APPENDIX F:

FLORA AND FAUNA IMPACT ASSESSMENT

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APPENDIX G:

SUPPLEMENTAL ARCHAEOLOGICAL INVENTORY SURVEY PLAN

G

FINAL

PLAN FOR SUPPLEMENTAL

ARCHAEOLOGICAL INVENTORY SURVEY

LANDS OF KAHUKU, PUNALAU, ULUPEHUPEHU, ʻŌIʻO, HANAKAʻOE, KAWELA AND ʻŌPANA

KOʻOLAULOA DISTRICT

ISLAND OF OAHU

TMK: (1) 5-6-03: 040-042, 044; 5-7-01:01, 013, 016, 017, 020, 022, 028, 030, 031, 033; 5-7-06: 01-017, 019, 020

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Summary

At the request of Turtle Bay Resort Development (TBR), Haun & Associates prepared this plan for a Supplemental Archaeological Inventory Survey (SAIS) within the c. 840-acre resort property situated in Kahuku, Koʻolauloa District, Island of Oʻahu. The resort area spans seven traditional land divisions (Kahuku, Punalau, Ulupehupehu, ʻŌiʻo, Hanakaʻoe, Kawela, and ʻŌpana) and numerous (32) tax map parcels (TMK: [1] 5-6-003:040-042, 044; 5-7-001:001, 013, 016, 017, 020, 022, 028, 030, 031, 033; 5-7-006:001-017, 019, 020).

This plan was prepared in advance of the SAIS, in accordance with the requirements for an archaeological inventory survey plan detailed in Hawaiʻi Administrative Rules (HAR) §13-13-284-5(c) and §13-13-276-5 (a) and (b). This plan describes the current Turtle Bay Resort (TBR) facility and the environment of the area, presents the results of historical documentary and archaeological background research for the general Kahuku area and specifically for the TBR property. The plan also provides a synthesis of the background information and provides a research design with a methodology to guide the proposed SAIS work. This plan also discusses ongoing consultation with agencies and knowledgeable individuals.

Archaeological and historical background research indicate that in late prehistory the Kahuku Point vicinity was well populated and extensively cultivated. Land Commission Awards document continued traditional Hawaiian settlement in the mid-1800s. This traditional land use was soon displaced after the establishment Kahuku Ranch in the 1850s. The ranch prospered and expanded for nearly four decades until the establishment of Kahuku Plantation Company in 1890. The first sugarcane crop from 2,800 cultivated acres was harvested in 1892. By 1899, the OR&L railroad line extended from Honolulu to Kahuku to get the cane to market. By the early 1900s there were stations at Kawela and Kahuku Ranch. By 1935, 4,490 acres were cultivated in sugarcane and the plantation employed over 1,100 workers and a plantation camp was established on the TBR property.

The U.S. Army established Kahuku Army Airfield in 1942. The facility served as an auxiliary field that was used for flight training and coastal defense. Use of the airfield was short-lived and military use ended shortly after the end of World War II. Sugarcane cultivation continued until 1971 when the Turtle Bay Resort and the first golf course were constructed. Some inland portions of the property continued to be used for vegetable farming until the late 1980s. Private beach cottages lined the shores of Kawela Bay until 1990 when the area was cleared and preliminary construction for a hotel began, but was abandoned in 1991.

Based on previous archaeological research and historical documentary evidence, expected prehistoric to early historic remains on the TBR property include subsurface cultural deposits and a variety of subsurface features including fire pits, post molds and burials. Most of these features would date to between AD 1400 and 1800. Expected historic remains dating from the 1800s to 1900s include the OR&L railroad, plantation infrastructure (camps, roads, irrigation ditches, etc.) and walls marking property boundaries and Kahuku Ranch features relating to livestock control. Military-related remains dating from World War II include runways, revetments, defensive fortifications, and a variety of support facilities.

The proposed primary SAIS fieldwork effort will consist of subsurface testing that will build on the extensive previous archaeological work that has been conducted within the project area. The areas that are proposed for further testing were previously cleared for development with archaeological monitoring required. This clearance was based on the extensive archaeological subsurface testing and data recovery work conducted between 1977 and 1991, and on the extensive prior disturbance to the property by more than a century of sugar cane cultivation, the construction and operation of Kahuku Air Airfield, and the development of resort facilities since the 1970s.

Despite the prior clearance, TBR has elected to take a proactive approach to ensure the protection of cultural resources within the proposed expansion lands as part of the SEIS process. Toward that end a combined program of extensive systematic and discretionary archaeological test excavations, both mechanical and manual, are proposed for undeveloped areas of the property where substantial construction-related excavations are planned.

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INTRODUCTION

At the request of Turtle Bay Resort Development, Haun & Associates prepared this plan for a Supplemental Archaeological Inventory Survey (SAIS) within the c. 840-acre resort property situated in Kahuku, Koʻolauloa District, Island of Oʻahu (*Figure 1*). The resort area spans seven traditional land divisions (Kahuku, Punalau, Ulupehupehu, ʻŌiʻo, Hanakaʻoe, Kawela, and ʻŌpana) and numerous (32) tax map parcels (TMK: [1] 5-6-003:040-042, 044; 5-7-001:001, 013, 016, 017, 020, 022, 028, 030, 031, 033; 5-7-006:001-017, 019, 020– *Figure 2* and *Figure 3*).

This plan was prepared in advance of the SAIS, in accordance with the requirements for an archaeological inventory survey plan detailed in Hawaiʻi Administrative Rules (HAR) §13-13-284-5(c) and §13-13-276-5 (a) and (b). This plan describes the current Turtle Bay Resort facility and the environment of the area, presents the results of historical documentary and archaeological background research for the general Kahuku area and specifically for the present project area. The plan also provides a synthesis of the background information and provides a research design with a methodology to guide the proposed SAIS work. This plan also discusses ongoing consultation with agencies and local knowledgeable individuals.

TURTLE BAY RESORT

Turtle Bay Resort is currently owned and operated by Turtle Bay Resort Development (TBR). The resort was constructed in the early 1970s by casino developer Del Webb and opened its doors in May 1972 as the Kuilima Resort and Country Club. Hyatt Hotels operated the resort in the mid-1970s. Hilton Hotels and Resorts purchased it in August 1983 and renamed it The Turtle Bay Golf and Tennis Resort.

Today the resort encompasses the Turtle Bay Hotel located at Kuilima Point, the adjacent Ocean Villas and Beach Cottages, the Kuilima Estates development, restaurants, beachside amenities, two 18-hole golf courses, a clubhouse, ten tennis courts, several swimming pools, a horseback riding facility and parking lots (*Figure 4*). Access to the resort is from Kamehameha Highway via Kuilima Drive. The proposed resort expansion plans includes two hotels, 590 resort residential units, 160 affordable housing units and additional parks, shoreline setback areas and public shoreline access.

SUMMARY OF TBR ARCHAEOLOGICAL STUDIES

The Bernice Pauahi Bishop Museum (BPBM) conducted the first systematic archaeological survey of all undeveloped TBR property (649 acres) in 1977 for Prudential Insurance Company (Dye 1977). This pedestrian survey was followed by a series of subsurface testing projects conducted by Paul H. Rosendahl, Ph.D. Inc. (PHRI) in the mid-1980s. Beginning in 1984, PHRI (Bath *et al*. 1984) conducted a subsurface reconnaissance survey of thirteen areas throughout the resort property including further investigation of subsurface deposits initially identified by Dye. The initial reconnaissance testing project was followed by three intensive subsurface testing surveys conducted in 1986 that focused on cultural deposits identified by Bath *et al*. at Kawela Bay (Walker *et al*. 1988a), Kahuku Point (Walker *et al*. 1988b), and Punahoʻolapa Marsh (Davis *et al.* 1986).

In 1987, PHRI prepared an archaeological Data Recovery Plan (DRP; Walker *et al*. 1987) to mitigate the effect of resort expansion on archaeological sites at Kawela Bay, Kahuku Point, and Punahoʻolapa Marsh. The Plan was incorporated into a Memorandum of Agreement (MOA) executed in 1988 by the U.S. Army Corp of Engineers – Honolulu District (COE), the Hawaiʻi State Historic Preservation Department (SHPD) Officer, the Office of Hawaiian Affairs (OHA), the Advisory Council on Historic Preservation (ACHP), and the City and County of Honolulu (CCHONO). In addition to implementation of the DRP, the MOA required development and implementation of plans for archaeological monitoring and for burial disinterment and reburial. PHRI prepared the plans for

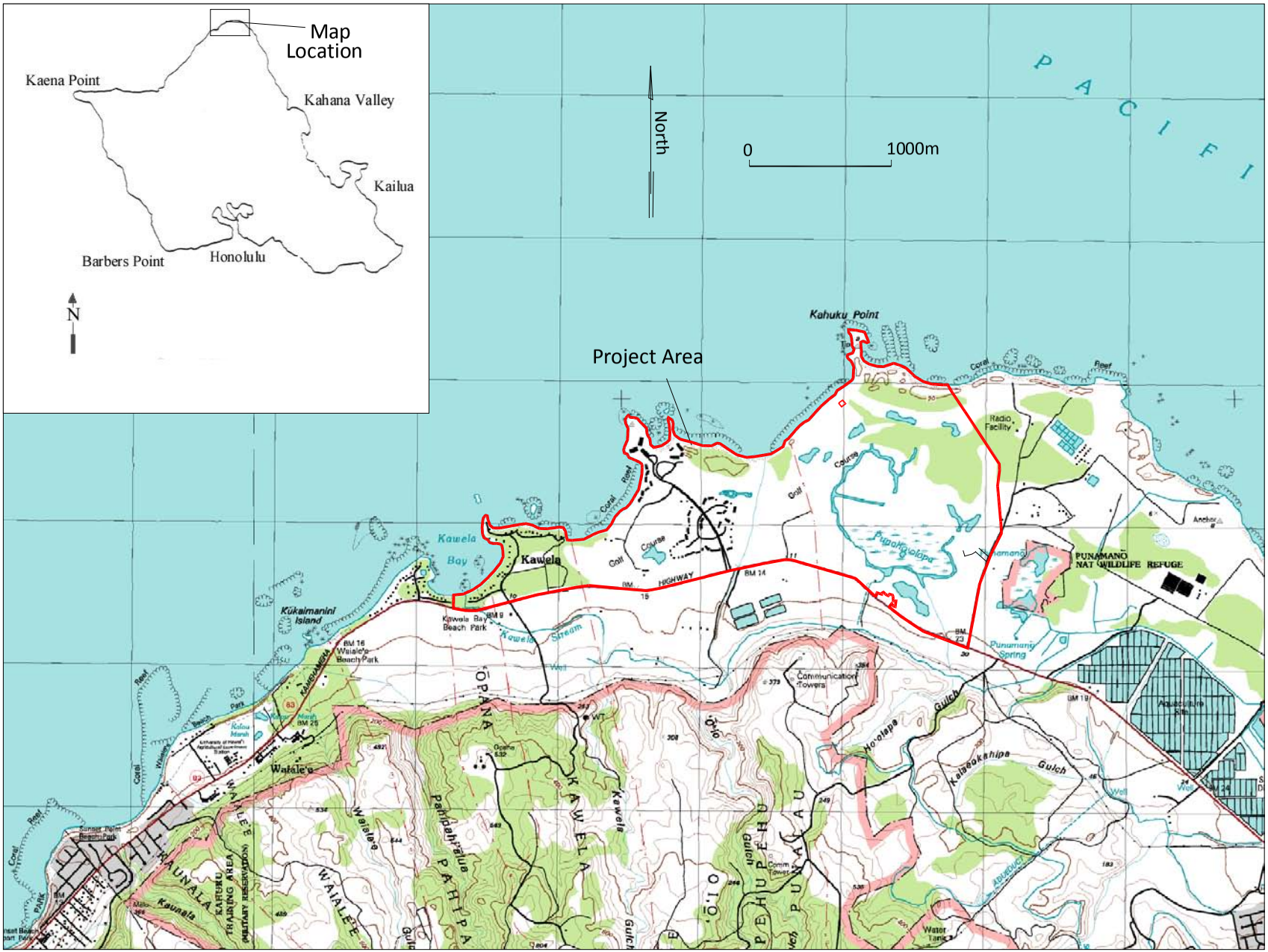


Figure 1. Portion of 1998 USGS Kahuku Quadrangle showing Project Area

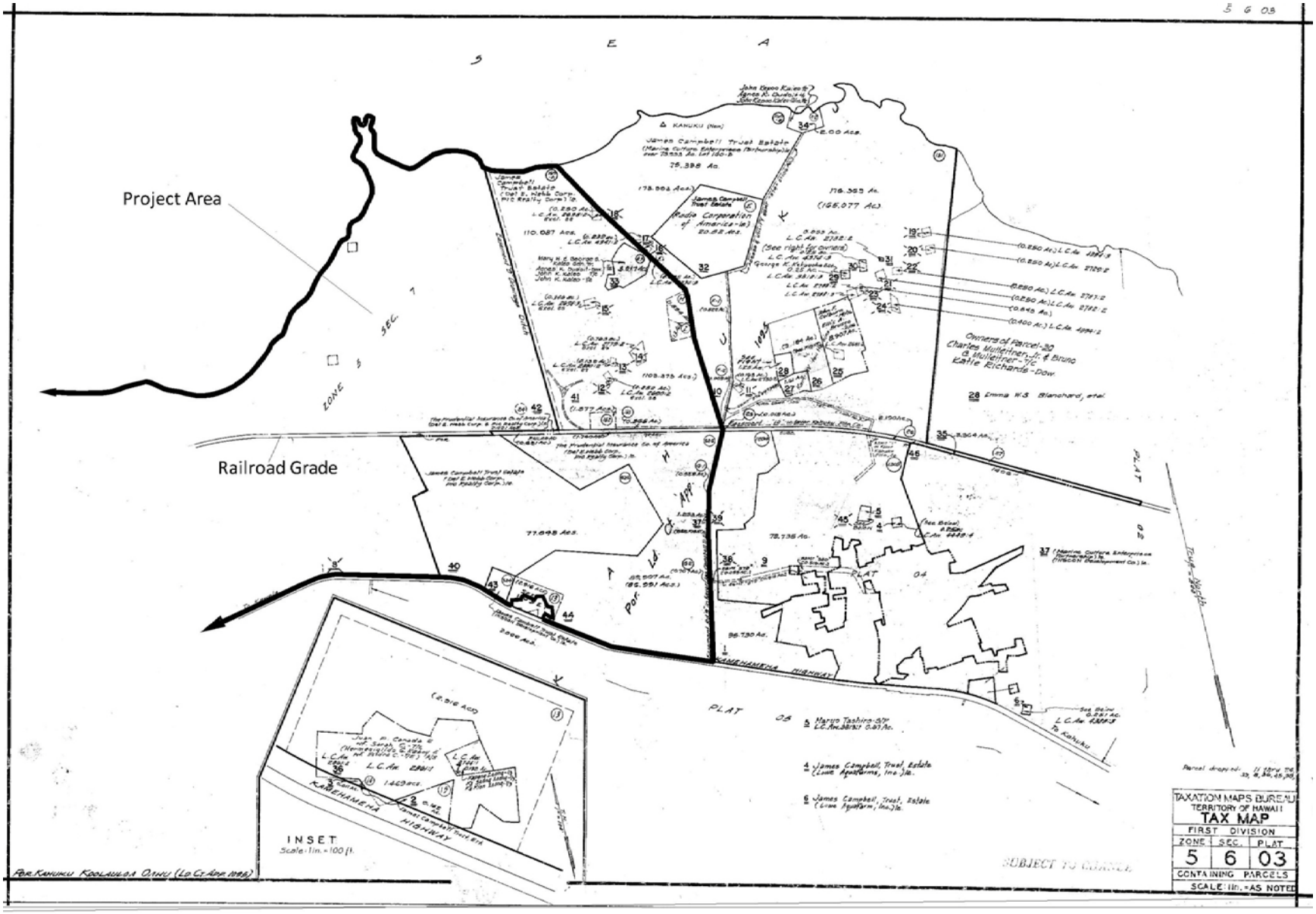


Figure 2. Tax Map Key 5-6-03 showing Portion of Project Area

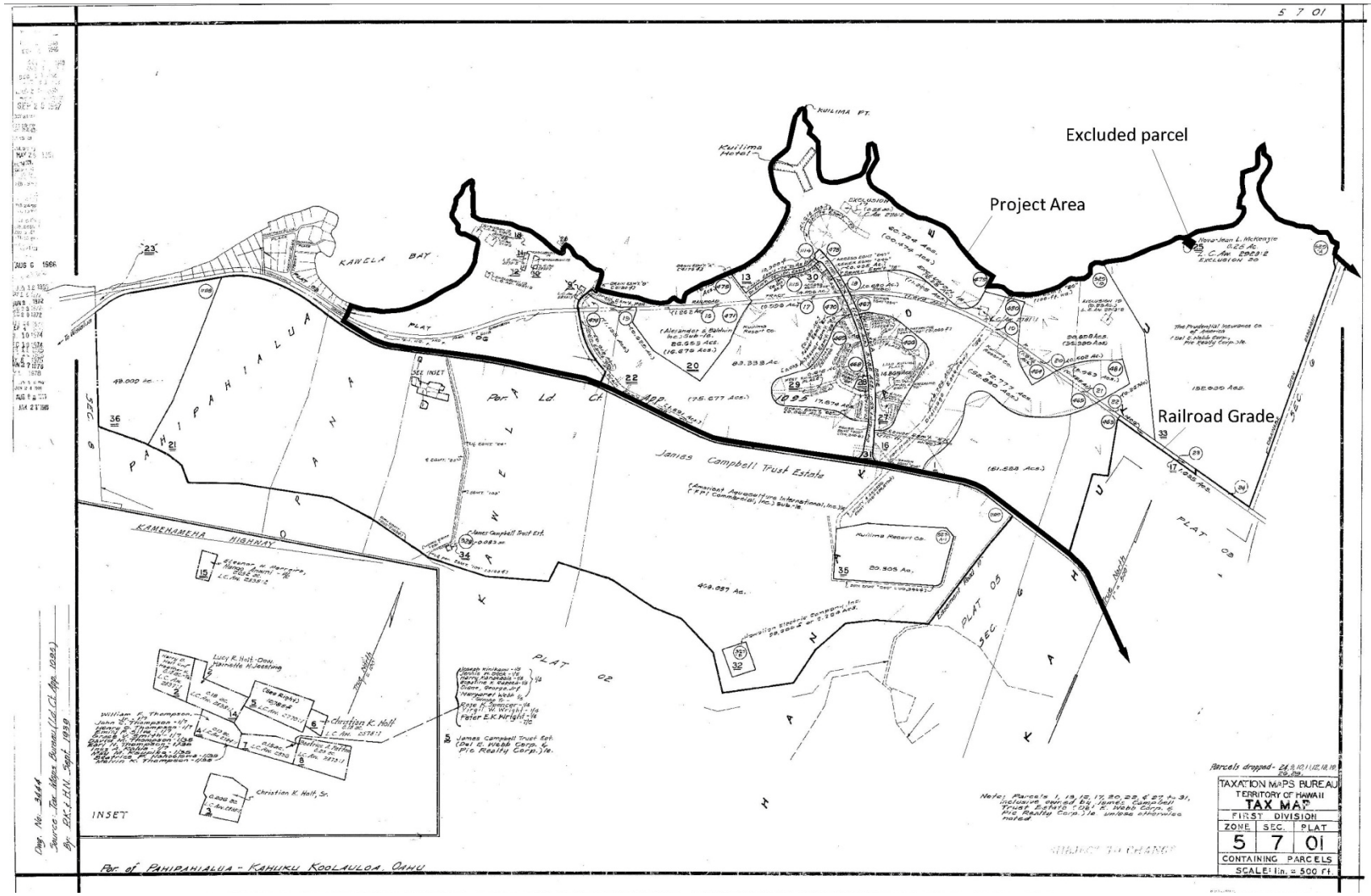


Figure 3. Tax Map Key 5-7-01 showing Portion of Project Area

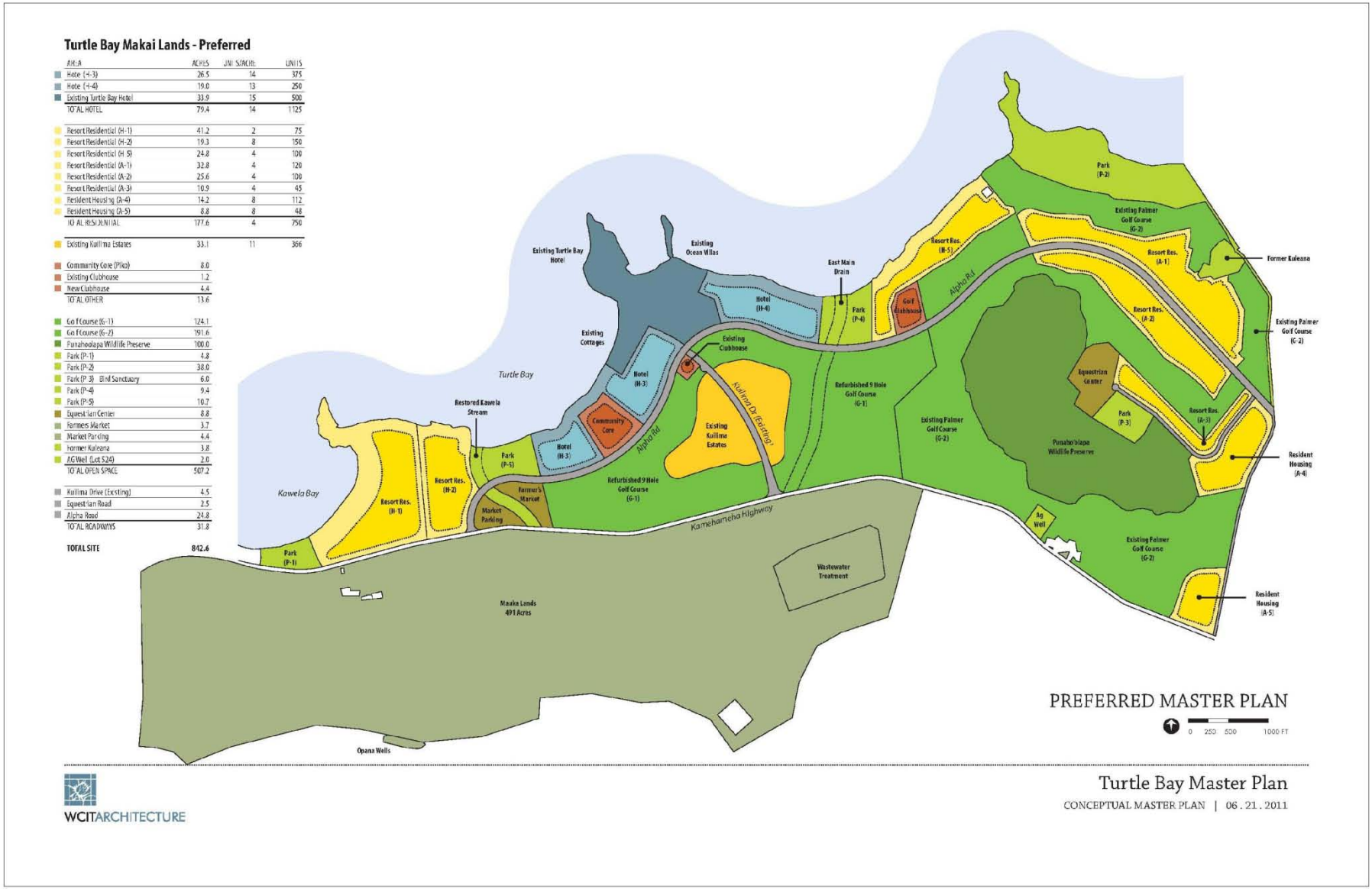


Figure 4. Turtle Bay Master Plan

monitoring and burial treatment (Jensen 1989b) that were approved by the Department of Land and Natural Resources (DLNR) State Historic Preservation Program Director in 1990 (January 9, 1990 letter from Don Hibbard to Paul Rosendahl).

The archaeological data recovery work and monitoring were conducted by PHRI from late 1990 to 1991. After initial data recovery excavations at the Kahuku Point Site were initiated, the landowner decided to halt further work and preserve the site. Monitoring fieldwork results were reported in a series of monthly status reports prepared by PHRI (Sullivan 1990, 1991; Dunn 1991; Donohue 1991). Corbin (2003) reported the full descriptive findings of the PHRI data recovery and monitoring fieldwork and subsequent analyses. DLNR-SPHD approved the Corbin (2003) report in 2005 (letter from Melanie Chinen to Paul Rosendahl March 11, 2005 LOG NO: 2005.0110; DOC NO: 0501SC05).

In 1992, PHRI prepared a Burial Treatment Plan (Maly and Rosendahl 1992) for the reburial and preservation of remains recovered during previous data recovery and monitoring. The plan was prepared to comply with legislation enacted in 1990 pertaining to the treatment of traditional Hawaiian burials under Hawaiʻi Revised Statutes (HRS) Chapter 6E:43, Act 306. The plan also included reburial of remains inadvertently discovered in 1992 near the resort hotel (Kennedy 1992) and in the mid-1980s at Kahuku Point (Neller 1984, 1989). MOA mandated osteological analysis of human remains by PHRI is reported by Kalima (1993).

In 1996 and 1999, a report on inadvertent discovery of additional burials was prepared by Archaeological Consultants of the Pacific (ACP) for human remains inadvertently discovered in 1996 (Carson *et al*. 1996, 1999). Cultural Surveys Hawaiʻi (CSH) conducted archaeological monitoring for golf course refurbishment in 2001 but encountered no cultural deposits (Borthwick *et al*. 2001).

ENVIRONMENT

The Turtle Bay Resort project area is a c. 840-acre parcel located on a broad, low-lying coastal plain at the north end of the Island of Oʻahu. Kamehameha Highway borders the property on the south (inland) side. The west side terminates at the center of Kawela Bay, while Marconi Road and undeveloped land border the east side. The land is generally level, with the terrain sloping gently to the north towards the shoreline. Elevation rises from sea level at the coast to a maximum of c. 40 ft at the southeast corner of the property, extending one-quarter mile to just over a mile inland. Some dunes at the coast rise 20 ft above mean sea level (amsl), but much of the property is significantly less than 20 ft amsl, and Punahóolapa Marsh is only c. 3 ft amsl. An aerial view of the project area is depicted in *Figure 5*.

The property spans seven traditional land divisions within the Koʻolauloa District (*Figure 6*). From east to west these consist of Kahuku, Punalau, Ulupehupehu, ʻŌiʻo, Hanakaʻoe, Kawela and ʻŌpana. Only the boundaries of Kahuku, ʻŌpana and Kawela are individually defined on current USGS quadrangle and tax maps of the area. The Land of Kahuku occupies the largest portion of the project area, encompassing 480-acres or 57% of the total area; Kawela encompasses 68-acres (8%) and ʻŌpana 9-acres (1%). The four remaining *ahupuaʻa* are depicted on the maps with no boundary divisions between them. These *ahupuaʻa* (Punalau, Ulupehupehu, ʻŌiʻo, Hanakaʻoe) encompass 283-acres (34%).

Kawela Stream originates at the base of the coastal bluff in the Land of Kawela at c. 800 ft elevation and enters the property beneath the Kawela Bridge on the Kamehameha Highway and empties into the central portion of Kawela Bay; its original channel has long been covered by sediments and the stream course has been artificially channeled for quite some time. ʻŌiʻo Stream originates in Waialua District ʻŌiʻo Gulch at c. 1,400 ft elevation; it empties into the ocean between Kuilima and Kahuku Points. The 120-acre freshwater Punahoʻolapa Marsh is located in the east half of the property. The James Campbell National Wildlife Refuge, administered by the US Fish and Wildlife Service (FWS), was established in 1976 and encompasses 1,100 acres, including Punamanō Marsh and Kiʻi Pond, adjacent to the resort's east boundary.

Figure 5. Aerial View of Project Area (from Google Earth)

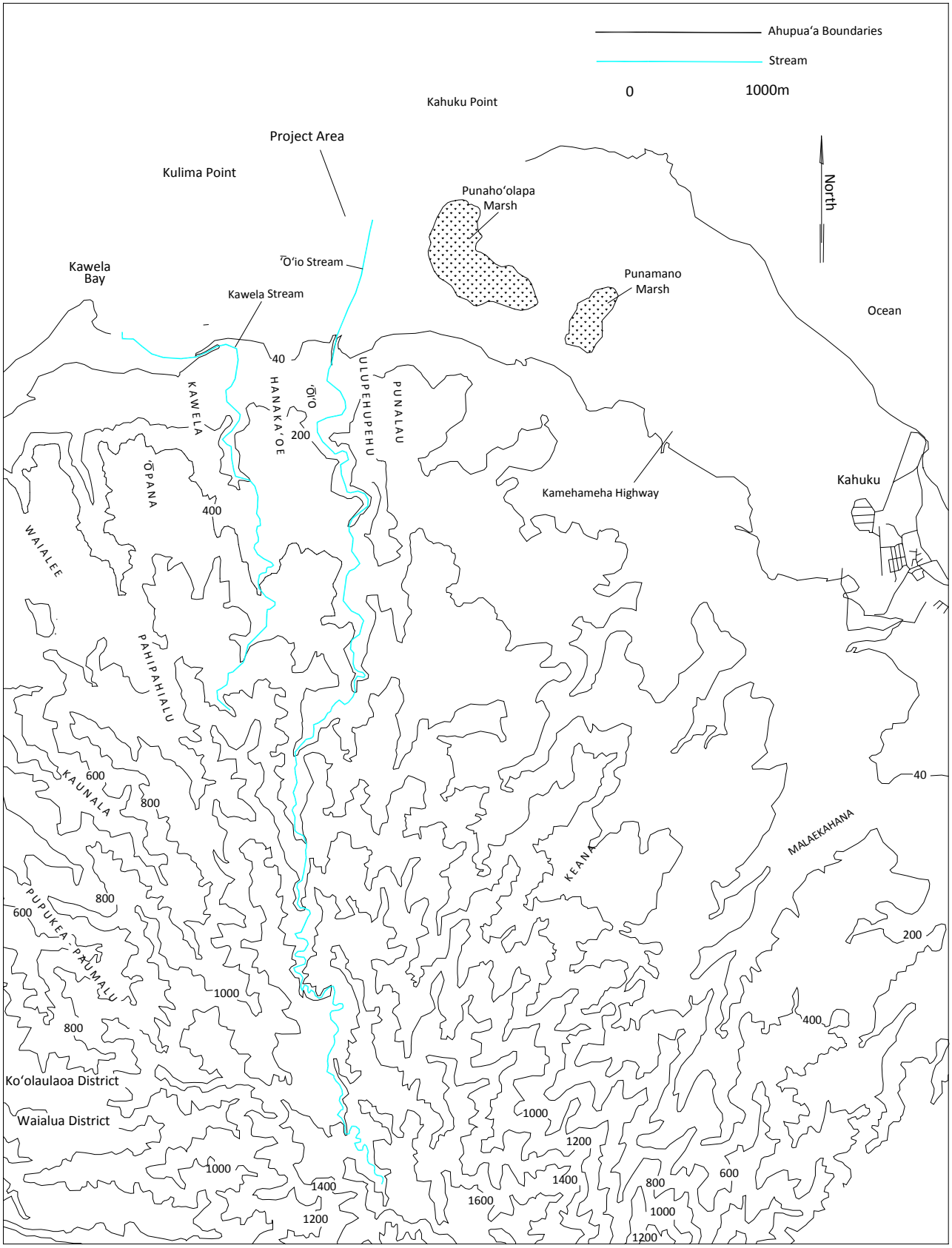


Figure 6. Ahupua'a Boundaries

Climate in the vicinity of the project area is typically mild with average year-round temperatures ranging from 71 to 79 degrees (city-data.com). Rainfall in the area varies from 30 to 40 inches along the coast and 40 to 60 inches per year in the inland areas (Juvik and Juvik 1998:56). The adjacent National Wildlife Refuge (FWS 2011) protects habitat for over 120 species, including four of six endangered native Hawaiian birds. It preserves coastal habitat for the endangered Hawaiian monk seal (*ʻilio holo i ka uaua*) and nesting habitat for threatened green sea turtles (*honu*) and important seabirds. The Refuge provides a strategic landfall for migratory birds coming from the northern Pacific Rim and wetlands birds including Northern pintail (*koloa mapu*), Northern shoveler (*koloa moha*), lesser scaup, Pacific golden plover (*kolea*) and ruddy turnstone (*ʻakekeke*). The migratory populations represent some of the largest concentrations of these species in Hawaiʻi and the Pacific. Other native species that benefit from the protected refuge habitat include the Hawaiian owl (*pueo*) and a species of rare damselfly. These fauna will probably also be found on the resort property.

Undeveloped portions of the TBR property support a variety of introduced plant species. The most prevalent are *koa haole* (*Leucaena glauca*), ironwood (*Casuarina equisetifolia*), Christmas berry (*Schinus terebinthifolius*) and banyan (*Ficus* sp.). Native plants include *hau* (*Hibiscus tiliaceus*), *naupaka* (*Scaevola sericea*), coconut palms (*Cocos nucifera*) and *milo* (*Thespesia populnea*). Sedges (*Scrious lacustris*), saw grass (*Cladium leptostachyum*) and ferns (*Cyclosoro interruptus*) dominate the Punahoʻolapa Marsh vegetation; Christmas berry and *hau* surround the perimeter. The adjacent National Wildlife Refuge marsh supports stands of bulrush and cattail. Invasive alien species targeted for removal on the adjacent refuge include California grass (*Urochloa mutica*), marsh fleabane (*Pluchea x fosbergii*), bullfrogs and feral mallards.

Geology, Hydrology and Soils

Oʻahu is just less than six million years old and encompasses two extinct shield volcanoes: Waiʻanae in the west and Koʻolau in the east (Juvik and Juvik 1998:41). The underlying bedrock on the TBR property was formed by lava deposited 1.7 to 2.5 million years ago from Koʻolau Volcano (*ibid*.:42). The Kahuku Plain is composed of an uplifted fossilized limestone reef formed underwater on the volcanic substratum. The reef formed during inter-glacial periods of higher sea level in the Pleistocene, 12,000 to 2,500,000 years ago (Macdonald *et al*. 1983). Sea level in the northern main Hawaiian Islands reached its Holocene maximum height (c. 2.00 m greater than present) 3,500 years before present (B.P.); subsequent sea level reduction, coupled with island uplifting, exposed the reef bench to high-intensity waves that eroded the reef surface and created the fossilized, stabilized and active sand dunes that formed along the shore (Grossman 1998, Grossman and Fletcher 1998).

The emerged limestone reef surface was eroded by waves and freshwater flows that created karstic features consisting of sinkholes, subterranean streams, fissures and caverns. The karst topography resulted in pools, ponds and marshes inland of the coastal dune fields on the nearly level Kahuku Plain. The water table is close to the surface. Small areas of limestone outcrop are still visible inland of Kawela Bay and Kuilima Point, where they are erroneously called “coral” outcrops (*Figure 7*).

Ground surface weathering also subsequently modified the limestone reef surface after the sea level receded. Accelerated weathering combined with alluvial deposition of sediments and rock derived from the volcanic uplands to essentially cover the Kahuku Plain’s limestone surface with a mantel of silt and clay sediments. Talus and alluvial deposits are interbedded, bordered along the coast by wind and wave deposited sands, especially at Kahuku Point where extensive relict and modern dunes are present (Takasaki and Valenciano 1969; Soest 2011). At Kahuku Point, lithified dunes are “shaped by chemical weathering, intertidal bioerosion, and the northeast trade winds to which they are fully exposed” (*ibid*.). Lithified clay (laterite) covers the marine bench inland of the shore at Kahuku Point (Chapman 1946).

The north shore of Oʻahu receives the full brunt of massive waves of the North Pacific Swell in the winters, which move large quantities of sand to the shore. Beach sands are calcareous (calcium-rich) and coarse-grained, typical

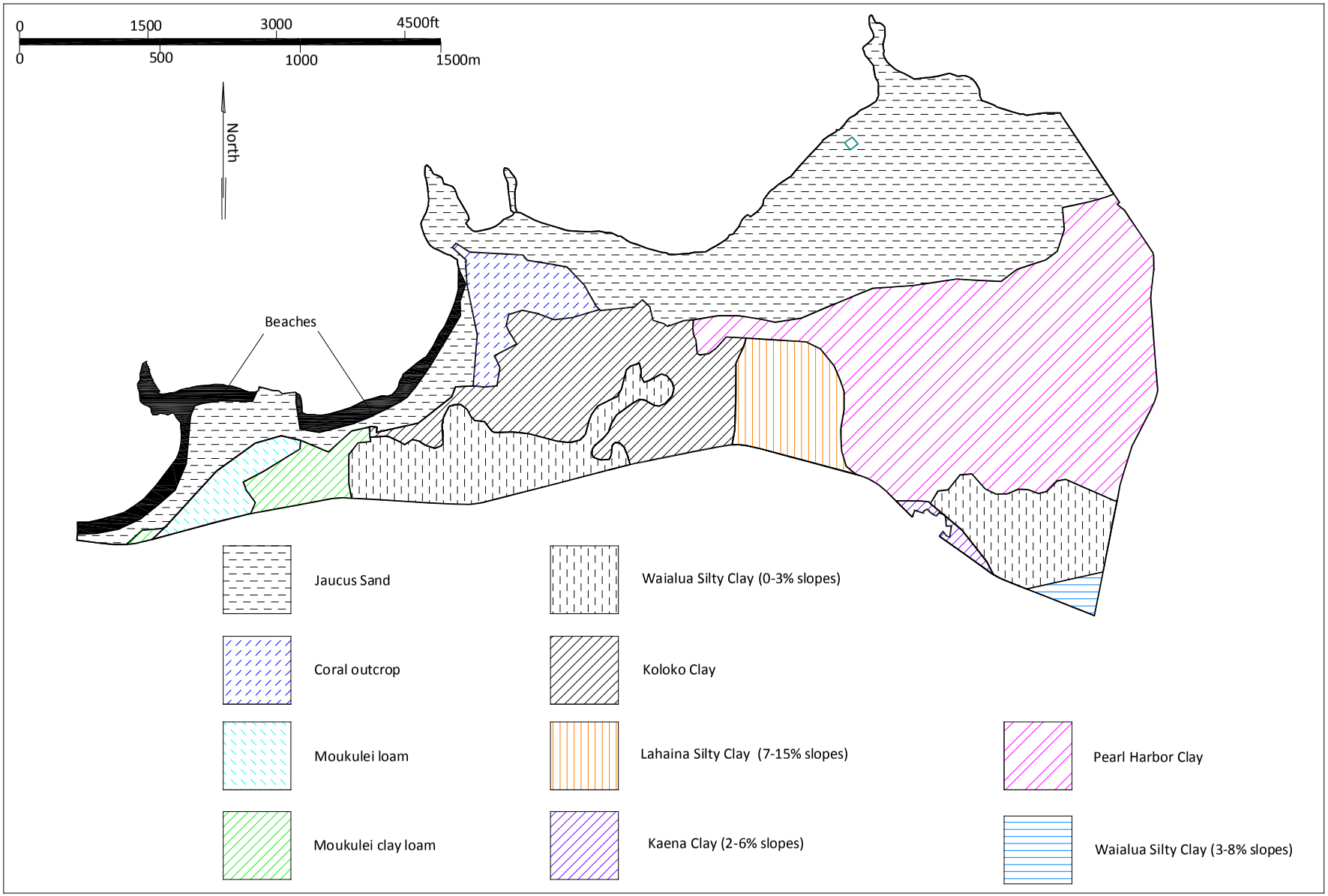


Figure 7. Distribution of Soils within Project Area

of high-energy waves that move detritus from the submerged reefs to shore. Active dunes at Kahuku Point "exist seaward of vegetated Holocene dunes" and "sand dunes and perched beaches along Kahuku Point are continuously reshaped by the persistent trade winds" (USGS 2011a). Catastrophic tidal waves and stream flooding from winter storm runoff are known hazards around the Kahuku Point coastline (*ibid*.):

> During the 1946 and 1957 tsunamis, flood inundation heights of 27 and 23 ft were recorded at Kahuku Point. The hazard associated with high waves is ranked high around the entire Kahuku Point, but…[t]he storm threat is ranked moderately low along the Kahuku coast because it is partly sheltered from the impact of the majority of tropical storms that historically track to the west and south of Oahu. Erosion is ranked moderately low for the small embayments lining the western portion of Kahuku Point, except along the rocky point immediately northeast of Kawela Bay beach where it is low.

On the Kahuku Plain, freshwater constitutes a major natural resource. Perennial and intermittent streams once provided ample water across the plain. Coastal brackish marshes on the Kahuku Plain formed in the elevated coral reef, fed by the numerous streams originating in the uplands to the south, by rainfall, springs and seeps (Hunt and De Carlo 2000; Takasaki and Valenciano 1969:48). Subterranean seawater extends inland from Kahuku west to Kawela and beyond, naturally contaminating the basal freshwater body (Takasaki and Valenciano 1969). Basal water channeled from volcanic dikes in the Kóolau Range recharges the shallow water table underlying the Kahuku Plain and is perched above the infiltrating seawater (*ibid.*). This provides sufficient pressure for springs, seeps and artesian wells. Flooding is most prevalent in March, but can occur throughout the year (*ibid*.:16).

Eleven soil types have been described and mapped in the property (Foote *et al*. 1972). These consist of beach sands, coral outcrops, Jaucus sand (0-15% slopes), Pearl Harbor clay, Waialua silty clay (0-3% and 3-8% slopes), Kaloko clay, Lahaina silty clay (7-15% slopes), Mokulei loam and clay loam, and Kaena clay (2-6% slopes). The distribution of these soils is shown in *Figure 7* and their characteristics are summarized in *Table 1*.

Jaucus Sand is the most widespread sediment, which encompasses 277 acres, or 33% of the property. It is exposed along the coastal margins and is characterized by well-drained single-grained sand to depths exceeding more than 60 inches. It is considered suitable for pasture, sugarcane, truck-crops, and urban development.

Pearl Harbor Clay is the next most extensive sediment, encompassing 227 acres, or 27% of the property. It largely coincides with the former extent of Punahoʻolapa Marsh and consists of poorly drained, mottled clay overlying mottled clay subsoil, formed on layers of muck or peat. Pearl Harbor clay is classified as suitable for pasture, sugarcane, taro and bananas.

Waialua Silty Clay covers 105 acres, or 12% of the total on gentle slopes in the southeastern corner of the property. It is moderately well drained and characterized by a silty clay surface layer overlying a subsoil of blocky silty clay formed on a mottled silty clay substratum. It is suitable for pasture, sugarcane and truck crops.

Kaloko Clay covers 96 acres, or 11% in the central portion of the property. It is developed in alluvium derived from igneous rock and is poorly drained. It consists of clay overlying multiple layers of clay and silt clay. It is classified as suitable for pasture and sugarcane.

Lahaina silty Clay covers 39 acres (5%) in the east-central portion of the property. It is derived from weathered igneous rock and is well drained, and is typically exposed on slopes above the coastal plain. The surface layer is severely eroded and overlies a blocky silty clay and silty clay loam subsoil, formed on weathered igneous parent material. It is classified as suitable for sugarcane and pineapple.

Coral Outcrops cover 27 acres, or 2% of the area, inland of Kuilima Point. The outcrops are composed of cemented coral or calcareous sand that formed in shallow ocean waters when the sea levels were higher. It is classified as suitable for military installations, quarries and urban development.

Table 1. Summary of Soils within Project Area

Soil Type	Acres	% of Project Area	Description	Permeability	Runoff	Erozion Hazard	Suitability
Jaucus Sand (0-15% slope)	277	33	Single grained sands	Rapid	Very slow to ponded	Slight	Pasture, sugarcane, truck crops, urban development
Pearl Harbor Clay	227	27	Mottled clay surface layer over mottled clay subsoil, over muck or peat	Very slow	Very slow to ponded	Slight	Pasture, sugarcane, taro, bananas
Waialua Silty Clay (0-3% slope)	105	12	Silty clay surface layer over subsoil of blocky silty clay over mottled silty clay substratum	Moderate	Slow	Slight	Pasture, sugarcane and , truck crops
Kaloko Clay	96	11	Clay surface layer over clay and silt clay subsoils	Moderately slow to slow	Slow to very slow	Slight	Pasture and sugarcane
Lahaina Silty Clay (7-15% slope)	39	5	Severely eroded silty clay surface layer over blocky silty clay and silty clay loam subsoil over weathered igneous rock substratum	Moderate	Medium	Moderate	Sugarcane and pineapple
Coral outcrop	27	3	Cemented coral or calcareous sand	n/a	n/a	n/a	Military installations, quarries, urban development
Mokulei Clay Loam	20	2	Clay loam surface layer over sand and loamy sand subsoils	Moderate	Very slow	Slight	Pasture, sugarcane and truck crops
Beaches	19	2	Sandy, gravelly or cobbly areas	n/a	n/a	n/a	Recreation
Mokulei Loam	18	2	Clay loam surface layer over sand and loamy sand subsoils	Moderate	Very slow	Slight	Pasture, sugarcane and , truck crops
Kaena Clay (2-6% slope)	6	1	Clay surface layer over clay subsoil over highly weathered gravel	Slow	Slow	Slight	Pasture, sugarcane, homesites
Waialua Silty Clay (3-8% slope)	5	1	Silty clay surface layer over subsoil of blocky silty clay over mottled silty clay substratum	Moderate	Slow	Slight	Pasture, sugarcane and truck crops
Total	840	100					

Mokulei Clay Loam encompasses 20 acres or 2% of the project area. An area of Mokulei loam (18-acres, 2%) is located in the southwest portion of the parcel. This soil is characterized as well-drained clay loam surface layers, over sand and loamy sand subsoils (1972:96). These soils are classified as suitable for pasture, sugarcane and truck crops.

Beaches cover 19 acres or 2% of the total property area and are restricted to Turtle Bay and Kawela Bay. The coastal strands in these bays are characterized as sandy, gravelly or cobbly and are classified as suitable solely for recreation.

Kaena Clay encompasses 6 acres, or 1% of the property, and is found only along the southeast edge of the resort. The clay is very deep, poorly drained, and is exposed on alluvial fans and talus slopes. It is characterized by a clay surface layer overlying clay subsoil, formed on a highly weathered gravel substratum. It is classified as suitable for pasture and sugarcane.

HISTORIC BACKGROUND RESEARCH

Place names of prominent locales often reference memorable historic people and deities, notable events, or significant activities. These have come to encapsulate salient aspects of local Hawaiian history. Hawaiian toponymic etymology explains or elaborates on important aspects of the physical environment, such as fresh water sources, food sources and prominent natural features. Place names also reference the locations of specific structures and often persons explicitly associated with a site. Legendary history recounts mythical events in the distant past and historical events tied to genealogical lineages of a particular place or general area. These provide the basis for developing a cultural context for understanding the area's social geography.

Place Names

Pukui *et al*. (1974) offer the following translations (or possible translations) for several of the project area land divisions. The literal translation of Kahuku is "the projection" or "the hillock", and Punalau means "many springs". ʻŌiʻo is the Hawaiian word for "bonefish" and ʻŌpana, which is perhaps related to *ʻōpā* translates as "the squeeze". Kawela is translated as "the heat" which is also the name used to describe the coastal portions of the Pahipahiʻāula, the land bordering Kawela to the west. No translations for Hanakaʻoe or Ulupehupehu are presented in Pukui *et al*. (*ibid*.).

Several other natural features within the project area and adjacent lands have traditional Hawaiian names (*Figure 8*). The shoreline at Kawela Bay was referred to as "Wākiu" meaning "northwest wind sound" (Clark 1977:132). A fishpond of the same name was reportedly once located inland from this beach. The east section of Kawela Bay was called "Waikalae", or "divided water", which is likely a reference to ʻŌiʻo Stream that formerly divided in this area with one fork extending to Kuilima Bay and the other emptying into Kawela Bay. (*ibid*.:132-133). A small offshore island and reef north of the northern end of Kawela Bay is called "Pāpaʻamoi" which translates as "scorched threadfish"; "Pāpaʻamoi" was frequented by the gods Kanaloa and Kane who went there to "scoop up fish" (McAllister 1933:147).

"Kuilima" is a recent name for the area between Kawela Bay and Kahuku Point. Kuilima translates as "to go arm in arm", which is a reference to a story of three men who walked across the plains with linked arms (Clark 1977:133). The point of land at Kuilima was once referred to as "Kaleokaunui" or "the point of the altar" and the eastern end of the cove is called "Kalaekamanu" or "the point of the bird". The cove between these points is called "Kalokoiki" or "the little pool".

The traditional name for the broad bay between Kuilima and Kahuku Point was "Kaihalulu" or "roaring sea", likely in reference to the large waves that crash upon the shoreline (*ibid*.:134). "Kalaeokaunaʻoa" is the traditional name

Figure 8. Named Places within and Adjacent to Project Area

for Kahuku Point, which translates as "the point of kauna'oa" (*ibid*.). The area to the west of Kahuku Point was called "Punapalaha" or "slippery spring" with the area to the east of this called "Kauhala" or "to move up and down as waves" (*ibid*.). Punaho'olapa Marsh located inland of Kahuku Point means "restless spring" (Pukui 1983:229).

Kapi Pond is located just outside the project area to the west. A spring feeding this pond is called Punáulua, which means "*ulua* (crevalle jack) spring" in reference to the abundance of *ulua* (Crevalle jack) just offshore. The abundance of this fish in this area was attributed to the mixing of salt water with the fresh water from the spring (Clark 1977:131-132).

A *heiau* once existed in the vicinity of the project area, likely situated inland of Kamehameha Highway. Although destroyed prior to McAllister's survey of Óahu, informants indicated to him that it was called Pu'uala Heiau and was "located on the ridge overlooking Kahuku Ranch" (McAllister 1933:152). According to the "Legend of Kāma'akamahi'ai", the area around Púuala Heaiu was used for sports:

> When Keaua'ula reached Pu'u-'ala in Kahuku, he met some people who were indulging in sports there….They were spear throwing and moa sliding and they urged him to stop and play (J.W.K. Kauaililinoi, originally published in Hawaiian in the newspaper *Ku'oko'a,* Nov. 5, 1870, translation in Sterling and Summers 1978:149).

Legendary History

The following discussion of the legendary background of the project area vicinity is largely derived from Lehua Kalima's research presented in Corbin (2003). Although Kahuku is an *ahupua'a* of the Ko'olauloa District, it is often referenced a district or region, with many references to its physical volatility. An example of this is presented in the following Hawaiian adage: *Kahuku 'aina lewa* (Kahuku an unstable land). O'ahu, according to legend, was once two islands that grew together; Kahuku is the part that bridges the gap (Pukui 1983:144).

There are several accounts of Kahuku once being a floating island that created a disturbance when it would collide with Oahu, causing the Ko'olauloa people to attach it to the mainland with fishhooks (Boswell 1958:68):

> Kahuku District, according to legend, was once a floating island blown about by the winds. As it banged against Oahu, it made noises, which disturbed the old women guarding the Princess Laieikawai. The old women grappled the island with fishhooks and attached it securely to Oahu. Polou pool on the sea side of the Kahuku Mill is one spot where the hook was fastened. The other end was fastened in Kukio.

The missionary Levi Chamberlain (1957:35-36) heard the following legend during a tour of the island in 1928:

> The natives tell a marvelous story respecting the origin of this district, which they say floated in from the sea, and attached itself to the ancient shore of the island, that there was a subterranean communication between the sea and the ancient shore, by which a shark used to pass and make depredation up on land. The basis of the tract, which is from 5 to 7 miles in length and from 1 to 2 miles in breadth appears to be of coral and it was evidently redeemed from the sea, as a good deal of the land, in many places along the shore around the whole circuit of the island, evidently has been.

The following legend indicates that the floating island of Kahuku was once the home of the Menehune (Paki In Silva 1984:3):

> Kahuku section of O'ahu was once a separate island...It was an islet whose people were the Menehune, or Dwarfs as they are called today. Many stories are told about the miraculous feats

> performed by the Little People of ancient Hawaii. It is known, also that they always worked from just after sunset until just before dawn.
>
> Legend tells us that Kahuku was a floating island situated several miles out to sea. For a long time, the people of Oʻahu had planned to make the island a part of their land, for they say it came close to Oʻahu's shores. The floating island of the Menehune did not have any fresh-water springs because there were no high mountains covered with verdure and trees to capture the rains. So, the Little Folk used to paddle their islet into the bays of O'ahu at night to haul water from the springs of the large island.
>
> One day, a resident of Kahuku suggested that all the people gather together to make strong hooks of whalebone and attach them to a stout rope made of sacred Olona fibers. This was done.
>
> The Menehune came to take water as usual, then the residents of Oʻahu attached the large hooks to the floating isle while the Little Folk were off at the water-springs. When the water was loaded, the Menehune started to paddle off again, but they could not move their islet or free it from the ivory hooks and Olona ropes.
>
> Today, many people who travel Kahuku section of Oʻahu and see the many islets seeming to float off shore, and hear the sea singing its songs, they say, "Listen to the Menehune grumbling while they try to move their island that used to float!" The rumbling and grumbling is heard only at night, for that is the time for the Menehune to be working at Kahuku.

Pukui (1983:239) presents a proverb that indicates that the Kahuku region was once connected to Waipahu via an underground stream: "*Pukana wai O Kahuku*" (The water outlet of Kahuku). This stream is also cited in Thrum who indicates that it flowed between Punahoʻolapa Marsh in Kahuku and Waipahu Stream in Waipahu (Thrum 1910:130-131):

> A kapa-beating log of peculiar sound, unlike any other known on the island, which was placed in its waters at the close of a kapa-making season to keep it smooth and free from cracks that would impart an impression to the cloth in its manufacture, was missed, and, believing it to have been stolen, search was made all through the Koolau, Waialua, and other districts till at last it was found in use at Waipahu. Recognizing it by its resonant tone, it was claimed by the searching owner and right thereto by those in possession as vigorously maintained. To test the truth of ownership as claimed, the Ewa people accompanied the claimant back to Kahuku to visit the scene and witness a test of the underground stream theory. A bundle of ti leaves were gathered, which was wrapped together and consigned to the Waters of Punahoolapa. In the course of a few days they were lost to sight, whereupon the party set out for Ewa, and after careful watching, as predicted, the bundle of ti leaves came forth on the bosom of the waters of the Waipahu stream. The kapa log was thereupon recognized as the rightful property of the Kahuku claimant.

Handy and Handy (1974:443) support the potential existence of this legendary subterranean water course :

> It is said that Oahu's most famous burial cave was in Kanehoalani. Its name was Pohukaina. One entrance was in the northern cliffside facing Kaʻaʻawa and another is at a spring named Kaʻahuʻula. This great cavern was believed to run right through the Koʻolau range. There was an opening in Moanlua on the leeward side of the island, and others were in Kalihi, Puiwa, and Waipahu. Still another was in Kahuku. The "roof" of the cavern was called Kauhuhu, and this was "in the mountain Konahuanui, sloping down toward Kahuku." Many are said to have gone with *kukui* nut candles from Kona (leeward Oahu) to Kahuku. In the caves are "many creeks, rivers and streams" (*Ke Au Hou,* June 28, 1911).

Early Historic Period (Contact to 1846)

The first western description of the Kahuku region comes from Captain Clerke on February 28, 1779 (quoted in Nakamura 1981). Clerke, who had taken command of the H.M.S. Resolution following the death of Captain Cook two weeks earlier, observed a large settlement in the vicinity of Kahuku Point and described the land as "exceedingly fine and fertile" (ibid.: 1). Another member of the crew, Lieutenant James King, provided the following account of the region between Kaneohe Bay and Waialua (quoted in McAllister 1933:153):

> It [Oʻahu] is by far the finest island of the whole group. Nothing can exceed the verdure of the hills, the variety of the wood and lawn, and the richly cultivated valleys, which the whole face of the country displayed.

In 1792, the British ship Daedalus, part of Vancouver's squadron, anchored in Waimea Bay to obtain water. The shore party, consisting of the commander, the astronomer, and two seamen, was attacked and all were killed except one seaman (Kuykendall 1967). In 1794, Vancouver (1798: Vol. III: 71) described the Kahuku region as less flourishing and inhabited than King had earlier described, a situation that Nakamura (1981) attributed to depopulation:

> …In every other respect our examination confirmed the remarks of Captain King excepting, that in point of cultivation or fertility, the country did not appear in so flourishing a state, nor to be so numerously inhabited, as he represented it have been at that time, occasioned most probably by the constant hostilities that had existed since that period.

During Levi Chamberlain's 1828 tour of the area he stopped at several schools in the vicinity of the project area, including those in the communities of Lāʻie, Mālaekahana and Kahuku. There is however no mention of any schools in any of the other project area *ahupuaʻa*, which suggests that these communities were too small to support a school (O'Hare and Hammatt 2006:14). According to Chamberlain (1957: 35-36):

> Tuesday Feb. 5th. After breakfast I examined two schools, belonging to Laie & Malaekahana, and was pleased with the appearance of the scholars. At a quarter before 11 A.M., we set out for Kahuku, and after traveling about two hours over a level sandy country, arrived at the school house, where we found 83 scholars assembled, waiting to be examined.

Land Commission Awards (1846-1855)

A significant transition from the traditional land tenure system to the introduced concept of private land ownership occurred in Hawaii in the mid-1800s. "At that time, Kamehameha III relinquished absolute ownership of lands in the Islands and individuals were allowed to register legal verifiable claims to their households and agricultural plots" (Bath *et al*. 1984: C-15). Further, "[t]he old feudal arrangement of joint and undivided ownership had given place to the system of individual allodial tenures, and aliens had been admitted to the enjoyment of the same rights as Hawaiian subjects in the ownership and use of land" (Kuykendall 1967:298).

Ahupuaʻa within the project area are depicted in several ways depending on the source. The current USGS quadrangle maps of the area depicts seven land divisions including Kahuku, Punalau, Ulupehupehu, ʻŌiʻo, Hanakaʻoe, Kawela and ʻŌpana (see *Figure 1*); however, an 1878 Government Survey Map of the island only depicts Kahuku, Kawela and a combined area including ʻŌiʻo and Hanakaʻoe (*Figure 9*). O'Hare and Hammatt (2006:14) suggest this disparity may be the result of politics: "It seems likely that prior to the conquests of Oʻahu by the chiefs of Maui (c. 1783) and Hawaiʻi Island (1795) that Ōiʻo 1 & 2, Ulupehupehu, Punalau, Hanakaʻoe and Kawela were understood as separate *ahupuaʻa* but that they were combined for political purpose by 1848".

Kahuku and Kawela were designated as Crown Lands of King Kamehameha III (Indices 1929:27-28) while the remaining *ahupuaʻa* in the project area were taken as government land (1929:40-44). The Waihona ʻAina (2000)

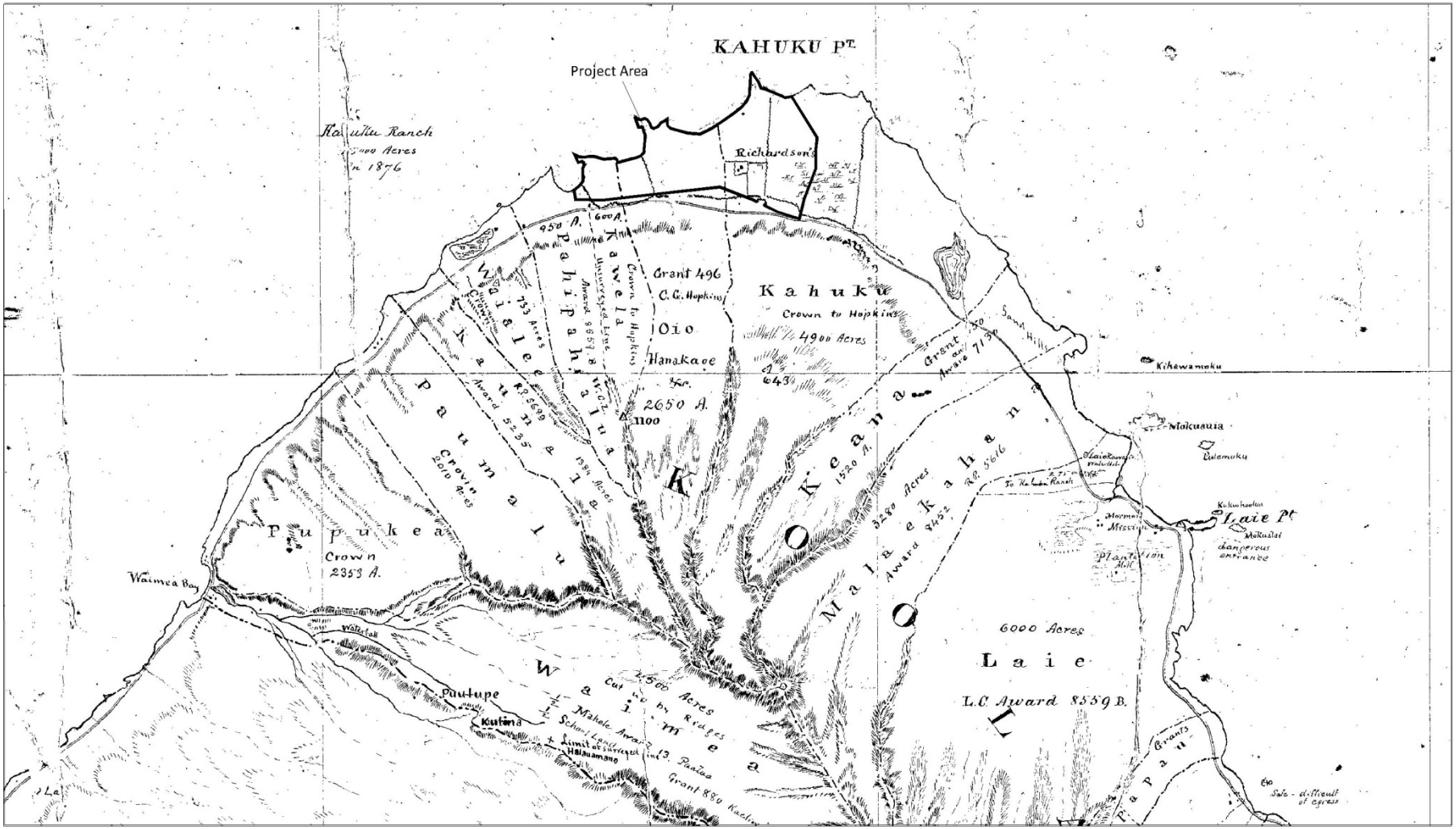


Figure 9. Portion of Lyon's 1878 Government Survey Map of Oahu

Mahele Database is a compilation of data from the Indices of Awards (Indices 1929), Native Register (NR n.d.), Native Testimony (NT n.d.), Foreign Register (FR n.d.) and Foreign Testimony (FT n.d.). The Database lists 101 land commission award (LCA) claims for the project area *ahupuaʻa*. Of these 101 claims, only 88 were awarded. The Database also reflects the disparity in the names of the project area *ahupuaʻa* because ʻŌpana, Ōiʻo, Hanakaʻoe, Ulupehupehu and Punalau are sometimes referred to as separate *ahupuaʻa*, although in other instances are referenced as *ili* of Kahuku or Kawela.

Of the 101 LCAs, 35 are located within the boundaries of the project area and 66 are located in the surrounding area. The locations of the LCAs were determined through analysis of historic maps and tax maps. The majority of the 66 LCAs are depicted in *Figure 10* and summarized in *Table 2*. Sixty-six LCAs name 64 individuals: single claimants filed on 62 LCAs and the remaining four LCAs were awarded to two claimants (Kaio LCAs 4394 and 4396; and Uha 2681 and 3748).

Of the 66 LCA claims, most are listed in the Land of Kahuku (n=47). Of the 19 remaining claims, seven list Kawela. Three list Kahuku and Punalau. Two list Kawela and Kahuku. Two list Kahuku and Ulupehupehu. Two list Kahuku, Punalau and Ulupehupehu. One lists Ōiʻo. One lists Ōiʻo, Hanakaʻoe and Kahuku. One lists Kahuku, Ulupehupehu, ʻŌiʻo, Hanakaʻoe, Kawela and ʻŌpana. The claims outside of the project area are clustered in four areas, with the majority located in Kahuku, in the vicinity of the Kamehameha Highway (see Inset 1 on *Figure 10*). A second cluster is situated seaward of the first in the central Kahuku area. Four LCAs are situated to the east of the first cluster. The fourth cluster is located in the Land of Kawela, just inland of the highway (see Inset 2 on *Figure 10*).

Thirty-five LCAs within the project area are summarized in *Table 3* and their locations are presented in *Figure 11*. Thirty-five LCAs name 31 individuals: single claimants filed on 27 LCAs and the remaining eight LCAs were awarded to four claimants (Waanui – LCA 2698, Hoolae – 2716, Pakanaka – 2744, Kaohele – 2861). Of these 31 individuals, 21 claimed parcels in areas adjacent to the project area. These additional claims are indicated by asterisk in *Table 3* and are depicted on *Figure 10*. The majority of the LCAs within the project area and several east of the project area are also depicted on the 1890 map of the Kahuku Plantation (*Figure 12*).

Most of the claimed parcels are located in Kahuku Ahupuaʻa (n=17). Eleven are located in Kawela. The remaining seven claims list Kahuku and one or two additional *ahupuaʻa*. Three list claims in Kahuku and Punalau, three list Kahuku, Punalau and Ulupehupehu and one lists claims in Kahuku and Ulupehupehu.

ʻŌpana, Ōiʻo, Hanakaʻoe, Ulupehupehu and Punalau are sometimes listed as *ili* of Kahuku and Kawela. Claim testimonies mention additional *ili* land divisions within both Kahuku and Kawela. The *ili* in Kahuku include Aamo, Ahamau, Kakala, Kalimaloa, Lanahu, Lauhine, Mookini, Mookahi, Punama, Puaakea and Uwalakui. The *ili* in Kawela include Kamalua, Kamooiki, Kaneloko, Kaunala, Kawelaluna, Keokea and Kumpali. Most parcels were conveyed to claimants during the time of Kamehameha I (n=12). Seven were conveyed during the time of Kamehameha III and four during the time of Kamehameha II. Testimonies from two claims indicate they were conveyed in 1842.

House lots are mentioned in 24 claims. There are 36 *loʻi* (pondfields) described in the claims with three claims specifically mentioning *kalo* (taro). Testimonies refer to cultivated bananas (6 references), sweet potatoes (6), *wauke* (6), sugar cane (3), bitter melon (3), *noni* (2) and orange tree (1). Other named plants are *Pandanus* trees or *hala* or groves (2) and *koa* trees cultivated for canoes (1). One claim mentions a *puna paʻakai* or brackish spring and one mentions a fishery.

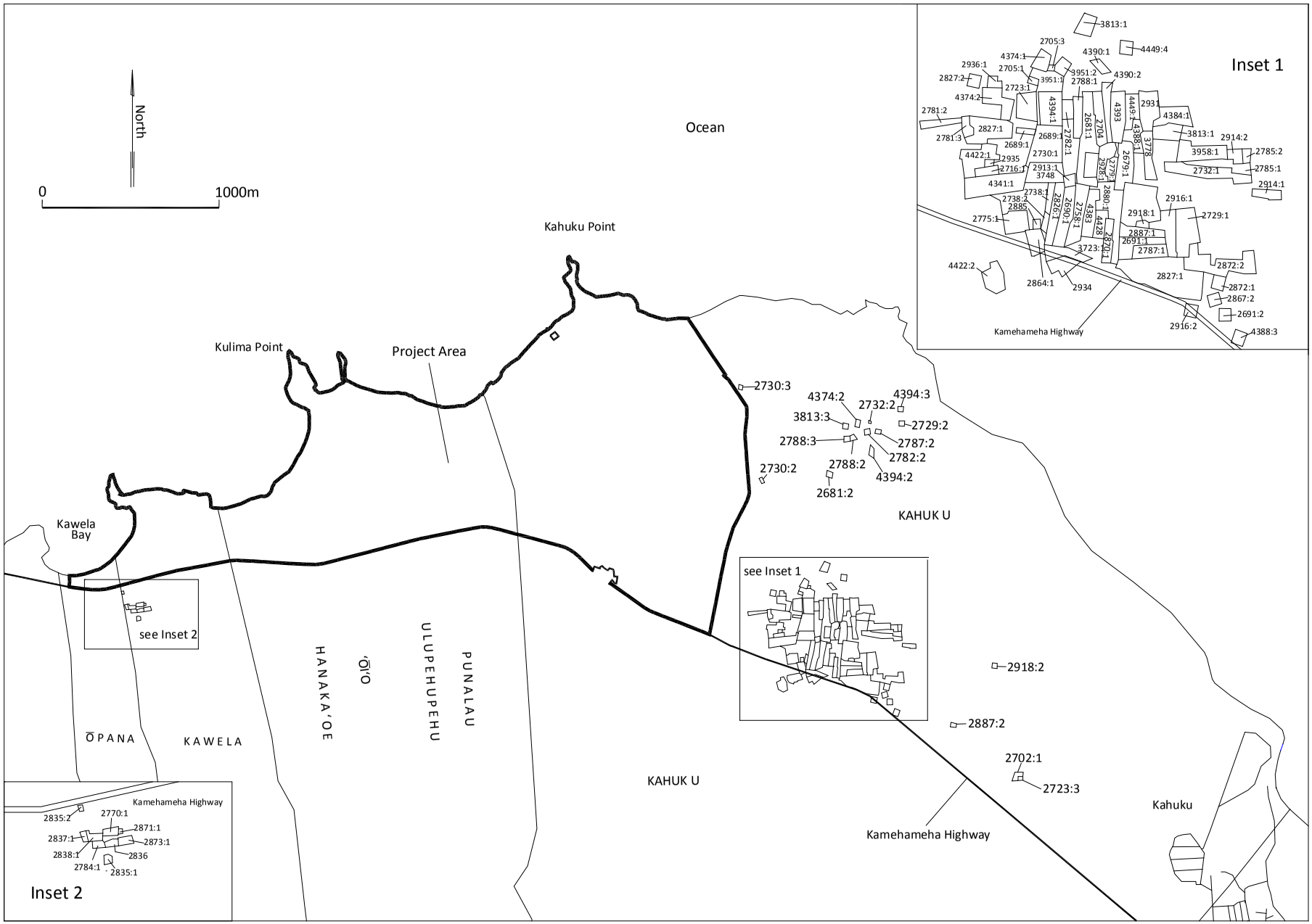


Figure 10. Land Commission Awards outside Project

Table 2. Summary of Land Commission Awards outside of Project Area

LCA	Claimant	Ahupuaʻa	Ili	Awarded
2681	Uha	Kahuku		Yes
2691	Luamea	Kahuku	Akamau, Kaipauloa, Puulu, Kalehunui	Yes
2702	Waialua	Kahuku	Kaupoo, Koolina, Mahukini	Yes
2704	Haui	Kahuku		Yes
2705	Hao	Kahuku		Yes
2723	Puu	Kahuku	Kaupoo, Koolina, Mahukini	Yes
2729	Polena	Kahuku		Yes
2730	Pahanui	Kahuku	Keahupuaa, Ahamau, Punakaipo	Yes
2732	Pukawale	Kahuku	Keekee	Yes
2758	Napoe	Kahuku	Ulepehupehu	Yes
2771	Maulua	Kahuku	Oio	Yes
2776	Mahoe	Kawela	Keokea	Yes
2778	Mahu	Kawela		Yes
2780	Muli	Kawela		Yes
2782	Makole	Kahuku, Punalau	Punalau Ahamau, Oio, Luahine, Kahala, Amo	Yes
2785	Makakiekie	Kahuku	Ahamau	Yes
2787	Makaokalai	Kahuku	Luahine, Hanumoha	Yes
2788	Mauoli	Kahuku	Hanapaua, Poohalulu, Waiula, Manono	Yes
2789	Mooni	Kahuku	Waiula, Ahamau, Kakala, Haleamani, Poohalulu, Kaea	No
2817	Kimo	Kahuku		Yes
2826	Kalaweaumoku	Kahuku	Mookini, Punalau, Ulupehupehu, Ahamau	Yes
2827	Kanahuna	Kahuku	Mana, Ahamau	Yes
2836	Kelemana	Kawela, Kahuku	Mahealani	Yes
2864	Kiha, Josua	Kahuku	Kahuku, Punalau, Ulupehupehu	Yes
2867	Keino	Kahuku	Limalaa, Amo, Kaloaloa	Yes
2868	Kapaiaala	Kahuku		
2870	Kai	Kahuku		Yes
2872	Kaihikapu	Kahuku		Yes
2873	Kaunahi	Kawela		Yes
2875	Kaopuu	Kawela, Kahuku	Mahealani	No
2878	Kekua	Kawela	Kamooiki	Yes
2885	Kupihea	Kahuku, Punalau, Ulupehupehu		Yes
2887	Keawe	Kahuku	Ahamau	Yes
2888	Kaupaona	Hanakaoe, Kawela, Oio, Kahuku, Opana, Ulupehupehu	Lanahu, Uwalakui	No
2889	Kekohai	Oio, Hanakaoe, Kahuku		No
2890	Kaika	Kahuku		No
2892	Kainalu	Kahuku, Punalau	Lanahu, Haleaniani, Amo, Niukolu	Yes
2906	Kaaumakua	Kahuku, Ulupehupehu	Ikemaka	Yes
2909	Kamalama	Kahuku, Punalau, Ulupehupehu	Kaunala	Yes
2914	Keakaokawai	Kahuku	Ahamau	Yes
2916	Kaluau	Kahuku	Ahamau	Yes
2918	Kawaa	Kahuku		Yes
2931	Keawelekini	Kahuku	Ahamau, Keana	Yes
2932	Kailiuku	Kahuku, Ulupehupehu	Puuakea, Oio, Hanakaoe	Yes
2934	Kalahana	Kahuku	Oio	Yes
2935	Kekuauli	Oio, Hanakaoe, Kahuku	Oio, Ualakui	Yes
3712	Moku	Kahuku		No
3723	Male	Kahuku	Keahupuaa, Makapala, Ahamau	Yes
3748	Uha	Kahuku	Ahamau, Poohalulu, Puulu, Kahani	Yes
3778	Aaiki	Kahuku	Ahamau, Ao, Wiwikalani	Yes
3813	Pakui	Kahuku	Ahamau, Poohalulu, Keahupuaa	Yes
3871	Palau	Kahuku		No
3951	Niau	Kahuku	Puohalulu, Kakaako	Yes
4329B	Kuapuhi	Kahuku		Yes
4374	Kuapuu	Kahuku	Paohaulu, Pauwela	Yes
4383	Kula	Kahuku	Makaha, Kapawa, Keana	Yes
4384	Kekipi	Kahuku	Ahamau, Kahauloa, Makapala, Kalimaloa, Poohalulu	Yes
4388	Kau	Kahuku	Ahamau, Amo, Poohalulu	Yes
4390	Kupaihea	Kahuku	Ahamau, Paohalulu	Yes
4393	Kaumi	Kahuku	Ahamau, Paohalulu	Yes
4394	Kaio	Kahuku, Punalau	Ahamau, Poohalulu, Wikiwikilani	Yes
4396	Kaio	Kahuku		No
4422	Kaumualii	Kahuku	Nanahu, Waihokahala, Luahine, Ahamau, Ulupehupehu	Yes
4428	Kuhoopohopoho	Kahuku		Yes
4449	Kaaikaula	Kahuku	Ahamau	Yes
8810	Kawahaku	Kahuku		No
10931	Uluhao	Kahuku		No

Table 3. Summary of Land Commission Awards within Project Area

LCA	Claimant	*Ahupua'a*	*ili*	Apana Claimed	Apana Awarded	Other Claims	Section No.	Land Use	Boundary North	Boundary East	Boundary South	Boundary West	Date Rec'd	Giver	Acreage	Royal Patent	Sources	Comment
235M	Kaili	Kawela		2	1			House lot, 5 kalo patches	Kauaula's land	kohanaiki land	Kookoo's land	kohanaiki land			0.41	508	FT 11: 239	Claimant died in 1849 and left property to his daughter Nahuli
2679*	Umeume	Kahuku	Punama, Mookini,	2	1		2	House lot, *puna pa'akai* (Brackish spring?), two hala trees	kula	kula	kula	kula			0.25	259	NR 3: 679 FT 10:174	
2690*	Luiki (Luihi?)	Kahuku	Ulupehupehu	2	1		2	House lot	Land fence	weed grown kula	weed grown kula	kula	Kam I times		0.25	339	NR 3: 591-592 FT 10: 164	
2698*	Waanui	Kahuku, Ulupehupehu	Oio	3	2				Lokea's land	Kailiuku's land	Kaukaha's land	Napoe's land	Kam III times			340	NR 3: 595-596 FT 10:165	
							2	2 *loi*	n/d	n/d	n/d	n/d	Kam III times					
							3	Open flat lands	n/d	n/d	n/d	n/d	Kam III times					
2706	Holoaia	Kahuku	Lanahu	2	1		2	House lot	kohanaiki land	kohanaiki land	kohanaiki land	kohanaiki land			0.25	244	FT 10:186	His daughter Kaleikini is Holoaia's heir
2716*	Hoolae	Kahuku	Oio, Lanahu, Hanakaoe	3	1		1	House lot	Kaumualii's land	Kaukaha's land	Malailua's land	kohanaiki land	Kam II times		0.6	8000	NR 3: 601-602 FT 10:161	
							2	*loi* with wauke, sweet potatoes, bananas, bitter melon, sugarcane, koa trees										
2724	Paku	Kawela	Kamalua, Kumupali	3	1		3	House lot	kohanaiki land	kohanaiki land	kohanaiki land	Kuheleloa's land		Kinau	0.25	514	NR 3: 608 FT 10: 156	
2734	Paukoa (Pakoa)	Kawela	Opana	1	2	1	3	House lot, 2 *loi*	kula	kula	kula	Kookoo's land					NR 3: 612, FT 10:158	
2738*	Palu	Kahuku	Oio, Ulupehupehu, Ahamau	3	1		3	House lot	kula	kula	kula	kula	Kam II times		0.25	518	NR 3: 614 FT 10: 183	Property left to his widow Iheihei
2744	Pakanaka (Manaka)	Kahuku	Oio	2	1								Kam I times		0.38		NR 3: 617-618 FT 10:177	
							1	1 *loi*	Makole's land	Kainalu's land	Kainalu's land	kohanaiki land						
							2	House lot	Kauahikai's land	kula	I's land	Ocean						
2770*	Makaino	Kawela	Keokea	2	1	1	2	House lot, 1 *loi*, 1 fishery	kohanaiki land	kohanaiki land	kohanaiki land	kohanaiki land	Kam II times	Kaeo	0.25	513	NR 3: 628 FT 10: 155	
2775*	Malailua	Kahuku, Punalau		2	1		2	House lot	Land fence	hala grove	hala grove	hala grove	Kam III times		0.25	534	NR 3: 630 FT 10:166	
2779*	Makilo	Kahuku					2	Open flat land with bananas and wauke	kohanaiki land	kohanaiki land	kohanaiki land	kohanaiki land	Kam III times		0.75	530	NR 3: 266 FT 10: 167	
2781*	Manukeokeo	Kahuku, Punalau	Uwalakui	2	1		1	House lot and 4 *loi* with wauke, sweet potatoes, bananas, bitter melon	Heea's land	kohanaiki land	Lono's land	Kanahuna's land	1842		1.09	533	NR 3: 632-633 FT 10: 177	
2784*	Moo	Kawela		2	1		2	House lot, 4 *loi*	Kekua's land	Kaunahi	Kuheleloa	kula	Kam I times	mauka's	0.13	512	NR 3: 634, FT 10: 156	
2835*	Kuheleloa	Kawela	Opana	2	1	5	2	2 *loi*	kula	kula	kula	kula			0.5	514	NR 3: 657, FT 10: 157	
2837*	Kamakai	Kawela	Kaunala	2	1		2	House lot	sea	pond	sandy gulch	Peelalau's land		Kaeo	0.09	507	NR 3: 658, FT 10:158	
2838*	Kauwahi	Kawela	Kaunala	3	1		2	House lot	kohanaiki land	kohanaiki land	kohanaiki land	Paukoa's land	Kam I times		0.25	510	NR 3: 368 FT 10: 159	
2850	Kawi	Kawela	Kumupali	1	1	1			pond	Moo's house	land fence	sea				515	NR 3: 663, FT 10: 155	
2861	Kaohele	Kahuku, Punalau, Ulupehupehu	Oio	1	1		1	House lot	Makoli's land	kula	kula	kohanaiki land	Kam I times		n/d	n/d	NR 3: 667-668 FT 10: 153	
							2	5 *loi*	Makoli's land	kula	kula	kohanaiki land						
2868	Kapaiaala	Kahuku		2	1		2	House lot	kula	kula	kula	kula			0.25	531	NR 3: 670 FT 10: 153	

Table 3. Summary of Land Commission Awards within Project Area (cont.)

2878	Kekua	Kawela	Kamooiki	3	1	1	2	House lot	Kauwahi's land	Kaunahi's land	Kelemana's land	kula	1842	Kaeo	0.43	515	NR 3: 676 FT 10: 155	
2880*	Kupau	Kahuku		2	2	1	2	Cultivated land planted in sweet potato, noni, sugarcane and banana	kohanaiki land	path	kohanaiki land	kohanaiki land	Kam I times	Kahahana	0.14	338	NR 3: 675 FT 10: 164	Liuki also assumes claim as Kupau died before completion of award
2897	Kookoo	Kawela, Punalau		2	1		2	3 kalo patches, 1 house lot	Kaili's loi	kula	kula	Peelalau's land	Kam I times		0.25	506	NR 3: 683, FT 10: 159	
2913*	Kekua	Kahuku, Punalau, Ulupehupehu	Aamo, Ahamau, Mookahi	3	1	1	2	2 kalo patches with wauke, sweet potatoes, bananas, oranges	Luiki's land	Napoe's land	Luiki's land	water course	Kam I times		0.47	337	NR 3: 690-691 FT 10: 180	On Kekua's death land was left to Luiki
2928*	Kauihaiwale	Kahuku		1	1		2	House lot	Mala of wauke	Taro *loi*	kula	kula	Kam III times		0.25	251	NR 3: 697 FT 10:168	
2936*	Kauihikai	Kahuku, Ulupehupehu	Lanihau, Uwalakui, Oio, Hanakaoe	2	1		2	House lot, 5 *loi* with noni, wauke, hala, sweet potatoes, bananas, bitter melon, sugarcane	kohanaiki land	kohanaiki land	Keea's land	kohanaiki land	Kam III times		0.52		NR 3: 701 FT 10:186	Kauaihikai died in 1848, leaving land to his widow Upai
3809	Lokea (Waanui)	Kahuku	Puaakea, Kakala, Kalimaloa	1	1		1	House lot, 7 *loi*	Puu's land	Heea's land	Kaukaha's land	Pahanui's land	Kam I times		0.27	334	NR 4: 174 FT 10:165	Waanui also assumes claim as Lokea had died before completion of award
3815	Pailalau (Peelalau)	Kawela	Kaneloko, Kawelaluna, Kalimaloa, Hanakaoe	1	1		1	House lot	stone wall	Kamakai's lot	Kamakai's lot	stone wall	Kam II times	Kaeo	0.1	511	NR 4: 176, FT 10: 170	
3958*	Naukuhao (Naukuhae)	Kahuku	Ahamau, Lauhine, Kalimaloa	2	1		2	House lot	kohanaiki land	kohanaiki land	kohanaiki land	kohanaiki land	Kam I times	Parents	0.25	254	NR 4: 200 FT 10: 151	
4341*	Kaukaha	Kahuku		2	1		2	House lot	Pasture	kula	kula	kula	Kam I times		0.25	526	NR 4: 266 FT 11: 320	

2679* = Also claimed parcel outside project area but within project area ahupuaʻa

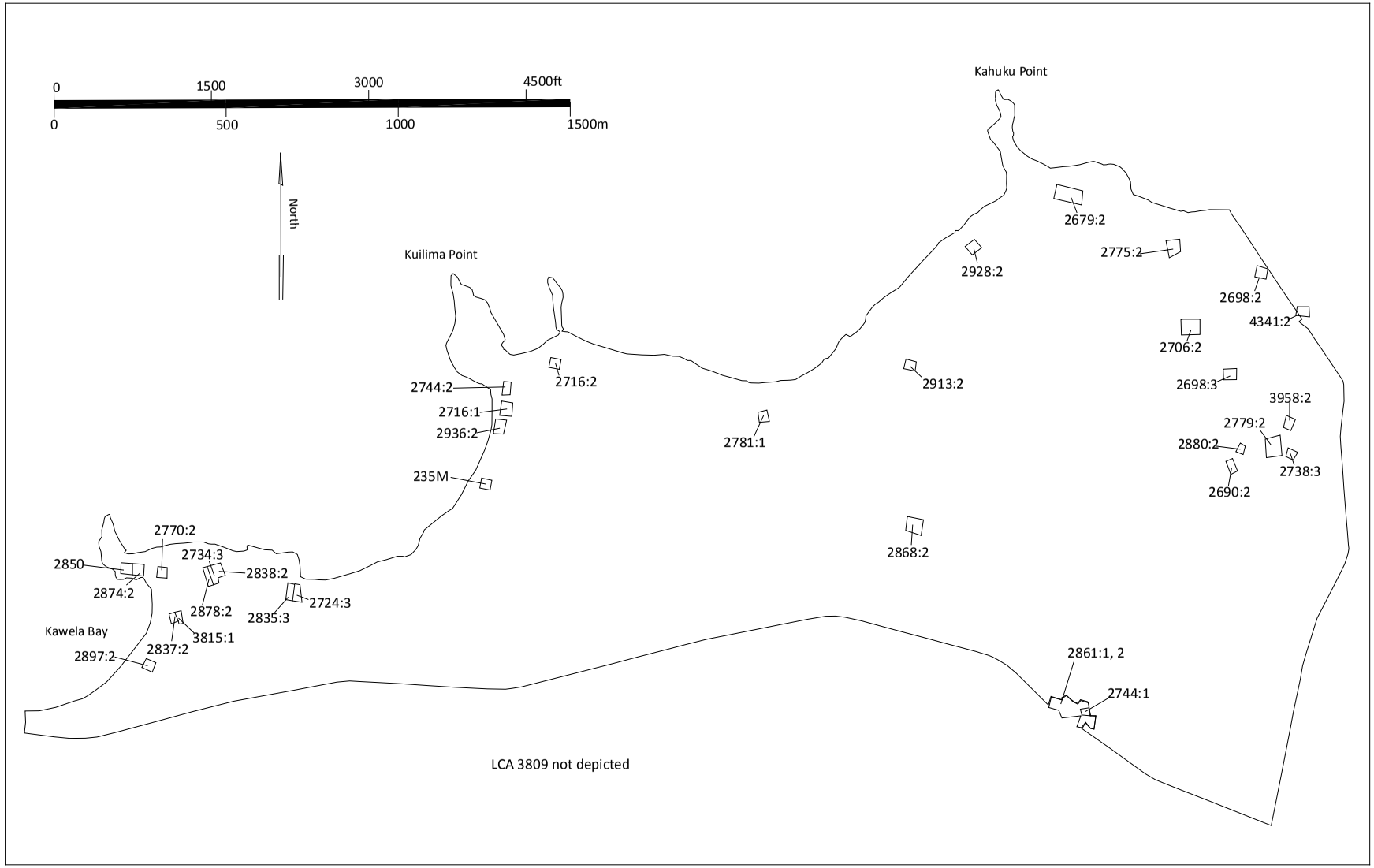


Figure 11. Land Commission Awards within Project Area

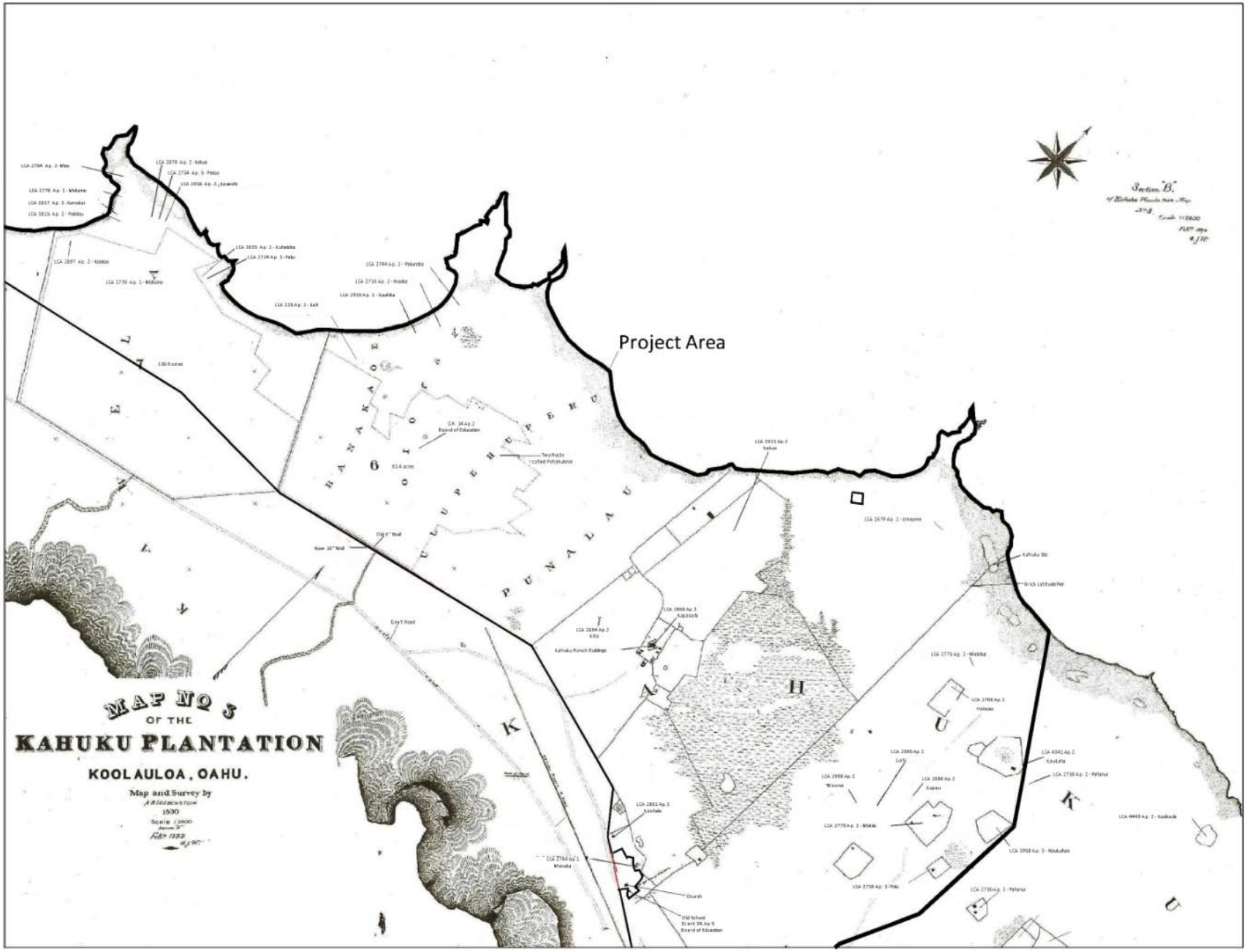


Figure 12. Portion of Loebenstein's 1890 Map of Kahuku Plantation

Kahuku Ranch (1850-1880)

Charles Hopkins, an Englishman, purchased 8,000 acres at Kahuku in 1850-1851 from Kamehameha III and established a sheep and cattle ranch, which he named Kahuku Ranch. Hopkins venture had immediate impacts on the landscape, which were particularly disturbing to the Hawaiian inhabitants of the area. According to O'Hare and Hammatt (2006:16):

> The natives became concerned for their lush and legend-filled homeland. Kahuku and the *hala* (*Pandanus*) trees in whose shade it had slept through the centuries, was being threatened by a new kind of white stranger. The herds and flocks ran over the small homesteads scattered here and there through the land, stripping it of verdure. The Hawaiians asked in vain for protection of their trees and vegetable patches. They wrote to the missionary, Emerson, who urged them to build fences and appealed to authorities on their behalf asking that government pounds be set up to enforce newly established trespass laws.

McAllister (1933:153) also cites the impact of the ranch on the Kahuku Plain during an interview with local informant Mrs. John Kaleo: "She remembers the time when trees, now found only on the mountains, covered the Kahuku plain, now a desolate, windswept area". The destruction of the native landscape was accompanied by a decline in the local Hawaiian population. According to census data there were 1,345 people in Koʻolauloa District in 1853 (Schmitt 1977:12). The population declined to 1,187 in 1860 and by 1878, only 1,082 people remained.

By 1856 a carriage road was completed between Honolulu and Kahuku (Haun and Henry 2001b). During the mid-1860s through the 1870s, the Kahuku Ranch changed hands several times. Robert Moffitt purchased the ranch from Hopkins and in 1873; H.A. Widemann gained ownership from Moffitt. In 1873 the ranch consisted of 15,000 acres including the *ahupuaʻa* of Kaunala, Pahipahíāula, ʻŌpana 1 and 2, Kawela, Hanakaʻoe, Ōiʻo, Ulupehupehu, Punalau, Kahuku, Mālaekahana, Keana, and part of Lāʻie. In 1874, Widemann sold "Kahuku and Mālaekahana Ranch" to Julius Richardson for $45,000.00. Richardson sold the ranch to James Campbell for $63,500.00 in 1876. An 1876 Government Survey Map of the Island Oʻahu depicts the extent of "Richardson's" Ranch and what appear to be a series of walled enclosures (see *Figure 9*). An article in the Hawaiian Gazette (cited in Bath *et al*. 1984:C-16) describes the ranch at the time of the 1876 sale to Campbell (excerpted from the Hawaiian Gazette, 10/4/1876, p. 3:2):

> Kahuku Ranch. This fine ranch, covering the north portion of Oahu, formerly the property of the late R. Moffitt, and more recently of Julius L. Richardson, Esq., was last week sold by the latter to James Campbell, Esq., one of the proprietors of the Pioneer Sugar Mill of Lahaina, for the sum of $63,500 cash. It includes 25,000 acres in fee simple, and large tracts of mountain land under long leases, with $34,000 worth of livestock, including 3,000 head of cattle, with the choice band of merino sheep and horses now on it. It is unquestionably the best stock ranch on these islands and it has been brought to a high state of perfection under the management of the late proprietors, who divided the plain into ten or twelve large paddocks, walled with heavy stone walls. It stretches from Laie to Waimea, a distance of thirteen miles and those who have ever visited it must have admired its lovely green pastures of manienie grass so fattening to stock. It is the intention of Mr. Campbell to increase his band of sheep to 30,000 of the choicest breed. The price paid is a handsome one, securing to its present proprietor the most desirable ranch on the Island, and to Mr. Richardson a comfortable fortune, and result in part of his industry and good management, and in part of the Reciprocity Treaty, the first fruit from which he has been so fortunate as to reap…

James Campbell operated the Kahuku Ranch until November 1889 when much of the land was leased to Benjamin Franklin Dillingham (Kuykendall 1967:69). George Bowser (1880:409) describes the extent of the ranch as it was in that year:

> Kahuku Ranch. Main Road, Kahuku: Proprietor, James Campbell, Esq., of Honouliuli: Manager, W.R. Buchanan: post office address, Kahuku, 38 miles [61 km] from Honolulu, at the northern point of Oahu: 23,608 acres [9554 hectares] occupied as a cattle ranch: extends 14 miles [22 km] along the coast, in close proximity to the sea. A valuable fishery is attached to this property.

Kahuku Plantation (1890-1971)

In 1889, Benjamin Franklin Dillingham chartered the Oʻahu Railroad and Land Company (OR&L) and commissioned two hydrographic engineers to investigate the potential for a commercial sugar cane plantation at Kahuku. In that same year he leased the Kahuku lands of James Campbell for 50 years. Dillingham then subleased the lands to James Castle. Castle's Kahuku Plantation Company received its charter in 1890.

The company began commercial production of sugarcane using pumped spring water, streams and rain for irrigation. This mode of irrigation was soon found to be inadequate for the amount of land available and artesian wells became the primary irrigation water source. A total of 2,800 acres were planted in sugarcane with the first crop harvested in 1892 (Kuykendall 1967:69). The Loebenstein 1890 Map of the Kahuku Plantation (see *Figure 12*) shows the location of the Kahuku Plantation and on the east side of the ranch buildings a series of walled enclosures, which correspond to Land Commission Awards. An old school and a church are located seaward of the Old Government Road and the Kahuku Ranch buildings are located in the central portion of the TBR property, west of Punahoʻolapa Marsh.

By 1898, the OR&L railroad line extended from Honolulu to Waialua; in 1899 it reached Kahuku. According to O'Hare and Hammatt (2006:21):

> No record appears to survive which gives the date the railroad was started at Kahuku Plantation. Annual reports do not appear prior to 1893. However, the road must have been started soon after the January 30, 1890 charter, for the Baldwin Locomotive Works records note an order for the first Kahuku motive power, Keana, on February 2, 1890 and a second order for Kahuku in 1891.

The Loebenstein map also depicts "Two Rocks called Pohakulanai" located in the Land of Ulupehupehu. Pohaku Lanai is also the name of a rock feature located on the west side of Kaiaka Bay Beach Park in Haléiwa, well to the northwest of the project area; the Haleʻiwa site (State Inventory of Historic Places, hereafter SIHP, 80-04-0218; National Register of Historic Places, hereafter NRHP, 50-OA-226) consists of two massive balanced limestone boulders, one on top of the other (NRHP n.d.). Legendary explanation (Alameida 1994) has it that the boulders floated ashore from the distant land of Kahiki and were used as a lookout by fish spotters (*kilo iʻa*). The presence of the "Two Rocks called Pohakulanai" on the 1890 map in Kahuku is unexplained. Perhaps they were destroyed by natural forces or as a result of development. McAllister did not document the two rocks in Kahuku in his 1930s inventory.

A 1906 train schedule indicates that the train ran from Waimea Station to Kahuku in 24 minutes with no stops (Mayberry and Haun 1988). The railroad is depicted on Donn's 1906 map of Óahu (*Figure 13*) and on King's 1928 map of the Kahuku Forest Reserve (*Figure 14*). The 1930 USGS Lā́ie Quadrangle depicts the railroad extending through the TBR property with stations at Kawela and Kahuku Ranch (*Figure 15*). Marconi Station was located just east of the property at Punamanō Marsh.

The Kahuku Plantation continued in operation through the 1920s and 1930s. By 1935, 4,490 acres were cultivated in sugarcane, with the plantation employing 1,137 workers (O'Hare and Hammatt 2006:21). A 1920s map of the Kahuku Plantation (*Figure 16*) depicts a series of numbered sugarcane fields occupying the inland portion of the TBR property. The extent of the sugarcane fields and a plantation workers camp (Camp 3) beside the OR&L railroad are depicted on a 1932 USGS map (*Figure 17*). The map shows sugarcane fields extending to the coast and a line of houses fronting Kawela Bay. The map also shows a rock wall extending inland from the coast approximately half

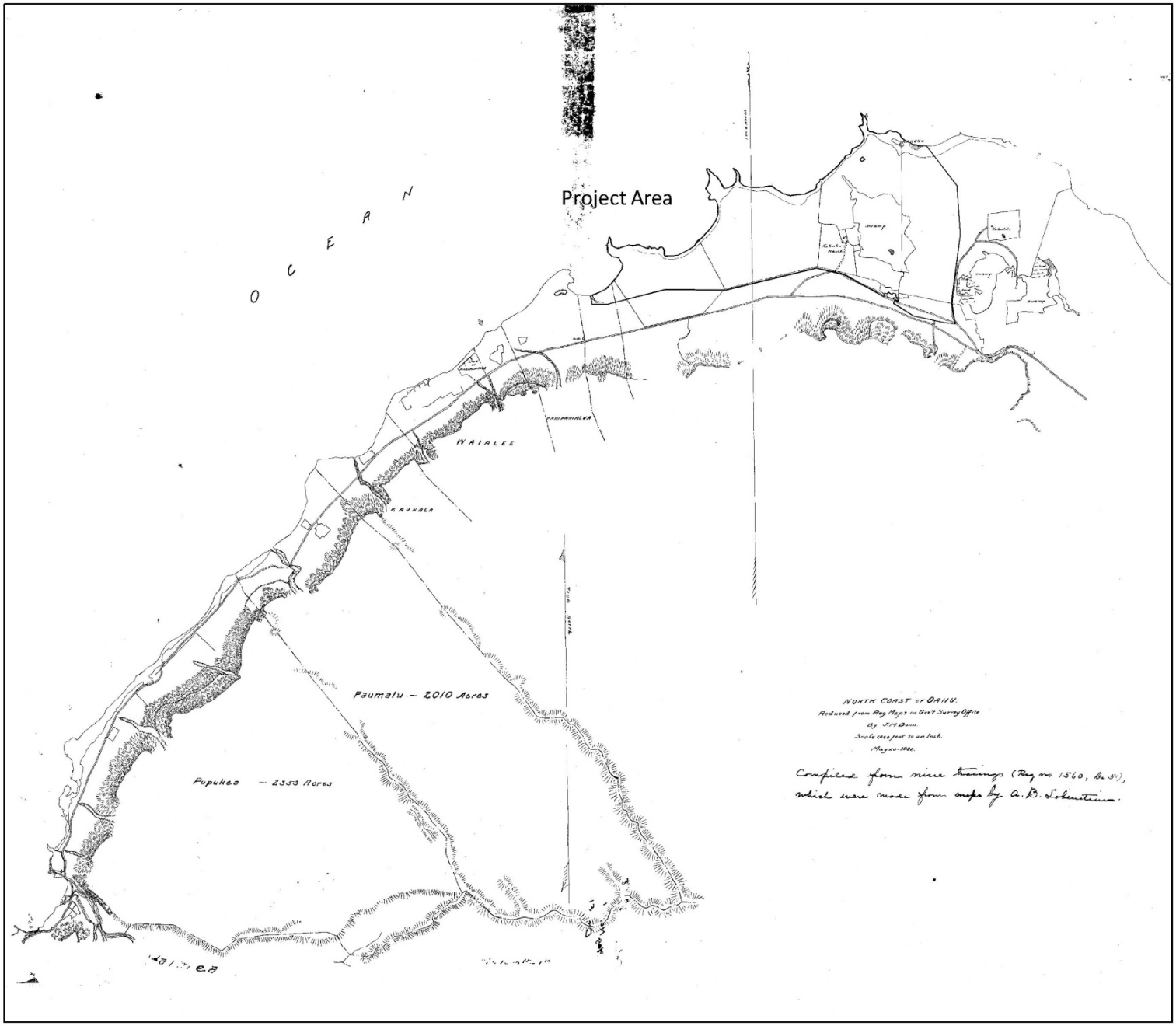


Figure 13. Portion of Donn's 1902 Map of North Coast of Oahu

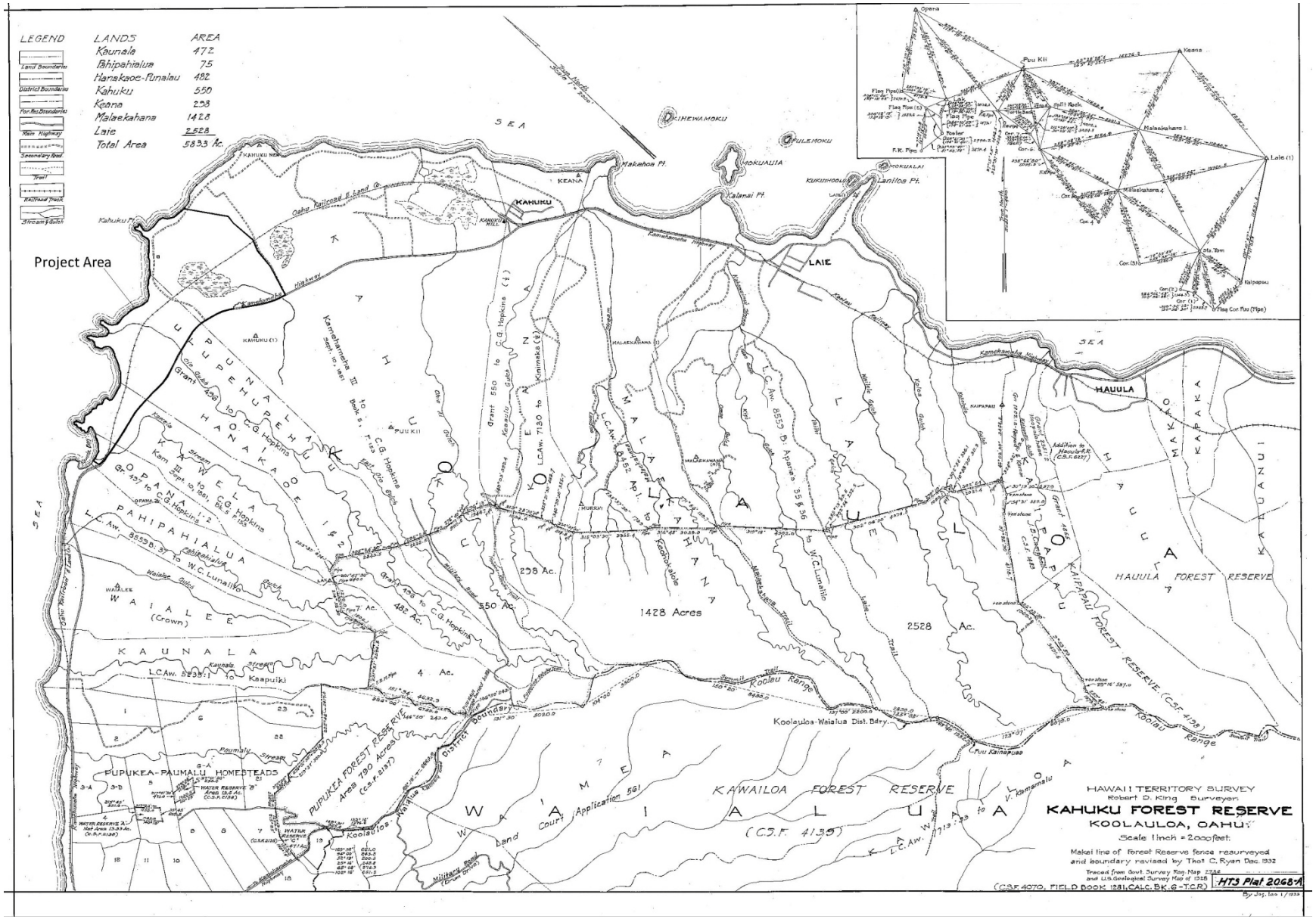


Figure 14. King's 1928 Map of Kahuku Forest Reserve

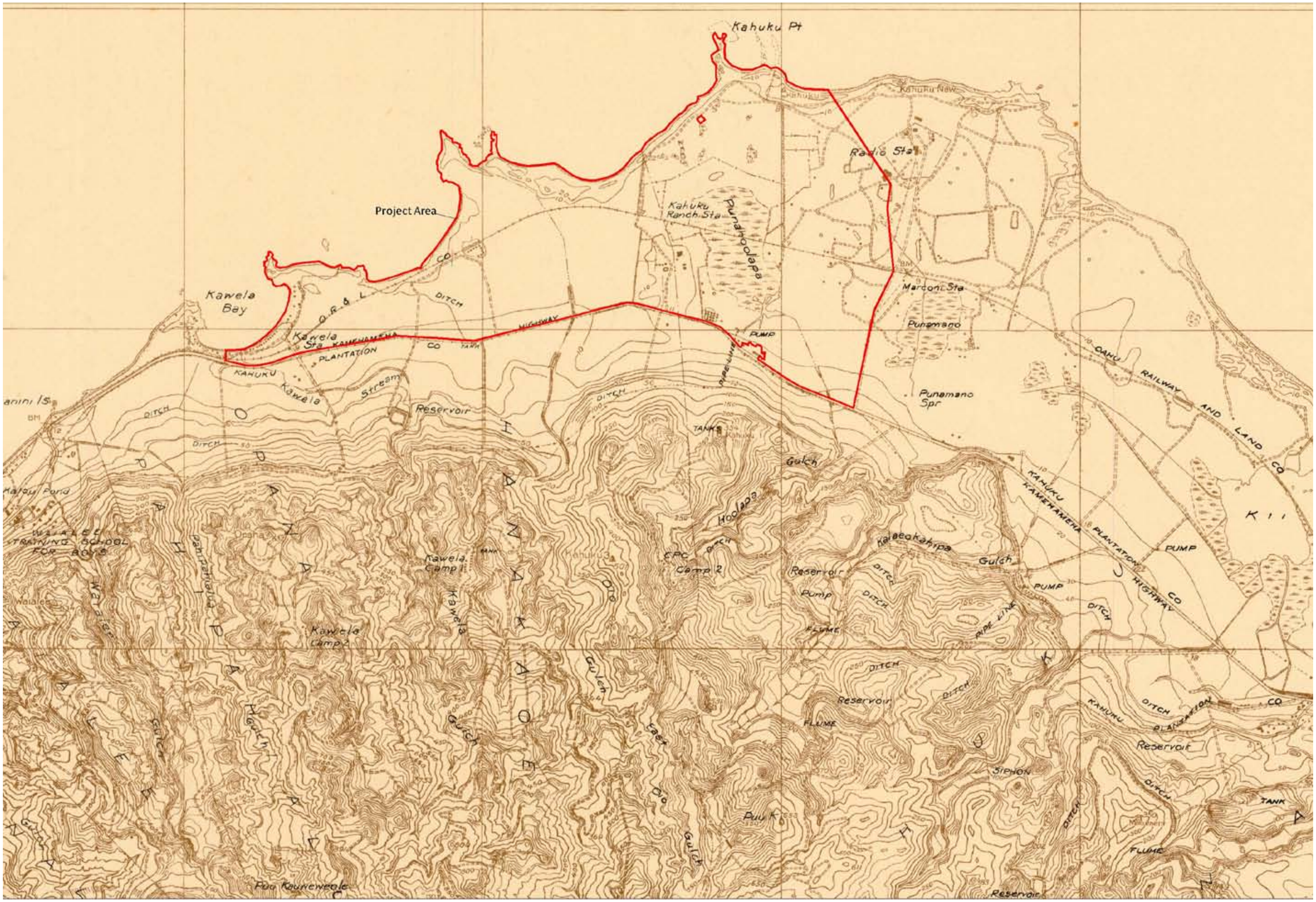


Figure 15. Portion of 1930 USGS Laie Quadrangle

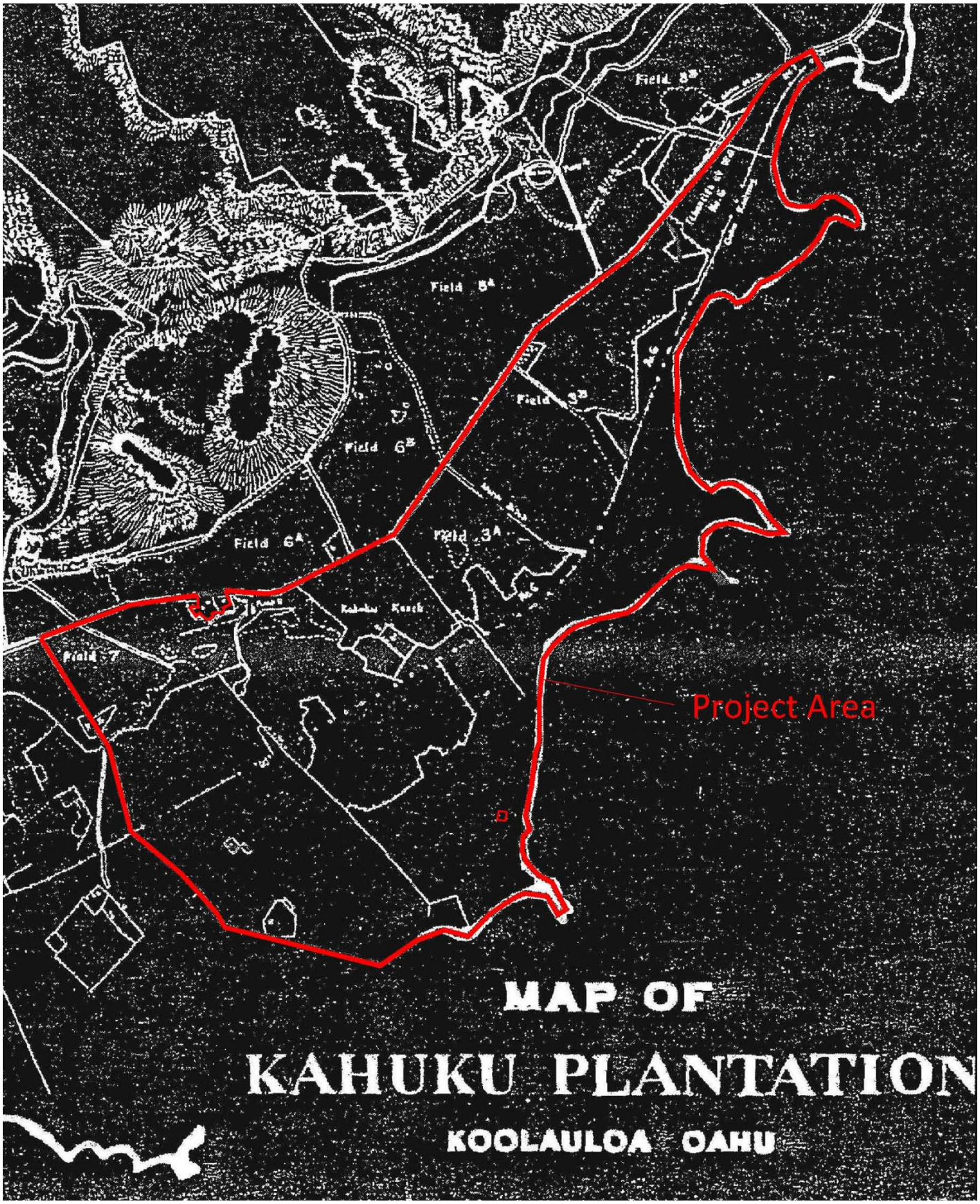


Figure 16. 1920's Map of Kahuku Plantation

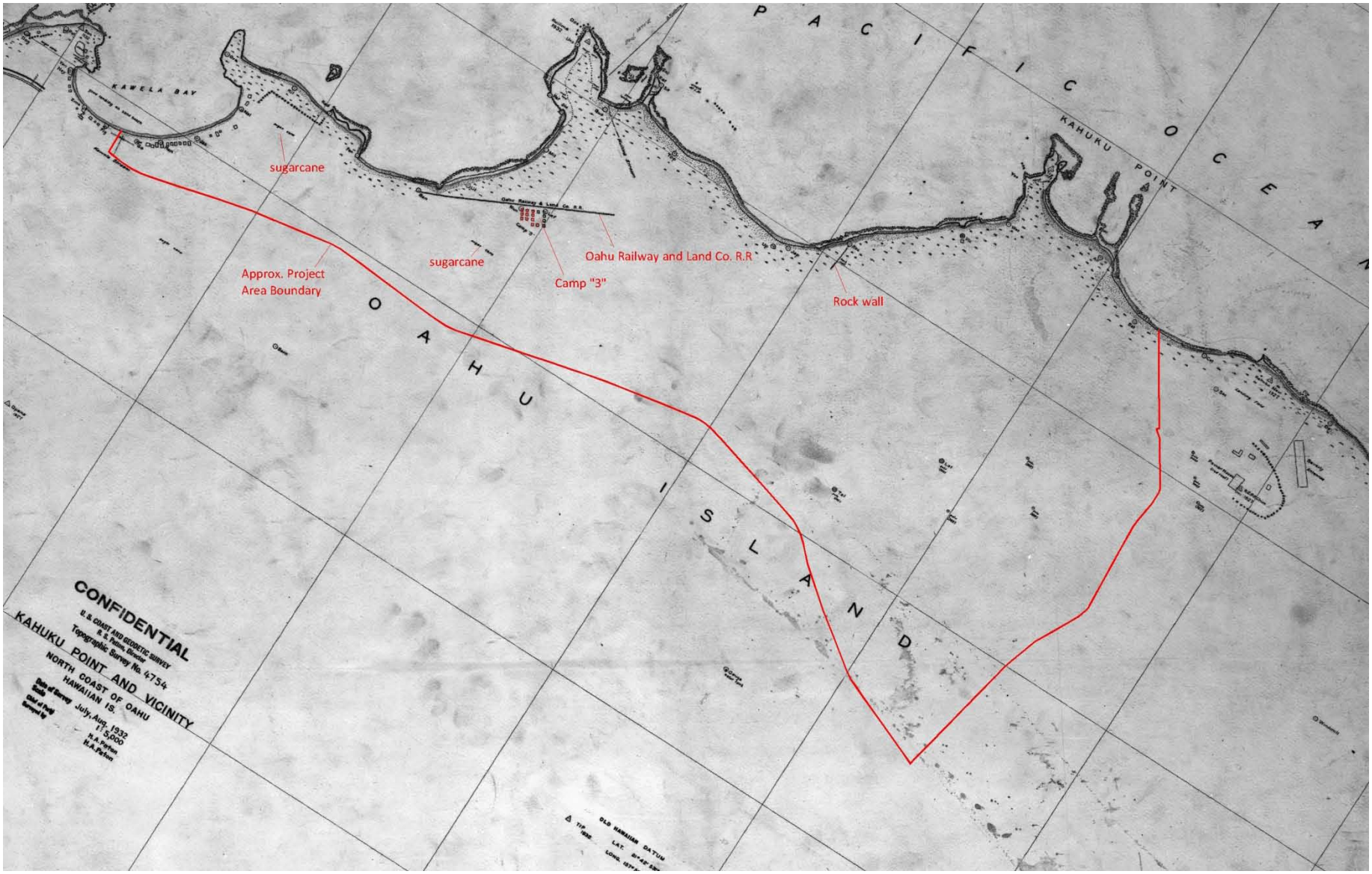


Figure 17. Portion of 1932 U.S. Coast and Geodetic Survey Map of Kahuku Point Area

way between Kahuku Point and Kuilima Point. The wall appears to correspond with one in the same location depicted on the 1890 Loebenstein map (see *Figure 12*).

In addition to sugarcane, pineapples were also extensively cultivated at Kahuku Plantation. According to Nakamura (1981:13), a lease was signed in 1916 between the plantation and C. Okuyama whereby Okuyama contracted to lease 171.5-acres for $10.00 per acre per year. Following acquisition of the leased lands, Okuyama entered into a restrictive agreement with the Hawaiian Pineapple Company:

> On November 9, 1916, Okuyama signed a "chattel mortgage" with the Hawaiian Pineapple Company Limited for a financial advance of $2,000 and further advances not to exceed $13,000. Okuyama possibly used the initial $2,000 to pay his first year's lease rent with the remainder used to buy equipment and supplies. In addition to repayment of the advance, Okuyama was obligated to contract to deal only with the Hawaiian Pineapple Co. Ltd.

Additional smaller tracts of land were also leased to pineapple growers from the OR& L Railroad Company (*ibid*.). These primarily Japanese farmers also signed "chattel mortgages" with the Hawaiian Pineapple Company. By 1934, a total of 38 mortgages had been signed between the small growers and the California Packing Corporation (CPC). Following the expiration of the leases, the Kahuku Plantation leased large tracts of land to the CPC, driving out the smaller farmers. The CPC changed its name to the Del Monte Corporation in 1967 (*ibid*.: 14).

World War II- Kahuku Army Airfield

Portions of the plantation within the TBR property were used by the U.S. Army to construct the Kahuku Airfield in 1942 (*Figure 18*). The airfield encompassed runways, taxiways, revetments, bunkers and artillery emplacements. A composite of three blueprint sheets of the airbase shows its various components (*Figure 19*); note the U-shape revetments used for airplane storage located adjacent to the runways. A recent aerial photograph of the TBR property shows the extent of the Kahuku Army Airfield facility superimposed on it (*Figure 20*) as well as a large area for barracks and other facilities inland of the airfield. According to *Figure 20*, the airfield and barracks occupied approximately 195 acres (23%) of the property.

David Trojan of the Hawaiian Aviation Preservation Society (Trojan, n.d.) presents a brief history of the construction and use of the airfield:

> There are references to Kahuku as an emergency field dating to the 1930's, but it was not until the United States entered World War II that the airfield was developed. Kahuku Army Airfield was classified as an auxiliary field and had a very short life span, from 1942 until it was closed in the late 1940's. Ground troops were stationed in the area to protect the airfield and man the shoreline fortifications. The northern tip of Oahu had a total of three airfields in close proximity during World War II. The Kahuku Point Airfield was located near the tip of Kahuku Point, and was evidently the most elaborate.
>
> The Kahuku Army Airfields were used for training of pilots from Wheeler AAF for instrument flying on different types of aircraft. The airfield was ideal for training because it had a good approach, runway length, and take off clearance. This field was not over populated like Hickam or Wheeler. It is documented that the 18th Air base Group, 47th Pursuit Squadron was stationed there along with B-24s and B-17s that were based at Kahuku for short periods of time during World War II.
>
> At the end of World War II, the military returned the Kahuku property to its owners when it was no longer needed to defend Oahu from attack and all three of the Kahuku airfields were closed.

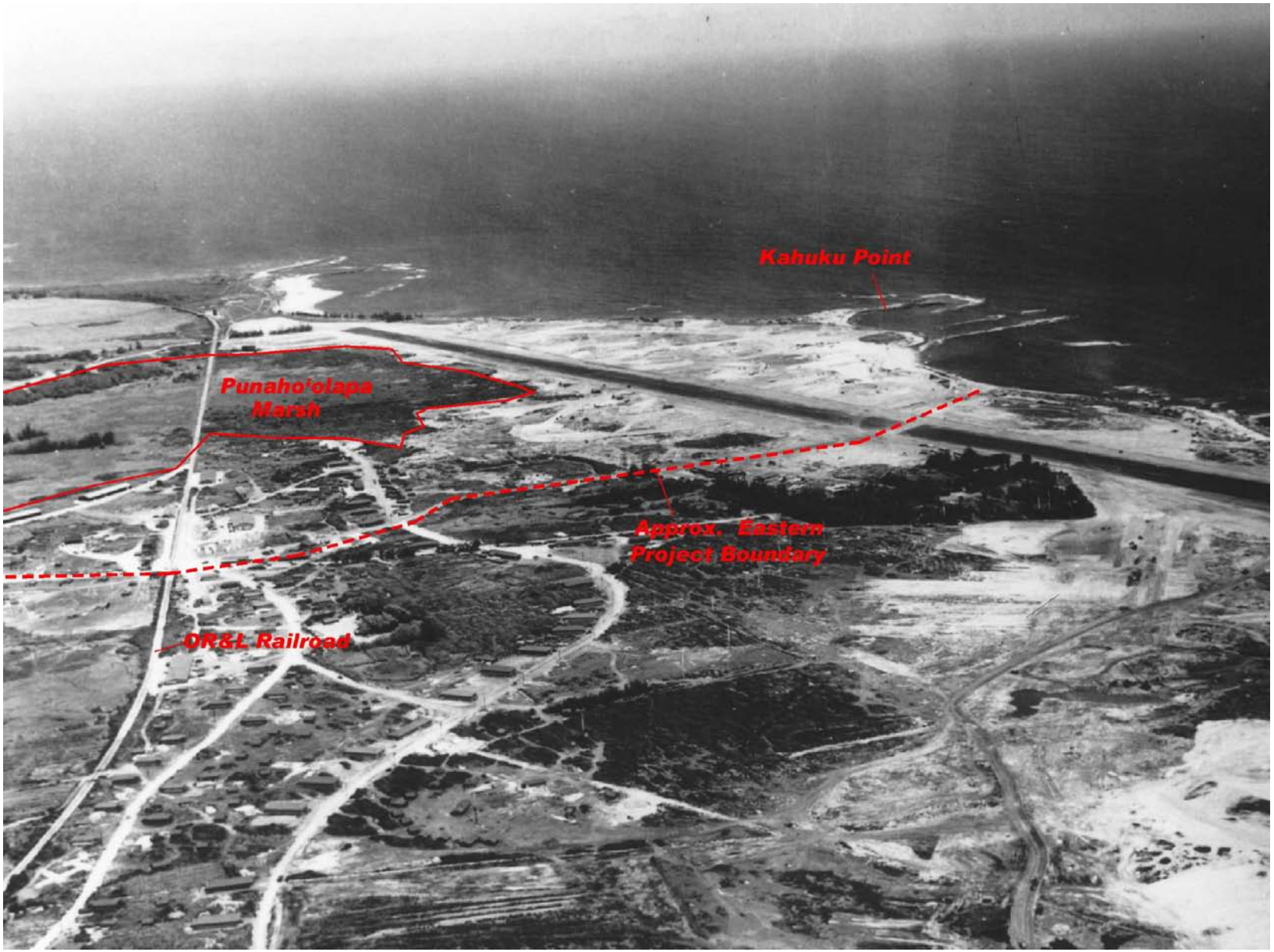


Figure 18. August 20, 1942 Photograph of Kahuku Point Airfield

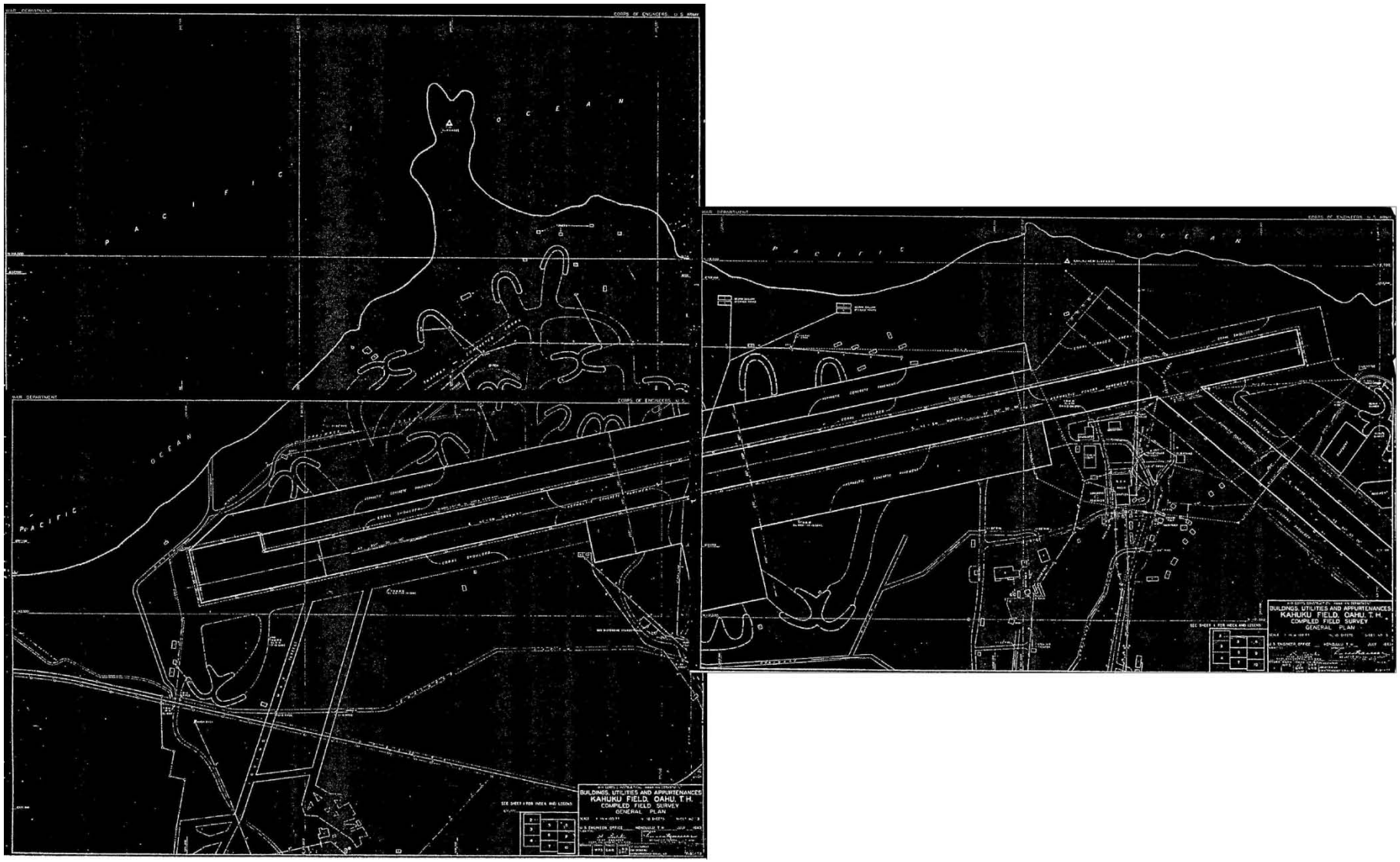


Figure 19. Composite Map of Kahuku Army Airfield (Sheets 2, 3 and 5)

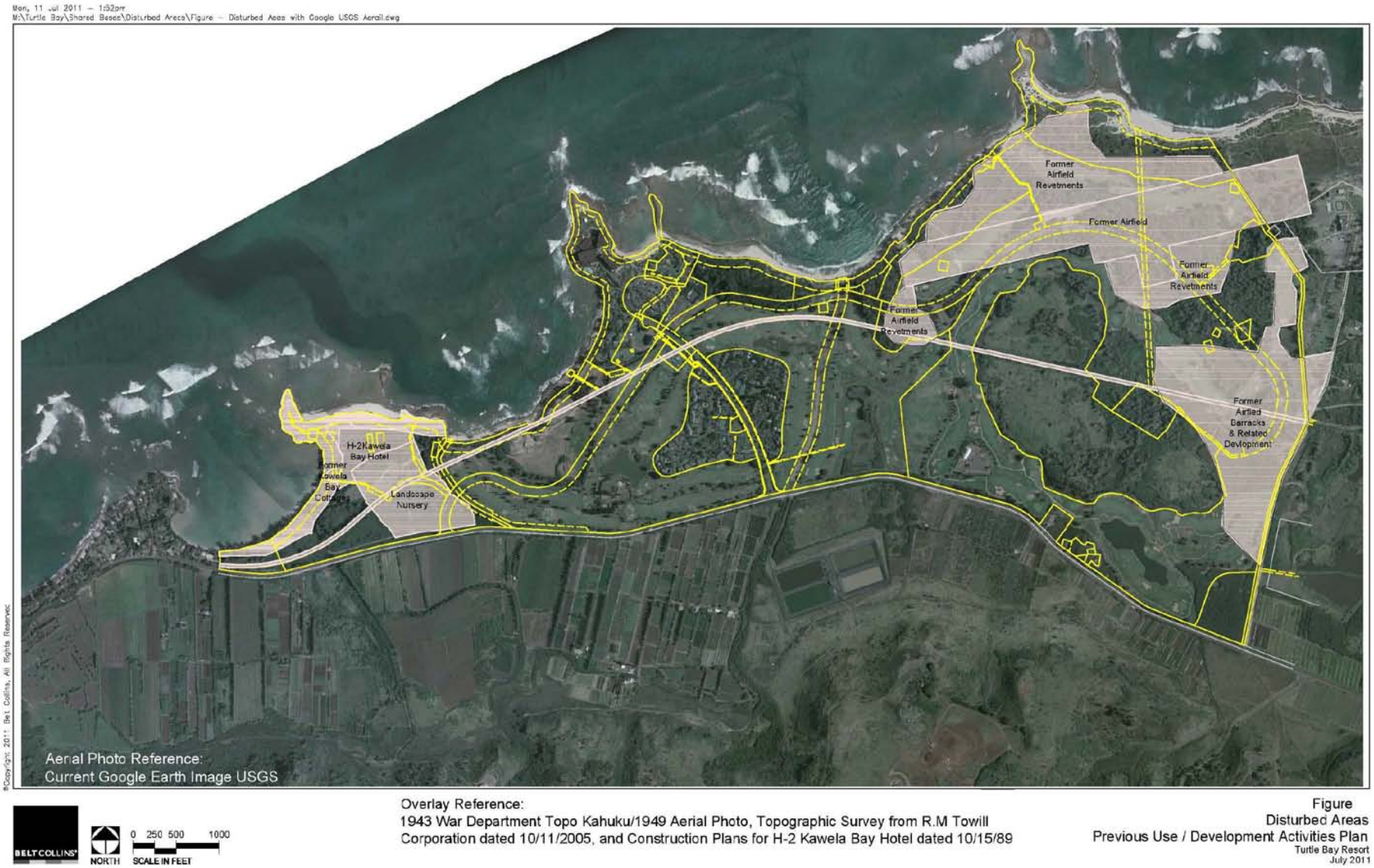


Figure 20. Aerial Photograph of Project Area showing Extent of Kahuku Army Airfield

Kahuku AAB was depicted on the 1947 Hawaiian Islands Sectional Chart as a closed airfield, having a 6,500' hard-surface runway. This was presumably the former "Kahuku Point" Airfield. The other two Kahuku airfields were not depicted at all. No airfields at Kahuku were depicted on the October 1954 Hawaiian Islands Sectional Chart. In the early 1960s prior to the opening of the Campbell Race Course, the Kahuku airfield runways were used for both drag racing & the first Hawaii Grand Prix sports car race…. At some point between 1954-77 the former Kahuku Point airfield was apparently reused as a private civil airfield, as that is how "Kuilima Air Park" was depicted on the December 1977 Hawaiian Islands Sectional Chart. It was depicted as having a single 2,700' hard-surface runway. The 1983 USGS topo map depicted a single 2,800' runway at the location of the former Kahuku Point Airfield, labeled simply "Landing Strip". However, it also depicted much longer (5,200') cleared area resembling another runway, running south of the "Landing Strip" to the south. At the site of the former Kahuku Golf Course Airfield, it depicted a 6,500' long cleared area, unlabeled.

Very little remains today of the three Kahuku Army Airfields. The Turtle Bay Hilton's golf course has absorbed two of the runways. This site is typical of a former airfield converted into a golf course. The long runways are ideal for golf fairways. Ironically, the only airfield to survive is a short length of the Kahuku Golf Course Airfield. The northwestern portion has been covered by aquaculture equipment built on the runway by a lease tenant. Very little evidence of Kahuku's World War II fortifications remain except one bunker site that is keeping its past military secrets. The entrance to the bunker is buried in sand and brush leaving only two concrete structures exposed. Scattered concrete pillboxes covered by low brush and debris can be found in the surrounding jungle. No historical markers indicating the area's past could be found. All guests and hotel staff questioned had no idea of the area's history. Currently, a small privately owned heliport for daytime VFR use only is located at the Turtle Bay Hilton next to the main hotel building.

A major catastrophic event, which is not mentioned in the preceding airfield history, but had a massive destructive impact on the recently abandoned airfield facility was the tsunami that struck Hawaiʻi on April 1, 1946. A recent analysis of the event's effects on the airfield at Kahuku (Keating 2008:157-168) provides a fuller understanding of the impact of such events that have influenced land use in the vicinity for centuries. The estimated 7.2 m run-up of the waves caused widespread flooding that extended 1,600 m inland and covered nearly the entire airfield facility. Following the event, standing water covered the seaward revetments and runway (see *Figure 19*). An estimated 2 million cubic meters of sand where moved by the event, both by the force of the incoming water and as it receded. Wooden buildings were destroyed and "the flood of salt water damaged vegetation and salt water infiltrated the porous soil and underlying reef rock" (ibid.:165). Massive reworking of sediments resulted from the repeated cycles of run-up and draw down that occurred with each pulse of wave energy. As many as twenty waves were recorded on a Honolulu tide gauge.

As documented, the Kahuku Army Airfield was reused as a civilian airfield after control was relinquished by the military. The civilian airport is depicted in *Figure 21*, labeled as the "Kahuku Airfield (Abandoned)". This map depicts a c. 2,250 ft long runway that extends outside the project area to the east-northeast, and a smaller 1,930 ft long runway parallel to it on the seaward side. A third runway extends southeast from the east end of the main runway for a distance of c. 3,150 ft.

Figure 21 also depicts a series of houses or beach cottages present along the east side of Kawela Bay and on the coast to the east of the bay. A second cluster of buildings inland of Kuilima Point and a row of buildings in the southeast portion of the TBR property is visible along the seaward side of Kamehameha Highway.

Figure 21. 1954 Kahuku Quadrangle

The use of the Kahuku area by the government for military training occurred between the 1950s and the early 1980s. According to Nakamura (1981:14):

> A brief investigation of the use of Kahuku land for military training purposes shows a number of leases between the United States government, C.P.C, and the Campbell Estate dating from the mid 1950s. A lease between the United States government and C.P.C is dated August 1956 and consisted of nearly 200-acres at Kahuku (TMK [Oahu] 5-6-05:1). Of more importance was the lease signed in October 1956 between the United States government and the Campbell Estate. This lease involved over 3,500 acres of land at Kahuku (TMK [Oahu] 5-6-08:1 and 5-7-02:1. Military training is practiced today at Kahuku.

The TBR property was used for sugarcane cultivation until 1971 when the property was purchased by casino developer Del Webb for the subsequent construction of the Kuilima Resort and Country Club. Aerial photographs of the TBR property taken on June 10, 1970 (*Figure 22*) and September 11, 1970 (*Figure 23*) by the Del E. Webb Corporation indicate that the majority of the parcel was under sugarcane cultivation at the time of the sale.

PREVIOUS ARCHAEOLOGICAL WORK

A search of the DLNR-SHPD archaeological report database and other sources identified 27 survey and excavation projects undertaken in the project area vicinity in the Koʻolauloa District from the Lands of Kaunala to the east and Mālaekahana to the west. These projects are summarized in *Table 4* and their locations are presented in *Figure 24*. Not included in the figure or table are the general studies by McAllister (1933), which focused on major sites throughout Oʻahu, and Sterling and Summers (1997), which also lists McAllister's sites along with information from legends and early historic observations.

Previous Archaeological Work in Vicinity of Project Area

McAllister reported nineteen sites along the coast from the Kahuku side of Waimea Bay to Kahuku Point. The sites consist of four fishing shrines, three *heiau*, six stone and rock formations with legendary significance, three fishponds, an area of saltpans, a water hole, and cliff face burial caves. Sites in the general vicinity of the project area consist of Site 255, a lava shelf with a group of lava boulders of legendary significance in the water at Pūpūkea; Site 256, a stone on the side of a bluff at Paumalū said to resemble George Washington; Site 258, Kapi Pond near Kawela Bay, and Site 262, Kukio Pond situated south of Kahuku Point.

The projects in *Table 4* cover more than 3,500 acres identifying 60 sites with 210 features. To aid in reconstructing settlement patterns, features were quantified by probable age and function, and the studies are ordered by elevation. Traditional Hawaiian features were categorized as habitation, agricultural, burial (including possible burials) and ritual. Features not assignable to these categories were categorized as miscellaneous or indeterminate. Traditional sites in this category include petroglyphs and *ahu*. Habitation sites are further subdivided into temporary and permanent for studies making this distinction. Historic features were not segregated by function in *Table 4*. The majority of the historic features are ranch walls, plantation-related features and WWII military features.

Density values are given for sites, features and habitation features. Overall, the studies have identified 5 permanent habitation features, 11 temporary habitations, 13 agricultural features and 17 burials. Density values for survey areas larger than 35 acres do not show any consistent trends by elevation. Overall feature density values for these studies vary from 0.01 to 5.0 features per acre. Habitation feature density ranges from 0.01 to 0.12

Figure 22. 1970 Aerial Photograph of Project Area

Figure 23. 1970 Aerial Photograph of Project Area

Table 4. Previous Archaeological Work in Project Area Vicinity

Author	Land	Study Type	Elevation (ft)	Historic Use	Area (ac)	Total Sites	Sites/ acre	Total Features	Features/ acre	Hab. Features	Hab. Features/ acre	Perm. Hab. Features	Temp. Hab. Features	Ag. Features	Burial Features	Historic Features	Misc. Features
Rogers-Jourdane (1982)	Kahuku	RN	0-10	Ranching, Sugarcane	45.00	0		0									
Dagher (1993), Jourdane (1994b)	Malaekahana	BR	5	?	<1	2	2.000	5	5.000						5		
Collins (1999)	Kaena	BR	5	?	<1	1	1.000	1	1.000						1		
Komori (1992)	Kahuku	BR	5	?	<1	1	1.000	1	1.000						1		
Jourdane (1994a), Hibbard (1997)	Kahuku	BR	5	?	<1	1	1.000	2	1.000						2		
Davis (1982)	Kahuku	RN	5-10	Sugarcane	1.00	0		0									
Haun and Henry (2001b)	Kaunala	IN	5-10	?	19.19	4	0.21	6	0.31	2	0.10					4	
Sinoto (1981)	Kahuku	IN	5-10	?	103.00	1	0.01	1	0.01							1	
Collins and Nees (2006)	Opana	CIA	5-10	?	<1	0		0									
Calis and Tome (2002)	Kahuku	MN	10	?	1.00	0		0									
O'Hare et al. (2004)	Kahuku	DOC	10	Processing	8.00	1	0.125	1	0.125							1	
Kennedy (1990)	Kahuku	EX	10	Processing	1.25	1	0.800	1	0.800							1	
Perzinski and Hammatt (2001)	Kahuku	IN	15-20	?	2.00	0		0									
Clark (1978), Barrera (1979), Schilt (1979), Sinoto (1986)	Kahuku and Kaena	RS	15-20	Sugarcane	57.30	10	0.175	17	0.297	7	0.12			6	3	1	
Barrera (1981, 1985), Walker and Rosendahl (1986), Jensen (1989a), Stride et al. (1992), Rechtman (2010)	Pahipahilu to Malakahana	RN, IN	20-800	Ranching, Sugarcane, Pineapple, Military	3310.00	37	0.011	148	0.045	46	0.01	5	11	7	5	72	2
Farrell and Cleghorn (1995)	Ulupehupehu and Punalau	IN	190-300	Ranching, Sugarcane, Military	18.00	1	0.07	27	1.80							27	
Hammatt (1996)	Malaekahana	RN	200	Ranching	0.50	0		0									
				Total/Average	**3566.94**	**60**	**0.20**	**210**	**0.48**	**55**	**0.08**	**5**	**11**	**13**	**17**	**107**	**2**

IN = Inventory Survey, RN = Reconnaissance Survey, MN = Monitoring Project, EX = Excavation, DOC = Documentation, CIA = Cultural Impact Assessment, BR= Burial Discovery

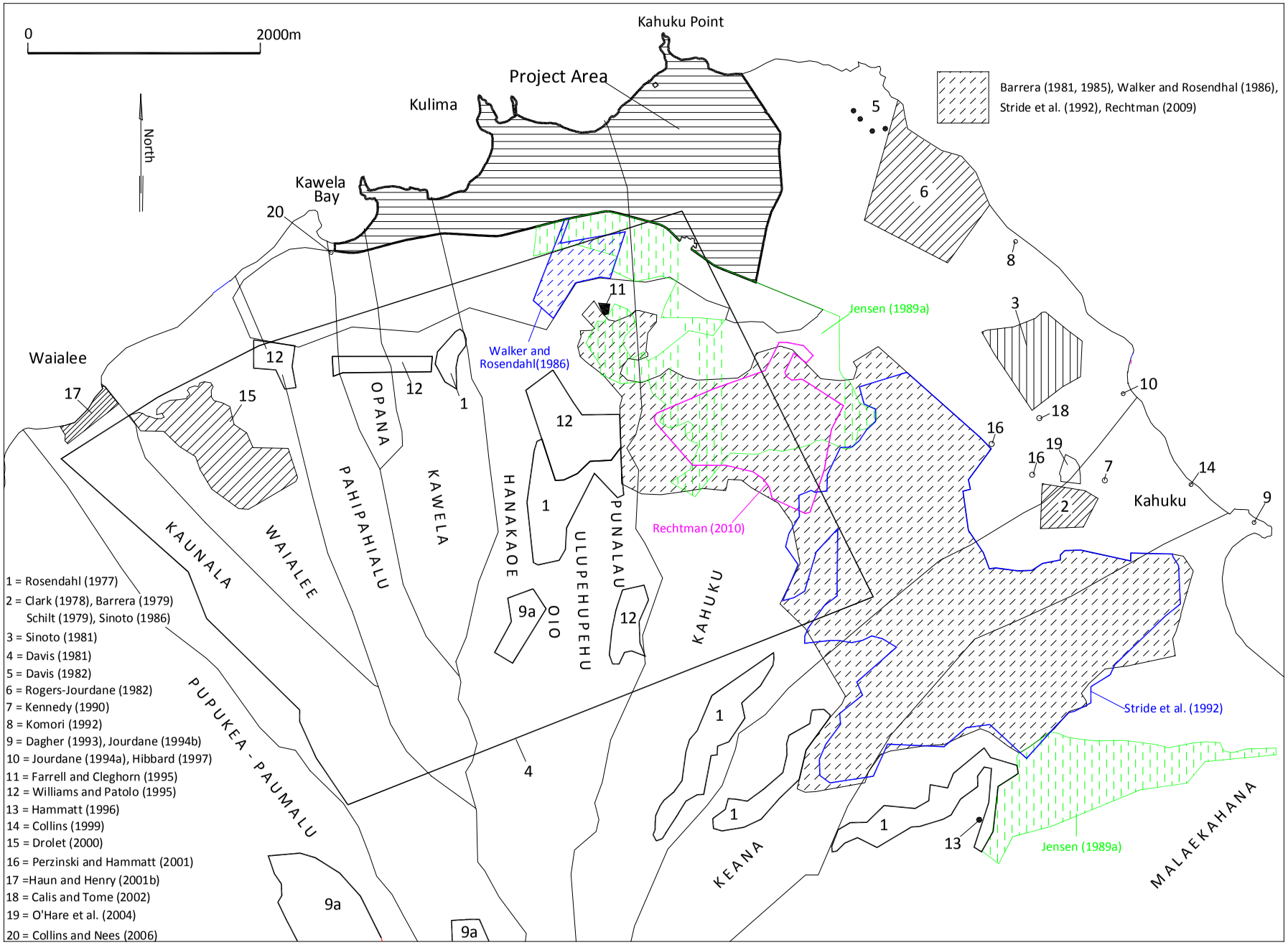


Figure 24. Previous Archaeological Work in Project Area Vicinity

features per acre. The near absence of agricultural features is also notable. The density values are extremely low compared with areas in the Kona Field System of Hawaiʻi Island (Haun and Henry 2000a, 2001a) where sugarcane was not cultivated historically, but are similar to values from the Hana District on Maui (Haun and Henry 2000b) where ranching and sugarcane cultivation dominated the region for over 150 years, as is the case for the project area vicinity.

Most coastal habitation sites consist of subsurface cultural deposits containing artifacts, food remains and a variety of pit features. These sites are usually interpreted as permanent habitations. Most of the temporary habitation features are overhangs along the base of cliffs at the inland edge of the coastal plain. Burials are frequently found eroding from the sand dunes along the coast and in caves in the cliff faces.

The largest survey in this area consists of a reconnaissance survey of three parcels totaling approximately 2,500 acres by Barrera (1981). Subsequent studies by Barrera (1985), Walker and Rosendahl (1986), Stride *et al*. (1992) Jensen (1989a) and Rechtman (2010) included areas within or adjacent to Barrera's (1981) study area. The combined area of these overlapping projects is approximately 3,310-acres. Thirty-six sites with 130 features are reported for this area, the majority of which are related to sugarcane agriculture. The following summaries of individual surveys are organized by land division.

The Barrera (1981) survey area was extensively impacted by sugarcane cultivation. He identified three areas containing cultural remains, all within the Land of Kahuku. In 1985, Barrera surveyed three proposed well sites in Kawela, Hanakaʻoe and Kahuku but identified no sites.

In 1986, Walker and Rosendahl conducted a reconnaissance survey of a 70-acre parcel located directly inland of the TBR property on the south side of Kamehameha Highway. This project was done in conjunction with the development of a wastewater treatment plant for TBR. The survey identified an agricultural terrace and two historic irrigation ditches.

Stride *et al*. (1993) conducted an inventory survey of a 785-acre portion of the 1,666-acre Kahuku Agricultural Park located in Kahuku, Keana and Mālaekahana. Six sites consisting of four temporary habitation sites with overhangs, a temporary habitation enclosure, and a complex of permanent habitation walls, terraces, an overhang and a terrace were documented. Subsurface testing at one of the overhangs revealed a human burial.

Rechtman (2010) conducted an inventory survey of a 230-acre property for a proposed wind farm located in Kahuku. This survey identified remnants of the Kahuku Sugar Plantation (Site 4707) with individual features consisting of flumes, ditches, pipes, reservoirs, wells, pumps, markers, roads and bridges.

Jensen (1989a) surveyed two areas totaling 866 acres for proposed golf courses at Punamanō (638 acres) and Mālaekahana (228 acres). The survey identified 20 sites with 38 features consisting of temporary habitation sites, sugarcane infrastructure features and remnants of World War II military utilization.

Clark (1978) conducted an archaeological reconnaissance survey of the Koʻolauloa Housing Project and an adjacent park expansion area, located within the Lands of Kahuku and Keana. The park expansion area was subsequently developed into Kahuku Elementary School and the Kahuku District Park. Local informants identified an area referred to as "the sacred way" within the housing area. A stone platform was relocated in the park area that corresponds to Site 269 recorded by McAllister (1933). A coral slab on the platform surface was identified as a *kūʻula* or god-stone used to attract fish. Although situated outside Clark's project area, the nearby Keana Cave (McAllister Site 270) was also examined and determined to contain human remains. Schilt (1979) surveyed a 4-acre Kahuku School expansion area. The Site 269 platform and Keana Cave (Site 270) were relocated and two newly identified sites, a stone mound and an overhang, were documented.

In 1979, Barrera (1979) returned to the housing project area to conduct additional archaeological survey and subsurface testing. Five sites were identified: (1) two walls, (2) a rock-lined depression, (3) a complex of three

walls, three stone mounds and a cave, (4) a wall segment and (5) a soil mound with an attached L-shaped wall. No subsurface remains were identified during testing.

Sinoto (1981), Davis (1982), Rogers-Jourdane (1982) and Kennedy (1990) conducted archaeological reconnaissance surveys in Kahuku. The Davis and the Rogers-Jourdane surveys identified no sites. Kennedy (1990) reported no sites, although he reports that the Ki'i Ditch extended through the survey area. Sinoto (1981) identified a section of the OR&L railroad grade and documented the 100-acre Ki'i Wetlands that were assigned Bishop Museum Site No. 50-Oa-F4-10/11. The wetland also is referred to as "Kahuku Fishpond", although according to McAllister, it was always a swamp and was not used as a fishpond (1933:154).

Farrell and Cleghorn (1995) conducted an inventory survey of a 15-acre parcel situated in Ulupehupehu and Punalau. A single site with 27 features related to the agricultural and military use of the area was documented. Perzinski and Hammatt (2001) conducted archaeological inventory surveys of two detour roads to be used in conjunction with a proposed drainage improvement project. The associated drainages are located to the southwest of the Kahuku Village Subdivision and were designated as the Hospital Ditch and the Ki'i Drainage. No archaeological sites were identified in either area.

In 2001, Haun and Henry (2001b) conducted an inventory survey of a 19-acre parcel in coastal Kaunala. This project consisted of a pedestrian survey and excavation of 32 backhoe trenches. The study documented three features associated with the historic OR&L railroad, an historic house foundation and the truncated remnants of two subsurface cultural deposits. Subsequent data recovery work (Haun *et al*. 2003) documented a late prehistoric habitation deposit and the remains of a burial, both in secondary contexts.

Calis and Tome (2002) conducted archaeological monitoring for a wastewater force main replacement in the Land of Kahuku. Twelve trenches were excavated along the 670 m long corridor and exposed deposits interpreted as imported fill related to sugarcane cultivation.

O'Hare *et al*. (2004) documented the remains of Kahuku Mill. The report provides a detailed history of the mill including a summary of the various types of mill equipment used at the facility. The study included Historic Architectural and Engineering Record (HAER) photographic documentation.

Collins and Nees (2006) prepared a Cultural Impact Assessment for the replacement of the Kawela Stream Bridge located in 'Ōpana Ahupua'a. The area was surveyed during the project but no sites were identified.

On several occasions, inadvertently discovered human remains eroding from the coastal sand dunes in the Lands of Kahuku, Keana and Mālaekahana were reported to DLNR-SHPD. SHPD personnel documented the finds (Komori 1992; Dagher 1993; Jourdane 1994a and 1994b; Hibbard 1997; and Collins 1999), and the remains were returned to the original locations and stabilized to prevent further disturbance.

The studies by Walker *et al*. (1988a, b), Jensen (1989a) and Stride *et al*. (1992) report 38 radiocarbon dates. Many of the age determinations results produced multiple age ranges or long single age ranges between the 1600s and 1950. When all portions of all potential age ranges are examined, two results span the AD 1000s, three each include the 1100s and 1200s, eight span the 1300s, 18 include the 1400s, 19 span the 1500s, 28 span the 1600s and 16 each include the 1700s and 1800s. The results suggest initial use of the area occurred between A.D. 1000 and 1200, followed by a gradual increase between the 1300s and 1500s. The most intensive use dates to the 1600s with declining use in the 1700s and 1800s.

Figure 24 also depicts a series of four surveys that were conducted within the Kahuku Training Area (KTA) by Rosendahl (1977), Davis (1981), Williams and Patolo (1995) and Drolet (2000). These projects are not however included in *Table 4* as the majority were not available for review. The findings from these surveys, summarized in Drolet (2000) are presented below.

Rosendahl (1977) conducted a limited survey of several inland gulches within the KTA. This was followed by a brief reconnaissance-level survey by Davis (1981) conducted in unspecified portions of the KTA area. These studies identified nine sites associated with historic and pre-contact agricultural and habitation activities. Williams and Patolo (1995) undertook a subsequent study of inland gulches and bluff areas in the KTA. This survey identified seven sites with traditional agricultural, habitation and ritual functions and two World War II era military bunkers.

Drolet (2000) conducted an inventory survey of ac. 410-acre portion of the c. 16,000-acre Area A-1 of the KTA. This study resulted in the identification of 13 sites consisting of a burial cave, two temporary habitation rock shelter sites, two agricultural terrace sites, an *ahupuaʻa* boundary wall, an historic road, two World War II era bunkers and four sites that were assigned an indeterminate function.

Previous Archaeological Work within the Project Area

At least sixteen archaeological studies have been conducted within the boundaries of the TBR property. In addition, a mitigation plan, a data recovery plan and a burial treatment plan have been prepared for project area cultural resources. These studies and plans are summarized in *Table 5* and their locations are presented in *Figure 25*. Twenty-six sites have been identified, including 25 burials. These studies report a total of 654 excavations of various types consisting of 444 auger cores, 153 "test" units, 29 backhoe trenches, 21 surface exposures and 7 shovel tests. The exposures consist of places where subsurface strata were evident in eroded sand dune faces, drainage banks and old excavations. Most of the "test" units are 1 sq m excavations conducted during testing phases or work; however, the Corbin (2003) report describes 32 "test" units that actually are designations for block excavation units at Kawela Bay (Areas A and D). Eight of these "test" units are 4 sq m in area and the rest are 1 sq m, yielding a total of 71 square meters of data recovery excavations.

J. Gilbert McAllister of the Bernice P. Bishop Museum conducted the earliest archaeological investigation during his island-wide survey of Oʻahu. One site in the project area was identified, consisting of Kukio Pond. According to McAllister (1933:153):

> Site 262. Kukio Pond, a natural basin filled with brackish water, located about 300 feet [90 m] from the sea, Kahuku Point. The pond was formerly much larger and contained many kinds of fish. It is said to have been surrounded by a large Hawaiian settlement. Mrs. John Kaleo is probably the only survivor and her former friends and relatives have been buried in shallow graves in the sand between the pond and the sea.

Kukio Pond was filled, probably during the construction of the Kahuku Army Airfield. The estimated location of the pond is presented in *Figure 26*, inland of Kahuku Point and seaward of the north side of Punahoʻolapa Marsh. According to Handy and Handy (1972:462), taro terraces once existed around the pond, but:

> There seems no evidence of old terraces in the uplands along either branch of Kahuku Stream, but in the seaward swampland north and south of Kukio Pond [which would have included Punahoʻolapa Marsh] there are such remains.

The B.P. Bishop Museum conducted an archaeological reconnaissance survey of 649-acres in the project area (Dye 1977). The study included pedestrian survey of a 98-acre area to the west of the TBR property along Kawela Bay and a 551 acre area to the east of the resort at Kahuku Point. Four sites were identified by Dye (1977): a remnant of Kapi Pond, two cultural deposits and a possible cultural deposit. The remains of Kapi Pond were identified along the west side of Kawela Bay, outside the project area. This pond was previously identified by McAllister (Site 258) and was subsequently assigned BPBM Site No. 50-OA-F3-1.

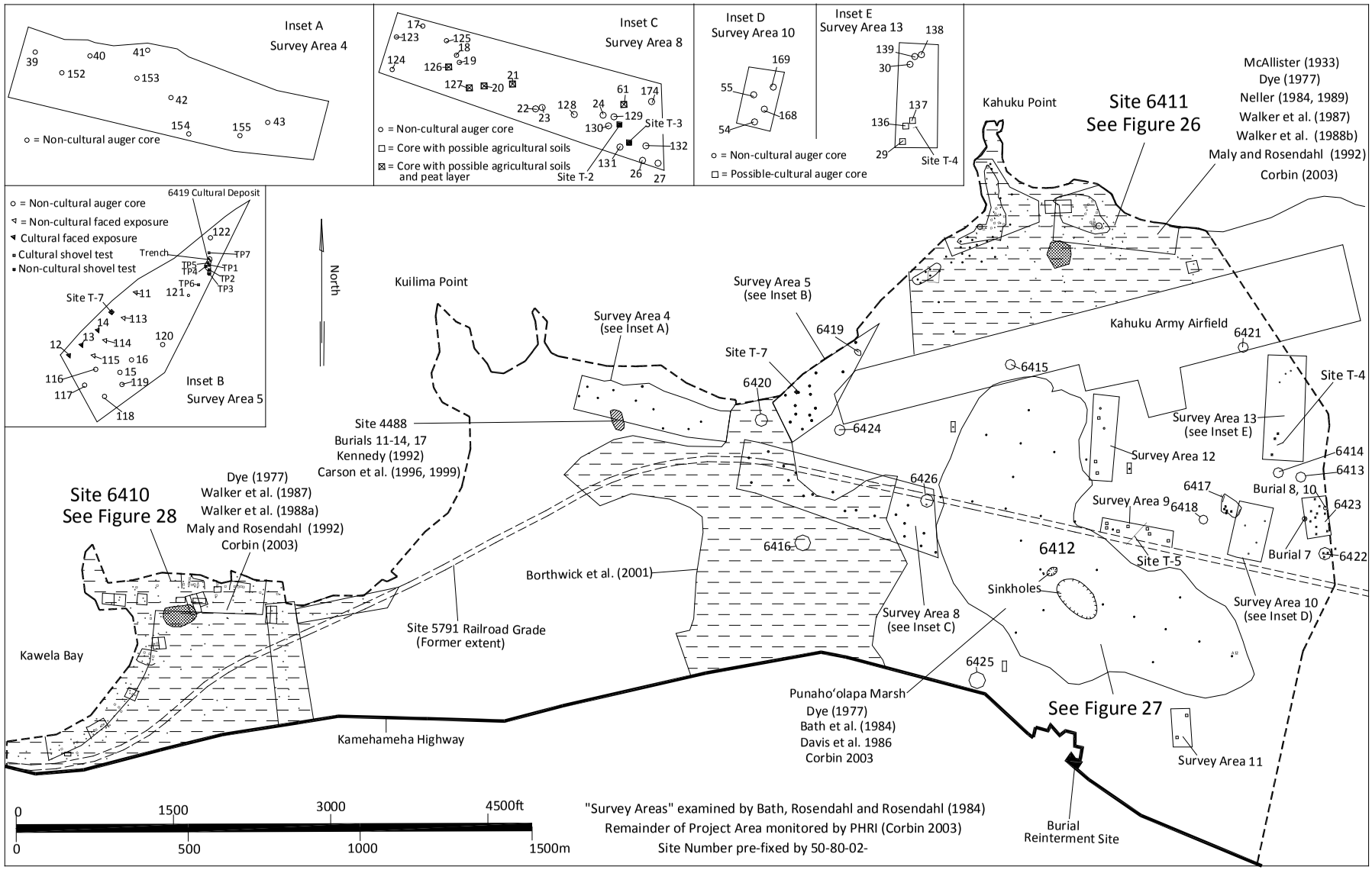


Figure 25. Location of Previous Archaeological Work in Project Area

Table 5. Previous Archaeological Work within Project Area

Author	Company/ Organization*	Location	Study Type	Excavations					Comment
				Auger Tests	Test Units	Backhoe Trenches	Exposure Examinations	Shovel Tests	
McAllister (1933)	Bishop Museum	Survey of Oahu	General Survey						Identified Kukui Pond (Site 262), filled in during construciton of Kahuku Airfiled
Dye 1977	Bishop Museum	Kawela Bay, Kahuku Point, Punaho'olapa Marsh	Reconnaissance		1	1			Identified Kapi Pond (Site 258) remnant, two cultural deposits and one poss. cultural deposit
Neller (1984)	SHPD	Kahuku Point	Osteological examination						Examination of three sets of human remains exposed in dune area
Bath et al. (1984)	PHRI	Kuilima Resort Expansion	Surface and Subsurface Testing	124			11		Examined 13 survey areas and identified four surface features and five subsurface deposits
Davis et al. (1986), Corbin (2003)	PHRI	Punaho'olapa Marsh	Subsurface Testing and Mapping of Sinkholes	27	4	3			Data recovery excavations in Punaho'lapa Marsh
Walker et al. (1987), Corbin (2003)	PHRI	Kuilima Resort	Data Recovery Plan	43	44	5			Data recovery plan and excavations at Kahuku Point and Kawela Bay
Walker et al. (1988a)	PHRI	Excavations with Kawela Bay Archaeological Area	Subsurface Testing	140	36				Identified four discrete cultural deposit areas with abundant cultural remains numerous subsurface features and two burials
Walker et al. (1988b)	PHRI	Excavations with Kahuku Point Archaeological Area	Subsurface Testing	105	38		8		Identified three discrete cultural deposit areas with abundant cultural remains numerous subsurface features and three burials
Neller (1989)	SHPD	Kahuku Point	Osteological examination						Examination of human remains exposed n dune area
Jensen (1989b)	PHRI	Kuilima Resort	Mitigation Program						Proposed four-phase mitigation program for Kawela Bay Archaeological Area and Punaho'olapa Marsh
Sullivan (1990, 1991), Dunn (1991), Donohue (1991), Corbin (2003)	PHRI	Kuilima Resort	Archaeological Monitoring	5	30	20	2	7	Identified 14 new sites
Maly and Rosendhal (1992)	PHRI	Kuilima Resort	Burial Treatment Plan						Burial treatment plan for human remains noted within project area
Kennedy (1992)	ACH	Kuilima Point Burials	Burial recovery/testing						Examination of human remains noted during construciton
Carson et al. (1996, 1999)	ACH	Kuilima Point Burials	Burial recovery/testing						Examination of human remains noted during construciton
			Total Excavations	444	153	29	21	7	

** ACH = Archaeological Consultants of the Pacific, PHRI = Paul H. Rosendahl, Inc., SHPD = State Historic Preservation Division*

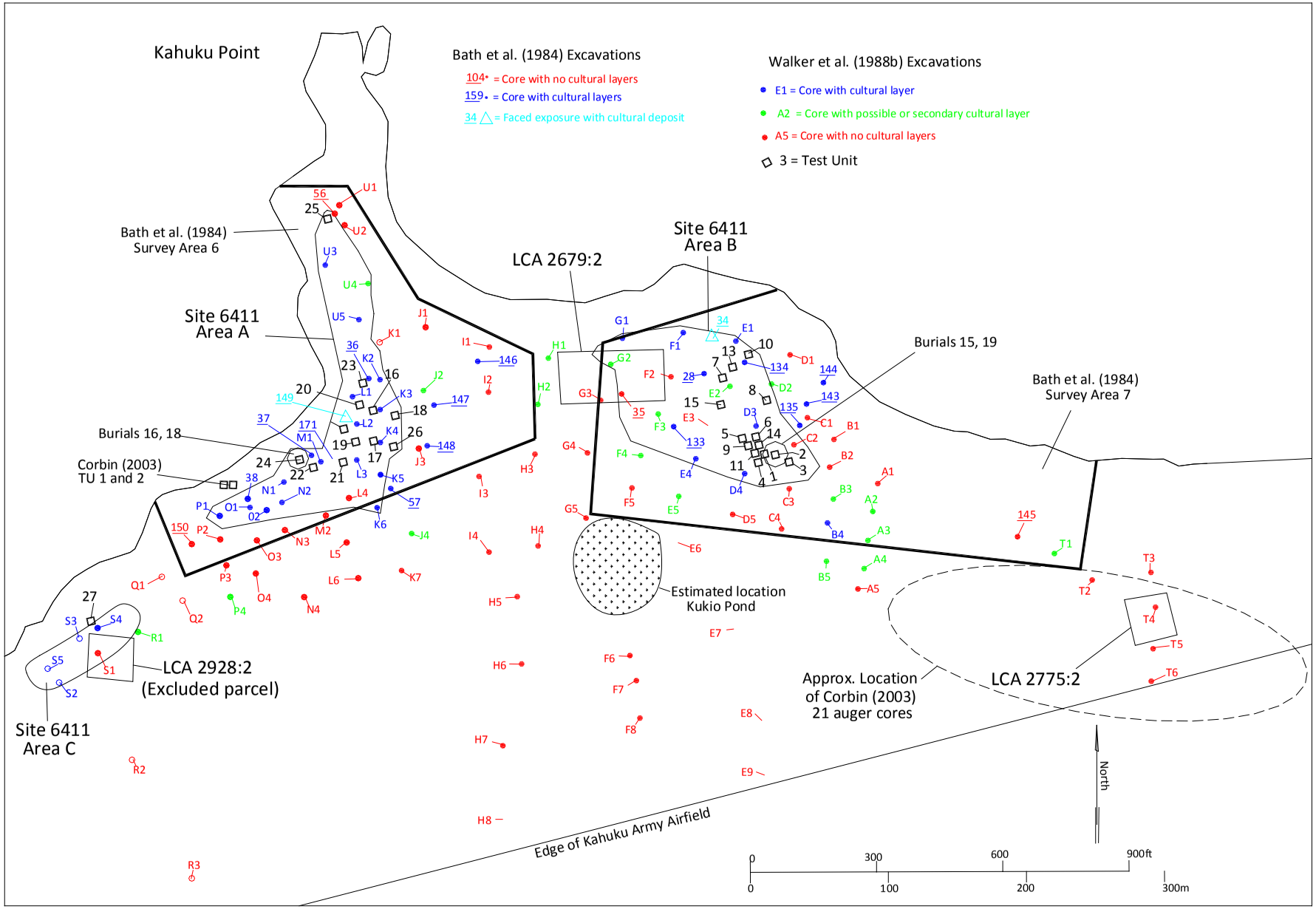


Figure 26. Excavations within Kahuku Point Archaeological Area (Site 6411)

One cultural deposit was identified along the inland side of the sand dunes at Kahuku Point (see *Figure 26*). This site was designated BPBM Site 50-OA-F4-14 and was subsequently assigned State Inventory of Historic Places (SIHP) Site 50-80-02-6411. A test unit was excavated into the deposit revealing four stratigraphic layers. No cultural remains were present in Layers I and II. Layer II contained fire pits, midden, a stone fishing sinker and metal debris. Charcoal was present in the Layer IV deposit.

BPBM Site 50-OA-F4-15 (SIHP Site 6412) is a cultural deposit located adjacent to the OR&L railroad grade near Punahoʻolapa Marsh area (*Figure 27*). The deposit was evident in the wall of a backhoe trench and included a black clay layer that was interpreted as the remnant of a prehistoric agricultural plot. It is likely that this deposit corresponds to the cultivated swampland described for this area by Handy and Handy cited previously.

The fourth site reported by Dye (1977) consisted of two layers of gray sand noted in the eroded face of a dune west of Kahuku Point in the vicinity of Kahuku Army Air Field. These soil layers were considered to be a "possible site", but were not assigned a site designation because no test excavation was conducted to confirm the nature of the deposit (*ibid*.: 3).

In 1984, the discovery of human remains in the dunes east of Kahuku Point was reported to DLNR-SHPD. Sand vehicles using the area disturbed the remains. Earl Neller (1984) of the SHPD visited the site and examined the remains that had been collected. These remains consisted of two complete human skeletons and a partial skeleton. The site was subsequently designated "Burial 15" of Site 6411 (see *Figure 26*).

Later in 1984, Paul H. Rosendahl, Ph.D. Inc. (PHRI) conducted an archaeological reconnaissance survey of the Kuilima Resort Expansion Area (Bath *et al*. 1984). The survey area included a proposed golf course adjacent to the existing TBR and a proposed hotel at Kawela Bay.

The PHRI survey work consisted of seven specific tasks (*ibid*.:3):

1. Inspection of all existing subsurface exposures for presence of cultural deposits or features (especially burial features with skeletal remains);
2. Subsurface testing of proposed drainage and stream alignments or realignments passing through both the Kuilima Resort property and the adjacent shoreline area (State Conservation District);
3. Subsurface testing in vicinity of Site F3-1, Kapi Fishpond, for presence of buried cultural deposits (Dye 1977:2);
4. Subsurface testing of the previously identified "possible site" to determine if exposed gray deposit is cultural (Dye 1977:3);
5. Subsurface testing of Site F5-15 to determine if the exposed black layer represents evidence of prehistoric wetland agriculture (Dye 1977:6);
6. Subsurface testing at Site F-4-14 to clarify the nature, age and horizontal extent of previously identified buried cultural deposits (Dye 1977:3-5); and
7. General subsurface reconnaissance testing to sample remaining areas within the expansion project area.

Task 3 subsequently was deleted from the scope of work because the area was outside the resort expansion property. This task was replaced with additional subsurface testing in several areas bordering Punahoʻolapa Marsh. The subsurface testing work included excavation of 124 auger tests and the documentation of 11 exposures along berms, road cuts and sand dunes. The auger tests were located in 13 "Survey Areas" (Nos. 1-13; see *Figure 25*). Several discretionary test units were also excavated. The survey identified seven new sites (T-1 through T-7), of which five were tested in addition to subsurface testing at two previously identified sites (F4-14, -15). The tested sites are described below in the order as originally presented by Bath *et al*. (1984). The untested sites consist of an enclosure of wooden posts and corrugated sheet metal (Site T-3) in Survey Area 8 and a stacked limestone wall (Site T-5) in Survey Area 9.

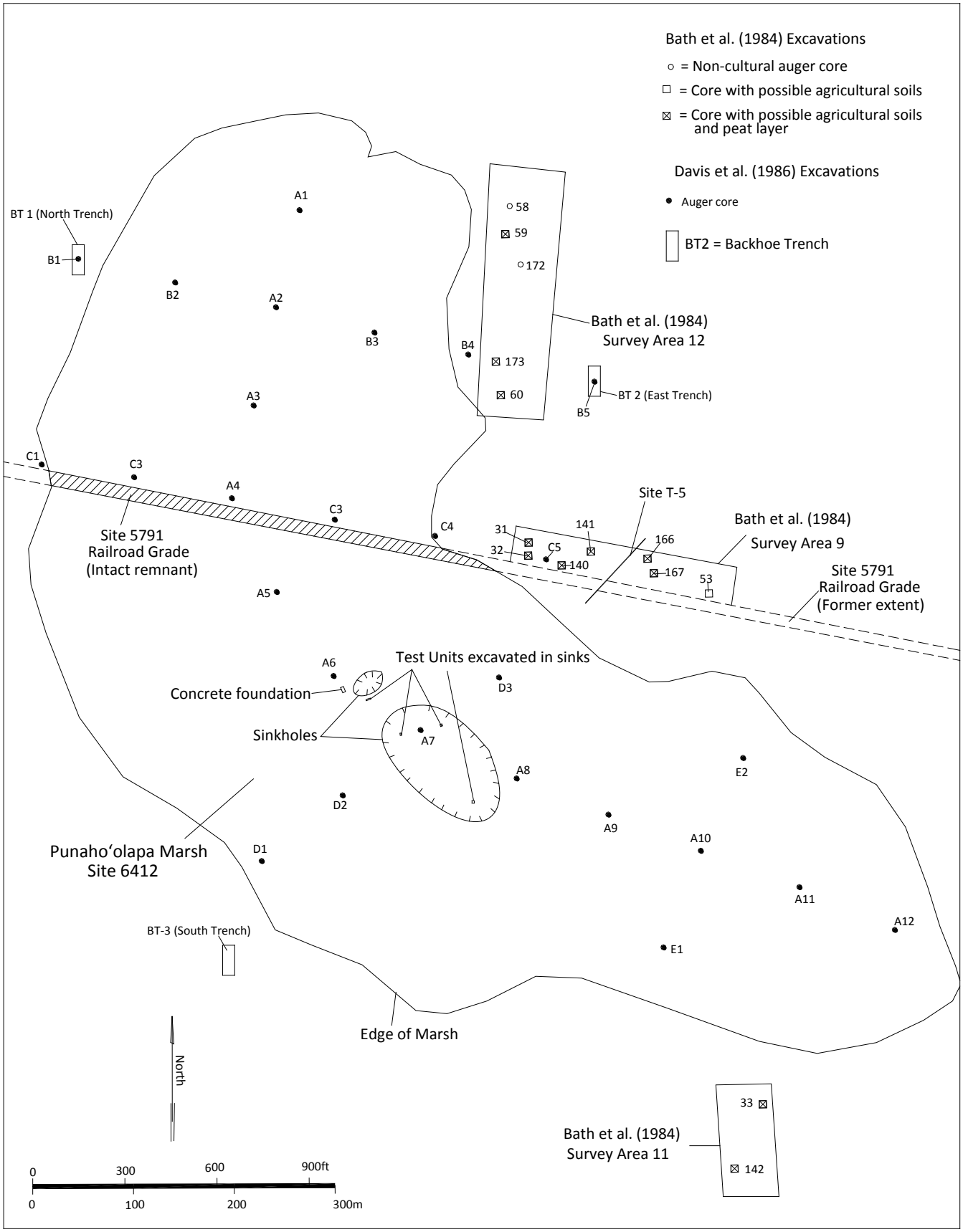


Figure 27. Location of Excavations within and adjacent to Punahoʻolapa Marsh (Site 6412)

Site T-6 (subsequently assigned SIHP Site 6410) is located in Survey Area 1 (*Figure 28*). It consists of a subsurface cultural deposit identified as a result of the excavation of 20 auger tests along the east shore of Kawela Bay and the shoreline north of the bay. The cultural deposit was evident in 17 of the tests. The deposit is described as a 0.12 to 0.56 m deep surface layer of a brown to black silty sand containing large quantities of marine shells, charcoal and a bone fishhook. One auger test (TU-112) penetrated a "capped underground solution chamber" and recovered a piece of human bone and three basalt flakes (Bath *et al*. 1984:22). The site was determined to likely extend west along the bay outside the project area, but not inland of the "coastal fringe" to the east where the land had been plowed for farming since at least 1927, based on review of aerial photographs.

Site T-7 is the "possible site" noted by Dye (1977) located in Survey Area 5 between Kuilima and Kahuku Points (see *Figure 25*). Nine auger tests and seven faced exposures were documented in this area (Bath *et al*. 1984: 25); four exposures encountered two cultural layers in the seaward face of coastal dune. The cultural layers overlie a non-cultural sand deposit (Layer IV). One auger test, which was excavated on the inland side of the dune where the two cultural layers were absent, recovered ironwood tree needles and cones from beneath Layer IV. Based on the assumption that the Layer IV deposits on the seaward and inland sides of the dune were contemporaneous, Bath *et al*. (1984) indicated that the two cultural layers were likely historic in origin because ironwood trees were introduced to Hawaíi in the 19th century.

Site 50-Oa-F4-14 (SIHP Site 6411, Area B) is a cultural deposit documented by Dye (1977) at Kahuku Point that is located in the Bath *et al*. (1984:27-29) Survey Area 6, where 11 auger tests and one faced exposure were documented (see *Figure 26*). Nine of the auger tests encountered two to three cultural layers containing charcoal, bone and shell midden. The uppermost cultural layer was considered to be historic in age and the lower ones attributed to prehistoric occupation.

Site T-1 (subsequently assigned SIHP Site 6411, Area A) is located in the Bath *et al*. (1984) Survey Area 7, east of Kahuku Point (see *Figure 26*), where eight auger tests and one exposed face were documented. Two cultural layers, encompassing an area 240 m long (east-west) by 140 m wide, were identified in the auger tests. Marine shells, bones (bird, fish, and mammal), charcoal and a single volcanic glass flake were recovered from the auger tests. Several of the auger tests were excavated in the vicinity of the three burials reported by Neller (1984) and one test exposed additional human remains.

Site T-2 is an L-shaped wall made of limestone in Survey Area 8, where 23 auger tests were excavated without encountering any cultural material. A single test (TU 25) was excavated next to the T-2 wall that Bath *et al*. (1984:23) noted might correlate with walls depicted on Loebenstein's 1890 map of Kahuku Plantation (see *Figure 12*).

Five auger tests were excavated and two exposed faces were documented in Survey Area 9, near Punahoʻolapa Marsh where Site 50-OA-F4-15 (SIHP Site 6412), a cultural deposit initially identified by Dye (1977), is located (see *Figure 27*). Three of the auger tests identified a layer of dark gray clay over a black peat deposit. This formation is typical of the Pearl Harbor clay soil type and led Bath *et al*. (1984) to re-interpret it as natural deposit instead of an agriculturally modified soil, as originally suggested by Dye (1977).

Site T-4 is a military feature in Survey Area 13 where six auger tests were excavated without encountering cultural material. The feature is described as an octagonal, formed concrete structure with no roof that is 2.25 m in diameter and 1.22 m high (Bath *et al*. 1984:37). A second concrete structure was located nearby but not recorded.

Bath *et al*. (1984) identified an isolated human incisor on the ground surface in Survey Area 12 and a burial was observed eroding from a dune to the west of Kahuku Point. The burial was reported to the Honolulu Police Department, who disinterred it on April 3-4, 1986. These remains were subsequently examined by Neller (1989) and were eventually designated as Feature 16 of Site 6411 (see *Figure 26*).

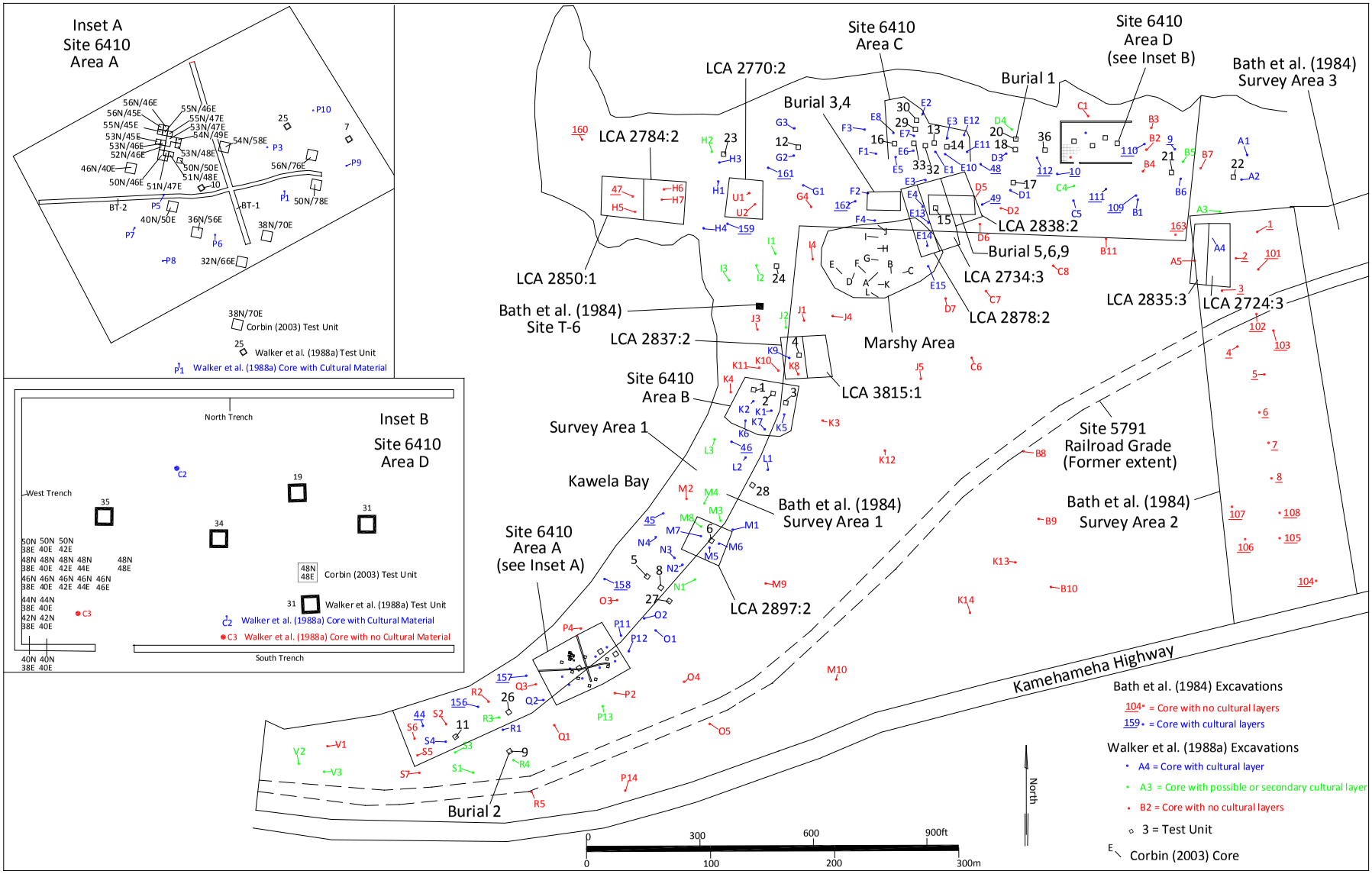


Figure 28. Excavations within Kawela Bay Archaeological Area (Site 6410)

In January and February of 1986, PHRI (Walker *et al*. 1988a) undertook a survey at the Bath *et al*. (1984) Site T-6 at Kawela Bay. The site was named the Kawela Bay Archaeological Area and assigned the BPBM Site No. 50-Oa-2899. The site was subsequently assigned SIHP Site No. 6410 and was determined to be eligible for nomination to the NRHP in an August 13, 1985 letter from Susumu Ono of SHPD to Everett A. Flanders of the U.S. Army Engineer District.

Walker *et al*. (1988a) excavated 140 auger cores and 36 test units along the east side of Kawela Bay and the shoreline to the north (see *Figure 28*). The testing effort extended inland from the coast approximately 300 m. Cultural deposits were identified in 64 cores, primarily in cores located seaward of a dirt road that paralleled the beach. Thirty-six test units were excavated along the shoreline to define four cultural deposits, designated A-D (see *Figure 28*). Area A is on the east-central portion of the bay, Area B is on the east side of the bay, and Areas C and D are on the shoreline north of the bay. Large quantities of food remains consisting of marine shells and bones (bird, fish, and mammal), and 454 artifacts of shell, bone and stone were recovered from the excavations. The excavations also documented 50 subsurface features including post molds, rock alignments, fire pits, ash lenses and charcoal lenses. Several historic artifacts were recovered and charcoal samples from 17 locations were submitted for radiometric age determination.

Walker *et al*. (1988a: 67-69) documented human remains in two locations. A stone-lined burial cist was identified in TU-20, between Deposit Areas C and D. The cist was encountered at the base of the excavation unit, capped by large limestone slabs. A complete human skeleton (Burial 1) was interred within the cist. The burial cist corresponds to the location of the "natural solution cavity" where Bath *et al*. (1984) discovered a human bone fragment in an auger test (TU-112). A subsurface pit (HF 45) was identified in Test Unit 9 (TU-9), situated southwest of Deposit Area A. Human remains (Burial 2) were present within the pit. Both the cist burial and the pit burial were left in place and the excavations were backfilled. Subsequently, in 1990 or 1991, the burials were moved.

From March to April of 1986, PHRI conducted test excavations at the Kahuku Point Archaeological Area (Walker *et al*. 1988b; see *Figure 26*). This area corresponds to Site 50-Oa-F4-14 recorded by Dye (1977) and was subjected to auger coring by Bath *et al*. (1984). The area examined by Bath *et al.* (1984) east of Kahuku Point designated as Site T-1, and Site 50-Oa-F4-14 on the east side of Kahuku Point were combined into a single site by Walker *et al*. (1998b), designated Site 50-Oa-2911. This site was subsequently designated SIHP Site 6411.

Walker *et al*. (1998b) documented eight stratigraphic exposures in the dunes at Kahuku Point and excavated 105 auger cores and 38 test units there. The cores extended from the coast up to 100 m inland. Cultural deposits were identified in 20 of the cores, all within 50 m of the coast. These deposits were noted in three discrete areas designated Areas A-C. Area A is located on the west side of Kahuku Point, Area B east of the point and Area C west of Area A (see *Figure 26*).

The test units were excavated in the three areas. Excavation yielded food remains consisting of marine shells and bones (bird, fish and mammal); stone, shell and bone artifacts; and 44 subsurface features including post molds, charcoal concentrations and fire pits. Charcoal samples collected from 21 locations were submitted for radiometric age determination. Three human burials were identified during the test unit excavations. Two burial pits, designated Burial 19, were identified in TU-2 in Area B and one burial pit was indentified in TU-24 in Area A (Burial 18). The burials were left in place and the units were backfilled.

Concurrent with the Walker *et al*. (1988b) survey at Kahuku Point, PHRI also undertook testing at Punahoʻolapa Marsh (Davis *et al*. 1986; see *Figure 27*). This area was previously documented as Site 50-Oa-F4-15 by Dye (1977) and portions were tested by Bath *et al*. (1984) in Survey Area 9. During the Davis *et al*. (1986) study, the marsh was designated BPBM Site 50-Oa-2912; the site was subsequently designated SIHP Site 6412. Davis *et al*. (1986) released a preliminary report of the testing results and the full descriptive account of the work was included in the Archaeological Mitigation Report for the Kuilima Resort Expansion Project (Corbin 2003).

According to Corbin (2003:193), initial examination of the marsh area identified three large limestone sinkholes and several associated walls in the vicinity of the Bath *et al*. (1984) Survey Area 8. The sinkholes varied in size from 5.0 to 15.0 m and in depth from 2.0 to 3.0 m. The largest was partially filled with alluvium. The second sinkhole had been used as a trash dump and contained rusted metal, bottles and jars dating between the 1870s and 1890s. The floor of the third sinkhole was flooded.

Four test units were excavated at the sinkholes. Two test units were excavated within the largest sinkhole (Units 1 and 4), one was excavated in the sink used as a dump (TU-2) and one was located adjacent to the water-filled sink next to a stone wall (TU-3). According to Corbin (2003:197), "these test units appear to have been excavated into a generally heavily disturbed area, as evidenced by surface and subsurface historic artifacts, trash in subsurface layers and bulldozer tracks in the area".

Additional subsurface testing undertaken by Davis *et al.* (1986) included three backhoe trenches and 27 sediment cores obtained with a modified Livingston coring device used for sampling submerged sediments. The typical stratigraphy observed in the cores consisted of seven strata overlying limestone bedrock. Three major stratigraphic units were defined: (1) a 1.0 to 1.5 m thick organic root and rhizome mat submerged under 0.1 to 0.2 m of water, (2) an unconsolidated peat-like organic deposit 3-3.5 m thick, and (3) a 0.04 to 0.1 m thick layer of "diagenetic carbonate silt" overlying limestone bedrock (Corbin 2003: 202). Charcoal was collected from three of the cores (A1, B1 and B3).

The three backhoe trenches were excavated around the perimeter of the marsh. These excavations revealed five to nine layers of clays to peaty clay deposits and were terminated within the water table. Land snails and charcoal were present in all three of the backhoe trenches. Twelve charcoal samples were submitted for radiometric age determination, nine from the backhoe trenches and three from the cores. Two hundred and twenty pollen samples were submitted for analysis from two of the trenches and all of the cores. These samples yielded a "record of the vegetation for the past 7,000 years of for this area of the Kahuku plain of northeastern Oahu" (*ibid*.:209). Based on the testing with the marsh, Corbin states, "…prehistorically, the marsh may have supported a more open and wetter environment than at present, with loulu palms [Pritchardia] being a dominant element" (*ibid*.:210).

In 1987 Walker *et al*. (1987) prepared a Data Recovery Plan (DRP) for the Kuilima Resort, to mitigate Site 2899 at Kawela Bay and Site 2911 at Kahuku Point. These sites were subsequently assigned SIHP Sites 6410 and 6411, respectively. Three research questions were proposed to guide the data recovery work:

1. What is the nature of the intra-site spatial organization or site structure?
2. What is the social composition (age, sex and relative social status) of the site occupants? and;
3. What is the nature and sequence of site occupation?

Walker *et al*. (1987) proposed excavation of six backhoe trenches at the Kawela Bay Site (6410), with two trenches in Area A and four within Area D. A similar approach was proposed for the excavations at the Kahuku Point Site (6411). Additionally it was proposed that excavations be undertaken in a small marsh inland of Kawela Bay and at the buried Kukio Pond at Kahuku Point.

This data recovery work fieldwork commenced in November 1990 shortly after SHPD approval of the Walker *et al*. (1987) DRP and was completed in July 1991; however, analysis and reporting of the work was suspended for nearly a decade and was not completed until 2003. The data recovery findings were reported in the Corbin (2003) Archaeological Mitigation Report for the Kuilima Resort Expansion Project. According to Corbin the data recovery field work included excavation of 44 excavation units totaling 102 sq m in extent, 5 backhoe trenches and 40 auger cores (see *Figure 28*).

The excavations at the Site 6410, Kawela Bay Archaeological Area consisted of 42 excavation units (99.94 sq m), five backhoe trenches and 12 auger cores. Twenty-three of the excavation units and two of the backhoe trenches were situated within Area A. These excavations revealed a stratified subsurface cultural deposit that encompassed

an area 60 m long by 46 m wide. Fifty hearth features and 8 postholes were documented, and a large assemblage of subsistence remains and artifacts was recovered for analysis.

The remaining 19 excavation units and three trenches were excavated in Area D. These excavations indicate that Area D is c. 60 m long by 30 m wide and also characterized by stratified cultural deposits. Excavations documented 63 hearths and earth ovens (*imu*) and 80 postholes. Large quantities of subsistence remains and artifacts were recovered.

Twelve auger cores were excavated in a marshy area inland of the northern end of Kawela Bay. The area was the reported location of Waikū Pond, depicted in *Figure 8*. The coring was undertaken to identify evidence of pre-contact agricultural use of the marshy area; however, it was determined that the marsh was a sinkhole that had been filled in and compacted by contractors (Corbin 2003:88). No cultural remains were present in the cores.

Data recovery work at the Site 6411 Kahuku Point Archaeological Area included excavating 21 auger cores and two test units. The excavations were not as extensive as outlined in the DRP because shortly after the fieldwork began, Kuilima Resort Development Co. decided that the area would not be developed and all work was terminated. The excavated test units recovered substantial quantities of food remains and several stone artifacts. Ten soil features including five hearths or fire pits, four postholes and a large pit of undetermined function were documented. Marine shells, metal and glass were present in the cores.

In 1989, Jensen (1989b) prepared Phases I and II of a four-phased mitigation program for the Kawela Bay Mitigation Project. The four phases consisted of a Monitoring Plan (Phase I), a Burial Treatment Plan (Phase II), Field Monitoring (Phase III) and Data Recovery (Phase IV). This program proposed archaeological monitoring of all construction work at the Kawela Bay Archaeological Area and construction of a moat around the Punahoʻolapa Marsh. Collection of bulk soil samples for dating and pollen analysis was also proposed. The Burial Treatment Plan detailed procedures for the treatment of human remains identified during future work, along with the proposed disinterment of two burials identified at Kawela Bay by Walker *et al*. (1988a).

PHRI subsequently monitored all construction activity within the TBR property (late 1990 into 1991) as outlined in the Jensen (1989b) mitigation program. Archaeological monitoring included areas within the existing golf course, the new golf course, the sod farm area, the proposed hotel site at Kawela Bay, the ʻŌpana wells site, Borrow Area 3 located on lands owned by the Campbell Estate, a wastewater line trench along Kamehameha Highway, and a wastewater pumping station near the existing Turtle Bay Hotel.

The monitoring work was preliminarily reported in a series of 17 Status Reports prepared by Sullivan (1990, 1991), Dunn (1991) and Donohue (1991). These status reports briefly document 14 newly identified archaeological sites (Temporary Monitoring Sites [TM] 1 through 14) and ten burials (Burials 1-10). The complete descriptive findings of the monitoring work are presented in Corbin (2003).

The 14 sites identified during monitoring were assigned SIHP Site numbers by Corbin (2003; Sites 6413 thru 6426; *Table 6*). The sites include nine cultural deposits (Sites 6413, 6414, 6416-6419, 6422, 6423 and 6425), two stone walls (Sites 6424 and 6426), an enclosure (Site 6415), an alignment (Site 6420) and a pool divided into three sections by discontinuous stone walls (Site 6421). Subsurface testing was conducted at 10 of the 14 sites including 30 test units, 20 backhoe trenches, 7 shovel tests, 5 auger cores, and documentation of two exposed faces in the banks of a lake in the golf course. These sites and excavations are summarized in the following section.

In 1992 human remains were discovered in sand fill that was excavated from a dune area south of Kuilima Point. The remains were transported to the Kahuku Police Station and eventually to the Medical Examiner's office in Honolulu. Kennedy (1992) examined the sand fill and the dune area. The sand fill was screened to recover all of the skeletal material. The dune area was examined and no additional remains were observed. The recovered remains were analyzed and four individuals were identified, consisting of an adult female and three sub-adults of indeterminate sex. These remains were assigned SIHP Site No. 4488 and were transferred to SHPD for curation. The burials were subsequently designated as Burials 11-14.

In 1996, additional human remains were discovered in the Site 4488 area (Carson *et al*. 1996, 1999). SHPD collected an adult scapula and facial bones, and a sub-adult tibia epiphysis from the area. The area was excavated and sand from the area was screened to recovering additional skeletal remains; in addition wood fragments and square nails were recovered. The wood and nails were inferred to be the remnants of a coffin. The skeletal remains were designated Burial A. A second set of remains was identified 3 m from Burial A, consisting of disarticulated adult long bones (Burial B). The skeletal remains were turned over to SHPD for curation and collectively were designated Burial 17.

In 2001, Cultural Surveys Hawaiʻi conducted archaeological monitoring of modifications to seven existing golf course holes, construction of two new holes and of a new driving range in the central portion of the project area (Borthwick *et al*. 2001). No surface or subsurface archaeological sites were identified.

Summary of Previously Identified Sites

Studies discussed above document 18 SIHP sites within the TBR property (Sites 4488 and 6410-6426). Site locations are illustrated in *Figures 25-28* and are summarized in *Table 6*. Bath *et al*. (1984) assigned temporary site designations to several additional identified sites that were not addressed in subsequent studies (Sites T-2 through T-5). The remains of two historic sites, the OR&L railroad grade and Kahuku Army Airfield, are present within the project area, but were not explicitly treated as historic properties by any previous study.

To date, three sites have been preserved: Kahuku Point Archaeological Area (Site 6411), Punahoʻolapa Marsh (Site 6412) and Site T-5 documented by Bath *et al*. (1984) that is included within the boundary of 6412. Fifteen sites were mitigated through data recovery excavation or burial disinterment and relocation (Sites 4488, 6410, 6413-6420, 6422, 6423, 6423, Kukio Pond and Bath *et al*. 1984 Site T-7). The current disposition of the remaining sites (5791 railroad grade, the airfield, 6421, 6424, 6426, and T-2, T-3, and T-4) is unclear. It is proposed that the disposition of these sites can be determined during the SAIS fieldwork. The previously identified sites are summarily described below.

Site 4488 is located inland of Kuilima Point. Human remains of at least eight individuals were discovered in 1992 and 1996 during sand mining operations (Kennedy 1992; Carson *et al*. 1996, 1999). These remains were designated as Burials 11-14 and 17. Following analysis the remains were temporarily curated by SHPD until they were reinterred on the TBR property. The location of the reinterment site is shown on *Figure 25*.

A portion of the OR&L railroad grade extended through the TBR property. The alignment of the railroad is depicted on current tax maps (see *Figures 2 and 3*) and on several historic maps (see *Figures 13-16*). None of the previous investigations documented this historic transportation route or assigned the railroad grade an SIHP site designation. The 1946 tsunami destroyed the railroad and it was abandoned in 1954 (Haun and Henry 2001b).

A portion of the railroad grade west of the project area in the Land of Kaunala and was assigned SIHP Site 5791 by Haun and Henry (2001b:15). A 525-meter long section of the railroad grade was recorded, along with several bridge foundations. Another section of the railroad grade in the vicinity of Ewa Beach was documented as SIHP Site 9714 and that segment of the OR&L mainline railroad grade was enrolled on the NRHP on December 1, 1975 (NRHP n.d.).

Formerly, a c. 3,950 m segment of the railroad grade spanned the TBR property, extending from inland of Kawela Bay across Kahuku Plain in a northeasterly direction for c. 2,120 m and then to the east-southeast for an additional 1,830 m where it exited the property. The railroad continued east to Kahuku Mill. The SAIS fieldwork will attempt to locate any extant remnants of the railroad grade.

Table 6. Summary of Previously Identified Sites in Project Area

SIHP Site No.	Bishop Museum Site No.	Other Site No. /Name	Site Type	McAllister (1933)	Dye (1977)	Bath et al. (1984)	Neller (1984)	Walker et al. (1988a)	Walker et al. (1988b)	Davis et al. (1986)	Kennedy (1992)	Kennedy (1996)	Sullivan (1990, 1991), Dunn (1991), Donohue (1991)	Haun and Henry (2001)	Corbin (2003)	Excavations					Current Status
																Auger Tests	Test Units	Backhoe Trenches	Exposure Examinations	Shovel Test Pits	
4488	-	-	Cultural deposit with burials								X	X									Burials removed as reinterred
5791/ 9714	-	-	Railroad Grade											X							To be determined
6410	50-Oa-2899	-	Cultural deposit with burials			X		X							X	179	78	5			Mitigated through Data Recovery; Burials removed and reinterred
6411	50-OA-F4-14 50-OA-2911	T-1	Cultural deposit with burials		X	X	X		X						X	145	41	1	11		Preserved
6412	50-OA-F4-15 50-OA-2912	-	Cultural deposit in Marsh with 3 sinkholes		X	X				X						35	4	3	1		Preserved
6413	-	TM-1	Cultural deposit										X		X			1			Mitigated through Data Recovery
6414	-	TM-2	Cultural deposit										X		X		4	1			Mitigated through Data Recovery
6415	-	TM-3	Enclosure										X		X		1				Mitigated through Data Recovery
6416	-	TM-4	Cultural deposit										X		X			11			Mitigated through Data Recovery
6417	-	TM-5	Cultural deposit										X		X		5	3	2		Mitigated through Data Recovery
6418	-	TM-6	Cultural deposit										X		X			1			Mitigated through Data Recovery
6419	-	TM-7	Cultural deposit										X		X			1		7	Mitigated through Data Recovery
6420	-	TM-8	Alignment										X		X	5	1				Mitigated through Data Recovery
6421	-	TM-9	3 pools with walls										X		X						To be determined
6422	-	TM-10	Cultural deposit										X		X		4	1			Mitigated through Data Recovery
6423	-	TM-11	Cultural deposit with burials										X		X		15	1			Mitigated through Data Recovery; Burials removed and reinterred
6424	-	TM-12	Stone wall										X		X						To be determined
6425	-	TM-13	Cultural deposit										X		X						Mitigated through Data Recovery
6426	-	TM-14	Stone wall										X		X						To be determined
-	-	Kahuku Air Base																			To be determined
		262	Kukio Pond	X					X												Mitigated through Data Recovery
		T-2	Stone wall			X															To be determined
		T-3	Cattle enclosure			X															To be determined
		T-4	Military structure			X															To be determined
		T-5	Stone wall			X															Preserved
-		T-7	Gray sand layer in dune (determined to be historic)		X	X										9			7		Mitigated through excavation
Additional excavations conducted in Non-site locations						X										71					
Totals																**444**	**153**	**29**	**21**	**7**	

Site 6410 is a cultural deposit designated as the Kawela Bay Archaeological Area, located in the east portion of the TBR property. This site has been subjected to extensive subsurface excavation (Bath *et al*. 1984; Walker *et al.* 1988a; Corbin 2003). Excavations consisted of 179 auger cores, 78 excavation units and five backhoe trenches (see *Figure 28*). These excavations documented four concentrations of cultural deposits designated as Areas A-D.

Area A excavations typically identified a single cultural layer that varied in thickness from 0.15 to 0.58 m (Walker *et al*. 1988a); however, data recovery excavations by Corbin (2003) in this area documented as many as three cultural layers (Layers II, III and IV). These cultural deposits are overlain by a disturbed sand deposit (0.03 to 0.28 m thick) and are underlain by pre-cultural sand layers. Layer II averaged 0.18 m in thickness, Layer III averaged 0.11 m and Layer IV averaged 0.2 m. Large quantities of subsistence debris, artifacts and numerous subsurface features were identified in these excavations.

Area B excavations documented a single prehistoric cultural deposit that varied in thickness from 0.1 to 0.25 m (Walker *et al*. 1988a). One to two sand layers typically overlie the cultural layer, with the upper deposit containing historic debris. Marine shells, artifacts and charcoal were recovered from the prehistoric cultural deposit.

Area C excavations documented a single cultural layer that varied in thickness from 0.15 to 0.55 m (Walker *et al*. 1988a). Recent fill and a beach sand deposit overlies the cultural deposit, which is characterized by fire pits, ash lenses, marine shells, stone and shell tools, modified mammal bones and fire-altered rock.

Area D excavations encountered a discontinuous 0.15 to 0.45 m thick cultural deposit with fire pits and ash lenses, marine shells, shell and stones tools, charcoal and modified bone (Walker *et al*. 1988a). Subsequent data recovery in this area by Corbin (2003) revealed two cultural layers: the upper cultural layer (Layer II) varied in thickness from 0.08 to 0.45 m and contained numerous fire pits, hearths, postholes, marine shells and charcoal, while the lower cultural deposit (Layer III) varied in thickness from 0.07 to 0.35 m and contained hearth, postholes, shells and charcoal. Both cultural layers were overlain by a disturbed sand deposit with modern debris (Layer I) and were underlain by multiple layers of pre-cultural sand.

Eight LCAs are present in the Kawela Bay area (see *Figures 11 and 28*). Several of the LCAs are located in close proximity to Areas A-D, but none correlate exactly to the any of the cultural deposits documented.

Historic documentary research indicates that Waikū Pond once existed in the vicinity of Site 6410 south of Area C (see *Figures 8 and 28*). It was proposed in the Walker *et al*. (1987) data recovery plan that coring be undertaken in the "marshy area" labeled on *Figure 28*, which was thought to correspond to the former location of Waikū Pond. Twelve cores were excavated in the "marshy area", none of which yielded cultural remains or pond deposits. The core samples were interpreted to indicate that the "marshy area" represented a sinkhole filled and compacted by contractors.

Site 6410 has been subjected to extensive survey and data recovery excavations. No human burials were found during the excavations in Areas A-D; however, seven burials have been identified at Site 6410 during excavations adjacent to these areas (Bath *et al*. 1984; Walker *et al*. 1988a; Sullivan 1991). These burials were excavated and reinterred in the reinterment site adjacent to Kamehameha Highway. These burials are discussed in more detail in the following section. The data recovery at the site was considered sufficient to mitigate adverse effects from development and the site has subsequently been altered by resort-related construction.

Site 6411 is the Kahuku Point Archaeological Area located to the east, west and south of Kahuku Point. Extensive archaeological inventory survey and data recovery excavations were undertaken in this area (Dye 1977; Bath *et al*. 1984; Neller 1984; Walker *et al*. 1988b; Corbin 2003). Three concentrations of cultural deposits (Areas A-C) were identified at the site, potentially representing remnants of a single habitation area impacted by wind erosion and damage by unrestricted sand vehicle activity.

Area A excavations identified a 0.15 to 0.55 m thick cultural deposit in an area 230 m long by 30-75 m wide (Walker *et al*. 1988b). Large concentrations of midden material and artifacts were present in the central portion of Area A. This deposit is located in the dunes to the west of Kahuku Point.

Area B is located east of Kahuku Point and covers an area 180 m long by 45-90 m wide. A discontinuous cultural deposit that varied in thickness from 0.05 to 0.3 m, characterized by subsurface features, artifacts and food remains, was documented. Area B appears to correspond to LCA 2678:2 (see *Figure 26*)

Area C is located to the south of Area A, in an area 90 m long by 25 m wide. Excavations documented a cultural deposit 0.1 to 0.25 m thick, characterized by midden debris, artifacts and subsurface features. Area C appears to correspond to LCA 2928:2 (see *Figure 26*).

Limited data recovery work was conducted at 6411 before it was determined that the area was to be preserved. The auger cores identified no intact cultural deposits; disturbance was inferred from historic and/or modern debris in a subsurface context. However, two test units excavated in the south portion of the site documented a disturbed surface layer overlying a prehistoric cultural deposit with subsurface features, artifacts and marine shells.

Site 6411 was subjected to extensive survey excavations, but with limited data recovery. Four burials consisting of seven individuals were identified at Site 6411. Two burials were exhumed by either SHPD or the Honolulu police and were interred at the reinterment site (Neller 1984, 1989). The two remaining burials, noted by Walker *et al*. (1988b) were left following their identification and the units were backfilled. These are discussed in more detail in a following section. The Site 6411 was preserved as a park area shortly after the data recovery at the site was suspended.

Site 6412 encompasses Punahoʻolapa Marsh, the large freshwater marsh area located in the east portion of the TBR property (see *Figure 27*). Dye (1977), Bath *et al.* (1984), Davis *et al*. (1988) and Corbin (2003) examined the marsh and its perimeter. A total of 35 auger cores, four test units, three backhoe trenches and the examination of one exposed soil profile have been documented within and adjacent to the marsh. A complex of sinkholes was noted within the marsh itself. The majority of the subsurface tests were located in the wet marshy area, yielding no cultural remains. However, these excavations documented pre-contact floral biota through pollen analysis (Corbin 2003). The presence of possible marsh deposit in excavations conducted outside the current boundary of Punahoʻolapa Marsh suggest that the wetlands was likely once much larger. Punahoʻolapa Marsh has been preserved because it is a wetland. The T-5 rock wall (discussed below), noted by Bath *et al*. (1984) is located within the preserve.

Site 6413 is a surface and subsurface historic and prehistoric cultural deposit located along the east-central edge of the TBR property, found within the TBR sod farm and greenhouse nursery (see *Figure 25*). Prehistoric and historic surface artifacts were collected (Corbin 2003). Subsurface testing consisted of excavating one backhoe trench to document a subsurface profile of two subsurface features, consisting of a hearth and posthole. Charcoal, shells, coral and fire-cracked rock were collected from the features but not analyzed. Site documentation and testing were considered sufficient to mitigate data loss from resort-related construction. The site was subsequently destroyed.

Site 6414 is a subsurface cultural deposit located near the east-central edge of the TBR property, on the west side of Site 6413. This site was first documented in a TBR equipment yard as a subsurface cultural layer exposed in profile in a mechanically excavated pit for a fuel tank (Corbin 2003). The pit was expanded into a trench. Four 1.0 by 1.0 m test units were excavated to the southwest to determine the areal extent of the deposit (*Figure 29*). Excavation documented 8 hearths, 3 pits, 4 postholes, marine shells, debitage, charcoal and a variety of historic debris. Charcoal from the trench was submitted for radiometric age determination. Site documentation and testing were considered sufficient to mitigate data loss from resort-related construction. The site was subsequently destroyed.

Site 6415 is a small enclosure located near the west-central edge of the Kahuku Air Base, on the northern periphery of Punahoʻolapa Marsh. The structure is built of coral cobbles and small boulders and is 2.96 m long, 2.29 m wide by 0.47 m high (*Figure 30;* Corbin 2003). A test unit was excavated in the center of the enclosure; only wire and metal were recovered. After documenting the site, it was cleared for destruction. According to Corbin (*ibid*.:230):

> The function of the enclosure is unknown. The enclosure may predate the construction of the Kahuku Air Base, having survived the construction because of its proximity to the edge of Punahoʻolapa Marsh. The Air Corps appears to have excavated a drainage ditch running parallel to the edge of the marsh; the site is on the marsh side of this ditch, making it fairly inaccessible.

Site 6416 is a subsurface cultural deposit located west of Punahoʻolapa Marsh in the central portion of the TBR property. The site was documented during excavation of a sewer line #2 trench (Corbin 2003). Eleven trenches were excavated in order to determine the extent of the cultural deposit (*Figure 31*). A total of 103 feet of trench was profiled to document four hearths, a possible earth oven (*imu*), a dog burial, a historic or modern pit and a pit of undetermined function. Charcoal from the site was submitted for radiometric age determination. Artifacts include modified bone fragments (medium-sized mammal, artiodactyl, *Bos*) and a possible urchin abrader. Site documentation and testing were considered sufficient to mitigate data loss from resort-related construction. The site was subsequently destroyed.

Site 6417 is a subsurface cultural deposit located on the east edge of the TBR property on the eastern periphery of Punahoʻolapa Marsh and west of the TBR sod farm. The site was initially encountered during construction of a golf course lake (*Figure 32*) and its areal extent was determined through test excavations of two backhoe trenches, five test units and profiling two exposures along the lake cutbank. A series of six concrete pads located north of the lake were interpreted as barrack foundations. Test excavations documented six fire pits and possible subsurface floor characterized by flat coral stones, marine shells, coral, basalt flakes, charcoal, and historic and modern debris (Corbin 2003). Several basalt adze fragments, a basalt flake and piece of slate were collected from the surface of the site. Several fragments of charcoal were submitted for radiometric age determination. Site documentation and testing were considered sufficient to mitigate data loss from resort-related construction. The site was subsequently destroyed.

Site 6418 is a subsurface cultural deposit located at the east end of the TBR property, on the east side of Punahóolapa Marsh and west of Site 6417. A concentration of charcoal was noted in a pit during the removal of a coconut tree (*Figure 33*). The site was extensively impacted by "earthmoving equipment associated with the Kahuku Army Air Corp Base" (Corbin 2003:262-264). Site testing consisted of excavation of a backhoe trench that did not encounter cultural remains. The location of the backhoe trench was not depicted on the site map. Site documentation and testing were considered sufficient to mitigate data loss from resort-related construction. The site was subsequently destroyed.

Site 6419 is a subsurface cultural deposit located along the shoreline between Kuilima Point and Kahuku Point. The site was initially encountered during sand mining activity on the south side of a beach berm within Survey Area 5 (Corbin 2003). Testing consisted of excavating a backhoe trench and seven shovel tests, which indicated that portions of dune had been highly disturbed (Corbin 2003; *Figure 34*). Site documentation and testing were considered sufficient to mitigate data loss from resort-related construction. The site was subsequently destroyed.

Site 6420 is an oval alignment of coral and basalt boulders located along the central bay front mid-way between Kahuku and Kuilima Points. The site was initially identified in 1990 during monitoring activities (Corbin 2003). The alignment is 3.5 m long by 2.87 m wide, with the interior measuring 0.45 m in depth below the surrounding ground surface (*Figure 35*). Site testing consisted of excavating a 1.0 by 1.0 m test unit and five auger cores. Charcoal from a possible *imu* was recovered from the test unit and one of the cores, along with a modern penny and several recent nails from the test unit. The site was inferred to be modern. Site documentation and testing were considered sufficient to mitigate data loss from resort-related construction. The site was subsequently destroyed.

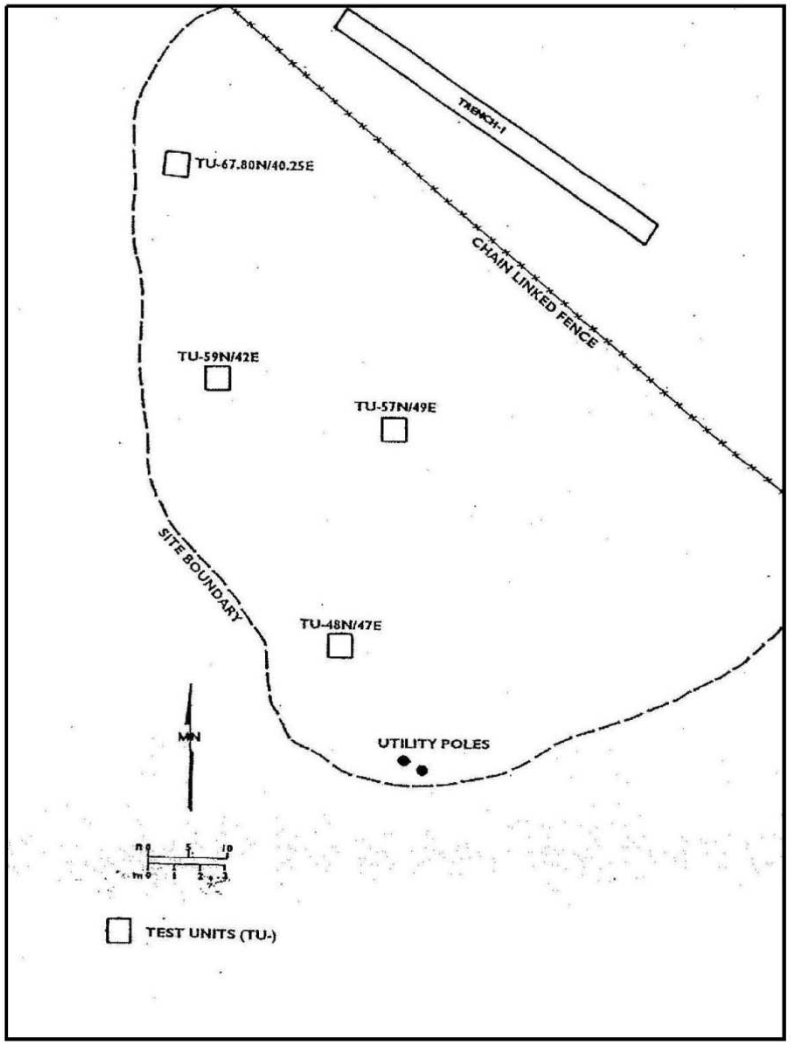


Figure 29. Site 6414 Plan Map (from Corbin 2003:222

Figure 30. Site 6415 Plan Map (from Corbin 2003:231

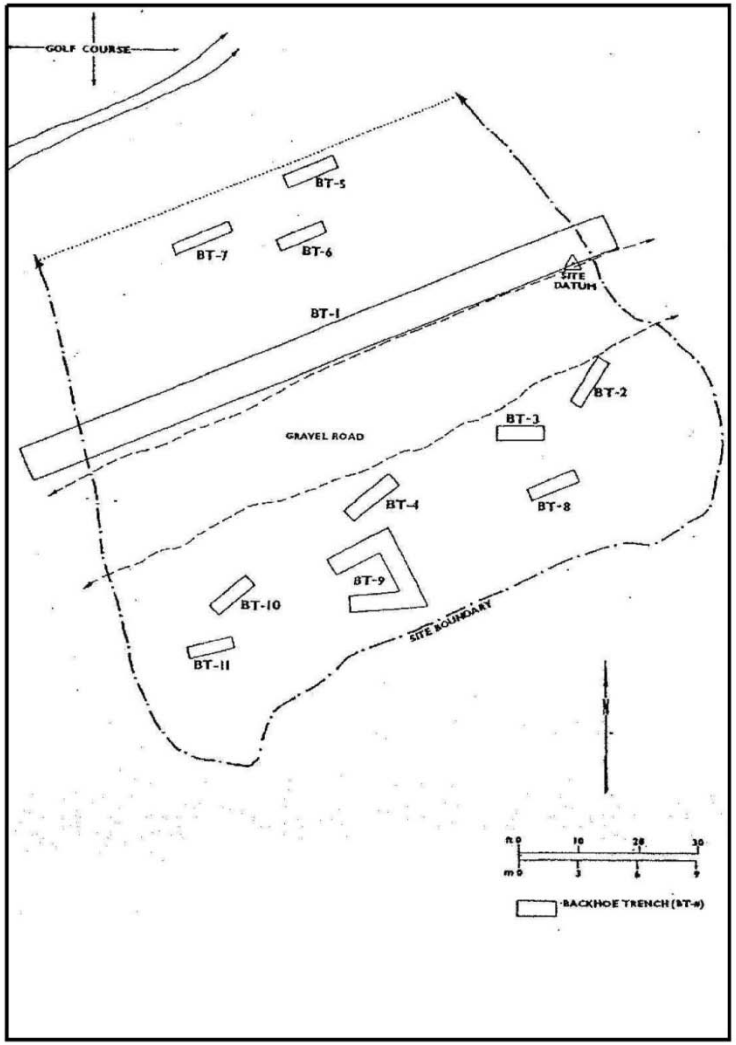


Figure 31. Site 6416 Plan Map (from Corbin 2003:234

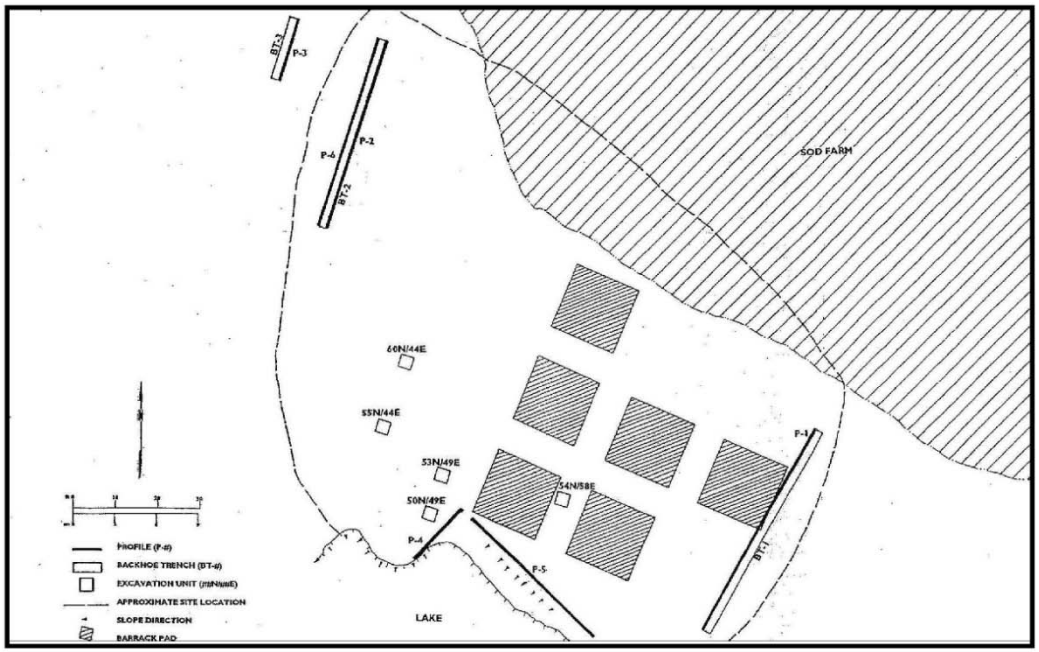


Figure 32. Site 6417 Plan Map (from Corbin 2003:249)

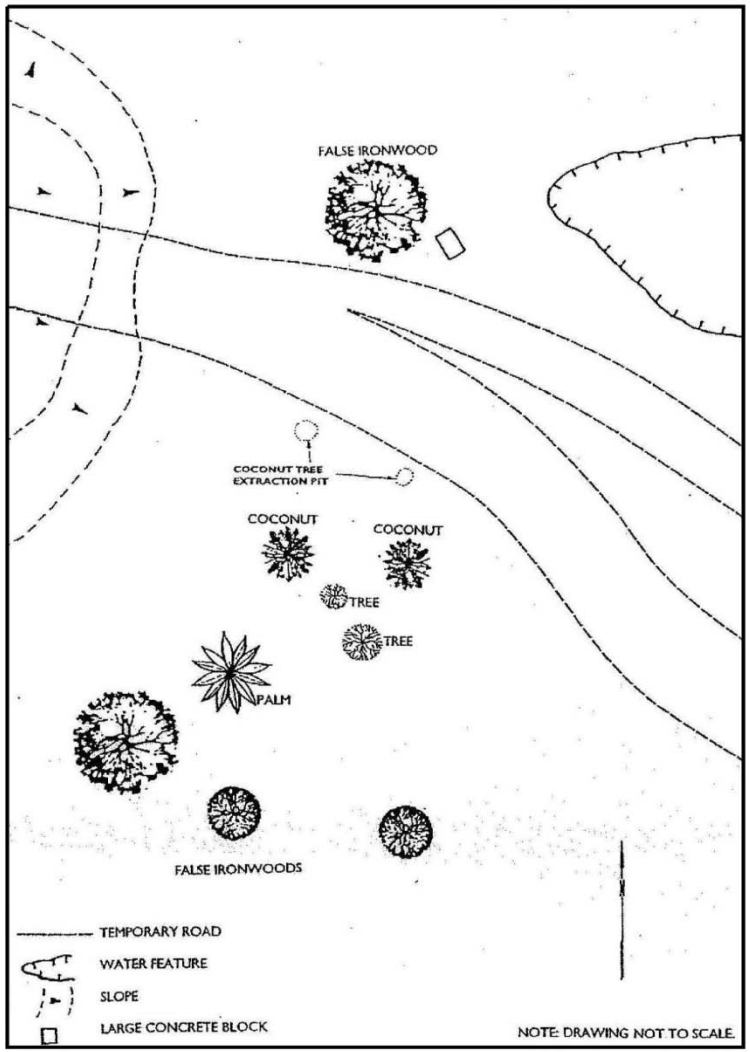


Figure 33. Site 6419 Plan Map (from Corbin 2003:266)

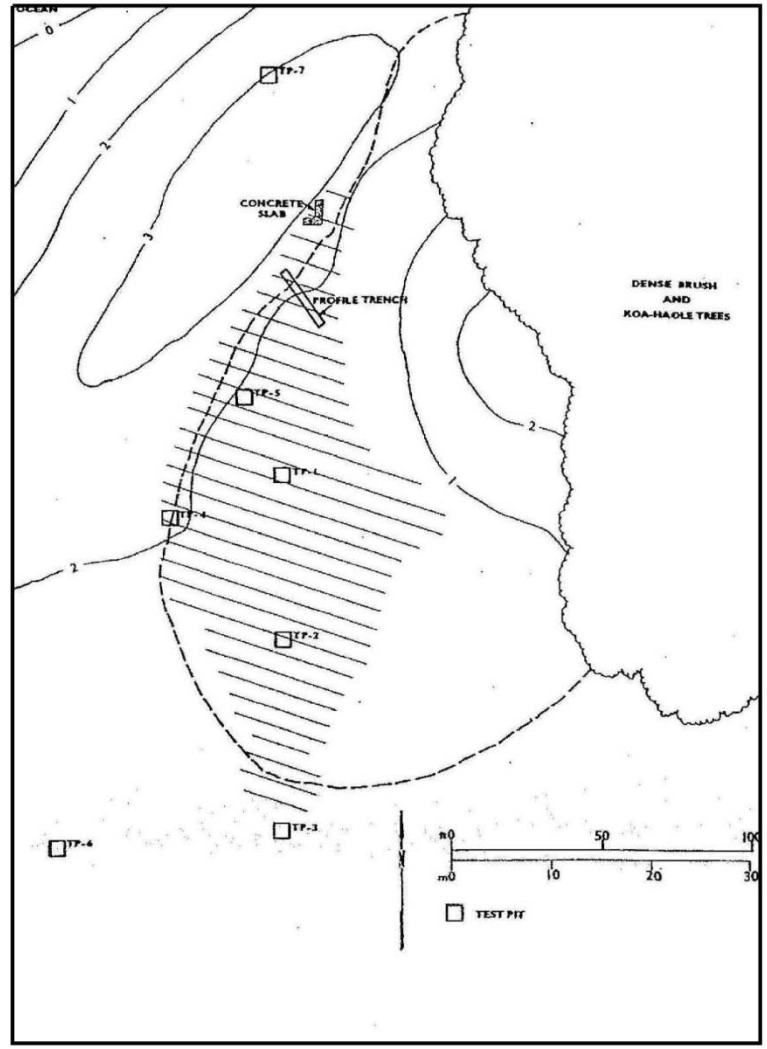


Figure 34. Site 6418 Plan Map (from Corbin 2003:263)

Site 6421 is a pool divided into three sections located on the southeast edge of the Kahuku Army Airfield in an area designated as wetlands along the east boundary of the TBR property. The US Army Corp of Engineers identified the site for PHRI to document (Corbin 2003). The pool is located in an area 10.8 m long by 10.8 m wide. Pool depth varies from 0.45 to 3.0 m (*Figure 36*). Basalt boulders are stacked to form a retaining wall on the east-central edge and aligned discontinuously around the pool perimeter and across the pool to divide the central pool from the south pool. A metal pipe and hose extend into the south pool. No testing was undertaken, but the site was interpreted as possibly historic. The current condition of the site is unknown.

Site 6422 is a subsurface cultural deposit located on the east-central boundary of the TBR property on the north side of the OR&L Railroad grade within the Oʻahu Construction Company's yard (*Figure 37*). The site was identified during excavation of a waterline trench. Site testing consisted of excavating a backhoe trench and four test units to determine the areal extent of the deposit. The backhoe trench (BT-1) was excavated on the west side and parallel to the west fork of Marconi Road and extended north beyond the boundaries of the site into Site 6423. A hearth was documented and excavated in the trench wall. Cultural remains from the hearth fill consisted of marine shells, burned coral and charcoal. A charcoal sample was submitted for radiometric age determination. A basalt adze fragment was noted on the ground surface near the site and collected from near TU-4, but its location was not mapped. The east, west and south areal extent of the site was not determined. Site documentation and testing were considered sufficient to mitigate data loss from resort-related construction. The site was subsequently destroyed.

Site 6423 is a subsurface cultural deposit located on the east-central boundary of the TBR property at the north end of the waterline trench (BT-1) that originated at Site 6422, on the west side of Marconi Road. Testing consisted of excavation of an additional backhoe trench (BT-2) and 15 test units (see *Figure 37*). Excavations documented 11 subsurface features consisting of hearths, fire pits, a pit and possible postholes. A human burial (Burial 8) was identified in the wall of BT-1 and a second human burial (Burial 7) was encountered in Test Unit-12. The burials were disinterred and reinterred at the TBR burial reinterment site. Cultural material collected during testing consisted of marine shells, basalt and volcanic glass flakes, groundstone, a game stone (*ʻulu maika*), pieces of coral, fire-altered rocks, crab exoskeleton fragments, urchin spines, burned small mammal bones and charcoal. Several fragments of charcoal were submitted for radiometric age determination. A railroad spike, a shell button and metal, glass and ceramic fragments were also recovered. Site documentation and testing were considered sufficient to mitigate data loss from resort-related construction. The site was subsequently destroyed.

Site 6424 is a surface feature located at the southwest corner of the Kahuku Army Airfield and was initially documented during monitoring in 1991. The site consists of a short section of wall 2.36 m long by 1.4 m wide, represented by aligned coral boulders and interpreted as a possible *ahupuaʻa* boundary wall between Kahuku and Punalau (Corbin 2003; *Figure 38*). The site map depicts a concrete block, a coated copper wire, an ash deposit and a fragment of melted bottle glass that are not mentioned in the site description. The status of this site is unknown.

Site 6425 is a subsurface charcoal deposit exposed in a cutbank on the north side of Kamehameha Highway along the southeast boundary of the TBR property and was initially document during monitoring in 1991. The charcoal deposit was 2.0 m long and 0.45 m thick (Corbin 2003). The context of the exposure suggested that the deposit was impacted during construction of the highway. No subsurface testing was undertaken. The site is presumed destroyed.

Site 6426 is a rock wall located south of the OR&L railroad grade (Site 5791) on the western perimeter of Punahóolapa Marsh in the central portion of the TBR property and was initially documented in 1991 (Corbin 2003). The wall was constructed of stacked coral limestone boulders and is 40 m long by 0.7 m wide and 0.85 m high. A post and remnant of a wire fence are located adjacent to the north end of the wall. No cultural remains were observed in association with the wall and its function was not determined. The current condition of the site is unknown.

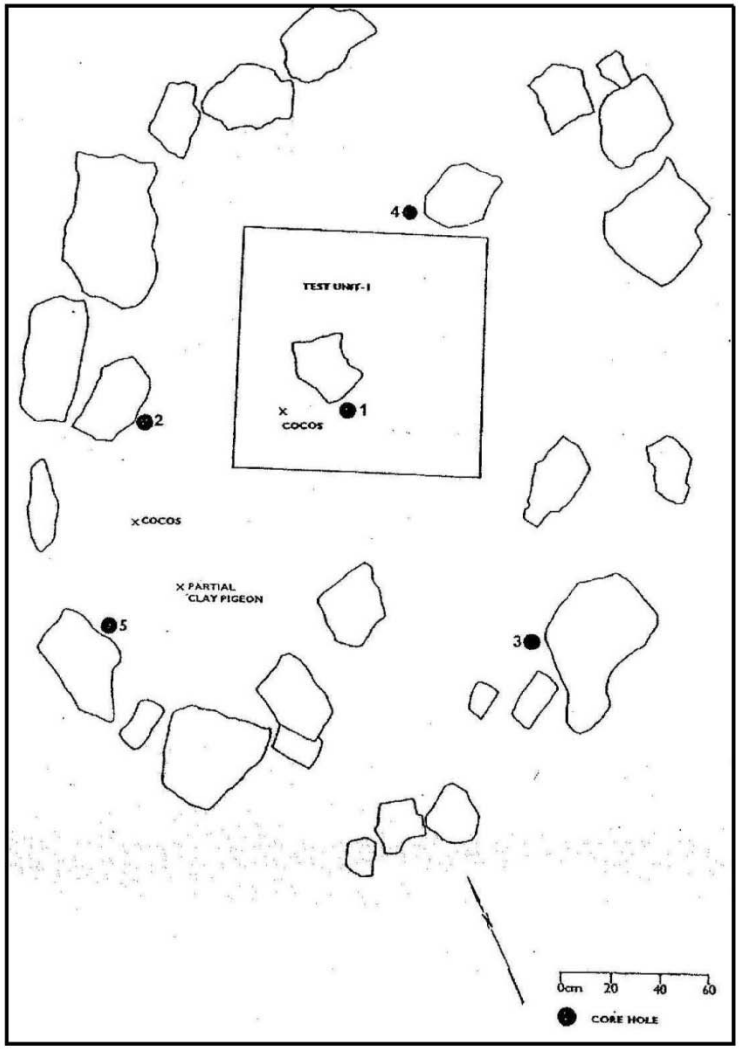


Figure 35. Site 6420 Plan Map (from Corbin 2003:269)

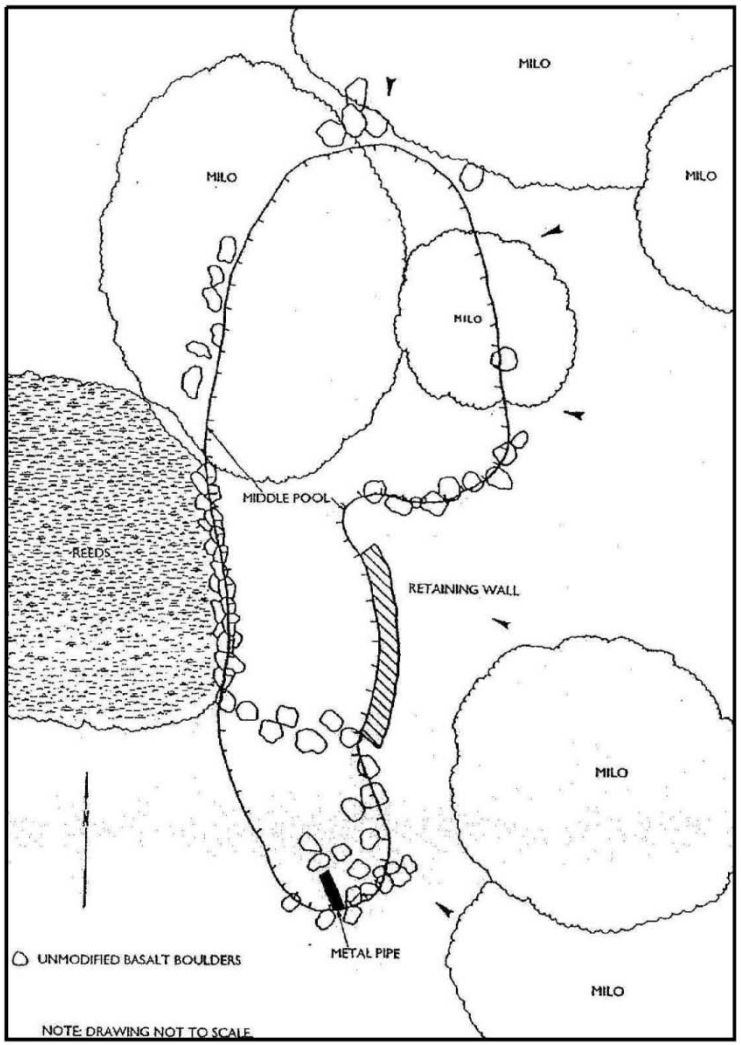


Figure 36. Site 6421 Plan Map (from Corbin 2003:272)

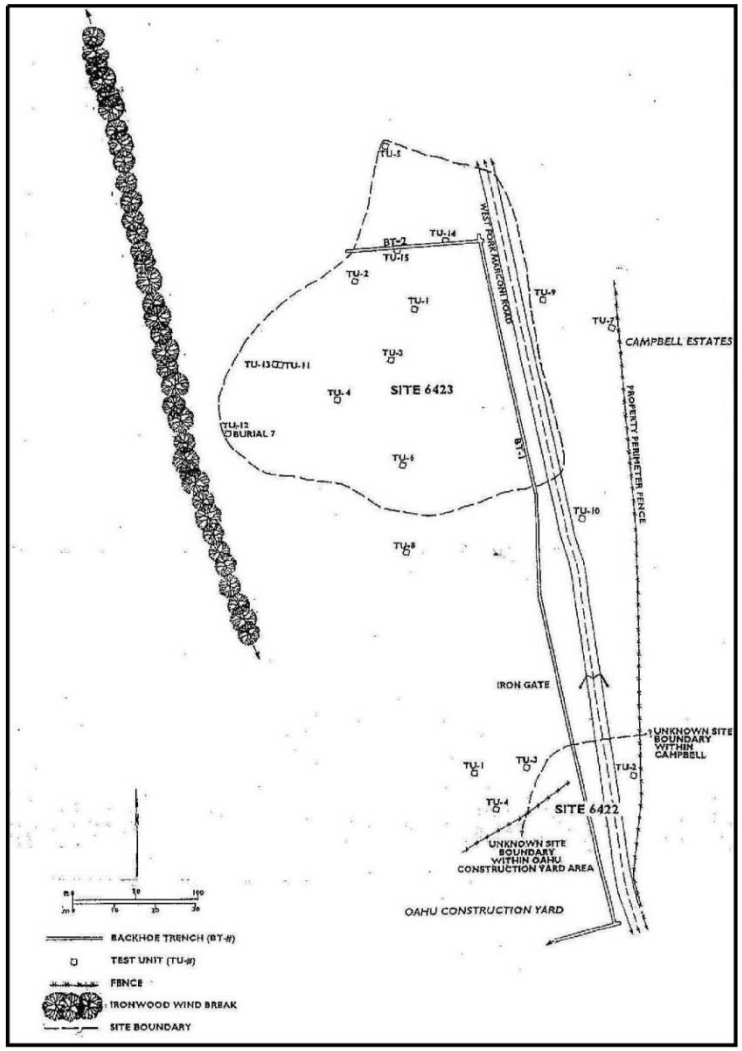


Figure 37. Site 6422 and 6423 Plan Map (from Corbin 2003:274)

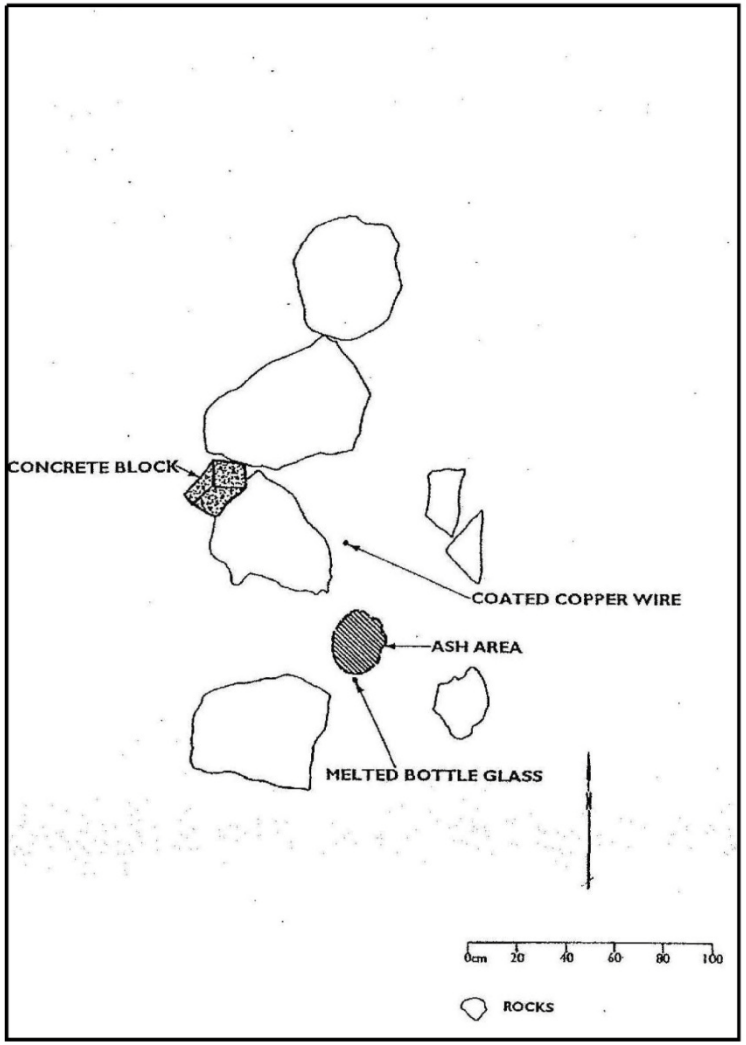


Figure 38. Site 6424 Plan Map (from Corbin 2003:304)

Other sites were identified on the TBR property during earlier studies that were not assigned SIHP site designations during subsequent studies (Bath *et al*. 1984; see *Figure 25*). These include two rock walls, an enclosure, and a military structure. One wall (Site T-2) is located on the western periphery of Punahóolapa Marsh in Survey Area 8; the other (Site T-5) is located in Punahoʻolapa Marsh. A cattle enclosure (Site T-3) is located near the Site T-2 wall on the west side of Punahoʻolapa Marsh, also in Survey Area 8. A military structure (Site T-4) is located near the east-central boundary of the TBR property in Survey Area 13. The current status of these four sites is unknown. The wall designated Site T-5 will be preserved within the Punahoʻolapa Marsh wetlands.

Kahuku Army Airfield has been noted by a number of researchers within the project area, but it has not been assigned an SIHP site designation or fully recorded. Small portions of the airfield have been documented (Bath *et al*. 1984; Corbin 2003), but not in a comprehensive fashion. A series of concrete foundations interpreted as barrack foundations in Survey Area 10, a buried asphalt surface interpreted as a runway apron in Survey Area 12 and the Site T-4 concrete military structure were summarily recorded (Bath *et al*. 1984). A second structure similar to Site T-4 was noted but not documented (*ibid*.). Corbin (2003:249) mapped and noted six barracks foundations during documentation of Site 6417 (see *Figure 32*). Although much of the airfield has been impacted by resort development, it is unclear if any remnants of the Kahuku Army Airfield are extant. The status of the airfield is unknown.

Summary of Project Area Burials

Various archaeological projects for the TBR property resulted in the identification of 25 human burials, designated as Burials 1 through 19. These burials are summarized in *Table 7* and their locations are presented in *Figure 39*. All the burials were identified during subsurface testing (Bath *et al*. 1984; Neller 1984, 1989; Walker *et al*. 1988a, 1988b; Sullivan 1990; Kennedy 1992; Carson *et al*. 1996, 1999). Most burials consist of a single set of human remains, however, Burials 11-14 and 17 contained a total of eight individuals and Burials 15 and 19 contained five individuals. Kalima (1993) reported the osteological analyses of Burials 3-6 from Site 6410 and Burial 8 from Site 6423. These analyses resulted in the identification of additional individuals that were subsequently designated as Burials 9 and 10. Burials are known from four locations on the property.

The greatest concentration of burials was associated with the area inland of Kuilima Point, where eight individuals (Burials 11-14 and 17) were buried in the dunes at Site 4488. These burials were initially encountered during sand mining operations (Kennedy 1992; Carson *et al*. 1996, 1999). Seven individuals were identified near the shoreline of Kawela Bay in association with Site 6410. Each burial contained the remains of a single individual, identified during data recovery excavations. Burial 1 was initially documented in 1984 (Bath *et al*. 1984; Walker *et al*. 1988a), Burial 2 was identified a few years later (Walker *et al*. 1988a), and Burials 3-6 and 9 were identified a few years after that (Sullivan 1990).

Seven individuals from four burials were also identified at Site 6411 near the shoreline on either side of Kahuku Point. Five burials were located in the sand dunes east of the Point (Burials 15 and 19) and two were located in dunes to the west (Burials 16 and 18). Burial 15 was exhumed by SHPD after its discovery in 1984 by recreational sand vehicle operators who were using the area. Neller (1984) identified three individuals from the location designated as Burial 15. Two individuals were identified during excavation at the location designated as Burial 19 (Walker *et al*. 1988b). The Honolulu Police exhumed Burial 16 after its discovery in 1986; the remains were turned over to SHPD and examined by Neller (1989). Burial 18 was encountered during subsurface testing (Walker *et al*. 1988b).

The fourth concentration of burials is located east of Punahoʻolapa Marsh (Site 6423), where Burials 7, 8 and 10 each contain the remains of a single individual. These remains were encountered during archaeological monitoring of resort-related construction activity (Sullivan 1991).

Table 7. Summary of Burials Previously Identified within Project Area

Burial Number	Site Number	Location	Number of Burials	Researchers	Description	Final Disposition of Remains
1	6410	TU-20	1	Bath et al. (1984), Walker et al. (1988a), Jensen (1989), Maly and Rosendahl (1992), Kalima (1993)	Adult female burial in wooden coffin within stone-lined cyst noted 1st by Bath et al. (1984), then Walker et al. (1988a). Burial disinterred following guidelines in (1989b) mitigation program. Osteological analysis by conducted by Kalima (1993). Burial reinterred at Reinterment Site as specified in Maly and Rosendahl (1992) Burial Treatment Plan (BTP).	Reinterred
2	6410	TU-9	1	Walker et al. (1988a), Jensen (1989), Maly and Rosendahl (1992), Kalima (1993)	Adult male burial in flexed position noted in pit feature (HF-45) by Walker *et al.* (1988a). Burial disinterred as part of Jensen (1989b) mitigation program. Osteological analysis by Kalima (1993), Burial reinterred following Maly and Rosendahl (1992) BTP.	Reinterred
3, 4, 5, 6, 9	6410	Inland of Area C	5	Sullivan (1991), Jensen (1989), Maly and Rosendahl (1992), Kalima (1993)	Human remains noted during monitoring of grading for Hotel H-2. Two clusters of two burials found 15 m apart. Burial 3 is a juvenile, Burial 4 is a infant, Burials 5 and 6 are adults. Burials disinterred following guidelines in Jensen (1989b) mitigation plan. During osteological analysis of Burials 5 and 6 by Kalima (1993), single humerous of third individual was noted, designated as Burial 9. Burial reinterred following Maly and Rosendahl (1992) BTP.	Reinterred
7	6423	BT-1, TUs 11 and 13	1	Sullivan (1991), Jensen (1989b), Maly and Rosendahl (1992), Kalima (1993)	Human remains noted during monitoring at Site 6423 area, found within a natural sinkhole feature used as a burial pit (HF-12). Cranium and infracranial skeletal remains interpreted as those of female adult from 25 to 30 years of age. Burials disinterred following guidelines in Jensen (1989b) mitigation plan and analysis conducted by Kalima (1993). Burial reinterred following Maly and Rosendahl (1992) BTP.	Reinterred
8, 10	6423	TU-14	2	Sullivan (1991), Jensen (1989b), Maly and Rosendahl (1992), Kalima (1993)	Human remains noted during monitoring at Site 6423 area, beneath resort access road and west fork of Marconi Road. Remains were partially articulated and are those of adult female. Burials disinterred following guidelines in Jensen (1989b) mitigation plan and osteological analysis conducted by Kalima (1993). During analysis, fragmentary remains of an additonal sub-adult were found and designated as Burial 10. Both sets of remains reinterred following Maly and Rosendahl (1992) BTP.	Reinterred
11-14, 17	4488	Inland of Kuilima Point	8	Kennedy (1992), Maly and Rosendahl (1992), Carson *et al.* (1996, 1999)	Burials 11-14 consist of 4 disturbed burials (3 sub-adults, 1 adult female) removed from dune south of Kulima Point (Kennedy 1992). Disturbed remains of 3+ adults and 1 bone from sub-adult noted by Carson *et al.* (1996, 1999) in same area and designated as Burial 17. Wood and nails suggesting a coffin were found in associated with one set of the Burial 17 remains. Burials 11-14 reinterred following Maly and Rosendahl (1992) BTP. Burial 17 curated with SHPD in 1996 and subsequently reinterred	Reinterred
15, 19	6411	East Kahuku Point Burial Area	5	Neller (1984), Walker *et al.* (1988b), Maly and Rosendahl (1992)	Burial 15 noted in dunes to east of Kahuku Point that were exhumed and examined by SHPD (Neller (1984) and determined to be two complete skeletons and one partial skeleton. Walker *et al.* (1988b) identified two burials (Burial 19) in pits in TU-2 in Area B. Burial 19 was re-buried in original location.	Reinterred (Burial 15), Left *in situ* (Burial 19)
16, 18	6411	West Kahuku Point Burial Area	2	Neller (1989), Walker *et al.* (1988b), Maly and Rosendahl (1992)	Burial 16 noted in dunes to west of Kahuku Point and exhumed by Honolulu Police. Remains were subsequently examined by SHPD (Neller (1989). Burial 18 identified by Walker *et al.* (1988b) in TU-24 in Area A. Burial 18 was re-buried in its original location.	Reinterred (Burial 16), Left *in situ* (Burial 18)
		Total	**25**			

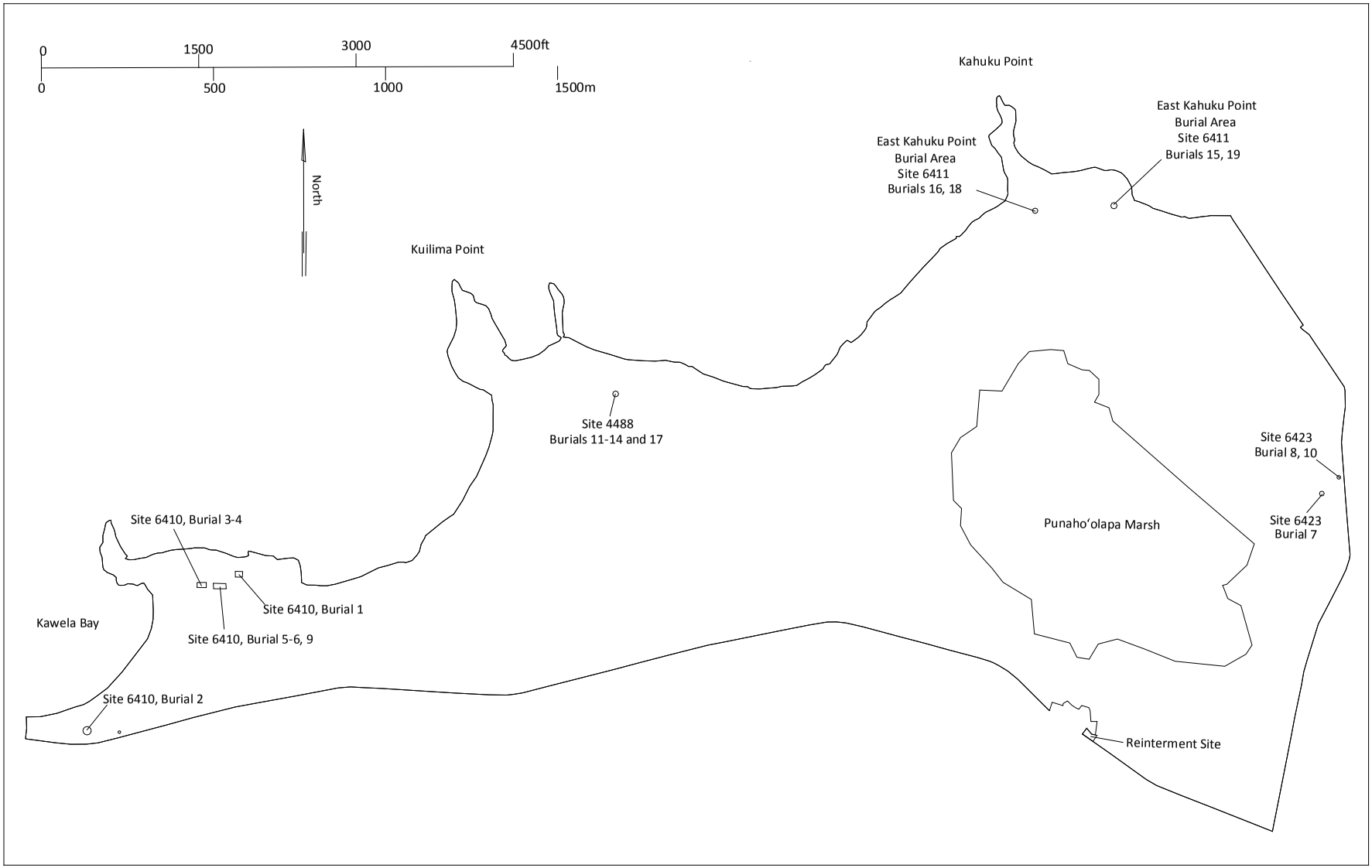


Figure 39. Location of Burials within Project Area

The majority of the burials identified on the TBR property are probably native Hawaiians interred prior to Contact or during the early post-Contact period. The exceptions are Burials 1 and 17, which contained remnants of wooden coffins, indicating the interment took place sometime after c. 1820.

A Burial Treatment Plan (BTP) was prepared for the human remains on the TBR property. Maly and Rosendahl (1992) prepared a BTP for Burials 1-10 recovered by PHRI archaeologists, for Burials 11-14 recovered by Kennedy (1992) and for Burials 15-16 recovered from the Kahuku Point area by Neller (1984, 1989). The remains of four individuals designated Burial 17, reported by Carson *et al.* (1996, 1999), were curated by SHPD and subsequently reinterred. Excavations that encountered the two remaining burials (Burials 18 and 19) were terminated on identification of the remains (Walker *et al*. 1988b). The three individuals designated Burials 18 and 19 were left in place and the excavation units were backfilled.

Project Area Chronology

Ninety-four charcoal samples from nine sites have been previously submitted for radiometric age determinations. *Table 8* lists the radiocarbon analysis results by site and *Table 9* is a graph with the age determinations ordered chronologically. The graph excludes all of the results that predate A.D. 600, since these are not considered to be determinations of cultural occupation. Six modern results were obtained which are not included in this analysis. *Figure 40* shows the mapped locations of deposits containing cultural material from AD 800 to 1800.

Nine age range determinations resulted in ranges that span 5760 to 54 B.C. These age determinations predate the arrival of Polynesian settlers, but could be pertinent to the timing of the Holocene emergence of the Kahuku Plain. The earliest age range determination (5760-5480 B.C.) was obtained from a sample excavated along Kawela Bay (Site 6410 Area A). Five other early age range determinations, spanning 5509-45 B.C., were obtained from Punahoʻolapa Marsh (Site 6412), two spanning 3865-845 B.C. were obtained from the southern periphery of the Marsh (Survey Area 11), and one spanning 210-165 B.C. was obtained from Kahuku Point (Site 6411 Area B). Two additional results, A.D. 2 to 601, obtained from Site 6422 on the eastern periphery of Punahoʻolapa Marsh, and A.D. 179 to 687 from Site 6423 in the same area, are probably too early to reflect cultural activity.

Of the 77 age range determinations that fall within the timeframes associated with Polynesian cultural occupation and later, 23 (30%) are from the Kawela Bay Archaeological Area (Site 6410). Twenty-five (32%) are from the Kahuku Point Archaeological Area (Site 6411). Twenty-nine (38%) are from Punahoʻolapa Marsh (Site 6412) and its environs (Sites 6414, 6416, 6417, 6422, and 6423). The earliest cultural deposits (*i.e.* prior to c. A.D. 1000) are to be found on the periphery of the Marsh. These early age ranges support the inference that the wetland was a highly desirable locale for initial settlement. The earliest cultural age range determinations were recovered from Site 6412 where a sample obtained from the east trench spans A.D. 645 to 979 and a sample from the north trench spans A.D. 785 to 1160 (see *Figure 27*). A second early cluster was obtained within and east of the Marsh from Site 6423. Age ranges from Site 6423 span A.D. 793 to 1105.

The A.D. 1000 to 1200-age ranges show continued use of the area east of Punahoʻolapa Marsh, along with settlements in the sand dunes east and west of Kahuku Point and around Kawela Bay. Settlement in these areas intensified in the period between A.D. 1200 and 1400. The earliest cultural deposits sampled along Turtle Bay post-date A.D. 1200. Sites dating to the period between A.D. 1400 to 1600 have been documented on the west and southwest of Punahoʻolapa Marsh, as well as southwest of Kahuku Point. Use of the area east of Punahoʻolapa Marsh, Kawela Bay and Kahuku Point continued as a population focal point into the A.D. 1600 to 1800s.

The central portion of the TBR property was developed in 1971, prior to state requirements for archaeological inventory and mitigation. Nearly 200 acres of the property were developed by the time of the first archaeological inventory survey undertaken by the Bishop Museum in 1977, and therefore almost no sites are known from this area. The single exception is Site 6416 in the approximate center of the property.

Table 8. Summary of Radiocarbon Dates from Previous Testing within Project Area

Site	Provenience	Layer/ Feature	Depth (cm)	C-14 Age in Years BP (one sigma)	C-13/C-12 Ratio	C-13 Adjusted C-14 Ages Years BP	Calendric Age Range	Researcher	Beta Analytic's Lab No.
6410	TU-158	II	12-68	less than 150	n/d	180+/-60	AD 1630-1950	Bath et al. (1984)	10633
6410	Area A - TU-25	II	28-45	70+/-60	-15.02 o/oo	230+/-60	AD 1505-1675 AD 1710-1805	Walker et al. (1988a)	16860
6410	Area B - TU-3	II	14-40	510+/-60	-24.95 o/oo	520+/-60	AD 1330-1480	Walker et al. (1988a)	16857
6410	Area C - TU-33	I	20-31	370+/-80	-25.50 o/oo	360+/-80	AD 1400-1660	Walker et al. (1988a)	15857
6410	Area C - TU-16	III	87-97	170+/-60	-20.23 o/oo	250+/-60	AD 1495-1800	Walker et al. (1988a)	16853
6410	Area C - TU-32	I	29-43	110+/-50	-26.92 o/oo	80+/-50	AD 1665-1940	Walker et al. (1988a)	16858
6410	Area C - TU-13	III	46-66	110+/-60	-26.72 o/oo	80+/-60	AD 1665-1940	Walker et al. (1988a)	15859
6410	Area D - TU-34	I	0-56	310+/-80	-20.75 o/oo	380+/-80	AD 1395-1660	Walker et al. (1988a)	15855
6410	Area D - TU-31	I	0-47	330+/-60	-23.18 o/oo	360+/-60	AD 1415-1645	Walker et al. (1988a)	15856
6410	TU-26	III	18-41	410+/-70	-26.61 o/oo	380+/-70	AD 1410-1635	Walker et al. (1988a)	15861
6410	TU-6	II	18-25	250+/-60	-26.91 o/oo	220+/-60	AD 1510-1680	Walker et al. (1988a)	16854
6410	TU-4	II	13-40	180+/-50	-25.06 o/oo	180+/-50	AD 1630-1950	Walker et al. (1988a)	16856
6410	TU-8	III	Lower	170+/-60	-25.79 o/oo	160+/-60	AD 1645-1950	Walker et al. (1988a)	15858
6410	Area A - 54N/58E	IIa, HF-2	60-70	280-240 230-70 40-0	-24.4 o/oo	n/d	AD 1650-1950	Corbin (2003)	171517
6410	Area A - 56N/45E	Ib, HF-4	n/d	Post 0 BP	-24.4 o/oo	n/d	AD 1650-1950	Corbin (2003)	171518
6410	Area A - 54N/58E	III/2, HF-6	n/d	900-850 810-750	-25.2 o/oo	n/d	AD 1030-1240	Corbin (2003)	171519
6410	Area A - 56N/76E	IV/5	n/d	7660-7480	-25.8 o/oo	n/d	5760-5480 BC	Corbin (2003)	171520
6410	Area D - 40N/38E	IV, HF-18	68-69	490-310	-20.9 o/oo	n/d	AD 1440-1660	Corbin (2003)	171521
6410	Area D - 46N/38E	IV	72-82	700-670	-24.9 o/oo	n/d	AD 1210-1290	Corbin (2003)	171522
6410	Area D - 50N/42E	IV/2, HF-66	79-88	630-600 560-520	-25.9 o/oo	n/d	AD 1300-1450	Corbin (2003)	171523
6410	Area D - N46/E40	V	75	530-500	-24.2 o/oo	n/d	AD 1410-1480	Corbin (2003)	171524
6410	Area D - N44/E40	III/IV/V, HF-106	71-101	510-450	-26.5 o/oo	n/d	AD 1430-1530 AD 1560-1630	Corbin (2003)	171525
6410	Area D - N44/E40	V, HF-110	75-89	630-600 560-500	-27.6 o/oo	n/d	AD 1290-1520 AD 1590-1620	Corbin (2003)	171526
6410	Area D - N48/E38	V	68-108	550-460	-24.1 o/oo	n/d	AD 1300-1650	Corbin (2003)	171527
6410	Area D - N48/E42	V, HF-78	49-63	80 +/- 50	-25.9 o/oo	n/d	Modern	Corbin (2003)	171528
6411	Area A - TU-34	II	42-62	130 +/-60	n/d	110+/- 60	AD 1655-1950	Bath et al. (1984)	10536
6411	Area A - TU-17	II	100-108	220+/-70	-24.75 o/oo	220+/-70	AD 1510-1950	Walker et al. (1988b)	16375
6411	Area A - TU-17	III	105-114	190+/-60	-14.04 o/oo	360+/-60	AD 1415-1645	Walker et al. (1988b)	16848
6411	Area A - TU-17	III	114-130	130+/-70	-23.60 o/oo	150+/-70	AD 1645-1950	Walker et al. (1988b)	16373
6411	Area A - TU-17	IV	130-135	500+/-100	-25.25 o/oo	490+/-100	AD 1315-1520	Walker et al. (1988b)	16849
6411	Area A - TU-17	IV	135-145	710+/-60	-18.92 o/oo	810+/-60	AD 1400-1525	Walker et al. (1988b)	16372
6411	Area A - TU-19	IV	22-40	100.3 +/- 0.07%	-21.25 o/oo	40+/-50	AD 1065-1285	Walker et al. (1988b)	16367
6411	Area A - TU-19	VIII	45-65	460+/-70	-27.11 o/oo	420+/-70	AD 1670-1715 AD 1800-1930	Walker et al. (1988b)	16731
6411	Area A - TU-23	IIA	60-88	110+/-70	-20.00 o/oo	190+/-70	AD 1620-1890 AD 1910-1950	Walker et al. (1988b)	16376
6411	Area A - TU-24	HF-14	67-105	270+/-60	-26.06 o/oo	260+/-60	AD 1490-1670 AD 1725-1790	Walker et al. (1988b)	16846
6411	Area A - TU-28	Ivb	99-118	50+/-70	-17.78 o/oo	160+/-70	AD 1645-1950	Walker et al. (1988b)	16850
6411	Area A - FP-3	HF-18	0-10	180+/-70	-24.66 o/oo	190+/-70	AD 1620-1890 AD 1910-1950	Walker et al. (1988b)	16366
6411	Area B - TU-149	IV	54-59	2070 +/-50	n/d	1990+/- 50	210-165 BC	Bath et al. (1984)	10537
6411	Area B - TU-2	II	23-25	640+/-70	-25.78 o/oo	630+/-70	AD 1260-1405	Walker et al. (1988b)	16378
6411	Area B - TU-5	Ia	0-8	760+/-100	-26.40 o/oo	740+/-100	AD 1070-1390	Walker et al. (1988b)	16377
6411	Area B - TU-10	II	18-50	300+/-50	-25.80 o/oo	290+/-50	AD 1435-1665	Walker et al. (1988b)	16365
6411	Area B - TU-12	I	0-6	350+/-50	-25.08 o/oo	350+/-50	AD 1420-1650	Walker et al. (1988b)	16369
6411	Area B - TU-14	I	0-9	550+/-70	-23.60 o/oo	570+/-70	AD 1305-1420	Walker et al. (1988b)	16374
6411	Area C - TU-27	VIII	112-132	420+/-70	-27.90 o/oo	370+/-70	AD 1415-1640	Walker et al. (1988b)	16379
6411	TU-2	II, HF-10	42-60	370 +/-70	-23.7	390 +/-70	AD 1411-1652	Corbin (2003)	44943
6411	TU-1	III, HF-3	16-21	112.7 +/-0.7%	-26.5	113.1+/-0.7%	Modern	Corbin (2003)	44948
6411	TU-1	IV, HF-3	21-31	107.3+/-0.7%	-26.3	107.5+/-0.7%	Modern	Corbin (2003)	44949
6411	TU-1	IV, HF-3	n/d	110.0+/-0.7%	-26.1	110.2+/-0.7%	Modern	Corbin (2003)	44950
6411	TU-1	I	10-16	430+/-60	-24.3	440+/-60	AD 1402-1526 AD 1556-1631	Corbin (2003)	44951
6411	TU-1	II, HF-2	30-38	670+/-130	-25.8	660+/-130	AD 1060-1086 AD 1122-1138 AD 1156-1470	Corbin (2003)	44953
6411	TU-1	II	5-16	340+/-60	-26.2	320+/-60	AD 1442-1668 AD 1782-1796	Corbin (2003)	44955
6411	TU-2	I	25-48	130+/-60	-27.6	90+/-60	AD 1665-1784 AD 1789-1955	Corbin (2003)	44956
6411	TU-2	I	15-25	101.1+/-0.7%	-24.3	101.0+/-0.7%	Modern	Corbin (2003)	44958
6411	TU-2	II, HF-8	36-95	70+/-70	-24.5	80+/-70	AD 1662-1955	Corbin (2003)	44959
6411	TU-2	II, HF-9	38-84	110+/-70	-26.3	90+/-70	AD 1659-1955	Corbin (2003)	44960
6412	Auger core A4	IV	n/d	100+/-80	-26.74 o/oo	70+/-80	AD 1659-1955	Davis et al. (1986), Corbin (2003)	16569
6412	South trench	I	n/d	170+/-60	-17.33 o/oo	280+/-60	AD 1446-1679 AD 1740-1752 AD 1756-1804 AD 1935-1947	Davis et al. (1986), Corbin (2003)	19371
6412	East Trench	IIb	n/d	640+/-70	-22.40 o/oo	680+/-70	AD 1220-1410	Davis et al. (1986), Corbin (2003)	19373

Table 8. Summary of Radiocarbon Dates from Previous Testing within Project Area (cont).

Site	Provenience	Layer/ Feature	Depth (cm)	C-14 Age in Years BP (one sigma)	C-13/C-12 Ratio	C-13 Adjusted C-14 Ages Years BP	Calendric Age Range	Researcher	Beta Analytic's Lab No.
6412	Auger core B1a	IV	n/d	1120+/-70	-29.99 o/oo	1040+/-70	AD 883-1160	Davis et al. (1986), Corbin (2003)	16571
6412	East Trench	III	n/d	1250 +/-80	-24.76 o/oo	1250 +/-80	AD 645-979	Davis et al. (1986), Corbin (2003)	16568
6412	South trench	II	n/d	2240+/-90	-25.47 o/oo	2230+/-90	410-45 BC	Davis et al. (1986), Corbin (2003)	16566
6412	Auger core B3a	V	n/d	3650+/-70	-25.67 o/oo	3640+/-70	2200-1875 BC 1842-1811 BC 1800-1777 BC	Davis et al. (1986), Corbin (2003)	16572
6412	East Trench	IV	n/d	3790+/-60	-25.20 o/oo	3790+/-60	2458-2032 BC	Davis et al. (1986), Corbin (2003)	19374
6412	East Trench	V	n/d	3950+/-60	-26.81 o/oo	3920+/-60	2573-2513 BC 2502-2267 BC 2261-2203 BC	Davis et al. (1986), Corbin (2003)	19375
6412	East Trench	IX	n/d	6320+/-130	-25.75 o/oo	6310+/-130	5509-5500 BC 5484-4940 BC 4868-4861 BC	Davis et al. (1986), Corbin (2003)	16573
6414	Trench 1	II	n/d	60+/-80	-19.8	140+/-80	AD 1640-1955	Sullivan (1990), Corbin (2003)	n/d
6414	Trench 1	II	n/d	370+/-130	-27.2	330+/-130	AD 1322-1340 AD 1390-1950	Sullivan (1990), Corbin (2003)	n/d
6414	Trench 1	II	n/d	550+/-100	-23.1	580+/-100	AD 1260-1470	Sullivan (1990), Corbin (2003)	n/d
6414	Trench 1	II	n/d	460+/-100	-26.1	450+/-100	AD 1290-1650	Sullivan (1990), Corbin (2003)	n/d
6414	Trench 1	II	n/d	770+/-100	-24.9	770+/-100	AD 1030-1400	Sullivan (1990), Corbin (2003)	n/d
6416	TR 1	II, HF-5	90-100	400+/-90	-27.3	360+/-90	AD 1410-1670 AD 1750-1796 AD 1945-1954	Sullivan (1990), Corbin (2003)	42154
6416	TR-2	II, HF-6	5-15	110+/-80	-25.5	100+/-80	AD 1650-1955	Sullivan (1990), Corbin (2003)	42155
6416	TR-9	I, HF-8	23-32	290+/-70	-20.5	360+/-70	AD 1420-1660	Sullivan (1990), Corbin (2003)	42156
6417	Profile 4	V, HF-1	n/d	1060+/-70	-22.1	1100+/-70	AD 920-1045	Sullivan (1990), Corbin (2003)	38668
6417	Profile 5	IVa	n/d	1200+/-130	-27.3	1170+/-130	AD 890-1105 AD 825-873 AD 793-815	Sullivan (1990), Corbin (2003)	38669
6417	BT-1	Iva, HF-6	n/d	600+/-100	-26.2	580+/-100	AD 1350-1470	Sullivan (1990), Corbin (2003)	38670
6417	Profile 4	Iva, HF-1	n/d	100+/-80	-21.9	150+/-80	AD 1527-1556 AD 1630-1955	Sullivan (1990), Corbin (2003)	38713
6422	Profile 4	IIIa, b, HF-1	55-74	180+/-80	-20.3	250+/-80	AD 1452-1891 AD 1908-1950	Sullivan (1990), Corbin (2003)	39987
6422	Trench	E Face, W. wall, IIIa, b	50-60	1056.4+/-1.8%	-25.4	105.4+/-1.8%	Modern	Sullivan (1990), Corbin (2003)	40129
6422	Trench	IIb	20-30	-	-21.0	1740+/-130	AD 2-601	Sullivan (1990), Corbin (2003)	44937
6423	TU-2	III, IV, HF-7	12-35	320+/-80	-25.1	320+/-80	AD 1433-1679 AD 1710-1752 AD 1756-1804 AD 1936-1947	Sullivan (1990), Corbin (2003)	40132
6423	Trench 1	III, IV, HF-9	10-20	620+/-130	-25.6	610+/-130	AD 1165-1167 AD 1187-1516 AD 1599-1616	Sullivan (1990), Corbin (2003)	39993
6423	Trench 2	III, HF-11	02-42	250+/-60	-25.4	240+/-60	AD 1489-1603 AD 1609-1693 AD 1726-1813 AD 1852-1859	Sullivan (1990), Corbin (2003)	39994
6423	Trench 2	IIb	43-53	790+/-100	-26.0	770+/-100	AD 1028-1334 AD 1336-1401	Sullivan (1990), Corbin (2003)	44938
6423	TU-5	IIb	53-63	250+/-70	-24.4	260+/-70	Ad 1466-1693 AD 1776-1812 AD 1853-1859 AD 1919-1949	Sullivan (1990), Corbin (2003)	44939
6423	TU-5	IIb	63-73	520+/-80	-24.6	520+/-80	AD 1295-1492 AD 1603-1609	Sullivan (1990), Corbin (2003)	44940
6423	TU-5	VIII	73-83	350+/-80	-24.3	360+/-80	AD 1415-1668 AD 1782-1796	Sullivan (1990), Corbin (2003)	44941
6423	TU-5	IV	42-46	430+/-70	-27.1	390+/-70	AD 1411-1652	Sullivan (1990), Corbin (2003)	44942
6423	TU-12	V, HF-12	89-94	1570+/-130	-25.0	1570+/-130	AD 179-189 AD 214-687	Sullivan (1990), Corbin (2003)	44944
6423	TU-13	V, HF-12	94-104	300+/-130	-26.0	290+/-130	AD 1405-1954	Sullivan (1990), Corbin (2003)	44945
6423	TU-13	V, HF-12	104-114	380+/-70	-24.4	1130+/-110	AD 663-1071 AD 1079-1131 AD1136-1158	Sullivan (1990), Corbin (2003)	44946
6423	TU-13	V, HF-12	114-124	1120+/-110	-24.4	1130+/-110	AD 663-1071	Sullivan (1990), Corbin (2003)	44947
Survey Area 11	TU-142	IV	84-94	3090+/- 130	n/d	2990+/-130	1575-845 BC	Bath et al. (1984)	10534
Survey Area 11	TU-33	III	120-215	4840+-130	n/d	4750+/- 130	3865-3165 BC	Bath et al. (1984)	10535

Table 9. Project Radiocarbon Age Determinations Ordered Chronologically

Site-Feature	Calendric Years AD
6412 **East Trench** Layer III **(16568)**	645-979
6423 **TU-13** Layer V HF-12 104-114 cm bd **(44946)**	663-1071 & 1079-1131 & 1136-1158
6417 **Profile 5** Layer IVa **(38669)**	793-815 & 825-873 & 890-1105
6412 **Auger Core B1a** Layer IV **(Beta 16571)**	883-1160
6417 **Profile 4** Layer V HF-1 **(38668)**	920-1045
6423 **Trench 2** Layer IIb 43-53 cm bd **(44938)**	1028-1334 & 1336-1401
6410 **Area A - EU 54N/58E** Layer III HF-6 **(Beta 171519)**	1030-1240
6414 **Trench 1** Layer II **(n/d)**	1030-1400
6411 **TU-1** Layer II 30-38 cm bd **(Beta 44953)**	1060-1086 & 1122-1138 & 1156-1470
6411 **Area A - TU-19** Layer IV 22-40 cm bd **(Beta 16367)**	1065-1285
6411 **Area B - TU-5** Layer Ia 0-8 cm bd **(Beta 16377)**	1070-1390
6423 **Trench 1** Layer III IV HF-9 10-20 cm bd **(39993)**	1165-1167 & 1187-1516 & 1599-1616
6410 **Area D - EU 46N/38E** Layer IV 72-82 cm bd **(Beta 171522)**	1210-1290
6412 **East trench** Layer IIb **(Beta 19373)**	1220-1410
6411 **Area B - TU-2** Layer II 23-25 cm bd **(Beta 16378)**	1260-1405
6414 **Trench 1** Layer II **(n/d)**	1260-1470
6410 **Area D - EU 44N/40E** Layer V HF-110 75-110 cm bd **(Beta 171526)**	1290-1520 & 1590-1620
6414 **Trench 1** Layer II **(n/d)**	1290-1650
6423 **TU-5** Layer IIb 63-73 cm bd **(44940)**	1295-1492 & 1603-1609
6410 **Area D - EU 50N/42E** Layer IV/2 HF-66 79-88 cm bd **(Beta 171523)**	1300-1450

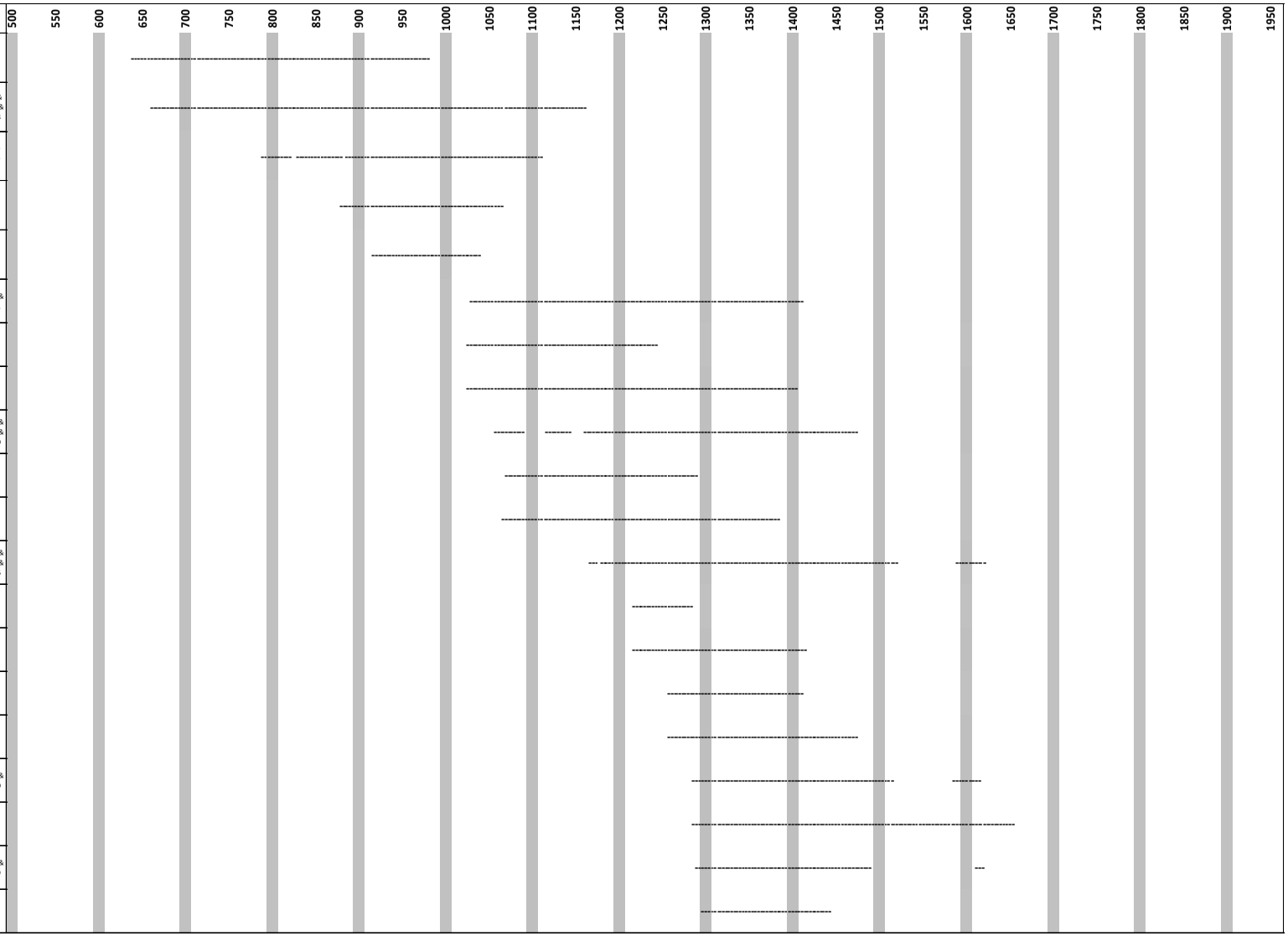


Table 9. Project Radiocarbon Age Determinations Ordered Chronologically (cont.)

Site-Feature	Calendric Years AD
6410 **Area D - BU 48N/38E** Layer V 68-108 cm bd **(Beta 171527)**	1300-1650
6411 **Area B - TU-14** Layer I 0-9 cm bd **(Beta 16374)**	1305-1420
6411 **Area A - TU-17** Layer IV 130-135 cm bd **(Beta 16849)**	1315-1520
6414 **Trench 1** Layer II **(n/d)**	1322-1340 & 1390-1950
6410 **Area B - TU-3** Layer II 14-40 cm bd **(Beta 16857)**	1330-1480
6417 **BT-1** Layer IVa HF-6 **(38670)**	1350-1470
6410 **Area D - TU-34** Layer I 0-56 cm bd **(Beta 15855)**	1395-1660
6411 **Area A - TU-17** Layer IV 135-145 cm bd **(Beta 16372)**	1400-1525
6410 **Area C - TU-33** Layer I 20-31 cm bd **(Beta 15857)**	1400-1660
6411 **TU-1** Layer I 10-16 cm bd **(Beta 44951)**	1402-1526 & 1556-1631
6423 **TU-13** Layer V HF-12 94-104 cm bd **(44945)**	1405-1954
6410 **Area D - BU 46N/40E** Layer V 75 cm bd **(Beta 171524)**	1410-1480
6410 **TU-26** Layer III 18-41 cm bd **(Beta 15861)**	1410-1635
6416 **Tr 1** Layer II HF-5 90-100 **(42154)**	1410-1670 & 1750-1796 & 1945-1954
6411 **TU-2** Layer II HF-10 42-60 cm bd **(Beta 44943)**	1411-1652
6412 **East trench** Layer III **(Beta 165668)**	1411-1652
6423 **TU-5** Layer IV 42-46 cm bd **(44942)**	1411-1652
6411 **Area C - TU-27** Layer VIII 112-132 cm bd **(Beta 16379)**	1415-1640
6410 **Area D - TU-31** Layer I 0-47 cm bd **(Beta 15856)**	1415-1645
6411 **Area A - TU-17** Layer III 105-114 cm bd **(Beta 16848)**	1415-1645
6423 **TU-5** Layer VII 73-83 cm bd **(44941)**	1415-1668 & 1782-1796

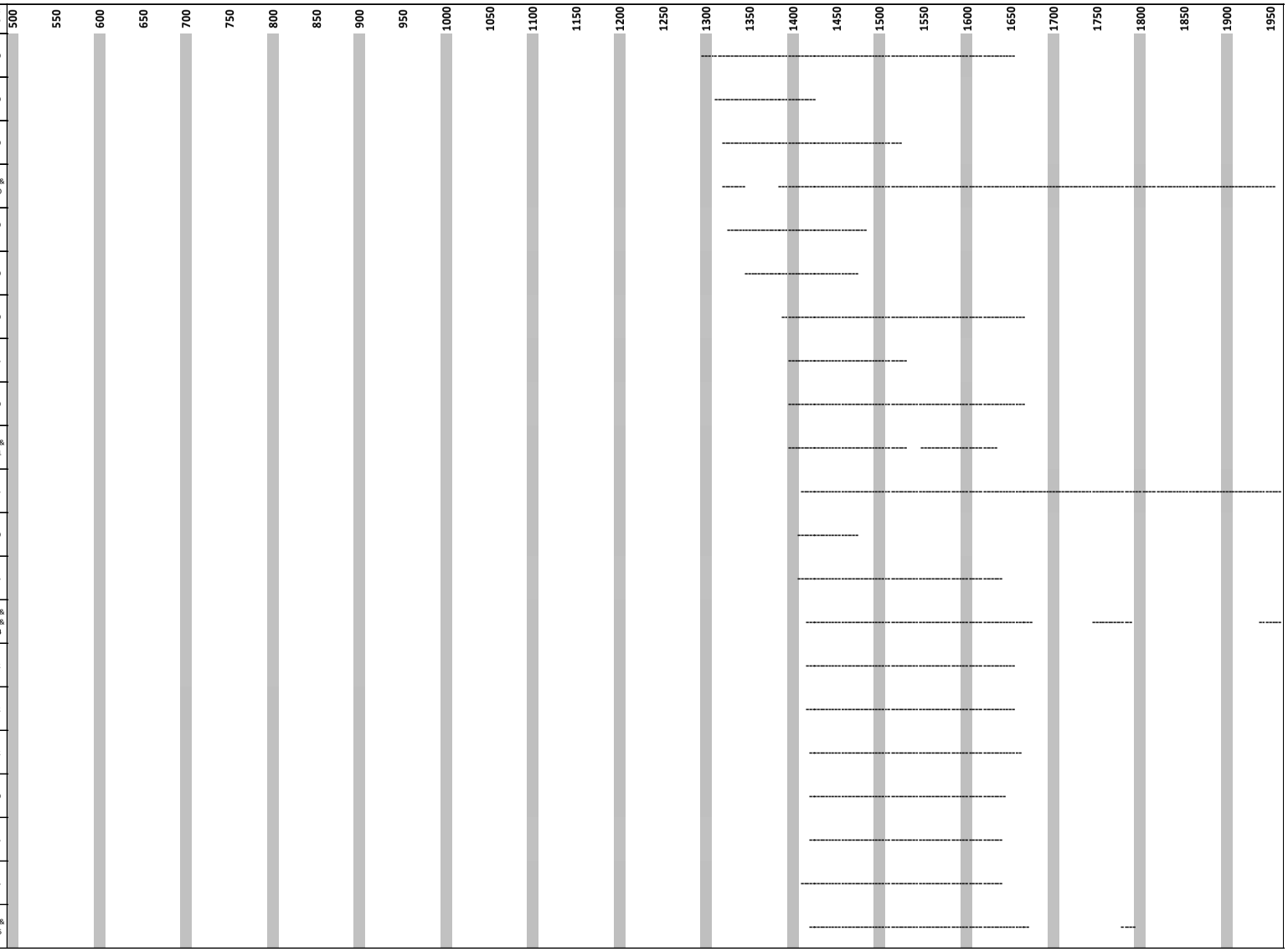


Table 9. Project Radiocarbon Age Determinations Ordered Chronologically (cont.)

Site-Feature	Calendric Years AD
6411 **Area B - TU-12** Layer I 0-6 cm bd **(Beta 16369)**	1420-1650
6416 **Tr 9** Layer I HF-8 23-32 **(42156)**	1420-1660
6410 **Area D - EU 44N/40E** Layer III/IV/V HF-106 71-101 cm bd	1430-1530 & 1560-1630
6423 **TU-2** Layer III IV HF-7 12-35 cm bd **(40132)**	1433-1679 & 1710-1752 & 1756-1804 & 1936-1947
6411 **Area B - TU-10** Layer II 18-50 cm bd **(Beta 16365)**	1435-1665
6410 **Area D - EU 40N/38E** Layer IV HF-18 68-69 cm bd **(Beta 171521)**	1440-1660
6411 **TU-1** Layer II 5-16 cm bd **(Beta 44955)**	1442-1668 & 1782-1796
6412 **South trench** Layer I **(Beta 19371)**	1446-1679 & 1740-1752 & 1756-1804 & 1935-1947
6422 **Profile 4** Layer IIIa, b HF-1 55-74 cm bd **(39987)**	1452-1891 & 1908-1950
6423 **TU-5** Layer IIb 53-63 cm bd **(44939)**	1466-1693 & 1776-1812 & 1853-1859 & 1919-1949
6423 **Trench 2** Layer III HF-11 2-42 cm bd **(39994)**	1489-1603 & 1609-1693 & 1726-1813 & 1852-1859
6411 **Area A - TU-24** HF-14 67-105 cm bd **(Beta 16846)**	1490-1670 & 1725-1790
6410 **Area C - TU-16** Layer III 87-97 cm bd **(Beta 16853)**	1495-1800
6410 **Area A - TU-25** Layer II 28-45 cm bd **(Beta 16860)**	1505-1675 & 1710-1805
6410 **TU-6** Layer II 18-25 cm bd **(Beta 16854)**	1510-1680
6411 **Area A - TU-17** Layer II 100-108 cm bd **(Beta 16375)**	1510-1950
6417 **Profile 4** Layer IVa HF-1 **(38713)**	1527-1556 & 1630-1955
6411 **Area A - TU-23** Layer IIa 60-88 cm bd **(Beta 16376)**	1620-1890 & 1910-1950
6411 **Area A - FP-3** HF-18 0-10 cm bd **(Beta 16366)**	1620-1890 & 1910-1950

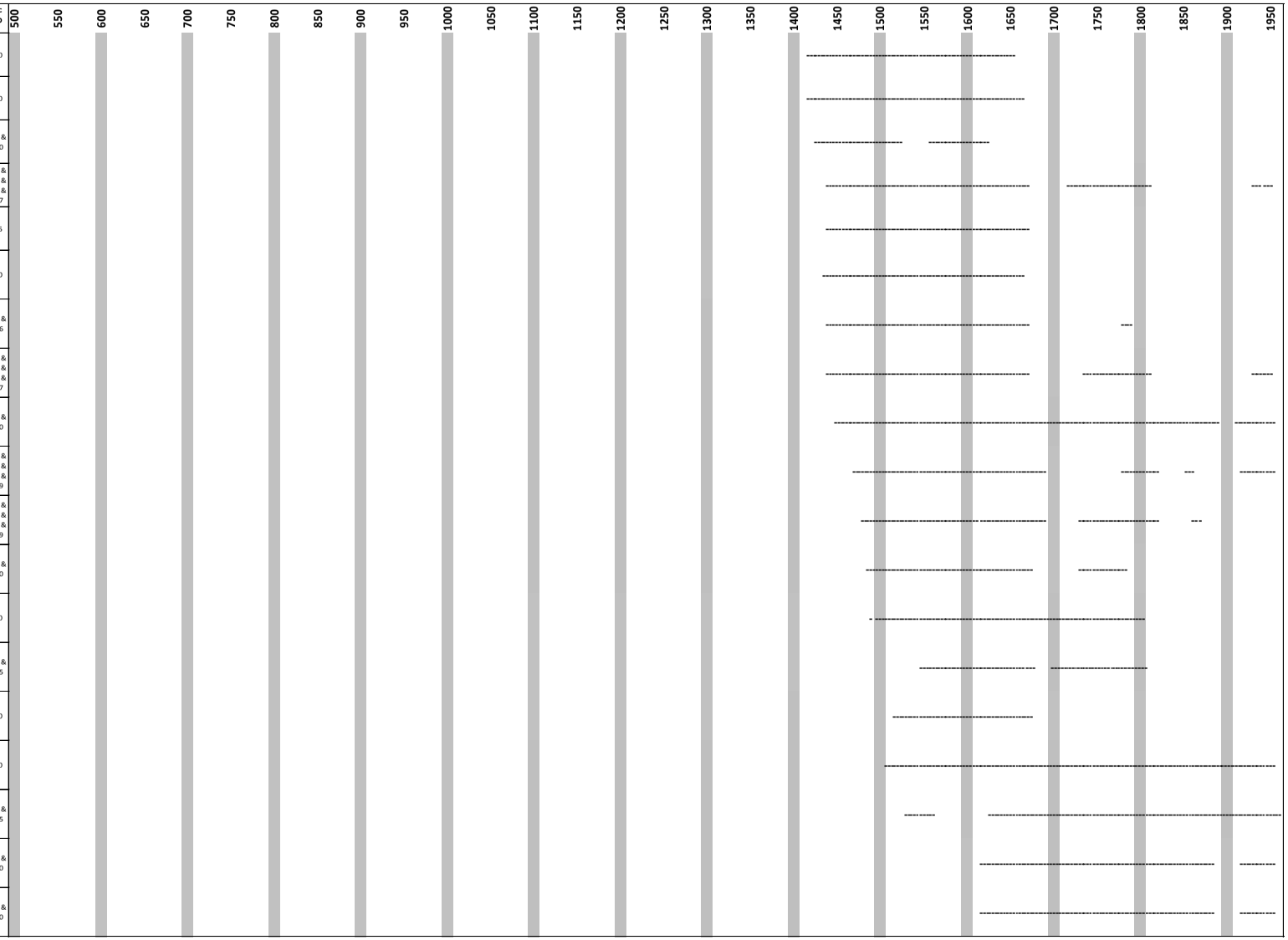
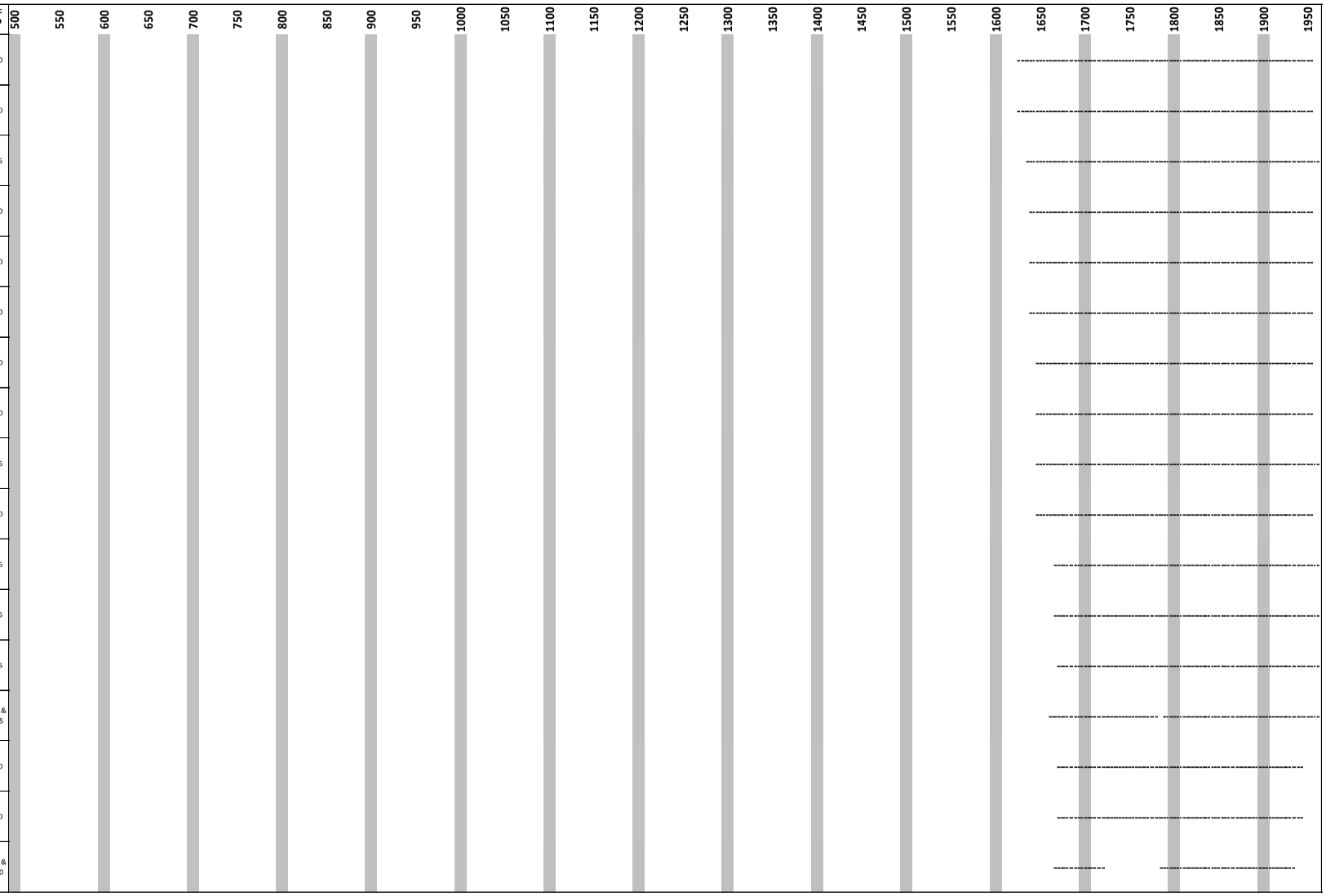


Table 9. Project Radiocarbon Age Determinations Ordered Chronologically (cont.)

Site-Feature	Calendric Years AD
6410 TU-158 Layer II - 12-68 cm bd **(Beta 10633)**	1630-1950
6410 **TU-4** Layer II 13-40 cm bd **(Beta 16856)**	1630-1950
6414 **Trench 1** Layer II **(n/d)**	1640-1955
6410 **TU-8** Layer III **(Beta 16858)**	1645-1950
6411 **Area A - TU-17** Layer III 114-130 cm bd **(Beta 16373)**	1645-1950
6411 **Area A - TU-28** Layer IVb 99-118 cm bd **(Beta 16850)**	1645-1950
6410 **Area A - EU 54N/58E** Layer IIa HF-2 60-70 cm bd **(Beta 171517)**	1650-1950
6410 **Area A - EU 56N/45E** Layer Ib HF-4 **(Beta 171518)**	1650-1950
6416 **Tr 2** Layer II HF-6 5-15 **(42155)**	1650-1955
6411 **Area A - TU-34** Layer II 42-62 cm bd **(Beta 10536)**	1655-1950
6411 **TU-2** Layer II HF-9 38-84 cm bd **(Beta 44960)**	1659-1955
6412 **Auger Core A4** Layer IV **(Beta 16569)**	1659-1955
6411 **TU-2** Layer II HF-8 36-95 cm bd **(Beta 44959)**	1662-1955
6411 **TU-2** Layer I 25-48 cm bd **(Beta 44956)**	1665-1784 & 1789-1955
6410 **Area C - TU-32** Layer I 29-43 cm bd **(Beta 16858)**	1665-1940
6410 **Area C - TU-13** Layer III 46-66 cm bd **(Beta 15859)**	1665-1940
6411 **Area A - TU-19** Layer VIII 45-65 cm bd **(Beta 16731)**	1670-1715 & 1800-1930



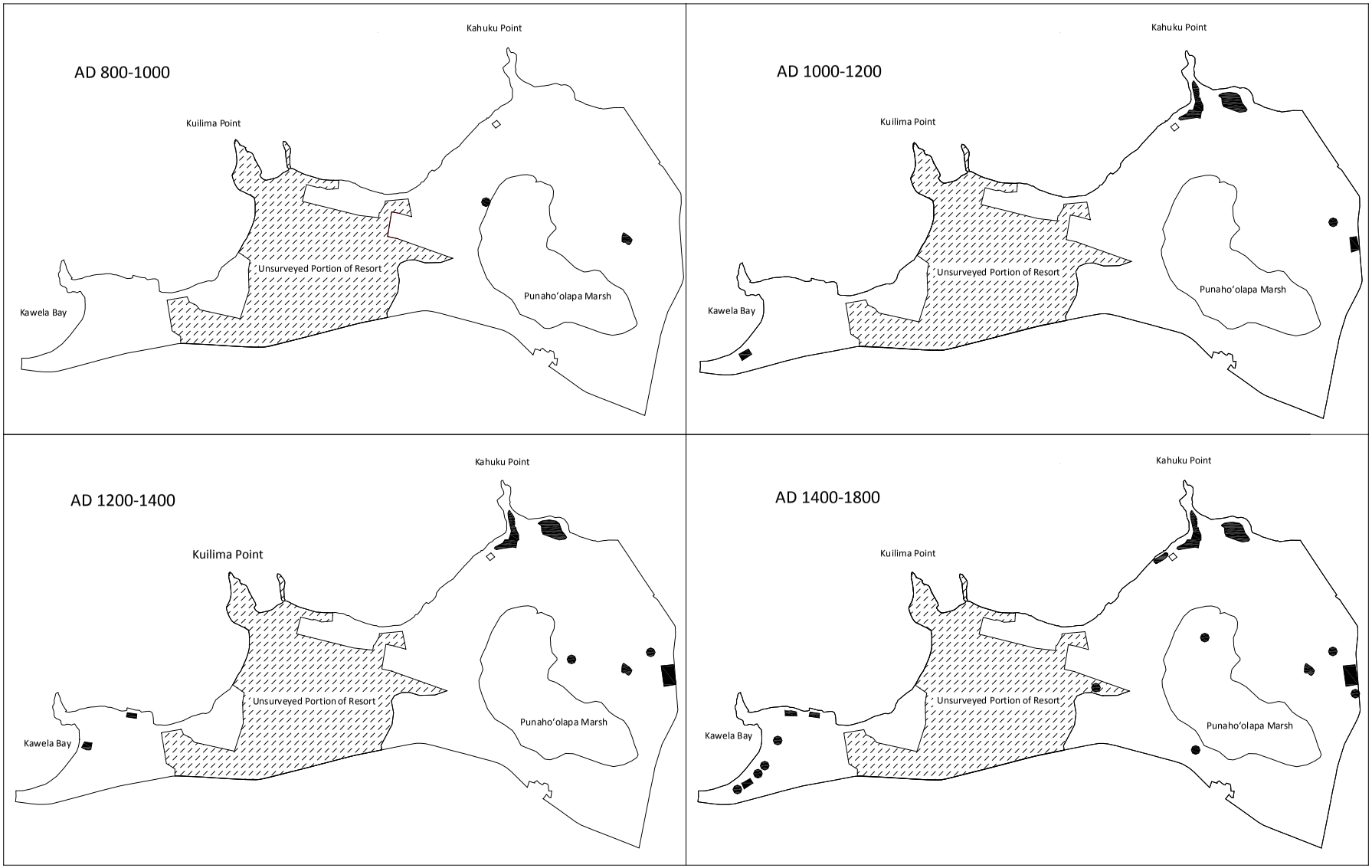


Figure 40. Pre-1800 Chronology of Occupation within Project Area

This developed portion of the property includes portions of the Turtle Bay beachfront, Kuilima Point and the west end of Kaihalulu Beach. The absence of data in this portion of the property should not be used to infer the absence of prehistoric use. Rather, the absence of data reflects the limits of archaeological data, combined with more than a century of agricultural use and subsequent resort development.

Figure 41 presents the distribution of deposits that post-date A.D. 1800, along with other evidence of the historic use of the TBR property. These historic elements consist of Land Commission Awards, the Kahuku Ranch facilities, areas planted in sugarcane, the former location of the OR&L railroad grade and the Kahuku Army Airfield. As indicated by this figure, nearly the entire property was affected by various historic activities and facilities.

SYNTHESIS AND EXPECTED SITE TYPES

Archaeological and historical background research indicates that in late prehistory the Kahuku Point vicinity was well populated and extensively cultivated. There were permanent residences scattered along the coast. Larger settlements were present in areas such as Kahuku and Kawela Bay where sheltered ocean access was available. Temporary habitation, probably associated with agricultural activity and natural resource exploitation, occurred in inland overhangs, caves, and walled shelters. Fishponds were present in sheltered areas and salt was collected from depressions along the shore. Fishing shrines and rock formations of legendary, and probably ritual significance were scattered along the coast.

Heiau were sited on prominent topographic features overlooking the coast. Sand dunes and cliff face caves were used for burial. Agricultural use included cultivation of taro in pond fields wherever topographically suitable locations could be provided with sufficient freshwater. The abundance of fresh water around Punahoʻolapa Marsh provided Ideal conditions for wet taro cultivation with minimal labor investment compared to pond field development of stream drainages. Dryland gardens were present around the coastal residences and on the lower volcanic slopes. Upland areas were also cultivated. Food remains from archaeological excavations include dog, pig, birds, and a wide variety of fish and marine invertebrates, documenting technologies for fishing, collecting, hunting, and animal husbandry. Radiocarbon dates for the area indicate settlement by at least the A.D. 1000s to 1200s with the most intensive use occurring after A.D. 1400.

Observations of Vancouver and early 1800s missionary censuses suggest depopulation affected the region shortly after European contact as postulated by Nakamura (1981). Some depopulation undoubtedly occurred as a result of introduced diseases following the onset of more frequent visits by whalers and missionaries in the early 1800s. However, the disparity in the initial descriptions of a flourishing well-cultivated settlement at Kahuku from Captain Cook's expedition in 1779 and those from Vancouver's fifteen years later in 1794 of a much diminished state of cultivation and population probably predates the onset of disease-inducted population decline. Captain King, who reported the observations during Vancouver's expedition, conjectured that the decline was the result of internal warfare. Another explanation might be that the region was struck by a tsunami. While this would have resulted in a dramatic decline in cultivation of the coastal plain, the effects would rapidly diminish, allowing the area to return to a high level of settlement and cultivation as indicated by mid-Nineteen Century land claim testimony.

More than 100 LCA claims were awarded in the mid-1800s in the area spanning the region from Kawela to Kahuku. Thirty-five LCA claims with at least 24 house lots were awarded in the project area. The LCA testimonies refer to numerous loʻi and cultivated plots of bananas, sweet potatoes, *wauke*, sugar cane, bitter melon, *noni* and an orange tree. Other named plants are *hala* groves and *koa* trees for canoes. A brackish spring and a fishery also are mentioned in the testimonies.

Charles Hopkins purchased 8,000 acres at Kahuku in 1850-1851 from Kamehameha III and established the Kahuku Ranch. Forests were cleared for pasture for free-ranging herds of sheep and cattle, which soon plagued the small Hawaiian farms that were scattered throughout the area, eventually displacing many of the farmers.

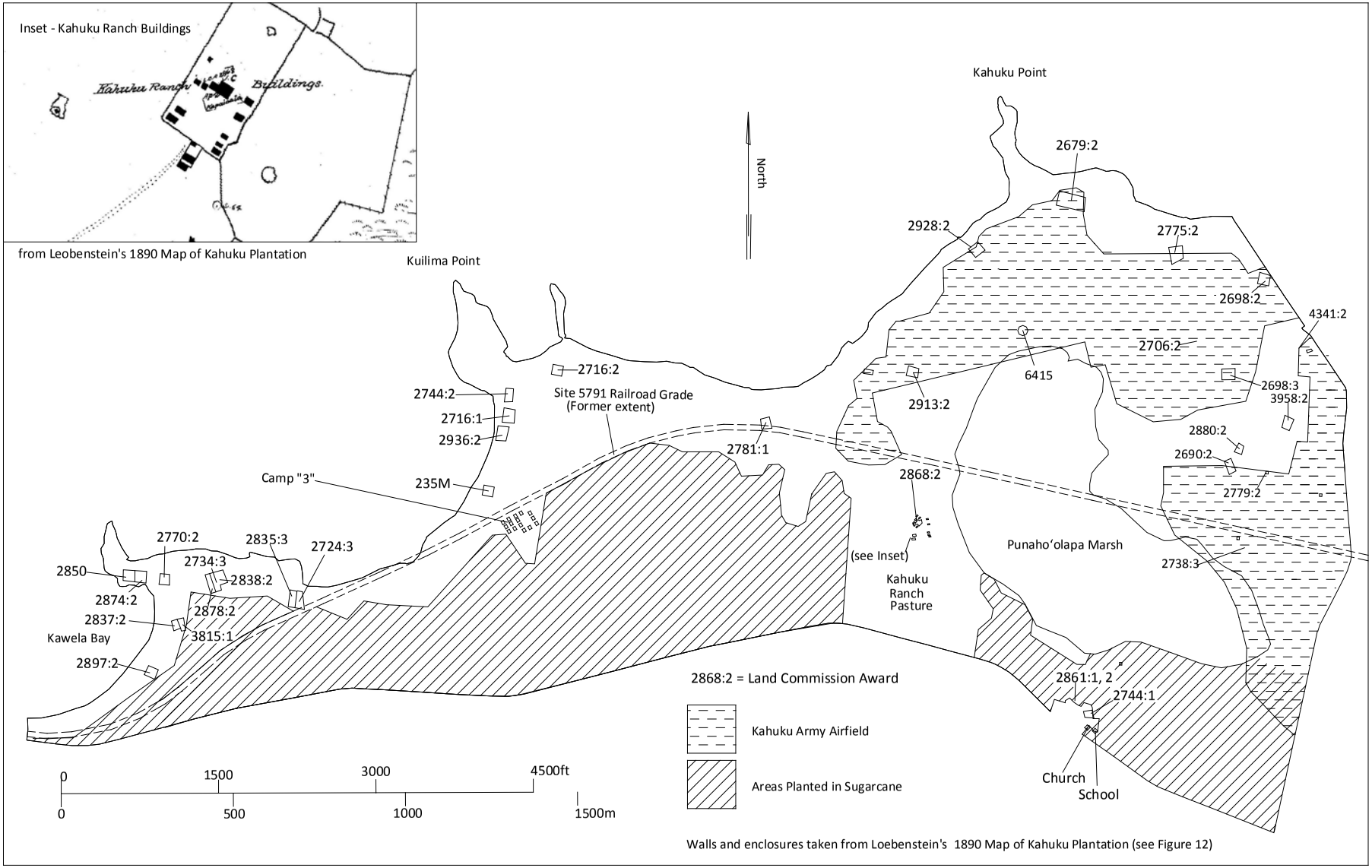


Figure 41. Post-1800 Use of Project Area

By 1856 a carriage road had been completed between Honolulu and Kahuku. The ranch changed ownership several times during the 1860s and 1870s. By 1873 the ranch consisted of 15,000 acres including the lands of Kaunala, Pahipahiʻāula, ʻŌpana 1 and 2, Kawela, Hanakaʻoe, Ōiʻo, Ulupehupehu, Punalau, Kahuku, Mālaekahana, Keana, and part of Lāʻie. In 1874, the ranch was sold to Julius Richardson, who then sold it to James Campbell in 1876 by which time it encompassed nearly 25,000 acres with 3,000 head of cattle and herds of sheep and horses. In 1889, most of the ranch was leased Benjamin Franklin Dillingham who chartered OR&L in the same year. Dillingham then subleased the lands to James Castle who chartered Kahuku Plantation Company in 1890.

The Kahuku Plantation began commercial production of sugarcane relying on water from springs, streams and rain for irrigation, but this was soon considered insufficient and artesian wells were drilled to augment the irrigation water supply. The first sugarcane crop from 2,800 cultivated acres was harvested in 1892. By 1899, the OR&L railroad line extended from Honolulu to Kahuku to get the cane to market. By the early 1900s there were stations at Kawela and Kahuku Ranch. Marconi Station was located just east of the property at Punamanō Marsh. By 1935, 4,490 acres were cultivated in sugarcane and the plantation employed over 1,100 workers. A plantation camp was established on the TBR property to house plantation workers by at least 1932.

In addition to sugarcane, pineapples were also cultivated beginning in the 1930s at Kahuku Plantation and on lands leased by the OR&L Railroad Company including small tracts leased to Japanese farmers. When the farmers' leases expired Kahuku Plantation leased large tracts of land to the California Packing Corporation (CPC), driving out the smaller farmers. The CPC became Del Monte Corporation in 1967.

The U.S. Army established Kahuku Army Airfield in 1942. The airfield encompassed runways, taxiways, revetments, bunkers, emplacements, barracks and support facilities. The facility served as an auxiliary field used for flight training and costal defense. Use of the airfield was short-lived and military use ended shortly after the end of World War II (September, 1945). The April 1946 tsunami devastated much of the facility shortly after the Army abandoned it. Subsequent use of the airfield runways included civilian aircraft and auto racing.

Sugarcane cultivation continued until 1971 when the Turtle Bay Resort and golf course were constructed. Some inland portions of the property continued to be used for vegetable faming until the late 1980s. Private beach cottages lined the east shores of Kawela Bay until 1990 when the area was cleared and preliminary construction for a hotel began, but was abandoned in 1991.

Based on previous archaeological research and historical documentary evidence, expected prehistoric to early historic remains in the project area include subsurface cultural deposits and a variety of subsurface features including fire pits, post molds for residential structures, and burials. Some cultural deposits will predate A.D. 1400, but most features will date between A.D. 1400 and 1800. Expected historic remains dating to the 1800s to 1900s include the OR&L railroad, plantation infrastructure (camps, roads, irrigation ditches, etc.) and walls marking property boundaries and serving to control livestock. Military-related remains dating from World War II will include runways, revetments, defensive fortifications and a variety of support facilities.

RESEARCH DESIGN

Professional archaeologists who meet or exceed the State of Hawaiʻi and U.S. Secretary of the Interior's qualifications will supervise the proposed SAIS work. Alan Haun, Ph.D. will function as the Principal Investigator for the SAIS project. Haun has conducted work in Hawaiʻi since 1978. Prior to founding Haun & Associates in 1999, he was the Senior Archaeologist for PHRI for 15 years. During his tenure with PHRI, Haun oversaw archaeological testing, data recovery and monitoring fieldwork on the TBR property between 1986 and 1990. As the firm's Principal Archaeologist, Dr. Haun will be directly involved with all aspects of project performance.

Other staff will include Haun & Associates' laboratory director and curation specialist Dianne Berrigan, M.A., project supervisors Juliana Kailihiwa, B.A. and Solomon Kailihiwa III, B.A. and Jack Dave Henry, B.S. who is responsible for fieldwork, AutoCAD drafting and preparation of technical reports. Henry also worked in a supervisory capacity during the PHRI data recovery and monitoring work in 1990-1991. The SAIS fieldwork would be completed within approximately two months following DLNR-SHPD approval of the SAIS plan.

The proposed primary fieldwork effort will consist of subsurface testing that will build on the extensive previous archaeological work that has been conducted on the property. Areas proposed for further testing and described below were previously cleared for development, with the stipulation that a professional archaeologist would monitor construction. This provision was based on the results of extensive archaeological subsurface testing and data recovery work conducted between 1977 and 1991, and on the extensive prior disturbance to the property by more than a century of sugarcane cultivation, the construction and operation of Kahuku Air Airfield, and the post-1971 development of resort facilities.

Despite prior archaeological clearance, TBR has elected to take a proactive approach to ensure the protection of cultural resources within the proposed expansion lands as part of the SEIS process. Toward that end a combined program of extensive systematic and discretionary archaeological test excavations, both mechanical and manual, are proposed for all areas within the resort property where substantial construction-related excavations are planned.

Figure 42 depicts the extent of proposed test excavation areas, labeled Test Areas A-G, on an aerial photograph of the TBR property. The majority of areas excluded from testing are already developed with golf courses and other resort facilities. Most of the proposed test areas are densely vegetated with *koa haole*, ironwood, Christmas berry and *hau*. Two forested areas, a proposed hotel site at Kawela Bay and a proposed golf clubhouse site in the central coastal portion of the property overlooking Kaihalulu Beach were graded to bedrock and filled during construction activity in 1990-1991. These areas are considered to lack any potential for significant intact subsurface cultural remains.

Figure 43 is an overlay of the proposed test excavation areas on the updated TBR master plan preferred alternative map. The combined test area extent is 173.2 acres. Test areas are located where future development is planned. No additional testing is proposed for parks and other open spaces where development impacts are anticipated to be minimal, primarily consisting of landscaping that would have very shallow, less than 1 ft (30 cm) deep impact. All ground disturbing activity in the open space areas would be subject to archaeological monitoring done in accordance with a new Monitoring Plan prepared for SHPD review and approval.

Portions of the proposed test areas were sampled during the PHRI survey in 1984 (Bath *et al*. 1984) and during the subsequent intensive survey and testing projects at Kahuku Point and Kawela Bay (Walker *et al*. 1988a, 1988b); however, testing generally was limited to widely spaced small diameter (10-15 cm) auger tests. Data recovery excavations at sites identified during monitoring (Corbin 2003) were conducted in the vicinity of SAIS Test Areas D and E. Several burials were inadvertently discovered in SAIS Test Area C (Kennedy 1992; Carson *et al*. 1996, 1999).

Figure 42. Aerial View of Project Area showing Proposed Test Excavation Areas

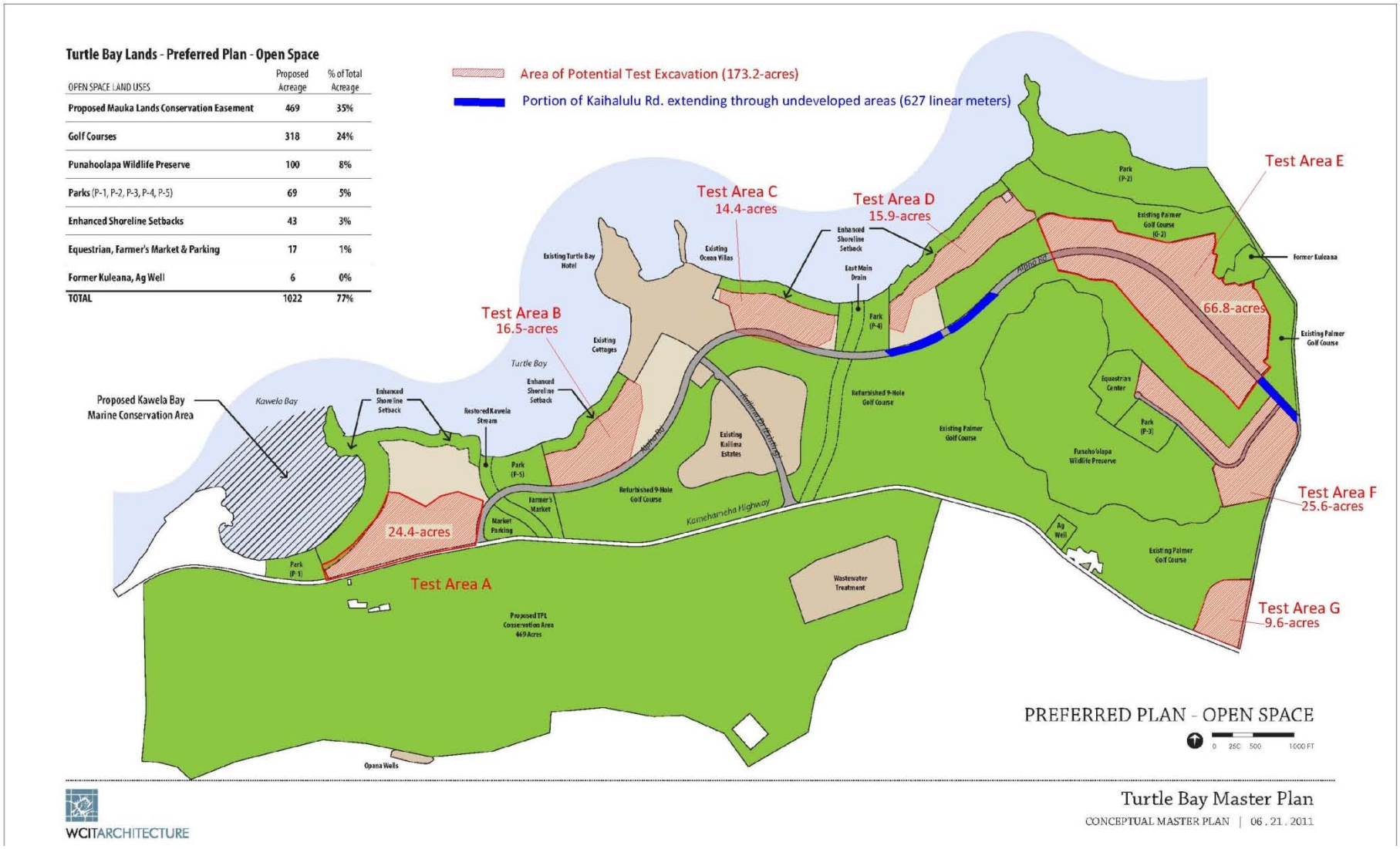


Figure 43. Potential Test Excavation Areas and Turtle Bay Lands - Preferred Plan - Open Space Lands

Previous archaeological studies for the TBR property have established the higher potential for encountering subsurface cultural remains including burials in mapped Jaucus Sand and Pearl Harbor Clay deposits (*Figure 44*). It is proposed that these two soil types will be subject to higher intensity testing. Lower intensity testing is proposed for the various clay and loam soil types elsewhere on the TBR property.

Backhoe-excavated trenches will be systematically placed along a series of uniformly spaced transects. A test trench density of two 5 m (16 ft) long trenches per acre for high-intensity testing and one trench per acre for low-intensity testing is proposed (*Figure 45*). *Figures 46 through 59* (at end of Consultation section) depict the proposed test areas. There are two figures for each area. The first shows the distribution of soil types and depicts previous test excavations within, or adjacent to each test area. The results of prior testing are presented in a tabular inset that shows one or more typical stratigraphic profiles for each area derived from the previous testing data. Stratigraphic information includes layer designation, layer thickness, Munsell color, sediment texture and soil type. The second figure for each test area depicts historic land use and the proposed placement of systematic test trenches. Also shown are proposed discretionarily placed trenches designed to sample areas missed by the systematically placed trenches, where subsurface deposits could potentially be present based on documented past land use or previous archaeological work.

Low density testing, consisting of 35 trenches, is proposed for the 24.4 acres of Waialua/Mokulei Clay soils at Kawela Bay (Test Area A; see *Figures 46-47*) and the residential housing area (Test Area G, 9.6 ac; see *Figures 58-59*). Five additional discretionary trenches will be placed along the northwest margin of Test Area A where Jaucus Sand deposits are present.

The remaining test areas consist of Jaucus Sand and Pearl Harbor Clay soils, where high-intensity testing will consist of a test trench density of 2 trenches per acre (139.2 ac = 279 trenches). The systematic sampling strategy would yield excavation and examination of a total of 314 trenches including both high and low density test areas.

Additional trenches for discretionary placement will be used for:

- Specific areas that might be missed by the systematic transect trenching such as LCAs (see *Figures 49 and 55*);
- The location of former plantation worker housing (Camp 3; see *Figure 49*);
- Areas were subsurface cultural remains were documented by previous archaeological studies (see *Figures 51 and 53*);
- Segments of the proposed Kaihalulu Drive outside the potential test excavation areas that are undeveloped (see *Figure 43*); and
- Defining the extent of subsurface cultural deposits identified in the systematic trenches.

Prior archaeological excavations in and adjacent to **Test Area A** reached a maximum depth of 1.15 m below surface with no cultural layers identified (see *Figure 47*). The prior testing identified two to three non-cultural sand layers in the seaward portion of Area A and three non-cultural sandy clay and clay loam layers in the inland portion. Evidence of plowing was observed in the eastern portion of the area where the test excavations reached the water table. The plow zone is a 0.35 m thick clay loam underlain by two layers of sand. Five discretionary trenches will be excavated along the northwest margin of this low density test area due to the presence of sand deposits (see *Figure 48*). Two of these discretionary trenches will test areas adjacent to LCA parcels.

No cultural layers were observed in prior excavations conducted adjacent to the west side of **Test Area B**. These excavations extended to a maximum depth of 2.1 m below surface exposing 3-4 layers of sand (see *Figure 48*). At least two discretionary trenches will be excavated in the eastern portion of the area where an LCA parcel (LCA 235M) and Kahuku Plantation Camp 3 were formerly located (see *Figure 49*).

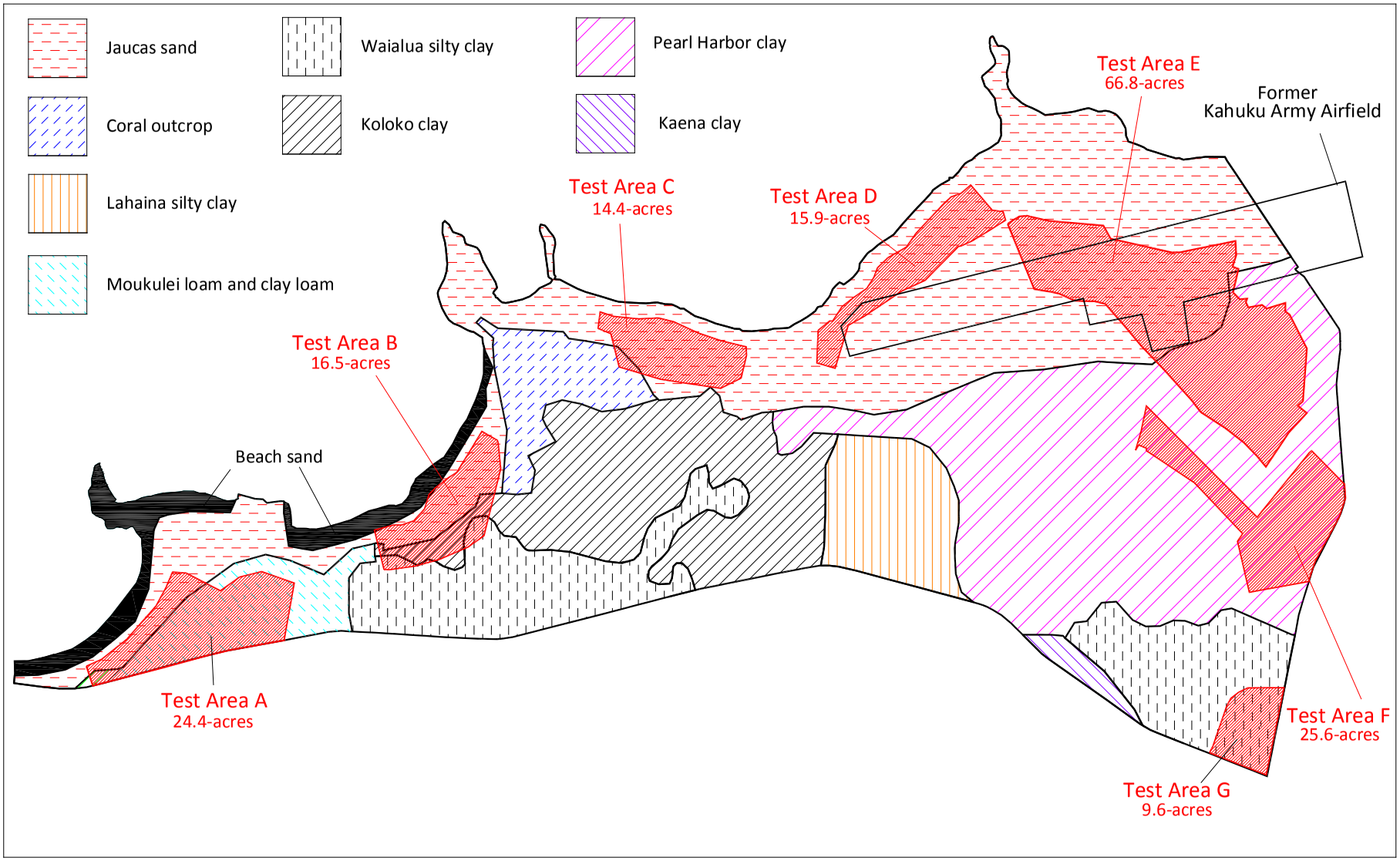


Figure 44. Potential Test Excavation Areas and Distribution of Soils within Project Area

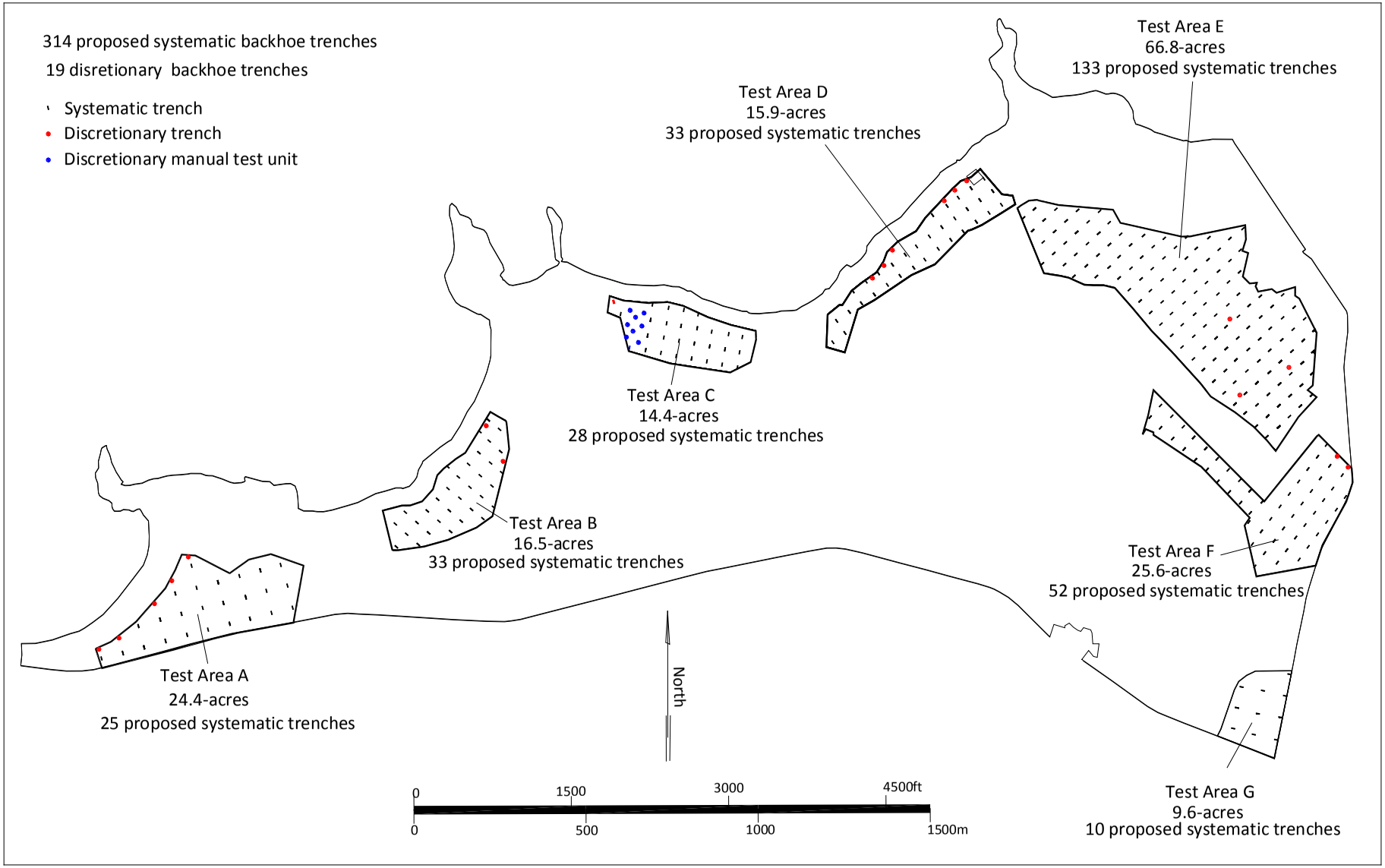


Figure 45. Proposed Test Areas and Trench Locations

Previous excavations in **Test Area C** documented three sand layers extending to a depth of 2.1 m below surface (see Figure 50). These sand deposits were highly disturbed with mixed prehistoric and modern debris. Site 4488, where several burials were recovered, is located in the western portion of this test area. Eight or more test units will be excavated in the vicinity of the site (see Figure 41). These test units will be excavated manually until the stratigraphy in this area is well documented and the potential for encountering additional burials is evaluated. Manually excavated fill will be screened with 1/8th-inch mesh to recover cultural remains. If no burials are identified, then mechanical excavation of the surrounding systematically-placed trenches will proceed. If a burial is identified all work in the immediate vicinity will cease and the procedures discussed below will be followed. A discretionary trench will also be excavated at the west end of Area C.

Previous excavations within and adjacent to **Test Area D** documented multiple (2-6) sand layers extending to a maximum depth of 1.6 m below surface (see *Figure 52*). An intact cultural deposit was indentified at the northeast end of the area (Site 6411, Area C), consisting of black loamy sand that varied in depth from 1.16 to 1.41 m. The central portion of Area D contains highly disturbed sand deposits with at least some cultural material, although Corbin (2003) does not indicate which layer(s) contained cultural material. The southwest portion of Test Area D was characterized by two non-cultural sand layers. At least three discretionary trenches will be excavated in the eastern and central portions of the Test Area to further examine the previously identified cultural deposits (see *Figure 53*).

Previous excavation in and adjacent to **Test Area E** attained a maximum depth of 3.6 m below surface. Most of the test excavations reached bedrock. An intact cultural layer was identified in the southeast portion of the area (Site 6414; see *Figure 54*). This deposit consists of dark brown silty clay loam that varies in depth from 0.59 to 0.89 m. Remnant wetland deposits are present at the northwest and west ends of the area, where soils were impacted by airfield construction at the northern end. Relatively shallow Pearl Harbor Clay deposits border Area D to the east, west and south. At least three discretionary trenches will be excavated in this Test Area in the locations of three former LCA parcels (LCA 2698:3, 2880:2, and 3958:2; see *Figure 55*). Additional discretionary trenches may be excavated in the vicinity of Sites 6414 and 6417 if the systematically placed trenches near these sites do not encounter cultural material.

Prior excavations adjacent to **Test Area F** extended to a maximum depth of 4.93 m below surface. Most of these excavations extended to bedrock or the water table. Stratified cultural deposits were identified in excavations adjacent to the northeast end of the area (Site 6422; see *Figure 56*). The upper cultural deposit consists of a very dark grayish brown silty clay loam that is 0.12 to 0.31 m in depth. It is directly underlain by a brown silty clay loam cultural layer that is 0.31 to 0.42 m in depth. At least two discretionary trenches will be excavated next to the reported location of these deposits (see *Figure 57).* Remnant wetland deposits associated with Punahoʻolapa Marsh are located west of the area and non-cultural Pearl Harbor Clay is present to the north and northwest.

No previous excavations were conducted in or near **Test Area G**; the closest test excavations consist of two cores located more than 100 m to the northwest (see *Figures 58* and *59*). These cores extended to a depth of 3.6 m and identified multiple layers of loam, clay and silt with an intervening peat layer. No cultural deposits were present.

When cultural deposits are encountered mechanical excavation will be suspended and further excavation will be conducted manually with shovels or trowels, as appropriate, to determine the horizontal extent of the deposit in the trench. Additional mechanically and manually excavated trenches would surround the trench where cultural deposits are exposed, halfway between the trench where the deposit is identified and the next systematic trench on all four sides. Additional trenches or manually excavated test pits will be used to fully define the horizontal extent of any subsurface cultural deposit.

In areas where previous archeological studies have identified remnant cultural deposits and subsurface features (post molds, fire pits and burials), and for subsurface deposit extent determination testing, a combination of mechanical and manual excavation techniques would be employed. Mechanized equipment will be used to remove non-cultural deposits overlying intact cultural deposits, followed by manual excavation methods to

determine the vertical extent of the cultural deposit. Fill from manually excavated cultural deposits and will be screened with 1/8th-inch mesh to recover cultural remains. After the cultural deposit is excavated within the trench additional mechanical excavation will be used to reach the water table or bedrock to determine if deeper cultural deposits are present.

Extensive vegetation clearing of test trench transects will be required prior to backhoe trench excavation. This can best be accomplished by using a mechanical flail attachment on an excavator. Use of this device reduces the vegetation to mulch that is broadcast over the ground surface eliminating the need for collection and removal. Trench excavations will be carefully monitored in the event that human remains or cultural deposits are encountered. Trenches will be excavated deeply enough (usually to the water table or limestone bedrock) to ensure that all buried cultural deposits are observed. Trench dimensions will be compliant with appropriate Occupational Safety and Health Administration (OSHA) standards.

Upon completion of each backhoe trench excavation, a representative trench face will be manually scraped to aid in recording the stratigraphy. The face will then be profiled and described using Munsell soil colors and U.S. Soil Conservation Service terminology and the GPS coordinates of all profiles will be recorded. Artifacts, food remains and charcoal samples will be collected from the trench walls as appropriate and the GPS coordinates of all collections will be documented. The completed trench will be photographed and immediately backfilled.

Another fieldwork task will consist of the relocation and potential documentation of specific sites previously identified on the TBR property. As discussed in a preceding section, the current disposition of seven sites needs to be determined. These consist of sites that were assigned SIHP site designations and those that have not (see *Table 6*). The SIHP sites consist of the Site 5791 OR&L railroad grade, the Site 6421 walled pool, and the Sites 6424 and 6426 rock walls. Sites with no SIHP site designation consist of remnants of the Kahuku Army Airfield, including the Site T-4 military structure, the Site T-2 wall and the Site T-3 cattle enclosure. The reported locations of these sites will be examined and if any are extant, they will be fully documented.

Site documentation will consist of preparation of scaled plan maps, photographic documentation, preparation of standardized site and feature forms, and evaluation of site condition and physical integrity. The location of any surface or subsurface sites or features identified during the SAIS will be determined with the aid of a hand-held Magellan Mobile Mapper Global Positioning System (GPS) device using the NAD 83 datum. The accuracy of this GPS device for a single point is less than one meter. Sites identified during the survey will be marked and their locations plotted on a scaled project area map. If any burials or subsurface features are identified that require in-place preservation, their locations will be plotted by a licensed land surveyor.

SHPD staff will be periodically briefed on the SAIS fieldwork findings and status. The agency and TBR management will be notified immediately in the case of any unusual or highly significant findings. If human remains are identified during the fieldwork, all work in the vicinity of the find will cease and the proper authorities, including DLNR-SHPD and TBR, will be contacted immediately. No further work including screening of fill, cleaning or excavating the remains, or other investigation in the immediate vicinity will take place until agency consultation is completed, except measures necessary to protect the remains from the elements and other disturbance. Following initial agency consultation and approval, the remains will be reburied or otherwise protected to ensure the safety and security of the remains until appropriate treatment is determined. All remains will be treated as "previously identified" in accordance with HAR §13-13-300-31(b). Appropriate treatment will be determined through the preparation of a Burial Treatment Plan for review and approval by the DLNR-SHPD and the Oʻahu Island Burial Council (OIBC).

Following completion of fieldwork, analysis of all recovered remains and data will use standard archaeological methods. All recovered artifacts will be analyzed to determine morphological type, condition/degree of completion and material. Metric measurements will include weight, length, width, and thickness. Standard typological classifications will be used for all artifacts. Food remains will be identified to the Family level, or to the Genus/species level, when possible. Quantitative analysis will include a determination of total weight and total number of fragments (TNF) per taxon. If suitable charcoal samples are recovered that have the potential to

contribute to the extensive chronology that has been developed for the project area, they will be submitted to Beta Analytic, Inc. for analysis.

The resulting data will be presented in a draft SAIS Report in conformance with regulatory agency requirements for archaeological inventory survey reports contained in HAR §13-13-276-5. The draft report will include significance assessments and specific recommendations for any further archaeological work.

CONSULTATION

This SAIS Plan will be prepared in consultation with DLNR-SHPD and the Office of Hawaiian Affairs (OHA). The consultation will ensure that the work complies with applicable laws, regulations and rules. This consultation also will ensure that the Plan reflects a mutually acceptable scope of work for the SAIS fieldwork prior to implementation. Consultation with the OIBC is planned to provide an informational briefing regarding the SAIS work, to solicit input regarding the study, and to identify additional interested parties.

The consultation process, which is an ongoing process that will continue concurrently with the SAIS tasks, also will require input from interested organizations and individuals, including the local community, Hawaiian cultural organizations, recognized lineal and cultural descendants, and individuals knowledgeable about the TBR property cultural resources and land use history. This interested party consultation is part of the ongoing Cultural Impact Assessment (CIA) work currently in preparation by Pacific Legacy, Inc. for the TBR property and is being conducted in accordance with HAR §13-13-284-(c)-(3) and §13-13-276-5-(g). Results of the consultation process will be incorporated into the SAIS Report.

Consultation already has included TBR management meetings with the Kahuku Burial Committee, composed of families who have a connection to TBR lands and who have expressed a desire to take an active role in caring for ancestral remains on the property. Consultation also has included TBR management meetings with OHA and with the Koʻolauloa and Koʻolaupoko Hawaiian Civic Clubs. TBR management has invited cultural practitioners, *kūpuna*, and knowledgeable individuals to be part of a cultural advisory council to share their *mana'o* on the cultural issues and opportunities associated with TBR.

Public notices seeking to identify interested parties, including lineal and cultural descendants, have been published in Honolulu Star-Advertiser (May 5, 2011) and the monthly OHA newsletter *Ka Wai Ola* (June 2011; APPENDIX A). Two responses to the notices were received, including one individual who owns a *kuleana* parcel within the TBR property.

Profile	Layer	Depth (cm)	Color	Texture	Soil Type
1	I	0-75	Pale brown	Very fine sand	Jaucus sand
	II	75-140	Light grey	Very fine sand	
2	I	0-90	Reddish brown to dark reddish brown	Sandy clay loam	Mokulei loam and Clay loam
	II	90-100	Yellowish red	Sandy clay loam	
	III	100-115	Yellowish red	Sandy clay	
3	I	0-35	Dark brown to dark reddish brown	Clay loam - Plow zone	Mokulei loam and clay loam
	II	35-80	Yellowish red	Calcareous sand	
	III	80-90	Very pale brown	Calcareous sand	

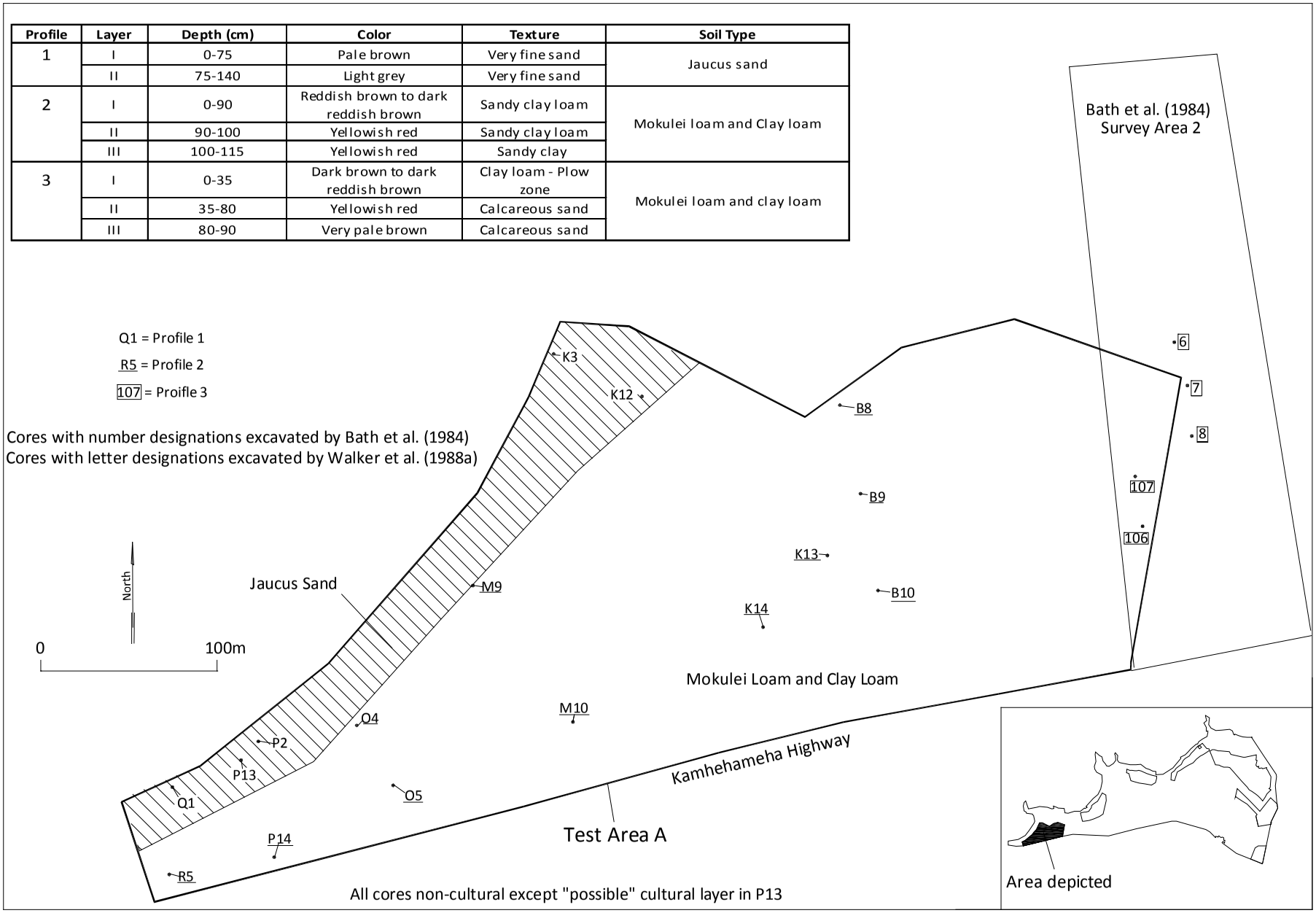


Figure 46. Test Area A, Soil Types and Previous Testing Results

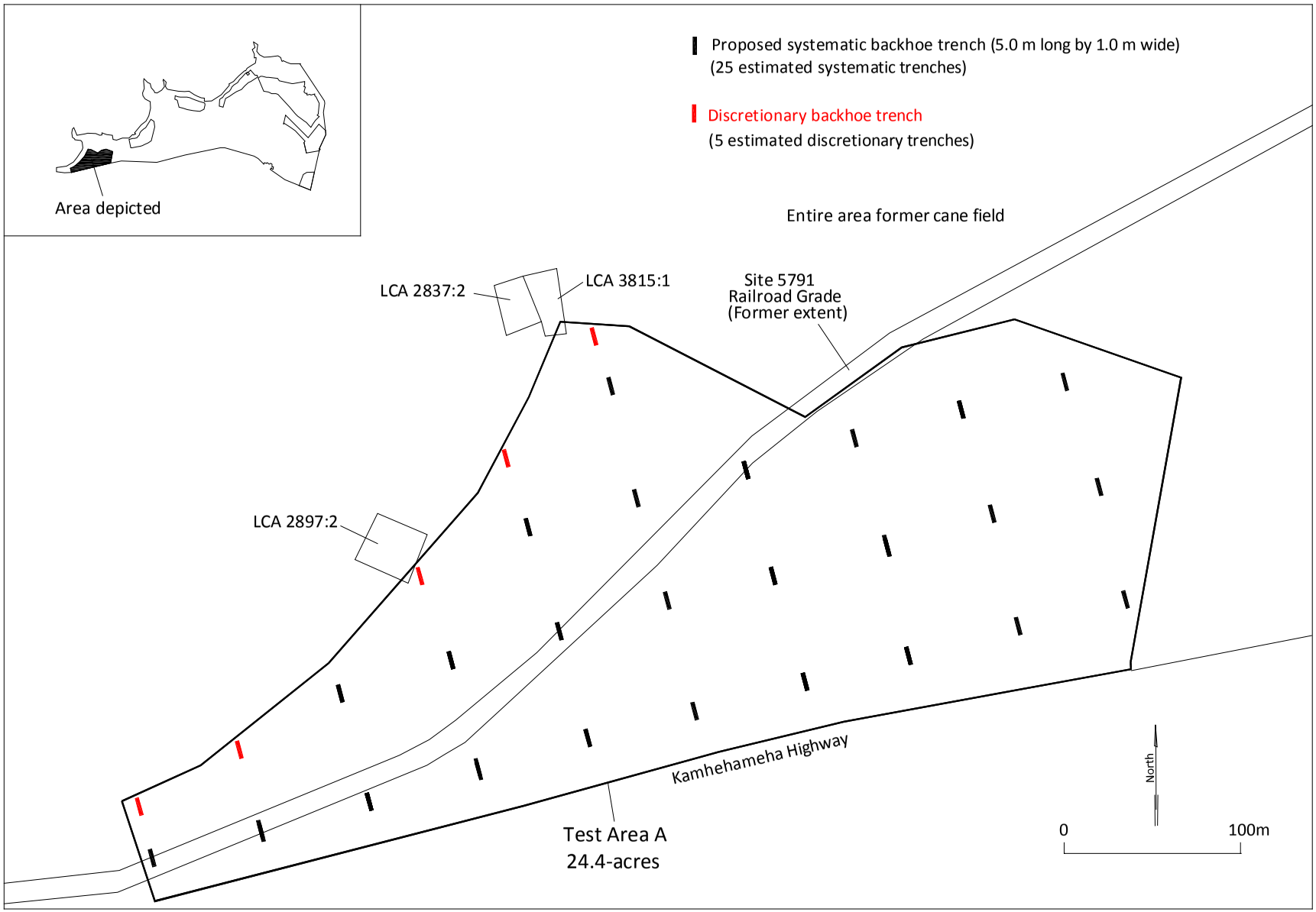


Figure 47. Test Area A, Proposed Trench Locations and Historic Land Use

Profile	Layer	Depth (cm)	Color	Texture	Soil Type
1	I	0-80	Dark brown to brown	Very fine sand	Jaucus sand
	II	80-120	Very pale brown to pinkish white	Fine sand	
	III	120-210	Very pale brown to pink	Very fine to fine sand	
2	I	0-50	Dark brown to brown	Very fine sand	Jaucus sand
	II	50-80	Dark buried A horizon		
	III	80-120	Very pale brown to pinkish white	Fine sand	
	IV	120-210	Very pale brown to pink	Very fine to fine sand	

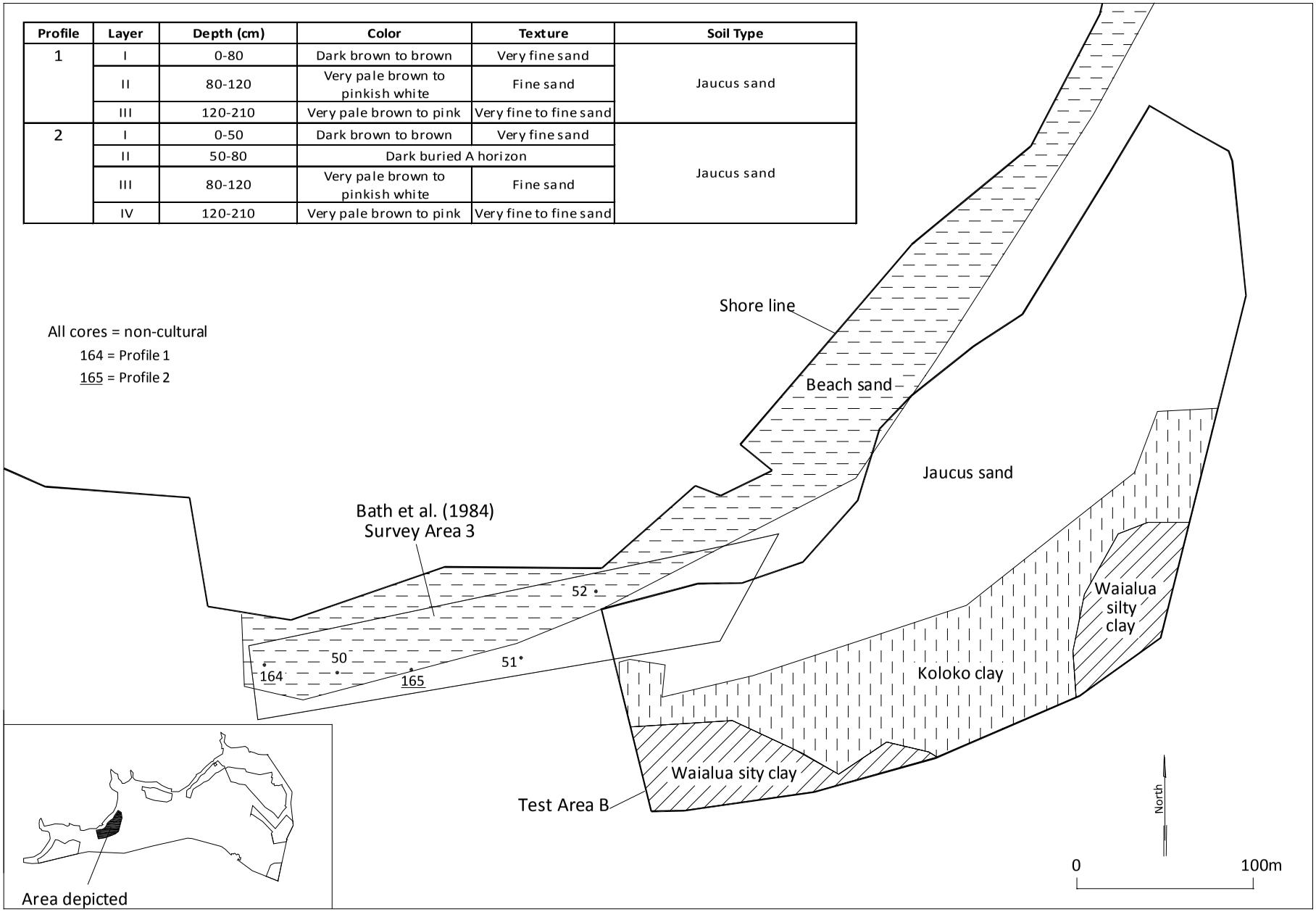


Figure 48. Test Area B, Soil Types and Previous Testing Results

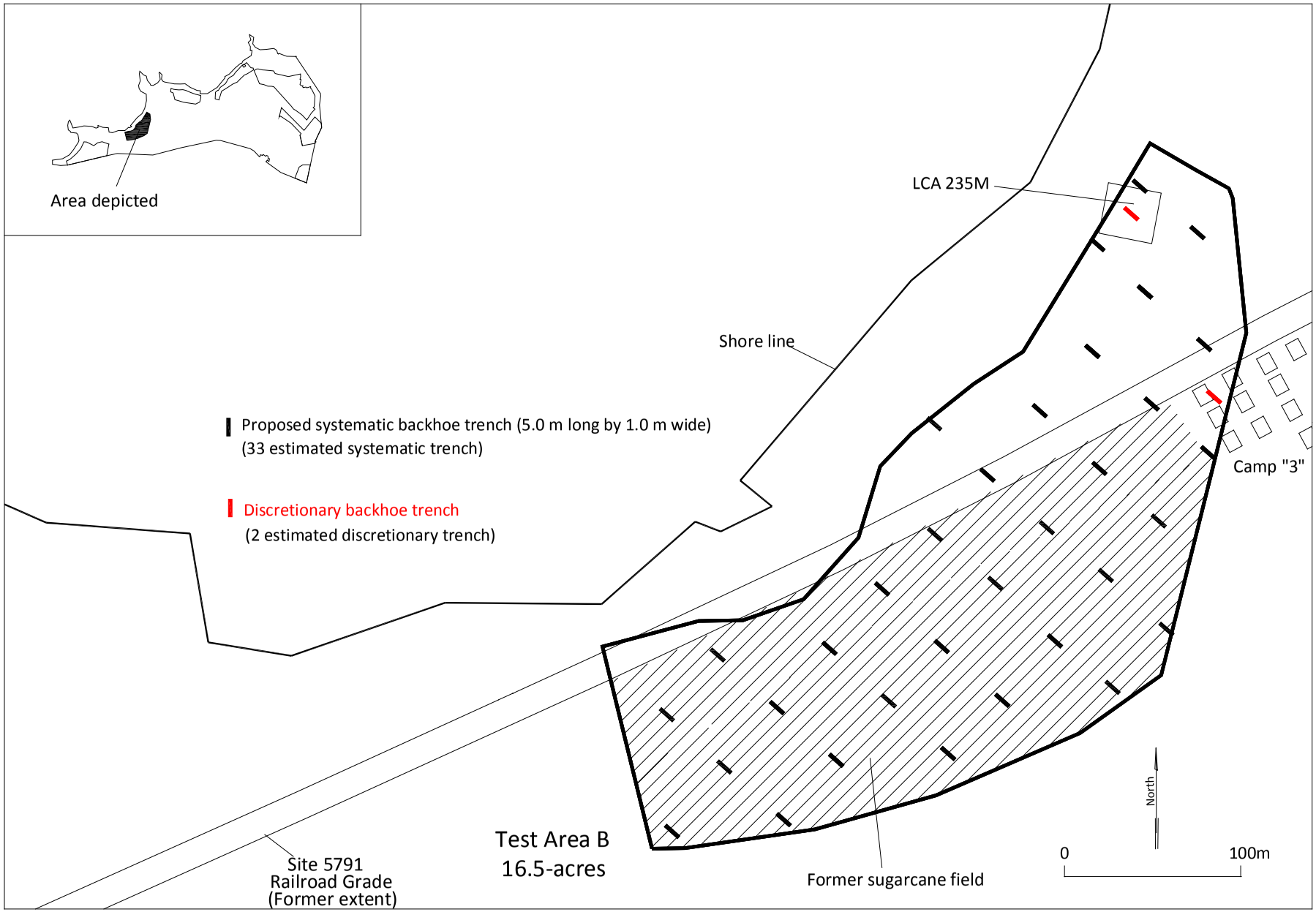
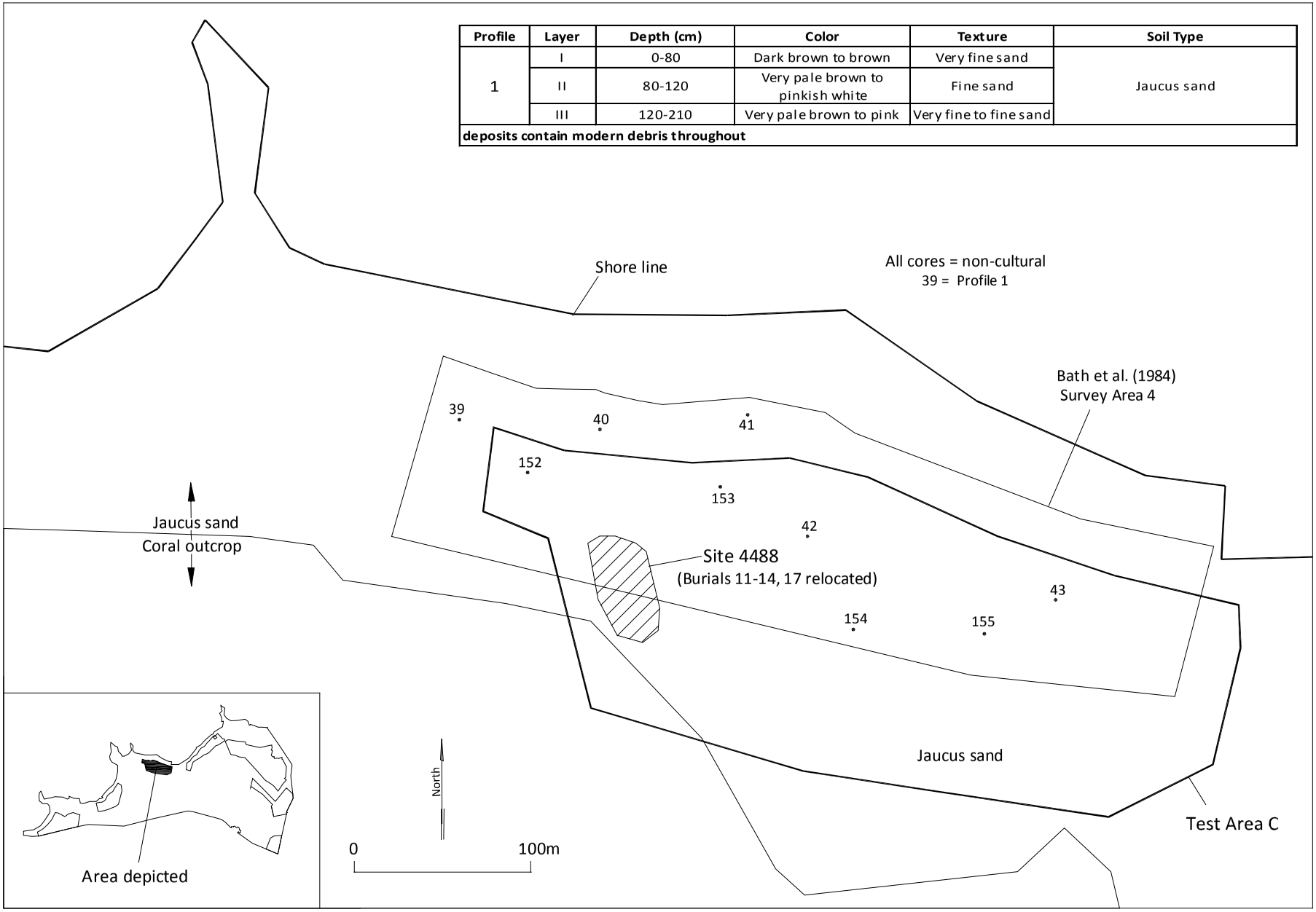


Figure 49. Test Area B, Proposed Trench Locations and Historic Land Use



Profile	Layer	Depth (cm)	Color	Texture	Soil Type
1	I	0-80	Dark brown to brown	Very fine sand	Jaucus sand
	II	80-120	Very pale brown to pinkish white	Fine sand	
	III	120-210	Very pale brown to pink	Very fine to fine sand	
deposits contain modern debris throughout					

Figure 50. Test Area C, Soil Types and Previous Testing Results

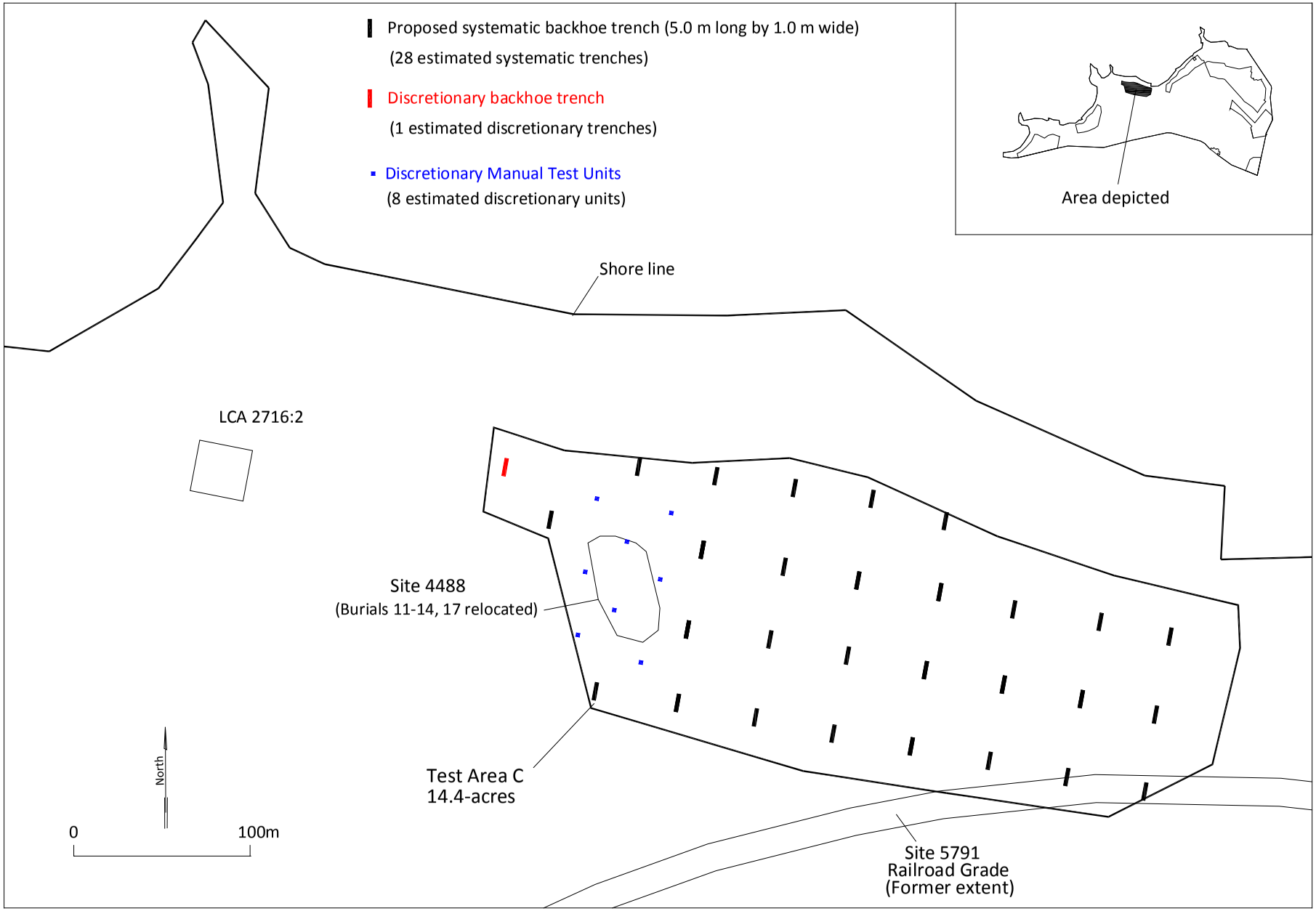


Figure 51. Test Area C, Proposed Trench Locations and Historic Land Use

Profile	Layer	Depth (cm)	Color	Texture	Soil Type
1	I	n/d	n/d	Aoelian sand	Jaucus sand
	II	n/d	n/d	n/d	
	III	n/d	Grayish black	n/d	
	IV	100	n/d	Sterile beach sand	
2	I	n/d	Light brown	Sand	Jaucus sand
	II	250	White	Sand	
3	I	0-30	Very pale brown	Sand	Jaucus sand
	II	30-44	Brown to dark brown	Loamy sand	
	III	44-78	Very pale brown	Very fine sand	
	IV	78-116	Yellowish brown	Loamy sand	
	V*	**116-141**	**Black**	**Loamy sand**	
	VI	141-160	Very pale brown	Very fine sand	
*** = Cultural layer**					
4	I	n/d	Very dark brown	Loamy fine sand	Jaucus sand
	II	n/d	Light brownish gray	Course sand	
	III	n/d	Pale brown	Course sand	
	IV	n/d	Pale brown	Very fine sand	
	V	n/d	Grayish brown	Very fine sand	
	VI	n/d	Pale brown	Very fine sand	
	VII	n/d	Grayish brown	Very fine sand	
	VIII	n/d	Brown	Very fine sand	
	IX	n/d	Very dark grayish brown	Very fine sand	
	X	n/d	Very pale brown	Very fine sand	
	XI	n/d	Very pale brown	Very fine sand	
Highly disturbed deposit					

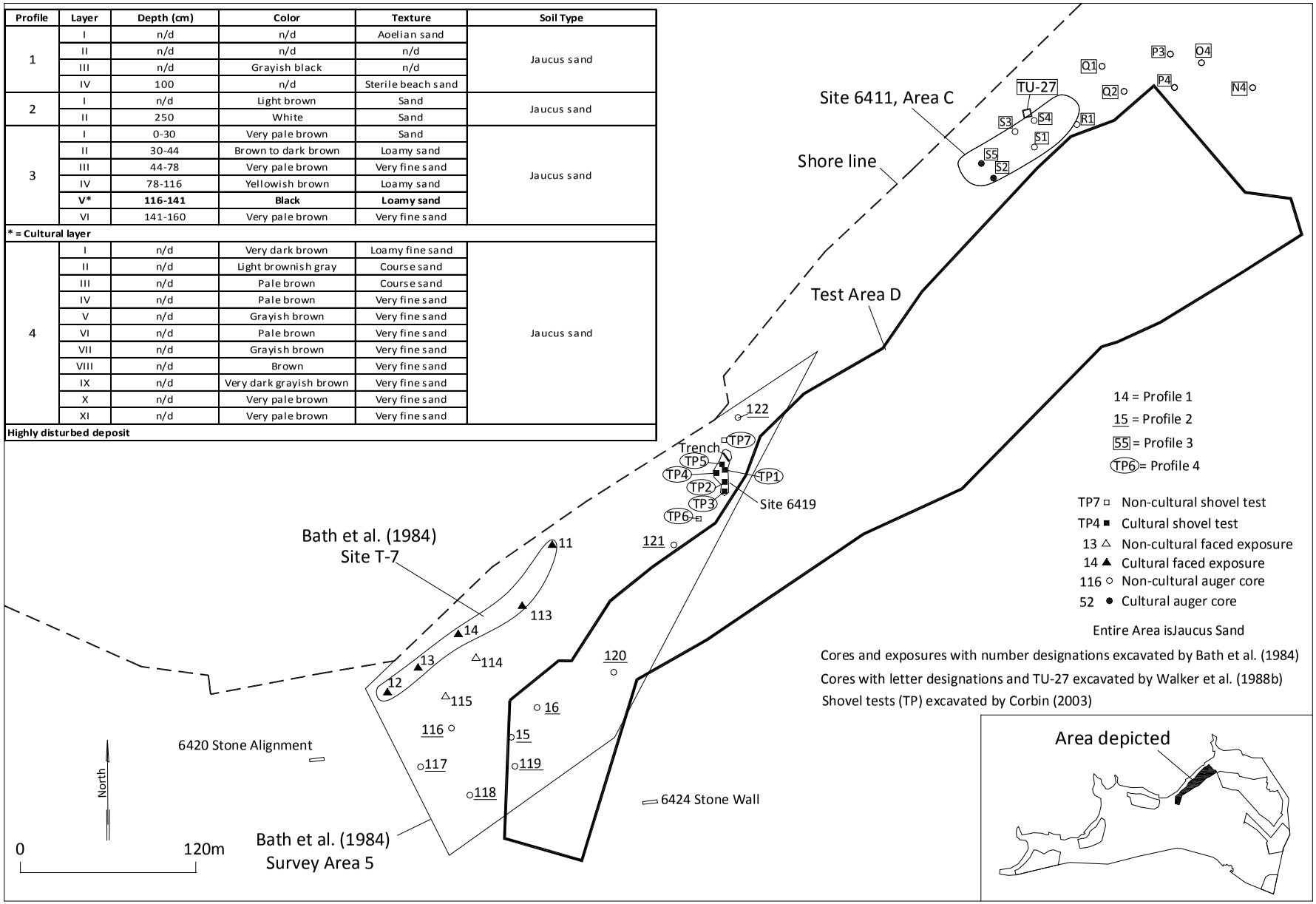


Figure 52. Test Area D, Soil Types and Previous Testing Results

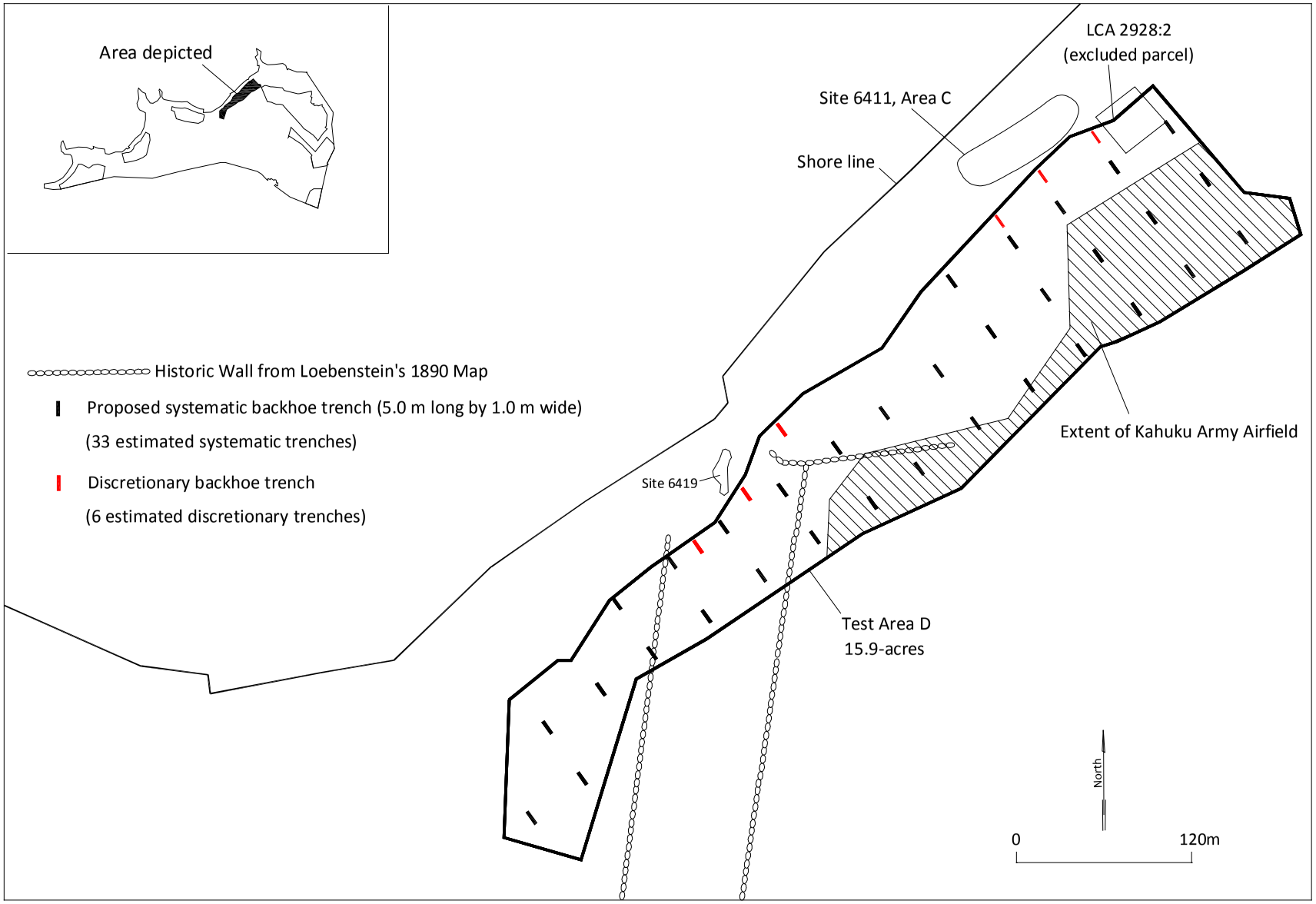
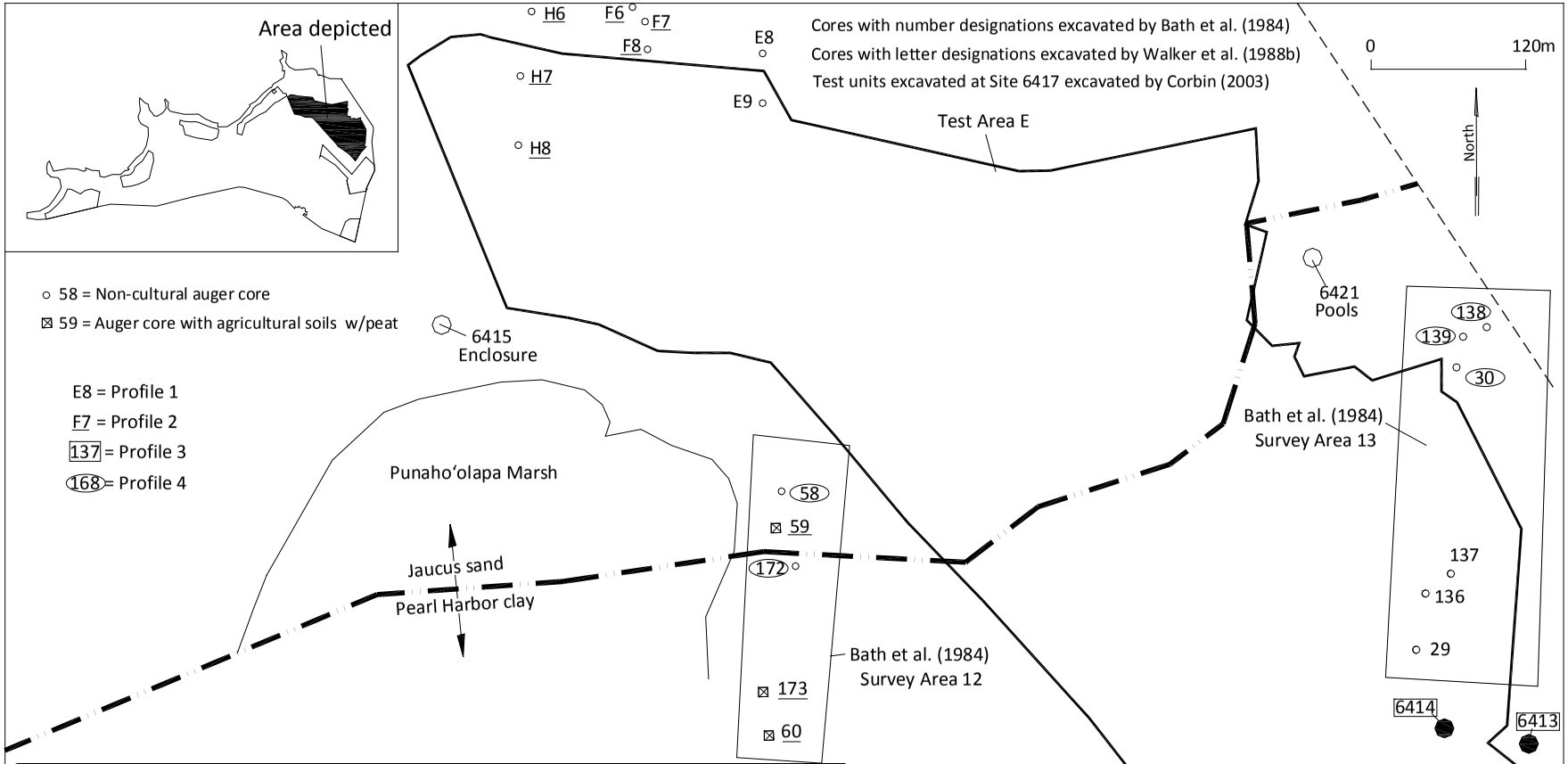


Figure 53. Test Area D, Proposed Trench Locations and Historic Land Use



Profile	Layer	Depth (cm)	Color	Texture	Soil Type
1	I	0-23	Dark yellowish brown	Loam sand	Jaucus sand and Pearl Harbor clay
	II	23-30	Light yellowish brown	Very fine sand	
Impacted by airfield construction					
2	I	0-80	Yellowish brown	Loam sand	Jaucus sand and Pearl Harbor clay
	II	80-110	Very dark grayish brown	Silty loam	
	III	110-160	Dark yellowish brown to	Clay	
	IV	160-210	Black	Peat	
	V	210-360	Very dark brown	Sandy silt	
wetland deposits					
3	I	0-18	Dark brown	Silty loam	Pearl Harbor clay
	II	18-38	Reddish brown	Silty clay	
	III	38-41	Brown	Silty clay loam	
	IV	41-59	Dark brown	Sand	
	V*	**59-89**	**Dark brown**	**Silty clay loam**	
	VI	89-125	Strong brown	Silty clay loam	
*** = Cultural layer at Site 6417 - Site 6414 cultural layer at c. 0.3-0.4 m bs overlain by two disturbed deposits**					
4	I	0-15	n/d	Loamy sand	Pearl Harbor clay
overlies coral bedrock					

Figure 54. Test Area E, Soil Types and Previous Testing Results

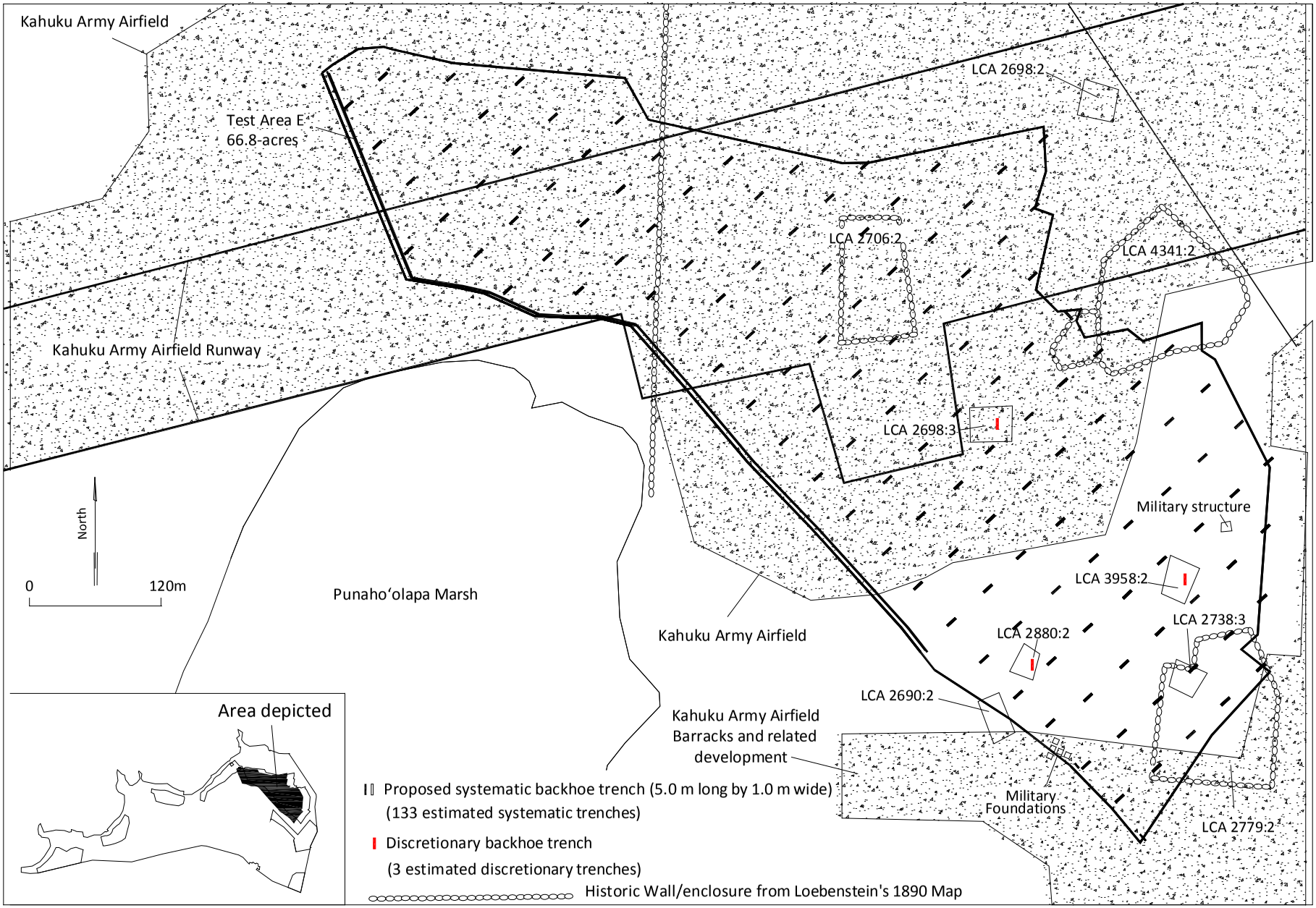
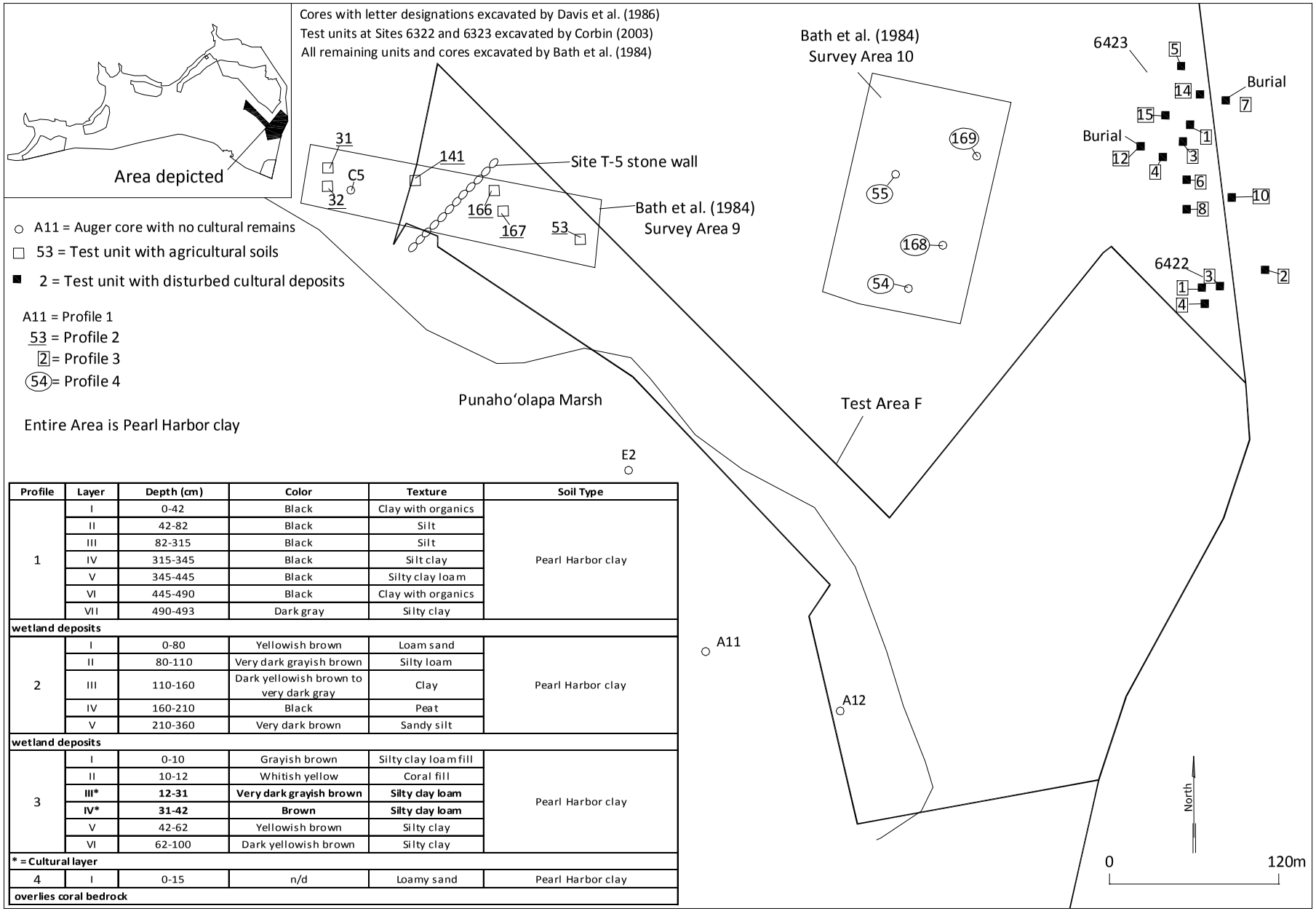


Figure 55. Test Area E, Proposed Trench Locations and Historic Land Use



Profile	Layer	Depth (cm)	Color	Texture	Soil Type
1	I	0-42	Black	Clay with organics	Pearl Harbor clay
	II	42-82	Black	Silt	
	III	82-315	Black	Silt	
	IV	315-345	Black	Silt clay	
	V	345-445	Black	Silty clay loam	
	VI	445-490	Black	Clay with organics	
	VII	490-493	Dark gray	Silty clay	
wetland deposits					
2	I	0-80	Yellowish brown	Loam sand	Pearl Harbor clay
	II	80-110	Very dark grayish brown	Silty loam	
	III	110-160	Dark yellowish brown to very dark gray	Clay	
	IV	160-210	Black	Peat	
	V	210-360	Very dark brown	Sandy silt	
wetland deposits					
3	I	0-10	Grayish brown	Silty clay loam fill	Pearl Harbor clay
	II	10-12	Whitish yellow	Coral fill	
	III*	**12-31**	**Very dark grayish brown**	**Silty clay loam**	
	IV*	**31-42**	**Brown**	**Silty clay loam**	
	V	42-62	Yellowish brown	Silty clay	
	VI	62-100	Dark yellowish brown	Silty clay	
*** = Cultural layer**					
4	I	0-15	n/d	Loamy sand	Pearl Harbor clay
overlies coral bedrock					

Figure 56. Test Area F, Soil Types and Previous Testing Results

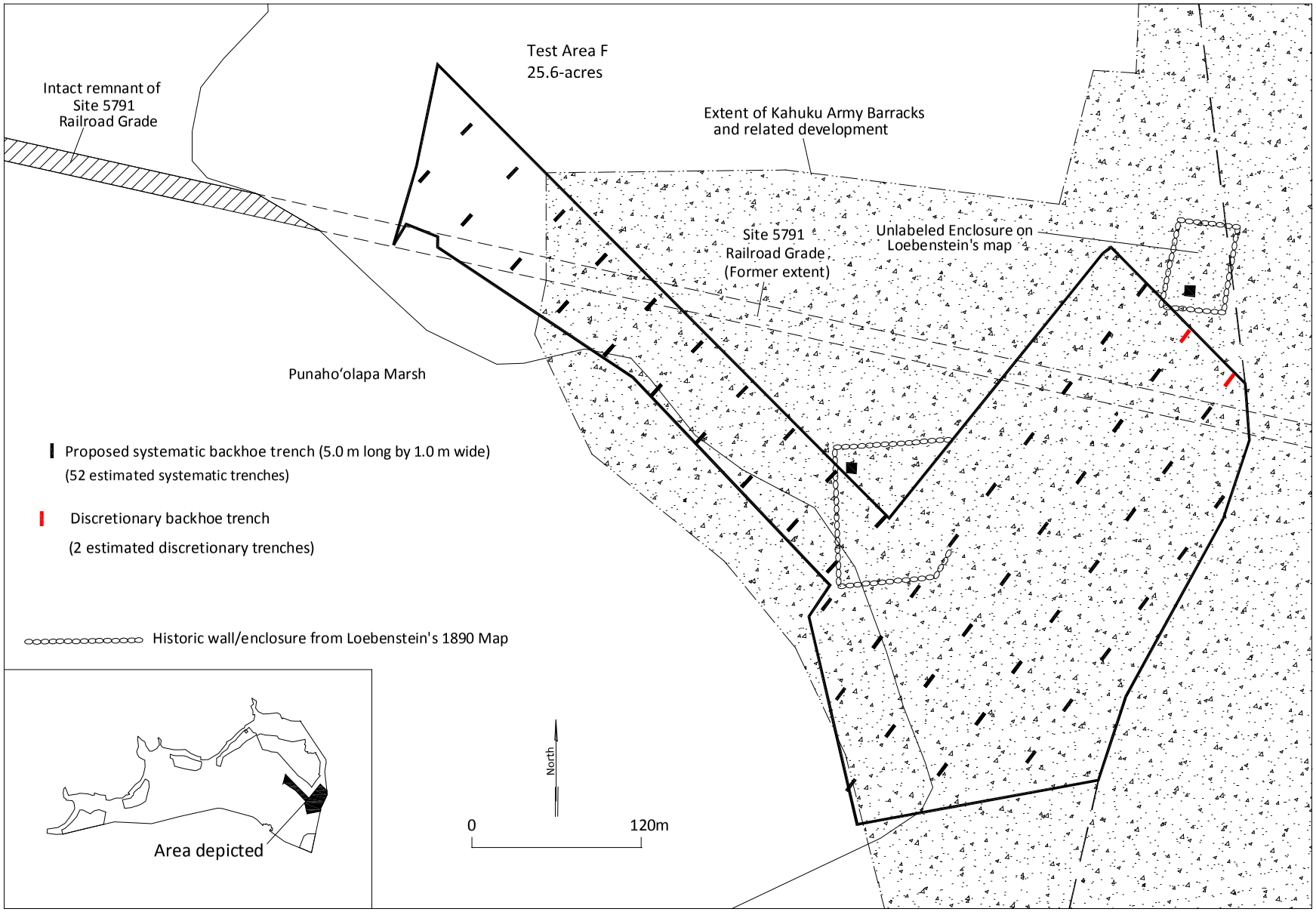
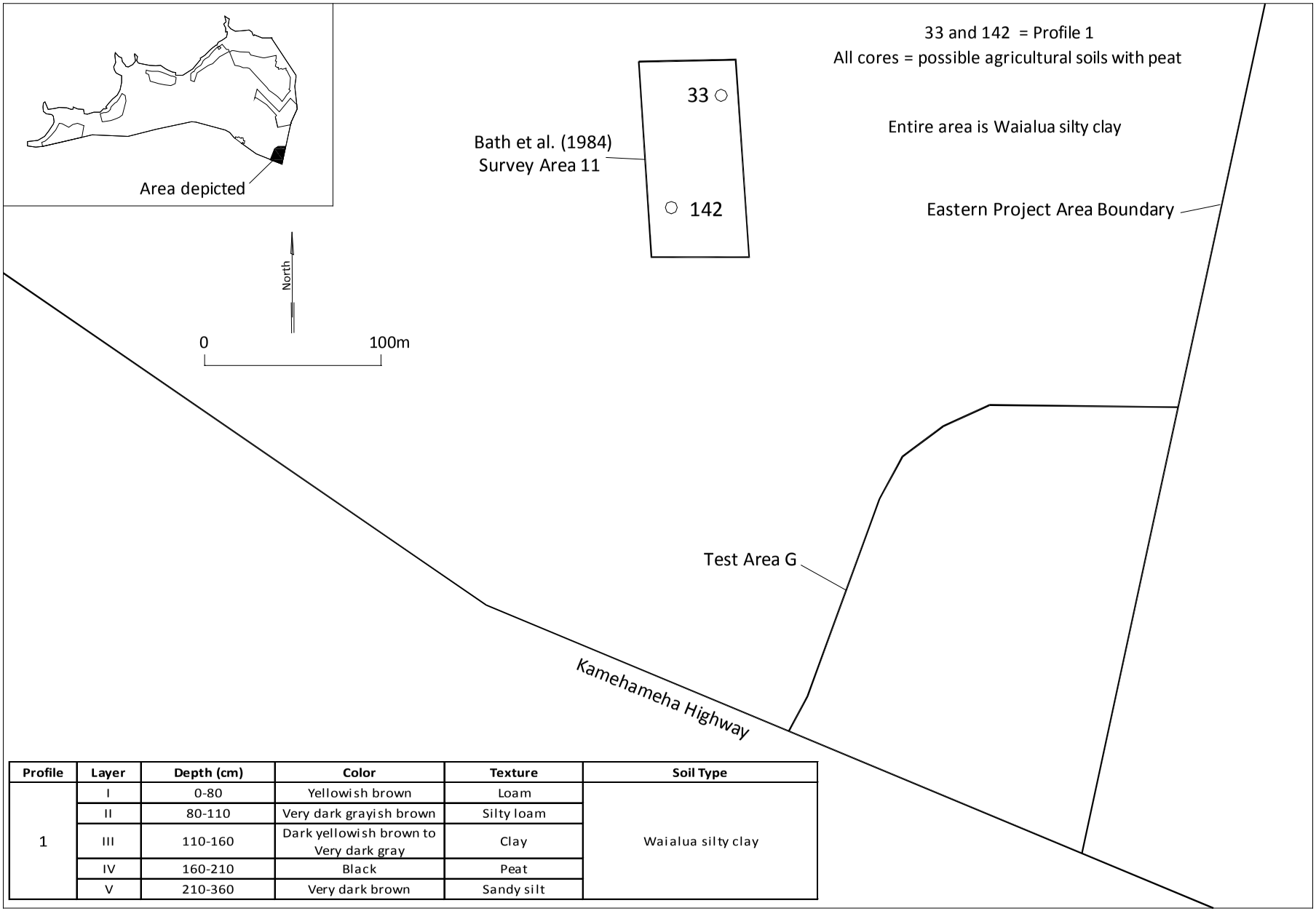


Figure 57. Test Area F, Proposed Trench Locations and Historic Land Use



Profile	Layer	Depth (cm)	Color	Texture	Soil Type
1	I	0-80	Yellowish brown	Loam	Waialua silty clay
	II	80-110	Very dark grayish brown	Silty loam	
	III	110-160	Dark yellowish brown to Very dark gray	Clay	
	IV	160-210	Black	Peat	
	V	210-360	Very dark brown	Sandy silt	

Figure 58. Test Area G, Soil Types and Previous Testing Results

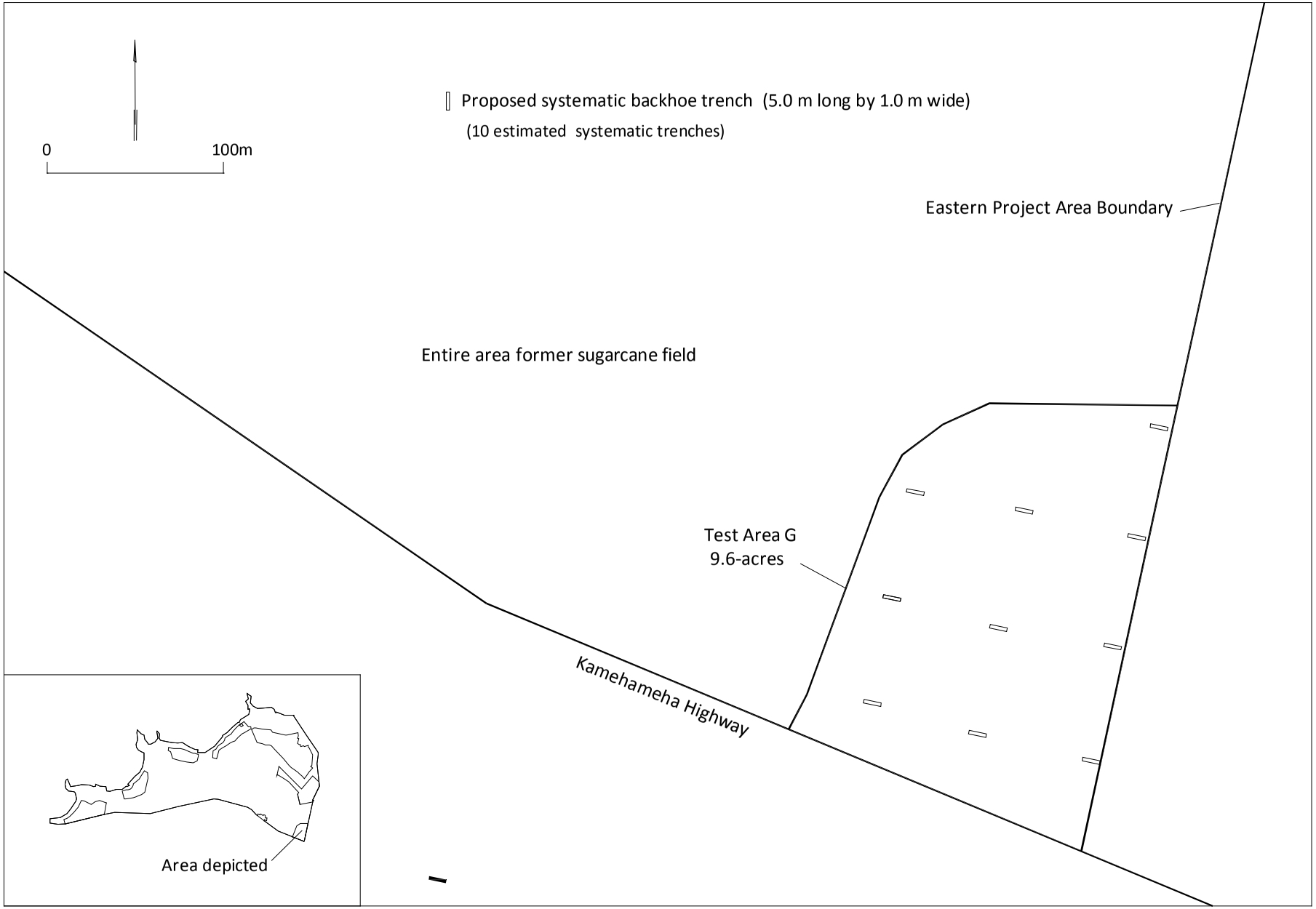


Figure 59. Test Area G, Proposed Trench Locations and Historic Land Use

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APPENDIX A – PUBLIC NOTICES

Public Notice | Public Notice | Public Notice | Legal Notices | Legal Notices | Legal Notices

Public Notice

NOTICE IS HEREBY GIVEN that Turtle Bay Resort LLC (TBR) is preparing a Supplemental Environmental Impact Statement for its revised Master Plan which covers approximately 840 acres within the Ahupua'a of Kahuku, Punalau, Ulupehupehu, 'O'io, Hanaka'oe, Kawela, and 'Opana within the Ko'olauloa District, Island of O'ahu (Project Area TMKs: [1] 5-6-003:041, 044; 5-7-001; 013, 016, 020, 022, 031, 033; 5-7-006:001, 002).

A total of 19 burials representing a minimum of 24 individuals were discovered from 1984 to 1996 within the project site; three burials were left in situ and the remaining burials were disinterred and reinterred within the burial preservation site within the former location of Land Commission Award 2744:1. In 1992, a Burial Treatment Plan was prepared (Maly 1992) for these burials.

The current project area consists of approximately 840 acres and includes the makai portions of seven ahupua'a: Kahuku, Punalau, Ulupehupehu, 'O'io, Hanaka'oe, Kawela and 'Opana. The subject property extends east from roughly the midpoint of Kawela Bay to Marconi Road. The existing resort consists of the 443-unit Turtle Bay Hotel, which opened in 1972, as the Ku'ilima Hotel, augmented by the 57-unit Ocean Villas Condominiums, two 18-hole golf courses, and the 368 multi-family unit Ku'ilima estates.

Hawaiian legends tell the story that the land of Kahuku from the shore to the middle of Waiale'e was once a floating island blown around by the trade winds. During ancient times, the area was known for many cultural resources, but in particular, it was known for its rich fishing resources including ulua and moi as there are fishing koa (alters), names reflect types of shores and reefs, including modern day use of salt collection. Over 80 land commission awards were awarded from 1846-1855 covering the seven Ahupua'a and most of these awards were for cultivation and habitation. The following is a list of LCA awarded for the project area; 2679:2 to Umeume; 2690:2 to Luiki; 2698:1-3 to Waanui; 2706:2 to Koloala; 2716:2 to Hoolae; 2724:3 to Paku; 2734:3 to Paukoa; 2738:3 to Palu; 2744:1 to Pakanaka; 2770:2 to Makaino; 2774 awardee unknown; 2775:2 to Malailua; 2779 to Makilo; 2781:1 to Manukaokeo; 2784:2 to Moo; 2835:3 to Kaheleloa; 2837:2 to Kamakai; 2861:1 to Kaohele; 2868 to Kapalaala; 2878:2 to Kekua; 2880:2 to Luiki; 2897:2 to Kookoo; 2913:2 to Kekua; 2928:2 to Kauihawale; 2936:2 to Kauaihikai; 2938 awardee unknown; 3815:1 to Pailalau; 3958:2 to Nauluhao; 4341 to Kaukaha.

From 1850 to 1880, the project area was used for large-scale cattle ranching operations known as Kahuku Ranch. In 1876, James Campbell purchased Kahuku Ranch. Campbell leased much of the land for sugar and railroad operations. During World War II in 1942, the United States took control of much of the land for the Kahuku Army Airfield and other military uses. Finally in 1972, Ku'ilima Hotel was built and the current use remains resort.

All persons having information about family or individuals that may be found in unmarked burial sites or would like to share information about any traditional and customary practices that they may be exercising on the project sites should respond within thirty (30) days of this notice to Dawn N.S. Chang, Ku'iwalu, Pauahi Tower 1003 Bishop Street, Suite 750 Honolulu, Hawai'i 96813 (808-539-3580).
(SA303890 5/11, 5/18/11)

CULTURAL IMPACT ASSESSMENT NOTICE

Kōloa Ahupua'a

Information requested by SCS of cultural resources or ongoing cultural activities on or near this parcel near the Omao Bridge, Kōloa Ahupua'a, Kōloa District, Kaua'i Island, Hawai'i [TMK: (4) 2-7-002:001; 2-7-007:001; and 2-5-001:008].

Please respond within 30 days to SCS at (808) 597-1182.

PUBLIC NOTICE

Turtle Bay Resort LLC

NOTICE IS HEREBY GIVEN that Turtle Bay Resort LLC (TBR) is preparing a Supplemental Environmental Impact Statement for its revised Master Plan which covers approximately 840 acres within the Ahupua'a of Kahuku, Punalau, Ulupehupehu, 'Ō'io, Hanaka'oe, Kawela, and 'Ōpana within the Ko'olauloa District, Island of O'ahu (Project Area TMKs: [1] 5-6-003:041, 044; 5-7-001; 013, 016, 020, 022, 031, 033; 5-7-006:001, 002).

A total of 19 burials representing a minimum of 24 individuals were discovered from 1984 to 1996 within the project site; three burials were left in situ and the remaining burials were disinterred and reinterred within the burial preservation site within the former location of Land Commission Award 2744:1. In 1992, a Burial Treatment Plan was prepared (Maly 1992) for these burials.

The current project area consists of approximately 840 acres and includes the makai portions of seven ahupua'a: Kahuku, Punalau, Ulupehupehu, 'Ō'io, Hanaka'oe, Kawela, and 'Ōpana. The subject property extends east from roughly the midpoint of Kawela Bay to Marconi Road. The existing resort consists of the 443-unit Turtle Bay Hotel, which opened in 1972, as the Ku'ilima Hotel, augmented by the 57-unit Ocean Villas Condominiums, two 18-hole golf courses, and the 368-multifamily-unit Ku'ilima estates.

Hawaiian legends tell the story that the land of Kahuku from the shore to the middle of Waiale'e was once a floating island blown around by the trade winds. During ancient times, the area was known for many cultural resources, but in particular, it was known for its rich fishing resources including ulua and moi as there are fishing koa (altars), names reflect types of shores and reefs, including modern day use of salt collection. Over 80 land commission awards were awarded from 1846-1855 covering the seven Ahupua'a and most of these awards were for cultivation and habitation. The following is a list of LCA awarded for the project area; 2679:2 to Umeume; 2690:2 to Luiki; 2698:1-3 to Waanui; 2706:2 to Koloaia; 2716:2 to Hoolae; 2724:3 to Paku; 2734:3 to Paukoa; 2738:3 to Palu; 2744:1 to Pakanaka; 2770:2 to Makaino; 2774 awardee unknown; 2775:2 to Malailua; 2779 to Makilo; 2781:1 to Manukeokeo; 2784:2 to Moo; 2835:3 to Kaheleloa; 2837:2 to Kamakai; 2861:1 to Kaohele; 2868 to Kapaiaala; 2878:2 to Kekua; 2880:2 to Luiki; 2897:2 to Kookoo; 2913:2 to Kekua; 2928:2 to Kauihawale; 2936:2 to Kauaihikai; 2938 awardee unknown; 3815:1 to Pailalau; 3958:2 to Nauluhao; 4341 to Kaukaha.

From 1850 to 1880, the project area was used for large-scale cattle ranching operations known as Kahuku Ranch. In 1876, James Campbell purchased Kahuku Ranch. Campbell leased much of the land for sugar and railroad operations. During World War II in 1942, the United States took control of much of the land for the Kahuku Army Airfield and other military uses. Finally in 1972, Ku'ilima Hotel was built and the current use remains resort.

All persons having information about family or individuals that may be found in unmarked burial sites or would like to share information about any traditional and customary practices that they may be exercising on the project sites should respond within thirty (30) days of this notice to Dawn N.S. Chang, Ku'iwalu, Pauahi Tower 1003 Bishop Street, Suite 750 Honolulu, Hawai'i 96813 (808) 539-3580. ■

Biological Surveys Conducted in Support of a Supplemental Environmental Impact Statement For the Turtle Bay Resort, Kahuku District, Island of Oʻahu

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Prepared for:

Turtle Bay Resort, LLC.

February 7, 2012

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Introduction

Turtle Bay Resort, LLC (TBR) is preparing a Supplemental Environmental Impact Statement (SEIS) updating their original EIS, which was prepared in 1985. The SEIS will cover all of the lands included in the original EIS plus the following three additional areas:

• Approximately 11 acres immediately south of Turtle Bay Hotel and immediately east of Ocean Villas. These lands are owned by TBR but were excluded from the 1985 EIS,
• A former *kuleana* of approximately 4 acres on the eastern boundary of the Turtle Bay Lands classified as State Agricultural District (TMK 5-6-003:033). (This parcel, now owned by TBR, was excluded from the 1985 EIS),
• Approximately 11 acres east of the Turtle Bay Lands. These lands constitute the Marconi Road ROW Lands and are currently owned by Cottonwood Development LLC, Marconi Point LLC, and the Estate of James Campbell.

This report describes the methods used and the results of the botanical, avian and mammalian surveys conducted on the subject property as part of the environmental disclosure process associated with the proposed project.

The primary purpose of the surveys was to determine if there are any botanical, avian or mammalian species currently listed, or proposed for listing under either federal or State of Hawaiʻi endangered species statutes within or adjacent to the study area. The federal and State of Hawaiʻi listed species status follows species identified in the following referenced documents, (Department of Land and Natural Resources (DLNR) 1998; U. S. Fish & Wildlife Service (USFWS) 2005a, 2005b, 2011). Fieldwork was conducted on March 23 and 24, 2011 and then repeated on September 19 and 20, 2011. Turtle Bay Resort, LLC will use the information in this report to evaluate the extent to which its proposed resort expansion plans may impact any endangered species (either current or proposed for listing) identified on the SEIS lands.

Hawaiian and scientific names are italicized in the text. A glossary of technical terms and acronyms used in the document, which may be unfamiliar to the reader, are included at the end of the narrative text.

General Site Description

The approximately 842 acres of land included in the SEIS lands are owned by Turtle Bay Resort, LLC (with the exception of the Marconi Road ROW Lands discussed above), and located *makai* of Kamehameha Highway, extending from the highway to the ocean, and laterally between Marconi Road (formerly known as the Kahuku Airport Road) on the east and the mid-point of Kawela Bay on the west (Figure 1). We did not survey the existing Turtle Bay Hotel grounds for avian or mammalian resources, though the botanist did make a cursory walkthrough of the grounds. We also did not survey the adjacent Ocean Villas, or Kuilima Estates, essentially the areas demarcated on Figure 1 in white.

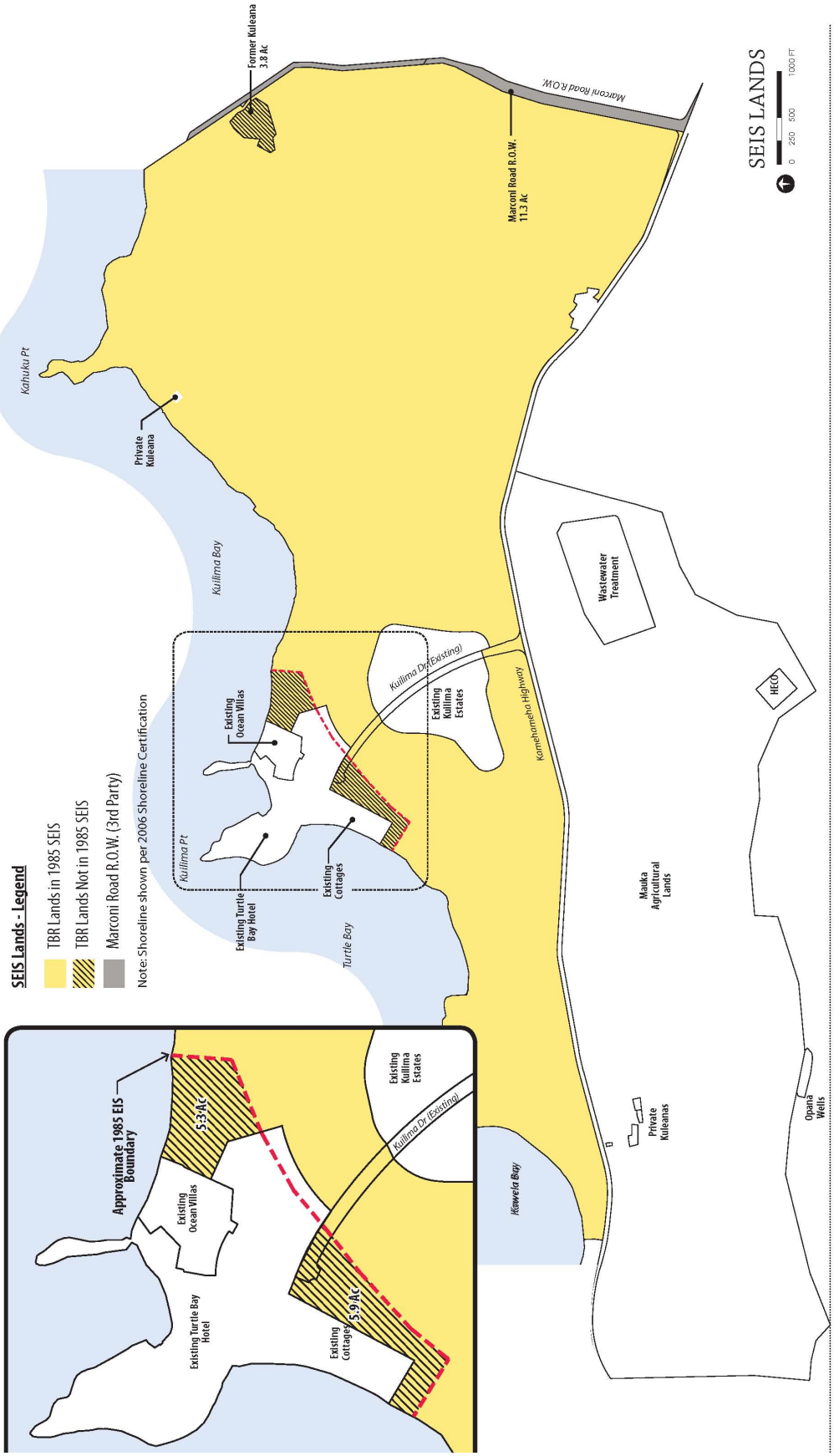

Figure 1- Turtle Bay SEIS Lands

The lands are located within three *ahpuaaʻa*. From west to east these are *na ahupuaʻa O ʻŌpana Kawela, Hanakaʻoe* and *Kahuku*. TBR lands extend inland from the shoreline between 150 meters at Kawela Bay and 2000 meters at the southern terminus along Marconi Road.

The SEIS Lands can be generally characterized as a disturbed area that has been subjected to development and redevelopment since the late 1700s. The first written descriptions of the area date back to 1779 when Captain Charles Clerke and Lieutenant James King of the HMS Resolution described the area of Kahuku Point as fine and fertile and occupied by a large village (Cook and King, 1784). Subsequent to the decline of the Hawaiian population in the area, the SEIS Lands were converted to a sheep and cattle ranch.

Records indicate that in 1873, Kahuku Ranch included all of the SEIS Lands; and scattered remains of the ranch have been found in the vicinity of Punaho`olapa Marsh. By the 1880s the land was transformed from cattle ranching to sugar cane cultivation (Figure 2). In 1889, construction of the Oʻahu Railway and Land Company's railroad linking Kahuku to other parts of O`ahu began The rail line was officially opened in 1899 and its right-of-way crossed the SEIS Lands, passing through Punaho`olapa Marsh.

The coastal plains around Kahuku Point were again dramatically transformed during the course of World War II. Land modification activities included the construction of concrete bunkers, asphalt runways, and large soil/sand revetments along with barracks and numerous other buildings. After the war, beach cottages were constructed along the shoreline, especially in the area of Kawela Bay and Kawela Point. The portions of the SEIS lands cultivated in cane eventually turned fallow with the closure of the Oahu Sugar Company.

In the early 1970s, the Kuilima Resort opened and the SEIS Lands were transformed once again with the development of the original Kulima Resort Hotel, residential condominiums, an 18-hole golf course and a wastewater treatment plant (Figure 2).

In the late-1980s, the residential cottages along Kawela Point and the eastern half of Kawela Bay were demolished, structural fill was brought in, and construction of the foundations for a new multi-story hotel structure began. The structure was never completed, but underground utilities and concrete piles remain today. During this period the 18-hole Palmer Golf Course was built and the Fazio Golf Course was reduced to 9-holes. Punahoʻolapa Marsh was enhanced by the construction of a moat around much of its perimeter. The original wastewater treatment plant was decommissioned after a more modern facility was constructed *mauka* of Kamehameha Highway. Around 2002 the Fazio Golf Course was expanded back to an 18-hole golf course.

The present-day vegetation of the site can be characterized as either developed landscape plantings (all hotel/resort grounds and appurtenances, and golf courses) or naturalized, non-native scrub and forest on previously disturbed lands. Areas of wetland vegetation are also extensive. Forming coastal strand and dune vegetation zones occur along most coastal

portions of the site. For the most part, the dune vegetation is also dominated by non-native, naturalized species and merges inland with either inland scrub/forest or landscaping. In contrast, the most seaward part of the coastal strand, and an area of active dunes at the east end of the SEIS lands, support a native strand vegetation.

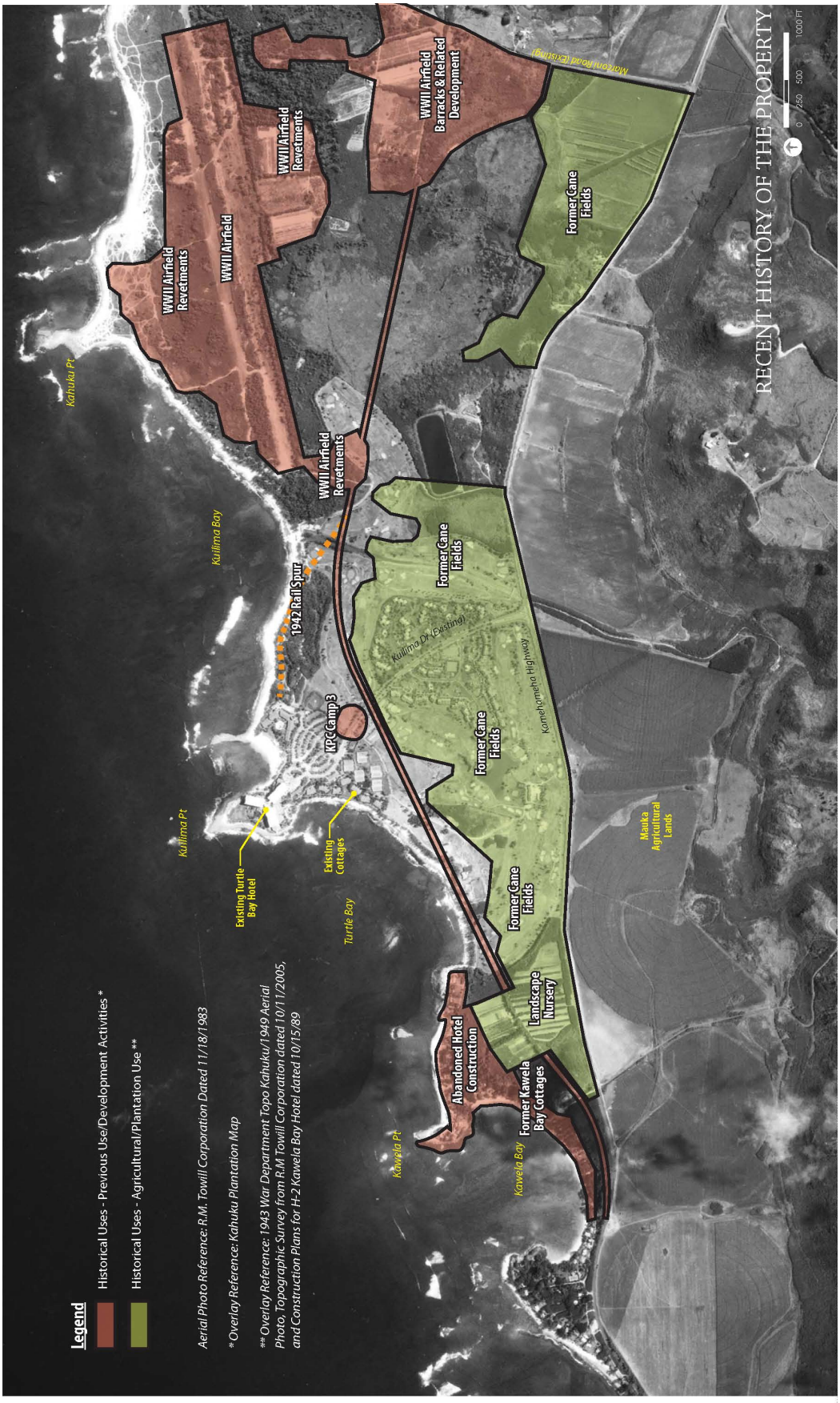

Figure 2- Turtle Bay Recent History of the Property

Methods

Plant names mostly follow *Manual of the Flowering Plants of Hawai'i* (Wagner *et al*., 1990, 1999) for native and naturalized flowering plants, Palmer (2003) for ferns, and *A Tropical Garden Flora* (Staples and Herbst, 2005) for crop and ornamental plants. Some plant species names have been updated following more recently published literature. The avian phylogenetic order and nomenclature used in this report follows the *AOU Check-List of North American Birds* (American Ornithologists' Union, 1998), and the 42nd through the 52nd supplements to the Check-List (American Ornithologists' Union, 2000; Banks et al., 2002, 2003, 2004, 2005, 2006, 2007, 2008; Chesser *et al*., 2009, 2010, 2011). Mammal scientific names follow (Tomich, 1986). Place names follow (Pukui *et al.*, 1974).

Botanical Survey Methods

The botanical survey was undertaken twice: a wet season survey on March 23-24, 2011 and a dry season survey on September 19-20, 2011. The two surveys were conducted independent of each other, which is to say the second survey was conducted without reference to any notes (or species list) generated by the first survey. The surveys both utilized a pedestrian (walking) transect methodology to cover the project area. Guided by a real-time, GPS tracking record, the botanist attempted to cover all parts of the site and to visit all areas representing various vegetation types and environments supporting plants. As the walking survey progressed, a list of all higher plants (ferns, conifers, and flowering plants) encountered was recorded in field notes, along with a sense of the relative abundance of each species overall or within various vegetation types.

This approach is vastly superior to using more rigorous quantitative transects when the primary purpose is to characterize the flora and discover the presence of normally rare, listed species or native species having resource value. In essence, by recording all plants encountered, the resulting flora (plant species) listing provides information useful to characterize the nature of botanical resources present, including species that now or perhaps in the future may be of interest or concern from a variety of perspectives, such as native plant protection, listed species, occurrence of invasive species, etc. Completeness of the listing is partly dependent upon the actual proportion of the land covered. It is neither reasonable nor necessary to cover 100 percent of an area by traversing continuously until every possible location is viewed. Utilizing ever-changing view planes and the fact that species occur in populations of individuals that form a repeating mosaic within environment types enables the botanist to direct the survey track into all areas of the site that hold promise of yielding species not encountered earlier in a survey; and this process is repeated until no new species are being added to the field notes. Thus, very rare species represented by one or just a few individuals in area as large as the SEIS lands could be missed. But certainly the vast majority of species present will be "discovered."

One result of conducting two "independent" field visits is to provide a cross check on the completeness of the surveys, although in this case, conducting one survey (March 2011) near the end of the wet season and the other (September 2011) near the end of the dry

season was more for the purpose of demonstrating that seasonal factors were covered. Much of the site consists of vegetation that is highly tolerant of extended dry conditions, so plants not seen due to the season would be annual species surviving as seeds in the soil. Finding native shrubs or trees would not be dependent upon the season, as these species are persistent and recognizable in both the wet and dry periods.

Avian Survey Methods

Point Counts

Twenty avian count stations were sited within the project site. Stations were roughly equidistant from each other. A single eight-minute avian point count was made at each count station. The same methodology was repeated during the fall survey. Field observations were made with the aid of Leica 10 X 42 binoculars and by listening for vocalizations. The point counts were conducted between 6:30 am and 11:00 am. Time not spent counting the point count stations was used to search the rest of the SEIS lands for species and habitats not detected during the point counts.

Time Dependant Waterbird Counts

Fifteen minute, time dependant waterbird counts were made at all of the water features located within the golf courses, and a set of thirty minute time dependant waterbird counts were made around and within Punahoʻolapa Marsh.

Mammalian Survey Methods

With the exception of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or *ʻōpeʻapeʻa* as it is known locally, all terrestrial mammals currently found on the Island of Oʻahu are alien species, and most are ubiquitous. The survey of mammals was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal sign. A running tally was kept of all terrestrial vertebrate mammalian species detected within the project area during the time spent on the site.

Results

Botanical Surveys, Flora

"Flora" is the diversity of plant species living in the survey area. A plant checklist (Table 1) was compiled from field observations, with entries arranged alphabetically under plant family names (standard practice). Included in the list are scientific name, common name, and status (whether native or non-native) for each species observed during the survey. Species status given in **bold** indicates a plant of particular interest to the Hawaiian Islands flora (indigenous, endemic, or Polynesian introduction). Qualitative estimates of plant abundance were recorded for each species on each survey date, and within the vegetation type indicated in the "notes" column. Abundance values are coded in the table as explained in the Legend to Table 1. For some species, a two-level system of abundance is used; with a letter-number code indicating a species having a somewhat clustered distribution. For example, a species infrequently encountered but numerous where found would have an abundance rating of "R" indicating a plant encountered only one to three times during the entire survey of the site, but an "R2" to indicate several to many individuals present where encountered. An "R3" would be a plant similarly seldom encountered (i.e., rare), but locally abundant in one or more of the locations where encountered. A species marked "O3" would be one seen with some regularity, usually occurring in patches of numerous individuals (as opposed to "C" for a species seen with regularity throughout the vegetation zone). As with any system attempting to ascribe abundance, the task becomes increasingly difficult where spread across a large area of constantly varying terrain.

A total of 226 species of vascular plants was identified from the survey area. This total number is certainly high, although the SEIS lands represent a large area with a variety of different environments. Forty-five or one-fifth (20 percent) of the tabulated species are ornamentals (**Orn**), meaning landscape plants that have not become naturalized in Hawai'i. A much higher percentage are actually serving landscape purposes at Turtle Bay Resort, since many naturalized species are also used for landscaping; once a plant introduced for landscaping escapes into the wild or naturalizes, it's status changes to naturalized (**Nat**). Eighty-two of the species (36 percent) in Table 1 were recorded in the "landscape" vegetation type (note <4>); that is, were observed either around the develop resort buildings and appurtenances or around the golf courses. Given the nature of this vegetation type, these species are either weeds or plants serving an ornamental function.

Twenty-six of the species (11.5 percent) are Hawaiian natives, indicated under the status column as either indigenous (**Ind**) or endemic (**End**). Another 8 species (3.5 percent) are early Polynesian introductions (**Pol**), technically not native, but so-called "canoe plants" that have been in the Islands for several thousand years. A majority (18 of 26 species or 8 percent of total species) of the indigenous and endemic species occur in the wetland and coastal strand vegetation, which is why these two environments are botanically the most sensitive in the SEIS lands. Only four native species were recorded within the developed lands or landscape vegetation areas. Another five Polynesian introductions—typically

thought of as Hawaiian native plants due to their association with native peoples and long presence in the Islands—are found in the landscaped areas surveyed.

Of course, percentages based upon total species recorded can be misleading without considering a sense of abundance. In this regard, plants such as *hala* (*Pananus tectorius*), *naupaka* (*Scaevola taccada*), and *niu* (coconut or *Cocos nucifera*) are prominent species in the landscaping, within the resort. The same is true for the wetland and the most seaward part of the strand vegetation, where natives tend to dominate (see below).

Comparison between wet and dry season surveys can be made, although interpreting these results is tricky. It is not entirely the case that the differences between the two species lists represents plants present in one season and not present in the other. A total of 45 species were recorded in March ("wet season") and not later observed in September ("dry season"). For the September listing, 33 species had not been previously observed on the SEIS lands in March. The higher number in March appears to be mostly ruderal species that might be expected to be more prominent under wetter conditions. All but seven of the 45 species were recorded either within the landscaped or disturbed areas (notes <3> and <4>) of the property. Two of the seven are forest vines seen only once each in the March survey; one an indigenous species: *kāʻeʻe* (*Mucuna gigantea*). Three other native, indigenous species were missed in September: *pāʻū-o-Hiʻiaka* (*Jacquemontia ovalifolia*), recorded as rare in a disturbed area previously; *moa* (*Psilotum nudum*) recorded from a single plant seen in the landscaping in March; and *ʻuhaloa* (*Waltheria indica*), a ruderal species that should have been seen, was uncommon in March.

Only thirteen of the 33 species recorded in September but not in March were from environments other than landscaped areas or highly disturbed areas. These were mostly weedy or non-characteristic species in the strand or wetland environments (notes <1> and <2>). Two indigenous species recorded in September were missed (or not present) in the previous, March survey. One, *pōhinahina* (*Vitex rotundifolia*) was only seen as a landscape bedding plant in September. The other, the sedge *ʻahuʻawa* (*Mariscus javanicus*), is a wetland plant noted as rare in September; and *ʻuhaloa* (*Waltheria indica*) should have been seen, although was uncommon in March.

Because the Turtle Bay Hotel grounds were included in both surveys only in passing—species encountered were recorded, but no attempt was made to be thorough around the buildings—differences in the species list are to be expected from this area: 17 species of ornamentals were recorded in only one or the other survey, 22 percent of the recorded once species. Clearly, these are plants that are not present or absent due to the season, but missed as a result of the route taken by the botanist around the grounds.

With but a few exceptions, the plants missed in one survey or the other, were recorded as (mostly) rare or uncommon when seen. The exceptions include a couple of grasses and

weedy species associated with mowed lawns. Grasses can be missed if not in flower at the time of the survey. Nephthytis (*Syngonium* sp.), elephant grass (*Pennisetum purpureum*), pitted beardgrass (*Bothriochloa pertusa*), narrow-leaved carpetgrass (*Axonopus fisifolius*) and prostrate indigo (*Indigofera hendecaphyla*) were each recorded as present in numbers greater than rare or uncommon in one survey, but still missed in the other survey.

Table 1 - Checklist of Plants Found in SEIS Lands at the Turtle Bay Resort, O'ahu, Hawai'I

FAMILY		STATUS	ABUNDANCE		NOTES
Species	**Common name**		**Wet Season**	**Dry Season**	
PTERIDOPHYTES ~ FERNS & FERN ALLIES					
NEPHROLEPIDACEAE					
Nephrolepis multiflora (Roxb.) F.M. Jarrett ex C.V. Morton	sword fern	Nat	U	---	<4>
POLYPODIACEAE					
Phymatosorus grossus (Langsd. & Fisch.) Brownlie	*laua'e*	Nat	R, R3	U2, U2	<4, 5>
PSILOTACEAE					
Psilotum nudum (L.) P. Beauv.	*moa*	**Ind**	R	---	<4>
THELYPTERIDACEAE					
Cyclosorus interruptus (Wild.) H. Itō	*neke*	Nat	O3	O3	<2>
GYMNOSPERMS					
ARAUCARIACEAE					
Araucaria columnaris (G. Forster) J.D. Hoiok..	Cook Island pine	Nat	U3	U3	<1>
FLOWERING PLANTS					
DICOTYLEDONS					
ACANTHACEAE					
Aphilandra squarrosa C. Nees	zebra plant	Orn	R	R	<4>
Asystasia gangetica (L.) T. Anderson	Chinese violet	Nat	R, U, C	R,U,O	<1, 4, 5>
Barlaria repens C. Nees	pink –ruellia	Nat	R1	--	<3>
Pseuderanthemum carruthersii var. *carruthersii* (Seemann) Guill.	---	Orn	R	R	<4>
AIZOACEAE					
Sesuvium portulacastrum (L.) L.	*'akulikuli*	**Ind**	O2, U	O,	<1, 3>
Tetragonia tetragonioides (Pall.) Kuntze	New Zealand spinach	Nat	U, U	O3, R	<1, 5>
AMARANTHACEAE					
Alternanthera pungens Kunth	khaki weed	Nat	R	U	
Ameranthus spinosus L.	spiny amaranth	Nat	R	R	<1>
Amaranthus viridis L.	slender amaranth	Nat	U	U	<3>
ANACARDIACEAE					
Schinus terebinthifolius Raddi	Christmas berry	Nat	O	O	<5>

Table 1 (continued).

FAMILY		STATUS	ABUNDANCE		NOTES
Species	**Common name**		**Wet Season**	**Dry Season**	
APIACEAE					
Centella asiatica (L.) Urb.	Asiatic pennywort	Nat	--	R	<2>
Ciclospermum leptophyllum (Pers.) Sprague	fir-leaved celery	Nat	R	--	<3>
Hydrocotyle sibthorpioides Lam.	pennywort	Nat	R	--	<4>
APOCYNACEAE					
Nerium oleander L.	oleander	Orn	U	U	<4>
Plumeria obtusa L.	Singapore plumeria	Orn	R	R	<4>
Plumeria rubra L.	frangipani	Orn	U	O	<4>
Thevetia peruviana (Pers.) K. Schum.	be-still tree	Nat	R3	U	<4>
ARALIACEAE					
Schefflera actinophyla (Endl.) Harms	octopus tree	Nat	U	U	<4>
Polyscias guilfoylei (W. Bull.) L.H. Bailey	panax	Orn	U	U	<5>
ASTERACEAE (COMPOSITAE)					
Ageratina riparia (Regel) R. King & H. Robinson	*Hāmākua pāumakani*	Nat	R	--	<3>
Bidens alba (L.) DC	beggartick	Nat	C3, C, O2	C1, C, U	<1, 3, 4>
Calyptocarpus vialis Less.	---	Nat	U2, U2	O, O	<3, 4>
Conyza bonariensis (L.) Cronq.	hairy horseweed	Nat	R	C	<3>
Cyanthillium cinereum (L.) H. Rob.	little ironweed	Nat	--	R	<3>
Eclipta prostrata (L.) L.	false daisy	Nat	R, --	--, U3	<4, 5>
Emilia fosbergii Nicolson	Flora's paintbrush	Nat	U	R	<3>
Pluchea carolinensis (Jacq.) G. Don	sourbush	Nat	C	O	<5>
Pluchea indica (L.) Less.	Indian fleabane	Nat	O, O, C	U, C, U	<2, 3, 5>
Pluchea x fosbergii Cooperr. & Galang	pluchea hybrid	Nat	O	R	<2>
Sonchus oleraceus L.	sow thistle	Nat	O, O3	--, R	<1, 3>
Sphagneticola trilobata (L.) Pruski	wedelia	Nat	C1, U, U	--, --, O	<1, 2, 3>
Verbesina encelioides (Cav.) Benth. & Hook.	golden crown-beard	Nat	U3	C	<1>
Xanthium strumarium L.	kīkānia, cocklebur	Nat	--	R	<3>
Youngia japonica (L.) DC	Oriental hawksbeard	Nat	R	--	<4>
BALSAMINACEAE					
Impatiens walleriana J. D. Hook.	busy lizzy	Nat	--	R	<4>
BIGNONIACEAE					
Spathodea campanulata P. Beauv.	African tulip tree	Nat	R	--	<4>

Table 1 (continued).

FAMILY		STATUS	ABUNDANCE		NOTES
Species	**Common name**		**Wet Season**	**Dry Season**	
Tabebuia heterophylla (A.P. de Candolle) Britton	pink tecoma	Orn	R	R	<4>
BALSAMINACEAE					
Impatiens walleriana J. D. Hook.	busy lizzy	Nat	--	R	<4>
BIGNONIACEAE					
Spathodea campanulata P. Beauv.	African tulip tree	Nat	R	--	<4>
Tabebuia heterophylla (A.P. de Candolle) Britton	pink tecoma	Orn	R	R	<4>
BORAGINACEAE					
Cordia subcordata Lam.	*kou*	**Ind**	R	R	<4>
Heliotropium anomalum Hook. & Arnott	*hinahina*	**Ind**	O	O	<1>
Tournefortia argentea L. fil.	tree heliotrope	Nat	C	C	<1>
BRASSICACEAE					
Lepidium virginicum L.	common pepperwort	Nat	--	U	<1>
CACTACEAE					
Hylocereus undatus (Haw.) Britt. & Rose	night-blooming cereus	Nat	R	R2	<5>
CAPRIFOLIACEAE					
Lonicera japonica Thunb.	Japanese honeysuckle	Orn	R	---	<4>
CARICACEAE					
Carica papaya L.	papaya	Nat	R	R	<5>
CARYOPHYLLACEAE					
Spergularia marina (L.) Griseb.	saltmarsh sand spurry	Nat	R	--	<3>
CASUARINACEAE					
Casuarina equisetifolia L.	common ironwood	Nat	AA, U, A	AA, U, C	<1, 2, 5>
CHENOPODIACEAE					
Chenopodium murale L.	*'aheahea*	Nat	U2, R	U, --	<1, 3>
CLUSIACEAE					
Calophyllum inophyllum L.	*kamani*	**Pol**	R	R	<5>
Clusia rosea Jacq.	autograph tree	Nat	R	R	<4>
COMBRETACEAE					
Conocarpus erectus L.	button mangrove	Orn	R	R	<4>
Terminalia catappa L.	tropical almond; false *kamani*	Nat	U	O	<1>
CONVOLVULACEAE					
Ipomoea alba L.	moon flower, *koali pehu*	Nat	R	--	<5>
Ipomoea obscura	---	Nat	U	U	<3>

Table 1 (continued).

FAMILY		STATUS	ABUNDANCE		NOTES
Species	**Common name**		**Wet Season**	**Dry Season**	
CONVOLVULACEAE (continued)					
Ipomoea pes-caprae (L.) R. Br.	*pōhuehue*	Nat	U	O	<1>
Ipomoea triloba L.	little bell	Nat	R	U	<3>
Jacquemontia ovalifolia (Choisy) H. Hallier	*pāʻū-o-Hiʻiaka*	**Ind**	R	---	<3>
CUCURBITACEAE					
Coccinia grandis (L.) Voigt	ivy or scarlet-fruited gourd	Nat	O, O	R, --	<1, 4>
Momordica charantia L.	wild bitter melon	Nat	--	R	<3>
EUPHORBIACEAE					
Acalypha hispida N.L. Burm.	chenille plant	Orn	--	R	<4>
Aleurites moluccana (L.) Wild.	*kukui*	**Pol**	R	R	<4>
Codiaeum variegatum (L.) Blume	croton	Orn	R	R	<4>
Euphorbia albomarginata Torr. & A. Grey	rattlesnake weed	Nat	R	U	<3>
Euphorbia degneri (Sherff) Croizat & Degener	*ʻakoko*	**End**	O2	O1	<1>
Euphorbia hirta L.	garden spurge	Nat	U	O	<1>
Euphorbia hypericifolia L.	graceful spurge	Nat	U	O	<3>
Macaranga tanarius (L.) Müll. Arg.	---	Nat	C	U	<5>
Manihot esculenta Crantz	cassava	Orn	R	---	<4>
Phyllanthus debilis Klein ex Willd.	niruri	Nat	U	O	<3>
Ricinus communis L.	castor bean	Nat	U	U	<3>
FABACEAE					
Albizia saman F. Muell.	monkeypod	Nat	R	R	<4>
Alysicarpus vaginalis (L.) DC	alyce clover	Nat	U	U1	<4>
Canavalia cathartica Thouars	*maunaloa*	Nat	R	U	<5>
Crotalaria incana L.	fuzzy rattlebod	Nat	--	U	<3>
Desmanthus pernambucanus (L.) Theilung	virgate mimosa	Nat	O3	U	<3>
Erythrina variegata L.	Indian coral tree	Nat	R	R	<4>
Indigofera hendecaphyla Jacq.	prostrate indigo	Nat	--	O	
Indigofera suffruticosa Mill.	indigo	Nat	R	R	<3>
Leucaena leucocephala (Lam.) deWit	koa haole	Nat	U, AA	O, AA	<1, 5>
Macroptilium atropurpureum (DC) Urb.	---	Nat	R	---	<3>
Macroptilium lathyroides (L.) Urb.	cow pea	Nat	R	U	<3>
Medicago polymorpha L.	bur clover	Nat	R	--	<1>
Melilotis indica (L.) All.	yellow sweet clover	Nat	R	R	<3>

Table 1 (continued).

FAMILY		STATUS	ABUNDANCE		NOTES
Species	**Common name**		**Wet Season**	**Dry Season**	
FABACEAE (Continued)					
Mimosa pudica L.	sensitive plant	Nat	U	U	<3>
Mucuna gigantea (Willd.) DC	sea bean, *kāʻeʻe*	**Ind**	R	---	<5>
Neonotonia wightii (Wight & Arnott) Lackey	glycine vine	Nat	U3, O	U2,	<3, 5>
Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	*kiawe*	Nat	R	U	<4>
Senna surattensis (N.L. Burm.) H. Irwin & Barneby	scrambled egg plant, *kolomona*	Nat	R	---	<1>
Sesbania grandiflora (L.) Poir.	sesban; *ʻohai keʻokeʻo*	Orn	---	R	<4>
Vigna marina (J. Burm.) Merr.	beach pea	**Ind**	U	U1	<1>
GOODINACEAE					
Scaevola taccada (J. Gaertn.) Roxb.	*naupaka kahakai*	**Ind**	C	C	<1>
LAMIACEAE					
Leonotis nepetifolia (L.) R. Br.	lion's ear	Nat	U	O	<3>
LOGANIACEAE					
Fagraea berteroana Benth.	*pua kenikeni*	Orn	R	--	<4>
MALVACEAE					
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	Nat	R	--	<5>
Hibiscus rosa-sinensis L.	Chinese hibiscus	Orn	U	U	<4>
Hibiscus tiliaceus L.	*hau*	**Ind**	U1	---	<5>
Hibiscus tiliaceus var. cf. *purpurascens*	*hau* cultivar	Orn	R	R	<4>
Malva parviflora L.	cheeseweed	Nat	R1	--	<3>
Malvastrum coromandelianum (L.) Garcke	false mallow	Nat	R, U	--, --	<1, 3>
Sida ciliaris L.	---	Nat	U	O	
Sida rhombifolia L.	Cuba jute	Nat	R	---	<3>
Sida spinosa L.	prickly sida	Nat	R	R	<3>
Thespesia populnea (L.) Sol. ex Corrêa	milo	Ind	U, O3	O, O	<1, 5>
MORACEAE					
Ficus elastica Horn.	India rubber tree	Orn	R	R	<5>
Ficus macrophylla Pers.	Moreton Bay fig	Orn	R	R	<4>
Ficus microcarpa L.	Chinese banyan	Nat	R	U	<4>
MORINGACEAE					
Moringa oleifera Lam.	horseradish tree	Orn	R	R	<4>

Table 1 (continued).

FAMILY		STATUS	ABUNDANCE		NOTES
Species	**Common name**		**Wet Season**	**Dry Season**	
MYRSINACEAE					
Ardisia elliptica Thunb.	shoe-button ardisia	Nat	R	R1	<5>
MYRTACEAE					
Psidium guajava L.	common guava	Nat	--	R	<5>
Syzigium cumini (L.) Skeels	Java plum	Nat	U	U	<5>
NYCTAGINACEAE					
Boerhavia coccinea Mill.	false *alena*	Nat	U	O	<3>
Boerhavia repens L.	*alena*	**Ind**	C	O	<1>
Bougainvillea spectabilis Wild.	bougainvillea	Orn	U	U	<4>
Mirabilis jalapa L.	marvel of Peru, four-o'clock	Nat	--	R	<5>
ONAGRACEAE					
Ludwigia octovalvus (Jacq.) Raven	primrose willowl	**Pol**	--	R	<2>
OXALIDACEAE					
Oxalis corniculata L.	yellow wood sorrel	**Ind**	O, U	U, --	<1, 5>
Oxalis debilis var. *corymbosa* (A.P. de Candolle) Lour.	pink wood sorrel	Orn	R	--	<4>
PASSIFLORACEAE					
Passiflora foetida L.	love-in-a-mist	Nat	--	U	<1>
Passiflora suberosa L.	wild passionfruit	Nat	O, R, U	U, --, U3	<1, 3, 5>
PHYTOLACCACEAE					
Rivina humilis L.	coral berry	Nat	O3	R	<5>
PITTOSPORACEAE					
Pittosporum sp.	---	Orn	R	--	<4>
PLANTAGINACEAE					
Plantago lanceolata L.	nrw-lvd plantain	Nat	U2	O	<1>
Plantago major L.	common plantain	Nat	O	O	<3>
POLYGONACEAE					
Antigonon leptopus Hook. & Arnott	Mexican creeper	Nat	R		<5>
Coccoloba uvifera (L.) L.	sea grape	Nat	U2, R	U, R	<1, 5>

Table 1 (continued).

FAMILY		STATUS	ABUNDANCE		NOTES
Species	**Common name**		**Wet Season**	**Dry Season**	
PORTULACACEAE					
Portulaca oleracea L.	pig weed	Nat	R	U	<1>
Portulaca pilosa L.	---	Nat	--	R	<3>
PRIMULACCACEAE					
Anagallis arvensis L.	scarlet pimpernel	Nat	R	---	<3>
RHIZOPHORACEAE					
Rhizophora mangle	American mangrove	Nat	--	R	<2>
ROSACEAE					
Rhaphiolepis umbellata (Thunb.) Makino	Yeddo hawthorn	Orn	R1	R1	<4>
RUBIACEAE					
Gardenia cf. *augusta* (L.) Merr.	gardenia	Orn	---	R	<4>
Gardenia taitensis A.P. de Candolle	tiare, Tahitian gardenia	Orn	R	---	<4>
Morinda citrifolia L.	*noni*	**Pol**	R, O	U, O	<4, 5>
Spermacoce assurgens Ruiz & Pav.	buttonweed	Nat	U	--	<3>
RUTACEAE					
Murraya paniculata (L.) W. Jack	mock orange	Orn	U	U	<4>
SCROPHULARIACEAE					
Bacopa monnieri (L.) Penell	*ʻaeʻae*	**Ind**	U	U	<2>
SOLANACEAE					
Lycium sandwicense A. Gray	*ʻōhelo kai*	**Ind**	R	R	<1>
Solanum americanum Mill.	*pōpolo*	**Ind**	U2	R	<3>
Solanum lycopersicum var. *cerasiforme* (Dunal) Spooner, G.J Anderson, & R.K. Jansen	cherry tomato	Nat	R	--	<3>
Solanum torvum Sw.	---	Nat	R	--	<3>
STERCULIACEAE					
Waltheria indica L.	*ʻuhaloa*	**Ind**	U	--	<3>
ULMACEAE					
Trema orientalis (L.) Blume	gunpowder tree	Nat	R	R	<5>

Table 1 (continued).

FAMILY		STATUS	ABUNDANCE		NOTES
Species	**Common name**		**Wet Season**	**Dry Season**	
VERBENACEAE					
Citharexylum spinosum L.	fiddlewood	Nat	--	R	<4>
Lantana camara L.	lantana	Nat	R	--	<1>
Stachytarpheta australis		Nat	--	U	<3>
Stachytarpheta jamaicense		Nat	R	R	<3>
Verbena litoralis Kunth	*ōwī*	Nat	--	R	<1>
Vitex rotundifolia L. fil.	*pōhinahina*	**Ind**	--	U	<4>
	MONOCOTYLEDONES				
AGAVACEAE					
Cordyline fruticosa (L.) A. Chev.	ti, *ki*	**Pol**	U	O	<4>
Furcraea foetida (L.) Haw.	Mauritius hemp	Nat	R?	R	<1>
Sansevieria trifasciata Prain	mother-in-law tongue	Orn	U2	U2	<5>
ARACEAE					
Epipremnum pinnatum 'Aureum' G.S. Bunting	pothos	Nat	R, R3	--, U	<1, 4>
Monstera delicosa Liebmann	monstera	Orn	R	R	<4>
Philodendron bipinnatifidum Endl.	selloum	Orn	R	R	<4>
Syngonium cf. *podophyllum* Schott	nephthytis	Nat	--	O	<5>
ARECACEAE					
Caryota cf. *mitis* Lour.	fishtail palm	Orn	R	R	<4>
Cocos nucifera L.	coconut, *niu*	**Pol**	R, C	R, C	<1, 4>
Dypsis lutescens (H. Wendl.) Beentje & Dransfield	golden-fruited palm	Orn	R	R	<4>
Phoenix dactylifera L	Phoenix palm	Nat	U, C	U, U	<2, 5>
Roystonia regia (Kunth) O. F. Cook	royal palm	Orn	--	U	<4>
Veitchia merrilli (Beccari) H.E. Moore	Manila palm	Orn	R	R	<4>
COMMELINACEAE					
Commelina diffusa N.L. Burm.	day flower	**Pol**	R	O	<2>
Tradescantia zebrina Bosse	*hohohono'ula*	Orn	R	--	<4>
CYPERACEAE					
Bulboschoenus maritimus (L.) Palla	*kaluhā*	**Ind**	C	O	<2>
Cladium jamaicense Crantz	*'uki*, saw-grass	**Ind**	O3	O3	<2>
Cyperus halpan L.	---	Nat	R	--	<4>
Cyperus involucratus Rottb.	umbrella sedge	Nat	--	R	<2>

Table 1 (continued).

FAMILY		STATUS	ABUNDANCE		NOTES
Species	**Common name**		**Wet Season**	**Dry Season**	
CYPERACEAE (continued)					
Cyperus polystachyos Rottb.	---	**Ind**	O, U	U	<2, 3>
Cyperus rotundus L.	nut grass	Nat	O, O2	--, U2	<2, 4>
Eleocharis sp.	---	Nat	R, R	O, --	<2, 4>
Fimbristylis cymosa R. Br.	*mauʻu*	**Ind**	R	U	<1>
Fimbristylis sp.	---	???	--	U	<2>
CYPERACEAE (continued)					
Kyllinga brevifolia Rottb.	*kiliʻoʻopu*	Nat		U	<4>
Mariscus javanicus (Houtt.) Merr. & Metcalfe	*ʻahuʻawa*	**Ind**	--	R	<2>
Schoenoplectus lacustris (L.) Palla	*ʻakiʻakai*, bulrush	**Ind**	O3	U	<2>
Schoenoplectus californicus (C.A. Mey.) Palla	great bulrush	Nat	A	A	<2>
IRIDACEAE					
Dietes bicolor (Steud.) Klatt	African iris	Orn	R	--	<4>
indet.	---	Orn	--	R	<4>
LEMNACEAE					
Lemna sp.	duckweed	Nat	--	R3	<2>
LILIACEAE					
Crinum asiaticum L.	giant lily	Nat	R	R	<1>
Crinum pedunculatum R. Brown	river lily	Orn	R	R	<4>
Hippeastrum striatum (Lam.) H.E. Moore	amaryllis; Barbados lily	Nat	R	--	<4>
Liriope sp	lilly turf	Orn	--	U	<4>
PANDANACEAE					
Pandanus tectorius Z	*hala*	**Ind**	R, U	U, U	<1, 4>
Pandanus tectorius cult. 'Veitchii'	*hala* cultivar	Orn	R	R	<4>
POACEAE (GRAMINEAE)					
Axonopus compressus (Swartz) P. Beau.	brd-lvd carpetgrass	Nat	O3	O3	<4>
Axonopus fisifolius	nrw-lvd carpetgrass	Nat	--	O	<4>
Bothriochloa pertusa (L.) Camus	pitted beardgrass	Nat	A	--	<4>
Cenchrus echinatus L.	common sandbur	Nat	U1	U	<5>
Chloris barbata (L.) Sw.	swollen fingergrass	Nat	U	O	<1, 3>
Chloris divaricata R. Br.	stargrass	Nat	R	--	<3>
Chloris virgata Sw.	feather fingergrass	Nat	U	U	<3>
Cynodon dactylon (L.) Pers.	Bermuda grass	Nat	O, AA	O, AA	<2, 4>
Cynodon x magennisii Hurcombe	Bermuda hybrid	Orn	R3	--	<4>

Table 1 (continued).

FAMILY		STATUS	ABUNDANCE		NOTES
Species	**Common name**		**Wet Season**	**Dry Season**	
POACEAE (GRAMINEAE) continued					
Dactyloctenium aegypticum (L.) Willd.	beach wiregrass	Nat	R	--	<1>
Digiteria ciliaris (Retz.) Koeler	Henry's crabgrass	Nat	O1	U	<3>
Digitaria insularis (L.) Mez ex Ekman	sourgrass	Nat	U, O	--, U	<1, 3>
Digitaria violascens Link	smooth crabgrass	Nat	U	--	<3>
Echinochloa crus-galli (L.) P. Beauv.	barnyard grass	Nat	O	O	<2>
Eleusine indica (L.) Gaertn.	wiregrass	Nat	O, C	,O	<1, 3>
Eragrostis brownie (Kunth) Nees ex Steud.	sheepgrass	Nat	R	R3	<3>
Eragrostis pectinacea (Michx.) Nees	Carolina lovegrass	Nat	A	U1	<3>
Eragrostis tenella (L.) P. Beauv. ex Roem. & Schult.	lovegrass	Nat	R1	R1	<3>
Eremochloa ophiuroides (Munro) Hackel	centipede grass	Orn	U	--	<3>
Panicum maximum Jacq.	Guinea grass	Nat	C3	A	<3>
Paspalum conjugatum Bergius	Hilo grass	Nat	C	O	<4>
Paspalum fimbriatum Kunth	Panama grass	Nat	U	--	<3>
Paspalum sp.		Nat	R	--	<3>
Pennisetum purpureum Schumach.	elephant grass	Nat	O	--	<2>
Paspalum vaginatum Sw.	seashore paspalum	Nat	O1	O1	<2>
Saccharum officinarum L.	sugar cane, *kō*	**Pol**	--	R	<4>
Setaria verticillata (L.) P. Beauv.	bristly foxtail	Nat	R	R	<3>
Sorghum bicolor (L.) Moench	---	Nat	R	R	<3>
Sporobolus cf. indicus (L.) R. Br.	dropseed	Nat	R	O2	<4>
Sporobolus virginicus (L.) Kunth	'aki'aki	Ind	AA	AA	<1>
Stenotaphrum secundatum (T. Walter) Kuntze	St. Augustine grass	Nat	U3	U	<1>
Urochloa mutica (Forssk.) Nguyen	California grass	Nat	A, R	C1,	<2, 3>
Zoysia matrella var. pacifica Gouds.	Mescarene grass	Orn	U, --	U, U	<1, 4>
STRELITZIACEAE					
Strelitzia reginae Dryander	bird-of-paradise	Orn	U	U	<4>
TYPHACEAE					
Typha latifolia L.	common cattail	Nat	R3	U2	<2>
ZINGERBERACEAE					
Alpinia purpurata (Viell.) K. Schum.	red ginger	Orn	R	--	<4>
Alpinia zerumbet (Pers.) B.L. Burtt & R.M. Smith	shell ginger	Orn	--	R	<4>
Etlingera elatior (Jack) R.M. Smith	torch ginger	Orn	--	U	<4>

Table 1 (continued).

Legend to Table 1

Status = distributional status

End = endemic; native to Hawaii and found naturally nowhere else.

I**nd** = indigenous; native to Hawaii, but not unique to the Hawaiian Islands.

Nat = naturalized, exotic, plant introduced to the Hawaiian Islands since the arrival of Cook Expedition in 1778, and well-established outside of cultivation.

Orn = exotic, ornamental or cultivated; plant not naturalized (not well-established outside of cultivation).

P**ol** = early Polynesian introduction (before 1778).

Abundance = occurrence ratings for plants in survey area.

R – Rare - only one, two, or three plants seen.

U - Uncommon - several to a dozen plants observed.

O - Occasional - found regularly around the site.

C - Common - considered an important part of the vegetation and observed numerous times.

A - Abundant - found in large numbers; may be locally dominant.

AA - Abundant - abundant and dominant in some areas surveyed, defining vegetation in those areas.

Numbers following a letter modify the letter to account for clustered distribution. Thus R3 would indicate a plant encountered ratrely (one to three times), but numerous where encountered.

Notes:

<1> Associated with beach, dune, and limestone shelf (strand vegetation)

<2> Associated with wetlands and golf course water hazard (aquatic) sites.

<3> Associated with disturbed areas around structures and golf course.

<4> Associated with the extensive mowed (lawn) areas; grounds landscaping; golf course.

<5> Associated with forest vegetation type inland of dunes.

<6> A plant which was lacking flowers or fruit; identification uncertain.

Botanical Surveys, Vegetation

"Vegetation" refers to the type of plants that dominate an area. For the SEIS lands, we can describe the following basic vegetation types: Landscape, Forest (several types), Shrub-scrub, Wetland, and, along a narrow zone at the coast, Strand. Each of these vegetation types and the distribution (shown in Figure 3) are discussed here, in order from the largest to smallest based upon proportion of area within the SEIS lands.

The Landscape Vegetation type (**Lnd**) refers to all areas where the dominant plants are controlled and maintained by humans. Included are hotel grounds, golf course (Figure 4) and other high resort use areas, Kuilima Estates, and other landscaped areas (roads and parking lots). Of course, many of the ruderal weed species (plants adapted to conditions of regular disturbance, such as mowing, grading, etc.) that occur on the property will be found in landscaped areas, since levels of maintenance will vary greatly dependent upon land use. Not all of these areas were surveyed (for example most of the hotel grounds and Kuilima Estates were excluded) because they represent completely developed areas where all botanical resources are managed and for the reasons stated in the Introduction. A sizable fraction (36 percent) of the listed flora occurs in the landscaped areas because this category constitutes a high percentage of the SEIS lands and because of contributions from both diverse plantings and ruderal weeds. This vegetation type has low numbers of native species with the exception of plants used in landscaping as discussed under Flora above and a few ruderal natives such as *pōpolo* (*Solanum americanum*) and *'uhaloa* (*Waltheria indica*), which were not very abundant in the surveys.

Figure 4 - View of highly manicured vegetation of the golf course at Turtle Bay Resort. Note aquatic feature (water hazard). Forest in background is actually trees in and around Punaho'olapa Marsh.

Figure 3 - Vegetation and "wetlands" map of the SEIS lands. Landward boundary of survey area shown in red and yellow dotted line. Wetlands and other aquatic features shown in blue, modified from National Wetland Inventory maps. Vegetation zones outlined in yellow: FoC - Ironwood forest; FoM - mixed forest; Grl - grassland and open disturbed areas; Lnd - landscaped and developed areas (and some highly disturbed areas); ShO - coastal shrubland; ShS - *koa haole* shrubland; STr - coastal strand.

The Forest Vegetation type (**Fo**) is the most complex on the property, consisting of trees forming a closed or nearly closed canopy. This vegetation covers a considerable proportion of the SEIS lands, and varies in composition from place to place, merging into all of the other vegetation types along boundaries that are, in places, not well-defined. For example, either planted trees or trees naturalized along the forest border may, at the interface between the Landscape and Forest types be included in the mapping as in one or the other. A line between the Forest and Strand cannot be accurately drawn where the strand is dominated by trees, such as ironwood (*Casuarina equisetifoilia*).

The ironwood forest (**FoC**) is the dominant Forest type on SEIS lands, found particularly close to the coast (Figure 5). Ironwood grows on dunes and immediately behind the beach (or rocky shore) in some places (see strand vegetation below). Ironwoods are very tolerant of the conditions that set the strand apart from inland plant communities, but are allelopathic (needle-like litter accumulated on the ground prevents most other species from germinating and forming an understory). Thus, an understory is either absent or sparse in dense ironwoods. In one area, the ground under the ironwoods is singularly covered by the vine, *Passiflora suberosa*, perhaps because scattered seedlings that do germinate can spread out over the surface unaffected by any allelopathic chemicals in the soil. Although obviously a useful species for the dry Kahuku Point area, and widely incorporated in the landscaping of the developed areas including the golf course, ironwoods should be considered invasive in two vegetation types: strand and wetland.

Figure 5 - Ironwood forest on dunes looking inland from the open part of the strand. Note the paucity of other vegetation under the dense canopy of the ironwoods.

Areas of forest not dominated by ironwood tend to comprise several common, mostly non-native tree species: Christmas berry (*Schinus terebinthefolius*), *Macaranga tanarius*, *milo* (*Thespesia populnea*), *koa haole* (*Leucaena leiucocephala*), Java plum (*Syzygium cumini*), and even hau (*Hibiscus tiliaceus*) as monotypic stands in a few low-lying areas. Ironwood is usually present, just not dominant. These forested areas are mapped as mixed forest (**FoM**). Many other species of trees, shrubs, and herbs occur in various parts of these forests, but tend not to be dominant. The understory typically includes Chinese violet (*Asystasia gangetica*), Guinea grass (*Panicum maximum*), and sourbush (*Pluchea indica* and *P. carolinenesis*), although many other shrubs and herbs are listed in Table 1 from this vegetation type. An area planted in Cook Island pines (**FoP**) occupies a part of the high dune just east of the Ocean Villas development.

Koa haole grows as a shrub or small tree, and can reach high densities. In areas where *koa haole* is the dominant species, the tall, woody plants approach a forest type, but here are labeled as scrub or shrub-scrub (**ShS**). Sometimes other trees occur scattered in this vegetation type or *koa haole* occurs as patches of scrub within the other forest types or diffused throughout the forest. The areas of purest shrub-scrub are areas of former sugar cane lands (see Figure 2) that have not been developed. Typical understory plants in the *koa haole* shrub-scrub are Guinea grass, Chinese violet, and gycine vine (*Neonotonia wightii*). Other scrublands occur (**ScO**) inland from the strand. These are dominated by *Pluchea* spp.

Wetlands on the SEIS lands are of two types: 1) former wetlands that were part of Punahoʻolapa Marsh and 2) wetlands and aquatic features associated with the golf course hazards. The latter were either constructed during grading for the courses (that is, are lined ponds), or incorporated (and perhaps dredged) from prior existing wetlands or stream courses. Aquatic features are mapped in Fig. 3 from the National Wetland Inventory (NWI) shape files provided by USFWS[1]. These shapefiles have been modified by removal of all features that are not ponds or wetlands (essentially NWI data base errors). Streams and marine habitats have also been removed, the former replaced by our stream designations. For "streams" and other water courses, and the boundary of Punahoʻolapa Marsh where not defined by a dredged moat, the map depicts results from a survey of these features undertaken by AECOS (2011).

Most of the features shown as "wetlands" on the property are in fact, open golf course ponds or moat-like ponds (Figures 4 and 6). Some, but not all of these ponds support wetland vegetation around their margins. Wetlands (as opposed to ponds) are present at

[1] The NWI includes errors (features that are not even aquatic),and may not be complete in some areas. The NWI is, therefore, a useful guide, but not a determiner of federal jurisdictional waters. Further, the NWI includes many aquatic features that are not wetlands at all, including nearshore marine habitats and anything USFWS thinks might be aquatic (such as lined ponds on the golf course, and treatment lagoons at the waste water treatment plant.

Punahoʻolapa Marsh, at an area east of the main entrance adjacent to Kamehameha Highway, in the lower part of the main drainage swale, and as a shallow manmade wetland/pond west of the latter (just northeast of Kulima Estates). These areas are not, or are only minimally maintained. Punahoʻolapa Marsh is the most interesting of the wetlands as it is part of a large complex of wetlands that existed in the distant past on the Kahuku Plain. The NWI indicates only the man-made moats surrounding Punahoʻolapa Marsh, despite the long history of a marsh frequently mapped in this location, (Land Study Bureau, 1963; USGS, 1965, 1983, 1998 Kahuku Quadrangle 7.5 Minute Topographic Series).

Figure 6 - Wetland interface between the golf course (Landscape vegetation) and the moat around Punahoʻolapa Marsh. Note abundance of ironwoods within Punahoʻolapa Marsh in background.

In Figure 3, the marsh is shown to consist of three areas outlined by the NWI moat-like features and the AECOS (2011) wetland delineation boundary in the area not mapped as moats (in fact, moats also occur in much of this area). Nearly all of Punahoʻolapa Marsh is overgrown with herbaceous vegetation. Many areas supporting tree growth are evident as well, including areas of *hau* forest (not mapped). There are however, extensive interior areas supporting *koa haole* shrub-scrub and ironwood forest. These areas were not visited, and therefore unknown is how much of the area enclosed by moats remains as wetland. Only one open pond area is seen in satellite images. Consequently, our map shows the extent of the former feature Punahoʻolapa Marsh, and does not further address the condition of the interior of that feature with respect to wetland function. Certainly a large portion of the outlined area remains a marsh, although densely covered with vegetation including various sedges (mostly natives), California grass (*Urochloa mutica*), *hau*, and

several patches of trees such as ironwood, and *koa haole* that might represent high (non-wetland) ground within the marsh border.

Starting along the shore, the substratum of the SEIS lands varies between consolidated limestone (rocky shore) and sand deposits (beaches; see Figure 7). Very few higher plant species can tolerate direct immersion in seawater or the shifting nature of sand deposits subjected to wave action. A number of environmental factors—brackish or saline groundwater, salt spray, absence of humus in the soil substratum, exposure to winds—are sufficiently harsh so as to limit the species that can survive in the strand. The Strand vegetation (**STr**) occupies a zone of variable width immediately inland of the ocean shore. Some of the vegetation grows on the upper part of active beaches (notably the vine, *pōhuehue* or *Ipomoea pes-caprae*) and *'aki'aki* grass or *Sporoblus virginicus*, seeding and or invading down the beach by rhizomal growth. Mostly, this vegetation is found on sand moving slowly inland under the influence of the wind (which is predominantly onshore at this location) forming dunes, which—where active (that is where sand is actively on the move)—might be mistaken for beach rather than wind (or in some cases, storm wave) deposited material. As far as plant growth is concerned, the difference is one of stability. Where the sand is actively moving about at a fairly good rate (waves constantly rework the beach sand), plants cannot get established, or are buried (or the roots exposed) and die.

Figure 7 - View of the shore showing sand and limestone substrata. All the plants visible here are part of the Strand vegetation type. Note ironwoods on right are invasive to the strand.

The distance the strand extends inland from the beach or rocky limestone shore depends upon several factors: 1) how far inland the dunes extend, 2) how marked are salt air effects on extant vegetation, and 3) disturbances that damage the vegetation or the substratum. In most areas along the coast of the SEIS lands, the width of this vegetation zone is too narrow to indicate on our map (Figure 3)[2]. The widest areas of strand vegetation occur at the rocky points (Kahuku and Kuilima) and behind the shore extending east from Kahuku Point. The typical strand plant community is one dominated by several native species—*naupaka kahakai* (*Scaevola taccada*), *'akoko* (*Euphorbia degeneri*), *'aki'aki* (*Sporobolis virginicus*), *hinahina* (*Heliotropium anomalum* var. *argenteum*), *ma'u* (*Fimbristylis cymosa*)—and at least one non-native tree (beach heliotrope or *Tournefortia argentea*). Along much of the shore, the area formerly occupied by dunes has been developed by the resort (golf course and hotel structures near the coast) or have been modified by the ironwood trees which grow nearly down to the shore; while these trees are a part of the strand vegetation, they are also a part of the ironwood and mixed forests that extend yet further inland. Thus, there is no simple way to differentiate the strand on the basis of vegetation alone where ironwoods predominate. As noted above, ironwoods can be invasive in this vegetation type.

Avian Survey

Point Counts

A total of 1735 individual birds of 27 species, representing 19 separate families, were recorded during the course of the wet and dry season point count surveys. Three of the species recorded, Common Gallinule (*Gallinula galeata sandvicensis*)[3], Hawaiian Coot (*Fulica alai*) and Hawaiian Stilt (*Himantopus mexicanus knudseni*) are endemic endangered waterbird species. One species recorded, Black-crowned Night-Heron (*Nycticorax nycticorax hoactli*) is an indigenous resident water obligate species, and four, Pacific-Golden Plover (*Pluvialis fulva*), Wandering Tattler (*Tringa incana*), Bristle-thighed Curlew (*Numenius tahitiensis*) and Ruddy Turnstone (*Arenaria interpres*) are indigenous migratory shorebird species. The remaining 19 species detected are considered to be alien to the Hawaiian Islands (Table 2).

There was very little difference between the results of the wet and dry season (spring and fall) bird surveys. We recorded two additional migratory shorebird species during the later survey that were not recorded during the course of the first survey. All of species detected during the wet season (spring) were also recorded during the dry season survey. These results were not unexpected, as the Hawaiian Islands unlike continental landmasses do not have a significant difference in avian species present during the course of a year. The significant intermonth differences in avian species usage of continental locations is a reflection of the presence and or absence of Neotropical migrant species in the Americas

[2] In reality, the strand probably does extend inland where the substratum is dune sand. However, these areas where a strand is too narrow for mapping have either development close behind the shore or ironwood forest, which interferes with defining where the strand/forest boundary occurs.

[3] The common and scientific names of this species were recently changed by the American Ornithological Union from Common Moorhen (*Gallinula chloropus*) to Common Gallinule (*Gallinula galeata sandvicensis*; Cheeser et al. 2011, Pg. 603).

and Palearctic migrants in Europe and Asia. The Pacific Islands do see some migratory shorebird and waterfowl species but no passerines.

Avian diversity and densities were in keeping with the vegetation and current usage of the site, most of which is either golf course, condos, apartments, forested lands, scrub lands or open maintained golf course. Four species, Common Waxbill (*Estrilda astrild*), Red-vented Bulbul (*Pycnonoyus cafer*), Zebra Dove (*Geopelia striata*) and Japanese White-eye (*Zosterops japonicus*) accounted for 51 percent of all birds recorded during station counts. Common Waxbill was the commonest species recorded.

Time Dependant Waterbird Counts

A total of 26 adult and two sub-adult Hawaiian Gallinule, three Hawaiian Coot, five Hawaiian Stilt and one domestic Muscovy (*Cairina moschata*) were recorded within water and wetland features on the property during the course of time dependant waterbird counts. These numbers reflect a best guess at a high count, as there are numerous water features on the property as well as on the adjacent USFWS Wildlife Refuge located to the south of Marconi Road and there is considerable temporal movement of birds between features.

Two sub-adult Hawaiian Gallinules were recorded, which may indicate on-site nesting activity. The two sub-adult birds were each seen with two separate sets of adults. No nests were observed in any of the water features, though unobserved nests could have been present with Punahoʻolapa Marsh, which in it's current state is not readily searchable for nesting waterbirds.

Table 3 – Avian Species Detected During Point Counts – Turtle Bay Resort, 2011					
Common name	***Scientific name***	***Status***	***Wet Season***	***Dry Season***	***Comb. RA***
	PHASIANIDAE - Pheasants & Partridges				
	Phasianinae - Pheasants & Allies				
Domestic Chicken	*Gallus sp.*	D	0.20	0.35	**0.28**
	PELECANIFORMES				
	ARDEIDAE - Herons, Bitterns & Allies				
Cattle Egret	*Bulbucus ibidis*	A	2.20	1.45	**1.83**
Black-crowned Night-Heron	*Nycticorax nycticorax hoactli*	IR	0.15	0.25	**0.20**
	GRUIFORMES				
	RALLIDAE - Rails & Allies				
Common Gallinule	*Gallinula galeata sandvicensis*	**EE**	0.15	0.30	**0.23**
Hawaiian Coot	*Fulica alai*	**EE**	0.10	0.30	**0.20**
	CHARADRIIDAE - Lapwings & Plovers				
	Charadriinae - Plovers				
Pacific Golden-Plover	*Pluvialis fulva*	IM	1.60	1.20	**1.40**
	RECURVIROSTRIDAE - Stilts & Avocets				
Black-necked Stilt	*Himantopus mexicanus knudseni*	**EE**	0.25	0.25	**0.25**
	SCOLOPACIDAE - Sandpipers, Phalaropes & Allies				
	Scolopacinae - Sandpipers & Allies				
Wandering Tattler	*Tringa incana*	IM	0.10	0.05	**0.08**
Bristle-thighed Curlew	*Numenius tahitiensis*	IM	0.05	-	**0.03**
Ruddy Turnstone	*Arenaria interpres*	IM	1.40	-	**0.70**
	COLUMBIFORMES				
	COLUMBIDAE – Pigeons & Doves				
Spotted Dove	*Streptopelia chinensis*	A	1.25	1.15	**1.20**
Zebra Dove	*Geopelia striata*	A	4.75	4.15	**4.45**

Table 2 – Continued

Common name	***Scientific name***	***Status***	***Wet Season***	***Dry Season***	***Comb. RA***
	PSITTACIFORMES				
	PSITTACIDAE – Lories Parakeets, Macaws & Parrots				
	Psittacinae - Typical Parrots				
Rose-ringed Parakeet	*Psittacula krameri*	A	0.65	1.40	**1.02**
	PASSERIFORMES				
	PYCNONOTIDAE - Bulbuls				
Red-vented Bulbul	*Pycnonotus cafer*	A	6.45	0.50	**5.85**
Red-whiskered Bulbul	*Pycnonotus jocosus*	A	5.25	1.00	**0.75**
	CETTIIDAE - Cettia Warblers & Allies				
Japanese Bush-Warbler	*Cettia diphone*	A	0.15	0.30	**0.22**
	ZOSTEROPIDAE – White-eyes				
Japanese White-eye	*Zosterops japonicus*	A	2.95	2.45	**2.70**
	TIMALIIDAE - Babblers				
Red-billed Leiothrix	*Leiothrix lutea*	A	0.15	0.40	**0.28**
	TURDIDAE - Thrushes				
White-rumped Shama	*Copsychus malabaricus*	A	0.85	1.05	**0.95**
	STURNIDAE – Starlings				
Common Myna	*Acridotheres tristis*	A	5.80	4.80	**5.30**
	EMBERIZIDAE – Emberizids				
Red-crested Cardinal	*Paroaria coronata*	A	1.15	1.50	**1.33**
	CARDINALIDAE – Cardinals Saltators & Allies				
Northern Cardinal	*Cardinalis cardinalis*	A	1.15	1.35	**1.25**
	FRINGILLIDAE – Fringilline and Carduline Finches & Allies				
House Finch	*Carpodacus mexicanus*	A	1.50	1.70	**1.60**
	PASSERIDAE – Old World Sparrows				
House Sparrow	*Passer domesticus*	A	0.20	0.95	**0.58**
	ESTRILDIDAE – Estrildid Finches				
Common Waxbill	*Estrilda astrild*	A	7.05	5.80	**6.43**
Nutmeg Mannikin	*Lonchura punctulata*	A	0.95	2.30	**1.67**
Chestnut Munia	*Lonchura atricapilla*	A	1.95	3.40	**2.68**

Key to Table 2.

EE	Endangered Endemic Species – Native and unique to the Hawaiian Islands, also listed as endangered under the ESA, and State HRS 195D
A	Alien Species – Introduced to the Hawaiian Islands by humans
D	Domesticated species – not considered to be established in the wild on the Island of O'ahu
IR	Indigenous Resident Species – Native to the Hawaiian Islands, but not unique to the islands, non-migratory
IM	Indigenous Migratory Species - Native to the Hawaiian Islands, but not unique to the islands, does not breed in the Hawaiian Islands
Spring	Spring Survey – Relative Abundance – Number of bird detected, divided by the number of count stations (20)
Fall	Fall Survey – Relative Abundance – Number of bird detected, divided by the number of count stations (20)
A-3	Area 3 – Relative Abundance – Number of bird detected, divided by the number of count stations (11)
Comb RA	Combined Relative Abundance - Number of bird detected during both spring and fall counts divided by the total number of count stations (40)

Mammalian Survey

Eight terrestrial and one marine mammalian species were detected on site during the course of this survey (Table 3). With the exception of endangered Hawaiian monk seals (*Monachus schauinslandi*) seen hauled out on the beach during both field surveys, all of the mammals recorded on the site are alien to the Hawaiian Islands.

Table 3 – Mammalian Species Recorded – Turtle Bay Resort, 2011

Common name	Scientific name	Status	DT
	RODENTIA - Gnawers		
	Muridae - Old World Rats & Mice		
European house mouse	*Mus musculus domesticus*	**A**	V
	CARNIVORA- Flesh Eaters		
	Canidae - Wolves, Jackals & Allies		
Domestic dog	*Canis f. familiaris*	**A**	V, A, Sc, Tr
	VIVERRIDAE - Civets & Allies		
Small Indian mongoose	*Herpestes a. auropunctatus*	**A**	V, A, Sc, Tr
	FELIDAE- Cats		
House cat	*Felis catus*	**A**	V, Tr
	PHOCIDAE - Hair Seals		
Hawaiian monk seal	*Monachus schauinslandi*	**EE**	V
	PERISSODACTYLA - Odd-Toed Ungulates		
	Equidae - Horses, Asses & Zebras		
Domestic horse	*Equus c. caballus*	**A**	V, Sc, Tr
Donkey	*Equus a. asinus*	**A**	V, Sc, Tr
Mule	*Equus asinus x Equus caballus*	**A**	V, Sc, Tr
	ATRIODACTYLA - Even-Toed Ungulates		
	Suicidae - Old World Swine		
Pig	*Sus s. scrofa*	**A**	Sc, Tr, Si

Key to Table 3

- **A** Alien – Introduced to the Hawaiian islands by humans
- **EE** Endangered Endemic – native and unique to the Hawaiian Islands, also listed as an endangered species
- V Visual – animal that was seen
- A Auditory – an animal that was recorded by hearing its call or other distinct sounds
- Sc Scat – an animal that was detected due to the presence of fecal material
- Tr Tracks – an animal that was recorded by seeing tracks or other sign

Discussion

Botanical Resources

The percentage of native plants in the area is generally typical for lowlands on Oʻahu (David & Guinther, 2006: 11 percent; David & Guinther, 2010: 12 percent) at 10.5 percent. As is also typical, for most of the SEIS lands, the abundance of natives in the vegetation is far below that of non-natives. This condition is not unexpected considering the long history of disturbance of the site going back over 100 years. Exceptions to these statements involve the wetlands (specifically Punahoʻolapa Marsh) and the coastal strand vegetation. In these environments, native plants remain abundant (Figures 8 and 9) and, in some places are the dominant members of their respective botanical communities. With the exception of landscaping close to the ocean shore, the Landscape, Forest, and Shrub-Scrub have minimal botanical resource value based upon occurrence of native plant species. The only endemic species recorded in the survey was ʻakoko, which was found exclusively on the dunes and mostly in areas where the dune vegetation is minimally disturbed.

Figure 8 - View across a moat into Punahoʻolapa Marsh showing dense growths of several native plants: *neke* fern, backed by *ʻuki* (saw-grass), with *hau* still further back.

Figure 9 - Area of dunes supporting native plants: mostly naupaka here, but with ʻakiʻaki (grass) and a few ʻakoko and hinahina plants growing on sand in front of the naupaka.

From a resources conservation perspective, both the Strand vegetation and Punahoʻolapa Marsh are deserving of special attention with a goal towards preservation. Other wetlands and inland aquatic environments on the SEIS lands are either well maintained ponds with wetland plants or otherwise protected as likely jurisdictional waters under the federal Clean Water Act; but in all cases, are partly or wholly integrated into the golf course landscapes on the site. Punahoʻolapa Marsh is very well protected physically by moats that surround most of the former marshland. Expansion of the moat system is presently being contemplated by TBR Development to complete the ring around the marsh. Although not part of the present survey, the marsh appears to have sufficient hydrology but is overgrown with vegetation, much of it non-native and actually or potentially invasive. The majority of open water existing today in this marsh is the bordering moat system, providing habitats of value to water obligate birds. Thus, the resource value of the marsh, while not threatened, is certainly well below what it could be.

The native Strand vegetation is present but poorly represented along most of the SEIS lands coastline. However, from Kahuku Point eastward, this community is well developed, forming a broad zone in from the beach. This community is heavily invaded by non-native species further inland across the dune complex. The greatest threat to this community appears to be from off-road vehicular (ORV) traffic entering from the east. The numerous ORV trails across the beach and dunes have caused destruction of the native vegetation,

with resulting erosion (sand movement) and enhancement of the process of invasion by non-native weeds. Fortunately, strand plants are adapted to disturbances resulting from storm waves and moving sand, and tend to recover from man-made disturbances. However, there is a limit to such resilience and prevention of unwelcomed traffic on these dunes under the control of TBR Development should be made a priority.

Avian Resources

The findings of the avian survey are consistent with the current habitat present on the site and the land usage of the area surveyed. During the course of this survey 27 avian species, were recorded during the course of the wet and dry season surveys. Three of the species recorded, Common Gallinule, Hawaiian Coot and Hawaiian Stilt are endemic endangered waterbird species. The various water features on the site provide foraging and loafing habitat for these three endangered endemic waterbird species. The only areas within the property boundaries that likely support any nesting activity for any of these species is within water features which have fairly dense emergent vegetation, Punahoʻolapa Marsh in particular.

One species recorded, Black-crowned Night-Heron is a commonly occurring indigenous resident water obligate species, and four, Pacific-Golden Plover, Wandering Tattler, Bristle-thighed Curlew and Ruddy Turnstone are indigenous migratory shorebird species which nest in the high Arctic during the late spring and summer months, returning to Hawaiʻi and the Tropical Pacific to spend the fall and winter months each year. They usually leave Hawaiʻi for their trip back to the Arctic in late April or the very early part of May. The remaining 19 species detected are considered to be alien to the Hawaiian Islands.

Although no seabirds were detected during the course of this survey, several seabird species potentially overfly the site on occasion. The primary cause of mortality in resident seabirds is thought to be predation by alien mammalian species at the nesting colonies (USFWS 1983; Simons and Hodges 1998; Ainley *et al.,* 2001). Collision with man-made structures is considered to be the second most significant cause of mortality in locally nesting seabird species in Hawaiʻi. Nocturnally flying seabirds, especially fledglings on their way to sea in the summer and fall, can become disoriented by exterior lighting. When disoriented, seabirds often collide with manmade structures, and if they are not killed outright, the dazed or injured birds are easy targets of opportunity for feral mammals (Hadley 1961; Telfer 1979; Sincock 1981; Reed *et al.*, 1985; Telfer *et al.*, 1987; Cooper and Day, 1998; Podolsky *et al*. 1998; Ainley *et al.,* 2001; Hue *et al.,* 2001; Day *et al* 2003).

Mammalian Resources

The findings of the mammalian survey are consistent with the current habitat present on the site and the land usage of the area surveyed. All of the mammalian species detected with the exception of several Hawaiian monk seals seen hauled out on the beach fronting the property are alien species.

Although no rodents were detected during the course of this survey, it is likely that the four established alien *muridae* found on Oʻahu, roof rat (*Rattus r. rattus*), Norway rat (*Rattus norvegicus*), European house mouse (*Mus musculus domesticus*) and possibly Polynesian rats (*Rattus exulans hawaiiensis*) use various resources found within the general project area on a seasonal basis. These human commensal species are drawn to areas of human habitation and activity. All of these introduced rodents are deleterious to native ecosystems and the native faunal species dependant on them.

No Hawaiian hoary bats were detected during the course of this survey. Given the paucity of documented records of this species on Oʻahu, this finding was not unexpected (USFWS, 1998; David, 2011).

Potential Impacts to Protected Species

Botanical

No species of plant listed as threatened or endangered under state or federal statutes was recorded during either the March or September, 2011 surveys of the SEIS lands, and none is expected to occur on this highly disturbed site. Only endemic species or subspecies are likely to be listed, and only the one endemic species (*ʻakoko* recorded in the strand environment) was recorded in our surveys. There are a number of Hawaiian *ʻakoko* species either listed or considered species of concern (USFWS, 2011), but not *E. degeneri*, the species detected. However, *E. degeneri* and *ʻohelo kai* (*Lycium sandwicense*) are uncommon species on Oʻahu due to limitations on habitat (these species only occur in strand environments) and disturbances that the habitat is subjected to.

Waterbirds

Potential impacts to listed waterbird species that have been and may be further attracted to the wetland features run the gamut from temporary disturbance of individual birds that may be attracted to the area as potential modifications of the ditch around Punahoʻolapa Marsh are constructed, to direct physical harm of individual birds. The use of certain herbicides, insecticides and fertilizers used in landscape and golf course maintenance can also pose threats to waterbirds, as can the unintentional migration of petroleum, oils, lubricants, cleaning agents and the like into water features. Golf course operations have the potential to result in physical harm to listed waterbird species that may use resources on the active golf course. As golf is and ongoing activity on the site it is unlikely that any expansion of the resort facilities will resulting any increased threats to waterbirds by the golf operations.

Following build out, and operation of the proposed improvements to the resort, nesting waterbirds could potentially be disturbed by human activity causing abandonment of the nest, broken eggs, trampled chicks, and increased predation of eggs and chicks when adults potentially flee human disturbance and leave their nests and young unguarded. An operating Resort will by its very nature attract certain human commensal species such as cats and rats, which also pose threats to these avian species, especially to young birds and

eggs. As the site is already operated as a resort it is unlikely that the proposed expansion of the facilities will attract any predators that are not already using resources on the property.

Seabirds

The principal potential impact that further modification of this site poses to protected seabirds is the increased threat that birds will be downed after becoming disoriented by lights associated with the project during the nesting season. The two main areas that outdoor lighting could pose a threat to these nocturnally flying seabirds is if, 1) during construction, if it is deemed expedient, or necessary to conduct nighttime construction activities, 2) following build-out, the potential use of streetlights or other exterior lighting during the seabird nesting season.

Hawaiian monk seal

No direct impacts to Hawaiian monk seals are anticipated from the further development of the SEIS lands is expected. The human activities of greatest concern to monk seals are the potential for entanglement in fishing gear, impact from boats, or predation by fishermen who may view the seals as direct competitors for fish resources. None of these sources of mortality are likely to increase as a result of resort development because the anticipated clientele are not likely to engage in these activities. However indirect impacts including increased interactions with fishermen, surfers, kayakers, and other ocean recreational uses may be anticipated as a result of improved access to the public and increases in shoreline population.

Hawaiian hoary bat

The principal potential impact that the further development of the Resort poses to bats is during the clearing and grubbing phases of construction as vegetation is removed. The removal of vegetation within the project site may temporarily displace individual bats, which may use the vegetation as a roosting location. As bats use multiple roosts within their home territories, the potential disturbance resulting from the removal of the vegetation is likely to be minimal. During the pupping season, females carrying their pups may be less able to rapidly vacate a roost site as the vegetation is cleared. Additionally, adult female bats sometimes leave their pups in the roost tree while they forage. Very small pups may be unable to flee a tree that is being felled. Potential adverse effects from such disturbance can be avoided or minimized by not clearing woody vegetation taller than 4.6 meters (15-feet), between June 15 and September 15, the period in which bats are potentially at risk from vegetation clearing. Given the likely very low levels of bat use of the site it is unlikely that construction activities will result in impacts to this species.

Recommendations

- If nighttime construction activity or equipment maintenance is proposed during the construction phases of the project, all associated lights should be shielded, and when large flood/work lights are used, they should be placed on poles that are high enough to allow the lights to be pointed directly at the ground.

- If streetlights or exterior facility lighting is installed in conjunction with the project, it is recommended that the lights be shielded to reduce the potential for interactions of nocturnally flying seabirds with external lights and man-made structures (Reed et al., 1985; Telfer et al., 1987).

- Punahoʻolapa Marsh, especially one that is further restored represents a wonderful educational and outreach opportunity. Development of an I&E program centered around the marsh, it's history and the native flora and fauna that use it is encouraged.

- Develop and implement an integrated monk seal and green sea turtle education program to educate coastal users of the property of the importance of not disturbing these trust resources.

- Future developments on the SEIS lands should continue utilizing appropriate native species in landscaping.

- Thinning of ironwood trees where these are invasive of either wetland or strand plant communities should be considered as a potentially valuable conservation activity.

- Efforts should continue or be increased to limit all access (but particularly by ORVs) to strand areas where the plant community is predominantly native.

Critical Habitat

There is no federally delineated Critical Habitat present on or adjacent to the property. Thus the further development and operation of proposed development will not result in impacts to federally designated Critical Habitat. There is no equivalent statute under state law.

Glossary

Ahupua'a – Traditional Hawaiian land division, usually extending from the uplands to the sea.
Alien – Introduced to Hawai'i by humans
Allelopathic – The inhibition of growth in one species of plants by chemicals produced by another species
Domesticated – Feral species, not considered established in the wild on the Island of O'ahu
Endangered – Listed and protected under the Endangered Species Act of 1973, as amended (ESA) as an endangered species
Endemic – Native to the Hawaiian Islands and unique to Hawai'i
Indigenous – Native to the Hawaiian Islands, but also found elsewhere naturally
*Maka*i – Down-slope, towards the ocean
Mauka – Upslope, towards the mountains
Muridae – Rodents, including rats, mice and voles, one of the most diverse family of mammals
Naturalized – A plant or animal that has become established in an area that it is not indigenous to
Nocturnal – Night-time, after dark
'Ōpe'ape'a – Endemic endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*)
Pelagic – An animal that spends its life at sea – in this case seabirds that only return to land to nest and rear their young
Phylogenetic – The evolutionary order that organisms are arranged by
Ruderal – Disturbed, rocky, rubbishy areas, such as old agricultural fields and rock piles
Sign – Biological term referring tracks, scat, rubbing, odor, marks, nests, and other signs created by animals by which their presence may be detected
Threatened – Listed and protected under the ESA as a threatened species

DLNR – Hawai'i State Department of Land & Natural Resources
DOFAW – Division of Forestry and Wildlife
ESA – Endangered Species Act of 1973, as amended
USFWS – United State Fish & Wildlife Service
USGS – U.S. Geological Survey
TMK – Tax Map Key

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