

ARCHAEOLOGICAL ASSESSMENT

KAWAI'ELI WILDLIFE SANCTUARY PHASE 2

Kawai'eli, Mānā Ahupua'a, Kona District, Kaua'i
(TMK: 1-2-02:1)



Kawai'eli Wildlife Sanctuary, Phase 1



STATE OF HAWAII
Department of Land and Natural Resources
Division of State Parks

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INTRODUCTION

The Kawai'eli Wildlife Sanctuary is located in the Kawai'eli dunes along the western coast of Kaua'i (Fig. 1). The Sanctuary was first established in 1989 when a large pond was excavated between Kaumuali'i Highway and the shoreline. Located to the south of access road to the Kawai'eli Pumping Station, the pond was excavated in former sugarcane lands adjacent to the Pacific Missile Range Facility (PMRF).

The Division of Forestry and Wildlife (DOFAW) requested the assistance of Division of State Parks with an archaeological assessment prior to a Phase 2 expansion of the Kawai'eli Wildlife Sanctuary. The expansion encompasses approximately 70 acres to the north of the existing 30-acre sanctuary. This assessment was conducted by State Parks archaeologists, Martha Yent and Alan Carpenter, with assistance from Nancy McMahan, Kaua'i archaeologist with the State Historic Preservation Division (SHPD). The assessment was conducted between June and August 2004.

Kawai'eli is being used as the spelling of the project area and the former wetland pond. This place name is found on the older maps of the Mānā area. Kawai'ele is the alternate spelling that appears on the USGS map. Kawai'eli also refers to a beach area, Point, fishing grounds, ditch and Pumping Station (Flores and Kaohi 1992: 17). The literal translation of Kawai'eli is the excavated water.

Project Location

The Kawai'eli Wildlife Sanctuary is located about 5 miles northwest of Kekaha town in the Mānā *ahupua'a*, Kona (Waimea) District. The Sanctuary is on the Mānā Plain, the flat coastal land from Kekaha to Polihale and between the foothills and shoreline of West Kaua'i. The sanctuary encompasses a portion of Tax Map Key 1-2-02: 1 as delineated by PMRF to the west, north, and south and Kaumuali'i Highway to the east (Fig. 2).

The State-owned land between PMRF and Kaumuali'i were formerly leased to Kekaha Sugar Company for the cultivation of sugarcane. As these lands were phased out of cane in the 1990s, other agricultural and aquacultural venues have been initiated.

Proposed Project

The Kawai'eli Wildlife Sanctuary is a wetland habitat restoration for Hawaii's endangered waterbirds, including the *ae'o* (Hawaiian stilt), *'alae 'ula* (Gallinule or moorhen), *'alae ke'oke'o* (Coot), and *koloa* (Hawaiian duck). Also benefiting from this habitat restoration is the *'auku'u* (Black-crowned Night Heron).

DOFAW proposes to expand the Kawai'eli Wildlife Sanctuary with a Phase 2 that involves the excavation of additional ponds in the 70 acres to the north of the existing one. Phase 1 was excavated in 1989 in the southern portion of the parcel. The two areas are currently separated by the dirt road that leads to the Kawai'eli Pumping Station.



FIG. 1 - Location of Kawai'eli project area to the north of Kekaha Town and adjacent to the Pacific Missile Range Facility at Barking Sand (Kekaha Quad, USGS).

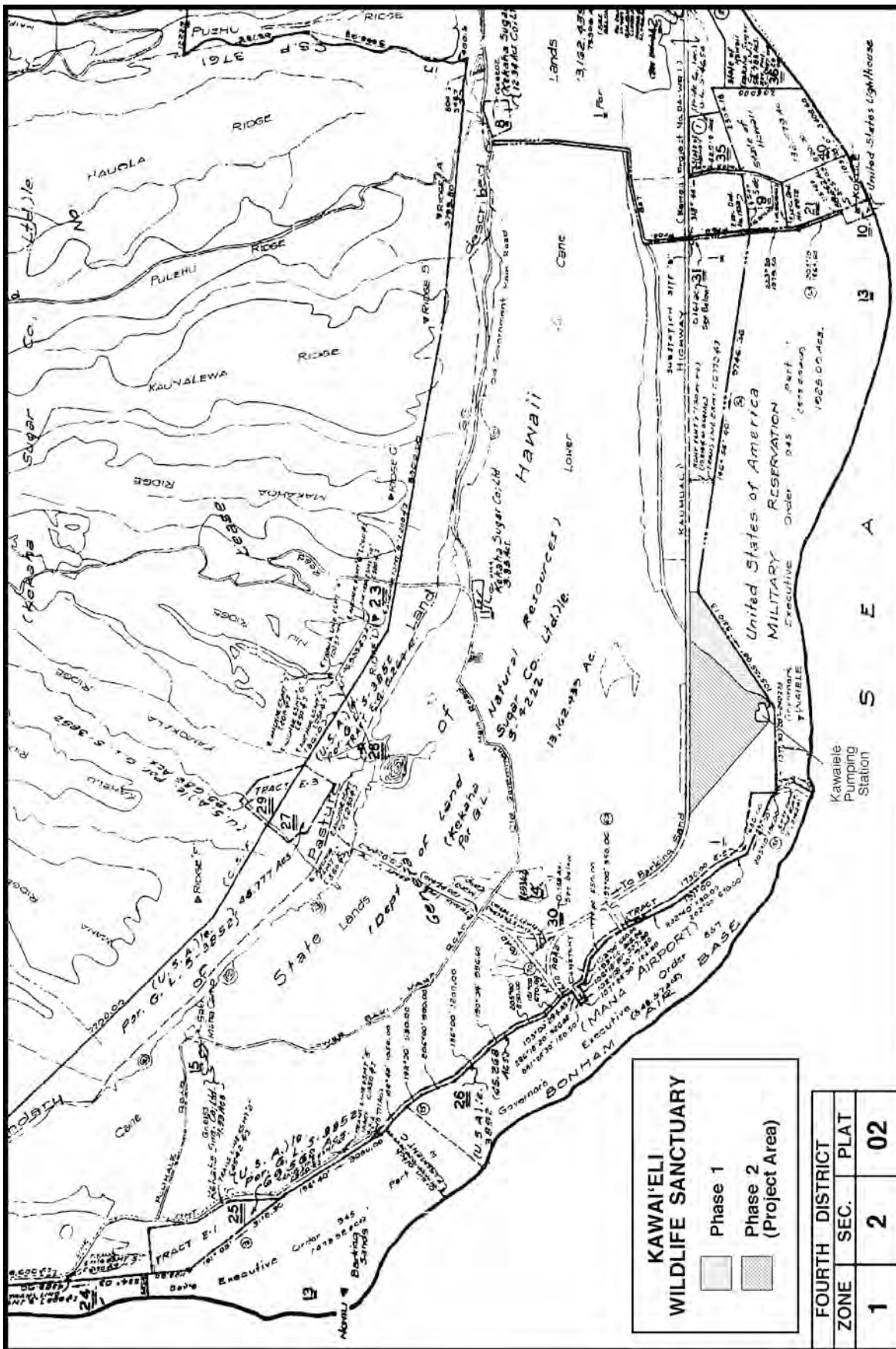


FIG. 2 - Location of the Kawai'eli Wildlife Sanctuary, Phases 1 and 2 (TMK: 1-2-02: 1).



PHOTO 1

Existing Kawai'eli Wildlife Sanctuary, Phase 1, as viewed from Kaumuali'i Highway. View is *makai* (west).



PHOTO 2

General view of expansion area for Kawai'eli Wildlife Sanctuary, Phase 2. View is northwest toward the Kawaiele Pumping Station from Kaumuali'i Highway.

ENVIRONMENTAL SETTING

The environment of the Mānā Plain was transformed in the 20th Century with the cultivation of vast fields of sugarcane. Sugarcane covered much of the west side of Kaua'i from Polihale to Līhu'e. On the Mānā Plain, sugarcane was grown between the mountain slopes to within 1,000 feet of the shoreline from the early 1900s until the 1990s.

Geology and Soils

The Kaua'i shield volcano erupted some 4 to 5 million years ago and the lava from this original eruption are referred to as the NaPali member (Blay and Siemers 2004). A long period of erosion intermixed with volcanic eruptions followed. The mountain slopes to the east of the project area are from the original shield volcano. These slopes were shaped by surf and represent ancient sea cliffs. During a period of higher sea level, a coastal "shelf" was eroded by waves. When the sea level dropped, calcareous sand was deposited on this shelf.

The Mānā Coastal Plain extends for 16 miles from Polihale to Waimea. The plain is fairly level and represents a relatively young sedimentary deposit. The *mauka* portion of the plain consists of alluvial deposits eroded from the inland mountain system. The *makai* portion of the plain is marked by calcareous sand deposits. The sand dunes that line the shoreline of this coastal plain are most pronounced in the Polihale and Barking Sands area, reaching heights of 80 feet above sea level. There is no fringing reef off the project area which makes this area susceptible to a loss of sand during winter high surf and deposition of wide beaches in the summer.

A series of shallow lagoons or wetlands formed behind the coastal dune system as water coming down the valleys and gulches collected on this level alluvial plain. Deposits of calcareous sand, gravel, marl, and clay formed in these lagoons. The two largest wetlands in the project area were known as Nohili and Kawai'eli (Fig. 3).

The soils of the area reflect the former marshlands of Kawai'eli and the coastal sand dune deposits. The project is on the boundary between the Jaucas-Mokuleia association of well-drained calcareous soils and the Kekaha-Nohili association of alluvial soils (silty clays) deposited over marly lagoon deposits (Foote et al. 1972). There are three (3) poorly drained soils in the Kekaha-Nohili association that are found on the coastal plain and can be expected in the project area. All of these soils are used for sugarcane.

Kaloko clay (Kfa) - Poorly drained clay with coral fragments and marly (mix of calcareous material and clay) material. Tends to be underlain by peat or muck.

Kaloko clay loam (Kf) - Similar to the Kaloko clay, but contains lenses of sand in the underlying deposit.

Nohili clay (Nh) - Deposited over marly lagoon deposits.

Climate

The Mānā Plain receives between 30" of annual rainfall at the foothills along the *mauka* side of the plain to less than 20" on the shoreline. The project area is one of the driest areas on the island of Kaua'i.

Vegetation

Feral sugarcane and grasses with stands of *koa haole* dominate the vegetation on the Mānā Plain. With the last harvest occurring in 1997 in the project area, other vegetation has had little chance to get established. *Kiaawe* trees line the *makai* side of the project area, separating the former cane fields from the military base along the shoreline. Thickets of *koa haole* and *pluchea* are found throughout the project area, especially along the irrigation ditches.

HISTORICAL OVERVIEW

Polihale, just north of the project area, is one of the most culturally significant areas on Kaua'i. Polihale Ridge is the leaping-off place for souls on their way to Po, the underworld, which is located offshore beneath the ocean. Polihale Heiau is located at the base of this cliff. Another *heiau* named 'Elekuna is located at Nohili. William Hyde Rice (1923) attributes the *heiau* and trails in the area to the *menehune*:

On the cliffs of Kauai are still seen many paths and roads which were built by them, and which are still called Ke-ala-pii-a-ka-menehune, the Trails-of-the-Menehune. These trails are still to be seen above Hanapepe, Makaweli, Mana, Napali, Milolii, Nualolo and Hanapu (sic). In the little hollows on the cliffs, they planted wild taro, yams, ferns, and bananas. No cliff was too steep for them to climb.

They also built many heiaus, including those at Elekuna, Polihale, and Kapa-ula, near Mana All the stones for these heiaus were brought from Makaweli.

Traditional Settlement-Subsistence Pattern

The project area is transitional between the coastal settlements and lowland agricultural zone on the Mānā Plain. Prior to the early 1900s, the Mānā Plain consisted of an extensive swamp with four (4) large wetlands set behind the coastal dune system (Photo 3) (Fig. 3). The names of these wetlands or ponds were Kolo (11 acres), Nohili (179 acres), Kawai'eli (77 acres), and Limaloa (Kikuchi 1973). Largely natural formations, these ponds would have contained brackish water and may have been connected to the ocean by long man-made channels. The ponds and *lo'i kalo* in Kekaha were fed by springs along the base of the cliffs on the *mauka* edge of the Mānā Plain. It is also recorded that more water flowed from the valleys onto the plain in the past (Handy and Handy 1972). Accounts indicate that the Hawaiians would paddle their canoes from Waimea to Mānā during periods of high water. The area was famous for its mirages created by the evaporation coming off the wetlands.

These ponds were once teeming with fish and waterbirds, and functioned as fishponds. The wetlands were also used for taro cultivation and taro was grown on rafts which would fluctuate with the water levels during the rainy season. Thus the proverb, "*Mana, i ka pu'e kalo ho'one'ene'e a ka wai*" (Mana, where the mounded taro moves in the water) (Pukui 1983: #2135). A description of the area details the fish and waterbirds found at Mānā:

Far to the west he came upon the flat plains of Mana' [sic] stretching sleepily for miles along the ocean . . . Extending toward Waimea was a wide lagoon, teeming with gold fish and strange new birds and ducks, the moha, the manu Koloa, the alae or mudhens with white and red heads, and the aio, a wading bird or stilt. There were thousands of them . . . (Knudsen and Noble 1944)



PHOTO 3

Wetlands on the Mānā Plain, circa 1915. View to the west from Na Pali Coast and Polihale area. Visible ponds are Kolo and Nohili in the distance.
(Kauai Historical Society A/C 4231E)

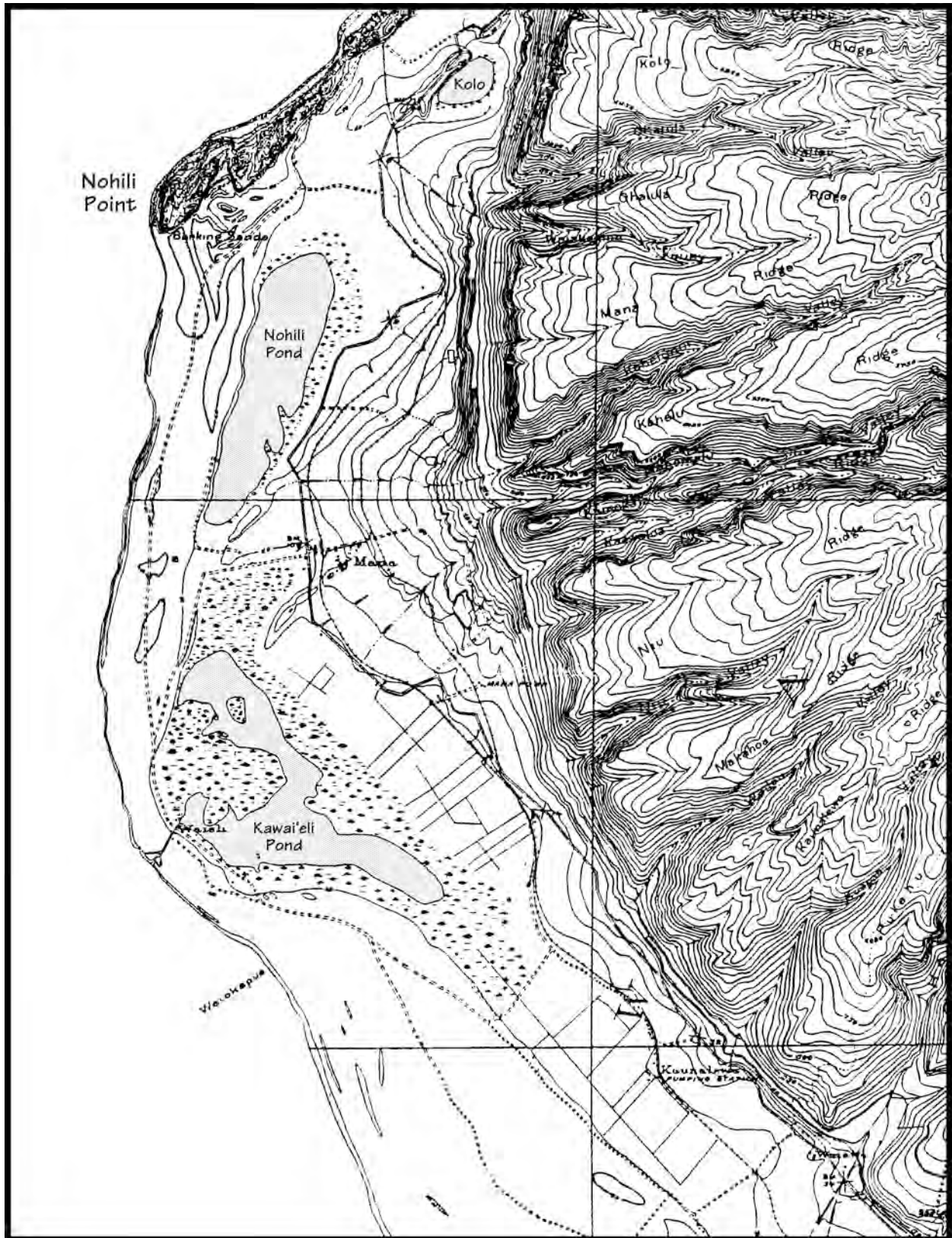


FIG. 3 - Location of the three wetlands on the Mānā Plain based on a map dated ca. 1910. Names and patterns denoting the ponds have been added. (Marshall, R.B. et al. 1910).

Another proverb in 'Ōlelo No'eau that is indicative of the subsistence pattern of Mānā is "*Ola i ka 'aiuahi'ole ke kini o Mānā*" (The multitudes of Mānā live upon food which is cooked without smoke). This is said of the people of Mānā who did very little *poi* making, except for Kolo where *kalo* was grown. The majority of the inhabitants were fishermen and gourd cultivators whose products were traded with other inhabitants of Kaua'i. Because all the cooking of the *kalo* and *poi* making was done elsewhere, the people of Mānā were said to live on "smokeless food" (Pukui 1983: #2480). The exchange of fish and *poi* is found in the saying of *Waikāhi o Mānā* (the single water of Mānā) (ibid: #2910):

When schools of 'ōpelu and kawakawa appeared at Mānā, Kaua'i, news soon reached other places like Makaweli, Waimea, Kekaha, and Poki'i. The uplanders hurried to the canoe landing at Keanapuka with loads of poi and other upland products to exchange for fish. After the trading was finished the fishermen placed their unmixed poi in a large container and poured in enough water to mix a whole batch at once. It didn't matter if the mass was somewhat lumpy, for the delicious taste of fresh fish and the hunger of the men made the poi vanish. This single pouring of water for the mixing of poi led to the expression, Waikāhi o Mānā.

E. S. Craighill Handy, in his Hawaiian Planter, Volume 1, adds the following:

The fresh-water marshes of Mana and Waiele (which no longer exist since the Kekaha Sugar Company drained the swamps), famous for their mirages were presumably planted in wet taro. Within the memory of living residents wet taro has been grown at the northern end of the Mana swamp, near the Barking Sands (Handy 1940).

Habitation in this area was concentrated at the back (*mauka*) side of the dune and in the mouths of the small valleys which bordered the wetland. Taro would have been raised in the swampy areas, as well as in the lower valley mouths. Dryland crops would have been raised in the valleys. Additional farming areas could be found on the plain behind the dunes, along the base of the slopes, and in the valleys.

It appears likely that the upland area of Kōke'e and the Alaka'i Swamp were utilized in the pre-contact period as resource gathering zones, rather than areas of permanent habitation or agriculture. Several legends suggest this use. One attributes the road of sticks through the Alaka'i Swamp to the *menehune* (Rice, 1923). Another refers to Lahi (or Lauhaka), a young man who would eat only birds, and traveled to the top of Kilohana (a lookout at the edge of the Alaka'i Swamp) where the *Uwa'u* bird nested to satisfy his hunger (ibid). Pu'u Ka Pele is referred to as an area for gathering *koa* canoe logs and other building materials:

At one time the Menehune built two canoes of koa in the mountains near Puu-ka-Pele. As they were dragging them down to the lowlands, they were caught by a heavy rain-storm, and were forced to leave the canoes across the little valley. The storm covered the canoes with debris, and later, a road was built across them, over which all the materials to build the village of Waimea were hauled (ibid).

Further evidence for the gathering of canoe logs from the uplands comes from the narrative of the Dutch merchant Captain Jacobus Boelen, who visited Waimea in 1828. While his ship was being loaded with sandalwood, he spent some time exploring the region and included the following observation:

On that day we visited Quequaheva's [Kaikio`ewa's] shipyard, which consisted of large sheds where the largest and most beautiful canoes that can be found in the islands were made. We were assured that the island of Atooi [Kauai] had always been the principal workshop of the islands in these matters. Under one very neatly made roof I saw two of the largest double canoes I have ever seen . . . Long, narrow, and lightly built, although of a strong and heavy type of wood [koa], they have only a shallow draught. . . some of these vessels - especially those double canoes of the largest sort, which the highest chiefs use - are up to seventy or eighty feet long . . . (Broeze, 1988).

It is obvious from this description that *koa* trees of exceptional size were being harvested in the uplands, where they were partially worked to lessen their weight prior to transport to the coast.

Handy does not specifically mention Kōke`e and the uplands with respect to Hawaiian agriculture, although he states that "the upper gulches and forests in and above Waimea Canyon should be favorable localities for yams" (Handy, 1940: 171). He also mentions that boggy areas in the uplands were utilized for the cultivation of *olonā*.

There are trails recorded which ran from the Nā Pali valleys to Kōke`e and Waimea Canyon. Bennett (1931) recorded several trails connecting different areas of the Nā Pali coast with the uplands. A network of upland and coastal trails is recorded in the following:

More anciently the old Hawaiians used a number of overland trails. The Kamaile trail descended into Nu`ulolo [Nu`alolo] Valley inland. There was a trail connecting Nu`ulolo with Honopu. A good trail overland connects Kalalau with Ha`ena. There is a trail from Koke`e in the mountains above Kekaha down into Kalalau. From Polihale travelers could go on foot, with a little swimming, to Miloli`i, and a trail connected Miloli`i with Nu`ulolo flats. Another trail connects Miloli`i with Koke`e. And there was the path (ala), said to have been built by King `Ola, that led from Waimea Delta up the canyon to Koke`e, over the Alaka`i Swamp, where it was said to have been paved with sticks (kipapa), and thence down Maunahina ridge into Wainiha by way of Koke`e. (Handy and Handy, 1972)

This trail system suggests a connection between the north and south sides of the island, although whether the trails facilitated trade or simply travel between the two areas is not known. It can be assumed that the upland forests were utilized as resource gathering zones for such items as hardwoods, bird feathers, and medicinal plants, as well as freshwater resources such as *o`opu* and *ōpae*. Undoubtedly, a substantial trail existed between the upper Waimea Canyon and Waimea Village to facilitate the transport of large canoe logs.

The mid-zone between the uplands and the coastal plain appears to be transitional in terms of environment, settlement, and subsistence. The area above Niu Ridge, near Pu'u 'Ōpae and Pu'u Moi, was said to be an area where trees were felled and worked into canoes (Handy and Handy, 1972: 411). Trails and temporary campsites would be expected in this area. This also suggests that the forests extended much further down the ridges and valleys in the past. However, it is uncertain if any agricultural planting, such as sweet potato and yam, was taking place on the *makai* ends of these ridges.

To summarize, Hamatt has divided the traditional Hawaiian settlement of the Kekaha regions into 5 zones from *mauka* to *makai* (Hammatt, 1996):

- Zone 1 Ridges above the cliffs used for dryland agriculture, forest gathering, and religious structures.
- Zone 2 Narrow valleys and slopes with intermittent streams, narrow alluvial terraces, and some permanent springs. These areas supported taro cultivation and permanent habitation. Steep slopes often contain burial caves.
- Zone 3 The swamp and marshlands which supported taro cultivation, fishponds, and water fowl.
- Zone 4 The *mauka* portion of the sand plain. This zone often used for burials and the planting of coconut trees.
- Zone 5 Shoreline area noted for fishing camps, canoe landings, salt pans, and a few *pu'uone* fishponds.

The project area falls largely into Zone 3. While sugarcane cultivation has destroyed all surface features in the project area, there is a potential for subsurface deposits indicative of the wetlands. Archaeological evidence for the use of these wetlands for cultivation and raising fish may be more problematic.

Post-Contact Period

In 1789, Portlock and Dixon sailed along the Kekaha shoreline. Dixon describes the country as “very dry” and covered in grass. He also mentions the swampy ground along the shore and the well established settlement at Kekaha which was known for its “manufacture of cloth”. Dixon described Kekaha as follows:

A Tappa is a pretty large village, situated behind a long row of cocoa-nut trees, which afford the inhabitants a most excellent shelter from the scorching heat of the noon-day sun. Amongst these cocoa-nut trees is a good deal of wet swampy ground, which is well laid out in plantations of taro and sugar-cane. (Dixon 1789: 125)

There was probably a close connection between Kekaha and Waimea. Handy and Handy suggest that sweet potatoes, gourds, and coconuts were taken from the dry regions of Kekaha and traded for bananas, sugarcane and taro from Waimea Valley (1972: 410).

Eric Knudsen describes the Mānā Plain in the mid to late 1800s as follows (1991: 99):

At Kaunalewa one mile beyond Waiawa, was a village and a grove of cocoanuts and at Limaloa on the edge of the swamp was a spring and seven cocoanut trees and a small patch of taro. Beyond for miles and miles all the way to Mana, the country lay open and bare with a great swamp full of Nekes or bullrushes lying between the fertile soil and the sand lands. This swamp extended all the way from Kekaha to Mana, and when we had heavy winter rains, the Hawaiians would paddle their canoes from Mana to Waimea on the inland sea and tie their canoes to the cocoanut trees in the Waiawa garden.

Knudsen goes on to mention a row of grass houses that extended all the way along the foothills from Waimea to Mānā (ibid: 100). He said food was plentiful with cattle roaming all over the land and goats abundant in the valleys. Taro and sweet potatoes were plentiful, along with rice, milk, yams and watermelons. By the mid-1800s, many of the taro fields had been converted to rice. The women continued to make *kapa* into the 1800s. An 1891 map of the Gay and Robinson lands in Mānā shows key place names and indicates the settlements on the Mānā Plain (Fig. 4).

A road extended along the base of the cliffs and linked the habitation and agriculture along the cliffs and in the valley. In the 1870s, there was no coastal road to Mānā. A trail followed the lower edge of the swamp all the way to Barking Sands. The swamp was full of stilts, ducks and mudhens (Knudsen 1991: 103).

Historic Land Use

Valdemar Knudsen started Kekaha Sugar Company in 1878 with the first planting of sugar in Kekaha at Poki'i (Wilcox 1997: 92). To be able to plant in an area dominated by wetlands, the water was drained with the use of pumps and drainage canals were dug to reduce seasonal flooding. Sand from the dunes was used to fill-in the wetlands and soil from the *mauka* areas was used to create a layer of topsoil for planting. Wells were dug for extensive irrigation systems. Maps from 1910 show the ponds still in existence which suggests the filling of the ponds occurred sometime later (Fig. 5). The following excerpt from the Waimea Planter (Vol. 4, No. 1 1959) indicates that these ponds were filled for agricultural purposes:

The swamp lands were reclaimed and made productive, with reclamation of the last lagoon wasteland being completed and planted in cane in 1959.

A system of ditches and reservoirs was constructed to irrigate the cane fields. Water is pumped from the Saki Mānā Shaft, located at the base of the cliffs just south of

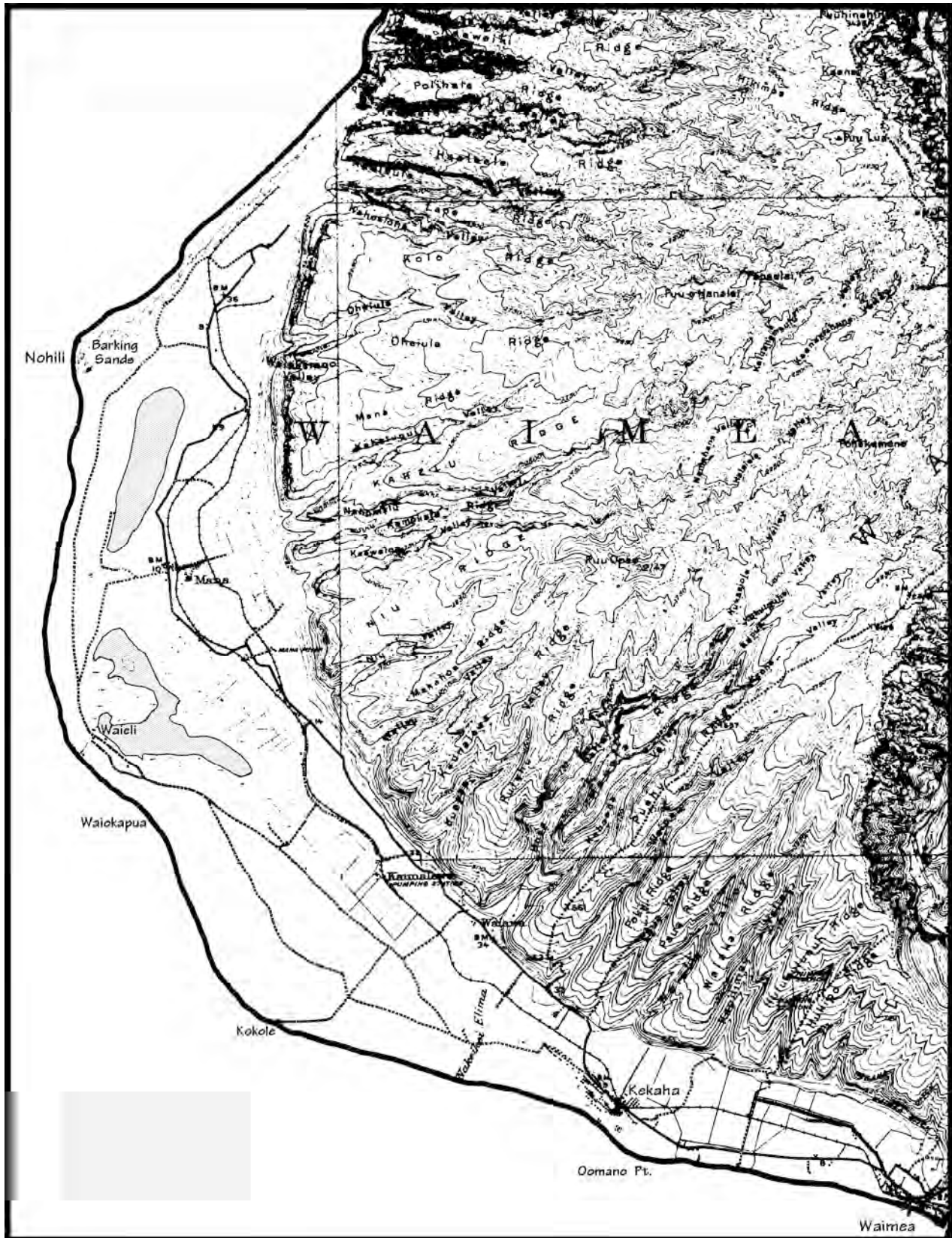


FIG. 5 - Map from 1910 showing sugar related developments on the Mānā Plain, including the railroad tracks and roads. Wetlands still present. (*Topographic Map of the Island of Kauai*, USGS, Territory of Hawaii, 1910.)

Waiakamo'o Valley. A channel runs the water along the base of the cliffs northward for approximately two miles, with a series of channels branching westward into the fields. An informant states that in early times, the Hawaiians had attempted to drain the marsh at Wai'ele by constructing a ditch that was abandoned when they struck sandstone. Later, Knudsen widened and deepened the old Hawaiian ditch and eventually drained the marsh for cane (Wilcox 1996: 92).

Railroad tracks were laid to carry the cane to the mill in Kekaha. Plantation camps grew up around the old springs. There has also been a history of sand mining in the area. Kekaha Sugar Company mined sand in the Kawai'eli project area over the past 30 years (Paty 1988 in Leidemann and Kishinami 1990).

Settlement-Subsistence Pattern

Based on traditional history and historic accounts, the Mānā Plain was dominated by the large wetland ponds. Temporary habitation was occurring on the backside of the coastal dune system. Fishing camps and burials are likely sites to be found along the coast and *makai* of the wetlands with subsurface cultural deposits possible in the dune.

Most of the permanent habitation was found along the base of the cliffs and into the small valleys. In these areas were springs and intermittent streams that supported small-scale agriculture. Terraces, platforms, and enclosures would be predicted in these areas along the *mauka* edge of the plain.

The wetlands were modified for agriculture and as fishponds. They also attracted waterbirds that provided another food source. Archaeological remains associated with these wetlands would most likely consist of subsurface deposits that might contain bird and fish bone and perhaps, some organic layers associated with the agricultural activities.

Predictive Model

Historic land use, particularly the cultivation of sugarcane that filled in the wetlands, has destroyed many on the surface sites on the Mānā Plain. Decades of plowing and tilling have disturbed the upper 12", including both the topsoil and underlying sand deposits. Sand mining has potentially destroyed coastal sites and subsurface deposits. Previous archaeological surveys in the general project area, would suggest a low probability of cultural remains in the Phase 2 area of the Kawai'eli Wildlife Sanctuary.

PREVIOUS ARCHAEOLOGY

Thrum recorded five (5) *heiau* from Polihale to Waiawa during his inventory of *heiau* sites in the early 1900s (Thrum 1906). In his archaeological survey of Kaua'i in the late 1920s, Bennett identified 17 sites from Polihale to Kekaha, including Thrum's *heiau* (Bennett 1931: 99-103). The sites include *heiau*, housesites, and burials. Table 1 provides a brief overview of these sites. Location of the sites is shown in Figure 6.

TABLE 1
Archaeological Sites Inventoried by Thrum and Bennett

Site #	Site Name	Location	Comments
50-30-01-01	Polihale Heiau	Base of Polihale cliff	4-terraced structure near the shore
50-30-01-02	Housesites	Ha'ele'ele Valley	Series of terraces and platforms on ridge between 2 streams
50-30-01-03	Housesite	Cliff behind Polihale Heiau	Modified cliff shelter with 12' high retaining wall; midden & artifacts
50-30-01-04	Kapaula Heiau	Kaulaula Valley	Two contiguous platforms; watertank
50-30-01-05	Housesites	Lapa Ridge	Series of terraces and platforms at base of ridge and running upvalley
50-30-01-06	Kapaula Heiau	Kolo, near Mānā	
50-30-01-07	Dune burials	Polihale to Barking Sands	Coastal dunes with burials, campsites, artifact scatters
50-30-01-08	Elekuna Heiau	Barking Sands at Mānā	Sandstone outcrop of cultural importance - place of offerings
50-30-01-09	Housesites	Barking Sands	Stone alignments or low walls on backside of the dune
50-30-01-10	Kahelu Heiau	Kahelua near Mānā	Platform at the base of a hill
50-30-01-11	Makahoe Heiau	Niu Ridge	Small platform shrine about 4.5 miles inland; associated with a village
50-30-01-12	Ho'one'enu'u Heiau	Kaunalewa Ridge	Two paved platforms; disturbed by construction of a ditch; <i>heiau</i> for circumcision (Thrum 1906)
50-30-01-13	Burial caves	Kaunalewa Ridge	Canoe burials in caves
50-30-01-14	2 small <i>heiau</i>	Waiawa	Small shrines
50-30-01-15	Housesites & kalo	Waiawa Valley	Taro terraces in lower valley
50-30-01-16	Hauola Heiau	Hoea Valley	Contiguous platforms on talus slope between stream and ridge
50-30-01-17	Burial caves	Poki'i ridge	

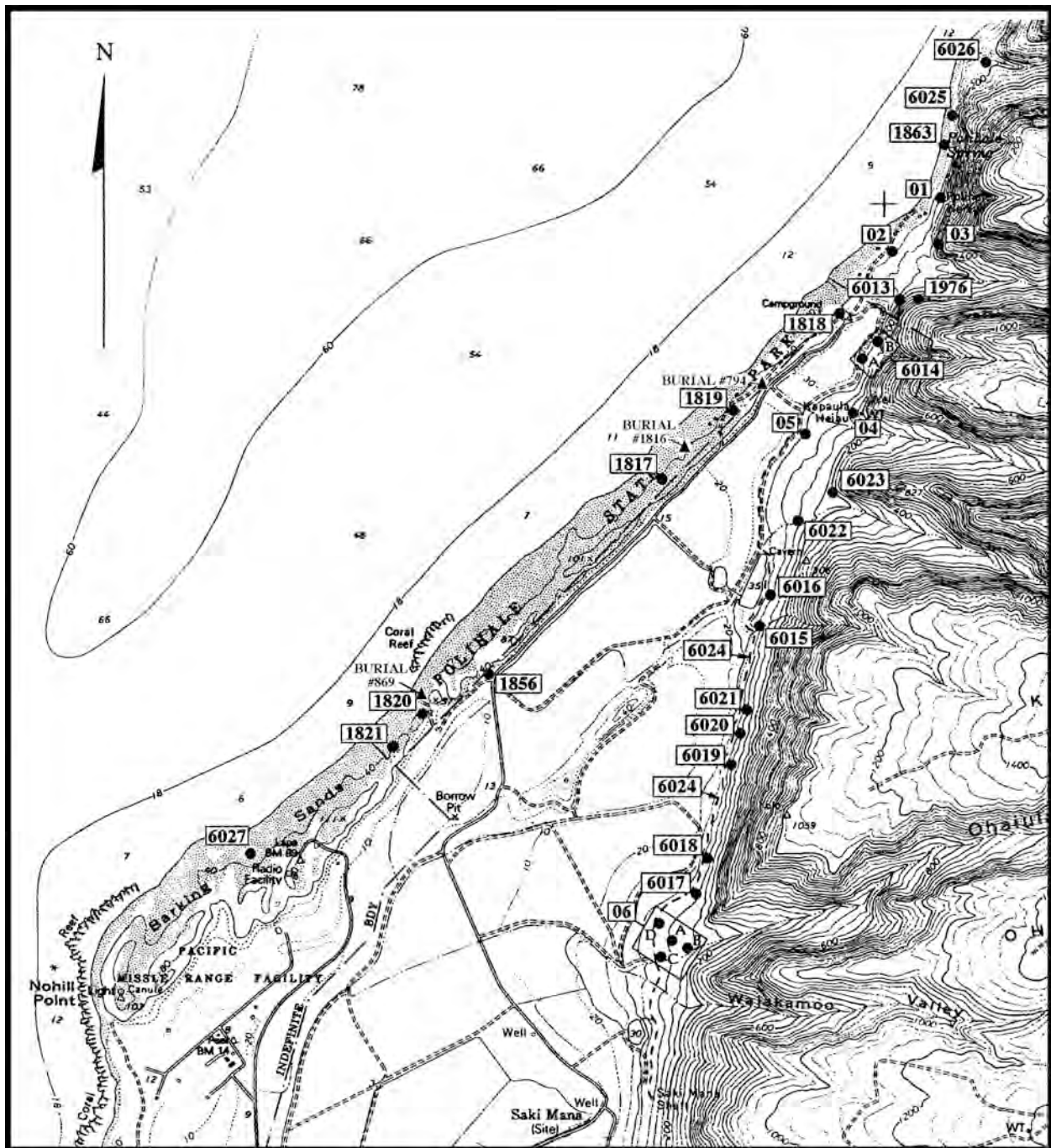


FIG. 6 - Location of previously identified archaeological sites.

State Parks conducted several archaeological reconnaissance surveys in the general area. Between 1990 and 1993, a surface survey was conducted for Polihale State Park and adjacent State-owned lands. The survey encompassed a total of 1,050 acres and included the coastal dune from Polihale to Nohili Point, the cliffs and valleys from 'Ohai'ula Valley (south) to Hikimoe Valley (north). Several of Bennett's sites were relocated and an additional 21 sites were inventoried. The sites in the dune area were burials sites and lithic scatters, while the sites along the base of the ridges and at the valley mouths included terraces, walls, and housesites (refer to Fig. 6). Archaeological sites are found outside the areas of sugarcane cultivation

In the immediate project area, several archaeological surveys have been conducted (Fig. 7). In 1988, Nancy McMahon with the State Historic Preservation Division, conducted a fieldcheck of sand mining activities at Kawai'ele (McMahon 1988). McMahon noted evidence of sugarcane cultivation, previous mining, and military activity. Where mining had been conducted, the water table was encountered at 15' below the ground surface. No cultural remains were exposed in the cut banks and trenches. The subsurface deposit consisted of sterile white sand layers. McMahon determined that any historic sites in the area would have been destroyed by the previous land uses. Also in 1988, Aki Sinoto with Bishop Museum conducted a surface survey of the project area and located avifaunal remains on the surface, including the remains of the Barn Owl and the American Coot, but no cultural materials (Sinoto 1989).

In 1989, Bishop Museum examined the trenches excavated in Phase 1 of the Kawai'eli Wildlife Sanctuary for archaeological and paleontological remains (Fig. 7) (Leidemann and Kishinami 1989). This project area of about 30 acres is located just south of the current Phase 2 site. A total of 10 backhoe trenches were excavated within 3 transects between the dirt road to the pumping station and the maintenance road along DLNR's southern property line with PMRF. The trenches were oriented north-south, averaged 3 to 5 meters in length, and 1.5 to 2 meters in depth. Three basic layers were found in these trenches:

Layer 1	0-30cm	Dark yellowish brown (10YR4/4), organically stained fine sand; aeolian deposit
Layer 2	30-90cm	Pale brown (10YR6/3) loose, fine sand, marine shells; aeolian?
Layer 3	90-150cm	Very pale brown (10YR7/4), weakly cemented sand; Brachidontes shell; beach deposit

Avifaunal remains were noted on the surface from species currently found in the area. Subsurface egg shell fragments may suggest the nesting of birds in the area. The Brachidontes shell in the lower layer is indicative of an intertidal zone.

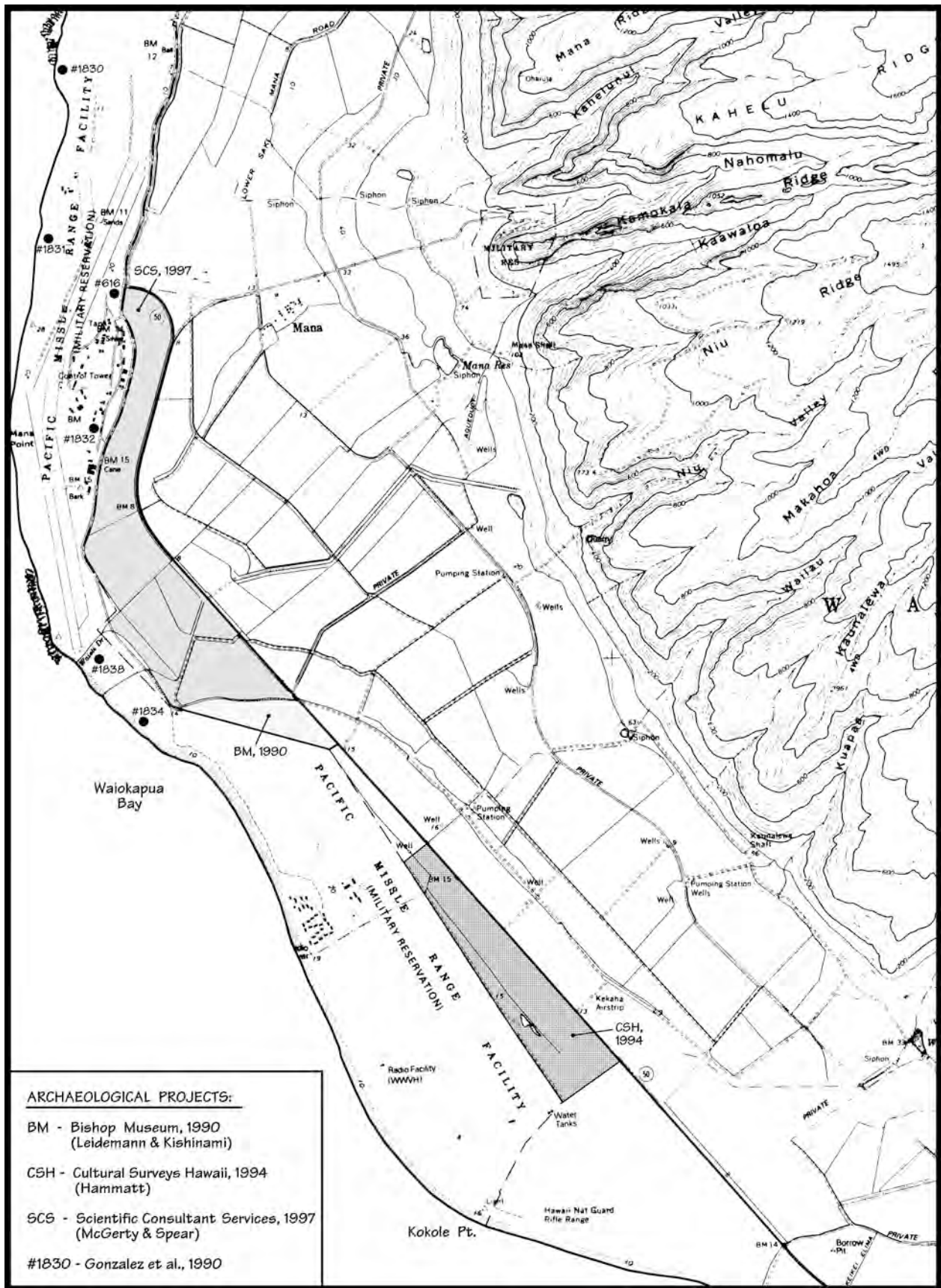


FIG. 7 - Location of archaeological surveys conducted in the Kawai'eli project area.

An archaeological survey with testing was conducted at Barking Sands (PMRF) in 1990 (Gonzalez et al. 1990). The survey area included the military land between the Kawai'eli Wildlife Sanctuary and the shoreline (Fig. 7). The sites located near Kawai'eli are mostly burial sites in the dune deposits. Using the SHPD inventory numbers (50-30-05-#), the sites are summarized below and their location is shown in Figure 7:

Site 616	Japanese Cemetery
Site 1830	Subsurface cultural deposits in Nohili dune
Site 1831	Burial Site
Site 1832	Burial Site
Site 1834	Burial Site
Site 1838	Burial Site

In 1993, an archaeological inventory survey was conducted on a 157-acre parcel being planned for an agricultural park in Kekaha (Fig. 7) (Hammatt 1994). The survey area is located about 3,000 feet south of Phase 1 of Kawai'eli Wildlife Sanctuary and between Kaumuali'i Highway and PMRF. Seven (7) backhoe trenches were excavated in the project area. These trenches varied from 30 to 70 feet in length. Two burials were found in two of the trenches at the Limaloa Pump Site. The trenches excavated in this project area reflected the following stratigraphy that appears to correspond closely with the stratigraphy found in the Phase 1 project area:

Layer 1	0-20cm	Brown (10YR5/3) very fine silty sand
Layer 2	20-110cm	White (10YR8/2) fine to medium grain, loose coralline sand; burial present in this layer at 110cm below surface
Layer 3	110-160cm	White (10YR8/2) lithified coralline sand; strongly cemented; horizontal bedding of fine to coarse sand

Three artifacts were found while screening the backdirt from the trenches. The adze fragment, chert flake, and urchin file are believed to be from a disturbed former A horizon and not the burials.

An archaeological reconnaissance survey with archival research and oral history interviews was conducted in 1997 for the area that encompasses the Kawai'eli Wildlife Sanctuary and an additional area to the north of the sanctuary (Fig. 7) (McGerty and Spear 1997). The work was done for CEATECH USA, Inc. No archaeological sites were located during the surface reconnaissance or in the examination of the ditch cuts. Based on these findings and the former land use, a low potential for sites was predicted in the project site.

ARCHAEOLOGICAL FINDINGS

The development of Phase 2 of the Kawai'eli Wildlife Sanctuary will involve the excavation of large ponds to depths up to 2 meters. This excavation is expected to expose both dune and pond deposits. It was decided by SHPD, DOFAW, and State Parks archaeologists that archaeological backhoe trenches would be excavated prior to the expansion of the wetland ponds to assess the presence/absence of any cultural or paleontological materials and to determine the significance of any finds. If cultural materials were uncovered, a more systematic testing strategy would be developed.

The trenches were excavated over a two week period in 2004: June 22-25 and August 23-26. The backhoe was operated by Dabney Miguel with the Kaua'i Branch of the DOFAW. State Parks archaeologists Martha Yent and Alan Carpenter monitored the excavation with assistance from Nancy McMahon, Kaua'i Archaeologist with SHPD.

Methodology

Prior to the placement of the archaeological trenches, a map of the project area was overlain on the 1910 map that approximate boundaries of Kawai'eli Pond were delineated. The extent of the pond was found to cover much of the project area. As a result, it was expected that pond soils would be present in most trenches and the pond soils would be overlain by the fill introduced for sugarcane cultivation.

Using a backhoe, a series of twenty-two (22) trenches were excavated along eight (8) transects placed throughout the Phase 2 area (Fig. 8) (Photo 4). Transects were given letter designations and trenches were noted by the transect letter and a corresponding number. Four (4) transects (A through D) were oriented N-S from the dirt road leading to the Kawai'eli Pumping Station. Four (4) transect (E through H) ran perpendicular to Kaumuali'i Highway, generally an E-W orientation. The location of the trenches was also recorded by GPS (Table 2). All the trenches measured 24" across, the width of the backhoe bucket, and most were 5 to 10 meters in length. The depth varied, but all were taken down to below the water table.

All excavated soils were visually inspected, but not screened. Stratigraphic profiles were drawn and soils were described for each trench (Photo 5). Photographs were taken prior to the backfilling.

Transect A

This transect was oriented to magnetic north (MN) with the south end between poles 575-6 and 575-7 along the Kawai'eli Pumping Station Road and about 500 meters *makai* of Kaumuali'i Highway. The transect was accessed using a dirt road running north from the Pumping Station Road. This road turns *makai* and parallels the Pumping Station Road for a short distance. A *mauka-makai* ditch runs between Trench A-1 and the Pumping Station Road. The ground in the area is relatively level with a vegetation cover of grasses and low-growing *koa haole* and *pluche*.

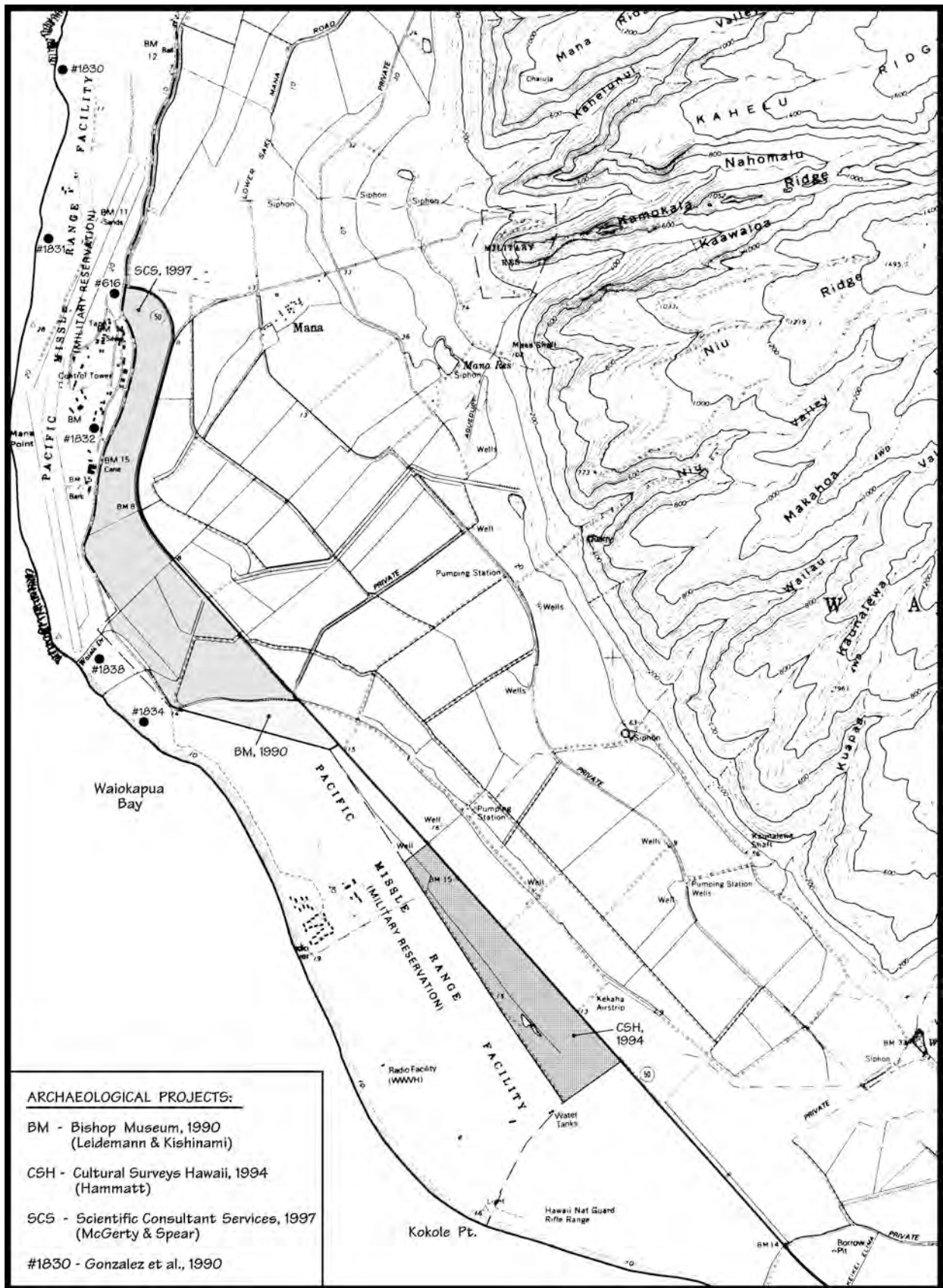


FIG. 8 - Location of transects and trenches in Kawai'eli Phase 2 project area.



PHOTO 4 (above)
Use of a backhoe to excavate trenches in the
Phase 2 project area. June 22, 2004



PHOTO 5
Recording the stratigraphic soil profiles
exposed in the walls of the trenches.
June 22, 2004

TABLE 2
Location of Trenches by GPS

Transect	Trench	Northing	Westing	Comments
A	A-1	22.00.808	159.46.372	~500m <i>makai</i> of highway; ~250m N of Pump Station road at pole 575-6; ~50m W of turn in dirt road; ~10m N of E-W running ditch; ~2m N of dirt road; oriented N-S; 9m trench
	A-2	22.00.780	159.46.379	54m S of A-1 and 48m S of dirt road; S side of ditch; 2m long trench
	A-3	22.00.856	159.46.361	80m N of A-1; 100m W of highway; 4m long trench
B	B-1	22.00.689	159.46.520	~800m <i>makai</i> of highway between poles 575-9 and 575-10; ~50m N of Pumping Station Road; N of dirt road; S end of 9m trench
	B-2	22.00.723	159.46.513	50m N of B-1; S end of 4.5m long trench
	B-3	22.00.746	159.46.507	47m N of B-2; S end of 5m long trench
	B-4	22.00.767	159.46.510	50m N of B-3; S end of 5m long trench
	B-5	22.00.805	159.46.493	50m N of B-4; S end of 6m long trench
C	C-1	22.00.694	159.46.595	At pole 575-14; 25m E of Pumping Station Road; S end of 5m long trench
	C-2	22.00.913	159.46.752	50m N of C-1; S end of 5m long trench
	C-3	22.00.857	159.46.771	40m S of c-1; 3m from road and ple 575-13; S end of 7m long trench
D	D-1	22.00.872	159.46.357	Between poles 575-1 and 575-2; ~160m <i>makai</i> of hwy.; 20m from Pumping Station Road; S end of 7m long trench
	D-2	22.00.902	159.46.350	50m N of D-1; S end of 6m long trench
E	E-1	22.01.272	159.46.819	50m N of E-2; N end of 7m long trench
	E-2	22.01.294	159.46.797	50m S of E-1; S end of 7m long trench
	E-3	22.01.317	159.46.774	50m S of E-2; S end of 6m long trench
F	F-1	22.01.235	159.46.673	~50m S of highway; S end of 5m trench
	F-2	22.01.215	159.46.702	48m S of F-1; S end 7m trench
	F-3	22.01.173	159.46.740	100m S of F-2; S end of 5m long trench
	F-4	22.01.121	159.46.796	100m S of F-3; 8m N of ditch; S end of 6m trench
G	G-1	22.01.031	159.46.800	W of pumping station; <i>makai</i> of E-W ditch; S end of 6m long trench
H	H-1	22.01.409	159.46.839	~40m S of highway; S end of 3m trench

A series of three (3) trenches were excavated along Transect A - A-1 in the middle, A-2 to the south of A-1, and A-3 to the north of A-1 (Fig. 8).

Trench A-1

The south end of this trench is about 2m north of the dirt road and about 250 meters north of the Pumping Station Road. The trench measured 9 meters in length and was excavated to a depth of 2 meters (Photo 6). A stratigraphic profile of 5 meters along the west wall of the trench is shown in Figure 9 and Photo 7.

The layers were fairly uniform with no evidence of features or cultural remains. The presence of the gray clay at the water table indicates that this trench was within the limits of the Kawai'eli Pond prior to sugarcane cultivation.

Trench A-2

This trench was placed 48 meters to the south of the dirt road and 54 meters south of Trench A-1. Trench A-2 was just south of the *mauka-makai* ditch that ends just *makai* of Transect A.

Trench A-2 was only 2 meters in length due to the constant collapse of the trench walls. The soil in this area is much drier and sandier which accounts for the unstable walls. The water table encountered at 130cm below surface. First noticed in this trench was the presence of a sand deposit underlying the clay layer.

Trench A-2, West Wall Stratigraphic Profile:

0-26cm	Layer 1	7.5YR3/2 (dark brown) sandy loam; dry, friable crumb structure; slightly sticky and slightly plastic; grass roots; wavy, mottled boundary;
26-30cm	Lens	7.5YR5/0 (dark gray) clay mottled with 7.5YR6/0 (gray) sandy loam; friable, crumb structure; sticky and plastic; appears uniform and continuous in exposure;
30-65cm	Layer 2	Mottled 7.5YR7/4 (pink), 7.5YR7/6 (reddish yellow staining), and 10YR6/3 (pale brown) fine sand; slightly moist, loose, single grain; level, distinct boundary;
65-77cm	Layer 3	Microbanding of 10YR4/1 (dark gray) fine sandy loam with 10YR4/1 clay; moist to wet, friable, crumb structure; slightly sticky and slightly plastic; wavy boundary;
77-180cm	Layer 4	7.5YR3/0 (very dark gray) fine sand with coral fragments; wet, loose, single grain; water table at 130cm.
180Cm	BOE	



PHOTO 6: Trench A-1, view N.



PHOTO 7: Trench A-1, west wall.

Trench A-1 Stratigraphic Profile:

0-72cm	Layer 1	7.5YR3/2 (dark brown) sandy loam; slightly moist, friable, crumb structure; slightly sticky and slightly plastic; grass roots, wavy, mottled boundary;
72- 125cm	Layer 2	Mottled 7.5YR 7/4 (pink), 7.5YR7/6 (iron stain), and 10YR6/3 (pale brown) fine sand; loose, single grain structure; level, abrupt boundary;
125-175cm	Layer 3	10YR4/1 (gray) fine sand; moist, loose; slightly sticky, slightly plastic; wavy boundary;
175-190cm	Layer 4	7.5YR3/0 (very dark gray) clay; wet, friable; sticky and plastic; water table;
190cm	BOE	

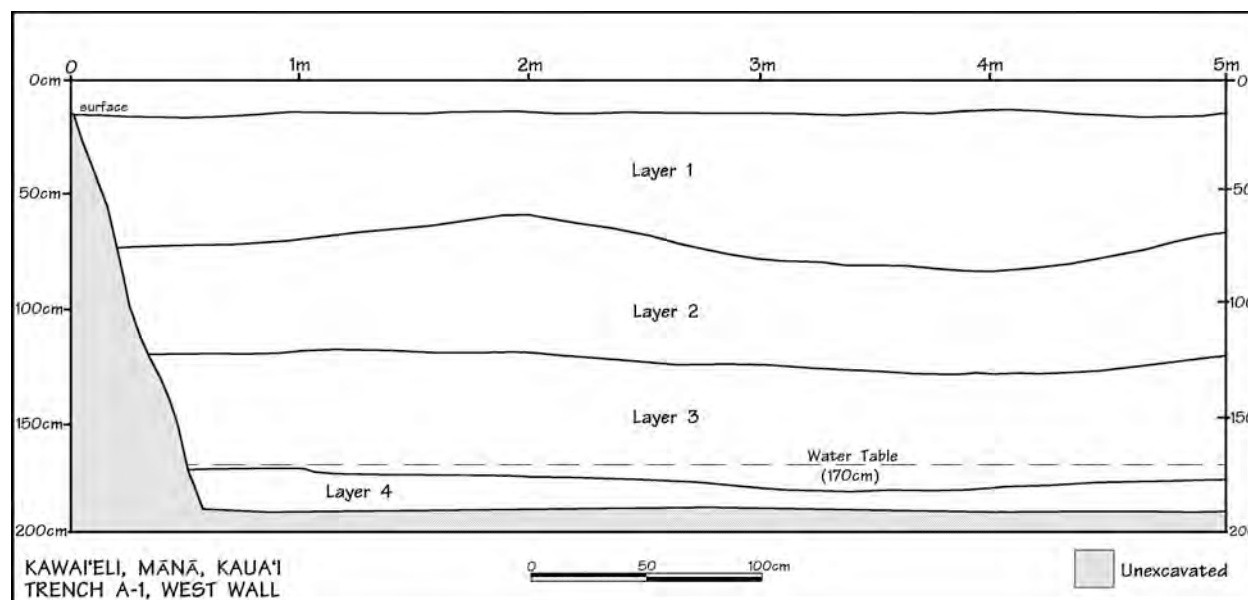


FIG. 9 - Stratigraphic profile of west wall of Trench A-1.

The layers were fairly uniform with no evidence of features or cultural remains. The presence of the microbanded gray sand and clay in Layer 3 indicates alternating period of deposition with the Kawai'eli Pond environment. This trench is also within the limits of the former pond prior to sugarcane cultivation.

Trench A-3

This trench was placed 80 meters north of Trench A-1 and was approximately 100 meters west of Kaumuali'i Highway. The water table was encountered at only 100cm below the surface, which was higher than the other trenches along this transect. For this reason, the length of this trench was only 4 meters (Photo 8). The stratigraphic profile of the trench is described on the next page and shown in Photo 9. The clay soil of the pond was not encountered, perhaps because the trench was not deep enough.

Transect B

This transect was oriented to magnetic north (MN) with the south end between poles 575-9 and 575-10 along the Kawai'eli Pumping Station Road and about 800 meters *makai* of Kaumuali'i Highway. The transect was accessed using a dirt road running north from the Pumping Station Road. The ground in the area is relatively level with a vegetation cover of grasses and low-growing *koa haole* and remnant sugarcane.

A series of five (5) trenches was excavated along Transect B, spaced about 50 meters apart. Trench B-1 is at the south end extending to Trench B-5 on the north end (Fig. 8).

Trench B-1

This trench was placed about 5 meters north of the dirt road and oriented N-S. The trench was 9 meters in length and excavated to a depth of 150cm below surface. The water table was encountered at 135cm below surface.

The stratigraphy in this trench showed some variation from those in Transect A because it lacks the upper brown loam (Photos 10 and 11). Instead, there is a gray loamy fine sand with coral gravel. The underlying sand in Transect B is "oranger", suggesting a higher iron oxide content and leaching. In Transect B, there is a thin band, about 2cm thick, of very orange sand at the contact with the underlying gray sand. The stratigraphic profile for Trench B-1 is shown in Fig. 10 and Photo 11.

Trench B-2

Located about 50 meters north of B-1, this trench was only 4.5 meters long. The stratigraphy in this trench was markedly different because it consisted solely of aeolian sand without any evidence of any pond soils. The sand deposits consist of banded microlayers that created the former dune (Photos 12 and 13). The dry, loose sandy nature of the deposit meant that the walls kept collapsing and excavation was terminated at a depth of 145cm below surface. The water table was encountered at 130cm below surface. The stratigraphic profile for Trench B-2 is shown in Fig. 11.



PHOTO 8
Trench A-3, view N.

Trench A-3 Stratigraphic Profile:

0-40cm	Layer 1	7.5YR3/2 (dark brown) sandy loam; slightly moist, friable, crumb structure; slightly sticky and slightly plastic; grass roots, wavy, mottled, wavy boundary;
40- 78cm	Layer 2	Mottled 7.5YR 7/4 (pink), 7.5YR7/6 (reddish yellow iron stain), and 10YR6/3 (pale brown) fine sand; loose, single grain structure; level, abrupt boundary;
78-96cm	Lens	7.5YR7/6 (reddish yellow) fine sand at contact of Layers 2 and 3; discontinuous coloration and appears to be transitional between the two layers; discontinuous, wavy boundary;
96-120cm	Layer 3	10YR4/1 (gray) fine silty sand; moist, loose; slightly sticky, slightly plastic; water table at 100cm below surface;
120cm	BOE	



PHOTO 9
Trench A-3, detail of stratigraphy exposed on east wall of the trench. Water table at 100cm below surface.



PHOTO 10
Trench B-1, view N.

Trench B-1 Stratigraphic Profile:

0-50cm	Layer 1	10YR4/2 (dark grayish brown) silty fine sand with coralline gravel to pebbles; dry, loose to crumb; grass roots, wavy boundary;
50- 70cm	Layer 2	Mottled 10YR 8/4 (very pale brn) and 7.5YR6/8 (reddish yellow iron stain) fine sand; loose, single grain structure; level, abrupt boundary;
70-80cm	Layer 3	7.5YR6/8 (reddish yellow) fine sand; moist, loose, single grain; wavy boundary;
80-105cm	Layer 4	10YR5/1 (gray) fine clayey sand; wet, friable structure; slightly sticky, slightly plastic; lens with higher clay content within layer; wavy boundary;
105-120cm	Layer 5	10YR4/1 (gray) clay; wet, friable; very sticky and plastic; wavy boundary;
120-150cm	Layer 6	2.5YRN3/0 (very dark gray) fine to medium sand with small amount of clay; wet, loose to friable; slightly sticky and slightly plastic.
150cm	BOE	



PHOTO 11
Trench B-1, stratigraphic detail.

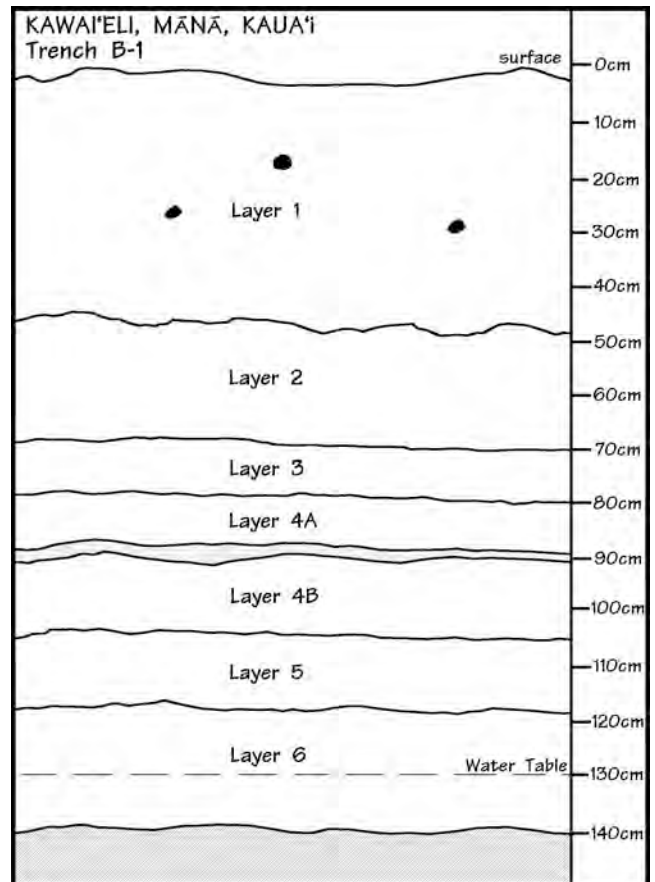


FIG. 10 - Stratigraphic profile of Trench B-1.



PHOTO 13

Trench B-2, detail of microbanding in Layer 3.



PHOTO 12

Trench B-2, stratigraphic profile on east wall.

Trench B-2 Stratigraphic Profile:

0-45cm	Layer 1	10YR4/2 (dark grayish brown) silty fine sand with coralline gravel to pebbles; dry, loose to crumb; grass roots; very uneven, wavy boundary;
45- 60cm	Layer 2	Mottled 10YR 8/4 (very pale brown) and 7.5YR6/8 (reddish yellow iron stain) fine sand; loose, single grain structure; uneven, wavy boundary;
60-105cm	Layer 3	5YR4/1 (dark gray) fine sand with numerous micro layers of sand of different grain sizes; moist, loose, single grain; wavy boundary;
105-145cm	Layer 4	2.5YRN3/0 (very dark gray) fine to medium sand with numerous micro layers of alternating fine and medium grain sand; wet, loose, single grain; slightly sticky and slightly plastic.
145cm	BOE	

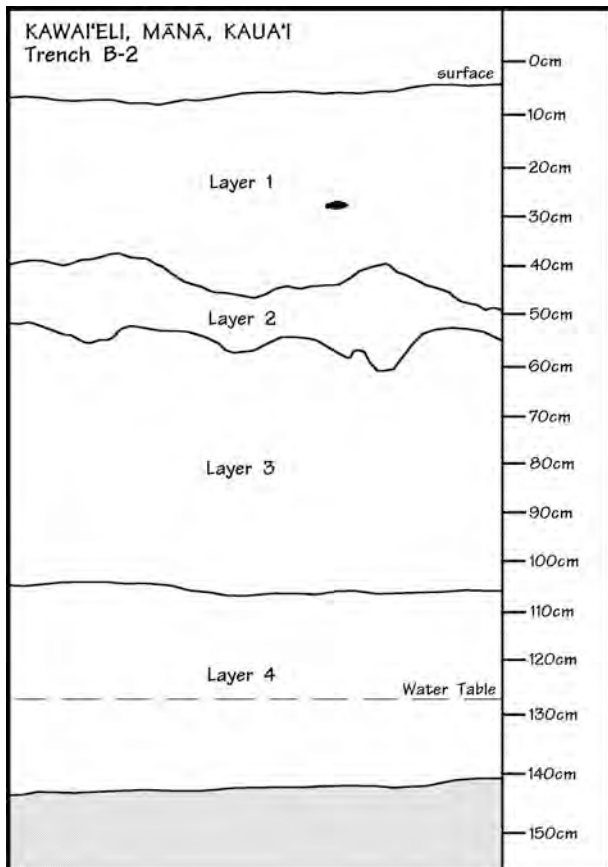


FIG. 11 - Stratigraphic profile of Trench B-2.

Trench B-3

This trench was located 47 meters north of B-2 and was 5 meters in length.

Trench B-3, Stratigraphic Profile:

0-20cm	Layer 1	10YR4/2 (dark grayish brown) silty fine sand with coralline gravel to pebbles; dry, loose, single grain; grass roots; wavy boundary;
20-50cm	Layer 2	10YR3/3 (dark brown) silty loam; moist, friable, crumb structure; sticky and plastic; uneven, very wavy boundary with pit-like features extending into Layer 3;
50-57cm	Layer 3	Mottled 10YR6/4 (yellowish brown) and 7.5YR6/6 (reddish yellow) fine sand; moist, loose, single grain; level, distinct boundary;
57-120cm	Layer 4	10YR6/1 (light gray) fine to medium sand; moist to wet, loose, single grain; water table at 95cm.
120cm	BOE	

Trench B-4

Located 50 meters to the north of B-3, this trench measured 5 meters in length. The stratigraphic profile for Trench B-4 is shown in Fig. 12 and Photo 14. The presence of the ponded silty loam deposit, indicates that this trench is located within the pond. Since Trench B-3 is a sandy deposit throughout the sequence, it appears that the edge of the pond is between Trenches B-3 and B-4.

Trench B-5

This trench was placed 50 meters north of Trench B-4 and 25 meters south of the ditch. Measuring 6 meters in length, this trench was different from the other trenches in Transect B because of the layer of limestone and cemented sandstone slabs found throughout the trench at a depth of about 150cm below surface. These slabs are at the contact of Layers 6 and 7. They are about 10cm thick and average 50 to 80cm in length. Some brackish water bivalve shells were noted in the sand on the topside of the slabs. The water table was at the same depth as the slabs. Also found on the topside of many slabs was a dark grayish brown (2.5YR4/2) silt that forms a thin surface, but does not appear in the stratigraphic profile. The stratigraphic profile for Trench B-5 is shown in Fig. 12 and Photo 15.

Transect C

The southern end of this transect was located between poles 575-12 and 575-13 at the curve in the Kawai'eli Pumping Station Road (Fig. 8). This is the most *makai* transect. It is oriented about 10° off MN and parallels the road. The transect is about 25 meters



PHOTO 14

Trench B-4, view N. Stratigraphic profile shown on the east wall of the trench.

Trench B-4 Stratigraphic Profile:

0-5cm	Layer 1	10YR4/2 (dark grayish brown) silty sand; friable, moist, loose; wavy boundary;
5-25cm	Layer 2	10YR3/3 (dark brown) silty loam; slightly moist, friable, crumb structure; sticky and plastic; grass roots, wavy boundary;
25- 60cm	Layer 3	10YR 7/4 (very pale brown), fine sand; moist, loose, single grain structure; level, abrupt boundary;
60-80cm	Layer 4	10YR5/1 (gray) clay; moist, friable; crumb to blocky structure; sticky and plastic; abrupt boundary;
80-110cm	Layer 5	2.5YR3/0 (very dark gray) medium grain sand; wet, loose, single grain; wavy boundary;
110-120cm	Layer 6	2.5YR6/0 (gray) coarse sandy loam; wet, loose to friable; slightly sticky and slightly plastic; water table at 120cm; wavy boundary;
120-125cm	Layer 7	10YR5/1 (gray); coarse sandy silt; wet, loose to friable; slightly sticky and slight plastic; sits on top of cemented sandstone;
125cm	BOE	Cemented sandstone bedrock; hard and compact.

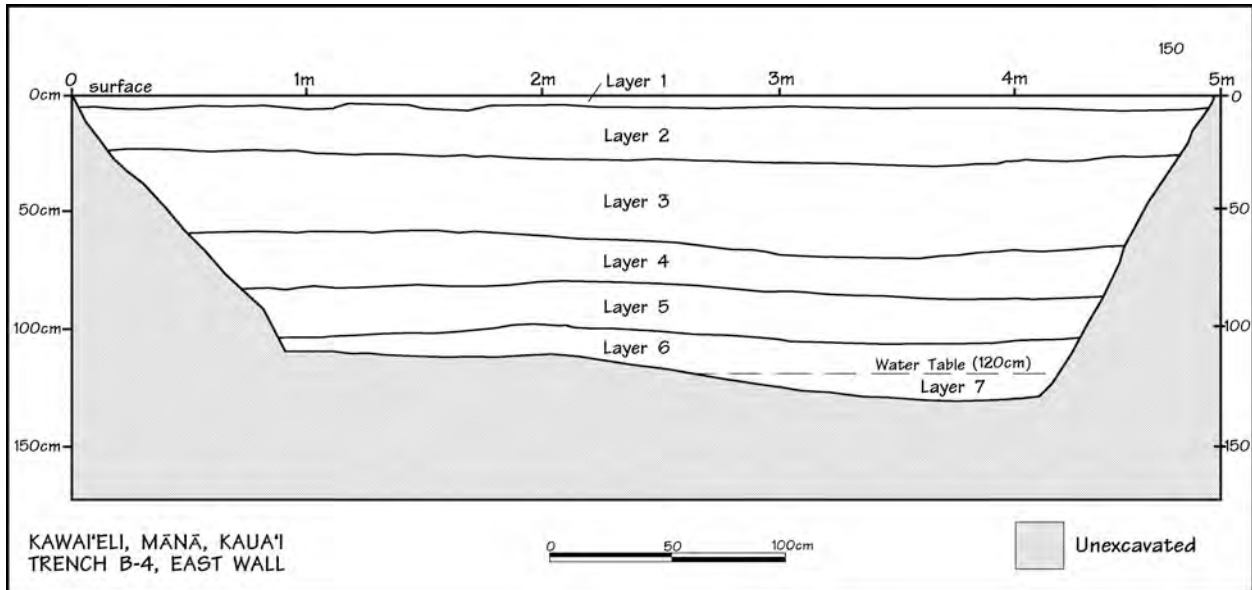


FIG. 12 - Stratigraphic profile of east wall of Trench B-4.



PHOTO 15
Trench B-5, detail of stratigraphic profile on east wall. View NE.

Trench B-5 Stratigraphic Profile:

0-5cm	Layer 1	10YR4/2 (dark grayish brown) silty sand; friable, moist, loose; wavy boundary;
5-35cm	Layer 2	10YR3/3 (dark brown) silty loam; slightly moist, friable, crumb structure; sticky and plastic; grass roots; wavy, uneven boundary with mixing of Layers 2 and 3;
35- 60cm	Layer 3	10YR 7/4 (very pale brown) with light orange staining, fine sand; moist, loose, single grain structure; level, abrupt boundary;
60-75cm	Layer 4	10YR5/1 (gray) gleyed clay; moist, friable; crumb to blocky structure; sticky and plastic; 2cm thick black fine sand lens within layer; abrupt boundary;
75-90cm	Layer 5	7.5YR7/1 (light gray) coarse sandy loam; wet, loose to friable; slightly sticky and slightly plastic; wavy boundary;
90-130cm	Layer 6	7.5YR5/0 (gray) coarse sand; wet, loose, single grain; small shell and coral fragments; sandstone slabs (average 10cm thick and 50-80cm in length) and water table at contact of Layers 6 and 7; thin deposit of 2.5Y4/2 (grayish brown) silt atop the slabs; wavy, abrupt boundary;
130-170cm	Layer 7	2.5YR4/0 (dark gray); silty loam; wet, friable; sticky and plastic.

170cm BOE

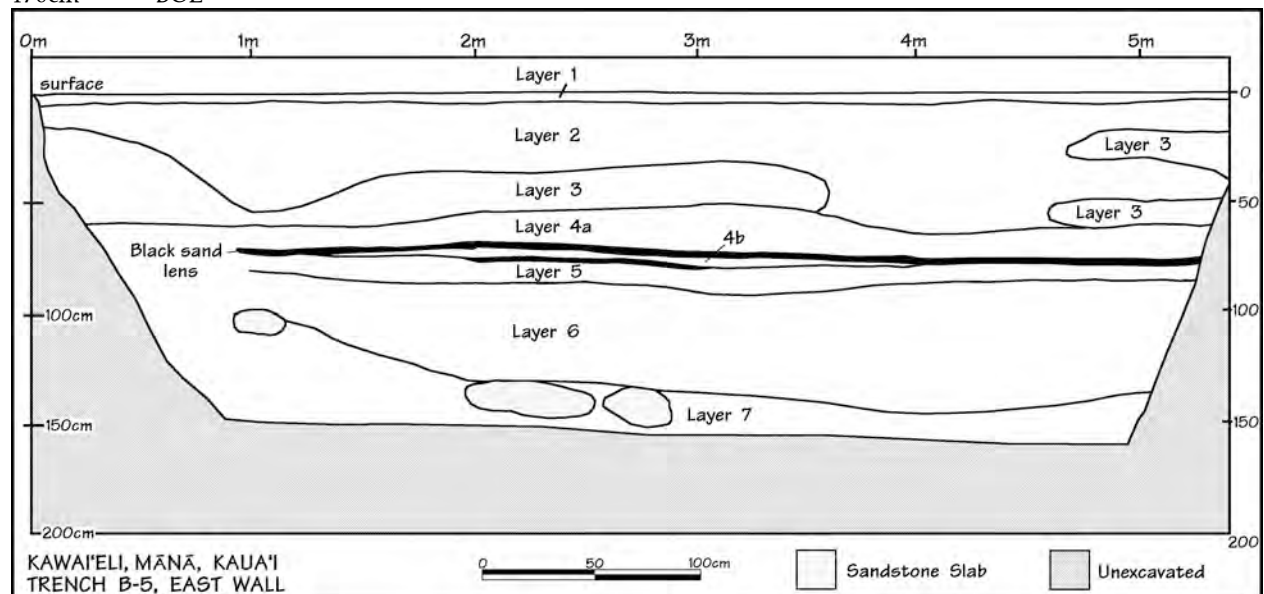


FIG. 13 - Stratigraphic profile of east wall of Trench B-5.

east of the N-S running portion of the road. The areas has a dense growth of *koa haole* (6-8 feet high) and an understory of grass. The ground surface is a grayish sandy silt with coralline cobbles and pebbles.

Trench C-1

Located about 25 meters east of the Pumping Station Road and 10 meters south of Pole 575-14. This trench measured 5.5 meters in length and was oriented generally MN. The stratigraphic profile consisted of a series of sand deposits with the water table at about 2 meters below surface. The sandy nature of the deposits resulted in problems with wall collapse. The stratigraphic profile was recorded at the southern end of the trench:

0-30cm	Layer 1	10YR4/2 (dark grayish brown) silty fine to medium sand with coralline pebbles and cobbles; dry, loose, single grain; grass roots; wavy boundary;
30-53cm	Layer 2	2.5YR5/2 (grayish brown) fine sand; moist, loose, single grain; wavy boundary;
53-114cm	Layer 3	5YR5/6 (yellowish red) fine sand; moist, loose, single grain; level, distinct boundary;
114-149cm	Layer 4	10YR6/4 (light yellowish brown) fine to medium sand; moist to wet, loose, single grain; wavy boundary;
149-250cm	Layer 5	10YR5/1 (gray) medium sand; wet, loose, single grain; water table at 200cm; base of excavation at 250cm below surface.

Trench C-2

This trench was excavated about 50 meters north of Trench C-1 at an angle of 10° (Photo 16). The stratigraphic profile in the 5-meter long trench closely resembled C-1 with an upper agricultural plow zone underlain by sand with no pond deposits. The stratigraphic profile of Trench C-2 is shown in Fig. 14 and Photo 17.

Trench C-3

Located 40 meters to the south of Trench C-1 at an angle of 190°, this is the most *makai* trench placed in the project area (Photo 18). The trench measured 7 meters in length. Like the other trenches in Transect C, this trench is comprised of sand deposits below the agricultural zone with no evidence of pond soils. Several pit features were exposed in this trench and appear to be associated with the upper layers and the agricultural use of the area. Feature 1 is a large, broad pit feature exposed in cross-section and may be a former ditch. The fill of the pit features is an introduced clayey loam. The stratigraphic profile of Trench C-3 is shown in Fig. 15.



PHOTO 16 (left)
View north of Transect C
with Trench C-2 in the
foreground.

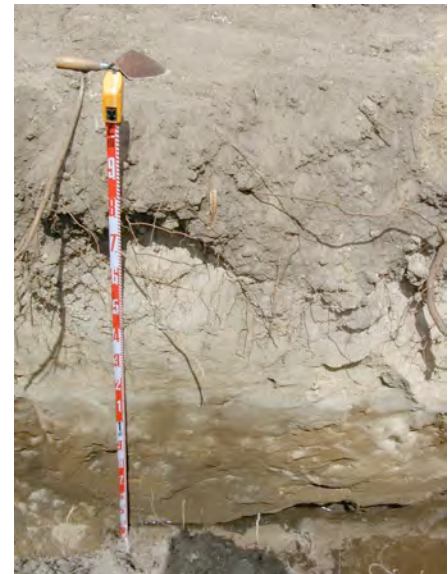


PHOTO 17 (right)
Detail of stratigraphy on
west wall of Trench C-2.

Trench C-2 Stratigraphic Profile:

0-40cm	Layer 1	10YR4/2 (dark grayish brown) silty sand; dry, loose, fine to medium grain sand with coralline pebbles; friable, crumb structure; wavy boundary;
40-55cm	Layer 2	10YR7/4 (very pale brown) fine to medium compacted sand; friable to hard with coralline pebbles; transitional, wavy boundary;
55- 85cm	Layer 3	Mottled fine to medium grain sand; dry, loose, single grain; wavy boundary;
85-88cm	Lens	10YR6/2 (light brownish gray) medium grain sand; dry and loose; wavy;
88-150cm	Layer 4	10YR6/4 (yellowish brown) fine to medium grain sand; moist, loose; wavy boundary with water table at contact of Layers 4 and 5;
150-200cm	Layer 5	10YR5/1 (gray) medium sand; wet, loose, single grain.
200cm	BOE	

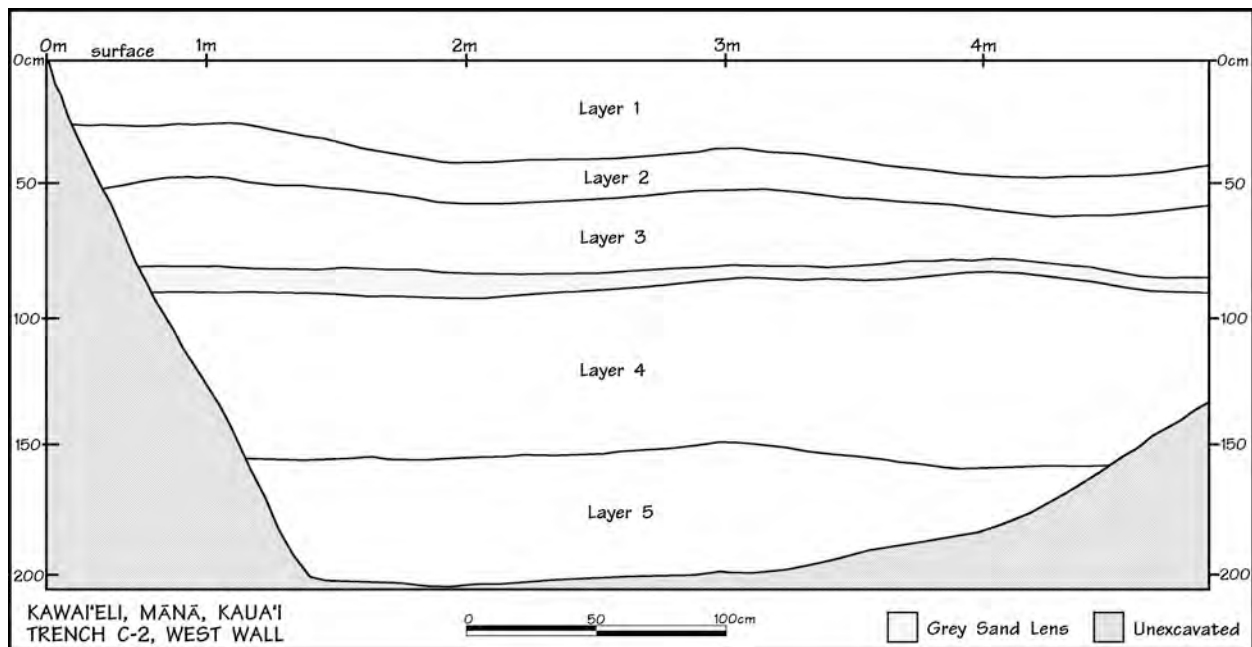


FIG. 14 - Stratigraphic profile of west wall of Trench C-2.



PHOTO 18
Trench C-3, view north.

Trench C-3 Stratigraphic Profile:

0-50cm	Layer 1A	10YR3/4 (dark yellowish brown) sandy loam; dry, loose at surface to friable with depth; probably fill of a ditch; wavy boundary;
	Layer 1B	At north end of the trench, layer of mottled brown sandy loam and sand with coralline pebbles.
	Feature 1	Pit feature with fill of 10YR2/2 (black) clayey loam; friable when moist and hard as it dries; sticky and plastic; ~2m wide in cross-section.
	Feature 2	Pit feature with fill of 10YR3/2 (dark grayish brown) clay loam; hard and compact; sticky and plastic; ~50cm wide in cross-section and 30cm deep.
50-80cm	Layer 2A	Mottled 10YR5/6 (yellowish brown) and 7.5YR5/6 (strong brown) fine to medium sand; moist, loose to friable; wavy boundary;
80-115cm	Layer 2B	10YR5/6 (yellowish brown) medium grain sand; moist, loose, single grain; wavy boundary;
115-200cm	Layer 3	7.5YR5/0 (gray) medium grain sand; wet, loose; wavy boundary with water table at contact of Layers 2/3.
200cm	BOE	

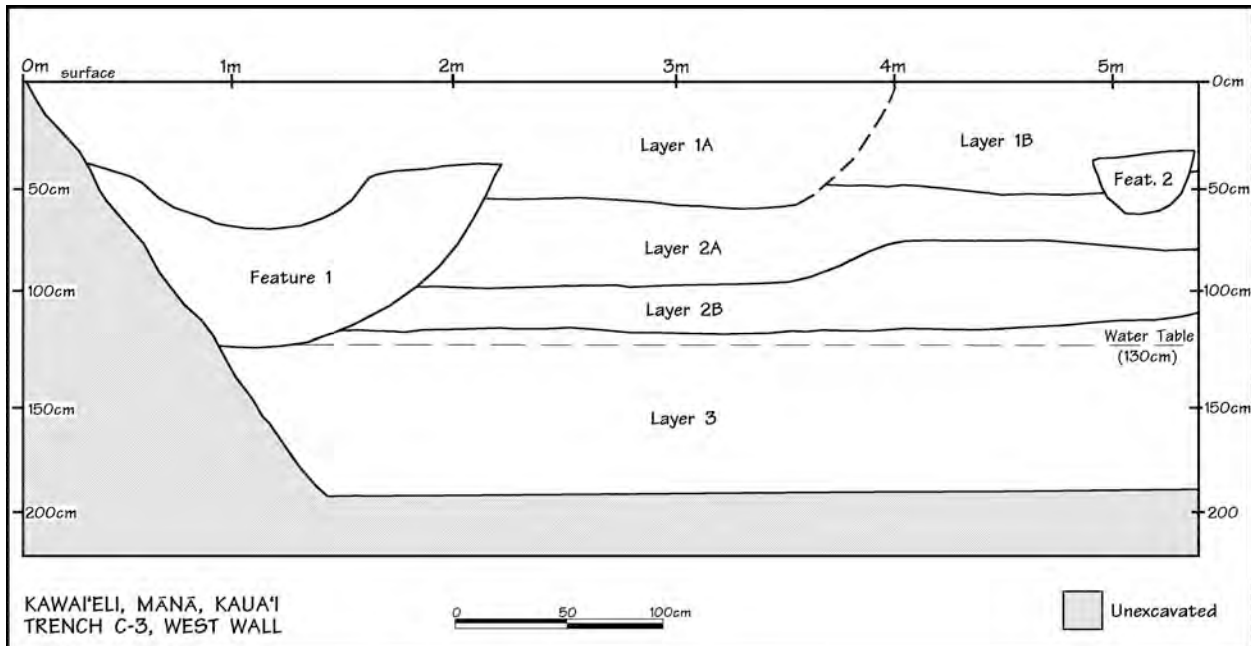


FIG. 15 - Stratigraphic profile of west wall of Trench C-3.

Transect D

This transect was placed to the east of Transect A to test near the intersection of Kaumuali'i Highway and the Kawai'eli Pumping Station Road (Fig. 8). Placed between poles 575-1 and 575-2 and oriented MN, this transect consisted of 2 trenches. The vegetation is a growth of *koa haole* with an understory of grass.

Trench D-1

This trench was located about 160 meters (500 feet) *makai* of Kaumuali'i Highway. It measured 7 meters in length and oriented MN. The stratigraphic profile of D-1 is shown in Fig. 16 and Photo 19. With a total of 7 layers, the upper 4 layers were reddish clay and clay loam, probably a mix of agricultural top soil and alluvial pond deposits. These clay layers were underlain by sand layers. The presence of shell in the sand suggests that the sand was deposited in a wetland environment.

Trench D-2

Located 50 meters north of Trench D-1 and about 30 meters from the highway (Photo 20). This trench was 6 meters in length. The stratigraphic profile of D-2 is shown in Fig. 17 and Photo 21. The stratigraphy is consistent with Trench D-1.

Transect E

This transect was oriented perpendicular (35° off MN) to Kaumuali'i Highway and roughly *mauka-makai*. This transect was in the western end of the project area with vegetation consisting of *koa haole*, pluchea bushes, and grasses (Fig. 8). There is a dirt road on the west side of the transect. Pond soils consisting of a gray clay were found in all 3 trenches comprising this transect (Photo 25). Underlying this pond clay soil was a lens, about 3cm thick, of angular sandstone gravel. Below the gravel was a brown clayey silt deposit and the water table.

Trench E-1

Located in close proximity to the highway, this trench measures 5 meters in length (Photo 22). The stratigraphic profile of Trench E-1 is shown in Fig. 18 and Photo 23. Sandstone bedrock was found at the base of the trench, about 125cm below surface.

Trench E-2

Placed 50 meters south of Trench E-1, this trench measured 9 meters in length. The stratigraphic profile of Trench E-2 is shown on page 42 and Photo 24.

Trench E-3

This trench was 50 meters south of Trench E-2 and 8 meters north of an east-west running ditch. The trench measured 7 meters in length. The stratigraphic profile of Trench E-3 is shown in Fig. 19 and Photos 26 and 27.



PHOTO 19
Trench D-1, east wall stratigraphy.

Trench D-1 Stratigraphic Profile:

0-45cm	Layer 1	10YR4/2 (dark grayish brown) silty loam; dry, loose, fine to medium grain sand with coralline pebbles; friable, crumb structure; slightly sticky and slightly plastic; <i>koa haole</i> roots; wavy boundary;
45-70cm	Layer 2	10YR6/2 (light brownish gray) clayey loam; moist, friable to compact crumb; no apparent sand grains; few roots; wavy boundary;
70-75cm	Layer 3	2.5YR6/2 (weak red) clay; compact, hard, blocky; sticky and plastic; uneven thickness; mottled transition to underlying layer;
75-105cm	Layer 4	Mottled 2.5YR6/2 (weak red) clay and 5YR5/6 (yellowish red) medium grain sand; moist, loose to friable; slightly sticky and slightly plastic; wavy boundary;
105-125cm	Layer 5	5YR5/6 (yellowish red) medium grain sand; moist, loose, single grain; wavy boundary;
125-140cm	Layer 6	10YR4/3 (brown) fine to medium grain sand with waterworn, small pieces of shell; moist, loose, single grain; wavy boundary;
140-170cm	Layer 7	10YR6/6 (brownish yellow) fine sand with small pieces of shell; wet, loose, single grain; water table and base of excavation at 170cm.

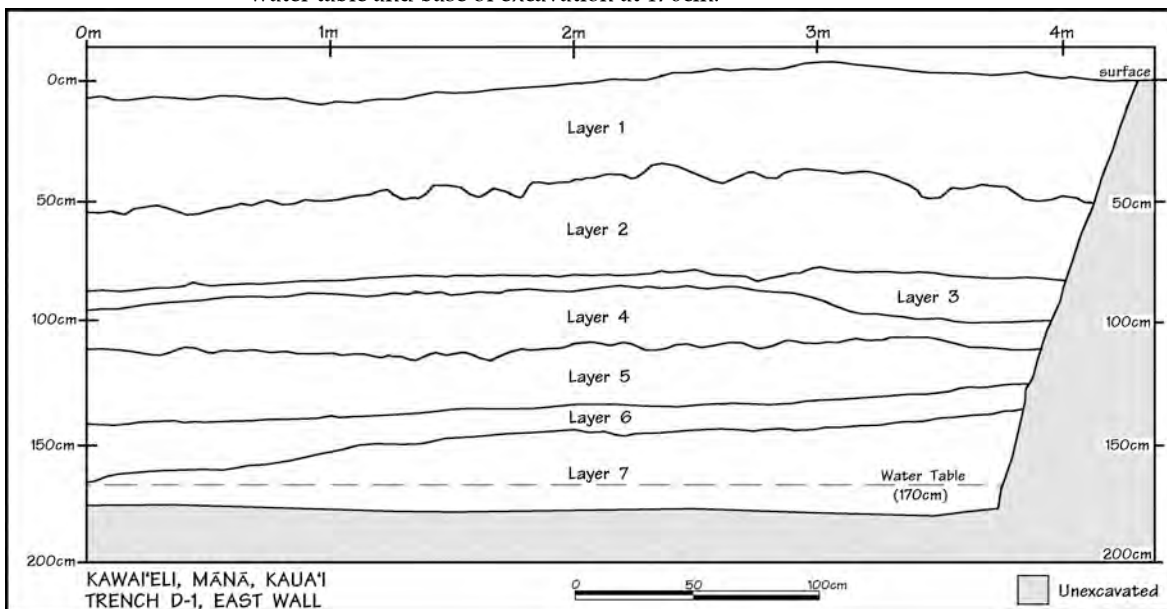


FIG. 16 - Stratigraphic profile of east wall of Trench D-1.



PHOTO 20: Trench D-2, view N.



PHOTO 21
Trench D-2, west wall stratigraphy.

Trench D-2 Stratigraphic Profile:

0-25cm	Layer 1	10YR4/2 (dark grayish brown) silty loam; dry, loose, fine to medium grain sand with sandstone pebbles; friable, crumb structure; <i>koa haole</i> roots; wavy boundary;
25-55cm	Layer 2A	10YR6/2 (light brownish gray) clayey loam; moist, friable to compact crumb; few roots; wavy boundary;
55-75cm	Layer 2B	10YR6/2 (brownish gray) clayey loam; compact, hard, blocky; sticky and plastic; mottled transition to underlying layer;
75-80cm	Lens	Band of 2.5YR6/2 (gray) clay; sticky, plastic; uneven thickness; wavy boundary;
80-90cm	Layer 3	Mottled 5YR5/6 (yellowish red) and 10YR6/2 (brownish gray) loamy clay; roots; abrupt, distinct boundary;
90-96cm	Layer 4	7.5YR6/6 (reddish yellow) medium grain sand; moist, loose; wavy boundary;
96-106cm	Layer 5	10YR3/1 (dark gray) fine to medium sand; moist, loose; wavy boundary;
106-138cm	Layer 6	10YR4/2 (dark grayish brown) fine to medium sand; moist, loose; wavy;
138-150cm	Layer 7	10YR3/1 (dark gray) fine to medium sand; wet, loose, single grain; water table and base of excavation at 150cm

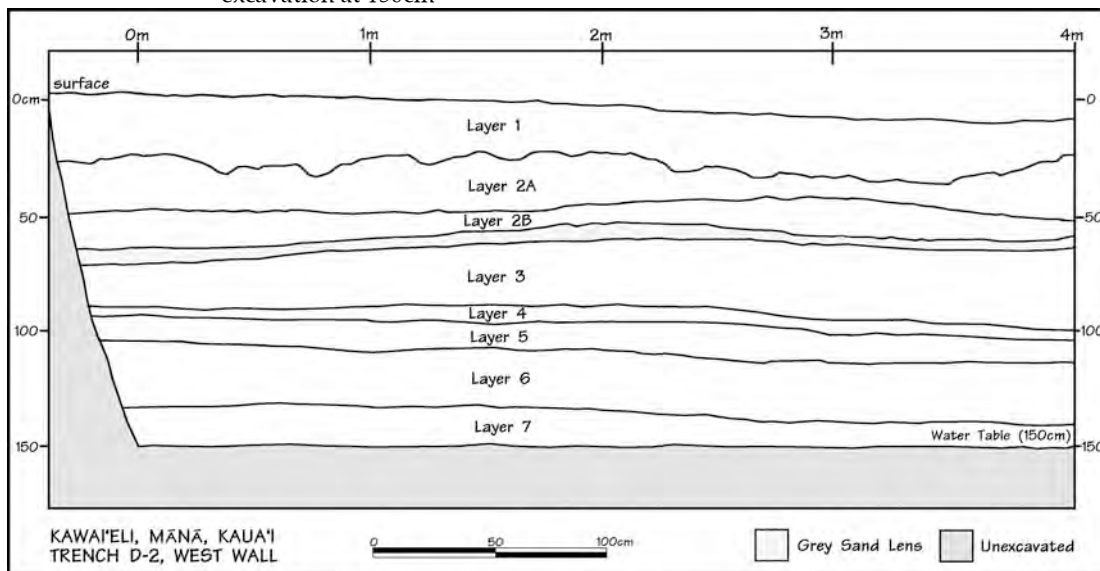


FIG. 17 - Stratigraphic profile of west wall of Trench D-2.



PHOTO 22: Trench E-1, view S.

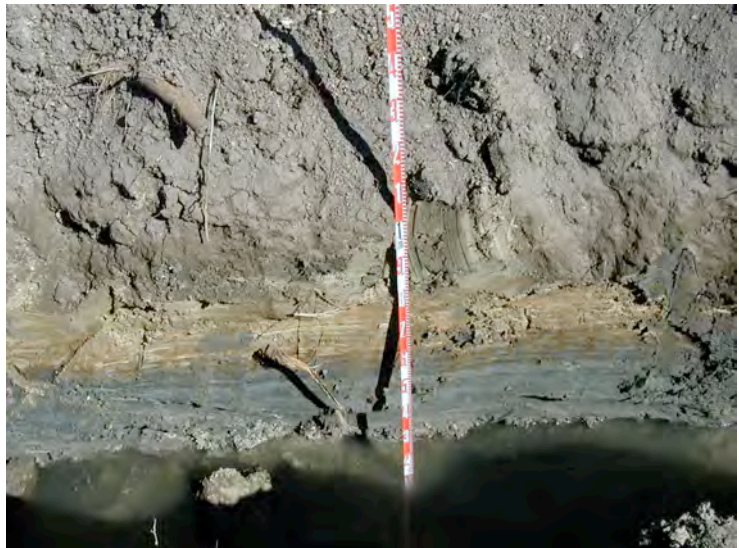


PHOTO 23

Trench E-1, east wall stratigraphic profile

Trench E-1 Stratigraphic Profile:

0-20cm	Layer 1	10YR4/2 (dark grayish brown) silty loam; friable, large crumb structure when moist; hard and blocky when dry; slightly plastic and slightly sticky; <i>koa haole</i> roots; wavy boundary;
20-50cm	Layer 2	10YR6/2 (light brownish gray) loamy clay; moist, friable, medium to large crumb; sticky and plastic; few roots; wavy boundary;
50-70cm	Layer 3	Mottled 7.5YR5/8 (strong brown) and 10YR6/3 (pale brown) fine sand; moist, loose, single grain; abrupt, distinct boundary;
70-120cm	Layer 4	2.5YR4/0 (dark gray) clay; wet; very sticky and very plastic; wavy boundary;
120-125cm	Lens	Angular sandstone gravel lens with sandstone bedrock at base of clay layer;
125-155cm	Layer 5	10YR3/1 (dark gray) clayey silt; wet; sticky and plastic; water table at 135cm; base of excavation at 155cm.

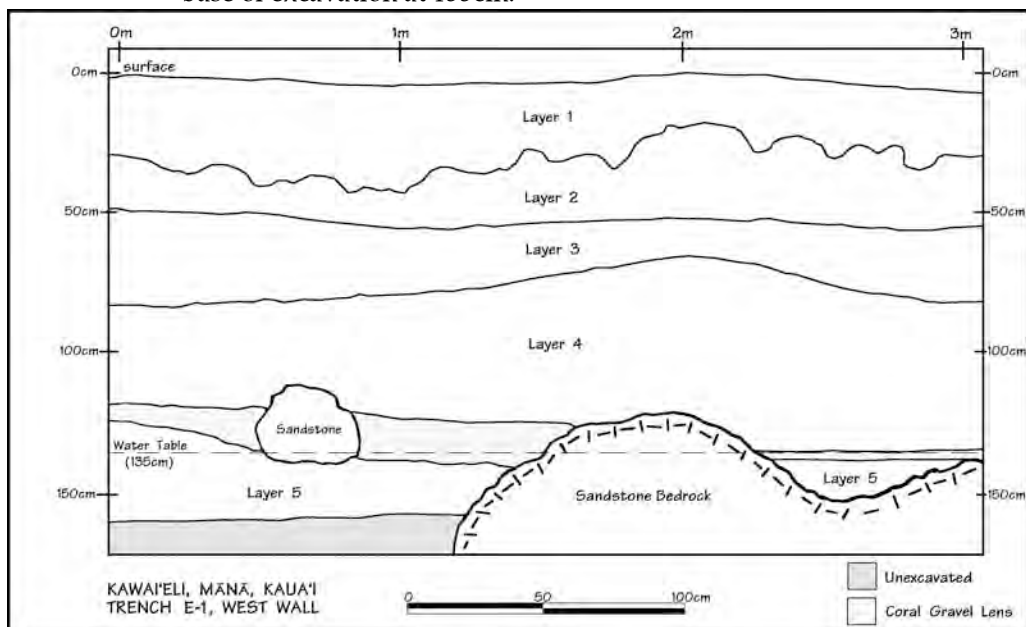


FIG. 18 - Stratigraphic profile of west wall of Trench E-1



PHOTO 24
Trench E-2, west wall stratigraphy.

Trench E-2 Stratigraphic Profile:

0-30cm	Layer 1	10YR4/2 (dark grayish brown) silty loam; friable, large crumb structure when moist; hard when dry; slightly plastic and slightly sticky; <i>koa haole</i> roots; wavy boundary;
30-45cm	Layer 2	10YR6/2 (light brownish gray) loamy clay; moist, friable, medium to large crumb; sticky and plastic; few roots; wavy boundary;
45-70cm	Layer 3	Mottled 7.5YR5/8 (strong brown) and 10YR6/3 (pale brown) fine sand; moist, loose, single grain; abrupt, distinct boundary;
70-92cm	Layer 4	2.5YR4/0 (dark gray) clay; wet; very sticky and very plastic; wavy boundary;
92-95cm	Lens	Angular, sandstone gravel lens with sand at base of clay layer;
95-115cm	Layer 5	10YR3/3 (dark brown) clayey silt; wet; sticky and plastic; water table at 85cm; base of excavation at 115cm.



PHOTO 25
Trench E-3 showing dark gray clayey silt found at base of all trenches in Transect E



PHOTO 27 (above)
Trench E-3, west wall stratigraphy with pit feature.

PHOTO 26 (left)
Trench E-3, stratigraphy at N end of trench.

Trench E-3 Stratigraphic Profile:

0-20cm	Layer 1	10YR4/2 (dark grayish brown) silty loam; friable, large crumb structure when moist; hard when dry; slightly plastic and slightly sticky; <i>koa haole</i> roots; wavy boundary;
20-35cm	Layer 2	10YR6/2 (light brownish gray) loamy clay; moist, friable, medium to large crumb; sticky and plastic; few roots; wavy boundary;
	Feature 1	Pit feature with mottled and mixed fill from Layers 1, 2, and 3; 50cm in diameter.
35-50cm	Layer 3	Mottled 7.5YR5/8 (strong brown) and 10YR6/3 (pale brown) fine sand; moist, loose, single grain; abrupt, distinct boundary;
50-87cm	Layer 4	2.5YR4/0 (dark gray) clay; wet; very sticky and very plastic; wavy boundary;
87-90cm	Lens	Angular, sandstone gravel lens with sand at base of clay layer;
90-100cm	Layer 5	10YR3/3 (dark brown) clayey silt; wet; sticky and plastic; water table at 95cm; base of excavation at 100cm.

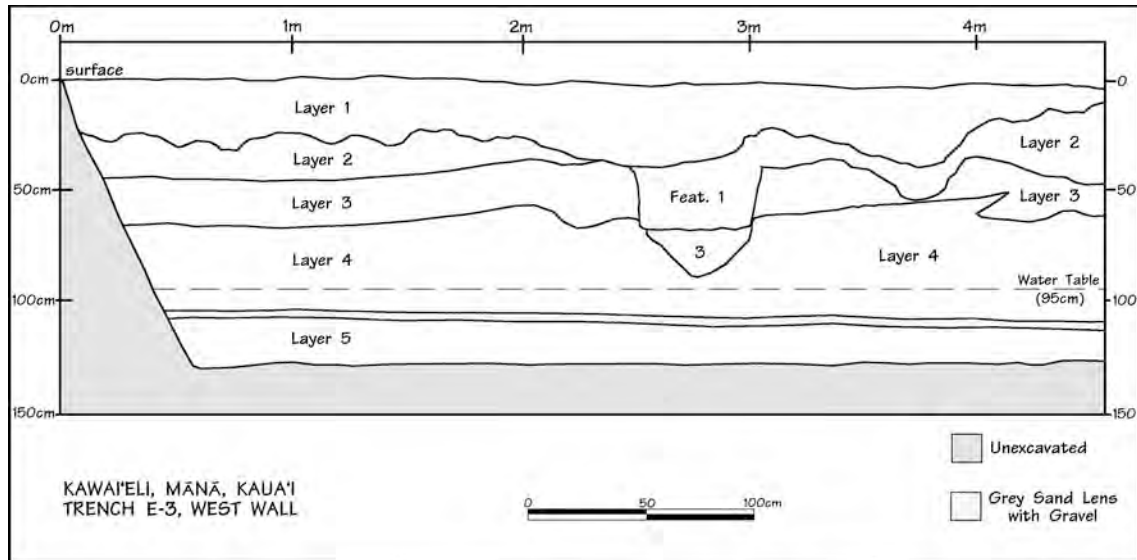


FIG. 19 - Stratigraphic profile of west wall of Trench E-3

Transect F

Located about 200 meters to the east of Transect E, Transect F is also oriented perpendicular to Kaumuali'i Highway at an orientation of 35° off MN (Fig. 8). This transect roughly parallels a dirt road and ditch that end at Kawai'eli Pumping Station. The transect also crosses an east-west running ditch. This transect consisted of 4 trenches.

Like Transect E, the stratigraphy in this transect is marked by the presence of an angular coralline gravel layer within the pond soil deposits. The pond soils sit atop the sandstone bedrock and are marked by a series of micro-layers of sand and clay deposits (Photo 32). The water table generally corresponds to the top of the sandstone bedrock.

These trenches were left open for about a week (August 30 - September 3, 2004) and during this time, Nancy McMahon, SHPD Archaeologist, and Lida Pigott-Burney visited the site. Pigott-Burney took samples from the pond soils to evaluate the presence of any pollen that might assist in understanding past environments and cultural use of the ponds. She reports that no pollen was found in the samples taken (Pigott-Burney, pers. comm., October 7, 2005).

Trench F-1

The north end of this trench is about 40 meters *makai* of the highway. The trench measured 6 meters in length. The stratigraphic profile of Trench F-1 is shown in Fig. 20 and Photo 28.

Trench F-2

Located 48 meters from south end of Trench F-1 to the north end of Trench F-2. This trench was 7 meters in length. The stratigraphic profile is shown on page 46 and Photo 29.

Trench F-3

Located 100 meters south (*makai*) of Trench F-2. The stratigraphic profile of this 6 meter long trench was uniform and is shown on page 46 and Photo 30. This trench is located 23 meters from the *mauka* (north) edge of a low-lying area where water collects during heavy rains. It is an open red dirt water basin with the water table at about one meter below the surface.

Trench F-4

This trench was located on the *makai* side of the east-west running ditch and 100 meters south of trench F-3. The stratigraphic profile of Trench F-4 is shown on page 47 and Photo 31.



PHOTO 28
Trench F-1, east wall stratigraphic profile.

Trench F-1 Stratigraphic Profile:

0-40cm	Layer 1	5YR3/4 (dark reddish brown) silty loam; friable, large crumb structure when moist; hard and blocky when dry; slightly plastic and slightly sticky; roots; very wavy boundary with mixing of Layers 1/2 at contact;
40-52cm	Layer 2	10YR6/2 (light brownish gray) loamy clay; moist, friable to dry and hard; sticky and plastic; few roots; wavy boundary;
52-68cm	Layer 3	Mottled 7.5YR5/8 (strong brown) and 10YR6/3 (pale brown) fine to medium sand; moist, loose, single grain; abrupt, wavy boundary;
68-76cm	Layer 4A	Transitional layer with micro-banding and mottled 7.5YR5/8 (strong brown) and 10YR6/3 (pale brown); fine to medium sand; wavy boundary;
76-106cm	Layer 4B	Microbanding of gray sand and clay;
106-108cm	Lens	Angular sandstone gravel lens with brackish water shell at base of clay layer;
108-130cm	Layer 5	10YR3/1 (dark gray) clayey silt; wet; sticky and plastic; water table at 130cm.
130-150cm		Sandstone bedrock; base of excavation at 150cm below surface.

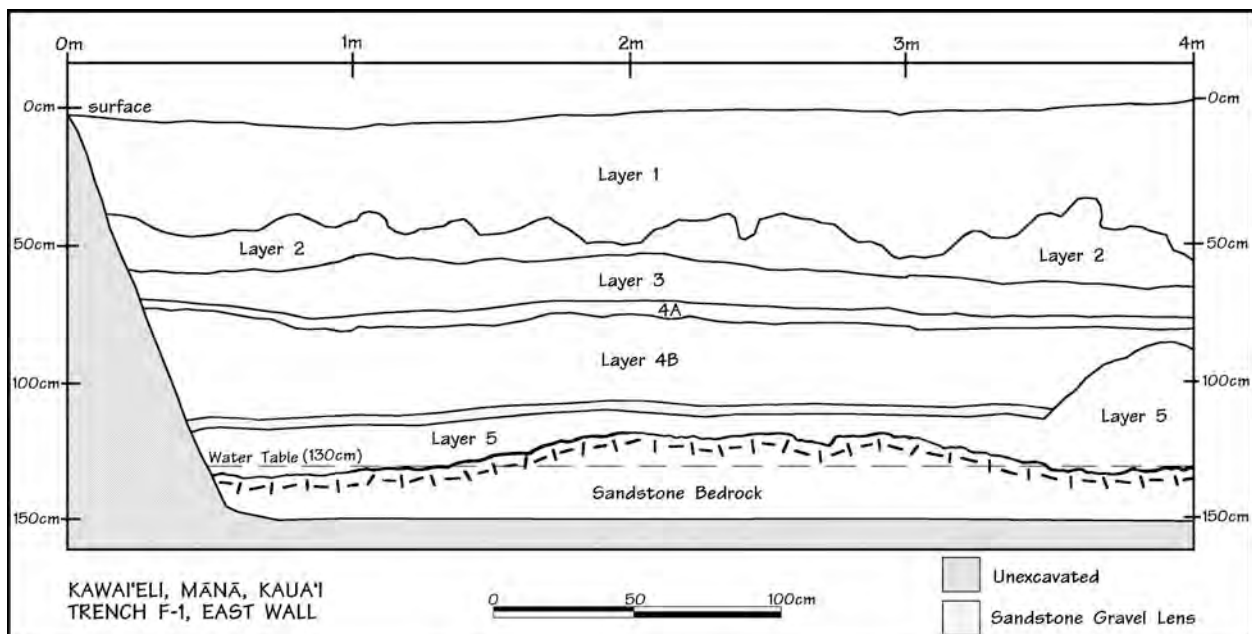


FIG. 20 - Stratigraphic profile of east wall of Trench F-1.

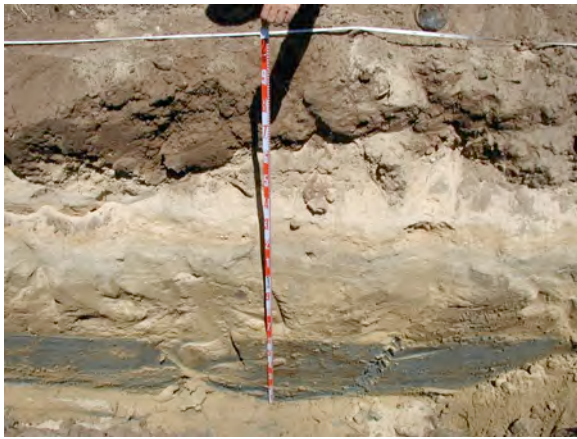
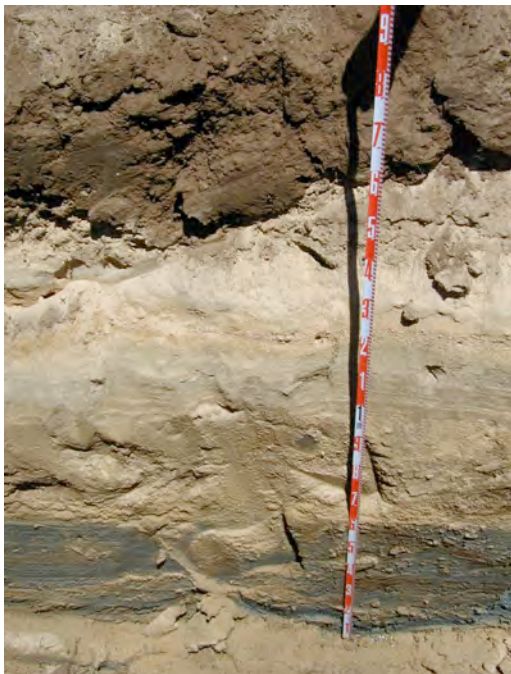


PHOTO 29
Trench F-2, east wall stratigraphic profile.

Trench F-2 Stratigraphic Profile:

0-40cm	Layer 1	10YR4/2 (dark grayish brown) silty loam; friable, large crumb structure when moist; hard and blocky when dry; slightly plastic and slightly sticky; roots; very wavy boundary with pit-like features extending into Layer 2;
40-48cm	Layer 2	10YR6/3 (pale brown) clayey loam; moist, friable to dry and hard; sticky and plastic; discontinuous; wavy boundary;
48-73cm	Layer 3	Mottled 7.5YR5/8 (strong brown) and 10YR6/3 (pale brown) fine to medium sand; moist, loose, single grain; abrupt, wavy boundary;
73-81cm	Layer 4A	Transitional layer with micro-banding and mottled 7.5YR5/8 (strong brown) and 10YR6/3 (pale brown); fine to medium sand; level, distinct boundary;
81-110cm	Layer 4B	Microbanding of gray sand and clay.
110-112cm	Lens	Angular sandstone gravel lens with brackish water shell at base of clay layer; water table at 90cm;
112-150cm	Layer 5	10YR3/1 (dark gray) clayey silt; wet; sticky and plastic; initial contact with sandstone bedrock at 150cm; base of excavation.



Trench F-3 Stratigraphic Profile:

0-35cm	Layer 1	10YR4/2 (dark grayish brown) silty loam;
35-50cm	Layer 2	10YR6/3 (pale brown) clayey loam;
50-55cm	Layer 3	Transitional mottled 7.5YR5/8 (strong brown) and 10YR6/3 (pale brown) sand;
55-100cm	Layer 4	Microbanding of gray sand and clay;
100-105cm	Lens	Angular sandstone gravel;
105-120cm	Layer 5	10YR3/1 (dark gray) clayey silt atop sandstone bedrock; water table and base of excavation.

PHOTO 30
Trench F-3, east wall profile.



PHOTO 31
Trench F-4, west wall stratigraphic profile.

Trench F-4 Stratigraphic Profile:

0-22cm	Layer 1	10YR3/3 (dark brown) silty loam; friable, large crumb structure when moist; hard when dry; slightly plastic and slightly sticky; roots; wavy boundary;
22-55cm	Layer 2	Mottled 7.5YR5/8 (strong brown) and 10YR6/3 (pale brown) fine to medium sand; moist, loose, single grain; wavy boundary with leaching of iron (orange staining) between the sand of Layer 2 and clay of Layer 3;
55-88cm	Layer 3	10YR 3/1 (dark gray) clay; microbanding of gray sand and clay; wet; wavy boundary;
88-130cm	Layer 4	10YR3/1 (dark gray) silty sand; wet, friable; slightly sticky and slightly plastic; base of excavation.



PHOTO 32
Trench F-2, detail of micro-banding of sand and clay layers.

Transect G

This transect was placed between Transects C and F on the *makai* edge of the project area and about 150 meters to the west of the Kawai'eli Pumping Station (Fig. 8). The transect was oriented 40°. This site was selected to determine if the contact between the sand dune and pond could be defined. This transect would also help to determine the *makai* extent of the pond. Only one trench was excavated along this transect.

Trench G-1

This 6-meter long trench was located *makai* of the ditch that runs west from the Pumping Station. The stratigraphic profile of Trench G-1 is shown in Fig. 21 and Photo 33. Pond soils were found in this trench, indicating that the pond extended at least this far *makai*.

Transect H

This transect was placed adjacent to Kaumuali'i Highway and about 200 meters west of Transect E (Fig. 8). Accessed from a dirt road off the highway, this transect is west of the second bridge in the project area.

Trench H-1

This trench was only 3.5 meters in length and oriented 35°. Located about 40 meters from the highway, it represents the most northwestern trench. The water table was relatively high (78cm below surface) in this trench. There was also a very distinct gray clay layer found at 50cm below surface and extending to the base of excavation and below the water table. The stratigraphic profile of trench H-1 is shown on page 50 and Photo 34.

Trench G-1 Stratigraphic Profile:

0-40cm	Layer 1	10YR4/2 (dark grayish brown) silty loam; friable, large crumb structure when moist; hard when dry; slightly plastic and slightly sticky; <i>koa haole</i> roots; wavy boundary;
40-60cm	Layer 2	10YR6/4 (yellowish brown) fine aeolian sand; moist to dry, loose, single grain; few roots; wavy boundary;
60-65cm	Layer 3	10YR6/4 (yellowish brown) coarse sand with shell fragments and coral chunks; moist, loose, single grain; toot casts; wavy boundary;
65-125cm	Layer 4	Alternate banding of grayish fine, medium, and coarse grain sand with shell fragments; banding reflects variation in both color and texture; wavy boundary;
125-127cm	Lens A	10YR6/1 (light gray) clay; moist, blocky; sticky and plastic; distinct boundary;
127-150cm	Layer 5	10YR3/1 (dark gray) clayey silt; wet, blocky; sticky and plastic; wavy boundary;
150-152cm	Lens B	10YR3/1 (dark gray) silty sand; wet; friable; sticky and plastic; wavy boundary;
152-165cm	Layer 6	Microbanding of 10YR3/1 (dark gray) clayey silt and silty sand; wet; sticky and plastic;
165cm	Base of excavation.	

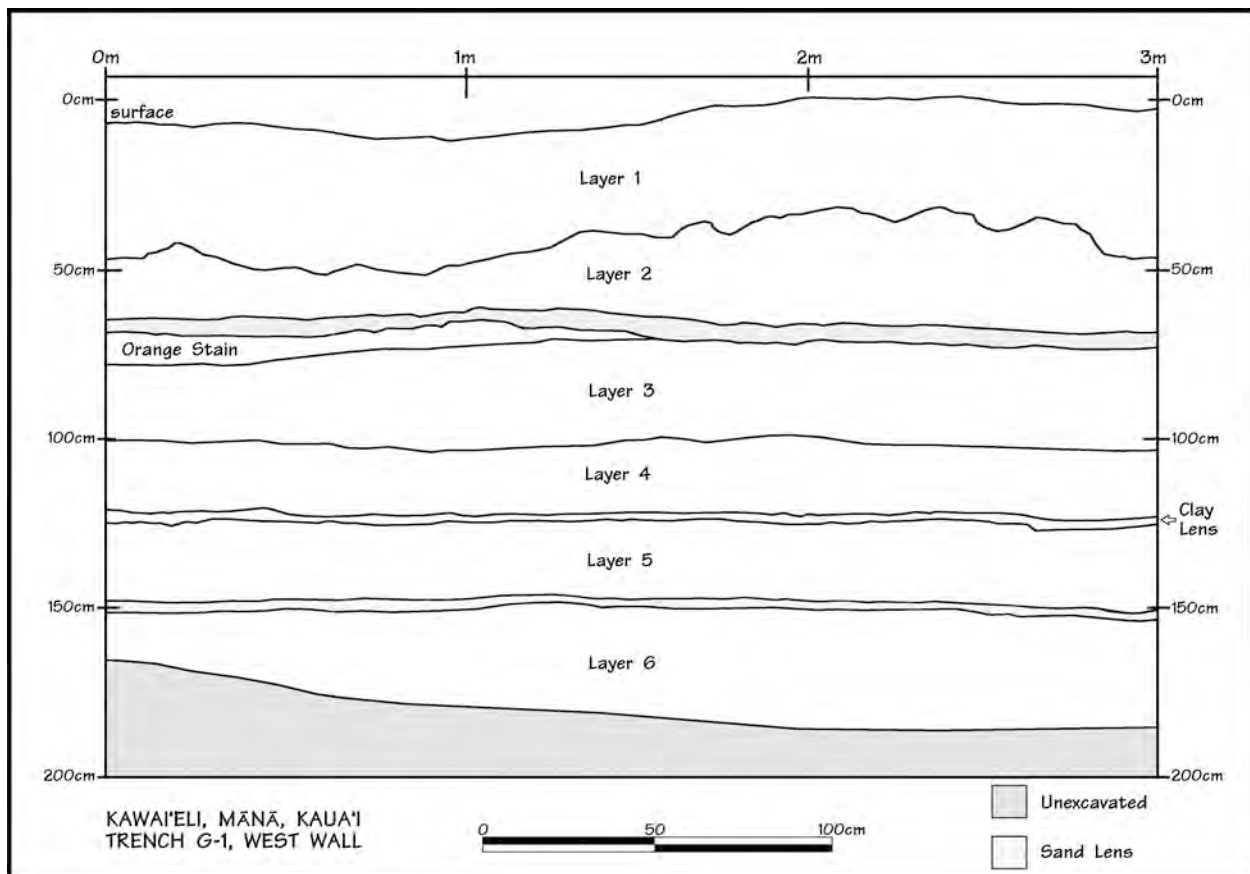


FIG. 21 - Stratigraphic profile of west wall of Trench G-1.



PHOTO 33
Trench G-1, west wall stratigraphic profile.

Trench H-1 Stratigraphic Profile:

0-32cm	Layer 1	10YR3/3 (dark brown) silty loam with visible sand grains; friable, large crumb structure when moist; hard and blocky when dry; slightly plastic and slightly sticky; wavy boundary;
32-52cm	Layer 2	Mottled 10YR5/3 (brown) and 10YR3/3 (dark brown) silty clay; moist, friable, crumb to blocky structure; sticky and plastic; indistinct boundary;
52-87cm	Layer 3	10YR3/1 (dark gray) clayey silt; wet; sticky and plastic; water table at 78cm;
87cm	Base of excavation.	



PHOTO 34
Trench H-1, west wall stratigraphic profile.

SUMMARY OF FINDINGS

The stratigraphic profiles exposed in the 22 trenches placed in the Kawai'eli Phase 2 project area indicated a pattern consistent with a wetland situated behind a coastal sand dune that was subsequently altered by agricultural land use. There were 2 general profiles noted - one where the pond soils are present and one where the pond soils are absent. Where the pond soils are absent, the soil consists of sand dune deposits.

The topography of the Phase 2 project area is relatively level, resulting from about a century of sugarcane cultivation. Cutting through the project area are numerous ditches that drain the water in the area, as well as former cane-haul roads. The upper agricultural layer or plow zone averages 20 to 40cm in depth below the surface. This layer is a mix of introduced silts and fine to medium grain sand that naturally occurs in the area. This agricultural zone appears to be fairly consistent throughout the project area and there is a wavy boundary with the underlying deposit indicating the former use of machinery to furrow the ground for planting.

Interpretation of Stratigraphy

Chuck Blay, a geologist working on Kaua'i, visited the project site on August 26, 2004 and inspected the trenches in Transect F. All of these trenches contain the gray clay deposit below the agricultural zone and above the sand deposit that rests on the sandstone bedrock. He suggested that the pond deposit consists of interlayered pond silts and clays with the sandy beach deposits, creating the microbanding that was well exhibited in Transects E and F (refer to Photo 32). The beach deposits probably reflect periods of dune movement and the shifting of sand during high winds. Blay also suggests that there were probably periods when the pond dried up and a series of the medium and coarser sands were deposited in the dry pond areas. It could also be during these times that the dunes formed and the aeolian sand deposits were laid down.

The draining of the ponds in the 20th Century for sugarcane cultivation lowered the water table to depths between 75cm and 170cm below the current ground surface. The water saturated sands below the water table are marked by a dark gray color. The silts and clays below the water table in many of the trenches can be described as gley, a sticky, bluish-gray soil layer formed under conditions of excessive moisture.

Table 3 is an assessment of the trenches relative to the presence or absence of the pond soils. Sand dune deposits refer to the fine to medium sand deposits above the pond soils and toward the *makai* edge of the former pond. The pond sands, including silty sand deposits, may be above or below the clay pond soils. The sands are believed to have been deposited during periods of either wet or dry pond conditions. The water table and anaerobic conditions have made these pond sands gray in color. The pond clays are distinctive with a dark gray color and very sticky and very plastic texture.

TABLE 3
Presence and Absence of Pond Soils in the Kawai'eli Trenches

TRENCH	SAND DUNE	POND SAND	POND CLAY	COMMENTS
A-1	x	x	x	Pond clay at 175cm below surface; overlain by dune/pond sand deposits.
A-2	x	x	x	Pond clay at 65cm below surface; overlain by dune/pond sand deposit; edge of the former pond?
A-3		x		Pond soils not evident; may represent deeper portion of pond not excavated; silty sand pond deposit at 96cm
B-1		x	x	Pond clay at 105cm below surface; underlain by pond sand.
B-2	x	x		No clay; fine to medium dune/pond sand.
B-3	x	x		No clay; fine to medium dune/pond sand.
B-4		x	x	Pond clay at 60cm below surface; clay underlain by pond sands.
B-5		x	x	Pond clay at 60cm below surface; clay underlain by pond sands.
C-1	x			No clay; fine to med. dune sand.
C-2	x			No clay; fine to med. dune sand.
C-3	x			No clay; fine to med. dune sand.
D-1		x	x	Pond clay at 70cm below surface; clay underlain by pond sand.
D-2		x	x	Pond clay at 75cm below surface; clay underlain by pond sand.
E-1		x	x	Pond clay at 70cm; clay underlain by sandstone gravel and bedrock
E-2			x	Pond clay at 70cm below surface; clay underlain by clayey silt deposit
E-3		x	x	Pond clay at 50cm below surface; clay underlain by sandstone gravel and clayey silt deposit
F-1		x	x	Pond clay at 76cm and underlain by sandstone gravel and bedrock.
F-2		x	x	Pond clay at 81cm and underlain by sandstone gravel, and bedrock
F-3		x	x	Pond clay at 55cm and underlain by sandstone gravel and bedrock
F-4		x	x	Pond clay at 55cm below surface; clay underlain by silty pond sand.
G-1		x	x	Pond clay at 125cm; underlain by silty sands; <i>makai</i> edge of pond
H-1			x	Pond clay at 52cm below surface.

The percolation of water through the soil column has resulted in varying degrees of iron oxide leaching and staining (orange coloration) throughout the project area. Much of this iron staining occurs below the agricultural plow zone and above the water table.

The stratigraphy of soil layers exposed in the 22 trenches showed two major profiles - one with pond soils indicative of the former Kawai'eli Pond and the other consisting of sand deposits associated with the dune formation *makai* and east of the pond. Based on the trenching, an approximate boundary for the Kawai'eli Pond in the project area is shown in Figure 22.

Transect A appears to represent a transition from sand dune to pond. The lack of pond soils in Trench A-2 suggests that this location is outside the pond, but near the southeastern edge of the pond. The presence of dune deposits to the east of Trench A-2 in Phase 1 confirm the edge of pond being located in the vicinity of A-2. The clay pond soils in Trench A-1 are located at 175cm below the surface and indicate this this location is within the pond. However, no pond clay soil was encountered in Trench A-3 which should be within the pond boundaries. Trench A-3 was only excavated to a depth of 120cm below surface and it is possible, that the clay deposit underlies this depth. The sandy deposits of A-3 resulted in constant slumping of the trench walls and the water table at 100cm below surface hampered any excavation to a greater depth. The depth of the clay deposit in Trench A-1 suggests that A-1 and A-3 locations may represent a deeper section of the pond.

All the trenches excavated in the northwestern portion of the project area contained the clay pond deposits. The clay layer tended to be found closer to the present ground surface (50-70cm below surface) than the clay layer in Transect A (175cm below surface). This would suggest that Transects E, F and H represent more shallow sections of the pond. The boundaries of the pond in this area appear to be outside the project area and therefore, are not shown in Figure 22.

The *makai* end of Transect B and all of Transect C appear to be dune deposits located to the *makai* edge of the pond. These transects included only sand deposits with no indication of the clay pond deposit. The banding of sand and clay in Trench G-1 is indicative of pond deposition and suggests that the pond extended more *makai* in the area to the west of the Kawai'eli Pumping Station.

Significance Assessment

A review of historical references and archaeological reports for projects conducted in the vicinity of the Kawai'eli project area suggests that Kawai'eli Pond once covered most of the project area. This pond may have served as a fishpond, waterbird habitat, and site for growing taro. *Makai* of the pond was the sand dune where fishing camps were constructed and ocean-related activities were carried out. The dunes in the Mānā area were used for burial by the Hawaiians. Land alteration in the 20th Century for sugarcane cultivation resulted in the filling in of the pond. Much of the coastal dune in

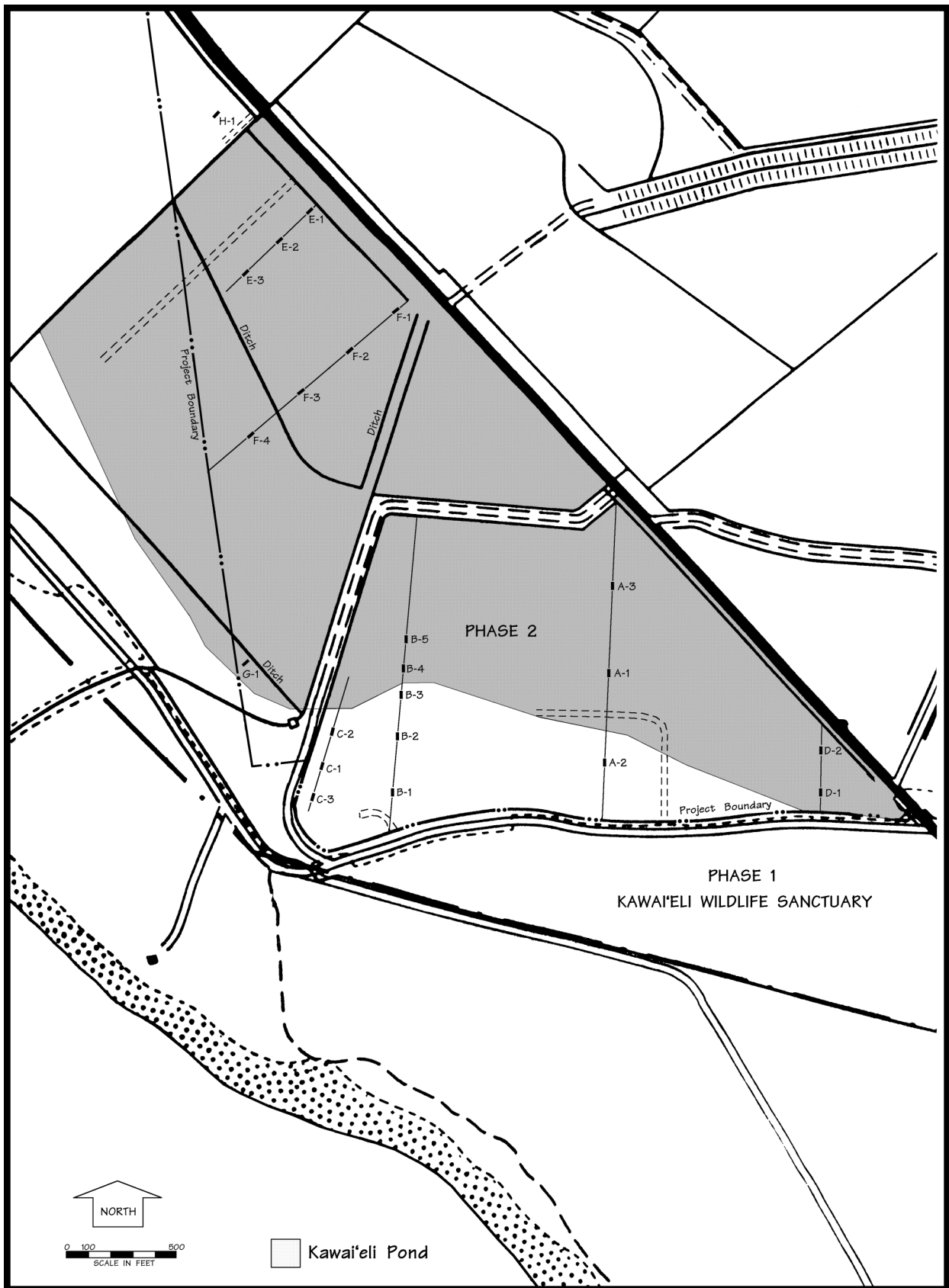


FIG. 22 - Approximate boundaries of Kawai'eli Pond in the project area based on stratigraphy in the excavated trenches. Boundaries to the north and west have not been determined.

the vicinity of the project area was altered for agriculture and the construction of PMRF. As a result, no archaeological surface remains are located in the project area.

The series of 22 trenches excavated throughout the 70-acre project area of Kawai'eli indicated a lack of subsurface cultural deposits and artifacts that would make the site significant for its archaeological remains or cultural values. The significance of the project area for its palynological and/or paleontological research potential is also limited. Oftentimes, pollen and other vegetable remains can be preserved in pond environments. However, a sample taken from the pond soils in Transect F did not yield any pollen. The initial archaeological testing and monitoring for Phase 1 of the Kawai'eli Wildlife Sanctuary suggested a limited potential for finding fossil bird bones. No fossil bird bones were found in any of the trenches excavated in Phase 2.

An archaeological assessment was conducted in compliance with §13-275-5 (Identification and inventory of historic properties). The lack of cultural remains and the low potential to yield significant information indicates that the construction of the waterbird ponds in Phase 2 will have "no adverse effect" of any significant historic properties in the project area.

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