

FINAL

ARCHAEOLOGICAL INVENTORY SURVEY OF 1,395 ACRES OF KAMEHAMEHA SCHOOLS' LAND IN WAIAWA AND WAIPI'O AHUPUA'A, 'EWA DISTRICT, O'AHU ISLAND, HAWAI'I

TMK (1) 9-4-006:034 por., 035 por., 036, 037 por.; 9-6-004:024 por., 025, 026; 9-6-005:001 por.

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> > > EXHIBIT "14"

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LIST OF ABBREVIATIONS

AIS	Archaeological Inventory Survey
С	Celsius
F	Fahrenheit
ft	Feet
GIS	Geographic Information System
GPS	Global Positioning System
HAR	Hawaii Administrative Rules
HRHP	Hawai'i Register of Historic Places
HRS	Hawaii Revised Statutes
in.	Inches
km	Kilometers
LCA	Land Commission Award
m	Meters
mm	Millimeters
OHA	Office of Hawaiian Affairs
SHPD	State Historic Preservation Division
SIHP	State Inventory of Historic Properties
ТМК	Tax Map Key

ABSTRACT — EXECUTIVE SUMMARY

TCP Hawai'i, LLC, conducted an Archaeological Inventory Survey (AIS) of an approximately 1,395-acre project area, which also included two existing access roads into the property and two proposed utility tieins (linear corridors extending out from the main project area to the north and west). The AIS supports the landowner's historic preservation review in the context of a land use change needed to develop a portion of the property for a solar power development. Based on previous archaeological studies in and near the project area, and other archival information including land surveys from the early 19th century, which indicated the project area was modified extensively by nearly 100 years of commercial, mechanized agriculture, we expected to encounter large numbers of archaeological features related to a plantation-era irrigation system (State Inventory of Historic Property [SIHP] # 50-80-09-2273) and transportation (roads and railroad-rights-of-way) network (SIHP # 50-80-09-2270). We were also expecting to possibly encounter remnants of old plantation camps (SIHP # 50-80-09-2271) and military storage areas (SIHP # 50-80-09-2272). We were particularly concerned about ensuring that all substantial gulches were resurveyed—even though at least three different groups of archaeologists have independently inspected these drainages between 1987 and 2012—because of the possibility of encountering traditional Hawaiian sites from precontact or early historic times. Our results indicate the entire project area has been completely altered by plantation-era activities and construction. We found evidence of extensive bulldozing and road construction in all three gulches, whose drainage bottoms have also experienced major flooding damage. Gulch C, in particular, was extensively "harvested" by plantation workers for surface rocks (basalt boulders) used to build formal irrigation ditches that extend throughout the project area (e.g., we documented over 13 km, or 8 miles, of linear ditches). We hand tested (excavated) a drystacked, basalt and sediment terrace in Gulch C because it was the most likely candidate for a possible precontact or early historic Hawaiian site. We recovered three, ferrous-metal nails in situ near the base of excavation, which confirmed a large body of observation and evidence that there are no extant precontact or early historic Hawaiian sites left in the project area. In our final analysis, we documented three historic properties, all plantation-era sites dating from the early to middle 20th century, consisting of 55 component features: (1) SIHP # 50-80-09-2270, a network of roads and railroad rights-of-way consisting of 28 features; (2) SIHP # 50-80-09-2273, an irrigation system consisting of 25 features; and (3) SIHP # 50-80-09-2271, the remains of workers' camps consisting of two features. We conclude the report by presenting our significance assessments, and then discussing the project effect and mitigation recommendations.

INTRODUCTION

TCP Hawai'i conducted an Archaeological Inventory Survey (AIS) of an approximately 1,395-acre project area in Waiawa and Waipi'o Ahupua'a, 'Ewa District, O'ahu, TMK (1) 9-4-006:034 por., 035 por., 036, 037 por.; 9-6-004:024 por., 025, 026; 9-6-005:001 por. (Figure 1, Figure 2 and Figure 3). The landowner and project proponent is Kamehameha Schools (KS) (567 South King Street, Suite 200, Honolulu, HI 96813). The project area is the entire parcel subject to a Land Use Commission (LUC) review (KS' Motion to Amend Decision and Order – Ref. No. P-14388, LUC Docket No. A87-610), plus the two existing access roads into the property and two linear transects representing utility tie-ins for a proposed solar farm development project. SunEdison (240 Makee Rd., Unit 8D, Honolulu, HI 96815) is working with KS and Hawaiian Electric Company to develop a 50 Megawatt solar facility on a portion of the LUC project area. With the exception of the utility tie-ins and existing access roads, the solar project area is completely subsumed by the LUC project area.

The project area is located just west of Pearl City, mauka¹ of the H-1 freeway and east of the H-2 freeway. The Waiawa Correctional Facility is a short distance north and mauka of the current project area. The well-known Waiāhole Ditch System (State Inventory of Historic Properties [SIHP] # 50-80-09-2268) crosses Waiawa Ahupua'a near the correctional facility. Nearly the entire project area (~90%) is in Waiawa Ahupua'a with a very small portion in Waipi'o Ahupua'a.

Based on archival research and previous archaeological surveys in the project area (Barrera 1987; Goodman and Nees 1991; Thurman et al. 2012), there is a low potential for identifying traditional (precontact) Hawaiian sites: nearly the entire project area (~98%) has been previously impacted—mechanically grubbed, graded, plowed, planted and harvested repeatedly for at least 80 years—by late 19th to 20th century commercial agriculture (first pineapple and then sugarcane). The ahupua'a² of Waiawa above the H-1 was part of LCA 7713:46 to Victoria Kamāmalu, sister of Alexander Liholiho (Kamehameha IV) and Lot Kamehameha (Kamehameha V). Many small kuleana (commoner) parcels were awarded well makai of the project area (south of the H-1) around Pearl Harbor. There are no other LCAs in the project area.

Historic Preservation Context

As a privately-funded development on private land subject to a land use change, the project's AIS was designed to satisfy the general requirements of HRS §6E-42 and HAR §13-284; and the specific details in HAR §13-276. In March, 2014, we initiated consultation with Susan Lebo, Ph.D., Lead O'ahu Archaeologist, State Historic Preservation Division (SHPD), regarding the SunEdison solar project, 99% of which consists of previously-impacted (by commercial plantation agriculture) plateau lands. We obtained a determination letter (Log No. 2014.01283, Doc No. 1404SL16) dated April 21, 2014, in which SHPD concurred with our assessment recommending an AIS of the entire (447-acre) project area. SHPD also requested an opportunity to review and accept a report that details the findings of the AIS prior to commencement of any project construction-related ground-disturbing activity. In June, 2014, while we were completing an AIS of the solar project area, which has not been submitted for review, SHPD, in a letter to the State Office of Planning, commented (Log No. 2014.02357, Doc No. 1405GC14 dated June 12) on the subject LUC motion and recommended an AIS of the entire 1,395-acre project area. On July 8, 2014, we began additional AIS fieldwork needed to satisfy SHPD's recommendation. Relevant correspondence from SHPD regarding both the SunEdison project area and KS' LUC project area is included in Appendix A.

¹ Hawaiian words are not italicized since Hawaiian is an official state language rather than a "foreign" language.

² We do not systematically define all Hawaiian words or provide a glossary of definitions for the same reason we do not italicize Hawaiian words (see Pukui and Elbert 1986 or <u>http://wehewehe.org/</u> for Hawaiian dictionaries).



Figure 1. Project area depicted on a portion of USGS 7.5-minute series topographic map 1998 Waipahu quadrangle (base map, www.usgs.gov)



Figure 2. Project area depicted on aerial image (base map from ESRI)



Figure 3. TMK map of the project area; data downloaded from City and County of Honolulu Office of Planning (<u>http://planning.hawaii.gov/gis/download-gis-data/</u>), processed using ESRI software

Natural Setting

This section describes the environmental conditions in the project area. Some observations on historic patterns of change are described where applicable. In addition to direct observations made during our survey, this information is derived from well-known sources including Foote et al. (1972), Macdonald et al. (1983), Juvik and Juvik (1998) and Ziegler (2002); and from Goodman and Nees' (1991) archaeological survey.

The physiographic setting of the project area is sometimes informally referred to as "tablelands" or plateau; however, it is more accurately the lower reaches of a moderately-sloping piedmont (transitional) zone between the Ko'olau Mountains to the northeast and the coastal plain around Pu'uloa (Pearl Harbor) to the south. This piedmont is dissected by several steep-sided, dry gulches, some of which are named (e.g., Pānakauahi and Pu'upōhaku). Elevation varies from approximately 12 to 200 m (40 to 650 ft) above sea level. Prior to mechanical grading and grubbing by commercial agriculture, the terrain in the project area was probably more irregular (e.g., with occasional rock outcrops and low hills), but today is nearly featureless except for the three main dry gulches that dissect the piedmont.

One noteworthy observation from our survey was the relative paucity of naturally-occurring basalt on the ground surface, including both bedrock outcrops and weathered clasts, particularly on the plateau lands, which are covered almost entirely by two invasive plant species: California grass (*Brachiaria mutica*) and koa haole (*Leucaena leucocephala*). One exception to this lack is Gulch C (Pu'upōhaku), which has a limited number of small outcrops along the drainage bank and some large boulder outcrops at the toe of slope and within the drainage itself. With the exception of the gulches, there are very few trees in the project area. The relative absence of surface rocks contrasts sharply with other similar settings the author has surveyed, including historically-farmed piedmont landscapes in central O'ahu at Kunia (Monahan and Thurman 2013) and Schofield Barracks (Monahan 2009). This combination of a more or less rock-free, treeless landscape dominated by thick stands of California grass, in particular, is characteristic of a terrain that has been completely transformed for the purposes of industrial monoculture. As discussed in more detail below (see ARCHAEOLOGICAL CONTEXT), the most impressive rock outcrops, high vertical sections of smooth basalt suitable for traditional Hawaiian use (e.g., as shelters or to create petroglyphs) are located at the south end of Gulch C, 50–100 m beyond the project area boundary.

Average annual rainfall is ~40 in. (1,000 mm); mean annual temperature is ~82°F (28°C). In addition to California grass and koa haole, other plants include invasive grasses (molasses grass, Melinus minutiflora; Guinea grass, Panicum maximum), feral sugarcane (Saccharum officinarum), klu (Acacia farnesiana, also known as Vachellia farnesiana), Christmas berry (Schinus terebinthifolius), kiawe (Prosopis pallida), ironwood (Casuarina spp.) and eucalyptus (Eucalyptus spp.)—both in the extreme north end of the project area along the edges of Gulch A only, strawberry guava (Psidium cattleianum)-also in the extreme north end around Gulch A, guava (Psidium guajava), liliko'i or passion fruit (Passiflora edulis), orange (Citrus spp.), and albezia (Paraserianthes falcataria). We did not observe any native and/or Polynesian-introduced species, which were reported by Goodman and Nees (1991:4) as occurring at the edges of ravines and at higher elevations. We did observe occasional kukui endocarps on the ground surface in some of the dry gulches, but we did not see any kukui trees. Inspection of survey maps from the 1930s indicate the following additional plant species were also once found in the project area: koa (Acacia koa), kukui (Aleurites moluccana), 'ōhi'a lehua (Metrosideros polymorpha), uluhe (Dicranopteris linearis), sandalwood (Santalum spp.), hau (Hibiscus spp.), mango (Mangifera indica) and, around workers' camps, cultivated banana (Musa spp.), papaya (Carica papaya), and plum (indeterminate variety).

According to Foote et al. (1972), nearly the entire project area is covered in variations of silty clay soils (Wahiawa, Lahaina and Manana) with extremely small areas of "fill land" (Fd) around one of the old historic reservoirs (designated Reservoir 3, see below) and silty clay loam (Manana) in the southeast portion of the project area. Exposed soils observed on and adjacent to earthen roads in the project area

have a compact, "red dirt" appearance typical of upland O'ahu. Three archaeological trenches excavated by Goodman and Nees (1991:15–16, 42–43) in or immediately adjacent to the northwest portion of the project area (it is not possible to determine their exact location) revealed an upper 1.1–1.4 m (3.6–4.6 ft) of reddish-brown loam (Layer I) atop dark red silt (Layer II) over dark red sandy silt (Layer III) and dark brown silty clay (Layer IV).

The dry gulches do not contain through-flowing water, but, according to Goodman and Nees (1991), they used to flow during major storms (see Goodman and Nees 1991:3–4, who observed such an event). We visited the project area a couple days after tropical storm Wali hit O'ahu in late July, 2014, and did not see any flowing water, or evidence of recent water flow such as strand lines, in Gulch A, which is at the top (elevation) of the project area. As described below, we observed two major flood control alterations of the landscape around historic-era reservoirs; and, it appears that efforts have been made to reduce or eliminate storm run-off into the dry gulches in the project area. The closest perennial stream is Waiawa Stream immediately east of the project area. Waiawa Stream flows through a deep, steep-sided gorge with alluvial flats containing numerous traditional Hawaiian sites that were a focus of Waiawa Ahupua'a's irrigated agriculture (cf. Bautista et al. 2013).

Built Environment

Other than the historic properties and their component features, all of which are related to commercialagricultural (plantation-era) infrastructure, there are no major modern structures in the project area, but there are a few substantial landscape alterations. The most obvious non-historic properties are simple earthen roads that traverse the project area, and do not appear on historic maps depicting the old road network. There are low earthen berms alongside some of these non-historic roads; these berms were formed when the roads were graded or scraped in modern times. The landscape around two of the old reservoirs—one at the top of Gulch C (labelled Reservoir 3 on historic maps from the early 20th century) (Figure 4) and the other at the northeast end of Gulch B (Reservoir 1-A on historic maps)—has been thoroughly remodeled and altered in recent times by civil engineers to control flooding.³ At both locations, the drainage bottoms immediately downstream of the old reservoirs have been groomed and filled in with large amounts of loosely-arranged boulders.

A heavily-built earthen berm, much wider and higher than those adjacent to the modern roads, is located in the northwest portion of the project area (Figure 5). This approximately 450-m long berm, clearly visible on aerial imagery, is located immediately north of Gulch A in an area that once housed plantation workers (known as Camp 41). Other than some modern fence lines in the northwest portion of the project area, there are no standing structures besides the historic properties described herein.

³ Most of the six reservoirs built and maintained by plantation workers in the early 20th century consist of minimallyaltered, topographic low spots on the landscape with no observable human modification (e.g., formal structural rock work around the perimeters); most reservoirs are numbered on maps from the 1930s (see Figure 7 for reservoir numbers).



Figure 4. Area of Reservoir 3, which has recently been modified by a flood-control project, view westnorthwest; original reservoir area was to the right (circled, behind the sign) in this view



Figure 5. Portion of the north side of the large earthen berm (behind the person for scale) in the northwest project area, view south

METHODS

This section describes the methods of archival research, fieldwork and consultation for this project. We begin by explaining a few conventions used in this report.

Conventions Used in this Report

In reference to interpretations of the age of construction or use of archaeological sites described in this report, all of the commonly used terms have their own potential built-in biases, strengths and weaknesses, the discussion of which is beyond this AIS report. Unless otherwise stated or discussed, the term "precontact" (rather than "prehistoric") is used to refer to the time before the arrival of Captain James Cook in the Hawaiian Islands, generally understood to be 1778. On the other hand, the term "historic" (rather than "post-Contact) is used to refer to events after 1778.

Plant species are generally referred to throughout this report by their common names only. Scientific (Latin, binomial) names have been provided in the Natural Setting section (above), and are not repeated elsewhere in this report.

A list of commonly used abbreviations is provided at the beginning of this report. In the text, abbreviated terms are usually defined the first time they are used; thereafter, only the abbreviation is used.

Archival Research

In general, archival research for AIS work is conducted to systematically obtain all relevant information for interpreting a project area's cultural, historical and archaeological context. This is important not only for predicting the types of historic properties a project area may contain, but also for understanding sites that are found during survey work. Much of the archival information in this AIS was originally compiled in four prior studies: (1) Goodman and Nees (1991), which is particularly valuable for its discussion of the historic period uses of the project area; (2) Thurman et al. (2012), which provides an extensive amount of data on traditional Hawaiian connections and associations with the project area and its environs; (3) Bushnell et al. (2003), and (4) Genz et al. (2010), which also cover Hawaiian perspectives on the project area and environs.

In addition to referencing the aforementioned reports and to conducting a records search at the SHPD's library in Kapolei, we also utilized the following on-line databases:

- Office of Hawaiian Affairs Papakilo database (<u>http://papakilodatabase.com/main/main.php</u>)
- OHA's Kipuka database (<u>http://kipukadatabase.com/kipuka/</u>)
- Bernice P. Bishop Museum archaeological site database (<u>http://has.bishopmuseum.org/index.asp</u>)
- Bishop's Hawaii Ethnological Notes (<u>http://data.bishopmuseum.org/HEN/browse.php?stype=3</u>)
- State Land Survey (<u>http://ags.hawaii.gov/survey/map-search/).</u>

Kamehameha Schools also provided copies of survey maps that included the project area dated 1933–5. These maps are not reproduced in this report, because they are proprietary materials, but information from them on the type, location and spatial distribution of historic properties has been used to create graphics and other analytical aids for this AIS.

Fieldwork

Fieldwork totaling 50 person days was conducted in two phases. The first phase, from May 1–7, 2014, consisted of 12 person days. Phase 1 was specifically aimed at documenting historic properties in the SunEdison project area. All Phase 1 fieldwork was conducted, managed and organized by Doug Thurman, B.A., who served as the Field Director. Thurman has eight years of archaeological experience in Hawai'i and additional experience on the U.S. mainland before that. He was assisted throughout the project by Rosanna Runyon-Thurman, M.A., who has a similar amount and type of professional

experience. The Principal Investigator (Chris Monahan), with over 13 years of supervisory experience in Hawai'i and 12 years elsewhere worldwide, was in the field for two of the five days of the Phase 1 work.

Phase 2, from July 7–30, 2014, consisted of 38 person days. Phase 2 was specifically aimed at documenting historic properties in the parts of the project area not covered by the SunEdison work. Particular attention was paid to the three major gulches, within which we conducted systematic pedestrian survey (described below). All Phase 2 fieldwork was conducted, managed and organized by Chris Monahan, Ph.D., who was present every day. Other than the first and last days of fieldwork, he was assisted at all other times by U'ilani Han, A.A., and Jeff Lapinad.

We used two different survey strategies for this project. First, given the results of archival research and previous archaeological work in the project area, which indicate the vast majority of the ground surface has been mechanically altered by commercial agriculture and the construction of irrigation and transportation (roads and temporary railroad rights-of-way) networks; and given the presence of dense, 6–8 foot-tall California grass throughout nearly the entire project area, we did not conduct systematic pedestrian transects of the entire project area. Instead, for all areas except the aforementioned gulches, we re-visited, or attempted to re-visit, all known historic properties or component features based on georeferenced maps compiled from previous archaeological reports including the historic (1930s) survey maps mentioned above. We went into the field with a Garmin eTrex 20 GPS device loaded with shapefiles of all previously-identified historic properties and component features as well as high-resolution aerial photographs depicting these data. We made some new discoveries of additional features (especially the irrigation infrastructure) that were not previously identified; and we also discovered that some features from the historic (georeferenced) maps are no longer there or have been severely altered by modern activities (e.g., certain roads and railroad rights-of-way; some of the retention basins).

The second survey strategy, employed exclusively in the gulches, was to conduct systematic pedestrian sweeps using three archaeologists separated by 5–10 meter intervals. In all cases, we walked parallel to the drainage flow and paid particular attention to the toe of slope area and drainage banks rather than the drainage bottoms, which have been severely altered in the past by flooding whose impacts can still be observed in some places. All historic properties and component features were recorded using a Garmin eTrex 20 GPS device, which consistently obtained excellent (2–3 meter) satellite reception and geospatial accuracy given the lack of tree canopy in most of the project area.

The survey rule (HAR §13-276) states that each historic property must be documented with a "drafted plan map to scale." Since nearly all of the extant historic properties and component features in the project area are linear resources (i.e., long irrigation ditches, siphons and flumes; roads and railroad rights-of-way), our primary mapping technique was to obtain multiple, accurate GPS points with a Garmin eTrex 20 device that we later used to create maps with ArcGIS software supported by ESRI. We also analyzed high-resolution aerial imagery (i.e., on-line ESRI data), and "ground truthed" our observations by inspecting portions of linear resources to verify their spatial extent. For about two dozen features, we augmented our "GIS mapping" with scaled plan maps, which were produced using a combination of tape-and-compass and laser distance/ range finder-and-compass. Representative photographs were obtained for every feature identified in the project area, and for many sub-features as well, where appropriate.

Subsurface testing (hand excavation) was conducted at one feature: a small, dry-stacked terrace in Gulch C designated Feature 21, Site 2273. Based on observations at the ground surface, it was unclear whether the terrace was a precontact or plantation-era construction. The main objectives of excavation were to determine construction methods and constituent materials of the terrace; and to recover physical evidence of building phases, site occupation and/ or dates thereof (relative and absolute), if possible. All excavation was conducted entirely by hand using a trowel. All excavated sediments were passed through a standard 1/8-inch metal screen. Excavation was conducted by arbitrary 10-cm levels. Soil-stratigraphy was described and interpreted by layers using standard archaeological criteria based on USDA soil scientific classification and terminology.

Consultation

As memorialized in Appendix B, we began our consultation process by contacting the SHPD in a letter dated March 5, 2014, requesting a meeting with Susan Lebo, Ph.D., Lead O'ahu Archaeologist. The first consultation meeting with Dr. Lebo took place, along with representatives of Kamehameha Schools and SunEdison, on March 10, 2014, in Kapolei. In addition to introducing SunEdison's proposed project, we also discussed the size and shape of the project area as well as the results of previous archaeological studies in and near the project area. We discussed the fact that, with a few prominent exceptions that do not apply in this case, the SHPD does not review *phased* historic preservation projects; thus, we initially created a project area (the "SunEdison project area") that included both their construction footprint area under immediate consideration for build-out as well as a second area (east side of the project area) that *may* be constructed in the near future. As described in the Introduction to this AIS report, however, these discussions about the SunEdison project area were largely subsumed (made moot) by the more recent need to conduct an AIS of the entire LUC project area. One of the important outcomes of consultation with SHPD was the recommendation that the access roads into the property also be included in the AIS project area.

Based on this (3/10/14) meeting, we prepared a formal request for HAR §13-284-5(b) determination regarding the identification of historic properties in the SunEdison project area in a letter dated March 19, 2014. This request eventually resulted in the SHPD's written determination letter dated April 21, 2014, which concurred with our assessment and recommended an AIS be conducted of the entire SunEdison project area (see SHPD letters in Appendix A).

As described in the Introduction, during completion of the AIS for the SunEdison project area, SHPD commented on Kamehameha Schools' LUC application (see Appendix A) and requested an AIS of the subject (current AIS) project area. On July 16, 2014, Chris Monahan phoned Dr. Lebo to notify her that TCP Hawai'i was completing an AIS of the entire ~1,395-acre project area. Also on July 16, 2014, Chris Monahan phoned Lauren Morawski, Compliance Enforcement, Office of Hawaiian Affairs (OHA), to likewise inform her of the in-progress AIS. On July 25, Chris Monahan emailed Kai Markell, Ka Pou Kāko'o, Kia'i Kānāwai, OHA, a letter requesting consultation for the subject AIS. The next day, Chris Monahan mailed the consultation letter to Kamana'opono Crabbe, Ph.D., Ka Pouhana, OHA (see Appendix B). It is important to state that we included OHA in consultation despite the fact that no traditional or precontact Hawaiian sites were identified in the project area during this AIS; and, no historic properties evaluated as significant to Native Hawaiians under criterion E were identified. However, since there are such cultural resources (including two different petroglyph sites) just outside the project area boundaries to the west and southwest, we included OHA as a good faith effort to inform them of our work and to invite them to contact us with any questions or concerns.

On December 18, 2014, representatives from TCP Hawai'i and Kamehameha Schools met with Susan Lebo to discuss Project Effect and Mitigation for the entire ~1,395-acre project area. Based on the results of this meeting, we revised our Mitigation Recommendations and submitted replacement pages for SHPD review on January 9, 2015. On February 25, 2015, representatives from TCP Hawai'i, Kamehameha Schools and SunEdison met with Susan Lebo to discuss the revised Mitigation Recommendations. Based on the results of this meeting, on March 2, 2015, TCP Hawai'i consulted with Anna Broverman, Architectural Historian at SHPD, regarding the Architecture Branch's requirements for possible mitigation (e.g., architectural recordation or additional photography) of several site-features in the project area. In an email dated March 6, 2015, Anna Broverman replied: "Tve reviewed the area of the AIS that pertains to the sites Susan discussed. After reviewing, I don't need to visit the site and I am not going to require any addition recordation for the Architecture Branch. I believe the sites are described well and photographed appropriately in the AIS." Based on this consultation, TCP Hawai'i again revised the Mitigation Recommendations for the current project area to include Preservation of certain site-features but not Architectural Recordation (see p. 142).

HISTORICAL CONTEXT

In view of the fact that the archaeological remains in the current project area are relatively well known, having been previously described in several prior surveys (Barrera 1987; Goodman and Nees 1991; Thurman et al. 2012), and in view of the well-documented history of commercial plantation activities starting around the turn of the 19th/20th century that destroyed any previously extant evidence of traditional Hawaiian activities on the plateau lands of Waiawa, this historical context section is relatively brief and to the point. The first section on the indigenous cultural landscape of Waiawa and surrounding lands draws from detailed treatments by Genz et al. (2010) and Thurman et al. (2012), to which the reader can refer for more details not included here (see also Bushnell 2003). Most of the second part of this section (Historical Period) is based on Goodman and Nees (1991).

Hawaiian Cultural Landscape

Waiawa Ahupua'a is part of the larger moku (or kalana) of 'Ewa. In general, prior to the introduction of western values, concepts of land use and ownership, and commercial activities in the 19th century, traditional Hawaiian life in Waiawa and its neighboring ahupua'a (Waipi'o to the west and Mānana to the east) was very much centered around the natural resource and wahi pana of Pu'uloa (Pearl Harbor), with its extensive shoreline and estuaries that were home to numerous fishponds and taro lo'i (pondfield complexes). As suggested by Māhele documents, the coastal flats around Pu'uloa (i.e., the area below, or south of, the H-1 freeway), including the lower reaches of Waiawa Stream and the Mānana Peninsula, all well makai of the current project area, were the favored places for permanent settlement and irrigated agriculture in this area.

McAllister (1933) recorded three fishponds at Pearl Harbor in Waiawa Ahupua'a: Loko Apala (SIHP # 50-80-09-118), Loko Kuhialoko (SIHP # 50-80-09-119) and Loko Mo'o (SIHP # 50-80-09-120). By this time (early 1930s), Loko Apala was reduced from a very large (75-acre) fishpond to just a few acres. Likewise, the other fishponds had also nearly disappeared by the 1930s (e.g., see Sterling and Summers 1978:48), but they were once major sources of food and tribute in traditional times.

The current project area, between 12 to 200 m (40 to 650 ft) elevation and consisting of the plateaus between Waiawa Stream to the east and ephemeral gulches to the west, was likely used for traditional Hawaiian purposes as a dryland (rain-fed) agricultural area. Recent research by Kirch and others (e.g., Kirch 2010; Ladefoged et al. 2009) has highlighted the contrast between the geologically-younger windward islands (Hawai'i and Maui) versus the older, leeward islands (O'ahu and Kaua'i) in terms of the quality of upland soil and opportunities for rain-fed (non-irrigated) agriculture in precontact times. These and other studies have shown that O'ahu's upland soils are relatively poor for such cultivation (because of their age), which helps explain the absence of extensive dryland agricultural complexes ("field systems"). As such, it is unlikely that the current project area was intensively modified for dryland agriculture, but there were probably scattered planting areas including small soil terraces and planting mounds. As discussed in the Archaeological Context section below, we know from a recent archaeological reconnaissance survey (Bautista et al. 2013) and an earlier inspection (Farrugia and Cleghorn 1994) that the perennial Waiawa Stream (also known as Kukehi in its lower reaches, according to 'Ī'ī 1959:96–97) contains abundant evidence of irrigated agricultural structures and habitations from precontact and early historic times. With the exception of major storm events, it appears the plateaus of Waiawa lacked year-round through-flowing water (i.e., the gulches rarely fill with water).

Puoiki Heiau (SIHP # 50-80-09-121), erroneously reported as "destroyed" by McAllister (1933) but relocated (with associated traditional features such as petroglyphs and habitations) by Goodman (1991), is on the eastern boundary of Waiawa Ahupua'a (with Mānana Ahupua'a) on a prominent ridge line at about the same elevation as the current project area. A second heiau in Waiawa, near the 'ulu maika playing field of Haupu'u below (makai of) the H-1 freeway, was apparently demolished in 1834 when the Protestant Ewa Church was built directly over it (Sterling and Summers 1978). Born in neighboring Waipi'o in 1800, writing in the 1860s, and describing O'ahu around 1810, the native historian and ali'i John Papa 'Ī'ī (1959:96-98) outlined a system of trails linking East Honolulu with central O'ahu, the Wai'anae coast and the north shore to Waimea. The coastal trail mauka of Pearl Harbor, in the area of the current H-1 freeway, passed through Waiawa Ahupua'a well south of the current project area; one branch headed upcountry to Kūkaniloko in central O'ahu approximately where the current H-2 freeway is located. Goodman and Nees' (1991) archaeological survey (described in detail in the next section) recorded a short segment of local trail in Pānakauahi Gulch (also known as "Gulch D" by these archaeologists) approximately 0.75 km southwest of the current project area.

Mo'olelo associated with Waiawa and environs include many references to Pu'uloa and its fishponds, sharks and shark 'aumakua, chiefs named Kawelo and Kūali'i, awa (milkfish, *Chanos chanos*) and 'awa (*Piper methysticum*). Pukui et al. (1974) translate Waiawa as "milkfish pond," and there are numerous oral-historical references to the "awa ponds" of Waiawa, referring to the lands around Pearl Harbor.

Historic Period

Early accounts from the historic period, including explorers and missionaries, focused on the lowlands around Pearl Harbor (e.g., Nathaniel Portlock and George Vancouver in the late 18th century; Archibald Campbell, F.J.F. Meyen and William Ellis in the early 19th century; Levi Chamberlain's famous tour of O'ahu in 1828).

The project area is part of a much larger ahupua'a-wide ali'i award (LCA 7713:46) to Victoria Kamāmalu, sister of Alexander Liholiho (Kamehameha IV) and Lot Kamehameha (Kamehameha V). Kamāmalu died in 1866, and her estate was inherited by Mataio Kekūanao'a (her father), who passed it on to his son Kamehameha V. After he died in 1872, Ruth Ke'elikōlani (his half-sister) received the estate. Upon her passing in 1883, it went to Bernice Pauahi Bishop (Kame'eleihiwa 1992), now entrusted to Kamehameha Schools.

There are no kuleana (commoner) awards in or near the project area. As such, there is a lack of traditional land-use information in the Land Commission documents. As stated above, practically all of the awarded kuleana parcels—where commoners lived and worked the land—were well south of the current project area. The most mauka awards begin around the location of the Kamehameha Highway, at least a mile south of the current project area (see Registered Map 1258).

According to Thurman et al. (2012:53), "the missionaries assigned to the 'Ewa Church in Waiawa allowed their cattle to roam on the Waiawa uplands as early as the late 1830s," and the Robinson family "ran cattle on the Waiawa lands" into the early 20th century.

By the late 1890s, most of Waiawa was leased to Oahu Sugar Company. Pineapple was grown there in the early 1900s. In 1906, Dole's Hawaiian Pineapple Company built a cannery and an adjacent camp along the northern margins of the current project area. In 1916, the Waiahole Water Company finished the Waiāhole Ditch System (SIHP # 50-80-09-2268), which passes through the correctional facility property above the current project area; and made possible the shift from pineapple to sugarcane in Waiawa. This shift to sugar appears to have been completed by 1930 (Cultural Surveys Hawai'i 1997).

From 1941 to 1945, portions of the Waiawa uplands, including portions of the current project area and areas higher (more mauka), were taken over by the U.S. military for training purposes. Goodman and Nees (1991:102) describe the area as part of a training course for tanks and personnel. After World War II, structures and buildings currently used or since modified (repurposed) for the Waiawa Correctional Facility were turned into a communications center. These formal structures were designated SIHP # 50-80-09-2272 as a result of Goodman and Nees' (1991) survey work. As described more systematically in the next section (Archaeological Context), several features described as military storage areas were identified in the current project area; however, Goodman and Nees (1991) never described any physical evidence of these; they just included tracings from historic (1940s) military maps. We investigated these possible storage areas during our survey (and did not find any such evidence).

ARCHAEOLOGICAL CONTEXT

In this section, we summarize relevant previous archaeological studies in order to reconstruct human use and modification of upland Waiawa and adjacent Waipi'o. In the second part of this section, we focus explicitly on previous archaeological work *within* the current project area to glean from it not only predictive data about the types and distribution of sites we might encounter but also information gaps the AIS is designed to address. In concert with the Historical Context presented above, the information in this section forms the basis of our predicted findings that are described in the next section.

Table 1 and Figure 6 summarize previous archaeological studies in and near the current project area. The text does not necessarily discuss all of these studies, some of which are not particularly relevant to the current AIS report, but they are listed for information purposes.

Relevant Studies in Waiawa Ahupua'a and Environs

McAllister's (1933) survey was the first scientific attempt to record significant archaeological and other cultural sites such as wahi pana on O'ahu. In keeping with McAllister's propensity to focus on large, formal structures (such as heiau) located in easily-accessible coastal areas, the only site he documented above (mauka of) the current H-1 freeway in Waiawa or the eastern side of Waipi'o Ahupua'a was Puoiki Heiau (SIHP # 50-80-09-121), located on a prominent ridge just north of the current Pacific Palisades residential area and east of Waiawa Stream.⁴ McAllister reported the heiau as "destroyed," but Goodman's (1991) site visit contradicts this. She described a variety of traditional Hawaiian features including the possible heiau ruins, habitation platforms, two petroglyphs and a rockshelter, among other features. For the purposes of our AIS, Goodman's description of the Puoiki Heiau site complex is important for establishing a clear Hawaiian presence at the same general elevation as the current project area. Other archaeological resources described by McAllister (1933) and Sterling and Summers (1978) below (makai of) the H-1 freeway and the current project—including an old heiau demolished in the early 1800s and several fishponds around the shoreline of Pearl Harbor—are discussed in the previous section (Historical Context).

In the 1970s, archaeological reconnaissance surveys just southeast of the project area in the Pearl City Industrial Park (Waiawa Gulch National Guard Storage Area) and Mānana Kai (Rosendahl 1977; Connolly 1980, respectively) did not identify any sites due to previous ground disturbance and development. McGerty and Spear (1995), and later Fong et al. (2005), conducted field inspections in the Mānana Kai Neighborhood Park but did not identify any traditional or historical sites. They noted that commercial agriculture and military use greatly impacted the area. Immediately adjacent to the southeast boundary of the project area along Waihona Street (Mānana Marine Housing), Tuggle (1982) identified the remnants of a possible agricultural canal whose source was thought to be a fresh water spring. Along Waihona Street, just southeast of the project area, Bell et al. (2006) conducted a field inspection for a rock-fall project and identified one historic property, a small terrace, along the top of a slope.

Of more direct relevance to our AIS, Bautista et al. (2013), conducting an archaeological reconnaissance survey of 274 acres for Kamehameha Schools, identified more than 40 sites in the Waiawa Stream gorge east of the current project area.⁵ This survey of the alluvial stream flats identified a series of extensive irrigated lo'i site complexes, habitation areas and two petroglyph sites, among others. Bautista's (2013) survey clearly shows there are extant Hawaiian sites of tradition design in Waiawa at elevations equivalent to the AIS project area, despite the historic-period disturbance by plantation workers and the

⁴ Sterling and Summers' (1978:16) *Sites of Oahu* includes McAllister's description of Puoiki Heiau under the adjacent (to the east) Manana Ahupua'a but depicts it on their map (following p. 56) as being in Waiawa. Goodman (1991:1) describes it as being on the ahupua'a boundary.

⁵ At the time of this writing, these sites have not yet been assigned SIHP numbers and are currently identified by their temporary field numbers (e.g., CSH 1, and so on).

Source	Type of Investigation	General Location	Findings*	
McAllister 1933	Island-wide survey	Waiawa	4 sites: Puoiki Heiau (Site 121), Loko Apala (Site 118), Loko Kuhialoko (Site 199) & Loko Moʻo (Site 120)	
Rosendahl 1977	Arch. Reconn. Survey	Kīpapa & Waiawa Gulches	No sites identified in Waiawa Gulch	
Connolly 1980	Arch. Reconn. Survey	Mānana Kai Neighborhood Park	No sites identified	
Tuggle 1982	Archaeological Survey	Waihona Street, Waiawa	Possible agricultural canal	
Hammatt & Borthwick 1985	Arch. Reconn. Survey	Wetland near LCC, Waiawa Kai	No significant findings, but survey of marshy area possibly found outline of Loko Mo'o (Site 120)	
Barrera 1987	Archaeological Survey	Waiawa Uka (includes portions of current project area)	4 sites: a boulder alignment (Site 1469), a dump site (Site 1470), a pineapple cannery (Site 1471), and an irrigator camp (Site 1472)	
Bath 1988 Pietrusewsky & Mahoney 1988	Burial Report	LCC campus, Waiawa Kai	Human skeletal remains in construction on LCC campus; MNI = 6 possibly of Chinese ancestry (Site 3761)	
Goodman & Nees 1991	Arch. Reconn. Survey & Inventory Survey	3,600 acres bounded by H-1, H-2, & Waiawa Stream, Waiawa Uka (includes current project area)	13 sites (both historic and precontact): Sites 2261–2273; these subsume Barrera's (1987) sites (Sites 1469–1472)	
Goodman 1991	Site Inspection	Just above junction of Waiawa and Mānana streams	Field trip to investigate Puoiki Heiau (Site 121), where numerous traditional features and the heiau remnants were observed	
Henry et al. 1993	Arch. Inventory Survey	Waiawa Kai Floodplain	1 site: linear rock alignment of indeterminate function (Site 4607)	
Sinoto & Pantaleo 1994, 1995	Archaeological Data Recovery	Mauka boundary of current project area	Subsurface testing was conducted at Site 2262 (lithic scatter) & a historic Japanese cemetery (Fea. 3, Site 2271); historical research and mapping at pineapple cannery building (Fea. 1, Site 2271)	
Jourdane 1995 Chaffee & Anderson 1995	Burial Report	Waiawa Road, Waiawa Kai	Human skeletal remains uncovered during excavation of trench paralleling Waiawa Road (Site 5302)	
McGerty & Spear 1995	Archaeological Assessment	Southeast Pearl City Waiawa & Mānana	No sites identified	
Hammatt et al. 1996	Arch. Inventory Survey	Castle & Cooke lands Waipi'o & Waiawa	No Hawaiian sites due to plantation-era disturbance; identified portions of Waiāhole Ditch (Site 2268) & Kīpapa Ditch (Site 9529)	
Rechtman & Henry 1998	Arch. Reconn. Survey	West of LCC campus, Waiawa Kai	No sites identified	

Table 1. Summary of Previous Archaeological Studies in and Near the Current Project Area

Source	Type of Investigation	General Location	Findings*
Hammatt et al. 2000	Arch. Assessment	Leeward Bike Path, Waiawa	No sites identified
Fong et al. 2005	Literature Review and Field Check	Makai of Mānana Kai Neighborhood Park, Waiawa	No sites identified
Bell et al. 2006	Literature Review and Field Check	Waihona Street, Waiawa	1 site: small terrace, was identified along the top of the slope
Rainalter et al. 2006	Arch. Reconn. Survey	LCC campus, Waiawa	1 burial site (5302) and 1 military fuel storage site (Site 6764)
Rasmussen & Tomonari-Tuggle 2006	Archaeological Monitoring	Waiau Fuel Pipeline	No sites identified
Tulchin et al. 2009	Arch. Inventory Survey Addendum	Addendum to Hammatt et al. 1996 report (above)	No sites identified in the Waiawa section of the project area
Hammatt 2010	Arch. Reconn. Survey	Honolulu High- Capacity Transit Corridor	No sites identified in the Waiawa section of the project area
Thurman et al. 2012	Arch. Reconn. Survey	Waiawa Uka(includes portions of current project area)	3 traditional Hawaiian sites in Gulch C
Bautista et al. 2013	Arch. Reconn. Survey	Waiawa Stream	More than 40 historic properties identified in 274-acre project area

* Complete (formal) site number designations are preceded by "50-80-09-"



Figure 6. Previous archaeological studies in and near the project area; LUC project area in red; SunEdison project area in magenta

Military. Bautista's findings confirmed an earlier brief reconnaissance by Farrugia and Cleghorn (1994:10) who concluded: "It seems that most of the project area in Waiawa Valley has a high potential of containing extensive archaeological resources . . . probably associated with traditional habitation and agricultural pursuits."

Other relevant studies include Hammatt et al.'s (1996) archaeological inventory survey of 1,339 acres owned by Castle and Cooke once slated for residential development in the uplands of Waipi'o and Waiawa Ahupua'a. Part of Hammatt et al.'s project area is immediately adjacent to (west and north of) the current project, but most of it is located at higher elevations. No traditional Hawaiian sites were documented due to extensive ground disturbance by commercial agriculture in historic times. Portions of the Waiāhole Ditch (SIHP # 50-80-09-2268) and Kīpapa Ditch (SIHP # 50-80-09-9529) were identified mauka of the current project area. Tulchin et al. (2009) conducted additional survey (written up as an addendum report to Hammatt et al.'s 1996 report), identifying two sites in Waipi'o Ahupua'a: SIHP # 50-80-09-7080, a historic clearing mound, and SIHP # 50-80-09-9528, a plantation-era ditch.

A number of studies have been conducted makai of the H-1 freeway on the coastal flats around Pearl Harbor, in association with the development of Leeward Community College (LCC). As indicated by Māhele documents, this area represented the main habitation and irrigated taro lands in early historic and precontact times. Hammatt and Borthwick (1985) delineated portions of the now-filled Loko Mo'o fishpond, and identified remnants of the Oahu Sugar Company's pumping station and dam. Human skeletal remains found during construction at LCC consisting of at least six individuals of possibly Asian ancestry (SIHP # 50-80-09-3761) were described by Bath (1988) and Pietrusewsky and Mahoney (1988). Another human burial site (SIHP # 50-80-09-5302), a minimum of one individual of indeterminate ethnicity, was documented just across Waiawa Road from LLC by Jourdane (1995) and Chaffee and Anderson (1995). Rainalter et al.'s (2006) archaeological inventory survey for the construction of a proposed LCC Second Access Road identified two sites: coffin and pit burials (SIHP # 50-80-09-5302) and the Ewa Junction Navy Fuel Drum Site (SIHP # 50-80-09-6764).

Henry et al.'s (1993) survey of the Waiawa Stream floodplain east of LCC identified one site (SIHP # 50-80-09-4607), a linear basalt-boulder alignment of indeterminate function, in a 23-acre area. Other studies in this coastal flats area makai of the H-1 freeway yielded no significant findings (e.g., Rechtman and Henry 1998; Hammatt et al. 2000; Rasmussen and Tomonari-Tuggle 2006).

Previous Archaeology in the Current Project Area

Three previous archaeological surveys have included portions or all of the current project area (Barrera 1987; Goodman and Nees 1991; Thurman et al. 2012) (see Figure 6). Portions of a data recovery project were also conducted in the current project area (Sinoto and Pantaleo 1994, 1995). After summarizing the results of these projects, we focus on several previously-identified historic properties within the current project area. Two of these sites extend beyond the boundaries of the current project area because they are geographically-extensive linear resources: a plantation-era irrigation system (SIHP # 50-80-09-2273) and a network of plantation roads and railroad right-of-ways (SIHP # 50-80-09-2270). Two other sites consist of multiple features distributed discontinuously across the landscape: some features are located outside of the current project area, and some may be within it (a series of plantation camps, SIHP # 50-80-09-2271; and military storage areas, SIHP # 50-80-09-2272). For consistency, we occasionally refer to lettered gulches and plateaus (e.g., Gulch A, Plateau E) originally defined by Goodman and Nees (1991:12, Figure 3), and referred to as such by later surveys (e.g., Thurman et al. 2012).

Barrera's (1987) archaeological survey for a proposed (never built) golf course in Waiawa Ahupua'a—at the same elevation as the current project area—identified four sites. In addition to pedestrian survey, Barrera's work also included subsurface testing. SIHP # 50-80-09-1469, two basalt boulder alignments at the base of Gulch A, was tested (excavated) and found to contain a glass bottle underneath the boulders.

Barrera concluded this site was not a traditional Hawaiian construction.⁶ SIHP # 50-80-09-1470, a historic dump by a pineapple cannery, and the remains of the cannery itself (SIHP # 50-80-09-1471), were on the plateau above Gulch A in the northern portion of the current project area. Some of the materials from the dump date to the early 1900s. The cannery ruins, later subsumed under SIHP # 50-80-09-2271 as Feature 1 by Goodman and Nees (1991), included a large three-walled structure. Sinoto and Pantaleo (1994) mapped this site in detail during data recovery. The last site identified by Barrera (SIHP # 50-80-09-1472) was a former camp, designated Camp 3 (also known as Ditchman's or Irrigator Camp) on historical maps from the 1930s, on the plateau above Gulch C near Reservoir 3.

Goodman and Nees (1991) conducted "archaeological reconnaissance and inventory surveys" of a 3,600acre area in Waiawa Ahupua'a and a very small portion of adjacent Waipi'o Ahupua'a that included all of Barrera's (1987) project area and the current project area. Goodman and Nees' project was in support of a proposed (never built) residential development ("Waiawa Gentry"). They conducted both pedestrian survey of the entire project area, which they called "reconnaissance," and subsurface testing (excavation), which they called "inventory." Their survey coverage included plateaus as well as gulches, and included backhoe excavation in a portion of the current project area. As summarized in Table 2, they identified 13 historic properties (SIHP #s 50-80-09-2261 through -2273). One of Goodman and Nees' sites (2271) subsumed three of Barrera's sites (1470, 1471 and 1472) as features. Six sites were traditional Hawaiian resources (2262, 2263, 2264, 2265, 2266 and 2267); only one of these (2262) is in the current project area. The remaining sites are mostly plantation-era constructions (2268, 2269, 2270, 2271 and 2273) with one military site (2272) and one indeterminate historic-era site (2261). Site 2262, a small lithic scatter including a basalt adze, an adze fragment, two polished flakes and two diagnostic flakes, was found on the ground surface near the edge of the plateau above Gulch A in the northeast corner of the current project area. We discuss this site, which was subject to data recovery (Sinoto and Pantaleo 1994), in the Results section.

Most recently, Thurman et al. (2012) conducted an archaeological reconnaissance survey focusing specifically on four gulches designated A–D by Goodman and Nees (1991). Thurman et al. did not survey the plateaus for new sites, but they did re-visit (or attempt to re-visit) all previously-identified sites (or features thereof) in their approximately 1,680-acre project area. Three new historic properties, or potential historic properties, were identified by Thurman et al. (2012) in Gulch C. These cultural resources, or potential cultural resources (identified currently only by their temporary field numbers), are a traditional Hawaiian petroglyph site consisting of three images (CSH-1), a possible rockshelter that requires additional investigation (subsurface testing) (CSH-2), and a possible traditional Hawaiian lithic quarry (CSH-3). We investigated all of these and report on them in the Results section.

Previously-identified Historic Properties in the Current Project Area

Based on the previous archaeological research summarized above, particularly Goodman and Nees (1991) but also Thurman et al. (2012), portions of five sites (SIHP #s 50-80-09-2262, 2270, 2271, 2272 and 2273) were documented either by direct observation or by reference to historic maps in the current project area (Figure 7). It is important to note that for two of these sites (2271 and 2272), prior to going into the field and based solely on reading Goodman and Nees (1991), it was not possible to determine whether all of the reported features were actually observed and located in the current project area. These uncertainties, in fact, were one of the reasons why the subject AIS was required.

Site 2270 is the remnants of a road and railway system originally built in the early 1900s by the Oahu Sugar Company consisting of abandoned railroad beds for a temporary railroad that was removed by the

⁶ Goodman and Nees (1991:20) later interpreted this as a component feature of the plantation-era road network (SIHP # 50-80-09-2270). We re-located this feature, concur with Goodman and Nees' assessment, and documented it as Feature 24, Site 2270.

Table 2. Summary of Historic Properties Identified by Goodman and Nees (1991)

Site #	Formal Type	Function	Age	Approx. Distance from Current Project Area*	Comments
2261	Rock alignment w. debris	Debris pile	Early 1900s	500 m	Edge of Plateau J above Gulch A
2262	Basalt lithic scatter (included an adze, adze fragment, and flakes)	Single visit or limited use (tool sharpening or retouching locus)	Precontact	Once located in the current project area; nothing is left of this site	Sinoto and Pantaleo (1994) excavated w. negative results confirming site was a single episode or limited use episode; all site materials were collected
2263	Rockshelters w. petroglyphs complex	Temporary habitation	Precontact (as early as A.D. 1430-1660)	750 m	This is a highly-significant site recommended for permanent preservation in perpetuity; located in Pānakauahi Gulch
2264	Mauka-makai trails through Panakauahi gulch	Traditional transportation	Precontact	750 m	Recommended for preservation in perpetuity; located in Pānakauahi Gulch
2265	Rock mounds (n=6) & possible earthen terraces (n=2)	Traditional agriculture	Precontact (A.D. 1674-1742)	2.5 km	Both traditional and historic-era artifacts observed; located in Panikahea Gulch
2266	Rock terrace and depression	Traditional agriculture	Precontact	2.5 km	Located in Panikahea Gulch
2267	Rock terrace	Traditional agriculture	Precontact	2.5 km	Located in Panikahea Gulch
2268	Portion of Waiāhole Ditch	Regional agricultural irrigation system	Constructed 1913–1916	500 m	Built by Waiahole Water Co.
2269	Tunnel through bedrock (labelled Ahern Ditch or Old Ahern Ditch on some maps)	Regional agricultural irrigation system	Late 1800s to early 1900s	500 m	Tunnel abandoned when Waiahole Ditch was completed around 1916
2270	Road and railroad system (44 features)	Waiawa Ahupua'a- wide network to transport cash crops	Turn of 19 th /20 th Century to 1940s (railroad); some roads still used	Parts of this site complex are in current project area	Goodman and Nees recommended no further work; the temporary railroad was removed in the 1940s; many of the roads continue to be used
2271	Remains of plantation camps, cannery, and small cemetery (3 features)	Living quarters, work area & cemetery for plantation workers	Late 1800s to early 1900s	Parts of this site complex are in current project area	Goodman and Nees documented features outside of current project area (subsumes Barrera Sites 1470, 1471 and 1472)
2272	Concrete buildings and stock pile areas	Military storage	World War II and after	Parts of this site complex are in current project area	Goodman and Nees documented features outside of current project area
2273	Irrigation system (35 features)	Waiawa Ahupua'a- wide system to irrigate commercial sugarcane	Early 1900s	Parts of this site complex are in current project area	Goodman and Nees recommended no further work

* This is the larger "LUC project area"



Figure 7. Previously-identified historic properties in and near the current project area; modified from Thurman et al. (2012); note, historic reservoirs in the current project area are labelled from 1930s survey maps; LUC project area in red; SunEdison project area in magenta

time of Goodman and Nees' (1991) survey; actively used and abandoned roads, both paved and unpaved; rock retaining walls and culverts; and other road- and railroad-bed (right-of-way) related structures used for the transportation of commercial plantation crops and also the military. Component features of Site 2270 extend throughout the entire current project area. One important caveat is that there were no actual rails or wooden ties by the time of Goodman and Nees' (1991) survey, but rather, rights-of-way that resembled earthen roads. Likewise, the extent of the roads in Figure 7 above (yellow lines) is an idealized depiction of their original layout based on maps from the 1930s (cf. Goodman and Nees' 1991:93, Figure 34). Goodman and Nees identified 44 features at Site 2270, nearly all of which were simple "paved and unpaved roads" with no rock or structural work. Paved roads were reported as occurring north of the current project area near the correctional facility.

Site 2271 is the remnants of camps and other facilities including a pineapple cannery and a small Japanese cemetery used by plantation workers in the early 1900s. Barrera (1987) initially designated three site numbers (1470, 1471 and 1472) that were eventually subsumed as different features of Site 2271 by Goodman and Nees (1991). The most significant features of Site 2271—the Japanese cemetery (Feature 3) and the cannery (Feature 1)—were subject to data recovery work by Sinoto and Pantaleo (1994, 1995) that included excavation, mapping, archival research, and interviews with local "informants" about the cemetery.⁷ Camp 3 (Barrera's Site 1472, also known as Ditchman's or Irrigator's Camp) and Camp 41 appear to have once been residential area for plantation workers (see Figure 7).

Site 2272 is the remnants of several World War II military structures and storage areas. The structures that Goodman and Nees (1991) focused on, composed of five features, are all mauka and north of the current project area within the Waiawa Correctional Facility grounds. Based on military maps from the 1940s, Goodman and Nees (1991) included several other areas used for military storage, three of which are depicted as within the current project area (see Figure 7). Goodman and Nees (1991) provided no other details regarding findings at any of these three former military storage areas.

Site 2273 is an irrigation complex of ditches, flumes, siphons, reservoirs, pumping stations and a well initially built in the early 1900s by the Oahu Sugar Company. Goodman and Nees (1991) identified 35 features. The extent of the irrigation system in Figure 7 (blue lines and polygons) is an idealized depiction of its original layout based on Bishop Estate maps from the 1930s (e.g., see Goodman and Nees' 1991:59, Figure 20). Goodman and Nees also note the presence of hundreds of simple earthen ditches and furrows oriented perpendicular to the slope that once carried small amounts of water from the more formal structural elements; at the time of Goodman and Nees' (1991) survey, these ditches and furrows were, for all intents and purposes, unrecognizable as archaeological features due to the combination of heavy vegetation growth, soil deposition, lack of maintenance, and other, natural and humanly-induced alterations (e.g., rill erosion and recreational, "off road," vehicles, respectively).

Regarding subsurface testing that may be relevant to the current project area, Goodman and Nees (1991) conducted backhoe excavation in an area they designated Plateau E, which, although not depicted with sufficient accuracy to plot on our project area maps, appears to be located within the northwest portion of the current project area immediately south of the main road leading up to the correctional facility. They excavated three trenches, each measuring 10–20 m long and 2.5–3.0 m deep (their methods and results are described in Goodman and Nees 1991:15 & 42–43, respectively); and identified no evidence whatsoever of subsurface cultural layers, materials or features, consistent with historical records indicating extensive previous ground disturbance from decades of mechanized agriculture.

Site 2262, a small lithic scatter including a basalt adze, an adze fragment, two polished flakes and two diagnostic flakes, were found on the ground surface near the edge of the plateau above Gulch A. All materials from this site were collected during the survey by Goodman and Nees (1991); subsequent data

⁷ Before Sinoto and Pantaleo's (1994, 1995) work, the human skeletal remains were removed by the families and reburied elsewhere.

recovery work by Sinoto and Pantaleo (1994), including 12 shovel probes and two excavation units, failed to find any additional material. Thurman et al. (2012) re-visited the site to look for more material, with negative results. We also re-visited the site and did not find any additional material.

Finally, Goodman and Nees (1991) recommended that all of the sites and features discussed above, except Site 2262 (which was the subject of additional, data recovery work), do not qualify as significant under historic register criteria. In a letter (Log No. 5699, Doc No. 0820t) dated July 7, 1992, the SHPD concurred that these "...have yielded the information on Hawaiian history and prehistory that they contain and are 'no longer significant."

PREDICTED FINDINGS OF THE AIS

Prior to the introduction of commercial agriculture in the late 19th century, the plateau lands in and near the project area likely contained traditional Hawaiian dryland (non-irrigated) agricultural features (e.g., rock and soil terraces, planting mounds) and temporary habitations and other work areas (e.g., small platforms). However, based on the historical and archaeological information summarized in the previous two sections, we did not expect to encounter any traditional or precontact Hawaiian sites on the plateau lands because the project area was used for commercial agriculture (first pineapple, then sugarcane) from the late 1800s to the 1970s; and historic maps from the 1930s depict an extensively modified landscape replete with irrigation infrastructure and a network of roads and railroad rights-of-way.⁸ As such, in addition to ground disturbance associated with the construction of subsurface irrigation ditches and other plantation infrastructure—for example, we documented at least 13 linear km (8 miles) of cut basalt and mortar ditches and a like quantity of earthen roads, nearly the entire project area was mechanically grubbed, graded, plowed, planted and harvested repeatedly for at least 80 years. There are traditional-style Hawaiian sites dating to precontact or early historic times in some of the gulches (e.g., a set of petroglyphs in the southern end of Gulch C, as demonstrated by Thurman et al. 2012); and other projects in broadly similar physiographic settings have shown this same pattern (e.g., Monahan 2009; Monahan and Thurman 2013). For these reasons, we believed there was a moderate possibility of encountering traditional or precontact Hawaiian sites in some of the gulches, particularly Gulch C.

Barrera (1987), referring to the general plateau area in and around the current project area, concluded it possessed "no archaeological value, and that construction [of a proposed but never built golf course] could proceed without the necessity for further archaeological research at the four identified sites" (quoted in Goodman and Nees 1991:8). He was, in fact, referring to the lack of traditional Hawaiian sites, and the potential of finding any, when he characterized the area as having "no archaeological value."

We know, of course, that there *are* historic properties throughout the current project area, based on Goodman and Nees' (1991) research, but that they are almost entirely plantation structures and infrastructure. As such, we anticipated encountering features related to the irrigation system that once covered nearly the entire ahupua'a of Waiawa. Likewise, we expected to encounter earthen "cane haul" roads and possibly railroad berms or converted (into roads) rights-of-way. Based on a close reading of Goodman and Nees (1991), we did not expect to find paved roads (which were only reportedly built by the military at the current Waiawa Correctional Facility, north of the project area in the middle 20th century).

Since the full lineal extent of both the irrigation system (SIHP # 50-80-09-2273) and the road/ railroad network (SIHP # 50-80-09-2270), as documented by Goodman and Nees (1991), was based in large part on tracing historic maps from the 1930s—rather than actually surveying and marking every single linear resource—we also anticipated that not all the features depicted on Goodman and Nees' (1991) Figure 20 (p. 59) and Figure 34 (p. 93) would necessarily be found since they were not all observed in 1991.

Finally, based on the fact that Goodman and Nees (1991) included polygons for several plantation-camp features (SIHP # 50-80-09-2271) and military storage areas (SIHP 50-80-09-2272), but only documented finds at some of these locations (their polygons were based on tracings from historic maps from the 1930s and 1940s, respectively), we believed there was a low possibility that structural evidence of camps or storage facilities would be found at locations other than those they reported.

⁸ The constituent material from a precontact site (Site 2262, a lithic scatter on the ground surface) on the ridge just east of Gulch A was reportedly collected in its entirety by Goodman and Nees' (1991) survey and Sinoto and Pantaleo's (1994) data recovery, and confirmed as such by our fieldwork.

RESULTS

This section presents the fieldwork results in the context of the cultural, historical and archaeological background information summarized above. Figure 8 depicts all historic properties and component features identified by TCP Hawai'i in the project area on a topographic map. Figure 9 depicts all historic properties and component features identified by TCP Hawai'i in the project area on an aerial image. These figures include *both* the "LUC project area" boundary and the "SunEdison (solar development) project area" boundary; these two different project area depictions are relevant to the project effect and mitigation recommendations described in the Conclusion.

The first part of this section summarizes our General Findings, which includes not only general observations that describe the overall archaeological character of the project area, but also the following specific categories of information: (1) historic properties (or their component features) we searched for, based on the results of previous archaeological studies, but did not find because they have been destroyed or altered beyond recognition; (2) evaluation of potential historic properties identified in previous archaeological studies as needing additional investigation, and deemed by our study to be non-historic properties; and (3) verification of the geospatial location of certain historic properties believed, on the basis of previous work, to be located outside of (but near) the current project area boundaries. The second part of the Results section—our primary data set—consists of the site and feature descriptions, including their significance assessments.

General Findings

One general observation from our survey, as mentioned in the introduction to our report, was the more or less complete absence of any naturally-occurring basalt on the ground surface. This contrasts sharply with other, physiographically similar settings we have studied that were also impacted by historic-era commercial farming (e.g., Monahan 2009; Monahan and Thurman 2013), where at least some large boulders, clusters of rocks around large trees, and/or bedrock outcrops are scattered around the landscape. The Waiawa plateau lands, in particular, appear to have been essentially "picked clean" of portable basalt clasts, and it is likely—given the lack of bedrock outcrops, hills or hillocks on the plateaus—that mechanical equipment was used by plantation workers to flatten these areas, and to smooth out topographic highs and lows on the plateaus, in the early to middle 20th century.

An important component of our fieldwork was to systematically survey the three main gulches, and we found only Gulch C to have bedrock outcrops including vertical sections of exposed basalt that could be used for petroglyphs, temporary shelters or storage, lithic quarrying, etc. The other two gulches (A and B) do not contain bedrock outcrops, and, with the exception of a very small number of dry-stacked and aligned rock structures described below, also do not contain portable basalt rocks. We found the highest quality bedrock exposures were at the far, south end of Gulch C, just outside of the current project area.

There is ample evidence of modern ground disturbance throughout the project area. Natural agents of ground disturbance include heavy vegetation growth, downslope soil erosion and deposition (which has filled most irrigation ditches with sediment), and rill erosion. Human agents of ground disturbance include off-road vehicular traffic such as motocross and ATVs, modern earthen roads that do not appear on historic maps, and a few modern fence lines. There is also evidence of ongoing pig and hunting trails, which are marked in many cases by small amounts of modern trash such as plastic bottles.

Finally, by way of introducing the general results, we did not find any previously-unidentified sites, and there are no traditional (precontact or early historic) Hawaiian archaeological resources of any kind. All of the reporting in the site description section below deals with three previously-identified sites: SIHP #s 50-80-09-2270 (roads and railroad rights-of-way), for which we identified and documented 28 component features; 50-80-09-2273 (irrigation complex), for which we identified and documented 25 component



Figure 8. Historic properties and features identified by TCP Hawai'i on a topographic map (base map from ESRI in ArcMap); LUC project area in black; SunEdison project area in light pink; roads in green; linear irrigation features in blue; dashed lines indicate feature continues out of project area



Figure 9. Historic properties and features identified by TCP Hawai'i on aerial image (base map from ESRI in ArcMap); LUC project area in yellow; SunEdison project area in light pink; roads in green; linear irrigation features in blue; dashed lines indicate feature continues out of project area

features; and 50-80-09-2271 (plantation camps and infrastructure), for which we identified and documented two component features.

Destroyed or Altered-Beyond-Recognition Sites and Features

We did not find any evidence of three military storage areas (SIHP # 50-80-09-2272). As discussed above, Goodman and Nees (1991) included polygons for these features on their maps when discussing this site because these feature boundaries were traced from historic maps from the 1940s, not because they actually had something to report about these locations. They did not specifically find or discuss archaeological remains in these places. The one Site 2272 area they did discuss was located north of the current project area at the present-day correctional facility. When we looked for these features, we found the plateaus had been impacted by previous ground disturbance and no extant materials related to these were observed. We believe these areas were cleared of debris sometimes between the 1940s and 1991. In their 2011 fieldwork, Thurman et al. (2012) likewise did not find any evidence of these three military storage areas.

We also did not find any evidence of one of the plantation camps (SIHP # 50-80-09-2271) known as plantation Camp No. 41. This camp was once located in the northwest portion of the current project area, north of Gulch B, near the main upper gate to the property. The area within which Camp 41 was once located is immediately adjacent to (south of) a massive, non-historic-age earthen berm (discussed in the Introduction) constructed in modern times. This area has been completely bulldozed and modified in modern times. In their 2011 fieldwork, Thurman et al. (2012) also did not find any evidence of Camp 41. As reported below, we *did* find physical evidence of camp debris and structures in two of the Site 2271 locations.

With the exception of one reservoir (designated Feature 21, Site 2273, also known as Reservoir 2-B), we did not find any unequivocal evidence of humanly-modified or created reservoirs. As discussed in the Introduction, two of these (Reservoir 1-A and 3) have been completely altered and mechanically remodelled by a recent flood-control project. The others (i.e., Reservoir 1-B, 2-A, and an un-numbered reservoir in the western arm of Gulch A) did not originally include structural rock work of any kind, and were simply topographic lows on the landscape that could be filled with water; we could not identify the boundaries of these reservoirs on the ground given the passage of time and the fact that they do not contain formal structural margins.

Although we were able to re-locate the vast majority of the earthen roads and railroad rights-of-way, a small number of these could not be identified on the ground during our survey due to a combination of abandonment, heavy vegetation and modern sedimentary deposition.

Finally, as discussed earlier in the report, we could not re-locate any constituent material from Site 2262, the only traditional (precontact or early-historic) Hawaiian site in the current project area, a lithic scatter on the ground surface on the ridge just east of Gulch A. All of these materials were reportedly collected during Goodman and Nees' (1991) survey and Sinoto and Pantaleo's (1994) data recovery, which included subsurface excavation. Our fieldwork confirmed there is no longer any lithic material on the ground surface at this location. In their 2011 fieldwork, Thurman et al. (2012) came to the same conclusion.

Potential Sites Evaluated as Non-Historic Properties

During their 2011 fieldwork, Thurman et al. (2012) identified a possible precontact lithic quarry along the east side of Gulch C. This possible historic property, CSH 3, was described as follows:

CSH 3 is on a [2-m long portion of] rock outcrop that begins approximately 20 m above the base of the gulch. The rock outcrop rises approximately 3 m in height. Along this rock outcrop, tucked under a slight overhang, are three areas, 15×10 cm in size, of missing basalt. Chip marks or scarring of the rock surface is visible at each location of missing material,

which may suggest this rock outcrop was used for basalt material collection. (Thurman et al. 2012:93)

Chris Monahan, who had never personally inspected this possible site prior to the current AIS, re-located CSH 3, which is on a very steep and dangerous slope that can barely be accessed without sliding down into the gulch (see Figure 10, which was taken with one hand holding onto an upslope koa haole). Based on this inspection, we do not believe this is a precontact lithic quarry, or a historic property of any kind. The weathered, decomposing bedrock outcrop is naturally fractured and friable, and no bona fide flake scars or hard-hammer percussion marks can be observed; chunks of basalt have fallen into the gulch below. All other factors being equal, including its extremely difficult-to-access location and the presence of much better outcrops at the south end of Gulch, TCP Hawai'i evaluates CSH 3 as <u>not</u> a historic property.



Figure 10. Non-historic property (potential traditional Hawaiian lithic quarry) identified by Thurman et al. (2012) as temporary site number CSH-3, view south; the section of naturally-decomposing bedrock outcrop in this image is approximately 2.0 m high

Historic Properties Confirmed to be Outside of the Current Project Area

Based on archival research conducted prior to this AIS, we knew that two previously-identified precontact sites of elevated cultural and archaeological significance—a petroglyph complex (SIHP # 50-80-09-2263) and the Puoiki Heiau complex (SIHP # 50-80-09-121)—are well outside the project area. We did not need to re-locate these historic properties because we have accurate geospatial information based on a combination of GPS data and GIS (ESRI) software. Puoiki Heiau is located on the east side of Waiawa Stream, separated from the current project area by a deep gorge, at least 400 m away. Likewise, the petroglyph complex in Pānakauahi Gulch (Gulch D), close to the H-2 highway, is at least 285 meters west of the current project area.

We were more concerned about verifying the location of two sites identified by Thurman et al. (2012) at the south end of Gulch C. CSH 2 is a possible small rockshelter at the north end of an approximately 100m long vertical outcrop on the west side of Gulch C. Thurman et al. (2012) described CSH 2 as a possible precontact habitation but recommended subsurface testing (excavation) "in order to determine whether cultural materials are present. Until testing takes place, it is not currently possible to assess site significance" (Thurman et al. 2012:91). This uncertainty is due to the fact that there are no humanlymodified structures such as rock alignments or stacking at the ground surface of CSH 2; thus, it may simply represent a natural, rather than an archaeological, feature. There is no doubt about the significance of the second, nearby site, CSH 1, a set of three petroglyphs along the same vertical outcrop (Figure 11 and Figure 12). We re-located both CSH 1 and CSH 2, obtained new GPS data, and verified their geospatial location using ESRI software: they are at least 105 m and 80 m (respectively) west of the current "LUC project area" boundary, and much more distant (at least 1.0 km) from the "SunEdison project area."

Finally, we analyzed previous archival reports and re-located what is left of Site 2271, Feature 3, a small Japanese cemetery that was the subject of data recovery by Sinoto and Pantaleo (1994, 1995). The original location of Site 2271, Feature 3, is approximately 70 m north of the northern limits of the current "LUC project area" (and at least 150 m north-northeast of the "SunEdison project area"). All human skeletal remains and headstones representing burials of several individuals were removed between the 1970s, when the plantation camps were finally abandoned, and 1995, when the data recovery effort, which included extensive consultation with knowledgeable individuals including descendants of those interred at the cemetery, was completed. More recently, Kamehameha Schools also contracted Cultural Surveys Hawai'i to conduct an ethnohistorical study of Kamehameha Schools' Lands in Waiawa, Waiau, and Kalauao (Genz et al. 2010), which included additional consultation regarding this cemetery. Based on all of this information, we did not expect to find any physical evidence of the cemetery. We did, however, discover a set of four headstone bases (Figure 13)—what would have been the foundation stones for the now-removed headstones—within the current project area, just southeast of the pineapple cannery complex (Site 2271, Feature 1). These headstone bases were moved from their original location on the slopes of Gulch A to their current location during the data recovery work 20 years ago.



Figure 11. Petroglyph (circled) designated Feature B, Temporary Site CSH-1, view west; north arrow is 20 cm long; photograph taken by TCP Hawai'i on 11 July 2014



Figure 12. Pair of petroglyphs (circled) designated Feature A, Temporary Site CSH-2, view west; same scale as above; photograph taken by TCP Hawai'i on 11 July 2014



Figure 13. Headstone bases (actual headstones were removed in 1994-5) from Site 2271, Feature 3, that were moved from the slopes of Gulch A, north of the project area boundary, to current location near Site 2271, Feature 1; scale bars in 10-cm increments

SIHP # 50-80-09-2273: Irrigation Complex

FORMAL SITE TYPE:	Irrigation Infrastructure	
NO. OF FEATURES:	25 (in the current project area) ⁹	
DIMENSIONS:	See Table 3 for individual feature dimensions	
CONDITION ABOVE GROUND:	Varies from Good to Poor	
FUNCTIONAL INTERPRETATION:	Irrigation for Commercial Agriculture	
AGE INTERPRETATION:	Historic Period—Early to Middle 20 th Century	

Site 2273 is an extensive system of infrastructure built, maintained and used by plantation workers to manage, store, transport and distribute water for commercial sugarcane. According to Goodman and Nees (1991), Site 2273 was initially built in the early 1900s by the Oahu Sugar Company as a network of ditches, flumes, siphons, reservoirs, pumping stations and a well. Based on our observations during the current AIS fieldwork, the major components of Site 2273 were built after 1916, when completion of the Waiāhole Ditch made available large quantities of water from the Ko'olau Mountains.¹⁰ We documented inscribed dates as early as 1925 on some features of this system. Operation of this system may have been interrupted altogether or simply altered by World War II, when parts of the current project area and its environs were used for military training. After the war, sugarcane agriculture continued up to the 1970s.

Goodman and Nees (1991) identified a total of 35 features distributed over a larger (3,600-acre) project area compared with the current (1,395-acre) project area. Our survey resulted in the identification of 25 features, which extend all throughout the current project area; many of these features also continue outside of the project area to the north, west and south. We observed the following types of features: a concrete-lined retention basin; a large, dam-like feature associated with a retention basin; ferrous-metal siphons (80-cm diameter); cut basalt and mortar ditches; earthen ditches; prefabricated flumes; industrial-sized (hand-operated) valves; small culverts; and large, formally-constructed cut basalt and mortar water-distribution basins.

Because Goodman and Nees (1991:59, Figure 20) provided numbers for 35 features at Site 2273, but since it is not always clear which of these they actually observed in the field or which numbers correspond exactly to which features, we assigned new feature numbers. Wherever possible, we have also included what we believe the corresponding Goodman and Nees feature number is. Table 3 is a summary of Site 2273 features identified by TCP Hawai'i in the current project area.

Significance Assessment

As described in the Conclusion to this report, Site 2273 is assessed as significant under criteria C and D for eligibility on the Hawai'i Register of Historic Places.

Feature Descriptions

Feature 1 is a large water-distribution and -retention basin constructed of cut basalt and mortar (Figure 14 to Figure 18) on the east side of a main mauka-makai earthen road (Feature 1, Site 2270). A siphon (Feature 2) connects to the east side of Feature 1 by way of a large, hand-operated valve that appears to be made of iron. A manufacturer's stamp on this valve reads "20 CRANE." Another, identical valve, toppled and ruined, is located on the west side of the large basin at Feature 1. The manufacturer's stamp on this one reads "CRANE 24." The siphon to which this valve is connected appears to link up with a buried (subterranean) siphon (Feature 3) partially exposed on the adjacent earthen road. A large siphon outlet on the south end of the main basin is blocked with sediment. The north end of the main basin grades into an

⁹ Additional features of Site 2273 occur outside of the current project area including mauka portions of Waiawa ¹⁰ Goodman and Nees (1991) note the large reservoir in the middle of the current project area appears on a 1916 survey map, thus some of the irrigation system components are older than 1916.

Table 3. Site 2273 Features Identified in the Current Project Area

Fea.	Other # ¹	Description	Dimensions (Area)	Comments
1	n.a.	Cut basalt and mortar water-distribution basin	10 m (NE/SW) by 7.5 m (NW/SE)	This is one of the most complex formal structures in the project area
2	32	Siphon (80-cm diameter pipe) oriented mauka- makai	2.0 km long (in the project area)	Pipe continues a short distance out of the project area to the south
3	?32	Siphon (80-cm diameter pipe) oriented mauka- makai	600 m long	Portions of this siphon were (by design) buried under an earthen road
4	n.a.	Prefabricated concrete flume (caulked sections)	800 m long	Runs east, upslope, and parallel to main earthen road (Feature 1, Site 2270)
5	n.a.	Prefabricated concrete flume (caulked sections)	20.5 m long	Feature is complete on its west end but broken on its east end
6	n.a.	Metal pole w. marker on concrete footing	5-m tall 3-in. diameter pipe	Possibly marking location of earthen ditch (see text)
7	34	Cut basalt and mortar ditch	970 m long	Partially filled in with sediment
8	?33	Cut basalt and mortar ditch	330 m long	Partially filled in with sediment
9	n.a.	Prefabricated concrete flume (caulked sections)	5.0 m long	Feature is complete on its west end but broken on its east end
10	n.a.	Earthen ditch	530 m long	Heavily overgrown with vegetation
11	33	Earthen ditch	500 m long	Heavily overgrown with vegetation
12	n.a.	Prefabricated concrete flume (caulked sections)	420 m long	Runs parallel up the slope just east of main earthen road (Feature 1, Site 2270)
13	28/31	Cut basalt and mortar ditch	1.5 km (in the project area)	Ditch continues out of project area to the west-northwest
14	27	Cut basalt and mortar ditch	3.4 km long	Ditch disappears in heavy ground cover, possibly buried by sedimentary deposition at its west end
15	n.a.	Earthen ditch ending in a 4-way sluice gate intersection	50 m long	Earthen ditches around 3 sides of the 4- way sluice gate are difficult to identify due to soil erosion and deposition
16	2	Combination cut basalt and mortar ditch and siphon	1.2 km long (ditch is 920 m long, siphon is 300 m long)	Feature traverses east half of project area from just below Gulch A to east end of Gulch B
17	?	Cut basalt and mortar ditch	1.3 km long	Connects Reservoir 1-A w. Reservoir 3
18	n.a.	Ditch-builders lithic processing area	26 m (N/S) by 14 m (E/W)	Abundant large flakes and debitage created with metal (presumably iron) tools

Fea.	Other # ¹	Description	Dimensions (Area)	Comments
19	6	Massive slope-retaining feature in Gulch B	38.0 m (E/W) by 33.0 m (N/S)	Part of a dam-like structure at the south
			· · · · · · · · · · · · · · · · · · ·	end of Reservoir I-B
20	n.a.	Prefabricated concrete flume (caulked sections)	25 m long	Upper end truncated by a modern (non-
				historic-age) road
21	8	Cut basalt and mortar lined reservoir	110 m (N/S) by 30 m (E/W)	According to historic maps from the
21				1930s, this is Reservoir 2-B
22	Part of 2	Cut basalt and mortar water-distribution basin	t basalt and mortar water-distribution basin 16.0 m (N/S) by 13.0 (E/W)	One of the most complex formal
	or 32?			structures in the project area
23	Part of 32? Cut basalt and mortar ditch	ut hagalt and marten ditah	260 m lana	Connects with Feature 22 and is
		Soo m long	damaged on its south end	
24	Part of 31	Basalt and mortar ditch	550 m long	Ditch uses natural (sub-rounded), rather
				than cut and dressed, boulders
25	35, 22	Cut basalt and mortar ditch	2.6 km long (includes 3 sections)	Ditch begins as a cut basalt and mortar
				ditch, changes into two earthen ditches

¹ Other # – Goodman and Nees (1991) feature number; n.a. = newly-identified feature (not mapped or described in Goodman and Nees); ? = we were unable to determine Goodman and Nees number

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Figure 14. Plan view of Feature 1, Site 2273 (water-distribution basin) in context with road (Feature 1, Site 2270) and partially-buried siphon (Feature 3, Site 2273); siphon connecting with the basin is Feature 2, Site 2273



Figure 15. Detail of Feature 1, Site 2273 (water-distribution basin), showing siphon (Feature 2, Site 2273) connecting at hand-operated valve; road (Feature 1, Site 2270) is depicted in upper left of the map