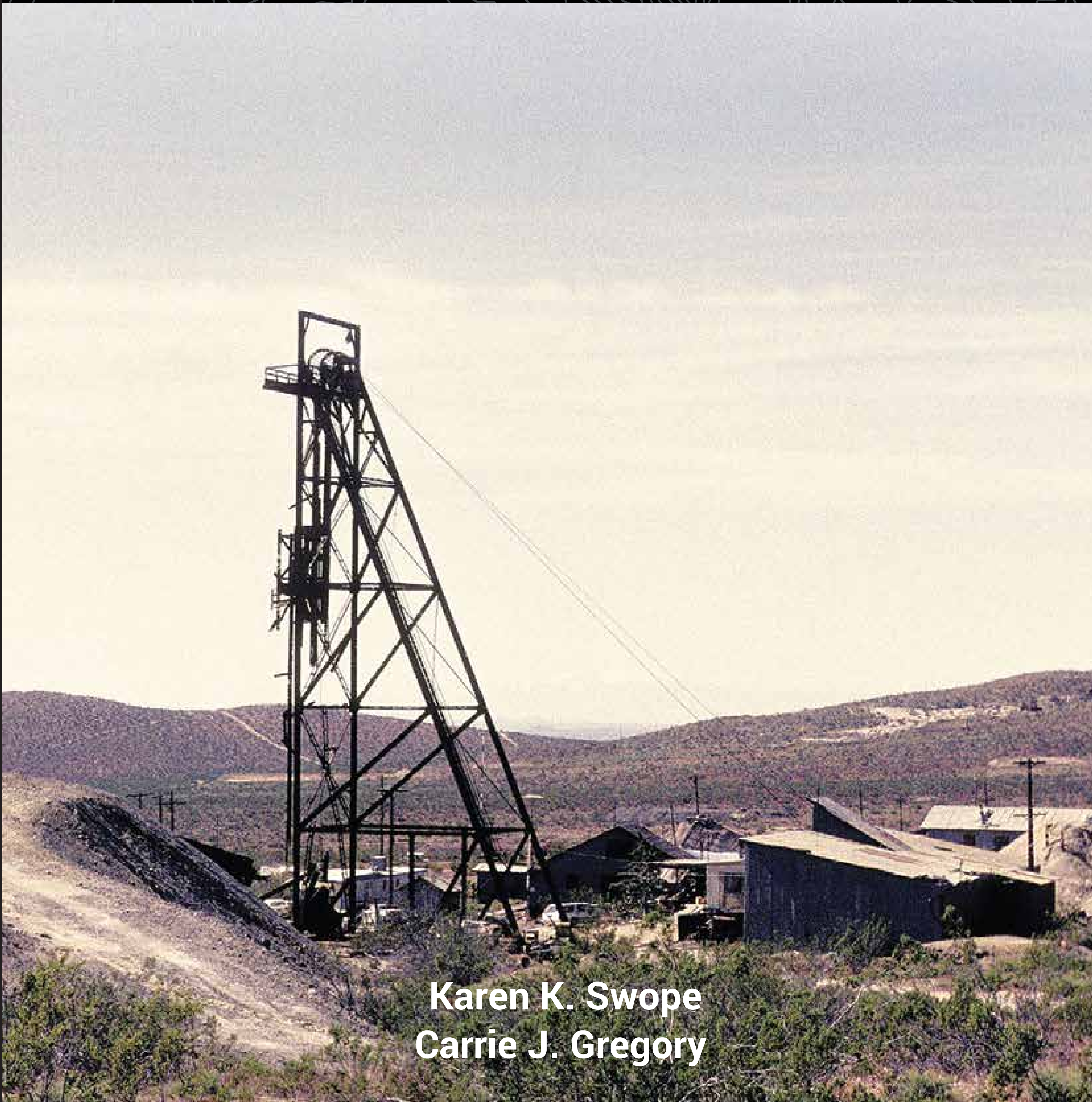
U.S. Department of the Interior
Bureau of Land Management

Mining in the Southern California Deserts

A Historic Context Statement and Research Design



Karen K. Swope
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Mining in the Southern California Deserts: A Historic Context Statement and Research Design

Karen K. Swope and Carrie J. Gregory

Submitted to

Sterling White
Desert District Abandoned Mine Lands and Hazardous Materials Program Lead
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Technical Report 17-42
Statistical Research, Inc.
Redlands, California

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October 2017

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LIST OF ACRONYMS AND ABBREVIATIONS

AML	Abandoned Mine Lands
AMSL	above mean sea level
APE	area of potential effects
ATV	all-terrain vehicle
BLM	U.S. Department of the Interior Bureau of Land Management
Bureau of Mines	U.S. Department of the Interior Bureau of Mines
Caltrans	California Department of Transportation
CASSP	California Archaeological Site Stewards Program
CDCA	California Desert Conservation Area
CDD	California Desert District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
CRHR	California Register of Historical Resources
CRM	cultural resource management
E&MJ	*Engineering and Mining Journal*
FLPMA	Federal Land Policy and Management Act
GIS	geographic information system
GLO	U.S. General Land Office
GPS	Global Positioning System
HAER	Historic American Engineering Record
HazMat	Hazardous Materials
M&SP	*Mining and Scientific Press*
MRB	Mining Records Book
MSHA	U.S. Department of Labor Mine Safety and Health Administration
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act of 1966, as amended
NPS	U.S. Department of the Interior National Park Service
NRHP	National Register of Historic Places
OHV	off-highway vehicle
OIG	Office of the Inspector General
PL	Public Law
SBCHA	San Bernardino County Historical Archives

SBCS	*San Bernardino County Sun*
SHPO	State Historic Preservation Office
SMARA	California Surface Mining and Reclamation Act of 1975
TCP	traditional cultural property
UAV	unmanned aerial vehicles (“drone”)
U.S.C.	*U.S. Code*
USFS	U.S. Department of Agriculture Forest Service
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator
WEMO	West Mojave

Since the 1970s, the U.S. Department of the Interior Bureau of Land Management (BLM) has recognized significant historical and archaeological values associated with mining sites on public lands in the southern California deserts. Mining has played an integral role in western American history, and the archaeological record presents an opportunity to understand and interpret mining history in a manner that is not accessible through historical documentation alone. This study provides a landscape-scale approach to the identification, evaluation, and management of these values, balanced with the need for BLM management of the growing demands for public land use in the California Desert District and Bishop Field Office (Study Area).

The study is concerned with cultural resources containing evidence of hard-rock mining, and the period considered extends from 1848 to approximately 1960. The objective of the study was twofold, including a historic context statement and archaeological research design consisting of guidance for the BLM in the identification of significant historical and archaeological values associated with mining sites on BLM-administered lands in the southern California deserts. Statistical Research, Inc. (SRI), prepared this historic context and archaeological research design at the request of Sterling White, BLM Desert District Abandoned Mine Lands and Hazardous Materials Program Lead, California Desert District. It was prepared for James Barnes, Associate State Archaeologist, BLM California State Office, and Tiffany Arend, Desert District Archaeologist, BLM California Desert District.

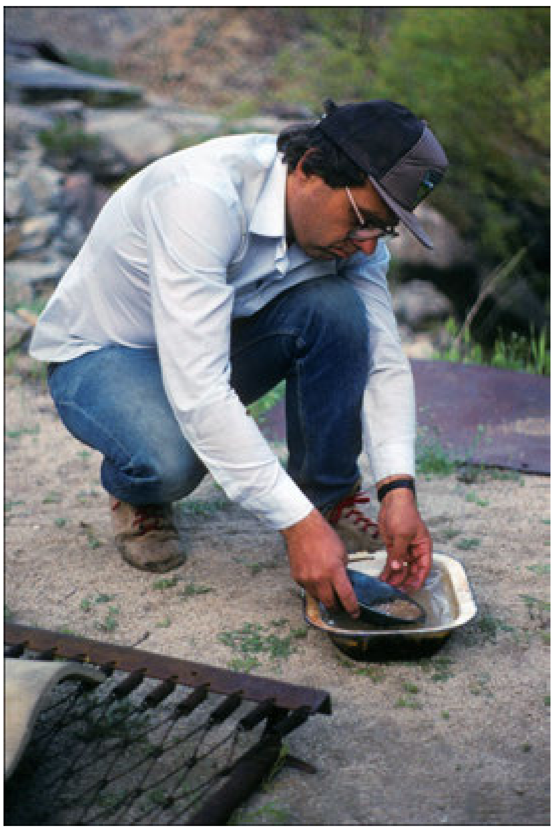
This guidance supports the BLM by helping the agency identify significant historical-period hard-rock mining sites on public lands in the southern California deserts. It will be applied most often to help the BLM comply with the requirements of Section 106 of the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA). The document will also be used by the BLM to proactively identify and manage significant mining-related sites under Section 110 of the NHPA and to protect the quality of archaeological and historical values under Section 102 of the Federal Land Policy and Management Act. The BLM also has responsibilities to protect mining sites that qualify as archaeological resources under the Archaeological Resources Protection Act.

After an introductory chapter, the document contains a historic context for mining in the Study Area, which encompasses the southern California deserts. Next, the report presents a list and description of important property types associated with the historic context and a research design specific to the Study Area. Later sections of the report contain procedures for evaluating the mining sites; a discussion of preservation goals and priorities, including recommendations for the treatment of mining-related historic properties and the resolution of adverse effects; a list of references cited; and a glossary of mining terms.

ACKNOWLEDGMENTS

We extend our sincere thanks to the U.S. Department of the Interior Bureau of Land Management (BLM) team for initiating this project and for guidance and input throughout the process of research, writing, and report preparation. The team included Associate State Archaeologist James Barnes, California Desert District Archaeologist Tiffany Arend, California Abandoned Mine Lands Program Lead/Environmental Protection Specialist Peter Graves, and California Desert District Abandoned Mine Lands and Hazardous Materials Program Lead Sterling White. BLM field-office staff who provided supporting documentary information from their files included Christopher Dalu (Needles Field Office), Greg Haverstock and Will Kerwin (Bishop Field Office), George Kline (Palm Springs Field Office), James Shearer (Barstow Field Office), Carrie L. (Simmons) Sahagun (El Centro Field Office), and Donald Storm (Ridgecrest Field Office).

Former BLM Geologist and current BLM Geographic Information Systems Coordinator (Bakersfield Field Office) Larry M. Vredenburgh provided invaluable information from his personal research files in support of the historic context. Larry is coauthor of the BLM report *Desert Fever: An Overview of Mining in the California Desert Conservation Area* (Shumway et al. 1980) and the book version of the report *Desert Fever: An Overview of Mining in the California Desert* (Vredenburgh et al. 1981) and has continued his research on mining in the California deserts since that time. Larry assisted me in the fieldwork for my dissertation research in the Beveridge Mining District and has remained a valued colleague. It is important to him that research be made publicly accessible, and to that end, he has created a vast repository of data that he shares on request. The photograph on this page shows Larry panning tailings at Beveridge in 1992. Thank you, Larry, for more than a quarter century of collaboration!



Former BLM Geologist and currently BLM Geographic Information Systems Coordinator (Bakersfield Field Office) Larry M. Vredenburgh provided invaluable information from his personal research files in support of the historic context.

Statistical Research, Inc. (SRI), staff contributed importantly to this project. Lori Lilburn assisted in locating historical images to illustrate the report. Stephen Norris created the project-location maps. SRI Publications staff provided their expertise in report formatting, layout, and graphics.

Karen K. Swope, Ph.D., RPA
Principal Investigator and Historical Archaeologist

CHAPTER 1

Introduction

> *Public lands managed by the Bureau of Land Management in California are a window to the past. These lands have shaped the way people live and connect with nature, from the historic travel routes of California's first people, to settlers, gold-seekers, our military and the people who call California home today* [U.S. Department of the Interior Bureau of Land Management (BLM) n.d.a].

Western American mining had a lasting and inextricable role in shaping the settlement patterns, landscape, and demographics of the southern California deserts. The topic presents a compelling narrative that continues to command the attention of the general public, generating books, movies, and a variety of other popular media. Martin (1998:4) noted that

> mining sites and lore occupy an important place in our collective memory and popular culture. . . . [T]he very notion of extracting essential and/or precious minerals from the bowels of the earth, working in perpetual darkness, and the attendant technologies for accomplishing these feats generate sincere interest at a basic emotional and humanistic level.

This narrative is particularly germane to historical-period activities on land administered by the BLM, because most of the mining in western states has taken place on our nation's public lands. Management of subsurface mineral resources is part of the BLM's organizational responsibilities. BLM management applies in cases where mineral resources are publicly held and managed by the federal government, including those located on BLM-administered lands and "split estate" situations (private or state lands where the subsurface mineral estate has been, for a variety of reasons, retained or returned to the federal government). Various other complex situations govern the ownership and/or management of mineral resources, but are beyond the scope of this document.

Mining has contributed indelible symbols to California iconography. Since 1934, the California State Highway shield, in the form of a miner's spade, has commemorated the miners of 1849 (*California Highways and Public Works* 1934; Dennis 1934; KCETLink 2017). The stereotypical lone prospector with his pick, pan, and burro is another persistent image (Figure 1.1), and although that figure is not entirely fictional, there is much more to be said about miners and mining in the California deserts.

By its broadest definition, mining is the act, technique, and industry of mineral discovery and exploitation, both at surface and below ground. This study is concerned with cultural properties containing evidence of hard-rock mining, including ore removal, conveyance, and processing as well as the residential, transportation, and support amenities that directly facilitated mining. Hard-rock mining may be defined as mining in material that has a "strong bonded structure" and requires blasting for removal (Thrush 1968:528). Mining of "soft rock" materials (sand, gravel, clay, and sedimentary rocks) and recovery of placer deposits, oil, gas, and coal resources are excluded from this study. Only mines accessed by underground workings are considered in this document; open-pit mines are excluded from consideration.

Mining activities leave a recognizable signature representing mineral extraction, processing, transportation, and the domestic pursuits of individuals and groups associated with the industry (Noble and Spude 1997:10–12). Mineral extraction includes prospecting activities and ore recovery from lode or vein formations. Processing, or beneficiation, results in "(1) regulating the size of a desired product, (2) removing unwanted constituents, and (3) improving the quality, purity, or assay grade of a desired product" (Thrush 1968:97). Support structures and facilities include those related to mining but not directly associated with extraction or processing. Domestic facilities reflect the residences and domestic lives of mine workers and their families. Roads, trails, footpaths—both within and outside the site—accommodated miners, pack animals, wagons, trucks, and equipment; other linear features, such as water-conveyance systems, can be part of the supporting elements of a mining site.

Figure 1.1. Fruit-crate label, dating ca. 1920s, from Mutual Orange Distributors, Redlands, California. The label demonstrates the pervasive image of the lone prospector in California iconography (from the author's collection).

The Study Area for this historic context and research design includes the BLM California Desert District (CDD) (more than 32 million acres [51,000 square miles]) and the Bishop Field Office (slightly more than 3,304,600 acres [5,163 square miles]) (Figure 1.2), for a total of more than 35 million acres. The CDD includes land in Kern, Inyo, Los Angeles, Riverside, San Bernardino, Orange, Imperial, and San Diego Counties. The district is divided into the following five resource areas: Ridgecrest Field Office, Palm Springs/South Coast Field Office, El Centro Field Office, Barstow Field Office, and Needles Field Office (BLM 2010:1.4).

The period considered in this study extends from 1848 to approximately 1960. Consideration of mining that occurred in the Study Area prior to the California Gold Rush is not included in this document.

The actual number of historical-period mining sites in the Study Area is unknown, and estimates from various sources differ. In 2014, a formula based on the number of mine symbols appearing on U.S. Geological Survey (USGS) topographic quadrangles yielded an estimate of 22,730 abandoned mine sites containing 79,757 features throughout the state of California (BLM 2014a:1.2, 16). That report included a "robust estimate" of the number of sites within the Study Area remaining to be inventoried by the Abandoned Mine Lands (AML) Program, quantified by field office (Table 1.1). The AML Program mission is to mitigate and remediate hard-rock AML sites on or affecting public lands. As many as 19,228 undocumented sites could be located within the Study Area, 16,793 of those within the CDD. The CDD Strategic Plan for the Abandoned Mine Lands Program (BLM California Desert Managers and California State Office Hazardous Materials [HazMat]/AML Programs 2008:6) cited "local historians" in estimating as few as 8,000 abandoned mines within the CDD. The CDD Programmatic Agreement for the AML remediation and closure process (BLM 2010:3.12) postulated that only approximately 5 percent of discrete historical-period mining sites with multiple features in the CDD have been recorded as archaeological sites.

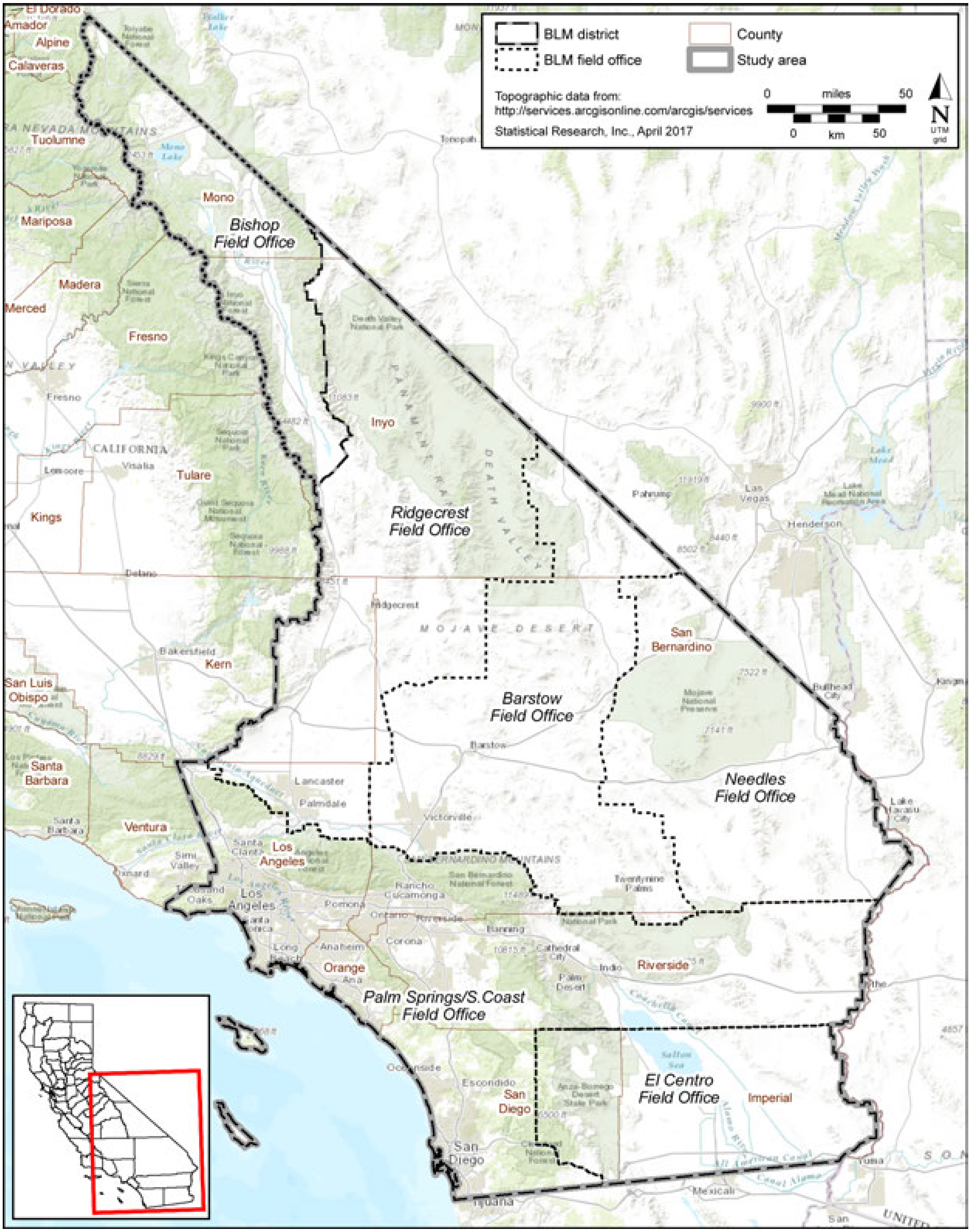


Figure 1.2. Map of the project Study Area, encompassing the U.S. Department of the Interior Bureau of Land Management California Desert District (including the Ridgecrest, Palm Springs/South Coast, El Centro, Barstow, and Needles Field Offices) and the Bishop Field Office.

Table 1.1. Estimates of the Numbers of AML Sites Remaining to Be Inventoried on BLM Lands within the Study Area, by Field Office

Field Office	No. of Sites
Barstow	6,556
Bishop	2,435
El Centro	792
Needles	2,447
Palm Springs/South Coast	1,376
Ridgecrest	5,622
Total	19,228

Note: Table data from the BLM (2014a:8, Figure 1).
Key: AML = Abandoned Mine Land; BLM = U.S. Department of the Interior Bureau of Land Management.

In 1980, the BLM demonstrated its recognition of the significant historical and archaeological values that may be associated with mining sites on public lands in the southern California deserts with the completion of *Desert Fever: An Overview of Mining in the California Desert Conservation Area* (Shumway et al. 1980). The objective of *Desert Fever* was to present the history of mining in the California deserts in support of the preparation of the 1980 BLM California Desert Plan (Vredenburgh 2010); therefore, it did not include archaeological considerations. This historical synthesis of mining in the CDCA was intended for public use and was later published in revised form as a book (Vredenburgh et al. 1981).

The objectives of this “best practices” guidance are as follows: (1) the historic context statement, and (2) the archaeological research design, which includes guidance for the delineation of areas of potential effects (APEs) and the documentation of historical-period mining resources. A historic context details the historical patterns or trends by which a historic property can be understood and through which its significance can be recognized. Property types are groupings of individual properties that share physical or associative characteristics and through which the historic context is linked to cultural resources. An archaeological research design outlines the goals and delineates the procedures for a research project. Together, the historic context statement and archaeological research design provide the BLM with guidance for identifying significant historical and archaeological values associated with mining sites on BLM-administered lands in the southern California deserts. The historic context provides the detail necessary to guide site-specific research and evaluation on an undertaking-by-undertaking basis, applied to mining-related sites in the Study Area. This study views mining history on a landscape scale, encompassing the California deserts and, in doing so, will assist BLM managers in identifying significant historical and archaeological values associated with mining sites on public lands in the region. That work will, in turn, support the ultimate goal of balancing conservation of mining sites with growing demands for public land use.

Other historic contexts and research designs for historical-period mining sites are referenced in this report; many of them provide valuable information that is applicable to this study. The intent of this study is to present a landscape-scale approach to the identification, evaluation, interpretation, and management of historical-period mining resources that has not been included in previous work, focusing on resources located within the Study Area. As will be seen, the Study Area possesses unique conditions (e.g., environmental, geological, social, and economic) that shaped regional historical hard-rock mining. Other historic contexts reflect specific periods or commodities that do not necessarily represent the themes and decades that are of primary interest in this study. The research design builds on the work of previous documents that have presented appropriate procedures for evaluating mining sites for listing in the National Register of Historic Places (NRHP); as appropriate, those procedures are applied in this study. Further, the research design identifies some data gaps that can be seen as future research opportunities and proffers some innovative lines of inquiry based on current research trends in historical archaeology and landscape studies.

Regulatory Context

As a federal agency, the BLM must take into account the effects of proposed undertakings (including AML remediation) on historic properties—that is, cultural resources listed in, or eligible for listing in, the NRHP. To accomplish this, the BLM, as lead federal agency, must first identify cultural resources that could be affected by its undertakings and then evaluate the significance of the resources, to determine whether they are historic properties. The findings of these efforts are used to fulfill the BLM's requirements under Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA) (54 U.S. Code [U.S.C.] 306108 and its implementing regulations Title 36, *Code of Federal Regulations*, Part 800 [36 CFR 800]). The guidance supports BLM cultural resource investigations in accordance with the *State Protocol Agreement* (BLM 2014b) and the Secretary of the Interior's Standards for Preservation Planning. The BLM also has proactive management responsibilities mandated by law, regulations, and policy. These include Section 110 of the NHPA, which requires federal agencies to establish historic preservation programs to identify, evaluate, and protect historic properties; the Federal Land Policy and Management Act (FLPMA) of 1976, as amended (43 U.S.C. 1701; Public Law 94-579), which establishes the agency's multiple-use mandate; and the Archaeological Resources Protection Act of 1979, as amended (16 U.S.C. 470aa–470mm; Public Law 96-95), which regulates legitimate archaeological excavations on public lands and enforces penalties for looting or vandalizing archaeological resources.

Methods and Sources

This study included preparation of a historic context statement and an archaeological research design, each requiring particular methods and sources. The historic context statement was informed by a review and analysis of primary source documentation and secondary published materials, including books; articles from newspapers, periodicals, and other works; cultural resource management (CRM) reports and archaeological site records; government data and reports on mining topics; historical maps; and aerial photographs.

Every effort was made to assess source materials for bias in historical perspective, methodological approach, and area of coverage. The BLM CDD and field offices provided primary documents available in their files. The numerous repositories and collections that were consulted for additional primary data and the sources of information available from those locations are listed in Table 1.2. In general, primary archival research was focused on the Study Area, to provide the bulk of the necessary information to form the historic context. Archival research also provided site examples from the Study Area to illustrate the text. Secondary research applied a broader regional lens, to adequately present the significant periods, patterns, trends, events, and/or persons germane to this study. Secondary sources were generally available from local and university libraries, through interlibrary loan, and via online sources.

BLM Geographic Information Systems (GIS) Coordinator and Geologist Larry Vredenburgh, one of the coauthors of *Desert Fever* (Vredenburgh et al. 1981), provided input, answered questions, and directed the authors to a number of sources that have become available in the nearly 35 years since that study was completed. His historical research is exemplary, and he has organized his work and made it available to researchers and the public.

Table 1.2. List of Repositories, Collections, and Materials Consulted

Repository	Collection	Materials
Bowers Museum	digital collection (http://www.bowers.org/collections/)	photographic materials printed materials
BLM Publications	cultural resource series, California (https://www.blm.gov/wo/st/en/prog/more/CRM/Research/california.html)	cultural resource reports
BLM California Desert District and Field Offices	primary documents on file	CRM reports maps historical photographs
California Department of Conservation	*California Geology* magazine collection (http://www.conservation.ca.gov/cgs/information/publications/Pages/california_geology_magazine.aspx)	*California Geology* magazine
California Geological Survey	digital-archive collections (http://cgsdigitalarchive.conservation.ca.gov/)	reports of the State Mineralogist reports of the State Mineralogist maps *Mineral Information Service* magazine county register of mines
California Historical Society	digital library (https://californiahistoricalsociety.org/research/)	images of southern California maps
California Division of Mines and Geology publications	California Division of Mines and Geology geological collection (http://archive.org/details/caminesgeo)	California Division of Mines bulletins California Division of Mines preliminary reports California Division of Mines special publications California Division of Mines special reports *California Journal of Mines and Geology*
Calisphere Digital Archive	(https://calisphere.org/)	digital collections
HathiTrust Digital Library	(https:www.hathitrust.org/)	California Division of Mines bulletins California Division of Mines preliminary reports California Division of Mines special publications California Division of Mines special reports *California Journal of Mines and Geology*
Newspapers.com	(www.newspapers.com)	historical newspapers
Library of Congress	(https://loc.gov)	historical maps
Los Angeles Public Library	California index (http://www.lapl.org/collections-resources/visual-collections/california-index)	digital collections

Repository	Collection	Materials
Mining History Association	*Mining History Journal* online archive (http://www.mininghistoryassociation.org/journal.htm)	*Mining History Journal*
Mojave River Valley Museum	special section (http://www.mojaverivervalleymuseum.org/)	reports on Daggett
Mojave Desert Heritage and Cultural Association	Mojave Desert archives	mining http://mojavedesertarchives.blogspot.com/search/label/mining
National Archives and Records Administration	(https://www.archives.gov/)	records of the U.S. Bureau of Mines, historical photographs
Online Archive of California	(http://www.oac.cdlib.org/)	digital collections
MSHA Technical Information Center and Library	Bureau of Mines collection (http://arlweb.msha.gov/TRAINING/LIBRARY/mshaPortal/index.html)	historical photographs research materials moving images
USGS	USGS publications warehouse (https://pubs.er.usgs.gov/)	bulletins reports circulars maps mineral-commodities summaries mineral-investigations resource maps monographs water-supply papers open-file reports
UCLA	UCLA Library digital collections (http://digital2.library.ucla.edu/)	mining and mineral resources—California mining camps—California
UCLA Digital Library	California Historical Society collection, 1860–1960 (http://digitallibrary.usc.edu/cdm/landingpage/collection/p15799coll65)	historical photographs

Key: BLM = U.S. Department of the Interior Bureau of Land Management; CRM = cultural resource management; MSHA = U.S. Department of Labor Mine Safety and Health Administration; UCLA = University of California, Los Angeles; USGS = U.S. Geological Survey.

Document Organization

This document presents a historic context statement and research design for hard-rock (or lode) mining in the southern California deserts. Following this introductory chapter, Chapter 2 presents the historic context statement, discussing the pattern of development of hard-rock mining on public lands in the Study Area from 1848 to ca. 1960. Chapter 3 identifies and describes important property types associated with this historic context, along with their character-defining and associative features. Chapter 4 presents a research design specific to the Study Area; particularly, the research design poses new research issues/questions that address data gaps in current research, directly applied to the potential value of physical remains at mining sites on public lands. Chapter 5 provides Study Area–specific procedures for evaluating the mining sites covered by this historic context statement. Specifically, it addresses both archaeological and built-environment site elements, discussing documentary/archival research, field methods, the evaluation process, reporting, and curation—all with regard to NRHP criteria. Chapter 6 lays the groundwork for preservation goals and priorities to build on this effort, including recommendations for the treatment of mining-related historic properties and the resolution of adverse effects. Following these chapters is a list of references cited and an appendix containing a glossary of the mining terms used in the document. Throughout the document, sidebars present supplemental information.

CHAPTER 2

Historic Context

> *[H]istoric contexts will help to unravel the separate threads of mining history which may exist within a single geographic area. . . . With regard to historic contexts for mining areas, the theme component of the context will revolve around some aspect of mining history [and] should attempt to span the period from the time of a mining region's initial discovery to the point of its abandonment or decline. . . . [T]he geographic component of a historic context can relate to political boundaries which define the extent of a . . . Federal land management unit* . . . [Noble and Spude 1997:3–4].

A historic context presents meaningful segments of the history of a particular geographic area by placing research themes or problems in an appropriate setting in both time and place. All of the possible historic contexts for an area would constitute a comprehensive summary of that area's prehistory and history. This historic context is concerned with the overall pattern of development of hard-rock mining on public lands in the Study Area from 1848 to about 1960. Because of the vast scope and long duration of hard-rock mining in the Study Area, this historic context is not comprehensive—that is, it does not include a description of every historical-period mining operation, or even a description of all major operations. Rather, it provides a foundation for the identification of mining-related historic properties in the area. Because this study is regionally focused on the California deserts, and further focused on hard-rock mining, the narrative does not include a discussion of the California Gold Rush or placer mining in general. For the same reasons, the study does not address mineral-resource procurement that does not result in underground workings—for example, sand, gravel, or other aggregate operations or cinder and clay quarries. However, because prospectors began searching for the hard-rock sources of placer deposits as soon as the Gold Rush began, this study covers the period from 1848 to ca. 1960.

Mining is recognized as one of the most significant industries powering the history of economic development and resource exploitation throughout western North America (Blodgett 2002:65). Much of it has been performed on public lands managed by the federal government. The search for, and particularly the successful recovery of, profitable minerals "created the impetus for migrations, settlements, and economic development that transformed the nation" (BLM n.d.b).

Lode mines in the southern California deserts played an important role in this transformation, yet the Study Area does not feature prominently in overviews of western mining in general. In fact, California hard-rock mining is rarely the subject of writings on western mining history. Where it is mentioned, there typically is a nearly myopic focus on the California Gold Rush. Nevertheless, a number of scholarly overviews contain valuable information on the history of lode mining in the western United States and are considered standard references on the topic. Other, specific works

Standard References on Lode Mining in the Western United States

- *Hard Rock Miners: The Intermountain West, 1860–1920* (Brown 1979)
- *The Bonanza West: The Story of the Western Mining Rushes, 1848–1900* (Greever 1963)
- *The Mining Frontier: Contemporary Accounts from the American West in the Nineteenth Century* (Lewis 1967)
- *The Hardrock Miners: A History of the Mining Labor Movement in the American West, 1863–1893* (Lingenfelter 1974)
- *Bonanzas & Borrascas: Gold Lust and Silver Sharks, 1848–1884* (Lingenfelter 2012a)
- *Bonanzas & Borrascas: Copper Kings and Stock Frenzies, 1885–1918* (Lingenfelter 2012b)
- *Mining Frontiers of the Far West, 1848–1880* (Paul 1963)
- *Mining Camps: A Study in American Frontier Government* (Shinn 1970)
- *The Bonanza Trail: Ghost Towns and Mining Camps of the West* (Wolle 1953)
- *Hard Rock Epic: Western Miners and the Industrial Revolution, 1860–1910* (Wyman 1979)
- *Western Mining: An Informal Account of Precious-Metals Prospecting, Placering, Lode Mining, and Milling on the American Frontier from Spanish Times to 1893* (Young 1970)
- *Black Powder and Hand Steel: Miners and Machines on the Old Western Frontier* (Young 1976)

largely focus on the more notable rushes following discoveries of precious metals, on specific commodities or companies, and on operations that resulted in well-known settlements that remain today as either ghost towns or surviving communities. Following the California Gold Rush was a half-century of successive rushes, including those to Oregon; Arizona; Pike's Peak, Leadville, and Aspen, Colorado; the Nevada Comstock; Idaho; Montana; and the Alaskan Klondike (Fetherling 1988:201; Greever 1963; Paul 1963:39, 56–57, 138, 1988:24–25; Rohrbough 1986:13–15; Wolle 1953:6). Popular accounts typically center on mining towns that have become tourist destinations, such as Bodie, California; Tombstone, Arizona; Virginia City, Nevada; and legendary "lost mines." The history of mining in western North America, of course, includes areas beyond the continental United States. Alaska mining history was recounted by Heiner (1977). The U.S. Department of the Interior Bureau of Mines (Bureau of Mines) produced a report on the mining history of Mexico, covering the period 1521–1937 (Braun 1947). A summary of Canadian mining history is Hoffman's (1947) *Free Gold: The Story of Canadian Mining*.

Precious metals, base metals, and other mineral commodities were produced during historical-period hard-rock mining activities in the California deserts. Mining-reclamation legislation was not enacted until the 1970s (e.g., the California Surface Mining and Reclamation Act of 1975 [SMARA] and Surface Management 43 CFR 3809 [1981]). Consequently, older mines were simply abandoned when a work stoppage occurred. Some mines were reopened when economic conditions suggested renewed profitability.

Mining sites and districts in the Study Area played critical roles in the development of California and the U.S. West and have far-reaching economic legacies that affect the nation and the globe. An understanding of western mining is necessary to understand national politics and policymaking, the emergence of business institutions and practices, the rise of organized labor, and Euroamerican colonization and settlement. The legacy of mining shaped the southern California landscape, whether mining settlements developed into towns and cities that remain today or cycled through boom and bust to become abandoned places.

In this chapter, we profile the patterns, trends, and events that drove the cycles of mining in the California deserts, including the economic and social conditions that drove the changing profitability of the pursuit of specific commodities; examples of mining sites from the Study Area are included to illuminate these topics.

In 1980, the BLM undertook an ambitious compilation and synthesis of documentation on the history of mining in the California desert region (Shumway et al. 1980). The resulting report was later published in book form, and since that time, *Desert Fever* (Vredenburgh et al. 1981) has become the standard historical reference for regional mining history. Today, copies of the out-of-print book (when they can be found) bring between $100 and $200! The *Desert Fever* study was based on government documents, newspapers, magazine articles, maps, unpublished material, and oral-history interviews. It covered a broader period (1760–1980) than the current study and had a somewhat different regional focus. The portions of the Study Area including Los Angeles, San Diego, Mono, and Orange Counties were not included in the *Desert Fever* study. The book was a historical study and did not address archaeological remains of mining sites.

National Register Bulletin 42, *Guidelines for Identifying, Evaluating, and Registering Historic Mining Properties*, was published in 1992 and revised in 1997 (Noble and Spude 1997). This guidance document, applicable nationwide, provides instructions and sources for preparing a historic context related to mining sites; details regarding the processes of identification, evaluation, documentation, and registration; a bibliography of pertinent published materials; and a glossary of mining terms.

More recently, the California Department of Transportation (Caltrans) (2008) prepared a historic context and archaeological research design for historical-period mining properties throughout the state. That historic context provides a broader regional analysis and a general overview of mining (including placer mining). The Caltrans study covers the period from 1850 to the entrance of the United States into World War II. The writers encouraged future researchers "to use this context as a starting point" (Caltrans 2008:i).

The BLM currently uses Course 8100-10 to introduce cultural heritage staff to the management of historical-period mining resources. The course provides a history of mining on public lands; introduces the types of mining and mining sites that might be encountered; discusses archival research, site recording, and reporting; and provides guidance on assessing integrity and NRHP eligibility and guidance for addressing project effects and implementing management objectives. Other useful historic contexts and research designs have been prepared for other parts of the nation for specific programs or site types, and these are cited in this document as appropriate.

The historic context offered in this study is not intended to replace or duplicate the valuable historical information contained in *Desert Fever*, which remains pertinent in regional mining studies. That document, however, was not designed to provide the necessary historic context upon which cultural resource documentation and evaluation of mining sites can be based. The information in this chapter serves two purposes: (1) it presents a historical overview for portions of the Study Area not considered in *Desert Fever*, and (2) it details a historic context for mining in the Study Area that takes a landscape-scale approach based on the periods, events, patterns, and persons that shaped the topic regionally. The present historic context and research design are intended to complement the Caltrans study and BLM Course 8100-10 by focusing on hard-rock mining in a specific region and period.

This historic context can serve as a framework upon which researchers can build detailed, project-specific historic contexts that focus on specific sites, mining districts, locales, commodities, and time frames as appropriate for particular projects.

In the following sections, we discuss the environmental setting of the Study Area, including a description of the regional geophysical provinces. Then, the discussion of the cultural setting of the Study Area is divided into three periods that reflect the major patterns in regional mining history.

Environmental Setting

Geophysical Provinces

Geophysical (or geomorphic) provinces are differentiated by their geological record, especially that of more recent earth history, and the similarities of relief features within their bounds. It is important to understand the character of the geophysical provinces for this study (Figure 2.1), because the geophysical circumstances (along with economic and social contexts) led to regionally specific property types and other conditions that shaped hard-rock mining historically within the Study Area. Cultural geographer Homer Aschmann (1970:172), in his article "The Natural History of a Mine," noted that the "considerations that are eminently geographic, that is, are tied to peculiar characteristics of particular localities" must be included if local mineral resources are to be studied in regional context.

Mojave Desert

Conspicuous with faulting, the Mojave Desert geophysical province is composed of a continuous succession of both long and narrow and broad basins divided by mountains, or fault blocks. The basins are subjected to erosional debris from the adjacent uplands. In California, the Mojave Desert province extends south and east from the southwestern corner of the Great Basin geophysical province; east of the Tehachapi Mountains, which is at the southern end of the Sierra Nevada geophysical province, along the Garlock fault; and north and east of the San Bernardino Mountains and the Colorado Desert geophysical province. The climate of the Mojave Desert is dry, with low annual precipitation and humidity levels. Although precipitation amounts increase with elevation, there is no consistency across the province. Temperatures are considered moderately high in winter and extremely high in summer; daily temperature ranges are notable (Caltrans 2008:17; Hinds 1952:89). The primary mineral commodities were gold, barium (or barite), borates, copper, feldspar, lead, and magnesite. Additional commodities included silver, manganese, strontium, and tungsten (Caltrans 2008:17). The Mojave Desert geophysical province includes almost all of the lands managed by the Needles Field Office, more than half of the southern portion of lands managed by the Barstow Field Office, the eastern portion and very small portions of land along the northern boundary of the lands managed by the Palm Springs/South Coast Field Office, a part of the southern portion of lands managed by the Ridgecrest Field Office, and the eastern portion of lands managed by the El Centro Field Office. Most of San Bernardino County, much of Riverside County, and portions of Imperial, Los Angeles, and Kern Counties are within the Mojave Desert geophysical province, as is the far-southeastern corner of Inyo County.

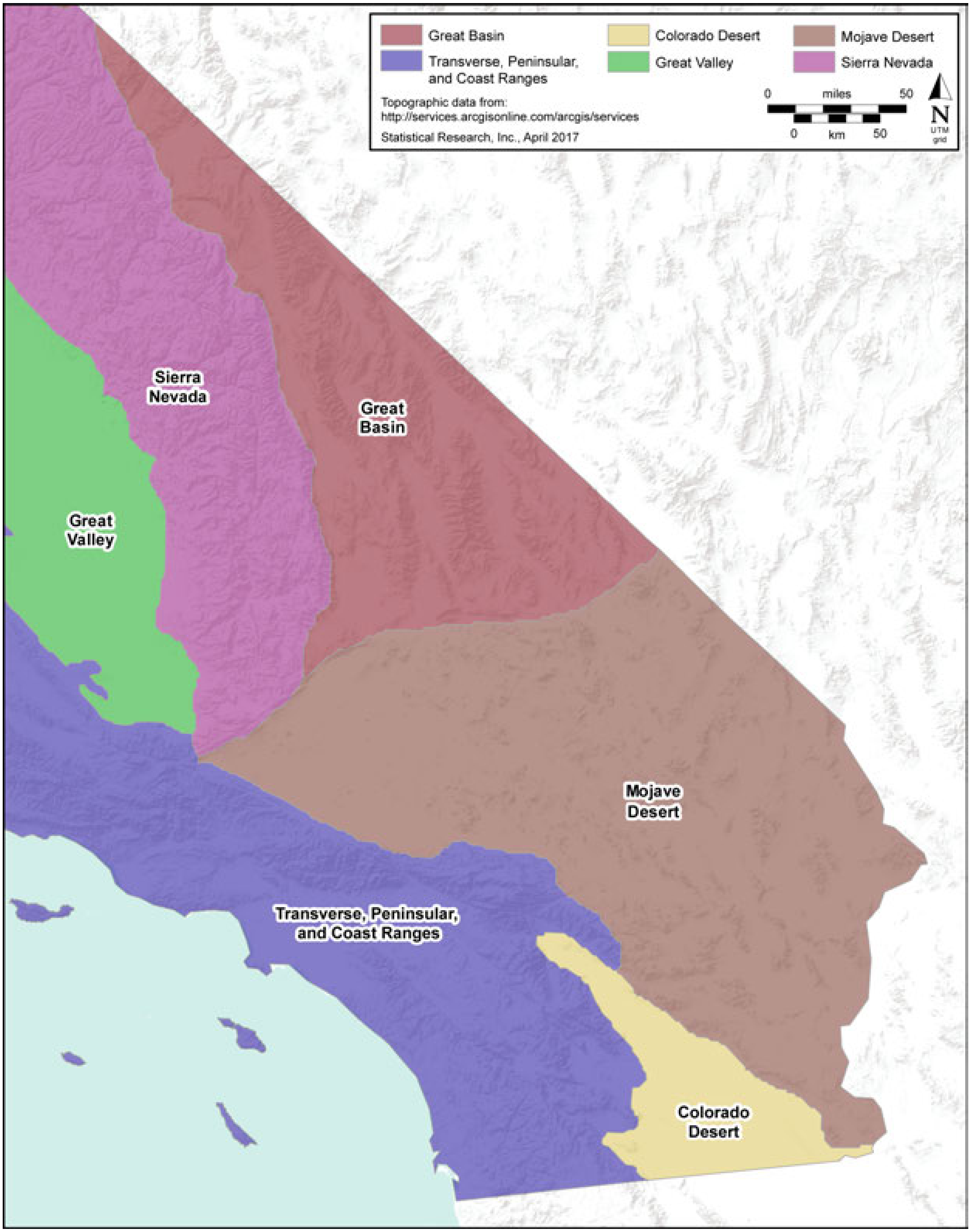


Figure 2.1. Map showing the geophysical provinces of the California deserts.

Great Basin

The Great Basin geophysical province consists of north-trending ranges between enclosed basins and troughs (or grabens) that are open at one or both ends. The province is immense and extends south from the Columbia Plateau in Washington and Idaho, west to the Warner Mountains in northeastern California, east through Nevada and Utah to the Rocky Mountains, and south to the Colorado Plateau in Arizona. Most of the ranges are relatively small, not particularly high, and discontinuous. In California, the Great Basin geophysical province includes the following prominent locales: Mono Lake, Owens Lake, Owens Valley, Panamint Range, Panamint Valley, Death Valley, White-Inyo Range, Coso Range, and Argus Range. The climate in the Great Basin is arid, with dryness increasing from north to south. It should be noted that Death Valley is the one of the most arid regions in the world and has set records as one of the hottest places in the world. Additionally, Death Valley's Badwater has the lowest elevation in North America. Rains occur principally during summer thunderstorms, and the ranges receive more precipitation than the basins and troughs. Snow does occur during the colder months, with heavier accumulations in the northern and higher ranges and basins. In California, the Great Basin geophysical province is bound by the Sierra Nevada and Modoc Plateau geophysical provinces to its west and the Mojave Desert geophysical province to its south (Caltrans 2008:16; Hinds 1952:63–72; Kirk 1977:25). Brown (1979:12) noted that Great Basin miners "confronted the vagaries of an inhospitable climate and an intractable terrain [where] most mining districts and towns were located in mountainous or semi-mountainous areas, and this high-altitude environment posed problems for newcomers." The Great Basin geophysical province includes an alluvial apron of debris at the base of the Sierra Nevada. This area also includes a volcanic field with cinder cones and lava flows (Hinds 1952:63–68). The primary mineral commodity of the Great Basin was boron (or borate). Additional commodities included gold, barium (or barite), tungsten, molybdenum, copper, bismuth, silver, copper, sulfur, magnesite, talc-soapstone, feldspar, and lead (Caltrans 2008:16). The Great Basin geophysical province includes the eastern portion of lands managed by the Bishop Field Office, the northern portions of land managed by the Ridgecrest and Barstow Field Offices, and a very small piece of land in the northwestern corner of lands managed by the Needles Field Office. The eastern portions of Inyo and Mono Counties are within the Great Basin geophysical province, as is the northeastern corner of Kern County and the northwestern section of San Bernardino County.

Sierra Nevada

The Sierra Nevada geophysical province consists of the largest mountain range in California and one of the most immense in North America. The range extends about 430 miles and trends northwest for most of its length and southwest at its southern end. Stretching south from Lassen Peak, within the Cascade Range in Washington, to the Garlock fault in southern California, the width of the range varies from 40 to 80 miles. Elevations of many of the range's peaks exceed 12,000 feet above mean sea level (AMSL), including California's Mount Whitney, the highest peak in the contiguous United States, at 14,496 feet AMSL. With some exceptions, streams run southwest off the western slopes and northeast off the eastern slopes. The climate in the Sierra Nevada consists of wet winters and dry summers. Most of the precipitation falls on the western side of the mountain range, concentrating in elevations between 4,000 and 9,000 feet. Areas of the heaviest precipitation can average 30–40 feet of snow, with as much as 60 feet in some years. Snows can fully melt as late as August and return as early as October. The Sierra Nevada geophysical province is flanked by the Great Central Valley geophysical province to its west and the Great Basin geophysical province to its east. Although it is a gentle ascent from the Great Central Valley into the Sierra Nevada, much of its eastern approach from the Great Basin consists of an imposing mountain escarpment. The southern boundary of the Sierra Nevada geophysical province follows the Garlock fault, where it meets the Mojave Desert and Coast Ranges geophysical provinces along the northeast–southwest-trending Tehachapi Mountains, in southern California (Caltrans 2008:16; Hinds 1952:13–14). The primary mineral commodities of the Sierra Nevada geophysical province were gold, silver, and copper. An additional commodity was tungsten (Caltrans 2008:16). The western and southwestern edges of lands managed by the Bishop and Ridgecrest Field Offices, respectively, are within the Sierra Nevada geophysical province, as are the western edges of Mono and Inyo Counties and a small portion of central Kern County.

Colorado Desert

The Colorado Desert geophysical province is a V-shaped depression opening to the southeast, or toward the delta of the Gulf of California. The depression, or trough, consists of the Imperial and Coachella Valleys separated by the Salton Basin, which contains the Salton Sea, a formerly dry lake bed inadvertently filled by humans in the early twentieth century. Along the borders of the province are badlands, with labyrinths of gorges separated by ridges. The Salton Basin is replete with sand dunes from the ancient inland sea that can rise 200–300 feet above the desert surface. The Colorado Desert geophysical province is very low in elevation, 275 feet below mean sea level at its lowest. The climate is characterized by extreme heat and aridity. It can be one of the hottest places in the United States and in the world. The small amount of precipitation that the Colorado Desert geophysical province receives is accumulated from December to February. The Colorado Desert geophysical province is primarily bound by the Mojave Desert geophysical province to its north and east and the Coast Ranges geophysical province to its southwest (Caltrans 2008:18; Hinds 1952:99–100, 108). There are no major mineral commodities of the Colorado Desert, but small mines operated along the edges of the desert floor (Caltrans 2008:18). The central portion of lands managed by the El Centro Field Office, and a small portion of lands managed by the Palm Springs/South Coast Field Office are within the Colorado Desert geophysical province, along with much of Imperial County, a small portion of central Riverside County, and small portions of eastern San Diego County.

Transverse, Peninsular, and Coast Ranges

In gross representations of North American landforms, the Pacific Coast Ranges and the Rocky Mountains are separated by the Basin and Range Province, which encompasses the California deserts. Although we recognize the distinct geomorphology, climate, and remoteness that differentiate the settings of the southernmost Coast Ranges, the Peninsular Ranges, and the Transverse Ranges, we nevertheless combine them in the following discussion. These ranges share certain topographical commonalities that make the combination appropriate for the purposes of this study. The mountainous terrain led to some similarities in historical-period land use and mining technology. The bulk of the ranges falls within the area managed by the Palm Springs/South Coast Field Office, yet the BLM manages only small portions of the land in the ranges.

The Transverse Ranges rise from the Mojave Desert geophysical province and trend east–west to the Pacific Ocean, nearly perpendicular to the Sierra Nevada geophysical province and the Coast Ranges to the north, and include a basin, in which Los Angeles is located. The Peninsular Range is mountainous land, east of the marine terraces along the ocean, on which San Diego is located. The southern part of the Coast Ranges geophysical province consists of mountain groups, hills, valleys, and the Channel Islands. Ranges can vary between 30 and 100 miles in width. The southern part of the Coast Ranges geophysical province includes locales such as Santa Monica Mountains, San Bernardino Mountains, San Fernando Valley, San Gabriel Valley and Mountains, San Jacinto Mountains, Ojai Valley, Valle San Jose, Riverside, Santa Barbara, and Long Beach. To the east of the Coast Ranges geophysical province are the Colorado and Mojave Desert geophysical provinces. The climate of the southern Coast Ranges geophysical province is temperate, with precipitation falling mostly on the western slope as storms travel east off the Pacific Ocean. This rainfall pattern has led to numerous large streams on the western slopes of the ranges that flow toward the ocean (Caltrans 2008:16–18; Hinds 1952:185, 197–200). The primary mineral commodities of the southern Coast Ranges were boron (or borate), barium (or barite), feldspar, lead, strontium, sulfur, and tin (Caltrans 2008:16–18). Caltrans (2008:17) noted that one of the biggest producers of boron was the Lang Mine in Los Angeles County. The Coast Ranges geophysical province includes most of the lands managed by the Palm Springs/South Coast Field Office, the western portion of lands managed by the El Centro Field Office, and small fragments of land along the southern boundaries of lands managed by the Ridgecrest and Barstow Field Offices. All of Orange County, most of San Diego and Los Angeles Counties and the western portion of Riverside County are within the Coast Ranges geophysical province, as are small portions of western Imperial and southwestern San Bernardino Counties.

Boundaries

We do not attempt to list or define mining districts in the Study Area. Mining districts generally encompass the known and expected extent of a valuable mineralization, and they were typically defined by the miners themselves. By the end of the nineteenth century, districts were recorded by county officials (Thrush 1968:335, 715). Unlike mining claims, mining districts were not limited to a certain size, shape, or dimension. Over time, mining districts were combined, separated, and renamed. In some cases, the only documentation of a mining district is a written description of its boundaries. Maps exist for some districts but often depict generalized bounds. Nevertheless, documentation in state and federal mining reports, in recorded claim papers, and in local newspapers typically refers to the district within which specific mines are located. Because the mines in a particular district share common historical elements, they should be considered within that context during archaeological investigations. Any and all of the mining-property types discussed in Chapter 3 could be present within a mining district, but a mine could develop and operate in isolation or along with other mines outside the confines of a mining district.

Although this report focuses on public lands managed by the BLM, it should be noted that most government reports concentrated on the mining industry and those that quantified mineral resources or commodities were organized primarily by county and occasionally by quadrangle. Therefore, the extrapolation of county and quadrangle data to provide statistics on lands within individual geophysical provinces or BLM field-office boundaries was not performed. Instead, specific examples of mining sites within BLM lands are provided, to elucidate significant periods, patterns, trends, events, and persons.

Cultural Setting

Historical Overview

Mining has played an integral role in the history of the western United States. As one of the most important industries shaping the regional landscape, mining has had a part in patterns of settlement, trade (exchange), economics (production, distribution, consumption), demographics, and transportation. The following discussion is a summary of the events, trends, and some of the persons important in the history of mining in the Study Area. In particular, economic history, social trends, pertinent historical events, and milestones in the history of mining technologies are discussed. This analysis does not address prehistoric exploitation of stone and minerals, nor is it concerned with the earliest recorded mining efforts, which occurred in the Study Area as early as the late 1700s. The period of interest for this study begins in 1848, when the world's attention was turned to California's promising reserves of gold. It did not take long for savvy miners and investors to begin the search for hard-rock gold deposits, the source of the more easily obtained placer gold that was the focus of the Gold Rush. At the same time, other valuable ores were sought in an ever-increasing area of the West.

The following narrative is arranged in general chronological order, organized into three thematic episodes with particular regional relevance: (1) Discovery and Early Mining Development, (2) Growth and Zenith of Mining Activities, and (3) Decline and Resurgence of Mining Activities. Though recognizing the interconnectedness of events affecting mining in the Study Area, we have arranged each episode according to the cultural and economic events, technological developments, and legislation that had particular influence in shaping regional mining history.

Discovery and Early Mining Development in the Study Area

The Discovery and Early Mining Development episode begins immediately following the achievement of California statehood in 1850 and continues until ca. 1890, when the industrial era was fully under way in the United States. Cultural events during this period include the enactment of early mining legislation and the beginnings of interest in the mineral resources to be found in the California deserts. During the 1860s and 1870s, "hundreds upon hundreds of mines big and little—but mostly little—were opened in the vast, broken area . . . A few of the ventures grossed magnificent sums, but . . . [m]ore were a dead loss from start to finish" (Lee 1963:72). Regulations intended to control immigrant miners are discussed here as cultural events, because of the overt xenophobia that they reflect. Economic events trace the fluctuating values of precious metals that motivated the exploitation of specific commodities. Though legislative, various coinage and monetary acts are discussed herein as economic events because of their inextricable linkage to the national economy. Technological developments during this time reflect the increasing industrialization and evolving mechanization of the period. Legislation includes federal mining laws that set the standards for filing a claim on public lands.

Cultural Events

Foreign Miners' Tax of 1850, Chinese Exclusion Laws

Among the acts of the first California state legislature upon achieving statehood was the enactment of the Foreign Miners' Tax. The law levied a tax of $20 *per month* on each foreign miner engaged in the state. By one measure, the value of $20 in unskilled-labor earnings in 1850 would be approximately $4,500 in 2017 (Williamson 2017)! Quite obviously, the tax would provide an impetus for immigrants to depart and would discourage further immigration. Most analysts agree that the tax inequitably targeted the numerous and successful Mexican and Chilean miners then working in California (Fernandez 2001:239; Peterson 1976, 1980, 1985). Numerous regulations and laws aimed at immigrant workers followed, including several Chinese Exclusion Laws enacted between 1882 and 1892 (Chen 1980:161; Heizer and Almquist 1971:154, 158–159, 198; Moses and Focht 1991:n.p.). More information on the laws and their effect on California labor can be found in the Caltrans (2008, 2013) historic contexts for mining and work-camp properties.

Post–Gold Rush Prospecting

It was not until the California Gold Rush was in decline that a "horde of prospectors swarmed over southern Nevada and southeastern California" (Hewett 1954:iii) in search of precious metal. As placer deposits became increasingly depleted, miners sought hard-rock, or lode, deposits to exploit. The 1859 discovery of silver in Comstock sparked interest in prospecting throughout the desert region. Technological advances made in mining the Comstock Lode paved the way for deep underground mining in the Study Area and elsewhere. Comstock ores were geologically concentrated and so fabulously rich in terms of mineral value that they may have inadvertently fomented (or perhaps even created a ruse for) speculative business practices in hard-rock mining in the Study Area during an era (1860s–1870s) in which this region and the western United States generally lacked mining engineers and science-based mining practices and expertise.

The *California Desert Conservation Area Plan* (BLM 1999:4) described miners during this period as

> fanning out . . . creating colorful desert settlements that went through boom-bust cycles until the end of the century. By 1868, with the subduing of the native population, most of the major modern California Desert land uses had become entrenched in some form: livestock grazing, mining, military bases, major transportation arteries, and the growth of permanent settlements. Railroad facilities and mining operations, mainly those for precious metals but also for the celebrated borax trade, had substantial, although often ephemeral, impacts.

In fact, this prospecting activity extended from the Sierra Nevada to the eastern slope of the Rocky Mountains (Brown 1979:3). Some of these prospectors were interested only in the search for minerals, and they sold their discovery sites to speculators in favor of continuing their explorations. Others provided the necessary labor and capital or found investors to fund the work, once it had been determined that a prospect represented a promising discovery (Aschmann 1970:175).

Throughout the second half of the nineteenth century, miners followed gold and silver strikes as they occurred in eastern California and southern Nevada. Strikes on the Comstock drew miners in 1859 and again in 1873 (Wolle 1953:328–333). In the 1860s, gold and silver discoveries in the Owens Valley and the Coso Range and at Cerro Gordo, Darwin, Mono Lake, and Aurora kept regional miners on the move (Chalfant 1933:293–295; Nadeau 1965:194–195; Swope 1993:70–71). Panamint was touted as a second Comstock (Wilson 1937:48). With Comstock mines in decline at the end of the 1870s, the Virginia & Truckee Railroad (which had served the Virginia City mines) built a branch narrow-gauge line called the Carson & Colorado Railroad in anticipation of a bonanza in eastern California. The line reached Keeler in 1881 and later (under the name Nevada & California Railway) served the Goldfield area (Kneiss 1954:72–75; Myrick 1962:168–213). Newspaper items and firsthand accounts of the period relate the interconnectedness of mining camps on both sides of the California-Nevada state border, as miners made appearances over the region.

Economic Events

Coinage Acts of 1849 and 1853

At the time of the California Gold Rush, the price of gold was $20.67 per troy ounce, a figure that had been set by the federal government in the 1834 Gold Standard. The Coinage Act of 1849 authorized the minting of U.S. gold coins in $1 and $20 ("Double Eagle") denominations. In 1853, the legal-tender value of silver coins was reduced to amounts not to exceed $5 (American Institute for Economic Research 1991:3).

1873 Coinage Act and Panic

The 1873 Coinage Act demonetized silver by removing silver coins from domestic mintage (Crane 1908:133; Reti 1998:67), in preference of the gold standard. Under the coinage act, the U.S. dollar was defined as a specific weight of gold rather than silver (American Institute for Economic Research 1991:2, 4). Western silver miners and investors understandably wished to maintain the silver standard and dubbed the act the "Crime of '73" (American Institute for Economic Research 1991:4). In his period study of the issue, George Weston (1878) stated that through the Coinage Act, Americans were deprived of "the benefit resulting from the richness and abundance of newly-discovered silver mines." Among the deflation resulting from the Panic of 1873 was deflated interest in mining investments and stocks that echoed through the industry for two decades (Reti 1998:67). The Bank of California, a critical financial institution for mines in the Study Area, folded in 1875 (Shumway et al. 1980:36).

Within the Study Area, silver mines at Panamint, Darwin, and Lookout limped through the ensuing recession. At Panamint, most of the camp's occupants deserted by November 1875, just 3 months after a 20-stamp mill began operation. The following year, bank failures put an end to a hoped-for rail connection at Independence, and the stamp mill ceased operation in 1877 (Shumway et al. 1980:31, 36).

1878 Bland-Allison Act

For centuries, silver and gold circulated as money throughout the global market, although gold was more valuable. In 1792, the United States adopted a policy of bimetallism when it fixed the silver/gold ratio at 15 to 1 (meaning 15 ounces of silver were equal to 1 ounce of gold). In 1834, Congress changed the ratio to 16 to 1, but the market ratio had not fluctuated much. Gold was overvalued and silver was undervalued; gold was the de facto standard. During the 1870s, the market price of silver was in decline, and silver producers lobbied Congress to buy silver at a higher price than could be obtained in the free market. In 1878, Congress passed the Bland-Allison Act, thus putting the federal government in the business of purchasing quantities of silver bullion for coinage at prevailing market price (American Institute for Economic Research 1991:4). The act authorized the U.S. Treasury to purchase $2–4 million of silver bullion each month to be coined, although the government rarely bought more than the minimum amount (Reed 1978). Silver Certificates (Figure 2.2) were issued in exchange for deposited silver coin; they were discontinued in 1965. The act was supported by "owners of silver mines in the West, farmers hoping that an expanded currency would increase the price of their crops, and debtors looking to ease the repayment of debts" (U.S. Department of the Treasury Bureau of Engraving and Printing 2013). The act came too late for silver mines in Inyo County, where high-grade ore had already been exhausted (Shumway et al. 1980:37).

Figure 2.2. Example of a silver certificate from 1928 (via Wikimedia Commons).

Technological Developments

Inexpensive black powder was employed by prospectors and miners until about the 1880s and required a generous-sized drill hole, typically prepared by double jacking. Dynamite (which came to be known as "Giant Powder," based on the success of the Giant Powder Company) had been introduced in California in 1867, a few years after its development by Alfred Nobel, but its cost exceeded that of black powder by as much as an order of magnitude. Its success in blasting railroad tunnels, as well as the additional safety that it afforded, compensated for its cost, however, and its adoption for hard-rock mining revolutionized the industry (Lingenfelter 1974:83; Wyman 1979:104–105). It required a much smaller drill hole per charge—a hole that could be drilled efficiently by single jacking. By the 1890s, dynamite was in widespread use in mining (Twitty and Fell 2010:62). A detailed history of developments in blasting powder and its role in the Industrial Revolution was provided by Twitty (2001:2–4, 8–30).

Blasting caps, also developed by Nobel in 1867, were used to trigger detonation of the main round of explosives. Constructed of a small copper cup filled with fulminate of mercury, the caps were packaged in embossed or lithographed metal boxes or cans, both cylindrical ($2^{3}/_{4}$ inches in diameter) (Figure 2.3) and rectangular ($2^{1}/_{8}$ by $2^{1}/_{2}$ by $1^{1}/_{2}$ inches) (Martin 1991). Because they are sensitive to heat, caps were detonated by lighting a fuse or, after it became available, by electrical current.

The only establishment in California that was making common and black powder in 1884 was the California Powder Works in Santa Cruz. Other California companies recorded as making high explosives that year were Giant, Vulcan, Safety-Nitro, and Vigorite; however, they did not anticipate the diminished demand and began to restrict production to make a profit (De Groot 1884:50–51).

Figure 2.3. Blasting-cap-tin lids, Hart Mining District, San Bernardino County, 1998 (photograph by Karen K. Swope).

1877 California State Geological Society Established

The California State Geological Society was established in 1877 with two primary objectives: (1) to make a Pacific Coast geological collection available to the State of California at no cost and (2) to encourage the study of geology in all its branches (California State Mining Bureau 1880:6).

1880 California State Mining Bureau Established

In April 1880, the California State Mining Bureau was established by the state legislature. The act charged a State Mineralogist with collecting and preserving for study and reference specimens of all of the geological and mineralogical substances found in the state. Additionally, the State Mineralogist provided analytical assays; maintained a library on mineralogy, geology, and mining; procured drawings of mining and milling machinery; corresponded with mining and metallurgy schools; obtained information on improvements in mining and mining machinery; and visited mining districts across the state, to record their history and describe the geology, the character of the mines and ores, and the development of the district. The State Mineralogist produced an annual report detailing the bureau's activities (California State Mining Bureau 1880:3–4).

The earliest comprehensive figures available on hard-rock-mining production come from the second annual report of the California State Mining Bureau (1882:174), which provided production numbers for deep mines of gold and silver between June 1, 1879, and May 31, 1880 (Table 2.1). At that time, the top-producing mining district in the Study Area, by far, was Bodie, in Mono County, whose production was more than four times that of the rest of the mining districts in the Study Area combined.

Table 2.1. Deep-Mine Production in the Study Area during 1879–1880, by County

Mining District	Ore Raised and Treated (Tons)	Gold Bullion Produced ($)	Silver Bullion Produced ($)
Inyo			
Alabama			
Beverage [sic]	354	17,699	
Cerro Gordo	4,223	3,307	140,517
Coso	350	939	17,622
Deep Spring Valley			
Fish Springs			
Kearsarge	200		9,400
Lee	100		6,500
Lookout	260	633	18,499
Pajaro			
Panamint	600		37,140
Russ	500	2,925	2,600
Snow's Cañon	100	200	1,300
Swansea	27		5,567
Tarrytown			
Ubehebe[c]			
Union			
Waucoba[c]			
Wild Rose			
Los Angeles			
Silverado	200		29,400
Mono			
Bishop Creek			
Blind Spring[a]	174	308	42,333
Bodie	55,969	2,765,927	341,375
Clover Patch			
Homer			
Indian	640		80,317
Montgomery, or White Peak	300		5,000
Piute			
Scattered	25		6,601
San Bernardino			
Clark[b]	389		64,050
Dry Lake			
Silver Mountain			
San Diego			
Banner	300	9,000	
Cargo Muchacho	10,000	154,000	

Mining District	Ore Raised and Treated (Tons)	Gold Bullion Produced ($)	Silver Bullion Produced ($)
Julian	213	8,850	
Picacho	6,000	66,000	
Pinacate			

Source: California State Mining Bureau 1882:176–185
Note: Imperial and Riverside Counties were still part of San Diego County during this period, and Orange County was still part of Los Angeles County.
[a] From 48 tons of tailings.
[b] From 270 tons of tailings.
[c] Abandoned.

Legislation

Mining Act of 1866

Important legislation was enacted in 1866, following the creation of Mines and Mining Committees in both the Senate and the House of Representatives. Although the new law was titled "An Act Granting the Right of Way to Ditch and Canal Owners over the Public Lands, and for Other Purposes," the 1866 "Lode Mining Law" nevertheless opened unclaimed mineral lands to exploration by all citizens, subject to the regulations of local mining districts. Upon investing labor and improvements valued at $1,000 in a single vein, the claim could be patented, along with the right to follow the vein or lode up to 200 feet, even into adjoining land. Under the law, states and territories were authorized to produce regulations for mines in their purview (Lacy 1999:8).

General Mining Act of 1872

The General Mining Law of May 10, 1872, as amended (30 U.S.C. 21–54, 611–615), governs locatable minerals on federal lands to this day. The law allows U.S. citizens to search for, discover, and obtain valuable mineral deposits on land open to mineral entry. It applies to most metallic minerals and also to some nonmetallic and industrial minerals (BLM 2011a:1). The 1872 law contained an important change from previous legislation. Whereas the 1866 law pertained to "mineral lands," the new law applied to "valuable mineral deposits," effectively adding a demonstrable threshold of value to claim requirements. The distinction is critical to the understanding of fluctuations in the focus of mining through history and across the Study Area. In 1873, the definition of "locatable minerals" under the law required that the minerals rendered the land "more valuable for mining purposes than for agriculture" (BLM 2011a:3). The general intent of the 1872 law was

> to spur the economic development and settlement of the West. The . . . Law changed miners from trespassers to legitimate users and occupants of the public lands. It also placed a high priority on mineral exploitation as a major use of the public lands. This created conflict over the years, as the Federal government devoted increasing attention to multiple use management and the protection of natural and cultural resources [BLM n.d.b:n.p.].

The law limited lode claims to 1,500 feet along and 300 feet centered on either side of a single vein. It granted the claim owner rights to follow the mineral along its entire downward course, provided the apexes of connected veins were within the main claim (Lacy 1999:9–10; Paul 1947:237–238). It also set out the annual assessment work required to maintain the claim. The 1866 and 1872 acts helped to clarify the land-tenancy status of miners operating on public lands. Beginning in 1894, the definition of "valuable" under the 1872 law was determined according to the "prudent man rule," wherein "a person of ordinary prudence would be justified in the further expenditure of his labor and means, with a reasonable prospect of success in developing a valuable mine" (BLM 2011a:4).

Growth and Zenith of Mining Activities in the Study Area

The Growth and Zenith of Mining Activities episode in the Study Area encompasses the period during which mining in the California deserts became an increasingly organized, technical, and capitalized industry. Beginning in about 1890 and continuing until the Stock Market Crash of 1929, the period includes such formative events as the San Francisco earthquake and World War I. As in other periods, economic trends determined the vitality of the industry. Mining technology increased prodigiously, particularly in milling and recovery methods. Transportation networks and electrical generation opened new opportunities in remote areas. Corporate management, safety regulations, labor organization, and federal legislation further shaped the industry during this time.

Cultural Events

World's Columbian Exposition, Chicago, 1893

At the time of the 1893 World's Columbian Exposition in Chicago, the United States was the world's leading producer of gold, with California in first place among the states (Crane 1908:140, 557–558). In recognition of the monumental role that mining played in the nation's economy, the Mines and Mining Building at the exposition (Figure 2.4) was among the most impressive architecturally and was situated in one of the most prominent locations on the central plaza (White and Igleheart 1893:68). The California Mining Exhibit featured displays related to placer and lode mining in the state. A nugget purporting to be the famed discovery in Sutter's millrace was briefly displayed, before being removed to prevent theft. Another display was a scale model of the Deidesheimer square-set timbering method that had been developed in 1860 for Comstock mines (Crane 1908:126) and was later used in deep California mines (Vendl and Vendl 2001:37–38).

In the year following the exposition, Australia, New Zealand, and other South Pacific islands produced more gold than the United States, and Colorado became the highest state producer of gold a few years later, in 1897 (Crane 1908:557–558).

Figure 2.4. Engraving of the Mines and Mining Building at the 1893 World's Columbian Exposition in Chicago, Illinois (courtesy of the Library of Congress, via Wikimedia Commons).

Unionization and Strikes

As the industrial revolution brought increasing technological and systematic developments to the mining industry, organization of labor, including unionization and legislative support for workers, followed (Wyman 1979:6). Labor strikes were the inevitable result of employer resistance to the implementation of regulated conditions, job benefits, and an 8-hour workday. Notable examples of labor strikes involving the Industrial Workers of the World and the Western Federation of Miners took place outside the Study Area, in northern California and Nevada. Nevertheless, tensions between laborers and mine owners/operators resulted in a few lesser-known and contentious regional episodes that included violence and death.

At Darwin in the Coso District, the Workingmen's Club of Darwin provided a social alliance for miners. A strike ensued when, in 1878, the New Coso Mining Company cut smelter workers' pay from $4 to $3 per day. The Workingmen blocked the entry of scabs intent on working at the lower wage, and two strikers were killed by law enforcement. A short time later, the Workingmen's Club was disbanded (Lingenfelter 1974:141–142).

The Bodie Mechanics' Union, which included mine hoisting engineers, went on strike in 1879, unsuccessfully seeking 8-hour shifts and a $5-per-day wage (Wedertz 1969:202). Also at Bodie, an event described as the Miners' War of 1879 resulted from a claim dispute between two mining companies. Gunfire and fisticuffs were exchanged; one man was killed. Over 500 members of the Bodie Miners' Union (Figure 2.5) took possession of the disputed claim and temporarily forced the opposition from town. A Citizen's Committee negotiated peace between the parties, but the Miners' Union was locally condemned for its actions and accused of overstepping its authority (Wedertz 1969:144–147, 202).

Figure 2.5. Bodie Miners' Union Hall in Mono County, California (courtesy of the U.S. Department of Interior National Park Service, HABS CAL, 26-BO).

At the Yellow Aster Mine in the Randsburg District, miners struck in 1903. Two days into the strike, when a fire began in town, it was discovered that the fire hose and a rope used to operate the fire bell had both been cut (Shumway et al. 1980:61). It was ultimately a labor strike that led to the 1939 shutdown of the Yellow Aster Mine (Shumway et al. 1980:66).

Mining Discoveries at the Turn of the Twentieth Century

A number of gold and silver discoveries in eastern California and southern Nevada at the turn of the twentieth century renewed interest in the area, and several camps briefly flourished. Among them were Ballarat (1897), Tonopah (1900), Goldfield (1902), Rhyolite (1904), Harrisburg (1905), Skidoo (1906), and Hart (1907) (Francaviglia 2007; Harris 1959; Paher 1981; Patera 1994; Snorf and Snorf 1991; Weight and Weight 1970; Stetz 1993). The Tonopah & Tidewater Railroad (built between 1905 and 1907) facilitated this rush by connecting the remote camps with major rail lines (Myrick 1962, 1963). The rush was localized to the northern part of the Study Area.

World War I

The scale and impact of mining throughout the western states increased exponentially until World War I (Francaviglia 1991:127–129). U.S. entry into the war in 1917 created a focus on the mining of base metals and a concurrent reduction in precious-metals mining (Swope 1997:6). Tungsten deposits, which had been known in the Randsburg District at Atolia since 1905, led to a second mining boom in the district during the war (Hallaran and Swope 1987:7; Troxel and Morton 1962:95); by 1919, however, the boom was over (Lemon and Dorr 1940:207). Tungsten was also produced in Imperial County during the war, and in the Paymaster District, manganese was also produced (Morton 1977:72–78; Shumway et al. 1980:18). Mining of talc deposits in Inyo County began during the war (Hall and MacKevett 1958:15; Norman and Stewart 1951:113–115). The Yellow Aster Mine in Kern County was inactive during World War I; it reopened in 1921, but the mill did not operate at full capacity again until 1933 (Shumway et al. 1980:66). Copper was mined in the Ord Mountains of San Bernardino County, and manganese was mined in the southeastern part of the county (Shumway et al. 1980:87, 90, 123).

Mining machinery was removed from idle mines—for example, the Good Hope Mine in Riverside County—for other applications during the war (Swope 1987:7). During the war, a 28-mile length of iron water pipe was removed from Skidoo in Death Valley for recycling (Perkins 2001:160). Some of the final team freighting that took place in the California deserts was accomplished during the war, hauling mining machinery to rail sidings for shipment to distant recycling facilities (Van Dyke 1997:130).

Economic Events

As the end of the nineteenth century approached, western mines were increasingly backed by investors in eastern states or European markets, particularly at mines where decidedly lucrative returns were expected. The myriad of mining stocks issued for mines in the Study Area (Figure 2.6) is a testament to the amount of speculation that surrounded even smaller and ultimately unproductive operations. Contemporary newspaper accounts typically exaggerated the potential of local mines. One historian (Patterson 1987:B-2), writing of the Good Hope Mine, Pinacate District, Riverside County, described the unreliability of production reports thus: “Such reports were often based on owners’ figures—sometimes over-estimated for stock-selling purposes and sometimes underestimated for tax or other business reasons.” An owner of the Good Hope Mine was sued by investors who claimed he had salted the mine (artificially introducing rich ore) and later allowed it to fall into disrepair (Crawford 1896:311; Swope 1987:7).

Figure 2.6. Mount Whipple Gold Mining Company stock certificate (from the author's collection).

Sherman Silver Purchase Act of 1890 and the Panic of 1893

Western silver miners and inflationists (those who called for currency inflation in the belief that ballooning the paper-money supply would guarantee prosperity) were dissatisfied with the 1878 Bland-Allison Act because it did not provide for the unlimited government purchase of silver. After more than a decade, their shared drive for more favorable legislation culminated in the Sherman Silver Purchase Act of 1890, obligating the federal government to purchase 4.5 million ounces of silver—the bulk of the silver then produced in western mines—each month at prevailing market prices (Poole and Rosenthal 1997:103). Treasury notes redeemable in gold or silver were given in exchange, and the silver acquired was to be minted into silver dollars for redemption of the notes (American Institute for Economic Research 1991:5). The act created fleeting inflation of silver prices, but these ultimately dropped over the ensuing 4 years as the quantity of silver in circulation exceeded its demand (Wyckoff 1999:51). By 1892, the price of silver had diminished to the lowest figure to that date, at $0.82 per ounce; it shrank further to $0.62 per ounce in 1893. The Bland-Allison and Sherman Silver Purchase Acts had an inflationary impact on the U.S. economy through the coinage of overvalued silver dollars and the issue of Treasury notes on silver bullion. This inflow of silver caused a drain on gold from the U.S. Treasury as shrewd investors purchased silver and exchanged it for gold, which could then be sold at a profit on the global metals market. The falling silver prices and reduced federal gold reserves contributed to the "crash" known as the Panic of 1893, which led to a severe nationwide economic depression (Crane 1908:141–142). The Sherman Silver Purchase Act was repealed in 1893 to prevent a consequent depletion of federal gold reserves, and the United States returned to a de facto gold standard (American Institute for Economic Research 1991:5).

Many silver-lead-producing districts in western states ceased operation in 1893 (Crane 1908:142) and did not recover until the end of the decade (Fell and Twitty 2008). A concurrent increase in the price of gold made little difference for mines where both gold and silver were produced.

An example from the Study Area is the rapid decline of Ivanpah and mines in the Clark Mining District. During its peak in 1880, Ivanpah had several stamp mills and furnaces to serve district mines, as well as residences, saloons, hotels, and blacksmith shops, but the town was deserted by 1891 (Casebier 1987:311–313; Vredenburgh et al. 1981:96–106). By the time the financial outlook for mining began to improve, electrical innovations were finally feasible, and many mines took advantage of the new technology by adapting existing equipment or purchasing machinery that operated on the new power source.

A revival of interest in mining began during this depression and resulted in the discovery of gold- and silver-mining districts in Kern, San Bernardino, and Riverside Counties, including Rand, Mojave, Tropico, Clark Mountain, Goodsprings, Sunshine Peak, Twentynine Palms, Silver Hills, Vanderbilt, Ibex, Old Woman Mountains, and Arica Mountain (Gardner 1954:51; Lyman 2010:112–113; Vredenburgh et al. 1981:276).

Gold Standard Act of 1900

The Gold Standard Act, executed in 1900, established gold as the single U.S. monetary standard and created a $150-million reserve for redemption of paper notes (American Institute for Economic Research 1991:5). Subsequently, silver values were far below the face value of the silver coins that remained legal tender (Yeoman 1975:12). The act led to renewed operations at gold mines in the Study Area, including several in the Hedges/Tumco Mining District (Imperial County), where "by 1909, several of the mines were reopened under new corporations. Part of the impetus was the Government's newfound commitment to the gold standard and its call for new gold to increase government reserves" (Cleland and Apple 2003).

San Francisco Earthquake 1906

The April 1906 San Francisco earthquake and the ensuing fire temporarily shut down the Pacific Stock Exchange, but the impact to western financial markets in general was longer-lived. Before the earthquake, investment capital had flowed from San Francisco to mines throughout the west. The financial health of many mines was irreparably damaged by the loss of company offices headquartered in the city, bank closures, and the diversion of investments for restoring city infrastructure (dePolo and Earl 2006). In the wake of the disaster, many mines lost funding and were forced to shut down during the rebuilding period, never to reopen. A Study Area example is Chloride Cliff; despite its remote location in the Funeral Mountains of Death Valley, the earthquake resulted in the mine's becoming idle for a period of at least 3 years (Swope 1999:8).

Panic of 1907

San Francisco received large amounts of monetary relief in the weeks following the disaster. British, German, French, and Dutch companies, heavily invested in underwriting most of the city's fire insurance policies, were forced to pay enormous sums on the claims. The Bank of England, followed by other European financial centers, in defense against the outflow, raised interest rates, pushing the United Sates into recession. Odell and Weidenmier (2004) used contemporary documents to demonstrate the cause and effect resulting in the Panic of 1907, "one of the shortest, but most severe recessions in American history" (Odell and Weidenmier 2004:1003). In the mining industry, the recession led to deflated interest earnings in mining investments and stocks (Lingenfelter 2012a:173).

Technological Developments

Between ca. 1820 and 1870 in the United States, the Industrial Revolution brought significant change in the form of mechanization, manufacturing, and motive power. Whereas previously, goods were produced by hand, and work was performed by human labor, machines increasingly performed those tasks. In the California mines, the Industrial Revolution manifested itself by about the 1870s, when operations were shifting from individual miners with little know-how or capital to a scientific pursuit with remote financial backing (Paul 1947:310). During the second half of the nineteenth century, many large western mines were backed by Eastern and European capital, with British money representing most of the European investment (McKay 2011:38).

Historian Ronald Brown (1979:xiv) stated that "[m]ining was an undertaking in which the stage of development of a given mine was more closely related to the time interval since its discovery than to the state of industrialization of the occupation as a whole." In other words, many mines were slow to adopt introduced technologies, and primitive processes persisted alongside more sophisticated operations for some time.

> More than machines went into the creation of that historical transformation known as the Industrial Revolution. Attitudes of businessmen, governmental leaders, inventors, and workmen were also crucial in the shift from animal to machine power, as was the availability of natural resources, labor, and paying customers [Wyman 1979:5].

Nevertheless, the transformation eventually affected the mining industry as a whole, including "technology, work organization, union formation, and protective legislation" (Wyman 1979:6). The following paragraphs are a discussion of important technological advancements during this period.

Before ca. 1870, underground-mine drilling and blasting were accomplished with hand-drills and black powder (McQuiston 1986:17). Nobel invented a way to render explosive liquid nitroglycerin less deadly by mixing it with diatomaceous earth. The resulting paste—dynamite—was shaped into rods that could be inserted into drilled holes (Nobel Media AB 2016). Following the introduction of dynamite, pneumatic drills (Figure 2.7) became increasingly common; the Ingersoll Rock Drill Company manufactured most of the drills used in hard-rock mining beginning in the 1870s (Ingersoll-Rand 2016). Air drills were in widespread use by the turn of the twentieth century (McQuiston 1986:17). Use of the earliest pneumatic drills, however, created dangerous clouds of dust—particularly during underground operation—resulting in silicosis illness and death. Dust was better controlled after the drills were equipped with a water supply (Keane and Rogge 1992:110). Improvements in blasting technology "reduced the costs of mining while increasing output" (Twitty 2001:vii). Additional details of mechanical-drilling technology were provided by Twitty (2001:39–56).

Before railroad construction in the California deserts, mining in most remote districts was prohibitively expensive. Construction of railroads across and within southern and eastern California facilitated movement of ore from mines to mills and increased the potential for mine development with large, heavy machinery and a reliable supply network. The Southern Pacific Railroad penetrated the eastern Mojave Desert in 1883, providing sidings that could serve outlying mines. An example in the Study Area is the Essex siding, which facilitated the success of the Bonanza King Mine and the development of Providence (Wilke and Swope 1989:4). Railroads enabled the productive development of the base-metal industry during and after World War II, when some remote mining districts in western states were said to be "industrial islands," isolated in space but connected to world markets by the rail lines (McKay 2011:38). Some workers who had arrived in the region as railroad-construction laborers stayed on to work in the mining trades. The railroad history of much of the Study Area was comprehensively reported by Myrick (1962, 1963) in *Railroads of Nevada and Eastern California*. Some history of eastern California mining railroads is also included in *Bonanza Railroads* by Kneiss (1954).

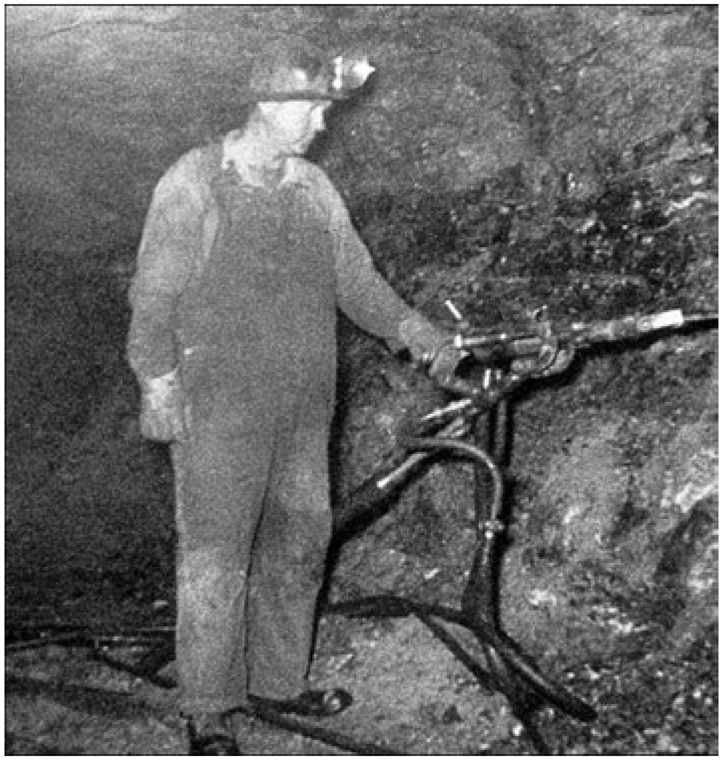


Figure 2.7. Photograph of Orville Rowe operating a mechanical drill underground, ca. 1950 (location unknown) (from the author's collection).

Other mines never reached by rail connections persisted, some implementing mule teams and, later, trucks for transport. Mule teams required regular water and rest stops and had to carry water and feed as well as ore, workers, and supplies. Twenty-mule teams were used to haul copper ore from Rosalie, San Bernardino County, to the smelter (Shumway et al. 1980:103). The Rose and Sidewinder Mines in Victor Valley, San Bernardino County, "utilized their extensive mule trains not only hauling ore to the railroad, but to bring necessary timbers and other supplies back to the camps" (Lyman 2010:113). Motorized vehicles required the construction of adequate roads and constant maintenance and repairs. Consider Chloride Cliff/Chloride City, on the ridge of the Funeral Mountains of the Amargosa Range, at the eastern boundary of Death Valley. From the time mining activity began in the 1870s until the first decade of the twentieth century—when the town of Rhyolite developed after strikes at the Keane Wonder Mine and in Bullfrog, Nevada—the nearest supply points were the distant towns of Barstow (125 miles direct distance) and San Bernardino (175 miles direct distance) (Latschar 1981:237–262; Paher 1973:30). Desert automobile travel remained treacherous into the twentieth century. The Automobile Club of Southern California did not begin signing roads and desert watering places until 1906, and progress was slow (Talley-Jones 2000:10, 14).

Innovations in the production of wire cable enabled aerial tramways for transporting ore, men, and equipment over long distances and rough terrain where costly roads, railroads, and tunnels would have been required (Wallis-Tayler 1911:1–2). The machinery enabled exploitation of ores in remote and rugged locations or in situations requiring that ore be transported over natural obstacles, such as ridges, gorges, or rivers (Trennert 2001:1–2, 4–5).

Several mines in Inyo County used aerial tramways, including the mine at Panamint, where a 2,600-foot aerial tramway hauled ore to the mill, the Lotus and Monte Cristo Mines south of Ballarat, the Little Mack Mine, and the Zinc Hill Mine northeast of Darwin (Shumway et al. 1980:31, 37, 40, 42).

In his work *Riding the High Wire: Aerial Mine Tramways in the West*, Trennert (2001:79) noted that rugged locations in the desert Southwest, particularly "the arid land around Death Valley," contained a "fair share" of the systems. The Keane Wonder Mine in Death Valley operated a system known locally as the "sky railroad" from its mines to the mill at the western base of the Funeral Mountains. Another tramway ran between the mines at Cerro Gordo and Keeler, on the Owens Valley floor (Trennert 2001:79–82), and two tramways operated in the Beveridge Mining District in the Inyo Mountains (Swope 1993:298–302) (Figure 2.8).

Figure 2.8. Aerial tramway, Beveridge Mining District, Inyo County, 1991 (photograph by Karen K. Swope).

Power hoists (Figure 2.9) were introduced, also enabled by the development of wire rope. Hoists were powered first by steam and later by gasoline or electricity, replacing the more labor-intensive and unpredictable winches or windlasses motivated by human or animal power. Although hoist-machinery failures and hoist-operator errors were subsequently implicated in numerous mine accidents, the technology resulted in significant improvements in efficiency and safety. Regarding a fatal hoist accident at Bodie, the *San Francisco Chronicle* (1879) reported: "As soon as the engineer saw that he had lost control of the cage, he put on his coat and took to the hills. Officers are in pursuit of him."

Electric hoists were implemented in mines of the Study Area, including the Blackhawk Mine in Kern County and the Bonanza King Mine near Lavic in San Bernardino County (Shumway et al. 1980:10, 93, 123).

The larger mines employed the services of mining engineers who were experienced and/or trained in the practical aspects of mining, such as valuation, design and management of underground and surface facilities, beneficiation, and even corporate administration (Thrush 1968:715). A study of the technical and social roles of mining engineers in the western United States was prepared by Spence (1993). Small-scale operations continued to work the less-productive mines with little capital and no formal design or management, outnumbering the major producers.

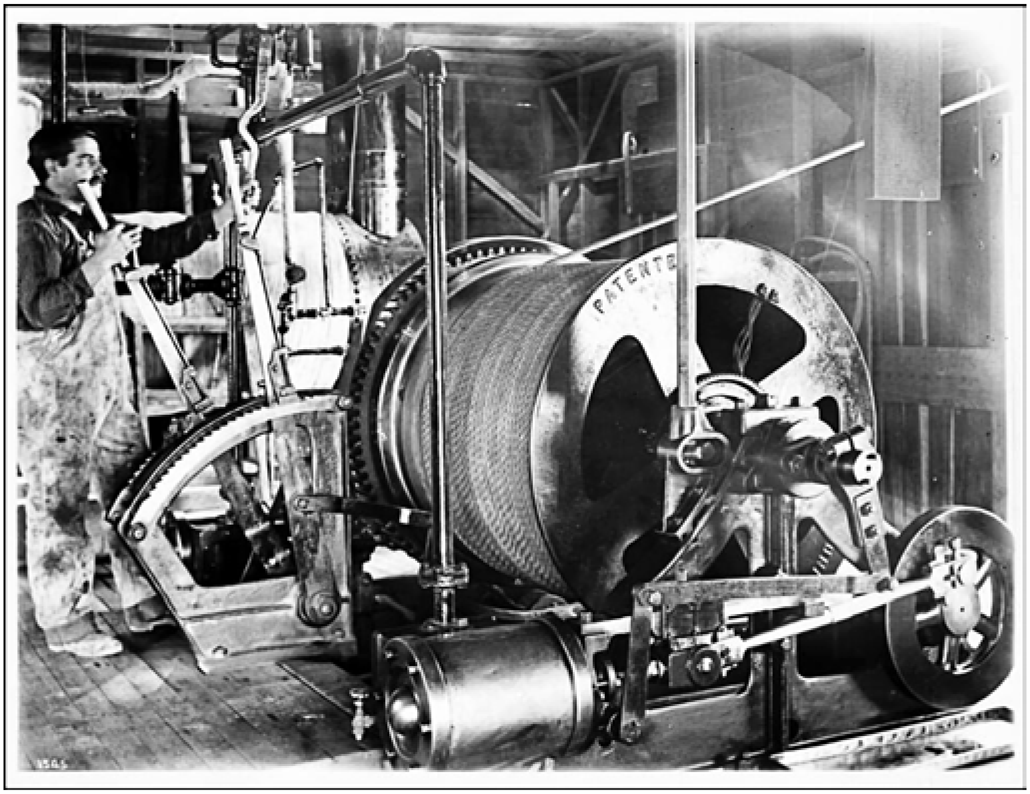


Figure 2.9. Photograph of a man operating a hoist at a mine run by Free Gold Mining Company, Hedges, California, ca. 1905. To the left, a man with a moustache wearing overalls and a striped shirt can be seen operating a hoist at the mine. A large iron drum winds rope that pulls ore cars (not visible). The boiler, pressure valves, smokestack, pistons, gears, and levers that operate the hoist are clearly visible in this wooden shack. On the side of the drum is the forged word "Patented" (digitally reproduced by the University of Southern California Digital Library, from the California Historical Society collection).

Mining engineers supported mines in the Study Area, at Cerro Gordo, Inyo County, and the Kramer District borax mines of San Bernardino County (Shumway et al. 1980:25, 27, 39, 69). The Furnace Creek Copper Mine in Death Valley, financed in part by Charles Schwab, attracted the attention of Guggenheim interests, who in 1906 sent a mining engineer to evaluate its potential. His negative report spelled the end for the operation (Shumway et al. 1980:39).

Air compressors and electrical equipment became increasingly common and affordable, and mines began incorporating the newer technologies. Underground spaces became lighted with electricity for the first time. The earliest mining application of electricity in the Study Area was in 1893, at the Standard Consolidated Mining & Milling Company, in Bodie (Crane 1908:143; Twitty 1998:108). Electrification of mining equipment was not common, however, until the 1900s, and even then, well-capitalized mines were more likely to have made the changes than their small-scale counterparts. This was partly because of the embryonic state of the technology. "Generators, currents, motors, and circuitry" were "nascent, quasi-experimental, and unstandardized" (Twitty 1998:110–111). The question of converting to electricity is demonstrated by the G. B. (Gold Bug) Mine, Stringer portion of the Rand District. In 1915, the G. B. mill ran on electricity, which cost $0.12 per ton (Brown 1915:494)—a considerable part of their profits.

Air compressors ran drills throughout the Study Area, including at the Blackhawk Mine, Kern County, and the Little Mack Mine, Inyo County (Shumway et al. 1980:10, 40).

Some remote mines continued to rely on older, steam-powered equipment for decades (Figure 2.10); miners eventually adapted older equipment to run on the new power source rather than laying out capital to purchase new machinery outright. Steam power, however, required wood for fuel, and the areas surrounding mining districts were quickly depleted of the fuel source (McQuiston 1986:16). In San Bernardino County, steam-powered machinery included mills operated at Garlock and in the New York Mountains; in the Old Woman Mountains, traction engines were used to haul ore from Ryan to Manvel (Shumway et al. 1980:38, 54, 106, 115). Steam-traction engines largely replaced mule teams for desert hauling (Mammoth Traction Engine 1903).

By the 1910s, electrical technology had advanced to a point where mining entities routinely replaced failing steam-powered machinery with that powered by electricity. With the development of electrical-power generation and distribution came increased markets for aluminum, copper, and steel (Horton 1982). In the Study Area, electricity was used to power hoists in Kern County by 1921 (Shumway et al. 1980:10).

Gasoline-powered engines became increasingly common during the same period, leading to new road building to replace older wagon roads. The internal-combustion engine provided motive and mechanical power for a myriad of mining-industry applications beginning at the turn of the twentieth century. The Little Mack Mine in Inyo County used a 1-stamp mill powered by gasoline, and the Bonanza King Mine in San Bernardino County had a 10-stamp mill operated by 3 gasoline engines (Shumway et al. 1980:40, 94).

All of these innovations reduced the cost of mining, which, calculated on a per-ton basis, increased the profitability of lower-grade ores. Thompson (1921:103) noted the replacement of animal power with automobiles:

> Until recent years the traveler in the desert used burros or horses and wagons as his means of transportation. Since the advent of the automobile the use of horses has nearly ceased. . . . When horses were used and travel was slow, the distance between watering places was important, and it was necessary that a watering place be reached at night or that large supplies of water be carried. . . . Today, with automobiles for transportation, the distance is of much less importance, and if water is not found at one watering place a few hours' trip will usually bring the traveler to another.

Figure 2.10. Steam engine, Beveridge Mining District, Inyo County, 1991 (photograph by Karen K. Swope).

The 1907 strike at Hart, San Bernardino County, attracted a “stampede” in “automobiles, buggies, and wagons, and on bicycles and burros” (*Mining and Scientific Press* [*M&SP*] 1908:84). A 1927 Nevada rush (to Weepah, near Tonopah) was reported thus (*Oakland Tribune* 1927): “Gone is the burro. Not one to be seen in the camp. It is a motorized goldrush. From every direction thin streaks of dust fleck the desert announcing the coming of still more assorted humanity.” At least one writer (Coolidge 1985:n.p.), though, suggested that prospecting might be better suited to travel by burro: “When the old-time prospectors were hunting for their burros they found gold, and when they were hunting for gold they found their burros. Since they have taken to Fords they don’t find anything.”

Recovery by Chlorination, Flotation, and Cyanidation

Gold-beneficiation processes underwent critical developments during this period, with the introduction of increasingly efficient methods to recover greater quantities of valuable metal.

In the process of amalgamation, precious metals are removed from ore by causing them to unite in an alloy with mercury. Amalgamation recovery was performed with arrastras and stamp mills. In the process, slimes (finely pulverized ore suspended in water) are allowed to flow over mercury-coated surfaces on level, paved areas, in a metal pan, or on copper plates. In the next step, the gold or silver is recovered by refining, with the mercury driven off and retorted. The amalgamation process was superseded by more-effective cyanide recovery processes.

Gold recovery by chlorination, introduced to California in the 1850s (Bunyak 1998:20), involves a process of dissolving gold in a chloride solution, leaching it from the solution with water, and precipitating and refining it. The chlorination process was quickly replaced with more-effective processes, becoming obsolete by the mid-twentieth century (Botwick 2012:39; Hardesty 2010:80).

In 1880, a chloride operation began at Ivanpah, and in the late 1880s, miners were employing the chloride process in the Whipple Mountains; both operations were in San Bernardino County (Shumway et al. 1980:84, 99).

As the highest-grade ores became depleted toward the end of the nineteenth century, the flotation recovery process was developed, to concentrate lower-grade ores and enable profitable recovery from them (Bunyak 1998:xi). For this reason, according to historian Bunyak (1998:23), “engineers consider flotation the beginning of modern mining.” The earliest flotation patents were filed in the 1880s (Bunyak 1998:25). The process, first used in the recovery of base metals, differed from earlier recovery methods that used gravity to separate minerals from gangue. After successful application to copper ores, the flotation process was used in recovery of gold (Tucker and Swainson 1934:44). Miners could expect no greater than approximately 70 percent recovery by earlier amalgamation methods; therefore, tailings from older amalgamation mills could be profitably reworked by flotation. The process had not been in use long when it was largely replaced by the more-efficient cyanidation process for gold and silver recovery. It remained in use thereafter, however, for recovery of base metals, including copper, lead, zinc, and iron (Bunyak 1998:10; Young 1970:37).

In San Bernardino County, a flotation mill operated in the Baker area, another at Rock Spring in the Providence Mountains, and another at Vanderbilt (Shumway et al. 1980:82, 93, 110).

Potassium cyanide was used as early as 1867, and work with sodium cyanide followed in 1881 (Scheidel 1894:9–10); the main difference between the two is the dissolving strength (MacFarren 1912:9–10). Based on the principle that “alkaline cyanide solutions have a preferential dissolving action on the gold and silver contained in an ore” (Heinen et al. 1978:2), various methods were devised for soaking, agitating, and/or precipitating ore in the recovery process. The elaborate but effective cyanidation process involves fine crushing (usually in stamp and ball mills), followed by the addition of cyanide solution to the ball-mill chamber. The solution begins dissolving the gold, after which classifiers (effectively, rakes) separate the resulting pulp by grain size. The pulp is afterward sent through riffles, where the ore settles. These slimes are then passed through agitators, where they are aerated to further activate the solution. Finally, countercurrent decantation in thickeners separated the cyanide/gold slurry from the gangue, which was discarded as tailings (Hallaran and Wilke 1987:7–8). Gold was recovered from the pregnant cyanide solution by precipitation on electrified zinc plates (Munroe 1905:596). The precious metals were then scraped from the zinc plates or dissolved in sulfuric or hydrochloric acid (MacFarren 1912:1) and refined into bullion. Cyanide was brought to the mines packaged in small drums with embossed lids (Figure 2.11).

Figure 2.11. Embossed cyanide-drum lid, Valley View Mine, Hart Mining District, San Bernardino County, 1991 (photograph by Karen K. Swope).

The process was pioneered in New Zealand (Fell and Twitty 2008:160), and the California State Mining Bureau was quick to "investigate the merits" of cyanidation (Scheidel 1894:5). The process of extraction and precipitation of gold via the cyanide process was patented in the United States in 1889 (McQuiston 1986:13), and cyanidation plants began replacing earlier chlorination plants in the early 1890s.

Cyanidation plants offered better gold and silver recovery than either amalgamation or chlorination. Miners could expect no greater than approximately 70 percent recovery by amalgamation methods, but the cyanide recovery process was found to be particularly useful in recovering precious metals from low-grade ores (Ely 1989:380). This initiated a gold boom of sorts, between 1890 and 1917, during which miners targeted deposits that had previously been unprofitable and reprocessed tailings from older mines (Young 1970:285). In many cases, the reworked tailings were from the earliest, high-grade deposits, and significant returns were sometimes achieved. During this period, interest, enabled by the new cyanide recovery process, was renewed in older gold and silver mines in the Study Area (Vredenburgh et al. 1981:276).

The Baltic Mill in the Stringer portion of the Rand District is one example of a mill in the Study Area that began as a mercury-amalgamation facility and was converted to a cyanide plant (Hallaran and Swope 1987:8; Wynn 1963:216). Another example is the Valley View Mill site in the Hart District, San Bernardino, which was the subject of archaeological investigations in 1987. Researchers (Hallaran and Wilke 1987) described the remains and the process, based on the results of field observations, archival research, and an oral interview with a Valley View mill worker. Other Study Area examples of the boom that followed the introduction of cyanide recovery technology include (1) reworked tailings from the Campbell Mill, Vanderbilt; (2) the Dry Lake Mining Company plant near Lavic; (3) the Silver King Mine, Calico; (4) the Yankee Maid Mine, Oro Grande District; and (5) the Exposed Treasure Gold Mining Company, the Queen Esther Mine, and the Tropico Mine, Mojave District (Vredenburgh et al. 1981:117–118, 143, 147, 150, 208–209, 212). During the first decade of the twentieth century, the cyanide plant of the Picacho Basin Mining Company, Imperial County, was touted as the largest in the United States (Vredenburgh et al. 1981:14).

Contemporary descriptions of cyanidation plants, including a plant at Bodie, may be found in the 1899 book, *Practical Notes on the Cyanide Process* (Bosqui 1899); illustrations of cyanidation-plant equipment can be found in MacFarren (1912).

Adoption of the cyanide process dealt a critical blow to the mercury industry, formerly used in mercury amalgamation, and California mercury mines transitioned to a lesser role in the international commodities market (Johnston 2013:82).

Safety Regulations and Accidents

The activities associated with lode mining presented dangers to health and safety, both above ground and underground, in mines, mills, assay offices, and transportation mechanisms. Potential injuries included wounds or death from falling objects (such as rocks, cages, buckets, or timbers), drilling/explosive mishaps, falling from equipment or down excavated recesses, illness from exposure to hazardous chemicals, breathing gases/particulates, lack of oxygen, environmental exposures, cave-ins/collapses, floods, and fires.

Corporate concern for liability over accidental injury and death played a major role in the development of safety measures as mines became increasingly industrialized (Wyman 1979:119). Federal and state regulations implemented in response to accidents in the mining industry outside the Study Area had a local impact. Health and safety standards were initiated, and inspections were required at both mines and mills. Another driving factor in the design and implementation of regulations in the workplace—including safety considerations, job benefits, and an 8-hour workday—were unionization and the ensuing miners' strikes. Additional details of labor organization, legislation, and unrest and the changes that they brought to California work and camp conditions during this time can be found in the Caltrans historic contexts and research designs for work-camp properties (Caltrans 2013:44–56) and mining properties (Caltrans 2008:74–79) in the state.

Records of accidents in historical-period California lode mines are not numerous, and no examples from the Study Area are known to have resulted in great numbers of lost lives. Official reports listing national mining disasters from 1839 to 2013 list only one incident within the Study Area (Centers for Disease Control and Prevention 2013). According to that source, in the Tioga Mine at Bodie, a hoist-cage accident on October 3, 1879, killed six men. A contemporary news item (*Healdsburg Enterprise* 1879) named the miners involved and indicated that the loss of life related to the accident was actually greater:

> A fearful accident occurred at Bodie the other day. Nine miners, named Thomas Moran, J. R. Cassidy, G. B. French, Samuel J. Martin, Pat Bannon, Manuel Alvarez, Henry Richards, Joseph Brodeur, and Peter Bluff got into a cage to be lowered to the 520 foot level of the Tioga Mine. Owing to a disarrangement the car was precipitated with great rapidity to the bottom of the shaft. Eight of the men have died from their injuries, and one, Moran, may recover.

Additional details regarding the accident appeared years later in the *M&SP* (McDonald 1916:244), confirming eight deaths and one survivor:

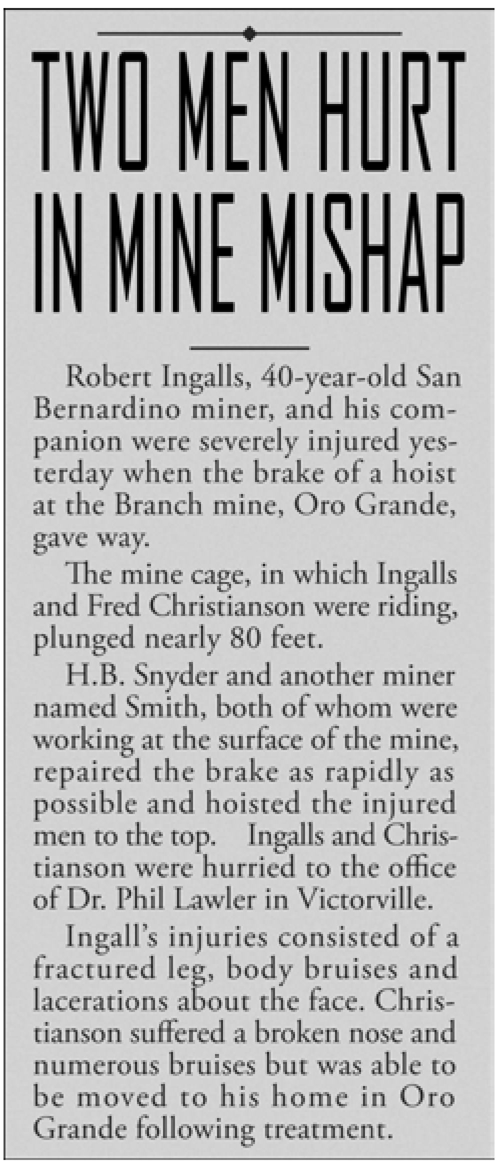
> At the Tioga mine, Bodie, Mono [C]ounty, California, in 1879, a man escaped death in a remarkable manner. The story as told by a prominent mining engineer of New York, and verified by the man who was his foreman at the time of the accident, is as follows: Nine men of the night shift were being lowered in the cage down a vertical shaft; contrary to orders the hoistman in the engine-room did not throw in the clutch of the hoist in advance, but began to lower the cage holding it merely by the brakes, probably intending to throw in the clutch later. The cage fell rapidly, so that the hoist-man could not stop it; the amount of friction he was able to give it only served to keep the cable taut so that the safety-catches did not work. In fact, it would have been better had the cable broken, as in that case the safety-catches would have caught and stopped the cage. The cage and men fell 520 ft., went through a bulkhead of 8-in. square timber, and dropped 20 ft. into a dry sump. Six of the men were killed, two were mangled and crippled, so that they subsequently died of the injuries, but the ninth man in some miraculous way received only a few insignificant abrasions. When rescued he was speechless but not unconscious.

Another notable accident at Bodie was the 1879 explosion at the Giant Powder Company storage magazine. At least 7 individuals died, more than 20 were injured, and Bodie mines and town buildings incurred major property damage. Reportedly, the explosion could be felt some 20 miles away, in Bridgeport (Wedertz 1969:192–195).

The Union Mine at Cerro Gordo reportedly was the location of frequent accidents due to a paucity of support timbers to reinforce the underground spaces (Shumway et al. 1980:26).

Most often, the only documentation for mining accidents in the Study Area can be found in local newspapers, as exemplified in the item shown in Figure 2.12, regarding the Branch Mine in San Bernardino County (*San Bernardino County Sun* [SBCS] 1938). A recent analysis of dangers in historical-period Minnesota mines found that "the vast majority of miners' deaths reported in the local newspapers placed the blame squarely on the miner's shoulders; some 'failure' on his part or of a co-worker resulted in his demise" (Byczynski 2016:45). Nevertheless, nationwide events and legislation had a lasting effect on the mining industry throughout western states.

A guide for mine development published in 1934 (Eaton 1934:392) stated that "accident prevention and the care of the injured have become one of the major operations in mining, just as the cost of compensation for injuries has become one of the large items on the cost sheet." The Bureau of Mines was not authorized to inspect mines, however, until 1941. The first federal statute to regulate underground mines other than coal mines was the Federal Metal and Nonmetallic Mine Safety Act of 1966, but even then, the standards it implemented were advisory in nature, and enforcement was "minimal" (U.S. Department of Labor Mine Safety and Health Administration [MSHA] 2014).



TWO MEN HURT IN MINE MISHAP

Robert Ingalls, 40-year-old San Bernardino miner, and his companion were severely injured yesterday when the brake of a hoist at the Branch mine, Oro Grande, gave way.

The mine cage, in which Ingalls and Fred Christianson were riding, plunged nearly 80 feet.

H.B. Snyder and another miner named Smith, both of whom were working at the surface of the mine, repaired the brake as rapidly as possible and hoisted the injured men to the top. Ingalls and Christianson were hurried to the office of Dr. Phil Lawler in Victorville.

Ingall's injuries consisted of a fractured leg, body bruises and lacerations about the face. Christianson suffered a broken nose and numerous bruises but was able to be moved to his home in Oro Grande following treatment.

Figure 2.12. Headline reporting an accident at the Branch Mine, San Bernardino County, as it appeared in the San Bernardino *Sun-Telegram*, 1938.

Bureau of Mines Established

Between 1894 and 1909, the USGS, as part of its commission, prepared reports and maps related to the country's mineral resources; some of these covered California topics. The Bureau of Mines was established in 1910, under the U.S. Department of the Interior, to adopt mineral-resource-related tasks previously performed by the USGS. The bureau's purpose was "to conduct inquiries and investigations calculated to increase health, safety, economy, and efficiency in the mining, quarrying, metallurgical, and miscellaneous mineral industries of the country" (Powell 1922:1). During its tenure, its responsibilities included mine inspections, explosives regulation, accident investigation, accident-prevention research, mine-hazard investigation, hygienic-conditions investigation, research in mine rescue, publicity, and mine and mineral-technology studies (Powell 1922:7–36). An example of the bureau's actions is the 1935 approval of a dust respirator for miners (Mine Safety Association 2017). The Bureau of Mines closed in 1996, and some of its functions returned to the USGS.

Carbide Lamps

Miners in western states opted for candles and candleholders for underground lighting, whereas those in eastern states (particularly coal miners) favored oil-and-wick lamps (Fox 1985:n.p.). The standard miner's candleholder is known as a "thimble and spike" holder, because the cup that holds the candle resembles a sewing thimble. Most of these were hand-wrought, and some had a folding mechanism, for portability.

Carbide mining lamps were introduced ca. 1900. Water, dripping from a reservoir at the top of the lamp onto calcium-carbide pellets in a chamber below, caused the release of acetylene gas. Although the process produces a sooty flame, the light is bright, dependable, and safer than candlelight. As personal gear, the lamps typically remained in each miner's toolkit, but cans of various sizes that contained the calcium carbide are commonly found at sites in the Study Area (Figure 2.13).

Figure 2.13. Calcium-carbide-can top, Hart Mining District, San Bernardino County, 1998 (photograph by Karen K. Swope).

Decline and Resurgence of Mining Activities in the Study Area

The period covering Decline and Resurgence of Mining Activities episode in the Study Area begins with the Stock Market Crash of 1929, and includes major events such as the Great Depression and World War II. As in each period, shifts in national and global economies prescribed regional mining industry patterns. Enforced closure of some Study Area mines and salvage efforts during World War II brought irreversible changes to California desert mines. Small-scale, Depression-era mining played an important role at this time. The reopening and repurposing of abandoned mines are the final chapter in the period, which extends to the end of the interval covered in this study—ca. 1960.

Cultural Events

1929 Stock Market Collapse and the Great Depression

The Stock Market Crash of 1929 and the ensuing depression are largely inseparable from one another; consequently, we combine them here in the section covering cultural events during this period. The economic depression following the stock market crash affected the mining industry in profound ways. With investors unable to continue backing their mining interests, many mines were forced to close. An example from the Study Area is the Tecopah Consolidated Mining Company, Inyo County, whose silver and lead production halted during this time (Norman and Stewart 1951:80).

Nonetheless, several factors led to moderate new mining during the Great Depression. The ensuing moderate increase in gold prices, the devaluation of the dollar, the desperation for new sources of income, and the availability of low-wage workers during this time led to the small-scale reopening of some old mines in the California deserts (Merrill et al. 1937:xi–xii; Vredenburgh et al. 1981:58–59). State mining departments encouraged small-scale operations during this time. The Arizona Bureau of Mines offered gold-panning classes and issued a publication on the topic, to equip "residents who would rather seek gold than remain idle" with the necessary guidance (Clements 2003:100), and the California Division of Mines and Geology published *Manner of Locating and Holding Mineral Claims in California* (Ricketts 1931).

For many during this time, working claims was an opportunity to live rent-free—an option that became particularly enticing after Congress waived the proof-of-labor-expenditures requirement for miners who could demonstrate insufficient income to pay the $100 assessment fee (Puckett 2006:452). A 1937 government report (Merrill et al. 1937:19) indicated that most of those seeking supplemental income from small-scale mining during this period worked placer deposits, rather than hard-rock ores, largely because placer mining was more easily performed by inexperienced workers. Some laborers possessing previous hard-rock-mining experience, however, did engage in small-scale Depression-era lode mining. Some of those with cars and money for gasoline roamed the desert seeking employment at remote mines. Edith Hockey (1955:24–25) wrote of the 1930 trip that she and her husband made by car across the Mojave Desert in search of promising minerals or a job, resulting in a "tentative offer of work with the Borax Company in Death Valley."

In the Sageland Mining District, Kern County, more than 200 people worked gold lodes during the 1930s. Reportedly, most of the excavations were 100 feet deep or less, yet they enjoyed some success (Vredenburgh et al. 1981:183). Others in that area reworked old tailings (Troxel and Morton 1962:57–60, 133–196). The owner of the Valley View Mine, Hart District, in San Bernardino County, worked both the mine and the mill singlehandedly during the 1930s, "raising the ore from the shaft, tramming it to the mill, and processing it" (Hallaran and Wilke 1987:8). The Little Mack Mine in the Lookout District, Inyo County, was developed during the Depression years (Shumway et al. 1980:40). In the Rademacher District north of Randsburg, a number of shallow gold mines were worked by prospectors alone or in pairs during the Depression (Troxel and Morton 1962:46–47, 133–196). In the El Paso Mountains, both hard-rock mines and dry placers were worked by family groups, as of 1929 (Levstik et al. 2016; Starry 1974:149). In San Bernardino County, gold mines in the vicinity of Barstow, Vanderbilt, Stedman, and Dale were worked during the Depression (Shumway et al. 1980:76). Throughout the western states during the Depression, small-scale hard-rock miners organized into associations to leverage desired legislation (Clements 2003:99–100). The situation in part of the Study Area—the Antelope Valley of Kern County—was described thus:

> During the depression years most of Antelope Valley was no better off than the rest of the country, but the mining industry began to pick up the slack. Farmers and other workers, unable to make a living at their former occupations, turned to the mines. Some eked out an existence on small prospects of their own. Others did well with their leases and trucked their ore to the Burton Brothers Mill [at Tropico] [Settle 1964:n.p.].

Renewed interest during this period also targeted gold in the Clark District of San Bernardino County, where activities included new road construction and erection of a surface plant (Swope et al. 2012:13–14). In 1933, a company leased the Good Hope Mine, Pinacate District, in Riverside County, to work the earlier low-grade-ore dump and extract a small quantity of new ore (Sampson 1935:511). Also in Riverside County, new mining methods enabled the working of previously unprofitable deposits at the War Eagle Mine, Crystal Mine, and Markeson Lode in the Twentynine Palms region (Duffield-Stoll 1996:13–103; Schaeffer and Duffield-Stoll 1996:143–165). Old dumps at the Cargo Muchacho Mine and the Tumco Mine, Imperial County, were reworked during the latter 1930s (Vredenburgh et al. 1981:9–10).

Gold was not the only commodity sought in the Study Area by Depression-era miners. A small copper mine at Copper City, in San Bernardino County, was reworked independently by Grace Finley during the 1930s and early 1940s. Finley worked the mine, netting approximately $19 each week, until the land was appropriated by the federal government for military use (Blackstock 2017a). During the Depression, talc claims were worked in the Warm Springs area of today's Death Valley National Park (Blackstock 2017b; Greene 1981:249–263; Zanjani 1997:12, 211, 215).

The General Mining Act of 1872 provided for occupancy of a claim, as a necessity to protect exposed minerals and mining equipment. White (2017:133) stated that the "misapplication of mining law" became "an expedient way of acquiring land for nonmining purposes." For federal land managers, the difficulty was in determining the intent of the occupancy; under the law, occupancy must be reasonably incident to the performance of minerals-related activities at the claim (BLM 1991a:15). As a result, some individuals and families remained in residence at mining claims after the Depression—sometimes for generations—even as the local mining industry declined. There was virtually no government scrutiny of unpatented claim occupancy on federal lands until after World War II, when the BLM was established (in 1946) and the U.S. Forest Service's (USFS's) administrative responsibilities and capacity were increased. The Multiple Surface Use Act of 1955 (69 Stat. 367; Public Law [PL] 167) was enacted to help eliminate serious conflicts between surface management and mining operations on federal lands. Claims located before July 23, 1955, could retain surface rights if such claims were verified as valid under Sections 5 and 6 of PL 167. However, claims located after July 23, 1955, were subject to all provisions of the law, including the federal government's right to manage surface resources. PL 167 was passed in response to abuses of the mining laws where claims were located for purposes other than mining, such as for recreational cabins, fishing and hunting sites, cafés, or timber, grazing, or water rights. PL 167 was a turning point in terms of how federal land managers addressed mining-claim occupancy. By the late 1950s, the BLM was examining the validity of unpatented mining claims with occupancy (including claims in the Study Area) and/or determining whether occupancy was reasonably incident to mining; specific cases and BLM actions variously resulted in amnesty (lifetime leases under the FLPMA, a mining-claim-patent process, court cases, or eviction for the occupant. The Mining Claim Occupancy Act of 1962 (76 Stat. 1127; 30 U.S.C. 701–704) was enacted to help address the situation, but this law had a limited term, expiring in 1972. The BLM continued to address mining-claim occupancy through the 1970s, 1980s, and 1990s. In 1996, on the findings of the Office of the Inspector General (OIG), federal regulations (43 CFR 3715) were established to provide specific scenarios under which a claim may be occupied, as well as the terms for removal from the claim (Gum 2004:274).

Cultural resource investigators may encounter evidence of unpatented mining-claim occupancies in the Study Area dating to the post–World War II era (many of them originating during the Depression or earlier periods). The occupancies were most common in portions of the Study Area that had reliable water sources and access, such as along U.S. Highway 395 north of Ridgecrest or in San Diego County. These occupancies may take the form of cabin foundations and other remains (perhaps related to a BLM occupancy case). Early BLM administrative records (such as validity examination case files) may exist and can be used to research the site. Much remains to be learned about these occupancies, and they should not be discounted as insignificant.

World War II

A cultural outcome of World War II that forever changed the California deserts and the ways in which people experience them is the Jeep and all of its four-wheel-drive descendants. Randall Henderson, the founder of *Desert Magazine*, a popular publication for desert dwellers and enthusiasts published from 1937 to 1985, wrote in 1946 about his war experience in the Sahara Desert:

> [T]he jeep dropped down to its axles in sand. It was one of those embarrassing moments. You know how it is—you don't like to ask the General to get out and start shoveling sand. . . . And I didn't, either. I shifted to the four-wheel drive, and pulled the lever that put the car in compound low—and the little old jeep got us out of that hole in less time than it takes to write about it. That day I resolved to own one of those jeeps when the war was over. Last month I went to one of the war surplus sales armed with a veteran's priority. And now I have a jeep [Henderson 1946:46].

And many followed his lead. The Jeep, the air-cooled engine, and later off-highway vehicles (OHVs) and all-terrain vehicles (ATVs) afforded access to even remote desert locations, and desert tourism consequently surged in the years following the war (cf. BLM 1999:4). In his later years, Erle Stanley Gardner, known for his mystery and crime novels, wrote nonfiction works on the Southern California and Baja California deserts. He wrote: "As soon as four-wheel-drive cars became available for civilians, I purchased jeeps. Then I supplemented these with a Land Rover, International four-wheel-drive pickups, and Ford four-wheel-drive pickups," but he acknowledged that "the development of four-wheel drive automobiles, the so-called dune buggies, [and] the air-cooled two-wheel power scooters . . . [has] all contributed to changing the face of the desert" (Gardner 1966:15, 40). During the Depression, Larry and Lucy Coke had moved to Calico to rework tailings. They also collected artifacts and opened a small museum for the occasional tourist. They reported that, after World War II, Calico shifted from a dying mining town to a thriving tourist attraction, leading them to lease the townsite and to hire extra help (Lerch and Hatheway 1993:12).

Economic Events

Gold Reserve Act 1933/Price-of-Gold Increase 1934/Silver Purchase Act 1934

The gold standard was abandoned in 1933, and gold was removed from circulation (Akin et al. 2016; Brooks and Ramp 1968:4). The U.S. price of gold had hovered around $20 per ounce for over 140 years when, in 1937, it increased to $35 per troy ounce. Despite nationwide depression, the higher gold value allowed some mines that produced lower-grade ores to resume operations, and new mines were opened on speculation. Miners returned as work in the industry resumed. The returns enjoyed by mine operators from the increased gold values sometimes resulted in improved infrastructure or the addition of new equipment and technologies at this time. Silver was nationalized in 1934, with the Silver Purchase Act, which called for private silver holdings to be relinquished to the federal government for monetary exchange. That year, the price of silver was artificially set at $0.5001 per ounce.

In Inyo County, the Arondo Mine installed a 50-ton mill in 1934, where 10 men worked until 1937 (Norman and Stewart 1951:38–39). At Vanderbilt in San Bernardino County, a 25-ton flotation plant was installed in 1934 (Tucker and Sampson 1943:464).

U.S. War Production Board Limitation Order L-208

From 1939 to 1941, as Europe entered into war and U.S. involvement appeared increasingly imminent, the price of lead and zinc rose in anticipation of needed armaments, spurring exploration and moderate development of mines to produce those commodities (Fell and Twitty 2008:41). The U.S. War Production Board, established by Franklin D. Roosevelt in 1942 as part of the Office of Emergency Management, was charged with directing wartime procurement, production, and distribution (Peters and Woolley 2016). Under the purview of the board, some peacetime industries were converted to manufacturing tasks deemed essential to the war effort, and nonessential production was curtailed. The board's actions had international impacts, in reducing the amount of mining machinery and supplies exported from the United States to other countries (Huebert 2001), and had a direct effect on mines in the California deserts in several lasting ways. The first was in the identification of a number of metals as strategic, particularly those minerals essential in armament production (Limbaugh 2006). Among the strategic metals produced by mines in the Study Area were antimony, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, tin, tungsten, uranium, vanadium, and zinc. Domestic sources were sought to produce a quota of these metals, based on 1941 production figures. Under the promise that producers exceeding the quota would receive a premium (McKay 2011:56), a uranium boom ensued. Some 4,000 soldiers with experience in mining work were excused from military service to continue strategic labor, most in the nation's copper mines.

In order to conserve equipment and workforce for the war effort, the board enacted Limitation Order L-208, directing domestic gold mines—which were considered nonessential—to cease operations (Puckett 2006:452). Under the order, any lode gold mine that had produced more than 1,200 tons of commercial ore during the previous year was forced to close. The Bagdad Chase Mine in San Bernardino County was allowed to remain open, because the gold-bearing ore also contained considerable amounts of silica and copper (Hallaran and Wilke 1987:10; Tucker and Sampson 1943:438). The Valley View Mill, which had previously processed precious metals in the Hart District, converted operations to tungsten milling during this period (Hallaran and Wilke 1987:10).

Although the order provided for minimal operations "necessary to maintain . . . buildings, machinery, and equipment in repair, and . . . access and development workings safe and accessible," such activity was not economically feasible at idle mines. The order caused many gold miners to seek work in mines producing strategic minerals. Some idle workings became flooded after pumping equipment was shut down, and support timbers and unused equipment deteriorated and rusted during the closures. Although the limitation order was lifted in 1945 (Puckett 2006:452), many of these mines were never worked again. At the Ruth Mine near Trona, the shutdown was reportedly "so rapid and improperly carried out" that reopening was not a possibility (Shumway et al. 1980:69).

World War II

During World War II, the federal government paid modest sums for scrap metal that could be recycled for the war effort (Carrier 1993:223). In 1942, the War Production Board spearheaded a nationwide scrap-metal drive (Figure 2.14), and regional drives continued for the duration of the war (Bernard 2015:90). Newspapers in the Study Area promoted the effort, promising a reward for counties where at least 100 pounds of scrap metal were collected per capita (SBCS 1942a). A local newspaper reported that "approximately 60,000,000 pounds of scrap are available in San Bernardino County and every attempt will be made to collect this material" (SBCS 1942b). The following month, the county had reportedly collected nearly double its quota, but "the drive will be continued until every bit of scrap in the county is collected" (SBCS 1942c).

According to a government report, field workers in the Bureau of Mines assisted in the location and recovery of scrap metal from abandoned and active mines (U.S. Department of the Interior 1943:21). Much of the machinery that remained at old mines in the California deserts was removed during this time. In Black Hawk Canyon, San Bernardino County, "salvage crews ripped apart the mill structures and removed scrap metal" (Wilkinson 1972:15). At Dale, also in San Bernardino County,

> regular watchmen could not be kept on duty. Expensive mill properties were left unattended. Scrap metal dealers systematically looted them, and losses to mill and mine owners were staggering. Harry M. Hess, owner of the Virginia Dale during that period, visited his property in time to catch a metal scavenger loading most of his mill on his truck. . . . Hess recovered his machinery and rails. Other owners were not so lucky [Miller 1998:57].

The growth of the base-metal industry during World War II led to large-scale, well-capitalized, corporate mining entities that one researcher termed "industrial islands" (McKay 2011:38)—isolated, yet connected to the world market by an established trade and transportation network. After the war, because of the reduced need for base metals and an increased cost of labor, mines that had focused on those commodities faltered.

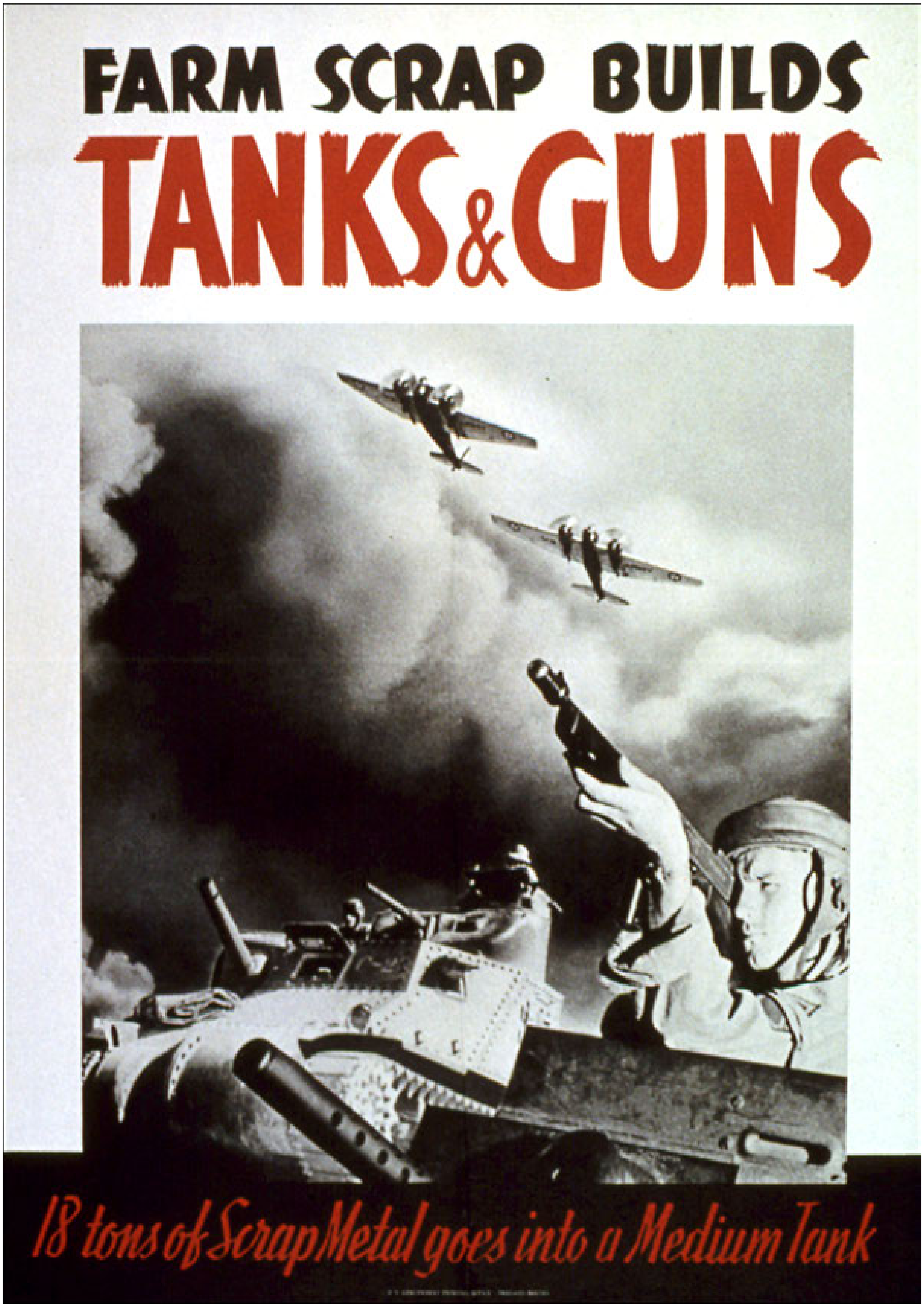


Figure 2.14. World War II scrap-metal-drive promotion poster (courtesy of the National Archives and Records Administration, via Wikimedia Commons).

Legislation

1952 Legal Guide for California Prospectors and Miners

In 1952, the California Division of Mines and Geology produced and sold its *Legal Guide for California Prospectors and Miners* (Norman 1952) This booklet provided a summary of mining law as it pertained to locating and holding claims, using water, disposing of wastewaters, and understanding safety regulations. It also provided guidance on ore-buyers' licensing and federal gold regulations. The first edition was produced in 1931 and titled *Manner of Locating and Holding Mineral Claims in California* (Ricketts 1931). Subsequent editions were compiled by various members of the California Division of Mines staff. With 13 editions and published as late as 1970, it is judged as the most popular item published by the California Division of Mines and Geology (Bruer 1970:3; Norman 1952; Weber 1963:43). Over the decades, this publication undoubtedly introduced innumerable small-scale and hobby miners to the California deserts.

Multiple Surface Use Mining Act of July 23, 1955

The Multiple Surface Use Mining Act of 1955 provided that only prospecting, mining, and processing activities could be performed at unpatented claims, effectively precluding uses such as maintaining a dwelling on the claim (Kennedy 1990:273).

Summary of the Modern Period in the Study Area

As noted earlier, this study is concerned with the period from 1848 to ca. 1960—a longer period than is considered in most other historic contexts for mining. A few concluding comments about the modern period in the Study Area follow.

As early as the 1960s, many mining sites had all but disappeared. For example, by the 1960s in New Dale, San Bernardino County, "vandals [had] destroyed much of the town. . . . What was not 'borrowed' or stolen was broken or burned. . . . thousands of bottles . . . were shot at and broken by campers (Miller 1998:57, 59).

The underground spaces of idle mines attracted a variety of creative reuse, ranging from civic undertakings to artistic ventures. During the Cold War, municipal civil-defense entities in the California deserts equipped abandoned mines as nuclear-fallout shelters, predicting that "miles of mouldering tunnels once used to snake ore cars to the surface may one day stream with human moles fleeing the deadly rain of radioactivity" (SBCS 1962a). In 1962, the inactive Victor Mine, near Midland, in Riverside County, was outfitted as a shelter (Vredenburgh et al. 1981:50). Also in 1962, a tunnel in the U.S. Borax and Chemical Company mine at Boron was equipped to shelter some 15,000 persons and included decontamination showers and a water supply (SBCS 1962b). In 1967, a shelter at the Apex Mine on Silver Mountain, west of Apple Valley, was said to be "in the process of being equipped with radiological monitoring equipment" to shelter 200 refugees from the city of Victorville in the event of nuclear war (SBCS 1968a, 1968b; Swope 2016:3.45). A shelter developed in the Sidewinder Mine, between Victorville and Barstow, was said to have a capacity of 859 persons and contained a 200-bed hospital, a library, and a recreation facility; seeds were among the stockpiles, for use in reestablishing plant life after evacuating the shelter (SBCS 1967; Vredenburgh et al. 1981:147). Residents could reserve their place in the shelter by donating labor, materials, or cash (SBCS 1962c). The demand for strategic minerals continued during the Cold War, with the U.S. Atomic Energy Commission's call for prospectors to locate uranium deposits, as well as a continued demand for lead, zinc, copper, and tungsten (BLM 2013:5).Underground spaces in the California desert were put to other unconventional uses at the end of the historical period. In 1966, a tunnel in the Tropico Mine, in Kern County, was equipped as a "Time Tunnel." It started with an idea from Jack Tomlinson, a history professor at San Francisco State College. He wanted to preserve for future archaeologists and historians a collection of things used by average people in their everyday lives. Members of the Kern-Antelope Historical Society gathered up all kinds of everyday items, such as clothes, magazines, televisions, radios, furniture, cooking utensils, newspapers, bottles, wrappers, and seeds. Yamaha even donated a new motorbike and a case of oil. All these things were stored in the old dead-end exploration tunnel, which was sealed with 10 feet of concrete and was not to be opened until 2866 (Burton 1977:n.p.).

The period covered in this study ends immediately before the 1972 surge in gold prices, when Americans once again were able to own gold (Vredenburgh et al. 1981:282). Renewed enthusiasm for the mineral reserves of the California deserts inevitably followed; mining interests ranged from individual hobby miners to international corporations. In the Study Area, old mines at Vanderbilt, Hart, Randsburg, the Clark Mountains, and the Bagdad Chase were reopened as modern, open-pit operations (Vredenburgh et al. 1981:281–282). During the 1980s and 1990s, numerous cultural resources investigations were performed as part of the permitting process for the new mining, resulting in historical and archaeological documentation of earlier mines.

In 2010, approximately 34 mineral commodities were in production in the deserts of California, including antimony, chrome, copper, gold, iron, lead, nickel, rare earths, silver, sulfur, talc, tungsten, uranium, and zinc. That year, California remained "one of the nation's top mineral producing states," ranking second in non-fuel mineral production (BLM 2010:3.15).

Important Personages

Persons considered important in the mining history of the Study Area include individuals associated with the foremost mines, those who were involved in important discoveries or were influential in general western mining developments, and some who were particularly representative of the typical regional prospector or miner. Some examples of persons who played notable roles in the mining history of the Study Area follow.

It is important to stress that importance in local or regional history, for the purposes of elucidating historic context, is not necessarily the same as significance for the purposes of NRHP eligibility. Considerations for site eligibility under Criterion b—that is, for sites that "are associated with the lives of persons significant in our past" (Shrimpton 2002:2)—are presented in Chapter 5.

Pete Aguereberry

Pete Aguereberry (Figure 2.15) emigrated from the Basque region of France at the age of 16 in 1890, with the goal of experiencing the California gold region. Beginning in 1905, he prospected in the Death Valley region, where he and Shorty Harris made the gold discovery that led to the Harrisburg camp. From 1907 to the 1930s, Aguereberry worked the Eureka Mine, almost single-handedly. Aguereberry died in 1945 and is buried at Lone Pine (*Desert* Staff 1984:27). His cabin at the Eureka Mine, built in 1907, remains standing (Coolidge 1985; Pipkin 1982); the cabin and the Eureka Mine are interpreted by the U.S. Department of the Interior National Park Service (NPS n.d.). He is representative of the many prospectors who, arriving decades after the Gold Rush, explored the California deserts, making a few notable discoveries and working small-scale mines as a source of income.

Elias J. "Lucky" Baldwin

Elias Baldwin earned his "Lucky" nickname after successful speculation in Comstock mines (Lingenfelter 2012a:225). He later became president of the San Francisco Stock Exchange and raced thoroughbred horses at his Rancho Santa Anita in Los Angeles County. Baldwin, a multimillionaire (Robinson 1989:66), could well afford to grubstake prospectors in hopes of another success to rival that of his Comstock investments. Among Baldwin's enterprises was the 1870s financing of a 40-stamp mill in the San Bernardino Mountains (Robinson 1985:9, 39, 43, 1989:64–72). The only other stamp mill of this size in the Study Area was that at the Yellow Aster Mine in Randsburg. Baldwin represents the wealthy financiers who speculated in remote mines of the California desert but who typically did not increase their wealth markedly as a result.

Figure 2.15. Pete Aguereberry at his Eureka Mine camp (courtesy of the U.S. Department of Interior National Park Service, via Wikimedia Commons).

Charles and Rose Burcham

Charles Austin Burcham, a former cattleman and owner of a meat market in San Bernardino, was grubstaked in a 2-year prospecting venture by his wife, Rose LaMonte Burcham, a medical doctor in the town. After unsuccessfully working the dry placers at Summit Diggings, San Bernardino County, the Burchams and partners John Singleton and Frederic M. Mooers in 1895 filed claims that would become the productive Yellow Aster Mine, in Randsburg (Hulin 1925:108; McGinnis 1984:3; Wynn 1963:75). The Burchams are examples of individuals who found the lure of gold irresistible, risking successful and established businesses to seek a fortune in mining. Only a few were successful.

William T. Coleman

William T. Coleman lent his name to the 1880s colemanite-borax discoveries at the Lila C. Mine in Death Valley (*Desert* Staff 1984:28; Hildebrand 1982:31). He had been a figure in San Francisco, particularly as a vigilante committee leader (Gerstley 1969:vii). Surface borax deposits were an important commodity (Belden 1962) when the colemanite discovery caused borax production to shift to hard-rock recovery methods. Coleman was involved in the implementation of 20-mule teams for transporting borax ores (Gower 1969:10). He was among those who found a lucrative role in secondary support industries.

Wyatt Earp

Wyatt Earp is not usually associated with his involvement in mining history, but the lawman's better-known exploits took place throughout the West as he followed mining booms over a period of 40 years. The famed gunfight at the O.K. Corral occurred in 1881 in Tombstone, Arizona, during the silver boom there. He operated saloons during mining booms in Silverton, Colorado, in 1883 (Roberts 2006:n.p.); the Idaho Coeur d'Alenes in 1884 (Dolph and Randall 1999; Tefertiller 1997:275); Nome, Alaska, in 1899 (Isenberg 2013:197–200); Tonopah, Nevada, in 1902 (Woodward et al. 1980:8.8); and Goldfield, Nevada, in 1905 (Monahan 2013:55). He reportedly filed nearly 100 claims in the area around the Whipple Mountains, California (Cilch 1998; Road 2009) (Figure 2.16). By the time of his death in 1929, Earp had reached 100 feet of depth in a shaft on 1 of his claims in the Whipple Mining District (Vredenburgh et al. 1981:80). Earp was among the many participants in the history of western mining who played supporting roles in camps and towns. The Whipple Mining District is on public lands managed by the BLM.

Figure 2.16. Wyatt and Josephine Earp at their mining camp near Vidal, California (courtesy of the Public Broadcasting Service, via Wikimedia Commons).

Charles "Seldom Seen Slim" Ferge

Prospector Charles Ferge, also known as "Seldom Seen Slim," arrived in Ballarat in 1917. His 50-year residence there included 35 years as the town's lone resident. During that time, he worked claims in the Panamint Mountains and reworked tailings from surrounding mines. Ferge gained widespread notoriety when humorous comments attributed to him were published in Harry Oliver's *Desert Rat Scrap Book* between 1946 and 1967. The 1950s and 1960s brought increasing numbers of sightseers to Ballarat (Taylor 1976:13–14). When Ferge died in 1968, "four hundred people, including an NBC television crew, braved the August heat to attend the funeral," which was broadcast nationwide (Pipkin 1982:81). Ferge has become a kind of folk hero representative of individualism and tenacity, and visitors to Ballarat leave tokens at his grave (Figure 2.17). This practice has been observed at the graves of notable persons in other mining cemeteries in western states. Ferge was one of many prospectors who found a means of support in small-scale desert mining.

James M. Gerstley

James M. Gerstley was president of Pacific Coast Borax and U.S. Borax and Chemical Company. His business acumen allowed the former company to survive the loss of the European export market during World War II. The Death Valley Days television show was initiated during his tenure at the company. During the 1950s, he led the conversion of the underground mine at Boron to an open-pit operation (National Mining Hall of Fame and Museum 2017a). Gerstley was a mining executive who weathered the uncertainties of global events; his involvement in California desert mining spanned the time from profitable, prewar borax production to the early days of media idealization of the mining industry.

Figure 2.17. Grave of Charles "Seldom Seen Slim" Ferge, Ballarat, showing coins, sun-colored-amethyst-glass fragments, and ore samples left as tokens, 1999 (photograph by Karen K. Swope).

Frank “Shorty” Harris

At only 5 feet tall, Frank Harris gained the nickname “Shorty.” Harris was a long-time Death Valley prospector and a partner in strikes in Bullfrog and Rhyolite, Nevada (Caruthers 1951:115; Crampton 1956:256; Lingenfelter 2012b:290). He is remembered in the naming of Harrisburg (Palmer 1980:34–35). Regional history is replete with anecdotal stories of Harris’s activities and antics; he appears to have personified the stock image of a reclusive desert dweller. He is among those desert prospectors who, though never finding fortune, nevertheless eked out a living from prospecting and small-scale desert mining. He died in 1934 and was buried in Death Valley (*Desert* Staff 1984:30).

Henry J. Kaiser

Henry Kaiser spearheaded the company providing metal for construction of Liberty Ships during World War II. His 1942 steel plant in Fontana was situated inland by order of the War Department, for protection from potential Japanese air strikes (Gregory 2008:10). During the war, ore was supplied by the Vulcan Mine, in San Bernardino County, and after the war, he opened the Eagle Mountain Mine in Riverside County (National Mining Hall of Fame and Museum 2017b). In his various enterprises, Kaiser gained a reputation for socialistic tendencies, because he was amicable to labor unions and concerned for employee welfare (Foster 1989:107; Stuck 2001; Swope 1992). Kaiser is one of the rare industrialists who became fabulously successful through investing in California desert mining interests.

Walter Marvin Knott

Walter Knott purchased the Calico townsite in 1950 and commenced a restoration program that ranged from ruins stabilization to fabrication (Lowe and Cook 1972:31). A recent publication on Calico (Peyton 2012a:83) termed Knott’s activities there “de-ghosting a ghost town.” Knott’s uncle had, in 1881, grubstaked the miners who discovered the Silver King Mine. Knott himself was employed in Calico district mines during the first part of the twentieth century. In 1966, Knott transferred title of the townsite to the County of San Bernardino, for operation as a regional park. When he created Knott’s Berry Place—America’s first theme park (later known as Knott’s Berry Farm)—in Buena Park, Knott constructed a facsimile ghost town, incorporating objects culled from Calico and other mining sites (Cedar Fair Parks 2017; Coke and Coke 1969:184; Knott’s Berry Farm 1959:1–3; Lerch and Hatheway 1993:12). As is true for Gerstley, Knott is one who capitalized on his knowledge and experience in California desert mining to bring some of that history to the general public.

John Lemoigne

Frenchman Jean “John” Lemoigne was one of best-known prospectors in the Death Valley region between the mid-1880s and his death in 1919. He is locally commemorated in the naming of Lemoigne Canyon (Crampton 1956:256–257; Greene 1981). He had cabins west of Emigrant Wash, where he worked a small silver-lead mine, and at Garlic Spring. One prospector who knew him stated:

> Old John must have prospected every hill within more than a hundred miles of Skidoo. He usually ranged between Owens Valley to the Amargosa and Pahrump. His prospects were scattered as far south as Calico and Owl’s Hole, east to Pioche and Ely, and north to Bishop and Virginia City. He did not go west so far—the Sierras stopped him [Crampton 1956:258].

Lemoigne is representative of the prospectors who ranged over the California deserts, finding subsistence by working claims on a small scale.

Remi Nadeau

Remi Nadeau was "King of the Desert Freighters." Beginning in the 1860s, Nadeau owned and operated a mule-team freighting business employed in carrying ore and supplies between mining camps in eastern California and coastal steamers at San Pedro, and later, railroad connections. Under one contract, from 1868 to 1871, Nadeau hauled Cerro Gordo bullion on the 200-mile, 3-week trip to Los Angeles, a 10-stamp mill from Mojave to the Bonanza King Mine in San Bernardino County, and charcoal from the Wildrose Canyon kilns to Lookout (Shumway et al. 1980:26, 35, 94). The freight teams were instrumental in facilitating mining efforts in remote areas. After his freighting days, Nadeau became an important figure in Los Angeles business (Nadeau 1999:95–117). Remi Allen Nadeau, 1920–2016, the great-great-grandson of freighter Remi Nadeau, wrote numerous books on California history topics, including *Ghost Towns and Mining Camps of California* (Nadeau 1965, 1992) and *The Silver Seekers* (Nadeau 1999).

William Henry "Burro" Schmidt

William Henry "Burro" Schmidt was a miner with several claims in the El Paso District of Kern County. Between 1906 and 1938, he drilled and blasted a tunnel measuring 2,087 feet in length through Copper Mountain, ostensibly for ore transport (Howser 1994). Schmidt's 1954 death was reported in *Desert Magazine* (Christman 1954:7). The tunnel and Schmidt's cabin attract visitors today and were featured on an episode of *California's Gold* with Huell Howser (Howser 1994; Levstik et al. 2016). Burro Schmidt's tunnel is listed in the NRHP, in part for its association with Schmidt and his Depression-era work in the El Paso Mountains (Padon 2003).

Francis Marion "Borax" Smith

In the early 1870s, Francis Marion Smith was involved in surface-marsh borax recovery in the Death Valley region. During the 1880s, he partnered with William T. Coleman, eventually taking over Coleman's assets (Greene 1981). Smith founded the Pacific Coast Borax Company, which used 20-mule teams for hauling, and later built the Tonopah and Tidewater Railroad to serve his mines (Figure 2.18). His success in the industry led to the nicknames "Borax Smith" and "the Borax King" (Hildebrand 1982; Walker 1962). Smith is one of many enterprising individuals who resourcefully incorporated changing mining technologies to remain successful.

Study-Area Mining History by County

This section presents an overview of mining history in each county within the Study Area. The counties are arranged in order as they are situated from north to south. Although historical and present-day county boundaries do not match the geophysical provinces affecting mineral resources in the Study Area, we use county divisions to discuss general historical patterns, because the information available in historical government reports is organized according to county. The preceding description of historical cultural and economic events, technological developments, and legislation related to mining in the Study Area contains numerous references to the various counties and their roles in shaping regional mining history.

Figure 2.18. "Old Borate," Borax Smith's mine at Harmony, Death Valley, ca. 1890. Smith's house can be seen on top of the hill (digitally reproduced by the University of Southern California Digital Library from the California Historical Society collection).

Mono County

Subsequent to the discovery of the silver Comstock Lode in Nevada, prospectors began looking for silver in California during the summer of 1861; this search began in Alpine and Mono Counties and then in Inyo County a year or two later (Busby et al. 1980:45). Gold discoveries in 1858 and 1859 resulted in settlements at Dogtown and Monoville. In southern Mono County, the Blind Spring Hill area was mined as early as 1862 for silver and gold and remained active until the late 1930s. However, it was the Bodie Mining District that would become the most important district in the county. Between 1888 and 1912, it produced more than $24 million of gold and silver (California State Mining Bureau 1884:361; Eakle and McLaughlin 1917:145; Fletcher 1987:30–34; Rinehart and Ross 1956:7).

In 1859, prospectors discovered both placer deposits of gold and gold-bearing quartz veins in what would become the Bodie Mining District. The district was organized in 1860, and the first mining company was formed in 1863. From 1859 to 1876, the district underwent sporadic development and moderate production. The first mill was situated at the northern end of the district in 1877. Rich ore, discovered in the Standard Mine in 1878, sparked a boom that lasted for about 10 years. During that period, up to 50 companies were operating simultaneously in the district, using eight mills powered by steam engines. It is important to note that the costs of mining and milling during this period within the Bodie Mining District were high, because steam was generated with expensive firewood. The Standard Mining Company was the first to bring electrical power in, during the early 1890s, using their own hydroelectric-power plant on a creek 13 miles away. Electrical power reduced costs and stimulated new interest in mine development for a short period. One of the larger companies, the Standard Consolidated Mining Company, was dissolved in 1915, and new owners acquired the title and continued small-scale lease operations for about 15 years. Extensive deep exploration occurred in the district between 1928 and 1931. The newest mill was constructed in 1935 and operated until 1942, at which time gold mining almost ceased in America, as the government refocused equipment and manpower on strategic metals. Sporadic activity has occurred in the Bodie Mining District since 1946. In 1956, the State of California established Bodie Historic State Park to preserve the ghost town adjacent to the Bodie Mining District (Chesterman et al. 1986:31–33; Eakle and McLaughlin 1917:145–146).

In the Antelope Valley Region, the West Walker River Mining District contains gold, silver, lead, copper, zinc, cadmium, iron, and barite. However, no deposits have been large enough to invest in, except the Golden Gate Mine, which produced the only gold in the region. Located in Roderique Cañon, it was discovered in 1898 and was dormant by 1917. The Blind Spring Mining District in the Benton Range produced high-grade silver. Other districts in this range included Montgomery, White Peak, Indian, and Clover Patch. Other known lode deposits in the county with little or no associated production include lead-zinc in Rush Creek (De Groot 1890a:338–340; Eakle and McLaughlin 1917:135–136; Matson 1949).

Mono County is also known for its tungsten deposits, which occur primarily in the southern part of the Benton Range. In 1917, scheelite was first discovered at the Black Rock Mine south of Benton, and tungsten was first produced at the mine in 1928. The Black Rock Mine was in fairly continuous operation from 1937 to 1956, and in 1953, it was the sixth-largest producer of tungsten concentrates in the United States. Three other scheelite deposits were identified prior to 1940, and in 1940, the Scheelore tungsten mine was discovered south of Mount Baldwin (Bateman 1951:3; Dupuy 1948:5; Lemmon 1941a; Rinehart and Ross 1956:7).

Of the aforementioned localities, Bodie State Historic Landmark, Blind Spring Mining District, White Peak Mining District, Indian Mining District, Clover Patch District, Blind Spring Hill, the Golden Gate Mine, and Black Rock Mine include public lands currently managed by the BLM.

Inyo County

The history of mining in Inyo County and, specifically, the histories of individual mines have been covered by Shumway et al. (1980:24–51) and Vredenburgh et al. (1981:222–283). A brief overview is provided here. Almost as soon as the California Gold Rush had begun, miners were enticed eastward across the Sierras, in pursuit of rumored discoveries of gold ledges in Inyo County. Because agricultural and ranching pioneers had already established a foothold in the region, early miners enjoyed the benefit of existing supply networks. Important gold mines in the county include the Cardinal Gold Mining Company mines, Reward Mine in the Russ Mining District, Skidoo Mine, Ratcliff Mine, and Keane Wonder Mine (Chalfant 1933:126–127, 140–145, 1947:30–33; Inyo County Board of Supervisors 1966:65; Jenkins and Wright 1957:219; Kersten 1964:493–495, 500; Norman and Stewart 1951:38; Smith 1978:188).

Although the first summary report for Inyo County appeared in the 1884 annual report of the California State Mineralogist (California State Mining Bureau 1884), the first comprehensive report dedicated to the mines and minerals of Inyo County was developed in 1902. This report showed that mineral production was assessed at 22 percent of the valuation of the entire county and noted that the lack of railroads retarded growth. The document reported 267 hard-rock quartz mines and 31 millsites (Figure 2.19). Lode minerals noted in this report included antimony, barium, bismuth, borax, gold, iron, lead, manganese, platinum, silver, and sulfur (Davidson 1902).

Norman and Stewart (1951:55) suggested that the first lead mined in the state was in Inyo County, in the southern part of the Panamint Range, by Mormons, sometime before 1859. Lead, silver, and zinc deposits are among the most important metallic commodities within Inyo County, with the Cerro Gordo Mining District producing the most ore. It was prospected and mined as early as the 1860s and, by 1870, saw more than 900 filed claims for mines. The accompanying town grew to 700 at the district's peak. The Cerro Gordo Mine was the most extensive in the district, with more than 30 miles of underground workings. Also important was the silver-lead deposit near Darwin and the Panamint Mining District. The town of Darwin developed around the New Coso Mining District and is said to have had a population of "several thousand inhabitants" (Knopf 1915:3). A pipeline from the Coso Mountains brought water to the mines, and 3 smelters were built near town. Silver was discovered in the Panamint Valley in 1873, and Panamint City was established. It first appeared to have the potential to become a "second Comstock," but it was not to be (Shumway et al. 1980:30; Wright and Troxel 1954:21).

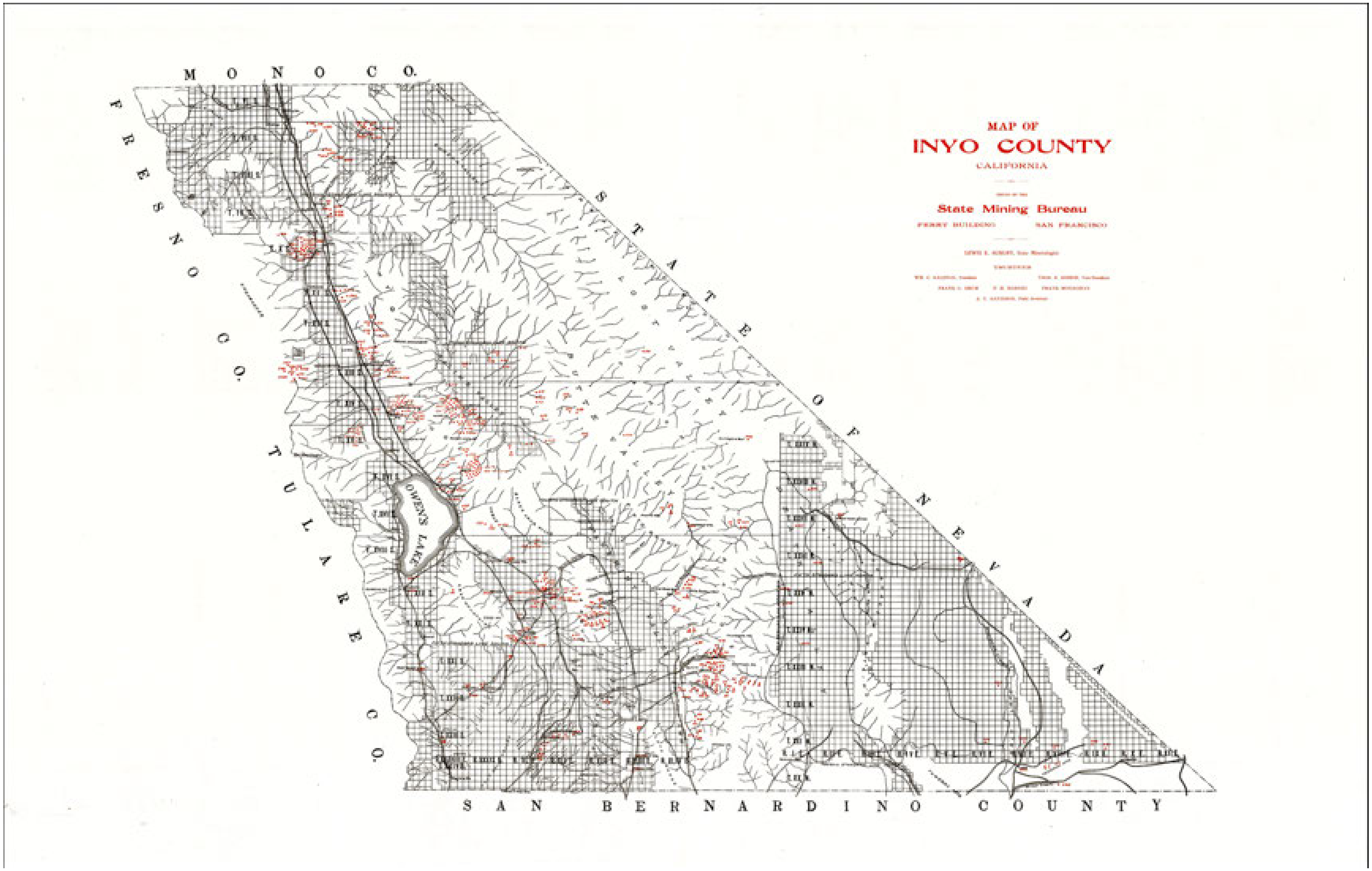


Figure 2.19. 1902 map of Inyo County, showing mines known by the California State Mining Bureau (Davidson 1902:map insert).

The Panamint Mining District includes the Lotus Mine, also called the Monte Cristo Mines, which was worked intermittently. Horn silver was discovered in the Sherman Mining District located at the easterly base of the Argus Range in the early 1860s, and a 10-stamp mill was constructed at Reilly within the district in 1882. Gold from the St. George Mine was valued at $8 per ton in the late 1930s. Also located on the east slope of the Argus Range is the Modoc Mining District, which accounted for $3,740,000 of lead and silver production. The largest producers of silver, gold, and lead in the Modoc Mining District were the Modoc and Minnietta Mines. The St. George Mine, also known as the Merry Christmas Mine, had a 5-stamp mill and two aerial tramlines. The Beveridge Mining District is "probably the most inaccessible gold-producing district in Inyo County, and also its most productive" (Shumway et al. 1980:36). This district included the Keynote and Big Horn Mines. The former was also called the Golden Princess; it went into operation in 1878 and produced $500,000 in gold. Both mines were worked for a short period during the 1930s. Copper, gold, lead, silver, and zinc production accounted for one-third of the value of mineral production in Inyo County between 1880 and 1951. Copper is recovered as a byproduct only in this county—for example, at the Green Monster Mine (gold) and Cleveland Mine (gold and silver)—as is most of the molybdenum; most of both commodities comes from the Pine Creek tungsten mine. Tungsten (scheelite) was discovered in the Tungsten Hills of Inyo County in 1913 through small-scale gold-placer operations. Tungsten mining was most active and most productive during World War I, World War II, and the Korean War. Tungsten production has not been recorded separately in the county, but it nears the value of lead production. One of the largest producers of zinc in Inyo County was the Zinc Hill Mine, northeast of Darwin (Bateman 1956:5, 82; Bateman and Irwin 1954:33; BLM 2011b:3.14; De Groot 1890b:209; Hall and Stephens 1963:5; Knopf 1914:120, 1915:1–3; Lemmon 1941b:497–499; Norman and Stewart 1951:18–19, 37, 45–46, 58, 84–85; Shumway et al. 1980:25–26, 29–32, 36–37, 42; Tucker and Sampson 1938:404, 418–420; Vredenburgh et al. 1981:226–227, 233–238, 255).

Two other important commodities in Inyo County are borax and talc. Borax was initially produced in the Great Basin regions of eastern California and Nevada, in marshes where it was "harvested" from the surface (Kemp 1892:8). In 1882, richer borax deposits, in the form of colemanite, were discovered in the Funeral Mountains, in Inyo County. This borate required hard-rock-mining methods of recovery. Inyo County was the largest borax producer in the state until the Kramer deposits in Kern County went into production. About half the 60 known talc-bearing regions in eastern California are in Inyo County. Talc mining began in eastern California during 1915–1918 and has become one of the nation's primary sources of high-quality talc. The value of talc production in Inyo County from 1940 to 1950 was second only to the Gouverneur Mining District in New York State. The most important mine in Inyo County was the Talc City Mine (Hildebrand 1982:39; Kemp 1892:8; Norman and Stewart 1951:19, 113–114, 128; Shumway et al. 1980:42; Vredenburgh et al. 1981:255).

Other small-scale or limited lode-mining operations in Inyo County included the production of antimony across the county, especially from the Wild Rose Mining District; barite in Gunter Canyon; feldspar from the eastern slope of the Sierra Nevada Range; iron in the southern and southeastern portions of the county; manganese in the southern end of Death Valley; sulfur from the western edge of the Last Chance Range; and quicksilver in the Coso Mountains. Other known lode deposits in the county with little or no associated production included asbestos in the Inyo Mountains and Panamint Range (Davidson 1902; Norman and Stewart 1951:19, 28, 53, 83, 84, 98–99, 112; Shumway et al. 1980:42; Vredenburgh et al. 1981:256).

Of the aforementioned localities, the Cerro Gordo Mine in the Cerro Gordo Mining District, St. George Mine in the Sherman Mining District, Lotus Mine/Monte Cristo Mines in the Panamint Mining District, Modoc and Minnietta Mines in the Modoc Mining District, Keynote Mine in the Beveridge Mining District, New Coso Mining District, Reward Mine in the Russ Mining District, the Green Monster Mine, Ratcliff Mine, Zinc Hill Mine, Tungsten Hills, Cleveland Mine, Panamint City, and the Talc City Mine include public lands currently managed by the BLM. The following localities are also on public lands currently managed by the BLM: Sterling, Copper King, Kopper King, and Golden Lady Mines in the Sherman Mining District; Keystone and Keynote Mines in the Panamint Mining District; World Beater Mine; Lookout City; and the Inyo District. Additionally, the Cerro Gordo and Cleveland Mines provide great opportunities for interpretation.

Kern County

The history of mining in Kern County and, specifically, the histories of individual mines have been covered by Shumway et al. (1980:52–75) and Vredenburgh et al. (1981:181–221). The Study Area comprises approximately the eastern third of the county, and a brief overview focused on the lands within the Study Area is provided here. In present-day Kern County, along the county line with San Bernardino, the Rand Mountains were first prospected as early as 1860. As provided by the BLM (2011b:3.14), the development of the Rand or Randsburg Mining District occurred after the discovery of placer gold in 1893. The Yellow Aster Mine, originally known as the Olympus Mine and the largest mine of the district, began operations in 1895 and dominated in production until the Rand Silver Mine overtook it in 1918. The Mining District included almost 40 mines, including the Granton, Midlothian, and New Deal Mines; several mills, including a 100-stamp mill; and a 28-mile standard-gauge railroad. The Randsburg Railroad, a spur line connecting Johannesburg with the Santa Fe Railroad in Mojave, was built in 1897. Intended to extend to Randsburg, it was never completed but, reaching Johannesburg, caused that town to become the supply center for the Randsburg mines (Figure 2.20), with a population of 3,900 at their peak (Reynolds et al. 1987; Seidman 1930; Wynn 1963). Shumway et al. (1980:52) reported that Kern County was first in overall gold production within the California desert, with nearly half the value produced by two mines: Yellow Aster near Randsburg and Gold Queen near Mojave (Aubury 1904; BLM 2011b:3.14; Hulin 1925:108; Shumway et al. 1980:52, 57–61; Troxel and Morton 1962:155, 173, 239; Tucker et al. 1949:237; Vredenburgh et al. 1981:181, 190–198).

Limited mining activity began in the El Paso Mountains in the 1850s; most of the activity occurred in the early 1890s, when prospectors discovered gold in 1893. One of the oldest mines was the Jolliver Mine, which became the Hummer Mine and was sometimes called the Hoover Mine; it was first developed ca. 1851. The Apache Mine, which consisted of six copper claims in 1949 and was established in the Goler Mining District in 1893, was reopened during the 1920s. Several mines and camps in the El Paso Mountains are important as mines that went into operation during and after the Depression era. Holland Camp was developed in the late 1930s but produced only a few ounces of gold and less than 100 pounds of copper. Bickel Camp was established in 1934 by Walter Bickel. Although a shaft was reported, no production has been recorded at the site. Consolidating three groups of older copper and gold claims—Layman, Walsh, and Walsh and McClaude—the Colorado Camp group was established in 1949 (Levstik et al. 2016:13–14; Shumway et al. 1980:54–56; Troxel and Morton 1962:85, 283; Tucker et al. 1949:208).

The Sageland Mining District was situated near the town of Sageland, which was fully established by 1868. However, the town depopulated within 1 year because of an exodus to the White Pine County, Nevada, silver discoveries. The most successful mines in this district included the Burning Moscow and St. John Mines. The San Antonio Mine helped to revive the district with its discovery in 1887. The Gold Peak Mine consisted of 17 claims with several tunnels and a mill at Dove Springs. The Sageland Mining District was another district that experienced a resurgence during the 1930s (Shumway et al. 1980:52–53; Tucker and Sampson 1933:305–306).

The Rademacher Mining District, organized in the 1890s, is located east of the Sageland Mining District and north of the Randsburg Mining District. Most of the activity occurred in the early 1900s and in the 1930s. Shumway et al. (1980:54) stated: “Two-thirds of the mines in the Rademacher District appear to be shallow prospects worked during the Depression by one or two men at each claim.” The most productive gold mines were the Gold Bug, Bellflower/Huntington, and Rademacher. Others mines included the Wildcat, Crown Consolidated Quartz/Red Wing/Haunita, Stellar, Jerry, Yellow Treasure/Lonely Camp, and Gold Pass (Shumway et al. 1980:53–54; Troxel and Morton 1962:47, 154, 196).

The first comprehensive report dedicated to the mines and minerals of Kern County was developed in 1904 by the California State Mining Bureau. In the report, Aubury (1904) noted the abundant mineral wealth of the county in its quartz-mining districts and the Kern River oil field (Figure 2.21). The report also named the Randsburg Mining District as “one of the prominent gold fields of the State” (Aubury 1904) and documented 352 hard-rock quartz mines and 44 millsites across the county. Lode minerals noted in the report included gold, silver, copper, iron, lead, borax, antimony, and sulfur (Aubury 1904).

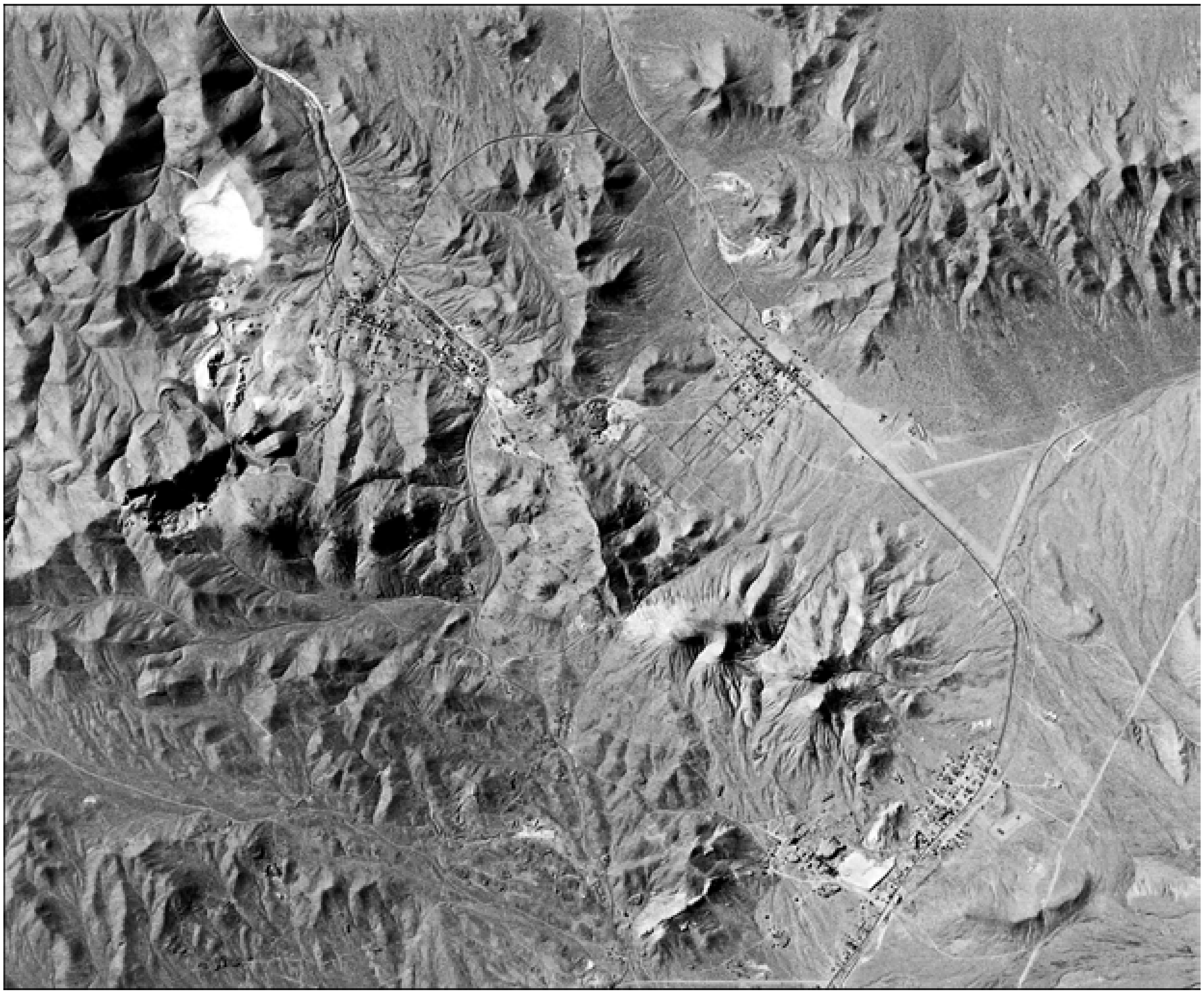


Figure 2.20. 1956 aerial photograph of Randsburg Mining District (*upper-left-hand corner*). Note the relationship to Johannesburg, located to the southeast, at the base of the Rand Mountains and along present-day U.S. Highway 395. Farther to the southeast is the town of Red Mountain, located at the western base of its namesake (courtesy of the U.S. Geological Survey, Photograph No. ARMPTF1610C0874). The use of aerial photographs as research tools is discussed in Chapter 5.

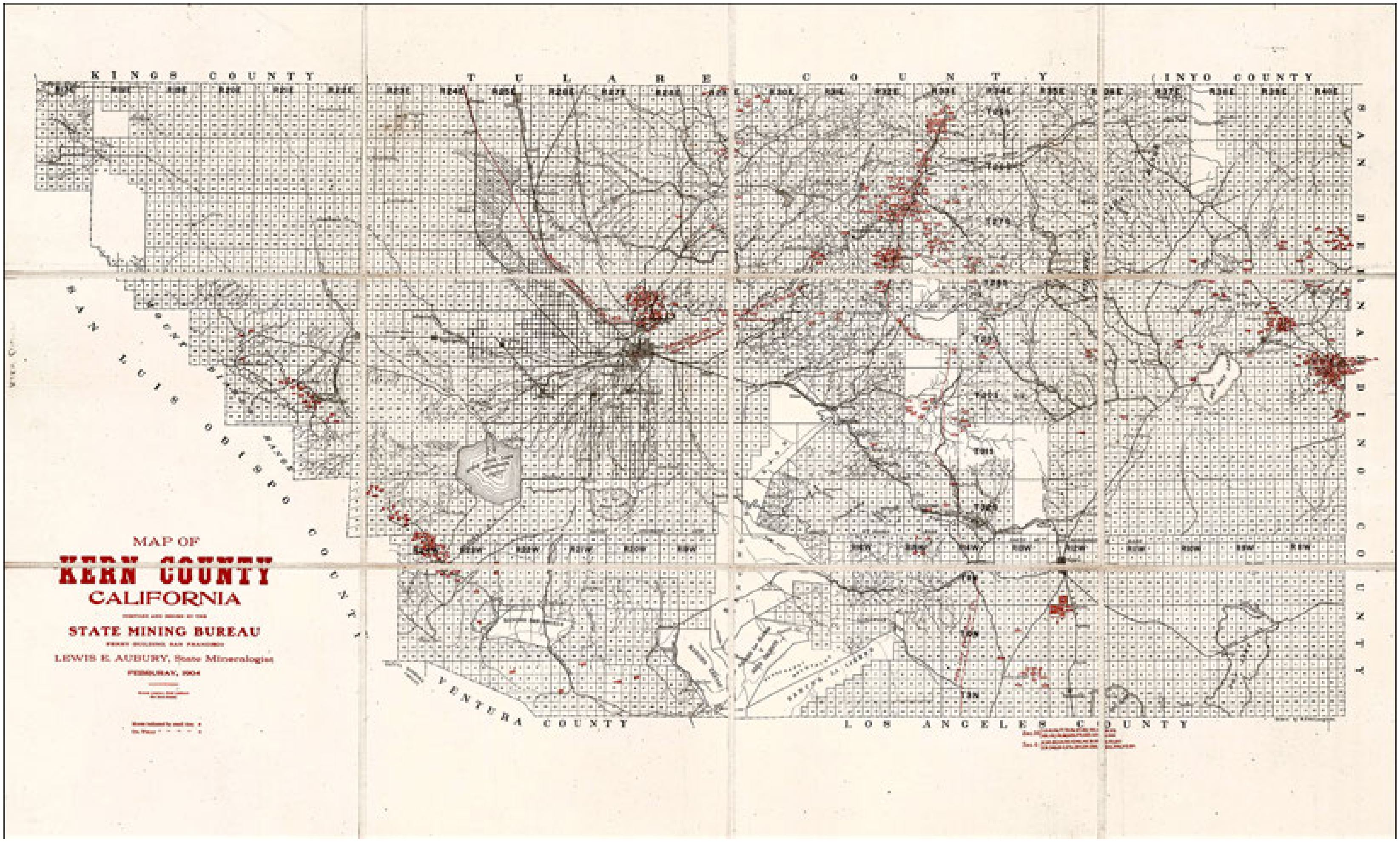


Figure 2.21. 1904 map of Kern County, showing mines known by the California State Mining Bureau (Aubury 1904:map insert).

The California Division of Mines conducted additional mineral investigations of Kern County in the late 1940s and early 1960s (Troxel and Morton 1962; Tucker et al. 1949). In the late 1940s, Kern County lode commodities in the Study Area included antimony, borate, copper, feldspar, gold, lead, magnesite, silver, and tungsten. Discovered in 1913, borax has been mined continuously at Boron (in the Kramer District) since 1927, most notably in the Baker and West Baker Mines by the Pacific Coast Borax Company. This boron deposit is the world's largest, and its value is "greater than that of many of the other mineral products in the county" (Troxel and Morton 1962:9). In the Study Area, feldspar comes from the Rosamond feldspar deposit. Tungsten production began in the part of the county within the Study Area in the Stringer Mining District in 1905 and greatly increased during World War II. Additionally, the USGS examined and assessed uranium deposits near Rosamond in 1952. Other known lode deposits in the county with little or no associated production included manganese and molybdenum (Shumway et al. 1980:70; Troxel and Morton 1962:9, 31; Tucker et al. 1949: 239–244, 246; Vredenburgh et al. 1981:214; Walker 1953a).

The Yellow Aster, Granton, Midlothian, and New Deal Mines in the Randsburg Mining District; the Apache, Colorado Camp, Holland Camp, Bickel Camp, and Jolliver/Hummer/Hoover Mines in the El Paso Mining District; the San Antonio and Gold Peak Mines in the Sageland Mining District; the Crown Consolidated Quartz, Yellow Treasure/Lonely Camp, and Gold Pass Mines in the Rademacher Mining District; and the Stringer Mining District include public lands currently managed by the BLM. The following mines are also on public lands currently managed by the BLM: Gerbracht Camp, Smith, and Owens Camp Mines in the El Paso Mining District; the Danny Boy, Sunset, North Star, Ora Grande, and Alphie Springs Mines in the Sageland Mining District; and the Nugget Central Mine and the Allstate, Hawk, and Hard Tack Prospects in the Randsburg Mining District.

San Bernardino County

The history of mining in San Bernardino County and, specifically, the histories of individual mines have been covered by Shumway et al. (1980:76–141) and Vredenburgh et al. (1981:28–180). A brief overview is provided here. The largest county in the United States, with a size of nearly 20,000 square miles and its varying regional geology, San Bernardino County has produced about 45 mineral commodities. With a mineral output valued at $48,351,102 in 1950, metals and non-metals comprised about one-sixth of that total. The first comprehensive report dedicated to the mines and minerals of San Bernardino County was written in 1902 (Bailey 1902) by the California State Mining Bureau. The document reported 301 hard-rock quartz mines—224 for primarily gold and silver and 77 for copper—spread throughout the county (Figure 2.22). By 1902, the following hard-rock minerals were in production within the county: gold, silver, copper, and lead. Other lode minerals known to exist included tin, iron, and zinc (Bailey 1902; Shumway et al. 1980:76; Vredenburgh et al. 1981:58–61; Wright et al. 1953:51).

Gold is the most widely distributed metal of commercial value within San Bernardino County and the most predominant metal in 27 of the 45 mining districts. Legend has it that Mexican prospectors first identified gold in today's San Bernardino County near Salt Springs, along the Santa Fe–Salt Lake Trail, in the 1820s. The first confirmed discovery of gold was in 1849 at this location, with placer-mining operations developing in the 1850s. Lode mining started shortly thereafter. Although gold was associated with many of the streams of the San Bernardino Mountains, no gold mines were in operation in 1855. The 1850s remained quiet, and prospectors fanned out in the 1860s and identified many deposits. Gold strikes were made, however, as early as 1855, in Bear and Holcomb Valleys (Beattie and Beattie 1939:364–368; Robinson 1958:37; Robinson 1989:47). Silver was first discovered in the New York Mountains in 1861, in the Providence Mountains in 1863 (King and Casebier 1981:300), in the Ivanpah Mountains in the 1860s, and in the Avawatz Mountains in 1870. King and Casebier (1981:304) stated that mining during the 1860s in the eastern part of the Mojave Desert was done largely to "demonstrate the richness of the mines and not as part of a normal productive operation," leading to focused work in the Clark and New York districts the following decade. Shumway et al. (1980:76) noted that mining activity was fairly intense between the late 1870s and World War I, with gold mining surpassing silver mining in the early 1890s. The Bagdad Chase Mine began producing in 1904 and was the principal single source of gold and copper within the county, and the Supply Mine and the Nightingale had the largest production in the Dale District (Shumway et al. 1980:76–77, 91–92, 104; Trask 1856:19–20, 63–64; Vredenburgh et al. 1981:62, 86, 109, 111; Wright et al. 1953:51, 69–86).

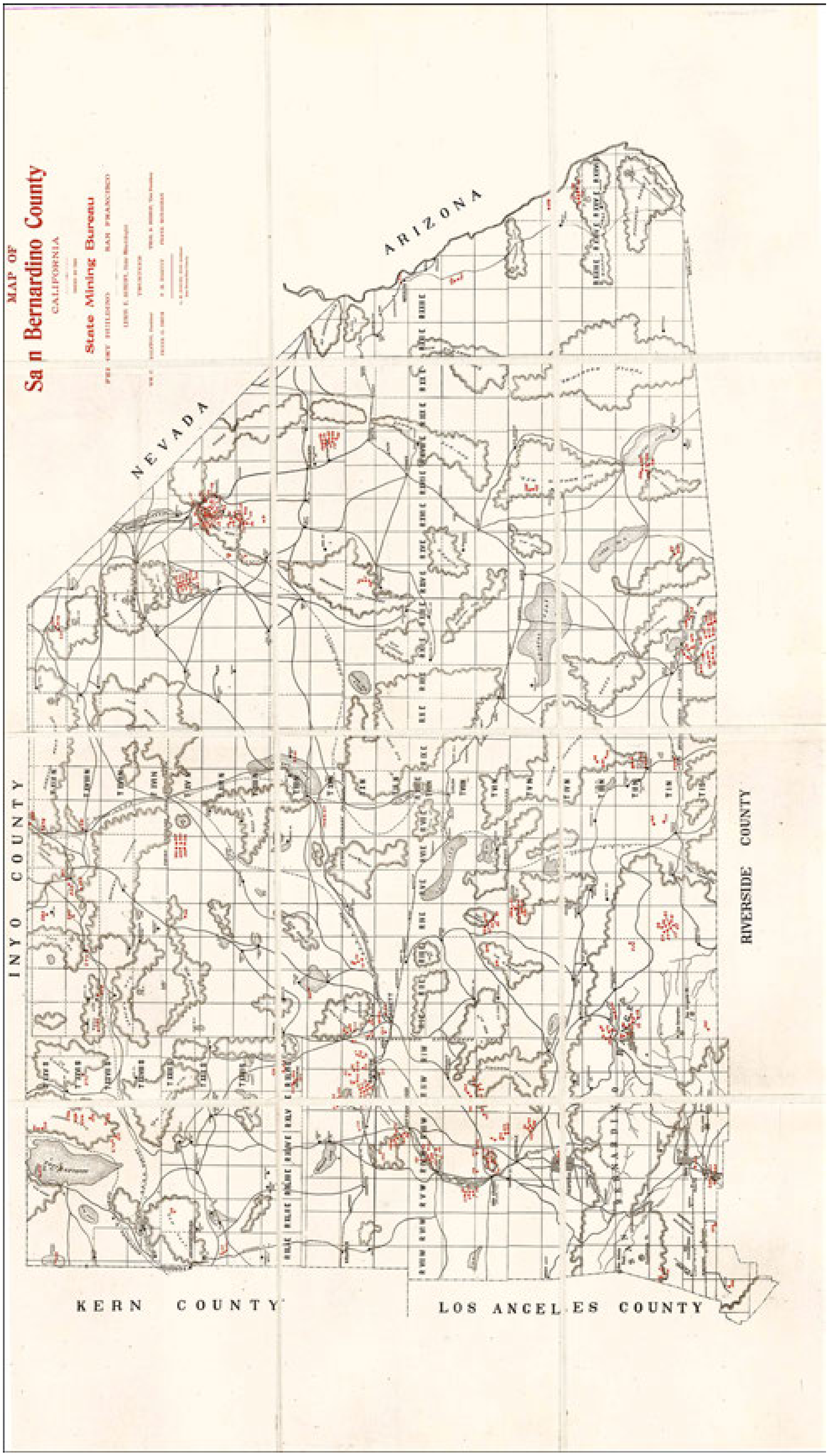


Figure 2.22. 1902 map of San Bernardino County, showing mines known by the California State Mining Bureau (Bailey 1902:map insert).

Copper and lead-silver-zinc deposits are widespread in the county and were produced through short-lived and discontinuous operations. Copper was discovered in the early 1860s, and the years with the highest copper yields included 1889, 1900, 1912, and 1916–1918. The most productive copper mines in the county were the Bagdad Chase gold mine and the Copper World mine (1899–1920). Whereas lead was predominant in most lead-silver-zinc deposits, zinc was predominant in the Carbonate King Zinc Mine discovered in 1900 and at the Cucamonga Zinc deposit discovered in 1930. Silver primarily came from Calico, discovered in 1881 and most active in 1883–1888, and Randsburg, discovered in 1919 and most active in 1920–1925. The Calico and Randsburg Districts were dormant by 1953 (Shumway et al. 1980:76–77, 84, 89, 91–92, 97; Vredenburgh et al. 1981:96; Wright et al. 1953:51, 60, 103, 126–127, 133).

Mining was quite active in the region from the turn of the century through World War I. The world's principal borate source was discovered in 1882 in San Bernardino County. Found in colemanite deposits in the Calico Mountains, borate was produced there from 1894 to 1903. Iron mines gained commercial interest in the early 1900s, but production remained small. The iron deposits of the Vulcan and Cave Canyon Mines were extensively worked, and several other small-scale operations existed across the county. Tungsten in the Atolia tungsten deposit was first discovered in 1904 and was in nearly continuous production at least through the 1950s. Talc mining was confined to two areas, one deposit near the San Bernardino–Inyo County line that opened in 1910 and another northeast of Silver Lake that opened in 1916 (Baker and Maniery 2015; Wright et al. 1953:51, 86, 140, 152, 197).

A promotional comment made in 1914 (Southern California Panama Expositions Commission 1914:200) stated:

> [t]he entire country is rich in mineral indications and honeycombed with prospect holes. Stringers of copper, silver and gold lure the prospector, and the county map is a checkerboard of mining locations and patented claims, but there are few developed mines. The man with money for development work and practical knowledge of mining can find in San Bernardino County many interesting localities to explore.

Nevertheless, across the region, mining quieted during the 1920s as a result of low metal prices and inflation. The 1930s saw greater mining activity because of the increase in the price of gold and the lack of work available during the Great Depression. Shumway et al. (1980:76) remarked that the principal centers of mining activity until World War II were the regions around Barstow, Vanderbilt, Stedman, and Dale. In late 1942, Kaiser Steel began the operations of the Vulcan Mine and produced iron in support of the Kaiser Steel plant in Fontana. It should be noted that both the Vulcan Mine and the Bagdad Chase Mine remained active during World War II. In 1949, rare-earth elements of commercial concentrations were first discovered, with an even larger body identified in 1951. These concentrations produced barite and rare-earth oxides. Also in 1949, the Starbright tungsten deposit was discovered and became a significant source of tungsten in the state. The total value of tungsten ore produced in the county likely exceeds that of any other metal (Shumway et al. 1980:76; Wright et al. 1953:51, 86, 121–123).

Small-scale or limited lode-mining operations in San Bernardino County included production of antimony from 1939 to 1942; asbestos from the Golconda deposit in 1943; barite in 1910–1912 and 1929–1937; magnesite from Sidewinder Mountain and the Needles deposit; manganese in 20 localities, with Owl Hole Spring the principal source in the county; mercury in 1940 and 1941; molybdenum from the Big Hunch deposit; strontium from the Argos and Barstow deposits during World Wars I and II; and tin from the Evening Star Mine, in the Ivanpah Mountains. Other known lode deposits in the county with little or no associated production include uranium and vanadium (Wright et al. 1953:51, 59, 114, 121, 140, 153, 155, 181, 184, 242).

Of the aforementioned localities, the Atolia Mine in the Randsburg Mining District, Bagdad Chase Mine, the Supply Mine, the Nightingale, and the Starbright tungsten deposit include public lands currently managed by the BLM.

Los Angeles County

Gold was discovered in Los Angeles County during the early 1800s, but reports conflict as to the location and date of the first discovery. Candidates include placers west of Castaic mined from 1834 to 1838, a discovery in Santa Felicia Canyon, deposits worked by priests from the San Fernando and San Buena Ventura missions, a discovery by a cattle rancher while digging up a wild onion for lunch, and placers discovered in 1842 in Placerita Canyon. Subsequently, Mexican and, later, American miners would work the aforementioned discoveries and placer deposits in Los Angeles County (BLM 2011b:3.13; Gardner 1954:51; Gay and Hoffman 1954:493–494).

Lode mining of gold- and silver-bearing veins began in the 1870s in Los Angeles County with the establishment and operation of the Cedar Mining District near Acton. Ore was hauled by oxen to San Pedro and then shipped to Mexico for treatment. The Acton mines, along with mines near Neenach and in the San Gabriel Mountains, were the most active lode mines in the county (Figure 2.23). The periods of greatest activity were in the late 1800s and the 1930s, the latter reflecting a period when the discovery of high-grade ores stimulated new excitement, prospecting, and mining. The most productive gold mine in Los Angeles County was the Governor Mine, in the Cedar Mining District. First mined in the 1880s, it began with a five-stamp mill. In the 1930s, ore was crushed at the mine but milled in Acton. Although intermittent activity has occurred since the 1930s, little gold from hard-rock mining has been produced since 1942. The largest obstacle to lode mining in Los Angeles County was the lack of water. In several locations throughout the county, there were no available sources from which to bring water practicably by flume to mining sites. This hindered the establishment of mills at several lode mines (Gay and Hoffman 1954:469, 494, 496–500; Merrill 1917:16–17).

Smaller lode-mining activities in Los Angeles County included the production of barite in San Dimas Canyon, borate at Lang mine in Tick Canyon, feldspar in Soledad Canyon, and gypsite in Mint Canyon. Almost all the lead, silver, and zinc produced in Los Angeles County was mined on Santa Catalina Island from deposits discovered as early as 1863 and worked from 1919 to 1929. The largest producer was the Black Jack Mine, in the central part of the island, which operated an aerial tramway to carry ore from the mine downslope to its flotation mill. The smaller Renton Mine, in the southern part of the island, also had an aerial tramway to transport ore to barges for milling on the mainland. Small-scale production of lead and silver also occurred east of Casteca Canyon in the late 1800s. Manganese was produced during World War I near Palmdale. Magnetite was primarily mined from the western San Gabriel Mountains but also in other places within the county. Titaniferous magnetite (or titanium) was produced in 1927–1928, by placer, and again in 1947–1952, with only some production from hard-rock mining. Los Angeles County ranked first in mineral production among California counties in 1950, because the Los Angeles Basin was the most productive oil-producing region of its size in the world. Other known lode deposits in the county with little or no associated production include antimony and uranium near Lancaster, chromium near Harold Station and Acton, copper and molybdenum across the county, iron in Soledad and Mint Canyons, and tungsten in the San Gabriel Mountains (Gay and Hoffman 1954:469, 481, 492–493, 502–506, 525; Merrill 1917:10–11, 18–19; Trennert 2001:95).

Orange County

Orange County is much richer in petroleum products than hard-rock-mining deposits. Orange County was separated from Los Angeles County in 1889. Before that occurred, extensive silver and some gold deposits had been discovered in the Santa Ana Mountains, including those of the Santa Rosa Mining District. The Pellegrin or Alma diggings were located on a branch of Santiago Creek, and silver ore was extracted from at least 1890 to 1894 (see Figure 2.23). Silverado, in Canada de la Madera, was a silver boomtown founded in 1878. Although the town only endured for 3 years, the community of up to 1,500 people was served by a daily stage from Los Angeles and Santa Ana. In 1880, Silverado had three hotels, three general stores, a school, seven saloons, and two blacksmith shops. Orange County historian Jim Sleeper believes that Mexican prospectors discovered Canada de la Madera (Billiter 1991). The most productive silver mine in the canyon was the Blue Light Mine, which produced zinc in the 1940s and was mined for silver until the late 1950s. Other known lode deposits in the county with little or no associated production include mercury east of Tustin and tin in the Santa Ana Mountains (Billiter 1991; Bowers 1890: 399; 402–403; Merrill 1917: 56, 58).

Figure 2.23. 1900 map of Los Angeles, Orange, and Ventura Counties, showing oil and mining districts (courtesy of the Library of Congress).

Riverside County

The history of mining in Riverside County and, specifically, the histories of individual mines have been covered by Vredenburgh et al. (1981:24–57). A brief overview is provided here. Riverside County's primary mineral wealth is in non-metallic products, but gold and silver were produced in sufficient quantities to be important for the county. Gold is distributed across Riverside County, most notably in the region near Perris and Elsinore and in the eastern desert area, between the San Bernardino Range and the Colorado River, and many gold mining districts have been recorded. Gold was mined in present-day Riverside County as early as 1857 on Redtop Mountain, near Perris, although Vredenburgh et al. (1981:24–27) provided that it was in the Mule Mountains in 1861. Additional gold deposits in the Perris region were found in the period between 1876 and 1882 (Figure 2.24). Mining districts in the eastern desert area were established as early as 1890. The largest gold rush in the county occurred in the 1880s with gold and silver discoveries in the Chuckwalla Mountains, including gold at the Red Cloud Mine in 1898. Mines were also established in the McCoy, Big Maria, Palen, and Orocopia Mountains and in the Joshua Tree and Pinto Basin areas (Eggers 2004; Merrill 1917:64, 67–69, 76; Tucker and Sampson 1940:51–52; Vredenburgh et al. 1981:24–57).

In 1853, the Temescal tin deposit was discovered in Riverside County, and a company to work the mine was established in 1860. Operations were suspended because of the U.S. Civil War and recommenced in 1868. Riverside County also had a very important and large deposit of iron at Eagle Mountain; in 1917, it was considered the largest deposit in Southern California. Copper was discovered in the Palen Mountains in 1880. Cuprite, a red copper ore, was present in quantity also at the Red Cloud Mine in the Chuckwalla Mountains. A 1914 report (Southern California Panama Expositions Commission 1914:159) noted "little production of gold, silver, lead and copper" but added that the county "is teeming with alluring prospects," including iron ore "measured by mountains." During World War I, manganese was produced in the McCoy Mountains; mines included the Black Jack and the Arlington. Although gold mining was most prominent during the period 1893–1901, several gold-mining operations started after World War I: for example, at the Alice, Gold Crown, Golden Rod, Lost Pony, and Sunrise Mines. By 1945, there were mines and prospects of the following additional commodities: feldspar, gypsum, lead-silver, and tungsten. Other small-scale or limited lode-mining operations in Riverside County included the production of uranium. Other known lode deposits in the county with little or no associated production include antimony southwest of Corona and magnesite near Winchester (Eakle 1923:98; Merrill 1917:64–67, 84–87, 119; Pabst 1938:105; Page and Thayer 1945:1; Sampson and Tucker 1945; Southern California Panama Expositions Commission 1914:159–160; Tucker and Sampson 1929:492, 1945; Vredenburgh et al. 1981:24, 44, 49).

Of the aforementioned localities, the deposit of iron at Eagle Mountain, the Black Jack Mine, the Arlington Mine, the Red Cloud Mine, and the Lost Pony Mine include public lands currently managed by the BLM.

San Diego County

Native Americans, Spanish settlers, and Mexican miners sought placer gold in the Cuyamaca Mountains and east of Escondido, in what is today San Diego County, before 1845. Prospectors identified lode deposits of gold in the Cuyamaca Mountains in 1870, and lode mining began shortly thereafter. Claims for the first mines in the soon-to-be Julian-Banner Mining District were for the Van Wert and the George Washington Mines (Figure 2.25). Seven miles south of Julian, prospectors discovered the Stonewall Jackson deposit, which would become the most prolific gold mine in San Diego County, yielding about $2 million. Julian, Banner, and Coleman City mining camps sprung up around the new mines. The ore was low grade and required substantial work in exchange for only modest returns. In 1873, plans for a railroad to San Diego fell through, and gold production numbers fell in 1874. By 1875, nearly all of the mines were idle. When a railroad did arrive in San Diego in 1885, mining activities increased, with the reopening of several older mines and the development of previously overlooked deposits within and outside the Cuyamaca Mountains (see Figure 2.24). That boom lasted until about the turn of the century (BLM 2011b:3.13–3.14; Ellsberg 1989; Gardner 1954:51; Merrill 1914:17; Weber 1963:36–37).

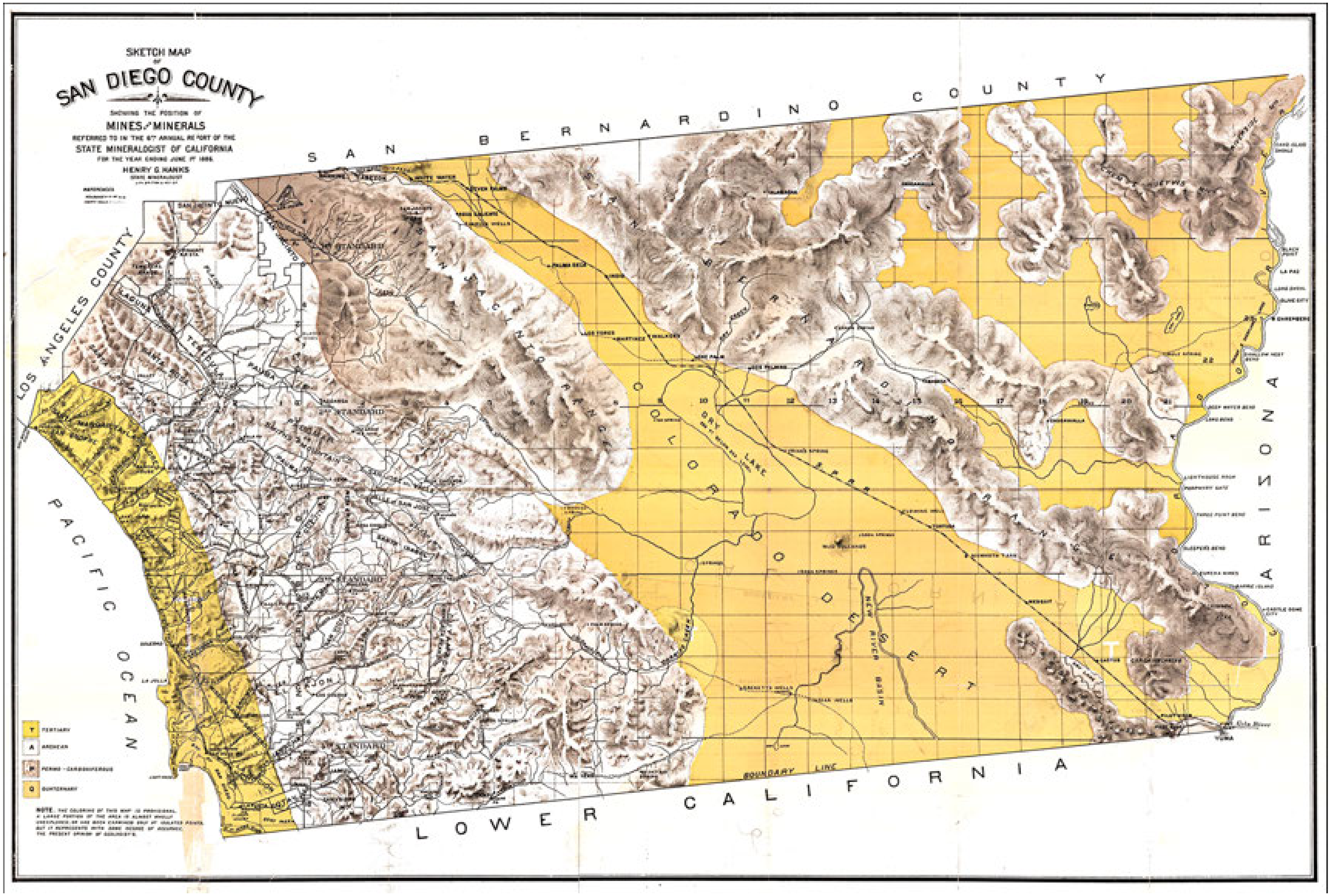


Figure 2.24. 1886 map of San Diego County, which includes present-day Imperial and Riverside Counties, showing mines and minerals known by the California State Mineralogist (Hanks 1886:map insert).

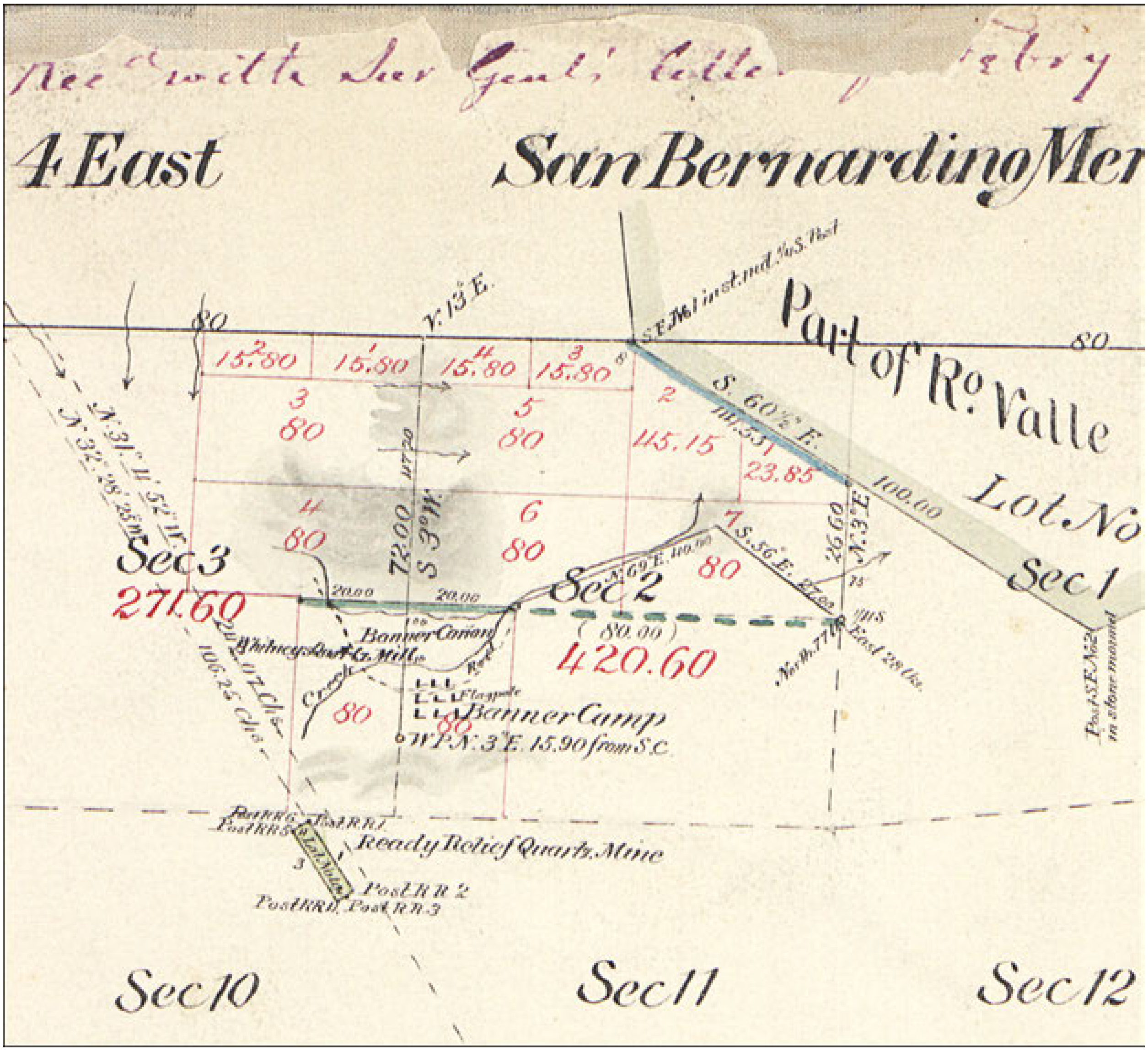


Figure 2.25. Portion of an 1876 U.S. General Land Office plat map, showing the Banner Camp, Whitney's Quartz Mill, and the Ready Relief Quartz Mine within the Julian-Banner Mining District (courtesy of the U.S. Department of the Interior Bureau of Land Management).

The California State Mining Bureau report (Hubon 1902), focusing on the mines San Diego County, showed it to be replete with mineral deposits. The document reported 80 hard-rock quartz mines and 15 millsites. Gold-mining districts included those of Banner, Julian, Escondido, Dulzura, Grapevine, Mesa Grande, and Pine Valley. Copper deposits had been identified near Encinitas, in the San Vicente Mountains, and in the Cuyamaca Mountains. Silver had been produced at Valley Center and near Laguna. Other known lode minerals noted in the report included antimony near Laguna, manganese across the county, and zinc in the San Vicente Mountains. Additional early hard-rock mine production in the county included lead across the county and lithium from the Pala Mining District (Weber 1963:173, 185).

Gold mines of Julian were reactivated during the 1930s, because of the Depression and the increase of the price of gold per ounce. Several other small gold deposits in the county were worked through the early 1940s with minor success (Weber 1963:39, 115). The BLM (2011b:3.13) noted that the mines of the Cuyamaca Mountains are representative of some of the earliest mining in the CDD, even though those mines were not "overly large or productive." The BLM (2011b:3.14) suspected that the region "contains significant cultural resources regarding the early mining history of the California desert," because there have only been limited studies of the Julian-Banner Mining District and surrounding area.

Lode mining in support of World War I included limited production of copper, molybdenum, tungsten, and feldspar. After World War I, tantalum was produced in 1920, zinc was produced in 1926, and copper was produced in 1938. In 1921, mining of the principal source of feldspar began in California, from a deposit near Campo. That deposit would produce through 1942. In addition to feldspar production through 1946, other lode mining activities in San Diego County during World War II included the production of tungsten across the county and molybdenum at Campo (Weber 1963:38–39, 68, 283).

After World War II, tungsten mining occurred again from 1950 to 1956, during a government purchase program. During that period, prospectors investigated pegmatite deposits for radioactive minerals, including uranium and thorium, and for vanadium, but these minerals were not mined. Other known lode deposits in the county with little or no associated production include nickel across the county, iron in the northern reaches of the county, pyrite near Julian, and tin in the pegmatite deposits in north San Diego County, northwest of Borrego Springs and east of Buckman Springs (Weber 1963:39, 171, 200–203, 270, 280).

Imperial County

The history of mining in Imperial County and, specifically, the histories of individual mines have been covered by Shumway et al. (1980:12–22) and Vredenburgh et al. (1981:7–23). A brief overview is provided here. The earliest recorded mining activities by Europeans occurred in the late eighteenth century by Spanish settlers in Potholes (near present-day Winterhaven, along the Colorado River), at La Sierra de San Pablo (today's Cargo Muchacho Mountains, in eastern Imperial County), and in Jackson Gulch. Here, Spanish miners sought placer and residual gold. Vredenburgh et al. (1981:7) reported that two mission colonies under the administration of Francisco Garcés mined placer gold in 1780 and 1781 in the southeastern Chocolate Mountains. During the Mexican period and according to legend, a group of boys returned to their camp laden with gold ore. The geographical name change from La Sierra de San Pablo to Cargo Muchacho Mountains was supposedly inspired by the "*muchachos cargados*" or "loaded boys." Hand- or "subsistence" mining in the Cargo Muchacho Mountains all but ceased during the Gold Rush and restarted again in the mid-1850s. Gold was discovered at Picacho Peak (northeast of what is today Yuma, along the Colorado River) and at La Paz (north of present-day Blythe) in the early 1860s. The first mining district was established in 1862, and mining continued through the 1870s. Heavy mining and milling equipment was brought within "wagon-hauling" distance by steamboat traffic along the Colorado River. Hard-rock mining began in the region after the completion of the Southern Pacific Railway to Yuma in 1877, partly because of the feeling that rail provided a safer means of transit for gold and silver concentrates or bullion (see Figure 2.24). The first stamp mills were built south of Yuma along the Colorado River in 1878–1979, in support of the Cargo Muchacho mines (Cleland and Apple 2003:46; Hector 1987:5; Merrill 1914:95; Morton 1977:7; Shumway et al. 1980:12; Vredenburgh et al. 1981:7–8).

The first comprehensive report dedicated to the mines and minerals of Imperial County (then part of San Diego County) was developed in 1902 by the California State Mining Bureau (Hubon 1902). The document reported 30 hard-rock quartz mines primarily clustered in two places where large bodies of cyaniding ore were discovered: (1) within a belt of gold-bearing rocks along the Colorado River and (2) within the Cargo Muchacho Mountains. The Picacho Mining District developed along the Colorado River, and in 1902, there were plans for a 1,000-ton-capacity cyanide plant. The Hedges (later Tumco), Ogilby, and Gold Rock Mining Districts developed in the Cargo Muchacho Mountains, and in 1902, Hedges had a 140-stamp mill and used water pumped 12 miles from the Colorado River. One additional hard-rock mine, the Paymaster, was north of the Picacho Mining District, along the Colorado River, and produced silver as early as 1867 (BLM 2011b:3.11; Gardner 1954:51; Hadley 1942:460; Hubon 1902; Merrill 1914:93–95; Morton 1977:91).

Imperial became its own county, separate from San Diego County, in August 1907, during a time of diminished mining activities in the Cargo Muchacho and Picacho Mountains. As noted by Cleland and Apple (2003:47) about the Cargo Muchacho Mountain mines during that period, much of the easily accessible ore had been exhausted, and several mines that had expanded without required capital or returns shut down. However, many of the mines in the Cargo Muchacho Mountains had reopened under new ownership by 1909, partly in response to the renewed commitment of our nation to the gold standard. Operations in the Picacho Mountains ceased in 1910. The flurry of activity in the Cargo Muchacho Mountains did not last long, and little mining activity occurred in the eastern Colorado Desert through 1930, with two exceptions. Manganese deposits were discovered in the western part of the Paymaster Mining District in 1916 and 1917 and were only in production from 1917 to 1918. Copper was also mined in small amounts from the Volunteer Group Mine, in the Paymaster Mining District, in the 1920s. Additionally, aluminum-silicate kyanite was found in the Cargo Muchacho Mountains and was produced in 1925. In 1936, the company town of Obregon was established, and it remained active in the Cargo Muchacho Mountains through 1940, causing a short spell of intense activity. Whereas most large-scale gold and silver mining ceased between 1940 and 1980, small-scale mining in the county continued. Heap- and leach-mining techniques of the 1980s revived large-scale gold and silver mining in the Picacho Mountains and near Glamis (Agey and Shibler 1949; Cleland and Apple 2003:47; Hadley 1942:461; Merrill 1914:99–100; Shumway et al. 1980:17–19; Vredenburgh et al. 1981:16, 19).

World War II production included celestite, an ore of strontium. Post–World War II lode mining included manganese, barite, and tungsten. Manganese was one of the principal mineral commodities of Imperial County, ranking the county first in total manganese production for the state. Manganese was in production during World Wars I (1917–1918) and II (1941–1945), but more than 80 percent of the total amount produced was mined between 1953 and 1959 as part of the nation's strategic mineral-stockpiling program. Manganese deposits were located in the Paymaster Mining District and in the Palo Verde Mountains. Discovered in the mid-1950s and produced from the early to mid-1960s, barite deposits also occurred in the Palo Verde Mountains. Tungsten was produced in small amounts across the county. Other known lode deposits in the county with little or no associated production include feldspar in the Superstition Mountains, iron near Mammoth Station, lead near the Picacho and Paymaster Mining Districts and in the Chocolate Mountains, mercury in the Palo Verde Mountains, nickel in the Coyote Mountains, sulfur in the Chocolate and Coyote Mountains and near the Colorado River, uranium in the Chocolate and Cargo Muchacho Mountains and northeast of Glamis, and zinc in the southwestern corner of the county (Merrill 1914:102–103; Morton 1977; Shumway et al. 1980:18; Vredenburgh et al. 1981:18–19; Walker 1953b:4).

Of the aforementioned localities, part of the Hedges (later Tumco) Mining District, the Paymaster Mine, the Volunteer Group Mine, and the town of Obregon include public lands currently managed by the BLM. The BLM has determined the Hedges/Tumco Mining District eligible for listing in the NRHP, and the El Centro Field Office employs the property as an interpretive area.

Summary

The Study Area is replete with mines; mineral discoveries date back to the 1780s. Although most hard-rock-mining activities began with the pursuit of gold and silver, more than 25 other lode minerals were produced in the Study Area between the 1870s and 1960. They include antimony, asbestos, barite (barium), borax (borates, colemanite), celestite, copper, feldspar, gypsite (gypsum), iron, kyanite (aluminum silicate), lead, lithium, magnesite, magnetite, manganese, molybdenum, quicksilver (mercury), rare-earth elements, strontium, sulfur, talc, tantalum, tin, titanium (titaniferous magnetite), tungsten, uranium, and zinc. Other known lode deposits in the Study Area with very little or no associated production include bismuth, cadmium, chromium, nickel, platinum, pyrite, thorium, and vanadium.

Property Types

> *The material evidence can offer clues about when the activity occurred, the longevity of the operation, productivity, the degree of capitalization, and the work environment experienced by the miners. Reading the ruins of mines requires the historian to think like a detective and rely on material evidence to reconstruct the past* [Twitty 2005:293].

In order for historic context statements to provide the necessary guidance for the identification, evaluation, and treatment of historic properties, applicable property types, with their character-defining and associative features, must be identified and defined. The historic context is linked to discernable cultural resources by the concept of the property type. A property type is a grouping of individual properties that share physical or associative characteristics. Physical characteristics may relate to structural forms, architectural styles, building materials, or site type. Associative characteristics may relate to the nature of associated events or activities, to associations with a specific individual or group, or to the category of information about which a property may yield information. On the basis of this framework, one can describe a property in terms of its physical and associative characteristics and then discuss its significance within the appropriate historic context (McClelland 1997:4, 51; Shrimpton 2002:7–10).

A number of historic contexts have been prepared for historical-period mining sites, and most of them include lists and descriptions of property types. Some extend to discussions of placer mines not considered here, and others are limited to property types associated with specific site types (mills, for example). The property types offered in the Caltrans historic context for mining properties (Caltrans 2008) occur widely across the mining regions of California, and many of the examples it provides for hard-rock sites are applicable to the Study Area and the site types considered here. The BLM 8100-10 training course (BLM n.d.b) presents mining site types found on BLM lands across the nation, noting a "great diversity in the types of associated archaeological sites, features, and structures" related to the diversity of mineral resources sought in different areas. Table 3.1 presents a list of references that discuss historical-period mining-property types; these documents contain additional descriptive and interpretive information that researchers will find useful in application to specific archaeological sites, particular mineral commodities, or distinct historical topics. Users of this document are encouraged to consult those sources for additional pertinent property-type information and to implement the guidance presented in the Caltrans (2008:81–112) research design for mining properties and the BLM 8100-10 training course (Module 2). Here, we detail those property types applicable to the Study Area. Comments about sources of additional information are provided as appropriate.

The property types detailed in this chapter are those related to hard-rock mining in the Study Area between 1848 and ca. 1960 and are directly related to the historic context presented in Chapter 2. In this chapter, we provide supplemental information focused on descriptions of properties most likely to be encountered by archaeologists working in the Study Area. Our emphasis is hard-rock-mining-related properties, including archaeological and built-environment resources, with particular attention given to property types and patterns that are specific to the California deserts, because of the unique environmental, geological, economic, social, or other circumstances that shaped the history of the region. The Study Area considered in this investigation is defined by the boundaries of the BLM CDD and Bishop Field Office. To provide adequate historical context, we discuss mining throughout that region, including on private land and on land managed by other agencies. Where possible, examples used in descriptions and illustrations are drawn from known archaeological sites within the Study Area.

Table 3.1. Property-Type Categories Presented in Other Documents

Author/Year	Title	Property-Type Category					
		Extraction	Beneficiation	Secondary Mining Related	Support System	Linear	Landscape
Bleakley 2000	*National Register of Historic Places, Multiple Property Documentation Form: Historical Properties Associated with Mineral Development in Wrangell–St. Elias National Park and Preserve, Alaska, 1898–1942*	X	X	X	X	X	
Botwick 2012	*Gold Mining in the Carolinas: A Context for Archaeological Resources Management*	X	X		X	X	X
Bruder 2002	*Prospects and Producers: Historic Context for Mining Properties, Chugach and Tongass National Forests, Alaska, 1850s–1950s*	X	X	X	X	X	
Bunyak 1998	*Frothers, Bubbles and Flotation: A Survey of Flotation Milling in the Twentieth-Century Metals Industry*		X	X		X	
California Department of Transportation 2008	*A Historical Context and Archaeological Research Design for Mining Properties in California*	X	X	X	X	X	X
Fell and Twitty 2008	*National Register of Historic Places, Multiple Property Documentation Form: The Mining Industry in Colorado*	X	X	X	X	X	
Hardesty 1990a	"Mining Property Types: Inventory and Significance Evaluation"	X	X	X	X		X
Keane and Rogge 1992	*Gold & Silver Mining in Arizona, 1848–1945*	X	X	X	X		
McKay 2011	*Mining Idaho's History: Metal Mining in Idaho, 1860–1960*	X	X	X	X	X	X
Mehls and Mehls 1991	*Routt and Moffat Counties, Colorado, Coal Mining Historic Context*	X	X	X	X	X	X
Twitty and Fell 2010	*Draft: Context for Historic Mining Resources in the Black Hills and South Dakota: A Guide for Identification, Interpretation, and Evaluating Eligibility to the National Register of Historic Places*	X	X	X	X	X	X

Hardesty (1999a:2) compared mining sites to "'repositories of historical information, analogous to archives of paper documents." We group historical-period mining-property types into six categories representing the major activities related to the history of a mining site:

- extraction property types,
- beneficiation property types,
- secondary mining-related property types,
- support-system property types, and
- linear property types.

Each category is discussed separately below. As defined here, extraction property types include those resulting from prospecting and hard-rock ore-recovery activities. Beneficiation property types include those related to milling and processing activities related to "regulating the size of a desired product," "removing unwanted constituents," and "improving the quality, purity, or assay grade of a desired product" (Thrush 1968:97). Secondary mining-related property types are those reflective of activities such as water catchment, blacksmithing, and livestock management. Support-system property types are those related to accommodating all activity at the mine but not directly related to mining itself, largely made up of domestic activities. Linear property types may be related to other property types but are discussed separately because of their unique morphology in the archaeological record and because they often link multiple property types.

Once a potentially profitable deposit was identified, the siting of surface facilities related to extraction was "inflexible" (USFS 1983:52), in response to the nature and orientation of ore bodies. Then, to the extent possible, beneficiation facilities were situated in response to the location and arrangement of extraction sites. Every attempt was made to make use of gravity for moving ore, waste rock, and water to the desired locations at the site, minimizing the need for hoists, conveyors, and pumps. Consequently, historical-period hard-rock-mining sites often occupy large expanses of hillsides, with mines toward the highest elevations and beneficiation facilities below. Support systems, particularly domestic features, were located near mines at small operations or in clusters at easily accessible areas near larger operations. In the following sections, we present each property type, associated property subtypes, and the artifact types commonly found in association with each of the property types.

Extraction Property Types

For the purposes of this study, extraction property types encompass the activities of prospecting, ore recovery from lode formations, and the attendant workspaces. The inherent goal of hard-rock mining is to locate and extract valuable minerals from lode deposits where they occur naturally. A lode can be a single vein or a zone/belt of mineralized rock separate from adjacent non-mineral-bearing rock. Historical works sometimes refer to a lode as a "lead" (pronounced *leed*).

Claim Markers

Claim markers are frequently found among the remaining features of mining districts. In some cases, together with minor prospects, claim markers may "constitute the *entire* physical record of mining activity in a particular locale" (Swope and Vredenburgh 2003:1 [original emphasis]). The patterning of claim markers can reveal details about the search for minerals in a specific area.

The physical remains of claim markers include rock cairns (Figure 3.1), blazed trees, posts (wood or metal) set in the ground, posts set in cairns (Figure 3.2), or posts set in concrete (USFS 1983:6). Whenever possible, posts were placed in conspicuous locations, but they also were placed in obscure positions, because of the need to mark discovery locations or claim corners. Often, the posts have fallen. Posts may be marked with aluminum tags (Figure 3.3) or painted information. Paper claim or assessment notices are sometimes found in stone cairns or affixed to posts. Researchers (Swope and Vredenburgh 2003:5) have observed a common practice in cairns in the Study Area: "incorporating one visually dissimilar stone, frequently of white quartz [that] could easily be removed to access a cavity and the claim document stored within."

Figure 3.1. Mining-claim marker consisting of a rock cairn, Lucky Day No. 1 Mine, Joshua Tree National Park, 1997 (photograph by Karen K. Swope).

Figure 3.2. Mining-claim marker consisting of a post set in a rock cairn, Hart Mining District, 1997 (photograph by Karen K. Swope).

Figure 3.3. Aluminum tags from a mining-claim marker (photograph by Karen K. Swope).

Paper notices are sometimes contained in tobacco cans, glass jars with threaded lids, plastic prescription vials, or lengths of polyvinyl chloride (PVC) pipe, all of which can provide chronological clues, even if the paper notice is illegible or missing. Upright pocket tobacco cans date from the 1890s forward (Rock 1987:62). Continuous-thread glass condiment jars were common from the 1940s to 1960s; plastic vials (typically amber colored to protect contents from ultraviolet light) can be surprisingly durable in desert environments; their use would date a claim to the 1950s or later (Griffenhagen and Bogard 1999:47). PVC pipe was used from the 1960s to the early 1990s but is prohibited today, and most claim markers incorporating PVC have been replaced or removed in compliance with California Public Resources Code, Section 3915.

The positions of the markers denote specific information about the mining claims. A marker can designate the point where a lode outcrops (the apex) (Osborn 1896:194; Thrush 1968:46; Young 1970:227–228), the Point of Discovery (BLM 2004:7–9), or corners or other boundary points of a lode or mill-site claim. Lode claims are filed on veins (lodes) of rock (in place) containing valuable mineral deposits (BLM 2004:7). The General Mining Act of 1872 continues to govern the dimensions for lode claims thus: “[I]n no case shall the claim extend more than 1,500 feet along the course of the vein or lode, or more than 300 feet on either side thereof as measured from the centerline of the vein at the surface” (Evans 2000:23). By this directive, claims are aligned with the strike of the vein as observed at the surface. “Lode mining claims have no standard orientation, resulting in a complicated pattern of land use superimposed on the environment” (Swope and Vredenburgh 2003:4) (Figure 3.4), and an accurate understanding of the boundaries of any claim requires a combination of physical data (information gleaned from markers) and documentary materials. Archival data—U.S. General Land Office (GLO) survey maps and surveyor’s notes, for example—can also help distinguish between mining-claim markers and monuments that were erected by land surveyors or parcel owners. The most useful GLO survey record for this effort is a Mineral Survey, but other surveys that were conducted in the area may also include useful information.

Prospects

In the Study Area, evidence of prospecting activity varies from small tests (hand-excavated pits and pickaxe scars on rock faces or outcrops) to mechanized explorations (including bulldozer excavations). The morphology of prospects is shaped by the type of ore sought, local geomorphology, available capital, and time period. A majority of mining prospects did not become producing mines. Consequently, researchers can expect to discover prospects in the form of shallow pits, minor shafts, or short tunnels (Figure 3.5) with greater frequency than other extractive property types. Minor vertical or horizontal cuts that did not develop into true shafts or adits are actually prospect tests for the presence of profitable ore. Even in areas containing developed underground workings, peripheral prospects are common, because miners explored the extent of valuable minerals. In these cases, it is important to recognize that the prospects and developed workings represent a coordinated mining effort. Prospecting can be patterned in a grid or on a line, or it might reflect “strategic sampling” following the expected strike of a vein (BLM n.d.b:Module 2).

Prospects and adits frequently contain drill scars (Figure 3.6), the remnant drill holes incompletely removed in blasting. These can be found on the walls, ceilings, or faces of the workings. Both single- and double-jack drilling methods required a graduated set of drill steel and hammers of appropriate size and weight, and pneumatic drills would have been used when they were available to prospectors. It is not uncommon to discover expended or otherwise abandoned drill steel at archaeological sites, sometimes embedded in the rock face of a prospect.

Abundant additional details regarding the mechanics of drilling and blasting, the equipment used, and the implications for the potential archaeological signature of various technologies can be found in Twitty’s (2001) *Blown to Bits in the Mine: A History of Mining & Explosives in the United States*.

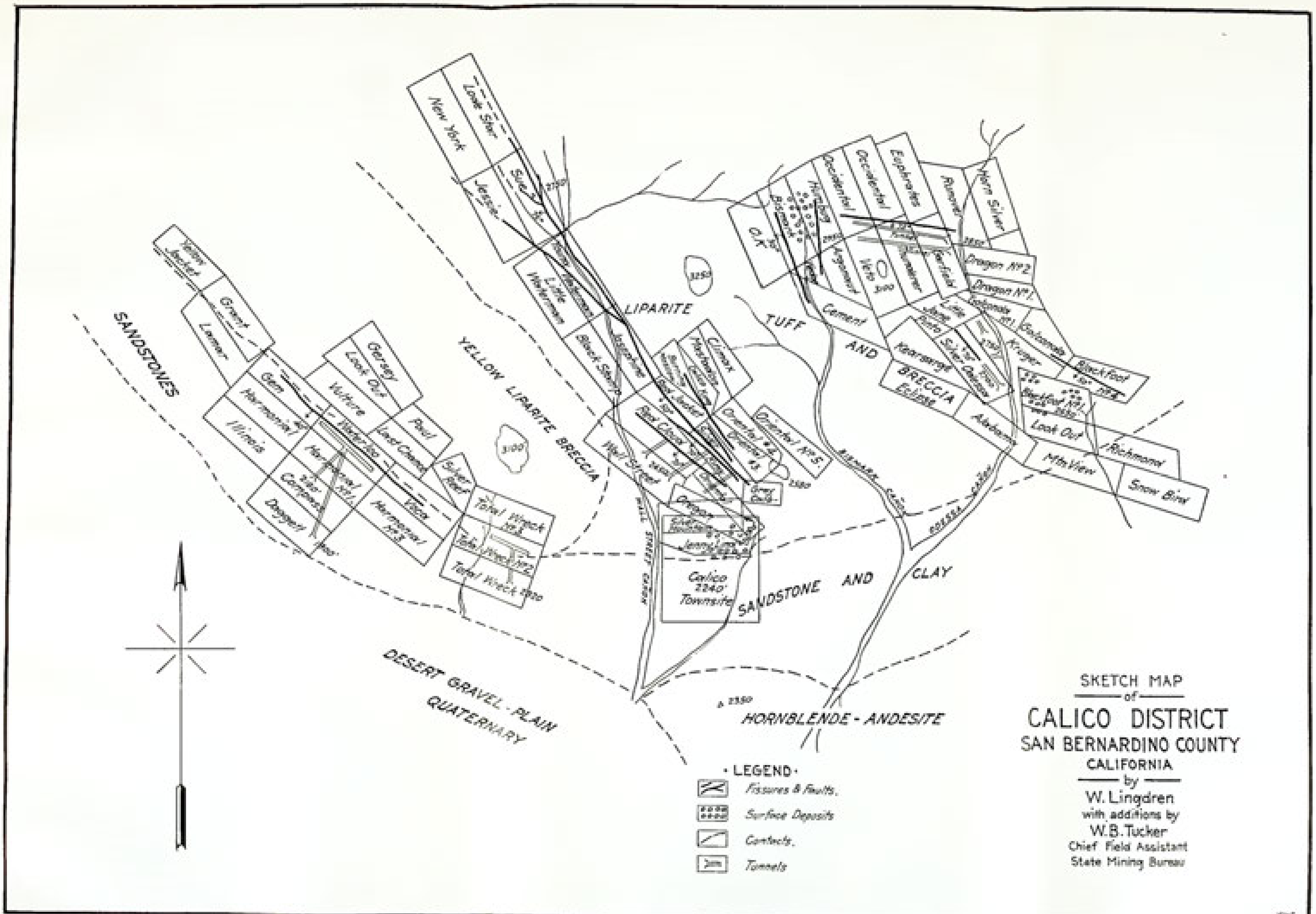


Plate VI. Sketch Map Calico District, San Bernardino County.

Figure 3.4. Map showing the locations of claims in the Calico Mining District and the layout of claims defined by the strike of ore bodies (Tucker 1921:Plate VI).

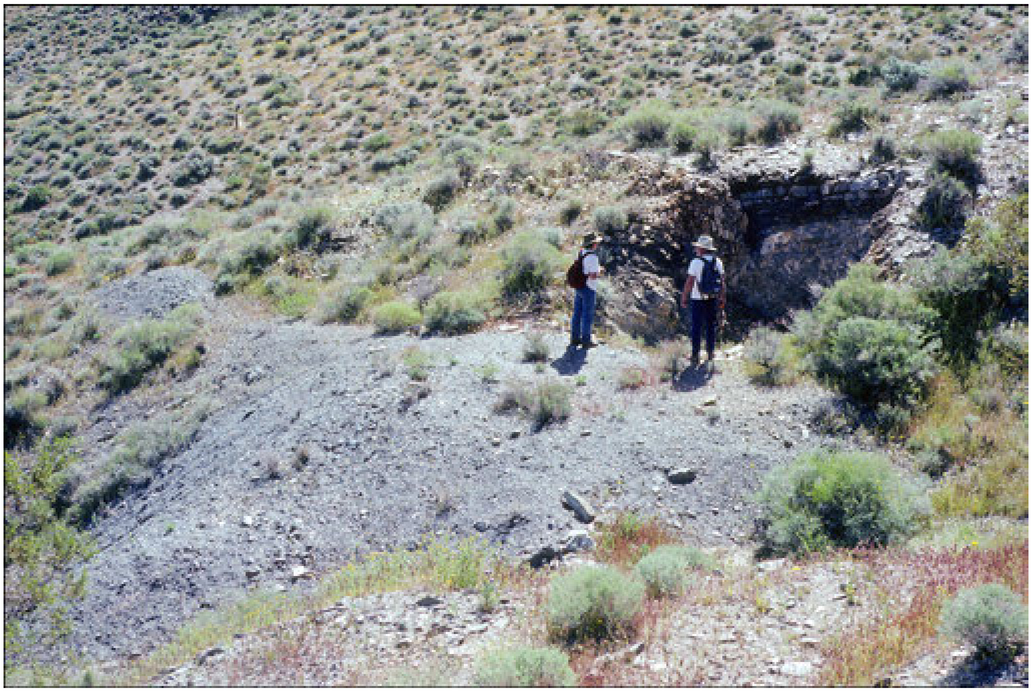


Figure 3.5. Typical hard-rock-mining prospect, Randsburg Mining District, 1993 (photograph by Karen K. Swope).

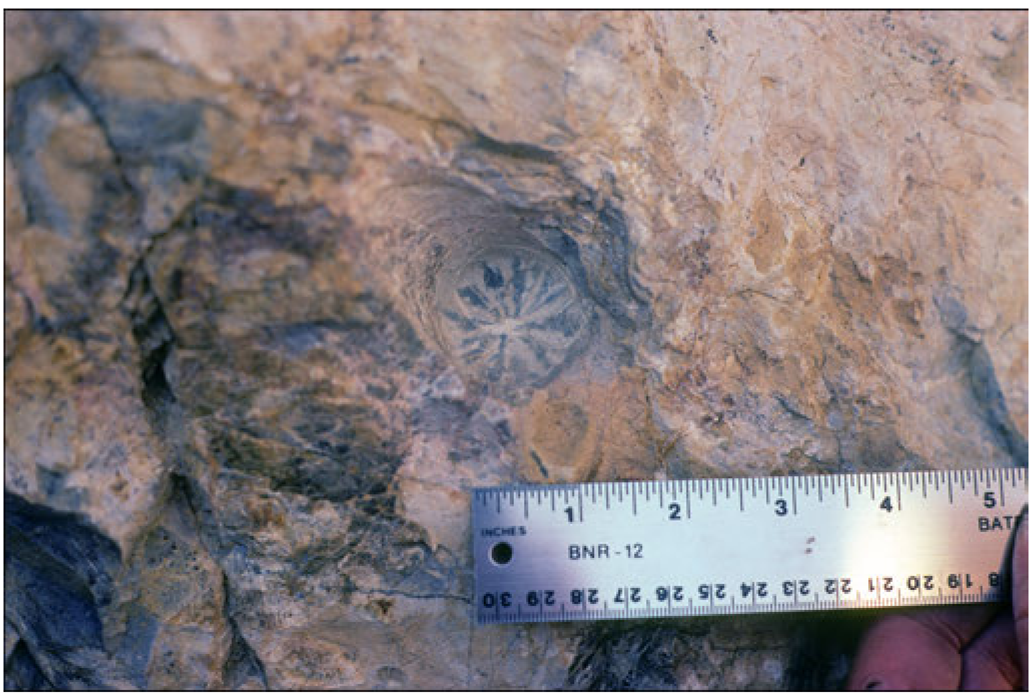


Figure 3.6. Drill scar, C&K Mine, Providence Mountains, San Bernardino County, 1989 (photograph by Karen K. Swope).

Shafts

Subsurface excavations are used to access ore deposits occurring in lodes or veins. Both vertical and inclined shafts may be used to access buried ore, and shafts may be excavated through barren rock to provide ventilation or openings through which ore can be hauled—for example, by dropping it to a lower level where transportation features are located. The aboveground archaeological evidence of shaft excavations can include the collar, headframe, and hoisting mechanism. The shaft opening is known as the collar. Some shaft collars were entirely unsupported (Figure 3.7), and others were reinforced with beams (Figure 3.8). Either type of collar may have a surrounding platform (typically a level area) to support surface structures, such as a headframe, and machinery mounts for a hoist, generator, or air compressor. The shaft might be lined, or cribbed, with wood for a distance below ground to support the portal and prevent rock fall. Headframes remain in the Study Area (Figure 3.9) but are becoming less numerous as they collapse, burn, or are removed.

To remove ore from the shaft and transport tools, equipment, and workers between the surface and underground spaces, a lifting mechanism was required. "In the shallower workings a hand windlass was the standard device for getting the ore to the surface. As the work progressed, it was necessary to install donkey engines and winches" (Caughey 1948:253) (Figure 3.10). Winches might be powered by steam or gasoline engines. In larger workings, a wooden or metal headframe might be erected over or adjacent to the shaft, to support the lifting mechanism. Deep mines later installed hoists operating on an electric, steam, or gasoline engine.

Figure 3.7. Unreinforced shaft collar, Calico Mining District, San Bernardino County (photograph by Sterling White, BLM).

Figure 3.8. Reinforced shaft collar, Red Rock Canyon State Park, 1991 (photograph by Karen K. Swope).

Figure 3.9. Headframe, Kelly Mine, Atolia Mining District (photograph by Karen K. Swope).

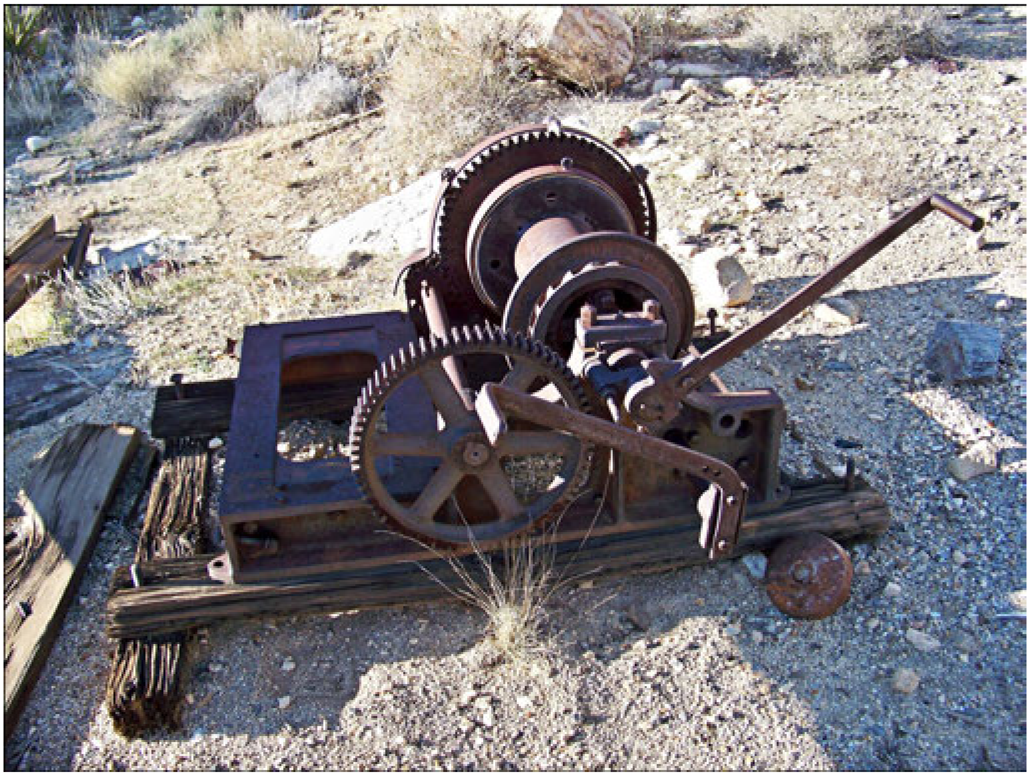


Figure 3.10. Winch, Old Woman Mountains (photograph by Sterling White, BLM).

Adits

Horizontal mine excavations are known as adits. The adit portal might be merely an unsupported opening (Figure 3.11), or it might be reinforced with timber or a metal framework (Figure 3.12). Heavy doors were used to close some idle or abandoned adits. Adits can vary in size from just large enough to be entered in a crouching position to spacious enough to accommodate a haul truck, providing clues as to the date of operation, the technologies used at the mine, and the amount of capital available. In cross section, adits may be near-rectangular, or the hanging wall (ceiling) may be rounded. Adit floors tend to be flat (rock fall sometimes obscures this feature) to accommodate transportation of ore and equipment via wheelbarrows or ore-car track. Ore-car track required level floors, and this feature can be a clue to the hauling technology used at the mine, even if the track has been removed.

Figure 3.11. Unreinforced adit portal, C&K Mine, Providence Mountains State Recreation Area, San Bernardino County, 1989 (photograph by Karen K. Swope).

Figure 3.12. Reinforced adit portal, Skidoo, Death Valley National Monument, 1999, (photograph by Karen K. Swope).

Surface Workings

Where hard-rock deposits outcrop (at their apex), ore is accessible via surface workings. In such cases, open cuts might follow a vein of ore, sometimes continuing underground horizontally (Figure 3.13) or vertically (Figure 3.14), as the vein dictates. This type of excavation can pose particular risks to researchers and should never be closely approached. Glory holes are another type of surface working and are connected to underground levels. Glory holes remove ore in a conical or semiconical pit open to the surface and to passages below (Figure 3.15). Ore is allowed to fall to the bottom of the pit and through an opening into the underground spaces from where it can be hauled out of the mine. Open-pit-mine excavations are open to the surface only. They were used by well-capitalized mines at the end of the historical period and into modern times. They do not connect to or result in subsurface workings (except where they may coincidentally encounter earlier underground passages) and are not considered in this study.

Underground Workings

Underground features (winzes and stopes, for example) related to ore extraction will not typically be encountered by archaeologists, because safety considerations usually limit their work to surface exploration. However, terms for underground features will be encountered regularly in historical technical reports and are informative with regard to the nature and extent of underground workings associated with a mining site. They are not included as property types in this section, but are defined in the glossary (see Appendix A).

Figure 3.13. Horizontally oriented surface workings, Randsburg Mining District, 1993 (photograph by Karen K. Swope).

Figure 3.14. Vertically oriented surface workings, Beveridge Mining District, 1991 (photograph by Karen K. Swope).

Figure 3.15. Glory hole at a magnesite mine in Riverside County in 1920 (courtesy of the U.S. Geological Survey).

Drilled Boulders

Boulders heavily perforated with drill scars (Figure 3.16) are common discoveries at mining sites. They likely represent drilling practice or a drilling contest. Such competitions (as well as mucking contests) are well documented in camp histories.

Waste-Rock Dumps/Low-Grade-Ore Dumps

Accessing the sought-after high-grade ore usually required hundreds of feet of vertical or horizontal excavation through country rock or low-grade ore. That process resulted in enormous quantities of rock brought from the mine and dumped downslope from the portal (Figure 3.17), to hang—in the words of one turn-of-the-twentieth-century desert prospector—"like a chin whisker" from the mouth of each tunnel (Albert 1967:139). The result is heaps of stockpiled low-grade ore and dumps of discarded waste rock. The rock dumps provide indication of the extent of underground workings, taking into account the amount of ore that was transported from the mine and processed. The same expressive prospector commented, "It looked to me as though the old-timers had ripped up the landscape with shafts and tunnels, as evidenced by the great waste-dumps, until there was hardly an acre that hadn't been literally turned inside out in their frantic search for treasure" (Albert 1967:57).

Both waste-rock and low-grade-ore dumps usually feature a level top surface, to facilitate the transport and dumping of additional rock over the edge of the slope. Sometimes, ore-car track or the supporting structure remains to indicate the use of that equipment.

Figure 3.16. Drilled boulder, showing evidence of drill practice or contest, Rand Mining District, 1993 (photograph by Karen K. Swope).

Figure 3.17. Waste-rock dump, Chloride Cliff, Death Valley National Park, 1998 (photograph by Karen K. Swope).

Artifacts

Artifacts specifically associated with extractive property types could be found anywhere at a mining site, because miners transported tools and items to shops, storage and work areas, and their residences. Common artifacts associated with extraction property types would include those related to prospecting, drilling, and blasting. These include picks, pickaxes, shovels, spades, wheelbarrows, buckets, ladders, air hoses, blasting-cap tins (see Figure 2.3), blasting-powder cans, fuse cans, and drill bits or hand-held drill steel (Figure 3.18). Long, thin "ore spoons" (frequently handmade) were used to remove fines from drill holes; Ihlseng (1904:414) described them as long iron rods "with a handle at one end the other flattened out and curved slightly . . . then bent to form a small cup that will scoop out the debris." In the Study Area, examples have been found in the archaeological record at Klondike Diggings, Red Rock Canyon State Park, Kern County, and at Beveridge, Inyo County (Figure 3.19) (Swope 1993:68–70). Non-sparking wooden sticks were used to tamp explosive charges into drill holes. Young (1976:33) described the sticks as long wooden rods used to ram the charge. Archaeological examples have been identified in the Study Area at Beveridge (Swope 1993:269–270) and in Wildrose Canyon, Death Valley (Figure 3.20). Lengths of wire cable, wire rope, or crank mechanisms may be found where windlasses, winches, or hoists were used to lift and lower ore, supplies, and workers in vertical shafts.

Mining-related artifacts are highly valued by collectors; consequently, source materials for identification abound. Table 3.2 presents some references that provide descriptive, illustrative, and/or chronological information for various artifacts related to the various property types described in this chapter.

Figure 3.18. Discarded handheld drill steel, Victor Valley, San Bernardino County, 1995 (photograph by Karen K. Swope).

Figure 3.19. Ore spoon, Beveridge Mining District, Inyo County, 1991 (photograph by Karen K. Swope).

Figure 3.20. Wooden tamping stick, Wildrose Canyon, Death Valley National Park, 1997 (photograph by Karen K. Swope).

Table 3.2. Sources of Information on Mining-Related Artifacts

Artifact Type	Reference
Blasting caps	Martin 1991
Candlesticks	Pohs 1974
Lamps	Clemmer 1987; Fox 1985; Paul 1915; Pohs 1974; Thorpe and Moon 2006
Machinery, structures, foundations, and various artifacts	Twitty 2005
Tokens	Akin et al. 2016
Various	Pearson and Bommarito 2016; Vogtmann 2002

Beneficiation Property Types

To varying degrees, sought-after valuable minerals are caught up in the surrounding matrix (gangue) and must be freed by reduction (crushing and milling) and physical and/or chemical separation. These processes are known as beneficiation, or ore dressing (Peele 1918:1621), which results in "(1) regulating the size of a desired product, (2) removing unwanted constituents, and (3) improving the quality, purity, or assay grade of a desired product" (Thrush 1968:97). Beneficiation property types include those associated with the activities of the entire process, including assaying, milling, recovery, and disposal of byproducts.

Cobbing Platforms

Cobbing is the process of manually separating valuable ore from gangue by removing as much barren rock as possible from lumps of ore containing valuable minerals. The work is performed by hand with a small hammer and requires some sort of surface to be used as an anvil in the bipolar shattering of the ore lump. Sometimes an expedient horizontal rock surface was used as an anvil; in such cases, the anvil exhibits scars from the pounding activity. In addition to the anvil, the features also typically contain small piles of broken ore. In the Beveridge Mining District, Inyo County, a cobbing pavement was built using recycled arrastra pavement stones as a platform (Swope 1993:277). Cobbing pavements were usually situated immediately adjacent to mine workings, the goal being to prevent unnecessary transport of waste rock in favor of high-grade ore, but they are also sometimes found at mill sites.

The procedure was applied in cases in which high-grade ores cleave easily from low-grade ore or barren matrix (Peele 1918:1621). The 1918 *Mining Engineers' Handbook* (Peele 1918:1622–1623) described cobbing hammers: "Cobbing hammers are 1-hand hammers, for cleaving and hand picking values from waste, the cobber sitting with a pounding block before him. A good cobbing hammer has at one end a sharp wedge-shaped pean [*sic*], either parallel or at right angles to handle. Weights range from 1.5 to 4 lb, average 2 to 3 lb; handle usually 12 in."

Assaying

Assaying involves the testing of mineral content in ore by chemical process or smelting. Assayers determine the commercial value of ores. Larger mines, as well as those that were isolated, maintained on-site assayers, usually near the workings. Commercial assayers operated in mining towns and districts, providing their services at a cost to miners and mining companies (Figure 3.21). Archaeological investigations at the town of Hart, in San Bernardino County, indicated that assay work was performed in town, away from the mines (Swope and Hall 2000:285). The American Borax Company plant at Daggett employed "two chemists and assayers" and let it be known that "they would gladly assay free of cost anything prospectors brought in" (Van Dyke 1997:66). At the Valley View Mine, an isolated operation in San Bernardino County, the assayer was part of the work crew and reportedly tested ore samples "as often as every 15 or 20 minutes" (Hallaran and Wilke 1987:9). Assaying activity areas are typically identified by evidence of an oven (refractory brick [fire brick], burned earth, charcoal, and/or slag) and a distinctive artifact assemblage (described below).

Contemporary works on the assay process are helpful in understanding the science behind the work, as well as providing illustrations useful in artifact and feature identification. Examples include *A Manual of Practical Assaying* (Furman 1902) and *A Manual of Fire Assaying* (Fulton 1911). Spude (2013) presented a study of assayers in the western mines, including a discussion of the contents, layout, and operation of assay offices, assayer training, and the assayer's role in the community.

Figure 3.21. Historical photograph inside an assay shop located at a tin mine in Santa Ana, Orange County (digitally reproduced by the University of Southern California Digital Library, from the California Historical Society collection).

Mills/Mill Foundations

Not every mine maintained its own on-site mill facility. In some cases, mills were located at considerable distances from the extraction site. Certain "economies of scale" were enjoyed (Aschmann 1970:174) when mills or smelters were centrally located and processed ore from numerous mines on a contract basis. Mills in the Study Area range from hand-constructed arrastra mills to highly engineered machinery produced in remote industrial centers and transported to mining regions at great cost, in terms of effort and expense. Mills include primary crushers, located at the beginning of a sometimes complex, multi-step system, and secondary crushers, which processed ore into increasingly smaller particles. Richey (2016) recently completed a thesis on the historical archaeology of ore milling.

Arrastra mills were used in nearly every mining district in California (Bradley 1934:266), usually during the early historical period or before formal milling machinery was introduced at a site. Arrastra mills were common at small-scale mining operations, largely because they could be constructed of local materials, and were driven by a variety of power sources, including a single animal with one miner to tend the operation (Kelly and Kelly 1983:86; Van Bueren 2004:6). Intact arrastra mills (Figure 3.22) are easily identified by the circular arrangement of rocks and the slickened surfaces of the floor, lower walls, and drag stones. Arrastra mills were typically dismantled upon abandonment, to retrieve gold from the crevices between stones (Louis 1899:291). In this case, the mills can be identified by the slickened surfaces of displaced stones. Drag stones frequently exhibit drilled holes (Figure 3.23) through which chains passed for dragging the stones on the floor of the mill. Gold was recovered from arrastra mills through simple panning or by mercury amalgamation and retorting. Details on the operation and physical construction of arrastra mills can be found in historical works (*Engineering and Mining Journal* [*E&MJ*] 1899; Storms 1911) and archaeological reports (Kelly and Kelly 1983; Van Bueren 2004).

Figure 3.22. Arrastra mill, Beveridge Mining District, 1991 (photograph by Karen K. Swope).

Figure 3.23. Arrastra drag stone, Beveridge Mining District, Inyo County, 1991 (photograph by Karen K. Swope).

Chilean mills, also known as “roller mills,” operate on a principle similar to that of an arrastra mill. They feature an enclosed circular pavement or metal plate on which ore is crushed by means of two vertically positioned rollers that roll around the circumference of the surface. No Chilean mills are known to remain in the Study Area.

Formal, engineered mills were situated on hillsides (Figure 3.24), to take advantage of gravity in moving materials through the milling process. In most cases in the Study Area, milling machinery has been removed from mill sites, but it is possible to identify milling activities by the terraced platforms that once held machinery, the presence of heavy, poured concrete machinery mounts, and the residual tailings emanating from the lowest portion of the system. Mills required a power source, which could be steam, water, electric, or gasoline power, represented by remnant water wheels, boilers, electrical plants, or gasoline engines.

Depending on the nature of local ores, primary mills were sometimes used for coarse, initial crushing in advance of the finer crushing possible in a secondary mill. Examples known from the Study Area include jaw breakers, which operated by crushing ore between a fixed, flat jaw and a reciprocating, angled jaw. Other secondary mill types used in the California deserts included gyratory crushers, such as cone mills, Huntington mills, and ball mills. Remnant machinery mounts (Figure 3.25) typically represent the locations and layout of milling and power machinery. The configuration of machinery mounts can assist in the identification of the type of equipment that was installed at a site. Machinery mounts sometimes reflect the paucity of materials and the expedient use of stone. Figure 3.26 shows a machinery mount in the Randsburg District incorporating very large rocks in the concrete of its construction.

Stamp mills were common in the U.S. West after about 1853 (Young 1970:195). Stamp mills operate by repeatedly dropping a battery of heavy stamp heads onto a die in a box of ore. A basic description of stamp mills and their operation was provided by Caldwell (1990:46). One-, 2-, and 4-stamp mills were produced (some have been reported in the Study Area [Swope 1993:287–288]), but most were combinations of batteries in 5-stamp sets; a 5-stamp battery measured about 5 feet wide. The largest stamp mill in the Study Area was the 100-stamp operation at the Yellow Aster Mine in Kern County. The process involved feeding mercury into the stamp battery, with pulverized material discharged from the battery allowed to flow over copper amalgamating plates. The resulting amalgam was retorted to separate bullion from mercury (Dunning and Peplow 1959:25–26).

Concentrating tables, amalgamation plates, cyanide tanks, zinc boxes, and sometimes retorts or smelters are located at the end of the beneficiation operation. A few examples from the Study Area demonstrate the range of beneficiation equipment that has been identified in the regional archaeological record (Figures 3.27–3.30). Smelters transformed concentrates to a liquid from which metals could be separated by specific gravity and viscosity (BLM n.d.b:Module 2).

An identification of the beneficiation process used at a particular site can provide chronological information regarding the history of a site. The beneficiation processes outlined in Chapter 2 represent the development of the technology as mining technology improved and miners focused their efforts on particular minerals and the geology peculiar to an area.

Built-environment resources (or property subtypes) specifically associated with beneficiation are few but very recognizable on the landscape; they include, but are not limited to, mill and concentrator buildings, assay offices, and smelters. Mill and concentrator buildings were often the largest features on a mining landscape. As noted above, these buildings were designed for gravity to assist in the processing. A character-defining feature of these buildings is a stepped-down design following the slope of a hillside or embankment. Mill and concentrator buildings were most often wood-framed buildings constructed on concrete piers and foundations. Assay offices were small support buildings providing space for an assayer to test ores. As noted by Caltrans (2008:103), “[a]ssay offices may be distinguished by the remains of furnaces or retorting facilities, as well as fragments of crucibles and cupules.” Using a combination of heat and/or chemicals, smelters separate metals from their matrices. Furnaces provide the heat to the smelter, and chimneys direct the heat and smoke away from the smelter. These chimneys are called “stacks.” As noted by archaeologist Paige Peyton (2012b:56), a headframe or smelter stack is “often the tallest and longest surviving structure” in a mining landscape (Peyton 2012b:56–60). Please see additional discussions below on built-environment resources under support-system property types, because most buildings and structures associated with lode mining in the Study Area fall into that category.

Figure 3.24. Cleveland Gold Mine and Mill Site, Inyo County (courtesy of the U.S. Department of the Interior Bureau of Land Management, Bishop Field Office).

Figure 3.25. Poured-concrete machinery mounts, Rand Mining District, 1993 (photograph by Karen K. Swope).

Figure 3.26. Machinery mount, Randsburg Mining District, showing the incorporation of very large rocks in the concrete construction, 1993 (photograph by Karen K. Swope).

Figure 3.27. Jaw crusher in operation, Western Museum of Mining & Industry, Colorado Springs, Colorado, 1996 (photograph by Karen K. Swope).

Figure 3.28. Lasky five-stamp mill, Beveridge Mining District, 1991 (photograph by Karen K. Swope).

Figure 3.29. Huntington mill, Beveridge Mining District, 1992 (photograph by Karen K. Swope).

Figure 3.30. Gyratory crusher, Beveridge Mining District, 1991 (photograph by Karen K. Swope).

Mill Tailings and Smelter Waste

Mill tailings, the final residues of milling and mineral recovery, were typically allowed to flow into a low area or a dry or flowing creek bed (Figure 3.31). Sometimes, tailings were contained in a redwood tank or an earthen impound pond. Tailings are the consistency of fine sand or flour and are frequently yellowish in color. At some mines, tailings were later reprocessed to remove metal that was not accessible via earlier beneficiation methods. At Beveridge, in Inyo County, later mining activity removed the sides of redwood tanks (Figure 3.32) containing tailings, to recover residual gold. Slag dumps, the result of smelting activities, may be found in piles near the site of a smelter. Figure 3.33 shows smelting waste at Rosalie, in San Bernardino County.

Figure 3.31. Mill tailings, Valley View Mine, San Bernardino County, 1991 (photograph by Karen K. Swope). Note that the tailings overflowed the dam and were later breached by erosion.

Figure 3.32. Redwood tanks containing mill tailings, Beveridge Mining District, 1991 (photograph by Karen K. Swope).

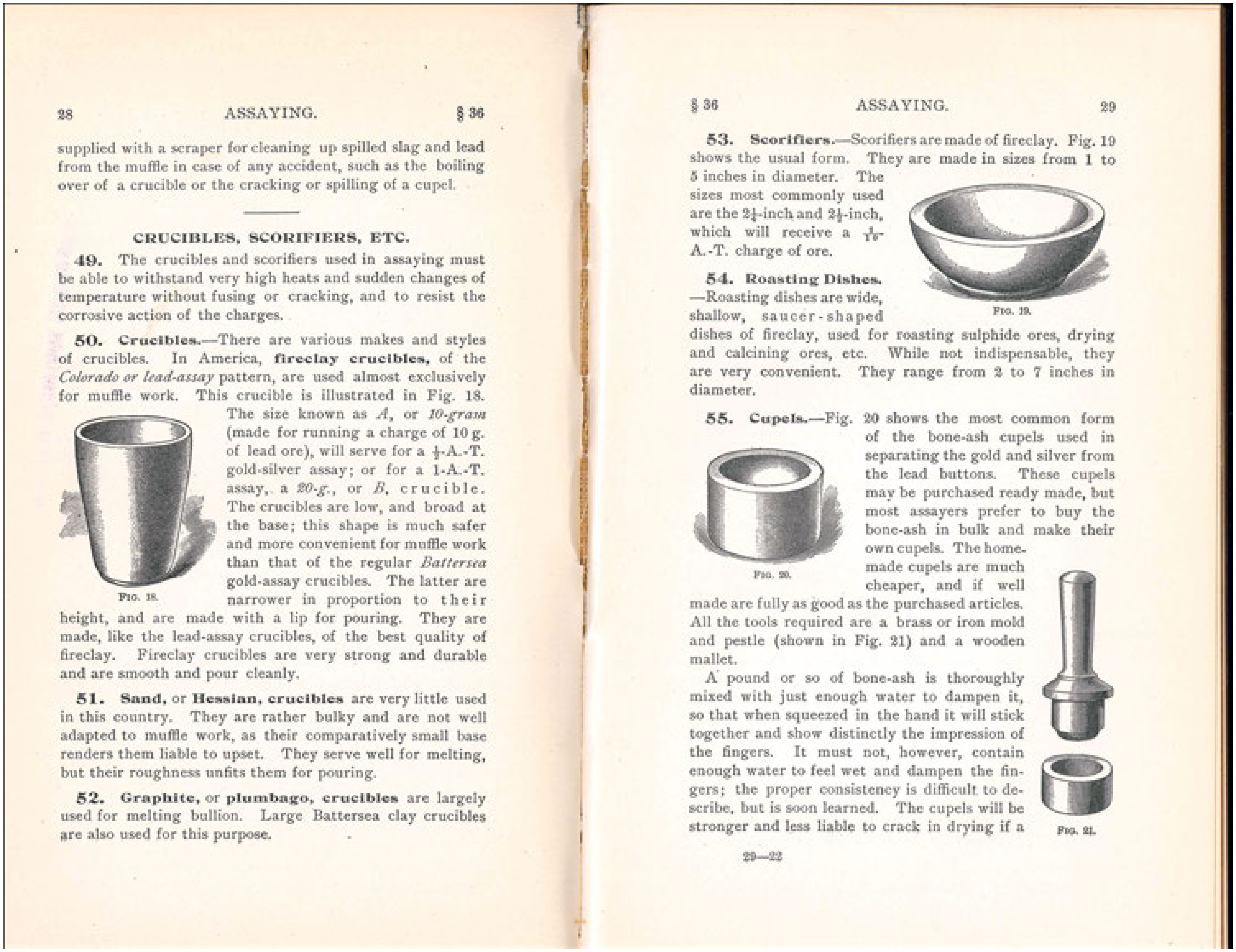
Figure 3.33. Smelting-waste dump, Rosalie, San Bernardino County, 1991 (photograph by Karen K. Swope).

Artifacts

Artifacts specifically related to beneficiation activities include machinery parts (including those from mills, boilers, and engines), mercury canisters, cyanide cans (see Figure 2.11), and metal or stone balls from ball mills. A specific array of artifacts indicates the location of assaying activities, including crucibles (Figure 3.34), cupels, button molds (Figure 3.35), pressure tanks, tongs, laboratory glassware (test tubes, flasks, graduated beakers, funnels, pipettes, and tubing), and fragments of weight scales. In the Study Area, the location of an assay office was identified at the Branch Mine, in San Bernardino County (Swope 2016:3.30–3.31), based on the presence of a foundation littered with artifacts, including a fragmentary, volumetric, glass laboratory vessel; a scale beam and poise; and small piles of mill tailings, as though sample bags had been stored in the building.

Secondary Mining-Related Property Types

Secondary mining-related property types include activity loci and structures that are directly related to the mining process but are not a specific part of either the extraction or beneficiation process. The Caltrans mining context provides detailed information about ancillary mining-property types (related to mining but not part of extraction/beneficiation work) and should be consulted by researchers working on historical-period mining sites. That document identifies and defines a wide variety of archaeological features related to this property type, as well as the artifacts one can expect to be associated with them. Here, we outline those mining-related property types that are most likely to be encountered by researchers in the Study Area.



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supplied with a scraper for cleaning up spilled slag and lead from the muffle in case of any accident, such as the boiling over of a crucible or the cracking or spilling of a cupel.

CRUCIBLES, SCORIFIERS, ETC.

49. The crucibles and scorifiers used in assaying must be able to withstand very high heats and sudden changes of temperature without fusing or cracking, and to resist the corrosive action of the charges.

50. Crucibles.—There are various makes and styles of crucibles. In America, **fireclay crucibles,** of the *Colorado or lead-assay* pattern, are used almost exclusively for muffle work. This crucible is illustrated in Fig. 18. The size known as *A*, or *10-gram* (made for running a charge of 10 g. of lead ore), will serve for a ½-A.-T. gold-silver assay; or for a 1-A.-T. assay, a *20-g.*, or *B*, crucible. The crucibles are low, and broad at the base; this shape is much safer and more convenient for muffle work than that of the regular *Battersea* gold-assay crucibles. The latter are narrower in proportion to their height, and are made with a lip for pouring. They are made, like the lead-assay crucibles, of the best quality of fireclay. Fireclay crucibles are very strong and durable and are smooth and pour cleanly.

FIG. 18.

51. Sand, or **Hessian, crucibles** are very little used in this country. They are rather bulky and are not well adapted to muffle work, as their comparatively small base renders them liable to upset. They serve well for melting, but their roughness unfits them for pouring.

52. Graphite, or **plumbago, crucibles** are largely used for melting bullion. Large Battersea clay crucibles are also used for this purpose.

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53. Scorifiers.—Scorifiers are made of fireclay. Fig. 19 shows the usual form. They are made in sizes from 1 to 5 inches in diameter. The sizes most commonly used are the 2½-inch and 2¾-inch, which will receive a $\frac{1}{10}$-A.-T. charge of ore.

FIG. 19.

54. Roasting Dishes.—Roasting dishes are wide, shallow, saucer-shaped dishes of fireclay, used for roasting sulphide ores, drying and calcining ores, etc. While not indispensable, they are very convenient. They range from 2 to 7 inches in diameter.

55. Cupels.—Fig. 20 shows the most common form of the bone-ash cupels used in separating the gold and silver from the lead buttons. These cupels may be purchased ready made, but most assayers prefer to buy the bone-ash in bulk and make their own cupels. The home-made cupels are much cheaper, and if well made are fully as good as the purchased articles. All the tools required are a brass or iron mold and pestle (shown in Fig. 21) and a wooden mallet.

FIG. 20.

A pound or so of bone-ash is thoroughly mixed with just enough water to dampen it, so that when squeezed in the hand it will stick together and show distinctly the impression of the fingers. It must not, however, contain enough water to feel wet and dampen the fingers; the proper consistency is difficult to describe, but is soon learned. The cupels will be stronger and less liable to crack in drying if a

FIG. 21.

29—22

Figure 3.34. Assaying vessels, including crucibles, cupels, and scorifiers, from a textbook dated 1905 (International Correspondence Schools 1905:28–29).

Figure 3.35. Cast-iron button-mold fragment, Victor Valley, San Bernardino County, 1994 (photograph by Karen K. Swope).

Ore Bins

Ore bins are sometimes located adjacent to underground workings, where ore was stockpiled for transport to the mill. Ore bins are also found at points in the early milling process. Ore bins (Figure 3.36) incorporate heavy milled timbers and sturdy hardware. The bin is basically a large box with an open top for loading and a sloped floor to produce gravity flow. Because of the extreme weight and forces inside the bins, they are sometimes tied together with long, heavy tie bolts or lengths of cable. At the bottom of the box is a closeable chute used for dispensing ore to wagons, trucks, or the machinery that is the next step in the milling process.

Ore Chutes

Ore chutes served to move ore by gravity flow at various points in the extraction process. Chutes might carry ore from higher workings to lower areas of the mine complex, or they might feed ore bins or mills. In the Study Area, ore chutes were typically fashioned of recycled materials, even at larger mines (Figure 3.37). The floors of chutes were usually lined with sheet metal, to facilitate the flow of ore. The Silver King Mine at Calico had an enormous chute built on a trestle looming large above the town.

Figure 3.36. Ore bin, Sheep Creek, Avawatz Mountains, San Bernardino County (photograph by Sterling White, BLM).

Figure 3.37. Ore chute, Bonanza King Mine, San Bernardino County, 1994 (photograph by Karen K. Swope).

Grizzlies

A grizzly is used for sizing ore by gravity flow. It is an inclined set of bars (Figure 3.38) over which larger ore fragments pass and through which smaller ore drops. Grizzlies were sometimes arranged over the top of an ore bin, so that ore was separated into larger particles requiring primary crushing and smaller particles ready for the next step in the milling process.

Smithy

An on-site blacksmith was a necessity at mining sites, to sharpen and repair tools and machinery and, at times, to fabricate objects or equipment. At larger mines or in established camps, the blacksmith facilities might be housed in a designated building, whereas at smaller operations, the blacksmith might set up his forge and anvil in any expedient location where the work was needed (Figure 3.39). At the Branch Mine, in San Bernardino County, evidence was found of a small smithy setup at the side of a road, near the top of the mill site (Swope 2016).

The location of a smithy can be identified by patches of burned earth, metal scrap, rod or bar stock, slag, charcoal, ash, and refractory (fire) brick typically occupying an area measuring approximately 4 feet on each side (BLM n.d.b:Module 2).

Figure 3.38. Grizzly separator, Western Museum of Mining & Industry, Colorado Springs, Colorado, 1996 (photograph by Karen K. Swope).

Figure 3.39. Historical photograph of a smithy operation set up on hillside trail, Colorado (courtesy of the Library of Congress, via Wikimedia Commons).

Livestock Facilities

Stables and corrals would be necessities at mines where animals were used in hauling and generating power. The archaeological signatures of these features would be similar to those found at desert homesteads. That is, they frequently incorporate natural features, such as boulder enclosures, to minimize the number of posts and amount of wire required to complete the space. Bundles or piles of baling wire can indicate the locations of corrals. Bundles or piles of baling wire can indicate the locations of corrals, and of course, horse and mule shoes and nails might be found in association with the facilities, as well.

Water-Storage Facilities

Arid conditions throughout the Study Area require careful management of water supplies. Mining, milling, and daily subsistence all require dependable quantities of water. Whether water was pumped from underground stores, hauled to the mining site, or brought in by pipe or ditch, various methods were devised for water storage at mines and mills and near living spaces.

Galvanized-metal tanks (Figure 3.40), earthen or concrete reservoirs or cisterns served for water catchment or impoundment (from rainfall or runoff) or containment (in tanks or cisterns) at the site. Where water could be obtained by drilling, wells with windmills or pumps can be found. The Caltrans (2000) document *Water Conveyance Systems in California* provides feature descriptions for water-related property types.

Built-Environment Resources

Built-environment resources categorized as a secondary mining-related property type include, but are not limited to, powder houses or magazines, company stores, offices, mess or dining halls, cook houses, shops, storage buildings or warehouses, garages, bunkhouses, latrines, shower houses, and change rooms (Eaton 1934:375). Of these property types, the most distinguishable is the powder house or magazine. Constructed to concentrate, shelter, and protect the mine's explosives supply, powder magazines came in a variety of shapes and sizes, including dugouts (Figure 3.41). A character-defining feature of this property subtype is the use of inflammable materials in its construction, including concrete, masonry, and concrete-masonry units.

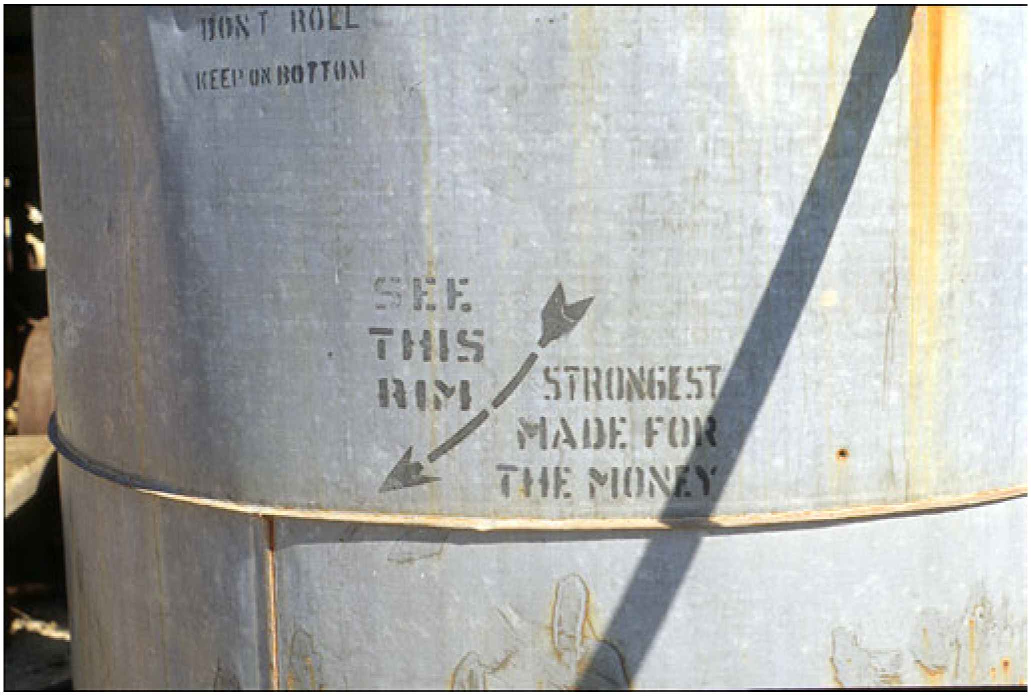

Figure 3.40. Galvanized-metal water tank, Wall Street Mill, Joshua Tree National Park, 1998 (photograph by Karen K. Swope).

Figure 3.41. Dugout powder-storage facility, Birthday Mine, San Bernardino County, 2011 (photograph courtesy of Statistical Research, Inc.).

Doors were often made of steel. The remaining buildings of this property subtype are small and would be constructed of the available materials at hand. Because they are potentially indistinguishable from each other, an analysis of the historical record and associated artifacts would be pertinent in defining the function of these buildings. Please see additional discussions below on built-environment resources described as support-system property types. Although most buildings and structures associated with lode mining in the Study Area fall under that category, the discussions of material use and building function are pertinent to all property types.

Support-System Property Types

By nature, most hard-rock-mining activities were performed "in otherwise little-settled and relatively isolated districts" (Aschmann 1970:174) where, wrote cultural geographer Aschmann (1970:176–177, 185),

> there must also be a substantial investment in an infrastructure not directly related to mining itself. The major elements in this infrastructure are a transportation system . . . and living quarters and social services for the labor force. . . . As an essential part of its earliest development a mine or the grouped enterprises of a mining district must create or have created for them a set of facilities that can serve not only the mines but the entire region. It happens with great frequency that the exploitation of mineral resources constitutes the first effective settlement of an extensive region.

Remote mines required an investment in domestic facilities, whether on a small-scale basis by individual or small groups of miners or on a grander, more organized scale by a mining company. The transient nature of mining camps is well known, and the longevity of a mining settlement was ensured at least as long as nearby mines continued to produce. Dilsaver (1982) studied post–Gold Rush settlement patterns in California. In his analysis of the post-boom period in two Arizona mining towns, Eric Clements (2003:277, 344) provided numerous first-hand accounts to indicate that mining-camp populations knew quite well that they would move on when the mines became unprofitable: "To be disillusioned by this process of settlement and abandonment, one had to have illusions about it in the first place."

The Caltrans mining context provides additional information about mining-community property types (related to domestic activities) and should be consulted by researchers working on sites that include residential features. That document identifies and defines the scope of archaeological features related to this property type and discusses the artifacts that might be associated with them. Here, we provide additional information and examples of the specific morphology of support-system property types most likely to be encountered at mining sites in the Study Area. Support facilities include those related to the domestic life of miners, their families, and other community members (residences [houses, dugouts, cabins, and tents], privies or outhouses, saloons, cook shacks or kitchens, dams, well houses, pump houses, power plants, powerhouses, refuse dumps, sheds, lean-tos, barns, stables or corrals, and dog houses). Other property types that might be found at town sites are detailed in the Caltrans historic context and archaeological research design for town-site properties throughout the state (Caltrans 2010).

Buildings and Ruins

In the Study Area, most historical-period mining-site buildings and structures have been reduced to ruins or destroyed by scavenging, vandalism, fire, or natural processes. Some are represented only by poured-concrete or stone foundations or leveled earthen platforms/pads. The morphology of a building and the nature of artifacts found in association with it can assist in the interpretation of specific functions carried out at that location, along with the historical record.

In the California deserts, canvas tents were the initial, most-frequent, and standard constructions in mining camps. At camps that became well established, some tents were later replaced with more-durable frame buildings, but historical photographs show that a few tents usually remained in use throughout the life of even long-lived camps (at Hart [Snorf and Snorf 1991:46–47], for example) (Figure 3.42). The locations of these constructions are usually identifiable in the archaeological record by leveled pad, sometimes partially dug out on one side, with perhaps rock alignments or partial stone foundations (Figure 3.43). Sometimes archaeological evidence of tents appears as wire-wrapped rocks or other anchors set in the ground, surrounding a level space. The size of the construction and the associated artifact assemblage can provide clues as to the use of a tent. Very large tents likely represent mess halls, bunkhouses, and the like, whereas one-room tents likely represent domiciles, businesses, or combinations thereof.

One eyewitness account (Snorf and Snorf 1991:29) described a tent at the Hart mining camp in San Bernardino County: "It was boarded up halfway with a double tent over the top. It was about 10 by 12 feet in size with a dirt floor. It was snug and warm. With a fire inside it was easy to keep warm and wind proof." The 1943 *Handbook for Prospectors and Operators of Small Mines* (VonBernewitz 1943:9) described the essential miner's tent:

> Tents are of many designs, but the pyramid or wall shape is best liked. Wall tents are made in sizes ranging from 5 by 7 to 14 by 16 feet. The walls are 3 to 4 feet high, and the center 7½ to 9 feet. They weigh 24 to 76 pounds, according to the quality of the canvas. For two men, the 9- by 9- by 12-foot tent weighing 24 to 40 pounds is big enough, although one 7 by 8 or 8 by 10 feet is often used.

A review of contemporary catalogs indicated that wall tents were reasonably priced; a 12-by-12-foot model cost $7.65 in 1902 (Sears, Roebuck and Company 1969:356) and $8.57 in 1909 (Sears, Roebuck and Company 1979:322) (Figure 3.44).

Many parts of the Study Area lacked standard building materials, such as large trees for lumber, and, as importantly, lacked sawmills or transportation facilities to bring building materials to a camp. At Bodie in 1878, it was noted, "The number of buildings here now would be increased by as many again if there was the lumber here to supply the demand at any price" (Johnson and Johnson 1967:n.p.). Quite commonly, miners made expedient use of natural resources in construction, dugouts being a prime example. With excavation tools in hand, the dugout was perhaps the most economical type of construction for a miner. It offered the extra advantage of insulation in a region known for temperature extremes. Dugouts were usually built into hillsides (Figure 3.45) and were enclosed with local stone and/or minimal amounts of lumber or sheet metal. In areas with soft soils, stone retaining walls were sometimes used to support the structure. In areas where dugouts were cut into consolidated matrices, additional support may have been unnecessary. Small dugouts—those too small for habitation—may represent storage facilities for food or explosives. A storage dugout at Hart was built into a soft marl deposit and was equipped underground with a sealable door. The interior storage space was fitted with a bar hanger and wire hooks for hanging foodstuffs, and an egg crate was found in the room (Swope and Hall 2000:94–95).

Many dry-laid-stone buildings in the Study Area are found as ruins (Figure 3.46) or foundations. Others used natural outcrops or other formations as an integral part of the construction. A vertical rock crevice could be used above a hearth as a natural chimney. The stone dwelling in Figure 3.47 was built against a natural outcrop, visible on the left side of the image. Other constructions made use of natural amenities; an outhouse at Beveridge was built over an open drop instead of over an excavated pit and was accessed by a plank catwalk (Figure 3.48).

Another masonry-building type of stacked construction was known as the "Cousin Jack" house. These dwellings, though often constructed like dugouts, were scattered across the hillside and consisted of "piled rock and scraps of wood" (Peyton 2012b:31). Archaeologist Paige Peyton (2012b:31) provided that the "dwellings were so named because of the Cornish miners that constructed them, many of whom were named John, but called Jack." She added that among the number of Cornish miners working in the U.S. West, many were cousins. At least one Cousin Jack house has been identified in the Calico area (Peyton 2012b:31).

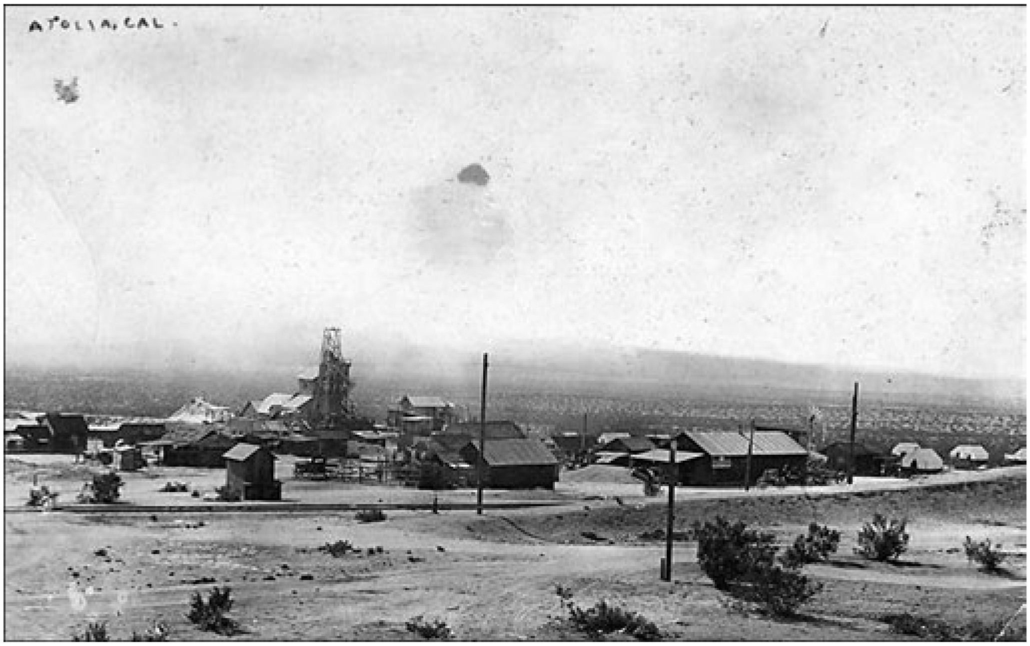

Figure 3.42. Postcard of Atolia, San Bernardino County, showing tents alongside frame buildings, ca. 1908 (via Wikimedia Commons).

Figure 3.43. Leveled tent pad outlined by rocks, Hart town site, San Bernardino County, 1998 (photograph by Karen K. Swope).

Figure 3.44. Advertisement for wall tents, dated 1902 (Sears, Roebuck and Company 1969:356).

Figure 3.45. Dugout, Copper Strand Mine, San Bernardino County (photograph by Sterling White, BLM).

Figure 3.46. Stone-building ruin, Calico Mining District (photograph by Sterling White).

Figure 3.47. Stone dwelling built against a bedrock outcrop, Beveridge Mining District, 1991 (photograph by Karen K. Swope).

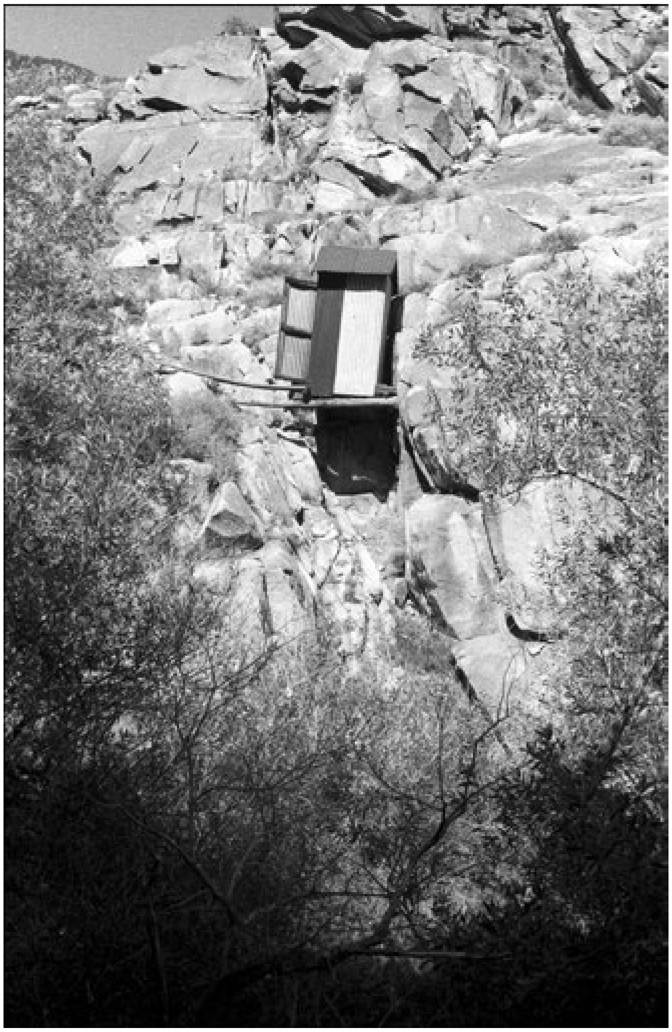

Figure 3.48. Outhouse built over an open drop instead of over an excavated pit, accessed by a suspended plank, Beveridge, Inyo County, 1991 (photograph by Karen K. Swope).

Other common materials were poured concrete and, to a lesser extent, logs and adobe. Adobe was also used as a replacement material in the reconstruction of buildings after a fire (for example, at Calico and Ballarat) (Figure 3.49). Some materials, like corrugated metal, are nearly ubiquitous at desert mining camps. Historical geographer and architectural historian Richard Francaviglia (1991:125) provided this discussion:

> Corrugated metal is one of the more ubiquitous building materials in mining districts. It represents the ultimate in functional building material, for it is about as strong and durable as sheet metal can be. Available in standardized sheets, it is unpretentious and inexpensive. The corrugations add strength while keeping down weight. When galvanized (zinc-coated), sheet metal withstands the weather well and, importantly, does not require painting. Sheet metal has another quality; it can be reused. Being simply nailed in place, it can be removed when the company decides to disassemble and relocate a metal-sheathed building. . . . In fact, if one were to choose a building material that personifies mining, it would be corrugated metal, for like many features in the landscape, it is an industrial product that is portable, easily removed for shipment elsewhere, and standardized.

In camps that experienced long periods of occupation, or where mining activity was renewed after a hiatus, materials were frequently recycled in later constructions (Figure 3.50).

Figure 3.49. Adobe- or rammed-earth-building ruins, Ballarat, 1999 (photograph by Karen K. Swope).

Figure 3.50. Recycled materials used in building construction, Masonic, Mono County, 1992 (photograph by Karen K. Swope).

Superstructure building elements can frequently be inferred from the scatter of construction materials at the locations where buildings once stood. Corrugated metal, flat sheet metal, milled lumber, roofing materials, window glass, nails, and other hardware are all informative and sometimes temporally diagnostic. Grommets, baling wire, tent stakes/anchors, nails, and sometimes window glass indicate the one-time presence of a tent structure. Fragmented milled lumber, roofing materials, door hardware, nails, and window glass indicate that a frame structure was located at the site.

Refuse Deposits

Refuse deposits can include sheet refuse (scatters of artifacts, such as in a house yard), refuse concentrations (surface artifact dumps) (Figure 3.51), and hollow-filled refuse pits (including trash-filled wells and abandoned cellars). Refuse deposits can represent single or multiple disposal events.

In camps that experienced limited durations of occupation, refuse deposits might be limited to sheet refuse. In such cases, the locations of refuse dumps may assist in determining the camp layout and the nature of activity areas. For example, it should be possible to distinguish among the refuse produced by a single individual, a family, and a group of workers. Similarly, the differences between residential refuse and that produced by a saloon would be readily apparent.

In addition to yielding information about activities performed at a site and site demographics, many types of refuse are important for the chronological information they can provide. Thus, refuse associated with a particular property type can provide temporal context. Refuse scatters and concentrations can be associated with an identifiable activity and contextual theme and can provide invaluable data regarding consumer choice, transportation networks, demographics, site layout, and socioeconomic conditions.

Figure 3.51. Surface refuse dump, Hart, San Bernardino County, 1997 (photograph by Karen K. Swope).

Privies

Privies are recognized as "repositories for material culture, chronological, economic, dietary, and social data" (Swope et al. 1997:157). Among the few hollow-filled artifact deposits that might be encountered at historical-period mining sites, they have the potential to produce significant archaeological information.

In the Study Area, known privy features range from intact outhouse shelters to mere depressions (Figure 3.52). They can be expected near the mine workings and mill facilities at smaller operations and near residential areas at small camps and established towns.

Cemeteries

Established camps and towns occupied for any considerable length of time typically required establishment of a cemetery. Cemeteries are attractions for site visitors and are among the parts of a site most often visited. They sometimes are also the best preserved (Figure 3.53). When the Hart town site was destroyed by modern mining, the cemetery was the only portion of the site avoided and preserved (Figure 3.54).

Figure 3.52. Collapsed outhouse, Leadfield, Death Valley National Park, 2000 (photograph by Karen K. Swope).

Figure 3.53. Mining-town cemetery, Johannesburg, San Bernardino County, 1993 (photograph by Karen K. Swope). Note the proximity of the cemetery to the mine plant.

Figure 3.54. Hart cemetery, showing its appearance after the erection of a chain-link fence, Hart Mining District, San Bernardino County, 1997 (photograph by Karen K. Swope).

Artifacts

Dwellings should have associated domestic refuse scatters, as at the abandoned camp described by an early-twentieth-century prospector, where claimants left "rings of empty tin cans, jars, and bottles around the spots where their tents had stood" (Albert 1967:207). Commercial enterprises may be identified by items related to the specific activities performed there.

The locations of wood-frame structures—even when materials were salvaged for reuse—typically are characterized by scatters of milled-lumber fragments, hardware, nails, and window glass. The locations of tents or dugouts are sometimes distinguishable by the associated artifact assemblages, including canvas grommets, tent stakes, wire, and anchors.

Artifacts related to domestic property types at historical-period mining sites can include any of those typically found at historical-period domestic sites, including clothing/clothing maintenance, communication, food preparation/consumption, food/beverage, food/beverage storage, heating/energy, household furnishings, household maintenance, leisure/recreation, lighting, medical/health, personal, and religious/ceremony.

Numerous mining tokens are known (Akin et al. 2016:93–94), including some from hard-rock mines in the Study Area (from Ogilby and Temescal, for example). After the Civil War, metallic merchant tokens became increasingly common in replacement of paper scrip. "Workers were kept in debt to their employers, and advances on wages were issued in scrip" exchangeable at the company store for high-priced basic goods, in a system sometimes termed "debt peonage" (Akin et al. 2016:93). A report on trade tokens from Arizona mining camps indicated that they were made by firms in either Los Angeles or San Francisco, California (Birt 1991:141). Although store tokens were used for on-site commerce, they also may have been curated as souvenirs, and miners or their families may have transported them from one job site to another. Other tokens related to mining include giveaways representing equipment suppliers (Pearson and Bommarito 2016:10), stockholder tokens (Heritage Numismatic Auctions, Inc. 2008:72), union-member tokens, and tokens made of sample ore or commemorating events such as a first successful mill run (Heritage Numismatic Auctions, Inc. 2006:58). Examples of mining tokens and medals have been recovered from archaeological contexts, including a medal representing the United Mine Workers of America recovered at the Rhyolite, Nevada, town site (Figure 3.55) (White 2008:71).

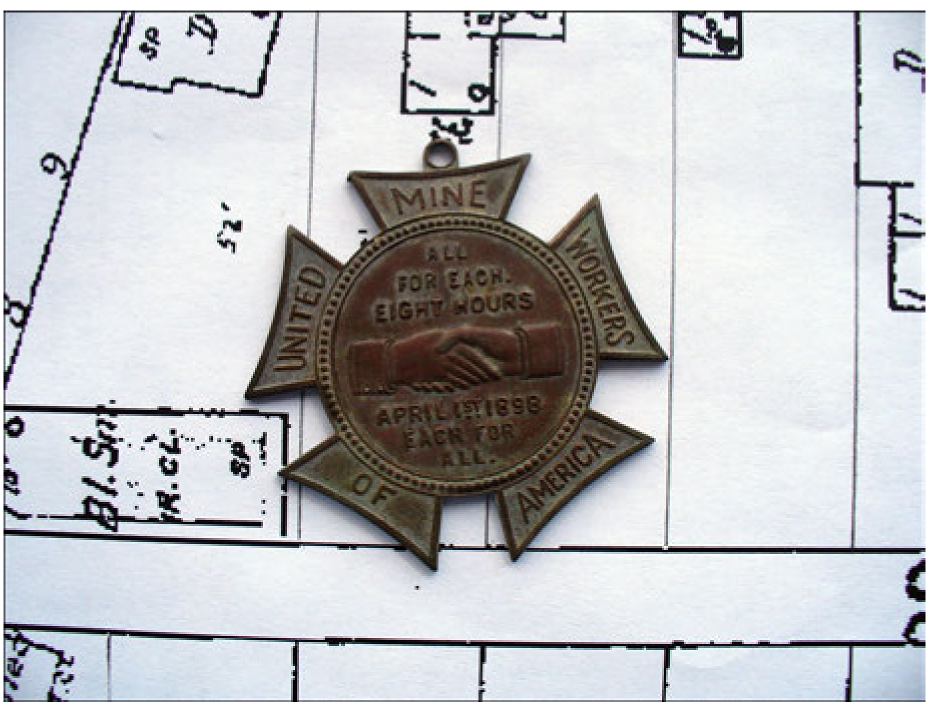

Figure 3.55. United Mine Workers of America medallion recovered at the Rhyolite, Nevada, town site (photograph courtesy of Statistical Research, Inc.).

Linear Property Types

Linear property types associated with mining sites tend to link the spatial arrangement of other property types. For example, water lines might run from a developed spring or artificial water-storage structure to extraction locations, beneficiation facilities, and support features, such as domiciles or mess halls. A network of roads might connect intrasite loci, as well as extending beyond the site boundaries to link the camp with outlying supply centers. Because of their unique morphology, linear features are discussed here as a discrete property type. Hardesty's approach—arranging property types in potentially intersecting universes including world, feature, and mining-district "systems" (Hardesty 1988, 1990a, 1990b, 2010)—is useful in preparing discussions of the relationships between linear property types and other mining-property types.

As with the property types listed above, the Caltrans mining context provides information about linear property types and should be consulted by researchers working on historical-period mining sites. In the following section, we outline the linear property types that are most likely to be encountered by researchers in the Study Area.

Transportation

Transportation features are linear resources related to pedestrian or pack-animal traffic, wagon or automotive roads, railroads, runways, helipads, and docks. As late as the 1860s, "exceptionally rich ores were required to make the [mining] enterprise pay; others had to be ignored" (Fletcher 1987:52) until transportation improvements rendered remote areas more accessible.

A viable network of transportation was a critical element in successfully developing strikes into producing mines. Although a prospector might feasibly carry his tools, supplies, and sustenance on a burro or horse, roads were necessary for transporting heavy mining and milling machinery, loads of ore, lumber, and supplies for a number of workers. Until the turn of the twentieth century, wagons and teams or trains of pack animals were used for this purpose. As automobiles became increasingly common, after about 1910, however, motorized trucks replaced animal power. In his *Routes to Desert Watering Places in the Mohave Desert Region, California*, Thompson (1921) mentioned numerous specific roads that were, at that time, used primarily by prospectors. Transportation features were frequently shared by multiple mines in a district or region (Aschmann 1970:182), although the roads within the boundaries of a mining claim or archaeological site were likely developed, maintained, and used explicitly for the benefit of that operation. Too, the transportation facility makes the "intervening terrain . . . more advantageous for settlement" (Aschmann 1970:184).

At a mining site, footpaths (Figure 3.56) carried traffic between mines and between mines and living spaces and connected all manner of activity loci. Established town sites had wooden boardwalks for pedestrian traffic in wet, muddy, and snowy conditions—Calico and Bodie in the Study Area both featured such constructions. Pack-animal trails, wagon roads (Figure 3.57), and automobile roads were used to bring supplies to a mining district and to transport ore to mill sites in the district or at distant points. A wagon road or informal automobile road is identifiable by the presence of two parallel tracks. Roads used by wagons typically have tracks spaced no wider than 4 feet apart, but roads intended for automobiles, particularly utility trucks or heavy equipment, must be wider. Where a road was cut or periodically graded, it may consist of a single swath rather than two tracks. Formal automobile roads have wide, relatively flat surfaces. Formal graded road types include dirt, gravel surface, oiled gravel surface, and cement, macadam, or asphalt pavement. Any of the above-listed paths and roads could be equipped with bridges or culverts.

Figure 3.56. Footpath, Lucky Day No. 1 Mine, Joshua Tree National Park, 1997 (photograph by Karen K. Swope).

Figure 3.57. Wagon road, Calico Mining District, 1991 (photograph by Karen K. Swope).

A Works Progress Administration report for 1935 (Merrill et al. 1937:17)—though discussing small-scale placer mining for supplemental, Depression-era income—offered an impression of automobile use for mining pursuits during that period:

> The miner's work and residence in isolated areas makes the cheapest type of automobile as much a part of a small gold producer's standard equipment as his pick, shovel . . . and tent. Ninety out of 138 miners said they owned an automobile, and 4 more indicated that they had an interest in one. At first thought, it might seem that the ownership of an automobile would be an uncalled-for luxury for a person with so small an income. . . . All of the cars were very old, probably averaging 10 years of age, and were equipped with the least expensive types of tires and other accessories.

Further, the report noted that in consideration of remote mining locations, a miner without an automobile was "severely handicapped."

The California deserts were penetrated by railroads during the 1880s. After that time, some remote mines in the Study Area, such as the Bonanza King, in San Bernardino County, built roads to rail sidings (Wilke and Swope 1989:4). Very productive districts—Randsburg, for example—were served by spur lines built specifically for their benefit (Reynolds et al. 1987). Other mines—at Calico, for example—built and maintained internal, narrow-gauge railroads to carry ore underground and to mills.

At the end of the historical period, helicopters and winged aircraft served remote desert locations and may have been pressed to service in carrying supplies and ore for mines in the Study Area. Following World War II, official and unauthorized landing fields were used throughout the California deserts, particularly on dry lake beds during the dry seasons.

Ore from the Black Jack Mine, Santa Catalina Island, was carried on the SS *Cabrillo* (Figure 3.58) to the Selby Smelting Works on the mainland in Contra Costa County smelting at Selby (Crawford 1894:25). Colorado River steamboats brought supplies to mining camps and settlements, reaching as far inland as the site of today's Hoover Dam (Lingenfelter 1978). A number of mining locales in the Study Area, including Calico and Cerro Gordo, found it economically feasible to ship ores to smelters in Swansea, Wales! The unprocessed ore was used as ballast in ships en route from San Pedro to Wales, where it was smelted (Baltazar 1993:1, 52; Nadeau 1965:189; Young 1976:4). This arrangement led to the naming of the camp that arose around a smelter just north of Keeler, on an old shoreline of Owens Lake. During the late 1860s and early 1870s, the Swansea smelter also processed ore from Cerro Gordo and then shipped the ingots to Los Angeles (Nadeau 1992:218). A steamboat, launched in 1872, carried Cerro Gordo bullion across Owens Lake to shorten the travel time to Los Angeles (Shumway et al. 1980:26).

Aerial Ore Conveyance

Implementation of aerial tramways began in the 1870s, and the technology became extensively used between about 1890 and 1920. It was an "economical alternative to building roads or railroads" to carry ore, supplies, and even workers over rough terrain and obstacles (Trennert 2001:vii, 1). According to historian Robert Trennert (2001:1–2), "many of the most notable western mines" would not have been able to operate without aerial tramways. Aerial tramways could operate in conditions where snow or rain would render surface transport impossible.

In their simplest form, aerial tramways were single-rope (mono-cable) apparatuses, each equipped with one bucket that moved in both directions. Tramway towers, either of wood or steel, were made in a variety of engineered and expedient forms (Trennert 2001:50–53) (Figure 3.59). Terminals at the ends of the route were equipped with operating machinery and might include ore bins, chutes, and related structures. In the archaeological record, the route of an aerial tramway is sometimes represented by collapsed towers and fallen cables.

Because aerial tramways had a number of industrial applications, technical works providing descriptive and illustrative data typically include overhead mechanisms used in a multitude of trades, such as logging, warehousing, and foundry casting. Examples of resource materials containing useful information are Wallis-Tayler's (1911) *Aerial or Wire Rope-Ways: Their Construction and Management* and the Cleveland Crane & Engineering Company's (1944) catalog.

Figure 3.58. Photograph of the SS *Cabrillo* loading ore at the ore dock at White's Landing at Catalina Island, showing an automobile, October 16, 1925. At the center, a narrow dock is shown, leading to the ship moored to the left. Toward the middle, an automobile can be seen, facing the viewer. Goods are lined on either side of the dock, in sacks. The photograph sleeve reads, "Loading with ore from Black Jack Mine for smelter at Shelby, California" (digitally reproduced by the University of Southern California Digital Library, from the California Historical Society collection).

Figure 3.59. Aerial tramway, Beveridge Mining District, Inyo County, 1991 (photograph by Karen K. Swope).

Ore-Car Conveyance

At most sites in the Study Area that are accessible by motor vehicles, ore cars (Figure 3.60) and rails were removed long ago for reuse elsewhere, for metal scrap, or by souvenir hunters. In fact, the relics retain such popularity that replicas are now made to satisfy the demand, for display purposes (Melcher Machine Works 2016). The alignments of ore cars may be visible by flat-topped, linear piles of waste rock ending in dumps. Support trestles may remain along an alignment (Figure 3.61). Spikes are commonly found in the archaeological record, however, and researchers will have no trouble distinguishing narrow-gauge ore-car spikes from their standard-gauge railroad counterparts. Standard spikes measure approximately 5.5 inches in length below the spike head (Camp 1903:125), whereas ore-track spikes measure about 3 inches in length below the head.

The 20-mule teams that became iconic in the imagery of western mining played a part in the hard-rock mining of the Study Area in the Calico Mining District and in the Funeral Mountains, in Inyo County. The teams, which had been used to haul borax from surface plants in eastern California, were, during the 1880s and 1890s, used to haul loads from hard-rock colemanite-borate mines to regional rail connections (Chappell 1996:95; Hildebrand 1982:39; Peyton 2012a:49–50).

Figure 3.60. Abandoned ore car, Beveridge Mining District, Inyo County, 1991 (photograph by Karen K. Swope).

Figure 3.61. Burned ore-car support trestles, Lucky Day No. 1 Mine, Joshua Tree National Park, 1997 (photograph by Karen K. Swope).

Utility Transmission

Some mines installed communication systems of bells, both above and below the ground; the bells could be operated by ropes or, later, by electricity. Telephones were useful in communication between surface plants and underground miners, as well as between an aerial-tramway terminal and the mine or mill. Only the well-established towns were equipped with local or far-ranging telephone service.

Water Conveyance

Water-storage structures (tanks, cisterns, and reservoirs) are discussed above. In most desert areas, it was necessary to obtain an exotic water supply by trucking it to the site, digging/lining ditches, or laying pipe. Water was critical to the viability of desert camps, not just for domestic purposes and for watering livestock but for machinery as well—some forms of drilling, mining, and milling operations consume enormous amounts of water, presenting an additional challenge. Wire-wrapped wooden water pipes have been found at sites in the Study Area (Figure 3.62). Water was carried in an iron pipe a distance of 28 miles to the Skidoo camp in Death Valley, from a spring near Telescope Peak (Perkins 2001:160).

Although it is focused on placer mining sites, the Caltrans (2000) historic context and research design for water-conveyance systems throughout the state of California provides useful property-type descriptions and valuable guidance for recordation methods and registration requirements. Davis-King (1990) described water-ditch systems in mining districts, and although it focused on the mother-lode region, her discussion contains useful considerations of adjacent site types that may or may not be related to the original purposes of the ditches.

Figure 3.62. Wire-wrapped wooden water pipe, Yellow Aster Mine, Kern County, 1993 (photograph by Karen K. Swope).

Artifacts

The artifacts that can be associated with linear property types are as diverse as the features themselves, yet they are functionally diagnostic. Ore-car track, spikes, and cars may remain, particularly at remote sites that are not frequently visited. Sections of wooden or cast-iron water pipe can assist in determining the source and origin of water at a site. Where aerial tramways operated, the following may be found: segments of wire cable (wire rope), pulleys, or ore buckets. Utility alignments may contain remnant telegraph/telephone wire, glass or kaolin insulators, or batteries.

Researchers have noted that "few types of human . . . enterprise generate such profound impacts on the landscape as mining operations. The scale of earth-moving, resource consumption, and environmental impact associated with mining generally exceeds that resulting from any other activity" (Martin 1998:4).

Cultural Landscapes

Cultural landscapes are not a property type, per se, under this historic context, as they are not recognized as a category of property in the NRHP. However, cultural landscapes are identified and evaluated as sites or districts. Therefore, it is important to identify and describe their character-defining features here, so that guidance for their identification and evaluation in a subsequent chapter has the appropriate framework. The NPS is the leading force of cultural-landscape identification, evaluation, and management in the United States. As defined by the NPS (1994, as cited in Birnbaum [1994:1]), a cultural landscape is "a geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values." This definition is broad and is "intended to foster a comprehensive approach to defining and understanding a place" (Mitchell 1997:285). Four non–mutually exclusive types of cultural landscapes are defined by the NPS: historic sites, historic designed landscapes, historic vernacular landscapes, and ethnographic landscapes (Birnbaum 1994:1). The following is a set of definitions and examples:

1. A cultural landscape identified as a historic site is a property directly associated with a historic person, activity, or event (Birnbaum 1994:2). Examples of historic sites include Sagamore Hill (a presidential home), Castillo San Felipe del Morro (a military fort), and Little Bighorn (a battlefield).
2. A cultural landscape identified as a historic designed landscape is a consciously arranged space and is significant as a design or work of art. These properties are designed, planned, and laid out by a landscape architect, architect, master gardener, or amateur following a design principle or recognized style or tradition. These landscapes are associated with a historic person, landscape or architecture movement, or trend. These properties can also have importance because of their relationship to the theory or practice of landscape architecture (Birnbaum 1994:2). Examples of historic designed landscapes include the Kenilworth Park and Aquatic Gardens (botanical garden and park), University of California at Davis (school campus), and the Biltmore Estate (family property).
3. A cultural landscape identified as a historic vernacular landscape is one whose use, construction, or physical layout reflects endemic traditions, customs, beliefs, or values. It expresses cultural values, social behavior, and individual actions over time. It is typically manifested in physical features and materials and their interrelationships, including patterns of spatial organization, land use, circulation, vegetation, structures, and objects (Birnbaum 1994:2). Examples of historic vernacular landscapes include Nantmeal Village (rural village), Saugus Iron Works (industrial complex), and Ebey's Landing (agricultural landscape).
4. A cultural landscape identified as an ethnographic landscape is a place that includes both natural and cultural resources that a living culture defines as heritage resources. These include plant and animal

communities, geographic and topographic features, subsistence and ceremonial grounds, and buildings, structures, and objects. The natural and cultural resources that constitute the ethnographic landscape may even have special local names (Birnbaum 1994:2). Examples of ethnographic landscapes include Acoma Pueblo (historical-period and contemporary settlement) and Devils Tower (massive geological structure and sacred site).

Historic vernacular landscapes are the most prolific cultural-landscape type, because they "have developed without the direct involvement of a professional designer, planner, or engineer" (Alanen and Melnick 2000:5). They are ordinary places that reflect the customs and everyday lives of people (Page et al. 1998:12).

In regard to property type, cultural landscapes are categorized as sites or districts. A site is the location of a significant event, occupation, or activity, where the location itself possesses historical or cultural value. Examples include a mine or a mining camp. A district is a spatially discrete area containing a range of associated properties or a significant concentration, linkage, or continuity of properties united historically or aesthetically by plan or physical development. Examples include a mining district or a town site.

In an effort to identify the complexities of cultural landscapes within the aforementioned framework, the NPS developed a list of cultural-landscape characteristics, which are the

> tangible evidence of the activities and habits of the people who occupied, developed, used, and shaped the land to serve human needs; they may reflect the beliefs, attitudes, traditions, and values of these people [McClelland et al. 1999:3].

The NPS (Page et al. 2005a:53) has identified 13 landscape characteristics that they have divided into processes and components, a classification system for organizing information. Processes were instrumental in shaping the land, and components remain evident on the land. When historic processes are linked to existing components, the cultural landscape can then be described, recorded, and evaluated as a unified whole.

Among the many methods for identifying landscape characteristics are archaeological and architectural investigations, ethnographic interviews, aerial photography, topographic and hydrographic surveys, geophysical surveys, mapping, archival research, and plant inventories. Tools can include magnetometers, ground-penetrating radar, electrical resistivity and electromagnetic conductivity equipment, Global Positioning System (GPS) units, and GIS.

CHAPTER 4

Research Design

The site of an abandoned camp, the graveyard of many buoyant hopes, is full of interest. It sits in the pure desert air, in the silence of the tomb. . . . Imagination can picture these streets, now silent as death, once teeming . . . [Chalfant 1947:173–174].

Industrial Archaeology, Historical Archaeology, and the Development of Mining-Sites Research

Archaeologists have not always recognized the research value of historical-period mining sites. Here, to provide research context, we briefly trace the development of mining-site archaeology and its place in industrial archaeology and historical archaeology.

Industrial archaeology began in the United Kingdom during the mid-twentieth century, with the recognition that the physical remains of industry were useful for "understanding and appreciating the scope and scale of industrialization" (Martin 2009:286) and, ultimately, the role of the Industrial Revolution in shaping the modern world. In the United States, archaeologists had been engaged in investigations at historical-period manufacturing sites as early as the 1930s (Martin 2009:286–287); the earliest industrial archaeology was focused on preservation of monumental-site examples (Martin 2009:287, 291). Attention to the field grew exponentially with the creation of the Society for Historical Archaeology and the Society for Post-Medieval Archaeology in 1967, the Historic American Engineering Record (HAER) documentation program in 1969, and the Society for Industrial Archeology in 1971.

The first issue of *Historical Archaeology* contained an article by noted California archaeologist Franklin Fenenga (1967), entitled "Post-1800 Mining Camps." By his reckoning, sites where important mining discoveries were made would be historically significant, and he provided examples of the Coloma discovery that launched the California Gold Rush and 1828 discoveries in northwestern Georgia that led to the first notable gold rush in U.S. history. He held the opinion, however, that the landscape's having been "turned over and churned over"—shaped by subsequent mining activity—negated the potential of the sites to contribute any important information regarding mining activity. He did, however, recognize the research value in inquiries related to the "social conditions" of mining sites, such as demographics, community layout and development, and corporate arrangements.

By the early 1980s, few archaeological investigations had targeted historical-period mining sites, but by 1990, Reno (1990:51) observed increased documentation and evaluation of the sites as part of environmental compliance. Schaefer and Duffield-Stoll (1996:175) wrote that "mining sites have undergone considerably greater scrutiny in recent years as their importance and fragility on the American landscape becomes increasingly appreciated." Two factors had led to the shift: increased modern mining activity at historical-period mining sites and the 1980 passage of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), which authorized the cleanup of Superfund Sites.

It was in the late 1980s that Hardesty presented his feature-systems approach to the description, interpretation, and evaluation of historical-period mining sites; variations on and applications of his work have continued to appear in various formats (Hardesty 1988, 1990b, 2010). In the approach, specific mining-related activities are recognized by the clusters (linked property types) of archaeological features they produced. Further, the approach is designed to target feature clusters likely to hold cultural significance.

National Register Bulletin 42, *Guidelines for Identifying, Evaluating, and Registering Historic Mining Properties* (Noble and Spude 1997), was published in 1992 and revised in 1997. In 1998, one of its authors

(Noble 1998:13) noted that the bulletin had "increased awareness of the importance of mining resources" and clarified the efforts of researchers.

Interest in California mining sites surged with the commemoration of the California Gold Rush sesquicentennial in 1998. A session titled "The Gold Rush and Beyond, A Symposium Celebrating the Sesquicentennial of the California Gold Rush" was presented at the Society for California Archaeology meetings, discussing the status of research on mining sites throughout the state. The U.S. Postal Service issued the California Gold Rush Commemorative 33-cent stamp (*Postal Bulletin* 1999:69). The NPS CRM periodical published an issue (*CRM*, vol. 21, no. 7) devoted to America's mining heritage (Greenberg 1998). In it, the plight of historical-period mining sites in the West was summed up thus: "The mining heritage sites that will be available to future generations will be largely confined to those chosen by land management agencies for preservation in the next few years" (Milford 1998:64). Spude's (1998:3) contribution noted:

> [M]ining history now needs new direction. There is a need for new points of view and historical methodologies. In particular, there exists a continued need for innovative guidance on preserving and protecting these fragile remains; a need for additional awareness about miners, prospectors, and countless other mining-related individuals; and a better understanding of the diversity of mining-related technologies and surviving historic resources within the national story.

As a result of better guidance for CRM practitioners and the focus on mining archaeology in the face of modern mining activity, archaeologists began to recognize that small-scale mines (those operated by individuals or small partnerships) constituted the majority of sites that researchers are likely to encounter in the southern California deserts (White 2017:47; Wilke and Swope 1989:38). The focus on independently operated mines was part of a trend in archaeology to give voice to groups that were underrepresented in historical documentation. For mining sites, these groups are those whose efforts typically were not recorded in government documents, historical works, or company records.

Although some recent guidance took the position that "the archaeological residues of mining, shafts, and pits, contain little information beyond their presence and location and hence do not require detailed study" (Joseph et al. 2004:130), most historical archaeologists now recognize that mining sites have the potential to provide a wealth of information that cannot be learned from the documentary record alone. When the archaeological and documentary records are considered together, new information and research issues may come to light. The detailed research designs that have been prepared for mining-sites research in recent years are a testament to that position. As a topic of study, historical-period mining continues to grow as a subject of interest in numerous disciplines—including studies of social history, archaeology, cultural geography, history of technology, material culture, economics, and labor relations—as attested to by the profusion of recent publications on the theme.

CRM projects have resulted in a body of information about historical-period mining in the California deserts, but the information is largely encapsulated on a scale limited to an archaeological site or to part of a mining district. Rarely are project limits inclusive of entire mining districts. The BLM recognized a need for a broader, unified management approach for application across the Study Area. This research design will assist BLM archaeologists in the identification, evaluation, and management of historical-period mining sites in the California deserts.

In *The Archaeology of American Mining*, White (2017:34–59) recently presented additional information on the history of investigations into American mining as a field of study within historical archaeology.

Previous Research at Mining Sites in the Study Area

Through about the 1970s, most of the literature focusing on California desert mining sites was in the form of ghost town histories appearing in magazines and books. *Desert Magazine* carried numerous articles on California desert mines (Budlong and Brooks 1997:309–314), some of which are useful in providing baseline information on the level of preservation of particular sites during a specific decade. Some works that present the history of mines in the Study Area appear in the list below. Erudite presses were sometimes responsible for their publication; nevertheless, some of the products are more scholarly than others. Nadeau (n.d.:52), writing of *Silver Stampede*, for example, said it was "a history with frank excursions into the unhistoric."

- *Desert Bonanza: The Story of Early Randsburg, Mojave Desert Mining Camp* (Wynn 1963)
- *Silver Stampede: The Career of Death Valley's Hell-Camp, Old Panamint* (Wilson 1937)
- *Mining Camps and Ghost Towns: A History of Mining in Arizona and California along the Lower Colorado* (Love 1974)
- *Mining Camp Days: Bodie, Aurora, Bridgeport, Hawthorne, Tonopah, Lundy, Masonic, Benton, Thorne, Mono Mills, Mammoth, Sodaville, Goldfield* (Billeb 1968)

To quantify current research at historical-period mining sites in California, we reviewed the paper and poster presentations offered at the Annual Meeting of the Society for California Archaeology over the past 5 years. All historical-period mining topics were included in this analysis, to better understand the scope of current CRM and academic investigations. Over the 5-year period from 2013 through 2017, 54 papers on historical-period mining topics were presented, averaging 10.8 per year. Placer- and hard-rock-mining sites were featured in nearly equal numbers (14 and 15 papers, respectively). Fourteen papers (26 percent) focused on sites within the Study Area. Mining sites located on agency lands were the topic of 36 papers; the following agencies were represented: California Department of Parks and Recreation (n = 15), BLM (n = 8), U.S. Bureau of Reclamation (n = 8), USFS (n = 3), U.S. Department of Defense (n = 1), and Caltrans (n = 1). The most frequent theme of the presentations was site management (including policy implementation, application of guidance, site stewardship, public interpretation, and AML): 25 papers (92 percent) were related to that theme. Eleven papers reported on the findings of CRM projects and/or historical studies. Examinations of ethnic expressions at mining sites were the next-most-frequent theme, represented by 9 papers (17 percent). Of these, Chinese, Native American, Chilean, and Euroamerican ethnicities were included. Themes represented by fewer papers were townsites, domestic sites, built-environment resources, millsites/smelters, linear sites, related industry sites (charcoal/wood camps, lumbering), mining-technology history, technological applications for site recording (lidar, drones, 3-D mapping/modeling, dendrochronology), and individuals related to mining. Many, if not most, of these presentations reported on research accomplished as part of environmental compliance. Still, the exercise indicates that many California cultural resource practitioners consider historical-period mining sites worthy of study and of presentation in a public forum. The analysis also shows that agencies support more than one-quarter of the mining-sites work presented and that management of the resources is a primary concern. The number of papers with a specific research focus was relatively low, clearly showing that opportunities are available to address data gaps with future work.

Every mining site follows a boom-to-bust trajectory, but, as the BLM course in managing historical-period mining sites (BLM n.d.b) notes, "each western state has its own array of interesting resources, studies, and accomplishments." In tailoring this study to the CDD and the Bishop Field Office, we have attempted to link the research design to the unique conditions that make the Study Area a cohesive region for investigation. Together, these conditions—environmental, social, and economic—shaped the history of hard-rock mining in the California deserts. The wide-open spaces of the California desert offer a setting wherein mining landscapes can frequently be viewed unobscured, allowing archaeologists to envision the layout of site loci over broad expanses. Before the arrival of rail connections and the improvement of automobile roads, the remoteness of the California desert region prevented extensive mining development. This remoteness contributed directly to regional technological adaptations and innovations. The sparse desert flora provided precious little material for construction or fuel. Wherever trees grew at mining sites in the Study Area, cut stumps and the scarcity of sizable trees indicate the amount of denudation that took place. In the arid deserts, lack of water presented a barrier to settlement and complicated the productivity of mills, which require water for operation. Most millsites in the Study Area were built with a system for water containment and recirculation; an example is the Cleveland Mill, Inyo County. Aridity also plays an important role in preservation in the Study Area: many materials (wood, leather, and fabric, for example) remain in the archaeological record much longer here than in many other climes. Because these materials are often preserved at desert sites, and because they are not typically targeted by looters or souvenir hunters, they constitute an important part of material culture studies. These conditions allow us to tailor research questions to the sites that are likely to be encountered in the Study Area.

Research Potential

The research potential of a particular historic property is assessed with reference to a specific historic context or research design and themes. Historic contexts establish the framework according to which much of the federal historic-preservation process is structured. The historic context is that body of information about properties, organized according to the basic elements of theme, place, and time (McClelland 1997:51). Theoretically, all of the historic contexts of a particular geographic area together constitute a comprehensive history of the area that could be separated into a series of historically meaningful segments, each segment being an individual historic context.

The Caltrans research design for historical-period mining sites (Caltrans 2008:118–154) presented the following six research themes: Technology, Historical Ethnography/Cultural History, Ethnic and Cultural Groups in the Mines, Women, Families, and Gender, Economy, and Policy. Research at mining sites in the Study Area has the potential to address questions under each of these themes, and investigators are encouraged to consult the Caltrans document in developing project-specific research designs. Here, we introduce four research themes, showing how each could address specific questions related to the unique historical conditions in the Study Area. Specifically, the themes relate to the material culture present at California desert mining sites, environmental conditions and landscape of the California deserts, the history of capitalism in the mines, and the singular character of cabins at mining sites in the Study Area. We selected these themes for specific reasons. The research theme addressing material culture is one that can be applied to virtually any mining site with an associated artifact assemblage. The artifact assemblage need not be domestic—the theme can be applied to mining equipment and technologies as well, as will be shown. The research theme addressing environmental modifications is well suited to investigations in the Study Area, where many examples of adaptation to the desert environment can be found at remote mining sites. The theme of dynamic capitalism provides a mechanism for getting at information about mining speculation in remote regions, as well as many of the economic topics presented in the historic context (see Chapter 2) that shaped mining in the Study Area throughout the historical period.

Using these examples as a guide, we suggest that the research themes offered in the Caltrans study can be adjusted along site- and project-specific lines of inquiry, thereby allowing the examination of the particular values of the archaeological and built-environment record at mining sites on public lands in the California deserts. Comparing the themes presented here reveals the overlap among themes and among the research values that can be addressed by the data related to each theme.

Research Theme: Material Culture at Mining Sites in the California Deserts

Historical archaeologist James Deetz (1977:160–161) commented that material culture is “the most objective source of information we have concerning America’s past.” The research theme devoted to material culture at mining sites in the Study Area requires us to consider the complete array of artifacts found at sites in the California desert mining frontier. The theme touches on issues of technology, supply, consumer choice, social stratification, innovation, and demographics. Therefore, it has implications for the analysis and interpretation of industrial, domestic, and corporate site components.

The material culture of mining technology is directly related to the mining processes and equipment used at the site; static conditions or innovations over time can be particularly informative regarding site history, regional and global economies, and the conditions of capital backing—all topics related to the theme of dynamic capitalism, discussed below. But, as an element of a site’s material culture assemblage, mining tools and machinery can also inform questions of supply and innovation. During the historical period, prospectors required very little equipment and typically were personally responsible for its transport. Some early mining and milling technologies, as well, required few tools and made expedient use of available materials (arrastras built with local stones, for example). Developing mines, however, required increasingly heavy and unwieldy machinery, copious amounts of water, and subsistence supplies for miners, other workers, and, sometimes, families. Sites in the Study Area have been found to contain evidence that newer technologies were incorporated over time; Beveridge and Reilly in Inyo County are two examples where more-costly, yet more-effective, milling equipment was installed over time. Archaeological and archival evidence suggesting the failure or success of installing better technologies at a particular site should be carefully evaluated within the context of the greater economic climate of the time. Barnes's (2002, 2004) study of Reilly, for example, shows that it was a mining operation that failed despite the application of advanced technology, in part because of declining silver prices and a national recession.

Erecting a millsite at remote mines was far more cost effective than transporting tons of ore over long distances. Either way, one of the first tasks undertaken in a mining district often was road construction. Roads might be financed and built by miners, but sometimes freight companies built roads on speculation of future profits. Many contract mills were erected in the Study Area, at central locations to serve surrounding mines, thus limiting the amount of necessary road building and obviating the need for each mine to erect mills. At Beveridge, in Inyo County, some mill equipment was transported by pack animals in pieces and then reassembled on-site (Swope 1993:324). At remote locations throughout the U.S. West, lengthy tram cable was transported by pack trains, in which every animal carried several coils on each side. Because the cable had to remain uncut, the animals were connected by loops of cable extending from one individual to the next in line (Wallis-Tayler 1911:108–109).

Many researchers have observed evidence of materials recycling in the often marginal settings of mining camps, and most interpret the behavior as a response to a physical need in the face of meager resources. Frequently, mine workers completed makeshift equipment repairs in the absence of replacement parts. A common discovery at mining sites is items manufactured on-site from recycled materials. At Beveridge, Swope (1993:261–262, 326–327) identified items repurposed in roughly equal numbers for industrial and domestic use. For example, fuel cans were reused industrially to line ore chutes and water-conveyance troughs, and domestically as buckets, stovepipe elbows, and scrap metal. Most mining-camp researchers have discovered the seemingly ubiquitous candle lanterns (sometimes called shadowgees) made from cylindrical food cans and wire.

Material culture studies are applicable to inquiries of site demographics at the settlement, household, and individual levels, if sufficient quantity and variety of refuse are present in identifiable contexts. Material culture studies are applicable to demographic themes of ethnic and cultural groups and of women, families, and gender. Mining camps were among the most diverse workplaces in the U.S. West, although ethnic groups were typically separated for expediency (common language, shared experience and skills) or out of racial apartheid. An example of an ethnic group that has been identified archaeologically at mining sites in the Study Area is the Mexican and Chilean miners who labored at Hedges/Tumco (Imperial County); Mexican miners are known from archival data to have worked mines at Cerro Gordo (Inyo County). Investigations at Hedges/Tumco and other sites occupied by Mexican miners have revealed specific artifact signatures related to food preferences and architectural elements (Burney et al. 1993; Fernandez 2001; Hector 1987; Hector et al. 1991; Van Wormer 2014). Numerous studies have focused on specific demographic groups in Gold Rush mines and camps, but in the Study Area, much work remains to be done in the identification and interpretation of underrepresented demographic groups such as children and immigrants. Of course, archaeologists must be cognizant of the facts that "few items were ever used exclusively [by a single ethnic group], and the same item could have multiple social meanings" and that "not all ethnicities have equal archaeological representation" (White 2017:85).

Archaeological studies of consumer choice in frontier settings provide information that does not consistently support the illusory narrative of the mining West. The stereotypical view emphasizes the hardships and deprivations of life in rural outposts. Teague and Shenk (1977:49) found, in their study of Harmony Borax Works, Death Valley, that "one gets the feeling that frontier conditions in the late 19th century were not totally spartan" (Figure 4.1). Nearly half a century ago, Toulouse (1970:59), in his article "High on the Hawg, or, How the Western Miner Lived . . ." wrote that "almost nothing has been said about the lighter side of [the miner's] life,

Figure 4.1. Setting of Harmony Borax Works, where conditions, according to Teague and Shenk (1977:49), "were not totally spartan" (courtesy of the National Archives and Records Administration).

how he obtained the necessities and the luxuries of living, or even the fact that he obtained luxuries." White (2017:62) noted that few mining camps existed in total isolation but rather had "critical linkages . . . to outside sources of labor, material, and capital" with needs satisfied through "imported goods and services," even when the miners were required to establish "entire supply chains connecting entrepôts to mining locales." After the arrival of railroad connections to the California deserts, virtually any commodity available in eastern markets, San Francisco, or Los Angeles could be had in remote mining camps, and innumerable archaeological reports confirm the presence of fragile or apparently costly goods in the camps. The presence of improved wagon/automobile roads or railroads, of course, determined the *quantity* of personal goods that site occupants could bring to the camps; it had remarkably little impact, however, on the *range* of personal goods transported to mining sites. As evidenced by the archaeological record, people found a way to bring items of personal importance (such as heirlooms) and objects of social display to remote mining camps, even before rail connections facilitated shipment. White (2017:107) wrote that people arriving at the mines "came from somewhere else, and they did not simply discard [their] identities and class-based aspirations upon reaching their destination." The steamboat *Bertrand* sank in 1865 on the Missouri River, carrying cargo bound for western gold camps. Archaeological investigations recovered approximately 10,000 cubic feet of cargo, which is considered "material culture 'captured in time'" and representative of the frontier economy of mid-nineteenth-century North America (Petsche 1974:2). Among the cargo in the ship's hold were utilitarian necessities, such as shovels, hobnail boots, smoking pipes, and lamp chimneys. Also among the cargo was a wealth of luxury commodities in bulk, including candies, brandied cherries, lemon extract, oysters, tamarinds, bolts of silk, lace, tassels, indigo dye, tablecloths, umbrella covers, waffle irons, and champagne (Petsche 1974:48–49).

Much attention has been paid to the public meaning of objects as status markers or for social display (e.g., Staniforth 2003:153). Purser's (1987, 1992) archaeological studies at the nineteenth-century mining community of Paradise Valley, Nevada, analyzed consumption as a process of social communication—that is, sending and receiving social messages, such as competition initiated through possession and display of luxury items.

More recently, Sweitz (2012) analyzed households at Cripple Creek, finding a variety of ways in which status was expressed, variously manifesting in the quality of foodstuffs vs. tablewares. At Hart, in San Bernardino County, a decorative, pressed-glass dinner castor was recovered during excavation of a dugout. Pressed glass was a less expensive alternative to cut glass; still, it is difficult to imagine that residents of a remote mining-camp dugout would transport such a fragile and ornate item to the site (Swope and Hall 2000:171–172).

In the frontier context, everyday objects can become imbued with heightened meaning if they are difficult to obtain, difficult to maintain, or new. In such a setting, the choice between a lightweight, portable camp stove and a cast-iron example intended for home use can suggest volumes in regard to consumer choice (Swope et al. 2005). Repurposing of items to serve new, heightened social and personal meanings is another recognized behavior of frontier life (Caltrans 2013:142; Deetz 1977:10; Schlereth 1980:147).

In coining the phrase "passionate possession," Akin (1995:102) postulated that individuals curate objects for five major reasons: "(1) to satisfy a sense of personal aesthetics, (2) to connect with history, (3) to enhance personal status, (4) to profit from an investment, and (5) for the satisfaction of ownership." Each of these reasons takes on specific meanings in a remote mining context, but the first is perhaps the most pertinent for understanding the lives of miners, their families, and others who may have been present at the camps. In his classic study of consumer behaviors, Zimmerman (1936) noted that one aspect of consumption is self-indulgence. To Schlereth (1980), these unnecessary items reflected "symbolic need." Archaeological investigations have directed less consideration to objects in the private sphere—that is, where possession of the object may or may not be known by others.

In light of the wealth of examples demonstrating that consumer choice played a role in the material culture of mining camps, what remains to be learned? Numerous studies in the California Gold Rush region and in Nevada have contributed to our understanding of mining-town layout, including the segregation of ethnic and socioeconomic groups. Archaeologists working in the Study Area will have few, if any, opportunities to study the archaeological record of formal mining towns. Opportunities remain for archaeological inquiries into the layout of less formal camps. Future investigations at these camps should take into account the potential for applying the information learned from townsites and organized labor camps to the situations found in less formal camps.

Research Questions

- What objects were repurposed/recycled in areas that were otherwise well supplied?
- Does the artifact assemblage reflect connections to local, regional, or global markets? Did the network of supply change over time? How did a changing supply network change site material culture, if at all?
- What can be learned about site demographics on the basis of the material culture assemblage? What material culture at the site might indicate the presence of particular ethnic, cultural, domestic, or gender groups? Does the material culture of the site indicate the presence of families? Of women? Of children?
- What can be learned from the material culture at various domestic loci at the site? How does information gleaned from the material culture record compare with indications in the archival record?
- How does the material culture record compare to that at other mining sites—for example, sites not located in desert regions or mining sites from the later historical period? How does the material culture record at informal camps compare to that of formal towns and organized company camps?
- What does the distribution of material culture at the site reveal about site layout? About social stratification? About ethnic segregation?
- What does the material culture record reveal about living conditions at the site?
- Does the material culture record reflect corporate paternalism? Is there evidence that workers used company supplies (such as a company store), or were they obtaining their own supplies?

Data Needs

This research theme can be addressed only if the site artifact assemblage contains sufficient quantity and diversity of artifact types. Intact, stratified artifact deposits (such as privy pits, trash pits, or even undisturbed surface dumps) must be present. Historical data regarding transportation networks are needed to assess the markets available to supply the camp. Proper identification of the original and repurposed functions of artifacts is necessary.

In order to apply Criterion d to a mining site for important information potential, investigators must prepare an adequate research design that takes into account the historic context for the site, considers the available archival information with regard to data gaps (regarding site occupants, for example), and assesses what information the site may possess to address the remaining questions. A site artifact assemblage that can be identified and dated is not sufficient to make the site eligible under Criterion d. Rather, the site must contain "critical information" to answer important research questions that cannot be accessed in other ways.

Noble and Spude (1997:17) stated:

> Questions about community . . . the miner's domestic household, the spatial organization of mining settlements, the production and consumption of commodities in the mining frontier marketplace, ethnicity and ethnic relations, gender, and social structure are likely to be important to scholarship on mining society and culture.

Research Theme: Small- and Large-Scale Environmental Modifications

The mineral-rich California deserts encompass some of the most forbidding terrain and environmental conditions to be found in the state. Nevertheless, miners, and sometimes their families and support-industry workers, braved the elements for the promise of wealth. The nature of mining activities, as well as adaptations in response to living and laboring in this unforgiving locale, shaped the environment on small and large scales, both of which are observable today in the archaeological record. This research theme is focused on environmental modification, both intentional and unintentional, that is the direct result of mining activities and the actions of miners in their daily living.

As is true of the other themes presented here, this theme includes several elements, addressing questions of technology and demographics, and has implications for the analysis and interpretation of industrial, domestic, and corporate site components.

Small-Scale Environmental Modifications

Careful inspection of archaeological remains reveals a myriad of ways in which miners responded to life in the unforgiving desert environment. At the heart of desert survival is providing for a reliable water supply and preparing for temperature extremes. Dugout dwellings, common at remote mining camps, provide insulation from heat and cold, while alleviating the need for imported building materials. Small-scale environmental modifications frequently include attempts to secure the health and safety of site occupants. Cabins were built under any available trees, and native or imported trees and shrubs were transplanted to create windbreaks.

Constructions made to assist in food preservation are frequently found at desert mining camps and homesteads. A food-storage dugout was found at Hart (Swope and Hall 2000:92, 94–95), and a cold-storage-room door was identified at the Valley View mess hall (Hallaran and Wilke 1987:18–19, 21). An evaporative-cooling cabinet was built in the creek bed at Beveridge (Swope 1993:257–258) (Figure 4.2); these features were described by a firsthand observer (Wynn 1963:89) in the Rand Mining District:

> There were a few real conveniences, such as the ever present, burlap-covered cooler of the desert dweller. These simple yet effective coolers were built out of various types of boxes. . . . Across the open face was hinged a screen door. . . . Then the whole was covered with several thicknesses of burlap. The burlap was kept wet by the cloth wick that trailed over it from a pan of water kept on the top of the cooler. The more elaborate cooling devices were screen all the way around, and the wooden frame work supported several shelves. In the dry atmosphere of the sage country these burlap coolers are most effective.

Figure 4.2. Evaporative-cooling cabinet, Beveridge, Inyo County, 1992 (photograph by Karen K. Swope).

The southern California desert is home to numerous rodent species. At Beveridge, in Inyo County, scrap sheet metal was used to shield a vertical roof support and wooden table legs, to discourage climbing pests (Swope 1993:257).

Beyond survival and safety measures, however, is archaeological evidence of seemingly nonessential efforts to shape the environment for aesthetics, pleasure, or comfort. Staniforth (2003:153–155) wrote that people use objects for "psychological reasons such as to reassure themselves about their place in the world, to validate choices and to make themselves happy" in circumstances that might seem otherwise untenable. A 1926 *Handbook for Prospectors* (VonBernewitz 1926) instructed: "In preparing his outfit the prospector should not leave out the things that will make him comfortable." Apparently, many miners followed this advice. Exotic plants and trees are frequently found at desert mining camps (Swope 1993:255) and homesteads. Some, such as fruit trees, were almost certainly imported to supplement food supplies, whereas others, such as flowering plants, seemingly were brought for aesthetics; some suggest the presence of specific ethnic groups. Rock enclosures have been found delineating walkways and garden plots at remote mining camps (Swope 1993:255). An administrator's residence at the Valley View Mine, in San Bernardino County, was equipped with a rock feature including a piped fountain (Hallaran and Wilke 1987:15–16). White (2017:60–81) discussed the ways in which companies established class structures in designated spaces. Historical archaeologist Mark P. Leone (1984) argued that gardens, rather than merely representing pleasurable diversions, could be mechanisms to wield power and prominence representative of class inequality (see also Mullins 2016:3).

The Beveridge Mining District, in Inyo County, was accessible only by extreme physical exertion over trails traversable on foot or by mule—even horses had difficulty navigating the paths, and no wagon roads were ever constructed. Inside cabins at the site, colorful magazine pictures and drawings (Figure 4.3) decorated cabin walls, and bound volumes of Shakespeare's works were cached in the rafters (Swope 1993:255–257).

Living in a remote cabin in north-central British Columbia from 1937 to 1941, where "for nine or ten months of the year, one is forced to spend much of the time inside," Theodora Stanwell-Fletcher (1946:52) wrote of how her husband had outfitted the dwelling: "Thanks to the trouble which he has taken over innumerable details, the cabin has become a never-failing source of comfort and pleasure. It is all the perfection of little things that makes a home in this land bearable."

Another type of small-scale environmental modification is related to mining technology. Because of the episodic nature of mining, as miners followed ore bodies, or as phases of mining were renewed, creating retaining walls or rock barriers or even moving waste rock dumps was often necessary to facilitate later activities. Such evidence is invaluable in recreating the sequence of events at a mining camp.

Figure 4.3. Drawings cut from magazine pages, nailed to the doorjamb inside a chemical-storage shed, Beveridge Mining District, Inyo County, 1992 (photographs by Karen K. Swope).

Large-Scale Environmental Modifications

That historical-period mining activities have resulted in large-scale environmental modifications cannot be denied. In his study of mining landscapes, Francaviglia (1991:3) wrote: "Rugged piles of fractured rock and colorful waste dumps are scattered amidst serene natural beauty; and everywhere our eyes are drawn . . . to the mega-scale features such as tailings ponds and towering ore dumps." The most obvious large-scale environmental modification created by hard-rock mining is its signature of excavations and dumps, which can reveal the nature, chronology, and number of mining activities that took place at a site. Mill tailings in sufficient quantity have blocked ephemeral washes (Figure 4.4), thereby changing drainage patterns in the immediate area.

Property types related to water catchment and conveyance, for domestic and/or mining purposes, are frequently found at desert mining sites, as water was essential for "excavation, dust control, equipment cooling, ore conveyance, metals recovery, and power generation" (White 2017:119). Included is the intentional damming of intermittent drainages. Although many of these dams (both earthen and concrete) have been breached in the postabandonment period by localized flash flooding, evidence of both water and tailings impoundment is commonly found. Water was recycled for use in mills, and tailings were stored against the day when improved technology could be used to recover more precious metal than was possible via earlier methods. These technologies may have been expedient, or engineered, and may be reflective of the economic conditions within which the mine operated.

The pinyon-juniper reserves of the Great Basin were systematically exploited to support regional mining, particularly in the period between the 1870s through the 1920s (Paher 1976:185; Young and Budy 1979:113). Mining camps consumed massive quantities of wood to fuel mining and milling machinery and for mine timbering and constructing buildings, as well as for domestic heating and cooking. Once the trees were exhausted in the area surrounding Bodie and other eastern California and western Nevada camps, it was necessary to exploit wood supplies from an ever-increasing area. Fuel was brought to the camps from the Sierra Nevada (Kersten 1964:501, 504; Young and Budy 1979:114). Cut pinyon stumps in the vicinity of mining sites attest to the intensive use of the resource.

Figure 4.4. Tailings flow, Yellow Aster Mine, Rand Mining District, showing the magnitude of landscape modification, 1993. Note that the tailings blocked the natural drainage but were later breached by erosion (photograph by Karen K. Swope).

Finally, town development results in large-scale environmental development. Sites like Randsburg, where streets, buildings, and structures remain in use today; Bodie, which survives as a semi-intact ghost town; and Hart, which, when it was the subject of archaeological investigation, remained as a series of roads, tent platforms, and refuse dumps, have an archaeological footprint that covers many acres.

No attempt has been made to compile and analyze information on environmental modification at mining sites in the Study Area. Data on exotic plants, identification of the various water-catchment and water-conveyance systems used in the California deserts, and comparisons of camp and townsite layout are all avenues of inquiry with research potential.

Research Questions

- What measures were taken by site occupants to ensure health, safety, and survival in the California desert environment? In what ways (construction techniques, embellishments) did site occupants respond to the environmental setting of the Study Area (temperature extremes, arid climate, sun exposure, and wildlife)?
- What evidence indicates that site occupants modified the environment for the purposes of comfort or aesthetics? What can be said about modification of personal space vs. corporately designed or managed spaces?
- What exotic plants remain at the site (e.g., shade trees, flowers, food plants, medicinal plants), and what do they indicate about the site occupants? Are species that might indicate the presence of certain ethnic or demographic groups present?
- How did mining activities at the site affect the surrounding environment? Does evidence remain of earthmoving for water/tailings impoundment?
- Did mining activities have a temporary or lasting impact on vegetation patterns? On drainage patterns? Does aerial-photographic evidence indicate changes over time in vegetation or drainage patterns?
- How do the physical site remains compare to descriptions of environmental modification (water-conveyance or water-catchment systems, for example) that may be described in contemporary accounts (reports of the State Mineralogist or newspaper articles, for example)?

Data Needs

Intact archaeological features exhibiting environmental modification are necessary to address this research theme. Proper identification of modified landscape elements is critical for accurate interpretation. Knowledge of native and exotic plant species is critical to interpreting modifications to the floral community at the site. The presence of cut tree stumps, particularly ax-cut (as opposed to saw-cut) tree stumps, indicates use on-site. Aerial photographs may indicate vegetation and drainage patterns before, during, and after mining activities, and it may be possible to compare aerial imagery taken soon after site abandonment with modern conditions. Evidence of imported building materials can provide data to address this research theme.

In order for a site to be eligible within this theme and under Criterion d, it would have to contain "critical information" that is applicable to important research questions regarding, for example, the domestic household or regarding the spatial organization of mining settlements. No attempts have been made to analyze data for domestic features in the Study Area with regard to their location as related to shade trees or exotic plants, for example.

Research Theme: Dynamic Capitalism

Historian William G. Robbins (1994:147) remarked that "the late nineteenth century was a remarkably tumultuous period in the development and expansion of worldwide capitalism" during which the U.S. West was changed from a "region dominated by preindustrial societies to a fully integrated segment of the modern world capitalist system." That shift is demonstrated in the innovations introduced by the Industrial Revolution in America and can be traced through the history of various industries, including that of hard-rock mining.

Historical archaeologist Mark P. Leone is recognized for urging historical inquiries that are socially relevant, particularly to the extent that they are "tied to the present" (Leone 1981:13). He advocated for historical archaeology attentive to the role of past constructs in contemporary inequalities (Leone et al. 1987) and called for archaeological investigations that consider capitalism a "system from which to interpret the past"—one "that archaeology may help illuminate" (Leone 1999:3–4).

Aschmann (1970:177, 183), in his study "The Natural History of a Mine," made observations on organization of labor from the viewpoint of cultural geography:

> [T]he largest possible fraction of the returns from a mining operation should reward the labor force that invariably performs exhausting, often dangerous work under conditions of isolation and social privation. . . . Even before laws favoring labor organizations were enacted . . . the stage of the stable operation of a mine was the one in which the worker could most effectively express his demands to the mine owner or operator. . . . Originally of diverse origins and sentiments, the workers had come to feel an identity of condition and purpose that could sustain a struggle for economic power.

More recently, Wurst and Mrozowski (2016:81) wrote that "discussions of capitalism are once more on the table." They applied these concepts to a nationwide archaeological case study involving the production and consumption of coal, linking "labor and the environment, past and present, to highlight the folly of seeing the exploitation of workers and the environment" as "an accepted part of capitalist economic development." They argue that historical archaeologists must explore dynamic capitalism in the coming decades if our investigations are to remain relevant. In the Study Area, the theme can be applied to questions such as the "ratio of surplus value to wages" accomplished, perhaps, (1) by the introduction of new machinery "that would increase productivity and decrease the amount of labor it takes to produce the goods necessary to cover the cost of workers' wages" or (2) by intensifying the "pressure on workers to work harder and produce more" (Wurst and Mrozowski 2016:82). Advances in mining technology adopted by the mining industry during the historical period provide a basis for investigating the process (Figure 4.5).

Both the mining study by Caltrans (2008) and the Caltrans (2013) historic context and research design for work-camp properties provide information related to investigations of capitalism. Areas of inquiry that can provide relevant data for studying capitalism include ethnicity, gender, immigration, labor conditions, labor organization/unionization, and corporate paternalism.

Mining sites in the Study Area can address specific aspects of this theme. For example, earlier mining operations in the California deserts (for the most part, precious-metals mines) typically were owned by individuals or partnerships, whereas later mining operations, such as tungsten mines in San Bernardino County, were more likely to be company owned and company operated than earlier, precious-metals mines. Mining sites can reflect the choices and capital of persons who may be identifiable in the archival record. Many of the small mines were big enough to have managers, foremen, and wage laborers. State Mineralogist reports are useful in determining the size of the labor force at a given mine.

Figure 4.5. The Valley View Mill, Hart Mining District, San Bernardino County, which converted commodities to keep up with changing economies, even operating with a single worker for a time, 1991 (photograph by Karen K. Swope).

Mining operations typically targeted high-grade ores; once these were depleted, they either moved on or attempted to extract values from lower-grade ores, sometimes by employing different equipment. "The profitable mining of low-grade ore bodies required working at greater economies of scale backed by significant financial investment. Deeper pockets permitted deeper mines, and deeper mines presented new technical challenges" (White 2017:21).

Mine workers frequently had to adjust equipment to the conditions encountered at a specific mine, because "ore bodies frequently change over the course of exploration. Variations in chemical composition, hardness, and the nature of surrounding rock impacted the performance of equipment from drill bits to ore processing machines" (White 2017:126).

In interpreting the time span during which a mining site operated, archaeologists must consider the potential for delays in adopting newer technologies at some mines. Such delays might reflect either a reluctance to embrace new technology or a lack of capital. Miners would not have invested in newer equipment after high-grade ores became exhausted. The State Mineralogist often reported his observations on the installation of new machinery and the number of men employed. Such archival information can be analyzed in concert with archaeological observations to assist with site interpretation (including chronology) and evaluation.

Research Questions

- What can be determined (through archival or archaeological inquiry) regarding extraction and beneficiation technologies in use at the site? If new technology was adopted during the site's operation, how quickly was the new technology implemented after it became available?
- Does the archival or archaeological record indicate environmental constraints (such as ore quality) that might have driven the type of technology employed at a specific mine?
- Did the mine have the benefit of professional mining engineers to assess the relative merits of installing specific equipment?
- What is revealed by delays in adoption of technology at specific sites? Is it possible to determine whether older methods were retained in preference to newer technologies? Because ore reserves were becoming depleted? Because of lack of capital to invest in new equipment? Does archival or archaeological evidence indicate a reduction in work force after the introduction of newer equipment? How does the situation at company-operated sites differ from the situation at those operated by individuals or small partnerships?
- How does milling technology employed at contract mills compare with that used at mills associated with a single mining company?
- Can the cause and effect of mine decline and closure be identified?
- Is there evidence of episodic or renewed mining at the site? Is this pattern reflective of economic trends or of decisions made by mine owners? If multiple episodes of mining/milling took place at the site, can archaeological loci or features related to the various episodes be identified?

Data Needs

Sufficient remaining evidence to allow identification of technologies employed at the site is necessary for addressing this theme. If equipment has been removed from the site, researchers may be able to determine the types of equipment installed there from inspecting the foundations, machinery mounts, and their arrangement and through archival research. Background information (mining industry publications) indicating production dates for mining machinery can assist in the identification and chronology of equipment at the site. Archival records listing ownership, labor arrangements, and machinery and equipment in use at a site would be similarly informative. Archival data, including government reports and newspaper articles, are informative with regard to the labor structure at a specific mine. Company records are rarely available but can be sought in the files of the California State Library. Comparative data for mining sites operating during the same period or employing similar technology are helpful in making correlations or contrasts.

The ability to identify the technology in use at a site is important but is not sufficient to render a site eligible under Criterion d. For a site to be eligible under Criterion d in relation to this research theme, the site would have to hold data potential to answer important questions related to technology and labor history. Noble and Spude (1997:17–18) stated: "Questions about mining technology . . . might require information about variability and change in architectural arrangements, the spatial arrangement of work-related activities, the arrangement and type of machinery, and landforms."

Research Theme: Character of Cabins Associated with Mining Sites in the California Desert

Cabins typically were associated with mining camps, both large and small. A cabin's character is a reflection of its design, function, use, history, and meaning to the mining site with which it is associated. The BLM has indicated the importance of better understanding historical-period cabins, because cabins associated with mining sites are often encountered in the Study Area.

To begin to understand a cabin's character, it is important to determine whether it is vernacular or designed. A vernacular cabin is one that was built based on local needs and materials, responded to function more than aesthetic, and reflected cultural or local traditions. Dell Upton and John Michael Vlach (1986:xvii) noted: “Vernacular builders use whatever materials are available and whatever skills they possess. As a result, techniques of construction vary widely, not only with the task at hand but with the locale.” A designed cabin is one that followed a drawing or plan, often prepared by a builder or architect. Determination of design type may assist in the identification of the designer or builder of the cabin, such as an individual (like a prospector or miner) or a company.

Interconnected to determining a cabin’s design is identification of the materials used in its construction and the sources of those materials. Paul White (2017:67) noted: “Mining camps materialized at alarming speeds and grew at a pace that had few precedents.” Expediency in developing accommodations took many forms, including the repurposing of water tanks or mine workings and the use of barrels, dynamite boxes, packing crates, automobile hoods, scrap metal, cardboard, waste rock, and railroad ties as building materials. Conversely, some novel forms of dwellings were not expedient; an example is the bottle house at Calico constructed of 5,419 bottles of varying sizes and colors (Peyton 2012a:102; White 2017:60–81).

Construction materials can provide temporal information (e.g., dimensional lumber, square nails, and asbestos-shingle siding) as well as potential clues to the builder and sources of those materials (e.g., brick or lumber stamps). Materials that are readily available on-site could indicate a vernacular construction with or without a design plan, whereas dimensioned lumber could indicate a designed cabin, a kit cabin, or a vernacular builder’s access to goods (e.g., nearby rail and freight lines). Multiple materials (Figure 4.6) may reflect multiple building episodes or a vernacular builder’s having used all materials at hand. As noted above, using recycled materials was a response to having meager resources. The technology in use at a cabin is also indicative of its function, use, and history. A cabin with multiple rooms, exterior porches or stoops, an electrical system, or indoor plumbing could reflect access to goods and funds by the builder or resident and potentially indicates long-term occupation.

Figure 4.6. Variety of materials used in building construction, Masonic, Mono County, 1992 (photograph by Karen K. Swope).

Cultural traditions can also be apparent in building design and construction, as noted by Stephen Van Wormer (2014:95) at the mining-camp townsite of Hedges, in Imperial County: "Architectural data indicated that construction methods reflected the use of both the traditional Hispanic and the blending and adaptation of Mexican-Sonoran and Anglo-American architectural traditions." Cultural traditions indicative of Hispanic cultures but not predictive of cultural affiliation included jacal construction, with upright sticks, poles, and brush plastered with mud; adobe-brick construction; some stacked-stone constructions; and flat roofs with mud-and-thatch coverings (Fernandez 2001:245–247; Van Wormer 2014). As discussed above, the Cousin Jack houses are often associated with Cornish miners (Peyton 2012b:31).

Although the availability of standard building materials does increase their use and the conformity of regional vernacular architecture, a region may still retain its distinctive vernacular traditions. At the Hedges townsite noted above, architectural styles of dwellings were based on vernacular traditions either brought by the builder (for the most part, Mexican-Sonoran architectural traditions) or borrowed from American vernacular designs. Because of this flexibility, there was an expanded repertoire of forms and materials from which to choose when constructing a building, and even a hybrid form emerged (Van Wormer 2014:113–114).

The physical form of cabins typically reflected a location's existing infrastructure, the financial standing of the owner or builder, local cultural traditions, and the development stage of the associated mine. Each cabin and its locale should be researched with respect to its proximity to supply lines and transportation networks, the point at which standard materials became available, the builder's or resident's access to local materials, its ownership by or association to mining companies, and local folk, cultural, and architectural traditions. Broad-based assumptions about the use of materials or architectural styles should be made carefully. Cabins made from locally available materials could reflect an early occupation, a lack of supplies available to the builder, absence of corporate support, or temporary nature of the work; however, previous investigations indicate that even when mining camps depended heavily on external supplies, miners still used local resources extensively (White 2017:66).

Another aspect of analyzing a cabin is looking at its placement on the landscape. Through an examination of the cabin's siting on the landscape, deliberate orientations may be recognizable (Figure 4.7). For example, is the cabin oriented to face or back a certain direction, mining site, or geographic feature or to take advantage of a geographic feature or weather pattern? The siting of a cabin may also be associated with its spatial relationships with (proximity to or distance from) other buildings, the mining site, or refuse-disposal areas. Is the cabin part of a larger camp or townsite plan? Another important observation with respect to placement is the mobility of a cabin (e.g., by wheels or skids) and if it has been moved. Understanding why a cabin is sited in its current location can provide information about its use and function and its association to the mining site.

The following research questions are designed to be answered about a cabin, without the existence or benefit of an archaeological record. These research questions would be applicable to any historical-period cabin (or other standing building) in the Study Area.

Research Questions

- Are any cultural traditions recognizable in the construction of the cabin?
- Are the cultural affiliations associated with this locale apparent in any cultural traditions recognizable in the construction of the cabin?
- In what ways did the cultural backgrounds or values of individuals working at this locale affect the design and construction of this cabin?

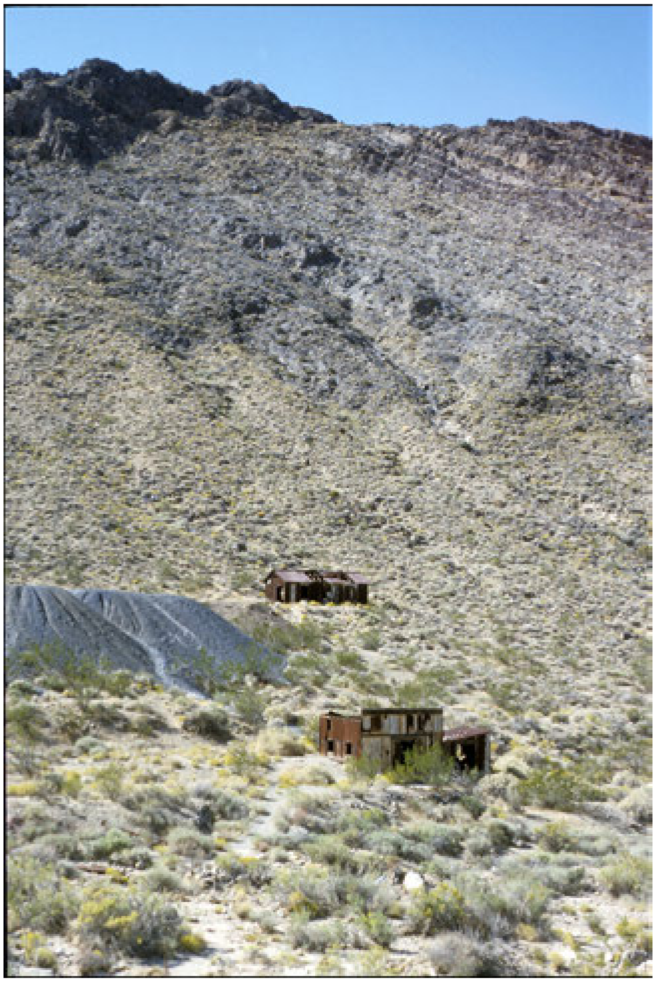

Figure 4.7. Siting of buildings on the landscape, Leadfield, Death Valley National Park, 2000 (photograph by Karen K. Swope).

Data Needs

The aforementioned research questions can be answered through observations of the cabin itself, in conjunction with a thorough examination of the historical record. As noted in the following chapter, the spectrum of archival materials available to elucidate the history of mining resources is broad and will not be presented again here. That said, the historical record should be reviewed throughout evaluation of a cabin, because it can provide insight during pre-field, in-field, and reporting efforts. Although on-site observations can address building materials and modifications, historical data would be required for the sources, availability, and temporal association of building materials.

With the rarity of built-environment resources listed in the NRHP under Criterion d, the threshold is high for Criterion d eligibility of a cabin. First, the cabin must have information to contribute to our understanding of the historical period. The cabin itself must be the principal source of data that can yield information through testing or research. Second, the acquired information must be important within its historic context and have a significant bearing on the research design. Examples of important information include data that fill significant gaps, provide alternative theories, or answer questions of high priority identified by an agency management plan. An example of a building eligible under Criterion d is as follows: "a building exhibiting a local variation on a standard design or construction technique can be eligible if study could yield important information, such as how local availability of materials or construction expertise affected the evolution of local building development" (Shrimpton 2002). A cabin eligible for listing in the NRHP under Criterion d must also retain integrity of location, design, materials, workmanship, and association.

Evaluation Procedures

When cultural resource management studies are conducted, we often forget that the story of mining is the story of people. Mining history is more than the physical presence of mines or mills. It is about new arrivals in a region, the creation of new towns, and the characteristic mining culture of boom and bust. It is about the mix of industrial workers of a region, the great cultural diversity, and the resulting social and political fabric. And, it is about the tale of innovators and entrepreneurs, opportunities and disappointments [Spude 1998:3].

This chapter presents procedures for evaluating mining sites with both archaeological and built-environment components. Procedures are discussed that have particular relevance in application in the Study Area. First, we offer guidelines for documentary and archival research in the Study Area. Next, we introduce field methods for inventory, significance testing, and data recovery. Study Area–specific procedures for site evaluation follow, including application of NRHP-eligibility Criteria a–d. A discussion of evaluation of built-environment resources is also included. The subsequent section presents a discussion of integrity, with examples drawn from the Study Area. Finally, reporting and curation standards are introduced.

Background, Archival, and Archaeological Records Research

In order to adequately identify, interpret, and evaluate historical-period mining sites, each project requires the performance of site-specific background and archival research. Both primary and secondary sources may provide useful information. As pointed out in BLM guidance (BLM n.d.b) for managing historical-period mining sites, researchers of mining history know that they must filter out the sensationalized treasure-hunting and lost-mine accounts; nevertheless, ghost-town reports sometimes provide useful bits of information with regard to archaeological remains. It is always best to trace information to a primary source.

Archaeological Records Search

Before fieldwork, background research should be performed to identify previous archaeological work performed in the project APE and the immediate surrounding vicinity. An archaeological records search should be obtained from the appropriate Information Center of the California Historical Resources Information System and the applicable BLM field office. Typically, data are collected for the project APE and a surrounding radius of 1 mile. The collected data may include previous archaeological investigation reports, archaeological site records, NRHP-eligible properties, and regional data, including potential historic contexts for evaluating site eligibility. The possible presence in the project area of prehistoric archaeological sites, Native American traditional cultural properties (TCPs), or places of cultural or religious importance to Native Americans should be taken into account. The archaeological-records-search radius and the types of documentation to be collected should be determined on a project-specific basis.

Background and Archival Research

In addition to the comprehensive *Desert Fever* volume, the online BLM Library contains numerous overviews (Table 5.1) that present the history of portions of the California deserts. Although most of these documents are now decades old, they nevertheless provide a valuable baseline of regional information upon which researchers can build site-specific histories. Some include lists of archives that might contain primary data useful in current studies. Other management plans, wilderness studies, and environmental documents available in the BLM Library contain brief historical overviews pointing investigators to pertinent information.

Another BLM resource that is critical in historical research is the database of GLO records, which is available online at the Official Federal Land Records Web site. The database contains federal land-conveyance records, including survey plat maps, surveyor's notes, land-title patents, and land-status records.

Government periodic reports usually provide the best historical information for details of a mine's operation. A periodic report sometimes includes descriptions of the machinery in use, the number of workers employed, the extent of underground development, and an assessment of ore values achieved or a prospectus of those anticipated. Researchers may find the required government reports in the California State Library or in regional university libraries, but over the years, many volumes have become lost, and many hard copy versions are unavailable. Historians have found that this situation is most acute in libraries near the region covered by the missing volume. As digital documents are increasingly available, these irreplaceable original documents are more frequently curated in library storage. Fortunately, digital versions of government documents are available for research. Bureau of Mines publications, housed at the MSHA Technical Information Center and Library, are available in their online digital library, and its primary records are curated at the U.S. National Archives and Records Administration. Some reports cover California topics, and others focus on themes of mining safety and technology.

Table 5.1. Historical Overviews for the California Desert in the BLM Library

Report Title	Date	Author(s)/Editor(s)
An Overview of the Cultural Resources of the Western Mojave Desert	1980	E. Gary Stickel, Lois J. Weinman-Roberts, Rainer Berger, and Pare Hopa
Background to Historic and Prehistoric Resources of the East Mojave Desert Region	1981	Chester King and Dennis G. Casebier
Current Status of CRM Archaeology in the Great Basin	1986	C. Melvin Aikens (editor)
A Cultural Resource Overview of the Eureka, Saline, Panamint, and Darwin Region; East Central California	1980	Richard H. Norwood, Charles S. Bull, and Ronald Quinn
Cultural Resources of the California Desert, 1776–1880: Historic Trails and Wagon Roads	1981	Elizabeth von Till Warren and Ralph J. Roske
A History of Land Use in the California Desert Conservation Area	1978	Frank Norris and Richard L. Carrico
The California Desert Mineral Symposium: Compendium	1989	BLM
Impacts: Damage to Cultural Resources in the California Desert	1980	Margaret M. Lyneis, David L. Weide, and Elizabeth von Till Warren
A Cultural Resources Overview of the Colorado Desert Planning Units	1981	Elizabeth von Till Warren, Robert H. Crabtree, Claude N. Warren, Martha Knack, and Richard McCarty
The Archaeology of the Western Mojave	1979	Gary B. Coombs
An Archaeological Inventory Report of the Owlshead/Amargosa–Mojave Basin Planning Units of the Southern California Desert Area	1981	Richard H. Brooks, Richard Wilson, and Sheilagh Brooks
Background to Prehistory of the El Paso/Red Mountain Desert Region	1981	Matthew C. Hall and James P. Barker
Cultural Resources Inventory of the Central Mojave and Colorado Desert Regions, California	1980	Dennis Gallegos, Emma Lou Davis, Gary Lowe, Frank Norris, and Jay Thesken

Key: BLM = U.S. Department of the Interior Bureau of Land Management; CRM = cultural resource management.

It is imperative that researchers recognize the strong relationship between the geology of ore deposits and the methods used to exploit them (Brick et al. 1998). Most state and federal mining documents contain important details on the nature of ore deposits and descriptions of local geology. The online California Geological Survey Digital Archive contains a wealth of documentation, including reports of the State Mineralogist and county registers of mines. In light of the Gold Rush and statehood, the newly designated California legislature recognized the importance of understanding the state's mineral resources and appointed Dr. John B. Trask as honorary State Geologist in 1851. The California legislature established the Geological Survey of California in 1860 and created the Office of the State Geologist. In April 1880, the state legislature established the California State Mining Bureau. The legislation charged a State Mineralogist with collecting and preserving for study and reference specimens of all of the geological and mineralogical substances found in the state. The State Mineralogist began producing an annual report detailing the bureau's activities. In 1927, the California State Mining Bureau became the Division of Mines and was placed within the Department of Natural Resources. In 1962, the Division of Mines became the California Division of Mines and Geology. In 2006, the Division of Mines and Geology became the California Geological Survey (California Department of Conservation 2017a; California State Mining Bureau 1880:3–4).

The aforementioned legislation that created the State Mining Bureau in 1880 required the State Mineralogist to "make a report in detail to the Governor, showing the amount of disbursements of the Bureau under his charge, the number of specimens collected, and giving such statistical information in reference to mines and mining as shall be deemed important" (California Geological Survey Digital Archive 2017a). The *Report of the State Mineralogist* materialized from this directive. These reports were produced annually from 1880 to 1890, biannually from 1891 to 1896, biannually from 1914 to 1922, and annually from 1923 to 1961. From 1947 to 1958, the name of the annual report was changed to *California Journal of Mines and Geology*. In 1965, the name of the annual report was changed to *Report of the State Geologist*. No reports were produced between 1897 and 1913 or between 1962 and 1964. Through the 1950s, the reports focused on mines and minerals of California and were organized primarily by departmental district, county, mineral or commodity, mining district, and mine name. Additionally, the reports included regional geology and mineral production articles, maps, drawings, and photographs. Maps (e.g., geologic, mines and prospects, workings, claims) were produced in conjunction with the reports and were either embedded in the text or folded in an attached pocket (California Geological Survey Digital Archive 2017a, 2017b). Important volumes for the study area are the following:

- *Sixth Annual Report of the State Mineralogist, Part I, for the Year Ending June 1, 1886* (covers San Diego and present-day Imperial and Riverside Counties) (Hanks 1886)
- *Eighth Annual Report of the State Mineralogist, for the Year Ending October 1, 1888* (covers Inyo, Kern, Los Angeles, Mono, San Bernardino, and San Diego, and present-day Imperial, Orange, and Riverside Counties) (Irelan 1888)
- *Ninth Annual Report of the State Mineralogist, for the Year Ending December 1, 1889* (covers Los Angeles, San Bernardino, and San Diego, and present-day Riverside, Orange, and Imperial Counties) (Irelan 1890a)
- *Tenth Annual Report of the State Mineralogist, for the Year Ending December 1, 1890* (covers Inyo, Kern, Los Angeles, Mono, Orange, San Bernardino, and San Diego, and present-day Riverside and Imperial Counties) (Irelan 1890b)
- *Eleventh Report of the State Mineralogist (First Biennial), Two Years Ending September 15, 1892* (covers Kern, Los Angeles, Orange, San Bernardino, and San Diego, and present-day Riverside and Imperial Counties) (Irelan 1893)
- *Twelfth Report of the State Mineralogist (Second Biennial), Two Years Ending September 15, 1894* (covers Inyo and Mono Counties) (Crawford 1894)
- *Report XIV of the State Mineralogist: Mines and Mineral Resources of Portions of California; Chapters of State Mineralogist's Report Biennial Period 1913–1914* (covers Imperial, Kern, and San Diego Counties) (Hamilton 1916)

- *Report XV of the State Mineralogist: Mines and Mineral Resources of Portions of California; Chapters of State Mineralogist's Report Biennial Period 1915–1916* (covers Inyo, Los Angeles, Mono, Orange, Riverside, and San Bernardino Counties) (Hamilton 1919)
- *Report XVII of the State Mineralogist: Mining in California during 1920* (covers Imperial Inyo, Kern, Los Angeles, Mono, Riverside, San Bernardino, and San Diego Counties) (Hamilton 1921)
- *Report XVIII of the State Mineralogist Covering Mining in California and the Activities of the State Mining Bureau during 1922* (covers Mono County) (Hamilton 1923a)
- *Report XIX of the State Mineralogist Covering Mining in California and the Activities of the State Mining Bureau* (covers Kern and San Bernardino Counties) (Hamilton 1923b)
- *Report XX of the State Mineralogist Covering Mining in California and the Activities of the State Mining Bureau* (covers Imperial, Inyo, Kern, Riverside, and San Diego Counties) (Root 1924)
- *Report XXI of the State Mineralogist Covering Mining in California and the Activities of the State Mining Bureau* (covers Orange, Riverside and San Diego Counties) (Root 1925)
- *Report XXII of the State Mineralogist Covering Mining in California and the Activities of the State Mining Bureau* (covers Imperial and Inyo Counties) (Root 1926)
- *Report XXIII of the State Mineralogist Covering Mining in California and the Activities of the State Mining Bureau* (covers Los Angeles and Mono Counties) (Root 1927)
- *Report XXV of the State Mineralogist Covering Mining in California and the Activities of the Division of Mines* (covers Kern and Riverside Counties) (Bradley 1929)
- *Report XXVI of the State Mineralogist Covering Activities of the Division of Mines Including the Geologic Branch* (covers San Bernardino County) (Bradley 1930)
- *Report XXVII of the State Mineralogist Covering Activities of the Division of Mines Including the Geologic Branch* (covers San Bernardino County) (Bradley 1931)
- *California Journal of Mines and Geology; Quarterly Chapters of State Mineralogist's Report XXIX* (covers Kern County) (Bradley 1933)
- *California Journal of Mines and Geology; Quarterly Chapters of State Mineralogist's Report XXXIII* (covers Los Angeles County) (Bradley 1937)
- *California Journal of Mines and Geology; Quarterly Chapters of State Mineralogist's Report XXXIV* (covers Inyo County) (Bradley 1938)
- *California Journal of Mines and Geology; Quarterly Chapters of State Mineralogist's Report XXXV* (covers San Diego County) (Bradley 1939)
- *California Journal of Mines and Geology; Quarterly Chapters of State Mineralogist's Report XXXVI* (covers Mono County) (Bradley 1940)
- *California Journal of Mines and Geology; Quarterly Chapters of State Mineralogist's Report XXXVIII* (covers Imperial County) (Bradley 1942)
- *California Journal of Mines and Geology; Quarterly Chapters of State Mineralogist's Report XXXIX* (covers San Bernardino County) (Bradley 1943)
- *California Journal of Mines and Geology; Quarterly Chapters of State Mineralogist's Report XLI* (covers Riverside County) (Bradley 1945a)
- *California Journal of Mines and Geology* 45(2) (covers Kern County) (see Tucker et al. 1949)
- *California Journal of Mines and Geology* 47(1) (covers Inyo County) (see Norman and Stewart 1951)
- *California Journal of Mines and Geology* 49(1–2) (covers San Bernardino County) (see Wright et al. 1953)
- *California Journal of Mines and Geology* 50(3–4) (covers Los Angeles County) (see Gay and Hoffman 1954)

In 1945, the Division of Mines published a comprehensive index entitled *Consolidated Index of Publications of the Division of Mines and Predecessor State Mining Bureau 1880–1943* (Bradley 1945b). The index included a variety of topics, including counties, mining districts, mines, and owners. As of the 1960s, the focus of the reports shifted from mines and minerals of California to geologic hazards and became broader in topics.

Subsequently, the California Division of Mines and Geology developed a complete bibliography entitled *Bibliography of California Division of Mines and Geology Publications to January 1976* (Oakeshott 1986).

Between 1898 and 1905, the California State Mining Bureau also published county registers of mines for 21 counties across the state. The reports included maps and tabulated data for historic (no longer operating) and operating mines, mills, arrastras, and mineral springs (California Geological Survey Digital Archive 2017c). Important volumes for the study area are the following:

- *Register of Mines and Minerals: San Bernardino County, California* (Bailey 1902)
- *Register of Mines and Minerals: Inyo County, California* (Davidson 1902)
- *Register of Mines and Minerals: San Diego County, California* (Hubon 1902)
- *Register of Mines and Minerals: Kern County, California* (Aubury 1904)

The California Geological Survey developed two additional publications. The first was a popular or public-audience magazine from 1948 to 2001, initially called *Mineral Information Service* (1948–1970) and later called *California Geology* (1971–2001). These issues can be searched through the California Geological Survey's Online California Geology Magazine Database. The second was the *Bulletin of the California Division of Mines and Geology*. Published from 1888 to 2001 by the California State Mining Bureau and its predecessor agencies, the series included geologic maps, guidebooks, and information on mines and minerals, mining law, and mining history. These documents have been digitized by the Internet Archive and are available as part of the California Mines Geological Collection (California Department of Conservation 2017b; Internet Archive 2017). Volumes important to the Study Area include the following:

- *Mines and Mineral Resources of Kern County, California* (County Report 1) (Troxel and Morton 1962)
- *Geology and Mineral Resources of San Diego County, California* (County Report 3) (Weber 1963)
- *Geology and Mineral Resources of Imperial County, California* (County Report 7) (Morton 1977)

The Internet Archive includes other volumes (often extracted and republished sections from the annual reports) produced by the California State Mining Bureau that are important to the Study Area:

- *Geology and Mineral Resources of San Diego and Imperial Counties* (Merrill 1914)
- *Mines and Mineral Resources of the Counties of Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus* (Bradley et al. 1915)
- *Mines and Mineral Resources of Alpine County, Inyo County, and Mono County* (Eakle et al. 1917)
- *Mines and Mineral Resources of Los Angeles County, Orange County, Riverside County* (Merrill 1917)
- *Mines and Mineral Resources of San Bernardino County, Tulare County* (Cloudman et al. 1917)

County government offices (such as the Office of the Recorder) often maintain records that are significant to historical mining research, including county parcel/official maps, deeds, mining claims, proofs of labor, tax assessments, voter registration rolls, liquor licenses, and county court litigation records dating back to the establishment of the county. Counties also sometimes have U.S. Census records, although these are now widely available online. Sometimes county historical records and files have been lost, have been curated in a county archive facility, or have been given to a local historical museum. Though not as useful for developing broad regional historic contexts, county records can be invaluable to developing site-specific contexts, including individual histories, if the researcher has the time to locate and delve into these kinds of records (which may not be well organized or easily searchable and may have illegible sections).

Additional background and archival research may be possible and appropriate after mining and milling technology is identified at a site—it is certainly a necessary component of site interpretation and evaluation. Armed with the detailed information from government reports, researchers can consult the various period technical publications and more recent works describing and sometimes illustrating specific mining machinery; the following are just a few examples:

- *The Cyanide Process, Its Practical Application and Economical Results* (Scheidel 1894)
- *Practical Notes on the Cyanide Process* (Bosqui 1899)
- *Text Book of Cyanide Practice* (MacFarren 1912)
- *Textbook of Ore Dressing* (Richards and Locke 1940)
- *Practical Mine Development and Equipment* (Eaton 1934)
- *Compressed Air in Mining and Industry* (North 1951)
- *Ventilation of Mines* (Weeks 1926)
- Various editions of *Mining Engineers' Handbook* (e.g., Peele 1918)

USGS Water-Supply Papers list important desert water sources (rivers and springs) in the Study Area and describe the historical routes leading to them. Many roads and trails are noted as used mainly by prospectors. Where water sources had been developed at the time of the report, improvements are mentioned in the descriptions. The reports are available online at the USGS Publications Warehouse. Some of those covering the Study Area are the following:

- *Some Desert Watering Places in Southeastern California and Southwestern Nevada* (Mendenhall 1909)
- *Routes to Desert Watering Places in the Mohave Desert Region, California* (Thompson 1921)
- *Salton Sea Region, California: A Geographic, Geologic, and Hydrologic Reconnaissance, with a Guide to Desert Watering Places* (Brown 1922)
- *Water Resources of Antelope Valley, California* (Johnson 1911)
- *Springs of California* (Waring 1915)
- *Geology and Water Resources of Owens Valley, California* (Lee 1906)

Additional information related to flood control and water-conveyance and water-storage facilities in the Study Area may be available in local water-district offices.

Repositories such as libraries, museums, and historical societies may contain information on the history of the project area (Table 5.2). Sources that should be consulted include local, regional, and statewide histories; historical maps (USGS and others) (Figures 5.1 and 5.2); historical aerial photographs (see Figure 2.20); land patents; land-entry files; mining claims and mineral surveys; and newspaper records.

Historical Aerial Photographs

Historical aerial photographs can be used to date districts, buildings, structures, objects, and sites. Furthermore, aerial photographs can provide perspective on historical land-use patterns, transportation routes, and spatial organization. Online repositories for viewing aerial photographs include the following:

- U.S. Geological Survey EarthExplorer
- Historic Aerials by Nationwide Environmental Title Research (NETROnline)

Other repositories that provide primarily on-site viewing of aerial photographs include the following:

- Some California Historical Resources Information System (CHRIS) Information Centers
- Regional historical societies and libraries
- Regional universities
    - Aerial Imagery Research Service, University of California, Santa Barbara
    - Air Photo Archive, University of California, Los Angeles
    - Earth Sciences and Map Library, University of California, Berkeley
    - Map Collection, University of California, Davis
    - Water Resources Institute, California State University, San Bernardino
- County agencies
    - Cartographic Services Section, Department of Public Works, County of San Diego
    - Engineering, Surveying and Permit Services, County of Kern
    - Flood Control and Water Conservation District, County of Riverside
    - Flood Control District, Department of Public Works, County of San Bernardino
    - Public Works Department, County of Inyo
    - Public Works Department, County of Orange
    - Public Works Department, Engineering Division, County of Imperial
    - Water Department, County of Inyo

Table 5.2. Resources and Repositories for Research Related to Historical-Period Mining Properties

Agency, Repository, or Resource	Collection	Description
BLM	mineral surveys	Shows legal boundaries of mineral deposits or ore-bearing formations on the public domain; may describe physical improvements.
	township survey plat maps	May show patented claims, buildings, roads, trails. Accompanying surveyor's field notes may contain additional descriptions.
	claim occupancy case files	May contain photographs, maps, Mineral Survey data, interviews with claimants, chain of title documentation (for resolved or unresolved cases).
USGS	National Mineral Information Center	Repository for more than a century of mineral statistics from the USGS, the U.S. Bureau of Mines, and the U.S. Department of Commerce.
	Mineral Resources Data System	Mine location data.
Office of Surface Mining Reclamation and Enforcement	National Mine Map Repository	More than 180,000 maps of closed/abandoned mines.
Secretary of War records		For minerals considered strategic to war effort.
Historical maps		
City directories		Sometimes include outlying portions of counties; may contain mining company information and information on mine workers.
Sanborn Fire Insurance maps		Historical plan-view maps of communities, showing roads; infrastructure (e.g., hydrants, pipelines); and building shapes, uses, and construction details.
Newspapers		Sometimes provide details of mine development but may include biased promotional information.
Assessor's Office	tax records	Information on the assessed value of land and improvements.
Title company	property-title records	Information on transfer of ownership.
State Lands Office		
Irrigation/farming records		
U.S. Federal Census	census records	Demographic information on individuals and domestic groups.
	vital records	Demographic information on individuals.
Oral histories/oral interviews		Firsthand accounts.
Mining-company records		Production records, capital outlay.
	court records	Information regarding company litigation and labor actions.
Local museums	local-history records, photograph collections	
Local historical societies	local-history records, photograph collections	

Key: BLM = U.S. Department of the Interior Bureau of Land Management; USGS = U.S. Geological Survey.

General Land Office Records

Land patents, land-entry files, mining claims, and mineral surveys are all products of the United States General Land Office. Begun in 1812 as an independent agency of the United States government, it was merged with the U.S. Grazing Service to become the BLM in 1946. Land-patent data are available remotely on the BLM's Official Federal Land Records Web site, whereas land-entry files are available by order through the National Archives and Records Administration. Land-patent data are federal land-conveyance records, whereas land-entry files consist of the paperwork generated by the United States government in support of those conveyance records, such as payment receipts; purchase applications; and evidence of military service, residence, land improvement, or citizenship. Mining-claim records are available for public inspection at the BLM State Office in Sacramento. Information about unpatented mining claims located on federal lands is available online through the BLM's Legacy Rehost System (or LR2000). Information on patented mining claims can be found in local government records, such as those held by the county recorder's office. This information was not filed at the federal level until 1979, because of changes made by the 1976 Federal Land Policy and Management Act. Mineral surveys mark the legal boundaries of mineral deposits or ore-bearing formations within public lands. These are official surveys executed by a U.S. Mineral Surveyor under the direction of a BLM Cadastral Chief in the jurisdiction where the mining claim lies or is located. Some Mineral Surveys are available remotely on the BLM's Official Federal Land Records Web site or in regional field offices (BLM 2017a, 2017b; Public Land Survey System Foundation 2009; Larry Vredenburgh, personal communication 2017).

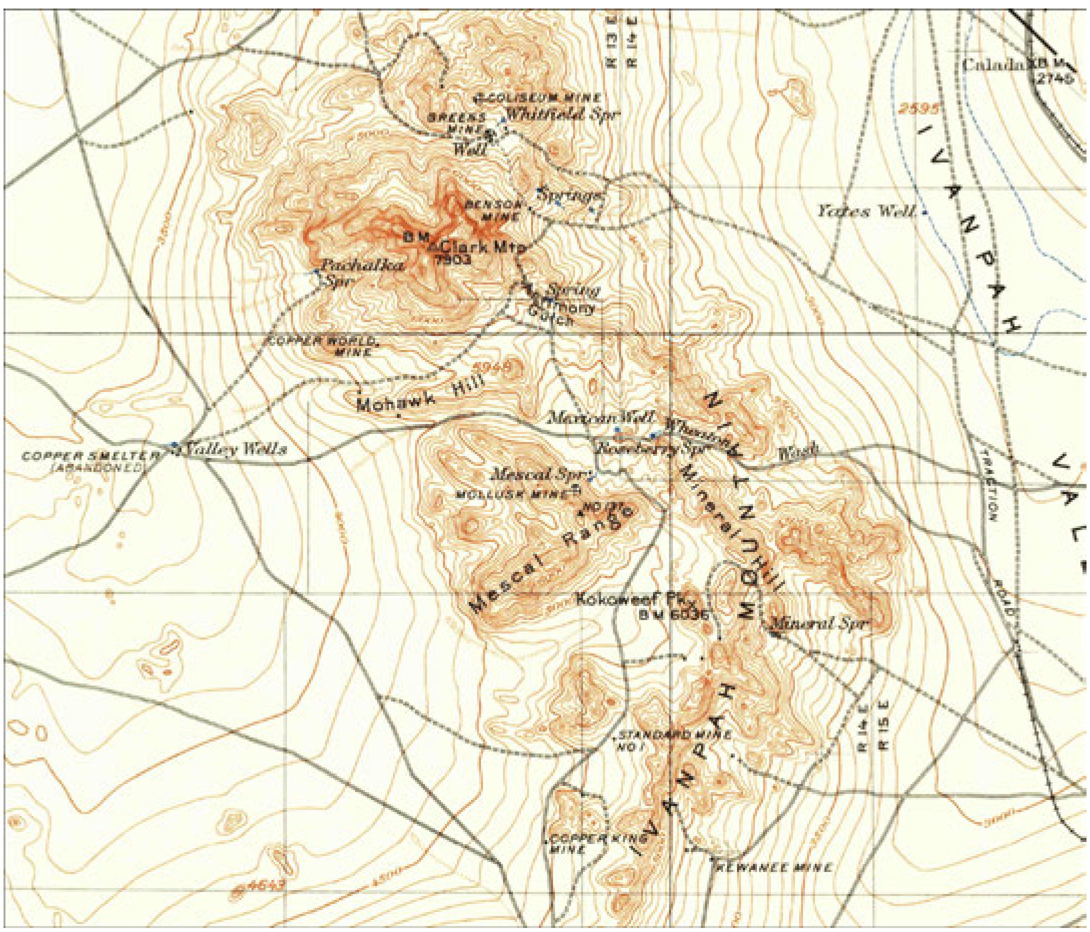

Figure 5.1. Historical U.S. Geological Survey map of the Ivanpah quadrangle in 1910, showing the locations of mining activities.

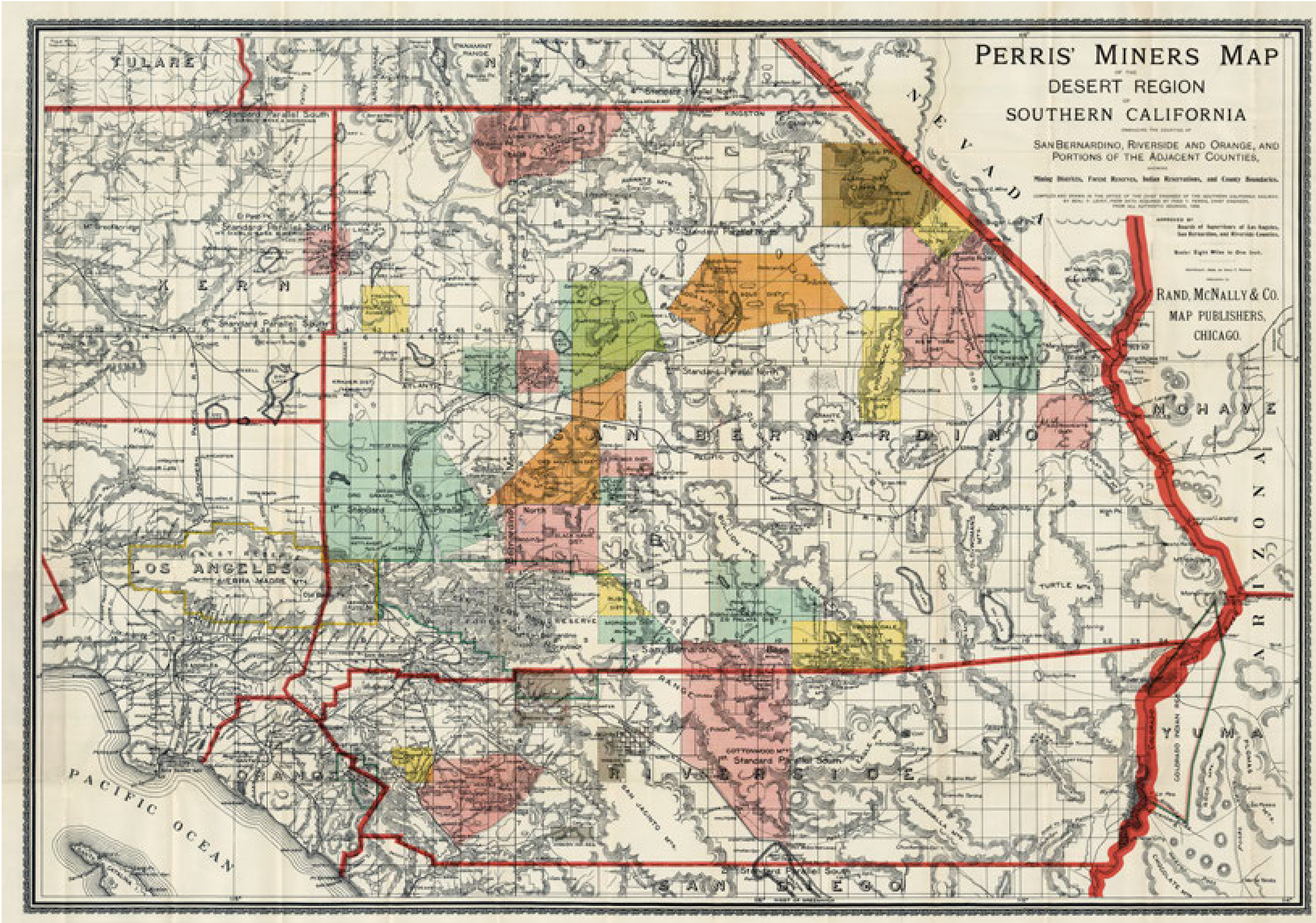

Figure 5.2. ***Perris' Miners Map of the Desert Region of Southern California Embracing the Counties of San Bernardino, Riverside and Orange, and Portions of the Adjacent Counties, Showing Mining Districts, Forest Reserves, Indian Reservations, and County Boundaries*** **(Perris [1896], digitally reproduced by Cartography Associates from the David Rumsey historical-map collection).**

In the following paragraphs, we list for the Study Area some of the most important published works containing information on historical-period mining, as well as principal sources for other materials, such as mining-industry reports. This is not a comprehensive list, and new resources are sure to become available in the form of new publications and newly digitized archival materials.

Several key sources remain the standards among published overviews on California desert mining history, although some were written decades ago. The two iterations of *Desert Fever* (Shumway et al. 1980; Vredenburgh et al. 1981) remain a primary source for most of the Study Area. William Clark's (1970) *Gold Districts of California* is a good starting point for finding information on particular gold mining sites. This book is organized by district, each with a bibliography that usually cites the government reports covering the district or mine. We do not list here the many other published works that focus on the history of specific mining districts, towns, or mines, and which researchers will seek out as needed for specific projects.

The *M&SP* and the *E&MJ* are good sources for primary historical data specific to the mining industry. The *M&SP* (issued also as *The Scientific Press* and *The Scientific Press and Mining Advocate*) was published weekly from 1860 to 1922. After that date, it was combined with the *E&MJ* to form the *Engineering and Mining Journal-Press*. Articles in both technical journals covered new technological developments, news from mines or districts, and news about mining personages. Full volumes of the *M&SP* are available in digital, paper, and microform format from the California State Library (digital versions on their Web site), and an index of named California mines appearing in the volumes can be found on the California Department of Conservation's Mineral Resources Web page. Full volumes of the *E&MJ* can be accessed in digital format on the HathiTrust Digital Library Web site.

It is particularly satisfying to find tangible correspondence between the archaeological and the archival records. At Chloride Cliff, Inyo County a historical-period petroglyph (Figure 5.3) reading "L.M./'30." could be attributed to Louis McCrea of Beatty, Nevada, who held claims in the immediate area beginning in 1925. When archival research is completed in advance of field studies, it is sometimes possible to collect repeat photographic views of historical-period vistas. The comparisons are invaluable in site interpretations and in identifying post-abandonment site-formation processes.

Overview of California Desert Mining History

Among the books on mining towns and camps that present solid historical data are the following:

- *The Bonanza Trail: Ghost Towns and Mining Camps of the West* (Wolle 1953)
- *Ghost Towns and Mining Camps of California: A History and Guide* (Nadeau 1992)
- *California Gold Camps: A Geographical and Historical Dictionary of Camps, Towns, and Localities Where Gold Was Found and Mined; Wayside Stations and Trading Centers* (Gudde 1975)

The California Mines Series published by La Siesta Press between the 1960s and 1980s (most of the volumes of which have been reprinted and/or revised) were authored by local historical experts and are generally considered reliable sources. These include the following:

- *Mines of Death Valley* (Belden 1998)
- *Mines of the Eastern Sierra* (DeDecker 1993)
- *Mines of Julian* (Ellsberg 1989)
- *Mines of the East Fork* (Robinson 1992)
- *Mines of the High Desert* (Miller 1998)
- *Mines of the Mojave* (Miller and Miller 1992)
- *Mines of the San Bernardinos* (Robinson 1985)
- *Mines of the San Gabriels* (Robinson 1990)

The most recent work on the history of mining in the Death Valley region is the following:

- *Ghost Towns of Death Valley* (Palazzo 2014)

The history of mining in the eastern California region is presented in the following:

- *High Mountains & Deep Valleys: The Gold Bonanza Days* (Clark and Clark 1978)
- *The Silver Seekers: They Tamed California's Last Frontier* (Nadeau 1999)

Mining history in the Colorado River region is presented in the following:

- *Mining Camps and Ghost Towns: A History of Mining in Arizona and California along the Lower Colorado* (Love 1974)

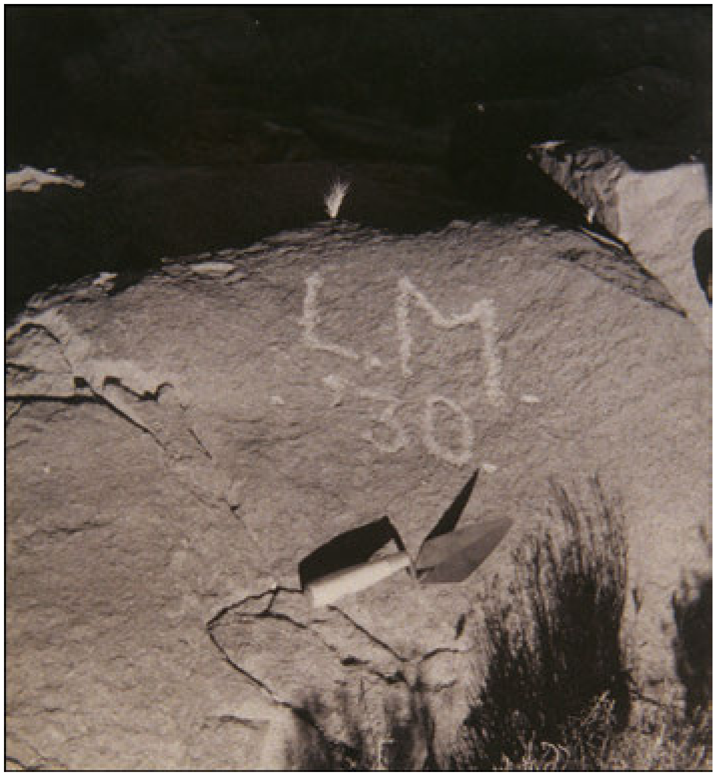

Figure 5.3. Historical-period petroglyph attributed to the mining work of Louis McCrea, Chloride Cliff, Death Valley National Park, 1998 (photograph by Karen K. Swope).

Given the number of historical California newspapers now available digitally, this type of research is sometimes viable even for BLM Class I (existing information inventory) studies. Online subscription services, such as newspapers.com (by ancestry.com) provide searchable access to global publications. The California Newspaper Project is the "most comprehensive source of information about California newspapers," containing details about nearly 9,000 newspapers that were published in California (Regents of the University of California 2017a). The database is updated periodically and is an invaluable tool for leading researchers to repositories holding materials pertinent to specific locations. The California Digital Newspaper Collection (Regents of the University of California 2017b) contains more than 1,500,000 digitized pages of California newspapers dating from 1846 to the present, and it is online and searchable.

Regional, and even distant, cities carried regular reports on mining discoveries in remote districts. Their promotional bias must be considered, however, because this was one of the primary ways in which speculators were enticed to invest in distant enterprises. With respect to eastern California mines, Lee (1963:72) wrote: "None ever quite matched in output the wealth of hyperbole expended on them by press agents." The newspapers of cities and towns that grew out of mining camps or that were located near mining districts contain some of the best information on persons and events associated with local mines. Finally, some mining camps in the Study Area were large enough, and operated long enough, to have their own newspapers, some of which are available for research. The *Calico Print*, for example, was published in Calico, California, from 1882 to 1887; big-city newspapers frequently carried quotes from it (Staples 1960). Brigandi (1996:58–93) prepared a history of newspapers, reporters, and editors operating in the Death Valley region. An informal search of the California Newspaper Project database for references produced in the Study Area yielded 7 newspapers published in Randsburg and 16 published in Julian!

A number of firsthand accounts of mining experiences in the Study Area have been published and provide unmatched comparative data for the California desert region. Some were transcribed by descendants or close friends. Crampton's (1956) *Deep Enough* relates his time working in the mining camps of eastern California and western Nevada. The memoirs of Lucy Bell Lane recount her life in the mining camps of California and Nevada, particularly Calico (Baltazar 1993). One family's gold-mining enterprise in Blackhawk Canyon, San Bernardino Mountains, continued from the 1880s to the 1980s; the story was told by Walter Del Mar (1998). John Snorf's *Early Days at Hart* (Snorf and Snorf 1991) reports on his time in that camp in the 1910s. Florence Smitheram's recollections of life at Borate at the turn of the twentieth century were transcribed by her grandson (Smitheram 1997:1–7). Ella Cain (1956) wrote the story of her life at Bodie. Edna Calkins Price (1973) recounted the experiences she and her husband had while prospecting in the deserts of California and Arizona during the 1930s. The Death Valley story of Pete Aguereberry was written by his friend George Pipkin (1982). Among the most scholarly are the works of historian Remi Nadeau, who, though not present to see the events firsthand, was the great-great grandson of Remi Nadeau, "King of the Desert Freighters," who operated 20-mule teams throughout much of the Study Area (*Los Angeles Times* 2016). Nadeau published *Ghost Towns and Mining Camps of California: A History and Guide* (Nadeau 1992), and *The Silver Seekers: They Tamed California's Last Frontier* (Nadeau 1999). Another ambitious retelling by a descendant is Wynn's (1963) *Desert Bonanza: The Story of Early Randsburg, Mojave Desert Mining Camp.*

Myrick (1962, 1963) remains the primary reference for historical information on railroads of eastern California, including data on routes that served numerous mining locales. A more recent summary of railroads in the Mojave Desert was prepared by Chappell (n.d.).

Historic-Context Development

As discussed Chapter 2, a historic context presents meaningful segments of the history of a particular geographic area by placing research themes or problems in an appropriate setting in both time and place. The quote introducing this chapter reminds us of the importance of site-specific historic context in understanding and evaluating mining sites. In addition to data gained through an archaeological records search, background information to support the historic context is gleaned through archival research, as described above.

Historical documentation will provide information about the chronology and productivity of mines in the district and will sometimes provide a name for the mine or claim, names of associated individuals, types of machinery that operated there, and more.

An aspect of the historical context is to compare/contrast the mine with others that produced the same commodity in other parts of the Study Area or with other mines that operated during the same time period, even if they produced a different mineral commodity.

National Register Bulletin 42, *Guidelines for Identifying, Evaluating, and Registering Historic Mining Properties* (Noble and Spude 1997:3), condensed the concept of historic contexts for mining properties as "a particular theme that is further delineated by a time period and a geographic area," providing the example of "Silver Production in Butte, Montana, 1879–1893" and stating: "[T]he theme component of the context will revolve around some aspect of mining history [and] should attempt to span the period from the time of a mining region's initial discovery to the point of its abandonment or decline." The themes presented in Chapter 2 shaped the history of mining in the Study Area, and it should be possible to associate a mine with one or more of those themes. The guidance provided in National Register Bulletin 42 outlines the steps for defining and demonstrating the theme, period, and geographic components of the historic context. In brief, the theme should not be defined too narrowly and should consider mining technology, transportation, water systems, domestic elements, labor concerns, ethnic groups, and prominent figures (Noble and Spude 1997:3). The time frame should encompass the period from mineral discovery to decline or abandonment, typically including discovery, boom, maturation, and bust, with the potential for resurgence (Noble and Spude 1997:3). The geographic component can reflect political boundaries or land-management units, a specific mining district, or a broader mining region (Noble and Spude 1997:3–4).

Field Methods

First and foremost, cultural resource practitioners working at mining sites must use extreme caution and adhere to project safety measures. National Register Bulletin 42 (Noble and Spude 1997:6) states: "Mines present special hazards with potentially lethal consequences. Field personnel should be trained in, familiar with, and able to recognize mining-related dangers prior to conducting field work."

Field methods for the identification and recordation of historical-period hard-rock-mining sites was provided in BLM National Training Center Course 8100-10, Managing Historic Period Mining Resources (BLM n.d.b), and the Caltrans research design for mining properties in California (Caltrans 2008). Researchers are urged to review and implement the guidance provided in those documents. Here, we offer some suggestions for mapping and recording sites, documenting built-environment resources, and excavation that are specific to the property types that are present in the Study Area (see Chapter 3). We also include a brief suggestion on delineation of the project APE.

Delineation of the APE

Two main considerations drive the delineation of the APE: (1) the extent of related cultural resources and (2) the proposed federal undertaking providing the impetus for cultural resource investigations. National Register Bulletin 42 indicates that "mining property boundaries should be selected to encompass, but not exceed, the full extent of the resources making up the property," encompassing "the significant concentration of buildings, sites, structures, or objects which comprise the mining property," adding that "byproducts of mining activity, such as tailings piles, should be included within property boundaries." Though acknowledging that underground mining spaces should not be inspected by cultural resource practitioners, the bulletin suggests that archival documentation should be used to identify the extent of subsurface mine workings and that these workings should be included in mining-property boundaries (Noble and Spude 1997:25). One reason for this approach, they argue, is to prevent ground subsidence in new development. Finally, however, the bulletin concedes that "in many cases . . . boundaries will relate only to the mining resources visible on the surface of the ground" (Noble and Spude 1997:25). This is certainly the standard for the delineation of archaeological site boundaries and, in the absence of compelling reasons for including underground spaces, should be the rule in CRM projects.

Mining sites can extend over large areas, with features, loci, and sites interconnected by linear property types extending long distances. Figures 5.4 and 5.5 illustrate the potential complexity of mining sites in the Study Area. Identifying the property types present at a site will assist researchers in understanding the mining activities represented by site loci and features. Deciphering mining activities is the first and main task in delineating site boundaries and, subsequently, the project APE. For example, a mine extraction locus may consist of nothing more than a number of prospects, one or more portals to a developed underground mine, piles of waste rock associated with each portal, and a series of roads leading to various features. Another mine extraction locus, however, might include ore-conveyance systems (ore-car track, aerial trams, ore chutes); ore bins where ore was stockpiled and loaded onto wagons or trucks; elements of beneficiation processes, including assay features; a mill; and a smelter. The most complex mining site would include elements representing each property type, including ore extraction, beneficiation, secondary mining-related properties, support-system features, and linear features. Best practice requires that if each of these elements is related to the others, and if their relationship can be ascertained, they should be included within the site boundary and should be considered for the purposes of the APE. The APE map is used to guide archival research, records search, agency and consultation efforts, and fieldwork and as an illustration in the report of findings.

Figure 5.4. Overview of a mining site, showing the complexity and extent of archaeological features, Rand Mining District, Kern County, 1993 (photograph by Karen K. Swope).

Figure 5.5. Overview of a mining site, showing the complexity and extent of archaeological features, Harrisburg, Death Valley National Park, 1999 (photograph by Karen K. Swope).

The very definition of the term APE refers to the area within which there is a potential to affect historic properties, if such properties exist. In standard CRM practice, the nature and extent of the undertaking must be taken into account in relation to any sites (or portions of sites) within that area. An AML project might have a precise and constricted APE, involving only a single mine portal, vehicle/equipment access, and, perhaps, staging areas. In addition to having a limited APE, an AML project might be designed to minimize impacts to the appearance of the mine portal. In such a case, the APE might be much smaller than the mining-site boundary. In any case, cultural resource practitioners should be able to determine the site boundary (encompassing related mining loci and features) and the project APE on the basis of an understanding of mining activities and the elements of the proposed undertaking.

Site Mapping and Recording

Field inventory should follow archival research, so that information about historical-period mining activities is available to field personnel. Site mapping and recording can proceed once the site extent and APE have been determined. Even when it is not possible to identify features during fieldwork, adequate measurement, description, and photography may lead to postfield identification. Recording procedures are detailed in BLM guidance (BLM n.d.b) and the Caltrans guidance for historic mining properties (Caltrans 2008:155–157). As is true for any archaeological site, recording and mapping include identifying and labeling each locus, feature, and artifact to be point-provenienced.

Mapping is best accomplished at two scales. First, the site boundary should be plotted on the appropriate USGS topographic map and recorded as GPS/Universal Transverse Mercator (UTM) coordinates. Second, a sketch map depicting the internal loci and features of the site should be prepared. The sketch map must include a scale and a legend that enable the reader to identify and interpret site elements.

Each locus, feature, and key artifact that has been selected for point-provenience must be measured, described, photographed, and quantified as appropriate. Photography should include site overviews photographs of site features and artifacts. BLM guidance for managing historical-period mining resources (BLM n.d.b) details the methods by which artifacts can be categorized according to industrial, domestic, or other functional categories. Often, prehistoric archaeologists are tasked with recording historical-period mining sites, and they may lack the ability to identify and interpret specific features and artifacts. In such cases, detailed written descriptions, photographs, measurements, and (when appropriate) sketches or rubbings usually suffice for a historical archaeologist to make the necessary identifications and interpretations.

Recording the Built Environment

Built-environment resources at historical-period mining sites in the Study Area include buildings and structures. These resources will run the gamut of property types and will include headframes identified as an extraction property type; mill buildings and tanks identified as beneficiation property types; offices, bunkhouses, and warehouses identified as secondary mining-related property types; dugouts, cabins, and dams identified as support-system property types; and railways, boardwalks, and powerlines identified as linear property types. The identification of built-environment resources includes the development of a historic context, the performance of archival research, and a survey of all buildings and structures (Figure 5.6). A recommended beginner's guide to vernacular built-environment studies is *Invitation to Vernacular Architecture: A Guide to the Study of Ordinary Buildings and Landscapes* (Carter and Cromley 2005).

Definitions for Building and Structure

Building: A building, such as a house, barn, church, hotel, or similar construction, is created principally to shelter some form of human activity. "Building" may also be used to refer to a historically and functionally related unit, such as a courthouse and jail or a house and barn (Shrimpton 2002:4).

Structure: The term "structure" is used to distinguish from buildings those functional constructions made usually for purposes other than creating human shelter. Examples include roads, bridges, railroads, dams, and tanks. Engineering systems are also structures; examples include power lines and retaining walls (Page et al. 2005a:127; Shrimpton 2002:4).

Recommended Guidance for Surveying and Recording the Built Environment

1. Use information gathered during archival research to guide your survey.
   - Consult archival materials that may provide information on building materials and changes over time.

2. Conduct a survey of the building or structure.
   - Develop a standard format in which all field observations can be recorded.
   - Begin by walking around the building or structure to get a feel for its totality.
   - Record the building's environmental context. Take notes on elements such as topographic position, slope, aspect, and vegetation.
   - Record buildings from the ground up and from the inside out, including the following: overall shape, massing, and height; foundation type and materials; structure type and materials; roof type, shape, and materials; roofing materials; chimney type and materials; other rooftop features; exterior materials; porch or balcony location, type, and materials; door location, type, and materials; window location, type, and materials; decorative features and materials; and other feature types and materials.
   - If you have access to a building's interior, note details about interior elements such as ceiling, flooring, and fixtures.
   - Record structures similarly and systematically, including the following: overall shape, massing, and height; foundation type and materials; structure type and materials; exterior or other materials; decorative features and materials; and other feature types and materials.
   - Note any characteristics that will need additional archival research to describe or interpret.

3. Note the condition of the building or structure,
   - Refer to any built-environment resource records or archaeological site forms of previous recordings, if available, to assist in the assessment of condition.

4. Photograph the building or structure.
   - Include all building corners and facades and any decorative features.
   - Include all angles of the structure and any decorative features.
   - Include some overview photographs of the building or structure at the mining site, capturing its association to other features, and of the overall building or structure, each facade and corner, and any character-defining features, such as a decorative door, a brick chimney, turned posts, a band of arches, or an integrated piece of equipment.

5. Draw the building or structure (this step may be optional for a structure).
   - Prepare a scaled plan of the building using the exterior walls.
   - Prepare a scaled floor plan of the building using the interior walls.
   - Prepare a scaled drawing of the main elevation, noting any entries, fenestration, and decorative details.

6. Map the building or structure in the landscape.
   - Create this map by recording GPS coordinates for all edges or corners and developing a map in a GIS, marking up an aerial photograph that can be georeferenced later, or hand-drawing a scaled sketch map.

7. Prepare a narrative description of the building or structure.
   - Describe the built-environment as recorded, from the ground up and the outside in.
   - Use standard architectural terminology to describe elements.
   - When developing descriptions, do not combine discussions of existing conditions and historical evidence (from archival research or on-site observations). Present the existing conditions; then describe any historical evidence pertinent to the built-environment description.

Figure 5.6. Recording a building, Beveridge Mining District, 1992 (photograph courtesy of Karen K. Swope).

The following references will aid in the understanding and identification of architectural and engineering elements:

- *A Visual Dictionary of Architecture* (Ching 1995)
- *American Architecture: An Illustrated Encyclopedia* (Harris 1998)
- *American Industrial Archaeology: A Field Guide* (McVarish 2008)
- *Dictionary of Architecture and Construction* (Harris 2005)
- *From Milestones to Mile-Markers: Understanding Historic Roads* (Marriott 2004)
- *Saving Historic Roads: Design and Policy Guidelines* (Marriott 1998)

Though focused more on architectural style, these references will also assist with the identification of architectural elements:

- *A Field Guide to American Houses* (McAlester and McAlester 2000)
- *American Homes: An Illustrated Encyclopedia of Domestic Architecture* (Walker 1996)
- *What Style Is It?* (Poppeliers et al. 1983)

These references will assist in the identification of building materials and their dates of use:

- *Historic Preservation: Project Planning and Estimating* (Swanke Hayden Connell Architects 2000)
- *Twentieth-Century Building Materials: History and Conservation* (Jester 1995)

Built-environment surveys should be conducted by an architectural historian, a historical architect, or a historic preservationist who meets the professional qualifications standards outlined by the Secretary of the Interior.

Recording Cultural Landscapes

In the context of historical-period mining resources in the Study Area, a cultural landscape is a mining resource that contains substantial areas of both natural and cultural features that embody, through past use or physical character, significant historical values (McClelland et al. 1999:3). Carey Feierabend (1990:24) observed that the resources of a mining area are "not just a collection of isolated features . . . The resources cannot be separated one from the other, for they operate as a single entity, with the landscape as the staging area." The NPS (McClelland et al. 1999:27) noted: "Mining properties may include not only the most prominent mining structures, but also the communities shaped as a result of the mining activity and the surrounding land covered by related mining claims and containing historic shafts, tunnels, pits, and tailings. Landscape characteristics can be used to describe and evaluate these properties."

In almost all cases, mining landscapes probably are best described as historic vernacular landscapes. Only a few may be better understood as historic site landscapes, designed landscapes, or ethnographic landscapes. An example of a historic mining site is Sutter's Mill, whereas a designed mining landscape would be an explicitly designed and constructed townsite, like those described in White's (1914:7–13) *Houses for Mining Towns*. An example of an ethnographic mining landscape would be a locale where ethnic religious practitioners have historically gone—and go today—to collect minerals for traditional activities. The following NPS documents provide the best guidance on identifying, recording, and evaluating mining landscapes:

- *A Guide to Cultural Landscape Reports: Contents, Process, and Techniques* (Page et al. 2005a)
- *Guidelines for Evaluating and Documenting Rural Historic Landscapes* (McClelland et al. 1999)
- *Guidelines for Evaluating and Documenting Traditional Cultural Properties* (Parker and King 1998)
- *Guidelines for Identifying, Evaluating, and Registering Historic Mining Properties* (Noble and Spude 1997)
- *How to Evaluate and Nominate Designed Historic Landscapes* (Keller and Keller 1994)
- *Protecting Cultural Landscapes: Planning, Treatment and Management of Historic Landscapes* (Birnbaum 1994)

The two most important components in identifying and evaluating the landscape are an on-the-ground reading of the landscape and archival research (Page et al. 2005a:15). Although people read landscapes on many levels, including "landscape as nature, habitat, artifact, system, problem, wealth, ideology, history, place and aesthetic," it is recommended that the landscape always be read in its context of place and time (Birnbaum 1994:7).

Cultural landscapes are listed in the NRHP as sites or districts, which are significant at the local, state, and/or national levels. Although most mining landscapes are best recorded as districts, small, discrete mining properties with few components may be recorded as sites; examples include a mining camp or a mine. Examples of a district include the Ballarat Mining District or the townsite of Tumco/Hedges. Noble and Spude (1997:22) stated: "Given the prevalence of mining systems, the historic district is a common framework for nominating a concentrated assemblage of related mining resources to the National Register."

It should be noted that a district, as defined by the NPS, does not necessarily resemble or geographically align with historically organized Mining Districts. The use of the word "district" differs. A Mining District, as historically organized, was a legal entity developed by miners to regulate mining activities and to resolve disputes. Boundaries were often arbitrary and did not always even encompass the ore body (Hardesty and Little 2009:20). An NRHP district is a group of related components: sites, buildings, structures, and objects. Boundaries for NRHP districts are drawn around extant components and do not necessarily align with any historical boundaries. NRHP districts can also be noncontiguous to encompass discrete areas of related activities.

Definitions for Site and District

Site: A site is the location of a significant event or a prehistoric or historical-period occupation or activity, or a building or structure, whether standing, ruined, or vanished, where the location itself possesses historic, cultural, or archaeological value regardless of the value of any existing structure.

District: A district possesses a significant concentration, linkage, or continuity of sites, buildings, structures, or objects united historically or aesthetically by plan or physical development.

Like archaeological sites, landscapes can vary in size, from a small, discrete mining camp with a cluster of buildings, structures, and features to a group of mining camps, a townsite, or an entire Mining District. The identification of a mining landscape can be proposed only after the performance of archival research, the development of a historic context, the delineation of proposed boundaries, and a complete survey of the landscape (typically, at the Class III level), resulting in the appropriate level of documentation to support the proposal. Cultural landscape surveys must be conducted by a historical landscape architect, a historical architect, or an architectural historian versed in landscape history and design. The BLM will determine whether to approve the proposed landscape on the basis of its review of the documentation.

Recommended Guidance on Surveying the Cultural Landscape

1. Use information gathered during archival research to develop a historic context and a proposed boundary to guide your survey.
   - Refer to a historic context to determine the type of landscape (e.g., vernacular, designed) present, the property type within the NRHP framework (site or district), and expected characteristics (processes and components).
   - Glean potential landscape boundaries and boundaries of landscape characteristics from narrative descriptions, aerial photographs (historical and current), and maps (historical and current: e.g., mineral survey maps, other GLO survey maps, connection sheets, topographic maps, and highway maps).

2. Conduct a survey of the landscape.
   - Develop a standard format in which all field observations can be recorded. Consider checkboxes for land-use categories or landscape characteristics.
   - If appropriate, be selective and focus the surveys on landscape characteristics. Landscape surveys can be scaled and range from windshield surveys to detailed recordings of all landscape characteristics. A pedestrian, transect-based survey, as practiced in archaeology, is strongly recommended, and the BLM may not accept landscape proposals unless an intensive (Class III) field survey has been performed for the entire proposed landscape, resulting in documentation.
   - If appropriate, record the landscape simultaneously with recording of cultural resources by additionally recording landscape characteristics.
   - Try to travel all roadways and access as much acreage as possible.

3. Identify all extant landscape characteristics.
   - Be systematic and use a checklist of the 13 processes and components to ensure that none is overlooked.
   - Examine all landscape characteristics and collect enough data on each one to fully describe it on resource records and to determine whether it is a contributing or noncontributing element to a district.
   - Note any characteristics that will need additional archival research to describe or interpret.

4. Note the condition of all landscape characteristics.
   - Refer to any built-environment resource records or archaeological site forms of previous recordings, if available, to assist in the assessment of condition.
   - Review historical photographs, maps, and aerial photographs to better assess visible changes in the landscape.

5. Photograph all landscape characteristics.
   - Include some landscape overview photographs, as well as photographs showing the relationship of landscape characteristics to one another.

6. Map all landscape characteristics.
   - Create this map by recording GPS coordinates for all characteristics and developing a map in GIS, marking up an aerial photograph that can be georeferenced later, or hand-drawing a sketch map using a scaled base map (e.g., topographic map).

7. Prepare a narrative description of the landscape.
   - Describe the landscape as a whole; then describe each process and component separately.
   - When developing descriptions, do not combine discussions of existing conditions and historical evidence (from archival research or on-site observations). Present the existing conditions; then describe any historical evidence pertinent to the landscape description.

8. Prepare an inventory report.
   - Include resource records and other elements of an inventory report that meets BLM standards.

Noble and Spude (1997:9) noted: “Planning for scale is critical since the physical remains of mining properties may cover a large geographical area” and large areas “call for inventive approaches to field mapping and documentation.” As is true for most cultural resource studies, the level of investigation—historic-context development, archival research, and survey—required for cultural landscape identification and evaluation is influenced by several factors, including management objectives, resource significance, resource complexity, and operations. The NPS provides three levels of investigation: exhaustive, thorough, and limited. For example, if the management objective is preservation as a treatment, then a limited level of investigation may be sufficient, as exhaustive investigations would be needed only if the proposed treatments were restoration or reconstruction. If information is already available on a landscape’s history, then perhaps only limited archival research may be needed. Cultural landscapes significant at the local level may require only a thorough investigation because they are not unique and may be more representative of a property type. Levels of investigation are also influenced by operations: that is, time, budget, and staff. The NPS noted: “Although operational and program factors have low priority in determining the level of investigation, they often have a profound impact on a project” (Page et al. 2005b).

Archaeological Excavation and Data-Recovery Strategies

Project-specific goals and the nature of property types encountered during a project are the determining factors in appropriate testing, excavation, or data-recovery strategies. The Caltrans (2008:156) study noted that “excavation is rarely necessary to identify and record” the remains of mining technologies. Excavation might be required, however, for cases in which changes in technology or phases of occupation can be identified through stratified deposits (Figure 5.7). Property types that might elucidate domestic life or site demographics may require excavation, as well.

More than 25 years ago, Leo Barker (1990:48) wrote in regard to historical-period mining sites: “If, in the process of establishing a context for the evaluation of a property type, it is determined that important information has typically been recovered from such property types, then that property could be considered significant.” Below, we list some considerations that can be applied in the creation of excavation and data-recovery plans for hard-rock-mining sites in the Study Area:

- Data recovery including controlled excavation and/or surface collection should be focused on addressing important research themes and questions.
- Many areas of mining sites (ore-extraction loci, ore-processing loci, and waste-rock/low-grade ore deposits) typically do not contain important subsurface deposits, and excavation should emphasize areas likely to yield important data; however, ore-extraction loci may contain surface evidence of blacksmith shops, machine shops, surface plants, and other supporting facilities, as well as evidence of actual mining tools, methods, and technologies. The evidence may be subtle and easy to overlook. Ore-processing features and loci may also contain obscure surface evidence of facilities and technologies from earlier periods. Careful investigation of features and loci (including through data recovery) may yield significant information regarding mining episodes, technologies, and methods.

Figure 5.7. Excavation at Hart town site, San Bernardino County, 1998 (photograph by Karen K. Swope).

Archaeological practice, in the environmental review context, is trending toward data recovery strategies that avoid broad data collection via subsurface excavation. Some mining sites in the California deserts hosted ephemeral occupations, resulting in surface-only deposits. At such sites, surface inventory and in-field or laboratory artifact analysis may suffice for data recovery. At sites frequently visited by the public, creative interpretation might constitute data recovery. In cases where a site will ultimately be destroyed, recovery of machinery, with off-site display and interpretation, could satisfy the goals of data recovery.

Well-designed, proactive data recovery projects may also be initiated under Section 110 NHPA efforts, resulting in contributions to historical archaeology and a better understanding of the resources and mining history.

Federal Responsibilities for Cultural Resource Management

Here, we outline the regulatory context framing the applicable federal responsibilities for CRM in regard to the NRHP. Cultural resources are evaluated under the provisions of the NHPA (54 U.S.C. 306108 and its implementing regulations 36 CFR 800). Specifically, federal agencies must comply with Section 110(a)(2) and Section 106. Section 110(a)(2), amended in 1992, requires that federal agencies establish a historic-preservation program that provides for the identification and preservation of properties under their jurisdiction. Section 106 requires federal agencies to take into account the effects of an undertaking on historic properties, which are defined as cultural resources listed in or eligible for listing in the NRHP.

NRHP-Eligibility Criteria

Determination of NRHP eligibility of cultural resources prior to making a finding of effect is done according to the following criteria:

> The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and
>
> (a) that are associated with events that have made a significant contribution to the broad patterns of our history; or
> (b) that are associated with the lives of persons significant in our past; or
> (c) that embody the distinctive characteristics of a type, period, method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
> (d) that have yielded, or may be likely to yield, information important in prehistory or history [36 CFR 60.4].

If cultural resources do not meet one or more of the above criteria, they are not historic properties and are not further considered in the Section 106 process.

In addition to these four criteria, there is a general stipulation that a historic property be 50 or more years old (for exceptions, see 36 CFR 60.4, Criteria Considerations). The integrity of a historic property is another consideration; a property must retain integrity of location, design, setting, materials, workmanship, feeling, and association in order to be eligible for listing in the NRHP. The importance of information in prehistory or history is measured by its ability to answer research questions (McClelland 1997). In addition to research potential, historic properties may have general-public and culture-specific values. Historic properties may also have broader public significance, such as serving to educate the public about important aspects of national, state, or local history. Two particular aspects of evaluation are discussed in the following section: research potential and integrity.

A number of documents have been prepared to guide researchers in identification of and significance evaluations for historical-period mining sites. National Register Bulletin 42 (Noble and Spude 1997) provides guidance in this regard, and supplemental guidance by the same author is also available (Noble 1998). Other research designs that contain applicable information regarding the interpretation and evaluation of mining sites appear in Table 5.3. Applicable procedures for evaluation of historical-period mining sites is revisited in this chapter, but users of this document are encouraged to consult other sources for pertinent information related to NRHP-evaluation criteria, integrity, and research questions that may be applicable to specific mining-related sites, particular locations, or certain commodities. Some of the previously prepared guidance is concerned only with select NRHP criteria, other guidance includes all four criteria, and a few guidance sources discuss additional criteria considerations.

The Caltrans research design presents specific steps to be taken for the evaluation of mining sites:

- Determine the property's structure, content, and the classes of data it may contain.
- Identify the appropriate historic context by which to evaluate the property.
- Identify important research themes and questions that might be addressed by the site data.
- Considering the property's integrity, structure, and content, assess whether the data it contains are of sufficient quality and quantity to address these important research issues.
- Identify the important information that the property is likely to contain.

Table 5.3. Guidance Documents Including Research Designs for Historical-Period Mining Properties

Author (Year)	Title	National Register of Historic Places Criteria Considered						
		Criterion A	Criterion B	Criterion C	Criterion D	Criteria Considerations	Integrity	Research Questions
Bleakley (2000)	*National Register of Historic Places, Multiple Property Documentation Form: Historical Properties Associated with Mineral Development in Wrangell–St. Elias National Park and Preserve, Alaska, 1898–1942*	X	X	X	X		X	X
Botwick (2012)	*Gold Mining in the Carolinas: A Context for Archaeological Resources Management*	X	X	X	X		X	X
Bruder (2002)	*Prospects and Producers: Historic Context for Mining Properties, Chugach and Tongass National Forests, Alaska, 1850s–1950s*	X	X	X	X	X	X	
Bunyak (1998)	*Frothers, Bubbles and Flotation: A Survey of Flotation Milling in the Twentieth-Century Metals Industry*	X	X	X	X		X	
California Department of Transportation (2008)	*A Historic Context and Archaeological Research Design for Mining Properties in California*				X		X	X
Fell and Twitty (2008)	*National Register of Historic Places, Multiple Property Documentation Form: The Mining Industry in Colorado*	X	X	X	X		X	
Hardesty (1990b)	"Evaluating Site Significance in Historical Mining Districts"	X		X	X		X	X
Keane and Rogge (1992)	*Gold and Silver Mining in Arizona, 1848–1945*	X	X	X	X	X	X	X
McKay (2011)	*Mining Idaho's History: Metal Mining in Idaho, 1860–1960*	X	X	X	X	X	X	X
Mehls and Mehls (1991)	*Routt and Moffat Counties, Colorado, Coal Mining Historic Context*	X	X	X	X		X	X
Neely (2001)	*Early Mining History: Fort Wainwright and Fort Greely, Alaska*	X	X	X	X	X	X	
Twitty and Fell (2010)	*Draft: Context for Historic Mining Resources in the Black Hills and South Dakota: A Guide for Identification, Interpretation, and Evaluating Eligibility to the National Register of Historic Places*	X	X	X	X	X	X	
Zeier et al. (2009)	*A Historic Context for Ione, Located in the Union Mining District, West-Central Nevada*	X	X	X	X		X	X

Historian Linda Greene (1990:22) wrote that, in consideration of importance in mining sites, "the biggest is not always the best." She further stated:

> We should not always be looking for the biggest producers or the largest number of ruins. Sites are often important simply because they illustrate a particular lifestyle, arrangement of structures, or mining process, or because they contain an example of something becoming very scarce, such as a stamp mill. . . . One should also look for groups of sites showing similarities in historical land use and modifications over time that indicate a geographically definable cultural landscape.

Table 5.4 presents a list of sites in the Study Area that have been listed in the NRHP or California Register of Historical Resources (CRHR) or as National Historic Landmarks or California Historical Landmarks. In addition to listed properties, several notable examples from the Study Area represent "firsts" or "exceptional circumstances," researchers should be aware of the roles of the following examples in regional context and be alert for other examples that may exist.

Table 5.4. Listed Mining Historic Properties in the Study Area

County Name	Property Name	NHL Status	Listed in the NRHP	NRHP Criteria	CHL Status	Listed in the CRHR	CRHR Criteria
Imperial	Picacho Mines				X		
Imperial	Tumco Mines				X		
Inyo	Farley's Olancha Mill Site				X	X	
Inyo	Furnace of the Owens Lake Silver–Lead Company				X		
Inyo	Leadfield		X	a			
Inyo	Reilly		X	a, c, d			
Inyo	Skidoo		X	a, g			
Kern	Burro Schmidt's Tunnel		X	b, c			
Kern	Havilah				X		
Kern	Keysville				X		
Kern	Last Chance Canyon		X	d			
Kern	Rand Mining District				X	X	
Mono	Bodie Historic District	X	X	a			
Mono	Dog Town				X	X	
Orange	Red Hill				X		
Orange	Silverado				X		
Riverside	Desert Queen Mine		X	a, g			
Riverside	Ryan House and Lost Horse Well		X	a, c			
San Bernardino	Holcomb Valley				X		
San Bernardino	Town of Calico				X	X	
San Bernardino	Wall Street Mill		X	a, g			
San Diego	Julian				X		

Key: CHL = California Historical Landmark; CRHR = California Register of Historical Resources; NHL = National Historic Landmark; NRHP = National Register of Historic Places.

The late-1940s uranium boom in the western United States was facilitated by development of the portable Geiger counter, and in 1949, Goodsprings, Nevada, was the location of a presentation of prospecting techniques employing the new technology (Hewett 1954:iv–v; Olson et al. 1954; White 2011). Inspired with the possibilities, a partnership was formed. Radioactive deposits were identified in the Mountain Pass area of San Bernardino County, and claims were filed (Hewett 1954:iv; San Bernardino County Historical Archives [SBCHA] 1949:354–367; White 2011:13–20). Testing performed at the Bureau of Mines laboratory in Boulder City, Nevada, revealed that the samples were bastnaesite, a rare-earth mineral primarily used in electronics at that time (Wright et al. 1953:121–123). The claims were quickly recognized as "the most important rare-earth deposits in the United States" (Murdoch and Webb 1954:10)—the ore contained the highest concentrations of bastnaesite and barite discovered in the world to that date. The claims were soon purchased by the Molybdenum Corporation of America (Molycorp, Inc.), which operated the mines through the end of the historical period and until recent years (Hewett 1954:iv–v; Olson and Pray 1954:23–29; SBCHA 1950:1–10; SBCHA 1951:592–598; White 2011:13–20; Swope et al. 2012:13–15).

The most important known deposits of borate minerals in the United States have been found in the Death Valley area, from where the well-known 20-mule teams hauled loads to rail connections at Mojave, in the Calico Hills, and at Boron (Hildebrand 1982; United States Borax & Chemical Corporation 1979:10–15). Only after the 1925 discovery at Boron, however, were the minerals recovered by underground mining methods, which continued until the mine began converting to open-pit methods in 1956 (United States Borax & Chemical Corporation 1979:18–19, 25–26).

At Vanderbilt, in San Bernardino County, two types of stamp mills were tested that were specifically adapted to the types of ore found in California. The Vanderbilt mills dropped faster but for less distance than the slower Colorado examples, which had a deeper drop. Both Vanderbilt mills realized profitable returns as reported in the *M&SP* (1894:1): "These mills, it is well known, have just been placed in operation. It had been predicted that the mills would not be successful, inasmuch as the ore is variable and of an unusual character. . . . Even the rock-breakers and the automatic feeders are different. Everything is different. . . ." The conclusion was that, based on the type of ore produced by mines in the two states, "the California mill is best for California and . . . the Colorado mill is doubtless all right for Colorado. . . . [T]here is no room for controversy as to the values of the mills. Both are good."

Bodie, in Mono County, was among the first mining areas in the United States to apply the cyanide leaching process in reworking tailings. The success of the experiment, attributed to the singular nature of the Bodie ores, was reported in an early analysis of the cyanide process in 1899 (Bosqui 1899:123–125).

Integrity

Another key determination regarding NRHP eligibility involves the concept of integrity, which refers to the physical condition of a historic property. If the physical condition of a site considered eligible for listing in the NRHP under Criterion d is such that important information about the past potentially can be derived from it, then it is said to possess good integrity. If various processes of disturbance—environmental or cultural, intentional or unintentional—have impacted the property such that the cultural essence of the site has been lost or severely damaged, then the property is said to lack integrity. The critical aspect of evaluating integrity is the assessment of the nature and extent of disturbance processes. Extensive impacts by recent human activity, such as vandalism or vehicular traffic, are relatively easy to recognize and assess, but other forms of disturbance are more subtle. For example, consider a surface-artifact scatter. If environmental processes, such as erosion, have displaced artifacts and altered the geomorphological context, the condition of the scatter today might be considerably different from what it was when it was first created. Many of the artifacts may have been redeposited, and those that remain may no longer be in primary context. If subsurface deposits are present, they may no longer be spatially associated with the surface component. Disturbance processes, and the extent to which they have altered the site, are not always easy to identify; therefore, the integrity of a historic property can be difficult to evaluate. It is critical that, before fieldwork begins, archaeologists and historians become informed about the cultural and environmental disturbances that they are likely to encounter in a project area and about the types of observations necessary to determine the existence, nature, and extent of such processes.

Guidelines for Identifying, Evaluating, and Registering Historic Mining Properties (Noble and Spude 1997), formerly National Register Bulletin 42, introduced a "problematic factor" in regard to the integrity of historical-period mining sites, "because mining properties are generally located in harsh environments that have taken a toll on their historic fabric over the decades" (Noble 1998:13). Specifically,

> [t]he few crumbling structures that may remain at a historic mining site today can not be properly evaluated by simply falling back on the seven aspects of integrity [setting, location, association, materials, design, feeling, and workmanship] that are traditionally applied to historic buildings. The bulletin suggests that individuals evaluating mining resources of questionable integrity should ask whether surviving mining-related features are part of an interrelated "system." In other words, a toppled head frame may appear to lack integrity as an individual structure, but it might potentially retain sufficient integrity as an integral component of a mining system that includes extraction facilities and transportation links to a refining operation.

Spude (1990:31) further noted that the sheer number of industrial mining processes that were "experimented with, used, then discarded" results in a complexity that can make it "difficult to differentiate the important from the ephemeral," observing that removal of machinery for reuse elsewhere or for scrap-metal drives further complicates interpretation and significance evaluation. The potential for interpretation is another consideration in assessing the integrity of historical-period mining sites, as noted by Noble (1998:14): "If a single dilapidated component of a mining operation exists as part of a larger system that can be viewed as an integrated working process and interpreted as such to the public, then it is likely to possess both integrity and significance."

A consideration unique to mining sites is episodic reuse. Chapter 2 provides numerous examples of mine closures, resurgence of mining activities, and the various forces driving cyclical mining efforts over the decades. Some mines in the Study Area were worked after the end of the historical period, and some remain in operation today. In evaluating earlier mining activity at a site, investigators should look beyond the physical manifestations of later mining work in order to assess the significance and integrity of specific phases of operation.

Evaluating Archaeological Property Types

Criterion a involves sites that are associated with events contributing to the broad patterns of history. Sites in every western state that are recognized in relation to the major gold and silver rushes have been listed in the NRHP under Criterion a. These sites range from California's gold discovery at Coloma to the Nome, Alaska, discovery site—both quite obviously associated with the broad patterns of mining frontier history and ensuing settlement patterns (Spude 1990:31). But Barker (1990:49) noted that "a mining boom camp composed of tent or cabin pads, fireplaces or stone ovens and little more may be eligible [under Criterion a] as representative of the mining boom period and pattern of settlement, yet may not contain sufficient associated archeological remains to have information potential." Historic mining properties within the Study Area have been listed in the NRHP under Criterion a; these are Leadfield, Reilly, and Skidoo in Inyo County; Bodie Historic District in Mono County; Desert Queen Mine, Ryan House, and Lost Horse Well in Riverside County; and Wall Street Mill in San Bernardino County (see Table 5.4).

Criterion b is for sites that are associated with the lives of individuals that are significant in history. For any historic property to be eligible because of its association with a specific person, the property would have to represent their significance in local, regional, or national history and not just be merely associated with them. Spude (1998:3) provided this example of an individual association that would provide significance to a mining site: Lorenzo Bowman was an African American and a former slave who became a metallurgical expert in the Georgetown Mining District of Colorado. Spude (1990:31) found that the extant archaeological evidence of Bowman's work "is an important reminder of the African Americans who participated in the Pikes Peak rush." Another example is Bonanza King Horace Tabor's association with Leadville, Colorado. National Register Bulletin 32, *Guidelines for Evaluating and Documenting Properties Associated with Significant Persons* (Boland ca. 1991), provides explicit guidance for assessing eligibility under Criterion b. An example from the Study Area listed in the NRHP under Criterion b is Burro Schmidt's Tunnel in Kern County (see Table 5.4). The site is eligible, in part, for its association with William Henry "Burro" Schmidt, a local miner who undertook an effort of more than 30 years to drill and blast a tunnel (ostensibly the longest hand-excavated tunnel in the world [Padon 2003]) through Copper Mountain for purposes of ore transport (Howser 1994).

Criterion c sites may represent distinctive characteristics of a type, period, or construction method; exhibit the work of a master; or possess high artistic values. Spude (1990:34) and Noble and Spude (1997:13) noted that mining-plant designs, as the craft of mining engineers adapting systems to the terrain, might be eligible under Criterion c. Perhaps more important in regard to mining sites is the last part of the criterion description, for sites "that represent a significant and distinguishable entity whose components may lack individual distinction." For a site to be eligible under Criterion c, the overall mining landscape and spatial relationships between activity areas would have to be readily apparent, evoking specific characteristics so that the site is representative of its type, or because it represents a significant and distinguishable entity whose components may lack individual distinction. Examples of historic mining properties from the Study Area that have been listed in the NRHP in part under Criterion c include Reilly in Inyo County, Burro Schmidt's Tunnel in Kern County, and Ryan House and Lost Horse Well in Riverside County (see Table 5.4).

Archaeologists are usually most comfortable evaluating a site for NRHP eligibility under Criterion d, for the potential to yield information important in history. Most familiar is the potential information held in intact subsurface deposits with stratigraphic integrity and discernible association. But information potential at historical-period mining sites also includes prospective data held in industrial remains, as well as important data to elucidate site demographics, labor conditions, and chronology. For industrial remains, Spude (1990:33) commented: "In the history of technology, many questions still remain about the application of theory to practice, especially prior to 1900." Caltrans (2008:163) noted that the presence of extant metal machinery "raises the value of what little does remain," because so few sites contain machinery (Figure 5.8). Suggestions for evaluating significance with regard to site demography, labor relations, and chronological considerations are available in the Caltrans mining context and research design (Caltrans 2008:113–153). Examples of historic mining properties in the Study Area that have been listed in the NRHP under Criterion d include Reilly in Inyo County and Last Chance Canyon in Kern County.

Figure 5.8. Extant machinery, Beveridge Mining District, Inyo County, 1991 (photograph by Karen K. Swope).

Evaluating Built-Environment Property Types

NRHP-eligible built-environment resources (i.e., mining cabins) must retain integrity of location, setting, design, feeling, and association and most of their materials and workmanship to qualify for listing in the NRHP. Cabins should retain most of their character-defining features, which include massing, form, and ornamentation. Subsequent modifications, such as small additions, general repair and maintenance, and, potentially, roof replacement, may not detract from a cabin's integrity if the modifications occurred during the property's period of significance. Buildings for which modifications occurred outside the property's period of significance and were not in accordance with the Secretary of the Interior's Standards may not retain integrity.

A discussion about condition and integrity is important here. Historic Hawai'i Foundation Preservation Program Manager Megan Borthwick (2017:n.p.) noted: "We often hear things like, 'why not tear it down—it's in terrible condition?' or 'it's practically falling down—how could it be historic?' We sometimes even hear the opposite, such as 'they did so many great improvements, why don't you consider it historic anymore?'" The answers are that condition and integrity are two different concepts that serve in integral, but different, evaluations of which resources are eligible for listing in the NRHP and which are not, as well as which resources are subject to preservation activities and which are not. Condition is the physical state of the resource, in regard to its appearance and working order, and common assessments are made in terms of *poor*, *fair*, *good*, and *excellent*. Integrity is the resource's ability to convey its historical significance as assessed by seven aspects: location, design, setting, materials, workmanship, feeling, and association. Resources either do or do not retain integrity.

Assessments of condition and integrity are often similar for historical-period archaeological sites, whereas assessments of condition and integrity can diverge greatly for built-environment resources. Accordingly, an extant cabin that has been maintained following the Secretary of the Interior's Standards for the Treatment of Historic Properties could be in excellent condition and retain integrity. An extant cabin that has not been maintained could be in poor condition and retain integrity. An extant cabin that has been modified in a way that does not follow the Secretary of the Interior's Standards for the Treatment of Historic Properties could be in excellent condition and not retain integrity (Borthwick 2017).

The distinction between condition and integrity is important. Whereas significance and condition are often among the considerations for preservation activities, significance and integrity are the only considerations for NRHP eligibility. Poor condition does not make a property ineligible for listing in the NRHP, but it "does threaten the longevity and viability of that property" (Borthwick 2017). Therefore, a cabin's condition may affect its integrity, but its condition is not a consideration in the NRHP-eligibility assessment.

Built-environment resources are typically eligible for listing under NRHP Criteria a, b, and/or c. In much rarer cases are buildings eligible for listing in the NRHP under Criterion d—only 15 buildings in California are listed in the NRHP under Criterion d. The National Register Bulletin *How to Apply the National Register Criteria for Evaluation* (Shrimpton 2002) should be followed closely when applying the NRHP-eligibility criteria to cabins. With respect to the NRHP, cabins are buildings, which are different from structures in that they are created principally to shelter human activity.

A cabin is significant and eligible for listing in the NRHP under Criterion a if it is associated with one or more events important in the historic context. The event can be a single episode, such as an important moment in history, or a pattern of occurrences, such as a trend that makes an important contribution to the development of a place. Examples include a cabin associated with the first wave of lode mining at an important site, the location of an important discovery in mining science or operations, an important era in a mining site's history, the development or community planning of a mining district or townsite; and the location where miners organized or strategized about unionization.

A cabin is significant and eligible for listing in the NRHP under Criterion b if it is associated with an individual or individuals whose activities are demonstrably important within a historic context. The cabin should illustrate, not commemorate, the achievements of the person(s). Examples include a cabin of a miner or family who played a significant role in associated mining operations that were important locally, regionally, or nationally; an important labor leader; or a noteworthy community member who made meaningful impacts on a mining district or townsite. To make the argument that a cabin is associated with a significant individual, the cabin could be compared to other properties of that individual to show that it best represents that person's historical contributions.

A cabin is significant and eligible for listing in the NRHP under Criterion c if it is significant for its physical design or construction through embodying distinctive characteristics of a type, period, or method of construction; representing the work of a master; possessing high artistic values; or representing a significant and distinguishable entity whose components may lack individual distinction. Examples include a cabin that represents an important or unique construction method, reflects a significant design or design philosophy of a historical period, was designed or built by an important architect or craftsman, expresses certain aesthetic preferences or a level of artistic achievement, reflects the evolution of cabin design or a transitional style, illustrates changing uses over time through adaptations of its historic character, or is an important member of a group of dwellings.

A cabin is significant and eligible for listing in the NRHP under Criterion d if important research questions can only be answered by the actual physical material of the cabin itself. As noted above, this is a rare scenario, and the cabin must be the principal source of the important information. Examples include a cabin that exhibits local variation on a construction technique or provides significant information on how the local availability of materials affected local building development.

Evaluating Cultural Landscapes

Evaluating a cultural landscape for listing in the NRHP includes evaluating its significance and assessing its historic integrity. Evaluation may occur only after the landscape has been identified and documented and has been accepted by the BLM. The requirements for identification are explained in Recording Cultural Landscapes, above, and include the performance of archival research, development of a historic context, delineation of boundaries, and a complete intensive survey of the proposed landscape with the appropriate level of supporting documentation. Evaluating significance consists of applying the NRHP criteria to the cultural landscape as a whole and its component properties and, using the historic context, determining under which criterion or criteria the property possesses significance. Assessing historical integrity includes determining whether the cultural landscape retains integrity of location, design, setting, materials, workmanship, feeling, and association within its period of significance. Cultural landscapes are dynamic, and some amount of change is expected. Thus, the assessment of integrity includes taking a measure of the evolution of the landscape and its current conditions. Comparisons to similar properties can assist this effort. Changes that have erased character-defining features or changed them beyond recognition result in the loss of integrity. Defining boundaries is an important component of the evaluation process. McClelland et al. (1999:24) noted: "Boundaries for rural historical landscapes must encompass the area having historic significance, rather than just scenic values, and contain contributing resources that express the characteristics of the historic landscape." Mining landscapes can include the communities shaped as a result of the mining activity, in addition to the mining property itself (Figure 5.9). Character-defining features consisting of processes and components are used to describe and evaluate these properties (McClelland et al. 1999:27). The most common cultural-landscape type in the Study Area may be the historical-period vernacular landscape. The National Register Bulletin *Guidelines for Evaluating and Documenting Rural Historic Landscapes* (McClelland et al. 1999) should be followed closely when applying the NRHP-eligibility criteria to vernacular landscapes.

A vernacular mining landscape is significant and eligible for listing in the NRHP under Criterion a if it is associated with one or more events important in the historic context. Events can be brief, like the discovery of a mine, or activities that spanned long periods of time, such as the duration of an active mining district. Under Criterion a, a vernacular mining landscape illustrates the significant contributions that the property has made through events and activities that have led to its development and achievements. Examples include a vernacular mining landscape that was important for its role in a commodity's production, was significant for the exploration of a specific region or commodity, was important for the role that ethnic heritage played in its development, or was significant for the role it played in the economic development of a larger mining district.

A vernacular mining district is significant and eligible for listing in the NRHP under Criterion b if it is associated with an individual or individuals whose activities are demonstrably important within a historic context. The person(s) may have been important because of their success or talent or because they contributed to the development or prosperity of a community. Although Criterion b may be unrelated to historic uses, such as a farm that was the home of a significant writer, that scenario will be uncommon in vernacular mining landscapes. Examples of vernacular mining landscapes include the property of a union leader that organized miners and strategized labor strikes within its bounds, the property of a family that began the mining operations at a significant mine, and the property of the founder or benefactor of the mining townsite.

Figure 5.9. Vernacular mining landscape of the Yellow Aster Mine, 1993 (photograph by Karen K. Swope).

A vernacular mining landscape is significant and eligible for listing in the NRHP under Criterion c if it is significant for its physical design or construction through embodying distinctive characteristics of a type, period, or method of construction; representing the work of a master; possessing high artistic values; or representing a significant and distinguishable entity whose components may lack individual distinction. Examples include a vernacular mining landscape that reflects a pattern of land use significant for reflecting traditional practices, represents important historical or regional trends, presents an engineering innovation, includes components with formal designs or that followed guidelines for mining-operations best practices, reflects unique aspects of a community's development, or is important as a member of a group of landscapes.

A vernacular mining landscape is significant and eligible for listing in the NRHP under Criterion d if important research questions can only be answered by the actual physical material of the cultural landscape. Surface or subsurface remains should be able to provide important information about land use, settlement patterns, or cultural traditions. Examples include a vernacular mining landscape that exhibits a unique technological innovation or a significant pattern of mining operations.

Reporting and Curation

As noted in BLM Course 8100-10, *Managing Historic Period Mining Resources* (BLM n.d.b:n.p.), all reporting of historical-period mining sites "should follow any standards set by BLM and the State Historic Preservation Office," as applicable. Users of this document are encouraged to consult that guidance as well as all other current BLM guidance and standards, as the information is not repeated here. Some users of this document may be working under a BLM-issued cultural resource use permit and must follow the terms and conditions of the permit including those related to reporting and curation requirements.

CHAPTER 6

Preservation Goals

> *What is preserved and what is not speaks to us about mining's past in a multitude of voices, some speaking loudly, others barely in a whisper. Some of the voices come from the underground, the buried remains of the practices of miners and mining that are affected by the ravages of nature and humanity alike. Other voices yell at us through still standing magnificent buildings and structures. Some voices speak in the legal language of public laws and policies, other voices come from the economics of tourism and the private interests of free enterprise. Yet other voices come from the role that the remains play as symbols of a glorious past or a bleak environmental future. Preservation clearly controls the future of mining's past* [Hardesty 1999b:2].

Historical-Period Mining Sites and the BLM's Multiple-Use Mission

The BLM is responsible for administering public lands, a task that includes the management of subsurface minerals,

> with focus placed on what will best serve the needs of the American people. Management is based upon the principles of multiple use and sustained yield—a combination of uses that takes into account the long-term needs of future generations for renewable and nonrenewable resources. These resources include recreation, range, timber, minerals, watershed, fish and wildlife habitat, and natural, scenic, scientific, and cultural values [BLM 2011a:i].

The BLM recognized the need for this historic context and archaeological research design as part of its multiple-use mission to balance growing demands for varying uses of public lands in the southern California deserts. The mission includes environmental protection, resource development, and recreation (BLM 1991b:ii), which must be balanced with the conservation of significant historical and archaeological values that may be present in historical-period mining sites. A major goal of the BLM Cultural Heritage Program is ensuring the development and implementation of management priorities that protect resources, mitigate adverse effects, and preserve cultural sites for the future and for interpretation (BLM n.d.b).

As expressed by historical archaeologist Donald L. Hardesty (1997:36), "mining archaeology and historic preservation sometimes have different goals, practitioners, and constituencies." In BLM terms, this is the specific challenge of balancing the management of recreational opportunities with necessary resource conservation and development, particularly when various land uses pose conflicts.

Historical-period mining sites may occupy the same space as a number of these public resources, presenting distinct challenges for managers. The physical remains of historical-period mining can present a compelling visual attraction for well-intentioned outdoor enthusiasts and professional or amateur historians, and BLM-administered lands are some of the last places where the nation's mining heritage can be observed intact. But recreational activities can pose threats to the scientific, historical, and other values that the archaeological sites and built-environment features retain; such threats include damage from unauthorized OHV/ATV use, as well as looting and vandalism. The locations where mining was performed in the past may contain minerals of modern commercial value, but modern mining methods can destroy the physical evidence of past mining activities. Clearly, the longevity of historical-period mining sites in the context of myriad modern land uses is imperiled, and meeting the needs of present and future generations requires a carefully constructed management approach.

Other land-management agencies face similar concerns; in an analysis of preservation challenges in Death Valley National Park, Marcom (1996:11–12) reported a mill structure “irreparably damaged when someone hooked a cable to it and pulled part of it down with their vehicle—for no apparent reason other than to destroy it.” He described the difficult balance between providing accessibility and site preservation, noting the threat posed by tourism but acknowledging the contributions of conscientious visitors in reporting new finds.

The changing focus of agency goals over time is illustrated by a unique dilemma faced by Parks Canada, the Canadian counterpart to the NPS, in regard to the interpretation of historical-period mining sites. From the period preceding World War II until at least the mid-1950s, Parks Canada supported and executed the removal of abandoned mining communities, razing structures and removing tailings “in an effort to return the area to a more natural state” (Hovis 1990:65). By the 1980s, however, it was realized that “areas that were once subjected to systematic efforts to erase them are now potential interpretation sites” (Hovis 1990:65). The situation may be applicable to some locations on lands managed by the BLM.

Brief History of the BLM’s Preservation Efforts at Historical-Period Mining Sites in the CDD and the Bishop Field Office

In 1980, the BLM outlined historical resource goals for the CDCA, including (1) inventory of a full array of cultural resources, (2) preserving/protecting a sample of the full array of cultural resources, (3) ensuring consideration of cultural resources in land-use planning and avoiding inadvertent impacts from BLM-authorized actions, and (4) ensuring data recovery of NRHP-eligible archaeological sites when adverse impacts cannot be avoided (BLM 1999).

Also in 1980, Russell Hartill prepared a document, entitled *Preserving Our Mining Heritage: The California Desert*, for the BLM Desert Planning Staff. The report was intended to support preservation activities in the CDCA, with two goals: listing the “outstanding” desert mining sites and judging each site’s “relative importance, research potential, and suitability for becoming a showcase of mining history” (Hartill 2006:2). The report was an early attempt to synthesize information about preservation efforts to that date and to anticipate the challenges and potential of site interpretation, calling for “dynamic interpretive programs” to ensure that the story of desert mining is “vividly told” (Hartill 2006:4).

The BLM Adopt-A-Cabin program was a volunteer partnership arrangement administered by the Ridgecrest Field Office from the late 1980s to 2005. It operated under the ambitious but ultimately untenable goal of saving historical-period mining cabins in the region, largely for recreational reuse. Under the auspices of the program, several mining cabins in the Study Area were renovated, including the Beveridge Ridge Cabin (Figure 6.1) in Inyo County. Inarguably, the work under the program prevented the collapse of several buildings. However, concerns over the lack of collection of baseline condition data prior to initiating work and the absence of involvement of BLM cultural resource managers brought an end to the program.

Another consideration for BLM management is compliance with the provisions of the Section 106 Programmatic Agreement for the West Mojave (WEMO) Route Network Project and Plan Amendment. The WEMO plan includes making motorized route designations as part of “an overall travel and transportation management strategy, implementation framework, and access network for public lands users in the West Mojave portion of the California Desert,” including portions of the Study Area in the Barstow, Ridgecrest, Needles, and Palm Springs Field Offices (BLM 2016).

The BLM National Training Center developed Course 8100-10, Managing Historic Period Mining Resources (BLM n.d.b), to assist cultural resource specialists in identification of mining sites, to provide guidance in NRHP significance evaluations, and to offer management direction for the protection, mitigation of adverse effects, preservation, and interpretation of historical-period mining sites. With a nationwide scope, however, it does not address the specific needs of cultural resource specialists working in the California deserts.

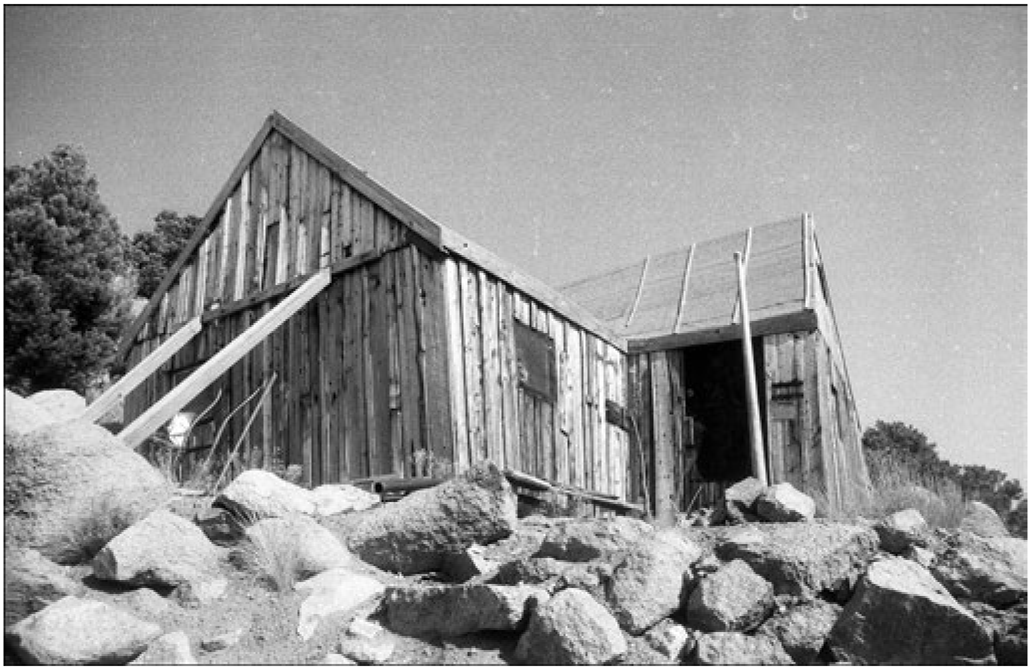

Figure 6.1. "Ridge Cabin," Beveridge Mining District, Inyo County, after stabilization under the Adopt-A-Cabin in program, 1991 (photograph by Karen K. Swope).

AML-Remediation Projects

The national public awareness campaign designed to warn about the dangers of abandoned mines is known as "Stay Out—Stay Alive." The campaign, launched in 1998 by the MSHA (BLM 2013:6), is today a partnership of more than 70 federal and state agencies (Natural Resources Agency 2009), private organizations, businesses, and individuals (BLM n.d.c) and has been operating in the Study Area for over two decades. The BLM AML Task Force was formed in 1989, and the AML program was established in 1997 (BLM 2013:6). The BLM in California regularly plans and executes physical modifications, or treatments, to remediate AML sites, for the purposes of improving public health and safety, stabilizing soil and watershed conditions, and restoring, protecting, and improving ecosystem health conditions. Remediation measures include treatment of hazardous mine features (adits, shafts, trenches, and prospect pits) by installing wildlife-friendly grates (Altenbach 1998) or closing mine openings using foam or backfill methods, removing solid waste in areas of environmental concern, and mechanically blading or ripping roads to decommission them. Because these activities are undertakings as defined in Section 106 of the NHPA, the BLM must determine if cultural resources eligible for listing in the NRHP exist in the APE, if the undertaking will have an adverse effect on those resources, and if so, resolve the adverse effects.

In recent years, successful AML projects have included agreements with cultural resource management firms to (1) survey, identify, and record cultural resources within areas that may be affected by the remediation of hazardous mine features; (2) provide an assessment of the content and integrity of cultural properties or portions of sites that may be impacted by remediation activities; (3) conduct an evaluation of cultural resources for NRHP eligibility; (4) determine whether identified cultural resources would be affected by remediation activities; (5) provide appropriate mitigation or treatment recommendations for how to avoid or mitigate impacts to the NRHP-eligible sites; and (6) report findings to the appropriate BLM archaeologist. Where significant mining properties are involved, AML remediation projects implement efforts to "minimize impacts to the historic fabric and visual intrusions into historic mining landscapes" (BLM 2011b:4.12).

Modern Mining in the California Deserts and the Threat to Historical-Period Mining Sites

Lands managed by the BLM contain substantial mineral deposits holding commercial development potential, many of which were also mined during the historical period. The FLPMA of 1976 "intended that mineral resource values be carefully weighed and not unjustly withdrawn from development by inclusion in wilderness areas" (BLM 1991b:1). In analyzing mining-industry interest in mineral exploration, the BLM found in 1991 that "the importance of mineralization in the California Desert[s] exceeds its current production" (BLM 1991b:9).

Because modern mining interests may wish to exploit the same mineral resources targeted during the historical period, the provisions made for resource exploration and development present unique preservation challenges with regard to historical-period mining sites. Figure 6.2 depicts an example of permitted mining activity in the Study Area nearly 20 years ago. Modern, open-pit mining operation destroyed a historical-period mining site; in this example, the appropriate state and/or federal inventory and evaluation processes were followed, and the site was determined not eligible for listing in the NRHP or the CRHR. BLM archaeologists Olsen and Portillo (1990:71) wrote that the BLM "is deeply involved in current mining efforts on a statewide basis. The stresses and strains are many but, hopefully, we can meet our historic preservation commitments while allowing the reasoned use of cultural resources" on BLM-managed lands.

Figure 6.2. Viceroy Mine haul truck, passing over food-storage feature at Hart, San Bernardino County, 1998 (photograph by Karen K. Swope). An operating open-pit mine is visible in the background.

Recreation in the California Deserts and Historical-Period Mining Sites

Public interest in mining history can be measured by the numbers of books, guides, maps, and websites devoted to the topic and the numbers of recreational visits to even the more-remote historical-period mining sites in the Study Area. Many of these sites are located on (or partially on) public lands administered by the BLM. Although providing recreational opportunities and interpretation of historical-period sites and landscapes is a desirable goal, maintaining access to remote sites brings management concerns for visitor safety and increased potential for site degradation.

Visits to historical-period mining sites are popular because outdoor recreation is inextricably linked to western American lifestyles and because certain cultural resources "contribute to the social fabric and identity of many rural California communities" (BLM 2010:3.21). The opportunity to experience mining history provides the primary attraction at some local, state, and national parks in the American West (cf. Hovis 1998:27). For both local residents and tourists from other states and abroad, experiencing remote mining sites is an unrivalled experience (Figure 6.3). A goal of the BLM AML program is to "protect the treasure trove of history and cultural resources revered by local communities and visitors alike," to ensure continued enjoyment and benefit from "the unique cultural and historical artifacts of our nation's important mining legacy" (BLM 2013:16.17).

Figure 6.3. Terrain traversed by visitors to Ballarat (photograph by Karen K. Swope).

As is true for all cultural resources, archaeological sites and the built-environment features associated with historical-period mining activities on public lands are threatened by a variety of recreational land uses, whether the activities are authorized or illegal. A variety of recreational land uses can jeopardize mining sites through unintentional damage, as well as (in some cases) intentional damage, looting, or vandalism. Site protection is complicated by the logistics of monitoring remote sites. The assistance of the California Archaeological Site Stewards Program (CASSP), staffed by volunteers (many of them avid public land recreationists), has been successfully employed to provide regular monitoring of mining sites, even in remote locales. Since the early 2000s, funding to support BLM's CASSP training workshops has been provided by grants from the State of California's Off-Highway Motor Vehicle Recreation Division—a positive example of interest groups working together for mutual benefit.

Heritage Tourism

In *Preserving Our Mining Heritage: The California Desert*, Hartill (2006:4–5) wrote that vandalism and relic hunting on BLM lands would be reduced by providing meaningful interpretive opportunities. The concept of heritage tourism presents such opportunities. The National Trust for Historic Preservation (2017) defines heritage tourism thus: "traveling to experience the places, artifacts, and activities that authentically represent the stories and people of the past and present. It includes visitation to cultural, historic, and natural resources." Typically, a heritage-tourism program would identify local or regional points of interest, develop those locations for visitation, and provide informational and promotional materials for distribution to travelers and interested parties. According to Clements (2003:251, 262), Tombstone, Arizona, was among the first mining communities to capitalize on historical frontier nostalgia, inaugurating "Helldorado Days" in 1929. Francaviglia (1991:167, 195–197), while recognizing the potential for tourism to support local economies by promoting mining-related history, was critical of mining-related heritage tourism that equates to "technostalgia," or "the romanticizing of the industrial past." White (2017:137) made a similar observation: "It is through memorialization . . . that the legacies of American mining are both mythologized and challenged." Public interest in sites such as Bodie, Calico, and Julian in the Study Area, however, demonstrates the potential for mining-related heritage tourism and accompanying interpretation, should the BLM elect to pursue that type of program in the future.

The BLM training course for managing mining resources (BLM n.d.b) states that many mining sites "offer interesting and compelling histories, making them particularly suitable for development as heritage tourism sites." At least six "ghost towns and mining towns" in five western states are currently interpreted by the BLM and are open to visitation. Visits to these sites present a broad range of experiences; the interpretative amenities provided at each are summarized in Table 6.1. Some of the sites consist of ruins accessible only by four-wheel-drive vehicles, whereas others are readily accessible, populated places. Some of the sites consist of archaeological remains, and a few have been stabilized or restored. Most are remote and primitive, but a few offer visitor's centers. Local BLM field offices provide driving directions, maps, brochures, historical photographs, and, in one case, children's activity pages related to the sites.

Numerous regional mining sites have been commemorated with historical markers (Figure 6.4) containing limited and, at times, historical descriptions of dubious reliability. Some historical-period mining sites within the Study Area are currently interpreted, and other opportunities may exist.

Table 6.1. Some BLM-Interpreted Historical-Period Mining Sites

State	Site Name	Amenities
Arizona	Swansea Ghost Town Site	• Building ruins/foundations, railroad grade, mining features, artifacts. The BLM Web page (BLM 2015a) provides historical photographs and directions to the site and urges visitors to avoid open mines and leave artifacts in place.
	San Pedro Riparian National Conservation Area	• Mining-town remnants (Contention City, Fairbank, Emery City, Millville, and Charleston). • Fairbank offers a self-guided tour, original and stabilized buildings, a foundation, and artifacts. The BLM Web page (BLM 2014c) provides a town-site map and links to non-BLM information. • The BLM Web page (BLM 2015b) for Charleston and Millville provides a map showing the approved parking area and urges visitors to respect the ruins and be wary of rattlesnakes.
California	Salt Creek Historic Mining District	• Building ruins, mining features, self-guided interpretive trail, parking area, and picnic area.
Idaho	Silver City	• Abandoned mines and partially restored buildings.
Montana	Garnet Ghost Town	• Stabilized buildings, guided tours, and a visitor center; a visitor fee is charged. The BLM Web page (BLM 2015c) provides a map of and directions to the site, an informational brochure, and an activity page for children.
New Mexico	Lake Valley Historic Townsite	• Restored buildings, stabilized buildings, and a self-guided, interpretive walking tour. The site has toilet facilities and water. The BLM Web page (BLM 2015d) provides directions, an informational brochure, and links to a photograph gallery and video; urges visitors to refrain from artifact collecting, metal detecting, and unauthorized digging; and warns against rattlesnakes.

Note: Information in Table 6.1 was obtained from the following electronic reference, no longer available online: Historic Sites: Helping to Tell the BLM Story. Electronic document, https://www.blm.gov/wo/st/en/info/history/features/historic_sites.html, accessed January 26, 2017.
Key: BLM = U.S. Department of the Interior Bureau of Land Management.

Figure 6.4. E. Clampus Vitus historical marker, Hart town site, 1998 (photograph by Karen K. Swope).

Bodie State Historic Park lies within the Bodie Bowl, in a BLM Area of Critical Environmental Concern managed to "protect, interpret and preserve the area's cultural, historic, natural and aesthetic values, including the special features of its scenic natural and historic landscape that enable visitors to enjoy the 'Bodie Experience'" (BLM 2007:n.p.):

> Nowhere in America can a person better journey back in time to experience a legendary Western boomtown than in the historic mining region of Bodie. As we walk the streets and view the structures and surrounding landscape, we begin to understand frontier life of the 1880s. . . . This experience helps us comprehend the place, events and people of various cultures and ethnic backgrounds contributing to the American spirit of fact and myth. Bodie offers an individual the unique opportunity to discover and experience the special sense of place suspended in time . . . free from the sights and sounds of contemporary intrusion. . . . This is the Bodie Experience.

Bodie is maintained by the California Department of Parks and Recreation in a state of arrested decay, presenting a snapshot of the town at a point during its demise.

The Calico town site, managed by the San Bernardino County Regional Parks Department (Figure 6.5), presents many replicated and a few remnant features of the original town elements. The Calico Mining District was the most productive silver district in the state (Ely 1990:18–19; Miller and Miller 1992:33; Nadeau 1999:243; Weber 1966:71; Wolle 1953:142). In keeping with Walter Knott's vision, the town operates much like an amusement park, offering shops, restaurants, a campground, and even a western-themed wedding venue. Special events, including costumed interpreters, attract school groups. A small museum operates on-site. Little interpretation of mining activity is provided (Lerch and Hatheway 1993); the bulk of the district mines, though visible from parts of the town, are outside the park boundary (Figure 6.6).

A few mining towns in the Study Area remain populated places, some with minor interpretive programs. Randsburg, with a current population of about 70, is not formally preserved or interpreted; tourists make the side trip from U.S. Highway 395 to see the remaining residences and commercial buildings that survive, and perhaps to patronize the general store, restaurant, or bed-and-breakfast inn.

The Cargo Muchacho–Tumco Mining District (also known as the Hedges, Ogilby, and Gold Rock Mining Districts and associated with the town of Obregon) is the largest former town and mine in the region and retains intact mills. The American Girl and American Boy mines in this district are listed in the NRHP and represent largely intact mining operations and structures. The BLM manages the former Tumco/Hedges Mining District and noted, "Obregon is representative of the best example of large-scale turn of the century industrial mining, and is the only intact gold mining complex in Southern California. The existence of turn of the century mining equipment at the site makes the site particularly useful for future research" (BLM 2011b:3.13).

The ruins at Ballarat and Skidoo are sought out by visitors to the Death Valley region. Although no interactive interpretation is provided at the sites, visitors at both locations encounter ruins and open expanses seldom encountered by the general public.

In keeping with perceived visitor preference, BLM is in favor of minimal signage at remote locations (typically limiting postings to directional and regulatory information). Even well-intentioned site interpretation, such as posting information signs, can yield undesired results by directing visitors to specific cultural resource locations that might otherwise go unnoticed. At historical-period mining sites, however, appropriate signage could include safety warnings and informational kiosks at trail heads, in parking loops, in campgrounds, or at locations overlooking site complexes that cover broad areas.

In providing access to historical-period mining sites, managers must give consideration to visitor safety. At Bodie State Historic Park, for example, the area containing the remains of a stamp mill, tailings plant, retort, smelter, and assay office are closed to public access and marked "hazardous area" in printed visitor materials (California Department of Parks and Recreation 2016). Mines in the Bremner Mining District, in the Wrangell–St. Elias National Park and Preserve, Alaska, presented a singular challenge in providing for public safety. Site improvements included removing hazardous materials (including batteries, fuel, fuses, dynamite, and blasting caps), closure of mine openings, reduction of aircraft hazards posed by aerial-tramway cables, and testing of water and sediment samples from nearby watercourses (White 2003:57–58). White (2017:158–159) noted that, despite the challenges in addressing heritage concerns in consideration of public health and safety, there is an opportunity for archaeology to "reveal the inconvenient truths about the consequences of this industry."

Figure 6.5. Directional sign for Calico Ghost Town, 1996 (photograph by Karen K. Swope).

Figure 6.6. Overview of the Calico town site, operated as a tourist attraction by the San Bernardino County Regional Parks Department, 1996 (photograph by Karen K. Swope). The mines, not interpreted to the public, can be seen in the hills above the town.

Creative Mitigation

Cultural resource practitioners have increasingly pursued innovative approaches to mitigate the loss of archaeological values, prompting dialogue in the form of conference presentations, archaeological society newsletter items, and archaeological Web sites, blogs, and listservs. Beyond archaeological mitigation, such as data recovery excavation, a few examples of "standard" mitigation in the Study Area are Skidoo and the Gold Hill Mill, which have been the subjects of HAER-documentation efforts to record the nation's hard-rock-mining heritage (Delony 1999:20) (Figure 6.7). Creative mitigation extends beyond the recovery of data that will be otherwise lost and, at its best, provides a publically available element that makes historical information accessible outside cultural resource management professions. Examples of recent creative mitigation at historical-period mining sites follow.

In 2012, New South Associates prepared a historic context for archaeological resource management, entitled *Gold Mining in the Carolinas* (Botwick 2012). The document was prepared as part of the mitigation for the effects of a modern mining project on a late-nineteenth- to early-twentieth-century stamp mill at the Haile Gold Mine in South Carolina. Creative mitigation for the site was performed under a Memorandum of Agreement between the South Carolina SHPO and the mining company and included historical and archaeological documentation of the site as well as preparation of the document for application in future research (Botwick 2012:ii, 2). This is an example of creative mitigation for the loss of an important site by providing a tool to support future NRHP evaluations and other research efforts related to regional mining.

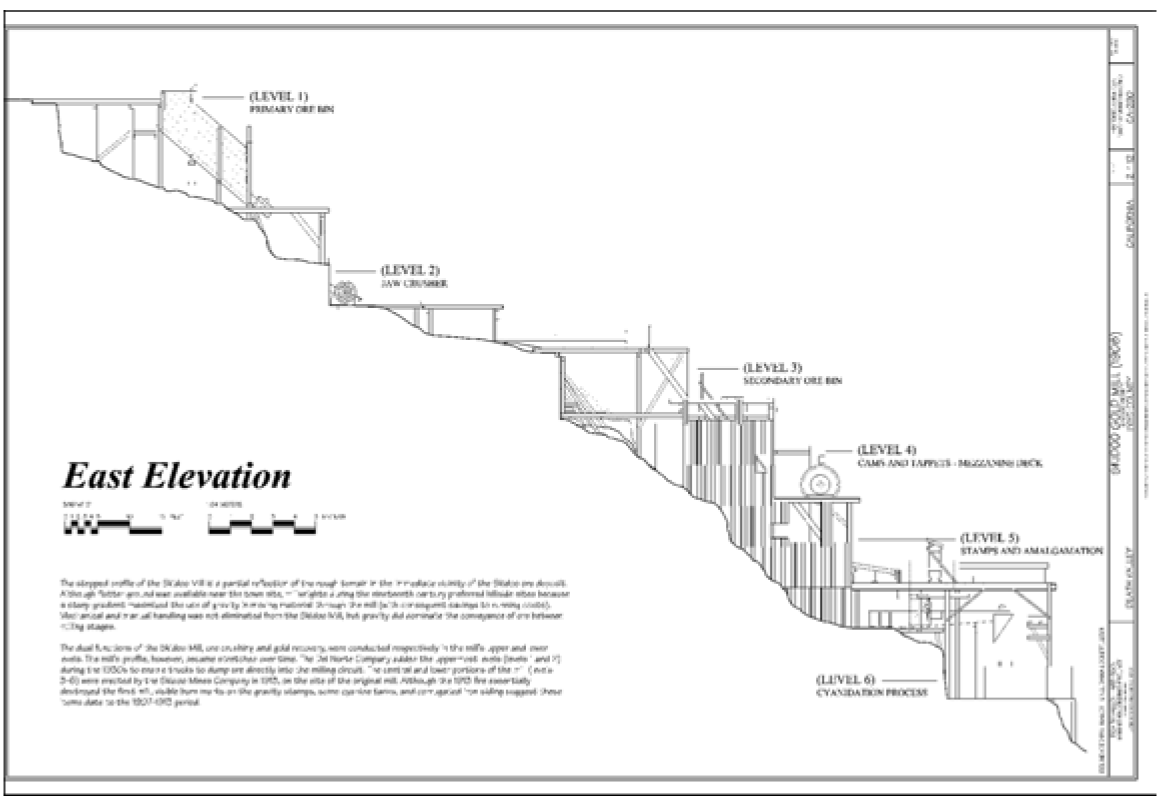

Figure 6.7. Skidoo Gold Mill, Death Valley National Park (courtesy of the U.S. Department of the Interior National Park Service, HAER CA-290).

Caltrans has used the information gained through archaeological compliance work at historical-period mining sites to complete successful creative mitigation. Lesson plans prepared as part of the mitigation effort for impacts to the La Grange Mine in Trinity County can be used in local schools to relate information on the late-nineteenth- to early-twentieth-century mining boom, effects of industrialization on the environment, and historical archaeology. Separate lesson plans were prepared for the seventh- and twelfth-grade levels. The lesson plans are posted for teachers on the agency's Web site (Hamusek 2004a, 2004b).

A highway project in El Dorado County, California, would affect the historical-period mining site of Logtown. Mitigation for the undertaking included archaeological and historical investigations, preparation of a technical report, and also an interpretive publication for public distribution (Obermayr 2011). Booklets such as this serve to disseminate information about our shared past that otherwise would remain in gray literature or compliance documents available only to the archaeological community.

The Kelly Mine, on lands managed by the BLM in San Bernardino County, was used under permit in 1996 for a movie set. The undertaking followed standard Section 106 compliance, including documentation and evaluation. The site was recommended eligible for listing in the NRHP, and a program of archaeological monitoring was enacted to ensure avoidance of cultural resources. The scene was to resemble a junkyard with piles of salvaged items and scrap. The dumps of tailings and waste rock at the Kelly Mine and millsite offered an easy way to reduce the quantity of materials required to create the artificial junkyard piles. The heaps of waste rock in place at the site were merely covered with a single layer of junk to resemble large piles. A town was temporarily erected on the 20-acre parcel. The temporary increase in pedestrian and vehicle traffic affected undergrowth and had some impact on a historical-period road, but, reportedly, BLM-permit requirements for avoidance and site restoration were successfully implemented (Mackey 1998).Few historical-period mining sites are supported by the financial means to provide interactive experiences like the operational machinery at the Western Museum of Mining & Industry in Colorado Springs, Colorado (Clements 1998; Frank 1990), but a number of museums and sites offer interactive opportunities of a different kind, such as abbreviated underground exploration of secure adit portals or static machinery available for tactile discovery. The Maggie Mine at Calico Ghost Town is an example. Considering modern mining interests on NPS land, Thompson (1990:109) noted, "If there is one area where preservationists and miners are often closest together, it is in their polarization against public use and appreciation, albeit for different reasons. Yet this I believe is the area where the greatest opportunities for preservation lie." During the time he was chief of the HAER, Eric Delony suggested that "the mining industry is completely capable of underwriting the costs of some of these interpretive sites and museums. And we have had some success interesting the industry in their own heritage" (Andrews 1994).

Outdoor industrial museums encompassing the visible mining landscape of a site, camp, or district can afford unrivalled educational information. Engaging the local community and tourists in site inventory and interpretation may be feasible in some areas, adding public-education value to work in progress.

Current Society for California Archaeology President Jelmer Eerkins (2016:4) recently wrote in support of creative ways of engaging "historical and other special interest groups, and the general public," calling for novel mitigation approaches such as three-dimensional digitized models, YouTube videos, and Web sites—all of which could be applied to mining sites. New technologies abound, and many remain untapped in application to historical interpretation. Unmanned aerial vehicles (UAVs, or "drones"), map-based interactive historical photographs and documents, photogrammetry, podcasts, blogs of archaeological work in progress, and three-dimensional virtual-reality presentations offer exciting new potential. Researchers will undoubtedly find ways to apply new archaeological methods, or old methods in new ways, in investigations at historical-period mining sites. Dendrochronology, for example, has been used for historical reconstruction (Hattori and Thompson 1987; Ritter 2016) and to corroborate the archival record (Wilke and Swope 1989).

Hardesty (1999b:2) summarized the preservation of mining sites:

> All of us should . . . work to keep the roads to mining's past well-maintained. Making it possible for others to travel the paper trail, for example, demands that we not only find and mark the road by locating documents but also maintain the trail by preserving documents. In the same way, preserving the relics of mining's past, the landscapes and buildings and machinery and ruins, makes it possible for others to travel along this road by experiencing first hand the material world of mining history.

Concluding Thoughts

We expect that this study will be useful in future documentation, interpretation, and evaluation of historical-period mining sites in the Study Area. It will be necessary to prepare site-specific and regional historic contexts and archaeological research designs for certain projects. Site-specific and local historic contexts prepared for particular investigations would result in more-detailed presentation of the history of specific mines, districts, and regions. Site-specific archaeological research designs would result in lines of inquiry focused on that historic context and the sites in the project area.

This document is intended to assist researchers and cultural resource managers in the inventory and evaluation of historical-period hard-rock-mining sites in the California deserts. The document does not establish specific mitigation actions, which should be made on a case-by-case basis for eligible cultural properties, in accordance with BLM's Section 106 NHPA and National Environment Policy Act (NEPA) policy and procedures. Mitigation efforts should be tailored to each specific undertaking and should afford sufficient flexibility for the consideration of creative mitigation opportunities.

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APPENDIX A

Glossary of Mining Terms

> *There are many terms and expressions unique to mining that characterize the field and identify the user of such terms as a "mining person." The student of mining is thus advised to become familiar with all the terms used in mining* . . . [Hartman and Mutmansky 2002:2].

Note: This glossary contains definitions of the mining terms used in this document, as well as a few additional terms that researchers are likely to encounter in archival documentation. Other useful glossaries and dictionaries containing exhaustive lists of mining terms are available and include Thrush's (1968) *A Dictionary of Mining, Mineral, and Related Terms*, the American Geological Institute's (1997) revision of that dictionary, and a periodically updated online glossary maintained by the Mining History Association (2011). These sources were consulted in compiling the definitions presented below; specific works are cited where text was drawn from those sources.

Abandoned Mine
"An abandoned hard rock mine on or affecting public lands administered by the BLM, at which exploration, development, mining, reclamation, maintenance, and inspection of facilities and equipment, and other operations ceased as of January 1, 1981 . . . with no evidence demonstrating that the miner intends to resume mining" (U.S. Department of the Interior Bureau of Land Management [BLM] 2013:7).

Adit
Horizontal or nearly horizontal mine passage beginning at the surface and extending underground, used for removing waste rock, ore, and/or water from a mine (Thrush 1968:12).

Aggregate
Clastic material, such as sand or gravel.

Amalgam/Amalgamation
An amalgam is an alloy of mercury and one or more other metals. Amalgamation is the production of an alloy in which mercury and another metal are united. The amalgamation process was used in gold and silver extraction. The term was also used to describe adjoining mining claims that were united for economic reasons (Thrush 1968:32), as in the Amalgamated Copper Company, at Greenwater near Death Valley Junction (Vredenburgh et al. 1981:251).

Apex
Topmost extent of a vein. May be subsurface or outcropped at the surface.

Arrastra
Also "arrastre" and "drag mill." One of the simplest and least-expensive milling technologies; probably introduced to California mines by Sonoran miners (Kelly and Kelly 1983:85–86). The mill consists of a circular pavement of flat stones upon which broken ore is crushed. The crushing is accomplished by dragging stones around the circle; power is applied by various means. Both the pavement and drag stones become slickened in the process. As noted by Van Bueren (2004), the use of arrastras at mining sites often went unreported in official documentation.

Assay
A test of mineral values by chemical process or smelting. Assayers determined the commercial value of ores.

Assessment Work
The annual work or fees required by law to maintain rights to an unpatented mining claim or site.

Backfill
Waste rock used to fill and support a stope, to prevent collapse.

Ball Mill
Crusher composed of a rotating cylinder or cone containing stone or metal balls that crush softer materials.

Base Metal
Metallic ore, including copper, zinc, and lead, of lesser value than precious metals.

Beneficiation
The concentration or enrichment of ore, including crushing, grinding, washing, flotation, and separation.

Blasting Cap, Blasting-Cap Tin
Tubular shell loaded with detonating mixture. A fuse was inserted into the tube, and the shell was crimped onto the fuse before firing. Electric blasting caps were equipped with an electrical firing device in the cap

and copper or iron wires extending from the cap. Standard sizes for mining applications were No. 6 and No. 8. Blasting caps were packaged in cylindrical or rectangular metal boxes (tins) and cushioned with heavy paper, felt, and sawdust. Boxes were embossed and/or lithographed with manufacturer information (Hercules Powder Company 1930; Martin 1991).

Breast
See “face.”

Button
A mass of lead containing gold and silver, produced during the scorification process of assaying. The hardened button is placed into a cupel, to separate the lead from the precious metals.

Carbide Lamp
A lamp, typically affixed to a miner’s helmet or hardhat, in which calcium carbide and water are combined in the generation of acetylene gas as fuel for a flame (Fox 1985).

Chilean Mill
Premotorized mill similar to an arrastra in its having an enclosed circular pavement or plate. Uses vertically-positioned rollers to crush ore. Also “roller mill.”

Chlorination
Gold-recovery process in which auriferous ores are roasted to oxidize base metals, exposed to chorine gas, and treated with water to remove chloride of gold, from which gold is precipitated.

Classifier
Separator to sort ore particles by weight and size. In ore dressing, a classifier separates the discharge from ball mills into what is ground fine enough and what which requires further crushing.

Cobbing
Sorting valuable ore from waste rock by breaking with a hammer. A cobbing platform can sometimes be identified as a horizontal rock surface exhibiting scars from the process.

Collar
The mouth or portal of a shaft, sometimes lined with wood as a support for subsurface lining or as a platform for aboveground structures.

Country Rock
The rock adjacent to an ore deposit or through which an ore deposit runs (Osborn 1896:199).

Cribbing/Cribbed Shaft
A shaft may be supported by cribbing, which is constructed by lining the open space with timbers and backfilling the space between the shaft walls and the crib.

Crosscut
A horizontal underground mine tunnel that crosses the trend of the vein, ore, or structure of the rock in a mine (Wyman 1979:6).

Crucible
A cup-shaped vessel made of refractory clay (fire clay), used in assaying for melting or calcining ores (Thrush 1968:283). Crucibles found at sites in California were typically made in western states or imported from Battersea, England. Sizes were numbered by capacity in grams (Fulton 1911:25; Furman 1902:59). Used crucibles frequently exhibit heat discoloration and sometimes contain glassy slag.

Cupel
A small, thick, cylindrical saucer most commonly made of bone ash but also made of Portland cement. Used in assaying, to separate lead from gold and silver. In the process, the lead is both absorbed by the cupel and volatized, and silver and gold are left in the cupped surface of the cupel as a metallic bead (Fulton 1911:76).

Daylight/Daylighted Stope
A stope or air vent that reaches the surface is said to be "daylighted."

Decline
A descending underground tunnel, not following the vein, used to access other parts of the mine.

Deposit (see Mineral Deposit)

Dimension Stone
Cut or otherwise shaped rock for architectural- or engineering-construction applications.

Double Jacking
Also "double hand-drilling." Drilling method requiring two miners, one holding the drill bit and one wielding the two-handed hammer (usually weighing approximately 10 pounds [Thrush 1968:342]).

Drift
A horizontal underground mine passage following the vein or structure of the rock.

Drill Scar
The hole or partial hole left by a drill, usually after blasting has incompletely removed the surrounding rock.

Drill Steel
Round or hexagonal drill bit used for boring into rock or ore.

Face
The vertical wall at the end of a horizontal mine excavation; also "breast."

Foot Wall/Footwall
Rock stratum beneath a lode or vein; opposite of hanging wall.

Gangue
Non-profitable minerals accompanying paying ore; sometimes includes minerals of lesser value than the targeted commodity.

Glory Hole
A conical excavation, the top of which is at the surface and the bottom of which connects to underground haulage shafts and/or drifts. Ore is broken around the perimeter of the cone and is transported by gravity out the bottom of the cone, from where it can be hauled out of the mine. Glory holes are used where rich ore outcrops over underground workings convenient for haulage. A glory hole differs from an open-pit mine in that with the latter, materials must be removed from the top of an open pit that does not connect with underground workings.

Grizzly
A stationary, sometimes portable, inclined screen used for sizing ore. Made of bars, perforated plate, or woven wire (Peele 1918:1651).

Grubstake
Supplies and/or capital provided to a prospector to be used while searching for valuable minerals. The arrangement typically includes an agreement for the benefactor to share a portion of any discoveries made.

Gyratory Crusher/Gyratory Breaker
A primary crushing mill that consists of a cone on a vertical spindle suspended in a larger cone. The interior cone crushes ore by eccentric gyration within the larger cone.

Hanging Wall
The stratum above a vein or ore deposit; opposite of foot wall.

Hard-Rock Mine
A mine excavated into hard rock—that is, material that can only be excavated by blasting. Excludes excavations into clay, sand, gravel, earth, and sedimentary rock. Sometimes "hardrock."

Headframe
Frame (timber or steel) on the surface above a shaft; supports hoisting apparatus.

High-Grade Ore
Rich ore (Thrush 1968:542).

Incline/Inclined Shaft
A shaft that deviates from the vertical, sometimes because it follows a vein.

Jaw Crusher
Primary crusher mill used for initial reduction of ore from large rocks to a size that can be crushed further by a secondary mill. Jaw crushers trap ore between two plates, one of which oscillates against the other or both of which oscillate against each other (Thrush 1968:598).

Level
Tunnels connecting on a common horizontal plane (Wyman 1979:6).

Location/Locatable Minerals
Can refer to the act of delineating a mining claim or to the claim itself. Locatable minerals are any minerals "subject to acquisition" under the Mining Law of 1872 (BLM 2011a:3).

Lode
A lode can be a single vein or a zone/belt of mineralized rock separate from adjacent non-mineral-bearing rock. Lode claims are filed on veins (lodes) of rock (in place) containing gold, silver, cinnabar, lead, tin, copper, or other valuable minerals (U.S. Department of Agriculture Forest Service 1983:5). Historical works sometimes refer to a lode as a "lead" (pronounced *leed*).

Low-Grade Ore
Ore that is relatively poor in the metal for which it is mined (Thrush 1968:660).

Mill
A reducing plant where ore is crushed and concentrated and where metals are recovered (Thrush 1968:706). Sometimes includes primary and secondary crushers for reducing ore into increasingly finer particles.

Mill Site
Under the Mining Law of 1872, as amended, a claimant could file on non-mineral land for the purposes of processing ore in the development of a mineral claim.

Mineral Deposit
"A concentration of minerals or elements of economic significance, in sufficient concentrations and quantities to warrant extraction at reasonable cost" (BLM 1991b:2).

Mineral Entry
A mining claim filed on public land.

Mining Claim
A lode claim relates to veins or lodes "having well-defined boundaries and also [including] other rock in-place bearing valuable mineral deposits. Examples include quartz or other veins bearing gold or other metallic mineral deposits and large volume, but low-grade disseminated metallic deposits. . . . Lode claims are usually located as parallelograms with the side lines parallel to the vein or lode. . . " (BLM 2011a:7–8).

Open Pit
Metalliferous lode deposits are sometimes accessed by open-pit-mining methods, which have become increasingly common during the past four decades, because technology and mineral values have made the mining of lower-grade ores profitable. Gold/silver, iron, and copper are most frequently mined using this method. Similar to quarrying, open-pit-mine workings are entirely open to the surface. Because they do not result in underground workings of lode deposits, open-pit mines are not considered in this study. Open pits should not be confused with glory holes, daylighted stopes, or collapsed stopes.

Ore Bin
A wooden or concrete box used to contain ore. Usually positioned above a mill or at the side of a road where ore can be loaded onto wagons, trucks, or a train for transport. The top of the bin is generally open so that ore can be dumped into it from wheelbarrows, ore cars, or conveyors. The floor of the bin is generally sloped toward a gate at the front, by which the flow of ore from the bin can be controlled.

Ore Car
A wheeled bin used to transport ore, waste rock, and/or tools through and from a horizontal mine passage. Frequently erroneously referred to as "ore cart."

Ore Dressing/Mineral Dressing
Beneficiation. The process of "mechanically separating and saving valuable minerals from the valueless material of an ore" or "mechanically separating two or more minerals, which combined have little value, into two or more products, each of increased value" (Richards and Locke 1940:1).

Patent/Patented Claim
A mining claim or mill site is patented when the federal government has conveyed title to the claimant. Upon title conveyance, the claim essentially becomes private land, and the patentee has legal title to the locatable minerals and activities on the surface (BLM 2011a:27).

Placer
Particles of metal that have been freed from ore-bearing deposits through exposure to weathering.

Portal
The entrance to a horizontal or nearly horizontal mine tunnel.

Prospect
A location where valuable minerals have been sought by exploration.

Pulp
Ground ore combined with water.

Raise
Underground passage driven from one level up to the next (Wyman 1979:6).

Roller Mill
See “Chilean Mill.”

Scorification, Scorifier
Scorification is the assay process by which gold or silver is dissolved through heat into a button of molten lead. The process is accomplished in a scorifier, a shallow vessel made of refractory clay (fire clay). Most scorifiers used in California mines were produced in western states or imported from Battersea, England. They are designated by the measurement in inches of their exterior diameters (Fulton 1911:26; Furman 1902:61).

Shaft
A vertical or inclined mine excavation used for recovering or accessing ore; for bringing water, ore, supplies, or personnel up from underground workings; or for ventilation.

Single Jacking
Also “single hand-drilling.” Drilling method performed by a single worker holding the drill steel in one hand and a small hammer (usually 4 pounds or less [Thrush 1968:1016]) in the other.

Slimes
Ore ground to such a fine consistency that the particles can be suspended in water.

Square-Set Timbering
A method of timbering used to support a stope; consists of vertical and horizontal members meeting at 90° angles. The square-set timbering method was devised for use in the mines of Comstock, Nevada, where veins and ore bodies were of very large size (Storms 1894:38–50).

Stamp Mill
A type of mill that crushes ore on the principle of a mortar and pestle, with the pestle repeatedly raised and dropped by force of gravity onto ore in a trough. The stamps, which are usually built in multiple batteries of five, can also be single-, double-, or five-stamp arrangements.

Stope
A pocket from which ore is removed, usually excavated as an enlargement of a drift or crosscut (Wyman 1979:6).

Stull
Post used in an inclined vein; usually the bottom of the post is set in a notch, and the top of the post has a cap between it and the hanging wall (Crane 1908:451).

Tailings
The debris from ore-beneficiation activities after valuable minerals have been removed to the extent possible. The term is frequently misused to describe waste-rock and low-grade-ore dumps.

Timbering
Posts and beams supporting portals and underground mine workings. Can be engineered (e.g., square-set method) or informal and expedient.

Tunnel
Horizontal or nearly horizontal mine passage running completely through a hill or mountain, with portals on each side (Thrush 1968:12, 1173).

Vein
A zone of mineralized rock that is clearly separated from the surrounding rock (Thrush 1968:1198).

Waste Rock/Waste-Rock Dump
Rock or ore that has been removed from a mine but is of insufficient value to be profitable if treated; it is deposited out of the way without entering the milling process. The term is frequently misused to describe tailings.

Whim
Also “whimsey”; a hoisting apparatus to raise water or ore from a shaft by winding a cable around a drum, using horsepower or a steam engine.

Winze
A downward-trending tunnel driven from a higher level, sometimes following an ore body (Wyman 1979:6).