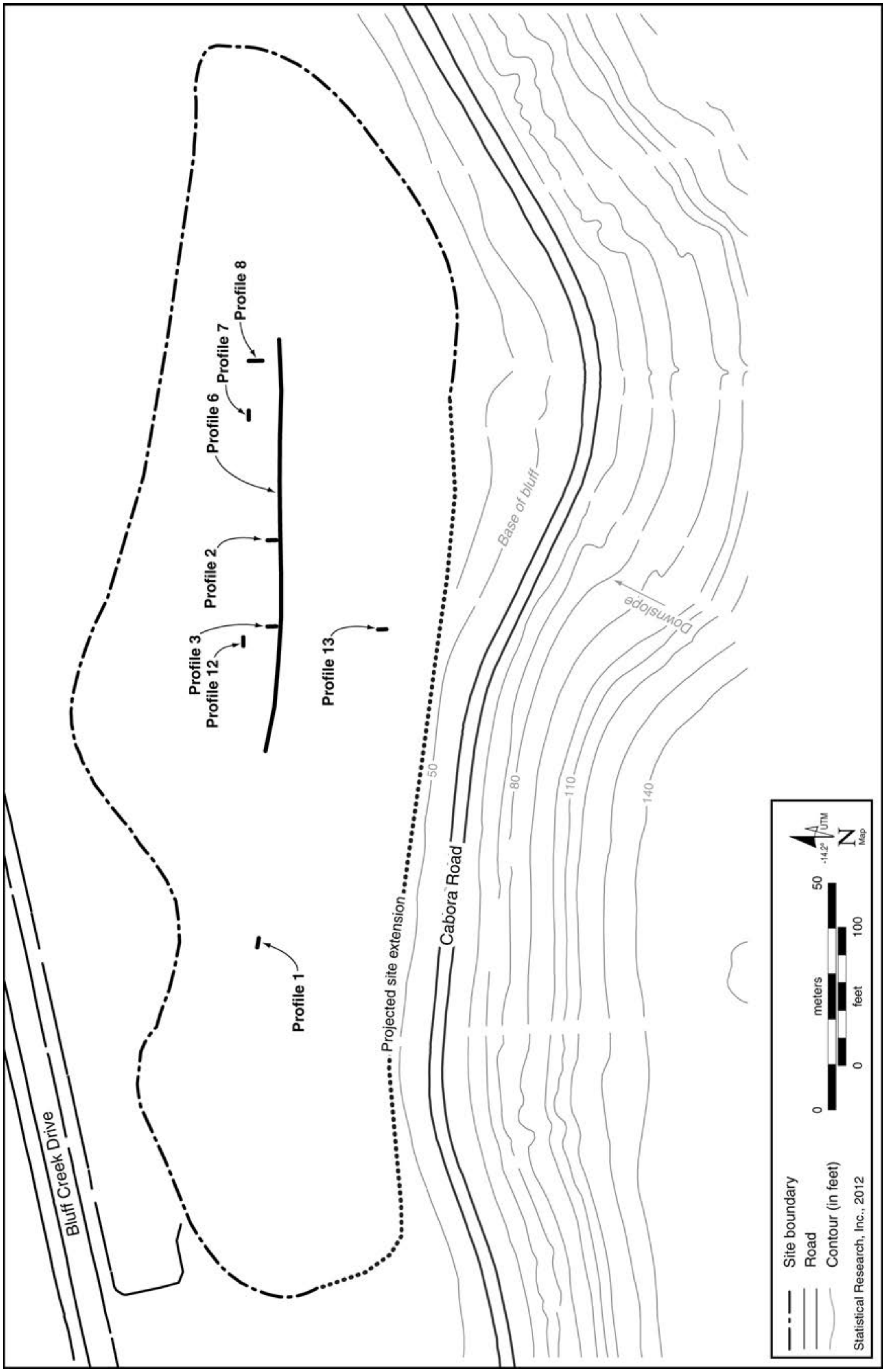

Figure 218. Map showing the locations of analyzed profiles at LAN-211.

Table 55. Stratigraphic Summary for LAN-211

Stratum	Description	Age Range
I	Fan alluvium with buried Bk horizon and clay lamellae; noncultural basal deposit underlying cultural deposits.	Pleistocene to midHolocene?
II	Fan alluvium with relatively sparse cultural remains.	ca. 500–300 B.C.
III	Fan alluvium; contained fewer artifacts than the overlying midden.	ca. 300 B.C.–A.D. 800
IV	~10- to 20-cm-thick midden deposit preserved in the western part of Excavation Block A; truncated to the east for building construction; grades to a marsh deposit in the western part of the site.	ca. A.D. 1000–1800s
V	~20- to 30-cm-thick midden deposit on the alluvial fan; preserved in the western part of Excavation Block A.	historical period
VI	Fan alluvium.	1938 flood
VII	Construction fill and modern alluvium/colluvium.	post-1938

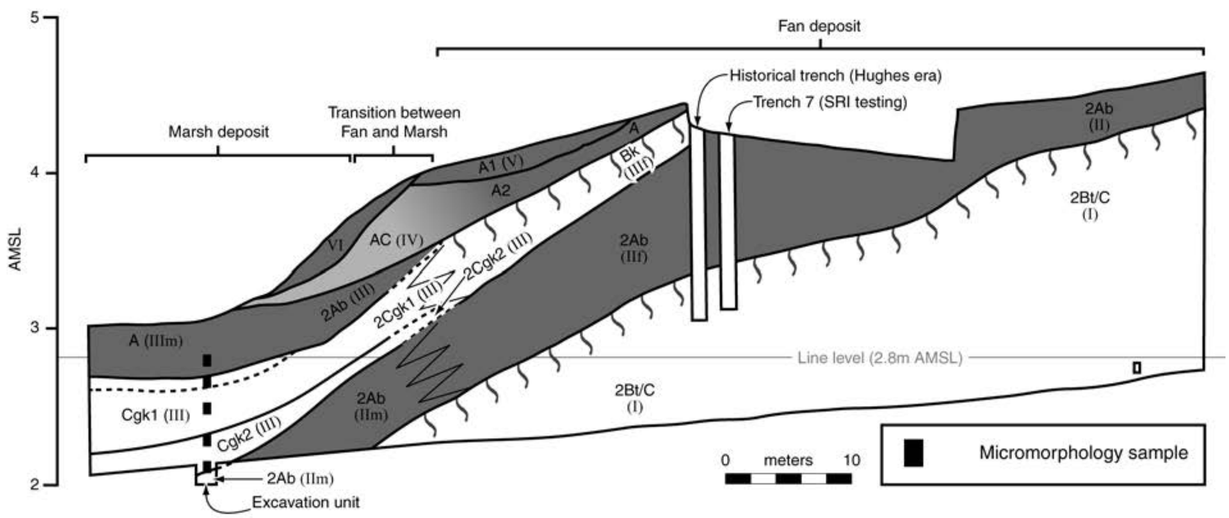

Figure 219. Schematic stratigraphic cross section of Profile 6 at LAN-211, showing the strata and major soil horizons of the alluvial-fan and marsh deposits.

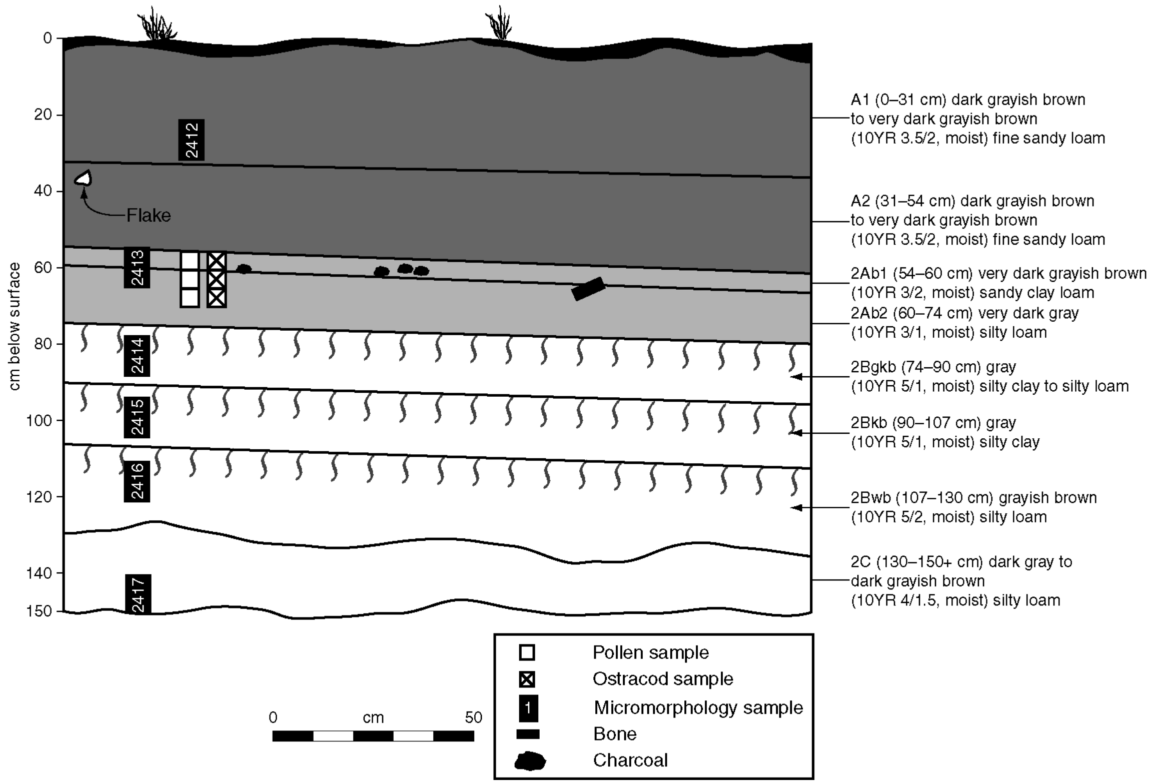

Figure 220. Profile 1 at LAN-211.

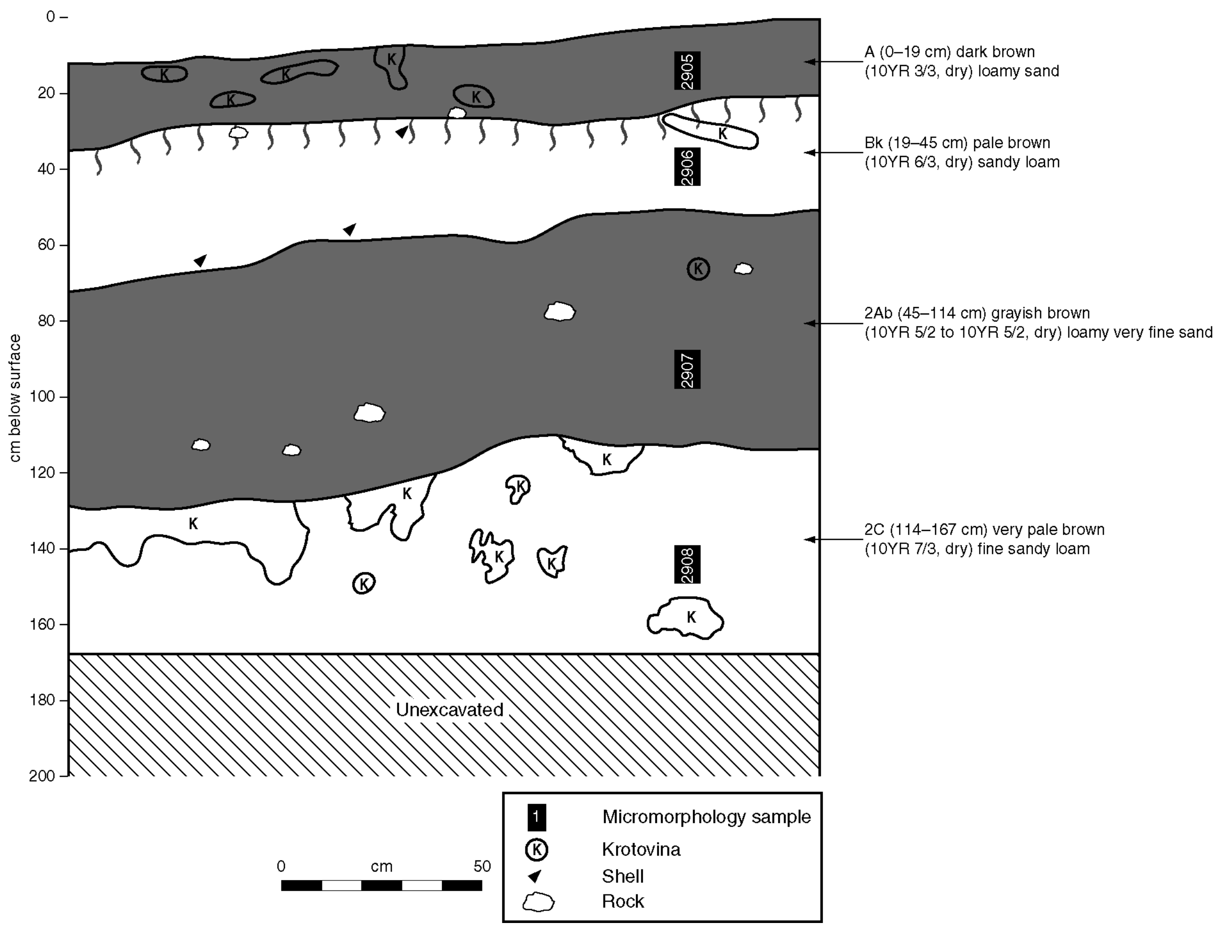

Figure 221. Profile 2 at LAN-211.

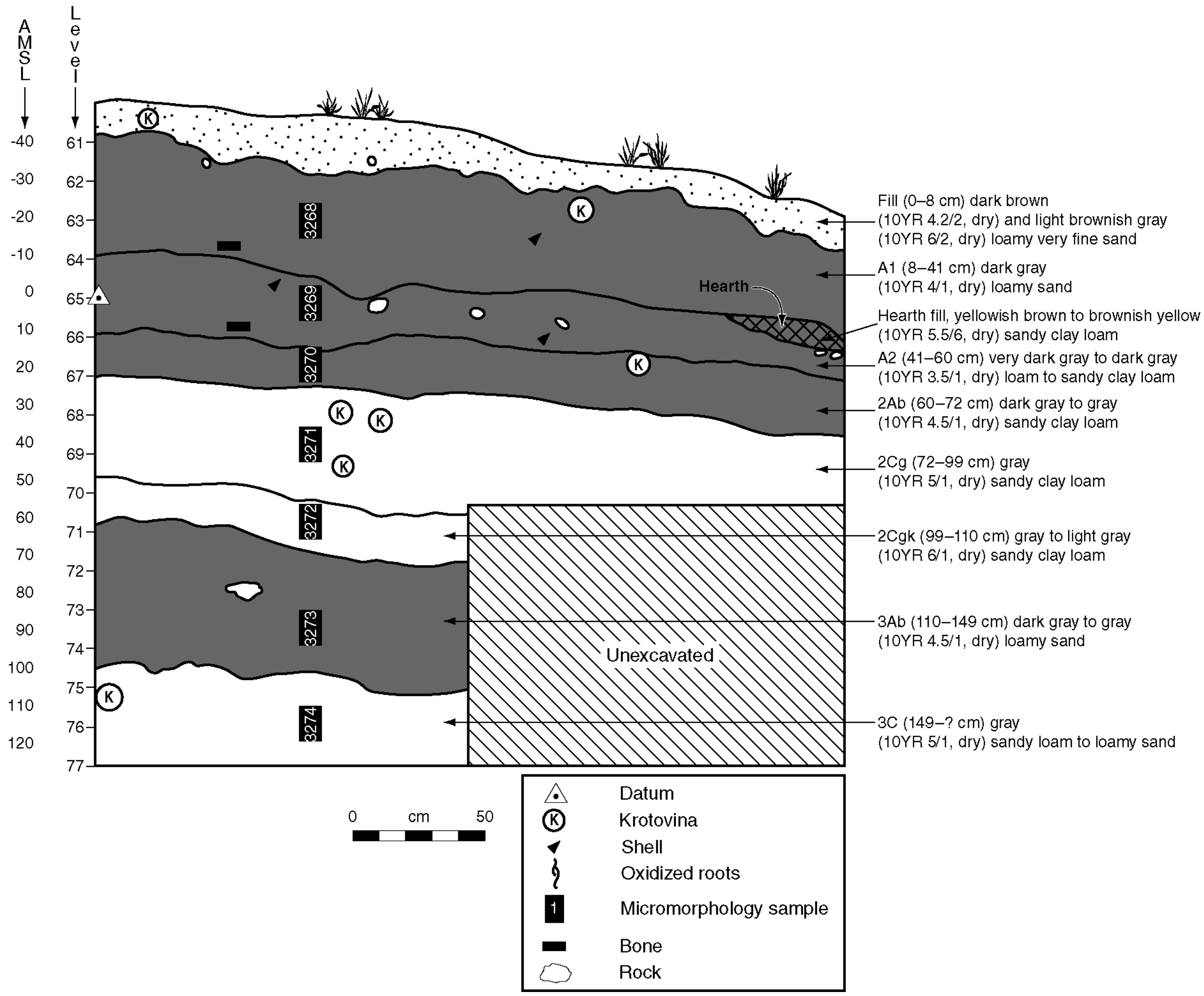

Figure 222. Profile 3 at LAN-211.

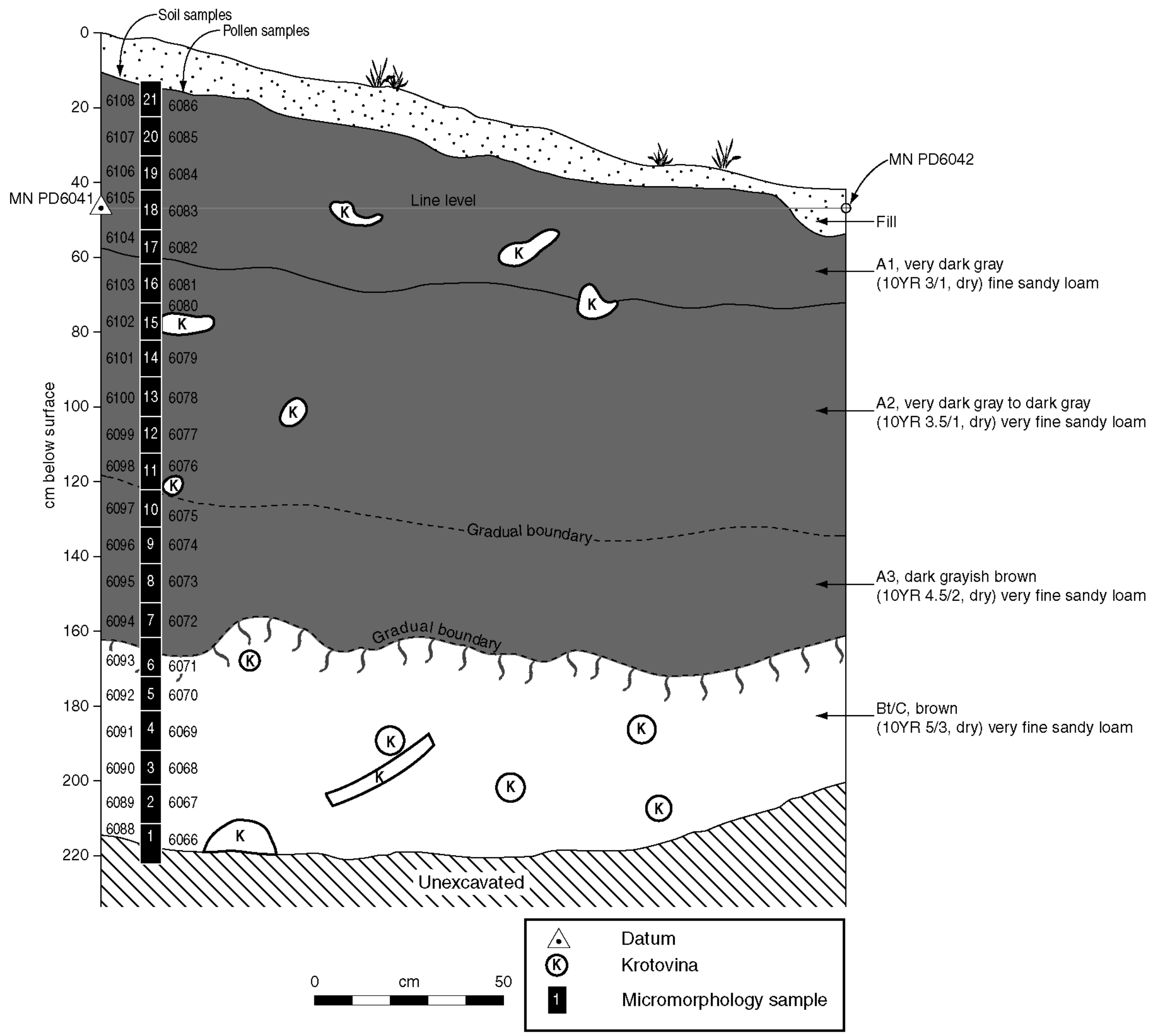

Figure 223. Profile 13 at LAN-211.

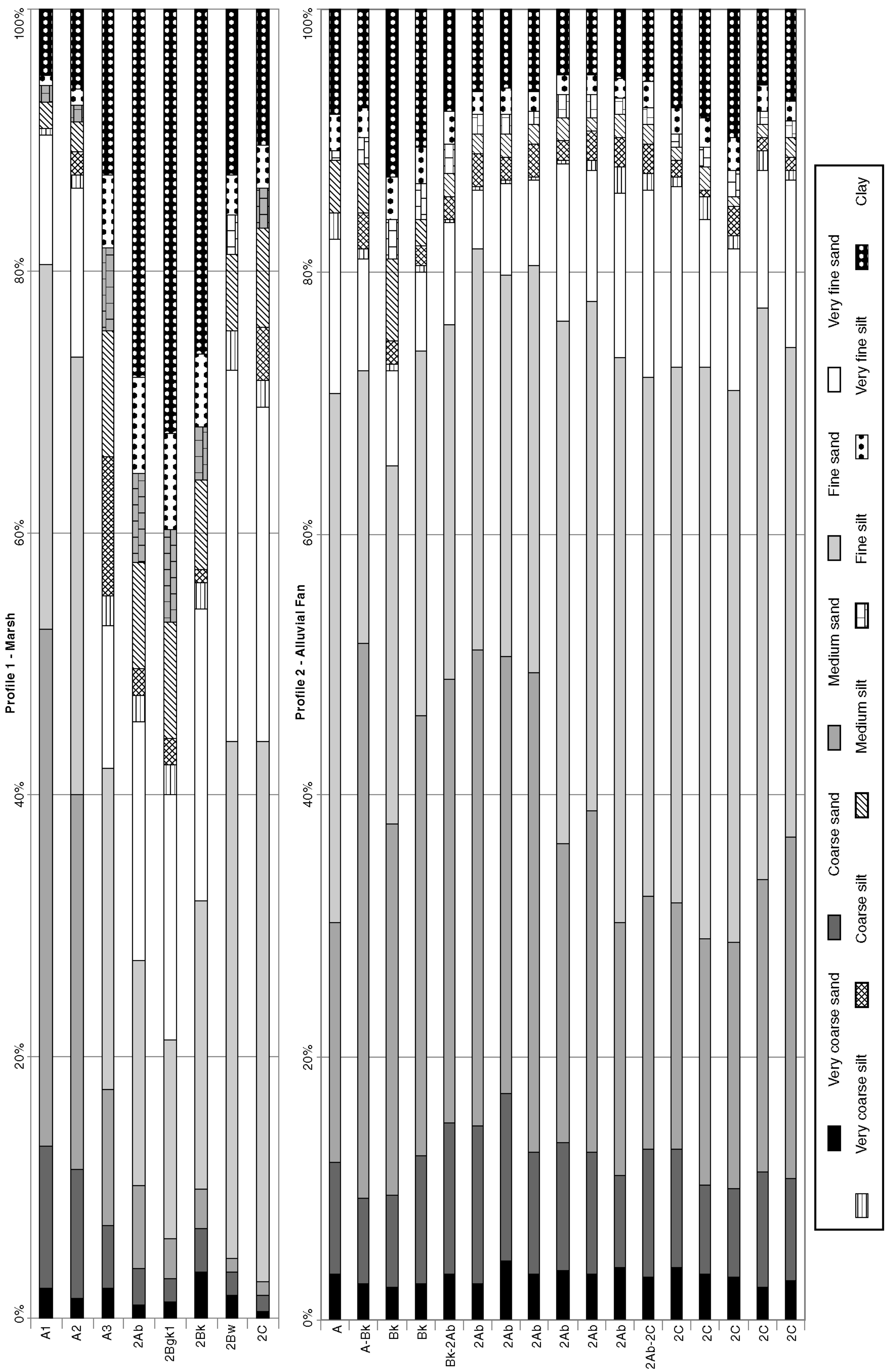

Figure 224. Particle-size graphs for LAN-211 (Profiles 1 and 2).

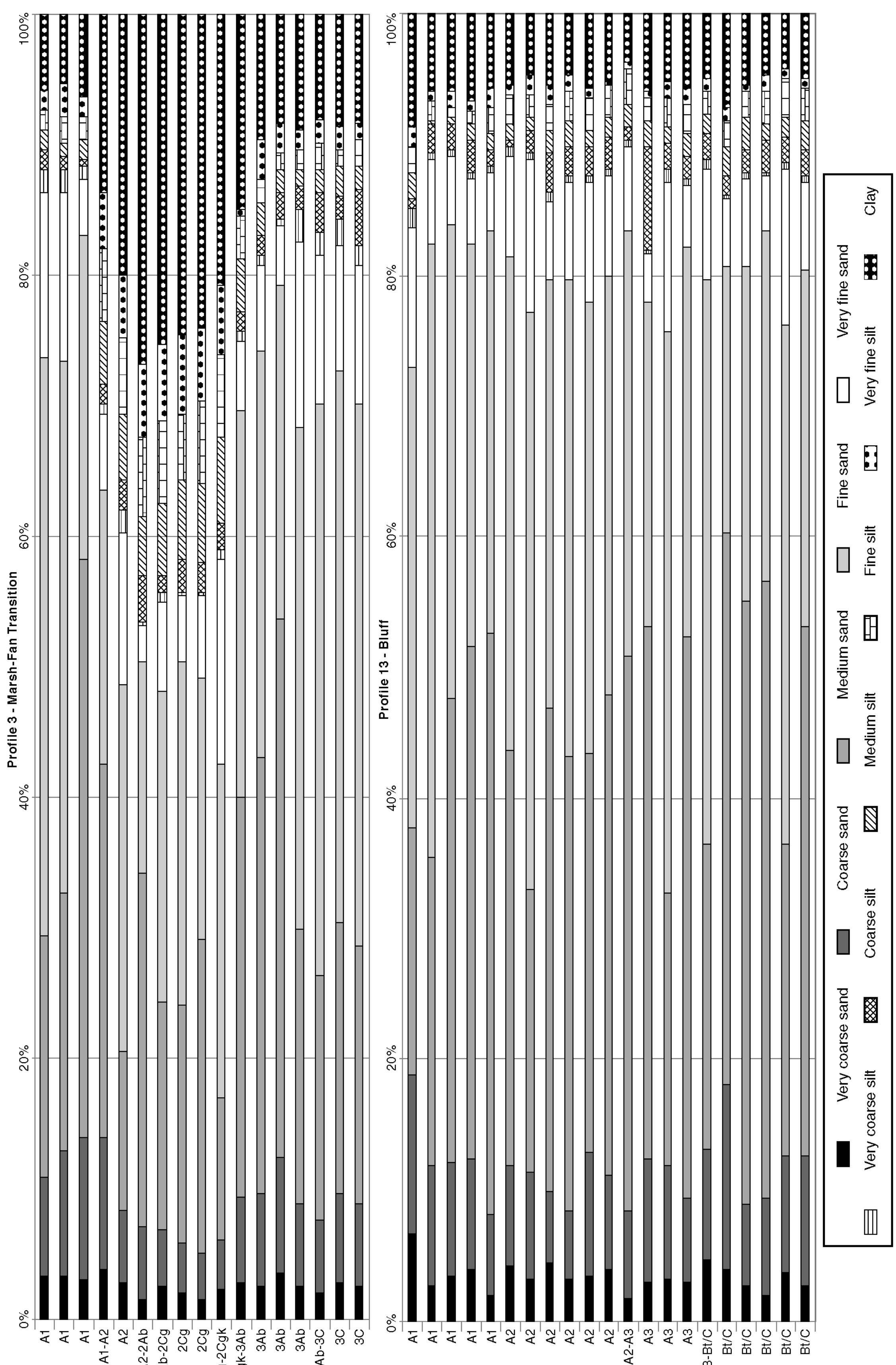

Figure 225. Particle-size graphs for LAN-211 (Profiles 3 and 13).

Table 56. Means and Standard Deviations of Soil Properties of Strata at LAN-211

Soil Property	Units	Stratum I			Stratum II			Stratum III			Stratum IV			Stratum V			Bluff		
		n	Mean	σ	n	Mean	σ	n	Mean	σ	n	Mean	σ	n	Mean	σ	n	Mean	σ
pH		8	7.8	0.1	10	7.6	0.3	11	8.0	0.4	6	7.8	0.2	5	7.6	0.4	21	5.5	1.3
Organic matter, Walkley-Black method	%	8	0.17	0.17	10	0.27	0.27	11	0.46	0.25	6	1.82	0.82	5	1.50	1.02	21	0.49	0.29
Organic matter, loss-on-ignition method	%	8	1.20	0.38	10	1.23	0.30	11	3.38	1.26	6	4.89	1.72	5	2.99	1.26	21	1.35	0.52
Nitrogen	g/kg	8	0.12	0.04	10	0.22	0.15	11	0.34	0.22	6	1.05	0.52	5	0.8	0.5	21	0.27	0.16
Calcium carbonate	%	8	0.9	0.4	10	1.1	0.8	11	7.29	5.81	6	5.75	3.85	5	1.3	0.3	21	0.88	2.12
Toral phosphorus	mg/kg	8	2,194	868	10	2,064	605	11	1,015	698	6	1,241	782	5	1,963	1,189	21	898	435
Available phosphorus	mg/kg	8	97	37	10	104	23	11	26	37	6	53	49	5	91	53	21	42	19
Extractable phosphorus	mg/kg	8	113	60	10	86	45	11	23	29	6	65	57	5	83	61	21	45	20
Bulk density	g/cm^3	8	1.73	0.04	10	1.69	0.07	11	1.57	0.10	6	1.43	0.27	5	1.44	0.13	21	1.50	0.28
Porosity	%	8	35	1.3	10	36	2.6	11	41	3.8	6	46	10.3	5	46	4.9	21	44	8.2
Gravel	%	8	1.1	0.5	10	1.5	0.4	11	1.0	1.1	6	1.5	0.8	5	3.9	3.4	–		
Sand	2–0.063 mm	8	85	2.7	10	85	2.7	11	65	13.3	6	67	12.8	5	87	1.8	21	87	1.9
Silt	63–2 mm	8	8	1.6	10	8	1.3	11	17	5.9	6	16	4.7	5	7	1.6	21	7	1.6
Clay	<2 mm	8	8	1.5	10	7	1.7	11	18	8.1	6	17	8.4	5	17	8.4	21	6	1.1
Geometric mean	2–0 mm	8	128	15.3	10	146	24.0	11	62	41	6	72	45	5	160	24	21	167	12
Geometric mean	2 mm–2 µm	8	190	11.2	10	210	27.4	11	126	58	6	142	41	5	217	34	21	225	18

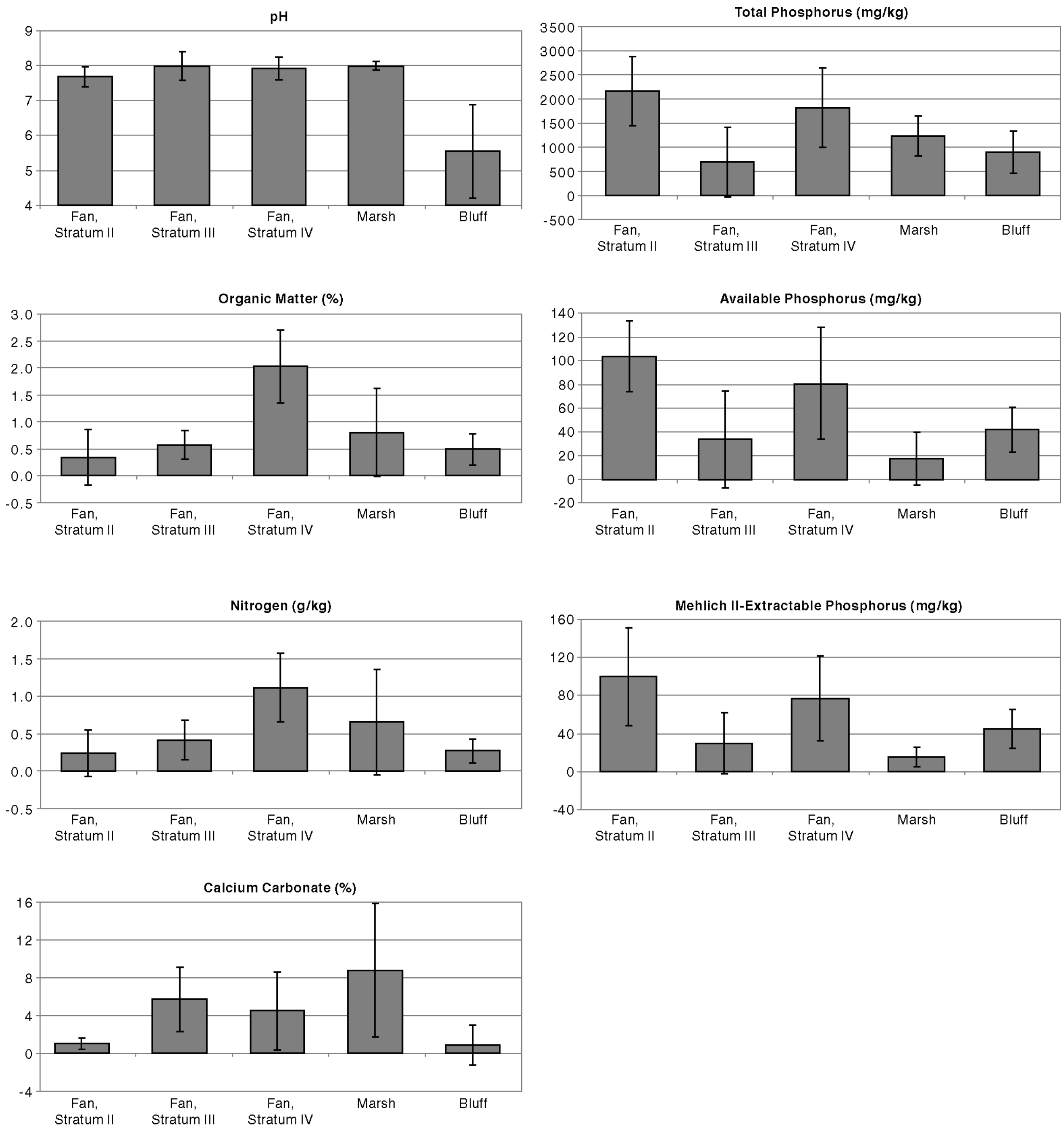

Figure 226. Graphs of means and standard deviations of soil chemical data (pH, organic matter, nitrogen, calcium carbonate, total phosphorus, available phosphorus, and Mehlich II–extractable phosphorus), by stratum, for the alluvial fan at LAN-211, in relation to the marsh and bluff areas.

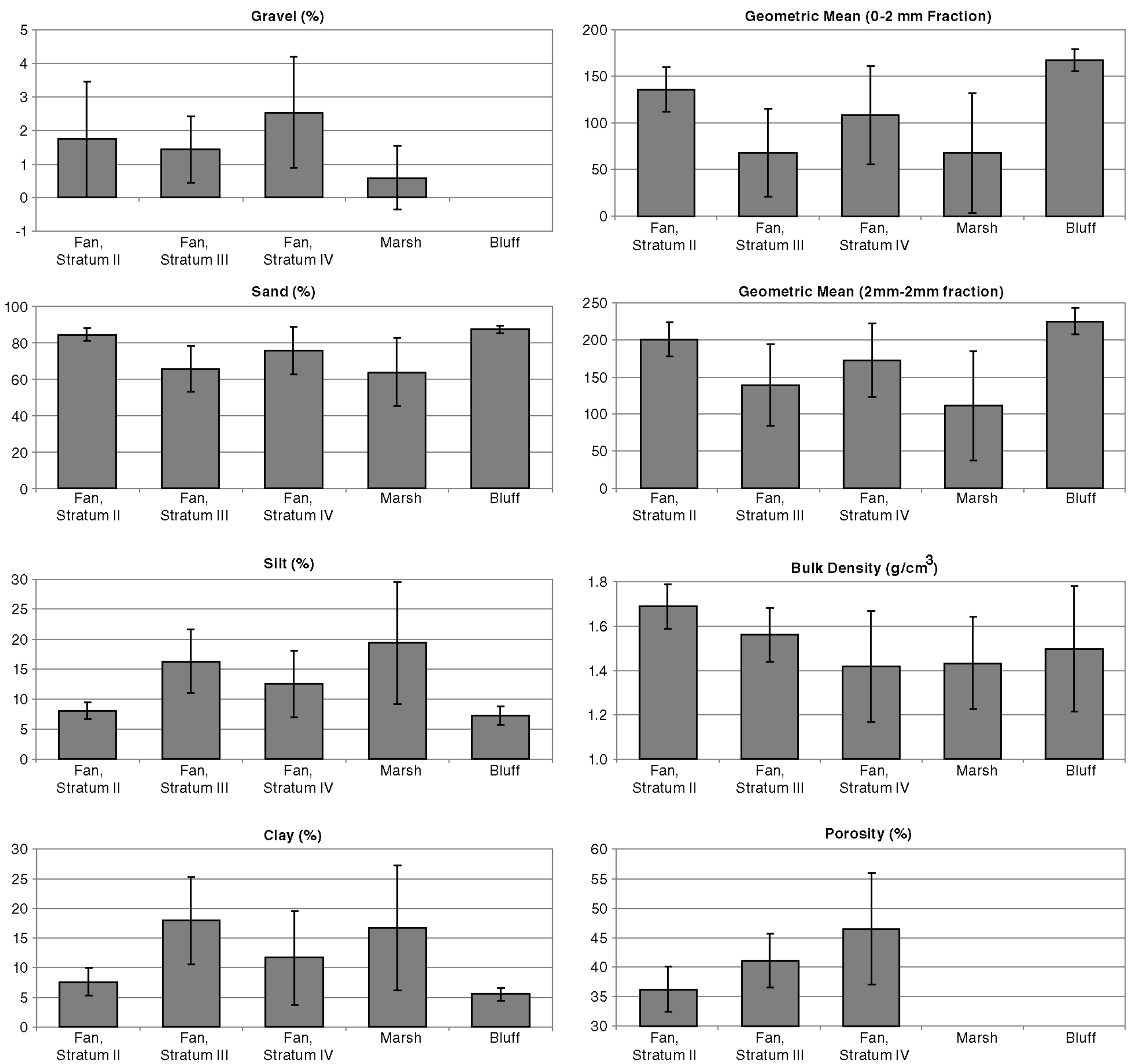

Figure 227. Graphs of means and standard deviations of soil physical data (particle size, bulk density, and porosity), by stratum, for the alluvial fan at LAN-211, in relation to the marsh and bluff areas.

Bone, which is composed of organic materials (collagen, fats, and proteins) embedded within an inorganic matrix of a mineral, hydroxyapatite ($Ca_5[PO_4]_3OH$), is least soluble and thus best preserved at pH 7.88. The highest pH level was recorded in the Bk horizon of Stratum III and resulted from the precipitation of calcium carbonate within and above the fluctuating water table. By contrast, the pH levels in the bluff soils were considerably lower and generally poor for bone and shell preservation. The bluff soils of Profile 13 were strongly to very strongly acid, ranging from pH 4.8 at the surface to 5.7 at the base of the thick A horizon; the Bt/C horizon was slightly acid, ranging from levels of 5.7 to 6.1. The lowest soil pH levels (and calcium-carbonate concentrations) were observed in the vicinities of the feature clusters in Stratum IV, especially in the area of Feature 1, and probably were attributable to the presence of acids generated from discarded organic debris.

Organic matter and nitrogen typically concentrate in areas of intense human activity, but levels also may become elevated in marshy environments. The high levels of organic matter in marsh deposits do not necessarily indicate high quantities of organic materials but, rather, result from better preservation of organic matter, because of high groundwater levels and low oxidation rates. Organic-matter and nitrogen levels peaked in Strata IV and V in Profile 3, which was associated with a large occupation surface and activity area in Excavation Block A (Feature 1). Organic matter was also high on the fan-marsh juncture of Profile 1, in the relict marsh deposits.

Phosphorus levels generally increase via many human activities that result in the incorporation of organic materials into the surrounding ground surface, such as ash, bone, plant material, excrement, and so on. Phosphorus is largely insoluble, and thus concentrations remain stable in most soils for long periods of time. Consequently, levels recorded during excavation provide a reliable indicator of intensity of human activities. SRI analyzed Mehlich 2–extractable phosphorus, the fraction of total phosphorus that is most easily enriched by cultural activities, in addition to total and plant-available phosphorus.

SRI inferred natural levels of soil phosphorus levels based on analysis of noncultural soil samples, which indicated a natural "background" concentration of 40–50 mg/kg (or ppm). Hence, extractable-phosphorus levels above about 40–50 ppm indicated a significant anthropogenic signal. Figure 226 shows a number of peaks in extractable-phosphorus levels in the analyzed profiles. The highest peaks occurred in Strata I, II, IV, and V (especially evident in Profiles 2 and 3). Phosphorus concentrations were particularly high in the vicinity of buried hearths and other cultural features within Feature 1. Three peaks were found in Profile 2, and two were found in Profile 3, each of which may correlate to buried occupation surfaces. Similar peaks also were found in total and available phosphorus. Overall, phosphorus levels tended to be lower than those observed in Loci A and G of LAN-62, suggesting less-intense levels of human occupation and land use.

The particle-size results suggested few lateral differences in different areas of the site; rather, most of the variation related to stratigraphic differences. The highest sand and lowest clay contents were recorded in Strata I, II, and V, all of which consist of loamy sand. Strata III and IV contrasted sharply to the other strata and exhibited relatively low sand and high silt and clay levels. The finer soil texture in Strata III and IV was attributable to the low-energy deposition along or near the edge of the marsh. As a result of their finer textures, Strata III and IV also revealed higher levels of soil porosity and bulk density (see Figures 226 and 227).

To gauge the relationship between the geochemical peaks and material-culture concentrations, the geoarchaeologists documented the presence of lithics, shell, charcoal, and faunal bone in the 293 soil samples (approximately 0.5 kg each) in various profiles (excluding Stratum VII). The artifacts and ecofacts were segregated from the matrix by sieving soil samples through 2-mm mesh.

Based on the 293 samples, the means and standard deviations for each stratum exposed on the surface and in truncated surfaces are illustrated in Figure 228. Ubiquity measures also were used to quantify the lithic, shell, charcoal, and faunal-bone materials among the samples, calculated as the percentage of the total number of samples per stratum from which one or more artifacts/ecofacts were recovered (Figure 229). Faunal bone was recovered from almost all of the soil samples, with the exception of those from Stratum V. Lithic and shell materials were concentrated in Strata II and IV, and charcoal was heavily concentrated in Strata IV and V, especially near the hearth features in the western portion of Excavation Block A. The high lithic and shell concentrations indicated periods of human occupation, but faunal bone and charcoal may occur in the absence of that evidence.

Disturbance

Several forms of disturbance were observed at LAN-211. Disturbance to cultural deposits through bioturbation and natural geologic processes was noted, and human disturbance was present in the form of ranching and farming and especially later construction activities related to the HHIC.

Geologically, the area of LAN-211 appeared to have been fairly active over the millennia that it was used as a locus of activity by humans. As discussed previously, the site rests below a large drainage that has cut a small canyon into the sand hills above the site. That canyon has been filled in as a result of construction activities related to LMU, but historical aerial photographs and topographic maps showed the cut to have been fairly substantial. During rain events, the site would surely have been inundated with sediment from the bluffs above, burying archaeological deposits and actually working to preserve cultural materials. It is also possible that cultural materials from the sites above, on the bluff tops, were transported downward and mixed with surface deposits at the site. Rills and gullies were also likely cut into the fan as fast-moving water flowed through the drainage. The effects of those types of natural disturbances

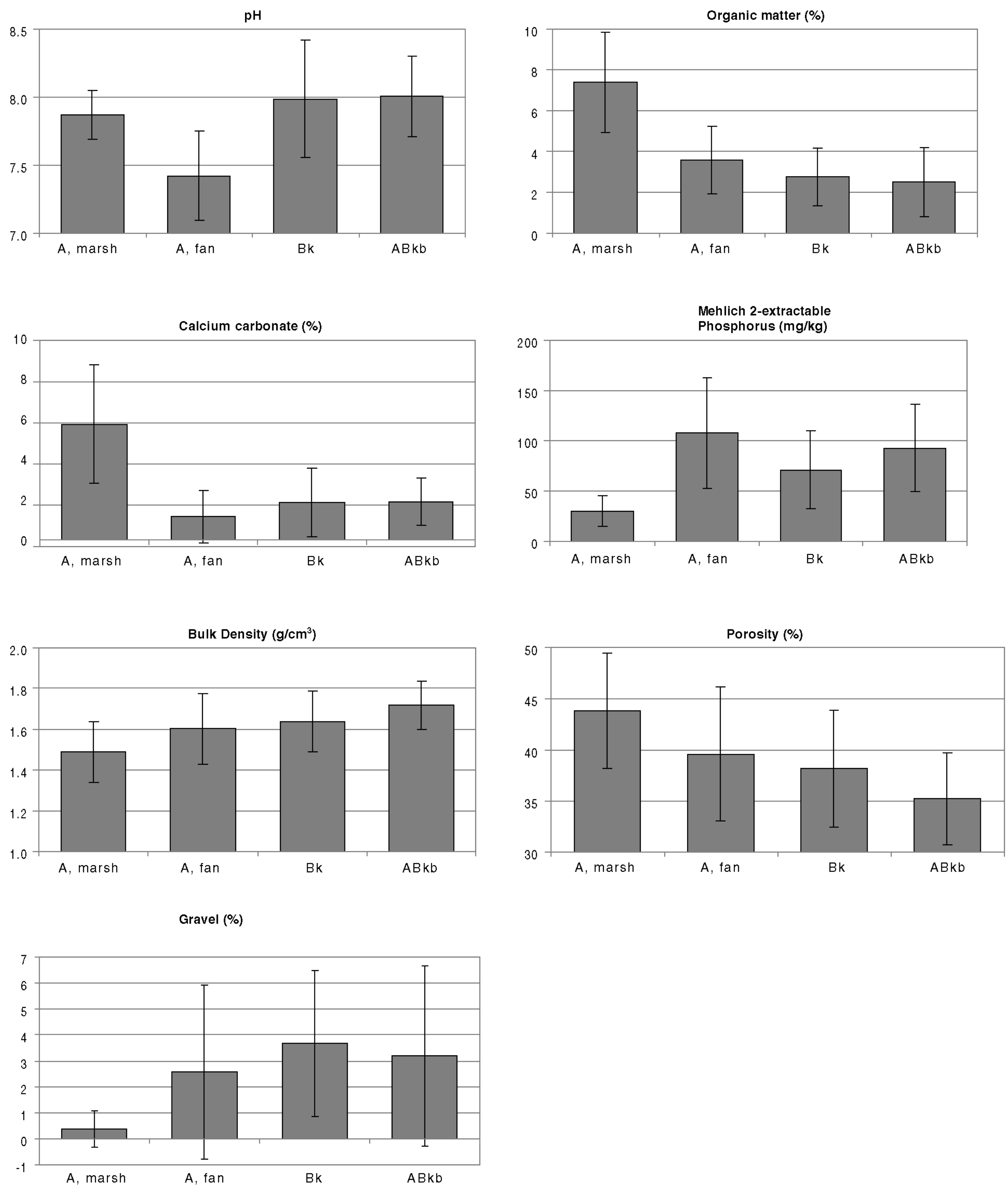

Figure 228. Graphs of means and standard deviations for soil properties on the surface and in truncated surfaces at LAN-211.

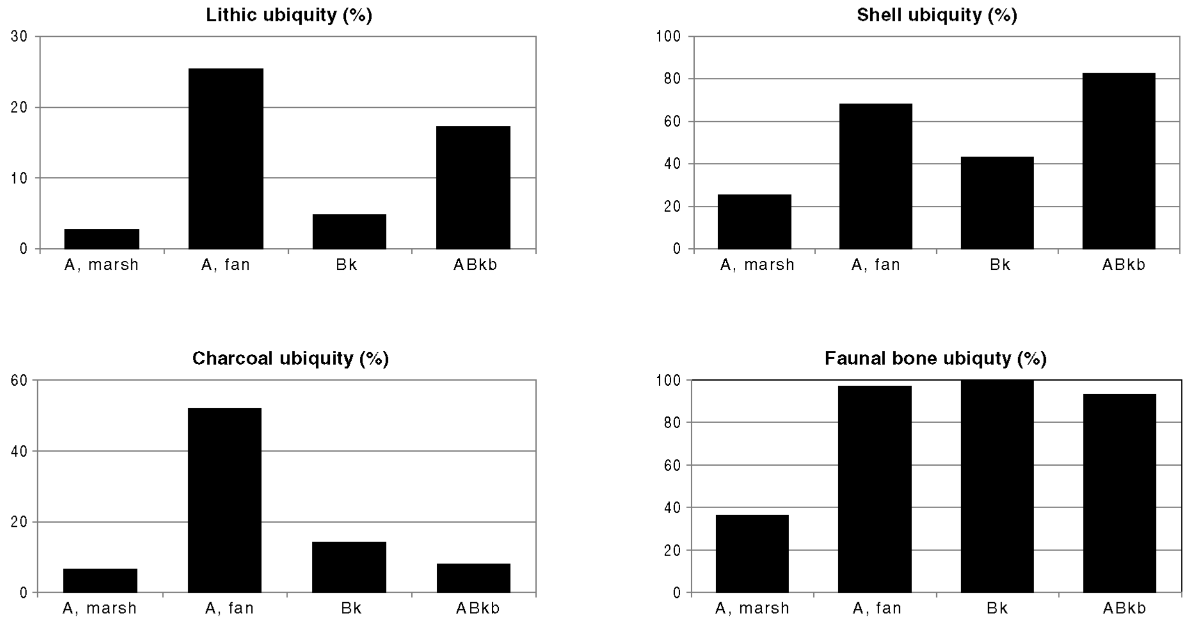

Figure 229. Graphs of ubiquity for lithic artifacts, shell, charcoal, and faunal bone in surfaces truncated at LAN-211.

may have been relatively minor when compared to the effects of bioturbation and historical-period and modern intrusion into cultural deposits.

Bioturbation caused by burrowing rodents and insects has significantly affected the integrity of cultural deposits at LAN-211. Pocket gophers are notorious as agents of stratigraphic disturbance at archaeological sites in California, and that was certainly the case at the well-drained, sandy sites in the project area. They typically dig burrows of approximately 7–8 cm in diameter, up to about 50 cmbs. Small artifacts are easily displaced from those activities. In-filled rodent burrows, or krotovinas, were found concentrated in the upper part of Stratum IV and in the contact between Strata III and IV and probably caused frequent translocation of small artifacts. Nonetheless, the visual distinctiveness of the subsurface strata suggested substantial subsurface integrity. Had the cultural deposits been thoroughly churned and mixed, soil horizons no longer would be recognizable. Translocation was apparently widespread at LAN-211, given that radiocarbon-dated shell specimens from the last few centuries were recovered from deep strata underneath older deposits dating to the Intermediate period (see Table 13, Appendix 10.8). This problem was especially evident in CU 119, where several radiocarbon-dated shell specimens assigned to Episode 3B were recovered from Levels 67–73, located below levels dated to the early Intermediate period. A single radiocarbon-dated shell specimen assigned to Episode 3B was also recovered from the lowest level of CU 274, which dated entirely to Episodes 1 and 2. Finally, in CU 120 cultural materials were recovered from Stratum I, which predates the recorded occupation of the Ballona.

By far, the most-severe impacts to cultural materials at LAN-211 were due to historical-period and modern activities related to farming, ranching, and the HHIC. The complex history of development was presented in detail by Altschul et al. (2003:35–46); in this section, we present a brief summary. During the early historical period, when cattle grazing was the primary economic endeavor, the Ballona remained relatively undeveloped; only a few structures dotted the landscape. Adobe and thatched structures, as well as associated corrals, appear to have been the only structures that existed for many years, until the early twentieth century. Although it is unlikely that the living quarters for landowners and their personnel had much of an impact on the landscape, cattle grazing surely did. Grazing of vast tracts of land in the Ballona surely affected drainage patterns, as protective brush was depleted on hill slopes and in the flood plains. The effects of that type of activity have been documented throughout the southwestern United States, especially in California. The effects on sites in the Ballona were likely related to increases in siltation rates, as native plant communities that acted as natural barriers to slope wash were denuded by large herds of cattle. At some level, the increased siltation may have actually worked to preserve archaeological materials, as large flows of colluvial materials scoured from the bluffs above covered those deposits during episodes of heavy rains. Aerial photographs in the modern period showed that kind of siltation even after the channelization of many of those drainages.

It was not until the early twentieth century that a significant amount of development was seen in the Ballona. One of the first major projects to affect cultural resources in the

Ballona was large-scale construction activity associated with the placement of the North Outfall Sewer line in 1924. The sewer line and access road ran along the base of the Ballona escarpment, across the project area. As discussed above, that major undertaking resulted in the development of an artificial slope to support the massive line and associated road. The artificial slope appears to have covered an expansive area of archaeological deposits along the base of the bluffs. Those deposits were likely exposed or near the natural surface at the time. It is unknown how much preparation or excavation may have taken place that would have impacted the deposits as the sewer line was constructed.

Review of aerial photographs and historical USGS topographic maps showed an increased amount of development of the Ballona area in the early to late 1920s. It is clear that early in the 1920s, the area of LAN-211 saw a significant amount of activity through both ranching and farming. In Figure 230 (a section of the 1924 Venice USGS topographic map), two structures can be seen in the vicinity of LAN-211. A few years later, in an aerial photograph dated 1929, a small complex of structures can be seen at the base of the bluffs, just below the LMU buildings, but those structures appear to have been more concentrated in the area of LAN-62 Locus D (Figure 231). At that location (see Chapter 9, this volume), very little archaeological material was found. The dearth of intact deposits may have been a result of damage induced by the farming activity and the construction of buildings in that area. The area east of the structures, where most of the intact archaeological deposits were found during our excavations, appears to have been fallow agricultural fields. The photograph also shows the proximity of prechannelized Centinela Creek to the site.

It appears that through the 1940s, there was much less activity in that area. A number of aerial photographs showed only two structures (possibly related to farming) and some cleared areas within the LAN-211 site boundaries. It appears that Hughes avoided that area until later in the 1950s. In Figure 232, an aerial photograph from 1946, a number of buildings and a paved parking area are visible in the location of the site. It is unknown how much damage those structures and the construction of the parking area would have created, but we assume that the area was at least graded for leveling. Later, sometime in the decades of the 1960s, 1970s, and 1980s, other structures were built in the area of LAN-211. At the time initial testing was conducted and prior to mechanical stripping of overburden, several of those structures were still standing (Figure 233). In sum, most, if not all, of the cultural materials at LAN-211 had been altered in some way by the varied effects of ranching and farming and the development of the HHIC. Even where intact deposits were encountered, it was clear that the upper portions had been truncated to some degree. Despite the numerous impacts to the site, intact deposits were indeed found, sometimes in direct contact with asphalt. Human-induced impacts were not the only forces playing a role in the disturbance of cultural materials. As at all sites in the PVAHP and in the region, in general, the actions of bioturbation, flooding, and other natural postdepositional processes complicated our interpretations of the material record.

Cultural Stratigraphy

To examine the correlation between the depositional history and human occupation, we plotted the elevations of excavated features and cultural materials recovered from the CUs and EUs relative to the natural stratigraphic horizons. In total, 43 radiocarbon and AM assays were obtained from LAN-211 (see Tables 13 and 14). The radiocarbon samples were drawn from a variety of feature and EU contexts, including 8 features and 8 EUs. The radiocarbon assays were obtained from shell specimens, with the exception of 1 assay obtained from canarygrass seeds. All of the AM dates were obtained from hearths associated with Feature 1, but only 5 produced reliable AM data from which date ranges could be inferred (for details, see Chapter 3, this volume). Four of the AM assays are consistent with a protohistoric or Mission period age, whereas one assay indicated a post–A.D. 1850 date.

Careful analyses of stratigraphic locations and chronometric results revealed five broadly defined occupation episodes at LAN-211, numbered 1 through 5; Episode 1 is the earliest (for details, see Chapter 3, this volume). The latest episode, Episode 3, was subdivided into earlier (3A) and later (3B) subepisodes. In these cases, the assays clustered into two subgroups, but the sigma ranges overlapped and could not be statistically separated into discrete episodes. The cultural stratigraphy and occupation episodes are presented in Table 57.

The date ranges for Episodes 1–3 incorporated the calibrated 2σ ranges derived from both the standard and age-specific ΔR correction values, which were applied to control for the "reservoir effect" in radiocarbon assays derived from shell specimens. The incorporation of both corrections produced larger date ranges than would have been the case with only one algorithm, because the two corrections produce slightly different sigma ranges. Although the standard ΔR of 1550–1950 and an age-specific ΔR of 1510–1950 were identified for Episode 3 (see Chapter 3), we generally date Episode 3 to the Late/Protohistoric/Mission period, the last of which ended in 1832 with secularization of the missions in California. Other tables and data presented in this chapter offer the more-specific radiocarbon ranges of dates, but for general discussions of cultural episodes here, we end Episode 3 at 1832 rather than the radiocarbon age of 1950, because we know there was no longer extended traditional Native American occupation of the Ballona after the Mission period. For Episode 4, the date range was broadly defined to encompass the late historical period, from California statehood in 1848 through the establishment of the HHIC in 1941. One probable late-historical-period feature was recorded at LAN-211, but no chronometric dates or time-sensitive artifacts were obtained to infer a more precise time range. The date range for Episode 5 encompasses the known dates of operation of the HHIC.

Figure 230. Close-up of the 1924 Venice, California, USGS 7.5-minute quadrangle (surveyed in 1923), showing most of the Ballona from the coast.

Figure 231. 1929 oblique aerial photograph showing structures at LAN-211/LAN-62D, below LMU (courtesy of the Benjamin and Gladys Thomas Air Photo Archives, Spence Collection, UCLA Department of Geography; Negative No. H-702).

Figure 232. Close-up of a 1946 aerial photograph showing structures and the paved parking area at LAN-211 (courtesy of the Benjamin and Gladys Thomas Air Photo Archives, Spence Collection, UCLA Department of Geography; Negative No. H-2222).

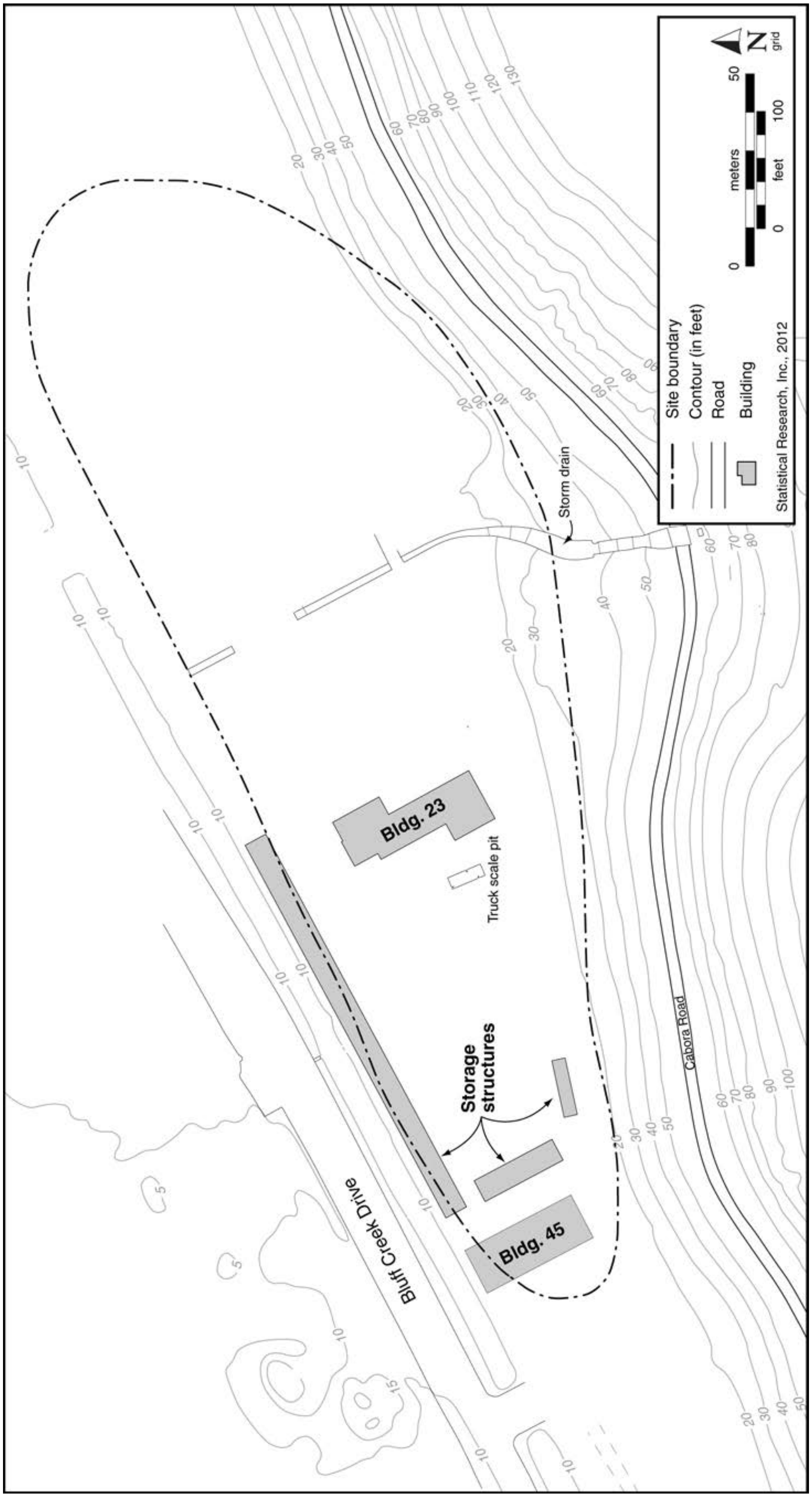

Figure 233. Map of LAN-211 prior to testing and overburden removal, showing standing HHIC structures.

Table 57. Cultural Stratigraphy and Occupation Episodes at LAN-211

Episode No.	Stratum	Age	Cultural Period
1	II	1110–250 cal. B.C.	early Intermediate
2	III	cal A.D. 140–790	late Intermediate
3	IV	cal A.D. 1330–1830	Late/Protohistoric/Mission
3A	IV	cal A.D. 1330–1680	Late/Protohistoric
3B	IV	cal A.D. 1550–1830	Protohistoric/Mission
4	V, VI	A.D. 1830–1941	Euroamerican
5	VII	A.D. 1941–1980s	Howard Hughes Industrial Complex

Episode Descriptions

The episode assignments for features and CU levels at LAN-211 are listed, respectively, in Tables 58 and 59. Table 60 lists the range of time-sensitive artifacts recovered from features at LAN-211.

Episode 1, the earliest detected occupation at LAN-211, was associated with the fan deposits in Stratum II. The radiocarbon assays from which this episode was inferred were drawn from nine shell specimens (see Tables 13 and 14) recovered from one feature and various levels in EUs (see Chapter 3, this volume). The combined ages of the radiocarbon assays for Episode 1 were 760–250 cal B.C. (standard ΔR) or 1110–700 cal B.C. (age-specific ΔR), which encompassed a pooled time range of 1110–250 cal B.C., an early Intermediate period occupation. A span of roughly 880–1,170 calendar years separated Episode 1 from Episode 2. No temporally diagnostic artifacts were associated with this occupation episode.

Episode 2 was associated with the fan deposits in Stratum III. Radiocarbon assays from 13 shell specimens recovered from two features and four EU levels were used to define this episode. The conventional dates obtained from those shells spanned 290 radiocarbon years, suggesting that more than one occupation was included in the group. However, the potential subepisodes could not be separated into statistically distinct groups; we therefore grouped the 13 samples as a single, broader episode that likely reflects multiple occupation surfaces and periods of site activity. The assays assigned to this episode produced combined date ranges of cal A.D. 190–790 (standard ΔR) and cal A.D. 140–710 (age-specific ΔR). A gap of 620 radiocarbon years, or roughly 670–910 calendar years, separated the beginning of subsequent Episode 3 from the end of Episode 2.

The sigma ranges indicated a pooled range of cal A.D. 140–790, suggesting occupation during the middle and late Intermediate period. One Malaga Cove point was recovered, suggesting a date range of about A.D. 500–1300 (more likely in the earlier portion of that range [Justice 2002:363]), which would be consistent with the late Intermediate period interpretation.

Notably, the radiocarbon date indicating an Episode 2 assignment for Feature 2 was erroneous. One additional assay from Feature 2 on a canarygrass sample produced a sigma range of cal A.D. 1440–1640, suggesting a Late or Protohistoric age for the feature. In addition, it was a subfeature of Feature 1 and was positioned within Stratum IV, both of which suggest a post–Intermediate period date. Feature 2 also included European plant domesticates (see Table 60) that underscored the feature's postcontact age. The littleneck-clamshell specimen that produced the Intermediate period date probably was not part of the primary feature deposit and may have been translocated into the feature matrix as a result of bioturbation or other disturbance.

Note that two features and a unit level could not be confidently assigned to either Episode 1 or 2, and therefore, we assigned them to a composite Episode 1/2 designation. That group included Features 29 and 30 (thermal rock features). A radiocarbon date from Level 71 in CU 359 produced sigma ranges of 360–40 cal B.C. (standard ΔR) and 750–400 cal B.C. (age-specific ΔR) and a pooled range of 750–40 cal B.C., statically outside the range of dates for Episodes 1 and 2. All of the above features and unit levels were assigned to a more broadly defined Intermediate period group.

Episode 3, which had two subepisodes (3A and 3B), was associated with the midden deposit in Stratum IV, which extends from the alluvial/colluvial bench and into the marshy area farther from the bluff edge. The conventional dates for those samples spanned 370 radiocarbon years and were divided into two subepisodes. Subepisode 3A was defined based on six radiocarbon assays. Dated specimens were recovered from four thermal features and two CUs. The radiocarbon assays from the shell specimens yielded sigma ranges of cal A.D. 1390–1810 (standard ΔR) or cal A.D. 1330–1680 (age-specific ΔR), indicating a pooled age range of cal A.D. 1330–1810, a likely Late, Protohistoric, or Mission period occupation. Three Cottonwood Triangular projectile points, a point style manufactured from about A.D. 950 through the historical period, were recovered from two features. In addition, shell beads recovered from Feature 52 suggested an age range between A.D. 1500 and 1700, a Protohistoric period date range (see Table 60).

Radiocarbon assays from 11 shell specimens (from two features and five CUs) were used to define Subepisode 3B. The conventional dates from those samples spanned 140 radiocarbon years and formed a cohesive group. The assays produced a combined date range of cal A.D. 1550–1950 (standard ΔR) or cal A.D. 1510–1950 (age-specific ΔR). The sigma ranges

Table 58. Episode Assignments for Features at LAN-211

Feature No.	Subfeature No.	Feature Field Type	Episode	Cultural Period	Calibrated Date Range
1	4	hearth	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
1	5	rock cluster	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
1	6	hearth	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
1	8	hearth	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
1	12	hearth	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
1	13	rock cluster	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
1	14	hearth	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
1	16	hearth	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
1	17	hearth	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
1	18	hearth	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
1	19	hearth	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
1	21	hearth	3A	Late/Protohistoric/Mission period	cal A.D. 1330–1680
1	22	hearth	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
1	24	rock cluster	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
1	25	rock cluster	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
1	26	hearth	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
1	28	hearth	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
1	41	hearth	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
1	42	hearth	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
1	50	hearth	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
1	51	hearth	3B	Late/Protohistoric/Mission period	cal A.D. 1510–1950
1	52	rock cluster	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
2		artifact concentration	2/3	late Intermediate/Late period	cal A.D. 140–1680
11		pit	1	early Intermediate period	1110–250 cal B.C.
15		rock cluster	2	late Intermediate period	cal A.D. 140–790
27		human burial	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
29		rock cluster	1/2	Intermediate period	1110 cal B.C.–A.D. 790
30		rock cluster	1/2	Intermediate period	1111 cal B.C.–A.D. 790
31		hearth	1	early Intermediate period	1110–250 cal B.C.
33		human burial	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
39		rock cluster	1	early Intermediate period	1110–250 cal B.C.
40		activity area	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
45		hearth	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
46		rock cluster	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
49		human burial		indeterminate	indeterminate
53		rock cluster	3B	Protohistoric/Mission period	cal A.D. 1510–1950
56		rock cluster	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950

Table 59. Episode Assignments for CU Levels at LAN-211

Level No., by CU No.	Natural Soil Horizon (Stratum)	Episode	Cultural Period	Calibrated Date Range
CU 119				
58–59	A2 (IV)	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
60-61	Bk (III)	2	late Intermediate period	cal A.D. 140–790
62	Bk (III)	1	early Intermediate period	1110–250 cal B.C.
63–64	Ab (II)	1	early Intermediate period	1110–250 cal B.C.
CU 120				
62–63	A1 (V)	3B	Late/Protohistoric/Mission period	cal A.D. 1510–1950
64–65	A2 (IV)	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
66	A2 (IV)	2/3	late Intermediate/Late period	cal A.D. 140–1680
67	Ab (III)	2	late Intermediate period	cal A.D. 140–790
68–69	Cgk (III)	2	late Intermediate period	cal A.D. 140–790
70	Cgk (III)	1/2	Intermediate period	1110 cal B.C.–A.D. 790
71	Cgk (III)	1	early Intermediate period	1110–250 cal B.C.
72–74	Ab (II)	1	early Intermediate period	1110–250 cal B.C.
CU 274				
59–60	Bk (III)	2	late Intermediate period	cal A.D. 140–790
61–62	Bk (III)	1	early Intermediate period	1110–250 cal B.C.
63–68	Ab (II)	1	early Intermediate period	1110–250 cal B.C.
CU 353				
62	fill			
63–65	A1 (V)	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
66–68	A2 (IV)	3	Late/Protohistoric/Mission period	cal A.D. 1330–1950
69	Ab (III)	2	late Intermediate period	cal A.D. 140–790
CU 359				
56–61	Bk (III)	2	late Intermediate period	cal A.D. 140–790
62–72	Ab (II)	1	early Intermediate period	1110–250 cal B.C.

Table 60. List of Features with Time-Sensitive Artifacts, LAN-211

Feature No.	Subfeature No.	Episode No.	Shell Beads		Historical-Period Artifacts	Projectile Points	European Domesticates	
			Minimum Date (A.D.)	Maximum Date (A.D.)			Plants?	Animals
1	4	3	1150	1700		Cottonwood point	yes	cow, possible sheep[a]
1	5	3	1500	1600				
1	6	3	1150	1600				
1	8	3					yes	
1	13	3	1800	1816			yes	
1	14	3	1150	1834				
1	16	3	1500	1834				
1	17	3	1500	1600				
1	21	3A				Cottonwood point	yes	
1	22	3	1500	1700				
1	25	3						possible sheep[a]
1	26	3	1150	1700				
1	28	3	1150	1816				
1	41	3						

Feature No.	Subfeature No.	Episode No.	Shell Beads		Historical-Period Artifacts	Projectile Points	European Domesticates	
			Minimum Date (A.D.)	Maximum Date (A.D.)			Plants?	Animals
1	42	3	1150	1816				
1	50	3						
1	51	3B						
1	53	3						
2		2[b]/3					yes	
11		1						
15		2						
27		3	1150	1834				
29		1/2						
30		1						
31		1/2						
33		3			glazed ceramic, glass, metal			
39		3						
40		3						
45		3						
46		1/2						
52		3	1500	1700		Cottonwood point		
56		3						

[a] Sheep may have been a European domesticate or New World (e.g., bighorn sheep).
[b] Probable erroneous date from translocated shell specimen.

indicated a pooled date range of cal A.D. 1510–1950, suggesting occupation during the Protohistoric or historical period. The conventional dates obtained from those samples spanned 160 radiocarbon years and formed a statistically distinct group.

No features were assigned to either of the subgroups of Episode 3, other than those from which radiocarbon dates were obtained, and only Levels 65 and 62–63 were assigned, respectively, to Subepisodes 3A and 3B. Given the overlapping sigma ranges of the subepisodes, the majority of features and CU levels at LAN-211 were assigned to the more broadly defined Episode 3. Although the calibrated-date ranges for Episode 3 encompassed the end of the Late period, other evidence supported a predominantly Protohistoric and Mission period designation. The presence of Cottonwood Triangular points and shell beads indicated an age range between A.D. 950 and 1834, but the majority of the shell beads indicated a range of A.D. 1500–1800.

More-precise dating information, however, derived from the presence of 62 glass beads and domesticated plant and animal species (especially in Feature 1), all of which were postcontact introductions. Charred seeds from European plant domesticates were recovered from four subfeatures of Feature 1 and from Feature 2; faunal bone from possible European animal domesticates were recovered from two subfeatures of Feature 1. The presence of those materials strongly suggested a Mission period occupation, although we could not rule out the possibility that some of the glass beads and domesticated-plant and animal materials were recovered from secondary contexts that had translocated downward via bioturbation.

AM date ranges were inferred for seven subfeatures of Feature 1, but only five assays yielded reliable results (see Table 14). The five AM dates partially supported the Mission period designation. AM results from three features indicated date ranges in the A.D. 1700s and 1800s, which supported the Mission period designation, but the date ranges for two other features did not clearly corroborate it. The inferred date range for Feature 8 (A.D. 1535–1590 or A.D. 1700–1750) predates the Mission period, although the presence of European domesticates suggested postcontact feature use; a date in the mid- to late 1700s is likely. The inferred AM date range for Feature 4 was A.D. 1850 to the present, postdating the Mission period. However, the feature's stratigraphic association suggested a date range the same as that of the other subfeatures in Feature 1. In all, the AM results largely corroborated a Mission period designation.

In addition to Feature 1, six features also were assigned to Episode 3, along with groups of levels in three CUs. The six features were assigned to this episode based on their stratigraphic position and the presence of time-sensitive artifacts. Burial Feature 27 included shell beads that ranged in date from A.D. 1150 to 1834, but most indicated a Protohistoric/Mission period association. Several Mission period and historical-period artifacts were recovered from burial Feature 33, including a ceramic-earthenware-plate fragment, glass bottles, metal jewelry, and nails.

Episode 4 was defined based on one feature presumed to date to the Euroamerican period: a horse inhumation recovered from redeposited fill. The Euroamerican period in the

Ballona encompassed the late A.D. 1800s and early A.D. 1900s, during which the Ballona witnessed a marked transition in occupation and land-use practices. During the early part of the period, the area was mainly used for ranching, but farming became more prevalent over time. The area also transitioned from a rural to an urban infrastructure, with the establishment of modern roads, rail lines, and industrial buildings.

Documentary and anecdotal evidence suggested Euroamerican period occupation and land use at LAN-211. Robinson (1939:108) quoted an elderly Cristobal Machado, who claimed to have observed "brush-and-mud huts" inhabited by Native American ranch hands along the bluff below LMU, which corresponds closely to the location of LAN-211 (Stoll et al. 2003:36; Vargas 2003:137–138). The huts presumably were occupied during the mid- to late 1800s, but Euroamerican development starting in the 1880s may have limited ranch-work opportunities by the late 1800s and early 1900s. The horse inhumation, though recovered in secondary context, presumably was interred in the area in connection with ranching, farming, or animal-husbandry activities, possibly in connection with the habitations. The precise date of the horse interment is unknown, however.

Episode 5 refers to the operational span of the HHIC. LAN-211 was situated near the core of the HHIC; a number of buildings and parking areas were constructed within the present-day site area. Those construction episodes involved severe landscape modifications, including flattening of the previously undulating landscape along the bluff. In the course of those modifications, Hughes Aircraft Company removed archaeological resources at LAN-211, resulting in a spotty mosaic of intact archaeological deposits. No features specifically related to the HHIC were recorded at LAN-211, but the effects of the complex were evidenced in the vast subsurface disturbance of the area.

Midden-Constituent Analyses

Five CUs were selected for detailed analysis: CUs 119, 120, 274, 353, and 359 (see Figure 216). Those particular CUs were selected to provide insights into midden materials in various areas of the site and to help gain an understanding of the large Protohistoric/Mission period activity area (Feature 1).

The CUs were excavated in 10-cm arbitrary levels, which were subsequently assigned to specific occupation episodes (Table 61). The changes in artifact and ecofact densities by level and episode are discussed below, with particular emphases on spatial and temporal trends and low- and high-intensity midden deposition. Intrasite spatial trends in land-use intensity (as measured by the density of discarded debris) during the different occupation episodes are also indicated.

The number of levels assigned to each episode varied among the five CUs. Levels assigned to Episode 3 were detected in CUs 119, 120, and 353, in the central and western portions of the site, but not in CUs 274 and 359, in the eastern area of the site, probably because of the truncation of the shallower subsurface strata during construction and earthmoving activities by Hughes Aircraft Company in the mid- to late 1900s. The deeper-lying Intermediate period deposits assigned to Episodes 1 and 2 were not truncated by the earthmoving activities. Consequently, Episodes 1 and 2 were recorded in all CUs across the site. Cultural deposits below the Episode 1, 2, and 3 materials could not be investigated, because of contaminates in the soil. It is possible that those deposits may have contained a continuation of Episode 1 and 2 materials or possibly earlier cultural constituents, such as the Millingstone period deposits found at other sites in the Ballona. Those deposits were left mostly untouched by grading activities.

Presumably, the Protohistoric/Mission period middens could have been present in all or most of the site area prior to the removal of the top deposits during the Hughes era. Surface truncation during the Hughes era did not extend as deeply in the central portion of the site, which explains the presence of intact middens dating to Episode 3 in that area.

Site-Wide Temporal Trends

Table 61 presents the density of lithic artifacts, vertebrate-faunal remains, and invertebrate-faunal remains by episode in each CU (see Appendix 10.7, this volume, for data by level).

Figure 234 illustrates change over time in occupational intensity at LAN-211, based on the average midden densities across the CUs for each episode. For this analysis, the presumption was that denser midden deposits indicated more-intensive occupation (i.e., more-frequent discard of domestic debris per unit of time). The graph clearly shows that peak occupation occurred during Episode 3, the Protohistoric/Mission period. To be sure, the density of the Episode 3 midden materials was underestimated, because much of the upper levels of the midden had been removed or truncated over much of the site, as a result of mechanical disturbance, as explained above. In addition, many levels were assigned to a mixed Episode 2/3 because of bioturbation. Most of the materials in these levels, however, probably dated to Episode 3.

Overall, the data suggests a general pattern of increase in occupational intensity over time. The artifact/ecofact density for Episode 2 was much higher than Episode 1 (again, mixed levels masked the full extent of this increase), suggesting an increase in occupational intensity from the early to late Intermediate period. It is worth noting, however, that the chronometric analysis suggested a likely settlement hiatus from the late first millennium through the early second millennium A.D. (see Chapter 3, this volume). Occupation frequency and intensity probably increased through the Intermediate period until about A.D. 700 or 800, at which time the site went into a period of abandonment (or very low-level use). The site

Table 61. Artifact/Ecofact Density per Occupation Episode in Five CUs, LAN-211

Level Nos., by CU No. (1 by 1 m)	Natural Stratum	Episode No.	Volume (m^3)	Lithic Artifacts: Flaked Stone Count (n)	Lithic Artifacts: Flaked Stone Density (n/m^3)	Lithic Artifacts: Ground Stone Count (n)	Lithic Artifacts: Ground Stone Density (n/m^3)	Vertebrate Fauna: NISP	Vertebrate Fauna: Density ($NISP/m^3$)	Invertebrate Fauna: Weight (g)	Invertebrate Fauna: Density (g/m^3)
CU 119											
58–59	A2 (IV)	3	0.18	136	755.6	—	—	1,904	10,577.8	183.8	1,021.1
60–61	Bk (III)	2	0.20	30	150.0	—	—	490	2,450.0	64.6	323.0
62	Bk (III)	1	0.10	30	300.0	—	—	nd	nd	64.2	642.0
63–66	2Ab (II)	1	0.40	94	235.0	—	—	414	1,035.0	75.0	187.5
Subtotal			0.88	290	329.5	—	—	2,808	3,600.0	387.6	440.5
CU 120											
61–63	A1 (V)	3B	0.30	700	2,333.3	3	10.0	12,533	41,776.7	622.6	2,075.3
64–67	A2 (IV)/2Ab (III)	2/3	0.40	201	502.5	2	5.0	5,228	13,070.0	206.8	517.0
68–69	2Cgk (III)	2	0.20	13	65.0	—	—	138	690.0	41.8	209.0
70	2Cgk (III)	1/2	0.10	11	110.0	—	—	127	1,270.0	33.1	331.0
71	2Cgk (III)	1	0.10	6	60.0	—	—	46	460.0	33.1	331.0
72–76	3Ab (II)	1	0.50	29	58.0	—	—	1,169	2,338.0	34.3	68.6
Subtotal			1.60	960	600.0	5	3.1	19,241	12,025.6	971.7	607.3
CU 274											
59–60	Bk (III)	2	0.20	94	464.2	—	—	843	4,163.0	699.6	3,454.8
61–62	Bk (III)	1/2	0.21	75	365.9	—	—	1,459	7,117.1	222.1	1,083.4
63–70	Ab (II)	1/2	0.81	397	492.4	—	—	4,513	5,597.5	4.0	5.0
Subtotal			1.21	566	466.3	—	—	6,815	5,614.8	925.7	762.7
CU 353											
63–65	A1 (V)	3	0.30	19	63.3	—	—	158	526.7	21.6	72.0
66–68	A2 (IV)	3	0.30	8	26.7	—	—	93	310.0	6.8	22.7
69	2Ab (III)	2	0.10	4	40.0	—	—	104	1,040.0	0.8	8.0
Subtotal			0.70	31	44.3	—	—	355	507.1	29.2	41.7
CU 359											
56–61	Bk (III)	2	0.61	273	449.4	1	1.6	4,637	7,632.9	2,527.6	4,160.7
62–72	Ab (II)	1	1.10	428	389.1	—	—	7,511	6,828.2	2.9	2.6
Subtotal			1.71	701	409.9	1	0.6	12,148	7,104.1	2,530.5	1,479.8

Key: nd = no data; NISP = number of individual specimens.

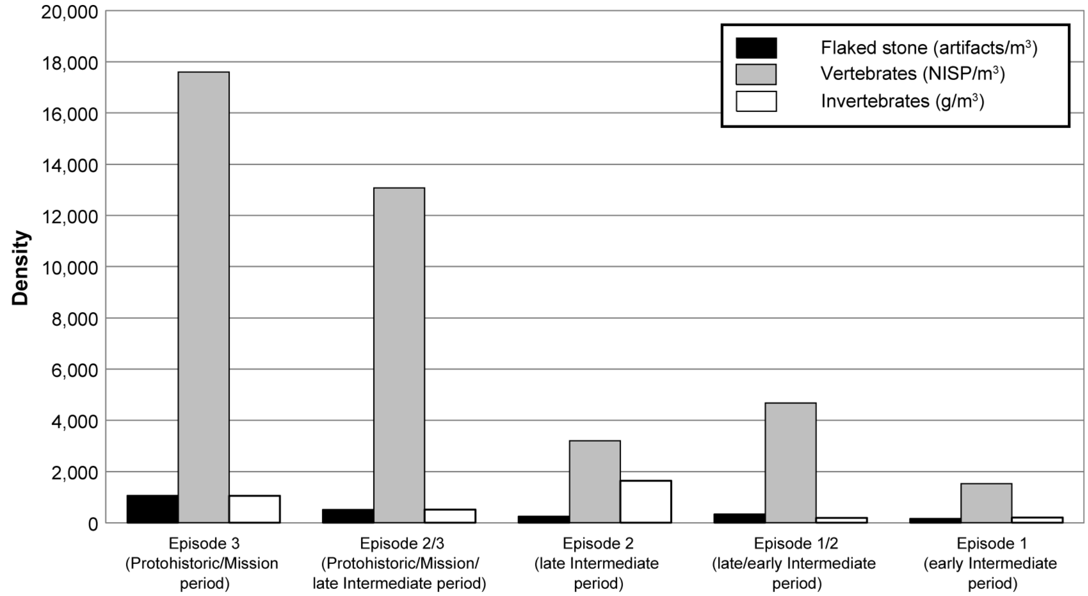

Figure 234. Artifact/ecofact density per episode averaged by CUs, LAN-211.

was subsequently reoccupied during the Protohistoric and Mission periods, during which time occupational intensity peaked, especially during the Mission period.

Table 62 lists the per-episode density for each material class. Vertebrate fauna composed the bulk of the materials throughout the entire sequence of occupation. Shell was the most variable, with a low density for Episode 1 deposits but much higher density for Episode 3 and especially in Episode 2 deposits. This pattern was most prominent for the Episode 2 deposits in the eastern portion of the site. By contrast, flaked stone density was particularly high during Episode 3, more than double that of the mixed Episode 2/3 deposits, which had the second highest density.

Intrasite Spatial Trends

Figure 235 illustrates the variability in artifact/ecofact densities among CUs in different areas of the site. The very high density in CU 120 was attributable to its location within the Feature 1 activity area. The activity area was a locus for cooking and food preparation during the Protohistoric/Mission period, which generated dense debris deposits. The four CUs outside Feature 1 contained considerably less-dense midden materials. The lowest density of midden materials was recovered from CU 353, in the western portion of the site, suggesting less-intense land use and deposition in that area of the site. The low-density midden in the western area was consistent with the recovery of similarly low-density cultural material in the nearby eastern portion of LAN-62 Locus D.

The principle source of variability concerned the density of shell in the midden deposit. Of the three artifact/ecofact classes, flaked stone tended to exhibit the lowest density in all units, although in several of the units (CUs 119, 120, and 353), flaked stone density was only slightly exceeded by the density of invertebrate fauna. Faunal bone was the most prominent material class in each of the five CUs, often exceeding the density of the other materials by a factor of over 10 to 1. By contrast, shell was most variable in distribution. Although shell density never approached that of vertebrate fauna in any of the CUs, shell density in CU 274 exceeded flaked stone density by a factor of 1.6 to 1, and the ratio of vertebrate to invertebrate density dropped to a little over 7 to 1. In CU 359, where invertebrate density was highest, it exceeded flaked stone density by a factor of 3.6 to 1, and the ratio of vertebrate to invertebrate density dropped to an even lower 4.8 to 1. These results suggested that denser shell deposits were present in the eastern portion of the site, where CUs 274 and 359 were located, than in the central or western portion of the site.

Figures 236–240 show the per-episode distributions of artifact/ecofact densities in each CU. For Episodes 1 and 2, the densest midden deposits were recovered in the eastern area of the site, and densities generally increased from west to east (see Figures 236–238). Virtually all of the midden materials assigned to Episode 3 were recovered from CUs 119 and 120, in the central portion of the site (see Figure 240), likely because of mechanical truncation of the subsurface materials. It is unlikely that the Episode 3 deposits were so spatially concentrated prior to the Hughes era.

Table 62. Artifact/Ecofact Density per Occupation Episode, LAN-211

Episode No.	Cultural Period	Volume (m^3)	Flaked Stone		Vertebrate Fauna		Invertebrate Fauna	
			Count (n)	Average Density (n/m^3)	NISP	Average Density (NISP/m^3)	Weight (g)	Average Density (g/m^3)
3	Protohistoric/Mission	1.08	863	1,044.6	14,688	17,590.9	834.8	1,047.9
2/3	Protohistoric/Mission/ late Intermediate	0.40	201	502.5	5,288	13,070.0	206.8	517.0
2	late Intermediate	1.31	414	233.7	6,212	3,195.2	3,334.4	1,631.1
1/2	late/early Intermediate	2.21	911	321.9	13,610	4,667.9	262.1	185.7
1	early Intermediate	1.10	159	153.2	1,629	1,530.0	206.6	195.4
Total/average		6.10	2,548	451.2	41,367	8,010.8	4,844.7	715.4

Key: NISP = number of individual specimens.

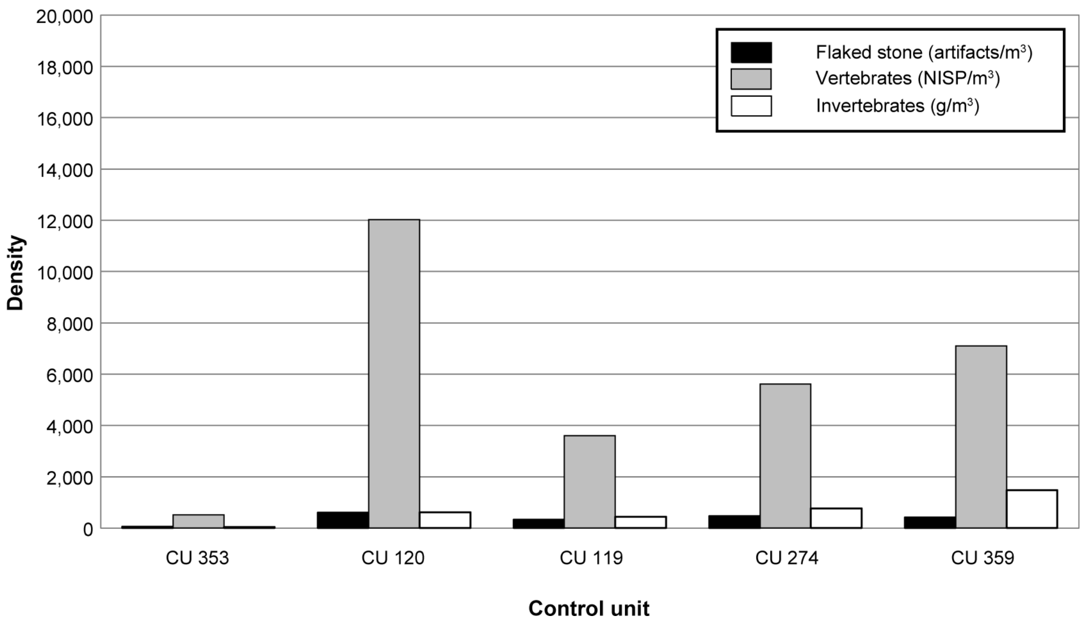

Figure 235. Artifact/ecofact density per CU (all episodes), LAN-211, arranged from west (left) to east (right).

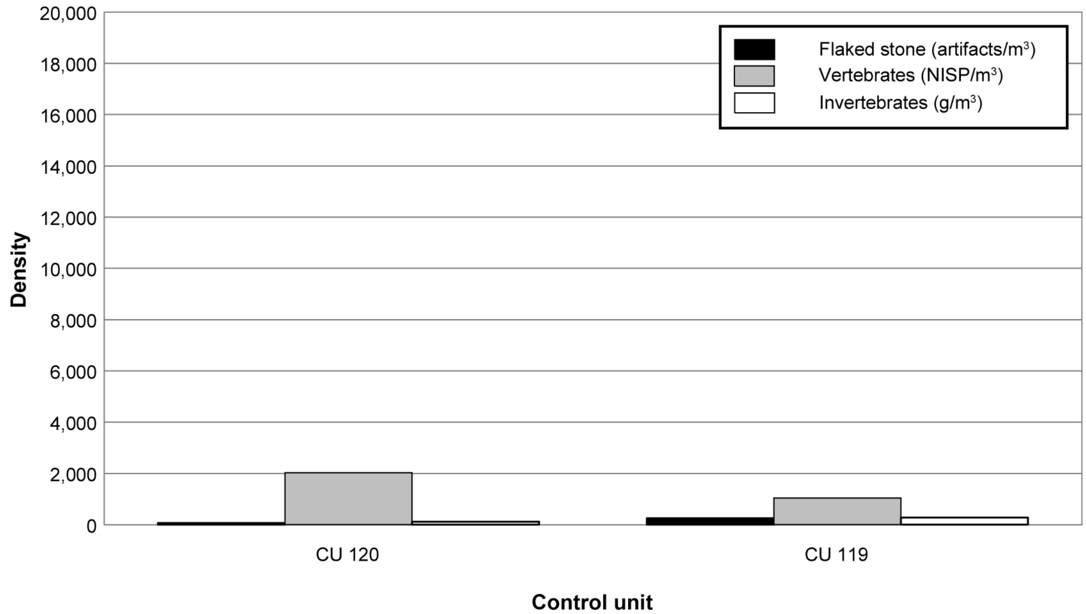

Figure 236. Artifact/ecofact density per CU, Episode 1 (early Intermediate period), LAN-211, arranged from west (left) to east (right).

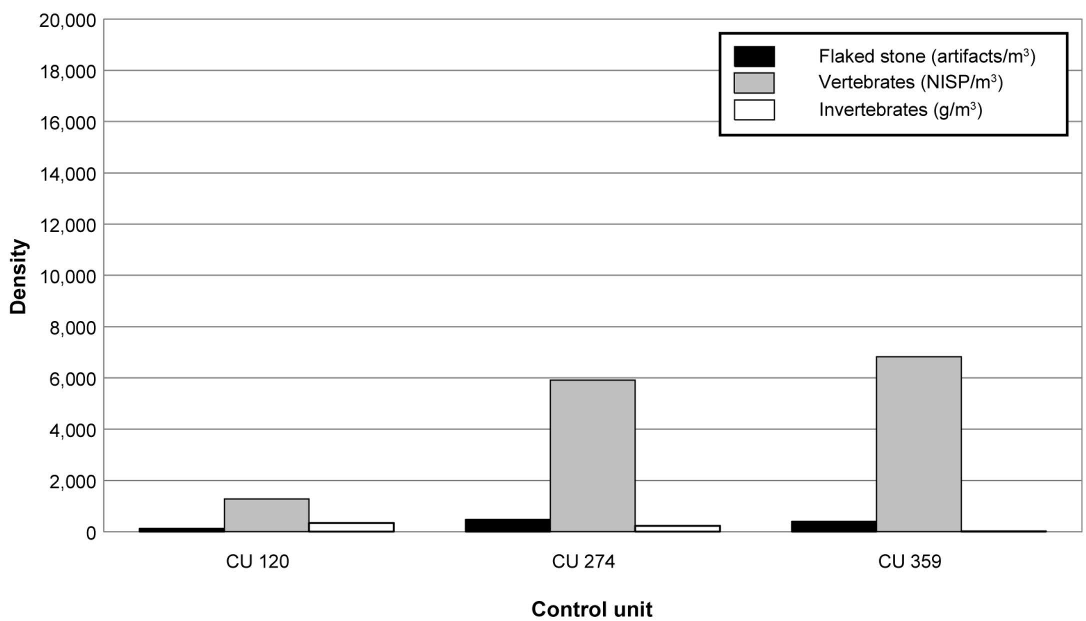

Figure 237. Artifact/ecofact density per CU, Episode 1/2 (late/early Intermediate period), LAN-211, arranged from west (left) to east (right).

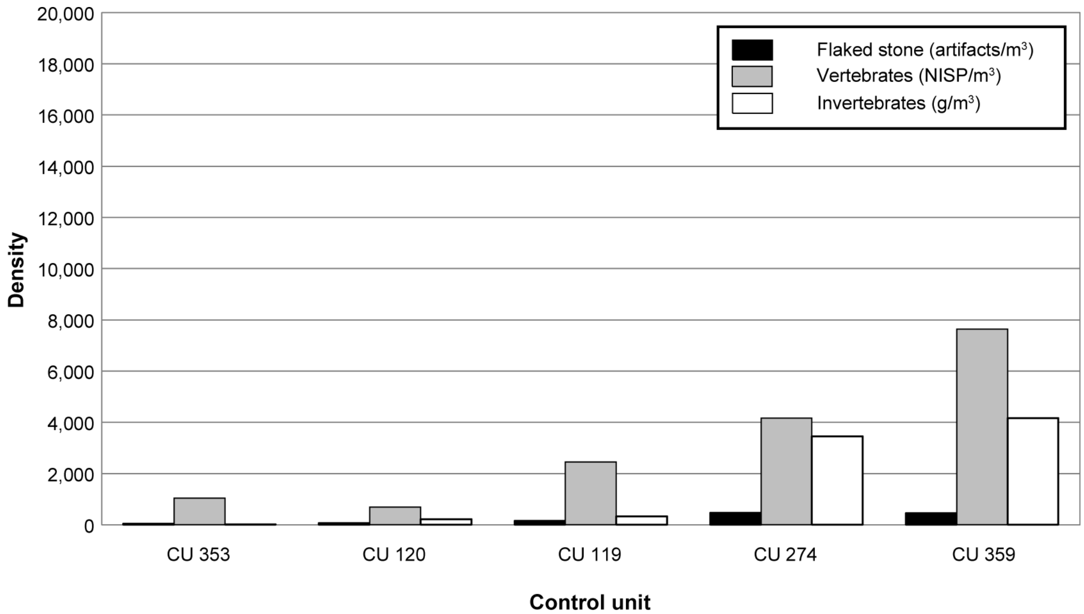

Figure 238. Artifact/ecofact density per CU, Episode 2 (late Intermediate period), LAN-211, arranged from west (left) to east (right).

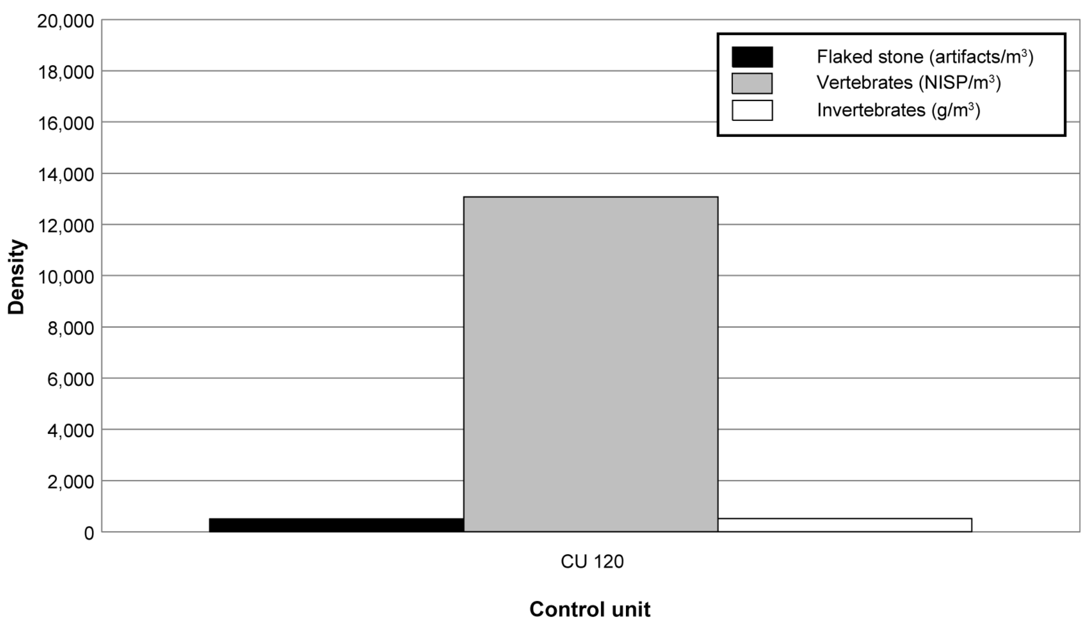

Figure 239. Artifact/ecofact density per CU, Episode 2/3 (Protohistoric/ Mission/late Intermediate period), LAN-211, arranged from west (left) to east (right).

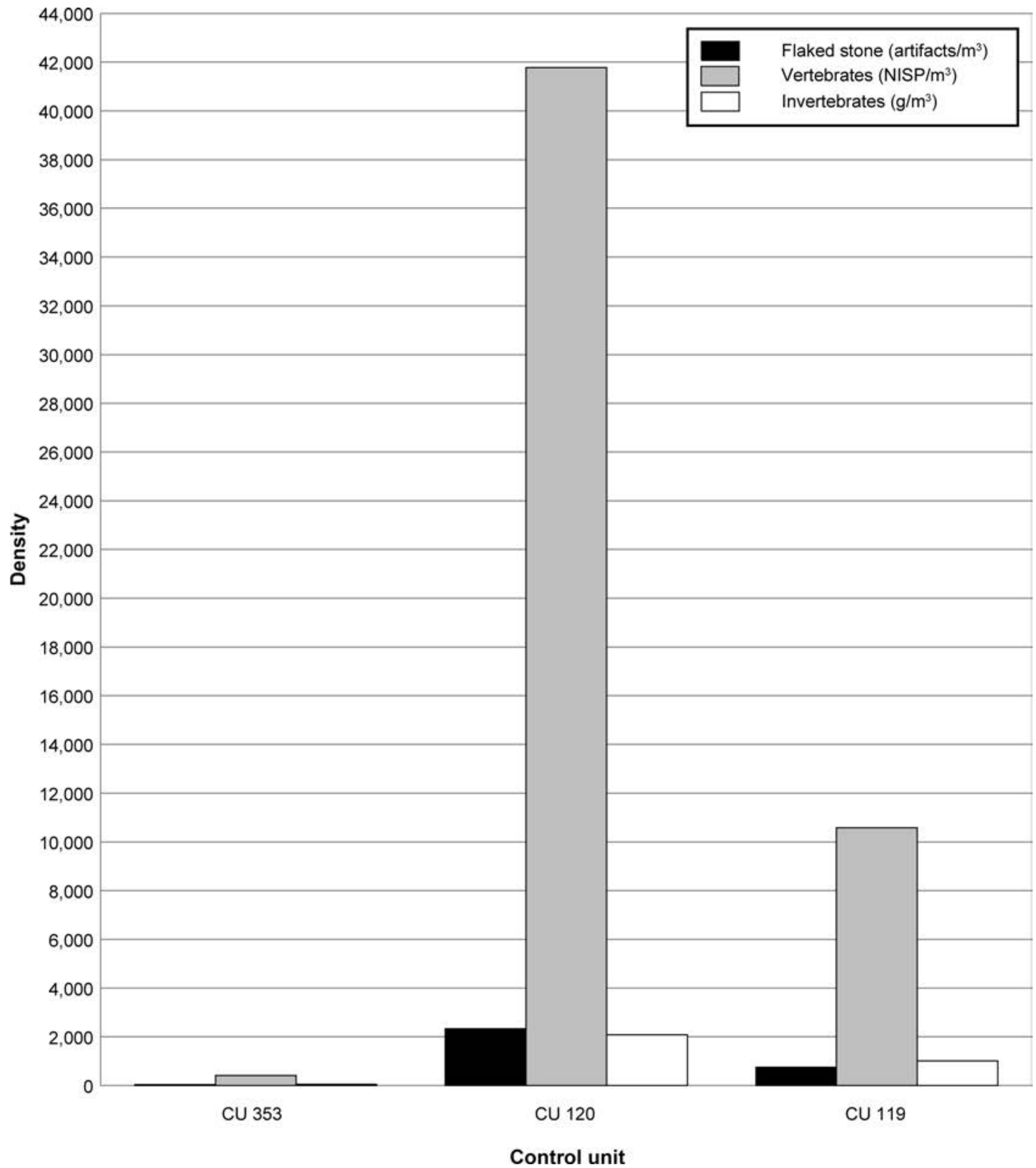

Figure 240. Artifact/ecofact density per CU, Episode 3 (Protohistoric/Mission period), LAN-211, arranged from west (left) to east (right).

Vertebrate fauna dominated the midden collections in all units and during all episodes, and flaked stone artifacts were consistently sparse. The density of invertebrate fauna, however, was highest in eastern CUs 274 and 359 during Episode 2, almost equaling the density of vertebrate fauna. The late Intermediate period inhabitants concentrated their shell-processing activities in the eastern areas of the site. That was not the case for the levels assigned to Episode 1. Invertebrates were sparse in levels assigned to Episode 1 in CUs 274 and 359. In fact, shell was sparse or absent from all CU levels assigned to Episode 1. It appears that, generally, the early Intermediate period inhabitants infrequently processed or prepared shellfish at this site. The same was largely the case for Episode 3, except in CU 120 and to a lesser degree in CU 119, where relatively high densities of both invertebrate fauna and flaked stone were present.

Detecting Subepisode Surfaces

The artifact/ecofact densities were considered on a per-level basis, to detect possible living surfaces or subepisodes within the groups of levels assigned to each episode. This was especially pertinent for episodes that encompassed large numbers of excavation levels; in some cases, a meter or more of subsurface cultural materials were assigned to one episode. This issue was addressed by examining patterns of variation in artifact/ecofact densities among the groups of levels assigned to a single episode; generally, we sought to detect two or more well-defined density peaks within the levels assigned to an episode. Of course, variation among levels was always evident, and it was not always clear what "degree" of variation among adjacent levels was sufficient to distinguish a living surface. Translocation from bioturbation further complicated those efforts. For that reason, the most effective strategy was to detect trends in the density data (i.e., patterns of consistent increases and declines that encompassed several contiguous levels). Ideally, the trends would have been marked by increases in density over several peaks, leading to a peak density in one or two levels, followed by a steady decline. A peak that encompassed a single level was considered tenuous.

Figures 241–245 illustrate changes in the artifact/ecofact densities over time in each CU. The variation by level and episode showed variability in artifact densities among the levels assigned to each episode, which indicated possible living surfaces. CU 359 exhibited the most peaks and declines. None of the peaks was particularly well defined, however; that is, the differences between the lowest and higher densities were relatively small. Generally, in the other CUs, no more than one monotonic trend was evident within the groups of levels assigned to a single episode. The peaks and trends largely correlated to a single episode. For example, in CUs 119, 120, and 274, clear-cut density peaks were associated with the levels assigned to Episode 3. Perhaps the most striking peak is that associated with Episode 3B in CU 120, although this peak is only represented by vertebrate fauna. Between Levels 62 and 64, however, the discard of vertebrate fauna exceeds all other cultural materials and during other time periods by a factor that exceeds 40 to 1. At its highest in Level 63, vertebrate fauna reach densities of almost 80,000 NISP/m^3. This is virtually unprecedented in the archaeological record of the Ballona and probably represents a unique event or set of events, perhaps relating to feasting, a subject that is explored in Volume 5, this series. CUs 120, 274, and 359 also reveal a small but definite decline in artifact/ecofact densities in the upper levels assigned to Episode 2, before the Episode 3 maximum.

In sum, the midden evidence revealed no clear evidence of subepisodes or multiple activity surfaces within the episodes. Compared to other sites in the Ballona, LAN-211 appeared to have had a relatively simple settlement history with a substantial occupation peak during the Protohistoric/Mission period and, at best, long episodes of modest occupation intensity during earlier periods. The Intermediate period occupations probably reflect a palimpsest of short-term occupations associated with a large number of brief resource-acquisition events or trips. Artifact/ecofact densities also reinforce the chronostratigraphic analysis suggesting a hiatus in occupation between the end of Episode 2 and the beginning of Episode 3.

Summary and Conclusion of Midden-Constituent Analysis

The midden-constituent analysis revealed several important spatial and temporal trends in the occupation history of LAN-211. The occupation intensity clearly peaked in Episode 3, the Protohistoric/Mission period. The levels assigned to that episode were considerably denser than the levels assigned to the earlier Episodes 1 and 2, despite the likely mechanical removal of some of the Episode 3 subsurface deposits during the Hughes era. The intact midden materials assigned to Episode 3 were concentrated in the central area of the site (Excavation Block A). For Episodes 1 and 2, densities were generally higher in the eastern areas of the site, which appeared to have been heavily used for processing shellfish during Episode 2 (late Intermediate period). An east–west gradient in artifact/ecofact density was evident among the levels assigned to Episodes 1 and 2, and there were higher peaks in the eastern CUs and lower peaks in the western CUs. An occupational hiatus is evident between the end of Episode 2 and beginning of Episode 3, a time that corresponds with the end of the Intermediate period and beginning of the Late period.

The western portion of LAN-211 and the eastern portion of LAN-62 formed a more or less continuous line of low-density midden deposits along the base of the bluff and between the more-substantial Protohistoric/Mission period

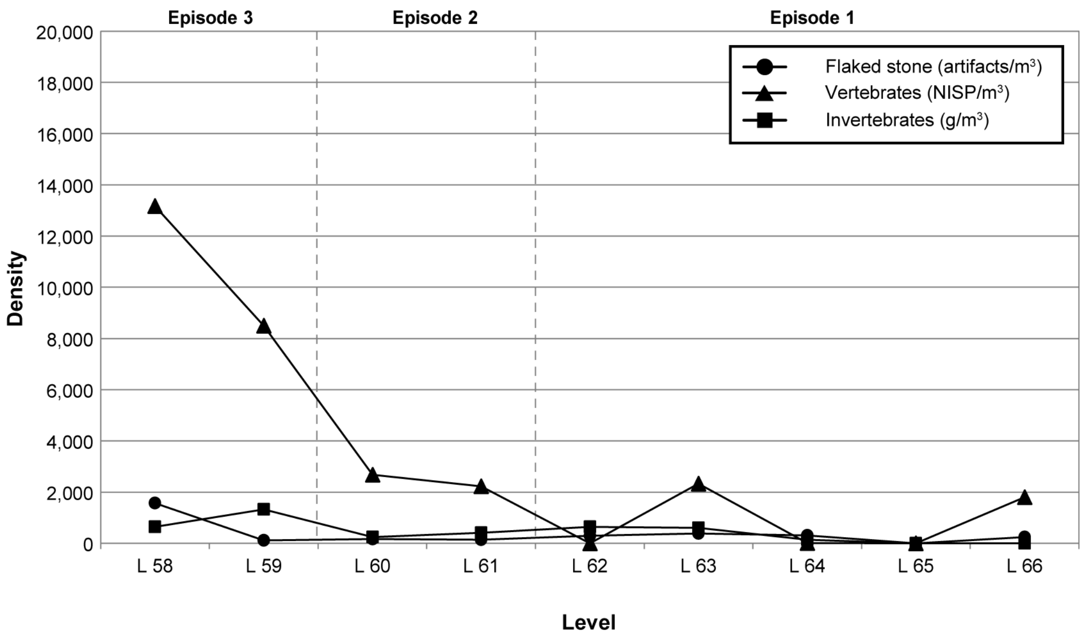

Figure 241. Artifact/ecofact density per level and episode, CU 119, LAN-211.

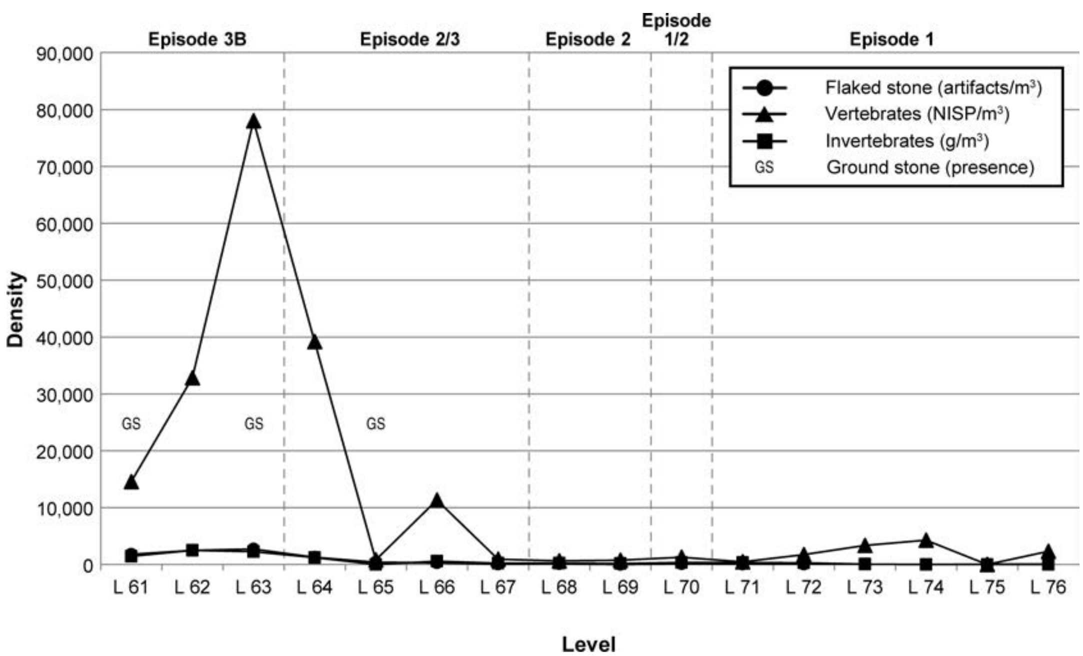

Figure 242. Artifact/ecofact density per level and episode, CU 120, LAN-211. *Note*: The scale for density is larger than that of Figures 234 and 236–238 because of the much higher density values.

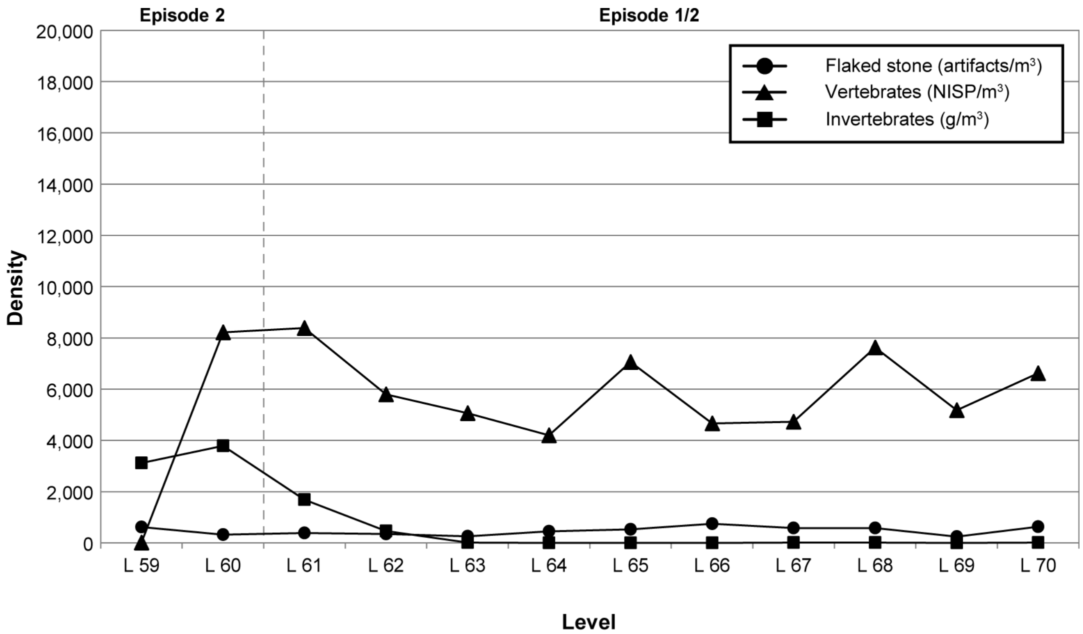

Figure 243. Artifact/ecofact density per level and episode, CU 274, LAN-211.

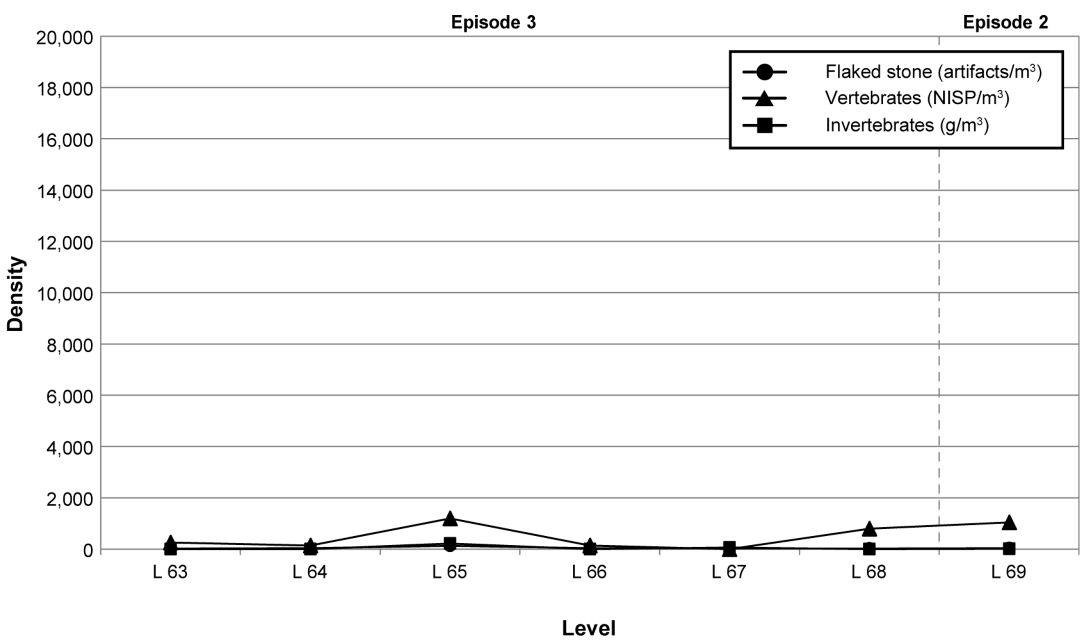

Figure 244. Artifact/ecofact density per level and episode, CU 353, LAN-211.

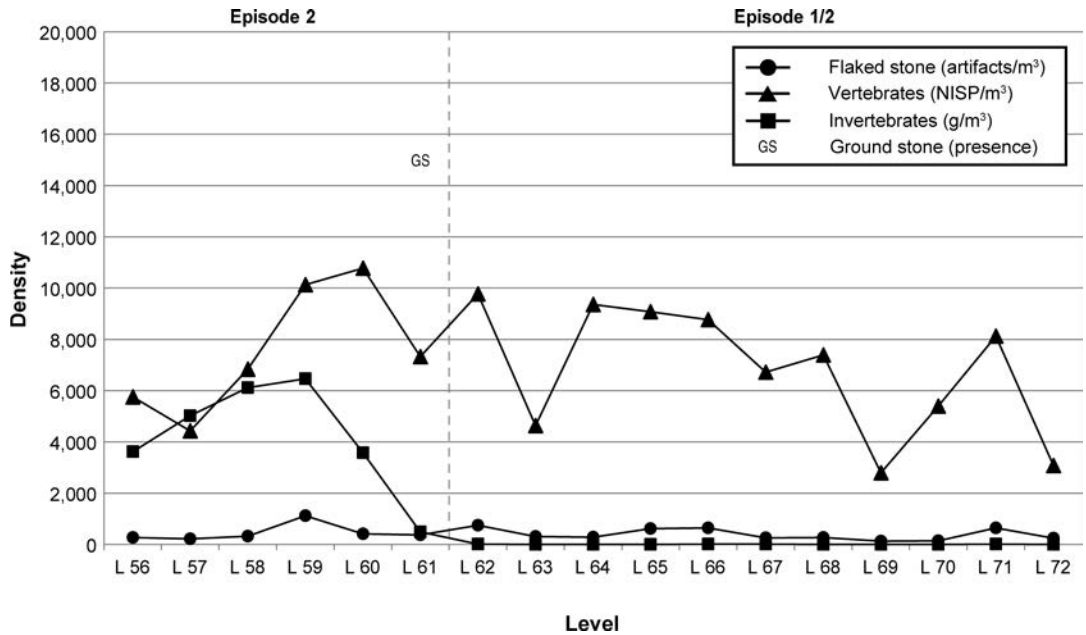

Figure 245. Artifact/ecofact density per level and episode, CU 353, LAN-211.

activity areas in Feature 1 at LAN-211 and in Locus A at LAN-62. Prior to the Protohistoric/Mission period, the entire area along the bluff likely contained a palimpsest of features and midden materials from short-term occupations related to resource-acquisition expeditions and camps, although some locations appeared to have been more frequently or intensively used. In the Protohistoric/Mission period, substantial activity areas were concentrated in Feature 1 at LAN-211 and Locus A at LAN-62, with scattered activity loci and midden deposits between. This hypothesis was difficult to test, however, because of the large-scale removal of subsurface deposits from many areas of the former HHIC and the fact that only a portion of the entire site was investigated.

Feature Analysis

The list of 46 features excavated at LAN-211 is presented in Appendix 10.8, this volume, and includes their classifications and final interpretations (feature-description forms are presented in Appendix 5.1, this volume). The episode and period assignments and the calibrated sigma ranges for the radiocarbon dates obtained from selected features at LAN-211 (the listed date ranges encompassed both the standard and age-specific ΔR values) are presented in Table 58.

The majority of features were located within a dense cluster of primarily hearths and domestic-discard areas in Excavation Block A. That large activity area was labeled Feature 1 and appeared to have been a locus for food preparation during some span of time within the Protohistoric and Mission periods (ca. A.D. 1540–1830). Feature 1 and most of the other site features were uncovered in the central and east-central portions of LAN-211, along a strip located roughly 20–40 m from the edge of the bluff. That strip had not been as deeply truncated during construction activities by Hughes Aircraft Company as had areas located directly to the north and south. No features were identified in the easternmost portion of the site, and virtually no features were uncovered in the western half of the site, which was consistent with the low feature volume in the easternmost portion of neighboring LAN-62 Locus D.

Feature Classification

The feature typology outlined in Chapter 5, this volume, was used to classify the 46 features excavated at LAN-211. As explained in Chapter 5, the typology involved several levels of classification. At a broad level, features were classified as burial/ritual features, domestic features, or late-historical-period/modern features (post-1850). In the case of LAN-211, most features (41 of 46) were classified as domestic features (or composite features with domestic components). The majority of domestic features were assigned to the Protohistoric and Mission periods, and a smaller number were assigned to the earlier Intermediate period. Also identified were three burial/ritual features, all human inhumations, and two late-historical-period/modern features.

Features also were classified as either thermal or nonthermal, based on evidence of in situ thermal activity (oxidized soil) or the prevalence of thermally altered materials (e.g., FAR and burned faunal bone) in a feature. For example, a feature composed predominantly of FAR was classified as a thermal feature, even in the absence of evidence of in situ thermal activity. However, many features included mostly unburned, discarded materials, such as flaked stone and shell, and smaller amounts of FAR and burned bone, and such features were classified as nonthermal, based on the prevalence of the nonthermally altered materials. In the case of LAN-211, most features were classified as thermal (27 features, or 59 percent); nonthermal features accounted for about 39 percent (18 features). Feature 1, the large activity area with 23 subfeatures, was classified as mixed, because it contained a large number of both thermal and nonthermal deposits. The burial/ritual and historical-period/modern features were classified as nonthermal. Two-thirds of domestic features (27 of 41, or 66 percent) were classified as thermal, and the rest were classified as nonthermal (13 features, or 32 percent) or mixed (1 feature, or 2 percent).

At a more detailed level, features were classified according to the more-specific formal categories listed in Chapter 5, this volume, based on morphology and content. As shown in Table 63, most of the features excavated at LAN-211 were domestic pit features with evidence of in situ thermal alteration; oxidized pits with and without FAR constituted about half of all features (22 of 46, or 48 percent) and 54 percent of the domestic features. All oxidized pits were interpreted as hearths, but some included nonthermal materials and therefore probably had become receptacles for nonthermal domestic trash by the time of abandonment. Also common among the features were general/multiple artifact concentrations or scatters (with or without visible pit outlines). Those features included a variety of discarded domestic debris related to subsistence activities (food preparation and eating) and, in most cases, a mix of thermal and nonthermal remnants, including FAR. Ten features were classified as general/multiple artifact concentrations or scatters.

Less frequent were FAR concentrations (4 features), which accounted for 9 percent of all features and 10 percent of domestic features. Those features typically were interpreted as debris deposits from cleaned-out hearths. No pit was visible in three of the four cases, suggesting surface deposits. In one case (Feature 13), a visible pit outline was exhibited, but no oxidized soil, and it is possible that Feature 13 had functioned as a hearth from which the remnants of oxidized soil were removed during a cleanout episode; another possibility is that FAR from a hearth-cleanout episode had been discarded in a nonthermal pit.

Two features were classified as lithic/ground stone concentrations: Features 24 and 25 included ground stone and

Table 63. Summary of Feature Classifications at LAN-211

Feature Morphology/Composition	Count	Percentage of Total
Domestic features		
Oxidized pit	14	30.4
Oxidized pit, no FAR	8	17.4
General/multiple artifact concentration, no pit, with FAR	4	8.7
General/multiple artifact concentration in visible pit	3	6.5
General/multiple artifact concentration, no pit	1	2.2
General/multiple artifact scatter	1	2.2
General/multiple artifact scatter, with FAR	1	2.2
FAR concentration, no pit	3	6.5
FAR concentration in pit	1	2.2
Lithic/ground stone concentration, no pit	2	4.3
Activity area for domestic activities (mixed)	1	2.2
Activity area for nonthermal domestic activities	1	2.2
Activity area for thermal domestic activities	1	2.2
Subtotal, domestic features	41	89.1
Burial/ritual features		
Primary inhumation	3	6.5
Late-historical-period/modern features		
Historical-period structure	1	2.2
Animal inhumation (late historical period)	1	2.2
Total	46	100.0

flaked stone and may have functioned as discard areas for a limited set of domestic activities or as cairns or post supports. Three features were interpreted as domestic-activity areas that encompassed multiple subfeatures or discrete deposits and included a mix of thermal deposits (Feature 52), a mix of nonthermal deposits (Feature 40), and a mix of thermal and nonthermal deposits (Feature 1). Feature 52 encompassed an oxidized pit and an adjacent discard area with FAR—probably a cleanout deposit related to the hearth; a concentration of asphaltum also was recovered from this feature (Figure 246). Feature 40 included several closely spaced discard areas (including Subfeature 46) with mixed thermal and nonthermal contents.

The three burial/ritual features (Features 27, 33 and 49) were classified as primary inhumations, and all of them had been highly disturbed from bioturbation or cultural processes. Burial Features 33 and 49 had one adult each (one male and one female, respectively), and burial Feature 27 was an inhumation of a fetus or infant. The fetus burial (Feature 27) was situated within the Feature 1 activity area, and the adult burials were recovered outside Feature 1. Burial Features 27 and 33 were dated to the Mission/historical period, but a temporal association could not be determined for burial Feature 49. It should be noted that previous descriptions of burials in other documents have preliminarily described LAN-211 burials as dating to specific time periods. The dating of the burials presented in this volume are the most up-to-date assessments.

The two late-historical-period/modern features were a group of structural remnants from an abandoned cistern (mostly unexcavated, to avoid exposure to chemical contamination) and a horse inhumation, which appeared to have been reburied from another location. The horse remains were recovered from redeposited fill and likely had been carried to their recovery location during earthmoving activities by Hughes Aircraft Company. These late-historical-period/modern features probably date to the early or mid-twentieth century.

Table 64 summarizes our interpretations of features at LAN-211. Hearths and possible hearths constituted half of all features (23 of 46). Small hearths (less than 70 cm in diameter) and large hearths (more than 70 cm in diameter) were distinguished based on Douglass et al.'s (2005) study of hearths at the bluff-top sites of LAN-63 and LAN-64. By those criteria, large hearths (n = 12) slightly outnumbered small hearths (n = 10) at LAN-211, which could suggest a focus on the preparation of large meals, possibly for multiple families. Also frequent were domestic-discard areas, which probably included debris generated from multiple domestic activities. Many of those features included FAR, flaked stone debitage, faunal bone, and unworked shell, which minimally suggest debris from eating, cooking, nonthermal food preparation (e.g., deboning), and stone-tool production or curation. The various types of domestic-debris deposits accounted for 13 features and 28 percent of all features. The 3 features interpreted as activity areas included various thermal- and nonthermal-discard areas and hearths and also generally related to cooking and food-preparation activities.

Features 24 and 25, as described above, consisted of tight concentrations of unmodified cobbles or ground stone fragments, along with other debris (flaked stone and faunal bone). They have been interpreted as cairns or post supports. Both were situated within roughly 7 m of one another within Feature 1 and could have marked the locations of post supports for houses, windbreaks, or other structures. It may be notable, also, that both features were located in relatively open spaces, with few neighboring features, which supports the possibility that they functioned as post supports for structures.

Occupation Surfaces

The analyses of occupation surfaces focused on the range of features and features types pertaining to each occupation episode or period, in an effort to infer changes in site function and land use over time. Here, features are grouped by period (see Appendix 10.9, this volume), because Episodes 1 and 2 and Subepisodes 3A and 3B, though chronologically detailed, each encompassed an insufficient number of features to infer patterns of land use and activities for the occupation span. Episodes 1 and 2 were merged into a broader Intermediate period group, with the caveat that some of the features were not strictly contemporaneous, and some deposits may have been separated in time by up to 1,000 years.

In total, 39 features were assigned to periods; 7 others were defined as indeterminate. The features were assigned to the Intermediate period (6 features), Protohistoric period (5 features), Mission period (4 features), a more broadly defined Protohistoric through Mission period (22 features), and the late historical/modern period (2 features). Because of the difficulty in distinguishing between Protohistoric and Mission period features, as well as the smaller numbers of features assigned to those periods, we analyzed the 31 features assigned to the Protohistoric, Mission, and Protohistoric/Mission periods as a single group (equivalent to Episode 3).

A comparison of the number of features assigned to each feature period indicated a well-defined peak occupation during the Protohistoric/Mission period, which included more than three-quarters of the period-assigned features. That pattern supported the results of the midden-constituent analysis, which indicated very high artifact/ecofact densities in CU levels assigned to the Protohistoric/Mission period. Fewer features were assigned to the Intermediate period and the late historical/modern period. Here, we separately discuss the analyses of the functional implications and spatial arrangements of features assigned to each of those periods.

Intermediate Period

The six features assigned to the Intermediate period were six domestic features (Table 65). They were scattered along a roughly 50-m stretch in the middle portion of the site that ran parallel to the bluff edge from the eastern portion of

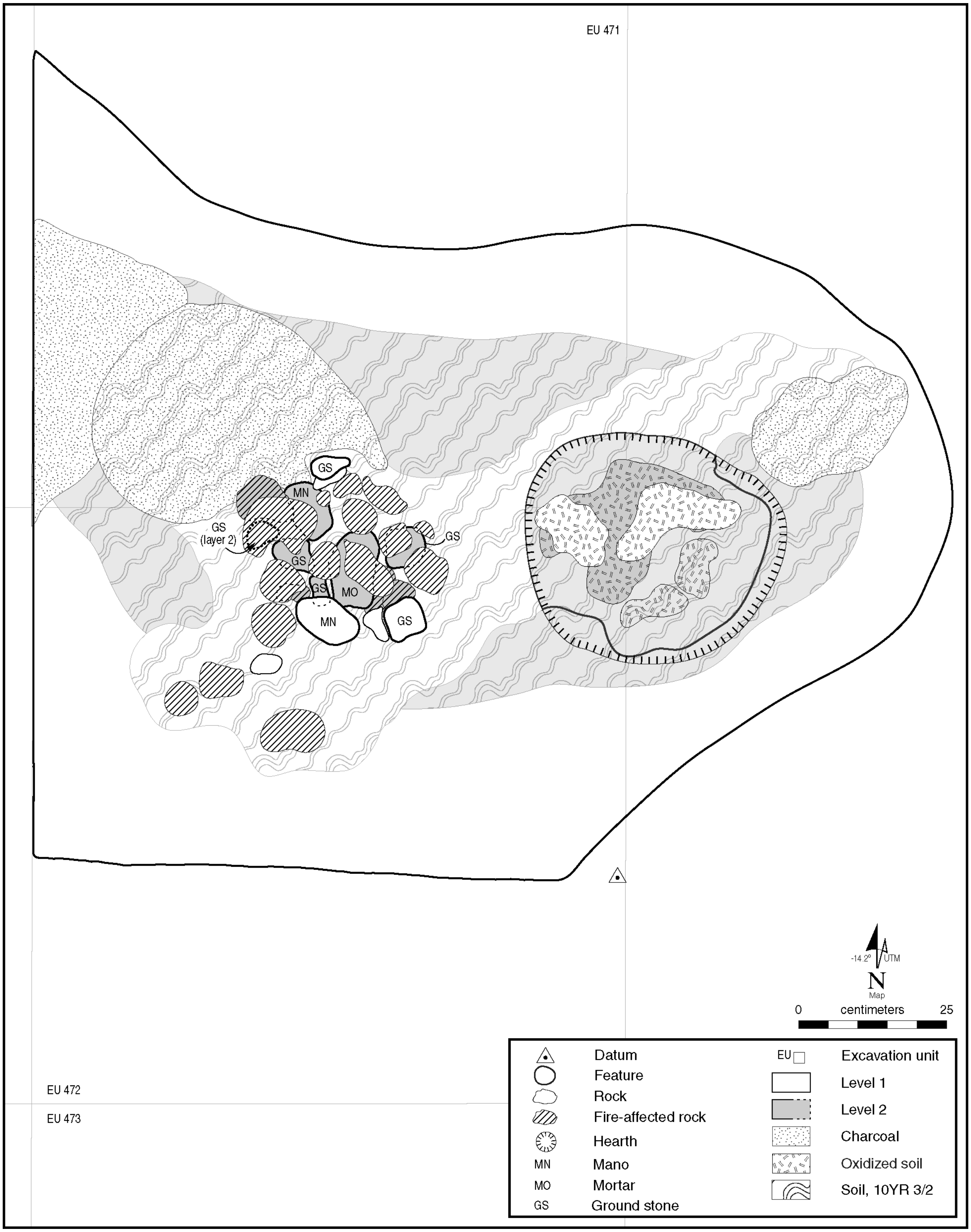

Figure 246. Plan-view drawing of Feature 52 (activity area), LAN-211.

Table 64. Summary of Feature Interpretations at LAN-211

Final Interpretation	Count	Percentage of Total
Domestic features		
Activity area	3	6.5
Small hearth	10	21.7
Large hearth	12	26.1
Small hearth or thermal-discard area	1	2.2
Domestic-discard area	10	21.7
Domestic trash or storage pit	3	6.5
Cairn	2	4.3
Burial/ritual features		
Human burial	3	6.5
Historical-period features		
Historical-period cistern	1	2.2
Animal burial	1	2.2
Total	46	100.0

Table 65. Features Dating to the Intermediate Period, LAN-211 (Episodes 1 and 2)

Feature No.	Field Designation	General Category	Thermal/ Nonthermal	Morphology/Composition	Final Feature Interpretation
11	pit	domestic	nonthermal	general/multiple artifact concentration, no pit	domestic trash or storage pit
15	rock cluster	domestic	nonthermal	general/multiple artifact concentration, no pit, with FAR	domestic-discard area
29	rock cluster	domestic	nonthermal	general/multiple artifact scatter, with FAR	domestic-discard area
30	rock cluster	domestic	nonthermal	general/multiple artifact concentration, no pit, with FAR	domestic-discard area
31	hearth	domestic	thermal	oxidized pit, no FAR	large hearth
39	rock cluster	domestic	nonthermal	general/multiple artifact concentration, no pit, with FAR	domestic-discard area

Excavation Block A through Excavation Block B (Figure 247). The distance between features ranged from 5 to 20 m. No activity areas were evident for this period.

Five of the six domestic features were classified as nonthermal, but all contained a mix of thermal and nonthermal debris, including FAR and abundant faunal bone, much of which had been burned. Unworked shell was conspicuously absent from most of these features, however, with the exception of Feature 15, which contained a small amount (45 g). Each of these features also contained a small to moderate amount of flaked stone debitage. These features appeared to have functioned as "generalized" discard areas and included debris related to various thermal and nonthermal activities. The mix of faunal bone, FAR, and flaked stone suggested debris related to, minimally, heating and cooking, food preparation, and stone-tool manufacture or curation. One worked-bone tool and three mineral fragments (concretions) were also recovered from Feature 29, suggesting possible debris generated from ritual activities.

Most of the five nonthermal domestic features appeared to have functioned as surface discard areas, and there were no visible pit outlines, except with Feature 11, which clearly was a pit. No oxidized soil was observed in Feature 11, but pockets of ash were observed within a matrix of mottled soil. It is possible that Feature 11 had functioned as a hearth but had been cleaned out and reused as a trash pit. That interpretation is questionable, however, because there were no signs of oxidization or other clear indications of in situ burning. If the feature had functioned as a storage pit, there were no concentrations of artifacts or other indications of uncooked foods; however, it is likely that these types of materials would not have preserved. The prevalence of burned bone suggested that the feature functioned as a trash pit or had functioned as a storage pit that was later used as a receptacle for refuse.

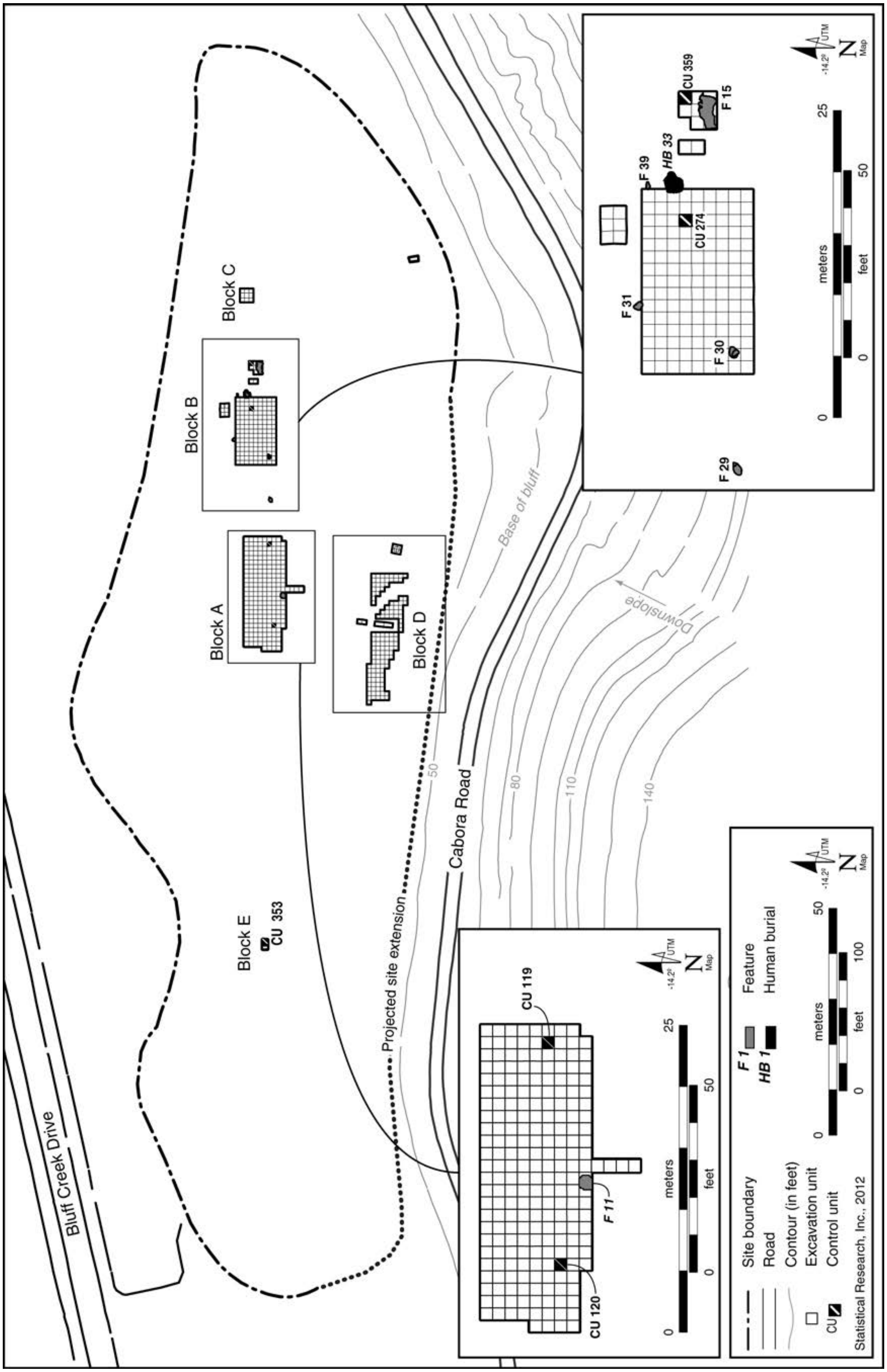

Figure 247. Map showing the locations of Intermediate period features at LAN-211.

Feature 31, an oxidized pit, was interpreted as a large hearth. However, FAR recovered from outside the oxidized area was relatively dispersed, suggesting possible cleaning and reuse of the hearth pit (Figure 248). Like the discard features, Feature 31 also contained abundant faunal bone, including many burned mammal bones and flaked stone debitage, suggesting that it was used as a trash pit after it had been used as a hearth. Notably, none of the discard areas was situated close to Feature 31—the nearest Intermediate period features were 8–9 m away. Thus, none of the discard features appeared to have been functionally connected to Feature 31; they probably represent debris generated during separate occupation events.

In all, given their spatial separation, the scattered Intermediate period features may represent a palimpsest of separate and unrelated depositional events related to resource-collection forays. The linear stretch of features may have marked a geographical boundary, such as a relict stream edge or berm, that would have provided an appealing setting for temporary camps during logistical trips. Moreover, based on the prevalence of faunal bones and the virtual absence of shell, trips to the area likely focused on hunting. The lagoon, streams, and riparian environment in the area certainly attracted animals.

Protohistoric/Mission Period

In total, 31 features were assigned to the Protohistoric, Mission, or composite Protohistoric/Mission period (Table 66; Figure 249). With the exception of burial Feature 33, they were mostly clustered in the central portion of the site in Excavation Block A, which exposed much of the Feature 1 activity surface (Figure 250). Feature 1 encompassed 23 subfeatures within an ovate area of about 35 by 17 m in maximum length and width. Six additional features were scattered in three small groups about 20–30 m to the south (2 features), east (3 features), and west (1 feature) of Feature 1. The subfeatures of Feature 1 were very likely part of the same occupation episode; that is, they likely were contemporaneous or, if not, were used successively within a short time over the span of the occupation. We were unable to infer the extent of chronological overlap between Feature 1 and the 6 outlying features.

All but 2 of the Protohistoric/Mission period features were classified as domestic: burial/ritual Feature 27 was excavated within Feature 1 and consisted of a primary inhumation of a fetus, and burial Feature 33, with an adult male, was located outside Feature 1. Among the 29 domestic features, the majority were classified as thermal deposits (24 features, or 83 percent); 4 were classified as nonthermal (14 percent), and Feature 1 was classified as mixed, because it included both thermal and nonthermal subfeatures. Of the 23 subfeatures of Feature 1, all but 3 (87 percent) were classified as thermal. Moreover, of the 20 thermal subfeatures, all but 1 were classified as oxidized pits and were interpreted as hearths; 1 additional deposit (Feature 52) was a composite feature that included a hearth and an adjacent concentration of FAR, a likely cleanout deposit. The oxidized pits varied in size and shape, but based on the size criteria discussed above, the area included roughly equal numbers of large hearths (10 features) and small hearths (9 features). The 3 nonthermal subfeatures of Feature 1 included 2 lithic/ground stone concentrations, possibly cairns or post supports, and the human burial.

The seven features located outside Feature 1 were four thermal features, two nonthermal features, and one burial (Feature 33). Unlike the subfeatures of Feature 1, however, only one was classified as an oxidized pit (Feature 45, west of Feature 1). Five others consisted of various domestic-discard areas. Features 53 and 56, both located south of Feature 1, were FAR concentrations that also included faunal bone, debitage, and ground stone fragments, suggesting domestic-discard areas generated from various subsistence-related tasks. Features 2, 40, and 46, located east of Feature 1, were also domestic-discard areas that included varying proportions of FAR and other subsistence-related materials. They also appeared to have been "generalized" discard areas, with the possible exception of Feature 46, which included FAR, cobbles, and faunal bones (mostly mammal bones, many of which had been burned), which could suggest remnants from a "single-event" hearth-cleanout episode. These features resembled many other features and activity areas excavated throughout the PVAHP that were interpreted as short-term logistical camping locations, including the Intermediate period features at LAN-211.

Most of the outlying features were relatively isolated and probably represent depositional episodes unrelated to surrounding features. In most cases, we had no reason to suspect that the features formed larger activity areas. One exception concerned Features 40 and 46, which were clearly part of the same depositional event and indicated an activity area (Feature 46 was a subfeature of Feature 40). We discuss that activity area in more detail below.

To sum up, the features assigned to the Protohistoric/Mission period were predominantly domestic features related to thermal activities. The Feature 1 activity area, which we discuss in the following section, included 20 hearths within the excavated portion (19 oxidized pits and 1 activity area that included a hearth). The abundance of hearths in Feature 1 suggested a principal focus on cooking and food preparation, although the hearths, at times, may have been for other functions (e.g., to generate warmth or to heat-treat stone tools). As discussed in Chapter 7, Volume 3, this series, ceramic-vessel fragments from Feature 1 exhibited evidence of having been used over a fire, likely as cooking pots, and supported a cooking function.

Residential intensity (i.e., length of occupation episode) was difficult to infer from these data. However, the hearths presumably were roughly contemporaneous or used successively over the course of a single short-term habitation episode. Furthermore, it seems unlikely that repeated use of a campsite would have generated a linear arrangement of hearths (see below). Nor would we expect such large hearths to have been necessary to accommodate a small group of hunters or collectors during a resource-collection expedition.

Figure 248. Plan-view drawing of Feature 31, a hearth, LAN-211.

Table 66. Features Dating to the Protohistoric/Mission Period, LAN-211 (Episode 3)

Feature No.	Field Designation	General Category	Thermal/ Nonthermal	Morphology/Composition	Final Feature Interpretation
1	activity area	composite (domestic)	mixed	activity area for domestic activities	activity area
2	artifact concentration	domestic	nonthermal	general/multiple artifact concentration, no pit, with FAR	domestic-discard area
4	hearth	domestic	thermal	oxidized pit, with FAR	large hearth
5	rock cluster	domestic	thermal	oxidized pit, with FAR	small hearth
6	hearth	domestic	thermal	oxidized pit, with FAR	small hearth
8	hearth	domestic	thermal	oxidized pit, no FAR	small hearth
12	hearth	domestic	thermal	oxidized pit, with FAR	small hearth
13	rock cluster	domestic	thermal	FAR concentration in pit	small hearth or thermal discard area
14	hearth	domestic	thermal	oxidized pit, with FAR	large hearth
16	hearth	domestic	thermal	oxidized pit	large hearth
17	hearth	domestic	thermal	oxidized pit, no FAR	small hearth
18	hearth	domestic	thermal	oxidized pit, with FAR	small hearth
19	hearth	domestic	thermal	oxidized pit, with FAR	small hearth
21	hearth	domestic	thermal	oxidized pit, with FAR	large hearth
22	hearth	domestic	thermal	oxidized pit, no FAR	large hearth
24	rock cluster	domestic	nonthermal	lithic/ground stone concentration, no pit	cairn
25	rock cluster	domestic	nonthermal	lithic/ground stone concentration, no pit	cairn
26	hearth	domestic	thermal	oxidized pit, with FAR	large hearth
27	human burial	burial/ritual	nonthermal	primary inhumation	human burial
28	hearth	domestic	thermal	oxidized pit, with FAR	large hearth
33	human burial	burial/ritual	nonthermal	primary inhumation	human burial
40	activity area	composite (domestic)	nonthermal	activity area for nonthermal domestic activities	activity area
41	hearth	domestic	thermal	oxidized pit, with FAR	small hearth
42	hearth	domestic	thermal	oxidized pit, no FAR	large hearth
45	hearth	domestic	thermal	oxidized pit, no FAR	small hearth
46	rock cluster	domestic	thermal	concentration of FAR, no pit	domestic-discard area
50	hearth	domestic	thermal	oxidized pit, with FAR	large hearth
51	hearth	domestic	thermal	oxidized pit, with FAR	large hearth
52	rock cluster	composite (domestic)	thermal	activity area for thermal domestic activities	activity area
53	rock cluster	domestic	thermal	concentration of FAR, no pit	domestic-discard area
56	rock cluster	domestic	thermal	concentration of FAR, no pit	domestic-discard area

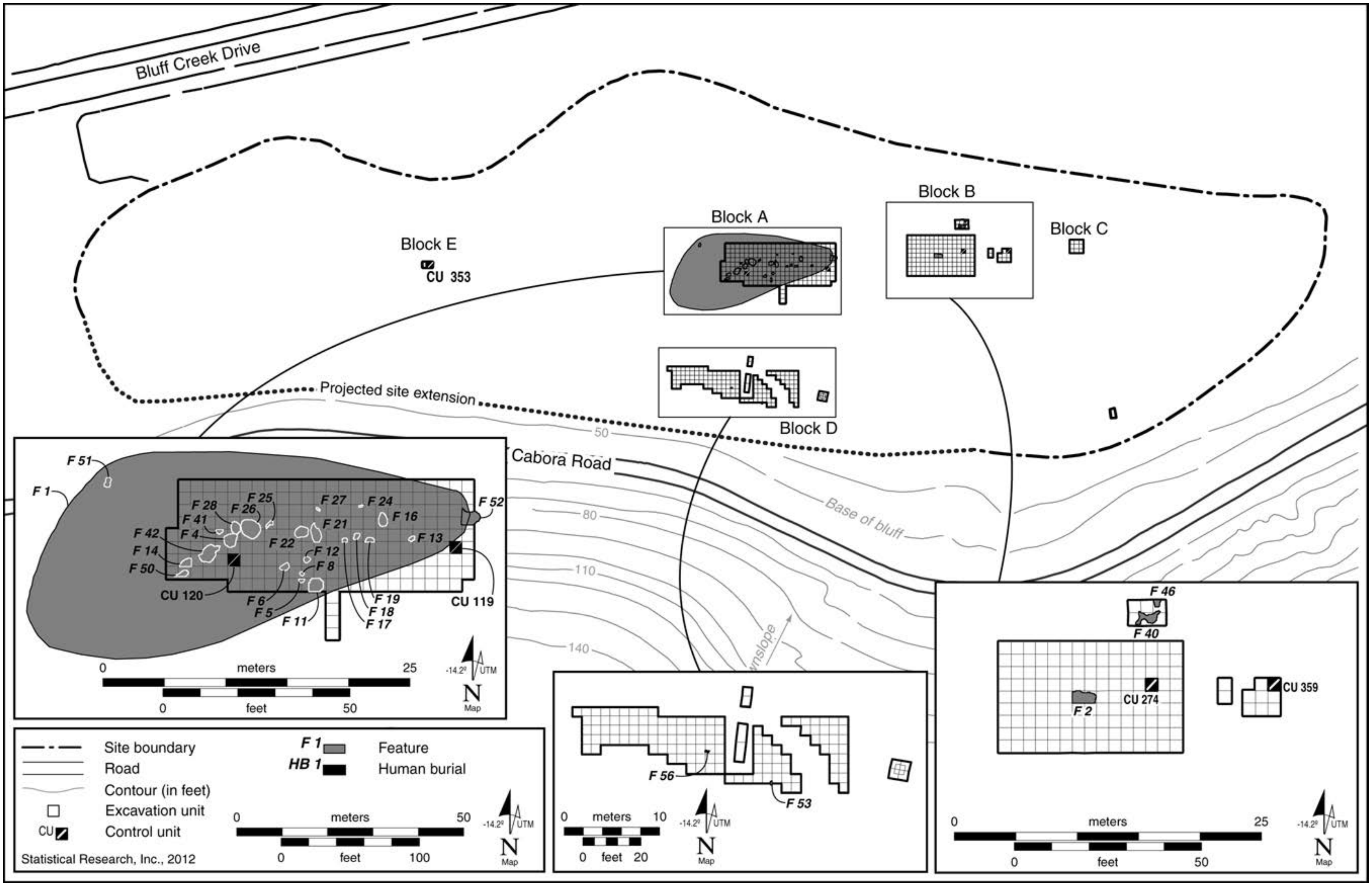

Figure 249. Map showing the locations of Protohistoric/Mission period features at LAN-211.

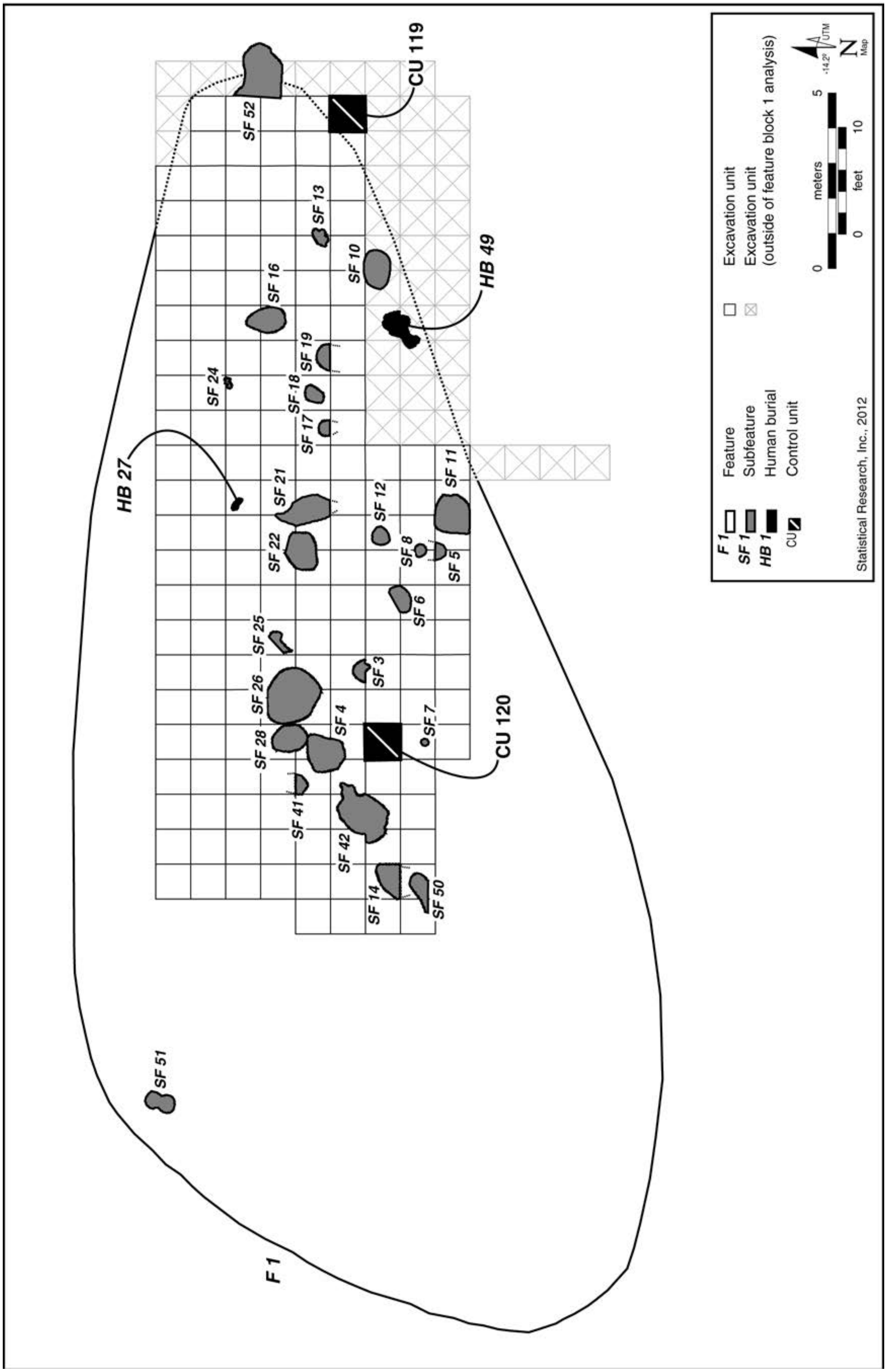

Figure 250. Detailed map of the Feature 1 activity area, LAN-211.

Presumably, they were constructed to accommodate cooking and heating needs for a larger group. This area of LAN-211 may have housed the residential community (or task group) that interred deceased group members in the burial area in Locus A of LAN-62, located about 1.5 km to the west. Additional analysis and information will be needed to corroborate that suspicion.

Outside Feature 1, the features identified to the east, south, and west likely represent various separate and unrelated depositional events, but some or all of them may have been related to Feature 1. The features to the east and south of Feature 1 were mostly domestic-discard areas that included a mix of thermal and nonthermal debris. To the west was a single hearth. It is possible that these were generated during a number of short-term logistical trips to the area prior to or after the occupation involving Feature 1. Calibrated radiocarbon dates and time-sensitive artifacts failed to clearly indicate the chronological relationships between the outlying features and Feature 1; the inferred date ranges overlapped with those derived from the subfeatures of Feature 1.

Late Historical/Modern Period

Two features were classified as late-historical-period or modern deposits. One was a horse inhumation that was classified as a secondary inhumation because it was discovered in redeposited fill. A second feature was an unexcavated cistern that probably dates to the early or mid-twentieth century. The two features were located about 70 m from one another and clearly do not represent part of the same depositional event. Nor is it clear that they were deposited as part of the same late-historical-period occupation episode (i.e., they may have been separated in time by several decades). Also notable was the absence of historical-period domestic trash deposits, which were excavated in several locations at neighboring LAN-62. Aerial photographs and historical-period maps indicated a substantial farming or ranching operation located near the border between LAN-62 and LAN-211. The absence of evidence of such features or any other structures suggested that much of the Late/modern period materials at LAN-211 had been truncated by earthmoving activities in the mid-twentieth century, which may have obliterated any evidence of a late-historical-period occupation in the area.

Activity Areas

Discrete activity areas were not evident for the Intermediate or late historical/modern period. However, the features assigned to the Protohistoric/Mission period indicated two possible activity areas: a large activity area, Feature 1, and a small activity area to the east composed of Features 40 and 46.

Feature 1 consisted of a large group of hearths and surrounding features, as well as a dense scatter of faunal bone and various lithic artifacts. Although much of the feature was revealed during hand-excavations within Excavation Block A; a large portion of it was identified during mechanical stripping as a lens of dense cultural material, especially faunal bone. During the stripping process, archaeological monitors tracked the extent of the feature within the impact area and tried to identify a boundary. The hearths were aligned in an east–west arrangement within the central portion of the activity area. The reason for or purpose of the linear pattern was difficult to discern, however.

One possible cause is a process of "drift" in the hearth locations: one or several hearths may have been abandoned over the course of the occupation, with newly constructed hearths situated adjacent to older ones. Over time, that continual process of drift could have created a large number of adjacent hearths. But that also brings up a question concerning why the arrangement was linear rather than scattered randomly over the area. If new hearths had been constructed next to older ones, why did the site occupants continue situating the hearths along a linear path? Perhaps other features or activity loci were situated to the north and south of the line of hearths, preventing expansion or drift into those areas.

A second possibility is that all or most of the hearths were used simultaneously, which may have been the case if the area functioned as a central cooking location for a larger community of residents. In this scenario, the linear arrangement of hearths was part of a larger community plan: the hearths (including any newer constructions) would have been situated within a single planned location, and areas to the north or south may have been reserved for other community functions and activities. For example, it is possible that mud-and-thatch residences were constructed around the line of hearths, as speculated in Chapter 7, Volume 3, this series, based on the presence of possible dried-mud or adobe fragments to the north and east of the hearths (Figure 251). If that was the case, the hearths may have marked the location of a common area or communal cooking and heating locus in the center of the residential community.

Possibly also important were the subgroups of hearths within the larger group. The line of hearths seemed to be divided into eastern and western halves. The western portion of the group included a tightly spaced line of seven hearths that was separated by about 3 m from a less tightly spaced line of six hearths in the eastern portion of the group. A smaller, nonlinear scatter of four hearths was situated about 2 m to the south of the gap and may have been affiliated with the eastern group. The eastern and western lines of hearths were roughly equal in number but varied in size: the western group included six large hearths and one small hearth; by contrast, the eastern group included three small and three large hearths. The four hearths located to the south of the groups were all interpreted as small hearths. It is difficult to speculate about the reason for that disparity in the ratios of large to small hearths between the eastern and western subgroups.

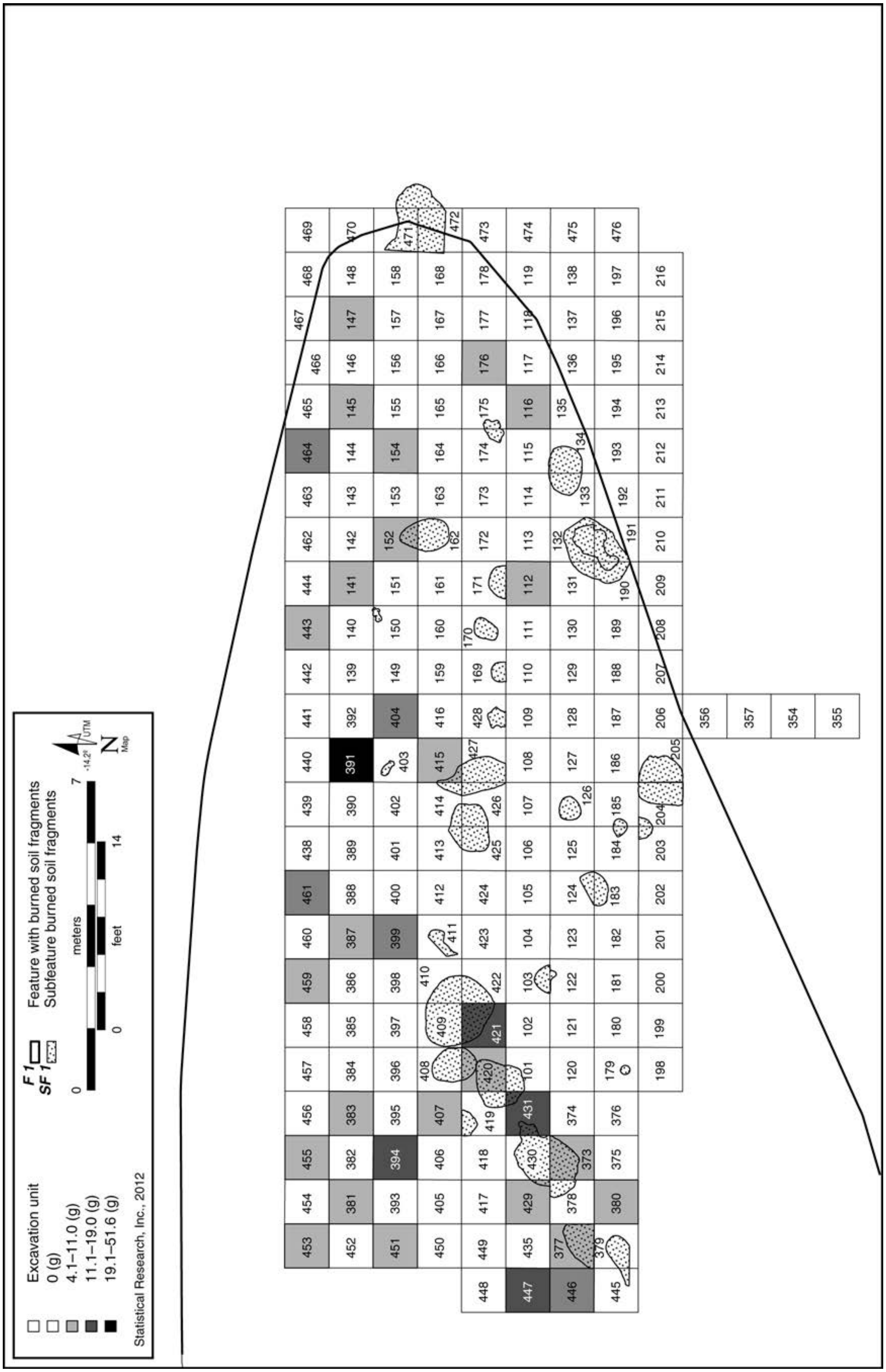

Figure 251. Map showing the distribution of mud/adobe fragments within Feature 1 at LAN-211.

The 3-m space between the eastern and western subgroups of hearths may have been the result of random drift, as noted above, but they also may have been situated to avoid a central structure or activity located between the two subgroups. Notable in that regard was the presence of Feature 25, a small concentration of cobble and ground stone fragments situated within the ca.-3-m gap between the subgroups. A second feature consisting of a small and dense concentration of cobbles and FAR fragments was excavated about 4 m to the northeast of Feature 25, a few meters north of the eastern line of hearths. These features might have functioned as post supports for structures, possibly domiciles. Indeed, both features were surrounded by an approximately 1–2-m radius of "open" area devoid of features, which could indicate the interior spaces of structures (although hearth Feature 26 was situated very close to Feature 25).

It is worth noting, however, that no additional evidence of structures was recovered from the vicinities of Features 24 and 25, with the possible exception of the dried-mud or daub fragments discussed in Chapter 7, Volume 3, this series. Mud or daub fragments, in fact, were recovered from the CUs adjacent to Features 24 and 25, but they also were recovered from CUs farther from them, to the east and west. One CU with an exceptionally high volume of daub or dried mud was recovered about halfway between Features 24 and 25, but the implication of that pattern is uncertain. In all, no clear association was evident between the possible post-support features and the concentrations of dried-mud or daub fragments.

One heavily disturbed burial of an in utero fetus (Feature 27) was located at roughly an equal distance from each of the two proposed post supports or cairn features. It is possible that the fetus had been interred in an open space between the two posited post-support structures associated with Features 24 and 25. It also could have been interred beneath the floor of one of the structures.

In sum, Feature 1 appeared to have been formed during a single occupation episode (i.e., it is unlikely a palimpsest of unrelated camping deposits). The size and density of the features implied a relatively intense occupation, possibly a permanent or semipermanent residential locus, especially compared to the bulk of the evidence of earlier land-use patterns in the Ballona, most of which has suggested temporary camps related to logistical resource-collection trips. The line of hearths may have marked the location of a communal cooking area, as evidenced by the dense concentrations of discarded faunal bone and shell in the vicinity and the presence of ceramic-vessel fragments with exterior soot deposits from exposure to fire. The possible post supports (Features 24 and 25) may indicate locations of two structures, perhaps domiciles for some of the area inhabitants (the evidence of cooking and subsistence-related activities was inconsistent with ritual structures), or may have been supports for a ramada structure. Moreover, the presence of two, or possibly three, groups of hearths could suggest a link between the structures and the hearths. That is, each structure was associated with its own group of hearths.

For the area outside Feature 1, we proposed a possible activity area that included Features 40 and 46, about 30 m east of Feature 1. Both features were discard areas that included various subsistence-related materials. Feature 40 mostly included FAR, two ground-stone-bowl fragments, a pestle, and small amounts of flaked stone, unworked shell, and mammal bones. The contents of adjacent Feature 46 were mostly FAR and faunal bone, about two thirds of which were mammal bones (half burned), along with small amounts of flaked stone debitage, unworked shell, and a tarring pebble. These features resembled many other "generalized" discard areas excavated in the PVAHP area, most of which have been interpreted as refuse from short-term logistical camps. Features 40 and 46 may or may not have been related behaviorally to the features and materials that made up Feature 1. They appeared to be contemporaneous temporally but were spatially separate. It is possible that they were simply outlying, ancillary features related to the activity area in Feature 1, or they may have been products of slightly earlier or later occupation episodes. Another possible explanation for the separation between these sets of features may have related to disturbance. Geoarchaeological studies identified a significant amount of disturbance to the upper A horizon soils at the site.

Summary

SRI's data recovery investigations at LAN-211 revealed intact, dense feature and midden concentrations within the site area and three burials (Features 27, 33 and 49). In other areas of the site, however, the archaeological resources had been heavily disturbed or completely obliterated, as a consequence of earthmoving and construction activities in the mid-twentieth century by Hughes Aircraft Company. In some places, the intact deposits had been deeply buried beneath a thick mantle of redeposited fill, and in other places, archaeological materials were found just below the surface, in direct contact with asphalt. The most prominent area of intact deposits was located in the central portion of the site, where archaeologists exposed a concentration of thermal features (mostly hearths) and dense midden deposits dating to the Protohistoric and Mission periods.

Study of the midden contents and densities at LAN-211 revealed very dense middens in levels assigned to the Protohistoric/Mission period, clearly the peak period of occupation at the site, although samples could not be collected or analyzed from the buried A horizon. The site was probably used relatively sporadically as a logistical camp and resource-processing location during the Intermediate period, and the very dense middens, in conjunction with the dense feature deposits and formal burial area at LAN-62, suggested a likely permanent or semipermanent residential population at the site during the Protohistoric/Mission period. Faunal bone (mostly from mammals) composed the bulk of the midden cultural materials throughout the occupation sequence, suggesting a longstanding focus on acquisition and processing of hunted terrestrial animals in the area. The residents in that area probably interred the deceased members of the community in the burial area in Locus A of LAN-62, about 1 km to the west. Note, however, that excavations at LAN-211 provided a limited "window" on settlement structure and components: it is likely that most of the former settlement was destroyed as a result of Hughes Aircraft Company's earthmoving and leveling efforts in the mid-twentieth century and that a large portion of the site to the north and south of SRI's excavations remains untouched and uninvestigated.

Redeposited, Unevaluated, and Not-Eligible Sites in the PVAHP Project Area

Christopher P. Garraty, Benjamin R. Vargas, John G. Douglass, Donn R. Grenda, and Richard Ciolek-Torello

SRI recorded nearly two-dozen archaeological deposits during the course of survey and testing in the PVAHP project area in the 1990s and early 2000s. Unless deposits were determined to be part of a previously recorded site (e.g., LAN-54), they were assigned numbers in SRI's internal tracking system (SR- numbers) at the time of discovery (Figure 252). In this chapter, we describe each of the SR- sites and explain the context of discovery, discuss the testing results, and provide management recommendations for each. Table 67 (see also Table 1, Chapter 1, this volume) summarizes the results for 23 deposits initially assigned SR-numbers, some of which were later assigned trinomial designations for Los Angeles County (LAN- numbers). Two of the deposits with SR- numbers, SR-18 and SR-22, were not used to record sites and therefore are not discussed in this chapter. Because other chapters in this volume focus in detail on sites that were determined eligible for listing and subsequently underwent data recovery, we refer to them in Tables 1 and 67 but do not go into detail regarding them, outside of their relationship with other sites in the project area.

SRI implemented different treatment plans for the SR-deposits based on the context, integrity, and significance of the site remains. Three SR- sites that were initially deemed significant and intact were assigned trinomial designations (LAN-2768 [SR-20 and SR-21] and LAN-2769 [SR-12]). Four other SR- sites were ultimately determined to be parts of culturally significant, previously recorded sites (LAN-62 [SR-15 and SR-16], LAN-193 [SR-25], and LAN-211 [SR-13]) and are subsequently referred to by their trinomial designations. With the exception of SR-12 (LAN-2769), each of the SR- sites was determined eligible for listing in the NRHP and subjected to detailed investigations. One other SR- site, SR-17 (the HHIC), was determined eligible for listing in the NRHP on the basis of archival research and therefore was not assigned a trinomial designation or subjected to further archaeological scrutiny (Greenwood and Associates 1991, 1995). LAN-2676 (SR-19) was also determined eligible for listing in the NRHP based on testing, but during data recovery, it was established that the site lacked integrity, because it was composed of redeposited material (see site discussion below).

The above sites were considered relevant to the broader research objectives for the project and offered the potential to provide new information regarding prehistoric and historical-period occupation of the coastal Los Angeles area (see Altschul et al. 1991). SRI defined two types of significant historical-period properties in the Ballona: (1) archaeological sites that contribute new information to the research themes of the PVAHP; and (2) historical-period buildings related to the HHIC and endeavors (Altschul et al. 1991:165). The principle research themes for the prehistoric component of the PVAHP include (1) human land use and landscape development and (2) cultural history and diachronic changes in human technology and cultural affiliation (Altschul et al. 1991:23–33). Generally, prehistoric sites had to exhibit potential to contribute significant new information to one or both of these themes to be considered eligible for listing in the NRHP. Sites that met these criteria were considered contributing members of the BLAD.

Most of the remaining SR- sites were deemed not eligible for listing in the NRHP. Seven SR- sites (SR-1, SR-3, SR-7, SR-8, SR-10, SR-11, and SR-24) were not assigned trinomial designations, because they had been heavily disturbed (e.g., by late-historical-period or modern construction or earthmoving activities) or were found in secondary (i.e., redeposited) contexts. SR-1 had actually been destroyed by development on the bluff top before SRI was able to evaluate it. Many of the disturbed sites determined not eligible for listing in the NRHP consisted of secondary deposits that had been removed from sites along the base of the bluff and imported as construction fill in various areas of the HHIC during the mid- and late twentieth century, a matter we explore in more detail in the following section. Those sites were not subjected to data recovery excavations. Other SR- sites were initially considered potentially eligible for listing in the NRHP and assigned trinomial designations but were subsequently determined not eligible because of heavy disturbance or secondary deposition, including LAN-1970 (SR-2), LAN-1932 (SR-6 and SR-23), LAN-1933 (SR-5), LAN-1934 (SR-4), and LAN-2769 (SR-12). These SR- sites were not considered contributing members of the BLAD and therefore were not subjected to data recovery excavations.

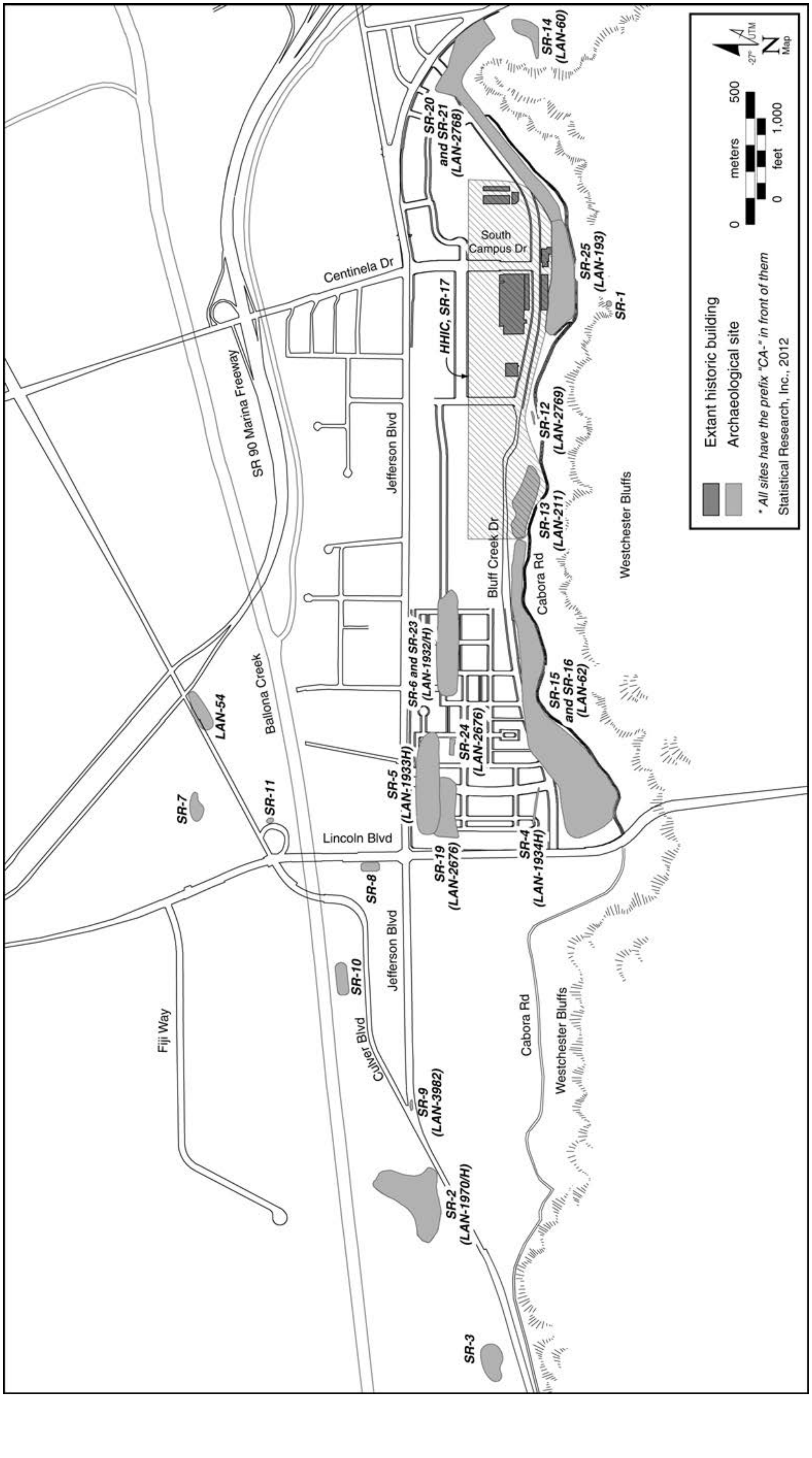

Figure 252. Map showing the SR- sites and their trinomials (if applicable) within the project area.

Table 67. Categories of SR- Sites Identified during the Initial 1990 PVAHP Survey and Subsequent Inventory of the Project Area

Eligible (Data Recovery) Sites	Redeposited (Runway) Sites	Sites Not Eligible	Noncultural Deposits	Sites Not Evaluated
SR-13 (LAN-211)	SR-6 and SR-23 (LAN-1932)	SR-2 (LAN-1970H)	SR-10	SR-1
SR-14 (LAN-60)	SR-19 and SR-24 (LAN-2676)	SR-4 (LAN-1934H)	SR-11	SR-3
SR-15 and 16 (LAN-62)		SR-5 (LAN-1933H)		SR-7
SR-17 (HHIC)		SR-12 (LAN-2769)		SR-8 (noncultural deposits; likely not eligible)
SR-20 and SR-21 (LAN-2768)				SR-9 (LAN-3982)
SR-25 (LAN-193)				

Note: As mentioned previously, "SR-" refers to archaeological deposits as they are listed in the internal tracking system of SRI; numbers SR-18 and SR-22 were not assigned to any sites.

Site Formation and Earthmoving Activities by Hughes Aircraft Company

Many of the SR- sites determined not eligible for listing in the NRHP were located in the vicinity of the HHIC, particularly the large airstrip situated in the northern portion of the complex. Hughes Aircraft Company removed sediment from the base of the bluff, much of which was from intact archaeological sites, and redeposited it as construction fill in various areas of the complex. That was particularly prevalent in the vicinity of the former Hughes Aircraft Company airstrip, where fill was used to raise the level of the runway above the surrounding floodplain. Hence, many of the sites recorded by SRI—some of which initially appeared to be intact and significant cultural deposits (e.g., LAN-2676)—were later determined to be secondary archaeological deposits (see discussion by Mbila and Homburg in Appendix 11.1, this volume).

Stuart Peck (1947, 1952) of the ASA witnessed that pattern of redeposition by Hughes Aircraft Company in the 1940s. Peck excavated sites on the property in the 1940s and 1950s and documented these events:

> When the landing strip at the Hughes Aircraft Co. plant in Culver City, California, was constructed, many cubic yards of earth were moved into low spots from the base of the bluff to the south. Included in this fill was the occupation debris from two fair-sized prehistoric Indian Villages and several campsites. At the time, a great number of artifacts were found and several burials uncovered. Most of this material was retained by the workmen who found it. As might be expected, single artifacts and worked fragments are still occasionally picked up along the margins of the grass-covered runway [Peck 1952:64].

In another publication, Peck went into more detail on the excavations at the base of the bluff and the resultant fill deposits at the western end of the runway:

> In 1942, when it was decided to increase the length of the landing field, the material was excavated from the cone [i.e., the elevated alluvial fan at LAN-62] to a depth of some eight to twelve feet to the hardpan layer over an area about 250 × 500 feet. During the excavations a large amount of archaeological material was found and a great deal more must have been moved without discovery. At the present time, the south and east banks of the excavation show the layers of shell and black greasy soil which are typical of camp sites of the Coastal Indian Tribes [Peck 1947:1–2].

The detailed geomorphological study by Mbila and Homburg (see Appendix 11.1, this volume) corroborated Peck's redeposition hypothesis. They studied soil texture, pH, mineralogy, and organic-carbon content at several runway sites. Many soil matrices at those sites included native soils composed of marsh deposits overlain by a mixture of soil types created under different geological conditions. Moreover, the imported soils were consistent with those formed within the alluvial fans along the base of the Ballona Escarpment, which is mainly composed of sand eroded from the Pleistocene El Segundo sand hills. Although SRI was unable to pinpoint the exact source locations of the redeposited fill, the study by Mbila and Homburg supported Peck's argument that the materials originated from sites along the base of the bluff. Given that much of the midden in Locus B of LAN-62 was missing when it was mechanically stripped, it is likely that a portion of the runway-site material hailed from that area. An oblique aerial photograph from the Hughes era documenting the construction of the runway extension illustrated two haul roads from the base of the bluff in the vicinity of LAN-62 Loci A/B and C/D to the runway extension (see Figure 139, Chapter 9, this volume). Large portions of LAN-62 Loci B and D were found during testing and data recovery to have been removed at some point in the past (see Vargas 2003). The photograph provided additional evidence that portions of LAN-62 had been used as runway fill.

We hypothesized that several sites in the project area were at least partially created as a result of the extension of the Hughes Aircraft Company runway in 1942. We sometimes refer to them as "runway sites" because of their depositional histories. Six of the 23 SR- sites (4 sites with LAN- numbers) were likely formed, or at least heavily disturbed, as a result of construction and earthmoving activities in the mid- to late twentieth century: LAN-1932 (SR-6 and SR-23), LAN-1933 (SR-5), LAN-1934 (SR-4), and LAN-2676 (SR-19 and SR-24). LAN-62, LAN-211, and LAN-2769 may have been the sources of some of the materials used to construct the runway sites.

Redeposited Archaeological Sites

In this section, we discuss four SR- sites (which constitute two sites, LAN-1932 and LAN-2676) that consist of redeposited archaeological materials.

SR-6 and SR-23 (LAN-1932)

SR-6 was a low, linear historical-period trash mound covered with grass, brush, and small trees. Later designated LAN-1932, it was originally recorded during SRI's pedestrian survey in 1990 (Altschul et al. 1991:153) and was evaluated for NRHP eligibility by Hampson (1991). Most of the site was located in the eastern portion of Area D1, although the westernmost part of the site slightly extended into Area D2. It was situated about 150 m south of Jefferson Boulevard and northwest of the HHIC. The area had been heavily disturbed as a result of grading activity and a long ditch that traverses the site. LAN-1932 was one of the runway sites likely formed during Hughes Aircraft Company's importation of construction fill from sites along the base of the bluff (see above).

SR-6 Initial Survey (1990)

Altschul et al. (1991:153) described the site as a secondary historical-period trash deposit that covered a linear stretch encompassing an area of 480 by 30 m. They reported materials dating from the 1930s and 1950s intermixed with more-recent debris, although they did conduct a systematic analysis of the surface materials. Backhoe-trench excavations revealed a mixed and homogeneous stratigraphy formed from repeated deposition of trash (Hampson 1991). Repeated deposition and possible grading/leveling of the area within a short period of time resulted in the homogeneous deposit. Materials included miscellaneous ceramics and glass fragments, but no wood, metal, or plastic items were recovered.

SR-6 Test Excavations (1991)

Subsequent to the initial survey by Altschul et al. (1991), Hampson's field crew excavated four backhoe trenches in different areas of the site, to expose the subsurface stratigraphy; they also excavated two 1-by-1-m test units, to obtain a sample of artifacts from controlled subsurface contexts. Three backhoe trenches revealed heavily mixed subsurface deposits with no defined stratigraphy, which supported the previous interpretation by Altschul et al. (1991) that the materials had been removed from their original depositional contexts and redeposited in the site area as fill (Hampson 1991:20). The original deposition (location unknown) likely occurred sometime between the 1940s and 1960s, most likely during construction and earthmoving activities by Hughes Aircraft Company in the 1940s or early 1950s.

SR-23 Initial Site Discovery and Testing (1999)

SR-23 was discovered during the routine monitoring of geological testing by Delta in 1999 (Taşkiran and Stoll 2000a, 2000b). SR-23 refers to the prehistoric component of LAN-1932 (SR-6 refers to the historical-period and modern components of the site), which Altschul et al. (1991) recorded during pedestrian survey in 1990 (see above). The site was located in the eastern portion of Area D1 and partly in Area D2, roughly 150 m south of Jefferson Boulevard and northwest of the HHIC. The site also was located in the area that had been the locus of the Hughes Aircraft Company landing runway, which was constructed atop imported fill from other areas of the site in the 1940s.

In February 1999, shells and a faunal-bone fragment were observed in the excavated matrix of one of Delta's test units during monitoring. (Delta had been conducting a study of the subsurface geology at the time.) The cultural materials were located in a dark-brown sandy silt layer resting on intact native clays, all of which had been buried beneath construction fill. Based on the recovered materials and the seemingly undisturbed stratigraphy, SRI determined the cultural deposit to be potentially intact and recommended subsurface testing to confirm that hypothesis.

Several days later, SRI developed and implemented a testing program to determine the integrity and horizontal extent of the prehistoric deposits at LAN-1932 (Taşkiran and Stoll 2000a:4). SRI mechanically excavated 8 trenches and manually excavated 30 1-by-1-m test units (most of the units were in three large blocks) in the vicinity of the prehistoric remains, to evaluate them. The test units were situated adjacent to and abutting the trenches, to facilitate detection of the subsurface stratigraphic units.

Generally, the upper 0.3–1.3 m of the trenches and manual EUs included historical-period debris, sometimes in dense deposits. The prehistoric materials were restricted to a thin layer of dark, organic soil ranging from 7 to 15 cm in thickness (Level 2). All excavated soils from Level 2 were wet screened using a 1/8-inch-mesh screen. The subsurface stratigraphy was composed of complex, interbedded deposits below several thick layers of redeposited fill. No features were observed during the excavations, but the results indicated a possible Protohistoric or Mission period deposit, which was considered a very significant find, if the materials represented in situ deposits. Overall, however, the implications of the test excavation were ambiguous concerning the integrity of the prehistoric remains, and additional testing was required.

SR-6 and SR-23 Monitoring (1998–2006)

LAN-1932 was subjected to additional testing in 2000 and during monitoring of construction activities (Beardsley 2001; Douglass 2007a). During the second phase of testing, a large area of overburden was mechanically removed (Figure 253), and trenches were excavated into the exposed midden. Upon examination of the trench profiles, it was immediately apparent that the midden materials had been redeposited. The midden had been deposited in even 6-inch layers, and the interfaces between layers exhibited evidence of having been mechanically rolled (Figure 254). Based on that evidence, we concluded that the materials had been imported into the area during construction of the runway (see Appendix 11.1, this volume).

Later in 2000, SRI monitored the excavation of three graded areas at LAN-1932, which uncovered a mix of modern and historical-period debris dating to between the 1920s and 1960s and including construction debris, glass fragments, tiles, porcelain fragments, silverware, and metal objects (Douglass 2001). Shell, possibly from prehistoric deposits, also was recovered from two of three graded areas (see discussion of SR-23, below).

In 2001, two deep trenches were excavated through a portion of LAN-1932 for the construction of storm drains (Douglass 2004a). The upper 5–6 m (17–20 feet) included black, dark-gray, and dark-green marsh soils overlain by mottled-brown fill that had likely been imported for runway construction; the upper fill lacked stratigraphic definition, which underscored the likelihood of secondary deposition. Modern or late-historical-period artifacts were recovered from some areas within the fill. An auger unit also was excavated for the placement of a water-monitoring well in 2001, but no artifacts or cultural materials were uncovered (Douglass 2004b).

Additional monitoring of construction occurred in 2002 and 2003, and a mix of historical-period and prehistoric remains was revealed to be interbedded in the upper level of construction fill overlying the native soil deposits (Denniston and Douglass 2007a, 2007b; Douglass 2004c, 2004d, 2007b; Pollock and Douglass 2006). Historical-period materials included brick, ceramic fragments, glass fragments, and construction debris; a number of shell fragments (abalone [*Haliotis* sp.]) presumably derived from prehistoric deposits.

In total, 26 trenches, 30 1-by-1-m EUs, and 13 other EUs were completed as a result of testing and monitoring activities at this site. Once it was determined that the cultural materials from the site had been redeposited and the site was not eligible for listing in the NRHP, we decided to analyze only a small sample of the materials from the 1999 EUs. We believed that those materials retained some information value for comparison with LAN-62 and LAN-211. Because large portions of both of those eligible sites apparently had been removed for construction of the runway, we concluded that the materials from LAN-1932 may have been related and could shed light on their missing portions.

Management Recommendations

Based on the recent dates of the materials and the clearly secondary depositional context at LAN-1932, Hampson concluded that the historical-period component of the site (SR-6) was not eligible for listing in the NHRP. SRI concurred with Hampson's assessment and recommended the site not eligible for listing in the NRHP (Taşkiran and Stoll 2000a, 2000b). After the discovery of SR-23, that component of the site was evaluated for listing in the NRHP and was also recommended not eligible. The site was subsequently dismantled to make way for development, and portions of it may still be in place, capped below Runway Road.

SR-19 and SR-24 (LAN-2676)

SR-19 is an oval-shaped midden deposit measuring approximately 70 by 225 m located near the intersection of Lincoln and Jefferson Boulevards (Altschul et al. 1998a), along what had been, until recently, the main Hughes Aircraft Company airstrip. LAN-2676 is one of the runway sites described above.

Initial Site Discovery (1997)

The site was discovered in 1997, when an SRI archaeologist monitoring the coring operations observed artifacts in back dirt from a backhoe trench that had been recently excavated as part of a construction project (Altschul et al. 1998a). The cultural deposit was subsequently verified with the excavation of two hand-drilled auger units. Once validated, SR-19 was designated as LAN-2676.

Figure 253. Photograph of the removal of overburden and trench excavation during the second testing phase at LAN-1932, view to the south.

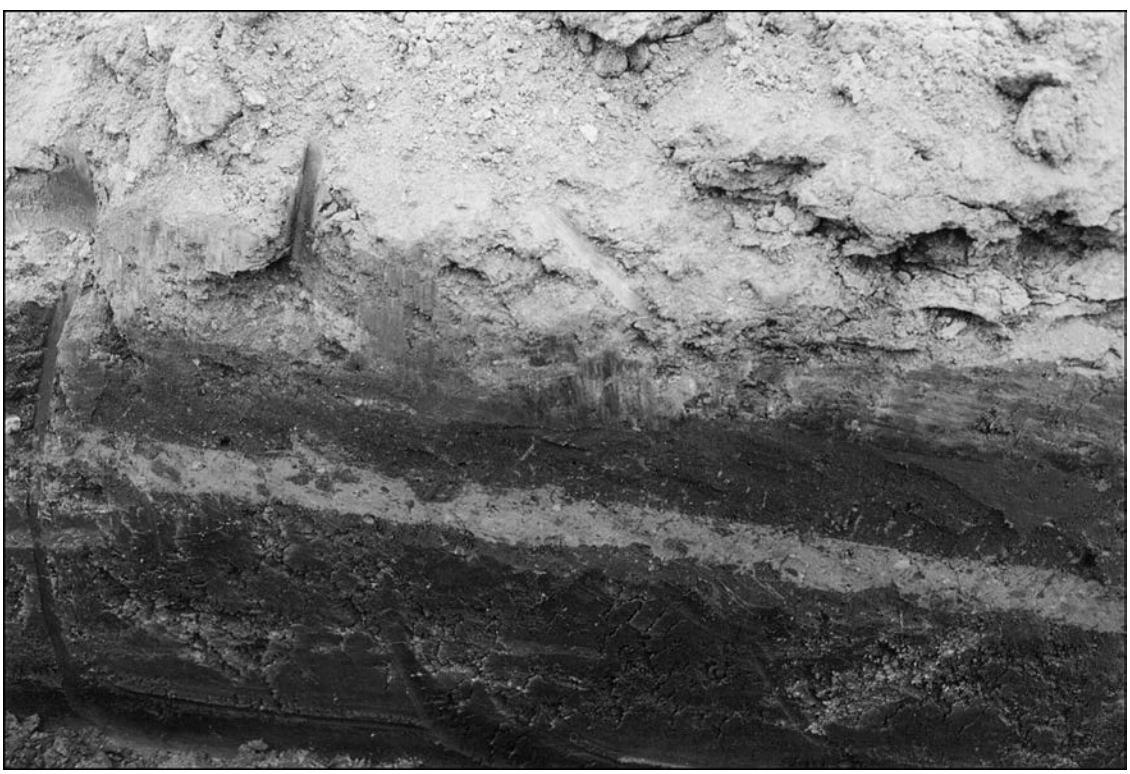

Figure 254. Photograph of a test-trench profile from the second testing phase at LAN-1932, showing the mechanically deposited layers.

Those findings raised several interesting questions. First, most of the documented prehistoric sites in the Ballona were located either along the southern bank of Centinela Creek and the base of the bluffs or on the bluff tops. Thus, LAN-2676 appeared to be like LAN-47, one of the few sites located at the edge of the prehistoric lagoon. Second, given the location of the site under the runway, we also suspected that it may have been redeposited. As discussed above, in 1945 and 1946, Peck (1947) excavated at LAN-62, then known as the Mar Vista site (see Chapter 9, this volume), and suggested that a substantial amount of the cultural deposits there had been removed from the alluvial fan and used as fill to build an elevated runway above the wetlands. Historical records documented that Hughes Aircraft Company used soils along the bluff as fill during construction of the runway (Greenwood and Associates 1991) (see above). Because the discovered materials lay near the western end of the historical-period runway built by Hughes Aircraft Company in 1942, SRI determined that it was critical to evaluate the site's integrity and to test the possibility that the materials at LAN-62 had been redeposited at LAN-2676 as fill. It was unclear whether LAN-2676 represented a relatively undisturbed primary cultural deposit. SRI thus developed a subsurface-testing program to explore that important question. Limited test excavations were also conducted at LAN-62 as part of the evaluation of LAN-2676.

SR-19 Site Testing (1998): Procedures and Results

SRI tested the possibility that LAN-2676 represented imported fill from LAN-62 by conducting testing at both sites in 1998. The testing of LAN-2676 presented two major challenges: (1) the cultural deposit lay below the water table, and (2) levels of methane and hydrogen-sulfide gases in test holes commonly exceeded safety standards (Doolittle and Altschul 1998). Attempts to verify the location and condition of the site through mechanical coring were largely unsuccessful because of concentrated levels of methane and/or hydrogen-sulfide gas.

Because of problems related to water intrusion and methane, SRI adopted a new approach using mechanical bucket augers (Doolittle and Altschul 1998). SRI researchers opted to use a 2-foot bucket auger, because the volume of soil removal per 1-foot level most closely approximated the volume recovered from a 10-cm level in a 1-by-1-m unit. The bucket-auger units were limited to the upper 15 feet, to avoid the deeper-lying methane and hydrogen-sulfide deposits. Nonetheless, an air monitor equipped with sensing equipment was present during the excavation, to test the air quality after each provenience had been removed.

In all, 38 bucket-auger units were excavated at LAN-2676. However, 4 units were halted prior to exposing cultural deposits, because of the presence of methane or utility lines. In all, 347 1-foot levels were excavated, 166 of which were collected and screened. The remaining levels encompassed the upper portions of each unit, which had been identified as imported fill overlying the deeper-lying artifact deposits. In addition, 6 3-inch cores were taken from the site, to better define the subsurface stratigraphy at LAN-2676. For comparative purposes, 8 bucket augers were excavated at LAN-62.

SRI archaeologists initially hypothesized relatively sparse cultural deposits at SR-19/LAN-2676 related to temporary food-processing loci. Instead, however, we uncovered dark, organic soils and an abundant and diverse array of artifacts; these discoveries were not consistent with expectations for a temporary processing site. Based on a study of the subsurface stratigraphy and a comparative analysis of the LAN-2676 and LAN-62 deposits, SRI concluded that the site deposits at LAN-2676 were intact, with the exception of those in the far-eastern portion of the site (Altschul et al. 1998b:115; Doolittle and Altschul 1998:34–35). Differences in artifact densities and soil strata suggested distinct archaeological deposits at the two sites. Six calibrated radiocarbon dates indicated that LAN-2676 contained multiple components dating to the Intermediate to Late period. Altschul et al. (1998b:120) thus recommended that LAN-2676 be considered eligible for listing in the NRHP.

In light of those results, Ciolek-Torrello and Altschul (1998) developed a treatment plan for SR-19/LAN-2676, to mitigate potential adverse effects caused by proposed construction in the area. They proposed a combination of hand- and mechanical excavations for data recovery at the site. They planned to mechanically strip the upper 7–8 m of modern fill covering the site and expose the midden in the south-central part of the site, where artifact density was high. They proposed hand-excavations within the exposed surface, to assess the integrity of the archaeological deposits and to identify buried features. They also proposed to systematically excavate a series of bucket-auger units to explore the other intact areas of the site. Subsequent monitoring efforts at the site, however, produced a change in SRI's initial assessment of the site as a largely in situ cultural deposit.

Reevaluation and Monitoring Activities (1999–2002)

Contrary to SRI's initial interpretation, subsequent evaluations suggested that LAN-2676 is a disturbed secondary deposit likely formed during Hughes Aircraft Company's earthmoving operations in the 1940s. As part of the planned data recovery excavations, a large area of overburden was mechanically stripped down to the level of the midden indicated by the bucket-auger tests. It was necessary to overexcavate the area, to expose a 50-by-50-m area of midden to Occupational Safety and Health Administration standards (Figure 255). Within that area, two 50-m-long trenches were excavated in a cruciform pattern, dividing the area into four 25-m^2 blocks. Four 1-by-1-m units were randomly selected for excavation within each quadrant. Examination of the trench and EU profiles made it readily apparent that the

Figure 255. Photograph of data recovery excavations at LAN-2676 after the removal of overburden, showing mechanical trenches and hand-excavation units, view to southwest, toward Lincoln Boulevard and LAN-62.

midden materials at LAN-2676 had been redeposited. Like the materials at LAN-1932, the materials had been deposited in regular 6-inch layers that contained prehistoric materials interspersed with small amounts of late-historical-period materials, such as brick fragments (Figure 256).

Upon that discovery, it was concluded that LAN-2676 had been redeposited, like LAN-1932, and further excavation was curtailed. That conclusion was supported by radiocarbon analysis, which revealed that the latest calibrated radiocarbon dates had been retrieved from materials near the base of the deposit, and the earliest dates had been derived from materials near the top (Doolittle and Altschul 1998:43). Detailed soil studies by Mbila and Homburg (see Appendix 11.1, this volume) provided additional confirmation of that hypothesis.

Based on their analyses of soil texture, pH, mineralogy, and organic carbon at LAN-2676, Mbila and Homburg (see Appendix 11.1, this volume) determined that the soil deposits containing the prehistoric cultural materials could not have originated from the clayey to silty clay marsh deposits or the Playa del Rey beach- and dune-sand deposits local to the vicinity of the site. In addition, soil descriptions and micromorphological analysis showed that the deposits contained soils that had been formed in different geological environments. Mbila and Homburg also described the unnatural distinctness of the stratigraphic boundaries of the soil horizons and the strongly contrasting and mixed soil fabrics within the same soil horizon. The extent and scale of the mixed soil fabrics likely resulted from mechanical disturbance rather than simple bioturbation by burrowing animals and insects. All of these lines of evidence confirmed that the soils had been transported from one or more sources, as earthen fill, for use in constructing the runway.

The attributes of the imported soil were consistent with those of soils formed within the alluvial fans along the base of the Ballona Escarpment, which is mainly composed of sand eroded from the Pleistocene El Segundo sand hills. Mbila and Homburg also compared soil samples from LAN-2676 with soils from 11 other localities in the Ballona, including 3 sites at the base of the Ballona Escarpment (LAN-62, LAN-211, and LAN-2679). The soil properties of samples from collected from the edge of LAN-62 were similar, which suggested the possibility that the fill deposits at LAN-2676 had originated in the northwestern portion of LAN-62. Although it was still not possible to determine with certainty that the materials had been imported from LAN-62, as Peck (1947) suggested in the 1940s, the results were consistent with that expectation.

Although the results confirmed that LAN-2676 had been redeposited, as had LAN-1932, we believed that materials from the site could provide some information about LAN-62, particularly the destroyed portion of Locus B. As a result, materials recovered from the 16 EUs were sorted for temporally diagnostic materials, and 1 EU was selected from each quadrant for detailed analysis of recovered materials.

Figure 256. Photograph of the profile of a hand-excavation unit at LAN-2676, showing the mechanically deposited layers, view to the east.

Another portion of the site, designated SR-24, was discovered during monitoring in 2001, when one of SRI's archaeologists observed shell and shell fragments in a black, sandy deposit in the southern sidewall during monitoring of the construction and excavation of a basement in 2001 (Altschul 2001). The exposed materials mainly included clamshells, oyster shells, and several large pieces of abalone shell, all of which were common food sources among the prehistoric occupants of the Ballona. The presence of the economically important shell species, in conjunction with the dark color and texture of the soil matrix, indicated a possible prehistoric archaeological deposit. Upon discovering the deposits, the archaeologists exposed a roughly 40-cm-thick lens of dark, organic soils mixed with visible shell remains, and they designated the lens SR-24.

After mechanically removing the overburden of modern fill, SRI archaeologists excavated two 1-m-by-1-m test units in 10-cm levels in the vicinity of the cultural deposit. The excavation uncovered additional shell (mostly clam), faunal bone, and several large lithic flakes. The materials recovered from the units were examined for temporally diagnostic artifacts. Wall profiles indicated two to three distinct layers of modern or late-historical-period fill overlying the dark, gleyed soil lens that contained the cultural deposits. Sparse prehistoric materials were also recorded, during monitoring of an elevator shaft in late 2001 (Douglass 2004b).

Based on the test excavations, SRI quickly determined the prehistoric remains at SR-24 to be secondary deposits that had likely been imported as construction fill. The matrix containing archaeological material in the basement excavations was not intact, as evidenced by the considerable mixing shown in the exposed profiles. Also, the deposits did not appear to extend laterally beyond the excavation area. SRI had previously monitored construction to the south and west of SR-24; no evidence of site remains had been uncovered. Also, previous coring and limited test excavations had found no cultural materials in the areas to the west, between SR-23 and SR-6/SR-19/LAN-2676, although the deposits at both sites were similar in color and texture. SR-24 likely encompasses a small area of redeposited fill that was imported from the base of the bluff during construction of the Hughes Aircraft Company runway in the mid-twentieth century. Given its location near LAN-2676, as well as the fact that it is in line with the former runway, SR-24 was designated part of LAN-2676.

Management Recommendations

Based on the data recovery results, SRI concluded that LAN-2676 (SR-19) had been heavily disturbed as a result of earth-moving and construction activities, likely conducted by Hughes Aircraft Company in the mid-1940s and 1950s. The cultural materials recovered from the site may have been removed and redeposited from LAN-62, located to the south and southeast. In light of the evidence of secondary deposition and the heavy disturbance, LAN-2676, though formerly found eligible for listing in the NRHP, clearly lacks integrity. Despite that problem, we believed that materials from the site retained some scientific value. Based on Peck's observations and our soil analyses, we strongly suspected that those materials derived from LAN-62, most likely from the completely destroyed Locus B area and that analysis of materials recovered from LAN-2676 could provide clues to the temporal range and nature of occupation in Locus B. SRI also concluded that SR-24, located immediately east of the main LAN-2676 deposit, also lacked integrity and thus could provide little information about prehistoric use of the Ballona. Altschul (2001) recommended that SR-24 did not meet the criteria for eligibility for listing in the NHRP and was not a contributing element of the BLAD (see Altschul et al. [1991] and above discussion). Because of its proximity to LAN-2676, SR-24 is considered a locus of that site. Portions of LAN-2676 were removed during development and construction in Phase 1; it is unclear whether there are still portions of the site remaining.

Archaeological Sites Not Eligible for Listing in the NRHP

In addition to the redeposited sites and the sites found eligible for listing in the NRHP and the BLAD, there were a number of sites that were evaluated and recommended not eligible. We discuss them below.

SR-2 (LAN-1970)

SR-2, later designated LAN-1970, is a historical-period oil-well complex located in the brackish marshland of the Ballona lagoon (Foster 1991). The site encompasses a roughly 400-by-200-m area in the northeastern portion of Area B, near the intersection of Jefferson and Culver Boulevards. It was located in the tidal mudflats of the Ballona Wetlands, slightly more than 1 km northeast of the Pacific Ocean coastline and south of the current Ballona Creek channel.

Survey and Historical Research (1990 and 1991)

SRI archaeologists first recorded the site during pedestrian survey in the project area in 1990 (Altschul et al. 1991:133–138). The extant remains of the complex consisted of oil-well pads connected by a series of linear earthen berms in 1990 (Altschul et al. 1991:133–138; Foster 1991:7–15). The pads and earthen berms presumably were required to protect the wells from water inundation, which likely was a frequent recurrence in the tidal flats. An aerial photograph from 1933 showed storage tanks and four oil derricks in the area; additional derricks were also visible in surrounding areas (see Altschul et al. 1991:Figure 54). SRI found no surface evidence of the latter group of derricks during the pedestrian survey, however. The oil derricks were dismantled in the 1960s, but their footings and platforms were generally intact at the time of the survey in 1990 (see below).

The SRI survey team recorded 13 features at LAN-1970 (for details, see Altschul et al. 1991:133–137). Feature 1 refers to the five concrete well pads and attached earthen berms. Feature 2 was a reservoir created by a rectangular 21-by-13-m berm that probably functioned as a retaining pool for the brackish water removed while drilling for oil in the tidal marsh. Feature 3 consisted of five rebar-reinforced concrete blocks (roughly 2 m wide at the bases) that may have functioned as footings for the oil derricks. That interpretation remains unconfirmed, however (Foster 1991:10). Features 4 and 5 were large concrete ramps, each roughly 2 by 2.5 m wide and 1.2 m in height, located slightly south of the Ballona Creek channel. Feature 6 was probably a remnant pier and consisted of nine wooden posts adjacent to one of the derrick platforms (Features 10–13). Notably, however, no planking was visible in that area in aerial photographs from the 1930s (Foster 1991:11).

Feature 7 was made up of remnants of a severely decomposed and oxidized automobile. The year and make were indeterminate, because of heavy corrosion, but Foster (1991:11) confirmed through interviews that it had been present at the site at least since 1965. It had likely been stripped of parts prior to being dumped in the area. Features 8 and 9 were both earthen berms. Feature 8 measured 35 by 8 m in length and was situated on an earthen, rectangular platform; its function is unknown. Feature 9 was a long berm raised 1–3 m above the ground surface; the berm crosscut the entire site area and presumably functioned as a roadway for automobile access to the derrick platforms during high tide. Finally, Features 10–13 were the earthen platforms, each roughly 40 by 24 m in size, on which the four derricks were situated.

The complex system of earthworks at the site was attributable to the site's location in an active portion of the tidal flats, which experienced frequent flooding. The raised-berm system allowed the derricks to operate without excessive water inundation; no doubt, the ground was flooded during much of the time that the oil-well complex was in operation. Consequently, Altschul et al. (1991:138) interpreted SR-2 as "representing a specialized technology for drilling oil in the salt marsh environment of the Ballona Lagoon." SRI conducted no additional research at LAN-1970, however.

Given the uniqueness of the oil complex and the sophisticated engineering practices employed to combat the problem of inundation, Altschul et al. (1991) suggested that additional archival research was needed to evaluate the site's potential eligibility for listing in the NHRP, a task assigned to John Foster (1991) of Greenwood and Associates. Foster reconstructed the history of oil-well development in the Ballona and at LAN-1970, in particular, based on archival research, inspections of two aerial photographs (from 1933 and 1938), site visits, and interviews with Southern California Oil Company employees (Foster 1991:1–4).

Foster determined that the oil-well complex had once been part of the Venice oil fields, which produced oil during the 1930s and early 1940s (Foster 1991:1–4). Oil-well construction in the Ballona Wetlands started in 1929 and peaked in the late 1930s and early 1940s. The oil reserves in the Ballona were mostly depleted as a result of heightened demand for oil during World War II, however, and by the mid-1940s, the area had been rededicated to the extraction of natural gas. Most of the derricks that composed the Venice oil fields, including those at LAN-1970, were dismantled and removed in the 1950s and 1960s.

Management Recommendations

LAN-1970 is the only site in the PVAHP project area with an extant archaeological footprint (as of 1990) that is associated with the early-twentieth-century oil industry. It is also the only known component of the large Venice oil fields and contains extant surface indications of having been constructed in the tidal flats of the Ballona lagoon. In spite of these associations, Foster (1991:16–17) concluded that it was unlikely that the site contained intact subsurface remains and that the most significant physical features of the oil field (e.g., the derricks) had been removed, destroyed, or modified through disturbance. Many of the original landscape features of the site, he explains, had been greatly altered when the area was rededicated to the extraction of natural-gas deposits (Foster 1991:4). Foster thus recommended the site not eligible for listing in the NRHP, and SRI researchers followed that recommendation. At the time of this writing, many of the features and associated dirt roads appeared to remain intact at this location.

SR-4 (LAN-1934)

SR-4 is a historical-period trash deposit originally recorded during SRI's pedestrian survey in 1990 (Altschul et al. 1991:150; Douglass 2007a) and later evaluated for NRHP eligibility by Hampson (1991). The site, assigned the trinomial LAN-1934, was located along channelized Centinela Creek, in the southwestern portion of PVAHP Area D1, slightly north of Locus A at LAN-62. It is situated about 150 m northeast of the Ballona escarpment. Hampson (1991) estimated that the trash remains covered a small, linear area of approximately 4 by 12 m.

Initial Survey (1990)

Based on surface evidence and heavy disturbance, Altschul et al. (1991:150) concluded that LAN-1934 consisted of a secondary deposit of historical-period debris. They observed a variety of trash remains, including glass, ceramics, wood, metals, and clamshells, and surmised that the trash remains were composed of mixed domestic debris dated from the 1930s through the 1950s. Their study was largely impressionistic, however, and not based on a systematic analysis of extant remains. Hampson (1991) subsequently conducted a systematic study of the materials from the site.

Test Excavations (1991)

Hampson (1991:7–8) examined and inventoried the temporally diagnostic surface materials from the surface and excavated two backhoe trenches, to evaluate the depth and stratigraphy of the trash deposit. Based on the testing results, he concluded that the deposits at LAN-1934 reflected "sequential dumping of undifferentiated fill materials in a linear pattern parallel and south of the drainage channel" (Hampson 1991:31). Hampson recognized multiple episodes of dumping in the trench-wall profiles. Most of the debris consisted of broken concrete and asphalt paving, concrete foundation segments, and associated dirt and debris. A small number of domestic artifacts also were present and, along with the presence of yellow traffic lines on the asphalt-paving sections, suggested a date in or later than the early 1960s. The materials at the site had clearly been removed from their primary contexts and redeposited in the site area as construction fill.

LAN-1934 conformed to the pattern of redeposition of cultural materials as construction fill that was observed at a number of other sites in the vicinity of the former HHIC (see above). As explained above, Hughes Aircraft Company regularly removed large amounts of soil containing archaeological materials from areas along the bluff and redeposited them as construction fill, especially in the vicinity of the former runway (see Appendix 11.1, this volume). Those earthmoving activities resulted in the removal and redeposition of large quantities of cultural materials from sites at the base of the bluff.

Construction Monitoring (2001–2002)

Three trench sections were excavated in the vicinity of LAN-1934 during monitoring of road construction in 2001 (Douglass 2004b, 2007a). The subsurface deposits in the trenches included a mix of historical-period bottles and construction debris. In addition, five areas in the same vicinity were graded in connection to the construction of a retention basin. The archaeological monitors collected a mix of historical-period and prehistoric materials, which underscored the extent of secondary deposition in the area; materials included lithic flakes, *Chione*-shell fragments, glass and china fragments, tiles, glass jars, and construction debris.

According to SRI archaeologist Anne Stoll (cited in Douglass 2004b:19), the deposit closely resembled what had been recovered from the historical-period deposits at LAN-193, which might indicate the source area for the redeposited soils. Also found in that area was a possible bifacial tool made from a piece of aqua glass, which suggested a Mission period component. That find might indicate that LAN-62, which contains a large Mission period component, was another source area of redeposited fill at LAN-1934 (the site was located just north of LAN-62). Additional monitoring of construction (3 graded areas and 12 trenches) occurred in 2002 and uncovered a mix of historical-period remains, including domestic refuse, construction debris, and a few prehistoric materials (Douglass 2004c).

Management Recommendations

The recent date for the site, as well as the undifferentiated fill materials contained within it, led Hampson to recommend LAN-1934 not eligible for listing in the NRHP. The site does not meet the aforementioned criteria for eligibility outlined by Altschul et al. (1991:168) (see above). The disposition of the site is unknown, but it was likely removed during construction.

SR-5 (LAN-1933)

SR-5 was a historical-period trash deposit originally recorded during SRI's pedestrian survey in 1990 (Altschul et al. 1991:150–153) and evaluated for NRHP eligibility soon after, by Hampson (1991). The site, later designated LAN-1933, was located in the western portion of Area D1, approximately 60 m west of Lincoln Boulevard and 75 m southeast of Jefferson Boulevard. The site also was situated roughly 100 m north of the western end of the Hughes Aircraft Company runway and partially overlapped with an area that, in 1990, still contained stamped, portable, iron runway sections anchored with iron stakes.

Importantly, the northern half of LAN-2676 overlapped the western portion of LAN-1933. Both sites encompassed different temporal occupation spans, however. LAN-1933 included only historical-period deposits, and LAN-2676 included mostly prehistoric deposits. LAN-2676 was considerably more deeply buried than LAN-1933, however. Both sites appeared to consist of redeposited materials used as fill from other parts of the PVAHP project area and are considered runway sites, as described above.

Initial Survey (1990)

Altschul et al. (1991:150) initially interpreted the historical-period debris as secondary fill deposits encompassing a linear area of 210 by 30 m. A ditch cut into the site area revealed continuous trash deposits up to roughly 1 mbs. The thick deposits lacked stratigraphic definition; for example, recent and modern debris (e.g., plastic items) was observed intermixed with debris dating as far back as the late 1800s or early 1900s. Based on the density and size of the trash deposit, Altschul et al. (1991:153) speculated that the site was, in fact, a historical-period landfill. They reported a variety of largely domestic-artifact types, including miscellaneous glass, metal, rubber, wood, and plastic (Altschul et al. 1991:150–153). Their observations were not based on a systematic study of the material remains, however.

Altschul et al. (1991) also reported three pottery sherds with makers' marks. One pottery sherd was from a large vessel made by the Wallace China Company in Los Angeles, which was founded in 1931 and liquidated in 1964. Two other pottery sherds came from vessels made by the Syracuse China Company, which has been in business since 1871 but operated as the Onondaga Pottery Company prior to 1895 (Preservation Association of Central New York n.d.). In more-recent times, the Syracuse China Company specialized in making pottery for railroad lines. Two monograms were identified on glass fragments, including the Thatcher Manufacturing Company (1900–1985), an important supplier of glass milk bottles in the twentieth century (Toulouse 1972). Another glass item was manufactured by the Owens-Illinois Pacific Coast Company in Oakland and suggested a date range of 1932–1943.

Test Excavations (1991)

Subsequent to the initial survey by Altschul et al. (1991), archaeologists with Greenwood and Associates examined and inventoried all temporally diagnostic materials from the site and excavated two 1-by-1-m test units, to collect a sample of cultural materials from controlled subsurface contexts (Hampson 1991:7). They also excavated three backhoe trenches, to expose and record the subsurface stratigraphy. Hampson (1991:26) reported two components of the site. The lower component encompassed a layer of more-deeply buried subsurface deposits extending to roughly 40 cmbs that covered the entire site area. The upper component, overlying the first, was composed of a linear stratum of fill recorded in the northern portion of the site, between the Hughes Aircraft Company runway and an old drainage ditch.

Although the lower component clearly underlies and postdates the more-widespread upper component, detailed analyses of temporally diagnostic materials revealed no temporal differences between them, which attests to the extent of subsurface mixing at the site that was also evident in the backhoe-trench profiles. The deposits likely had been originally deposited sometime between the mid-1940s and mid-1960s. The materials appeared to have been removed from their primary contexts and later redeposited in the area as fill, prior to construction. The materials found, including a mix of residential and hotel detritus, were similar to those recovered from LAN-1932. LAN-1933 was likely formed during Hughes Aircraft Company's construction or modification of the runway in the 1940s or 1950s.

Mixed deposits of historical-period and modern artifacts, including ceramic sherds and glass and metal fragments, also were recorded in the vicinity of LAN-1933 during monitoring of the destruction of the Playa Vista corporate office in 1998 (Fiore 1999:5). They were clearly disturbed secondary deposits, however, and additional field investigations were not pursued.

Construction Monitoring (2001)

Additional materials were collected from LAN-1933 during SRI's monitoring of construction activities in 2001 (Douglass 2004a). One trench excavated in the site area uncovered seven faunal bones with visible saw cuts. The materials likely were part of the redeposited historical-period trash reported by Altschul et al. (1991) and Hampson (1991). Several months later, SRI monitored excavation of five additional construction trenches, which uncovered a variety of historical-period and modern artifacts comparable to the residential and hotel detritus recovered during Hampson's testing program in 1991 (Douglass 2004b).

Management Recommendations

Citing the relatively recent dates and heavy disturbance of LAN-1933, Hampson (1991) concluded that the site was not eligible for listing in the NRHP. SRI and regulatory agencies concurred with Hampson's assessment. The present disposition of this site is unknown, but it was likely removed during construction activities.

SR-12 (LAN-2769)

SR-12 was first recorded during SRI's pedestrian survey of the PVAHP project area in 1990 (Altschul et al. 1991:153–155; see also various chapters in Altschul et al. [2003]). The site was later assigned the trinomial designation LAN-2769 once it became clear that it was a site with the possibility of intact prehistoric deposits (Grenda et al. 2003:58). However, after testing concluded that the site had been heavily disturbed, it was recommended not eligible for listing in the NHRP and was not a principal focus of SRI's archaeological investigations in the PVAHP project area (Ciolek-Torrello 2003). The site is situated within Area D, along the base of the Ballona Escarpment, roughly 300 m west of LAN-193 and directly adjacent to the HHIC (to the north). The relict alignment of Centinela Creek is roughly 60 m to the north.

Initial Survey (1990)

LAN-2769 was originally recorded during survey as a narrow band of midden deposits along the base of the bluff (Altschul et al. 1991:153–155). The surface at that time was heavily obscured by thick vegetation and an asphalt parking lot that covered much of the site.

Altschul et al. (1991:153) reported two narrow bands of undisturbed and nonvegetated soil immediately adjacent to the base of the bluff. They estimated that the soil within those bands was intact. The two bands, each roughly 1 m in width, were in the eastern and western portions of the site. The eastern band was about 20 m in length, and the western band measured approximately 40–50 m in length. The two bands were separated by roughly 20 m, of which the surface visibility was heavily obscured. Only the western band contained visible surface artifacts. The surface suggested a low-density deposit. Only 3–5 basalt flakes were observed on the surface in that area.

SRI researchers interpreted LAN-2769 as a probable intact, low-density midden deposit, although they conceded that the artifacts may have been secondary deposits from the top of the bluff (Altschul et al. 1991:153–155). They also hypothesized that if the artifacts were in their primary context, then the upper portion of the midden was likely located to the south, in which case it had likely been leveled and destroyed during construction of the asphalt parking lot. They estimated that 30–50 primary deposits may have been obliterated during the construction.

They also thought that LAN-2769 may have been the site originally recorded as LAN-193 by Hal Eberhart and formed a continuation of that site. Indeed, Eberhart had filed a site record for LAN-193 without having visited the site in person. Later investigations by SRI showed that LAN-2769 was spatially distinct from LAN-193 but may have once formed part of a more or less continuous expanse of midden deposits along the entire base of the bluff within Area D. Altschul et al. (1991:155) concluded that subsurface testing was needed to define site boundaries and to determine whether the site had integrity.

Test Excavations (1999 and 2001)

Grenda et al. (1999) outlined an excavation work plan for evaluating sites and cultural deposits in Area D of the PVAHP (see also Vargas and Feld 2003a:69–73). The original objective of the testing program was twofold: (1) determine whether the sites were intact or secondary deposits and, if intact, (2) determine their vertical and horizontal dimensions. Prior to testing, it was clear that traditional archaeological testing methods, such as trenching and manual test units, would be inadequate, because of the deeply buried cultural deposits.

To investigate the subsurface remains, SRI developed a two-phase testing strategy. During the first phase, SRI excavated three bucket-auger units and seven trenches of varying lengths within the site area (for a discussion of the benefits and drawbacks of bucket-auger testing, see Vargas and Feld [2003a]). For the second phase, SRI field personnel manually excavated three blocks containing a total of nine 1-by-1-m EUs. Underground utilities limited the placement of the subsurface exposures, however. All units were placed on the foot slopes of the bluff. All excavated matrix from the test units and a sample of matrix from the bucket-auger and trench units were wet screened using a 1/8-inch-mesh screen (Vargas and Feld 2003a:74).

In 1999, SRI excavated three bucket-auger units at SR-12/LAN-2769 (Vargas and Feld 2003a:72; Vargas 2003:136–142). Artifacts (five lithic-debitage fragments) were recovered from only one of the bucket-auger units, from a heavily disturbed context intermixed with modern construction debris. Three of the seven trenches were excavated into the asphalt parking lot covering most of SR-12/LAN-2769; four additional trenches were excavated within the estimated site boundaries to the west of the parking lot. None of the seven trenches encountered intact prehistoric cultural deposits, however. Moreover, close scrutiny of the trench profiles revealed that the subsurface soils within the site had been heavily mixed, likely via earthmoving activities and construction by Hughes Aircraft Company. The presence of drastically different stratigraphic profiles in the trenches, including those located in close proximity to one another, underscored the extent and severity of the subsurface disturbance in the area.

In 2001, SRI manually excavated the nine EUs (in three blocks) described above, all of which were situated within the toe slope, in the narrow band of midden deposits that Altschul et al. (1991:153) identified in 1990. The unit excavations also revealed heavy subsurface disturbance at the site, along the base of the bluff. The EUs generally contained small amounts of prehistoric cultural materials that were frequently intermixed with modern artifacts and materials in the upper levels, which probably included a mix of redeposited fill and alluvial and colluvial deposits from the overlying bluff top (Vargas 2003:139). The excavators exposed sparse, possibly intact prehistoric deposits in the deeper levels of the units; however, some or all of those materials may have shifted downward within the subsurface matrix as a result of bioturbation. (For details on unit-excavation results, see Vargas [2003:139–142]; summaries of artifact analyses from SR-12/LAN-2769 are presented in various chapters of Altschul et al. [2003].)

Construction Monitoring (2005–2006)

SRI archaeologists were present as monitors during construction of the Riparian Corridor, which extended along the base of the bluff and through a portion of LAN-2769 (Denniston and Douglass 2007a, 2007b; Douglass 2007b). The excavations included largely exposed, disturbed soils with construction debris. In some areas, excavation extended into deeper-lying native soils, but no cultural materials were recovered below the upper matrix of redeposited fill.

Management Recommendations

Based on the testing results, SRI concluded that LAN-2769 had been heavily disturbed as a result of earthmoving and construction activities that had likely been conducted by Hughes Aircraft Company in the mid-late 1900s. The prehistoric cultural materials at the site probably derived from redeposited fill or from colluvial and alluvial deposits from the overlying bluffs. Manual excavations revealed sparse, intact cultural deposits beneath the probable secondary deposits. The small quantity of prehistoric remains at the site suggested that the intact portion of LAN-2769 had been a lightly inhabited location, possibly a peripheral portion of a more-intensively occupied site that was no longer intact.

For these reasons, Ciolek-Torrello (2003:248) recommended SR-12/LAN-2769 not eligible for listing in the NRHP, adding that “[w]hat little information is present at the site is redundant and can add little more to our understanding” of the principle research goals of the PVAHP. Consequently, SRI conducted no additional investigations at SR-12/LAN-2769. Portions of the site were subsequently removed during construction of the Riparian Corridor.

Noncultural Deposits

In addition to archaeological sites in the PVAHP project area that contain archaeological materials, there were a small number of sites identified during initial survey that, after testing, were determined not to be prehistoric cultural deposits but, rather, detritus from modern work. Those noncultural deposits are discussed below.

SR-8

SR-8 was located in the northeastern portion of Area B, roughly 60 m south of the current Ballona Creek channel (Altschul et al. 1991:140; Ciolek-Torrello et al. 1998). Jefferson Boulevard is roughly 50 m to the south, and Lincoln Boulevard cuts through and truncates the eastern edge of the site.

Initial Survey (1990)

The site was first recorded during SRI’s pedestrian survey of the project area in 1990 (Altschul et al. 1991:140). It consisted of a very sparse scatter of shell extending over an area of 115 by 90 m. The shell remains included a number of species that were frequently exploited by native populations, including clams and scallops, as well as one species that was not frequently exploited, California hornsnail (*Cerithidea californica*). No indigenous artifacts or other cultural materials were found in the vicinity, although a thick, weedy ground surface obscured ground visibility. The survey crew recorded two isolated shotgun cartridges on the ground surface, but evidence of extensive historical-period occupation or land use was absent.

Given the observed range of species and the absence of artifacts, Altschul et al. (1991:140) were unable to determine whether the scatter formed as a result of indigenous cultural deposition or more-recent depositional episodes. The presence of scallop shells, which occur naturally in offshore locations, suggests the possibility that they were brought to and deposited at the site by human agents, most likely prehistoric or early-historical-period indigenous inhabitants (Ciolek-Torrello et al. 1998:25). One possibility is that SR-8 (along with nearby SR-9, SR-10, and SR-11) was formed by deposits left during a modern episode of dredging in Ballona Creek or during the construction of the Marina del Rey harbor in the 1960s (Altschul and Homburg 1996:8). A second hypothesis is that the shell materials were redeposited in the area as a result of earthmoving activities of Hughes Aircraft Company, as was common elsewhere in the project area (see above).

Archaeological Monitoring

On several occasions, SRI staff had the opportunity to monitor construction-related activities in the vicinity of SR-8. In May and June of 2000, several trenches and one auger were excavated near the boundaries of SR-8. Monitors did not encounter any intact cultural materials in those areas (Beardsley 2001). Later, in August 2000, more trenching on Lincoln Boulevard, immediately adjacent to the eastern boundary of SR-8, also did not reveal anything to indicate that the surface deposit at SR-8 represented an intact archaeological site (Douglass 2001).

Management Recommendation

Based largely on testing results at SR-10 and SR-11 (see below), the results of nearby monitoring activities, and the similarity of the SR-10 and SR-11 deposits, SRI determined the materials at SR-8 to be the result of dredging for the marina. For that reason, SR-8 is recommended not eligible for listing in the NRHP.

SR-10

SR-10 was located in the Ballona lagoon, in the northern portion of Area B (Altschul et al. 1991:143; Ciolek-Torrello et al. 1998; Keller 1999), 45 m north of Culver Boulevard and 400 m west of Lincoln Boulevard. The modern channel of Ballona Creek forms the northern boundary of the deposit, which appeared to have truncated the site when the creek was channelized in the 1930s.

Initial Survey (1990)

SR-10 consisted of a light, surface shell scatter covering an oval area of approximately 150 by 60 m. The site was first recorded during SRI's pedestrian survey of the PVAHP project area in 1990. At that time, Altschul et al. (1991:143) reported that the site had been moderately disturbed by modern grading/leveling equipment and by a small dirt road that intersected the project area. A borehole had been drilled into the site by LeRoy Crandall and Associates as part of a geotechnical study in the 1980s, which explained much of the evidence of disturbance and leveling at the site (Ciolek-Torrello et al. 1998:25).

The shell remains included four species frequently used by indigenous inhabitants of the area, including oyster and clam. The presence of those shell species suggested the possibility of cultural deposition; all four species have been recovered from archaeological sites in the area. No artifacts were found in association with the shell scatter, but modern trash was scattered in the vicinity. Altschul et al. (1991:143) concluded that additional testing was needed to determine the depositional context and integrity of the shell scatter.

Test Excavations (1998)

In 1996, SRI developed a plan for evaluating NRHP eligibility at SR-10 and other sites in the area (Altschul and Homburg 1996; Grenda and Altschul 1997). As discussed above, Altschul and Homburg (1996:7) proposed three hypotheses for the deposition of the shell scatter: (1) an archeological deposit; (2) a relict, natural shell-bed deposit exposed to the surface; and (3) redeposited shell placed in the area during periodic dredging of the Ballona Creek channel.

Cultural and natural deposition can be distinguished by the age distribution and taxa proportions in the collections (Altschul and Homburg 1996:8). Natural deposits are characterized by a full range of locally available shell species and age groups. Conversely, cultural shell deposits tend to feature a subset of locally available species and lack immature specimens.

Altschul and Homburg (1998:7–8) proposed a series of controlled surface collections using a 20-m-grid system. As explained above, the field crew removed the vegetation and systematically collected a sample of shells and shell fragments from a 10-by-10-m subsection of each grid cell. Because of heavy rains, however, most of the site was under 30–90 cm of water at the time of fieldwork in March 1998 (Keller 1999:1–2). Because surface collection was not possible, the field crew instead excavated 25 shovel-test pits at 20-m intervals and drilled 5 auger cores within the previously defined site area. All shell materials were analyzed by an experienced shell analyst, to identify the shell species and age ranges represented in the collection. Subsurface investigations were pursued only if surface evidence was not ample for assessing the depositional context of the shell materials. To inspect the subsurface stratigraphy, one test pit was excavated in a dry area near Ballona Creek (Keller 1999:8).

Auger cores revealed an A horizon roughly 1.2 mbs, but the shovel pits and test unit never reached undisturbed native soils. The subsurface above the A horizon was composed of modern fill, including a buried asphalt surface and other modern debris. The shovel tests showed that the shell remains observed on the surface had been intermixed with modern fill in the upper portions of the shovel-test pits, which suggested recent deposition of the shell remains. No prehistoric artifacts were recovered. At that time, SRI also interviewed a longtime employee of the Gillespie Corporation, Mr. Richard Terrell, who recalled storing large dredge piles in the vicinity of SR-10, along the side of Ballona Creek. Finally, the presence of mostly small, immature shell specimens and species that were not typically exploited as food resources by indigenous populations in the area reinforced the interpretation that the shell remains were not prehistoric or early-historical-period archaeological deposits (for details, see Keller [1999]).

Management Recommendations

The testing results indicated that the shell remains at SR-10 had been redeposited as a result of dredging of the Ballona Creek channel. For that reason, SR-10 was recommended not eligible for listing the NRHP (Keller 1999:38–39). The current disposition of the site is unknown, but it is likely still present, because no development has occurred in that area.

SR-11

SR-11 was located in the southern portion of Area C (Altschul et al. 1991:145; Ciolek-Torrello et al. 1998), roughly 40 m southwest of Culver Boulevard and directly adjacent (to the east) to the loop connecting Culver Boulevard to the northbound lane of Lincoln Boulevard. The Ballona Creek channel is roughly 100 m to the southeast.

Initial Survey (1990)

SR-11 was first recorded during pedestrian survey of the PVAHP project area in 1990 (Altschul et al. 1991:145). The site consisted of a sparse shell scatter encompassing a linear area of about 100 by 25 m. A thick cover of weeds obscured the ground visibility; nonetheless, the survey crew observed a number of modern or late-historical-period surface artifacts, including items made of ceramic, glass, rubber, metal, and wood, none of which appeared to predate the late 1930s. Many of the artifacts were highly fragmentary, likely as a result of modern plowing. The cultural materials likely were secondary deposits that had been dumped in the area as fill, probably during road construction. Although the artifacts likely were not significant cultural deposits, Altschul et al. (1991) suggested that additional testing was needed to determine whether the shell remains were archaeologically significant.

Altschul et al. (1991:145) reported California hornsnail, oyster, and venus clam on the surface at SR-11. Altschul et al. (1991:145) observed that, despite evidence of heavy disturbance in the area from road construction, dumping, and the channelization of nearby Ballona Creek, the surface deposits at SR-11 appeared to be relatively intact, although a portion of the site had been cut into with heavy machinery. Small amounts of concrete and asphalt were noted in the vicinity but were thought to have caused little disturbance to the deposit (Altschul et al. 1991:145; Shelley and Ciolek-Torrello 1998:7). Even so, Altschul et al. (1991) were skeptical that the shells were part of an archaeological deposit, because of the apparent absence of prehistoric artifacts or features. A much denser scatter of shell was noted in the center of the nearby traffic loop but was determined to have been redeposited as fill from an unknown location during road construction.

Several years later, however, Shelley and Ciolek-Torrello (1998:7) pointed out that prehistoric people living around the lagoon exploited both of the shell species recovered from SR-11 as food resources. Considering that the shell deposit was located on what was once the margin of the Ballona tidal marsh, they hypothesized that the surface scatter, in fact, was part of a cultural deposit. Shelley and Ciolek-Torrello (1998) developed a testing plan to determine whether intact archaeological deposits were present in the area and, if so, to assess whether those deposits were contributing members of the BLAD.

Test Excavations (2000)

Shelley and Ciolek-Torrello's testing plan was implemented in 2000 (Altschul 2002). Because the results have not been published, we report the testing results in detail here.

At the time of the test excavations, dense, weedy vegetation (mule-fat [*Baccharis salicifolia*]) covered most of the non-fill areas. After an initial surface examination failed to locate surface shell remains, the SRI archaeologists excavated two backhoe trenches. The excavators were careful to avoid damaging the mule-fat plants, which previously had been declared an environmentally sensitive plant species by the California Coastal Commission. Although the distribution of mule-fat constrained trench placement, sufficient areas were available for trenching to avoid compromising the goals of the project.

Trenches were excavated using a backhoe equipped with a 4-foot- (1.3-m-) wide, smooth-edged bucket. Sediments were slowly excavated in approximately 20-cm-thick lifts until confirmed marsh deposits were exposed. After excavation, the field personnel cleaned, photographed, and illustrated the profile from one wall of each trench. A sample of each sediment type was collected for analysis from Trench 2. The field crew collected four 5-gallon buckets of sediments, which were water-screened through 1/8-inch mesh. Both trenches were backfilled, and the area was restored to original conditions.

Trench 1 was located approximately 10 m southeast of the previously mapped shell deposit, to determine whether buried portions of the deposit extended beyond the known location. The trench was oriented west-northwest–east-southeast and measured 9.5 m in length, 1.3 m in width, and about 1.3 m in depth. No marine shell was observed during excavation or profiling. Small amounts of modern trash were observed in the upper 60 cm.

Trench 2 was located in the northern half of the previously mapped shell deposit. It was oriented northwest–southeast and measured 8 m in length, 1.3 m in width, and 1.25 m in depth. Small amounts of marine shell were observed in the trench wall during profiling. Small amounts of modern trash were observed in the upper 40 cm. Four 5-gallon buckets of sediments were collected from non-lagoon sediments and were screened. The sediment profile in Trench 2, which was typical of the project area, consisted of an approximately 50-cm-thick stratum of dark-grayish-brown clay loam over a 40-cm-thick stratum of light-brownish-gray silt. The boundary between the two sediments was relatively abrupt but heavily disturbed from bioturbation. The silt stratum was positioned over a sequence of loamy clay sediments that varied in color, from very dark gray to olive gray to olive, with increasing depth. The boundary between the silt and the lower loam clay sediments was noticeably abrupt. A darker color and a slight sulfur smell in the upper portion of the loamy clay sequence indicated a high organic content.

The loamy clay sediments were consistent in color and texture with marsh and lagoon deposits exposed in other excavations within the PVAHP project area. The light-brownish-gray silt sediments were interpreted as overbank-flood deposits, based on their relatively coarser texture and abrupt contact with the underlying loamy clay. The upper stratum of dark-grayish-brown clay loam contained a sparse assemblage of marine shell—mostly hornsnail, a small number of juvenile-oyster-shell fragments, and an even smaller number of jackknife-clamshell fragments. This stratum likely represented the margins of a brackish tidal-marsh environment. The tidal-marsh sediments likely were periodically inundated and would not have been conducive to human habitation, although people could have used the area for occasional forays into the marsh, to collect food and other resources.

No prehistoric artifacts were recovered during screening from the 20-gallon bulk sediment sample recovered from Trench 2. A very sparse collection of marine shell was recovered during screening, including seven hornsnail specimens of various sizes; five tiny, juvenile-oyster valves; two razor-clam-valve fragments; and one very small, juvenile-pismo-clam- (*Tivela stultorum*–) hinge fragment. Although some of those species were used by native peoples, the extremely small size of the specimens collected from SR-11 undermined their economic value. We doubt that they were deposited by human agents. The range of specimens represented among the hornsnail-shell fragments was particularly telling, because it included a range of age groups, from tiny, juvenile specimens to large, adult specimens, suggesting a natural population (i.e., one not subjected to the human selection of food specimens). No additional faunal remains were found during screening.

Construction Monitoring (2002–2003)

In 2002 and 2003, SRI monitored grading, augering, and trench-excavation activities related to the widening of Culver Boulevard (Douglass 2004c, 2004d, 2004e). The SRI monitors uncovered shell in several trenches and graded areas. They also observed one trench with a mix of modern and historical-period trash and construction debris mixed with shell remains. Many areas revealed evidence of heavy disturbance, however, and several of the trenches had been excavated entirely in imported fill. One temporally diagnostic bottle indicated a date of deposition in the 1940s.

Management Recommendations

SRI's findings demonstrated that the shell remains recorded as SR-11 derived from natural deposits. SRI found no evidence of prehistoric cultural activity. The sedimentological context indicated that the deposit was probably not from fill associated with road construction but, rather, likely formed via natural deposition. For that reason, SR-11 was recommended not eligible for listing in the NRHP (Altschul 2002). The site has subsequently been dismantled to make way for the realignment of the Culver Boulevard and Lincoln Boulevard intersection.

Unevaluated Archaeological Sites

Here, we briefly detail several other SR- sites that have not yet been evaluated. With the exception of SR-1, all these sites are located on land now owned by the State of California.

SR-1

SR-1 was discovered and recorded during SRI's initial pedestrian survey of the project area in 1990 (Altschul et al. 1991:146–150; Altschul and Ciolek-Torrello 1997:19), on the edge of the Ballona Escarpment, in The Campus portion of the project area (formerly known as the EMTD), near and to the south of LAN-193. The site extended from the margin of the bluff onto the slopes of a side canyon that had been incised into the bluff face. Because the site extended onto the crest of the bluff, which was located outside the project area (on adjacent property), SRI was unable to conduct surface reconnaissance over the entire site area.

Initial Survey (1990)

SR-1 consisted of a sparse to moderately dense shell midden. Altschul et al. (1991:146), who reported the survey results, observed sparse artifact debris on the site surface, including FAR, split cobbles, and lithic debitage, as well as various shell species. No temporally diagnostic artifacts were recovered. Altschul et al. (1991) were unable to estimate the age of the site. The portion of the site within the project area encompassed roughly 100 by 50 m, but the full extent of the site was unknown.

Altschul et al. (1991:150) suggested that many of the surface remains probably had been redeposited from the overlying bluff through erosion and colluvial activity. The deposits located farther downslope in the site area were almost certainly secondary deposits. In places, what appeared to be intact and consolidated sedimentary matrix and structural development was observed, suggesting possible in situ deposits. It was speculated, however, that many of those deposits might have washed down from the overlying bluff top and been incorporated in a weakly developed soil. It was not possible to quantify the extent of secondary deposition and in situ remains at the site based solely on the surface evidence (Altschul and Ciolek-Torrello 1997:19). Subsurface testing was required.

Management Recommendations

Altschul and Ciolek-Torrello (1997:29–30) considered SR-1 to be potentially significant and therefore developed a detailed testing plan for the site, to evaluate the extent and integrity of the archaeological resources. Their plan was to excavate three mechanical auger units and one manual test unit. Unfortunately, however, SRI never had an opportunity to conduct those investigations. The site was destroyed sometime between 1991 and 1997, during home construction and development along the crest of the bluff, outside the PVAHP area. During construction, the bluff edge was completely resculpted prior to the initiation of SRI's testing program in the area in 1997 (Altschul and Ciolek-Torrello 1997), and all surface evidence of the site was obliterated. Any subsurface remains, if present, also likely were obliterated, because of the landscape modifications in the area.

SR-3 (The Cox Stable)

SR-3 was recorded during SRI's pedestrian survey in 1990 and encompassed a historical-period horse stable and riding ring constructed in the mid- to late 1940s along the perimeter of the Ballona lagoon, in the southwestern portion of Area B (Altschul et al. 1991:138–140). The site was situated slightly more than 100 m northwest of Culver Boulevard and roughly 350 m south of the Ballona Creek channel. The northern boundary of the site was marked by a small canal linking Ballona Creek to the Pacific Ocean roughly 700 m to the southwest; the southern boundary was a fence line that separates the PVAHP project area (Area B) from the neighboring city of Playa del Rey. A trinomial designation was not assigned to SR-3.

Survey and Historical Research (1990 and 1991)

The historical-period component of the site (horse stable and riding ring) encompassed an area of about 150 by 60 m. The site was once a local tourist attraction called the Cox Stable, which remained in operation until 1988, when the standing structures were dismantled (see Altschul et al. 1991:140). The outlines of four structures were visible (Features 1–4). Features 1 and 3 were remnants of horse stables evidenced by outlines of wooden posts and manure remains within them. Feature 1 measured 27 by 8 m and contained six stalls. The dimensions of Feature 3 were 42 by 26 m, divided into two rows of stalls. Feature 2, located only 2 m from the edge of Feature 3, was a rectangular corral covering an area of 22 by 8 m partitioned into seven smaller sections of varying sizes. Feature 4 refers to the riding ring, an oval-shaped, fenced area with dimensions of 80 by 65 m.

The SRI survey crew observed sparse historical-period artifacts on the site surface, primarily metal nails and standing fence posts. Sparse prehistoric surface remains, including one prehistoric core tool made from quartzite (probably a scraper) and small amounts of marine shell, suggested a possible prehistoric component. Altschul et al. (1991:140) speculated that prehistoric features may have been present in the site area but had been obscured by recent historical-period remains. They initially recommended test excavations to explore the possibility of prehistoric features, but SRI personnel later reviewed the data and determined that additional testing was unnecessary.

Management Recommendations

SRI has not evaluated this site for eligibility for listing in the NRHP. According to local residents, the structures were dismantled in 1988, and it was unknown whether there were subsurface materials. This site is now on land owned by the State of California.

SR-7

SR-7 encompassed a scatter of historical-period-artifact refuse located roughly 300 m west of LAN-54, in Area C (Altschul et al. 1991:145). Lincoln Boulevard is about 110 m to the southwest of SR-7, and Jefferson Boulevard is roughly 180 m to the southeast. The site, first recorded during SRI's pedestrian survey in 1990, was subjected to severe disturbance as a result of historical-period and modern plowing, grading/leveling activities, and road construction.

Initial Survey (1990)

The artifact scatter covered an area of roughly 100 by 25 m. Dumping of historical-period and modern trash in the area created an undulating terrain at SR-7 and a large, artificial depression formed in the southeastern portion of the site as a result of modern mechanical-removal disturbance and leveling. The survey crew observed a variety of surface materials, including glass, ceramic, metal, wood, and rubber items, none of which predated the 1930s. The surface artifacts and materials were highly fragmented, likely as a result of modern plowing and grading activity. Altschul et al. (1991:145) concluded that the remains had been redeposited in the area as fill.

Management Recommendations

It was determined from SRI's initial survey that the site likely consisted of secondary deposits of relatively recent age. That stated, SR-7 has not been formally evaluated for eligibility for listing in the NRHP. The present disposition of this site is unknown, but the area appeared to have been left relatively untouched since SRI's survey work in 1991. This site is now on land owned by the State of California.

SR-9 (LAN-3982)

SR-9 was first recorded during survey in 1990 as a discrete surface scatter of shells and shell fragments (Altschul et al. 1991:143; Douglass 2004d). The deposit was situated in the central portion of Area B, 80 m east of the intersection of Culver and Jefferson Boulevards.

Initial Survey (1990)

In 1990, Altschul et al. (1991:143) observed an extremely light scatter of shell over a 90-by-55-m area. Most of the shell consisted of oyster and, to a lesser extent, clam, both of which were commonly exploited by indigenous populations in the area. One species that was not frequently exploited (California hornsnail) also was observed. No artifacts or other cultural materials were found in the area, although thick, weedy growth obscured the surface visibility.

Altschul et al. (1991:140) were unable to determine whether the scatter had formed as a result of indigenous cultural deposition or more-recent depositional episodes, including modern or late-historical-period dredging or earth-moving activities. However, the mixture of the different types of shell at SR-9 (culturally economic and noneconomic), as well as the lack of other cultural artifacts on the surface, suggested the possibility that the shell remains were not indigenous cultural deposits; similar concerns have been raised concerning other shell scatters in the project area, including SR-8, SR-10, and SR-11.

Monitoring of Construction (1998–2002)

The site was not systematically tested, but portions of the site have been exposed and recorded as a result of extensive monitoring of construction in the vicinity of SR-9 from 1998 through 2002 (Douglass 2001, 2004d). In light of the monitoring results, SRI researchers interpreted the shell deposits at SR-9 as spoils from dredging associated with historical-period drilling activity or the development of the marina; they were determined to be unrelated to prehistoric occupations or subsistence activities in the Ballona. During monitoring activities, however, SRI archaeologists observed subsurface historical-period architectural remains and artifacts immediately to the west of the original location of SR-9, which indicated a historical-period component of the site. The boundaries of SR-9 were subsequently moved approximately 100 feet to the west, to accommodate the historical-period remains.

In 2000, SRI monitors uncovered a rectangular structure constructed of wood and concrete at the southwestern corner of the intersection of Culver and Jefferson Boulevards. In 2002, SRI monitors again found exposed historical-period features in the vicinity of SR-9. The structure exposed during monitoring in 2000 had been constructed of concrete (4 feet thick) and covered with a tar-impregnated, redwood-type wood. The platform had been built into the native marsh soils (see Douglass [2004d:20–24] for further details). SRI archaeologists identified one isolate and two additional features during monitoring at SR-9 in 2002 (see Douglass [2004d:Appendix A] for additional details). All of the remains had been covered by fill. Isolate 1 was a heavily corroded steel I beam measuring 9 feet 11 inches in length, 6$^1/_2$ inches in width, and 9 inches in height. Isolate 1 did not appear to have been recovered in situ, however. A large pulley, 8 inches wide and extending out 10$^1/_2$ inches, was attached to the center of the beam. A square, metal plate was attached with four large bolts to the top of the beam, at either end. The plates might have functioned to attach the beam to a superstructure. The western end was twisted, which, given the weight of the beam, must have required considerable force. Based mostly on the presence of concrete on one end, that beam might have originally been erected vertically.

Feature 1 was a rectangular, box-like construction built of thick (6$^1/_2$-inch-by-8-inch), creosote-soaked railroad ties. The outside of the box measured 6$^3/_5$ by 4$^1/_2$ feet and was at least 4 feet in height. The outside of the box had been faced with vertical redwood planks (3 by 7 inches) that were flush with the top of the rectangular box of railroad ties and extended into native soils. The full length of the planks is unknown, because they extended below the water table, at which point excavation ceased. A portion of a corroded metal pipe measuring 3 inches in diameter was observed in the fill about 3 feet from the western edge of the box and might have functioned in association with the wooden box. Three artifacts were found in association with Feature 1: two clear, colorless-glass bottles and a large piece of metal, likely a crushed bucket. The two glass bottles, both milk containers, were temporally diagnostic of the period 1909–1940 (Toulouse 1972:57, 536). A portion of an Excelsior firebrick found near Feature 1 dated to 1921–1942 (Gurke 1987:232). The feature had likely been used during the 1920s and 1930s. The function of Feature 1 is unknown. However, the heavy-duty construction of the box suggested an industrial function, as reflected in the girth of the internal beams.

Feature 2 was located approximately 30 feet southeast of Feature 1 and contained two components: piles of wooden beams and an attached wooden platform. The piles (or piers, defined as wooden beams used as supports) were thick, 1-square-foot, creosote-soaked timbers. The piles were found in situ and had been originally buried to an unknown depth into the greenish native marsh deposits. A second component of Feature 2 was a platform constructed from wooden planks attached to the piles of wooden beams. The planks had been laid in a roughly east–west alignment, parallel to Jefferson Boulevard, and measured 1 foot across by 4 inches thick. Only a portion of the platform was found in situ; the other portion had been damaged by excavators during construction. Feature 2 likely was associated with the wooden-platform features uncovered in 2000, although the construction methods of the two features differed. Temporally diagnostic artifacts from Feature 2 included a metal fragment, a ceramic fragment, and a glass fragment, all of which indicated a date of 1900–1950.

Site Interpretation and Context

The historical-period remains uncovered during monitoring at SR-9 may have been associated with either the Playa Street or Motordrome Station of the Pacific Electric railroad or the remnants of an oil-drilling facility. The Playa Street Station was constructed in 1910, to coincide with the opening of a nearby automobile racetrack called the Motordrome. After extensive research, Douglass (2004d) was unable to locate photographs or plans of the station. As a result, the exact location, size, and organization the Playa Street Station is unknown. However, early maps of the Pacific Electric trolley routes indicated that it was located at the intersection of Playa Street and Speedway Boulevard (now Jefferson and Culver Boulevards, respectively). It is unclear how long after the racetrack burned to the ground in 1913 that the station continued before it was closed down. The spur between the Playa Street Station and the nearby Motordrome Station was partially removed in 1916 and had been fully demolished by 1934 (Myers and Swett 1976:71). The western portion of the spur from the Playa Street Station was clearly visible on an oblique photograph dating to 1938 (Foster 1991:Figure 3). Footprints of both that spur and the Motordrome Station spur could be identified in aerial photographs from as late as the 1950s. SR-9 might include a portion of the former Playa Street Station or affiliated structures.

As explained above, oil drilling was prominent in the Ballona Wetlands from 1929 through the 1940s, but oil derricks were dismantled and removed during the 1950s and 1960s. The physical remains of oil rigs in the Ballona have not been well documented. One historical-period oil complex at SR-2 (LAN-1970) (see above) has been documented (Foster 1991) (see above), but the facility had been severely damaged and disturbed prior to its examination. An oblique aerial photograph from 1939 showed two oil derricks in the vicinity of SR-9, on either side of Jefferson Boulevard, close to the intersection with Culver Boulevard (Altschul et al. 1991:Figure 31; see also Foster 1991:Figure 3). Both included access roads leading to Jefferson Boulevard. No wooden platforms or other outbuildings were evident in the immediate vicinity of SR-9. Along Culver Boulevard, the electric and rail lines for the Pacific Electric trolley system were clearly visible.

By themselves, these features and a single isolate from SR-9 did not clearly indicate an association with either the early-twentieth-century oil-production industry or the Pacific Electric trolley line. Isolate 1, a pulley and heavy steel beam, functioned for lifting objects. Oil production necessitates the transportation of heavy tools and equipment, and many of the stations along the Redondo Beach–Del Rey line functioned as both passenger and freight stops; both could have used such an item. Features 1 and 2, as well as the wood-and-concrete structure uncovered in 2000, were functionally ambiguous, but the heavy-duty construction of those features suggested an industrial function.

The 1927 USGS map showed an area to the north and adjacent to the road in which three structures, possibly tanks, were located. The three structures were not likely residential in nature, considering their distance from other habitation areas. Abundant fill soils were found within the site boundary, some of which contained small amounts of historical-period debris, such as fragments of brick and glazed-cement pipe. One plausible interpretation of this site is that it represents a remnant of oil- or gas-well operations that required the buildup of soil. However, neither Feature 1 nor Feature 2 was directly placed on the surrounding fill. Rather, they had been dug into native marsh soils. Isolate 1 was discovered in the fill unit but was not in situ.

Feature 2 and the structure uncovered in 2000 could have also been associated with the Playa Street Station. The location of the feature at the intersection of Culver and Jefferson Boulevards concurred with the documented location of the station. Unfortunately, SRI has found no written descriptions or photographs of the Playa Street and Motordrome Stations.

An alternate possibility is that, because of excessive tidal flow or flooding in the Ballona, Jefferson Boulevard had to be raised over the marsh soils, onto a wooden causeway, for some portion of its length. Indeed, Feature 2 paralleled the current alignment of Jefferson Boulevard. The causeway could have been later abandoned when the Ballona became drier. If that was the case, it likely occurred prior to the final channelization of Ballona Creek in 1935 (Altschul et al. 1991:76), which directed overflow farther to the west.

In sum, the site function of SR-9 remains indeterminate. It is highly likely that the features were constructed for activities related to oil exploration or for the Playa Street Station of the Pacific Electric railroad.

Management Recommendations

SR-9 is a historical-period site likely related to industrial activities or infrastructure improvements (rail-line or road maintenance) during the 1920s and 1930s. Although there were features identified during monitoring, their exact functions were enigmatic. As a result, although SRI has not formally evaluated this location for eligibility for listing in the NRHP, the evidence presented here strongly suggested that it is not eligible for listing, because of heavy disturbances to the location and the unknown function of the features recorded. The site has been formally recorded with the SCCIC and assigned both a trinomial (LAN-3982) and a primary number (P19-003982).

Summary

Christopher P. Garraty

This chapter provides a brief overview of the major points and findings reported in this volume, with a focus on the data recovery results at the five main sites (LAN-193, LAN-2768, LAN-54, LAN-62, and LAN-211). In the conclusion, a broader view of the analytical results are presented, through an intersite-level and project-wide perspective.

Overview of Results

The PVAHP involved the excavation of 1,526 units and 820 features (including burial and nonburial features) (Table 68), in addition to trenches and SUs. Not all of the units and features were subjected to analysis; instead, a sample was selected, based on integrity, location, character, and age. Generally, the units designated as CUs were fully analyzed in detail, to characterize a sample of the midden remains at each of the sites. The CUs were selected to maximize spatial coverage and to ensure analysis of middens in different areas of the sites and loci. In addition to the CUs, from which a number of material classes were subjected to analysis, selected material classes from a sample of other EUs were analyzed.

In total, 820 features were recorded during the PVAHP data recovery. The features were selected for analysis based on several criteria. All of the human burials were subjected to detailed study, including analyses of the human remains by physical anthropologists and analyses of several different material classes of associated artifacts. All recovery contexts in which isolated human remains were found were also analyzed. Nonburial features were selected for analysis in order to characterize a sample of different feature classes from each site or locus. They were also selected to ensure a sample of analyzed deposits from different spatial or temporal (stratigraphic) contexts within each site and locus.

Table 68. Summary of Data Recovery Units and Features Excavated in the PVAHP

Site No.	Units	Features
LAN-54	82	32
LAN-62[a]	844	608
LAN-193	119	55
LAN-211	370	46
LAN-2768	111	79
Total	1,526	820

[a] Includes Loci A–D and G.

A feature-classification system was devised to characterize and interpret the features and is described in Chapter 5, this volume. That system included multiple levels of classification based on various criteria, including morphology and feature content. At a broad level, features were classified as premodern/indigenous features or as late-historical-/modern-period features. Premodern/indigenous features, which constituted about 96.5 percent of the classified features, were further categorized as domestic or burial/ritual features or as thermal or nonthermal deposits. On a more detailed level, the features were classified according to their material content (e.g., FAR, flaked stone, shell, and faunal bone) and morphology. A final level of classification involved interpretations of feature function. Slightly higher numbers of features were classified as burial-ritual features (52 percent) than as domestic features (45 percent) related to subsistence activities. Outside LAN-62 Locus A, domestic features outnumbered burial/ritual features by about 13 to 1 (193 domestic to 15 burial/ritual features, excluding LAN-62 Locus A) and composed 93 percent of the features. Domestic features dominated the feature classes assigned to the Millingstone and Intermediate periods and among the Protohistoric/Mission period occupations outside the burial area.

Late-historical-period features (post-1850) were relatively scarce (n = 28, or 3.5 percent) and accounted for no more than about 15 percent at each of the sites, with the exception of LAN-62 Locus B/C/D, where half the recorded features (5 of 10) were late historical period in age. The late-historical-period features mostly consisted of trash dumps and structural remains, which were easily recognized as late historical period by the presence of glass, bottles, metal objects, saw-cut bone and wooden planks, cement and construction debris, and, in some cases, rubber and plastic. Several horse inhumations also were recovered and probably had been interred by ranchers or farmers in the area during the late 1800s or early 1900s. The generally small number of late-historical-period features might have stemmed from Hughes Aircraft Company's leveling and construction activities, which removed shallower archaeological deposits from many areas along the edge of the bluff.

Data Recovery Results at PVAHP Sites

The following discussions summarize the results of data recovery at the five main PVAHP sites. Volume 5, this series, presents detailed intersite interpretations and discussions of the archaeology of the Ballona at a regional scale. The main purpose of the discussions in this volume was to present descriptive data as a backdrop to the detailed analyses presented in Volumes 3–5, this series.

LAN-54

The data recovery efforts at LAN-54 were mostly concentrated in the southern half of the project area. Overall, 32 features were recorded, including 23 domestic features, 5 burial/ritual features, and 4 late-historical-period features. The results indicated that LAN-54 was a multicomponent site with intact prehistoric components dating to the late Millingstone and early to middle Intermediate periods and a minor historical-period component.

The densest concentration of features and midden deposits was in the southern portion of the project area (Keller and Altschul 2002). The northern portion had been heavily disturbed by construction of a packinghouse and an associated rail-spur line in the early twentieth century, although some intact subsurface deposits were observed beneath the footprint of the structure, in the far-northern portion of the project area (Keller and Altschul 2002).

Most of the domestic features at LAN-54 were assigned to the late Millingstone and very early Intermediate periods. Those early features appeared to be concentrated on a relict berm or raised area, which would have offered an appealing locus for camping in the largely wet and marshy environment of the lowland Ballona at the time. The domestic features assigned to the Millingstone and early Intermediate periods were mostly nonthermal deposits with abundant shell. Moreover, shell dominated the sampled midden deposits at LAN-54, composing 70 and 85 percent of the midden constituents from the Millingstone and Intermediate periods, respectively. That pattern suggested a focus on shellfish-processing activities in the vicinity of LAN-54 during the Millingstone and Intermediate periods, probably because of its proximity to the ancient lagoon.

A slightly later Intermediate period component was marked by several primary inhumations and ritual deposits, which were likely offerings associated with the inhumations. All three primary inhumations contained the remains of adult females interred in fully flexed or semiflexed positions. Two other features dated to that episode were nonthermal deposits mostly consisting of unworked shell and smaller amounts of other artifacts. Those features suggested continued use of the site as a locus for processing food, but not to the extent that it had been during the previous episodes. The site functioned as a one-time or short-term mortuary locus during the later episode. We suspect that the individuals probably were interred during one or several trips to the area. That all three burials were of adult females could suggest that the collection of shell was a predominantly female activity.

The excavations at LAN-54 yielded no evidence of Late, Protohistoric/Mission, or Rancho period occupation. The Euroamerican period at LAN-54 was evidenced by early-twentieth-century features and evidence of urban development in the Ballona. Also, a packinghouse was constructed in the early twentieth century, suggesting a focus on agriculture in the area.

LAN-62

LAN-62 was the most complex of the five main PVAHP sites in the Ballona and had seven loci (Loci A–G). The focus of the data recovery was in Locus A, but excavations were conducted in the other loci, too. In total, 844 units and 608 features were excavated at LAN-62. The features included 179 domestic features, 410 burial/ritual features (which included 374 human-burial features), and 19 historical-period features. The results indicated that LAN-62 was a multicomponent site with intact prehistoric components dating to the Millingstone period and primarily the Protohistoric/Mission period. Human occupation at the site covered a long time span, from the early Millingstone period (ca. 5000–4000 b.c.) through the Mission period (A.D. 1770–1830), albeit with occupational hiatuses in the middle Millingstone period (ca. 4000–3000 b.c.) and the early centuries of the Late period (ca. A.D. 1000–1200). Three spatially and temporally distinct areas were delineated at LAN-62 Locus A, based on dense concentrations of features and associated middens, and included FB 3 (Protohistoric/Mission period), FB 4 (Intermediate period), and FB 7 (Millingstone period).

Most of the features were classified as burial/ritual features and were concentrated in or near the burial area in Locus A. The burial/ritual features included mostly primary inhumations (some of which exhibited evidence of cremation). Less frequently recognized were secondary inhumations and relatively intact cremations (primary or secondary interments). Many of the human burials within the burial area in Locus A were associated with scattered and disarticulated bones from multiple individuals within the feature matrix, sometimes with a mix of thermally altered and unaltered remains. Among domestic features, most prevalent were "generalized" nonthermal-debris deposits that contained mixes of materials, such as faunal bone, shell, FAR, lithic artifacts, and other items. The deposits probably represented discrete accumulations of debris generated during short-term camping episodes. Also present were several deposits, each of which was dominated by a single material class, such as shell, FAR, faunal bone, cobbles, or ground stone. Those features may have functioned as cairns or posthole supports used to stabilize structures constructed on the unconsolidated sands, as site "furniture" used to support tools or other objects, or as small refuse dumps. Only a small number of features containing evidence of in situ thermal activity, such as oxidized soils and ash, suggested well-defined hearths.

Features and midden deposits assigned to the Millingstone period were recovered only from Loci A and G. Those features were mostly domestic-discard areas and represented discard areas for task groups that established short-term camps in the lowland Ballona, to procure resources. In contrast to LAN-54, however, at which shell dominated the feature and midden assemblages, the Millingstone period middens and features at LAN-62 contained primarily faunal bone, mostly from mammals, and small amounts of shell. Hence, the tasks groups that used the Ballona targeted LAN-54 for shellfish and LAN-62 Loci A and G for terrestrial mammals.

The Intermediate period witnessed a continuation of land use in Loci A and G for camping and processing locations for task groups, but the foci of the tasks were somewhat different. Faunal bone dominated the Millingstone period middens and feature collections, but the Intermediate period collections contained abundant faunal bone, shell, and bony-fish remains. The abundance of mammal bone, fish bone, and shell suggested that the area had been targeted for several kinds of resources, including fish, shellfish, and mammals, in contrast to the generally narrower focus of resource-acquisition activities at the other sites during the Intermediate period. The high density of Intermediate period midden remains at Locus A/G conformed to the evidence of multiple resource-collection tasks at that location, suggesting high-intensity land use of the area in the form of frequent reuse of the site and/or a larger number of task-group members. Furthermore, the diversity of material remains recovered from an Intermediate period activity area suggested that a large-sized forager group(s) used the site as a locale to acquire multiple resources—fish, shellfish, and mammals—during a single visit. The larger group size (inferred from the large number of subfeatures) and the presence of various material classes (shell, mammal bone, and fish bone) may suggest a task group that included both male and female group members. Presumably, the males were responsible for hunting and possibly fishing, and the females were tasked with collecting shellfish and other resources.

Only four features were assigned to the Late period at LAN-62, all located in Loci A and G, which suggests a relatively light occupation during the first half of the second millennium A.D. All four of the features were classified as domestic deposits and were interpreted as discard areas containing debris related to various subsistence tasks. These results suggested that the large fan encompassing Locus A and nearby Locus G continued to be used as a location for short-term camping during the early second millennium A.D., but with a much lower frequency than during the previous Intermediate period.

The Protohistoric and Mission periods witnessed peak occupation intensity at LAN-62, as evidenced in the large number of features and dense midden deposits. A formal mortuary-ritual area was established during that time, and the burials in Locus A were mostly concentrated in or near the burial area. About half were located outside the dense cluster, which may suggest that the main burial cluster was not perceived as the "core" of the burial area during the Protohistoric period but probably occurred later, during the Mission period. Three domestic features were assigned to the Protohistoric/Mission period, all located at a distance of 5 m or greater from the main burial area, which may indicate that area inhabitants refrained from performing domestic subsistence tasks in the direct vicinity of the burials. The burial area was culturally perceived as an area in which domestic tasks were prohibited or restricted, although it is possible that some of the domestic, subsistence-related features were locations of food preparation for mortuary feasts associated with the burial area.

Glass beads recovered from the burial area in Locus A suggested continued use through the A.D. 1810s (see Chapter 6, Volume 3, this series).

LAN-193

The data recovery efforts at LAN-193 were mostly concentrated in the east-central portion of the site, which encompassed a concentration of features. Overall, 55 features were recorded at LAN-193, including 49 domestic features, 4 prehistoric burial/ritual features, and 2 late-historical-period features. The domestic and burial/ritual features and midden levels subjected to radiocarbon dating suggested a late Millingstone through late Intermediate period occupation and an occupation peak during the middle and late Intermediate period, from about 500 b.c. to A.D. 500.

The domestic features were mostly thermal deposits composed of FAR and smaller amounts of other materials, especially ground stone and flaked stone. Most were probably cleanout deposits from hearths. No definite hearths were identified among the Intermediate period features at LAN-193, but it is likely that some of the features identified as FAR concentrations were, in fact, heavily disturbed hearths; many centuries of bioturbation and other postdepositional effects could have dispersed the feature matrices and displaced any burned and oxidized soils. The nonthermal features were mostly "general" discard areas containing some mix of flaked stone, ground stone, unmodified cobbles, FAR, and small amounts of faunal bone and shell. Three "mixed" features were classified as containing thermal and nonthermal components; all of them were large activity areas that contained mixes of thermal and nonthermal subfeatures. The deposits likely represent a palimpsest of discarded remains generated during short-term forays by hunter-gatherer groups over the course of the roughly 2,000-year span of the Intermediate period.

Unlike most contemporaneous Intermediate period features at other sites, the domestic deposits contained high frequencies of flaked stone and ground stone and sparse concentrations of shell or faunal bone. Shell was also virtually absent from the Intermediate period midden deposits at LAN-193, although faunal bone was fairly abundant. The Intermediate period function and land-use pattern at LAN-193 is ambiguous. The high frequency of thermal deposits, flaked stone, and ground stone suggested frequent cutting, grinding, and heating activities, but the dearth of faunal bone and shell in the features suggested that they did not function as "workstations" for processing hunted animals, fish, or shellfish. It is possible, however, that task groups entered the area to hunt and process animals, but the animal byproducts (mainly bones) were not usually discarded in the same locations as the processing tools and thermal debris.

The prehistoric burial/ritual features included three primary inhumations (one male and two possible females, all adults), and one nonthermal ritual deposit composed of a metate fragment and a deliberately arranged concentration of abalone shells. The latter deposits appeared to have been a mortuary offering associated with one of the primary inhumations. These burials were not spatially concentrated and did not compose a well-defined burial location. More likely, as explained in Chapter 6, this volume, the interred individuals probably perished during resource-collection forays in the area and were buried near the locations of their deaths.

The late-historical-period features consisted of a horse skeleton and a refuse pit. The horse had probably been buried (or placed) in the area by a local farmer or rancher in the mid- to late nineteenth century or early twentieth century. It likely postdated the Mission period occupation but predated the establishment of the HHIC. A large refuse pit with domestic materials and other debris dating to the 1920s and 1930s was encountered during monitoring work within the LAN-193 boundaries. Archival research identified several photographs that placed the Kitahata Hog Ranch at the same location during the 1920s. It is likely that the deposits found in this large feature were related to that operation. Late-historical-period artifacts also were recovered in scattered units and trenches throughout the site area. Importantly, additional late-historical-period remains may have been obliterated in the mid-twentieth century by the leveling and construction activities of Hughes Aircraft Company.

LAN-211

During the data recovery at LAN-211, in total, 370 units in five variably sized blocks and 46 features were excavated in different areas of the site. The 46 features included 41 domestic features, 3 human burials, and 2 late-historical-period features. Generally, the feature collection suggested a focus on thermal activities. A large Protohistoric/Mission period activity area labeled Feature 1 contained subfeatures, mostly hearths characterized by well-defined pits with evidence of in situ thermal activity (oxidized soil and ash). The results indicated that LAN-211 was a multicomponent site with intact prehistoric components dating to the late Intermediate period and primarily the Protohistoric/Mission period.

Most of the Intermediate period features were general discard areas that contained mixes of discarded debris, such as FAR, faunal bone, and lithic artifacts. Those deposits had probably accumulated over a long span, from repeated logistical visits to the site area to acquire resources, including animal meat. The scattered Intermediate period features represent a palimpsest of separate and unrelated depositional events from resource-collection forays in the Ballona. Faunal bone, primarily from mammals, was prevalent in the Intermediate period features and midden deposits at LAN-211. Flaked stone artifacts also were frequent and presumably functioned as cutting tools for processing mammals.

The large concentrations of features and dense midden deposits at LAN-211 underscored a peak occupation during the Protohistoric/Mission period, especially the Feature 1 activity area in the central portion of the site. All but one of the Protohistoric/Mission period features were classified as domestic (one fetus burial was recorded within the Feature 1 activity area); most were hearths or hearth-cleanout deposits, suggesting a central focus on cooking and food preparation. The excavated portion of Feature 1 (referred to as FB 1) contained 23 subfeatures, including 20 hearths, some of which formed a linear arrangement. Residential functional use (i.e., permanent vs. temporary residence) was difficult to infer from the data. However, the hearths presumably had been roughly contemporaneous or used successively over the course of a single habitation episode; the group of hearths likely represents a grouping of related occupation events—a pattern atypical of earlier occupations in the Ballona.

The quantity of hearths and the large size of many of them implied relatively intense occupation, possibly semipermanent occupation during all or much of the year. In contrast to earlier occupation episodes, Feature 1 was not likely a palimpsest of unrelated deposits from various camps. In Chapter 10, this volume, we speculated that post supports marked the locations of domiciles to the north of the line of hearths. That interpretation is tentative, given the dearth of conclusive structural evidence, but indigenous architecture in California is notoriously difficult to identity (Chartkoff and Chartkoff 1984; Ciolek-Torrello 1998). If those areas did contain domestic architecture, then the line of hearths and surrounding "open" areas could have functioned as communal cooking and activity loci adjacent to them. The high density of remains within FB 1 may suggest that the area was used for communal feasting related to the burial area. The residents of this proposed community probably interred their dead in the burial area at LAN-62 starting in the Protohistoric period. The Mission period occupation probably ended in the 1810s.

No evidence of Rancho period occupation was uncovered at LAN-211, although such evidence may have been removed as a result of construction during the Hughes era. Documentary and anecdotal evidence suggested Euroamerican period occupation and land use at LAN-211. Robinson (1939:108) quoted an elderly Cristobal Machado, who claimed to have observed “brush-and-mud huts” inhabited by Native American ranch hands along the bluff below LMU, which corresponds approximately to the location of LAN-211 (Stoll et al. 2003:36; Vargas et al. 2003:137–138). The huts presumably were occupied during the mid- to late 1800s, but starting in the 1880s, Euroamerican development may have limited ranch-work opportunities by the late 1800s and early 1900s. The horse inhumation, though recovered in secondary context, presumably had been interred in the area in connection with ranching or farming activities during that period.

LAN-2768

The data recovery efforts at LAN-2768 were mostly concentrated in the eastern portion of the site (Loci A and B), which encompassed a concentration of features. Four loci were identified at the site: Loci A, B, C, and D. Overall, 79 features were recorded, including 65 domestic features, 3 burial/ritual features, and 11 late-historical-period features. The features and midden levels subjected to radiocarbon dating suggested an Intermediate period occupation and an occupation peak during the early and middle Intermediate period.

The Intermediate period occupation in Locus A likely represents a palimpsest of seasonal visits to the area to procure marine or other resources over a long span. Most salient was a series of functionally ambiguous concentrations of primarily unmodified cobbles that mostly postdated a proposed house pit found at the site. The cobbles did not exhibit evidence of thermal cracking or spalling, and few were concentrated tightly enough to have functioned as cairns or posthole supports (although they may have been dispersed as a result of bioturbation). Determination of their function will require additional testing.

As was the case in Locus A, completely or partially intact midden deposits were encountered in the southern portion of Locus B, along the base of the bluff. Two prehistoric thermal-refuse features also were encountered in that portion of the site. In the northern half of the site, 11 historical-period features were excavated, including portions of structures, leach pits, wells, a rail spur, and a trash deposit. Most of those remains were associated with the Hughes-era occupation (mid-twentieth century) in the Playa Vista area, but 1 feature, a trash pit, contained bottle glass and ceramics that indicated occupation in the early 1900s, prior to the Hughes era (1910s–1930s).

Intact deposits also were present along the base of the bluff in Loci C and D. The majority of features in that vicinity were prehistoric thermal features; especially prevalent were refuse deposits from hearths. The range and proportions of inferred feature functions were remarkably similar to those of features recovered in adjacent LAN-193. The features in both areas were mostly thermal-discard deposits and deposits of flaked stone and ground stone. Faunal bone was generally sparse (relative to FAR and lithic-artifact frequencies), and shell was virtually absent. The features at LAN-193 and at LAN-2768 Locus C/D indicated a similar pattern of land use, which involved thermal activities as well as frequent cutting and grinding but few or no activities related to processing or preparing shellfish, fish, or other fauna.

One radiocarbon assay from a hearth in Locus C generated a Protohistoric or Mission period date, and the hearth may have marked the location of a short-term camp. No additional features or midden deposits in The Campus area were dated to the Protohistoric/Mission period. The presence of the hearth suggested at least modest use of that area during the Protohistoric/Mission period, but it is possible that archaeological remains from that or later periods were removed during construction and grading episodes by Hughes Aircraft Company.

Twenty glass beads dated to the Rancho period (1830–1848) were recovered from SUs at LAN-2768, suggesting a post–Mission period component at the site, but no features or midden deposits were dated to that period. We were therefore unable to investigate Rancho period occupation in the area. Additional features and other evidence (archaeological or documentary) of Rancho period occupation were not found, but any such materials might have been removed as a result of Hughes Aircraft Company’s construction and earthmoving activities. The project area was part of the Rancho Ballona at that time (see Stoll et al. 2003:26–31), and it is possible that Native American ranch hands residing in the area used and discarded the glass beads.

Historical evidence suggested possible Euroamerican period (1848–1941) land use and occupation at LAN-2768. Surveyor George Hanson’s handwritten notes and field maps from the 1870s indicated the presence of several structures in the area below the bluff, including several in the vicinity of LAN-2768 (Stoll et al. 2003:36–38). One structure labeled the “Mais house” appeared to have been located within the site area, but no archaeological evidence of the structure was found. SRI’s excavations exposed structural remains in Loci A and B that may date to that period, including wells, concentrations of wooden posts, and concrete footings. In addition, a historical-period trash pit in Locus B (Feature 204) revealed temporally diagnostic ceramic and glass fragments that suggested occupation between the 1910s and 1930s.

Conclusion: A Land-Use History of the Lowland Ballona

Intersite and regional-scale analyses of feature distributions highlighted changes in the settlement and land-use history of the lowland Ballona. The Millingstone period occupation was mostly concentrated at the western edge of the project area, specifically at LAN-54 and LAN-62 Locus A/G. Features in those areas probably marked the locations of short-term camps situated on raised areas or berms above the largely unstable and marshy landscape. Analyses of the Millingstone period features, midden components, and activity areas at LAN-54 suggested that task groups used the area to procure and process shellfish and possibly other aquatic resources. In contrast, analyses of features, midden components, and activity areas indicated a more pronounced focus on the hunting and processing of mammals in Locus A/G.

The Intermediate period witnessed the most extensive pattern of land use and occupation in the prehistory of the Ballona. Intermediate period components were identified at all sites and loci in the PVAHP project area. Again, based on our analyses of features, we suspect that most of the features and midden remains represent a palimpsest of debris that accumulated during short-term trips by mobile groups over a roughly 2,000-year span, although SRI uncovered a single house pit (later reused as a roasting pit) associated with intramural and extramural features at LAN-2768 Locus A that suggested at least a brief period of semipermanent or seasonal residential use.

The "zoned" land-use patterns of the late Millingstone period that were first evident in various areas of the lowland Ballona expanded during the Intermediate period. The Ballona Creek area (LAN-54) mainly was used as a collection area for shellfish and aquatic resources. In the easternmost portion of the area along the bluff (LAN-2768 Locus A/B), the presence of several cobble concentrations suggested some as-yet-indeterminate nonthermal activity. To the west of that area, at LAN-2768 Locus C/D and LAN-193, land-use practices focused on another yet-unknown activity that made frequent use of hearths and lithic artifacts (flaked stone and ground stone). In the western bluff area, locations in the vicinities of LAN-211 and LAN-62 Locus B/C/D seemed to have been predominantly used as loci for hunting and processing mammals. Finally, the westernmost area along the bluff, at LAN-62 Locus A/G, accommodated a variety of subsistence activities, including shellfish procurement, hunting, and fishing, along with the processing activities associated with each (e.g., defleshing). The multifunctional land-use pattern at LAN-62 Locus A/G generated higher Intermediate period midden densities than were observed at any other site or locus in the PVAHP project area.

The lowland Ballona fell into a period of disuse or infrequent use during the Late period, but new settlements had been founded by around the mid-second millennium A.D., possibly in response to Spanish colonialism and the influx of European epidemics (especially smallpox). The Protohistoric and Mission period settlements encompassed a landscape division between the living area at LAN-211 and a mortuary-ritual area at LAN-62 Locus A. The very high midden densities in the CU levels assigned to the Protohistoric/Mission period suggested peak occupation intensity, which may indicate establishment of a permanent or semipermanent habitation. As explained above, based on several lines of evidence, we posit that the living area at LAN-211 consisted of one or several residential structures and a common area used for cooking, heating, and other domestic tasks (as evidenced by the line of hearths). It is possible that the high density of artifacts associated with that area may suggest its use in communal feasting related to the burial area at nearby LAN-62.

The lowland Ballona was established as a ranching location by the early to mid-1800s, but SRI recovered sparse evidence of Rancho period occupation (ca. 1830–1848). A handful of glass and ceramic beads that dated to the Rancho period were recovered from SUs at LAN-2768. Several glass and ceramic beads recovered from SUs at LAN-193 also indicated possible Rancho period occupation, but the majority postdated the Rancho period (see Chapter 6, Volume 3, this series).

Euroamerican period features and materials were recovered throughout the project area and from each of the five main PVAHP sites. Several features included domestic-trash deposits containing glass bottles, ceramic dishes, and saw-cut bone and metal; others appeared to have contained mixes of domestic and industrial materials, such as rebar, nails, and concrete. Several deposits included rubber and glass, suggesting occupation no earlier than the 1930s. Euroamerican period structural remains also were recovered throughout the project area, and there was a dense concentration at LAN-2768 Locus B. The latest premodern occupation in the project area was related to the founding of the HHIC, along the base of the bluff, from the 1940s through 1980s.

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